A Step Forward

It took only the merest information to examine and prescribe for the Jersey Shore. Here the processes were simple as were their forms and the operative value was single and strident—survival by the sea. Yet can the values which nature represents be weighed and measured so that decent, prudent men can act in deference to them? Moreover—the example of the Jersey Shore involved such a dramatic threat—can the same ecological method be employed for more complex problems and less dramatic values?

The problem of a major highway presents an excellent opportunity to demonstrate that natural processes can be construed as values in such a way as to permit a rational response to a social value system. It is necessary only to abandon the economic model and the callous indifference of anthropocentric man.

The highway is a particularly appropriate study. If one seeks a single example of an assertion of simple-minded single purpose, the analytical rather than the synthetic view and indifference to natural process—indeed an anti-ecological view—then the highway and its creators leap to mind. There are other aspirants who vie to deface shrines and desecrate sacred cows, but surely it is the highway commissioner and engineer who most passionately embrace insensitivity and philistinism as way of life and profession.

In highway design, the problem is reduced to the simplest and most commonplace terms: traffic, volume, design speed, capacity, pavements, structures, horizontal and vertical alignment. These considerations are married to a thoroughly spurious cost-benefit formula and the consequences of this institutionalized myopia are seen in the scars upon the land and in the cities.

Who are as arrogant, as unmoved by public values and concerns as highway commissions and engineers? There they go, laden with money, offering the enormous bribe of ninety per cent of the cost of realizing their narrow purposes. Give us your beautiful rivers and valleys, and we will destroy them: Jones Falls in Baltimore, the Schuylkill River in Philadelphia, Rock Creek in Washington, the best beauty of Staten Island, the Stony Brook-Millstone Valley near Princeton. Give us your cities, their historic areas and buildings, their precious parks, cohesive neighborhoods, and we will rend them—in New Orleans and Boston, San Francisco and Memphis. Urban freeways cut white swaths through black neighborhoods but this is not discrimination, it matters little whether they are black or white, rich or poor—although black and poor is easier. Having scarred the cities, what next? Surely those areas throughout the country that are particularly beautiful—these must be served by scenic highways. The accumulation of gasoline taxes in the Highway Fund must be expended, and the most powerful lobby in the United States is determined that it shall be so. Unmoved by the more pressing needs for humanizing cities, reducing poverty or improving education, four billion dollars will be expended on scenic highways. So those areas defined as beautiful must now be savaged. In the process scenic areas can only become less scenic.

Yet it was not always so and need not be today. The beginnings were more promising when the Bronx River Parkway was conceived, over forty years ago—the first example of a modern highway. The objective was not only to satisfy traffic requirements, but to use this investment of public funds to rehabilitate the foul river and its raddled landscape to create new public values. This it accomplished. The highway was used as an ameliorative device to improve the landscape and provide a satisfying visual experience for the driver, while meeting the clear needs of traffic. In areas where remedy was unnecessary and the scene was beautiful, the task of the highway was to intervene with the least possible damage, to exploit and reveal the visual qualities of the landscape while meeting traffic requirements. So that
in the Westchester County Parkway system conceived in the thirties, in the Palisades Parkway and, perhaps most clearly, in the Skyline Drive of the Blue Ridge Parkway, these objectives were accomplished. Now these were all designed by landscape architects: and it became clear that their effete concerns with such inconsequential considerations as natural beauty, historic buildings, reclamation of landscapes or even deference to topography were obstructions to the task of creating a highway system for an automotive America. So the task was given to those who, by instinct and training, were especially suited to gouge and scar landscape and city without remorse—the engineers. The landscape architects were then retained to apply balm to heal the scars and wounds inflicted on the landscape.

A plumber is a most important member of society—our civilization could not endure long without his services: but we do not ask plumbers to design cities or buildings. So too with highways: the engineer is most competent when considering the automobile as a projectile that responds to the laws of dynamics and statics. He understands structures and pavements very well indeed and his services are indispensable. But the matter of the man in the automobile as a creature with senses is outside his ken; the nature of the land as interacting biophysical processes is unknown to him. His competence is not the design of highways, merely of the structures that compose them—but only after they have been designed by persons more knowing of man and the land.

