IMPACTS OF ADJACENT LAND USE ON BLUE RIDGE PARKWAY COSTS

by

A. Stephen Galea

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APPROVED:

_____
W. David Klemperer

_____   _____
Joseph Havlicek, Jr.   Marion R. Reynolds, Jr.

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INTRODUCTION

The National Park Service, since its inception in 1916, has maintained the policy of preserving the scenic, natural, and historic qualities of areas under its jurisdiction. However, burgeoning population and associated development have made it increasingly more difficult to protect the values offered by the National Parks. Development within the vicinity of a National Park may have direct impact upon the park and on the cost of providing recreation for the public.

Although the relationship between adjacent[1] land uses and National Park operations has been investigated in a qualitative fashion (Kusler,1974), no attempt has been made at quantifying this relationship. The merit of such an attempt would be to provide the park manager with information necessary to make more efficient decisions relating to budget and land use. The impact of incompatible neighboring land use could be minimized by alternative planning which considers such problems.
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[1]The words adjacent, neighboring and local as they are used
 in this study, will refer to the counties bording the Park-
 way.

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The effects of adjacent land use or private development
may vary depending upon the kind and intensity. In special
cases, most notably the Redwoods National Park controversy,
Congress has given the Secretary of the Interior special
authority to purchase adjacent lands for the purpose of pro-
tecting park values. In this situation, timber companies
holding adjacent lands and watersheds cut timber right up to
the park boundaries (Sax, 1975). The resultant siltation of
park streams and blowdown of timber spawned much public
furor and subsequent expansion of park boundaries for the
protection of park qualities. While this is an extreme
situation, it illustrates the kind of problems faced by park
management from external forces. Conversly, private camping
facilities near park areas may decrease user pressure on the
park's facilities, thereby decreasing park campground costs.
Low intensity, well planned development may have little or
no effect on park costs.

Kusler (1974) has discussed threats to parks from pri-
vate land use. These threats are easily recognized when one
views gateway communities such as exist in Gatlinburg, Ten-
nesse near the Great Smokey Mountains National Park.
Motels, signs, air pollution, highrise hotels, second home
developments and other land uses may destroy scenic beauty
and decrease satisfaction to some park users.

Urban sprawl resulting from industrial, residential and commercial growth can also increase park costs. Litter, vandalism, noise, traffic congestion, and pollution of air and water are just some of the general types of threats (Kusler,1974). We would expect disproportionately higher costs of maintanence, administration, and park land acquision for the park area near heavy private development.

The affect of external factors on park costs may be more dramatic when no coordinated planning framework exists between park and adjacent communities. The lack of technical expertise, data base, and regional perspective in local planning efforts are cited as sources of conflict between park management and local communities (Kusler,1974). Usually National Parks are located in rural areas void of any legitimate planning authority.

The Blue Ridge Parkway is a unique member of the National Park System which serves both regional and national recreational needs. Recreation services are the chief output of the Parkway. The cost of producing these recreation services are a function of many factors. In its 470 mile meander through the Appalachian highlands many neighboring communities are encountered. These communities range from pastoral to urban in character. The type of the surrounding

community may be an important factor in explaining variation in Parkway operating costs between different areas. For example, litter from fast food restaurants and use of Parkway trash barrels for the deposite of trash by inhabitants of local communities may be common in some areas and not in others.

Second home development is often attracted to areas adjacent to park lands because their natural and aesthetic qualities are secured under park management (Iowa Law Review,1971). Several problems can result from such development (Am. Soc. Planning Officials, 1976). Park land aquisition programs may be thwarted by land prices which are driven prohibitively high by land speculators (Shands and Woodson,1974). Public recreation facilities may be overcrowded by the disproportionately higher use by second home occupants. The threat of wildfire may be increased. Critical wildlife habitat may be destroyed, and inadequate waste treatment facilities may degrade water supplies.

The use of park facilities for non-recreation purposes may also affect park costs. The Parkway receives much use from the local populace as an alternative travel route (Smith and Assoc., 1974). The Parkway in many areas is better maintained and offers a more favorable travel route than

local or state maintained roads. An increase in local population will increase Parkway use and influence the cost of maintaining the road surface. Heavy localized traffic can also cause significant safety problems at points of access. The local commuter may be more interested in getting to his destination than the more casual recreationist and thus cause a possible conflict upon the roadway.

Smith and Associates (1974) recommended restriction of at-grade crossings and access to improve visitor safety and to protect scenic quality. Such restrictions might also discourage incompatible development. However, the Park Service incurs substantial costs in circumventing such problems. The cost of such a grade separation program on one section of the Parkway in 1973 was near 200,000 dollars.

The more dramatic impacts from adjacent land use effect special projects carried out by the Park Service. Ongoing land acquisition programs and access elimination projects fall under this category. The costs associated with special projects are not budgeted in the same manner as the annual operating budget, but depend a great deal upon congressional appropriation for each separate project. The majority of lands acquired under the ongoing program are for the purpose of access elimination. The term *lumpy* is used to describe

these costs because they are large, non-continuous allocations.

The impacts related to access elimination are more site specific than the general kind of impacts thought to influence operating costs. Several reasons exist for access control. Access control provides some control over immediately adjacent land use. It can eliminate poorly designed intersections and funnel entering traffic to more safely designed locations. In addition, it can cut down on commuter use and maintain the scenic attributes of the Parkway.

Where operating costs are concerned, it is possible that increased visitation per year may result in decreased costs per visitor because of increasing returns to scale. However, we expect total costs to increase with increased visitation. It is not clear how development and the per visit cost to the Park Service are related. The analyses conducted in this study are aimed at determining these relationships.

In the following chapters, literature related to this study are reviewed and the statistical design and modeling procedures used in the analyses are given. Results are presented and discussed and policy implications addressed in the context of the objectives stated below.

Objectives

In summary, the specific objectives of this research are:

1. To determine what internal and external factors affect the cost per visit and the total cost of operating the Blue Ridge Parkway.

2. To provide information useful to the budgetary and land use planning process for Blue Ridge Parkway decisionmakers.

LITERATURE REVIEW

Most investigation into the area of external influences upon park operations has been of a qualitative nature. Kusler (1974), for example, pointed out the ways in which parks may be affected by adjacent land uses. He compiled from a survey of park administrators' several broad categories of threats based on the administrators responses. While this study gives insight into what park administrators subjectively percieve as threats, no knowledge is gained about the degree to which these threats affect park costs. Kusler's investigation deals more with the protection of parks from threats by examining various legal and land use planning techniques. The mechanism by which broad categories of land use may affect park cost is illuminated somewhat. The Conservation Foundation (1972) highlights the problem of land use around park areas and stresses the importance of land use controls for adjacent areas. No economic basis is given for their argument however.

