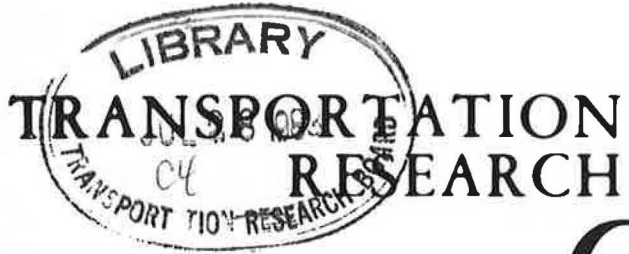


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CIRCULAR

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RESEARCH PROBLEM STATEMENTS IN LANDSCAPE AND ENVIRONMENTAL DESIGN

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- 1 highway transportation
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INTRODUCTION

This circular contains sixteen research problem statements developed by the Committee on Landscape and Environmental Design. The statements were screened by a subcommittee

and the order in which they appear represents the best consensus of priority research needs within the scope of the Committee's activities.

RESEARCH PROBLEM STATEMENTS

PRIORITY LISTING

<u>STATEMENT NUMBER</u>	<u>NAME OF PROBLEM</u>	<u>PAGE</u>
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PROBLEM NO. 1

- I. NAME OF PROBLEM - COST-EFFECTIVENESS OF ROADSIDE REVEGETATION IN PROVIDING PHYSICAL AND PSYCHOLOGICAL FUNCTIONAL NEEDS TO THE MOTORIST AND THE COMMUNITY
- II. THE PROBLEM - Inflation and reduced revenues are causing severe cutbacks in transportation construction, including roadside development. Roadside development and vegetation restoration is a necessary element in transportation systems to provide physical (safety, glare screen), psychological (buffers and visual relief) and community values.
- Restoration of roadside vegetation disturbed during construction is presently done by seeding of grasses and legumes and/or planting of woody vegetation. The vegetation used for revegetation is most often considered exotic and not necessarily compatible with existing environmental conditions or competitive with native vegetation unless certain maintenance measures are undertaken. Maintenance measures include weed control, brush control, mowing, fertilization, among others. These actions are normally perpetual and therefore their cumulative costs are high.
- III. OBJECTIVES
- A. Identify and prioritize roadside development needs which are essential elements in satisfying physical and psychological needs of the motorist and the community.
- B. Develop methods for revegetating roadsides

that will satisfy motorist and community needs and are cost-effective to construct and maintain.

- C. Evaluate methods of revegetating roadsides with plant communities that are competitive and compatible with site conditions.
- D. Identify plant communities that will answer the following:
1. Compatibility with the primary function of transportation facility:
 - a. relationship of height to sight distance, icing conditions, etc.;
 - b. maintaining structural integrity of pavements, structures;
 - c. littering caused by branch breakage, leaf drop, fruit drop.
 2. Competitive durability with existing vegetation and invading weeds.
 3. Establishment methods and feasibility:
 - a. availability of seeds and plants;
 - b. propagation methods;
 - c. seeding and planting methods (without irrigation);
 - d. natural revegetation;
 - e. herbicide programs and soil management.
 - f. cost.
 4. Visual qualities.

IV. CURRENT ACTIVITIES

- A. Research in progress: not determined.
- B. The following reports related to the subject have been published:
1. Washington State Department of Transportation Report FH-WA Highway Research Report No. 34.1, "Chemical Weed Control in Roadside Vegetation on Highway Rights of Way," 1979.
 2. Washington State Department of Highways Report FH-WA Highway Research Report 14.1, "Vegetative Cover for Highway Rights of Way," 1973.
 3. Washington State Department of Highways Report FH-WA Highway Research Report 14.2, "Vegetative Cover for Highway Rights of Way," 1976.

V. URGENCY - Increased cost of petroleum-derived products such as fuel, fertilizers and herbicides are increasing roadside maintenance costs. The length of study required for this requires an early start in order to have results that can be applied on large enough scale that would have practical results when maintenance activities would otherwise be cost-prohibitive.