The method that has been used traditionally by the Bureau of Public Roads and State Highway Departments involves calculating the savings and costs derived from a proposed highway facility. Savings include savings in time, operating costs and reduction in accidents. Costs are those of construction and maintenance. It is necessary to obtain a minimum ratio of savings to costs of 1.2:1.0. Any qualitative factors are considered after the conclusion of the cost-benefit analysis, and then only descriptively. The objective of an improved method should be to incorporate resource values, social values and aesthetic values in addition to the normal criteria of physiographic, traffic and engineering considerations. In short, the method should reveal the highway alignment having the maximum social benefit and the minimum social cost. This poses difficult problems. It is clear that new considerations must be interjected into the cost-benefit equation and that many of these are considered non-price factors. Yet the present method of highway cost-benefit analysis merely allocates approximate money values to convenience, a commodity as difficult to quantify as either health or beauty.

Interstate Highways should maximize public and private benefits:
1 by increasing the facility, convenience, pleasure and safety of traffic movement.
2 by safeguarding and enhancing land, water, air and biotic resources.
3 by contributing to public and private objectives of urban renewal, metropolitan and regional development, industry, commerce, residence, recreation, public health, conservation and beautification.
4 by generating new productive land uses and by sustaining or enhancing existing ones.

Such criteria include the orthodoxies of route selection, but place them in a larger context of social responsibility. The highway is no longer considered only in terms of automotive movement within its right of way, but in context of the physical, biological and social processes within its area of influence.

The highway is thus considered as a major public investment, which will affect the economy, the way of life, health and visual experience of the entire population within its sphere of influence. It is in relation to this expanded role that it should be located and designed.
The present method of cost-benefit analysis, as employed for route selection, has two major components: (i) the savings in time, operating costs and safety provided by the proposed facility and (ii) the sum of engineering, land and building purchase, financing, administrative, construction, operation and maintenance costs.

On the credit side it seems reasonable to allocate all economic benefits derived from the highway. These benefits accrue from the upgrading of land use, frequently from agricultural to industrial, commercial or residential uses. Great indeed are these values. In certain favored locations they may be multiples of the cost of the highway. But highways do reduce economic values; they do constitute a health hazard, a nuisance and danger; they can destroy the integrity of communities, institutions, residential quality, scenic, historic and recreational value.

This being so, it appears necessary to represent the sum of effects attributable to a proposed highway alignment and to distinguish these as benefits, savings and costs. In certain cases these can be priced and can be designated price benefits, price savings, or price costs. In other cases, where valuation is difficult, certain factors can be identified as non-price benefits, savings or costs.

A balance sheet in which most of the components of benefit and cost are shown should reveal the alignments of maximum social utility.

Considerations of traffic benefits as calculated by the Bureau of Public Roads can be computed for alternative alignments. The cost of alternative routes can be calculated. Areas in which increased land and building values may result can be located, if only tentatively, in relation to the highway and prospective intersections. Prospective depreciation of land and building value can also be approximately located. Increased convenience, safety and pleasure will presumably be provided within the highway right-of-way; inconvenience, danger and displeasure will parallel its path on both sides. The degree to which the highway sustains certain community values can be described as can the offense to health, community, scenery and other important resources.

The method proposed here is an attempt to remedy deficiencies in route-selection method. It consists, in essence, of identifying both social and natural processes as social values. We will agree that land and building values do reflect a price value system, we can also agree that for institutions that have no market value there is still a hierarchy in values—the Capitol is more valuable than an undifferentiated house in Washington, Independence Hall more precious than a house in Philadelphia’s Society Hill or Central Park more valuable than any other in New York. So too with natural processes. It is not difficult to agree that different rocks have a variety of compressive strengths and thus offer both values and penalties for building; that some areas are subject to inundation during hurricanes and other areas are immune; that certain soils are more susceptible to erosion than others. Additionally, there are comparative measures of water quantity and quality, soil drainage characteristics. It is possible to rank forest or marsh quality, in terms of species, numbers, age and health in order of value. Wildlife habitats, scenic quality, the importance of

