Fiscal 2020 – 2021
BIENNIAL WORK PROGRAM
STATE PLANNING AND RESEARCH

SUBPART B – RESEARCH

June 1, 2019

Amendment 1 (amending Table 7) – March 18, 2020
Amendment 2 (Fiscal Year 2021) – June 1, 2020

Research Section
In cooperation with the
Federal Highway Administration

OREGON DEPARTMENT OF TRANSPORTATION
ODOT POLICY STATEMENT - TITLE VI OF THE CIVIL RIGHTS ACT

The Oregon Department of Transportation ensures compliance with Title VI of the Civil Rights Act of 1964; 49 CFR, Subpart B1; related statutes and regulations to the end that no person shall be excluded from participation in or be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance from the U.S. Department of Transportation on the grounds of race, color, sex, or national origin. The Research Section actively collects Title VI compliance information from our contractors on an annual basis. More information is available online at:

http://www.oregon.gov/ODOT/CS/CIVILRIGHTS/Pages/nd_def.aspx
Section 23 CFR 420.209(c) Certification

June 1, 2020

I, Michael Bufalino, Research Manager of the State of Oregon, do hereby certify that the State is in compliance with all requirements of 23 U.S.C. 505 and its implementing regulations with respect to the research, development, and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.

Appendix A of the Fiscal 2020 – 2021 Biennial Work Program contains a summary of SPR Subpart B program compliance requirement and Oregon’s compliance mechanisms.

Michael Bufalino, Research Manager
Jerri Bohard, Division Administrator
Transportation Development Division
Oregon Department of Transportation
555 13th St. NE, Suite 2
Salem, OR 97301

Dear Ms. Bohard,

The Federal Highway Administration (FHWA) has completed our review the Oregon Department of Transportation’s (ODOT) State Planning and Research Part B work program for July 1, 2019 – June 30, 2020, submitted to our office on June 3, 2019.

We are approving the SPR Part B work program, effective for work completed July 1, 2019 - June 30, 2020, including:

<table>
<thead>
<tr>
<th></th>
<th>Federal</th>
<th>Non-Federal Match</th>
<th>Total</th>
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<tbody>
<tr>
<td>SPR Part B</td>
<td>$5,410,562</td>
<td>$1,223,472</td>
<td>$6,634,034</td>
</tr>
</tbody>
</table>

This approval does not constitute an obligation of Federal funds. Subject to the availability of funds, ODOT may request funding obligation in accordance with established procedures. These funds shall be administered in accordance with the provisions of 2 CFR 200 and 23 CFR Part 420. All work must be eligible under 23 U.S.C. 135 and 505 and the provisions of 23 CFR 420 and 23 CFR 450.

FHWA Planning funds are granted to State transportation agencies to support planning related activities as specified in 23 U.S.C. 135 and 505. FHWA determines eligibility of proposed activities and whether suitable activities are included to meet legislative and regulatory requirements for statewide planning.

If you have any questions, please contact me at (503) 316-2561.
Sincerely,

Jasmine Harris
Transportation Planner

cc:

ODOT: Michael Bufalino, Research Section Manager
      Arlene Santana, SPR Program Manager
      Jeff Flowers, Program & Funding Services Unit Manager

FHWA: Rachael Tupica, Senior Planner
      Timothy Rogers, Technical Services Team Leader
In Reply Refer To: HDA-OR/740.000

Jerri Bohard, Division Administrator
Transportation Development Division
Oregon Department of Transportation
555 13th St. NE, Suite 2
Salem, OR 97301

Dear Ms. Bohard,


We are approving the SPR Part B work program, effective for work completed July 1, 2020 - June 30, 2021, including:

<table>
<thead>
<tr>
<th></th>
<th>Federal (Table 1, Page 1)</th>
<th>Non-Federal Match (Table 8, page 9)</th>
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<tbody>
<tr>
<td>SPR Part B</td>
<td>$5,952,562</td>
<td>$1,192,446</td>
<td>$7,145,008</td>
</tr>
</tbody>
</table>

This approval does not constitute an obligation of Federal funds. Subject to the availability of funds, ODOT may request funding obligation in accordance with established procedures. These funds shall be administered in accordance with the provisions of 2 CFR 200 and 23 CFR 420. All work must be eligible under 23 U.S.C. 135 and 505 and the provisions of 23 CFR 420 and 23 CFR 450.

FHWA Planning funds are granted to State transportation agencies to support planning related activities as specified in 23 U.S.C. 135 and 505. FHWA determines eligibility of proposed activities and whether suitable activities are included to meet legislative and regulatory requirements for statewide planning.

If you have any questions, please contact me at (503) 316-2561 or at jasmine.harris@dot.gov.

Sincerely,

JASMINE MARIE HARRIS
Transportation Planner
cc:  
ODOT:  Michael Bufalino, Research Section Manager  
        Arlene Santana, SPR Program Manager  
        Jeff Flowers, Statewide Investment Management Section Manager  
        Alice Bibler, Program & Funding Service Manager  

FHWA:  Rachael Tupica, Planning, Finance, Admin Team Leader / Senior Planner  
        Urvashi Sehdev, Financial Manager  
        Ruth McNamee, Transportation Finance Specialist  
        Whitney Anne Kwek, Transportation Finance Specialist
BIENNIAL WORK PROGRAM

FOR

STATE PLANNING AND RESEARCH SUBPART B (RESEARCH)

JUNE 2019
AMENDED MARCH 2020
AMENDED JUNE 2020

Prepared by

Oregon Department of Transportation

In Cooperation With

FEDERAL HIGHWAY ADMINISTRATION

Oregon Fiscal Years 2020 and 2021
July 1, 2019 to June 30, 2021
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BIENNIAL WORK PROGRAM
FOR STATE PLANNING AND RESEARCH (SPR)
SUBPART B – RESEARCH
July 1, 2019 to June 30, 2021

INTRODUCTION

An effective transportation research and development program serves a vital role in improving the efficiency and effectiveness of the transportation system. Properly organized and executed research and development activities can help the Oregon Department of Transportation (ODOT) achieve its strategic vision for the transportation system by developing the necessary supporting technology. In the private sector, an effective research effort has long been recognized as a requisite for keeping products and techniques competitive in the marketplace. To enhance the cost-effective use of public funds, research is also needed in the public sector. ODOT established the Research program to administer this work that is funded in part by the Federal Highway Administration’s (FHWA) State Planning and Research (SPR) program.