VI. COST: \$100,000

VII. DURATION: 3 years, 2 man-years

PROBLEM NO. 2

I. NAME OF PROBLEM - COST-EFFECTIVE ANALYSIS OF STRUCTURAL AND VEGETATIVE MATERIALS AND TECHNIQUES FOR EROSION CONTROL

II. THE PROBLEM - Effectiveness of various materials and techniques used for erosion control has not been evaluated in terms of cost of the end results. Nor has any effort been made to develop a value system to assign relative values of effectiveness of the various materials and techniques available either individually or collectively.

NOTE: See Conclusions and Suggested Research, reference 1 below. Use of the Universal Soil Loss Equation as set forth in reference 2 below is limited at best without such value assignments. Economics of the various alternatives must be considered as well.

III. OBJECTIVE - A cost-effective analysis having a system of relative values assigned for the various materials and techniques of erosion control both individually and in combination thereof.

IV. CURRENT ACTIVITIES

- A. Evaluation of the physical properties of a number of erosion control materials is being conducted by Virginia. Pennsylvania is looking at some of the broader aspects of erosion control techniques, although not specifically at cost-effectiveness of erosion control materials.

B. References: The following reports relative to the subject have been published:

1. Transportation Research Board, "Erosion Control During Highway Construction," NCHRP Report 220 (1980).
2. Transportation Research Board, "Erosion Control During Highway Construction: Manual on Principles and Practices," NCHRP Report 221 (1980).

V. URGENCY - Implementation of results of references 1 and 2 research is dependent upon research as proposed herein. With the ever increasing cost of highway projects and the continuing emphasis placed on water quality a cost analysis of the various alternatives and combinations thereof is essential.

VI. COST: \$200,000

VII. DURATION: 2 years, 3 man-years

PROBLEM NO. 3

I. NAME OF PROBLEM - VALUE OF THE PSYCHOLOGICAL EFFECT OF VISUAL BARRIERS IN SOLVING NOISE ATTENUATION PROBLEMS

II. THE PROBLEM - There are many instances where fences or plants have been installed to provide privacy for abutting dwellings. Although these screens have not reduced the noise any appreciable amount the affected resident has reported substantial reduction in noise. Is the "out of sight - out of mind" approach of value in solving the highway noise problem?

III. OBJECTIVES

A. Determine methods evaluating the psychological effect of visual screens.

B. Determine if health is truly protected through the use of visual screens which produce a psychological protection from noise.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: none known.

V. URGENCY - If results show that there is true value in providing visual barriers in lieu of more substantial noise barriers there are many places where planting could be used as a cost-effective method for noise attenuation.

VI. COST: \$100,000

VII. DURATION: 3 years, 2 man-years

PROBLEM NO. 4

I. NAME OF PROBLEM - MAINTENANCE COSTS OF INTENSIVELY LANDSCAPED HIGHWAY AREAS

II. THE PROBLEM - Highway agencies often attempt

to beautify some areas of the highway system with intensive and expensive landscaping programs. These are sometimes done to placate local citizens or environmental activist groups or merely because of aesthetic propensities of the landscape unit in the highway agency. Often, however, these areas are subsequently neglected because of the high cost of maintaining them and the investment is wasted. In fact, the landscaping may hinder the use of conventional equipment to at least keep the area neatly mowed.

One of the factors that may lead to this seeming waste of money is the lack of knowledge about what costs are to be expected in maintaining an intensively landscaped area. The compilation of data would enable highway agencies to make landscape design decisions with some enlightenment about the subsequent maintenance costs. Such information would also be useful background data when soliciting public input about highway landscaping plans.

III. OBJECTIVES

- A. To select a number of landscape conditions that are typical to many highway localities and agencies.
- B. To collect information on the cost of maintaining these areas in a satisfactory manner.
- C. In the absence of hard cost data for some conditions a reasoned cost estimate should be made.

IV. CURRENT ACTIVITIES

- A. Research in progress: not determined.
- B. Related research activities: There are and have been a number of studies which address landscaping and vegetation management in the right-of-way, but apparently none consider the long term costs of maintenance.