Theoretical aspects of the problem can be found in literature on the economics of pollution or on external economies and diseconomies. Bator (1958) discusses general

aspects of inefficient resource allocation in the context of market failure. Simply stated, when incidental effects are not included in the pricing scheme (e.g., pollution), efficient resource decisions cannot be made. Mishan (1967) also discusses this point of external costs or incidental effects which should be added to the private costs in order to fully specify the cost of a given activity.

Reduction in visual quality and related soil disturbance and stream siltation are frequently encountered where second home development is extensive (Am. Soc. Planning Officials, 1976). The idea that areas near parks are attractive for such development and increase the incidence of environmental deterioration has been explored by other authors. Burby et al. (1972) developed a model for simulating residential development of rural recreation areas and noted that most development is haphazard with little planning consistency. More importantly, they noted that the most significant increases in second home development have occured near recreation sites located in the vicinity of metropolitan areas. One would therefore suspect a larger impact from areas displaying a higher degree of urbanization.

Smith and Associates (1974) have examined the impact of access on the Blue Ridge Parkway. They noted regulating local use through access control might help park management preserve scenic and historic qualities of the Parkway. Access control was viewed as a possible constraint on development and commuter use. Therefore, access elimination costs may be related to adjacent land use.

Literature on the subject of land use and encroachment in the legal context is volumous. Sax (1975), for example, wrote at length about the need for comprehensive legislation dealing with regulation of private land use as it effects National Park lands. The mechanisms by which the Park Service deals with incompatible land uses adjacent to park lands and the constitutional issues associated with such situations are discussed. While the issues are broad they nevertheless form the basis of property rights disputes such as who may be liable for incidental damage done by specific land uses and what measures may be taken to minimize the impact from incompatible adjacent land use.

Models

Quantifying the impact of land use on Parkway costs requires the development of a statisical model. Cross-sectional analysis is a method frequently employed to estimate

the long-run cost curves for industries. Data on costs and other important variables is collected for the firms within the industry. Econometric techniques are then employed to determine the relationship between cost and the other variables. The model in this study includes the Parkways total and per unit costs as well as variables thought to be internally and externally related. The economic relationships which may exist between stochastic variables within a model can be illuminated with the use of regression analysis (Intrilligator, 1978).

Many variables are considered relevent to the cost function specification. Since the number of observations on the given data are limited, it may be necessary to condense the information contained in many variables into few variables. This can be done with principal component analysis (Morrison, 1972) which extracts the linear dependance between variables and expresses the variables as linearly independant factors.

English (1968) used multivariate regression analysis to determine the relationship between land use patterns and the cost of providing public services in a metropolitan area. He showed that the variables best explaining per capita expenditures were population density, the amount of commer-

cial activity and the proportion of multiple dwelling units. These variables also indicate degree of urbanization within the area. While direct comparison to the National Park problem is not possible, some similarities do exist. Both cases concern the effects of land use patterns on public expenditures.

Swanson (1972) hypothesized that diseconomies of scale exist where residential land use predominates and that economies of scale exist in areas of commercial or industrial land use where contribution to the tax base is concerned. In other words, larger industries or more commerce in a given metropolitan area implies greater tax revenue. Relatively higher levels of residential development are associated with lower tax revenue. Swanson also showed that per capita public service expenditures varied with land use changes.

The findings of English can be related to work done by other authors. Williams (1979) showed that roughly one-third of Blue Ridge Parkway recreation use comes from local areas. If use is the greatest contributer to operating costs then areas of higher population density and also higher use would be expected to contribute relatively greater impact upon total costs. The exact impact on annual

cost per visit may be somewhat different. Per visit costs may actually decrease with increased visitation holding all other factors constant. Williams determined that roughly 23 per cent of the local population used the Parkway for commuter purposes. This figure was the same for rural and urban areas. Thus, for any given number of out-of-county recreationists, a higher percentage of commuter use of the Parkway would be expected near urban centers or areas of higher population.

METHODOLOGY

Study Area

The Blue Ridge Parkway has been selected for this study because of its long linear nature. This attribute makes it possible to study a park under the same management but exposed to a wide range of variation in the environment through which it passes. This environment contains both rural and urban extremes. Meandering 470 miles through the Appalachian Highlands, the Parkway crosses through Virginia and North Carolina, encountering 29 counties. Figure 1 shows the general location of the Parkway. The Parkway has been divided into 2 districts, 6 sub-districts and 12 sub-subdistricts with maintenance facilities for park operations located at each of the sub-subdistricts.

Sampling

The desire to achieve as fine a resolution as possible in the analysis prompted the use of the 12 sub-subdistrict breakdown on park organization. Figure 2 shows the sub-subdistrict geographic organization. It was a natural choice since costs could be allocated at this level and provide the