The FAST Act requires that states set aside 2 percent of the apportionments they receive from four of the core Federal-aid programs for “State Planning and Research” activities. Pursuant to 23 CFR 420.107, states must allocate 25 percent of this amount for research, development, and technology transfer. The allocation for research, development, and technology is referred to as SPR Subpart B ($2,714,514 in FY’20, and $2,714,514 in FY’21). Oregon expects to exceed this minimum by $45,000 in FY’20 and $45,000 in FY’21 with a corresponding reduction in the SPR Part 1 Program. Oregon also expects to receive approximately $161,948 in FY’20, and $34,657 in FY 21 as pooled funds transfer into Oregon. It is anticipated that $236,930 will remain unspent at the end of FY’20, and these funds will be spent in FY’21.

This work plan documents the planned FY’20 and FY’21 Oregon research program budget including federal funds of $2,921,462 in FY’20 and $3,031,100 in FY’21. The Federal Research spending documented in this work plan is summarized in Table 1. The state matching level varies by program and is documented starting on page 8.

Table 1 Anticipated Federal SPR Research Budget

<table>
<thead>
<tr>
<th></th>
<th>FY 20</th>
<th>FY21</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPR Research Appropriation</td>
<td>$2,714,514</td>
<td>$2,714,514</td>
</tr>
<tr>
<td>SPR Request above minimum 25%</td>
<td>$45,000</td>
<td>$45,000</td>
</tr>
<tr>
<td>Pooled Fund Transfers into Oregon</td>
<td>$161,948</td>
<td>$34,657</td>
</tr>
<tr>
<td>Unspent FY’20 Funds</td>
<td></td>
<td>$236,930</td>
</tr>
<tr>
<td>Federal Portion of SPR Research Program Budget</td>
<td>$2,921,462</td>
<td>$3,031,100</td>
</tr>
</tbody>
</table>

The total combined FY’20 and FY’21 federal portion of the SPR Part B fund expenditure (not including pooled funds) is anticipated to be $5,952,562.

1 FAST Act core SPR Subpart B Federal-aid values are estimates. These values were forecast assuming full FAST Act core funding of the states. A federal highway authorization does not exist for FY’21; therefore FY’20 values are used as an estimate. (FHWA) “SUMMARY OF APPORTIONMENTS AUTHORIZED FOR FISCAL YEAR (FY) 2020, https://www.fhwa.dot.gov/fastact/comptables/table11p4.cfm, Accessed 5/18/2020
Details regarding expenditures may be found in the following pages. Cooperative research (e.g. Pooled Funds, TRB and NCHRP) is documented starting on page 5, and the core SPR research program administered by the Research Section is documented starting on page 8. The available funds documented above in Table 1 are anticipated to be expended in the activities shown in Table 2 below.

**Table 2 Anticipated Federal SPR Research Expenditure**

<table>
<thead>
<tr>
<th>Description</th>
<th>FY'20</th>
<th>FY'21</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCHRP and TRB SPR Research Assessments (Table 3)</td>
<td>$178,844</td>
<td>$179,529</td>
</tr>
<tr>
<td>SPR Contributions to Cooperative Research (Table 4)</td>
<td>$110,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>Research Led Pooled Funds (Table 7)</td>
<td>$319,581</td>
<td>$47,311</td>
</tr>
<tr>
<td>Research Projects for Fiscal 2020 and 2021 (Table 8)</td>
<td>$2,019,902</td>
<td>$2,749,880</td>
</tr>
<tr>
<td>Research Peer Exchange</td>
<td>$10,584</td>
<td></td>
</tr>
<tr>
<td><strong>Anticipated Federal Portion of SPR and TPF Research Program Expenditures</strong></td>
<td><strong>$2,638,911</strong></td>
<td><strong>$3,076,720</strong></td>
</tr>
</tbody>
</table>

*State matching contributions are documented in the text with the appropriate programs.*

The Oregon SPR Subpart B program is administered by the Research Section of the Transportation Development Division of ODOT. The primary objectives for this program at ODOT are to:

- Coordinate, administer, and supervise research activities within the agency.
- Conduct research projects.
- Assure the use of proper research methods.
- Prevent duplication of effort.
- Cooperate and communicate with other agencies doing transportation research.
- Assist other transportation providers by sharing and disseminating new technology and research findings.
- Serve as an information source.
- Promote the implementation of research findings.

Amendments to this work program will be developed and submitted for FHWA approval to document major changes to anticipated research work. Major changes include the addition of a new major project, pooled fund hosted by Oregon.

**RESEARCH SECTION RESPONSIBILITIES**

The Research Section coordinates research activities and maintains continuing monitoring on transportation-related research throughout the nation. The Section functions with the guidance of a Research Advisory Committee supported by Expert Task Groups. Specific responsibilities of the Section are to:

- Solicit transportation users for research needs.
- Develop strategic direction that identifies the State’s transportation research priorities.
• Review all research problem statements and obtain the information necessary to formulate a research program.
• Chair Expert Task Groups in order to recommend promising research projects to the ODOT Research Advisory Committee consideration.
• Select principal investigators and Technical Advisory Committee members for each project.
• Conduct literature research as required.
• Review and determine cost eligibility of research activities and equipment purchase.
• In some cases, conduct research projects.
• Assist in the preparation of reports covering the results of research and make recommendations for application into policies, procedures, standards, and other guides governing the activities of ODOT.
• Promote the implementation of the research findings through distribution of research results to appropriate persons for their consideration and use.
• Provide expertise for ODOT in specialty areas pertaining to research and technology.
• Participate in federal and state-sponsored seminars and training meetings to help implement new research findings.
• Provide a liaison with FHWA, universities, consultants, and other agencies conducting and supporting research for ODOT.
• Provide a continuous liaison and surveillance of progress and expenditures for all research projects.
• Provide liaison with the Transportation Research Board and the Cooperative Research Programs.
• Prepare annual and biennial budgets for research activities.
• Conduct periodic Peer Exchanges.

