PERFORMANCE STANDARDS FOR SELECTED SITES ALONG THE U. S. 321 - BOONE/BLOWING ROCK CORRIDOR

A Thesis

by

BRIAN MICHAEL FLEER

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Brian Michael Fleer

November 1987

APPROVED BY:

Robert E. Reiman
Chairperson, Thesis Committee

H. Daniel Stillwell
Member, Thesis Committee

Roger Winsor
Member, Thesis Committee

Neal Lineback
Chairperson, Department of Geography and Planning

Joyce V. Lawrence
Dean of Graduate School

ABSTRACT

PERFORMANCE STANDARDS FOR SELECTED SITES ALONG
THE U. S. 321 - BOONE/BLOWING ROCK
CORRIDOR. (December 1987)

Brian Michael Fleer
B. S., Michigan State University
M. A., Appalachian State University
Thesis Chairperson: Robert E. Reiman

Uncontrolled growth of the built environment along recently upgraded highway connectors often results in many kinds of environmental and societal problems. There are suggestions in the literature that these problems might be alleviated by applying the concept of "performance zoning."

Performance zoning is based on the notion that there is a definite relationship between site and site capacity for development. To test this idea four sites along the U. S. Highway 321 - Boone/Blowing Rock Corridor were examined for their adaptability to this innovative system of land-use regulation.

Components of the site capacity calculation included the following: (1) delimiting the base site areas; (2) selecting suitable resource protection

(four resources were deemed most restricted in terms of development potential, they were woodlands, floodplains, soil erosion potential and slope); (3) including recreation land (or land within a site that was most suitable for public or common space) and (4) determining the net buildable area or the amount of land within a site that could actually be developed. The individual resources were assigned three alternative levels of open space ratios to illustrate the affects of changes in open space on net buildable site.

Recommendations were formulated concerning residential use on each site using various housing types and density levels. The objective of the final manipulation of use levels was to exemplify the possibilities of allowing a cost effective number of dwelling units to be built while still maintaining maximum open space restrictions.

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CHAPTER ONE

INTRODUCTION AND OVERVIEW

Introduction

In the past major thoroughfares, including highways, have been the nucleus for existing development. The highway corridor not only provides a route for transportation, but also the means by which persons can easily locate in central areas. This fact alone has determined land use patterns along highway systems. Unfortunately, the resulting land use has often times not been planned. The outcomes of the lack of planning can be characterized by strip development, water and sewage systems being used to their limits, urban sprawl occurring beyond the highway fringe, and sites within highway networks being used beyond their actual carrying capacity. The last problem explores the potential for developing land beyond its site carrying capacity. Exceeding the carrying capacity of a site results in a negative impact on the landscape, one that usually can not be mitigated and has both environmental and societal implications.

The objective of this thesis is to show how to determine site carrying capacity occurring with development, citing a residential land use example along the U. S. Highway 321/Boone-Blowing Rock corridor,

(Figure 1.1). There is much concern that without proper site analysis and planning, new development within a prospective site could adversely affect existing natural resources or features within the corridor. On the other hand, environmental factors could serve to negatively impact development. In order to maintain a balance between a site and its use the concept of performance zoning will be introduced.

Performance zoning relies on site analysis to determine the limits of development. In determining a site's capacity, at least four questions must be addressed: (1) What are, and what is the extent of, the natural resources or features within the site? (2) How much open space is required to protect the natural resources or features and yet allow some development to occur? (3) Considering environmental constraints, what is the carrying capacity of a particular site, and (4) To what degree will development affect the site or the site affect development? Answers to these questions will be used in determining site capacity calculations in each of four selected sites along the U. S. 321 corridor between Boone and Blowing Rock. The corridor is approximately six miles in length and is outlined, along with the sites that have been selected for study, in Figure 1.2.

