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RESEARCH PROBLEM STATEMENTS ON LANDSCAPE AND ENVIRONMENTAL DESIGN

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subject areas
23 environmental design
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RESEARCH PROBLEM STATEMENTS

PRIORITY STATEMENTS BY SUBJECT

PROBLEM NO. 1

I. NAME OF PROBLEM - COMPARISON OF FUNCTIONAL VALUES OF CREATED WETLANDS VERSUS EXISTING NATURAL WETLANDS

II. THE PROBLEM - Construction of highways located in floodplains and surrounding low-lying areas usually results in wetland involvement. Executive Order 11990 and the Section 404 permit program of the Clean Water Act has resulted in several regulatory agencies requesting replacement in wetlands for those wetlands eliminated by highways. Naturally occurring wetlands generally possess characteristics absent from created wetlands: e.g., high net primary productivity, increased species and habitat diversity, excellent wildlife habitat, and low maintenance costs. Wetland involvement generally dictates a request for replacement instead of protection of existing wetlands. Because of the incomplete enforcement of current laws and because it is not illegal to drain wetlands (as long as there is no discharge of material), many acres of wetlands continue to be lost yearly. Therefore, retention of high-quality natural wetlands would appear to be viable mitigation. Substantial savings could be generated if transportation agencies could document the increased functional values of existing wetlands versus created wetlands.

III. THE OBJECTIVES - Identify those characteristics of naturally occurring wetlands over created wetlands and substantiate that expenditures on a cost-benefit ratio favor retention and protection of existing wetlands versus created wetlands.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined

B. Related research activities: Ongoing research directed towards value of existing wetlands, creation of wetlands, and utilization of wetlands as waste management purifiers. Little emphasis directed toward comparison of cost/benefit ratio of natural versus created wetlands.

V. URGENCY - Continuing emphasis on wetlands by regulatory agencies and attendant request for replacement on an acre-per-acre basis results in increased costs for transportation projects wherever there is wetland involvement. Substantial savings could potentially result from satisfactory documentation on cost/benefit ratio favoring retention of natural wetlands over creation of new wetlands.

VI. COST -- $500,000

VII. DURATION -- 5 years

PROBLEM NO. 2

I. NAME OF PROBLEM - SIGNIFICANCE OF VISUAL RESOURCE ASSESSMENTS ON TRANSPORTATION PROJECTS

II. THE PROBLEM - Transportation projects affect (impact) the visual environment. Although several methods have been developed to determine and identify the significance of visual issues on a project, there is no method to relate the level of effort necessary to produce an adequate visual analysis with the scope of the project.

III. OBJECTIVES - Project impacts, once identified, must be meaningfully assessed. However, the level of effort required to produce an adequate assessment must be related to the significance of the project.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: FHWA - V.I.A. for highway projects 1981.

V. URGENCY - Transportation projects impacts are everywhere! There is no end in sight to transportation construction therefore no end to the impacts.

VI. COST -- $150,000

VII. DURATION -- 2 years

PROBLEM NO. 3

I. NAME OF PROBLEM - COST EFFECTIVE DESIGN, CONSTRUCTION, AND MAINTENANCE CRITERIA FOR ROADSIDE VEGETATION

II. THE PROBLEM - There is presently no consistent nationwide procedure to determine the need or scope of roadside development in the programming, design, and maintenance process. The result of the current design process ignores some roadsides while others are overdesigned and constructed. Both extremes often cause extensive perpetual maintenance. When, because of funding limitations, these required maintenance levels cannot be obtained, costly investments deteriorate and design intents are lost unless funds are diverted from other areas. Last but not least, departments do not have a tool that offers a rational explanation to the public as to what level a project's roadsides should be developed in order to adequately serve all needs. The results have often been controversial.

III. OBJECTIVES - The objective of the research is to develop a methodology which identifies the degree of roadside development on the basis of cost effectiveness. With this methodology it will be possible to distribute the available funds on a priority basis and analyze the maintenance levels. A methodology will be developed which integrates the physical and psychological functions of roadsides with highway traffic and location factors, such as use, exposure, and sensitivity. This will be used for a roadside classification system. Criteria will be developed to select suitable vegetation types for the needs and conditions of the roadsides. Cost analyses, based on a representative

number of plant selections and communities will be developed. Correlation of the roadside classes with the vegetation type cost factors will provide for minimum development standards for the roadsides. These minimum standards are related to the most cost-effective vegetation types.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: "Esthetics and Visual Resource Management in the Highway Development Process", a manual prepared by Jones and Jones, Seattle, WA.

