# PRIORITY PROGRAMMING FOR HIGHWAY PROJECT SELECTION

by

Sally Jensen
Research Assistant



Virginia Highway & Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways & Transportation
the University of Virginia)

Charlottesville, Virginia

July 1981
VHTRC 82-R5

TRANSPORTATION PLANNING RESEARCH ADVISORY COMMITTEE

MR. R. C. LOCKWOOD, Chairman, Transportation Planning Engineer, VDH&T

MR. E. D. ARNOLD, JR., Research Scientist, VH&TRC

MR. D. W. BERG, Assistant Public Transportation Engineer, VDH&T

MR. G. W. BROWN, Assistant City Manager, City of Martinsville, City Hall

MR. G. R. CONNER, Assistant Rail Div. Admin., VDH&T

DR. DONALD R. DREW, Prof of Civil Engineering, VPI & SU

MR. JAMES C. ECHOLS, Executive Director, Tidewater Transp Commission

MR. TOM FAULKNER, JR., Civil Engineering Department, VPI & SU

MR. D. R. GEHR, Regional Transp Engineer, VDH&T

MR. J. N. HUMMEL, Chief, Planning & Engineering Division, Arlington Department of Public Works

MR. D. E. KEITH, Resident Engineer, VDH&T

MR. J. D. PAULUS, Planner I, Transportation Peninsula Planning District Comm.

MR. J. K. SKEENS, Assistant Urban Engineer, VDH&T

MR. F. L. TODD, Assist Planning & Research Engineer, FHWA

## SUMMARY

This report provides an introduction to the methodologies of priority programming as developed by state transportation departments in their highway and transportation project selection processes. It explains the interrelationships between needs studies, long-range transportation planning, and the enumeration of system-wide goals and objectives which are all an integral part of the programming process. Presented is a step-by-step format which describes the sequential phases common to all programming and prioritizing techniques.

The report represents the state of the art of priority programming obtained through a survey of the methodologies developed by twenty-six state transportation departments. It details the prioritizing techniques of Arizona, Wisconsin, Minnesota, New Jersey, and California to illustrate how priority programming can respond to each state's unique goals and objectives.

# PRIORITY PROGRAMMING FOR HIGHWAY PROJECT SELECTION

by

Sally Jensen
Research Assistant

## INTRODUCTION AND PROBLEM STATEMENT

In the current era of fiscal constraint state transportation departments have become aware of the need to redefine their goals and objectives. Most states have shifted their focus away from construction of interstate highways and expressways to preserving and maintaining existing facilities at a level sufficient to prevent major reconstruction and maintain safe conditions. Nevertheless, maintaining previous levels of service is becoming increasingly difficult. Because it has become so important to fund only the most necessary highway improvement and construction projects, many Departments are developing system-wide programming methodologies as part of their statewide transportation planning process. This planning process includes those activities required for financing, selecting, and scheduling construction and maintenance projects identified through the planning function of federal, state, and local transportation agencies.

In an effort to fund projects in a more efficient and equitable manner, state transportation departments are developing programming techniques to establish priorities for candidate projects according to specified criteria. The result is a broad spectrum of priority programming methods which respond to the unique philosophies and needs of each state. This report discusses the interrelationship between needs studies, long-range transportation planning, and programming. It then presents a general framework for understanding both programming and prioritizing processes. Finally, it illustrates the wide variety of priority programming methods by examining the programming techniques of five states — Arizona, Wisconsin, Minnesota, New Jersey, and California.

## THE RELATIONSHIP BETWEEN NEEDS STUDIES, PLANNING, AND PROGRAMMING

The basic elements of the statewide transportation planning process are needs studies, long-range transportation plans, and short-range implementation programs.

The needs study provides the technical data necessary for assessing the condition of the highway system and making projections for long-range estimates of needed improvements. Thus, the needs study is the foundation for establishing transportation priorities and goals within the long-range transportation plan. When these goals are considered in light of funding constraints, a programming process can be developed that provides a mechanism for selecting a short-range highway improvement program consistent with the long-term goals.

## Needs Studies

While each state has developed its own procedures for estimating transportation needs, there is a general consensus across the nation that a project-by-project approach to identifying needs is not an adequate method for initiating the development of the most cost-effective transportation systems. Transportation planners must examine system-wide needs to be able to identify the trade-offs among the highest priority projects. This process provides opportunities to reduce design standards and limit project-choice options to fit available funding. Consistent with this notion is the current priority given to maintenance of the existing system over new construction projects.

An essential component of the needs assessment is the establishment of criteria for determining those transportation facilities and services that are most desirable. These criteria for highway segments are typically based upon the following elements:

- Operation Characteristics
- Design Standards
- Performance Standards
- Safety Standards

Many states, notably Wisconsin and Tennessee, are experimenting with the possibilities of downgrading current standards, especially those in design categories.

Needs studies often result in decisions to reduce the magnitude of new programs, maintenance, and operations to fit budgets. Often the options are to (1) reduce the number of projects to be funded, (2) reduce the design standards, (3) redesign the scope of the project, or (4) employ a combination of these.

## Long-Range Transportation Plan

After a system-wide needs assessment has been conducted, it is possible to develop a long-range transportation plan that embraces realistic long-term goals and priorities for the state transportation system. Most state transportation plans are limited to a reasonable time period, usually 5 to 7 years, and are tied to a realistic appraisal of the fundings to be available. The goals and objectives outlined in the state transportation plan must be updated annually in response to changes in priorities and funds available. The plan provides a clear statement of the DOT's priorities and should be the basis for decisions concerning project selection.

## Short-range Implementation Programs

As previously noted, the transportation planning process includes those activities required to finance, select, and schedule projects identified through the planning functions of the various federal, state, and local agencies. Programming includes funding considerations such as the allocation of funds to geographic areas of the state, among modes of transportation, and among project categories. Since at this point a department will have already identified system-wide needs and developed long-range goals and objectives, it is now able to develop criteria to be used in the selection of candidate transportation projects.

## Programming Process

The programming process does not have a precisely defined format, although all programming methodologies share common elements. Each state must develop a programming technique in response to its own fiscal constraints, systems problems, political climate, and legislative mandates. Because programming must incorporate so many variables, it is a dynamic process that must be flexible enough to allow for shifting priorities.

NCHRP Synthesis 48[1] provides the most widely accepted definition of the programming function: "Defined simply, programming is the matching of available projects with available funds to accomplish the goals of a given period." The phrase "to accomplish the goals of a given period" refers to the planning phases of the development of a statewide transportation plan. If those activities are carried out properly and tied to the programming process, programming will not become merely an exercise of matching projects with money; it will be a means of obtaining the most urgently needed and cost-effective projects to ensure system-wide benefits. To obtain the greatest benefits from competing projects, programming must prioritize projects based upon need.[2] Therefore, the

assignment of priorities based upon needs becomes the central focus of the programming process. Prioritizing is "the overall process of producing a rank order of priority projects and project sections, using technical and nontechnical, quantifiable and non-quantifiable factors as the basis for ranking."(1)

Basic to an understanding of transportation programming are the following key factors.

- The short-range program is rarely new, it contains commitments from previous years.
- Proposed projects are always in varying stages of development, from preliminary planning studies to final design.
- The available funds may be restricted to certain categories of use, although there may be some flexibility in transferring funds between categories or reassigning projects among categories.
- Priorities may be constantly changing because of shifting philosophies, transportation needs, economic conditions, energy availability, political conditions, and other factors.

Table 1 gives 15 steps common to most programming methodologies and is followed by comments upon each step. Programming for transportation project selection begins with project initiation and results in a final printed document that details the priority of projects based upon established criteria.

Table 1

Steps in the Basic Programming Process

1. Project initiation
   A. Technical sources
   B. Nontechnical sources
2. Initial listing
   A. Headquarters
   B. District
   C. County
   D. Metropolitan Planning Organization

Table 1. (Continued)

3. Preliminary analysis
   A. Available data and analyses
   B. Planning report (project description)
4. Combined listing (first draft)
5. Advanced analysis and prioritizing
   A. Technical prioritizing
      (1) Sufficiency ratings
      (2) Priority ratings
      (3) Option-evaluation techniques
      (4) Input from other agencies
   B. Nontechnical prioritizing
      (1) Political commitments
      (2) Legislative mandate
      (3) Emergency
      (4) Special emphasis
      (5) Commitments to other agencies
      (6) System continuity-connectivity
      (7) Position in pipeline
   C. Feedback from project planning and development
      (1) Development of alternatives/joint development
      (2) Environmental analysis (environmental impact statement — social, economic, and environmental factors)
      (3) Community and technical interaction
      (4) Input from other agencies
6. Combined listing (second draft)
7. Financial analysis
   A. Categorical grants
   B. Geographical distribution
   C. Fiscal-year projections (fund forecasting)
   D. Manpower analysis
   E. Financial modifications
8. Preliminary program (projects vs. projected allocations)
9. Executive session
10. Short-range program (first draft)
11. Executive and legislative review
12. Short-range program (final draft)
13. Scheduling
14. Monitoring
15. Modifying

Source: Reference 1.