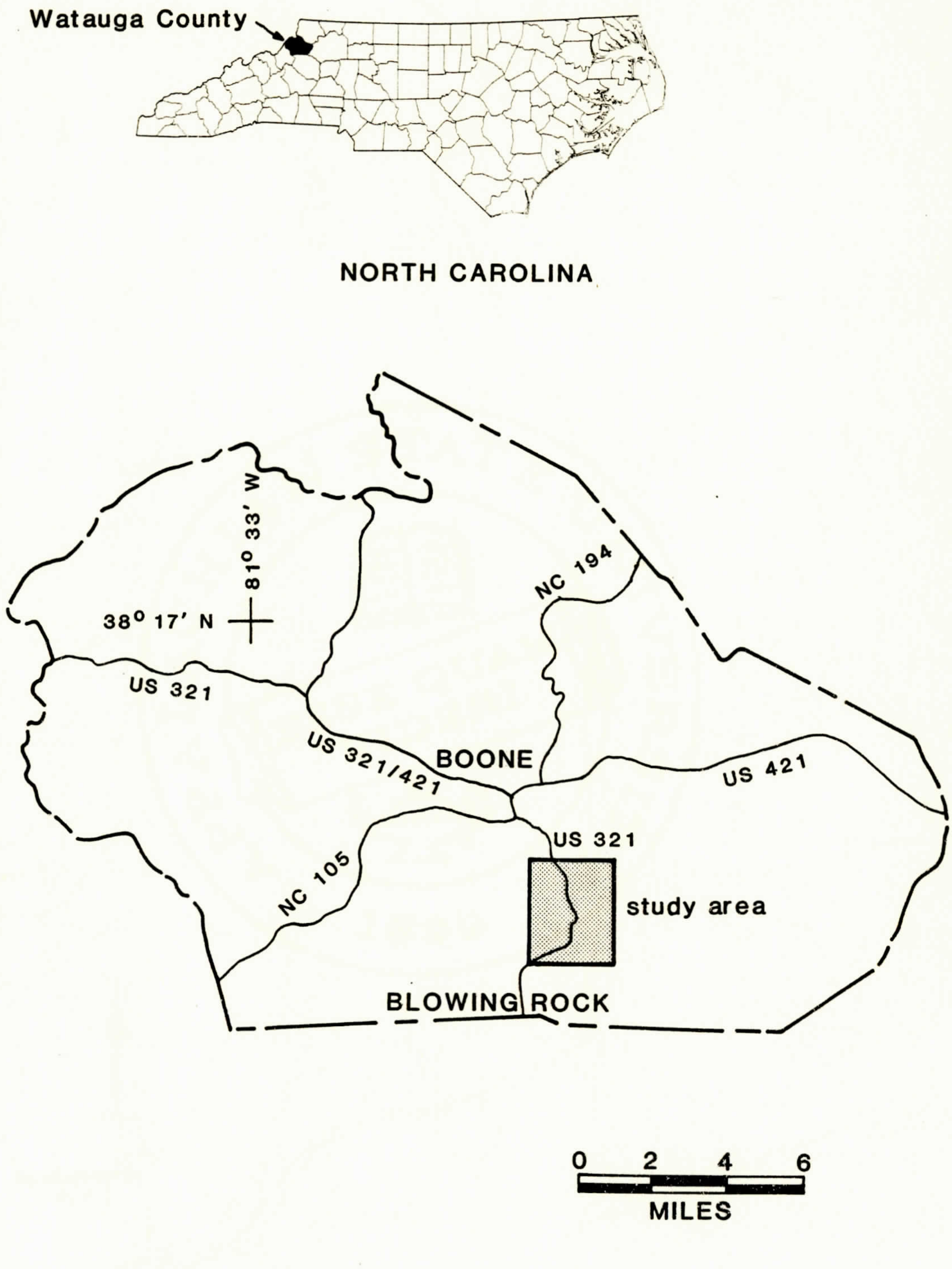

Figure 1.1 Location of the Study Area in Watauga County

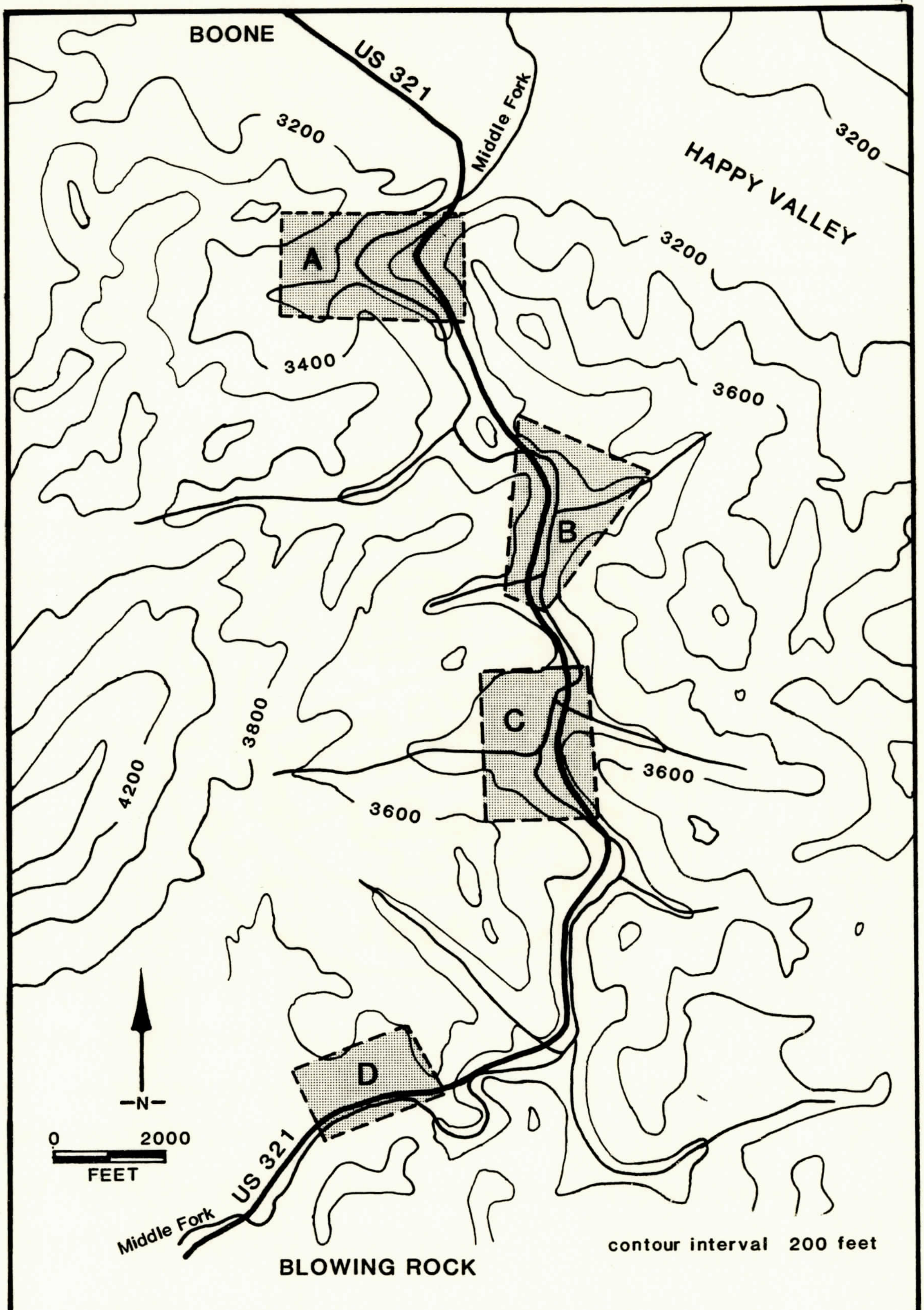

Figure 1.2 Location of Sites A, B, C and D Along the US 321 Corridor

The Physical Setting

The U. S. 321/Boone-Blowing Rock corridor lies within the Blue Ridge physiographic province of the Appalachian Highlands. Deep and thorough stream dissection in much of the area has resulted in sharp local relief, mainly in the form of irregular ridges and intervening valleys. Level land is nearly non-existent; only a few tracts of appreciable size even have mild hilly, rolling or undulating relief. The elevation of the corridor floor ranges from 3,360 feet to approximately 3,440 feet above mean sea level. The largest stream that drains the study area is the Middle Fork, which flows into the South Fork of the New River, (Figure 1.2).[1]

Predominant rock types in the area consist of crystalline igneous and metamorphic varieties including gneiss, schist, granite, diabase, diorite, metarhyolite, and metadiabase. Blowing Rock gneiss is the prevalent formation in much of the area between Blowing Rock and Boone. It is dark gray or blackish gray.[2]

Ashe and Perkinsville soils, falling within the Ashe-Perkinsville-Tate association, are derived from the above mentioned rock material; this soil association exists throughout the corridor.[3]

The dominant forest types within the corridor can be classified as mixed hardwoods with intermittent stands of conifers; within the understory of most of the forest types is Rhododendron shrub. Because of extensive logging that took place in the area at the turn of the century much of the vegetation that exists within the corridor is considered secondary growth. Regardless of classification, the corridor is again heavily forested, especially in areas of extreme slope, adding to the soil stability and scenic beauty of the area.

The climate of the study area is classified as Humid Subtropical (cool summer). Average temperatures in Boone (which lies partially at one end of the study area) range from 36 degrees Fahrenheit in January to 69 degrees Fahrenheit in July.[4] Snow is fairly well distributed throughout the winter months. Rain usually falls throughout the spring and summer months, during the growing season; average annual total precipitation is approximately 53 inches.[5] The dominant wind direction, occurring an average of 53 percent of the time, is from the west.[6] Eastward moving cyclonic storms occur in all seasons and are the prime controls of the regional climate.[7] It is also important to note that, because of the mountainous relief, narrow belts of micro-climate exist. This is in part due to differences in sun exposure and altitudinal influences, resulting in widespread temperature and wind fluctuations within the corridor.

The Cultural Setting

Historically, settlement along the Highway 321 corridor has been sparse. But because of recent highway improvements and a rapidly expanding real estate market, along with burgeoning tourism in the area, pressure for development has been increasing. Presently, the corridor is only moderately developed, with the most extensive development occurring within sites labeled A, B, C and D in Figure 1.2. These four sites were chosen because they are exemplary of the kinds of development that are beginning to occur within the corridor.

Field reconnaissance revealed that the majority of past and current development in the study area could be placed into three major categories. The first category was that of residential housing, with a combination of 43 single family housing units on all sites. Although the number of housing units varies for the four sites, the density of housing within these sites is relatively low.

The second category of development is light industry and is represented within site B. This is a concrete mixing plant which serves both towns in the local area. The third and last category consists of tourist and other commercial recreation development. Within the corridor there are two family theme parks; both attractions are quite visible and also support other businesses such as gas stations, convenience stores, gift shops, flea markets and motels. All the above activities exist within at least one of the four sites. Details pertinent to individual sites are listed in Table 1.1 and shown in oblique aerial photos in Figures 1.3 through 1.6. Mentioned also in Table 1.1 is the density of development within each site, e.g. low, medium, high.

Review of the Relevant Literature

This study examines the impact of human use on the land and the suitability of an individual site for development. The literature on land use and carrying capacity concerning development revealed three relevant themes: (1) The spatial character of site planning, (2) the potential for applying performance zoning and (3) resources and methods available for site planning.

The first theme, the spatial character of site planning was exemplified in the writings of three authors, Andrews, Lynch, and McHarg. Andrews indicates that beneath all the particular issues of land use conflict, there is a fundamental dualism between land, its status as a natural resource base, and its status as a commodity. Every piece of land is a unique physical and biological

Table 1.1

LAND USE CHARACTERISTICS BY SITE

Land Use	Site A	Site B	Site C	Site D
Residential				
single-family units	20	6	5	12
multi-family units	1	-	-	-
Industrial				
concrete mixing plant	-	1	-	-
Tourist and Commerical Recreation				
family theme park	-	-	1	-
go-cart track	-	1	-	-
motel	1	-	-	1
gift shop	1	-	-	2
convenience store	-	-	-	2
gas station	-	-	-	1
Density				
low	x	x	x	-
medium	-	-	-	x
high	-	-	-	-

Figure 1.3, Site A

Figure 1.4, Site B

Figure 1.5, Site C

Figure 1.6, Site D

entity. It is the basis of living ecological systems that can provide life and community supporting services to humans as well as other populations. If they are disturbed many of these functions cannot be replicated or reconstructed by human activities. Every piece of land is also unique in its location. Land has both ecological and economic implications for its use and in its structure, which includes topographic and other physical characteristics as well as asthetic appearance. Land is also a marketable commodity, a property subject to ownership and taxation, and a necessary platform for human activity.[8]

Lynch notes that proper site planning is the organization of the external physical environment to accommodate human behavior and deals with the qualities and locations of structures, land activities, and living things. Also it creates a pattern of those elements in space and time which will be subjected to continuous future management and change. While the site needs to be analyzed for fitness to purpose, it also must be viewed in its own right as a living, changing community of plants and animals. Such a community has its own interests. Although developers may expect their own interests to prevail, the conditions of the existing site, either social or environmental, must be carefully examined.[9]

McHarg states that there is a need for simple regulations which ensure that society protects the values of natural processes and is itself protected. Conceivably, lands with environmental constraints could still provide the source of open space for metropolitan areas. If so, they would satisfy a double purpose, ensuring the operation of vital natural processes and employing lands unsuited to development in ways that would leave them unharmed by the often violent processes of nature. Presumably, development should occur in areas that are intrinsically suitable, where dangers are absent and natural processes unharmed.[10]

The second theme germane to this study examines the use of performance zoning as it is employed to establish criteria for the placement of individual types of development. Kendig points out that the failure of traditional zoning to protect social and natural environments indicates a need to explore alternative ways of regulating land use development. Performance zoning provides a different approach to the zoning process, one which enables a community to plan for its future population, while safeguarding the natural, social and economic qualities that have made it an attractive place to live. It was developed to address areas of regulation where conventional zoning has failed or could be expected to fail. Unlike traditional zoning, it does not organize land uses into a hierarchy which is then used to protect one use from another. Rather, it imposes minimum levels of performance, based on environmental constraints within individual sites, by setting standards which must be met by each land use. Site capacity calculations are used to determine the amount of developable land that exists within a specific site. Kendig's calculation uses the idea of reserving open space to protect natural resources or features which may be harmed by development. Once the amount of open space is calculated, the capacity of a site for development can be determined.[11]

The third focus deals with the methods and resources utilized when examining environmental constraints within sites that have development potential. In order to effectively utilize Kendig's site capacity calculation, a considerable amount of environmental information must be obtained. In this respect Marsh emphasizes the need for and use of data and information sources to produce reliable, timely and appropriate environmental information for land use planning. Marsh states that two kinds of knowledge are necessary: (1) the essential processes of landscape formation and (2) the nature of planning processes involved within the site itself. Marsh points out effective ways for calculating and mapping such natural features as floodplains, vegetation (woodlands), slope and soil erosion potential. He observes that much of the above information may be obtained from various governmental agencies, such as the U. S. Geological Survey, the Soil Conservation Service, and also from aerial photographs produced by the Agricultural Stabilization and Conservation Service. Information from local governments or agencies may be utilized along with information obtained from individual field work.[12]

All the above techniques were utilized in determining environmental constraints within the selected sites along the U. S. 321/Boone-Blowing Rock corridor. Below a list of terms is included that are germane to the topic and that are utilized throughout the text.

Definition of Terms

Base Site: Certain portions of land may not be suitable for the activities proposed for the site (e.g. roadways, right of ways, bufferyard). These are subtracted from the gross site area to determine what is called the base site area.

Bufferyard: Bufferyard refers to a strip of land created to separate and protect one type of land use from another; for example, as a screen of plantings or fencing to insulate the surroundings from noise, smoke, or the visual aspects of a roadway.

Carrying Capacity: The level of land use or human activity that can be permanently accommodated without an irreversible change in the quality of air, water, land or plant and animal habitats. In human settlements, this term also refers to the upper limits beyond which the quality of life, community character, or human health, welfare and safety will be impaired.

Composite Resource Classes: Used in determining net buildable site; refers to the overlaying of mapped resources one on top of another in order to determine the most restrictive open space requirement; for example, combined, the composite resource class floodplains and less than 2 percent slope has the highest open space ratio restriction and where found within a site, would dictate the greatest open space requirement.

Conventional Zoning: A zoning practice which designates land uses by large districts, separating one level of land use from another. Basically all land within a single district is of equal value, and significant changes in land value are largely a result of land being reclassified from one zoning district to another.

