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I. INTRODUCTION

This is the first edition of the *RD&T Annual Report* for ODOT’s Research, Development and Technology Transfer Program. The impetus for an annual report was a recommendation from our 2001 Peer Exchange\(^1\).

RESEARCH AS AN INVESTMENT

In recent years, investments in transportation have not kept pace with needs. In a climate of scarce resources, research and development becomes extremely important in that it can help ODOT to work smarter and to make the most efficient and effective use of the resources available.

Furthermore, in the nation as a whole, public sector transportation agencies are currently under-investing in research and development. According to the National Highway R&T Partnership, approximately one half of one percent of public sector highway spending is allocated to research and technology, much less than practically any other industry.\(^2\)

In the fiscal year 2002, ODOT Research spent approximately $2.4 million on research projects and activities that directly support research projects. We initiated 14 new projects and completed 20.

Limits on length preclude treating every research activity in depth. Instead, projects included were those which are of most general interest, representative of a range of subject areas and expected to be of high value to ODOT.

ORGANIZATION OF THE REPORT

This report is intended to be a complement to another annual ODOT Research document, our *Annual Work Program*, but with some key differences. The *Annual Work Program* is prospective, focusing on activities planned for the coming year. The *RD&T Annual Report* is retrospective, focusing on accomplishments from the previous year. The *Annual Work Program* is designed to support administrative goals. The *RD&T Annual Report* focuses on research results. The audience for the *Annual Work Program* is mainly the FHWA Oregon Division Office, while the *RD&T Annual Report* is intended for a broader audience of non-technical users.

\(^1\) The *Research, Development and Technology Transfer Program Peer Exchange* is a review of a state’s RD&T Program, involving a panel of Research Managers and Engineers from other states, FHWA research program managers and researchers from academia and the private sector. A Peer exchange is conducted every three years, as a condition for RD&T Program grant approval (CFR 23, 420.207).

The main body of this report is organized as follows. Chapter 2 is an overview of the year, noting specific highlights and accomplishments.

Chapter 3 summarizes a number of other important completed or continuing research projects. Chapter 4 is a report on activities and accomplishments in addition to major projects, and includes information about project selection, small projects and various ongoing responsibilities. Chapter 5 summarizes completed and continuing projects in tabular form, along with a budget and expenditures summary.

If you have questions about the contents of this report or about any aspect of Research at ODOT, here is contact information:

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**TARGETING RESEARCH INVESTMENTS**  
*A message from Deputy Director Craig Greenleaf, Transportation Development Division*

Research has long been a part of this department’s activities, and for good reason. New materials, bridge preservation techniques, construction methods, new planning strategies, better approaches to safety—these are just a few positive results of research. Every area of ODOT’s responsibility can benefit from carefully planned and executed research. This annual report provides an opportunity to view, in one document, the scope of our research efforts. The projects run the gamut from highly specialized laboratory and field tests to policy research with department-wide implications.

In these times of tight budgets we can also use this report to consider how well we are targeting our research investments. Are we focusing on those needs most important to our customers and most likely to yield significant cost savings and long-term improvements in quality?

These are questions for each of us, particularly for managers, staff and partners who give of their time and talent serving on research committees and technical advisory panels. Our reorganized research program is beginning its sixth full year of operation. I applaud the dedication of all involved and your willingness to work together for common research goals.
II. HIGHLIGHTS OF THE YEAR

Fiscal 2002 was a landmark year in a number of important respects. In this section the focus is on five key accomplishments that made this year a success. ODOT Research:

1. Completed the largest and possibly the most successful ODOT research project to date, “Rockfall Catchment Area Design Guide;”

2. Initiated three new, high-profile projects designed to address (a) alternatives to the motor fuel tax, (b) remaining life of shear-cracked reinforced concrete bridges, and (c) outsourcing of project delivery

3. Launched the Roads Scholar Program through the Oregon Technology Transfer Center. It is a road maintenance and preservation technology training program aimed at local government agency personnel.

4. Completed the Federally required 2001 Research, Development and Technology Transfer Program Peer Exchange; and

5. Played a central role in planning, organizing and delivering the 2002 Northwest Transportation Conference;

These accomplishments are described in more detail in the next few pages.

Rockfall Pooled Fund Project

Starting in 1998, Oregon served as lead state and performing organization on the pooled fund project SPR-3(032), A Modern Design Standard for Rock Fallout Areas. This project was completed during Fiscal 2002, at a final cost of just over $640,000, using contributions from seven states and four FHWA offices. Oregon’s total cost was $95,000, with the balance contributed by the other partners.

Through this joint effort, ODOT completed an extensive research project to study the physics of falling rocks. The results of the study are contained in a “Rockfall Catchment Area Design Guide.” The guide contains a set of “practitioner-friendly” design charts, which can be used to design rockfall catchment areas.

The report and supporting information was published on CD in both English and metric units for distribution to state DOTs and to fulfill other requests. To date about 450 CDs have been distributed.
This was an important milestone in the development of ODOT’s research program. First, it was the largest project, in terms of cost, and level of effort, ever undertaken by the ODOT Research.

Second, the research was planned, designed and carried out entirely with in-house expertise.

Third, the Rockfall Catchment Area Design Guide is among the most important work ever completed by ODOT Research, in terms of its eventual impact on engineering practice in this subject area. We expect the design guide to define the state of practice in the design, construction and evaluation of rock slopes for years to come. We also expect these design tools to result in worldwide cost avoidance and safety improvements.

**Engagement in Key ODOT Issues**

In 2002 ODOT Research started two projects, and selected two others, which address key priority areas for ODOT that are critical to the future of transportation in Oregon.

**Alternatives to the Motor Fuel Tax**

One of these projects, completed during 2002, was “Alternatives to the Motor Fuel Tax.” This project was designed specifically to summarize existing research on road financing methods and technologies, and to identify issues and options for the Road User Fee Task Force.

The Road User Fee Task Force was established through HB 3946, passed by the 2001 Oregon Legislative Assembly. Its mission is to develop a new system of road user fees, acceptable to the public, that ensures sufficient revenue to maintain, preserve and improve Oregon’s road system. Among other things, this new system should be designed to address declines in fuel tax revenue that are expected from improvements in fuel and vehicle technologies. ODOT Research is continuing to work with the Road User Fee Task Force to provide additional technical expertise and research services.

**Shear Cracked Bridges**

A second high-priority research area is shear-cracked bridges. Oregon has approximately 500 reinforced concrete bridges that have developed or will likely develop serious cracks. Repairing or replacing these bridges will be a major funding and
An engineering challenge for ODOT over the next two decades. One research project started early in 2002, and is now 50% complete. A second project was selected in Fiscal 2002 to begin in Fiscal 2003. The research objectives of both projects are to address engineering questions that will help to provide ODOT with a rational basis to apply load restrictions, prioritize bridges for repair and replacement, select re-inspection intervals, and develop effective repair techniques for shear-cracked bridges.

**Outsourcing**

A third high priority research topic is *outsourcing*. In 2002, ODOT Research selected a project proposed by ODOT’s Project Delivery Manager, to research *alternative models of project delivery*. This project is designed to support and evaluate steps being taken by ODOT to outsource the needed project development and project management resources to deliver highway projects funded through the Oregon Transportation Investment Act (OTIA).

**Technology Transfer (T2) Center Road Scholar Program**

The Oregon Technology Transfer (T2) Center has historically offered training courses on a list of popular topics, for public works employees in Oregon. Late in FY’01 the Oregon T2 Center decided to launch a “Road Scholar Program,” as several states have done in recent years. This represents a significant new direction for at least three reasons. Existing training courses were designed to stand alone, while the Road Scholar Program is an integrated curriculum leading to a certificate. Second, existing training is focused primarily on safety, while the Road Scholar Program focuses on road construction, preservation and maintenance technology. Third, the Roads Scholar Program sets high standards. Unlike other T2 courses, completing a Roads Scholar course entails passing a written examination.

Progress in the development of the Roads Scholar Program has included the following.

(1) Development of a design for the program and an outline of the curriculum.
(2) Development of registration and tracking materials.
(3) Initial registration of 55 agencies.
(4) Development of four training courses.
(5) Delivery of 26 Roads Scholar classes to 314 students.
The RD&T Peer Exchange is required once every three years, to maintain our eligibility for Federal research funding. Our first Peer Exchange was held in 1998, and the second, August 20-24, 2001. The panel consisted of six individuals.