## 1. Project Initiation

Project proposals are developed from planning studies, special studies, and trained observations from district personnel. In Virginia, some proposals come from county boards of supervisors.

## 2. Initial Listing

The four sources of projects are a central office list, a district list, a county list, and a metropolitan planning organization list required as part of the annual element of the transportation improvement program.

## 3. Preliminary Analysis

This analysis is based upon existing or easily available data. It provides an outline of the major elements of each project including a description, estimated costs, and its importance within the system.

## 4. Combined Listing/First Draft

This is a combined listing of all new project proposals.

## 5. Advanced Analysis and Prioritizing

This step has three major phases: technical prioritizing, nontechnical prioritizing, and feedback from project planning and development. This is a continuous process.*

- Technical prioritizing requires the examination of each project in terms of some type of sufficiency rating that measures the physical condition of the road in addition to accident totals and traffic volumes. More complex rating systems are often developed to include benefit/cost, social, economic, and environmental factors.

- Nontechnical prioritizing adds factors that are not easily quantifiable and that influence project selection such as legislative mandates, emergencies, commitments to other agencies, and position in the project pipeline.

---

*This phase will be examined in greater detail in the next section of the report.

- Feedback from project planning and development includes the development of alternatives, environmental impact assessments, citizen concerns, and input from other agencies. Any of these factors can have a significant impact upon whether a project is advanced, expanded, or decreased in scope.

  Once all of the relevant factors have been considered, there is a return to the long-range planning goals. Information about the need for the project, the impact it will have on the region, and its importance to the connectivity/continuity of the system will be used to determine its desirability in the program.

6. Combined Listing/Second Draft

This is a compilation of the list of new projects and projects from previous years and will include projects in various design phases and levels of prioritizing.

7. Financial Analysis

The financial analysis determines how much money is available and how much is already committed. The five components of financial analysis are categorical grants, geographical distribution, fund forecasting, manpower analysis, and financial modifications.

8. Preliminary Program

The first programming step is to list the projects with projected available funding. A priority order is given to the extent possible and each category of project is overprogrammed to provide needed flexibility.

9. Executive Session

In this step, the departmental staff reviews the preliminary program in preparation for publication.

10. Short-Range Program/First Draft

After the executive review, a short-range program is published.

### 11. Executive and Legislative Review

This step submits the preliminary program to legislative review and the funding appropriations process.

### 12. Short-Range Program

The final draft becomes the official program of the department. It details the state's goals and objectives to the citizens of the state. Often this final short-range program is referred to as a bids list.

### 13-15. Scheduling, Monitoring, and Modifying

Steps 13 through 15 deal with the implementation of the program.

## PRIORITY PROGRAMMING PROCEDURES

There are some instances when the arraying of projects to establish priorities can be accomplished solely through an engineering judgement about the physical characteristics of the candidate projects. In most cases, however, other variables must be taken into account. Priority rating methodologies are designed to bring these other variables together within the programming structure. Thus, priority ratings may consider such factors as a safety rating (accident total or rates), a capacity rating (volume/capacity), a benefit/cost (or cost-effectiveness) rating, and such difficult-to-measure factors as uncertainty, interrelationships with competing or connecting facilities, and agreements or commitments.(1)

Most priority programming procedures consist of both rating and ranking techniques.

> The rating scheme first establishes the need or desirability of an improvement in terms of sufficiency or deficiency of the existing facilities by using quantitative and qualitative parameters. The ranking scheme, on the other hand, orders the proposed improvement according to its urgency relative to other projects.(2)

The foundation of the rating techniques is almost always an analysis of the physical condition of the highway segment. Historically, the basis for highway programming has been the sufficiency

rating, and this is true today. The typical sufficiency rating system includes three elements: condition, safety, and service. Examples of the factors that might be considered in the sufficiency rating follow.

1. Condition: foundation, surface, shoulder, and drainage.

2. Safety: surface width, shoulder width, stopping distance, consistency, and accidents/hazards.

3. Service: alignment, passing opportunity, surface width, and ridability.(3)

Sufficiency ratings are composites based on the condition of a road segment and its ability to provide the desired level of service in a safe and efficient manner. Typically, 100 points are assigned to the ideal condition, with lower numbers indicating the degree of deficiency. This rating system is used so widely because it is simple to administer and the necessary data are easily obtainable.(3) Probably the least complex form of sufficiency rating is used by the state of Iowa. According to a legislative mandate, the Iowa DOT must rate all segments of the primary highway system each year as part of the long-range transportation planning process. Each segment is rated in three major categories as follows:

| Rating Item | Points |
|---|---|
| Structural Adequacy | 25 |
| Safety | 40 |
| Service | 35 |
| TOTAL | 100 |

Each segment is given a rating on the 100-point scale, which is then adjusted to magnify those rating items which fall below a tolerable standard and finally adjusted to reflect route continuity considerations.(4)

Nevertheless, the sufficiency rating cannot be the sole determinant of need since it can describe only the structural adequacy, not the relative importance of one project as compared to another. With the increasing complexity of system-wide needs and the emphasis on multimodal planning, programming techniques have been developed that can merge the considerations of fiscal constraints, political realities, and social,economic and environmental (SEE) factors with the technical sufficiency data. Therefore, once the candidate projects have been rated according to some form of sufficiency criteria, they can then be ranked according to their relative importance based upon another set of criteria. This brings the rating into the prioritizing process. Below is an outline of the evolution of priority ratings.

1. Sufficiency (deficiency) rating
2. Priority rating/arraying
   a. Addition of safety factors
   b. Addition of capacity factors
   c. Addition of economic factors (e.g. benefit-cost, cost-effectiveness, displacement of businesses, jobs during construction)
   d. Addition of quantifiable social and environmental factors (e.g., displacement of families, air pollution)
   e. Addition of non-quantifiable SEE factors
      (1) Social (e.g. disruption, neighborhood cohesion)
      (2) Economic (e.g. economic base, accessibility, land-use impacts)
      (3) Environmental (e.g. aesthetics, effect on natural resources, water pollution,noise)(1)

Arizona uses a fairly simple form of priority rating. Along with its 100-point sufficiency rating, the Arizona impact system includes environmental factors (40 points), socioeconomic factors (35 points), and traffic safety factors (25 points). This technique thus rates each candidate project according to a 200-point scale and then orders the projects by their relative importance to the system.

Priority ratings fall into two basic categories — composite scores and priority arrays. Under the composite score methodology, each candidate project is rated according to specified criteria and then ranked in one listing according to its urgency/importance relative to that of every other candidate project. In the priority array methodology, candidate projects are first grouped into categories of like projects, often based on functional classification

or use, and rated according to criteria unique to each category. (For example, bridge projects are rated according to different criteria than are highway reconstruction projects.) All candidate projects are then ranked within their categories. This technique of priority array is used by many states because it corresponds readily to the process of allocating highway funds by functional classifications.

It has been previously stated that each state has developed its priority programming methodology in response to its unique political, fiscal, and system characteristics. It is easy to see that when social, economic, and environmental factors are considered, along with other incommensurable elements, all within each state's long-range transportation planning goals and objectives, the range of priority programming methodologies is infinite and constantly changing. The next section of this report examines the programming systems developed by five states. They are presented not so much as ideal methodologies, but as examples of the spectrum of priority programming methods that can and have been effectively utilized in the highway project selection process.

## STATE METHODOLOGIES FOR PROGRAMMING

In obtaining information for this report, 25 states were surveyed concerning their approaches to transportation programming. Literature was provided by about 20 of these states. The 5 states whose priority programming procedures are discussed here offer different perspectives on the ways agencies can develop programming methodologies. Minnesota provides a good example of how a programming process is developed. Arizona provides perhaps the most easily understandable sufficiency rating system. New Jersey practices a unique form of priority arraying. Wisconsin illustrates how programming fits into the long-range transportation planning process and how different funding levels for classifications of candidate projects aid in management decision making. California is included as an example of a highly complex, relatively computerized approach to priority programming.

### Minnesota

The 1976 legislation that established the Minnesota Department of Transportation also directed that agency to develop a statewide transportation plan as a means of achieving and maintaining an efficient and effective transportation system within the state.(5) This plan was to include all modes and types of

transportation and was to guide the Department in making decisions related to system planning, policy development, funding, and project selection. According to the legislation, the plan was to be completed by July 1978. The Commissioner was required to:

> Based upon the statewide transportation plan, develop statewide transportation priorities and schedule authorized public capital improvement and other authorized public transportation expenditures pursuant to the priorities....
> (Law 1976, Chap. 166, Sec. 3, Subdivision 1-C)

The legislation provided a step-by-step process for programming. The five basic phases given below describe the cycle of planning activities that occur on a regular basis within the planning, programming and project development duties of the Minnesota Department of Transportation.

## Identification of Issues, Needs, and Proposals

The process begins with an evaluation of the existing transportation system and the legislation and departmental policies which affect the system. From this step, an assessment of needs is made from which candidate projects are developed.