- V. URGENCY - While this is not urgent in any emergency sense there has been a recent tendency to placate the wishes of various activist groups both national and local with intense landscape plans. Once installed the landscaping is often neglected and does not please anyone, neither the activists nor the highway agency that is urged to spend whatever it costs to maintain the landscaped areas in a pleasing manner. There appears to be insufficient data to aid in making rational decisions on these questions. It would seem that intensive landscaping should be done and maintained or not done at all.

VI. COST: \$75,000

VII. DURATION: 18 months, 1 man-year

PROBLEM NO. 5

- I. NAME OF PROBLEM - ACCOMMODATION OF INTERESTS IN RIGHT-OF-WAY VEGETATION AND ROADSIDE OUTDOOR ADVERTISING
- II. THE PROBLEM - A conflict of interests and

practices exists between the efforts of highway agencies to maintain vegetation along highway rights-of-way and efforts of outdoor advertising sign owners to maximize the visibility of their signs. Each year substantial amounts of trees and shrubs are removed, often by illegal and unnecessarily destructive methods, for the benefit of roadside advertising. The resulting damage to landscaping, visual environment, erosion and noise abatement and plant and wildlife habitats has reached serious levels in some regions.

Although most states have some laws protecting vegetation on public rights-of-way the pattern of protection is diverse, and penalties and enforcement procedures generally are poor. Efforts to develop policies and technical guides for accommodation of roadside vegetation and advertising interests are hampered because the environmental, engineering and administrative consequences of the various options have not been identified.

- III. OBJECTIVES - Identify and evaluate the consequences of unauthorized destruction of vegetation on highway rights-of-way and correlate this information with options for developing legally sound and operationally prudent practices for states regarding the interests in protecting roadside vegetation and in improving billboard visibility.

IV. CURRENT ACTIVITIES

- A. Research in progress: not determined.
- B. Related research activities: The outdoor advertising industry is promoting its interests through contact with FHWA offices in Washington and the field, the AASHTO Maintenance Operating Committee and individual state highway departments. By memoranda of December 30, 1976; March 15, 1977; and FHPM 7-6-2, Att. 1, para. 2 of September 26, 1975, FHWA has expressed a policy favoring preservation of vegetation but authorized states to accede to advertising industry wishes by entering into agreements which turn vegetation control over to industry elements. Currently the subject of vegetation control policy is on the agenda of the National Advisory Committee on Outdoor Advertising and Motorist Information. This committee is charged with recommending future federal policy on this and other subjects relating to billboard control.

- V. URGENCY - Annual damage to roadside vegetation is substantial and continuing, especially in the eastern, central and southern regions. State-industry agreements for vegetation control have raised serious legal questions and administrative problems. Neither state nor federal agencies can make sound policy or technical decisions until the consequences of current practices and options are evaluated.

VI. COST: \$75,000

VII. DURATION: 1.5 years, 1 man-year

PROBLEM NO. 6

- I. NAME OF PROBLEM - EVALUATION OF PLANTS FOR CITY STREETS AND REQUIREMENTS FOR HEALTHY SURVIVAL .
- II. THE PROBLEM - Harsh city environment requires special characteristics in trees and special planting methods. There seems to be a lack of dependable guidelines for selection and establishment of street trees which will remain healthy under city conditions.
- III. OBJECTIVES - Study of methods, materials and results of street tree planting in city environment. Recommend on regional basis, plant lists and planting methods for establishing trees in adverse city conditions. A synthesis of existing documents should be examined for a possible solution to the problem.
- IV. CURRENT ACTIVITIES
- A. Research in progress: not determined.
- B. Related research activities: none known.
- V. URGENCY - The results of this research could be used to advantage as soon as completed. There is a good possibility that the results would lead to immediate savings related to improved cost-effectiveness.
- VI. COST: \$50,000
- VII. DURATION: 1 year, 1 man-year