- Basil Barna, Idaho National Engineering and Environmental Laboratories
- Alan Hilton, Nevada Department of Transportation
- Harold Hunt, Division of New Technology and Research, CalTRANS
- Martha Nevai, FHWA, California Division
- Martin Pietz, Washington Department of Transportation
- Bob Raths, Federal Highway Administration, Oregon Division

The team reviewed documentation describing Oregon’s research procedures and program. During the exchange, the team discussed Oregon DOT’s procedures and those used in other team members’ respective agencies and organizations. They also interviewed more than 60 people representing both internal and external stakeholders. The team identified 12 opportunities for program improvement, and presented those opportunities, along with other comments, to the ODOT Research Advisory Committee on the final day of the exchange. In general, our program received very high praise from the Peer Exchange Team for our project selection process, for the level of interest and participation that our program enjoys within the Department, for streamlining of contracting procedures and for effective project management. At this point all of the 12 recommendations of the Peer Exchange Team have been or will soon be implemented. The 2001 Peer Exchange was closed out with a formal, written response to the FHWA Oregon Division in March 2002.
2002 NORTHWEST TRANSPORTATION CONFERENCE

ODOT Research played a greatly expanded role in the 2002 Northwest Transportation Conference. The conference was well attended, attracting about 300 participants. It received high marks from attendees for organization and quality of content.

Barnie Jones, ODOT Research Manager, chaired the Conference Steering Committee and served as conference MC. ODOT Research publicized the conference, produced the conference program and led fund-raising activities. Other research employees served on the steering committee, organized and chaired sessions, and presented papers. ODOT Research and the Oregon Technology Transfer Center hosted vendor displays at the conference.

The conference theme was “Sustainable Transportation.” Highlights included:

- A keynote address on sustainable transportation by Oregon Transportation Commissioner Gail Achterman.
- A video teleconference with members of Oregon’s Congressional Delegation, including Senator Gordon Smith, Senator Ron Wyden, Representative Earl Blumenauer and Representative Peter DeFazio.
- A panel discussion on alternatives to the motor fuel tax with members of the Road User Fee Task Force, including Representative Bruce Starr, Oregon Transportation Commissioner Randall Pape, Eugene Mayor Jim Torre and Cascade Policy Institute Environmental Policy Director John Charles.
- A banquet keynote presentation on smart growth by Portland City Commissioner Charlie Hales.
- A student poster competition
- Eighteen breakout sessions on a wide range of transportation topics.
- Initiation of the “Showcase of Innovations” contest to encourage city, county, state and federal transportation employees to share ideas to improve safety and/or efficiency.
This chapter describes completed and continuing projects which, while they do not rise to the level of significance of the projects discussed in Chapter 1, are producing valuable information.

This chapter does not include information about all the active projects either completed or continuing in each subject area. It is a sampling of projects that either have produced or are expected to produce notable results and significant benefits for ODOT. A complete listing of projects is available in the 2001-2003 Annual Work Program.

**Completed Projects**

**Precast Concrete Barrier Crash Testing**

FHWA required that states must confirm that their safety features are acceptable under new standards defined in NCHRP Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features.” To address these requirements ODOT conducted crash testing on Oregon’s Standard (32-inch) F-shape barrier and the newly adopted Tall (42-inch) F-shape barrier. Both barriers passed crash testing with a ¾-ton pickup truck traveling at 62 mph. Furthermore, FHWA acknowledged both barriers as having the best performance of any free-standing precast concrete barriers to date. The Tall barrier was also tested with a 17,600 lb. single unit truck going 50 mph. The barrier effectively contained and redirected the truck, and the vehicle remained upright. Several states have expressed interest in using Oregon’s design for their concrete median barriers.

**Performance of Zinc Anodes for Cathodic Protection of Reinforced Concrete Bridges**

ODOT uses cathodic protection (CP) systems on several reinforced concrete bridges at the coast to stop those structures from corroding. The systems are expensive, but the alternative is to replace the structures. A key part of these systems is the zinc metal that is melted and sprayed onto the bridges in a thermal spraying process to create what is called an anode. When ODOT started applying CP to the coastal bridges, the long-term performance of the anodes was unknown.

The U.S. Department of Energy’s Albany Research Center completed an ODOT research project to
characterize the zinc anodes in these CP systems. ODOT now has an estimate of how long the anodes will last, what is needed to make them operate efficiently, and why they will eventually need measures to determine how much life remains. The results of the research are used in specifying anode installation and in predicting the life of CP systems.

Assessing Public Inconvenience in Highway Work Zones

A survey of over 2,000 motorists and truck drivers statewide from all five ODOT Regions revealed that the public is generally satisfied with how ODOT manages its work zones. The survey did reveal several areas, however, where ODOT could improve its work zone management. Key findings showed that users were concerned about the lack of nighttime visibility in work zones. Drivers also voiced willingness to accept 12- to 15-minute construction related delays. Highway users in more populated regions experienced longer actual delays than those in rural areas and reported lower tolerance of acceptable delay. All groups cited the need for greater speed enforcement as an essential change for work zones. A working group is developing specific recommendations for implementation, to be presented to Highway Division management.

Survey Methods for Assessing Freight Industry Opinions

As transportation planners seek to involve the freight industry in the planning process, it is a challenge to obtain a representative sample of opinions. Past freight survey efforts have tended to yield low response rates, indicating poor participation and involvement from the industry. The low response rates also cast doubt on the suitability of data gathered in this manner to fairly and accurately represent the views and wishes of the freight industry.

This research tested various survey methodologies and developed an approach that yielded a 61% response rate. This method will be useful to other states and metropolitan areas. In addition, ODOT now has a representative sampling of opinions from over 1,800 firms about the problems they perceive on Oregon's freight transportation system. ODOT Planning staff is exploring the feasibility of geocoding the problem locations related to infrastructure so they might be mapped and compared with other sources of information on infrastructure needs.
Evaluation of Microwave Traffic Detector
A new vehicle detection sensor using microwave technology was compared to a conventional inductive loop. It was found to detect about the same number of vehicles as the inductive loop and was suitable for providing “extension” and “call” functions for the traffic signal controller.

The microwave has several advantages. A single unit can detect five separate lanes from the edge of the roadway, including vehicles hidden behind larger vehicles. It is also non-intrusive to the road surface, making it a desirable choice for steel reinforced concrete bridge decks. Serviceability from the side of the road is safer for the road crews and results in less disruption to the motorist.

CONTINUING PROJECTS

Shear Capacity Assessment of Corrosion-Damaged, Reinforced Concrete Beams
In recent inspections of highway bridges in Oregon concern has been raised for the loss of shear capacity of bridge elements due to corrosion of the shear reinforcement. The actual effect of corrosion damage to the shear reinforcement cannot readily be determined by nondestructive testing techniques. The severity of the damage may not be fully understood until a significant failure has occurred. This study will determine the shear capacity of reinforced concrete bridge girders as a function of the corrosion damage to the shear reinforcement.

Fish Passage Through Retrofitted Culverts
In determining whether retrofitted culverts are passing fish, fish distributions and movement in and around retrofitted culverts have been measured in seven streams. Additionally, the effectiveness of different baffle configurations are being investigated.

Thirty-two releases of steelhead trout in a reinforced concrete box culvert on Big Noise Creek on Highway 30 were used to test three baffle configurations and a control (with no baffles). Preliminary conclusions are: 1) addition of baffles to a culvert increases the ability of steelhead trout to maintain position or swim upstream under winter
base flows; 2) 45° baffle deflectors and 90° baffle weirs are slightly more effective than 30° baffle deflectors in improving fish passage; and 3) movement incentives (baiting, fright, crowding) do not change movement patterns. In the future, tagged fish will be collected at the seven culvert sites and their movement recorded. Summer flow studies on Big Noise Creek will be conducted. The project is expected to run through June 2003.

**Selection Criteria for Using Nighttime Construction and Maintenance Operations**

As ODOT places more emphasis on preservation of existing highways and bridges, daytime lane closures to accommodate maintenance and construction activities are a significant threat to highway service levels. To avoid disruption of daytime traffic flow, more maintenance and construction activities are being accomplished at night. Nighttime maintenance and construction eliminates daytime disruption of traffic, but this also brings a new set of factors and concerns, including cost, productivity, quality, noise, safety, public awareness, and illumination.

In deference to its commitment to maintain service levels, ODOT has used, and continues to use, nighttime operations for maintenance and construction on many of its high volume highways. However, the choice to work at night is subjective. Flawed assessments about when to conduct maintenance and construction operations can lead to greater costs and increased traffic and worker safety risks. This research effort will develop a structured, systematic, and standardized decision making process for assessing the use of nighttime operations for maintenance and construction. The research is expected to be completed by December 2002.