## Preliminary Planning

This phase requires the implementing agency to analyze the issues, needs, and problems surrounding candidate projects and recommend (a) that a project be advanced to programming, (b) that the issue/need deserves further study to define a specific project, or (c) that the issue/need should be deferred.

## Programming

This phase requires the evaluation of all candidate projects and provides a method of selection among those projects from available funding. The programming phase of the planning process can be subdivided into the following four steps.

Step 1. Project identification — A list of all projects is submitted to the central office for programming consideration.

Step 2. Project classification — Projects are classified by mode, program, or type according to common funding, geographic, or functional classifications, so that funding decisions and project evaluation and selection can be made.

Step 3. Project evaluation — Projects in each classification are evaluated to determine which ones best satisfy the purpose of the state transportation plan. Evaluative methods vary from one classification to the next, ranging from weighted-criteria-based ranking of projects to subjective comparison of projects. Participation in this step varies from one classification to another, depending on the candidate projects' impact on various agencies or local governmental units.

Step 4. Program development — In this step, various considerations and constraints are applied to the list of candidate projects in each classification. Considerations are factors which cannot be used in project evaluation (Step 3) because they are not easily quantifiable. These would include local and regional priorities, district priorities, project interdependencies, and degree of project readiness. Constraints would include available funding and legal and legislative requirements. With the application of considerations, projects are selected for funding and a draft program is prepared.

To illustrate the use of this process by the Minnesota DOT, these steps are applied below to project selection for one classification of system improvement — the Regular Trunk Highway.

Step 1. Project identification — Based on planning and engineering studies, candidate projects for programming are identified by the districts with assistance from the central office.

Step 2. Project classification — The regular trunk highway program has only one classification of projects. All projects provide for the elimination of inconsistencies and the upgrading of highway segments to appropriate standards. Within this classification, there are the following types of projects;

- new highway construction
- projects which add one or more lanes to existing facilities
- projects which bring a substandard roadway cross section up to standards

Step 3. Project evaluation — The office of program development establishes criteria which evaluate the present roadway characteristics, cost-effectiveness, economic benefit, and functional classification of each candidate project. Annually, the district and regional offices of the department are requested to assign weights to the criteria. The weights multiplied by the measures for each criterion are used to rank candidate projects.

The following are examples of five criteria and the weights assigned to each. The points for all criteria are totaled to provide an overall ranking score for each candidate project.

Criterion 1: Give priority to projects on highway segments currently the most deficient based on safety, condition, and service.

Measure: The present sufficiency of the highway is measured according to a sufficiency rating system based upon an analysis of structure, load capacity, surface width, shoulder width, stopping sight distance, hazards, access, passing opportunity, ride quality, and traffic capacity.

The following points are allocated to the sufficiency rating:

| Sufficiency Rating | Points |
|---|---|
| 50 or less | 10 |
| 51-55 | 8 |
| 56-60 | 6 |
| 61-65 | 5 |
| 66-70 | 4 |
| 71-75 | 3 |
| 76-80 | 2 |
| over 80 | 1 |

The points listed in the right-hand column are multiplied by the weights determined by the district staff to obtain project ranking points for this criterion.

Criterion 2: Give priority to projects that are most cost-effective.

Measure: This criterion is measured by multiplying the forecasted (20-year) average daily traffic (ADT) by the expected increase in

sufficiency rating, and then dividing that by the estimated cost per mile for the project. The following points are allocated to the cost effectiveness.

| Cost Effectiveness | Points |
|---|---|
| 100 or over | 10 |
| 80-99 | 8 |
| 60-79 | 6 |
| 40-59 | 4 |
| 20-39 | 2 |
| Less than 20 | 1 |

The points listed in the right-hand column are multiplied by the weight determined by the district staff to obtain project ranking points for this criterion.

Criterion 3: Give priority to projects that provide needed economic benefits in terms of the movement of goods.

Measure: This criterion is measured by multiplying the increase in pavement strength that the candidate project provides by the projected heavy commercial ADT as follows:

| Increase in Pavement Strength X HCADT | Points |
|---|---|
| 800-or more | 10 |
| 600-799 | 8 |
| 400-599 | 6 |
| 200-399 | 4 |
| less than 200 | 2 |

The points listed in the right-hand column are multiplied by the weight assigned to this criterion by the district staff.

Criterion 4: Give priority to projects that provide needed economic benefits in terms of the movement of recreational traffic.

Measure: This is measured by the amount of seasonal traffic times the percent of total traffic which is seasonal.

| (Peak Month ADT - AADT) | (Peak Month ADT - AADT) / AADT | Points |
|---|---|---|
| 1000 or more | | 10 |
| 800-999 | | 8 |
| 600-799 | | 6 |
| 400-599 | | 4 |
| Less than 400 | | 2 |

Criterion 5: Give priority to projects on highways of a higher functional classification.

Measure: The functional classification involves the determination of which role each highway should serve.

| Functional Classification | Points |
|---|---|
| Principal Arterial or Intermediate Arterial | 10 |
| Minor Arterial | 7 |
| Collector | 4 |

The points listed in the right-hand column are multiplied by the weight assigned at the district level to obtain project ranking points.

Step 4. Program development — The office of program development, with assistance from the district offices, applies the following considerations which may modify the ranking of projects.

- District priorities
- Local and regional priorities
- Project interdependencies
- Degree of project readiness
- Distribution of funds
- Statewide priorities
- Coordination with other modes
- System continuity
- Special funding

The following constraints are used in program development.

- Financial resources — all programs are established through legislative action
- Legal and legislative requirements

## Arizona

The Arizona DOT highway rating system was developed in compliance with a statute passed by the state legislature in 1974.[6] This legislation mandated that certain factors be taken into consideration in a priority rating formula that would indicate the need for a proposed highway project. The rating methodology was designed to provide an objective basis for the selection of projects for inclusion in the state's five-year construction program.

The Arizona priority rating system is a simple methodology that combines sufficiency ratings with safety, economic, and environmental factors to obtain a single priority rating figure. The formula is comprised of a maximum of 200 points:

| | |
|---|---|
| 100 | Sufficiency rating |
| 65 | Economic rating |
| 25 | Traffic safety |
| 10 | Environmental factors |
| 200 | Maximum Total |

The safety condition is factored in twice, both in the sufficiency rating and in the separate traffic safety score. The greater the aggregate score for these four factors assigned to each candidate project, the greater the benefits which could be derived from the construction of it.

### Sufficiency Rating

The sufficiency rating reflects the ability of a road segment to satisfactorily and safely carry the traffic that uses it, both at the present and over its expected life. The 100 points of the sufficiency rating fall into three categories:

| Condition | | Safety | | Service | |
|---|---|---|---|---|---|
| Structural Adequacy | 15 | Traffic accident rate | 15 | Surface width | 10 |
| Ride | 25 | Skid resistance | 15 | Passing safety distance | 10 |
| Percent Cracking | 10 | | | | |
| | 50 | | 30 | | 20 |

Through the use of apparatus such as the dynaflect, MU Meter and Mays ride meter approximately 2/3 of the 100 points are objectively determined. Every segment of roadway on the state highway system is evaluated biannually. All segments with sufficiency ratings of 60 or less (or a deficiency rating of 40 or more) are eligible for inclusion in the five-year construction program and are then subjected to economic, traffic safety, and environmental ratings.

## Economic Rating

Of the 65 points allotted to economic factors, 40 are allocated to road user benefits and 25 to indirect economic effect. The road user benefit category is rated on a simplified benefit/cost ratio that considers such factors as condition of the existing roadway, vehicle operating and maintenance cost saved by the proposed facility, estimated facility cost, current and future average daily traffic, and current interest rate on capital. The 25 points assigned to indirect economic impact are broken down as follows:

| | |
|---|---|
| Population | 7.5 |
| Regional environmental impact | 15.0 |
| Facility | 2.5 |

The population segment is concerned with the number of people in the area and the density of the population in the vicinity of the facility. The regional impact statement considers the project's effect on the physical development of the area, including any changes in land use that might be induced by the proposed improvement. Also considered is the adequacy of the existing street, right-of-way costs, and the effect of the project on the local tax base, employment, and tourism. The type of facility effect addresses the impact of factors such as an overlay vis-a-vis a reconstruction and/or a widening project and the economic effect of interchanges.

## Traffic Safety Rating

The 25 points of the traffic safety segment are broken down into the following:

| | |
|---|---|
| Substandard items | 4 |
| Hazards | 6 |
| Operator inconvenience | 3 |
| Accidents/million vehicle miles | 12 |

Substandard items include inadequate lighting, dangerous slopes and shoulders, and the like. Hazards include such factors as unfenced ranges, curves and dips, and narrow bridges. Operator inconvenience analyzes items like left-turn lanes, climbing lanes, and operator distractions.

## Environmental Impact Rating

Ten points are allotted in this section on an all or nothing basis. If no difficulty is anticipated with the environmental impact statement for a project, the project is allotted 10 points. If difficulties will require delays or revisions in the project, zero points are given and the project is flagged until such time that the environmental problems have been reconciled. If the project will have only minor environmental impacts, these can be easily remedied and a rating of 10 assigned.