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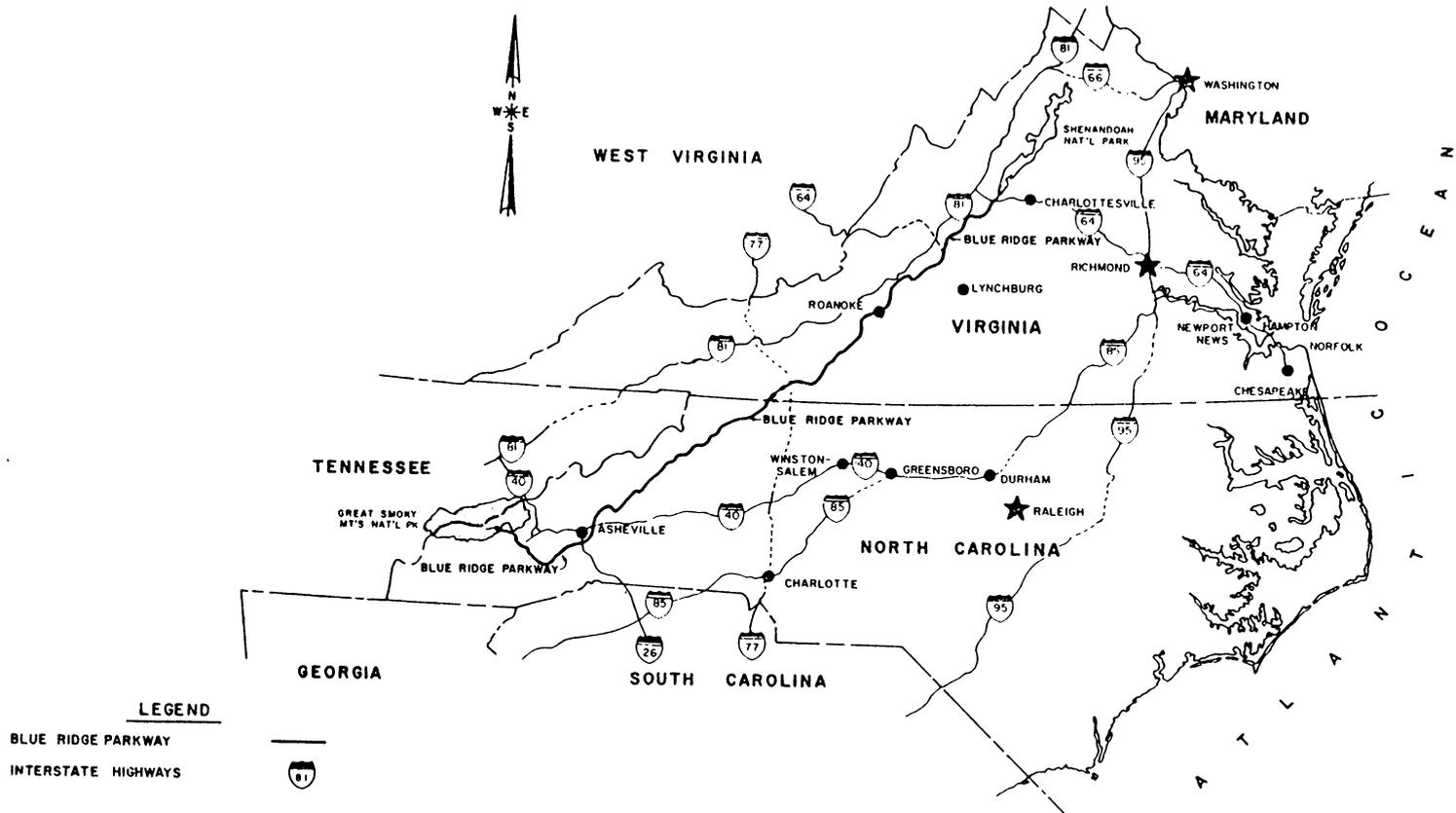
Figure 1: Blue Ridge Parkway General Location

largest number of observations possible on park operating costs.

County clusters are defined about each sub-subdistrict of the Parkway. Attributes of the area surrounding each sub-subdistrict are thus captured in the aggregate of individual counties in each cluster. Table 1 lists county clusters corresponding to Parkway sub-subdistricts. The county clusters average approximately 40 miles long and 40 miles wide and range from approximately 25 to 50 miles long and 20 to 50 miles wide.

The sub-subdistrict boundaries in most cases were congruent with county boundaries. Where overlap occured, the overlapping county was included in a cluster if the overlap was greater than a quarter of a sub-subdistricts length, and/or major access route(s) to the Parkway emanated from the overlapping county.

Model Specification

The primary focus of this study is the Parkway's operating cost function and factors affecting it. These factors are hypothesized to be of two distinct categories: internal factors associated with Parkway activities and external factors beyond park boundaries over which the Parkway has little or no control.

BLUE RIDGE PARKWAY

TYPICAL SUB-DISTRICT ORGANIZATION
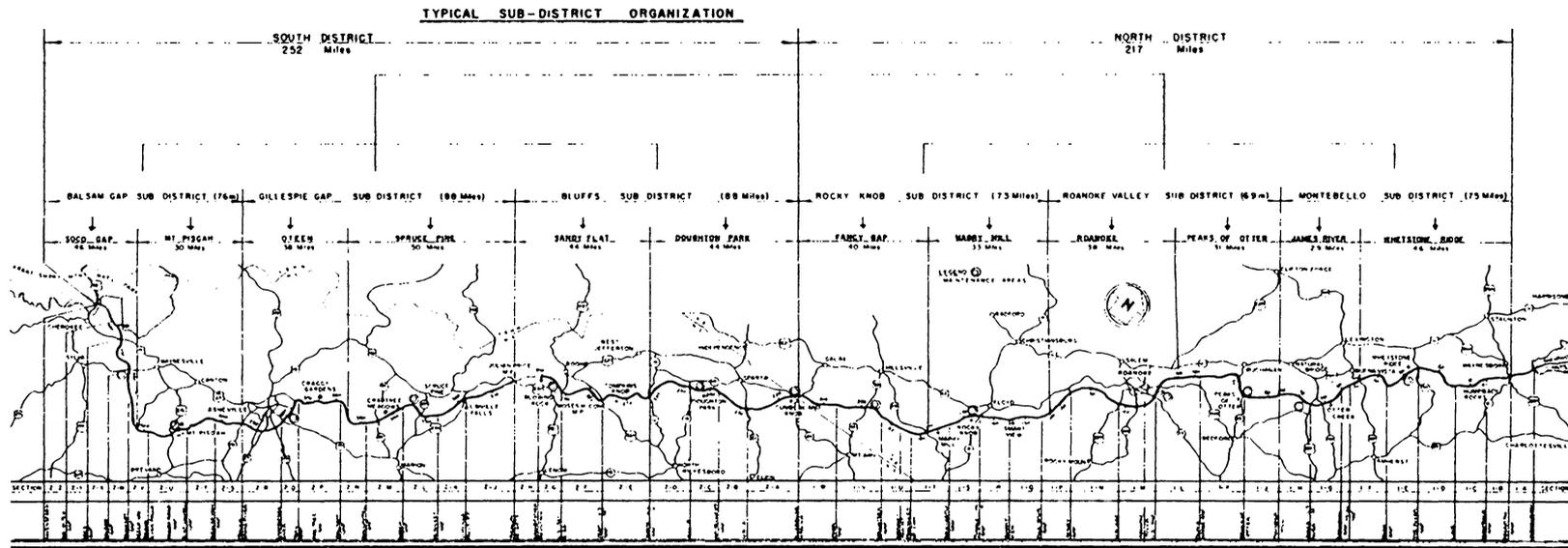
Figure 2: Sub-subdistrict Geographic Organization as Indicated in Table 1

TABLE 1

Organization of County Clusters and Sub-subdistricts

Cluster number	Sub-subdistrict	Counties in Cluster
1	Whetstone Ridge	Amherst, Augusta, Nelson, Rockbridge
2	James River	Amherst, Bedford, Botetourt, Rockbridge
3	Peaks of Otter	Bedford, Botetourt, Roanoke
4	Roanoke	Floyd, Franklin, Roanoke
5	Mabry Mill	Floyd, Franklin, Patrick
6	Fancy Gap	Carrol, Grayson, Patrick
7	Doughton Park	Alleghany, Ashe, Surry, Wilkes
8	Sandy Flat	Avery, Burke, Caldwell, Watauga
9	Spruce Pine	Avery, Burke, Mitchell, Mcdowell, Yancy
10	Oteen	Buncombe, Henderson
11	Mt. Pisgah	Haywood, Transylvania
12	Soco Gap	Haywood, Jackson, Swain

The objective was to determine what factors in each category where the most important in explaining the variation in both total cost and cost per visit for each of the Parkway segments.

