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# Concurrency: a system design approach to environmental management and sustainability

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**Abstract:** The lessons of history indicate that mismanagement of natural resources and the environment often leads to potentially adverse consequences. The increasing interest in economic development, particularly in the developing countries of the world coupled with increasing population pressures and the globalization of economic activity is placing noticeable stresses on the ultimate sustainability of both human and environmental systems. Sustainable development is not a new concept. It has been an area of concern for different elements of society for some time. Yet efforts to understand the implications of sustainable development have not, until recently, been formalized. We have focused singularly on economic development and environmental quality as if they were mutually exclusive. This paper focuses on the concept of concurrency as both a conceptual framework and practicable method of understanding and implementing the ecology and economy of sustainability.

**Keywords:** sustainability; concurrency; ecological economics; environmental management

## Introduction

Many government agencies are beginning to link development approvals to the adequacy of public facilities and resources available to serve such developments. The requirement for adequate public facilities and resources is often called “concurrency” because the public facilities and resources must be available at the time service to the new development is required (i.e., “concurrent” with the development).

Concurrency as a conceptual design mechanism is not new. It has been in use by various levels of local government for water and sewer systems for many years. However, policy makers are now beginning to expand its use to include other types of public facilities, public resources (i.e., roads, solid waste, storm water systems, police, fire, parks and recreation facilities, schools, transit, etc.), and environmental quality standards. In the United States, several states have enacted growth management laws requiring the use of concurrency for some of these facilities and standards, and authorize its use for all other types of facilities. The need for environmental management tools to address issues of sustainability is becoming increasingly important as population growth and economic development programs begin to stress already fragile ecosystem balances. This is especially true with regard to water resources.

This paper presents a design framework for an environmental public facilities management system based on the concept of “concurrency” as the leading design paradigm in achieving balance and sustainability in the human/environmental system (as opposed to “systems”). While the term “governing unit” is used throughout the paper, the concepts should not be taken as limited to government as the governing unit (“governing unit” is intended to represent any jurisdictional unit capable of legislative and/or quasi-judicial activity in the area of land use planning, development, and ultimate decision making). Although the traditional use of concurrency was in terms of public works facilities, the concept is clearly applicable as a systems approach (both closed and open systems) to a host of alternative issues including drainage, erosion control, ground water quality, air quality, etc. This paper is intended to address, and hopefully answer, policy and administrative questions about concurrency as a planning tool in the management of development and its impacts on human and environmental systems. Specifically, (1) What is concurrency? (2) What does concurrency apply to? (3) Who performs the concurrency evaluation? (4)

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How are levels of service applied? (5) How is facility capacity reserved for those who pass the concurrency test? (6) What are the steps in the concurrency management process?

By presenting the proposed concurrency management system in this preliminary design phase, those individuals, groups, and agencies affected by the new approach will have an opportunity to review the approach before the framework and accompanying management design are fully developed and implemented. This design framework is conceptual in nature, and any final concurrency management system could vary somewhat as a result of the review process.

## **1 What is concurrency?**

### **1.1 Concurrency defined**

The dictionary defines concurrency as, "... occurring at the same time, existing together". For purposes of land use planning and development impact assessment, concurrency is a requirement imposed by a government authority relating the availability of adequate capital facilities (capital facilities is used here as a general term for all infrastructure and resources existing within a given system) environmental capacities to the approval of proposed development projects.

Concurrency means matching the capacity of capital facilities (infrastructure) and environmental systems with development proposals such that adequate capital facilities for all users are available and environmental quality is not diminished at the time the impacts of development are manifest within the system. Concurrency, as proposed here, consists of two parts: adequacy and availability. (1) Adequacy: Development is not allowed if it causes the capacity of public facilities (level of service) or environmental quality levels to fall below standards established by the governing unit. Typically such standards are determined following extensive "baseline" studies. (2) Availability. Development is not allowed if adequate public facility capacities are not available by a specified time.

### **1.2 How concurrency works**

Concurrency is determined by the governing unit (city, municipality, province, basin authority etc.) of an impacted area by comparing the capacity of public facilities and environmental systems necessary to meet the needs imposed by a development (the cumulative impacts) to the uncommitted system capacities currently available. If the uncommitted available capacity is equal to, or greater than, the capacity requirements attributable to a new development, the applicant passes the concurrency "test". If the uncommitted available capacity is less than the capacity required, the applicant fails the concurrency "test". In the absence of appropriate mitigation measures, the development will not be allowed until such time that the concurrency test is passed.

The governing unit has the option of applying the concurrency "testing" process in one of three ways: (1) plan consistency, (2) annual certification, or (3) case-by-case review.