Corridor: As used within the text refers to U. S. Highway 321 and the designated study areas between Boone and Blowing Rock.

Development: The term development as used within this thesis refers to any people/land interaction that temporarily or permanently alters the landscape; be it either residential, commercial, industrial, tourist or recreation orientated.

Gross Site: Gross site refers to an entire area in terms of acreage, resources, roadways, right of ways or bufferyards, etc. The base site is calculated from the gross site area.

Maximum Density Factor: Refers to the number of dwelling units allowed per acre in any given district. Within this study a maximum density factor of two dwelling units per acre is used and is calculated from the base site area.

Natural Resources or Features: As used herein make reference to floodplains, woodlands, slopes and soil erosion potential.

Net Buildable Site: Is the total amount of land that can be developed after resource protection land, recreation land, roadways and bufferyards are subtracted from the gross site. Net buildable site is determined by use of the site capacity calculation.

Open Space: The amount of land reserved to protect designated resources within a site. The amount of open space reserved depends on the open space ratio assigned to particular resources.

Open Space Ratio (OSR): Is a numerical value assigned to natural resources or features, depending on the assigned amount of open space protection that is required. The open space ratio is multiplied by the number of acres within a resource, to determine the amount of open space that will be reserved in order to protect the resource; for example, an open space ratio of 1 would be the most restrictive, in that any multiplication of acreage by this OSR would result in the total amount of the resource being reserved as open space.

Performance Zoning: Performance zoning is a fairly new zoning concept, in that it requires specific performance standards within a site, based on environmental constraints and the site's capacity to support development. Its counterpart "conventional zoning" attempts to regulate land use by separating high density development from low density development with little regard to the site.

Recreation Land: Is land to be set aside within a site proposed for development for the purpose of common space or recreational use.

Resource Protection Land: This element of the site capacity calculation adjusts for the presence of land that needs protection from development. Each resource is protected by an open space ratio designated for each such resource.

Site: A spatial location of land, that may or may not be developed. A site may have societal or environmental characteristics or a combination of both that render it unique in terms of its land use.

Site Capacity Calculation: A way to determine the carrying capacity of a site by first calculating the base site and from there subtracting resource protection land and area of the recreation land to determine the net buildable site.

Slope: Used to describe the deviation of a land surface from the horizontal.

Methodology

Introduction

In this study environmental protection of resources is based on an open space ratio assigned to each resource category. Although no accepted formula for the empirical determination of open space ratios exists, there is a tremendous body of knowledge about the environment. The standards to be used have been deduced from that material.[13]

The premise is that the more important the need to protect a resource, the higher its level of protection ought to be. In addition, there are unique factors about a resource and people's interactions with it which dictate the need for more or less protection. A resource which is easily destroyed, degraded or rendered unusable requires more protection than a resource that is less easily damaged. The most stringently regulated features should be those which, if not regulated, could present some threat to the public safety or health, e.g., floodplains. At the other end of the continuum are resources which play a less critical role in affecting development, e.g., lakes and pond buffers. Even though the regulation of these latter features is based more on the protection of a common good, such as air or water quality, their degradation still poses a potential cost or threat to the public. Open space necessary to protect resources is shown by utilizing Kendig's site capacity calculation to determine the net buildable area for selected sites.[14]

Site Capacity Calculation

Defining The Study Area

The study area (Figures 1.1 and 1.2) is divided into four sites, which for the purposes of this study have been labeled A, B, C and D. These sites were chosen because of currently existing and expanding development. They are also the sites that seem to have the highest potential for development. Potential for development, in this case, has been determined by noting the amount of land that could be easily altered or changed, such as land that was less steep or large amounts of land within floodplains. Within each of the four sites a portion of the land is already developed. However, because of the fact that the sites have the highest density of development within the Boone-Blowing Rock corridor, it is assumed that they would most likely become the nodes for future expansion.

Calculating The Base Site Area

Certain portions of tracts of land may not be suitable for the activities proposed for the site. Examples would be areas within planned or existing road or railroad right of way, easements for other purposes, or land for bufferyards. These areas are subtracted from the gross site to determine base site area.[15]

The base site area for the selected sites is determined by first calculating the acreage for adjacent and/or interior roadways. The roadway acreage is then doubled in order to set aside enough land for bufferyards. The number of acres for both roadways and bufferyards is then subtracted from the gross area of each of the sites to determine the base site acreage.[16]

Determining Resource Protection Land

An open space ratio (OSR) indicates the amount of land from the base site that is required to protect either natural resources or features. All land within the base site area is mapped and measured, and then classified into resource categories for the purpose of determining the amount of open space needed to protect it. Each resource, such as floodplains, land with soil erosion potential, steeply sloping land and woodlands is assigned an OSR. In calculating resource protection land, the OSR is then multiplied by the actual number of acres within a resource to determine the amount of land needed to protect it.[17]

In order to demonstrate the significance of open space in protecting resources, these resources have been evaluated and assigned three different open space ratios. The first OSR is a minimal value, whereby very little land is set aside in order to protect resources. The second is set at a more moderate level which will reserve an intermediate amount of land for protection. The third and last is a maximum protection value which will indicate a very tightly regulated resource protection scenario. Table 1.2 lists the resources along with their assigned open space ratios.

Table 1.2

OPEN SPACE RATIOS BY RESOURCE

Resource	Open Space Ratio		
	Minimum	Moderate	Maximum
Floodplains	.250	.500	1.000
Woodland	.187	.375	.750
Slope			
less than 0-2%	.250	.500	1.000
2-7%	.025	.050	.100
7-15%	.000	.000	.000
15-30%	.125	.250	.500
30% or greater	.187	.375	.750
Soil Erosion Potential			
No Erosion Hazard	.000	.000	.000
Low Erosion Hazard	.025	.050	.100
Moderate Erosion Hazard	.050	.100	.200
Extreme Erosion Hazard	.125	.250	.500

Resource Evaluation

The selected resources within the individual study areas have been evaluated as follows:

Floodplains:

Floodplain acreage within the Boone-Blowing Rock corridor was determined by utilizing flood insurance rate maps developed as part of the National Flood Insurance Program. Limits of the floodplain were determined by using the one hundred year flood boundary and were denoted for each of the study sites.[18]

Woodlands:

Woodland areas were determined by using the Boone Quadrangle (USGS 7.5 minute topographic map series) to establish general boundaries. Specific boundaries were delineated from recent oblique air photos and verified by field inspection for each site.[19]

Slope:

Acreages of land within certain ranges of slope percent were calculated from the topographic map. Slope categories are based on erosion potential caused by development and are established by the Soil Conservation Service, U. S. Department of Agriculture. Slope categories to be used are 2 percent or less, 2 to 7 percent, 7 to 15 percent, 15 to 30 percent, and more than 30 percent.[20]

Soil Erosion Potential:

Certain soils have higher erosion potential than others; because of this fact some soils are inherently better suited for development. In order to show soil erosion potential, detailed soil maps were prepared for each site using the Watauga County Soil Survey. Once the maps were compiled, the amount of soil erosion potential (in acres) was calculated according to the following categories: no erosion hazard, low erosion hazard, moderate erosion hazard, or extreme erosion hazard.[21]

Determining Recreation Land

While some of the open space derived by the site capacity calculation may serve as resource protection land, the specific intent of setting aside recreation land is to provide usable public or common space as close to each building unit as possible. The amount of land so designated varies with the density of proposed development. A recreation factor of .10 is suggested in the literature and has been adopted arbitararily in order to set aside at least a minimum of unrestricted land for recreation use. The recreation calculation is not made until the total land (in acres) with resource restrictions has been subtracted from the base site area. The remainder is the total unrestricted land within each site, which is then multiplied by the recreation factor (.10). The product is the total area set aside for recreation land within each base site.[22]

Determination of Site Capacity

Individual site capacity is the final outcome and is found by calculating net buildable site area. The total resource protection land within each site is then added to the calculated recreation land. This equals the required total reserved space for each site. The total reserved space is then subtracted from each of the respective base site areas. The final result is the net buildable site acreage within each of the four sites.[23]

Summary

Findings of this study are based upon the idea of site carrying capacity in the context of performance zoning. Land with development potential may contain environmental constraints which could adversely affect development, or, on the other hand, development could negatively impact the land. The process of utilizing site capacity calculations can be used to demonstrate the extent to which a site can be developed without destroying it. While conventional zoning has long been used to regulate land use by merely labeling blocks or large areas, performance zoning utilizes the more logical concept of site capacity based on land use for determining development in specific areas.

NOTES

[1]U. S. Department of Agriculture. Soil Survey: Watauga County, North Carolina. (Washington, D. C.: Government Printing Office, 1944) p. 55.

[2]Ibid., p. 52

[3]Ibid., p. 57.

[4]Planning Techniques Classes, "Planning Base Studies, Town of Boone, North Carolina, 1981-1982", Department of Community Planning and Geography, Appalachian State University, pp. 28-33.

[5]Ibid., pp.28-33.

[6]James Freeman, "Feasibility of Air Transportation: The Case of Watauga County, N. C." (Master's Thesis, Appalachian State University, 1977,) p. 22.

[7]Ibid., p. 17.

[8]Richard N. L. Andrews, Land in America (Lexington: D. C.Heath and Co., 1979) pp. 1-3.

[9]Kevin Lynch, Site Planning. (Cambridge, Mass.: The M. I. T. Press, 1977) pp. 7-10.

[10]Ian McHarg, Design with Nature (Garden City: Doubleday and Co., 1971) p. 10.

[11]Lane Kendig, Performance Zoning. (Washington, D. C. Planners Press, American Planning Association, (1980) p. 1-3.

[12]William M. Marsh, Environmental Analysis for Land Use and Site Planning. (New York: McGraw Hill Book Co., 1978) pp.1-5.

[13]Kendig, Performance Zoning. p.324..

[14]Ibid., p. 322.

[15]Ibid., p. 38.

[16]Ibid., p. 321.

[17]Ibid., p. 322.

[18]U. S. Department of Housing and Urban Development, National Flood Insurance Program, Flood Insurance Rate Map., Watauga County, N. C. June 18, 1980.

[19]U. S. G. S. Topographic Map Series, 1959, Boone, N. C. Quadrangle, Photorevised, 1978.