V. URGENCY - Immediate - Roadside vegetation involves construction and scarce, long-term maintenance funds. The nation is involved in a major program of completion and update of Interstate and other highway construction projects. Cost-effective roadside vegetation will save large dollar amounts.

VI. COST -- $98,000

VII. DURATION -- 3 years

PROBLEM NO. 4

I. NAME OF PROBLEM - INCREASE ENERGY EFFICIENCY AND REDUCTION OF MAINTENANCE COSTS BY ENHANCEMENT OF NATURAL COMMUNITIES WITHIN HIGHWAY RIGHTS-OF-WAY

II. THE PROBLEM - The rights-of-way of highways have been maintained on an annual basis by mowing for safety considerations and maintenance of the existing facility. This cost has been considered as a yearly necessary expense and incorporated into transportation budgets without consideration for the planned reduction in expenditures. Budget and personnel reductions, affecting all transportation agencies, have resulted in decreased acreages of rights-of-way mowed and maintained at the expense of the motoring public. This problem could potentially be alleviated by selecting those naturally occurring plant communities which provide suitable traits to reduce the increased energy costs of intensive maintenance.

III. OBJECTIVES - Identify those naturally occurring plant communities which by their growth form, morphology, and vegetative traits would reduce energy expenditures and maintenance costs by incorporation into highway rights-of-way.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Ongoing investigations in several states directed toward establishment of native plant communities in terms of restoration. No research directed toward reduction of energy and maintenance costs aspects that naturally occurring plant communities could provide.

V. URGENCY - As a yearly expense is programmed for mowing of highway rights-of-way, the selection and identification of naturally occurring plant communities could potentially provide substantial cost reductions for transportation agencies nationwide.

VI. COST -- $400,000

VII. DURATION -- 5 years

PROBLEM NO 5

I. NAME OF PROBLEM - AN ANALYSIS OF DESIGN FEATURES IN MITIGATING HIGHWAY CONSTRUCTION IMPACTS ON STREAMS

II. THE PROBLEM - The biological impact of stream relocation and culvert construction associated with the construction of the first stage of the Allegheny Valley Expressway Completion Project are documented in the Final Report for Research Project 79-10, "The Impact of Stream Relocation on Fish Populations and Bottom Fauna." The second stage of this highway project, which includes additional stream relocation and construction of three miles of limited access highway was scheduled for completion in the fall of 1984. An analysis of the cost and effectiveness of the mitigative design features incorporated into the entire project (Stages 1&2) to post-construction biological evaluation of the stream is needed to determine the total impact of the second stage construction. This information is important for increasing our understanding of the impacts of stream relocations and culvert construction and the cost effectiveness of mitigative design features.

III. OBJECTIVES - The objectives of this research are to (1) determine the effectiveness of the mitigative design features incorporated into the project to avoid or minimize the adverse stream impacts; (2) compare the design features; (3) determine the biological impacts of constructing the three miles of limited access highway in the Bull Creek and Little Bull Creek watersheds after all construction activities are completed and (4) produce an illustrated report and slide presentation which provide useful documentation for highway designers and environmental professionals to use in designing cost-effective mitigative design features for projects affecting streams.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: none known.

V. URGENCY - There is an important need to understand the impacts of stream locations and culvert construction and the cost effectiveness of mitigative design features.

VI. COST -- $50,000

VII. DURATION -- 12 months

PROBLEM NO. 6

I. NAME OF PROBLEM - WETLAND REPLACEMENT TECHNIQUES - CASE STUDIES

II. THE PROBLEM

A. Presidential Executive Order 11990 (1977) requires the avoidance of wetlands, whenever practicable, or action to minimize direct and indirect effects upon wetlands.