The research portion of the SPR Program aids in the achievement of the above-named objectives. The research is directed toward the solution of local problems, conditions and materials that prevail in Oregon. The Research Section develops or assists in the development of research study proposals and acts as a coordinator during the projects. The project work may be contracted, conducted by the operating section that has the concern and expertise for the particular program, or carried out by Research Section staff. The Research Section coordinates and maintains oversight of the projects to minimize duplication of effort and to broaden the scope of projects.

Research needs are identified through formal inquiry and through annual solicitation of ideas for State, SPR, multi-state, and national projects. Needs are also identified by the Expert Task Groups and/or the ODOT Research Advisory Committee. Informal identification of research needs is an ongoing activity, and the annual solicitation for ideas takes place in the fall with review continuing through the winter. Topics are reviewed by Expert Task Groups to determine those for consideration by the Research Advisory Committee. The Research Advisory Committee then evaluates the proposals for merit, assigns priorities, and recommends funding.

Funds are budgeted for projects by fiscal year based on forecasted tasks for research project work. Estimates are based on anticipated material, contract labor and staff-time needs. These
estimates are based on “Stage 2 Research Problem Statements”, and then refined in individual project “Work Plans”. Due to the typically fixed costs of the research process, estimated research project costs are relatively accurate. Overall research project cost estimates involve little risk. Project timing of university led research is sometimes highly variable, and project schedules must be flexible. The variability of schedule necessitates the revision of project budgets during the preparation of this Research Work Program to move project funds between fiscal years based on actual expenditures.

The implementation of research varies with the nature of the project. To the extent required, research findings are transmitted to concerned individuals for their consideration and appropriate action by additional means, including implementation workshops, conferences, research notes\(^2\), and articles in the agency-wide “inside-ODOT” newsletter. The implementation budget in the SPR Work Program provides for preparation of various materials and the conduct of activities to expedite the implementation of research.

**OTHER RESEARCH SECTION ACTIVITIES**

Research activities in addition to those specifically funded by the SPR Program include the following:

**A. The Oregon Technology Transfer (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. The T2 Center is one of 49 such centers across the country (one in nearly every state and Puerto Rico). These centers are a key part of FHWA’s Local Technical Assistance Program (LTAP). The FY’20 budget for the T2 Center is approved under a separate work program.

The Technology Transfer Center is housed with the Research Section. The T2 Director, an assistant, and three part-time “Circuit Riders” are supervised by the Research Manager.

T2 provides the following services at no cost to client agencies:

1. A lending library of audio/visual materials.
2. A lending library of technical publications.
3. Sponsorship and delivery of training courses, workshops, seminars, etc., including a “Roads Scholar” program.
4. On-site informational presentations.
5. Response to information requests.
6. A quarterly newsletter of information on transportation related topics.

As its name suggests, the T2 Center strives to make each local public 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.

\(^2\) Research Notes are published with select projects online at: [https://www.oregon.gov/ODOT/Programs/Pages/Research-Publications.aspx](https://www.oregon.gov/ODOT/Programs/Pages/Research-Publications.aspx)
**B. A State-funded Research Account** On an ongoing basis, additional funds are budgeted each biennium. This pool constitutes funds for research in addition to the SPR (Subpart B) program of research.

**C. A State-funded Indirect Account** Approximately $1,008,000 for the 2020-2021 biennium covers facilities rent and maintenance, some travel, office services and supplies, data and word processing, capital outlay, and miscellaneous other services needed to support the Research Section.

**COLLABORATIVE RESEARCH**

ODOT Research participates in several collaborative research programs using a mix of SPR and other funds. These programs include:

**A. Support for the National Cooperative Highway Research Program (NCHRP)** utilized 5.5% of the SPR allocation. The anticipated total annual support for FY’20 is $597,192.97, and support for FY’21 is anticipated to be $597,193. Oregon funds NCHRP using a blend of SPR Part A and Part B funding; with 75 percent from SPR Subpart A and 25 percent from SPR Subpart B. The SPR Subpart B contribution for the NCHRP program is anticipated to be $149,298 for FY’20 and $149,298 for FY’21.

NCHRP is also supported through submittal of problem statements, coordination of ODOT balloting, and service on NCHRP panels. These activities cost approximately $10,000 per year, mainly in staff time. See Table 3 NCHRP and TRB SPR Research Assessments

**B. The Transportation Research Board (TRB)** subscription fee covers the cost of all publications, information service retrievals, registration, and related services provided to the State by TRB. The fee is expected to be $118,184 for FY’20, and 120,924 for FY’21. As with NCHRP, Oregon’s TRB subscription is shared 75-25 percent between Subpart A and Subpart B. The SPR Subpart B TRB contribution is anticipated to be $29,546 for FY’20 and $30,231 for FY’21. (see Table 3)

Table 3 NCHRP and TRB SPR Research Assessments

<table>
<thead>
<tr>
<th>Title</th>
<th>FY’20</th>
<th>FY’21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions to TRB (25% of assessment)</td>
<td>$29,546</td>
<td>$30,231</td>
</tr>
<tr>
<td>NCHRP Contributions (25% of assessment)</td>
<td>$149,298</td>
<td>$149,298</td>
</tr>
<tr>
<td>Planning Contributions to TRB (75% of assessments and not a part of this work program)</td>
<td>$88,638</td>
<td>$90,693</td>
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<tr>
<td>Planning NCHRP Contributions (75% of assessments and not a part of this work program)</td>
<td>$447,895</td>
<td>$447,895</td>
</tr>
<tr>
<td>Total NCHRP and TRB SPR Subpart B (This work program)</td>
<td>$178,844</td>
<td>$179,529</td>
</tr>
</tbody>
</table>

Beginning in FY’06 ODOT Research and ODOT Planning agreed to share the cost of the NCHRP and TRB assessments.