[20]Planning Techniques Classs, "Planning Base Studies, Boone, N. C.", pp. 7-9, Appalachian State University.

[21]<u>Soil Survey: Watauga County, N. C</u>. pp. 68-75.

[22]Kendig, <u>Performance Zoning</u>. p. 321.

[23]Ibid., p. 41.

CHAPTER TWO

SITE ANALYSIS

Introduction

In performance zoning, most of the natural features and resources are divided into classes. They are characterized by topographic or hydrologic factors, vegetation, soil types, or landforms. The mapping of natural features on a site by site basis at the time they are proposed for development is critical. The features on-site can be regulated only to the extent that they can be accurately and simply identified.

Within this chapter four resource classes are examined: woodlands, floodplains, soil erosion potential, and slope. It is important to note that any number of resource classes can be used when conducting an in-depth site analysis. The four classes were chosen because of their relevance to mountain environments, especially within the U. S. 321/Boone-Blowing Rock corridor. They are ideal for purposes of showing how the concept of performance zoning can be used in applying open space ratios to protect natural resources or features within a site. Each of the four resource classes are defined and outlined below for sites A, B, C and D.

Woodlands

Few components of the landscape lend themselves to identification of environmental stress as does vegetation, specifically woodlands. Woodlands can be described as trees with an average height greater than fifteen feet with 20 to 60 percent canopy cover.[1] Five parameters, or measures of impact related to woodlands, can be highlighted. First, the sheer loss of cover, measured for example by the area of woodland lost to development, is a very significant indication of impact because of its implications with respect to runoff, microclimate, and asthetics. Second, the loss of valued species, communities, and habitats is a critical measure of environmental impact, especially as mandated by law at various levels of government (e.g., the requirement for environmental impact statements). Third is the economic loss represented by the loss of merchantable vegetation (such as timber) and the longer term loss of profitable production areas. Fourth, woodlands are often an integral part of larger environmental systems, such as microclimate or soils and hydrology (alteration or loss of plant cover can spell serious decline in these systems). And fifth, vegetation in general becomes adjusted to a certain set of environmental conditions.

Changes in these conditions, even subtle ones, are often reflected in the composition of plant communities. Therefore, woodlands serve as a valuable indicator of environmental performance.[2]

In Figure 2.1, the delineation of woodlands is shown for sites A, B, C and D respectively. It can be observed that the largest amount of woodland lies within site A, and consists of roughly 53 percent (82 acres) of the total 156 acre site. On the other hand the smallest portion of woodland lies within site D. Here woodlands occupy approximately 25 percent (18.9 acres) of the 74 acre total. Much of the woodland lies within areas of moderate to extreme soil erosion and where the slope is 15 percent or greater. Woodlands serve to protect such areas; removing them can cause extreme erosion problems, especially in mountain environments. Woodlands require a sufficient amount of open space, not only to protect their aesthetic beauty, but also to protect the natural environment they sustain.

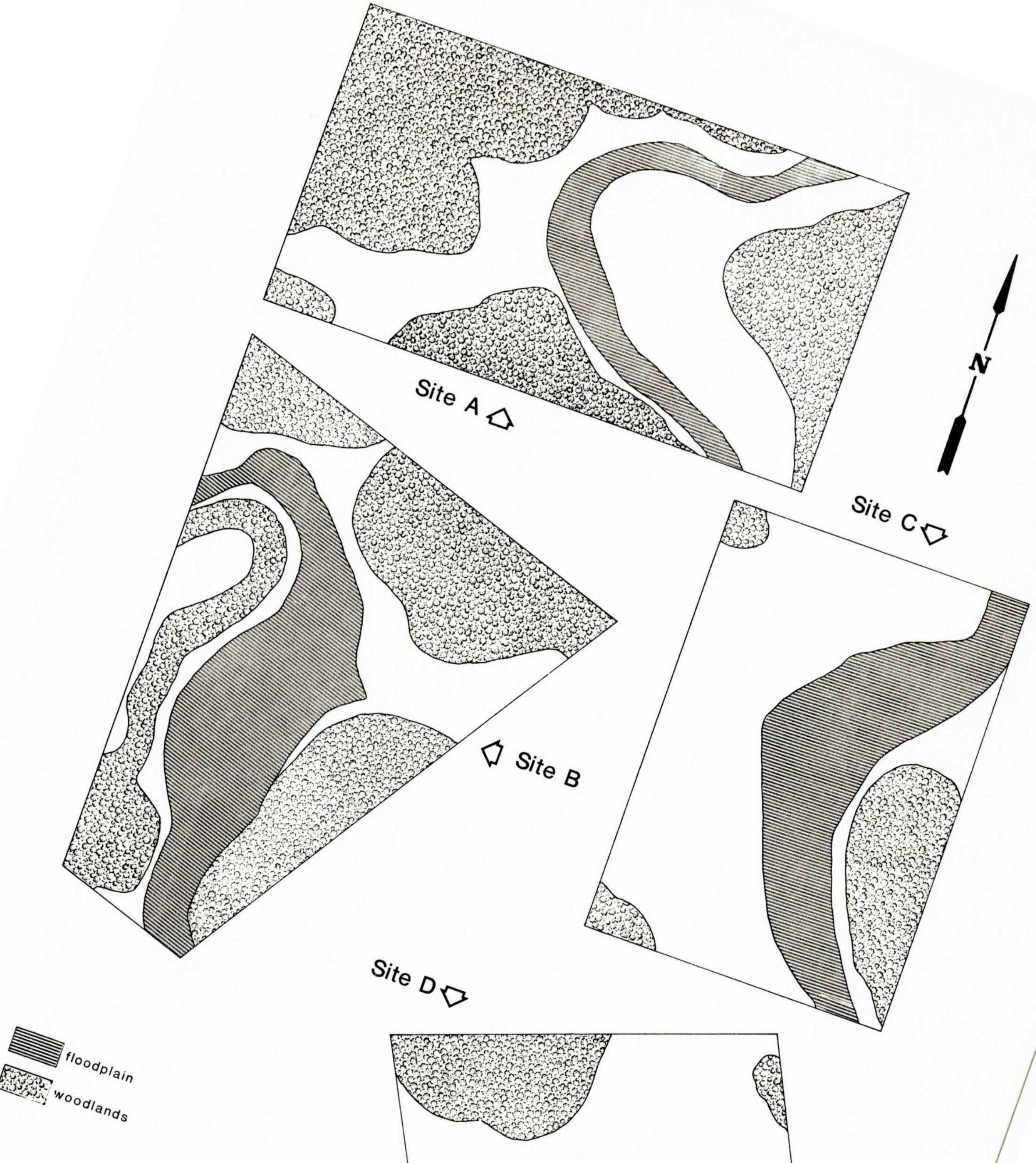

Figure 2.1 Woodlands and Floodplains

Floodplains

From a planning perspective, the floodplain may be the most important feature of the river valley. Defined according to geomorphic criteria, the floodplain is the low-lying land along the stream, the outer limits of which may be marked by steep slopes or valley walls. The floodplain is important for several reasons: first, excluding the stream channel itself, the floodplain is generally the lowest part of the stream valley and thus is most prone to flooding; second, because of the nearness of the water table to the surface and saturation by floodwaters, floodplain soils are often poorly drained; third, and last floodplains are formed by incremental erosion and deposition associated with the lateral migration of streams in their valleys. The U. S. National Flood Insurance Program is based on a definition of the "100-year floodplain." According to the criteria, two zones are actually defined: (1) the regulatory floodway, the lowest part of the floodplain where the deepest and most frequent floodflows occur; and (2) the floodway fringe, on the margin of the regulatory floodway, an area that would be lightly inundated by the 100-year flood. Buildings located in the regulatory floodway are not eligible for flood insurance, whereas those in the flood fringe are eligible, provided that a certain amount of flood proofing is established.[3]

Figure 2.1 also delineates the 100-year floodplain boundaries for each of the four sites. Floodplains are the most restrictive in that they require the greatest amount of open space to protect not only the natural features (the stream or river valley), but also to protect persons who might otherwise try to use the floodplain for inappropriate cultural activities. Needless to say, floodplains are often highly developed and in turn dramatically altered. Because of this, the highest priority of open space has been given to the resource class "floodplains". In examining the extent of floodplains within each site, sites B and C have the greatest amount with 26 percent (35.8 acres/137 acre total) and 29 percent (32.6 acres/114 acre total) respectively. Site A, the largest of the four sites, has a relatively small amount of floodplain with 10 percent of the 156 acre total (15.4 acres). Site D, while having only 14 acres in floodplain is much smaller (74 acres), thus making the amount of floodplain within the site, (19 percent of the total) much more significant.

Soil erosion potential

Soil characteristics, such as compactness and structure, influence erosion, but in general soil texture can be taken as the leading parameter in assessing the potential for erosion. If running water is applied to soils of different textures, sand will usually erode first. In order to erode clay, the velocity of the runoff would have to be increased to the point where sufficient stress overcomes the cohesive forces that bind particles together. Similarly high velocities also would be needed to move pebbles and larger particles, because their masses are greater than those of sand particles. Thus, in considering the role of soil type in erosion problems, it appears that intermediate textures (sand) tend to be most erodible, whereas clay and particles coarser than sand are measurably more resistant.[4]

Figure 2.2 shows the potential for soil erosion for each of the four sites. This category is further divided by hazard levels: (1) no erosion hazard, (2) low erosion hazard, (3) moderate erosion hazard, and (4) extreme erosion hazard. The individual hazard levels were delineated by soil texture, as mentioned above. In sites A, B, and D, the hazard level with the highest percent of the total acreage is that of