**Truck Trip Data Collection Methods Study**

ODOT’s data on truck movements comes from traffic counts, which are inadequate for transportation modeling and freight planning. ODOT has limited information on truck trips, routes traveled and commodities carried. Further, little is known about truck trip chaining and the use of distribution centers. This project with Washington State University will look into more effective ways to collect data on truck trip origins and destinations, particularly in metropolitan areas. The project will review data collection methods currently being used and development of a method that is best suited for metropolitan areas. The project is expected to run through June 2003.
Methods of Detecting Defects in Composite Reinforced Structures

Fiber reinforced polymer (FRP) composites are increasingly being used to strengthen deficient structures. For the bridge inspector, though, most defects in composite reinforced structures are not visible to the naked eye and are difficult to assess in terms of how they impact structural integrity. Procedures to accurately detect defects in composite-strengthened structures and to assess the effect of these defects have not been established. This project will provide methods for inspecting bridges that have been strengthened with FRP composites.

Development and Evaluation of Fiber Optic Traffic Sensor

Fiber optic traffic sensors are being developed and tested on I-84 near Fairview. The sensors – consisting of microscopic gratings etched within the fiber – are imbedded in concrete pavement two inches deep and are capable of detecting extremely small pavement strains. Specialized equipment detects small shifts in the signal wavelength and generates an electronic output pattern similar to piezoelectric sensors.

When combined with a second sensor, the vehicle speed and axle spacing can be computed. It is believed that the fiber optic sensor can provide long life and be refined to provide inexpensive weigh-in-motion capabilities.

Railroad Locked Gate Crossing Intrusion Detection

Under newer high speed rail (HSR) operating conditions, the need for protecting trains from derailment by vehicles or other objects on the track is leading to closure or grade separation of grade crossings. Elimination of the crossing or grade separation is not an option, however, at some low-volume crossings on the Oregon HSR corridor. In order to protect the train on a 100% failsafe basis at these crossings, a new approach to grade crossing safety is needed.

One approach is to protect the crossing with a locked gate and automatic intrusion detection. The goal of this project is to evaluate intrusion detection technologies that could be used in combination with a locked gate on the HSR corridor. Microwave and video detection technologies are being tested in
the lab and the field for their capability to provide the level of intrusion detection needed for this application. This project is expected to be completed by June 2003.

**Evaluation of Statistical Pay Factors for Dense Graded Mix**

ODOT has been using statistical pay factors for its asphalt pavement for a number of years. Those pay factors have been based on acceptance tests of the asphalt content, gradation and level of compaction. The level of incentive or disincentive is based on the consistency of the mix produced, not on how close the mix comes to the mix design targets. The current pay factors are not adequate performance measures for a quality pavement. Other constituents like smoothness and volumetrics may better measure quality.

This study evaluates the most important quality control factors and establishes a means to include them in the pay factor calculation. The results of the research will lead to changes in current procedures so that the new pay factors encourage contractors to make adjustments to the mix that will result in improved long term performance of the pavement. Currently, the researchers are evaluating the new set of pay factors on ODOT projects concurrently with the existing pay factors in place. The researchers expect to fully implement the new pay factors by the 2004 construction season.

**Aggregate Resource Inventory and Needs Forecast Study**

As the demand to preserve and maintain ODOT's infrastructure increases, so will demand for good quality rock, a finite source already limited in some areas. Future ODOT aggregate requirements and availability of aggregate sources have not been determined. Additionally, the quality and quantity of aggregate is not known in many of ODOT's existing quarry sites.

This study was undertaken to determine the quantity and quality of available aggregate on ODOT's owned or leased active, inactive and potential sites. Global positioning coordinates were captured for mapping purposes, and information was gathered relating to water quality impacts and adjacent land uses. Finally, the study includes a forecast of the amount of aggregate needed to meet future ODOT maintenance and construction needs. The completion date for the study is September 2002.
IV. OTHER RESEARCH ACTIVITIES

In addition to major research projects, our program is responsible for a number of ongoing programs and activities, smaller projects, and for annual selection of new research projects. These include:

- The Oregon T2 center, Oregon’s local technical assistance program
- New research project selection
- Small, discretionary projects
- Specific activities to support research implementation
- The experimental features program
- Oregon’s participation in the Long Term Pavement Performance Project (LTPP)
- Selection and participation in Pooled Fund projects with other states
- Serving as ODOT’s point of contact for national transportation research activities

Over the next few pages, accomplishments in these other areas are discussed.

OREGON TECHNOLOGY TRANSFER (T2) CENTER

The Oregon T2 Center provides transportation related information to local government agencies throughout Oregon. The Center is jointly funded by FHWA, the counties and cities of Oregon, and ODOT. T2 is one of 49 such centers that are part of FHWA’s Local Technical Assistance Program (LTAP). T2 provides the following services:

1. A lending library of audio/visual materials and technical publications.
2. Sponsorship and delivery of training courses, workshops, conferences and seminars.
3. On-site informational presentations and on-call response to information requests.
4. A quarterly newsletter of information on transportation related topics.

As its name suggests, the T2 Center strives to make each agency in the state aware of the latest and most effective transportation technologies. T2 does this by acting as an information resource and encouraging and strengthening communications between government agencies at all levels. During Fiscal 2002 the T2 Center had two major
accomplishments. One of these was a substantial overhaul and upgrade of “Oregon Roads,” the T2 quarterly newsletter. The second accomplishment was the effective launch of the “Roads Scholar Program,” an integrated curriculum of training courses leading to a certificate. The Roads Scholar Program is highlighted in Chapter 2 of this report.

**Research Project Selection**

Research project selection is carried out in two stages. Initial recommendations are made by six Expert Task Groups (ETG), with support and coordination from the Research Group staff. Then the final decision on projects is made by the ODOT Research Advisory Committee (RAC).

Project selection starts in the fall, with modifications and updates to published research priorities, and ends in the spring, with the annual project selection meeting.

Membership of the RAC and ETG committees is listed in the Appendix, along with a detailed list of the priorities used for project selection in Fiscal 2002.

**PROJECT SELECTION TIMETABLE**

The project selection process is systematic and thorough. In Fiscal 2002, research project selection proceeded according to the following timetable.

- Oct.-Nov. 2001: Expert Task Groups met to update research priorities as needed.
- Nov. 20, 2001: the Research Advisory Committee met to review and approve revised priorities.
- Dec. 7, 2001: the New Project Solicitation Packet was e-mailed to all of ODOT, and the Oregon Transportation Research Community.
- Feb. 2002: problem statements were sorted by subject area, reviewed, clarified and screened by Research Coordinators and expert task groups.
- March, 2002: Research staff developed more detailed “Stage 2” problem statements for the best project ideas in each subject area.
- April 5, 2002. The Research Advisory Committee made the final project selection. These are listed in Table 4.1
RESEARCH PRIORITIES, FISCAL 2002
(A more detailed listing is provided in the Appendix)

ROADWAY DESIGN, HYDRAULICS, GEOTECHNICAL AND ENVIRONMENTAL

- Low cost/low maintenance safety appurtenances.
- Develop design guidance for stream bank stabilization.
- Cost effective maintenance and repair activities for an aging culverts.
- Water quality control from impervious surfaces.
- Cost effective identification and stabilization of soft sub-grade.
- Innovative methods to deal with problematic coastal landslides and beach erosion control.

CONSTRUCTION AND MAINTENANCE

- Effective roadside and work zone safety.
- Effective project delivery and quality assurance.
- Effective pavement delineation.
- Winter maintenance practices.
- Efficient maintenance practices and equipment.

TRAFFIC, SAFETY, ITS & HUMAN FACTORS

- Reduce crashes related to excessive vehicle speed.
- Reduce traffic incident duration.
- Reduce intersection collisions.
- Develop accurate roadway ice detection systems.

SOCIOECONOMIC, PLANNING, MULTIMODAL AND PUBLIC TRANSIT RESEARCH

- Transportation funding mechanisms.
- Changing populations and economies.
- Mobility and accessibility indicators.
- Land use and transportation planning interactions, impacts of special transportation areas.
- Patterns of freight movement.
- Social, economic and operational impacts of Intelligent Transportation Systems.

PAVEMENTS AND MATERIALS

- Identify design, materials, construction, and maintenance practices that optimize performance.
- Develop construction processes that allow construction phase completion to minimize service disruptions.
- Identify materials and construction practices that optimize application while minimizing environmental and safety risks.

