case study of the milwaukee-green bay interstate corridor location

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In October 1969, the Wisconsin Division of Highways contracted with the Environmental Awareness Center of the University of Wisconsin's Department of Landscape Architecture to develop a computer program to be used in the corridor location study for the proposed Interstate highway from Milwaukee to Green Bay. The expertise of the Awareness Center was also to be an integral part of the corridor selection process carried out by the Wisconsin Division of Highways. The purpose of the computer-oriented selection process is to simultaneously weigh the social, economic, and environmental factors of a large area to determine the most acceptable corridor for a transportation facility.

The staff of the Awareness Center decided to take advantage of similar work being done by the Department of Landscape Architecture and the Laboratory of Computer Graphics at Harvard University and by Steinitz Rodgers Associates of Cambridge, Massachusetts. Grid, a computer evaluation and graphic display program, was purchased from Steinitz Rodgers as the basic component of the process.

The first step in the process was the development of a data bank capable of providing a quantitative and qualitative inventory of existing and future resources throughout the total study area of approximately 4,500 square miles shown in Figure 1.

The data bank was developed through a reference system based on the universal transverse mercator projection, the reference system employed by various federal agencies for high altitude and satellite imagery data collection. The use of this system allows for future data maintenance from the imagery of the earth's resources technical satellite, which is intended to provide data every 18 days for the entire state of Wisconsin.

The basic data storage unit, as defined by this project system, is a 1-km square or cell of which there are more than 9,000 in the study area. Each of these cells contains 247.5 acres. A list of data items to be quantified within each cell was developed by the staff of the Awareness Center. The items were intended to be general in nature and responsive to the existing Wisconsin landscape, availability of information, and

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practicality of being measured over a large study area. Other constraints were that the structure should allow for updating and revision and that each item should be maintainable. Originally, there were 130 data items basically structured as follows: (a) Natural characteristics including hydrological, ecological, physiographical, and pedological systems; and (b) cultural characteristics including existing land use, projected land use, population distribution, and communications systems. In addition to these basic items, others can be generated by the computer program. For example, the orientation or direction of a stream was determined within a cell by searching adjacent cells for the existence of the stream.

The data were extracted from various special purpose maps and aerial photographs and converted to dimensional units for computer input. This particular phase was the most time-consuming part of the entire process, and a more sophisticated data extraction process using modern remote-sensing technology would be necessary for studies of a large area and a long time period.

Once stored within the computer, the data are readily accessible and can be displayed in various formats that show the percentage of agricultural land in each cell, the type of ecological system, and the type of water.

The first step in determining the importance of each data item on a highway corridor location was categorizing the necessary social, economic, and environmental criteria to be considered. These determinants or factors affecting location were developed through the combined efforts of staff members of the Awareness Center, Wisconsin Divisions of Highways and of Planning, and the Federal Highway Administration. The members of the study group found little difficulty in consolidating their thoughts into the 9 corridor determinants listed below:

1. Least engineering difficulty,
2. Least cost of construction,
3. Least cost of acquisition,
4. Projected traffic generation,
5. Least impact on the cultural system,
6. Least impact on the ecological system,
7. Least impact on quality of agricultural lands,
8. Greatest scenic potential, and
9. Least impact on potential recreation and conservation lands.

Sufficient data were not readily available for adequately defining determinant 4. Consequently, it was not used in the final analysis. A tenth determinant, greatest potential for development of joint communication corridors, was added later in the study.

These determinants and the data items were arranged in a working matrix that was used to group the variables (a single variable will frequently be assigned to more than one determinant) into broad influences commonly used in highway location studies. Within each determinant, the variables were weighted relative to each other based on the significance of the resource indicated and the anticipated impact by the proposed facility. This grouping and weighting process was carried out by the composite study group. As anticipated, it was much easier to weigh variables within those determinants associated with dollar cost than those associated with cultural values.

To represent various viewpoints or opinions, relative weights were then assigned to each determinant; each combination of weighted determinants formed an alternative. For any alternative selected, the computer analysis resulted in a numerical expression of appropriateness for a highway corridor for each cell. This value is based on the quantity of the various resources in a cell and the weights assigned. Ten intermediate increments of the total range of the values obtained were assigned symbols varying from dark for low values (more suitable for locating a highway) to light for high values (least suitable). These symbols were then printed out providing a graphic display of suitability for highway location as shown in Figure 2, an alternative with all determinants weighted equal. The most desirable location for the proposed highway corridor, based on this methodology, is one passing through the darkest shaded cells. A computer program was developed later in the study to select the continuous series of cells between