### **1.3 Plan consistency**

Concurrency can be accomplished via "plan consistency" if the proposed development is consistent with the governing unit's overall land use plans and environmental standards (as determined by a "master plan" and map), and if the governing unit has conducted a test that documents the ability of governing unit facilities to maintain the level of service and/or environmental standards for the maximum development capacity allowed in accordance with the land use map. The test would need to be conducted before applications for development are received, and the test is conducted in anticipation of the impact current "buildout" development projections have on existing facilities and systems.

### **1.4 Annual certification**

Concurrency can be accomplished by annually certifying the capacity of facilities and systems to maintain the level of service and environmental standards for development that is estimated to occur during

the following year. In terms of both annual certification and plan consistency the “concurrency test” needs to be conducted prior to applications for development. While the annual certification process anticipates only one year’s development, plan consistency evaluates conditions and impacts at currently anticipated buildout levels identified in the master plan.

### **1.5 Case-by-case review**

If the governing unit has not prepared concurrency tests prior to receipt of development applications (method 1 or 2 above), the governing unit must conduct the tests on a case-by-case review basis where each application is compared to the capacity of each facility or system that may be impacted both now and at the time of buildout.

These three approaches to concurrency testing could also be applied separately. For example, plan consistency could be used as a test for water and sewer impacts, annual certification used for storm water impacts, and the case-by-case review for impacts to streets, parks, air quality, wetland disturbances, etc. The deciding factor in each case would be the availability of information regarding future development and the facility or system capacities necessary to support either the long-term analysis for plan consistency or the intermediate term analysis for annual certification. If information availability or forecasts are insufficient, the governing unit has little choice but to use the case-by-case review methodology.

Both the environmental and public facility capacities should be measured by standards for levels of service or capacity established and adopted by the governing unit prior to development considerations. It is important to understand that concurrency is a “neutral tool” that imposes a governing authority’s choices for levels of service on applications for development. Concurrency, by itself, does not set standards for levels of service and appropriate system capacities (acceptable standards are established as “best management practices” as determined through research and appropriate scientific inquiry). Any concerns that concurrency will be “too difficult” or “too easy” to achieve should begin with the level of service and system standards adopted by the appropriate governing unit. Further, it must be kept in mind that the approach thus far is directed toward impacts within any given authorities domain. In many instances the impacts to environmental systems and/or level of service standards must be addressed in an aggregate context (basin, province, etc.). That is the impacts to certain standards are often cumulative, especially within water basins or other closed systems. Development decisions made upstream within a basin could have implications for downstream development potential and vice versa. In such instances, concurrency as a management tool, must be utilized from the perspective of the basin as the appropriate controlling authority and not local governing units. Local levels of development decision making need to be included in an integrated concurrency management plan (basin, province, etc.).

## **2 Who and/or what does concurrency apply to?**

### **2.1 What types of capital facilities should be subject to the concurrency test?**

Concurrency can be applied to some or all of the environmental systems and public facilities that serve a development and region, including those provided by agencies other than the local governing unit. There are several reasons for applying the concurrency requirement in a broader perspective: (1) Concurrency provides assurance to developers, builders and investors (owners) of a new development that they will enjoy the same level of service as existing users in the governing unit’s area or region. (2) Concurrency assures existing users in the governing region that new development will be provided with adequate public facilities, and that existing facilities and capacities will not be overcrowded or overused (they are sustainable) as a result of the new development. (3) Concurrency is one of the few tools available to implement local government land use plans. Concurrency can direct development to those areas/regions within the governing unit’s control where development is desired, and away from areas that are not yet

ready for development. (4) The need to provide adequate facilities and/or enforce standards in a timely and predictable manner provides an incentive to the government to prepare realistic, fully funded and sustainable programs for growth management. (5) The experience of several cities indicates that serious problems can arise if some public facilities are subject to concurrency and others are not. Specifically, the facilities that are required for concurrency receive priority for funding, and the "non-concurrency" facilities have greater difficulty in obtaining adequate funding.

Concurrency, levels of service, and environmental quality standards can be applied in three ways: (1) the levels of service can be used to determine the adequacy of existing facilities and systems to serve proposed developments concurrent with the impacts of the development; (2) the levels of service and quality standards can be used to determine the need for additional facilities; or (3) the levels of service per capita and quality standards may be determined to not be applicable in certain cases.

#### Development approvals "exempt" from the concurrency requirement

Some development applications may be "exempt" or receive special review because they are vested, or they do not create any impact on service or quality standards, or because they were tested as part of an application for an earlier development. The concurrency test may not be required for situations where there is vested development rights, no added impacts, or expansion of an existing development.