STRUCTURES

- Load capacity evaluation and improvement of structural members.
- Remediation of corrosion in reinforced concrete.
- Non-destructive evaluation technologies for assessing structures.
Table 4.1: New Projects Selected for Fiscal 2003

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Sponsor</th>
<th>Duration</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deterioration Models for Shear-Cracked Bridges, Phase 1</td>
<td>Raymond Mabey, ODOT Bridge Section</td>
<td>2 years*</td>
<td>$200,000*</td>
</tr>
<tr>
<td>Models of Project Delivery</td>
<td>Mike Wolfe, ODOT Project Delivery Manager</td>
<td>4 years</td>
<td>$325,000</td>
</tr>
<tr>
<td>Measuring the Impacts of Speed Reduction Technologies</td>
<td>Ed Fischer, ODOT Traffic Engineer</td>
<td>16 months</td>
<td>$100,000</td>
</tr>
<tr>
<td>Monitoring Bioengineering Stabilization Projects</td>
<td>Dave Bryson, ODOT Geo/Hydro Section</td>
<td>4 years</td>
<td>$170,200</td>
</tr>
<tr>
<td>Latex Polymers to Resist Stripping in Asphalt Pavements</td>
<td>Mike Remily, ODOT Pavements Engineer</td>
<td>16 months</td>
<td>$55,000</td>
</tr>
<tr>
<td>Geotechnical Analysis of Large Translational Landslides in Seaward-dipping Sedimentary Rocks</td>
<td>Mike Long, ODOT Geo/Hydro Section Mgr</td>
<td>5 years</td>
<td>$439,700</td>
</tr>
<tr>
<td>Transportation Plan Performance Measures</td>
<td>Brian Gregor, ODOT Planning</td>
<td>2 years</td>
<td>$100,000</td>
</tr>
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</table>

*The full cost of this project is much greater. The RAC approved an initial phase of the project, and asked that project sponsors return to the Research Advisory Committee with a revised work plan and budget in 2004. Subsequently the project was determined to be of such high priority, that it was accelerated and fully funded using other sources of funds. Expected FY'2003 expenditures are now $1,360,000.

**SMALL, QUICK RESPONSE & DISCRETIONARY PROJECTS**

Each year funds are set aside for small, quick-response projects and activities. These may be funded using federal SPR funds, but they sometimes use 100% state funds.

**Information Requests**

Research staff are periodically called upon to conduct a literature search or to provide other information to other ODOT staff on a particular topic. We do not track information requests, but research staff spent approximately 375 hours responding to them in Fiscal 2002.

**Discretionary Projects**

Twelve small projects were active during Fiscal 2002, of which 5 were completed and seven are continuing. Completed projects included the following:

**Chemawa Interchange Microwave Detector**

This project was described in Chapter 3.

**Strain Monitoring of Sylvan and Horsetail Falls Bridges**

Fiber optic sensors were installed on two reinforced concrete bridges that had been strengthened with fiber reinforced polymer (FRP) composites. The primary objective for one of the bridges was to provide strain data to verify a computer model for
the bridge developed under a separate project. A second objective – to evaluate the effect of FRP composite reinforcement on bridge response – was not achieved, because usable strain data were not acquired prior to retrofit. The project had additional value in allowing us to gain experience in the application of fiber optic sensing technology to bridge beams.

**Motor Carrier Overweight Enforcement**

This study examined the effectiveness of overweight enforcement levels, by monitoring axle loads before, during and after a long-term closure of the Woodburn weigh station on I-5 northbound. There was no evidence of diversion of overweight traffic between mainline and bypass routes in response to closure, and there were only modest changes in axle weights on I-5, indicating a smaller than expected response to the absence of enforcement. Additional analysis explored the incidence of overloading among ODOT Green Light pre-clearance program participants. Green Light participants were less likely than non-participating vehicles, to overload in response to scale closure.

**Arrow Panel Display**

This project evaluated the effectiveness of a “sequentially flashing diamond” arrow panel display as an advance caution warning in temporary work zones. This display was compared to two others. In survey responses from other state DOTs, each display was rated about the same in terms of effectiveness. Field trials showed that the largest speed reduction was achieved from the sequentially flashing diamond. Over 70% of people interviewed at a highway rest area chose the diamond display as the most effective in getting their attention. A large majority (80%) said they would like to see the flashing diamond used when work is taking place on Oregon highways.

**Flashing Yellow Arrow**

This project’s purpose was to collect data as part of a national evaluation (NCHRP 3-54) of a new protected and permissive left turn traffic signal configuration. No report was produced in Oregon. A final report will be published by the Transportation Research Board.

**Research Implementation**

Ongoing research implementation activities through FY 2002 involved the following specific activities and accomplishments.

**Research Notes**

Ten research notes were published. A research note is a short (two- to four-page) summary, usually of a research report, but sometimes on another topic, designed to provide information of immediate usefulness directly to the user. Research Notes can be found at the ODOT Research web page: [www.odot.state.or.us/tddresearch/](http://www.odot.state.or.us/tddresearch/) under “Research Notes.”
**Quarterly Newsletter**

We initiated publication of *ODOT Research News*, a quarterly electronic research newsletter, with the Fall 2001 edition. The newsletter is one of the recommendations resulting from our 2001 Peer Exchange. The quarterly newsletter has a similar function to the research note, except that it contains more information about events and ongoing research, as well as completed research, and it has broader potential distribution. The quarterly newsletter is distributed through a link to *Inside ODOT*, the Department’s internet newspaper. It is also distributed via listserv to the AASHTO Research Advisory Committee, FHWA and TRB. The Quarterly Newsletter can be found from the ODOT Research web page: www.odot.state.or.us/tddresearch/ under “Publications.”

**Maintenance Outreach**

Fiscal 2002 was the third year for the Maintenance Outreach program. The program consists of a part-time “circuit rider” who travels around the state to make contact with ODOT maintenance forces. Currently the circuit rider is a retired ODOT employee with substantial knowledge and experience with paving materials and pavement preservation methods. The circuit rider’s role is to spread useful information about maintenance innovations. This occurs in a variety of ways. Some information is gathered and developed from ODOT Research projects and research reports from other states. Some is delivered through specific courses developed and/or delivered by the circuit rider. Most of the best innovations, however, are gleaned from particular maintenance crews and simply passed along to crews in other parts of the state.

**Northwest Transportation Conference**

As noted earlier in this report, ODOT Research played a greatly expanded role in the 2002 Northwest Transportation Conference.

**Implementation Closeout Memos**

In order to improve documentation of the implementation of specific projects and to provide a basis for a potential outcome-based performance measure, a new practice was established during Fiscal 2002. As a research project is concluding, the responsible research coordinator 1) holds a discussion of implementation options at the final Technical Advisory Committee meeting, and 2) prepares a memorandum that documents the implementation that has occurred or is expected to occur, as a result of the research. This too was a recommendation from the 2001 Peer Exchange.

**Experimental Features**

The experimental features program provides ODOT with an opportunity to test and evaluate materials and devices on Federal Aid construction projects. The program provides Federal funds to assist with
removal of experimental features, providing ODOT with an opportunity to evaluate new products and methods without incurring financial risk. The role of research is 1) to document the experimental feature “as built,” 2) to monitor the feature for performance, and 3) to prepare and publish a report on performance of the feature.

In Fiscal 2002 we completed two experimental features reports. One documented the performance of a cosmetic treatment applied over shotcrete called “Desert Varnish,” which was used on a segment the Historic Columbia River Highway near Dabney State Park. The second reported on the performance of the URETEK method of injected polyurethane, used to correct settling of a concrete slab at the approach to the Glenn Jackson Bridge in Portland.

There are two continuing experimental features projects – one on bridge bearings, and one on variable speed limits.

**LONG TERM PAVEMENT PERFORMANCE (LTPP)**

The LTPP project is a 15-year national study of pavement performance, involving hundreds of monitoring sites across the United States. Each site collects traffic counts and classifies traffic by length and axle configuration. Also, during four 7-day sessions each year, axle weight data are collected using weigh-in-motion sensors. Oregon is responsible for maintaining and calibrating sensors and equipment at eight sites, as well as downloading and transmitting data. The national LTPP database is a rich resource that has produced, and will continue to produce, valuable information about optimal pavement design, construction, preservation and rehabilitation.

**POOLED FUND PROJECTS**

The Federal Highway Administration allows states to cooperate in funding of research through a Transportation Pooled Fund (TPF) project. The pooled fund program offers several advantages.

One advantage is cost sharing. On recent projects, for every ODOT dollar contributed, we’ve been able to leverage approximately $14 from other states.

A second advantage is that TPF projects are approved for 100% Federal funding, which means participating states do not need to find state matching funds.