PROBLEM NO. 7

- I. NAME OF PROBLEM - USE OF LANDSCAPE PLANTS BY WILDLIFE
- II. THE PROBLEM - There is a great potential for highway rights-of-way to support populations of birds and small mammals. The importance of this habitat is greatest in urban and agricultural areas where little natural habitat exists. In urban areas large areas of rights-of-way are landscaped. In developing a landscape plan usually the wildlife potential is ignored.
- III. OBJECTIVE - To determine the use of selected landscape plant species by wildlife. Research will not only consider their use for food and shelter but optimum planting design.
- IV. CURRENT ACTIVITIES
- A. Research in progress: not determined.
- B. Related research activities: none known.
- V. URGENCY - Millions of dollars are spent annually in landscaping. Little or no consideration is given to the wildlife value of the plants. Proper right-of-way management should include consideration of this important aspect, especially in light of the importance of highway rights-of-way for wildlife.
- VI. COST: \$50,000
- VII. DURATION: 1 year, 1 man-year

PROBLEM NO. 8

- I. NAME OF PROBLEM - DEVELOPMENT OF BEST MANAGEMENT PRACTICES (BMP) FOR HIGHWAY CONSTRUCTION
- II. THE PROBLEM - Provisions of the Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977 require the control of non-point source (NPS) pollution through best management practices (BMP). Resource agencies have begun implementing this legislation by cooperative development of BMP's with development agencies and other concerned parties. A conspicuous lack of quantitative data exists on the environmental impacts of some highway construction activities. This fact makes development of BMP's for transportation agencies particularly difficult.
- III. OBJECTIVES - To conduct a literature search and to generate a sufficient data base to evaluate environmental impacts of different construction techniques available for a given construction activity. Suggestions include: a quantitative evaluation of construction parameters affecting water quality and aquatic habitat due to placement of fill in lakes and streams; stream crossing techniques and their effect on the riparian ecosystem; and techniques to prevent or control sediment runoff in fragile granitic soils, typical of Idaho, during and after construction.
- IV. CURRENT ACTIVITIES
- A. Research in progress: not determined.
- B. Related research activities:

1. Qualitative assessments of sediment control provided by U.S. DOT (BMP for Erosion and Sediment Control), U.S. EPA (Methods to Control Fine-Grained Sediments Resulting from Construction Activity).
 2. Quantitative assessment of water quality impacts resulting from construction of small sized bridge structures. Methods of abutment construction evaluated are: spread footing, driven pile and drilled caisson. These data have been generated by Idaho Transportation Department and are presently being evaluated.
- V. URGENCY - In most states compliance with BMP's will assure a transportation agency's compliance with state water quality standards. The obvious benefits gained include: protection of environmental quality, increased public acceptance of transportation projects, a decrease in conflict between resource and transportation agencies and expedient completion of a project due to decreased environmental delays.
- VI. COST: \$75,000
- VII. DURATION: 1 year, 1 man-year

PROBLEM NO. 9

- I. NAME OF PROBLEM - EFFECTS OF SOLIDS FROM HIGHWAY CONSTRUCTION ON AQUATIC COMMUNITIES

II. THE PROBLEM - During most highway construction projects one or two streams are crossed or are near the limits of the construction activities. Even with the latest erosion and sediment control devices being used on the construction project, sediment still enters the stream or streams. The effects and the tolerable limits of this sediment as suspended and bedload material on various aquatic communities (flora and fauna) have not been determined.

III. OBJECTIVES

A. To determine the amount of bedload material the flora and fauna of a stream can tolerate above ambient conditions without having any adverse effects.

B. To determine the amount of suspended solids the flora and fauna of a stream can tolerate above ambient conditions without having any adverse effects.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Several federal and state agencies have thought about setting suspended solids limits on non-point pollution sources such as highway construction but have refrained from doing so since the effects of various amounts of suspended solids on aquatic communities have not been determined.

V. URGENCY - This study would seem to be of high priority since regulatory agencies would like to set bedload or suspended solids limits on non-point sources. However, they have no idea what effects various amounts of suspended solids or bedload material have on different aquatic communities.

VI. COST: \$150,000

VII. DURATION: 3 years, 2 man-years

PROBLEM NO. 10

I. NAME OF PROBLEM - SCENIC HIGHWAY SELECTION CRITERIA

II. THE PROBLEM - It is just a matter of time before the various states will need to identify a scenic highway. The identification should be determined by professional criteria rather than individual opinions. When the need to identify scenic highways occurs the criteria should be available.