Several preliminary models were tried. Time series linear regression was the first technique considered. Two similar areas of the Parkway, one urban and one rural were to be selected. The costs of operating the two where to be studied over time. The difference in correlation of operating cost and associated land use changes between the two areas would be compared to test for different response over time. The lack of consistent data over time eliminated this approach.

A cross-sectional linear regression model was employed to determine the importance of internal and external variables in explaining changes in the Parkway's operating costs. The number of observations for such a model is limited to the number of distinct areas existing on the Parkway.

The small sample size and the large number of candidate variables placed constraints upon the size of model allowed. Initial attempts with the cross-sectional model included the use of principal component analysis on the two distinct categories of independent variables. However, the depen-

dence structure existing between variables of the internal category was not suitable for principal component analysis.

The final model consisted of a cross-sectional linear regression of the form:

$$TC_i = f_1(I_{i1}, \ldots, I_{ij}, E_{i1}, \ldots, E_{ik}) \qquad (1)$$

$$CV_i = f_2(I_{i1}, \ldots, I_{ij}, E_{i1}, \ldots, E_{ik}) \qquad (2)$$

Where: TC_i = total cost of operating Parkway segment i

CV_i = cost/visit of operating Parkway segment i

I_{ij} = internal variable j on Parkway segment i

E_{ik} = external variable k on Parkway segment i

The total cost and cost per visit on segment i are expressed as a function of the intensity of internal parkway management activity j on segment i, and the intensity of external development type k in county cluster i around segment i.

An array of different Parkway management activities and external development indicators can be searched to find the combination of variables that best explain Parkway total cost and cost per visit.

Dependent Variables

Total Cost. The recreation industry is service oriented. The cost of operating the Parkway is composed primarily of labor cost. Parkway personnel estimate that 80 percent of the maintenance budget is used for payroll expenses. The total operating cost for any given mainte- nance area was estimated using the employee records of man- hours worked and the wages paid to those employees for the area of interest. The administrative costs were prorated over all Parkway segments according to the relative staffing level in any given area. This procedure was suggested by Parkway personnel.

The materials and administrative costs associated with each sub-subdistrict are assumed to be directly proportional to the staffing level. Since only the magnitude of the total operating cost changes with this assumption and not the relative differences between total operating cost of the sub-subdistricts, omission of administrative and materials costs does not change the analysis or the results. For the sake of computational efficiency, the total operating cost is assumed to be equivalent to sub-subdistrict labor costs, given that the relative difference of total operating cost between sub-subdistricts is dependent on these costs. Park-

way sub-subdistricts recieved roughly the same proportion of total operating budget for several recent years. Therefore, the 1977 fiscal year was chosen for analysis.

The total cost for any segment is given as the sum of the product of the manhours of employment for workers in a segment and their wage rate and benefits, or simply:

$$TC_i = \sum_{j=1}^{k} (MHE_{ij} \ W_j) \qquad (3)$$

Where: TC_i = total operating cost for sub-subdistrict i

MHE_{ij} = manhours of employment for employee j in sub-subdistrict i

W_j = hourly wage and benefits of employee j

i = sub-subdistrict index

j = employee index

k = number of employees on sub-subdistrict i

Cost per Visit. The Park Service manages the Parkway to produce recreation services. Cost per recreation visit is therefore the more meaningful per unit cost measure for management. Parkway visitation is measured by entrance counters located at major access routes and also north-south counter pairs located at various points along the main traffic flow of the Parkway.

Annual visitation figures for a counter location were derived by summing monthly traffic count estimates. The Parkway is not a closed system and therefore determining the exact number of visits for any given section is confounded by unmonitored exits and minor access points, as well as 'on again-off again' travelers that may be double counted. In addition, it is plausible that a good number of visitors go back the way they came and thus are recorded twice. The number of visits for any sub-subdistrict would be at least the number of entries recorded on entrance counters going to a respective segment plus some adjustment for the number of visits moving into the segment along the Parkway, and recorded by the nearest north-south counter pairs.

Visitation records were reduced to reflect only recreation visits, and not commuters. Parkway personnel estimate that roughly 75 to 90 percent of use during January, February and March is non-recreation use. It is assumed that at least as much commuter use occured in both spring, summer and fall seasons as occured in the winter season. Recreation visits were thus estimated as total visits minus 4 times 75 percent of winter season use.

Sub-subdistrict visitation was estimated by summing the commuter-adjusted major access counter data for the segment,

and adding an estimate of recreation visits flowing into the sub-subdistrict along the main trunk of the Parkway.

The location of north-south counter pairs frequently did not coincide with sub-subdistrict boundaries and therefore some additional assumptions had to be made with regard to traffic movement along the Parkway. The best information available on actual traffic flow for any given point on the Parkway would be the nearest north-south counter pair. When a counter pair was absent from a sub-subdistrict boundary, the change in volume between the two nearest pairs was assumed to be a linear relationship. To estimate south-bound traffic volume for any point between two separated south-bound counters, the slope of a line between the two counters' annual volumes was calculated, given the distance between the two counters. The traffic volume could then be calculated, given the distance from the northern counter location and the slope of the line drawn between estimates from the two counter locations.

A similar calculation was made for northbound traffic. Estimates for the amount of traffic entering a sub-subdistrict along the Parkway could then be approximated with the estimated southbound volume entering the sub-subdistrict on the northern boundary, plus the northbound traffic volume

entering the sub-subdistrict on the southern boundary. Estimates of sub-subdistrict annual recreation visits for fiscal year 1977 are shown in Appendix A along with other data used in the analysis.

Independent Variables

Internal Variables. Table 2 lists internal variables believed to affect Parkway operating costs. Maintenance efforts are concentrated on areas recieving the greatest use by and exposure to the public. The Parkway facilities known to be the most heavily visited are picnic grounds, restaurants, and visitor centers (Williams, 1979). One hypothesis was that facilities are located near attractive areas. However, testing this hypothesis with a preference index developed by Tingle (1977), showed no relationship, and so the index was not used.