**SUGGESTED CRITERIA FOR INTERSTATE HIGHWAY ROUTE SELECTION**

**BENEFITS AND SAVINGS**

**Price Benefits**
- Reduced time distance
- Reduced gasoline costs
- Reduced oil costs
- Reduced tire costs
- Reduced vehicle depreciation
- Increased traffic volume

**Increase in Value (Land & Bldgs.):**
- Industrial values
- Commercial values
- Residential values
- Recreational values
- Institutional values
- Agricultural land values

**Non-price Benefits**
- Increased convenience
- Increased safety
- Increased pleasure

**Price Savings**
- Non-limiting topography
- Adequate foundation conditions present
- Adequate drainage conditions present
- Available sands, gravels, etc.
- Minimum bridge crossings, culverts, and other structures required

**Non-price Savings**
- Community values maintained
- Institutional values maintained
- Residential quality maintained
- Scenic quality maintained
- Historic values maintained
- Recreational values maintained
- Surface water system unimpaired
- Groundwater resources unimpaired
- Forest sources maintained
- Wildlife resources maintained

**COSTS**

**Price Costs**
- Survey
- Engineering
- Land and building acquisition
- Construction costs
- Financing costs
- Administrative costs, Operation and maintenance costs

**Increase in Value (Land & Bldgs.):**
- Industrial values
- Commercial values
- Residential values
- Recreational values
- Institutional values
- Agricultural land values

**Non-price Costs**
- Reduced convenience to adjacent properties
- Reduced safety to adjacent populations
- Reduced pleasure to adjacent populations
- Health hazard and nuisance from toxic fumes, noise, glare, dust

**Price Costs**
- Difficult topography
- Poor foundations
- Poor drainage
- Absence of construction materials
- Abundant structures required

**Non-price Costs**
- Community values lost
- Institutional values lost
- Residential values lost
- Scenic values lost
- Historic values lost
- Recreational values lost
- Surface water resources impaired
- Groundwater resources impaired
- Forest resources impaired
- Wildlife resources impaired
historic buildings, recreational facilities can all be ranked.

If we can evaluate and rank aesthetic, natural-resource and social values, we can then proceed. Thus, if destruction or despoliation of existing social values were to be caused by proposed highway alignment, that alignment value would be decreased by the amount of the social costs. The physical costs of construction are social costs too. Therefore we can conclude that any alignment that transects areas of high social values and also incurs penalties in heightened construction costs will represent a maximum-social-cost solution. The alternative is always to be sought—an alignment that avoids areas of high social costs and incurs the least penalties in construction costs and creates new values. The basis of the method is constant for all case studies—that nature is interacting process, a seamless web, that it is responsive to laws, that it constitutes a value system with intrinsic opportunities and constraints to human use.

If we can accept the initial proposition we can advance to a second. That is, if physical, biological and social processes can be represented as values, then any proposals will affect these. One would ask that such changes be beneficial, that they add value. But changes to land use often incur costs. The best of all possible worlds would be a proposal that provided new values and incurred no costs. In the absence of this unlikely circumstance we might be satisfied if new values exceeded the costs incurred. Preferably these costs should not involve irreversible losses. The solution of maximum social benefit at least social cost might be the optimum. This could be called the solution of maximum social utility.

In essence, the method consists of identifying the area of concern as consisting of certain processes, in land, water and air—which represent values. These can be ranked—the most valuable land and the least, the most valuable water resources and the least, the most and least productive agricultural land, the richest wildlife habitats and those of no value, the areas of great and little scenic beauty, historic buildings and their absence and so on. The interjection of a highway will transect this area; it will destroy certain values. Where will it destroy the least? Positively the highway requires certain conditions—propitious slopes, good foundation materials, rock, sand and gravel for its construction and other factors. Propitious circumstances represent savings, adverse factors are costs. Moreover, the highway can be consciously located to produce new values—more intense and productive land uses adjacent to intersections, a delightful experience for the motorist, an added convenience to the traveler. The method requires that we obtain the most benefit for the least cost but that we include as values social process, natural resources and beauty.