The total priority programming rating is the sum of the deficiency rating, environmental rating, economic rating, and traffic safety rating. This composite score is examined in conjunction with such factors as continuity of system needs, and the constraints imposed by the availability of funding, in the decision to include a project in the 5-year construction program.

## New Jersey

The New Jersey DOT has developed a methodology for arraying proposed projects into a priority order within funding categories. Their stated goal is to compare "apples with apples and oranges with oranges at the technical level."[7] In other words, projects in each category are evaluated by appropriate criteria for each project type, yet there is no desire to compare the relative priorities of projects between categories.

The basic project priority evaluation criteria are expressed in Table 2. The appropriate departmental units rate the candidate projects. For example, design engineers evaluate engineering need, while environmental specialists evaluate the environmental impact. After a project has been evaluated, it receives a rating under each criterion according to the following ratings:

A = critical
B = first priority
C = second priority
D = third priority

The overall evaluation is obtained by averaging all of the ratings for one project using the appropriate weight for each criterion. If a project receives a critical rating of A in either engineering need or urban impact, it will be given an overall critical rating, regardless of the other evaluation ratings. For each general category of improvement project, the general evaluation criteria are subdivided into 7 groups: engineering need, environment, energy, systems accessibility, air quality, urban impact, and community impact. These are commented upon below.

## Engineering Need

The design engineers evaluate each candidate project relative to the other projects of the same type and give it a rating based "on whatever information or knowledge the engineers have concerning these projects." These ratings are based solely on engineering judgement.

## Environmental Impacts

Since data vary from one project stage to another and between project types, it is necessary to evaluate projects by asking questions appropriate to all projects and for which answers are readily available. The points assigned to responses to environmental questions are negative, so that projects with greater adverse environmental impact will receive lower ratings. If a project has no significant impact it will be rated first priority. Second priority ratings are assigned to projects from -1 through -20, and -21 or more points will receive a third priority rating under environmental impact. The questions used in this rating scheme are given below.

Table 2

New Jersey Highway Project Priority Determination (Technical Evaluation)
(From reference 7.)

| PROJECT TYPE: | EVALUATION CRITERIA | | | | | | | OVERALL EVALUATION |
|---|---|---|---|---|---|---|---|---|
| | Engineering Need | Environment | Energy | Systems Accessibility | Air Quality | Urban Impact | Community Impact | |
| Freeway on New Alignment | 40% | 15% | 5% | 20% | 5% | 5% | 10% | 100% |
| Major Capacity Increase | 40% | 15% | 5% | 20% | 5% | 5% | 10% | 100% |
| Reconstruction/Rehabilitation of Roadway | 60% | 10% | 5% | 5% | 5% | 5% | 10% | 100% |
| Reconstruction/Rehabilitation of Bridges | 70% | 20% | --- | --- | --- | --- | 10% | 100% |
| Safety Improvements | 50% | 10% | 10% | 5% | 10% | 5% | 10% | 100% |
| High Occupancy Vehicles | 30% | 15% | 15% | 5% | 15% | 5% | 15% | 100% |
| Park and Ride | 30% | 15% | 15% | 5% | 15% | 5% | 15% | 100% |
| Transportation Systems Management Projects | 50% | 10% | 10% | 5% | 10% | 5% | 10% | 100% |
| Drainage Improvements | 80% | 20% | --- | --- | --- | --- | --- | 100% |
| Landscape | 75% | 25% | --- | --- | --- | --- | --- | 100% |
| Signing | 100% | --- | --- | --- | --- | --- | --- | 100% |
| Miscellaneous | Variable | Variable | Variable | Variable | Variable | Variable | Variable | 100% |

1. Will there be an impact on either of the following?

   -5 Known historic sites
   -5 Known archaeological sites

2. Will there be an acquisition of land from any of the following?

   -5 Wildlife refuge
   -5 Park
   -5 Designated open space

3. Will the project affect any of the following protected ecological features?

   -4 Wetlands
   -3 Floodplains
   -2 Agricultural Land

4. Is additional right-of-way acquisition necessary?

   0 No
     Yes, how much
   -2 A large amount
   -1 A small amount

5. Will significant relocations of business or people be required?

   -2 Yes
    0 No

Energy

A primary concern of the New Jersey Department is to provide the most energy-efficient system possible. The following questions are designed to give a quick reading for each project as it relates to public transportation and ride sharing. Four points or more receive a first priority rating, one point receives a second priority rating, and zero points receives a third priority rating under energy evaluation.

1. Will this project provide new or improved direct feeder service access to transit stations?

   3 YES
   0 NO

2. Will this project result in a significant improvement in the level of service of the facility (transit and auto flow)?

   1 YES
   0 NO

3. Will this project tend to increase vehicle occupancy (high-occupancy vehicle lanes, car pool, park-n-ride, etc.)?

5 YES
0 NO

Systems Accessibility

Much of the value of a highway improvement project is that it may add a critical link to an existing system or it may significantly improve the functional aspects of other elements within the system. The following questions address these issues. If a project receives 10 or more points, it will receive a critical rating (A) under systems accessibility; if it receives 3 points, it will receive a first priority rating (B); if it receives 2 points, it will receive a second priority rating (C); if it receives 1 or zero points, it will receive a third priority rating (D).

1. Is this one of the critical missing links?

10 YES
0 NO

2. What is the functional classification for this road?

3 Principal arterial
2 Minor arterial
1 Collector
0 Local

Community Support

Because transportation agencies are required by federal regulations to consider community input at various levels of the project development process, the following five questions are asked of the district planners. A response of one indicates a critical rating, a number two indicates a first priority, and three or five indicates a second priority. If four is the appropriate response, the project will be given a third priority rating.

Which of the following statements is appropriate for this project?

1. The community considers this project to be urgently needed. (A)

2. There is moderate community support for this project. (B)

3. The community does not feel strongly one way or the other about this project (neutral). (C)

4. There is community opposition to this project. (D)

5. No evaluation in terms of community support can be made (due to insufficient information or knowledge). (C)

After each project is evaluated under each separate criterion, an overall evaluation is determined by averaging all the ratings for each project. A priority array is then developed using the resulting scores.

## Wisconsin

As an integral component of their statewide planning effort, the Wisconsin DOT has developed a long-range programming process as well as an initial 6-year short-range program derived from that process.[8] The 6-year highway improvement program was formulated through a programming methodology which analyzed the existing conditions and deficiencies of the state trunk highway system, developed and evaluated alternative projects, and selected a recommended program within the 2-year budgetary process.

The objectives of the programming process are to:

- Provide policy choices and the impacts of those choices by considering
  1. alternative types of improvements for each roadway segment,
  2. alternative total program levels,
  3. differing dollar emphasis among program areas.
- Maximize system-wide benefits over individual project benefits.
- Utilize consistent criteria and systematic procedures to define deficiencies, develop solutions and select projects.

The 6-year program is divided into 4 program areas: resurfacing, reconditioning, and reconstruction (RRR) work; major

projects; bridges; and interstate. The Department devises alternative programs within each category to provide management with options at low, medium, and high funding levels, as well as information pertaining to the effects of each funding level on the system. The Department then selects from this range of alternatives a recommended program and, therefore, a recommended funding level in each program category. However, every 2 years the governor must recommend, and the legislature must approve, a transportation budget. If the approved budget is different than all alternatives considered by the Department, then the legislature is in effect requesting an additional program option.

In developing their programming methodology, the Wisconsin DOT wanted to move away from the judgemental system they had used and which they felt was too subjective, yet avoid using a purely formula approach. The methodology they developed was "a combination of both technical and quantitative information and subjective and qualitative judgements" to be used to compare the merits of projects and achieve statewide consistency in meeting objectives. Each step of their programming process is illustrated in Figure 1 and outlined below.

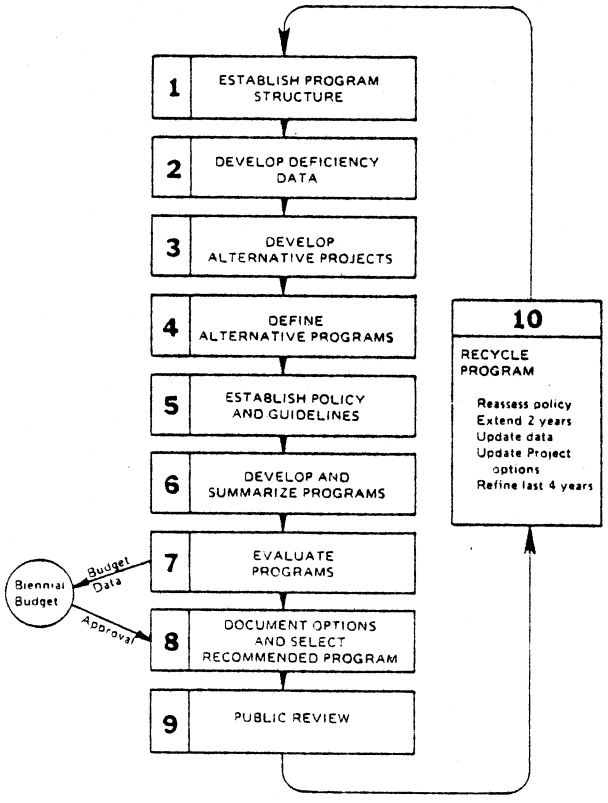


Figure 1. Major steps in Wisconsin DOT programming process. (From reference 8.)