Scenic overlooks are the most frequently encountered recreation facilities along the Parkway. Parkway management devotes more time and effort maintaining areas that are closer to the public eye than those areas the public never sees. The area surrounding an overlook requires more maintenance effort because of the amount of use, and also because of the larger area immediately surrounding an over-

TABLE 2

Independent Variables Considered Important in Cost Models

Independant Variable		Data Source

Internal (I_{ij})

1.	Overlook capacity	(cars)	Park Service
2.	Tent and trailer facility capacity	(sites)	Park Sevice
3.	Picnic facility capacity	(sites)	Park Service
4.	Concession capacity	(seats)	Park Service
5.	Lodge capacity	(pillows)	Parkway Ccncessionaires
6.	Visitor center capacity	(cars)	Park Service
7.	Recreation area acreage		Park Service
8.	Composite of tent, trailer, and picnic facility capacity	(sites)	Park Service

External (E_{ik})

9.	Population	Tayloe Murphy Institute, University of Virginia Employment Security Commission of N. C.
10.	Population density	Tayloe Murphy Institute, University of Virginia Employment Security Commission of N. C.

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look that requires mowing and cleaning. Interpretive dev-
ices, trash cans and occassionally picnic tables are also
found at overlooks. The expected intensity of maintenance
activity for any given overlook is assumed to be directly
related to the number of parking spaces. Therefore, simply
summing the individual overlook parking spaces for each
sub-subdistrict will give a relative measure of the inten-
sity of management for overlooks within the sub-subdistrict.
These capacities were estimated from architectural drawings
of the Parkway.

The difference in maintenance procedures between camp-
sites, trailer sites, and picnic sites is not large enough
to warrant separate treatment in the analysis according to
Parkway personnel. The numbers of developed recreation
units for tents, trailers, and picnic sites were therefore
summed for each sub-subdistrict. A measure of occurence of
these recreation facilities for each sub-subdistrict was
thus established.

Visitor centers are also expected to contribute signi-
ficantly to operating costs. These highly developed recrea-
tion facilities are the closest contact the Parkway has with
the public and therefore recieve more maintenance. Inten-
sive landscaping and grounds care occurs near visitor cen-

ters.   The capacity of a visitor center was approximated by
the number of parking spaces available for visitors to the
structure.

The number of acres managed intensively for recreation
services was considered an important candidate variable in
explaining operating cost for any given sub-subdistrict.
More equipment and manpower would be needed to care for lar-
ger acreages.   Multiple facilities are also expected to
occur more frequently on larger acreages.

The remaining internal variables,   Parkway concession
and lodge capacity, were included in the list of candidate
independant variables.   They are not directly operated by
the Park Service but are major facilities which could
increase user pressure on neighboring Parkway lands.   Con-
cession size is measured by seating capacity, and lodge size
is measured by the number of pillows. Since attributes
associated with a lodge or concession may be more important
than the relative size of such facilities, the use of a qua-
litative, 0-1 dummy variable was also considered in place of
the capacity measures.

External Variables. Originally, the level of employ-
ment in selected industries was used to represent the inten-
sities of particular land uses.   However, there were numer-
ous problems with that approach.

County business data obtained from the Virginia Employment Commission and the Employment Security Commission of North Carolina showed little consistency between states. Bureau of Census data gave the same results. In fact, when this data was used, no correlation was found to exist between employment and population or population density. This result can be explained in several ways. Employment reported in one county may actually have taken place in another county. This is especially true with smaller counties, where commuting outside of ones' home county for work is more common. Secondly, some industry sectors are left completely out of the reporting.

The Bureau of Economic Analysis (BEA), in the Department of Commerce, was able to provide consistent data that was adjusted for the above mentioned problems. Still, multicollinearity was found to be extreme between most industrial sectors as indicated by correlation coefficients in excess of 0.80. Population was found to be correlated at very high levels with the adjusted BEA data. Therefore, population and population density were selected as the best indicators of county development. Population density is probably the best index of development concentration, since county cluster acreages vary. More populated areas are assumed to be more urban in character and also contain more

industrial development as indicated by the high correlation
of industrial employment with population when BEA data was
used.

Data Analysis

All statistical estimation was done using SAS (Statis-
tical Analysis System). The two dependant variables and two
categories containing ten variables altogether were placed
in a data set. Maximum R^2 improvement and stepwise variable
selection procedures were employed to search for linear
relationships which existed between the dependent variables
and independant variables. Some non-linear model forms were
tried but the results showed little or no improvement over
linear techniques.[2]

The stepwise variable selection procedure enters varia-
bles one by one and checks the F-statistic for those varia-
bles to determine their significance in the presence of
other variables in the model.   No significance level was
chosen for entry of a variable into the model in order to
lower the probability of a type I error, or not including a
variable that may become significant in the presence of
other variables to be introduced.   Once a new variable is

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[2]Analysis of the residuals from the linear models showed no
trends.

included in the model, all other variables in the model are checked for significance by an F-test. Any variable not significant at the 0.25 level was removed. This process continued until no other variables met the criteria for removal from the model.

The maximum R^2 improvement technique for variable selection employs a search for the one variable model yielding the highest R^2 out of all possible one variable models. Then all possible two variable models are checked in the same manner. Then three variable models, and so forth. One criteria used to select the final model was the relative strength of a variable in explaining the variation in the dependant variable. The variable selection process was given greater freedom to enter variables in the screening procedure. No absolute cut-off for significance of the F-statistic was used for initial variable entry. However, the criteria for acceptance of variables in the final model depended on judgement of relative significance of the F-statistic. A variable may not be significant if included early in the stepwise procedure but may become significant in the presence of some other variable due to possible interaction between variables.

Non-operating Expenditures

The impacts of adjacent land use may be more obvious where development is immediately adjacent to Parkway boundaries than the more general influences believed to affect annual operating costs on the county wide level. These immediate impacts affect Parkway cost through special projects designed to protect the natural and historic qualities of the Parkway. These projects include land aquisition, access elimination and landscape screening. Access control usually includes purchase of lands being affected in the control process. In addition, construction costs are also born predominantly by the Parkway. Because of the small number of access elimination projects, no meaningful statistical analysis was possible. Instead, associated costs were compared with the character of communities adjacent to these projects.

Access eliminations or consolidations and relocations may be more frequent where dispersed private ownerships are more common. The percent of total Parkway acreage by its origin of ownership, i.e., public or private, for each county cluster is used to indicate the relationship between certain adjacent land characteristics and the total number of accesses.

Parkway management objectives are more easily attained where the Parkway passes through public lands than where adjacent private development is uncontrolled. Lack of a sufficiently large sample of special project costs prohibits sophisticated analysis. Such costs are therefore analyzed in a comparitive fashion.

RESULTS AND DISCUSSION

The major objective of this study was to determine what internal and external factors influence park operating cost. Many variables influence these costs, but only certain ones are considered major determinants of variation in budget allocations.

Total cost should be more sensitive to the relative changes in key internal variables. Cost per visit contains information relating not only to internal activities of Parkway management, but also information linked more strongly to Parkway attendence. Since both models have Parkway operating cost in common, the same key internal variables were expected to explain the total cost component of the dependent variables. The interaction between operating cost and external factors should be greater in the cost per visit model because more information about the external environment is being translated. The cost per visit model is also more complex than the total cost model due to the interaction between internal and external factors.