**C. Transportation Pooled Fund Projects** Oregon will contribute SPR funds to at least four Pooled Fund projects in FY’20 and three in FY’21. For each fiscal year funds are set aside for unidentified projects that could benefit ODOT. For budgeted funds set aside for unidentified pooled fund opportunities; the ODOT Research Manager may independently commit up to $10,000. For commitments greater than $10,000, the Research Advisory Committee must be consulted. RAC pooled fund commitment decisions are usually made via e-mail. The SPR funded cooperative research pooled funds are summarized in Table 4.
Table 4 SPR Contributions to Cooperative Research

<table>
<thead>
<tr>
<th>Study No.</th>
<th>Title</th>
<th>FY’20</th>
<th>FY’21</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPF-5(353)</td>
<td>Clear Roads Phase II</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>TPF-5(358)</td>
<td>Wildlife Vehicle Collision Reduction and Habitat Connectivity</td>
<td>$20,000</td>
<td>$20,000</td>
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<tr>
<td>TPF-5(386)</td>
<td>Gravel-Bed River Assessment Tool for Improved Resiliency of Engineering Design</td>
<td>$5,000</td>
<td>$5,000</td>
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<tr>
<td>TPF-5(399)</td>
<td>Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis Phase II</td>
<td>$15,000</td>
<td>$15,000</td>
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<tr>
<td>TPF-5(433)</td>
<td>Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls</td>
<td>$15,000</td>
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</tr>
<tr>
<td>TPF-5(442)</td>
<td>Transportation Research and Connectivity</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>TPF 5(384)</td>
<td>Non Traditional Methods Vehicle Volume</td>
<td>$10,000</td>
<td>0</td>
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<tr>
<td>TPF-5(442)</td>
<td>Transportation Research and Connectivity</td>
<td>$10,000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal for SPR Part B Pooled Fund Projects</strong></td>
<td><strong>$110,000</strong></td>
<td><strong>$90,000</strong></td>
</tr>
</tbody>
</table>

In addition to SPR funds, the Research Section facilitates the investment of State funds in cooperative research. These fund contributions are provided under the budgets of the sponsoring ODOT unit. See Table 5 for a summary of the current State funded cooperative research.

Table 5 State Funded Cooperative Research

<table>
<thead>
<tr>
<th>Study No.</th>
<th>Title</th>
<th>FY’20</th>
<th>FY’21</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPF-5(260)</td>
<td>Next-Generation Transportation Construction Management (TCM)</td>
<td>$25,000</td>
<td></td>
</tr>
<tr>
<td>TPF-5(316)</td>
<td>Traffic Control Device (TCD) Consortium</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>TPF-5(349)</td>
<td>Western Alliance for Quality Transportation Construction (WAQTC)</td>
<td>$12,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>TPF-5(357)</td>
<td>Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>TPF-5(367)</td>
<td>Evaluation and Full Scale Testing of Concrete Prefabricated Bridge Rails</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>TPF-5(398)</td>
<td>Moving Forward with the Next Generation Travel Behavior Data Collection and Processing (SPR Part A Commitment for FY’21)</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>TPF-5(440)</td>
<td>Support for Urban Mobility Analyses</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>TPF-5(447)</td>
<td>Traffic Control Device (TCD) Consortium</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>Solicitation: 1500</td>
<td>EconWorks - Improved Economic Insight</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
</tbody>
</table>

Note these projects are not funded with SPR Part B funds and are not a part of this work program.

ODOT continues to monitor all open pooled funds that have received a contribution of funds from Oregon. These projects are still active but will not receive new funds in FY’20 or FY’21. These projects are listed in Table 6.
Table 6 Continuing Projects with Previous FY Contributions

<table>
<thead>
<tr>
<th>Study No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPF-5(178)</td>
<td>Implementation of the Asphalt Mixture Performance Tester (AMPT) for Superpave Validation</td>
</tr>
<tr>
<td>TPF-5(218)</td>
<td>Clear Roads Winter Highway Operations</td>
</tr>
<tr>
<td>TPF-5(232)</td>
<td>Underwater Noise Attenuation Experimental Methods</td>
</tr>
<tr>
<td>TPF-5(241)</td>
<td>Western States Rural Transportation Consortium (WSRTC)</td>
</tr>
<tr>
<td>TPF-5(253)</td>
<td>Member-level Redundancy in Built-up Steel Members</td>
</tr>
<tr>
<td>TPF-5(255)</td>
<td>Highway Safety Manual Implementation</td>
</tr>
<tr>
<td>TPF-5(264)</td>
<td>Passive Force-Displacement Relationships for Skewed Abutments</td>
</tr>
<tr>
<td>TPF-5(272)</td>
<td>Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site</td>
</tr>
<tr>
<td>TPF-5(283)</td>
<td>The Influence of Vehicular Live Loads on Bridge Performance</td>
</tr>
<tr>
<td>TPF-5(288)</td>
<td>Western Road Usage Charging Consortium</td>
</tr>
<tr>
<td>TPF-5(299)</td>
<td>Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis</td>
</tr>
<tr>
<td>TPF-5(307)</td>
<td>Validation of Tsunami Design Guidelines for Coastal Bridges</td>
</tr>
<tr>
<td>TPF-5(313)</td>
<td>Technology Transfer Concrete Consortium (TTCC).</td>
</tr>
<tr>
<td>TPF-5(317)</td>
<td>Evaluation of Low Cost Safety Improvements</td>
</tr>
<tr>
<td>TPF-5(334)</td>
<td>Enhancement to the Intelligent Construction Data Management System (Veda) and Implementation</td>
</tr>
<tr>
<td>TPF-5(338)</td>
<td>Simplified CPT Performance-Based Assessment of Liquefaction and Effects</td>
</tr>
<tr>
<td>TPF-5(343)</td>
<td>Roadside Safety for MASH</td>
</tr>
<tr>
<td>TPF-5(350)</td>
<td>Development of NGL Database for Liquefaction-Induced Lateral Spread</td>
</tr>
<tr>
<td>TPF-5(355)</td>
<td>Stormwater Testing and Maintainability Center</td>
</tr>
<tr>
<td>TPF-5(369)</td>
<td>Collaborative Development of New Strategic Planning Models</td>
</tr>
</tbody>
</table>

ODOT is the lead state for five pooled fund projects. The Research Section is administering TPF-5(301) Support Services for Peer Exchanges, TPF-5(307) Validation of Tsunami Design Guidelines for Coastal Bridges, and TPF-5(371) Highway Capacity Manual" Capacity Adjustments for Agency Connected and Autonomous Vehicle Operational Planning Readiness under Varying Levels of Volume and Market Penetration. For these three projects we anticipate receiving transfers of approximately $165,632 in FY’20, and $38,340 in FY’21 from other states. TPF-5(288), and TPF-5(355) are being administered by other ODOT units with research staff assistance. Table 7 includes anticipated expenditures on Oregon Research led pooled funds.