B. Since the FHWA has adopted the U.S. Fish and Wildlife Services Classification system, wet environments typically encountered on bridge replacement projects or highway relocation projects result in involvement with wetlands.

C. Pennsylvania is required to replace wetlands on projects in the State.

III. OBJECTIVES - Develop conclusions and recommendations based on case studies regarding wetland replacement efforts associated with highway project development comprising pre-construction, construction, and post-construction in the following areas:

A. Replacement area locations.

B. Effective design and revegetation of wetland replacement areas.

C. Overall cost effectiveness of various replacement designs.

D. Vegetation, topography, soils, hydrology, etc. of wetlands to be impacted and wetlands to be created.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: not known.

V. URGENCY - There is little or no data or experience available from transportation or environmental agencies on the development of acceptable, low-maintenance, functional wetlands.

VI. COST -- $100,000

VII. DURATION -- 5 years

PROBLEM NO. 7

I. NAME OF PROBLEM - UTILIZING WETLANDS FOR TREATMENT OF HIGHWAY RUNOFF

II. THE PROBLEM -One of the main concerns of resource agencies when a proposal exists to upgrade or build a major expressway is the impact of highway runoff to receiving streams.

With runoff constituents consisting of nitrates, phosphates, heavy

metals such as lead, zinc, and copper as well as many other compounds, the potential exists for receiving streams to receive high concentrations of pollutants, especially if certain environmental factors exist, i.e., long periods of having no rain thus allowing pollutants to build up on and along the highway, and if the surrounding area receives industrial air pollution.

III. OBJECTIVES - To create or utilize existing wetlands for receiving highway runoff. Runoff should be monitored for the components before entering the wetland and the existing waters should be monitored for the components which are not retained by the wetlands.

As this is new research, size of wetlands, type, vegetative cover, soils and all receiving water sources will have to be fully described and factors listed which will be controlled as well as ones which are not controlled will have to be fully listed and described.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Past research has generally been directed to highway impacts to wetlands, creation or enhancement measures for mitigation, and overall assessment for wetland functions.

V. URGENCY - An immediate need exists to be able to relate to regulatory agencies what the constituents of highway runoff are and whether or not these pollutants can be trapped, filtered, and retained by wetlands before entering any watercourses. If wetlands can effectively and efficiently filter our pollutants without any long-term degradation of the wetland or surrounding environment, then utilization of such should become commonplace as well as a useful mitigation tool by highway agencies.

Due to close scrutiny of achieving and maintaining high water quality standards, highway departments should be aware of any pollutants which are being added to the stream environment by their actions. Pollutants which enter the water system from highways should be monitored in order to determine if they pose a threat to the drinking water supplies.

VI. COST -- $125,000

VII. DURATION -- 5 years

PROBLEM NO. 8

I. NAME OF PROBLEM - PERCEIVE ROADSIDE AS A MANAGED RESOURCE RATHER THAN CONTROLLED VEGETATION

II. THE PROBLEM - The roadside is thought of as a necessary evil where the grass must be mowed, the weeds controlled and the advances of woody plants held at bay. This attitude colors the thinking of workers and supervisors so that the real potential of the roadside in terms of function and aesthetics is often not realized.

III. OBJECTIVES - Examine roadside vegetation from the standpoint of the land that supports it, types of vegetative cover, associated life forms, methods or practices to sustain the system and controls for safety and aesthetics.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined

B. Related research activities: Believe there are studies about wildlife, nesting habits, habitat etc., but the information should be incorporated into a total program, and should recommend practical applications.

V. URGENCY - This is timely because we are becoming more aware of public concern over what is being done on public lands. Practical guidelines from a management rather than control point of view would be timely as a means of preserving resources and heeding the reasonable concerns of the general public.

VI. COST -- $75,000

VII. DURATION -- 2 years

PROBLEM NO. 9

I. NAME OF PROBLEM - WETLAND REPLACEMENT - ENHANCEMENT

II. THE PROBLEM - In the course of highway construction, wetlands are encountered. According to federal mandate the an agency must identify the resource, evaluate, avoid or minimize the impact. If no alternative exists for using the wetland, a mitigation plan must be implemented.

III. OBJECTIVES - Define the methods of minimizing impacts to wetlands, methods of mitigating impacts to wetlands, methods of defining wetlands.