Direct causality can not be implied by statistical significance, given such a small sample. Indirect influences operating on the cost equations can be hidden beneath significant variables. It should be pointed out that the sample size of 12 severely limits predictive applications of the models derived. They are intended as purely descriptive tools for the planning processes carried out by Parkway management. A constraint had to be placed on the size of the model to preserve degrees of freedom for error. The number of variables permitted in the final models had to be less than the error degress of freedom. This constraint was not hard to satisfy because the final models contained fewer variables than expected.

Internal and External Factors Influencing Total Operating Cost

The final total operating cost model formulated by regression and variable selection procedures is shown in Table 3 . Fifty-seven percent of the variation in total operating cost among the 12 sub-subdistricts is explained by the model. Total operating cost is estimated to be a function of visitor center capacity and the composite variable for tent, trailer, and picnic sites. No external variable was found to be significant even at the 0.15 level.

TABLE 3

Estimated Cost Functions, Blue Ridge Parkway, 1977

Dependent Variable	Adjusted R^2	Intercept	Independent Variable and Coefficient[*]		
Total Operating Cost					
TOC_i	0.57	110,630.22	$718.77I_{i6}$	$162.41I_{i8}$	
			(340.13)	(75.02)	
Cost per Visit					
C_i/V_i	0.68	0.074615	$0.066677I_{i4}$	$0.000010I_{i7}$	$-0.000199I_{i8}$
			(0.017010)	(0.000004)	(0.000104)

[*]Standard error for each coefficient appears in parentheses.

Variables: I_{i4} is the 0-1 concession variable; I_{i6} is visitor center capacity; I_{i7} is recreation acreas; I_{i8} is composite of camp and picnic sites; i is the sub-subdistrict index.

Some models tried had illogical signs of coefficients associated with lodge and concession capacities. Only four of the twelve sample areas had lodges, and seven of the twelve had concessions. The relatively small sample decreased the reliability of these capacity variables. Therefore, a qualitative, 0-1 dummy variable was used to indicate either the presence or absence of a lodge or concession facility in a sub-subdistrict. After this change, the signs were more reasonable, but still, no significant relationship could be shown to exist between these variables and total operating cost. Care and maintenance for lodge and concession facilities is almost entirely the responsibility of the private operators. The presence of these facilities does not seem to affect the surrounding Parkway operating costs.

In the selection process, the strongest[3] single variable was found to be recreation area acreage. It explained 52 percent of the variation in total operating cost, and was significant at the 0.008 level. The next variable to enter the model in the selection procedure was visitor center capacity. It was significant at the 0.196 level and there-

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[3]Criteria used to measure relative strength of a variable were the F-statistic and amount of variation in the dependent variable explained by the selected independent variable.

fore was not considered a very strong variable in the presence of recreation area acreage. Recreation area acreage was then replaced with the composite variable of tent, trailer, and picnic area capacity. Visitor center capacity became significant given that the composite variable was included in the model. Visitor center capacity was significant at the 0.064 level. The composite variable was significant at the 0.059 level. This result was not unexpected, since visitor centers are by far the most capital intensive structures operated by the Park Service for the public. They are a showplace of the Park Service for the public and recieve considerable care and maintenance. The capacity of the visitor center, as measured by the parking lot size, determines the amount of acreage that recieves the intensive maintenance effort.

Williams (1979) showed that visitor centers were among the three most heavily visited Parkway facilities by the local public. The other two were restaurants and picnic areas. The three most heavily visited facilities are associated with short duration, day visits, and not the extended overnite visits associated with campgrounds. It is interesting to note that picnic area capacity was significant at the 0.127 level when included with recreation area acreage. Some relationship does exist even though it may be weak as

shown by the significance level. The number of tent and trailer sites regressed on total operating cost in the presence of recreation acreage was found to be insignificant at relatively high levels. However, the correlation coefficient between camping capacity and recreation acreage was 0.67, suggesting that increased camping capacity is correlated with larger recreation area acreages, even though it does not explain total operating cost very well by itself.

The correlation coefficient for recreation area acreage and visitor center capacity was found to be 0.54. Larger visitor centers are more likely to be associated with larger recreation area acreages than are small visitor centers. The two variables, visitor center capacity and the composite variable for camp and picnic capacity, are more descriptive of what occurs on the acreages to affect total operating cost than simply using a univariate model containing recreation area acreage alone. The latter would say very little about internal land use. The sign on both coefficients in the final model are positive, as would be expected for internal variables. As either visitor center capacity, or camp and picnic capacity increases, the total operating cost is expected to increase.

The correlation coefficient between the composite camp and picnic variable and recreation acreage is 0.63. However, observation of the correlation matrix revealed no discernable relationship between recreation acreage and capacity of picnic facilities. These results seem reasonable, since picnic areas are less dependent upon large acreages than are camp sites. Parkway picnic areas also recieve a higher volume of use according to Williams (1979).

When picnic capacity was used to explain total operating cost together with visitor center capacity, the coefficient was significant at the 0.11 level. When camp facility capacity replaced it, the slope coefficient for camp facility capacity was significant at the 0.15 level. Finally, the results suggest that picnic area capacity is less dependent on acreage, and is a stronger variable when used to explain total operating cost in the presence of visitor center capacity. Therefore, the more intensively used picnic sites are thought to contribute more to operating cost than the same acreage managed for camping, even though both camping and picnic sites together showed better results based on relative significance and R^2.

Internal and External Factors Influencing Cost per Visit

The search for a model to explain the cost per visit led to a three variable equation shown in Table 3 . The cost per visit is a function of recreation acreage, camp and picnic sites, and whether or not there is a concession facility present on the sub-subdistrict. This equation explains 68 percent of the variation in the cost per visit. No external variable was found to be significant even at the 0.15 level.

The qualitative variable for concession presence was relatively strong in this model since its coefficient was significant at the 0.004 level. The sign on the coefficient was positive, suggesting that sub-subdistricts with concession facilities tend to have a higher cost per visit than do sub-subdistricts without concession facilities. Since this is a qualitative variable, the information it conveys is related to certain physical attributes of the sub-subdistrict in which the concession is contained. The correlation coefficient for lodges and concessions is 0.60 and significant at the 0.04 level. Concessions can occur alone but lodges never occur without concessions.

The correlation coefficient for lodges and visitor center capacity is 0.54 and significant at the 0.07 level. The

strongest single variable in explaining cost per visit was found to be the qualitative variable for lodge presence on the sub-subdistrict. When cost per visit was regressed on the dummy variable for lodges, the R^2 was 0.56 and significant at the 0.005 level. If sub-subdistricts with lodges tend to have higher per visit costs, and concessions and lodges are correlated, then it is expected that sub-subdistricts with both a lodge and a concession also have higher per visit costs, especially since no lodge exists on a sub-subdistrict without a concession.