1. Establish program structure — This consists of 4 program areas

   - RRR work
   - Major projects
   - Bridge replacement
   - Interstate projects.

2. Develop deficiency data — These provide a consistent data base using the pavement serviceability index.

3. Develop alternative projects — The improvement options are patching and maintenance resurfacing (no-build option), improvement resurfacing, recondition, reconstruction, and major construction. Districts develop information on alternative construction concepts, SEE impacts, right-of-way and construction costs, and possible scheduling and funding for each candidate project.

4. Define alternative program concepts — Based on the analysis of highway deficiencies, general policy, and a likely range of available revenues, a set of alternative program concepts in each program area can be defined.*

5. Establish policy and guidelines for program development — Alternatives are analyzed against Departmental objectives and legislative requirements.

6. Develop and summarize programs — Districts and units throughout the Department revise and develop new program alternatives.

7. Evaluate programs — Evaluated are program consistency; impacts on transportation performance; social, economic, and environmental impacts; emergency and coordination problems; and, finally, key trade-offs.

8. Document options and select recommended program — When program evaluation is completed, the array of program choices and their costs and benefits are fully documented and reviewed by the secretary and other key decision makers in the Department. The secretary then selects a recommended 6-year program in each area.

---

*See Appendix A for examples of high, medium, and low funding projections and program alternatives.

9. Public review —Hearings are held after the release of the 6-year program to allow citizen comments into the planning process.

10. Recycle the program —Because program development is a continuous process, when each of the steps discussed above has been completed, the entire process is repeated. This involves extending the program for two years, making refinements to improve consistency, reassessing policies, and maintaining and updating data and project alternatives.

## California

The programming methodology used by Caltrans applies to all rehabilitation, reconstruction, and new construction but does not include maintenance.(9) The priority phase of the state transportation improvement program (STIP) consists of a system for rating and ranking highway improvement projects with 15 highway capital outlay program components. For example, three component classifications are resurfacing and roadway reconstruction and restoration, bridge, and new highway. The methods and criteria for rating projects vary by program components. In general, rating figures are obtained by multiplying intensity-of-impact variables (such as highway user time savings per vehicle, or dBA of noise reduction)— each derived from project objectives — times breadth-of-impact variables (such as vehicle miles traveled or affected housing units) for the numerator of a ratio. Impacts may be weighted before they are added together, if they are not measurable in dollar amounts. The sum of project impacts, or the numerator, is then divided by project costs to obtain either a benefit/cost ratio (for impacts measurable in dollars) or a cost-effectiveness index. This ratio or index is the criterion by which projects are ranked with a component class to determine their formula priority. The formula priorities are advisory tools to be considered in the formation of the annual STIP. These priorities are evaluated along with such considerations as legislatively mandated projects or outside technical and cost considerations not included in the priority rating formula.

The priority-setting phase of the annual STIP begins at the district level, where candidate projects are listed. It is also the responsibility of district directors to provide ratings of candidate projects according to uniform, prescribed rating criteria. These data are then analyzed at the Departmental level to obtain statewide project priority lists for each component classification.

To clarify the methodology used in obtaining the project index, an example of rating criteria used in prioritizing projects within the new highway classification is given below.

HE-1 New Highway

The project index no. for each project is calculated as

$$PI = EI + SDI + 50,$$

where

PI = Project index for assigning priority numbers:

EI = Environmental index = Σ of public acceptance, social & economic, and environmental factors shown on HE-1 rating sheet;

SDI = Safety/delay index = 2/3 X SI + 1/3 X DI = 150 maximum; and

50 = Additional points if project is in previous or current STIP.

The statewide HE-1 priority listing is calculated from information furnished by the districts on individual rating sheets (see Appendix B). After a project index number has been calculated for each project to appear on the statewide priority listing, a comparison is made to all priority index numbers. The priority number for a project is then the relative position that the project occupies on the listing based on its project index number.

The following is a listing of the criteria used in the HE-1 new highway priority listing process.

Rating Criteria

I. Public Acceptance

Public acceptance includes the following items.

A. Consistency with local plans.
B. Consistency with regional plans.
C. Consistency with state urban strategy.
D. Previous commitments.

A and B — The first two items are a measure of project acceptance by local and regional planning bodies. Consistency with the transportation element of local or

regional comprehensive plans indicates whether or not the project furthers the goals of the community or region as expressed by the planning body. Inclusion in county and regional transportation improvement plans (TIP's) likewise indicates the priority and importance of the project to the concerned planning bodies. Consistency with local or regional plans is based on rating a project on a scale from -10 to +10, with points assigned for the degree of project compliance with the following statements.

1. Included as an important element in local and regional comprehensive plans, +8 to +10 points.

2. Included as a minor element in comprehensive plans, +5 to +7 points.

3. Compatible with plans though not specifically identified, +2 to +4 points.

4. Mixed positive and negative compliance with features of plans but no major conflicts, 0 to +1.

5. Negative minor features outweigh positive ones with some major conflicts, -1 to -5 points.

6. Major conflicts exist with plans and there is open and formal opposition by government planning bodies, -6 to -10 points. Explain why project should not be dropped from further consideration in the remarks section.

C — Consistency with state urban strategy is required by Governor's Executive Order B-41-78. The following guidelines are used in rating compliance with urban strategy goals and objectives.

1. If the project clearly meets the goals and objectives of state urban strategy, score +10 points.

2. If project meets most of the goals and objectives, or if it is rural, or state urban strategy does not apply, enter +5 points.

3. If project is not inconsistent but does not meet the goals and objectives, score zero.

4. If project is clearly in opposition to the goal and objectives of urban strategy, score from -1 to -10 points depending on severity of conflicts. Explain why project should not be dropped from further consideration in the remarks section.

D — Previous commitments is a measure of state and local commitments to do the project. Prospective community investment is a good measure of public acceptance as is a previous promise by Caltrans to complete the proposed project. The rating of this category is based on the following:

1. If (a) there is an executed freeway agreement covering the project, or if a freeway agreement is not required, and (b) if the project has been included in previous planning programs or STIPs in a specific year (not "after"), and (c) if there has been an extensive community investment commitment in the project (e.g., local plans and/or business investment, or financial contributions), score +10 points.

2. If two of the three factors listed in 1 above pertain, enter +7 points.

3. If one of the three pertain, enter +5 points.

4. If none of the factors pertain, enter zero.

5. If a freeway agreement is required but it has not been executed, enter -5 points.

6. If locals refuse to execute a required freeway agreement, enter -10 points. Explain why project should not be dropped from further consideration.

II. Social and Economic Impacts

Social and economic impacts of the following types are included here under a common heading because of their interrelationships. The categories are:

A. Displacements of people and improvements
B. Employment

C. Cultural resources
D. Development or redevelopment
E. Tax base
F. Other community effects

Generally, the scores for each of the categories are determined based on the effects remaining after any mitigation.

A — The first item dealing with displacements is intended to cover the impact on relocations of residents and businesses from the rights-of-way acquired for highways. The following rating system is to be used in scoring the impact.

1. If (a) upgraded housing is provided and (b) the number of affordable housing units remains the same, enter a score of +1 to +10 depending on percentage of displacees provided with upgraded housing. If 10% are provided with upgraded housing, enter +1, if 50% are provided with upgraded housing enter +5, etc.

2. If upgraded housing is provided but the number of affordable housing units is reduced, score from +1 to +5 by allowing 1/2 point for each 10% provided with upgraded housing.

3. If there is virtually no displacement of people and/or improvements, enter a score of zero.

4. If the total number of affordable housing units is decreased and the project causes the displacement of people and/or improvements without providing upgraded housing, score from -1 to -10, depending on the percentage displaced.

B — This item covers the long-term effect on employment only. Employment effects of a new facility are included solely for those situations where desirable developments involving creation of needed jobs in an area of underemployment hinge on provision of a highway facility. An example would be where a project serves an urban redevelopment area of considerable magnitude that will provide needed jobs in a depressed portion of a city with high unemployment rates. Ordinary employment effects are usually short-lived and too difficult to identify. In addition, they may be only a transfer of benefits to another area within the region or state rather than a true net benefit.

Use the following criteria to score Item B.

1. If the project is associated with extensive development or redevelopment resulting in creation of a substantial number of new jobs, enter +10 points.

2. If there are some long-term jobs created, enter +5 points.

3. If there is no significant effect on employment, score zero.

4. If the project has some detrimental effect on long-term employment, enter -5 points.

5. If there is a substantial impact on employment caused by the project, enter -10 points.

C — Item C covers the effect the project has on cultural resources. Cultural resources are defined as archaeological or historical resources, or current-day resources such as parks, libraries, museums, etc. Use the following system to rate the impact on cultural resources.