IV. CURRENT ACTIVITIES

A. Research in progress: An on-going inventory is being conducted to identify wetlands created by construction.

B. Related research activities: none known.

V. URGENCY - Mitigation of wetlands destroyed by highway construction is critical and we must replace wetlands or enhance existing borrow area which has wetland potential.

VI. COST -- $100,000

VII. DURATION -- 2 years

PROBLEM NO. 10

I. NAME OF PROBLEM - ASSESSMENT OF OPTIMAL HERB, SHRUB, AND TREE SPECIES FOR MITIGATION, ENHANCEMENT, AND RESTORATION OF HABITAT CONVERSION BY CHANNELIZATION

II. THE PROBLEM - Highways generally involve channelization during construction because of engineering constraints at stream crossings. Channelization is typically located in low-lying areas which are generally considered as the most valuable wildlife habitat. Because involvement with regulatory agencies is usually mandatory, mitigation is almost always requested on an acre-per-acre basis for the habitat converted. Due to difference physiographic regions located within geopolitical boundaries no single mixture of herbs, shrubs, and trees is applicable on a statewide basis. Consequently, there exists a need for an appropriate selection of species on a physiographic basis which would optimize the restoration of habitat along channelized areas associated with highway construction.

III. OBJECTIVES - Identify those herbs, shrubs, and trees which would provide the optimal wildlife habitat, soil retention properties, reduced maintenance costs, and aesthetic qualities for areas of channelization on a physiographic basis.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Investigations by private, state, and federal agencies primarily directed toward assessment of impacts of channelization. Other studies directed toward reclamation from introduced or non-native species.

V. URGENCY - A continuing need exists for this information due to comments received from regulatory agencies on transportation projects.

VI. COST -- $300,000

VII. DURATION -- 6 years

PROBLEM NO. 11

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. Establish 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 FHWA 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 FHWA Highway Research Report 14.1, "Vegetative Cover for Highway Rights of Way", 1973.

3. Washington State Department of Highways Report FHWA 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. 12

I. NAME OF PROBLEM - ROADSIDE VEGETATION: PERFORMANCE OF LEGUMES AND COOL SEASON GRASSES ON MAN-ALTERED SITES

II. THE PROBLEM - Inducing climax vegetation with herbaceous plant community dominants.

III. OBJECTIVES - Evaluate the establishment and performance of Roseacacia, Crown Vetch, Birdsfoot Trefoil, Perennial Sweet Pea, Lathia Flatpea and cool season grasses for reduced maintenance of roadside safety clear zones.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Maine Department of Transportation has been working jointly with the USDA Soil Conservation Service (SCS) for 25 years in grassland management and legume introductions. Maine Department of Transportation has developed two successful, low-cost establishment techniques: (1) direct overseeding on established grassland and (2) one-year containerized transplants. Long-term performance evaluations have been completed for Roseacacia, Crown Vetch and Birdsfoot Trefoil. They have useful climax values for erosion and brush control on man-altered sites. Perennial Sweet Pea, Latco Flatpea and cool season grass evaluations are not completed.

V. URGENCY - Continued fiscal austerity threatens the public investment in roadside safety clear zone management and reliable highway safety integrity. Also, mowing and herbicide spraying may become cyclic socioeconomic trade-offs for energy conservation and health safety issues.

VI. COST -- $60,000

VII. DURATION -- 4 years

PROBLEM NO. 13

I. NAME OF PROBLEM - REFERTILIZATION TO IMPROVE EXISTING VEGETATION TO REDUCE EROSION AND WEEDS

II. THE PROBLEM - Most projects receive fertilizer on initial installation and the grasses are not developed enough to utilize the supplied nutrients, then the areas receive no additional maintenance. Many projects are constructed with poor quality topsoil, and fertilizer in subsequent years would contribute to plant vigor, reduce weeds, and slow erosion.

III. OBJECTIVES - Research objectives are, develop specific rate of application, time of application, type of fertilizer, and cost effective method of operation.