### 2.3 Vested development

Applicants for some types of development permits become "vested" with the right to be reviewed according to the laws, rules, and regulations in place at the time their application was approved. They should not be subject to laws, rules, and regulations that are adopted after their application is approved. An important aspect of vesting is that it vests the applicant only for the development action sought, and not for subsequent phases of the same development. Since a building permit is the final phase of development, vested development applications for building permits will not be subject to concurrency.

### 2.4 No added impact

Applicants for some permits are exempt from the concurrency requirement because such development does not impact the public facilities for which concurrency is required.

### 2.5 Expansion of an existing development

Applicants for expansion of existing development should not be tested for concurrency, provided the expansion was disclosed in an earlier development application and the planned expansion was previously tested for concurrency. Expansions that were not previously disclosed and tested will need to be subject to the concurrency requirement.

Impacts of exempt development will be noted in the governing unit's concurrency management records in order to monitor the cumulative impacts on facilities and quality standards, and the subsequent reduction of capacity that is available for development that is not exempt from the concurrency requirement.

Exempt properties may still develop even if they "fail" the concurrency test. There are four possible scenarios that could lead to exemptions from the concurrency and available capacity standard requirement: (1) Property is exempt from concurrency and capacity is available: the development permit is issued and capacity is reserved (because capacity is available, no exemption is necessary). (2) Property is not exempt from concurrency, but capacity is available: the development permit is issued and capacity is reserved (because capacity is available, no exemption is necessary). (3) Property is exempt from concurrency, but capacity is not available, or is not sufficient. The development permit is issued (because applicant is exempt) and any available capacity is reserved. Any remaining deficiency constitutes a "lien" on future capacity until the capacity of the system catches up with demand. (4) Property is not exempt from concurrency and capacity is not available: Development permit is not issued and capacity is not reserved (because there is insufficient capacity, and the applicant is not exempt).

## **2.6 Concurrency management processes and other governments agencies**

Some of the capital facilities needed for a new development are provided by other agencies: fire protection districts, schools, solid waste treatment, transit, etc. The relevant governing unit and the providers of these facilities need to work out details regarding concurrency and concurrency testing. This is particularly true in for “basin” level standards and capacities. The various governing units will need to enter into an agreement with each other under the auspices of the primary authority unit regarding their participation in the concurrency management process and the appropriate cumulative standards and capacities that are to be enforced. The agreement will need to cover such issues as methodology, testing, timing, indemnification, and the means of settling disputes among other things.

## **3 Service levels and environmental standards**

Concurrency depends on achieving and maintaining standards for levels of service and environmental quality for the various capital facilities and environmental systems within the management area. A “level of service” is an indicator of the extent or degree of service provided by each type of capital facility. “Standards” are system level baselines or indicators established to provide the basis for assessing environmental health. Both the “level of service” and “standards” should be quantifiable, objective measures, such that the controlling authority can address both point source and cumulative impacts associated with growth and development issues. The intent of the governing unit should be to not issue development approvals and permits which result in a reduction in service levels or standards below those established by the primary authority for the types of public facilities and environmental system standards selected for concurrency testing. Levels of service and standards may also be established for facilities and systems not subject to the present concurrency requirements. In such cases, the standards should only be used in determining the need for additional facilities or treatment procedures and to set priorities in choosing programs and funding. The governing authority will need to adopt level of service and quality standards for each type of capital facility and environmental system they wish to include in the concurrency requirement. The standards should then be set forth in the concurrency regulations and updated on a regular basis.

### **3.1 What geographic area will be used to test concurrency?**

Considering the relatively small geographic area administered by most governing units, all development proposals, levels of service, and standards subject to the concurrency requirement must be tested within the context of the entirety of governing unit’s area. If the facilities throughout the governing unit’s area are adequate in terms of level of service and/or environmental system capacity to meet the impacts of the development, the development can be approved anywhere within the governing unit’s area. Conversely, if the facilities and environmental capacities are not adequate to support the development at a specific location, development will not be approved anywhere in the governing unit.

### **3.2 When does concurrency have to be achieved?**

The deadline for achieving concurrency depends on whether or not the facilities and system capacities are needed to meet public health standards. Specifically, sewer, solid waste, and water facilities need to be in place no later than the occupancy and use of the new development. Also, toxicologic standards for water, air, and soil resources must not be exceeded. Those concurrency facilities not crucial to the public health could be provided within some time limit, say two years from the time occupancy and use i.e., fire protection, parks, police, schools, storm water, streets and transit. In order to proceed with a development that relies on facilities that are not in place at the time of occupancy and use, but will be built within two years, a “financial commitment” to complete the facilities must be established at the time the development is approved by the governing unit. If an applicant expects to need more time to complete the

development, the deadline for completing facilities could be extended beyond the time specified after issuance of the development permit (or comparable approval) only if the applicant provides the financial commitments for any facilities that it needs.