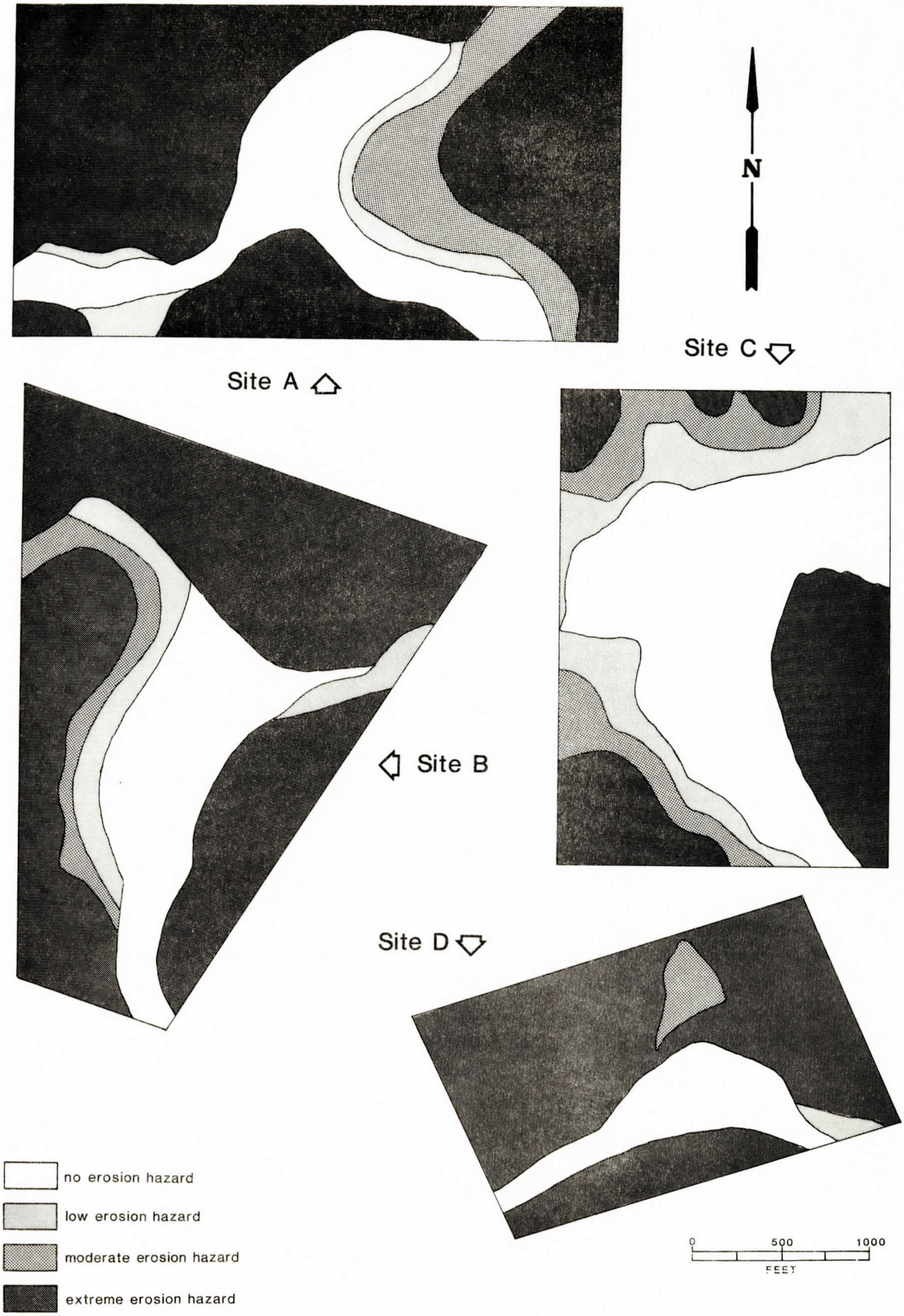

Figure 2.2 Soil Erosion Potential

extreme erosion. This level alone contains well over 50 percent of the gross acreage for the above mentioned sites. Even site C has over 25 percent of its gross acreage within the extreme erosion hazard level. It is obvious that the mountain environment, with steep slopes, plays a significant role in the above figures, and that special techniques need to be utilized to minimize erosion. Because of the topography within the corridor many areas with extreme erosion hazard are developed. This is primarily because of the relatively small amount of flat land available, which is normally considered suitable for development. Proper developmental practices can greatly reduce most soil erosion problems. Although open space ratios assigned to the category "soil erosion potential" are not as high as those found in the other three resource categories, it is still important to maintain adequate reserved space for areas with severe soil erosion problems.

Slope

In planning, the need to consider topography is an outgrowth of widespread realization that land uses not only have slope limitations, but that slopes have often been misused in modern land development. The misuse arises from two types of practices: (1) the placement of structures and facilities on slopes that are already unstable or potentially unstable; and (2) the disturbance of stable slopes resulting in accelerated erosion, and/or ecological deterioration of the slope environment. The first practice can result from inadequate analysis of slopes in terrain that has a history of slope instability. More frequently, however, it probably results from inadequate performance standards placed on development. Disturbance of slope environments is unquestionably the most common source of slope problems in the U. S. 321/Boone-Blowing Rock corridor. Three types of disturbances stand out:

1. Mechanical cut and fill, in which slopes have been reshaped by heavy earth moving equipment. This often involves steepening and straightening, resulting in a loss of the equilibrium associated with natural conditions. Examples of rock slides, steep slopes

and erosion caused by mechanical cut and fill can be seen throughout the corridor.

2. Deforestation in hilly terrain by lumbering operations, agriculture, and urbanization. This not only results in a weakened slope because of the reduced stabilizing effect of vegetation, but also increases stress from runoff and groundwater.

3. Improper siting and construction of buildings and related facilities, leading to an upset in the slope equilibrium because of the alteration of vegetation, slope materials, and drainage.[5]

The following slope categories have been established for the purposes of development by the Soil Conservation Service, U. S. Department of Agriculture: less than 2 percent, 2 to 7 percent, 7 to 15 percent, 15 to 30 percent, 30 percent or greater. Maps showing individual categories within the resource class slope for sites A, B, C and D are shown in Figure 2.3. Due to mountainous terrain there is a wide range of acreage within the slope categories for all of the sites. The most restrictive open space requirements are for the categories of 2 percent or less and 30 percent or greater. The 2 percent or less category lies mainly in floodplains. The 30 percent

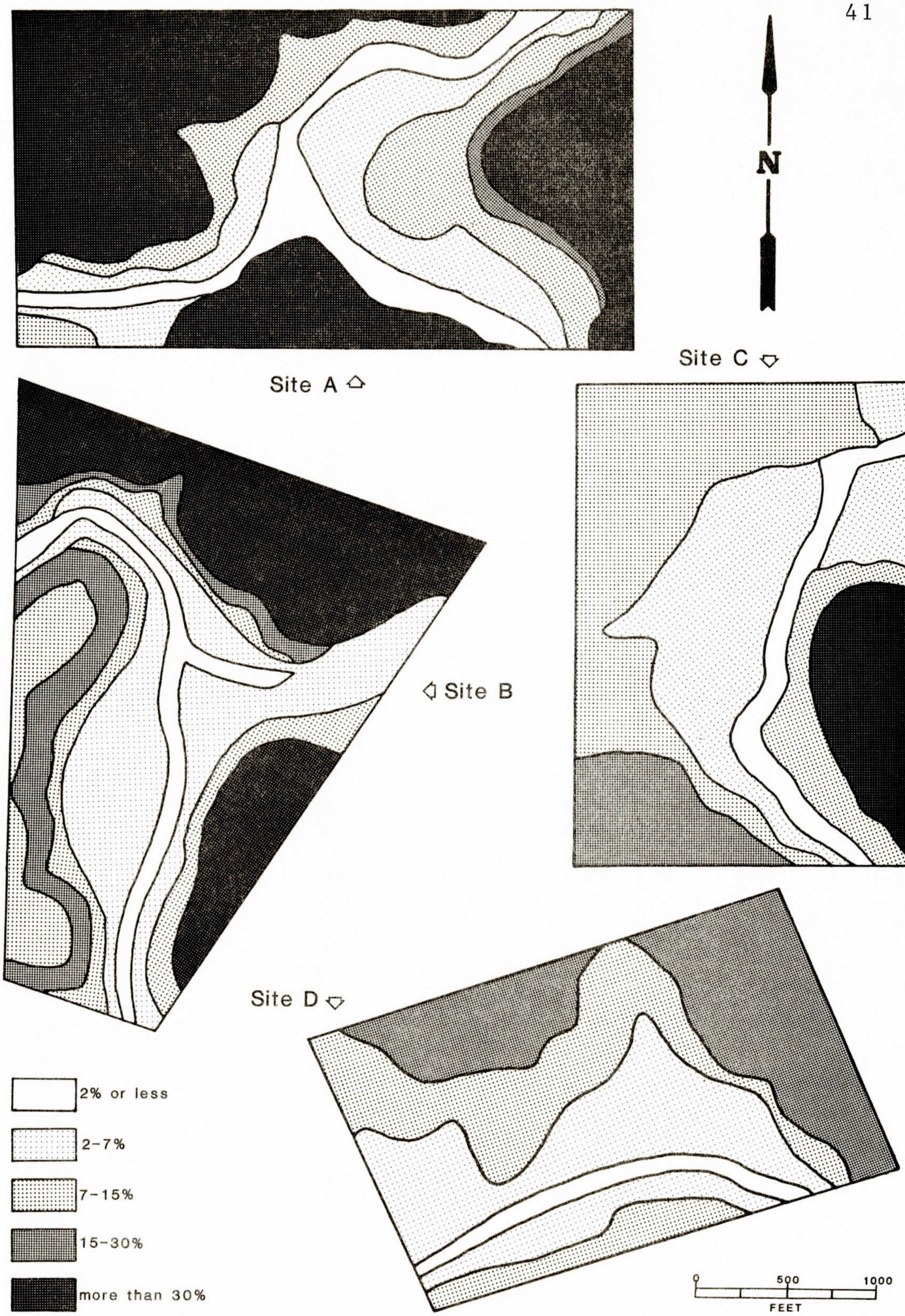

Figure 2.3 Slope Categories

or greater category has a high potential for extreme slope erosion and thus must be tightly regulated with a higher open space ratio. The 7-15 percent site type or category has no open space restrictions, due to its low erosion potential and high drainage capabilities. The remaining slope categories can be less tightly regulated because of their less restrictive percent of slope.[6]

Summary

In reviewing the resource classes "woodlands", "floodplains", "soil erosion potential", and "slope", within the U.S. 321/Boone-Blowing Rock corridor for each of the selected sites, the individual needs or restrictions that must be maintained in order to protect selected sites become apparent. Without prior knowledge of natural features or resources within a site, there is very little effective planning that can be done to establish performance standards concerning development. Once accurate environmental data are gathered and the information interpreted, only then can effective open space requirements to protect natural resources or features be applied.