Table 7 Research Led Pooled Funds

<table>
<thead>
<tr>
<th>Project #</th>
<th>Name</th>
<th>FY’20</th>
<th>FY’21</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPF-5(288)</td>
<td>Western Road Usage Charging Consortium</td>
<td>State funded</td>
<td>State funded</td>
</tr>
<tr>
<td>TPF 5(301)</td>
<td>Peer Exchange Support</td>
<td>$12,029</td>
<td>$12,029</td>
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<tr>
<td>TPF 5(307)</td>
<td>Tsunami Design Guide</td>
<td>$5,000</td>
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<tr>
<td>TPF-5(355)</td>
<td>Stormwater Testing and Maintainability Center</td>
<td>State funded</td>
<td>State funded</td>
</tr>
<tr>
<td>TBD</td>
<td>RUC West</td>
<td>State funded</td>
<td>State funded</td>
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<tr>
<td></td>
<td>RESEARCH LED POOLED FUNDS</td>
<td>$165,632</td>
<td>$38,340</td>
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</table>

Additional information about the Transportation Pooled Fund Program and individual pooled fund projects may be found online at: [http://www.pooledfund.org/](http://www.pooledfund.org/).
Table 8 documents the core of the SPR research program. The details of each project can be found on the following pages.

### Table 8: Research Projects for Fiscal 2020 and 2021

<table>
<thead>
<tr>
<th>Project #</th>
<th>Name</th>
<th>FY’20</th>
<th>FY’21</th>
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<tbody>
<tr>
<td>301</td>
<td>SPR Project Development</td>
<td>$315,000</td>
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<td>302</td>
<td>Implementation</td>
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<tr>
<td>303</td>
<td>Unallocated Funds (FY’21 reserve allocated to projects 839 to 849 below)</td>
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<td>$-</td>
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<tr>
<td>304</td>
<td>Small Projects Discretionary Fund</td>
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<td>RPE</td>
<td>Research Peer Exchange (100% Federal)</td>
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<tr>
<td>TNI</td>
<td>Transportation Needs and Issues</td>
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<td>$45,000</td>
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<tr>
<td>719</td>
<td>Climate Change Impact on Coastal River Estuaries in Oregon</td>
<td>$23,717</td>
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<td>801</td>
<td>Development Of A Balanced Mix Design Method In Oregon</td>
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<td>802</td>
<td>Seismic Performance Design Criteria for Bridge Bent Plastic Hinge Regions</td>
<td>$5,000</td>
<td>$-</td>
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<td>805</td>
<td>Performance of High-Strength Steel Reinforcement in Shear Friction Applications (Publication Pending)</td>
<td>$3,114</td>
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<td>807</td>
<td>Coastal Landslide and Bluff Retreat Monitoring for Climate Change Adaptation</td>
<td>$79,014</td>
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<td>808</td>
<td>Automated Landslide “Hot Spot” Identification Tool for Optimized... Resiliency Planning</td>
<td>$107,706</td>
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<td>809</td>
<td>Predicting Seismic Induced Rockfall Hazard for Targeted Site Mitigation</td>
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<td>810</td>
<td>A Framework to Evaluate Causes and Effects of Truck Driver At-Fault Crashes in Oregon</td>
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<td>811</td>
<td>Project Progress Tracking Using LiDAR and 4D Information Models</td>
<td>$264</td>
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<td>812</td>
<td>Modeling Chloride Accumulation in Streams from Winter Road Salt Application for Federal...</td>
<td>$47,175</td>
<td>$83,625</td>
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<td>813</td>
<td>Methods for Non-motorized Travel Activity Estimation and Crash Analysis</td>
<td>$50,000</td>
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<td>814</td>
<td>Best Practices for Installation of Rectangular Rapid Flash Beacons (RRFB)...</td>
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<td>815</td>
<td>Bridge Deck Asphalt Concrete Pavement Armoring</td>
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<td>Resilient and Rapid Repair Measures for Seismically Vulnerable Bridges...</td>
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<td>817</td>
<td>Concrete Bridge Deck Performance Data and Metrics for the State of Oregon</td>
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<td>Implementation of ODOT Tack Coat Technologies and Procedures...</td>
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<td>820</td>
<td>Development of Reliable Geotechnical Standards in Diatomaceous Silt</td>
<td>$48,893</td>
<td>$141,209</td>
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<td>821</td>
<td>Using Weigh-in-Motion Data for Predicting Freight flow</td>
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<td>822</td>
<td>Speed Variation and Safety in Work Zones</td>
<td>$89,707</td>
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<td>823</td>
<td>Improving Constructability and Durability of Concrete Pavements</td>
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<td>Cascadia Ground Motion Estimates in Comparison to ODOT Design Criteria</td>
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<td>825</td>
<td>Bicycle Feedback Detection Device and the Accompanying Sign</td>
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<td>826</td>
<td>Constructing High Performance Asphalt Pavements by Improving In-Place Density</td>
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<td>827</td>
<td>Update to Methodology for Setting Speed Limits in Oregon</td>
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<td>Reversing Oregon’s Rise in Deaths and Serious Injuries for Senior Drivers and Pedestrians</td>
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<td>Project #</td>
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<td>-----------</td>
<td>----------------------------------------------------------------------</td>
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<td>---------</td>
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<tr>
<td>829</td>
<td>Rumble strip design analysis and the durability of inlaid stripEs</td>
<td>$120,600</td>
<td>$78,000</td>
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<tr>
<td>830</td>
<td>Exploring Seismic Soil-Pile-Superstructure Interaction</td>
<td>$86,000</td>
<td>$135,000</td>
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<tr>
<td>831</td>
<td>Leveraging Numerical Modeling for Development of Design Criteria for</td>
<td>$70,137</td>
<td>$98,000</td>
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<td></td>
<td>Gabion Rockfall</td>
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<td>832</td>
<td>Expanding the Oregon Motor Carrier Safety Action Plan: Best Return on</td>
<td>$42,025</td>
<td>$85,341</td>
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<td></td>
<td>Investment</td>
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<td>833</td>
<td>Impacts of Intersection Treatments and Traffic Characteristics on Bicyclist Safety</td>
<td>$24,500</td>
<td>$99,250</td>
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<td>834</td>
<td>Enhancing Design and Maintenance of Horizontal Landslide Drain…</td>
<td>$71,615</td>
<td>$166,718</td>
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<td>Ashfalt Mixtures</td>
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<td>835</td>
<td>Implementation of a Laboratory Conditioning and Testing Protocol….</td>
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<td>$164,033</td>
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<td></td>
<td>Asphalt Mixtures</td>
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<tr>
<td>836</td>
<td>Prioritizing Wildlife Collision Mitigation Zones for Long Range Planning Efforts</td>
<td>$-</td>
<td>$70,000</td>
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<tr>
<td>837</td>
<td>Automated Detection of Traffic Sensor Malfunctions</td>
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<td>$97,250</td>
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<td>838</td>
<td>Center Line Rumble Strip Effects on Pavement Performance</td>
<td>$76,000</td>
<td>$124,000</td>
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<td>839</td>
<td>Work Zone Safety During Traffic Control Setup, Removal, and Changes</td>
<td>$80,000</td>
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<td>840</td>
<td>Safest Placement for Crosswalks at Intersections</td>
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<td>841</td>
<td>Pedestrian Equity Analysis</td>
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<td>842</td>
<td>Constructing High-Density Longitudinal Joints to Improve Pavement</td>
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<td>Longevity</td>
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<td>843</td>
<td>Vulnerability and Risk Prioritization for Coastal Highway Erosion Areas of Concern</td>
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<td>$111,000</td>
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<tr>
<td>844</td>
<td>Evaluation of Curb Ramp Compliance</td>
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<td>$85,000</td>
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<tr>
<td>845</td>
<td>Optimizing Maintenance Priorities for Driving Safety</td>
<td></td>
<td>$79,000</td>
</tr>
<tr>
<td>846</td>
<td>Last Mile Delivery: Impact of More Delivery Vehicles on Safety and Congestion</td>
<td></td>
<td>$47,000</td>
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<tr>
<td>847</td>
<td>Alternative Bridge Deck Overlays</td>
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<tr>
<td>848</td>
<td>Trucking Platooning Impact on Bridge Loading – Policy and Regulatory Implications</td>
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<td>$48,800</td>
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<tr>
<td>849</td>
<td>Improved Systematic Analysis to Predict Roadway Safety Performance</td>
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<td>$56,000</td>
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</tbody>
</table>