We can identify the critical factors affecting the physical construction of a highway and rank these from least to greatest cost. We can identify social values and rank them from high to low. Physiographic obstructions—the need for structures, poor foundations, etc.—will incur high social costs. We can represent these identically. For instance, let us map physiographic factors so that the darker the tone, the greater the cost. Let us similarly map social values so that the darker the tone, the higher the value. Let us make the maps transparent. When these are superimposed, the least-social-cost areas are revealed by the lightest tone.

However, there is one important qualification that must be recognized. While in every case there should be little doubt as to the ranking within a category, there is no possibility of ranking the categories themselves. For example, it is quite impossible to compare a unit of wildlife value with a unit of land value or to compare a unit of recreational value with one of hurricane danger. All that can be done is to identify natural and social processes and superimpose these. By so doing we can observe the maximum concurrence of either high or low social values and seek that corridor which transects the areas of least social value in all categories. Exact resolution of this problem seems unrealizable. Economists have developed price values for many commodities but there seems no prospect that institutions, scenic quality, historic buildings, and those other social values considered, can be given exact price values.

It is immediately conceded that the parameters are not co-equal. In a given area, considered by itself, existing urbanization and residential quality are likely to be more important than scenic value or wildlife. Yet it is reasonable to presume that, where there is an overwhelming concentration of physiographic obstruction and social value, such areas should be excluded from consideration; where these factors are absent, there is a presumption that such areas justify consideration.

This is not yet a precise method for highway route selection; yet it has the merit of incorporating the parameters currently employed and adding new and important social considerations, revealing their locational characteristics, permitting comparison, disclosing aggregates of social values and costs. Whatever limitations of imprecision it may have, it does enlarge and improve existing method.

The preceding discussion has emphasized the identification of physiographic corridors containing the lowest social values as the preferred route for highways. In our discussion of cost-benefit analysis, we mentioned the role of the proposed highway in creating new values. This view deserves a greater emphasis. Within limits set by the points of origin and destination, responsive to physiographic obstructions and the pressure of social values, the highway can be used as conscious public policy to create new and productive land uses at appropriate locations. In any such analysis cost-benefit calculations would require that any depreciation
of values would be discounted from value added. In addition, scenic value should be considered as possible added value. It is, of course, possible that a route could be physiographically satisfactory, avoid social costs, create new economic values at appropriate locations and also provide a satisfactory scenic experience.

The highway is likely to create new values whether or not this is an act of conscious policy. Without planning, new values may displace existing ones, but even if a net gain results there may well be considerable losses.

Some years ago I gave an address at Princeton on The Ecological View. I extolled the diagnostic and prescriptive powers of this integrative science. The following day I was asked to employ ecology in the selection of a thirty-mile route for I-95 between the Delaware and Raritan Rivers. The inhabitants of this bucolic region were threatened by an alignment that appeared to select almost all that was precious and beautiful—the maximum destruction to be accomplished with the least benefit at the greatest cost. The enraged citizenry constituted themselves into The Delaware-Raritan Committee on I-95. Faced with the problem, little time and less money, the method we have just outlined was developed and applied. Through the transparencies—like light shining through a stained glass window—was visible that alignment of least-social-cost. Its influence was felt and, one after another, through thirty-four alternative alignments, the proposed highway moved nearer and nearer to that ultimately proposed by the author.

To claim this as an ecological method is to flatter it. It is enough to say that it did use data reflecting social, resource and aesthetic values, but the data were hurriedly assembled and gross. Residential value was derived from land and building values that gave high social value to the wealthy and too little to the poor, urbanization was classed into a few gross categories, excluding the enormous variety of conditions within this description. Nonetheless, it offered a large measure of success. It provided a method whereby the values employed were explicit, where the selection method was explicit—where any man assembling the same evidence, would come to the same conclusion. It introduced the least-social-cost/maximum-social-benefit solution, a relative-value system that could consider many nonprice benefits, savings and costs, and not least, the measure of scenic experience as a potential value.