The research objective should show that correctly supplied fertilizer will improve the erosion control potential of existing vegetation.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: In 1979 the Montana Department of Highways refertilized most of the interstate system with results the prime goal. No check plots were used and due to an abnormally wet spring and summer, it was difficult to quantitatively evaluate the response of the vegetation.

V. URGENCY - With rising cost for maintenance, it is imperative that erosion be controlled. Improved vegetative vigor will reduce noxious weeds and control erosion.

IV. COST -- $200,000

VII. DURATION -- 5 years

PROBLEM NO. 14

I. NAME OF PROBLEM - TREES IN PAVEMENT - ROOT ZONE REQUIREMENTS

II. THE PROBLEM - Increasingly, the urban transportation systems use trees as one of the environmental impact-mitigation measures. A large number of these trees are surrounded by pavement. This pavement often causes root zones that are restricted and different from the natural, undisturbed environment. A less than favorable root zone will result in limited growth and greater susceptibility for diseases. Thus, often urban trees do not perform as desired and are costly to maintain.

III. OBJECTIVES - The objective of this research is to develop criteria for selection of tree species and root zone development and management in pavement areas. These criteria will be used to develop guidelines which will result in improved tree development and lower maintenance cost.

Consideration will be given to variables such as:

A. Tree species/variety selection.

B. Soils.

C. Soil penetration resistance.

D. Groundwater availability.

E. Air exchange with adjacent soils.

F. Backfill mixture composition.

G. Pavement type (solid versus open).

H. Climate/evapotranspiration.

I. Environmental setting.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined

B. Related research activities: various research by:

Dr. C. E. Whitcomb - Oklahoma State University
Dr. T. O. Perry - North Carolina State

V. URGENCY - Large numbers of trees are being planted in urban areas that, because of unfavorable root environments, will not develop to the size intended. Often maintenance and replacement costs involve large dollar amounts.

The research will take considerable time. Therefore, immediate start is urgent.

Implementation at state levels will result in improved performance of urban tree plantings, thus improved acceptance of new transportation facilities.

VI. COST -- $60,000

VII. DURATION -- 3 years

PROBLEM NO. 15

I. NAME OF PROBLEM - COST-BENEFIT ANALYSIS FOR ACCOMMODATING BICYCLISTS/PEDESTRIANS IN TRANSPORTATION PROJECTS

II. THE PROBLEM - Not all highway designers recognize that facilities satisfying the transportation needs of pedestrians and bicyclists are as important within a transportation corridor as those for motor vehicles. Accommodating pedestrians and bicyclists is too often tolerated as a "nicety", and rarely recognized as an essential element of transportation. Because there is no widely accepted method for determining the cost benefit of pedestrian and bicycle facilities,

they are usually justified on intuitive and subjective reasoning and thus do not compete successfully with today's fierce competition for new construction funds. Research is necessary to develop a widely accepted, readily understood and easy to use cost-benefit methodology for bicycle and pedestrian facilities on transportation projects.

III. OBJECTIVES

A. Identify and assess the real dollar benefits of pedestrian and bicycle facilities, including, but not limited to, the following:

1. The average costs of pedestrian and bicycle accidents including deaths, injuries, costs of hospitalization, lost time from work, damage to all involved vehicles, claims, awards and findings of liability.

2. The economic impact of improved pedestrian/bicycle access to commercial areas and tourism.

3. Consumer spending on pedestrian/bicycle equipment.

4. Health benefits of increased physical activity.

5. Reduced air pollution and traffic congestion.

B. Evaluate case studies to determine whether improved pedestrian and bicycle facilities actually generate increased pedestrian/bicycle usage, thereby resulting in a lower cost per user.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: none known.

V. URGENCY - In some instances, pedestrian and bicyclist facilities are not being built because of misconceptions as to their real value to the community and the traveling public. Research results may immediately help to provide a usable cost/benefit basis for justifying the construction of these facilities.

VI. COST -- $150,000

VII. DURATION -- 2 years

PROBLEM NO. 16

I. NAME OF PROBLEM - LIVING SNOW FENCE MODELING WITH SCALE MODEL JUNIPERS

II. THE PROBLEM - By far the most important winter land transportation problems in the 10-state Great Plains area are driving hazards and road closures caused by blowing and drifting snow. That portion of the national transportation system in the Great Plains, as well as state and county roads in that area, could be made safe and more usable during winter if improved wind and snow barriers could be developed.