Federal Total                                  $2,019,902 $2,749,880
State Total                                    $504,976  $687,470

TOTAL SPR Research Projects                    $2,524,878 $3,437,350
OVERVIEW AND OBJECTIVES
Funds are not available for individual research studies until a study work plan has been
developed and approved. Funds budgeted under this item will be used to develop or assist in the
development of SPR projects.

In the fall of each year the Research Program issues an open call for research ideas, or research
problem statements. Participation is open to literally anyone. Historically, up to 100 or more new
problem statements are received every year. For the most part, problem statements are prepared
by ODOT employees, university researchers, other state and local transportation agencies, other
research organizations, and consultants emphasizing the “bottom up” approach.

The money will cover the costs of soliciting new projects, organizing and facilitating expert task
groups, developing stage 1 and stage 2 problem statements, identifying potential investigators,
preparing work plans and executing agreements (if any) to carry out the research.

ACCOMPLISHMENTS
The Research Section selects between 10 and 12 research projects each year. The intensive
project development and selection process helps identify research with a high potential to
produce a benefit to the State’s efforts to provide for transportation within Oregon. This process
includes coordination with experts throughout the agency and with University Transportation
Centers. In FY’20 the Section initiated nine new projects and has selected ten projects forecasted
to start FY’21.

RESPONSIBLE PARTIES
Responsibility for this activity rests with Research staff and with members of Technical
Advisory Committees (TAC). TAC membership is drawn from ODOT professional, technical
and operational units, Oregon universities, other transportation agencies, resource agencies and
the FHWA.

COST INFORMATION

<table>
<thead>
<tr>
<th>SPR 301</th>
<th>FY’14</th>
<th>FY’15</th>
<th>FY’16</th>
<th>FY’17</th>
<th>FY’18</th>
<th>FY’19</th>
<th>FY’20</th>
<th>FY’21</th>
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<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
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<td>$250,000</td>
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<td>$306,337</td>
<td>$304,919</td>
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<td>REVISED BUDGET</td>
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<td>$306,337</td>
<td>$304,919</td>
<td>$323,952</td>
<td>$326,785</td>
<td>$333,232</td>
<td>$325,000</td>
<td>$325,000</td>
</tr>
</tbody>
</table>

FY’14 through FY’19 expenditure values are actual. FY’20 expenditure values are actual plus
estimated through the end of the fiscal year. FY’20 and FY’21 budget values are estimated based
on forecasted project work.
OVERVIEW AND OBJECTIVES

Technology transfer means those activities that lead to the adoption of a new technique or product by users and involves dissemination, demonstration, training, and other activities that lead to eventual innovation.

When a project ends and the report is published the project budget is no longer available for continuing activities related to dissemination and technology transfer of results. These funds combine implementation activities across projects. The objective is to provide a resource for more effective, ongoing implementation of research findings and to ensure research is focused on high priority projects.