Subsequently the method was employed in the Borough of Richmond in New York where, as is now commonplace, a treasured open space was threatened by highway destruction. Here the subject of traffic was not in dispute, no intersections were proposed for the controversial five-mile section of the Richmond Parkway, and social benefit was thus limited to the convenience of the trip and the scenic experience of the motorist. In this example the matter of reducing social costs to maintain social values was preponderant—but increasingly this is the overwhelming problem.

The issue was a simple one. Should the highway select the Greenbelt for its route in order to reveal it to the public or should it serve the Greenbelt, but avoid the destruction of transection? The character of the highway is not changed by entitling it a parkway but this title has been used to describe highways in areas of great natural beauty—the Blue Ridge and Palisades Parkways, for example. Here, where beautiful landscapes are abundant, there is little social loss and great social benefit. Where resources are as precious as the Greenbelt in Staten Island, this conception is not appropriate. Better, follow the example of the Bronx River Parkway and create new values while avoiding destruction of the few oases that remain for twelve million New Yorkers.

We can now apply the method to the Richmond Parkway. The first group of factors included some of those orthodox criteria normally employed by engineers—slope, bedrock geology, soil foundation conditions, soil drainage and susceptibility to erosion. The degree of opportunity or limitation they afford is reflected directly in the cost of highway construction. The next category concerns danger to life and property and includes areas vulnerable to flood inundation from hurricanes. The remaining categories are evaluations of natural and social processes including historic values, water values, forest values, wildlife values, scenic values, recreation values, residential values, institutional values and land values. Each factor, with its three grades of values, is photographed as a transparent print. The transparencies of the first group are superimposed upon one another and from this a summary map is produced that reveals the sum of physiographic factors influencing highway route alignment. Each subsequent parameter is then superimposed upon the preceding until all parameters are overlaid. The darkest tone then represents the sum of social values and physiographic obstructions to a highway corridor; the lightest tone reveals the areas of least social value representing the least direct cost for highway construction. The highway should be located in that corridor of least social value and cost, connecting points of origin and destination. Moreover, it should provide new values—not only of convenience, but also of scenic experience—as a product of public investment.

It is important to observe that the reader parallels the experience of the author at the beginning of the study. The method was known but the evidence was not. It was necessary to await its compilation, make the transparent maps, superimpose them over a light table and scrutinize them for their conclusion. One after another they were laid down, layer after layer of social values, an elaborate representation of the Island, like a complex X-ray photograph with dark and light tones. Yet in the increasing opacity there were always lighter areas and we can see their conclusion.
**SLOPE**

ZONE 1  Areas with slopes in excess of 10%.
ZONE 2  Areas with slopes less than 10% but in excess of 2½%.
ZONE 3  Areas with slopes less than 2½%.

**SURFACE DRAINAGE**

ZONE 1  Surface-water features—streams, lakes and ponds.
ZONE 2  Natural drainage channels and areas of constricted drainage.
ZONE 3  Absence of surface water or pronounced drainage channels.

**SOIL DRAINAGE**

ZONE 1  Salt marshes, brackish marshes, swamps, and other low-lying areas with poor drainage.
ZONE 2  Areas with high water table.
ZONE 3  Areas with good internal drainage.
BEDROCK FOUNDATION

ZONE 1  Areas identified as marshlands are the most obstructive to the highway; they have an extremely low compressive strength.

ZONE 2  The Cretaceous sediments: sands, clays, gravels; and shale.

ZONE 3  The most suitable foundation conditions are available on crystalline rocks: serpentine and diabase.

SOIL FOUNDATION

ZONE 1  Silts and clays are a major obstruction to the highway; they have poor stability and low compressive strength.

ZONE 2  Sandy loams and gravelly sandy to fine sandy loams.

ZONE 3  Gravelly sand or silt loams and gravelly to stony sandy loams.

SUSCEPTIBILITY TO EROSION

ZONE 1  All slopes in excess of 10% and gravelly sandy to fine sandy loam soils.