1. If the project provides enhancement (e.g., better access, better views, etc.) to cultural resources, score from +1 to +10 depending on features provided.

2. If there is no impact on cultural resources, enter a zero.

3. If there are any unmitigated impacts remaining as a result of the project, enter a score from -1 to -10, depending on the severity.

D — Planned development or redevelopment covered by this category deals with only development of major significance which hinges directly on the project. The development should be in accordance with local, regional, and state goals and policies. Ratings for this category should be scored based on the following.

1. If major development or redevelopment hinges on the project, enter +10 points.

2. If important development consistent with goals and policies would be facilitated, score +5 points.

3. If there is little or no effect, enter zero.

4. If the project has a detrimental effect on development, score from -1 to -10, depending on severity.

E — The impact on the local tax base is covered by Item E. Scoring on this item depends on the net effect on the tax base, considering land and improvements removed from the tax rolls, local services no longer needed (police, fire protection, etc.), and any estimated land values. Use the following as a guide.

1. If the net effect on the tax base is a substantial increase after considering land and improvements removed, any new development or redevelopment, and changes in local services, score +10 points.

2. If there is some net increase in the tax base, enter +5 points.

3. If there is no significant change, enter a zero.

4. If there is some net loss in the tax base, enter -5 points.

5. If there is a substantial net loss in the tax base, score -10 points.

F — This item is intended to reflect any other impacts on the community not covered in the other factors. Examples are: change in traffic on local streets (including conventional state highway); change in mobility for local residents; change in access to business districts, recreation; change in access for emergency personnel and equipment; change in school travel patterns; etc. Use the following as a guide to score this item.

1. If the effects on the community are on the positive side, score from +1 to +10 points, depending on the impact.

2. If there is no impact, enter a zero.

3. If the effects are on the negative side, score from -1 to -10, depending on severity.

III. Environmental Impacts

The following environmental impacts are considered.

A. Air quality
B. Noise levels
C. Appearance
D. Water quality
E. Biological resources

Scoring of items in this category is to be done depending on the net effects of the project remaining after mitigation.

A — Air quality impacts are included, even though highway projects will generally have been included in a regional air quality management plan. A highway project that reduces or increases pollutants should be given credit or demerits for that fact, since it either reduces or increases the future costs of complying with state or federal air quality standards. Most HE-1 projects have little net impact on vehicle emissions; therefore, the effect of this rating procedure should usually be minor. Use the following guidelines to enter a score for the category.

1. If the proposed project reduces the air pollutants in the area, enter a score of +1 to +10 points, depending on the estimated degree of reduction.

2. If there is no effect, score zero.

3. If there is an estimated increase in pollutants, enter a score of -1 to -10, depending on severity of impact.

B — Mitigation of noise impacts should be proposed on all projects when the predicted design-year traffic noise level will exceed 70 dBA or when the level is estimated to increase by 10 dBA over ambient level and is expected to equal or exceed a level of 65 dBA. In rating this item, the score should also reflect a change in noise level on the old highway facility if a new facility is being constructed. Use the same approach to scoring this category as was used to rate the air quality factor, Item A above.

C — Highway appearance is rated by comparing the proposed project with a simple set of statements that express visual or aesthetic judgments about the different aspects of the highway and its structures. The rating is to be done from two viewpoints — that of a highway user and a nonuser — and the scores combined for a single entry on the rating sheet.

## Highway Users

1. If (a) the project produces a pleasant line-of-sight view for motorist, and (b) ugly or blighted areas visible to motorists will be shielded by highway design or landscaping, score +5 points.

2. If one of items above pertains, score +3 points.

3. If there is no change in current appearance or the above items do not apply, enter zero.

4. If the project results in unattractive views which are not shielded or avoided, enter -3 points.

5. If, in addition to 4 above, the project will require removal of roadside vegetation without replacement, enter -5 points.

## Highway Nonusers

1. If (a) facility presents an attractive view blending well with the terrain and development and (b) project applies high aesthetic standards to structures and roadway profiles, enter score of +5 points.

2. If one of criteria above is met, enter +3 points.

3. If there is little or no change to current facility and/or criteria above do not apply, enter zero.

4. If project does not utilize high aesthetic standards in the treatment of structures and roadway items, enter -3 points.

5. If, in addition to 4 above, project does not fit the terrain or development in the area, score -5 points.

D — Water quality as covered by this item is intended to measure the impact of surface runoff as well as the interference with or enhancement of existing surface flows. Use the following as a rating guide.

1. If project does not adversely impact the quality of surface runoff and there is an improvement in existing surface flow characteristics, enter a score of +1 to +10 points, depending on the magnitude of the improvements.

2. If there is no change in either surface runoff or existing surface flow, enter zero.

3. If surface runoff is adversely affected and/or there are changes to existing surface flow conditions which may result in significant interference with surface water flow, score from -1 to -10 points, depending on severity of changes.

E — Biological resource impacts involve highway effects on the physical environment for plant and animal species, either directly by removing ground cover and by creating barriers and impervious surfaces or indirectly through changes in water purity or flows. In rating this category the following are to be considered.

1. Does project make or induce changes which may encourage increased development of existing animal and plant species or will project provide a new environment which will stimulate growth or new and additional plant and animal species. If so, score from +1 to + 10, depending on magnitude of desirable changes.

2. If there does not appear to be a significant change resulting from this project, enter zero.

3. If this project effects or induces changes which are detrimental to existing plant and

animal species or will result in encouraging the invasion of undesirable new plant or animal species, score from -1 to -10, depending on severity of expected results.

IV. Environmental Index

The environmental index is the sum of the points recorded for public acceptance, social and economic impacts, and environmental impacts.

V. Safety Index

The score for this category should be reported as a whole number; i.e., a SI of 10% as a score of 10.

VI. Delay Index

Record the score for this item in the same manner as for the safety index.

VII. STIP Status

Projects which have been included in a previous STIP will receive additional points. Complete this item as appropriate entering the STIP year, and headquarters will then determine the additional points.

VIII. Remarks

This section is to be used to explain any negative scores which have been entered on any of the items listed.

## FINDINGS AND CONCLUSIONS

1. Priority programming was originally intended to provide a way to prescribe technical criteria in order to remove subjective judgement from the decision-making process. While many states developed highly computerized programming methodologies as a means of centralizing the process, this left little room for input from the district level. In recent years, however, most states have developed programming methodologies which combine departmental goals and the prescribed criteria to measure their attainment with adequate feedback from the district staff.

2. Priority programming is used by well over half the states in the country, and because of its versatility it is widely applicable to any state.

3. Prioritizing, from simple priority ratings to the more complex priority arrays, is responsive to the unique characteristics of each state including system needs, fiscal constraints, environmental concerns, and statewide transportation goals and objectives. It is also a dynamic process that is adaptive to changing situations, funding levels, and statewide goals.

4. Priority programming should be goal oriented and readjusted as goals change. As long as it is tied to the long-range planning process and realistic funding projections, it will provide the guidance the central office needs in choosing the most effective highway program.

5. Priority programming is neither a centralized nor a decentralized decision-making process. It combines input from the district level, along with citizen concerns, with criteria established on the departmental level.

6. Prioritizing candidate projects allows management to make the most cost-effective decisions in project selection, while emphasizing system-wide benefit over a project-by-project selection process.

## REFERENCES CITED


1. Transportation Research Board, Priority Programming and Project Selection, National Cooperative Highway Research Program, Synthesis of Highway Practice 48, Washington, D. C.: Transportation Research Board, 1978.

2. Transportation Research Board, Bibliography on Project Evaluation and Priority Programming Criteria, Transportation Research Circular 213, Washington, D. C.: 1980.

3. Anderson, Robert B., et al., "Highway Programming Using Cost Effectiveness Techniques", prepared for Transportation Engineering Journal of ASCE, 1974.

4. G. W. Anderson, Iowa Department of Transportation, letter dated Oct. 27, 1980.

5. Minnesota Department of Transportation, A Process for Transportation Programming: Final Report, St. Paul: 1979.

6. Robert J. Murphy, Arizona Department of Transportation, letter dated Oct. 27, 1981.

7. New Jersey Department of Transportation, Highway Project Priority Analysis, 1980.

8. Wisconsin Department of Transportation, Six-Year Highway Improvement Program: 1980-1985, Madison: 1979.

9. California Department of Transportation, Capital Projects Priority Process Manual, Sacramento: 1980.

SELECTED TRANSPORTATION RESEARCH BOARD PUBLICATIONS

Evaluating Options in Statewide Transportation Planning/Programming: Issues, Techniques, and Their Relationships, National Cooperative Highway Research Program, Report 179, Washington, D. C.: 1977.

Priority Programming, Finance, and Highway Investment Analysis, Transportation Research Record 698, Washington, D. C.: 1979.

Program Planning, Finance, and Preconstruction Management, Transportation Research Record 742, Washington, D. C.: 1980.

Statewide Transportation Planning: Needs and Requirements, National Cooperative Highway Program, Synthesis of Highway Practice 15, Washington, D. C.: 1972.