Living snow fences, composed of juniper and selected shrubs, offer a tremendous potential for effective snow storage. In addition, such barriers have a potential to save a significant amount of tax dollars, provide highway beautification, and enhance wildlife habitat. The potential of such fences is just being recognized in the Great Plains and some plantings are being established.

III. OBJECTIVES - Proper design and location in relation to roads is critical to living fence effectiveness as a snow barrier. Also, proper placement of wildlife habitat components is critical if winter wildlife benefits are realized. A literature search reveals that almost no research data is available on living snow fence design and location.

Specific technical questions the proposed research should answer are:

A. Most effective living fence location in relation to distance from road.

B. Number of rows needed for efficient snow storage.

C. Drift cast at equilibrium (capacity) by mature juniper barriers.

D. Down volume stored at equilibrium.

E. Most efficient twin-row high density design.

F. Extent of downwind effectiveness of different designs.

G. Proper placement of wildlife components.

IV. CURRENT ACTIVITIES

A. Research in progress: Preliminary testing of model performance and practicability was done by Dr. Dale Shaw at Diamond Lake in February of 1985. Model design and testing was done after consultation with scientists who used this method in developing the Wyoming design structural snow fence.

B. Related research activities: Extensive research has been conducted relative to production, maintenance, and extent of trees and shrub, wind and snow barriers. A publication titled "Windbreak Bibliography" by William L. Loucks and published by the Great Plains Agricultural Council (Publication 113) lists, 1,582 research papers. Publications listed deal primarily with windbreak planning, planting, fertilization, maintenance, insects, disease, rodent control, wind erosion, livestock protection, acres planted, microclimate studies, effects on crops, species adaptations, wildlife benefits, and popular articles promoting windbreak planting and maintenance.

Research most related to this proposal is that done by scientists at the Rocky Mountain Forest and Range Experiment Station. This work was done to develop the Wyoming design structural fence used extensively along I-80 between Laramie and Rock Springs, Wyoming. Researchers found that models gave data

essentially the same as did actual fences placed in the field.

V. URGENCY - Blowing and drifting snow is a major threat to land transportation routes in the 10-state Great Plains area during winter months. Drifting not only closes major transportation routes but also poses winter driving hazards and requires significant expenditures of tax monies for snow removal.

Living fences will have a significant impact on the Federal government's interest in keeping Great Plains and other land transportation routes open. Such interest involves:

A. Keeping routes open at all times for transport of defense and other strategic materials.

B. Significant savings in federal and other expenditures for snow removal and related costs.

C. Significant decrease in winter highway closures which cause hardship and/or inconvenience for citizens.

D. Beautification of transportation routes.

E. Assistance to U.S. Fish and Wildlife Service relative to enhanced wildlife habitat.

VI. COST -- $150,000

VII. DURATION -- 3 years

PROBLEM NO. 17

I. NAME OF PROBLEM - COST EFFECTIVENESS OF GROWTH REGULATORS ON COOL-SEASON ROADSIDE TURF GRASS

II. THE PROBLEM - Reduction in manpower and operational budgets for key roadside maintenance operations such as mowing point to a need beyond simply reducing the amount of mowing performed on an annual basis.

Sight clearance as a safety consideration; noxious weeds and roadside drainage requirements cannot be adequately maintained by simply reducing the overall width and/or frequency of the area to be mowed.

The use of a wide variety of growth regulators on cool-season perennial grasses have historically been impractical on a large scale basis due to such factors as erratic response, narrow application window or the timing of application, phytotoxicity to permanent grass and overall expense.

III. OBJECTIVES

A. Establish what chemical compounds and at what rates may be applied without injury to desirable cool-season turf grass.

B. Determine what chemical compounds applied singly or in combination may be utilized to control or eradicate broadleaf weeds while inhibiting the rate of vegetative growth and/or inflorescence development.

C. Establish criteria for proper dates of application.

D. Establish maximum duration of effective control as it relates to intrusion of warm-season grass and broadleaf weeds, height of cool-season turf and infloresence, and overall appearance as an acceptable aesthetic consideration.