Observation of the data on independent variables shows that not only does a sub-subdistrict with a lodge also have a concession, but it also has a visitor center. Not all visitor centers are located on sub-subdistricts with lodges. However, the larger visitor centers are usually found in the presence of a lodge, and lodges are usually found in the presence of concessions.

It is apparent from the results that intensive recreation facility development tends to be a clustering of various facilities, and that these clusters tend to have higher cost per visit than do scattered, independently occuring facilities. This idea is further supported by the fact that larger visitor centers are positively and significantly cor-

related with larger recreation area acreages. A two varia-
ble model, consisting of recreation area acreage and the
qualitative variable for concessions, was found to explain
57 percent of the variation in per visit cost with both
coefficients positive, the former being significant at the
0.02 level, and the latter being significant at the 0.09
level. Although more costly, clusters of facilities have
intuitive appeal for land use planning. Keeping park devel-
opment in isolated areas helps preserve the natural and
scenic qualities that the Park Service was established to
protect.

The coefficient for recreation acreage was significant
in the final model at the 0.02 level and positive. Larger
recreation area acreages are associated with higher per
visit costs. It is interesting to note that the correlation
coefficient for camping facilities and recreation area acre-
age is 0.67 and significant at the 0.02 level. Picnic
capacity has no significant correlation with recreation
acreage. This suggests that as the number of recreation
acres increases, the number of campsites increases but not
necessarily the number of picnic sites. It may also be true
that similar size picnic areas can be found on large or
small acreages.

The third variable, the composite of camp and picnic facility capacity has a negative coefficient, significant at the 0.09 level. This implies some economy of scale may exist with camp and picnic facilities. A larger number of camp and picnic sites will attract more visitors and lower the cost per visit.

According to Williams (1979), picnic facilities draw more visits than do camping facilities. It is believed that the decrease in cost per visit is attributable to increased visitation associated with more highly visited picnic facilities. If the assumption made by Parkway personnel that there is little difference in the cost of maintaining either site type is correct, then a combination of picnic and camp sites would be expected to show a lower cost per visit as the proportion of picnic sites increased.

External Land Use Impacts on Non-operating Expenditures

The impact of adjacent land use on non-operating expenditures appeared to be far greater than its impact on annual operating expenditures. Table 4 reveals the association between the percent of Parkway land originally in private ownership and the number of Parkway accesses in Virginia. The correlation coefficient between the percent of private ownership and the number of access points was 0.87 and

positive. The number of access points to any given area of the Parkway is also related to Parkway section completion dates. Very few accesses were permitted after 1938.

Mabry Mill and Fancy Gap sub-subdistricts both have the highest percent of private original ownership and also the highest number of total access points. The three sub-sub-districts with the largest number of access points also have the oldest dates of Parkway completion. These three areas had deed purchase dates prior to 1938, at which time the Secratary of Interior sent a letter to the Governors of both states urging strict adherence to the no access policy within their states (Blue Ridge Parkway, 1979).

Once access had been granted, great costs are associated with their removal, as shown in Table 5 . The majority of access eliminations have occured in the areas associated with both early Parkway completion and a concentration of private ownership. Clusters one through four showed few access control projects and a low concentration of private ownership.

Landscape screening projects are another source of costs associated with the protection of Park values. Little data was available on these costs. However, it was learned from Parkway personnel that screening projects are concen-

TABLE 4

Relationship of Ownership Characteristicts to Number of
Accesses

County Cluster	Ownership Origin (percent) Private	Public	Total Number of Accesses
1	0.00	100.00	23
2	0.03	99.97	5
3	0.68	99.32	6
4	27.23	72.77	15
5	55.13	44.87	57
6	51.50	48.50	80

TABLE 5

Access Elimination or Relocation Costs

Year	County Cluster	Construction Cost*
1960-80	1-4	none found
1972	5	$153,440.86
1960-62	6	$141,087.00
1964	6	$ 82,491.76
1966	6	$148,695.09
1973	6	$198,794.77

*Not adjusted for inflation

trated in the same areas as major private developments immediately adjacent to Parkway boundaries. Examples are the Groundhog Mountain, Chalet High, and Skyland Lakes developments in county cluster six. The average cost of such a project was estimated at 5,000 dollars by Parkway personnel. These screening projects were also located in the same sub-subdistricts as the major access elimination and land acquisition projects are concentrated.

SUMMARY AND CONCLUSIONS

This study sought to find possible adjacent land use impacts upon the Blue Ridge Parkway operating costs. It was therefore necessary to quantify total and per visit operating cost. The analysis then expressed these costs as a function of Parkway related variables and some index of external development in order to find which factors were the prime determinents of cost variation. It was hoped that this would provide some information about relationships existing between these variables. The prime effort was to provide information for Parkway land use and budgetary decisions and at the same time illuminate the question of land use impacts.

Special project costs were also considered in the analysis. These are costs associated with access control, land acquisition and landscape screening. The data limitations imposed on the analysis for these costs allowed only a few comparisons between different areas.

Factors Influencing Total Operating Cost

Total operating cost was expressed as a function of visitor center capacity and the number of camp and picnic sites, as shown in Table 3. Fifty-seven percent of the variation in total operating cost is explained and the coefficients were significant at the 0.064 and 0.059 levels respectively, and positive. No external variable was found significant. The major contributors to Parkway operating costs were Parkway management activities and not the degree of urban development in bordering counties.

Areas with Parkway facilities recieving more intensive day use have higher total operating costs. It does seem reasonable that highly visited areas such as picnic sites and visitor centers would incur higher total operating cost. More visitors on a given area would increase litter, garbage pick-up and toilet use among other things, and thus increase the need for maintanence.

One explanation for the lack of correlation between total operating cost and external development is the location of Parkway facilities. There is apparently no correlation between the location of cost-generating facilities and the population of adjacent counties.

Factors Influencing Cost per Visit

Cost per visit was expressed as a function of three variables as shown in Table 3. These variables were the qualitative, 0-1 dummy variable for concessions, recreation acreage and camp and picnic sites, significant at the 0.004, 0.02 and 0.09 levels respectively. The two former variables had positive coefficients, the latter negative. The model explained 68 percent of the variation in cost per visit.

Cost per visit was shown to increase with the presence of a concession. This fact was related to attributes of sub-subdistricts with concessions. Larger recreation acreages also relate to higher costs per visit. However, some economy of scale was found with the camp and picnic variable. The cost per visit declined with increased size of these facilities. This was related to the higher visitation they recieve.