NOTES

[1]William M. Marsh, Landscape Planning. (Menlow Park: Addison Wesley Publishing Co., 1983) p. 259.

[2] Ibid., pp. 275-276.

[3]Ibid., pp. 157-159.

[4]Ibid., pp. 222-223.

[5]Ibid., pp. 202-203.

[6]U. S. Department of Agriculture. Soil Survey: Watauga County, North Carolina. (Washington, D. C.: Government Printing Office, 1944) pp. 68-75.

CHAPTER THREE

SITE CAPACITY CALCULATION

Introduction

After careful analysis of the physical features of selected sites, performance zoning can be applied using a site capacity calculation to take into account three basic factors that limit development. To be considered first are locational and external constraints such as proposed road right-of-ways, utility easements, and the setting aside of other areas which have been otherwise reserved from development. Also, land for bufferyards, to protect adjoining uses, specifically roadways, needs to be determined. Second, it is necessary to take into account the constraint that is imposed by sensitive, fragile or dangerous natural environmental features and to determine the amount of open space necessary to protect them. Lastly, a calculation is made to set aside land for recreational purposes, in order to insure public or common space. Each of these limitations on site development, expressed in terms of their land area, must be known in order to calculate net buildable site.

Roadway and Bufferyard Limitations

Certain portions of potentially developable land may not be usable for the activities proposed, including roadways and bufferyards. Roadways within selected sites, (specifically U. S. Highway 321), have been mapped in Figure 3.1 and their space converted to land area in Table 3.1. Bufferyards make up the amount of land required to separate and protect one type of land use from another. For example, as a screen of plantings or fencing to insulate the surroundings from the noise, exhaust, or visual aspects of a roadway. To insure proper buffering along the U. S. 321 corridor, the same amount of buffer zone has been allotted for each site as there is roadway. Table 3.1 shows the calculation of the base site area. Both roadways and bufferyards are subtracted from the gross site area.

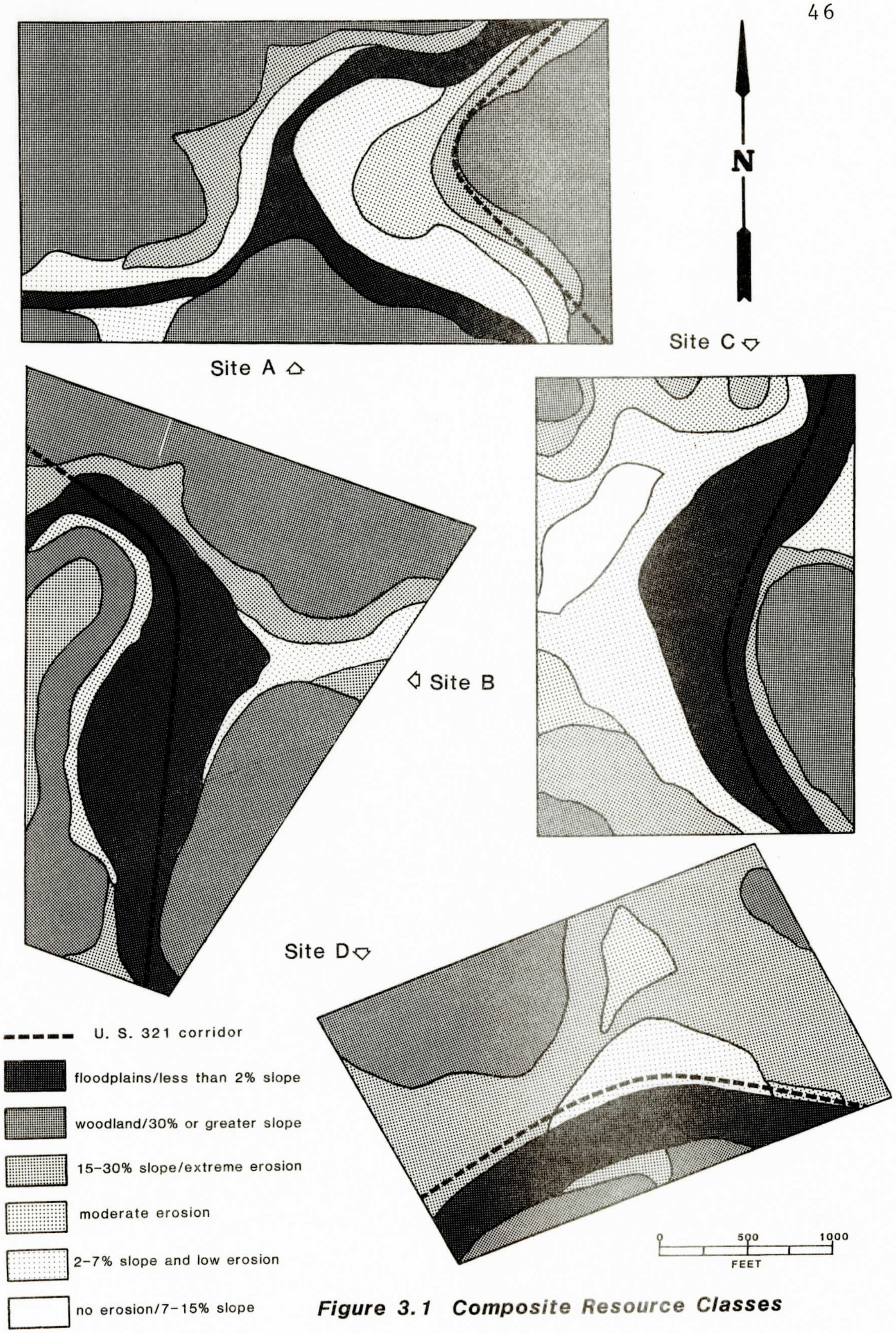

Figure 3.1 Composite Resource Classes

TABLE 3.1

Base Site Acreage by Site

	Site A	Site B	Site C	Site D
Given: Gross Site Area...........	156	137	114	74
Subtract: Land within Roadways.......	2.2	3.1	2.6	2.2
Subtract: Land for Bufferyard Areas..	2.2	3.1	2.6	2.2
Equals: Base Site Area	151.6	130.8	108.8	69.6

Adapted from: Kendig, Performance Zoning, 1980.

Open Space Requirements

The primary restriction derived from the site capacity calculation is the Open Space Ratio (OSR), or the amount of open space assigned to a given natural resource or feature. The OSR is the most limiting factor when considering the amount of development that could occur within a site. For the purposes of this study, three levels of open space ratio, minimum, moderate, and maximum, have been assigned to the individual resource classes in accordance to what is perceived to be their required level of protection. The fact that the resource classes have been deductively derived from careful study removes them from the realm of arbitrariness. While open space ratios may not be the result of the direct application of a scientific formula, they are the product of scientifically legitimate thought processes.[1] Table 3.2 lists assigned OSRs for the selected resources by resource classes. Also listed is the gross acreage per site, acres within individual resources and the amount of open space acreage needed, given a particular open space level. For the purposes of illustration, three levels of open space have been assigned each resource in order to ascertain the effects of open space on individual sites.

Recreational Requirements

The premise behind the recreation land requirement is that a certain amount of land should remain available for recreation in all developments. The amount of land depends on the density of proposed development and should be land suitable for recreational activity. It may not, therefore consist solely of marsh or floodplain, for example. Because land suitable for recreation may also encompass natural resource features, the developer may simultaneously preserve the resource and satisfy the recreational land requirements. For example, areas of forest are resources which are restricted from development, but which may be designated and used as the development's recreational land. For the purposes

Table 3.2

RESOURCE ACREAGE AND OPEN SPACE RATIOS, SITES A AND B

Resource Class	Site A, Gross Site Acreage = 156: Acres in Resource	Maximum Open Space Ratio	Acres Open Space	Moderate Open Space Ratio	Acres Open Space	Minimum Open Space Ratio	Acres Open Space	Site B, Gross Site Acreage = 137: Acres in Resource	Maximum Open Space	Acres Open Space	Moderate Open Space Ratio	Acres Open Space	Minimum Open Space Ratio	Acres Open Space
Woodlands	82.00	0.75	61.50	0.375	30.75	0.187	15.30	71.5	0.75	53.60	0.375	26.80	0.187	13.35
Floodplain	15.40	1.00	15.40	0.50	7.70	0.25	3.85	35.8	1.00	35.80	0.500	17.90	0.25	9.00
Soil Erosion Potential														
No Erosion Potential	32.00	0.00	00.00	0.00	0.00	0.00	0.00	26.0	0.00	0.00	0.00	0.00	0.00	0.00
Low Erosion Potential	8.00	0.10	00.80	0.05	0.40	0.025	0.20	18.0	0.10	1.80	0.05	0.90	0.025	0.45
Moderate Erosion Hazard	15.70	0.20	03.14	0.10	1.57	0.05	0.79	15.3	0.20	3.00	0.10	1.53	0.05	0.77
Extreme Erosion Hazard	100.00	0.50	50.00	0.25	25.00	0.125	12.5	77.4	0.50	38.70	0.25	19.35	0.125	9.68
Slope														
2% or Less	16.50	1.00	16.50	0.50	8.25	0.25	4.13	9.7	1.00	9.70	0.50	4.85	0.25	2.43
2 to 7%	23.7	0.10	2.37	0.05	1.19	0.025	0.59	35.00	0.10	3.50	0.05	1.75	0.025	0.88
7 to 15%	29.9	0.00	0.00	0.00	0.00	0.00	0.00	26.0	0.00	0.00	0.00	0.00	0.00	0.00
15 to 30%	5.0	0.50	2.50	0.25	1.25	.125	0.63	30.7	0.50	15.35	0.25	7.68	0.125	3.84
30% or greater	80.7	0.75	60.50	0.375	30.26	0.187	15.00	35.3	0.75	26.48	0.375	13.24	0.187	6.60

Table 3.2 (continued)