### 3.3 At what point are levels of service tested?

The levels of service for some facilities and quality standards for environmental systems should be tested against the full development capacity ("buildout") of the impacted area represented in the approved land use plans (master plan). Any development that is consistent with the master plan would be automatically approved for concurrency because the impacts of development have been anticipated and accommodated by existing public facilities and environmental quality standards, or facilities and mitigation measures will be provided pursuant to the financial commitments made by the developer. Levels of service and quality standards for other facilities and systems can be tested at the time an application for development or other approval is given. There are two reasons this may occur. First, the proposed development is not consistent with the land use plan, therefore a special concurrency test is required to determine whether or not the proposal can be served with adequate public facilities and/or the environmental quality standards will not be exceeded. Second, the governing unit is not able to test the adequacy of certain facilities or standards against the full development capacity of the currently adopted land use plan (due to insufficient information or of her technical reasons).

Testing in advance enables development applications to be processed more quickly, and the results associated with development applications more predictable. These benefits are not obtained without a price, however. The governing unit must conduct significant research and prepare substantial analyses and baseline studies prior to receiving specific proposals for development and the necessary fees to pay for the research. The lack of financial resources will inevitably lead the governing unit to approach each development on a case-by-case basis, making it difficult to fully implement a cumulative, system wide approach to facility and environmental planning.

## 4 Conclusion

Increasing pressures from population growth and economic development are stressing both human and environmental systems. Sustaining these systems in the future will require new ways of thinking and new approaches to existing practices and management paradigms. Sustainable economic development and environmental quality are not mutually exclusive. Most of our research efforts have centered on the in-depth analysis of these respective realms and detailed processes within them. We have followed the approach that we need to know more (somehow determining cause and effect relationships) prior to formulating and implementing practicable management policies. However, if the issues (economic development and environmental quality) represent two sides of the same coin (sustainability of human and environmental systems), then an integrated policy management approach capable of growing with our knowledge base in each area is called for in the meantime. Concurrency, coordinating growth and development facility capacities and environmental quality standards can provide the coordinated perspective necessary in maintaining a sustainable balance between economic and population growth and environmental quality. Concurrency, as a management and planning tool, provides a unity of operational form between two often-perceived competing forms.

## References:

- Arrow K J, 1972. *The limits of organization*[M]. New York: W.W. Norton.
- Barbier E, 1987. *The concept of sustainable economic development*[J]. *Environmental Conservation*, 14(2), 101—110.
- Costanza R, Daly H E, Bartholomew J A, 1991. *Goals, agenda, and policy recommendations for ecological economics*[M]. (R. Costanza ed.), *Ecological economics—The science and management of sustainability*. New York: Columbia University Press. 1—20.

- Gladwin T N, Kennelly J J, Krause T, 1995. Shifting paradigms for sustainable development—implications for management theory and research [J]. *Academy of Management Review*, 20(4): 874—907.
- Gowdy J M, 1994. Progress and environmental sustainability[J]. *Environmental Ethics*, 16: 49.
- Grossman G M, Krueger A B, 1995. Economic growth and environment[J]. *Quarterly Journal of Economics*, 112: 353—378.
- Harremoes P, 1996. Dilemmas in ethics—towards a sustainable society[J]. *Ambio*, 25(6): 390—394.
- Holling C S, Berkes F, Folke C, 1998. Science, sustainability and resource management[M]. (F. Berkes, C. Folke, and J. Colding eds). Linking social and ecological systems. Cambridge: Cambridge University Press. 342—362.
- Lele S M, 1991. Sustainable development—a critical view[J]. *World development*, 19(6): 607—621.
- Mitlin D, Satterthwaite D, 1990. Human settlements and sustainable development[R]. Nairobi: UN Center for Human Settlements (Habitat).
- Munasinghe M, W Shearer(eds), 1995. Defining and measuring sustainability—The biogeophysical foundations[R]. Washington DC: The World Bank/UN University.
- Myers N. 1993. Ultimate security—The environmental basis of political stability[M]. New York: W.W. Norton.
- Myers N, 1995. Environmental unknowns[J]. *Science*, 269: 358—360.
- Serageldin I, 1996. Sustainability as opportunity and the problem of social capital[J]. *Brown Journal of World Affairs*, 3(2): 187—203.
- Solow R M, 1974. Intergenerational equity and exhaustible resources[J]. *Review of Economic Studies*, 41: 29—45.
- UNDP, 1996. Human development report 1996[R]. New York: Oxford University Press.
- van den Bergh J C, 1996. Ecological economics and sustainable development[M]. Brookfield: Edward Elgar.

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