RELATIONSHIP OF OBJECTIVES TO OVERALL PROGRAM

Research findings have no practical value until they are implemented. Design and operations offices and other ODOT programs are concerned with keeping abreast of new technology, but time restraints prohibit review of many research reports. This budget item will be utilized to more effectively inform potential users of promising research results. Interaction with maintenance and construction employees will bring new issues to light, as well as facilitating sharing of potential solutions and ideas developed by staff.

PROPOSED MAJOR ACTIVITIES

Research Notes will be distributed widely to management and maintenance crew leaders. Research will use electronic media and ODOT Internet to make updates and research information more accessible. Research Notes on project progress will be developed for major projects of interest. Implementation Guides will be developed, if appropriate, and distributed to those who would use the research findings.

As in the past, research results will be available on the Transportation Research Information Database (TRID) maintained by the Transportation Research Board (TRB) and the Bureau of Transportation Statistics (BTS). Investigators are also encouraged to present ODOT results at regional, national, and international conferences, and to publish ODOT supported work in engineering and scientific journals.

Finally, as in the past, on a project by project basis, specific implementation efforts will be identified and carried out as needed to assure that key implementation agents within ODOT have the information and the means to make optimal use of implementable research results.

Tech Transfer activities should focus on the implementation of the findings from completed research into practice. Expected actions include:

- Training classes based on research findings
- Workshops
- Based on completed research reports support the development of ODOT documentation (e.g. policy, procedures, specifications, or other implementation documents) to integrate research findings into practice.
The primary focus of these funds is to support the transfer of ODOT sponsored SPR research. In rare cases the transfer of research findings completed by outside entities (e.g. FHWA, AASHTO, TRB or a UTC) may be supported by these funds if it fulfills an identified need of the agency.

ACCOMPLISHMENTS

On numerous occasions, the Research Section has recommended the implementation of promising research findings. The implementation item in the SPR Work Program will permit this activity to be accomplished more thoroughly, and in some cases, more formally.

Projects

Nine major projects were completed in FY’19, and five projects have been completed in FY’20. Seven additional projects are expected to be completed by the end of FY’20. When a project moves into final stages, the Technical Advisory Committee discusses implementation issues and proposes an implementation strategy, which may or may not entail specific, post-publication efforts from the Research Section. The FY’21 budget will be used to support research staff time, follow-up analysis, and technology transfer activities for the following projects ending in FY’20 or in early FY’21 (Bold indicates a project published prior to June 2020):

<table>
<thead>
<tr>
<th>SPR-784</th>
<th>SPR-809</th>
<th>SPR-817</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPR-801</td>
<td>SPR-810</td>
<td>SPR-818</td>
</tr>
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<td>SPR-802</td>
<td>SPR-814</td>
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</tr>
<tr>
<td>SPR-805</td>
<td>SPR-815</td>
<td>SPR-828</td>
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</tbody>
</table>

METHODOLOGY

A cornerstone of our implementation effort is to include key agents of implementation from within ODOT on the project Technical Advisory Committee. These individuals are expected to carry the majority of the responsibility for keeping the project focused on implementable objectives, making sure information is delivered into the right hands, and to identify key steps in implementation such as revision of standards and specifications, incorporation into procedures and best practices manuals and guidebooks, etc.

It is not feasible from the standpoint of staff and time to expect operations staff to review all available research reports, but studies identified as being of major importance will be distributed to appropriate offices. In particular, reports generated from research projects conducted in Oregon will be reviewed for implementable findings and brief reports presenting suggested implementation procedures will be circulated to potential users.
SPR funds must be focused on the process of turning research into practice. SPR funds, expenditures on materials, equipment, and construction activities, planning activities, are not permitted. Funding materials, equipment, and construction activities must be the responsibility of the implementation champion or other partner.

RESPONSIBLE PARTIES

Implementation is the responsibility of primary users of the research in ODOT Divisions and Regions, with the support and assistance of the Research Section. In order to facilitate the most seamless research implementation, key users are engaged in research project development, management, and review, by participation on project Technical Advisory Committees.

The use of SPR Technology Transfer funds will be approved by the Research Section Manager based on one of the following conditions:

- Identified need documented in an SPR research project implementation memo
- Stage 1 or Stage 2 research problem statements where ODOT discovers a previously researched solution already exists, implementation has strong agency support, and the agency needs some research support to transfer existing research into practice
- Or to address an identified need of the agency that is solved by an established body of research, implementation has strong agency support, and the agency needs some support to transfer existing research into practice

COST INFORMATION

<table>
<thead>
<tr>
<th>SPR 302</th>
<th>FY'14</th>
<th>FY'15</th>
<th>FY'16</th>
<th>FY'17</th>
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<td>$50,000</td>
<td>$50,000</td>
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FY’14 through FY’19 expenditure values are actual. FY’20 expenditure values are actual plus estimated through the end of the fiscal year. FY’20 and FY’21 budget values are estimated based on forecasted project work.
This two year work program estimates work for both FY’20 and FY’21. In the fall of 2019 the Section conducted a solicitation for ideas for new research projects that will start in FY’21. In March of 2020 the ODOT Research Advisory Committee met and prioritized the proposed projects. This amendment in June of 2020 transfers the reserved funds to major projects approved for a start during the second year of the biennium (projects numbered 839 through 849).
OVERVIEW AND OBJECTIVES

Through the course of the fiscal year the Research Section receives requests for information and
a variety of other requests to perform research typically related to evaluation of new products
and methods. These projects typically require a quick response from the Research Section
because someone in the organization has made a commitment to the application of an innovation
that could benefit from monitoring and evaluation, but will go forward whether Research Section
participates or not. The discretionary fund gives us greater funding flexibility to participate when
these opportunities arise.

Similar opportunities arise when universities and other organizations propose small projects involving
cost sharing. In the past a number of projects have been undertaken when a medium priority project
could be launched because the cost was small, raising the benefit-cost ratio. Many such projects have
been, or will be, funded partially by one of five University Transportation Centers in the region. In
addition, projects that would previously have been funded under the “Experimental Features” program
will draw on the Research Discretionary Fund. Evaluations of experimental features will continue as
appropriate, but combining the funds into a single pool simplifies administration. This fund provides a
means of evaluating innovative products or non-standard methods and materials on an
experimental basis. It also provides the flexibility to respond quickly to other research needs that
emerge through the fiscal year, and to commit to small projects without specific approval from
the Research Advisory Committee.