Transportation Needs Studies and Financial Constraints, National Cooperative Highway Program, Synthesis of Highway Practice 72, Washington, D. C.: 1980.

Transportation Program Process; Proceedings of a Conference Held March 23-26, 1975, Orlando, Florida, Special Report 157, Washington, D. C.: 1975.

# APPENDIX A

# WISCONSIN DOT

TABLE S.2

SUMMARY
RRR PROGRAM OPTIONS
LOW AND RECOMMENDED

| | Low | Recommended |
|---|---|---|
| Program Description (1980-85) | | |
| Total Cost (millions) | $ 210 | $ 370 |
| Total Miles | 1,550 | 2,153 |
| Cost per Mile (thousands) | $ 135.0 | $ 153.0 |
| Miles of Work by TYPE | | |
| Resurfacing and Minor Reconditioning | 1,095 | 1,345 |
| Major Reconditioning | 318 | 524 |
| Reconstruction | 137 | 284 |
| Total Number of Projects | 544 | 696 |
| Average Deficiencies Addressed | | |
| Accident Rate | 312 | 322 |
| Accident Occurrences | 446 | 440 |
| Capacity (V/C) | 0.55 | 0.52 |
| Geometrics (% no passing zone) | 38 | 39 |
| Average Daily Traffic | 4,308 | 4,212 |
| Impacts on Transportation Performance (1980-85) | | |
| Total Accidents Reduced per Year | 479 | 811 |
| Miles of Congestion Addressed | 77.5 | 131.0 |
| Social, Economic, and Environmental Impacts (Reconstruction & Major Reconditioning)[1] | | |
| Number of Construction Jobs Generated (person years of work, all projects) | 5,550-5,960 | 8,850-9,480 |
| Income Generated Statewide ($ million, all projects) | $ 149.9 | $ 226.1 |
| Number of Businesses Displaced | 26 | 44 |
| Improvement in Peak Period Accessibility[2] | 466 | 630 |
| Households Displaced | 74 | 100 |
| Neighborhoods Severed | 0 | 0 |
| Farm Land Required (acres) | 1,510 | 1,946 |
| Farms Severed | 38 | 48 |
| Wetland Encroachment (acres) | 146 | 186 |
| Habitat Required (acres) | 570 | 1,150 |
| Infringements on Endangered Species | 0 | 0 |
| Infringements on Unique Areas (total) | 20 | 22 |
| Historic/Archeologic Sites | 4 | 6 |
| Other (Parks, Wildlife Refuges, etc.) | 16 | 16 |
| Air Quality (Number of Projects) | | |
| No Change in Carbon Monoxide Concentrations | 108 | 178 |
| Increased Carbon Monoxide Concentrations | 4 | 6 |
| Decreased Carbon Monoxide Concentrations | 32 | 42 |
| Noise (Number of Projects) | | |
| Total Number of Projects | 152 | 226 |
| To Exceed Existing Noise Levels (No. of Projects) | 12 | 12 |
| To Exceed Federal Design Noise Criteria(No. of Projects) | 66 | 90 |
| Energy Consumption (BTU X $10^{12}$, all projects | | |
| Materials and Construction Fuel | 2.3-4.9 | 3.4-8.5 |
| Vehicle Consumption | n.a. | n.a. |
| Public Acceptability of Improvements (No. of Projects) | | |
| No Controversy | 84 | 120 |
| Low Controversy | 54 | 88 |
| High Controversy | 14 | 18 |
| Number of Projects by WEPA Class[3] (All projects) | | |
| Type I | 8 | 20 |
| Type II | 76 | 157 |
| Type III | 422 | 502 |
| Unclassified | 38 | 17 |

Table S.2 (continued)

---

1 Impacts are estimated for only reconstruction and major reconditioning projects unless noted by statement "All projects", in which case resurfacing and minor reconditioning is included in the estimates. Environmental impacts of resurfacing and minor reconditioning are mainly construction impacts and do not produce most of the effects listed here.

2 In units of thousands of peak period vehicle hours reduced per year.

3 Under the Wisconsin Environmental Policy Act (WEPA):
Type I projects are <u>likely</u> to have a significant impact on human environment.
Type II projects <u>may</u> have a significant impact on human environment.
Type III projects <u>do not</u> have a significant impact on human environment.

n.a. Not Available. Changes in vehicle fuel consumption must be estimated on a project by project basis. The Department is developing a procedure to evaluate how specific projects affect vehicle fuel consumption.

Table S.3

SUMMARY OF MAJOR PROJECT PROGRAM OPTIONS
1980-1985

| | LOW Program | APPROVED Program[2] | RECOMMENDED Program | HIGH Program |
|---|---|---|---|---|
| | (Number of Projects Evaluated in Parentheses)[1] | | | |
| Total Cost ($Millions) | 160(8) | 270(12) | 370(15-23) | 410(17-28) |
| Bridges | 50(2) | 50(2) | DISTRIBUTION OF COSTS IS UNCERTAIN | |
| Interstate | 54(1) | 54(1) | | |
| Other | 56(5) | 166(9) | | |
| Total Miles (excluding bridges) | 110(8) | 152(10) | 225-245(15-23) | 254-277(17-28) |
| Cost Per Mile (excluding bridges) ($Millions) | 1.45(8) | 1.50(10) | 1.47-1.60(15-23) | 1.48-1.61(17-28) |
| Total Number of Projects | 8 | 12 | 15-23 | 17-28 |
| No. of Major Bridges | 2 | 2 | | |
| No. of Major Interstate Projects | 1 | 1 | | |
| No. of STH Projects | 5 | 9 | MIX OF PROJECTS UNCERTAIN | |
| Urban Projects | 1 | 2 | | |
| Rural Projects | 4 | 7 | | |
| Bypasses | 0 | 0 | | |
| Added Centerline Miles (Total) | 112(8) | 154(12) | 227-247(15-23) | 256-279(17-28) |
| Added Lane Miles (Total) | 387(8) | 471(12) | 536-632(15-23) | 588-686(17-28) |
| Added Lane Miles on Existing Alignment | 30 | 52 | 117-126 | 117-151 |
| Added Lane Miles on New Corridor, State Owned R/W | 357 | 357 | 357-383 | 383 |
| Added Lane Miles on New Corridor, New R/W | 0 | 62 | 62-123 | 88-152 |
| Average Deficiencies Addressed | | | | |
| Safety | | | | |
| Accident Rate (per 100 million VMT) | 191(6) | 279(10) | 236-253(12-20) | 242-258(14-25) |
| Accident Occurences(per 100 miles) | 583(6) | 1,046(10) | 779-919(12-20) | 829-960(14-25) |
| Capacity (v/c ratio) | 1.10(6) | 1.10(10) | 1.04-1.06(12-20) | 1.05-1.07(14-25) |
| Average Daily Traffic | 7,316(6) | 11,809(10) | 8,689-10,583(12-20) | 9,365-11,152(14-25) |
| Geometric (% no passing zone) | 63(6) | 30(10) | 38-39(13-21) | 38-39(15-26) |
| Pavement Width | 24.0(6) | 26.0(10) | 23.2-23.6(14-23) | 23.1-23.5(15-26) |
| Impacts on Performance (based on benefit/cost analysis) | | | | |
| Average Benefit/Cost Ratio | 3.5(2) | 5.4(3) | 5.3-6.2(7-15) | 5.7-6.4(9-20) |
| Total Accidents Reduced (one year) | 12(2) | 163(3) | 251-718(7-15) | 368-1,010(9-20) |
| Total Travel Time Saving (thousands of vehicle hours-one year) | 289(2) | 1,137(3) | 2,209-5,953(7-15) | 2,895-6,668(9-20) |
| Savings in Motor Vehicle Operating Costs (from 1980 to 1999)[3] | -13,661(2) | +57,700(3) | +48,643 to +189,989 (7-15) | +82,197 to +279,415 (9-20) |

1 The Department is in the process of developing consistent data on each major project. At this point in time, data on many indicators in the table is not available for all approved and candidate projects. The number of projects evaluated to obtain a value for an indicator is presented in parentheses. The ranges indicated in the "Recommended" and "High" columns are derived from examining, on the one hand, few higher cost projects and, on the other hand, more lower cost projects.

2 Consists of the major projects approved in 1979-81 biennial budget plus one candidate project (See Tables 5.1 and 5.3).

3 The negative sign for auto operating cost savings means that auto operating cost would increase for two projects evaluated in the Low program. According to the benefit-cost model, autos currently using the current two facilities evaluated are moving at the speed with lowest operating costs which is also the speed consuming the least energy. Improvements would raise speed and operating costs for these two projects.