SITES C & D

Resource Class	Site C Gross Site Acreage = 114 Acres in Resource	Maximum Open Space Ratio	Acres Open Space	Moderate Open Space Ratio	Acres Open Space	Minimum Open Space Ratio	Acres Open Space
Woodlands	19.6	0.75	14.7	0.375	7.35	0.187	3.70
Floodplain	32.6	1.00	32.6	0.50	16.30	0.25	8.15
Soil Erosion Potential							
No Erosion Hazard	49.2	0.00	00.0	0.00	0.00	0.00	0.00
Low Erosion Hazard	18.2	0.10	01.82	0.05	0.91	0.025	0.46
Moderate Erosion Hazard	13.6	0.20	02.72	0.10	1.36	0.05	0.68
Extreme Erosion Hazard	33.0	0.50	16.50	0.25	8.25	0.125	4.13
Slope							
2% or Less	8.8	1.00	8.80	0.50	4.40	0.25	2.20
2 to 7%	31.0	0.10	3.10	0.05	1.55	0.025	0.78
7 to 15%	46.4	0.00	0.00	0.00	0.00	0.00	0.00
15-30%	12.4	0.50	6.20	0.25	3.10	0.125	1.55
30% or greater	15.4	0.75	11.55	0.375	5.78	0.187	2.88

Resource Class	Site D Gross Site Average = 74 Acres in Resource	Maximum Open Space	Acres Open Space	Moderate Open Space Ratio	Acres Open Space	Minimum Open Space Ratio	Acres Open Space
Woodlands	18.9	0.75	14.18	0.375	7.00	0.187	3.50
Floodplain	14.0	1.00	14.00	0.50	7.00	0.25	3.50
Soil Erosion Potential							
No Erosion Hazard	14.20	0.00	00.00	0.00	0.00	0.00	0.00
Low Erosion Hazard	1.00	0.10	0.10	0.05	0.05	0.025	0.025
Moderate Erosion Hazard	2.80	0.20	0.56	0.10	0.28	0.05	0.14
Extreme Erosion Hazard	56.00	0.50	0.28	0.25	14.00	0.125	7.00
Slope							
2% or Less	3.70	1.00	3.70	0.50	1.85	0.25	0.93
2 to 7%	22.00	0.10	2.20	0.05	1.10	0.025	0.55
7 to 15%	23.60	0.00	0.00	0.00	0.00	0.00	0.00
15-30%	24.9	0.50	12.45	0.25	6.23	0.125	3.11
30% or greater	0.00	0.75	0.00	0.375	0.00	0.187	0.00

of this study recreational land will be cited separately from that of resource protection land and thus deducted separately from the total site. The recreation factor selected for this study has been set at a customary factor of .10.[2]

The recreation calculation is not made until the total land (in acres) with resource restrictions has been subtracted from the base site area. The remainder is the total unrestricted land within each site, which is then multiplied by the recreation factor, in this case .10. The product is the total set aside for recreation land within each base site. (Tables 3.3 through 3.6 show the total recreation land set aside for the three open space ratio levels in sites A, B, C and D, respectively).

Site Capacity Calculation: Net Buildable Site

In order to deduce the proper amount of net buildable area for all sites, composite maps have been drawn (Figure 3.1). The composite maps are the result of overlaying the four resource classes, allowing the most restrictive open space requirements to stand out. Certain resources overlap and by applying the data in Table 3.1 and 3.2 and Figure 3.1, the total net buildable acreage for each of the three open space ratio levels for sites A, B, C and D can be calculated. In examining Figure 3.1 note the resource classes that contribute to the shaded patterns. The denser the pattern the more restrictive the open space ratio. In overlapping the resource categories, six composite resource classes have emerged. Listed in order of highest open space restrictions, they are: (1) floodplains and less than 2 percent slope, (2) woodland and 30 percent or greater slope, (3) 25 to 30 percent slope and extreme erosion, (4) moderate erosion, (5) 2 to 7 percent slope, and (6) no erosion and 7 to 15 percent slope. All of the above composite resource classes were measured in acres and are listed in Tables 3.3 through 3.6. Tables 3.3 through 3.6 also show the calculated net buildable site acreage for each open space ratio at the maximum, moderate, and minimum levels for each study site. The individual composite resources (in acres) were multiplied by the ratios assigned in Table 3.2, to obtain the acres listed under the three open space ratio levels.

When examining the individual net buildable acreage calculations for the selected sites in the study area (Tables 3.3 through 3.6), it becomes

Table 3.3

Site Capacity Calculation For Site A

Composite Resources (in acres)	Open Space Ratio Levels (in acres)		
	Maximum	Moderate	Minimum
Floodplains and less than 2% slope: (18)	18	9	4.5
Woodlands and 30% slope or greater: (82.4)	61.8	30.9	15.4
15-30% slope and extreme erosion: (18)	9	4.5	2.25
Moderate erosion: (11.6)	2.32	1.16	.58
2-7% slope and low erosion: (25.7)	2.57	1.29	.64
No erosion and 7-15% slope: (0)	-	-	-
Open Space Requirement (OS) (total)	93.69	46.85	23.37
Base site area: 151.6 (subtract OS)	151.60	151.60	151.60
Equals:	57.91	104.75	128.23
Recreation land: (x .10) (subtract)	5.79	10.47	12.32
Equals: NET BUILDABLE SITE (acres)	52.12	94.28	115.41

Adapted from: Kendig, Performance Zoning, 1980.

Table 3.4

Site Capacity Calculation For Site B

Composite Resources (in acres)	Open Space Ratio Levels (in acres)		
	Maximum	Moderate	Minimum
Floodplains and less than 2% slope: (36)	36	18	9
Woodlands and 30% slope or greater: (68.8)	51.6	25.8	12.8
15-30% slope and extreme erosion: (19.6)	9.8	4.9	2.45
Moderate erosion: (6.2)	1.24	.62	.31
2-7% slope and low erosion: (6.4)	.64	.32	.16
No erosion and 7-15% slope: (0)	-	-	-
Open Space Requirement (OS) (total)	99.28	49.64	24.72
Base site area: 130.8 (subtract OS)	130.80	130.80	130.80
Equals:	31.52	81.15	106.08
Recreation land: (x .10) (subtract)	3.152	8.116	10.608
Equals: NET BUILDABLE SITE (acres)	28.37	73.04	95.47

Adapted from: Kendig, Performance Zoning, 1980.

Table 3.5

Site Capacity Calculation For Site C

Composite Resources (in acres)	Open Space Ratio Levels (in acres) Maximum	Moderate	Minimum
Floodplains and less than 2% slope: (33)	33	16.5	8.25
Woodlands and 30% slope or greater: (19.6)	14.7	7.35	3.67
15-30% slope and extreme erosion: (18)	9	4.5	2.25
Moderate erosion: (10.2)	2.04	1.02	.51
2-7% slope and low erosion: (26.3)	2.63	1.32	.66
No erosion and 7-15% slope: (6.9)	0	0	0
Open Space Requirement (OS) (total)	61.37	35.89	15.34
Base site area: 108.8 (subtract OS)	108.8	108.8	108.8
Equals:	47.43	78.11	93.46
Recreation land: (x .10) (subtract)	4.743	7.811	9.346
Equals: NET BUILDABLE SITE (acres)	42.69	70.30	84.11

Adapted from: Kendig, Performance Zoning, 1980.

Table 3.6

Site Capacity Calculation For Site D

Composite Resources (in acres)	Open Space Ratio Levels (in acres)		
	Maximum	Moderate	Minimum
Floodplains and less than 2% slope: (14.1)	14.4	7.05	3.53
Woodlands and 30% slope or greater: (18.9)	14.2	7.09	3.53
15-30% slope and extreme erosion: (32.1)	16.05	8.03	4.01
Moderate erosion: (2.8)	.56	.28	.14
2-7% slope and low erosion: (6.1)	.61	.30	.15
No erosion and 7-15% slope: (0)	-	-	-
Open Space Requirement (OS) (total)	45.5	22.75	11.36
Base site area: 69.6 (subtract OS)	69.6	69.6	69.6
Equals:	24.1	46.85	58.24
Recreation land: (x .10) (subtract)	2.41	4.685	5.814
Equals: NET BUILDABLE SITE (acres)	21.69	42.17	52.42

Adapted from: Kendig, Performance Zoning, 1980.

apparent how the use of open space ratios can restrict development. The maximum open space ratio level is obviously the most limiting. Site B (Figure 3.1 and Table 3.4), is the most restricted under the maximum open space ratio levels, with over 72 percent of the gross site being reserved as open space; the net buildable site is only 28.37 acres. It stands to reason that the natural resources or features within site B will require the application of more restrictions than those of site C (Figure 3.1 and Table 3.5), which under a maximum OSR has 54 percent of its total area reserved as open space with a net buildable site of over 42 acres. In other words, net buildable site is a function of how much open space is assigned to protect the natural resources or features within a site. Other restrictions, such as roadways, bufferyards and recreation lands, are also added to open space requirements in determining net buildable site. Again, under the maximum open space ratio level, using as example sites B (Figure 3.1 and Table 3.4) and site C (Figure 3.1 and Table 3.5), note that while site B is larger (137 acres), its net buildable area is only 28.37 acres, whereas site C (114 acre total), has a greater net buildable area of 42.69 acres. When performance standards are high, it is possible to have a large site with many resource restrictions, which will yield a relatively low net buildable component. In the strictest sense, the maximum open space ratio level best serves to protect natural resources or features. In many instances, however, the pressure and economic need for development is great. The type of ordinances necessary to restrict a 137 acre site to only 28.37 acres may be politically difficult to implement.

On the other hand, a moderate open space ratio allows greater net buildable site, when considering total acreage. The critical factor remains that when the amount of open space necessary to protect resources is decreased, the chances for environmental damage increase. When less than the maximum standards are used, it becomes even more critical to conduct intense evaluations of site development proposals. Without careful assessment, the risk of long range environmental and societal degradation is high. The figures for Site A (Table 3.3) show the results of increasing net buildable site when decreasing the open space requirements under the moderate open space ratio level. Under the maximum open space ratio level, the net buildable site is just over 52 acres, while the net buildable site using the moderate open space ratio level is over 94 acres. On the other hand, open space ratios decrease by one-half and thus there is only one-half the amount of open space compared to maximum open space levels.