III. OBJECTIVE - Develop general criteria for the selection, acquisition of control rights and management of scenic highways.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Although there is no knowledge of a concentrated national approach to solving this problem it is understood that several states have addressed themselves to the subject. The

State of California published a guide to scenic roads and the United States Forest Service published a technical bulletin relative to scenic highways.

V. URGENCY - The Federal Highway Administration on several occasions has alluded to a scenic highway program. This timely study would prepare the various states for such a program in addition to satisfying the numerous references towards scenic highways found in other transportation related programs.

VI. COST: \$100,000

VII. DURATION: 2 years, 1.5 man-years

PROBLEM NO. 11

I. NAME OF PROBLEM - AESTHETIC IMPROVEMENT OF RAILROAD AND RAIL TRANSIT RIGHTS-OF-WAY AND RELATED AREAS

II. THE PROBLEM - The view from passenger trains passing through many urban areas is of deterioration, rubbish strewn backyards, vacant lots and commercial or industrial areas. Such conditions do not encourage the use of mass transit. Ways to improve the visual quality of the railroad environment should be researched.

III. OBJECTIVES

A. Determine scope of the problem.

B. Determine if there are legal means to clean up and otherwise improve deteriorated areas viewed from the train.

C. Determine how the proposed improvements can be financed.

D. Determine if enabling legislation is needed.

E. Determine feasibility of accomplishing the work through local clean-up - fix-up campaigns versus public funding or combination of both.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: There has been much written about the visual improvement of the highway environment but little or nothing about the railroad environment.

V. URGENCY - Conserving energy has a high priority. If improving railroad transportation is an important energy conservation measure it would seem that research leading to better railroads would have a high priority.

VI. COST: \$50,000

VII. DURATION: 1 year, 1 man-year

PROBLEM NO. 12

I. NAME OF PROBLEM - USE OF HERBICIDES TO REDUCE

MAINTENANCE COSTS

II. THE PROBLEM - A large number of states are increasing the use of herbicides to save money on roadside maintenance. Each state has developed its own program and these programs vary significantly from state to state. Major uses of herbicides are for weed control on roadsides; control of vegetation in pavement cracks, around signs and under guardrail; weed control in landscaped areas; and chemical mowing. Research is needed to determine the extent of this work and how it can be coordinated and not duplicated from state to state.

III. OBJECTIVES

- A. Determine what research is being conducted concerning the use of herbicides.
- B. Determine what particular type of herbicide usage is proving most cost-effective.
- C. Determine what information can be transferred throughout the United States. Examples: equipment use, training, safety procedures. Determine what information can be transferred in a region. Examples: use of specific chemicals, control of specific weeds.
- D. Determine how to coordinate research so that little duplication occurs and how best to publicize the research conducted in each state.

IV. CURRENT ACTIVITIES

- A. Research in progress: Informal research is ongoing in nearly every state. Formal research is ongoing in many states including Georgia and Indiana.
- B. Related research activities: none known.
- V. URGENCY - The Georgia DOT is saving about 2 million dollars a year from a chemical mowing program started in 1977. More savings are possible and expected by increasing the use of herbicides for roadside maintenance.

PROBLEM NO. 13

I. NAME OF PROBLEM - ROADWAY SHOULDER SLOPE DRAINAGE AND VEGETATION

II. THE PROBLEM - The shoulder slope of roadways is the interface between the roadway foundation and the surrounding land forms. Obstruction of the drainage pattern through this interface increases moisture content of the roadway foundation which, in turn, endangers the structural integrity of the roadway. In order to reduce the chance for drainage obstruction the present practice is to eradicate vegetation on shoulder slopes with herbicides. This has resulted in extensive herbicide programs which are costly, cause potential erosion and water pollution and degrade visual quality of a highway facility.

III. OBJECTIVES - Analyze the effects of vegetated roadway shoulder slopes on the drainage of roadway base and thereby overall structural

integrity of the roadway. Develop design, construction and maintenance procedures that are cost-effective, preserve the quality of the roadway foundation and are less detrimental to water quality and visual quality of the facility.

IV. CURRENT ACTIVITIES

- A. Research in progress: not determined.
- B. Related research activities: none known.