In Fiscal 2002 ODOT contributed to 13 pooled fund projects. These are summarized in Table 4.2.
<table>
<thead>
<tr>
<th>Study No.</th>
<th>Title</th>
<th>ODOT Contact</th>
<th>Lead State</th>
<th>Oregon 2002 Contribution</th>
<th>Oregon Total Contribution</th>
<th>Total Project Cost</th>
</tr>
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<tbody>
<tr>
<td>SPR 3(049)</td>
<td>Urban Mobility Study (Regional Pooled Fund)</td>
<td>Brian Gregor, Planning Section</td>
<td>Texas</td>
<td>$20,000</td>
<td>$85,000</td>
<td>$1,030,010</td>
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<tr>
<td>SPR 3(076)</td>
<td>Animal-Vehicle Crash Mitigation Using Advanced Technologies</td>
<td>Kevin Haas, Research Group</td>
<td>Oregon</td>
<td>$25,000</td>
<td>$100,000</td>
<td>$945,000</td>
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<tr>
<td>SPR 3(082)</td>
<td>Evaluation of the Next Generation PQI Device</td>
<td>Mike Remily, Pavement Quality Engineer</td>
<td>Maryland</td>
<td>$10,000</td>
<td>$30,000</td>
<td>$254,000</td>
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<tr>
<td>SPR 2(212)</td>
<td>Non-nuclear Testing of Soils and Granular Bases Using the GeoGauge</td>
<td>Steve Narkiewicz, Geo-Hydro Section</td>
<td>FHWA</td>
<td>$12,000</td>
<td>$24,000</td>
<td>$330,813</td>
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<tr>
<td>SPR 2(208)</td>
<td>Pavement Subgrade Performance Study</td>
<td>Lucinda Moore, Pavements Engineer</td>
<td>New York</td>
<td>$15,000</td>
<td>$45,000</td>
<td>$1,865,000</td>
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<tr>
<td>SPR 2(218)</td>
<td>Durability of Segmental Concrete Block Retaining Walls</td>
<td>Jeff Swanstrom, Bridge Section</td>
<td>FHWA</td>
<td>$15,000</td>
<td>$45,000</td>
<td>$160,000</td>
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<tr>
<td>TPF 5(008)</td>
<td>Computer/Web Based Learning Project</td>
<td>Kevin Alano, Human Resources Development</td>
<td>FHWA</td>
<td>$10,000</td>
<td>$30,000</td>
<td>$755,000</td>
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<tr>
<td>SPR 3(071)</td>
<td>A New Approach to Road User Charges</td>
<td>Jack Svadlenak, Policy Section</td>
<td>Minnesota</td>
<td>$10,000</td>
<td>$20,000</td>
<td>$560,401</td>
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<tr>
<td>TPF 5(017)</td>
<td>WASHTO X Technology Transfer Initiative</td>
<td>Elizabeth Hunt, Research Group</td>
<td>Utah</td>
<td>$10,000</td>
<td>$20,000</td>
<td>$190,300</td>
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<tr>
<td>TPF 5(027)</td>
<td>Effects of Hot Plant Fuel Characteristics</td>
<td>Mike Remily, Pavement Quality Engineer</td>
<td>South Dakota</td>
<td>$15,000</td>
<td>$25,000</td>
<td>$309,000</td>
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<tr>
<td>TPF 5(043)</td>
<td>SCORT Bottom Line Rail Study</td>
<td>Ed Immel, Rail Division</td>
<td>Pennsylvania</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$100,000</td>
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<tr>
<td>TPF 5(018)</td>
<td>Evaluation of the Influence of Asphalt Binder on Mixture Fatigue</td>
<td>Bruce Patterson, Pavement Materials Engineer</td>
<td>Arizona</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$78,000</td>
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<tr>
<td>SPR 3(096)</td>
<td>Fish Passage Capability through Modified Culverts</td>
<td>Lance Clark, Geo-Hydro Section</td>
<td>Washington</td>
<td>$20,000</td>
<td>$40,000</td>
<td>$675,000</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>$172,000</strong></td>
<td><strong>$479,000</strong></td>
<td><strong>$7,252,524</strong></td>
</tr>
</tbody>
</table>
**National Research Program Coordination**

ODOT participates directly or indirectly in a number of national research programs and initiatives. In general, the role of ODOT Research is that of liaison, or point of contact. There are also funding relationships. Among the responsibilities carried out by ODOT Research in Fiscal 2002, are the following.

- Coordination of internal ODOT balloting for FY’03 NCHRP Project Selection.
- Nomination of ODOT employees to NCHRP Project Panels, and service on NCHRP Project Panels by ODOT Research staff.
- Coordination of the completion of NCHRP Synthesis Questionnaires.
- Dissemination of national research results.

**Transportation Research Board**

The Research Group Manager is the Oregon DOT representative to the Transportation Research Board (TRB). This responsibility involves a range of duties that relate to coordination of communication and services between ODOT and TRB.

**National Cooperative Highway Research Program (NCHRP) and Transit Cooperative Research Program (TCRP)**

NCHRP and TCRP are operated by the Transportation Research Board. States make voluntary contributions of funds, based on a percentage of their annual SPR funding. The research group carried out the following NCHRP responsibilities in Fiscal 2002.

- Assistance to ODOT employees who wish to submit problem statements.
- Payment of Oregon’s annual NCHRP contribution ($373,329 in FY’02).

- Coordination of internal ODOT balloting for FY’03 NCHRP Project Selection.
- Nomination of ODOT employees to NCHRP Project Panels, and service on NCHRP Project Panels by ODOT Research staff.
- Coordination of the completion of NCHRP Synthesis Questionnaires.
- Dissemination of national research results.

**American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee**

The Research Group Manager is a member of the AASHTO Research Advisory Committee. This organization has several important functions within AASHTO, and in setting the national transportation research agenda. It is also the principal point of contact for transportation research between states. Specific functions and duties include the following.

**Annual Meetings.** The AASHTO Research Advisory Committee meets regionally (via WASHTO) in odd-numbered calendar years, and nationally in even-numbered years. In FY 2002 the annual western region meeting was in Post Falls, Idaho.

**National RAC Listserv.** Members of the Committee are members of an electronic mail listserv, which is used to communicate on a variety of topics. A key use that has evolved is the gathering of information about practices in other states, particularly with regard to the applications
of new technology. ODOT Research coordinates hundreds of such requests for information from other states every year.

**WASHTO-X.** WASHTO-X is a video teleconferencing experiment involving 17 states in the western region. For the purposes of the initial trial, it is funded as a Transportation Pooled Fund study TPF-5(017). The purpose of WASHTO-X is to provide an opportunity for subject matter experts in western states to meet via video teleconference for a focused discussion of some aspect of emerging transportation technology, to share and learn from the experiences of peers in other states. In Fiscal 2002, ODOT Research participated by working with the project coordinators in Utah and North Dakota to resolve technical and procedural issues. The first substantive use of the system occurred on June 24, 2002, featuring a discussion of methods for noise abatement.
V. PUBLICATIONS, PROJECT ACTIVITY & SPENDING

The next few pages summarize, in tabular and graphic form, reports published, active projects and cost information.

RESEARCH PROJECTS

Table 5.1 summarizes the status of 65 research projects initiated from Fiscal Year 1994 through Fiscal Year 2002.

Table 5.2 summarizes 19 reports published in FY’02. Note that one project, Rural Public Transportation: Using GIS to Guide Service Planning, was published by TransNOW with significant financing and involvement from ODOT Research.

Table 5.3 summarizes 34 major projects that were active in Fiscal 2002. Major projects are defined as those projects that are selected by the Research Advisory Committee and typically have a budget of at least $75,000 and a duration of at least one year.

Table 5.4 summarizes all other research projects and related activities, and includes the Research Discretionary Fund, the Experimental Features Program, the Long Term Pavement Performance Project and miscellaneous continuing activities. These activities were described in Chapter 4.