The minimum open space ratio level shows the effect of assigning only a small amount of open space to natural resources or features within a site. The open space requirement is roughly three times less than that required at the maximum level. Figures for Site D (Table 3.6) show the increased amount of net buildable site. Of the 74 acre total, over 52 acres are designated as buildable. Only fifteen percent (11.36 acres) of the total site has been set aside as open space to protect natural resources or features. At this level, if all 52 net buildable site acres are developed, the threat of environmental damage is high. At the minimum, open space ratio level sites A, B and C have similar problems in terms of the amount of open space necessary to protect natural resources or features. This density of development is an example of going beyond the carrying capacity of sites within the U. S. 321/Boone-Blowing corridor. In order for this density of development to occur, many resources would have to be altered. There would be little or no open space left to protect resources or protect one level of land use from another.

Two other examples of going beyond the carrying capacity of a site are apparent for site D, using the composite resource categories of floodplains/less than 2 percent slope or woodlands/30 percent or greater slope. There it can be noted that only 3.53 acres are being set aside for both resource categories, when in fact there are 14 acres of the first composite category (floodplains/less than 2 percent slope) and almost 19 acres of the category woodland/30 percent or greater slope. At the minimum, OSR over 10 acres of the first category and 15 acres of the second category are left to be developed. At this density level the true carrying capacity of Site D is in extreme danger of being exceeded, thereby creating the threat of severe degradation.

Site Recommendations: An Example Concerning Residential Use

In examining Tables 3.3 through 3.6, it can be seen how open space restrictions can limit the total amount of net buildable site at maximum, moderate and minimum open space ratio levels. A key argument concerning residential development is that by decreasing the amount of land that is developable, the number of building units per site is also decreased. The following example shows that by increasing the density within buildable sites at maximum and moderate open space ratio levels, the number of dwelling units per site remain the same as those with minimum open space restrictions. More important is the fact that high open space levels can be maintained, while still offering a diversity of housing types. For purposes of illustration, a maximum density factor of two dwelling units per acre was delineated for each of the four base site areas. In determining the number of dwelling units (DU) allowed within each base site, it is necessary to multiply the maximum density factor of two dwelling units by the number of acres within each base site.

Tables 3.7 through 3.10 indicate some typical densities for common housing types as given in the literature, along with the following possible housing combinations for each of the four sites. Densities for individual housing types take into account streets, pedestrian walkways and public facilities. Although it is possible to go below the indicated density levels per housing type, the results in most cases would not be cost effective, particularly for

Table 3.7

Site A*

Site Density and Acreage by Housing Type
Base Site 151.6 Acres, 303 DU.

Housing Type	Density (DUs per acre)	Number of Acres Per Housing Type		
		Maximum OSR	Moderate OSR	Minimum OSR
single family	5 (x)	25	60.6	60.6
zero lot line detached	6	22	0	0
two family detached	7	2	0	0
row houses	12	1	0	0
stacked townhouses	18	0	0	0
three-story walkup apts.	20	1	0	0
Number of Dwelling Units (NODU)		303	303	303
Net Buildable Site (NBS)		52.12	94.28	115.41
Percent of Total Site Usage		98%	64%	52%
Net Buildable Site Density (NODU/NBS)		6 DUs/Ac	3.2DUs/AC	2.6 DUs/Ac

*Adapted from: Lynch and Hack, Site Planning, 1984.

Table 3.8

Site B*

Site Density and Acreage by Housing Type
Base Site 130.8 Acres, 262 DU.

Housing Type	Density (DUs per acre)	Number of Acres Per Housing Type: Maximum OSR	Moderate OSR	Minimum OSR
single family	5 (x)	13	52.4	52.4
zero lot line detached	6	5	0	0
two family detached	7	1	0	0
row houses	12	1	0	0
stacked townhouses	18	6	0	0
three-story walkup apts.	20	2	0	0
Number of Dwelling Units (NODU)		262	262	262
Net Buildable Site (NBS)		28.37	72.04	95.47
Percent of Total Site Usage		99%	71%	54%
Net Buildable Site Density (NODU/NBS)		9 DUs/Ac	3.6 DUs/AC	2.7 DUs/Ac

*Adapted from: Lynch and Hack, *Site Planning*, 1984.

Table 3.9

Site C*

Site Density and Acreage by Housing Type
Base Site 108.8 Acres, 217 DU.

Housing Type	Density (DUs per acre)	Number of Acres Per Housing Type: Maximum OSR	Moderate OSR	Minimum OSR
single family	5 (x)	35	43.4	43.4
zero lot line detached	6	5	0	0
two family detached	7	0	0	0
row houses	12	2	0	0
stacked townhouses	18	0	0	0
three-story walkup apts.	20	0	0	0
Number of Dwelling Units (NODU)		217	217	217
Net Buildable Site (NBS)		42.69	70.30	84.11
Percent of Total Site Usage		96%	62%	52%
Net Buildable Site Density (NODU/NBS)		5 DUs/Ac	3 DUs/AC	2.6 DUs/Ac

*Adapted from: Lynch and Hack, Site Planning, 1984.

Table 3.10

Site D*

Site Density and Acreage by Housing Type
Base Site 69.6 Acres, 139 DU.

Housing Type	Density (DUs per acre)	Number of Acres Per Housing Type: Maximum OSR	Moderate OSR	Minimum OSR
single family	5 (x)	10	27.8	27.8
zero lot line detached	6	7	0	0
two family detached	7	2	0	0
row houses	12	1	0	0
stacked townhouses	18	0	0	0
three-story walkup apts.	20	1	0	0
Number of Dwelling Units (NODU)		139	139	139
Net Buildable Site (NBS)		21.69	42.17	52.42
Percent of Total Site Usage		97%	66%	53%
Net Buildable Site Density (NODU/NBS)		6.4 DUs/Ac	3.3 DUs/AC	1.8 DUs/Ac

*Adapted from: Lynch and Hack, Site Planning, 1984.

the maximum open space levels. The objective in this exercise was to utilize the greatest amount of acreage possible in arriving at the calculated DUs per acre in each of the four sites. This was done to show the efficiency of a site in terms of its residential potential under the maximum density factor of two DUs per base site area. The results are shown in Tables 3.7 through 3.10.

Using the examples given, the size of the net buildable site has a direct relationship to the residential density within a site when using a maximum density factor of two DU's per acre for all three open space ratio levels. At the maximum OSR level the net buildable density is the highest, while the minimum OSR level has the lowest net buildable site density. It is important to note that under the maximum density factor of two DU's per acre, the most efficiently utilized sites are those under the maximum OSR level.

Within the four sites in this study the total amount of net buildable acreage is over 95 percent for maximum open space levels. At the minimum open space levels the amount of net buildable site usable is just over 50 percent. Even under the maximum open space level where net buildable site is less, the chance of using the site efficiently is greater and at the same time provides adequate open space to protect natural resources or features. In many planning districts a maximum density factor, in this case two DU's per acre, is set to control residential growth. The maximum density factor is applied to an entire base site as shown in Tables 3.7 to 3.10 above. Once the land suitable for development is determined, the number of building units calculated for the base site can be applied to the net buildable site. Maximum open space restriction need not affect the density of development on selected sites as long as open space requirements are followed in protecting natural resources or features. Using minimum OSR levels decreases density, but at the same time increases residential sprawl. By utilizing effective site planning and building design, such as a combination of single family housing to three-story walk up apartments, as listed in the tables above, selected sites can be efficiently developed with a minimal amount of residential sprawl. Yet, they can still maintain open space to protect natural resources or features within each of the four sites.

NOTES

[1]Lane Kendig, Performance Zoning. (Washington, D. C.: Planners Press, American Planning Association, 1980) p. 325.

[2]Ibid., pp. 321-322.

CHAPTER IV

Summary and Conclusions

In order to illustrate the need for a positive balance between site and site use, the concept of performance zoning has been presented; examples have been given of the results of the application of performance standards. Several terms, including carrying capacity, open space ratio, and net buildable site that pertain to those standards which enable land use activity to occur without destroying natural resources or features have been defined. For the purposes of this study, three open space ratio levels, maximum, moderate, and minimum were assigned to individual resources, providing different levels of open space. The premise is that, the more important the need to protect a resource, the higher the level of protection ought to be. In calculating site capacity, it was assumed the best open space requirements were those that allow not only adequate protection for natural resources or features, but also set aside open space areas so that the overall effect is a less intensive use of the land (site).

Performance standards that fall between the maximum and moderate open space ratio levels appear to be best suited for the U. S. 321/Boone-Blowing Rock corridor. From the developer's standpoint, the standards permit flexibility in net buildable site acreage. From the community's point of view the process provides sufficient open space not only to protect resources, but also to keep the area from continuing its trend toward becoming a sprawling commercial strip.

The "fit" of the built environment to the existing physical environment, cited earlier in the review of the literature, is extremely important. Without an in-place system of regulation, the intensity of use tends to exceed the carrying capacity of land, primarily because of the desire for the developer to maximize profit. This results in further deterioriation of the resource base, the very thing that the visitor came to enjoy in the first place. Subsequently, destruction of the physical environment and its scenic beauty increasingly occurs and a downward economic spiral ensues. If the deterioration becomes severe enough, the economic base of the communities at either end of the corridor will in turn suffer.

The present single-purpose nature of the corridor, i.e., commercial strip development, probably would have been the same had conventional zoning been in effect over the past several years. If performance zoning had been implemented the requirements for resource protection and buffering would have lowered the intensity of development, thereby promoting more mixed use (e.g., commercial combined with residential) of the land; in its present state, without any controls, the corridor can only continue its trend toward solid commercial development, with the accompanying clutter and congestion. What ultimately may be destroyed is what the visitor came to see.

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VITA

Brian Michael Fleer was born in Grand Rapids, Michigan. He attended local schools until the fall of 1975, when he graduated from East Kentwood High School. In the Fall of 1976 he entered Grand Rapids Junior College and graduated in the Summer of 1978. He was then accepted into the geography program at Michigan State University and graduated in the Summer of 1980 with a Bachelor of Science Degree.

In the Fall of 1980 Mr. Fleer accepted a position with Gulf Oil, Inc. in Houston, Texas. He remained with Gulf Oil until August of 1983, when he accepted a teaching assistantship at Appalachian State University, and began work towards a Master of Arts Degree in Geography with emphasis in community planning. The Master of Arts degree was awarded at the end of fall semester 1987.

Mr. Fleer is married to the former Kathryn Lee Yeager. His parents are Mr. and Mrs. Charles Fleer of Grand Rapids, Michigan and he has one sister, Theresa Ann Drabenstot of Marion, Indiana.