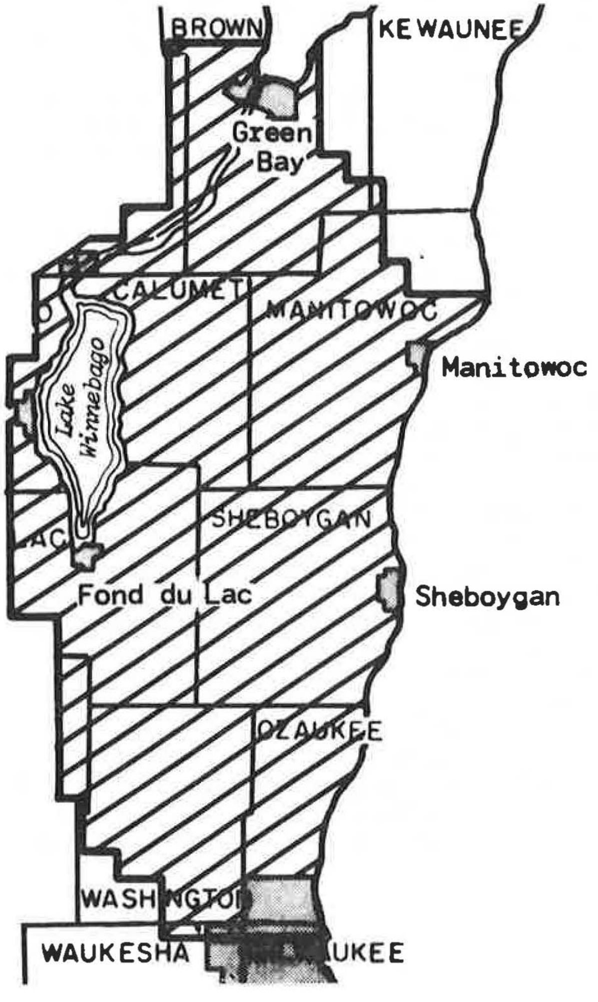

Figure 1. Study area of Interstate between Milwaukee and Green Bay.

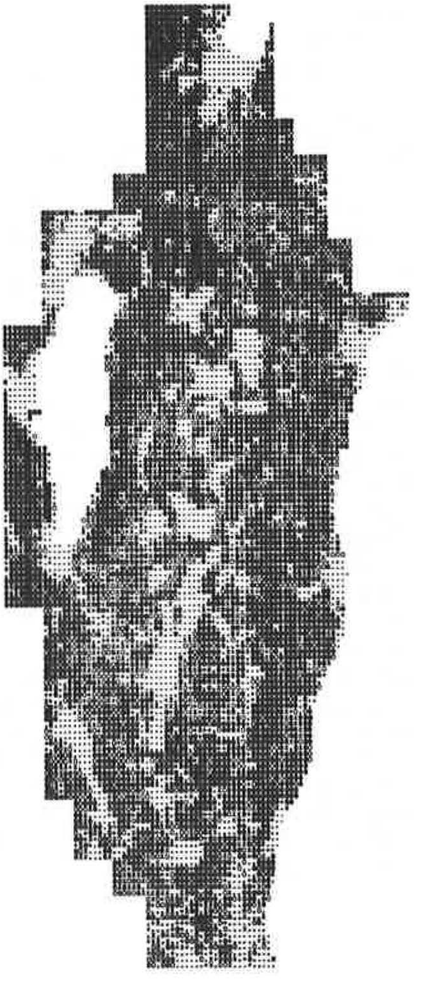

Figure 2. Equally weighted corridor determinants without demand.

termini that would minimize the potential impact based on the numerical values of the cells.

Although total acceptance of the corridor location defined by the computer is not yet practical, several incidental portions of the computer process proved valuable as input to these studies.

A computer-based storage and retrieval system is essential for handling the many data items involved. This particular data storage system provides the flexibility of obtaining a data inventory for any group of cells within the entire study area. This means that many varied data comparisons are possible. The quantity of any resource within a particular corridor can be compared with that of the entire corridor area or with that of any other corridor or area. A particular corridor can also be subdivided by political boundaries, making possible a separate analysis of the corridor by county or city.

The process of determining the proper location for an Interstate highway involves considerable input to the corridor study. Added emphasis to the depth, diversification, and documentation of the study was necessitated by considerable public interest and anticipation of the preparation of an environmental impact statement. The data-handling ability of the computer program proved to be a useful tool in the corridor studies. Computer printouts were readily available for inventorying resources throughout the study area, and their formats were useful in presenting data in the environmental statement. General areas of incompatibility were quickly identified, thus limiting the areas where more detailed studies might be made.

The application of the computer also provides the capability of simultaneously considering many variables as location parameters. This ability is becoming increasingly important as the highway location process becomes more complex and is influenced by interdisciplinary studies. It is only as good, however, as the weights that are assigned to the variables. Proper weights can only be assigned by individuals who have an understanding of the nature of the data items, the format by which they are input to the program (such as predominant type or percentage of cell), and the program itself. If they do not have this understanding, the values intended will not be reflected in the final output.

The use of this process for providing an indication of the environmental impact is also dependent on the assigned weights. This system is not a vehicle for determining how a highway affects the various resources in its vicinity. Studies and research on these effects are a necessary input to the weighting process. Even then, the indication provided is only that of the potential impact because the data are at a 1-km scale. The existence of a resource within a cell is not specific enough with respect to the final highway location to completely define the impact. This would indicate that additional studies are required to better define the actual anticipated impact.

The use of advanced remote-sensing techniques would greatly simplify the most time-consuming portion of this type of corridor selection process: data gathering. If an acceptable and efficient remote-sensing system were developed, the data bank could realistically be expanded to include the entire state of Wisconsin and would make the use of this process for any proposed land use relatively simple. Quick computer-oriented data inventories and area comparisons could be produced for all agencies attempting to determine the impact of a proposed land use on the environment.

The use of this computer-oriented selection program has proved to be an effective tool in the corridor location process. Additional flexibility and program development will substantially enhance its effectiveness. Practicality can be realized, however, only when large-scale application is employed through the effort of many agencies on a joint basis.