Table 5.1: Project Status Summary, FY 1994 – FY 2002

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Total New Projects</th>
<th>Inactive</th>
<th>Active</th>
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<tbody>
<tr>
<td></td>
<td>Complete</td>
<td>Cancelled</td>
<td>On Schedule</td>
</tr>
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<td>1994</td>
<td>9</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>1995</td>
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<td>6</td>
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</tr>
<tr>
<td>Total</td>
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<td>40</td>
<td>7</td>
</tr>
<tr>
<td>Author</td>
<td>Title</td>
<td>Report #</td>
<td></td>
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<tr>
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<tr>
<td>E. Brooks, K. Haas</td>
<td>Desert Varnish: MP 4.1 to Dabney State Park. Final Report</td>
<td>OR-EF-02-03</td>
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<tr>
<td>R. Edgar</td>
<td>Evaluation of Microwave Traffic Detector. Final Report</td>
<td>FHWA-OR-DF-02-05</td>
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<tr>
<td>D. MacDonald, A. Kirk</td>
<td>Precast Concrete Barrier Crash Testing. Final Report</td>
<td>FHWA-OR-RD-02-07</td>
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<tr>
<td>J. Strathman, G. Theisen</td>
<td>Weight Enforcement and Evasion: Oregon Case Study. Final Report</td>
<td>FHWA-OR-DF-02-12</td>
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<td>S. Lovejoy</td>
<td>A Fitness-For-Purpose Evaluation of Electro-slag Flange Butt Welds. Final Report</td>
<td>OR-RD-02-15</td>
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<tr>
<td>S. Soltesz</td>
<td>Strain Monitoring of Horsetail Falls and Sylvan Undercrossing. Final Report</td>
<td>FHWA-OR-DF-02-17</td>
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<tr>
<td>S. Soltesz</td>
<td>Injected Polyurethane Slab Jacking. Final Report</td>
<td>FHWA-OR-EF-02-19</td>
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<tr>
<td>T. Sanchez, N. Bania, L. Leete</td>
<td>Rural Public Transportation: Using GIS to Guide Service Planning (Published by TransNOW)</td>
<td>TNW2002-01</td>
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<tr>
<td>Project No.</td>
<td>Project Title</td>
<td>Spent in FY’2002</td>
<td>Expected End Date</td>
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<tr>
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<td>312</td>
<td>Fiber Optic Traffic Sensors</td>
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<td>314</td>
<td>Aggregate Needs Forecast</td>
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<td>317</td>
<td>Intermittent Cathodic Protection</td>
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<td>Mar-04</td>
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<td>321</td>
<td>Safety Benefits of Engineering Improvements</td>
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<td>Jul-01</td>
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<td>322</td>
<td>Selection Criteria for Nighttime Operations</td>
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<td>323</td>
<td>Acceptance Procedures for Dense Graded Mixes</td>
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<td>Oct-04</td>
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<td>324</td>
<td>Vegetated Riprap Stability</td>
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<td>Jan-02</td>
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<td>325</td>
<td>Fish Passage Through Culverts</td>
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<td>Jun-03</td>
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<td>326</td>
<td>Analysis of Brush Creek Concrete Beams</td>
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<td>Mar-03</td>
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<td>328</td>
<td>Freight Shipper &amp; Motor Carrier Survey</td>
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<td>330</td>
<td>Crash Testing Precast Concrete Barriers</td>
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<td>331</td>
<td>Driver Improvement Program Evaluation</td>
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<tr>
<td>332</td>
<td>Automated Data Collection</td>
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<td>Oct-02</td>
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<tr>
<td>333</td>
<td>Assessing Public Inconvenience on Highway Projects</td>
<td>$69,269</td>
<td>Aug-02</td>
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<tr>
<td>334</td>
<td>Concrete Repair Reference Guide</td>
<td>$24,048</td>
<td>Sep-02</td>
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<tr>
<td>335</td>
<td>Water Quality Facility Investigation</td>
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<td>336</td>
<td>Methods for Detecting Defects in Composite Reinforced Structures</td>
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<td>337</td>
<td>Using GIS for Rural Transit Planning</td>
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<td>340</td>
<td>Asphalt Pavement Analyzer to Evaluate Rut Resistance</td>
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<td>341</td>
<td>Life of Shear-Cracked Concrete Beams</td>
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<td>342</td>
<td>Treatment of Concrete Cure Water</td>
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<td>343</td>
<td>Methods to Collect &amp; Analyze Truck Trip Data</td>
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<td>344</td>
<td>Improving the Effectiveness of Partnering</td>
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<td>345</td>
<td>Effectiveness of Cathodic Protection</td>
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<td>355</td>
<td>Crumb Rubber Modifiers (CRM) in Asphalt Concrete Pavements</td>
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<td>364</td>
<td>Effect of Corrosion Film Growth on Adhesion of Zinc Coatings</td>
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<tr>
<td>371</td>
<td>F-Mix Maintenance Practices</td>
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<tr>
<td>373</td>
<td>Repair of Rutting Caused by Studded Tires</td>
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<td>375</td>
<td>Using Superpave Technology for Quality Management of HMA</td>
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<td>384</td>
<td>Humectants to Augment Zinc CPS</td>
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<td>391</td>
<td>Performance of Solvent-Free Emulsions</td>
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<td>Alternatives to the Motor Fuel Tax</td>
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<td>Rockfall Catchment Area Design Guide</td>
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<td>Evaluation of IPM on Water Quality</td>
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<td>$1,007,360</td>
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</table>
Table 5.4: Other FY 2002 SPR Activities: Research Discretionary Fund, Experimental Features, LTPP, Continuing Activities

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Title</th>
<th>Spent FY 2002</th>
<th>Due Date</th>
<th>Status</th>
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<tr>
<td>300</td>
<td>SPR Administration</td>
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<td>301</td>
<td>SPR Project Selection and Development</td>
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<td>302-000</td>
<td>SPR Implementation</td>
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<td>302-011</td>
<td>Maintenance Outreach</td>
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<td>302-021</td>
<td>2002 Northwest Transportation Conference</td>
<td>$23,834</td>
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<td>304-000</td>
<td>Small Project Development</td>
<td>$13,831</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>304-021</td>
<td>Chemawa Interchange Microwave Detector</td>
<td>$5,425</td>
<td>Mar-02</td>
<td>Published</td>
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<tr>
<td>304-031</td>
<td>Bridge Washing</td>
<td>$1,022</td>
<td>Jun-05</td>
<td>Continuing</td>
</tr>
<tr>
<td>304-051</td>
<td>Field Verification Process for Open Graded Mixes</td>
<td>$9,379</td>
<td>Jul-02</td>
<td>Published</td>
</tr>
<tr>
<td>304-071</td>
<td>2001 Peer Exchange</td>
<td>$18,060</td>
<td>Apr-02</td>
<td>Complete</td>
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<tr>
<td>304-081</td>
<td>Sylvan Bridge Composite Strengthening</td>
<td>$8,666</td>
<td>Jun-02</td>
<td>Published</td>
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<tr>
<td>304-101</td>
<td>Motor Carrier Overweight Enforcement</td>
<td>$19,153</td>
<td>Feb-02</td>
<td>Published</td>
</tr>
<tr>
<td>304-121</td>
<td>National Research Liaison and NCHRP Activity</td>
<td>$13,201</td>
<td>ongoing</td>
<td>N/A</td>
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<tr>
<td>304-131</td>
<td>Arrow Panel Display</td>
<td>$5,968</td>
<td>Aug-01</td>
<td>Published</td>
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<tr>
<td>304-141</td>
<td>Lava Butte Critter-friendly Median Barrier</td>
<td>$14,105</td>
<td>Sep-03</td>
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<tr>
<td>304-151</td>
<td>ITS Investment Case Studies</td>
<td>$14,400</td>
<td>N/A</td>
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<tr>
<td>304-161</td>
<td>Optimum Deployment of Police Patrols</td>
<td>$10,065</td>
<td>Dec-02</td>
<td>Continuing</td>
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<tr>
<td>304-171</td>
<td>Flashing Yellow Arrow</td>
<td>$2,596</td>
<td>Jun-02</td>
<td>Complete</td>
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<tr>
<td>304-181</td>
<td>Concrete Maturity Meter</td>
<td>$2,355</td>
<td>Dec-02</td>
<td>Continuing</td>
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<tr>
<td>304-191</td>
<td>Double Fines Signing Project</td>
<td>$1,099</td>
<td>Dec-02</td>
<td>Continuing</td>
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<tr>
<td>305</td>
<td>TRB Subscription</td>
<td>$84,060</td>
<td>Nov-01</td>
<td>N/A</td>
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<td>306-000</td>
<td>Experimental Features</td>
<td>$0</td>
<td>ongoing</td>
<td>N/A</td>
</tr>
<tr>
<td>306-111</td>
<td>EF: Base Isolation Bearings</td>
<td>$0</td>
<td>Dec-02</td>
<td>Continuing</td>
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<tr>
<td>306-211</td>
<td>EF: Desert Varnish</td>
<td>$2,199</td>
<td>Aug-01</td>
<td>Published</td>
</tr>
<tr>
<td>306-261</td>
<td>EF: Slab Jacking Using Injected Urethane</td>
<td>$2,263</td>
<td>Jun-02</td>
<td>Published</td>
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<tr>
<td>306-271</td>
<td>EF: Variable Speed Limits*</td>
<td>$1,548</td>
<td>Sep-04</td>
<td>Continuing</td>
</tr>
<tr>
<td>307</td>
<td>SHRP LTPP Activities</td>
<td>$29,546</td>
<td>Jun-05</td>
<td>Continuing</td>
</tr>
</tbody>
</table>

$453,680

Note that a number of these projects are using funds from other sources, in addition to research funds. These include 304-101, 304-161 and 304-191 which used additional funds contributed by the Transportation Safety Section, and 304-181 which used additional funds from a construction project.
BUDGET AND FUNDING

Research funding originates from several sources:

- **Federal State Planning and Research (SPR).** SPR program funding is set at two percent of each state’s FHWA highway funding under 23 U.S.C. 307(c). Of that two percent, at least 25 percent (0.5%) is specifically identified for Research, Development and Technology Transfer. For Oregon in recent years this amounts to $1.5 million to $1.7 million per year. SPR RD&T funds support a large share of direct expenditures on research projects.