Table S.4

SUMMARY OF SOCIAL, ECONOMIC AND ENVIRONMENTAL IMPACTS
OF MAJOR PROJECT PROGRAM OPTIONS[1]
(1980-85)

| Social, Economic and Environmental Impacts | LOW PROGRAM ($160M) | APPROVED PROGRAM ($270M) | RECOMMENDED[4] PROGRAM ($370M) | HIGH[5] PROGRAM ($410M) |
|---|---|---|---|---|
| No. of Construction Jobs Generated (person-yrs.) | 4,500-4,800 | 7,600-8,100 | 10,100-10,800 | 11,500-12,300 |
| Income Generated Statewide (Millions) | $109.6 | $178.1 | $246.6 | $280.85 |
| Number of Businesses Displaced | 8 | 23 | 25-65 | 35-89 |
| Improvement in Peak Period Accessability[2] | 101 | 432 | 473-752 | 543-926 |
| Households Displaced | 45 | 98 | 104-217 | 133-288 |
| Neighborhoods Severed | 0 | 0 | 1-2 | 1-3 |
| Farm Land Required (Acres) | 1,468 | 1,510 | 2,033-3,433 | 2,383-4,308 |
| Farms Severed | 53 | 54 | 68-109 | 78-134 |
| Wetland Filled (Acres) | 10 | 70 | 76-235 | 116-334 |
| Habitat Required (Acres) | 363 | 743 | 861-1,495 | 1,019-1,891 |
| Added Tons of Salt Per Year | 3,168 | 4,768 | 5,144-5,520 | 5,552-5,952 |
| Infringement on Endangered Species | 0 | 0 | 0 | 0 |
| Infringements on Unique Areas (Total) | 1 | 2 | 3-9 | 5-13 |
| Historical/Archeologic Sites | 0 | 1 | 1-3 | 1-4 |
| Other (Parks,Wildlife Areas, etc.) | 1 | 1 | 2-6 | 4-9 |
| Air Quality | | | | |
| No. of New Pollution Sources (Projects on New Location) | 4 | 6 | 5-9 | 6-12 |
| Projects on Existing Location | | | | |
| Increase CO Concentration | 1 | 2 | 2-2 | 2-2 |
| Decrease CO Concentration | 1 | 1 | 2-4 | 2-5 |
| No Change CO Concentration | 1 | 3 | 5-6 | 5-7 |
| Noise Levels | | | | |
| No. of New Pollution Sources (Projects on New Location) | 4 | 6 | 5-9 | 6-12 |
| Projects on Existing Location | | | | |
| Exceed Present Levels by 10dBA+ | 2 | 5 | 7-8 | 7-9 |
| Exceed Federal Design Year Noise Criteria | 1 | 1 | 2-3 | 2-4 |
| Energy Consumption[6] (BTU X $10^{12}$) | | | | |
| Materials & Construction | 3.4-5.1 | 4.7-7.0 | 7.3-10.8 | 8.2-12.2 |
| Vehicle Consumption | n.a. | n.a. | n.a. | n.a. |
| Public Acceptability of Improvements | | | | |
| No Controversy | 1 | 2 | 2-4 | 3-5 |
| Low Controversy | 4 | 6 | 9-13 | 10-15 |
| High Controversy | 3 | 4 | 4-7 | 5-8 |
| Number of Projects by WEPA Class[3] | | | | |
| Type I | 6 | 11 | 13-21 | 15-25 |
| Type II | 1 | 1 | 2-2 | 2-3 |
| Type III | 1 | 0 | 0 | 0 |

1 Impacts other than construction jobs, income generated energy consumption, public acceptability and projects by WEPA class do not include I-43 and I-94, Georke's Corners to USH 16.

2 In units of thousands of peak period vehicle hours reduced per year.

3 Under the Wisconsin Environmental Policy Act (WEPA):
Type I projects are likely to have a significant impact on human environment.
Type II projects may have a significant impact on human environment.
Type III projects do not have a significant impact on human environment.

4 Impacts on the recommended program equal those of the approved plus $100 million worth of candidates, which may range from 3 to 11 projects depending on their cost.

5 Impacts of the high program equal those of the approved plus $150 million worth of candidates which may range from 5 to 16 projects depending on their cost.

6 Does not include the two major bridges, Dubuque and Arrowhead.

n.a. - not available. Changes in vehicle fuel consumption must be estimated on a project by project basis. The Department is developing a procedure to evaluate how specific projects affect vehicle fuel consumption.

Table S.6

DESCRIPTION OF INTERSTATE (NON-MAJOR) PROGRAM OPTIONS

| Program Level | Key Program Elements | Impacts |
|---|---|---|
| LOW & RECOMMENDED ($145 million) | --High priority safety projects including median barriers (I-94). | --Reduces accidents; energy consumed in materials and construction. |
| | --104 bridge deck overlays to preserve existing system. | --Bridge surface renewal preserves structures; negligible if any disturbance to water quality. |
| | --Freeway surveillance and ramp metering system in Milwaukee. | --Adds highway capacity without extra lanes; avoids taking more land, homes, etc. Reduces fuel consumption and pollution due to freer flowing traffic though reductions may be partly offset by induced travel. |
| | --Interstate rehabilitation paving. | --Renews pavement condition. Prevents further physical deterioration of Interstate short term air and noise pollution during construction. |
| | --Selected park-ride lots. | --Reduces congestion, pollution and energy consumption in corridor provided significant diversion to transit occurs. Increases localized pollution at park-ride lots. |
| | --Removal of roadside obstacles. | --Improves safety. |
| | --Selected interchange improvements I-94, I-794. | --Improves local access to interstate; adverse environmental effects mainly occur during construction. |
| | --Truck weigh station.* | --Improves compliance with truck weight limits and, therefore, reduces pavement deterioration; localizes air pollution and noise at weigh stations. |
| MID ($195 million) | --All elements of Low Program. | |
| | --Additional removal of obstacles, park-ride lots. | |
| | --Lighting in Milwaukee. | --Improves safety. Added lighting increases energy consumption and air pollution at electrical generation plants. |
| | --Upgrade rest areas. | --Improves safety; increases localized pollution at rest areas. |
| HIGH ($230 million) | --All elements of Mid Program. | |
| | --Additional weigh station, upgrading of rest areas, lighting, park-ride lots and interchanges. | |
| | --Landscaping. | --Reduces erosion and improves local environment. |
| | --Noise abatement. | --Reduces noise, possible adverse aesthetic impact. |

* Proposed weigh station improvements may be modified pending Department study of portable versus fixed weigh stations.

# APPENDIX B

# CALIFORNIA DOT DISTRICT RATING SHEETS

## HE 1 RATING SHEET

Project Identification

Dist.-Co,-Rte.-P.M. _____

E.A. No. (s) _____

Subcomponent HE- _____

Project Description _____

_____

Project Cost _____ Estimate Date _____

| | | Range | Score |
|---|---|---|---|
| 1. | Public Acceptance | ± 10 | |
| | A. Consistent with local plans | | _____ |
| | B. Consistent with regional plans | | _____ |
| | C. Consistent with State Urban Strategy | | _____ |
| | D. Previous Commitments | | _____ |
| 2. | Social and Economic Impacts | ± 10 | |
| | A. Displacement of people & improvements | | _____ |
| | B. Employment | | _____ |
| | C. Cultural resources | | _____ |
| | D. Development or redevelopment | | _____ |
| | E. Tax base | | _____ |
| | F. Other community effects | | _____ |
| 3. | Environmental Impacts | ± 10 | |
| | A. Air Quality | | _____ |
| | B. Noise levels | | _____ |
| | C. Appearance | | _____ |
| | D. Water quality | | _____ |
| | E. Biological resources | | _____ |
| 4. | Environmental Index 1 + 2 + 3 | | _____ |
| 5. | Safety Index | | _____ |
| 6. | Delay Index | | _____ |
| 7. | STIP status | | _____ |

Is project in previous STIP, Yes ____ No ____

If yes, what year _____.

8. Remarks

_____ Prepared By _____ Phone _____ Date

271

# CALIFORNIA DOT

NEW
HA-22 RECONSTRUCTION PROGRAM
PRIORITY SYSTEM

| | PROBLEM TYPE | PRIORITY CATEGORY<br>ADT RANGE<br>≥ 5,000 | 1,000 to 5,000 | < 1,000 |
|---|---|---|---|---|
| RIDE ≥ 45 | MAJOR STRUCTURAL PROBLEM AND BAD RIDE<br>Flex: Allig.B = 11-29% & Patch > 10% or Allig.B ≥ 30%<br>Rigid: 3rd Stg. Crk. ≥ 10% | (1) | (2) | (11) |
| | MINOR STRUCTURAL PROBLEM AND BAD RIDE<br>Flex: Allig.B = 11-29% & Patching ≤ 10%<br>Allig.B ≤ 10% & Patching > 10% | (3) | (4) | (12) |
| | BAD RIDE ONLY | (5) | (6) | (15) |
| RIDE < 45 | MAJOR STRUCTURAL PROBLEM ONLY<br>Flex: Allig.B = 11-29% & Patch > 10% or Allig.B ≥ 30%<br>Rigid: 3rd Stg. Crk. ≥ 10% | (7) | (8) | (13) |
| | MINOR STRUCTURAL PROBLEM ONLY<br>Flex: Allig.B = 11-29% & Patching ≤ 10%<br>Allig.B ≤ 10% & Patching > 10% | (9) | (10) | (14) |

Ties are broken by $(1,000)/mi./ADT (e.g. unit cost per unit of traffic service)

ATTACHMENT A