V. URGENCY - Increased cost of petroleum-derived products such as fuel, fertilizers and herbicides are increasing roadside construction and maintenance costs. The length of study required for this proposal requires an early start in order to have results that can be applied at the earliest possible time.

VI. COST: \$75,000

VII. DURATION: 2 years, 1 man-year

PROBLEM NO. 14

I. NAME OF PROBLEM - ROADWAY LANDSCAPING AND SNOW DRIFTING PROBLEMS

II. THE PROBLEM - Although roadway landscaping has many positive benefits the proximity of such to roadways can cause snow drifting problems. The extent of snow drifting depends on many factors and some of them are: the region, location and type of landscaping, prevailing winds and type of roadway. In addition to increasing snow maintenance costs snow drifting can also have detrimental effects on the traffic operations.

III. OBJECTIVES

- A. To determine the types and location of landscaping which cause significant snow drifting problems.
- B. To determine the extent of the problem in relation to the benefits gained.
- C. To provide guidelines for landscaping which would reduce or eliminate snow drifting problems.

IV. CURRENT ACTIVITIES

- A. Research in progress: not determined.
- B. Related research activities: none known.

V. URGENCY - Landscaping improperly installed in regard to snow drifting considerations can cause increased maintenance and also affect the traffic operations for the life span of the facility. It is important to minimize these adverse effects.

PROBLEM NO. 15

I. NAME OF PROBLEM - NITROGEN FIXATION WITH GRASSES

II. THE PROBLEM - Legumes for roadside seed mixtures tend to be short lived and over a

period of several years the grasses become nitrogen deficient. Legumes are sensitive to many weed control chemicals. Production of ammonium nitrate fertilizer used to provide nitrogen for grasses requires large quantities of natural gas to produce.

III. OBJECTIVE - To develop a specie or species of grasses suitable for roadside use that would have the capabilities of nitrogen fixation and thereby would relieve the dependence on natural gas for the production of ammonium nitrate fertilizer.

IV. CURRENT ACTIVITIES

A. Research in progress: Some work is being done in developing an algae for the purpose of nitrogen fixation as indicated in the 1975 July issue of National Geographic. Also some work is being done by the State University, Leyden, the Netherlands, entitled "The Biology of Nitrogen Fixation." A researcher in Brazil is doing greenhouse work with grasses that have nitrogen fixation capabilities.

B. Related research activities: There is considerable interest and activity in this process amongst other disciplines.

V. URGENCY - This proposal is considered highly important to reduce the cost and dependence on petroleum products for a source of nitrogen.

VI. COST: \$200,000

VII. DURATION: 5 years, 2 man-years

PROBLEM NO. 16

I. NAME OF PROBLEM - SOILS ECOLOGY FOR HIGHWAY PLANTING ESTABLISHMENT

II. THE PROBLEM - To better correlate plant species propagation and establishment within given soil boundaries. Highway construction activities have altered natural pH, moisture

and temperature regimes of the various soil types within right-of-way planting sites. The degree and measurement of alteration from that cataloged in the National Cooperative Soil Survey is unknown.

Basic soils data are fundamental to the successful establishment of stable shrub communities for open space management in lieu of mowing, herbicides and hand cutting.

III. OBJECTIVES - To collect and catalog seasonal moisture, temperature and pH data on soil mapping units within our Interstate Highway right-of-way. This would be the first phase of a two phase study of induced secondary plant succession. The second phase would be trial seedling plantings for soil suitability, the results of which to be utilized as a predictor element for site specific controlled vegetation.

IV. CURRECT ACTIVITIES

A. Research in progress: Maine Department of Transportation is presently working on propagation and establishment techniques in conjunction with their landscape nursery program. Activities now underway include woody plant seed germination and cuttings under glass and field beds. Seedling containers, specialty fertilizers, herbaceous sod mats and species evaluation are also currently being studied in the nursery and on roadside.

B. Related research activities: none known.

V. URGENCY - Revenue shortfall problems and pesticide environmental/health issues are seriously affecting the quality of functional roadsides. Low cost successful establishment of controlled form plant communities is a cost-effective vegetation management alternative. Research findings can be directly implemented into a large scale ongoing plant succession program.

VI. COST: \$200,000

VII. DURATION: 5 years, 3 man-years

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