ZONE 2  Gravelly sand or silt loam soils and areas with slopes in excess of 2½% on gravelly to stony sandy loams.

ZONE 3  Other soils with finer texture and flat topography.
LAND VALUES

ZONE 1  $3.50 a square foot and over.
ZONE 2  $2.50-$3.50 a square foot.
ZONE 3  Less than $2.50 a square foot.

HISTORIC VALUES

ZONE 1  Richmondtown Historic Area.
ZONE 2  Historic landmarks.
ZONE 3  Absence of historic sites.
**FOREST VALUES**

ZONE 1  Forests and marshes of high quality.
ZONE 2  All other existing forests and marshes.
ZONE 3  Unforested lands.

**WILDLIFE VALUES**

ZONE 1  Best quality habitats.
ZONE 2  Second quality habitats.
ZONE 3  Poor habitat areas.
RECREATION VALUES

ZONE 1  Public open space and institutions.
ZONE 2  Non-urbanized areas with high potential.
ZONE 3  Area with low recreation potential.

RESIDENTIAL VALUES

ZONE 1  Market value over $50,000.
ZONE 2  Market value $25,000-$50,000.
ZONE 3  Market value less than $25,000.
**WATER VALUES**

**ZONE 1**  Lakes, ponds, streams and marshes.
**ZONE 2**  Major aquifer and watersheds of important streams.
**ZONE 3**  Secondary aquifers and urbanized streams.

**SCENIC VALUES**

**ZONE 1**  Scenic elements.
**ZONE 2**  Open areas of high scenic value.
**ZONE 3**  Urbanized areas with low scenic value.
INSTITUTIONAL VALUES

ZONE 1  Highest value.
ZONE 2  Intermediate value.
ZONE 3  Least value.
Each of the social values has now been superimposed. The first group of physiographic corridors is apparent. When the next factor of tidal inundation is examined it is seen to set western limits to the western corridor. Land values are highest in the Greenbelt but relatively low to the west save for the exception of a commercial area. Each subsequent superimposition of social values gives primacy to the Greenbelt until the final summation shows the highest concentration of social values and physiographic obstruction concentrated in the eastern sector. If the area of highest social value is clear, so too is that of the lowest value reflected in a broad band in the western physiographic corridor. The western limits of the zone of lowest social value are established by the Wildlife Refuge, the physiographic constraints offered by the sanitary landfill and marshes.

In sum, if the values identified and ranked are correct, the composite map on this page represents the sum of social values, physiographic opportunities and constraints. The darker the tone the greater the social cost of highway construction, the lighter the tone the less the social cost. The Greenbelt looms as the concentration of highest social value and physiographic obstruction; a path of least social cost is visible to the west.

The method is explicit in the identification and ranking of physiographic opportunities and limitations to a highway corridor. It is equally explicit as to social values. As can be seen clearly, the maximum concurrence of physiographic limitations and social values exists as a solid mass in the middle of the study area. This is the Staten Island Greenbelt. The presence and concurrence of these values is seen as a resistance to highway transection, their paucity as an opportunity. When the proposed alignments are examined from right to left, it is seen that the first would violate the highest social values and would incur the highest social costs. The second is as culpable, whereas the next two in large part conform to the corridor of least social cost. A propitious alignment can be found within the area defined by the two westward routes in their lower section, but to the north the least-social-cost corridor follows in a band to the west of the shared alignments.

The area free from tone on the adjacent map is the area of least social cost within which is revealed the least-social-cost corridor. Existing structures are superimposed on the map and the location of the two alternative minimum-social-cost alignments can be seen as a response to these local social values.

The Tri-State Transportation Commission reversed its decision to transect the Greenbelt with the Richmond Parkway and accepted the least-social-cost alignment developed in this study.

The Richmond Parkway Study was undertaken for the New York City Department of Parks by Wallace, McHarg, Roberts and Todd. The author was responsible for the project which was supervised by Mr. Narendra Juneja, assisted by Mr. Derek Sutphin and Mr. Charles Meyers.