- **Local Technical Assistance Program (LTAP).** FHWA LTAP funding is targeted for technical assistance and training for local agency public works programs. These funds provide half the funding for the programs and activities of the Oregon Technology Transfer (T2) program.

- **Oregon Highway Fund.** These funds are used in several ways. The Research Group uses state highway funds to cover indirect costs. Also, with some specific exceptions, SPR funds require 20 percent local participation, and in most cases the source of these “matching” funds is the Oregon Highway Fund. Finally, a few research projects are carried out with state highway funds.

- **Local Government.** LTAP funding requires 50 percent local participation, and because not all the activities of the T2 Program qualify for Oregon highway funds, most of these required matching funds are provided instead by the Association of Oregon Counties and the League of Oregon Cities. Members of both these organizations are the primary recipients of T2 services.

There are also two ways that Federal SPR funds are accessed. When a project is budgeted and carried out by the Research Group, ODOT applies for and receives reimbursement for the Federal share of any qualifying SPR project expense.

It is also possible to obligate Federal SPR funds to a pooled fund project. In this case the funds are never received by ODOT and therefore do not affect the budget. In a manner of speaking, the funds are simply redirected from one Federal account to another. This option is used to contribute to pooled fund projects managed by FHWA and other states. It is also used to make Oregon’s NCHRP contribution and to pay the annual Transportation Research Board subscription fee.

Table 5.5 summarizes expenditures by program area and by source of funds. Figure 5.1 presents expenditures by program area in graphic form. Table 5.6 summarizes the FHWA SPR Research Funds activity during Fiscal 2002.
Table 5.5: Budget and Expenditures Summary By Program and by Source of Funds

<table>
<thead>
<tr>
<th></th>
<th>Federal</th>
<th>State and Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPR</td>
<td>LTAP</td>
<td>Oregon Highway Funds</td>
</tr>
<tr>
<td>SPR Research Program</td>
<td>$1,118,396</td>
<td></td>
<td>$253,405</td>
</tr>
<tr>
<td>State Research Program</td>
<td></td>
<td></td>
<td>$102,517</td>
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<tr>
<td>Oregon Technology Transfer (T2) Center (LTAP)</td>
<td>$10,351</td>
<td>$139,774</td>
<td></td>
</tr>
<tr>
<td>National Cooperative Highway Research Program (NCHRP)</td>
<td>$373,329</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled Fund Research Projects led by Oregon</td>
<td>$380,248</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled Fund Research Contributions to Other States</td>
<td>$172,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rent, Utilities and other Indirect Costs</td>
<td></td>
<td></td>
<td>$234,379</td>
</tr>
<tr>
<td></td>
<td>$2,054,324</td>
<td>$139,774</td>
<td>$590,301</td>
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</table>

Figure 5.1: FY 2002 Research Expenditures

Note: These expenditures include both budgeted expenditures and funds made available to other organizations by obligating them through the FMIS system.
### Table 5.6: Federal SPR RD&T Funds Activity in FY 2002

<table>
<thead>
<tr>
<th>Income/ Expenditure</th>
<th>Date</th>
<th>Amount</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FY 2002 Beginning Balance</strong></td>
<td></td>
<td></td>
<td>$1,968,312</td>
</tr>
<tr>
<td>Adjustments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTAP Match for CY 2001 (Additional Funds for the T2 Program)</td>
<td>Aug-01</td>
<td>($28,640)</td>
<td></td>
</tr>
<tr>
<td>Net FY 2002 Apportionment</td>
<td>Dec-01</td>
<td>$1,696,951</td>
<td></td>
</tr>
<tr>
<td><strong>Adjustments subtotal</strong></td>
<td></td>
<td></td>
<td>$1,786,971</td>
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<tr>
<td><strong>Balance, after adjustments</strong></td>
<td></td>
<td></td>
<td>$3,636,623</td>
</tr>
<tr>
<td><strong>FY 2002 Work Program Expenses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds to be de-obligated (not used) For 2002</td>
<td>Jul-01</td>
<td>($1,285,868)</td>
<td></td>
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<tr>
<td>LTAP Match for CY 2002</td>
<td>Pending</td>
<td>$167,472</td>
<td></td>
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<tr>
<td><strong>Net FY 2002 Work Program</strong></td>
<td></td>
<td>($1,133,396)</td>
<td></td>
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<tr>
<td><strong>Balance, after FY 2002 Work Program Expenses</strong></td>
<td></td>
<td></td>
<td>$2,503,227</td>
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<tr>
<td><strong>Pooled Fund Project Contributions</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SPR 3(049) Urban Mobility Study</td>
<td>Jul-01</td>
<td>($12,000)</td>
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<tr>
<td>TPF 5(008) Computer/Web based Learning Project</td>
<td>Nov-01</td>
<td>($20,000)</td>
<td></td>
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<tr>
<td>SPR 3(071) A New Approach to Road User Charges</td>
<td>Jul-01</td>
<td>($10,000)</td>
<td></td>
</tr>
<tr>
<td>TPF 5(017) WASHTO X Technology Transfer Initiative</td>
<td>Nov-01</td>
<td>($20,000)</td>
<td></td>
</tr>
<tr>
<td>SPR 3(076) Vehicle Game Animal Collision Avoidance</td>
<td>Jul-01</td>
<td>($25,000)</td>
<td></td>
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<tr>
<td>SPR 3(082) Evaluation of Next Generation PQI</td>
<td>Jul-01</td>
<td>($10,000)</td>
<td></td>
</tr>
<tr>
<td>SPR 2(208) Pavement Subgrade Performance</td>
<td>Jul-01</td>
<td>($15,000)</td>
<td></td>
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<tr>
<td>SPR 2(218) Durability of Segmented Retaining Walls</td>
<td>Jul-01</td>
<td>($15,000)</td>
<td></td>
</tr>
<tr>
<td>TPF 5(027) Effects of Hot Plant Fuel Characteristics</td>
<td>Jul-01</td>
<td>($15,000)</td>
<td></td>
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<tr>
<td>SPR 3(096) Fish Passage Capability through Modified Culverts</td>
<td>Nov-01</td>
<td>($20,000)</td>
<td></td>
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<tr>
<td>TPF 5(043) SCORT National Rail Freight Initiative</td>
<td>Feb-02</td>
<td>($5,000)</td>
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<tr>
<td>TPF 5(018) Influence of Asphalt Binder on Mixture Fatigue Perf.</td>
<td>Jul-01</td>
<td>($5,000)</td>
<td></td>
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<tr>
<td>SPR 4(201) National Cooperative Highway Research Program (NCHRP)</td>
<td>Jan-02</td>
<td>($373,329)</td>
<td></td>
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<tr>
<td><strong>Pooled Fund contributions subtotal</strong></td>
<td></td>
<td></td>
<td>($555,329)</td>
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<tr>
<td><strong>Balance, after Pooled fund expenses</strong></td>
<td></td>
<td></td>
<td>$1,947,898</td>
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*The beginning balance matches the figure in the FHWA Financial Management Information System (FMIS). However, there may be additional unused funds to be de-obligated from the FY 2000 and 2001 work programs.
APPENDIX: RESEARCH ADVISORY COMMITTEE, EXPERT TASK GROUPS AND RESEARCH PRIORITIES

RESEARCH ADVISORY COMMITTEE
The Research Advisory Committee makes final decisions on research priorities and project selection. Each voting member also sits on an Expert Task Group.

Voting Members:
- Ed Fischer, ODOT Traffic Engineer
- Mark Hirota, ODOT Bridge Engineer
- Thomas Lauer, ODOT Roadway Engineering Manager
- Michael Long, ODOT Geo-Hydro Section Manager
- Kenneth Stoneman, ODOT Construction Section Manager
- James Strathman, Professor, School of Urban Studies and Planning, Portland State University

Non-Voting Members:
- Barnie Jones, ODOT Research Manager
- Robert Raths, FHWA Oregon Division
- Jerri Bohard, ODOT Planning Section Manager

EXPERT TASK GROUPS
Project selection is organized into six subject areas. Each area has its own Expert Task Group (ETG). These groups develop and recommend priorities and screen problem statements in their areas of expertise.