Again, the lack of correlation with external factors can possibly be explained by the location of facilities, as was the case with the total cost model. If visitation in a segment depended only on population of the adjacent cluster, then we might expect cost per visit to decline with increasing population, other things equal. However, Parkway attributes which attract visitors and generate costs seem to be unrelated to adjacent population levels.

Factors Influencing Non-operating Expenditures

Comparative analysis revealed a concentration of Parkway special projects in areas bordered by dispersed private ownerships. These projects are for access control, land acquisition and landscape screening, all of which protect Parkway qualities, and are directly related to adjacent land uses. In general, special project costs appear higher where commercial development borders the Parkway. However, lack of data prevented any testing of specific hypothesis.

Implications for Planning and Management

The establishment of Parkway facilities for more intensive day use activities near population centers would more than likely reduce the cost per visit. More visitors could then take advantage of the facilities, especially in times of high driving costs associated with rising gasoline prices. The Blue Ridge Parkway planners might consider that driving for pleasure may become less important in light of increased fuel costs. In an effort to provide recreation services for the public, and to conserve energy, planners might locate facilities closer to the public instead of expanding existing facilities that are farther from population centers. Intensive day use areas do not require the large acreages and are shown to have some economy of scale

in terms of cost per visit. It is true that the above approach would increase total costs near populated areas. However, if this is accompanied by increased use, Park Service objectives of providing recreation services to the public would be met. The negative impact of congestion does become a consideration, but is not addressed here.

This analysis suggests that immediately adjacent urban influence has no impact on costs of operating the Blue Ridge Parkway. However, special project costs appear to be related to adjacent land use. These impacts are associated with the history of Parkway establishment in the areas through which it passes. There appears to be little that the Park Service can do in addition to current efforts to protect the Blue Ridge Parkway from conflicting adjacent land use. The major source of conflict is the destruction of the natural and historic qualities of the 'scenic corridor' by adjacent development. In the process of trying to preserve these qualities the Park Service incurs substantial costs associated with special projects.

Constructing projects to protect Parkway qualities implicitly assumes that the value of these qualities is at least as much as the project cost in order to be justified. These projects offer no guarantee against future development

if access to adjacent lands is established by some other means.

The lack of a cooperative land use plan effective at the local level appears to be one of the major issues facing Parkway management. Special projects may provide some margin of protection but they are analogous to treatment of the symptoms rather than focusing on the actual sickness. No doubt Parkway management has concentrated on coordinated land use planning. However, acquisition of a thin margin of land immediately adjacent to the Parkway, or the elimination of access may provide less benefit than equal effort placed on cooperative planning.

A good example of such effort is found in a Virginia Polytechnic Institute and State University report by the College of Architecture in 1975, initiated by the New River Valley Planing Authority for Floyd county, Virginia entitled 'Analysis of Adjacent Land Use Potentials on the Blue Ridge Parkway in Floyd County, Virginia'. Various means of land use control by local government were suggested including some form of incentive program for local landowners. Getting the adjacent landowners to work with Parkway management is the focus. There is, however, much private resentment of the Park Service for initial Parkway establishment efforts and an ever present distrust of government.

Future Research Recommendations

An attempt was made in this study to assign visitation estimates to sub-subdistrict maintenance units on the Parkway. The technique used was crude, but given available data it was viewed as the 'best' possible estimation technique. Because many Parkway studies involve visitation estimates, consistent, reliable, and easily accessible data is needed. A study conducted to achieve this end is strongly recommended.

Although the budgeting system for the Parkway may be adequate for administrators, it is lacking in many respects for research purposes. If the Park Service desires information relating to specific costs, some locational index such as milepost should be tied to the budgeting program together with a finer resolution of specific jobs. This would facilitate cost effectiveness studies and decisions relating to private contracts.

The benefit and cost of pursuing cooperative land use plans in adjacent areas should be investigated. It is believed that through cooperative planning efforts, significant gains can be made to alleviate the adjacent land use impacts plaguing the Blue Ridge Parkway. Benefits and costs of access elimination projects should also be estimated so

that the returns of both alternatives can be compared. This idea has much intuitive appeal since most accesses occur within a few counties adjacent to the Parkway. A unified approach dealing not only with the immediately adjacent Parkway fringe, but with the entire 'scenic corridor' through which the Parkway passes is desperately needed. This can only be accomplished through cooperative efforts and a firm understanding of the existing social and political realities.

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APPENDIX A

APPENDIX A

TABLE 6

Data Set Used in the Analysis, Fiscal Year 1977

Area	Cost/ Visit	Total Cost	Visits	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	E_9	E_{10}
	Dependent Variables			**Independent Variables***									
1	0.121	149287	1233777	247	0	99	1	0	44	1240.00	99	159500	63.1
2	0.122	151975	1245697	236	67	7	1	0	30	552.00	74	179400	76.5
3	0.167	162442	972707	246	148	65	1	1	59	4150.00	213	308900	201.0
4	0.093	149337	1605774	508	108	0	0	0	0	2062.00	108	230700	169.5
5	0.195	211573	1084990	87	109	114	1	1	58	4704.00	223	59100	37.8
6	0.067	79067	1180104	112	0	26	0	0	0	0.00	26	62100	44.0
7	0.140	183344	1309600	236	136	89	1	1	35	7465.00	225	141000	72.5
8	0.089	206879	2324483	307	197	100	0	0	54	8080.00	297	170600	110.6
9	0.074	166286	2247108	462	168	182	1	0	0	1249.00	350	143200	83.4
10	0.055	179927	3271400	100	0	91	0	0	43	700.00	91	203600	196.7
11	0.103	129119	1253583	310	140	51	1	1	39	690.00	191	66000	70.7
12	0.077	126622	1644442	883	0	0	0	0	0	0.00	0	80100	51.1

*I_j and E_k refer to the same sequence of variables as shown in Table 2, pg. 26.

Area numbers are identified on pg. 18.

IMPACTS OF ADJACENT LAND USE ON BLUE RIDGE PARKWAY COSTS

by

A. Stephen Galea

(ABSTRACT)

Impacts from urban development on the cost of providing recreation services on the Blue Ridge Parkway were modeled using cross-sectional linear regression techniques. Twelve Parkway segments and corresponding adjacent counties provided the study sample. Total and per visit annual costs were expressed as a function of segment variables and external variables representing adjacent county development. No correlation between operating cost and external variables was found. Total operating costs are positively correlated with visitor center capacity and camp and picnic sites. Cost per visit is positively correlated with the presence of concessions and recreation acreage, and negatively correlated with the number of camp and picnic sites, suggesting economies of scale. Non-operating costs in developed and undeveloped sections were compared. Costs associated with access control, land acquisition, and landscape screening, were higher in areas with a greater percentage of private ownership.