E. Determine cost effectiveness of material cost plus application versus cost of mowing (contract and in-house).

IV. CURRENT ACTIVITIES

A. Research in progress: At university and departmental level in a number of states. North Carolina and Pennsylvania State universities have conducted research.

B. Related research activities: none known.

V. URGENCY - Many states, municipalities and airports are currently involved in chemical mowing programs. However, refinement in a number of different areas, as alluded to above, is necessary to develop same as an integral part of roadside maintenance systems.

VI. COST -- $250,000

VII. DURATION -- 5 years

PROBLEM NO. 18

I. NAME OF PROBLEM - USE OF HERBICIDES TO REDUCE HIGHWAY MAINTENANCE COSTS

II. THE PROBLEM - To study cost effectiveness, highway safety function, environmental safety, employee health monitoring and chemical risk assessment.

III. OBJECTIVE - To development a comprehensive basis for cost - benefit comparisons with other reliable kinds of roadside management technologies.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Maine Department of Transportation has engaged a health data-base firm to continually provide chemical risk assessments and employee pesticide applicator health monitoring.

Maine Department of Transportation is currently evaluating the performance of its interstate roadside safety clear zones with respect to winter solar access and snow control. Cost comparisons between herbicide spraying, manual/machine clearing and mowing are on-going since 1980. Right-of-way forest harvest studies have been completed.

V. URGENCY - Chemical issues are currently increasing anxiety levels of society and identifying their usage as environmental insults. Roadside managers need to better assess highway safety impacts resulting from the loss or over-regulation of chemical technology.

VI. COST -- $150,000

VII. DURATION -- 5 years

PROBLEM NO. 19

I. NAME OF PROBLEM - DETERMINING BEST METHOD FOR DISPOSAL OF REST AREA WASTE WATER

II. THE PROBLEM - Sewage disposal is a major factor in locating and operating rest areas. An up-to-date description and comparison of the various systems, cost comparisons, limitations, benefits, etc., is needed especially at the preliminary planning and site selection stage.

III. OBJECTIVES - The research should bring together the latest information so that a site selection, stage planners and designers can feel confident that they are aware of the available options for a particular type of site.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: The objective would be to glean from what has been published and what is being studied, only those practical solutions applicable at this time.

V. URGENCY - This is a timely subject. New rest areas are being planned and existing facilities are being upgraded. This consideration becomes more important each day in the selection of new sites and the upgrading and operation of existing facilities.

VI. COST -- $75,000

VII. DURATION -- 2 years

PROBLEM NO. 20

I. NAME OF PROBLEM - EVALUATION OF FISH PASSAGE THROUGH HIGHWAY DRAINAGE STRUCTURES

II. THE PROBLEM - Most fish migrations are essential to the survival of the species. During normal upstream migration fish expend 80 percent of their energy reserve. Thus, any major change in energy requirements, such as that caused by a delay at a barrier, might mean that a fish would fail to reach the spawning grounds.

When delayed or blocked, fish tend to concentrate below the barrier, where they become highly vulnerable to abnormal fishing pressure, which can result in overharvest. It is crucial that the

passage of migrating fishes not be delayed. Most of the trout species seek the small tributary streams for spawning. Each stream is important to the overall gross production.

III. OBJECTIVES - Effective size of resting ponds above and below structures (i.e., culverts) to allow the fish to rest before proceeding upstream.

Maximum length of covered structures that fish will navigate.

How bends in culvert design affect migration.

Elevation differences between inlet and outlet that fish will tolerate coupled with structure designs.

IV. CURRENT ACTIVITIES

A. Research in progress: not determined.

B. Related research activities: Past activity - Fish Migration and Fish Passage, USDA Forest Service, June 1980. EM-7100-12

V. URGENCY - Fish population are difficult to manage and maintain. In part, this is due to their sensitivities to changes in their environment. Improperly designed structures may have a significant negative impact on particular populations.

Research findings would be used to design structures that would not impede fish migrations. This way, game agencies would not be imposing mitigation measures on the project, saving dollars and public resources.

VI. COST -- $150,000

VII. DURATION -- 3 years

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