ROADWAY DESIGN, HYDRAULICS, GEOTECHNICAL AND ENVIRONMENTAL

Expert Task Group:
- Brett Sposito, Chair, ODOT Research
- Mike Long, ODOT Geo/Hydro Section
- Elton Chang, FHWA Oregon Division
- Dan MacDonald, ODOT Roadway Engineering Section
- Steve Narkiewicz, ODOT Geo/Hydro Section
- Bill Ryan, ODOT Environmental Services Section
- Paul Wirfs, ODOT Geo/Hydro Section

Research Priorities:
Create low cost/low maintenance safety appurtenances and test these systems to NCHRP 350 Standards.

Develop design guidance for streambank stabilization using bioengineering or other alternatives to riprap. Monitor bioengineering streambank stabilization projects.

Produce cost effective maintenance and repair activities for an aging infrastructure, such as culvert rehabilitation using trenchless technology. A culvert condition assessment program is needed to prioritize maintenance/repair activities.

Water quality control from impervious surfaces including effectiveness and maintenance issues.

Develop/locate cost effective approaches to early identification and stabilization of soft subgrade.
Produce/identify innovative methods to deal with problematic coastal issues, such as, landslides and shore protection structures (embankment protection from wave action for Hwy 101).

STRUCTURES

Expert Task Group:
Steven Soltesz, Chair, ODOT Research
Mark Hirota, ODOT Bridge Engineer
Scott Nelson, ODOT Bridge Operations
Jeff Swanstrom, ODOT Bridge Operations
Bruce Johnson FHWA Oregon Division
Solomon Yim, Director, Transportation Research Institute, Oregon State University

Research Priorities:
Load capacity evaluation and improvement of structural members. Research emphasis is on determining the load capacity of in-place structural elements and using high performance materials to increase integrity.

Remediation of corrosion in reinforced concrete. Efforts focus on improving and characterizing cathodic protection technologies and explaining the factors that lead to premature deterioration.

Non-destructive evaluation technologies for assessing structures. Research is aimed at developing technologies for monitoring the real-time behavior and long-term health of structures.

CONSTRUCTION AND MAINTENANCE

Expert Task Group:
Kevin Haas, Chair, ODOT Research
Tom Lauer, ODOT Roadway Engineering
Doug Hedlund, ODOT Office of Maintenance
Joe Jayne, ODOT Fleet Services
Steve Littrell, ODOT Region 2 Project Manager
Ted Paselk, ODOT District 7 Manager
David Rogge, Dept. of Civil, Const. & Environmental Engineering, Oregon State University
Jeffrey Graham, FHWA Oregon Division

Research Priorities:
Effective Roadside Roadside and Work Zone Safety. Materials, methods, policies and procedures need to be developed and implemented to enhance roadside and work zone safety for both the travelling public and the roadside workforce.

Effective Project Delivery and Quality Assurance. As our transportation infrastructure continues to deteriorate, the backlog of maintenance and construction needs continues to grow. As funding becomes available to address these needs, project delivery methods need to be streamlined and our quality assurance program improved to ensure that the public is receiving the highest-quality, most cost-effective transportation improvements for their tax dollar.

Effective Pavement Delineation. The climatic and topographical differences across Oregon provide unique challenges in providing positive guidance for motorists in all types of lighting and weather conditions. The deployment of effective pavement delineation devices
Research Priorities:

Winter Maintenance Practices. Oregon’s highways provide essential links to personal, business, and recreational services throughout the state. Efficient and reliable operation of our transportation network during winter months is vital to the health of the economy. The development of best maintenance practices, innovative equipment, and information sharing for winter maintenance activities will go a long way in keeping goods and services moving during the frequent severe weather events each winter.

Efficient Maintenance Practices and Equipment. As new maintenance equipment and practices become available, we need to continually review our fleet management and maintenance practices to ensure that we are providing the most cost-effective maintenance of our infrastructure for the taxpayer dollar.

Socioeconomic, Planning, Multimodal and Public Transit Research

Expert Task Group:

Alan Kirk, Co-chair, ODOT Research
Joni Reid, Co-chair, ODOT Research
Jim Strathman, Center for Urban Studies, Portland State University
Victor Dodier, ODOT Governmental Relations
Brian Gregor, ODOT Transportation Planning Analysis
Claudia Howells, ODOT Rail Division
John Merriss, Policy Unit, ODOT Policy Section
Fred Patron, FHWA Oregon Division
Kate Poole, ODOT Planning Group
Dinah Van Der Hyde, ODOT Transit Division

Research Priorities:

Transportation Funding Mechanisms: What are possible state and local funding mechanisms for all modes of transportation -- auto, truck, rail, bus, bicycle, etc. -- and how could they be structured, implemented and collected?

Changing Populations and Economies: Given different travel needs and behaviors in the near future, due to changing demographics and economics, how can ODOT tailor the multimodal transportation system to best meet the needs?

Mobility and Accessibility Indicators: How can ODOT measure impacts of project decisions on mobility and accessibility, including impacts of NOT funding a project or allowing/changing access?

Planning: What types of land use planning and development decisions have the greatest benefits and costs for the transportation system? How does urban form affect the types and rates of travel? What are the impacts of Special Transportation Areas on the population, economy, safety, etc.?

Freight: What are the patterns of freight movements, and how do those patterns respond to changes in transportation costs?

Intelligent Transportation Systems: What are the social and economic impacts of ITS? What are the effects of ITS on the transportation system, and its administration?
TRAFFIC, SAFETY, ITS & HUMAN FACTORS RESEARCH

Expert Task Group:
Rob Edgar, Chair, ODOT Research
Ed Fisher, ODOT Traffic Engineer
Chris Bell, Associate Dean, College of Engineering, Oregon State University
Troy Costales, ODOT Transportation Safety Division
Nick Fortey, FHWA Oregon Division
Galen McGill, ODOT ITS Unit
David McKane, ODOT Motor Carrier Services
Nathaniel Price, FHWA Oregon Division
Rodney Rosenkranz, ODOT Driver and Motor Vehicle Services

Research Priorities:
Reduce crashes related to excessive vehicle speed
Reduce incident duration (e.g. emergency response and roadway closure times)
Reduce intersection collisions
Develop accurate roadway ice detection systems

PAVEMENTS AND MATERIALS RESEARCH

Expert Task Group:
Andrew Griffith, Chair, ODOT Research
Ken Stoneman, ODOT Construction Section
Luci Moore, ODOT Pavements Services Unit
Mike Dunning, ODOT New Products Coordinator
Jeff Gower, ODOT Construction Section
Anthony Boesen, Federal Highway Administration
Jim Lundy, Civil Engineering Department, Oregon State University

Research Priorities:
Identify design, materials, construction, and maintenance practices that optimize performance.
Develop construction processes that allow construction phase completion to minimize service disruptions.
Identify materials and construction practices that optimize application while minimizing environmental and safety risks.
## RESEARCH STAFF

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnie Jones, Ph. D.</td>
<td>Research Manager</td>
<td></td>
</tr>
<tr>
<td>Deborah Martinez</td>
<td>Executive Support Specialist</td>
<td></td>
</tr>
<tr>
<td>Liz Hunt, P. E.</td>
<td>Technology Transfer Engineer</td>
<td></td>
</tr>
<tr>
<td>Andrea Asher</td>
<td>T2 Center Assistant</td>
<td></td>
</tr>
<tr>
<td>Rob Edgar, P. E.</td>
<td>Research Coordinator</td>
<td>Traffic, safety, human factors, Intelligent Transportation Systems, vegetation management</td>
</tr>
<tr>
<td>Andrew Griffith, P.E.</td>
<td>Research Engineer</td>
<td>Pavement and materials</td>
</tr>
<tr>
<td>Brett Sposito, P. E.</td>
<td>Research Engineer</td>
<td>Roadway design, hydraulics, geotechnical and environmental</td>
</tr>
<tr>
<td>Kevin Haas, P. E.</td>
<td>Research Engineer</td>
<td>Construction &amp; Maintenance, Experimental Features &amp; ODOT Product Evaluation Committee</td>
</tr>
<tr>
<td>Joni Reid</td>
<td>Senior Research Analyst</td>
<td>Planning, socio-economic, transit, intermodal, maintenance outreach program, research implementation</td>
</tr>
<tr>
<td>Steve Soltesz</td>
<td>Research Engineer</td>
<td>Structures, metallurgy, corrosion, fiber reinforced polymer composites, fiber optic sensors</td>
</tr>
<tr>
<td>Alan Kirk</td>
<td>Senior Research Analyst</td>
<td>Planning, socio-economic, transit, freight, intermodal</td>
</tr>
</tbody>
</table>

For more information on ODOT's Research Program and Projects, contact

**Oregon Department of Transportation**
Research Group
200 Hawthorne Ave. SE, Suite B-240
Salem, OR 97301-5192
Telephone: 503-986-2700
FAX: 503-986-2844

Or visit our website at http://www.odot.state.or.us/tddresearch/