This work program anticipates an expansion of these projects as the pace of innovation
accelerates. An increase in budget has been set aside for these projects.

ACCOMPLISHMENTS

In FY’20 the Research Section managed several sub-projects under project 304. The project
supported speakers and other conference expenses for the 2020 Northwest Transportation
Conference. Ongoing work included TRB Liaison and NCHRP Activity, supporting the
AASHTO Technology Implementation Group, and Multi-State Research Coordination.

PROPOSED ACTIVITIES

Project 304 allows for a limited number of discretionary transportation research projects.
Expected activities include:

- ODOT staff time.
- Consultant payments.
- ODOT Staff travel.
- Equipment for the exclusive use of the defined discretionary research project. This allows
  the purchase of specialized research equipment.
- Other activities that are necessary and reasonable for proper and efficient
  accomplishments of the identified transportation research.
Small projects limited to the above activities may be conducted without amendments to this work program. All discretionary transportation research project activities funded under Project 304 will be limited to activities that are necessary and reasonable pursuant to 23 CFR 420.113(a) (3).

**Sub-projects**

Sub-projects under Project 304 include discrete research efforts and research functions that occur continuously, or cyclically. The current sub-projects are listed below, with the balance of funds to be spent on yet to be identified FY’20 and FY’21 research projects. Current and planned sub-projects include:

- **Liaison and NCHRP Activity.** This covers coordination of annual NCHRP balloting, coordination of problem statement submittal and panel participation (status is ongoing).

- **AASHTO Technology Implementation Group (TIG).** TIG identifies useful and implementable new technologies and invests in their deployment through various means. TIG is supported through an assessment on member Departments. This year ODOT paid our $6,000 TIG assessment using the Research Discretionary Fund (status is ongoing).

- **Northwest Transportation Conference** Funds are set aside for speakers, staff time and other conference expenses for the Northwest Transportation Conference, which is held biennially during even numbered years. The conference is described more fully under research implementation above and is intended as a major part of the Section’s technology transfer efforts (status is C).

- **Multi-state Research Coordination** Provide support for multi-state research coordination, including response to other states’ requests and support of the AASHTO Research Advisory Committee and Transportation Research Board (status is ongoing).

- **Effects of Diatomaceous Earth on Driven Pile Foundations** Current design standards do not provide guidance for engineering properties, anticipated behavior, or construction quality control when constructing driven piles in diatomaceous earth. Instead, anecdotal and internal corporate knowledge is shared with designers working on diatomaceous earth projects, oftentimes resulting in both delays and costly change orders during construction due to the soil behaving differently than portrayed in contract documents and predicted in design. To address these design uncertainties, modeling of diatomaceous soil strength properties from full-scale pile driving is proposed. Specifically, diatomaceous soil data from previous ODOT projects together with comprehensive targeted investigation at a controlled project site will be leveraged to back calculate and validate soil strength properties, enabling development of correlations for future design guidance and incorporation into ODOT’s Geotechnical Design Manual (GDM). (status is Complete).

- **Spangler slide** Landslides are a frequent hazard to ODOT’s highways. One pressing example is the Spangler landslide, located southeast of the Portland Metro area where significant tension cracks have recently formed. The objective of this research is to evaluate the capabilities and limitations of a UAS lidar system to map and monitor landslide movements and activity. The UAS lidar data will be compared to recent airborne lidar surveys for change analysis. It will also be compared to a number of terrestrial laser scans (TLS) collected simultaneously with the UAS lidar survey for data quality evaluation. (status Complete).

- **MSE wall** One of the first geogrid-reinforced MSE walls in North America was built on the Oregon Coast in 1982 for a slide repair on ODOT right-of-way near Devil’s Punchbowl State
Park. This presents a perfect opportunity to (1) assess the geostructure’s integrity with a high-resolution laser scan, and (2) extract geogrid samples from the wall for laboratory testing, replacing extracted gaps with sufficient patched repairs. The mechanical properties of extracted samples can be tested in OSU laboratories, providing insight into how the material properties have changed versus the original documented material specifications, especially in a harsh environment such as the Oregon Coast. Supplementary in-kind testing will potentially be provided by Tensar International, the original manufacturer of the geogrids used to construct the structure. Project findings will result in a tangible example of long-term geosynthetic performance, of practical use for state highways throughout the United States. (status is Complete).

- **(GNSS) Methodologies** The objective of this research is to enable modernization of ODOT’s survey protocols by integrating recent advances in GNSS and RTN methodologies for increased cost efficiency and quality standardization across all ODOT regions, districts, and consultants. Considering that not all tasks and projects require the same level of project control accuracy, this guidance will also include updating ODOT project control requirements that reflect individual project complexity and needs. Specific objectives include: 1) Develop modernized ODOT survey procedures; and 2) Develop guidance and best practices decision matrix for tailoring survey procedures to project needs. (status is ongoing).

- **Mapping Fish Presence pre-STIP Mitigation** Lack of fish presence information at ODOT’s culvert locations has hampered ODOT’s ability to efficiently plan culvert repair and replacement projects. Effectively predicting fish presence at a culvert can aid in long-term planning of culvert repair projects and identify which approach to Oregon’s fish passage requirements are appropriate. The main objective of this research project is to provide a GIS based method to predict fish presence at ODOT’s small culverts. (status is ongoing).

- **Designing Fish Passage Flow Control Structures in Steep Slopes to Maintain ODOT Compliance** ODOT must comply with Oregon fish passage statutes when working in a fish-bearing stream. As a part of this requirement, ODOT hydraulic design incorporates engineered features to provide upstream and downstream passage for migratory fish. While design tools for flow structures exist for sizing streambed materials, these tools are reasonably well developed only for projects with low gradient stream channels. When designing streambed materials for flow structures within steeply sloped stream corridors practitioners often overlook design tool limitations, resulting in high-cost failures to ODOT and non-compliance with Oregon fish passage statutes. Recently, ODOT constructed an artificial stream realignment of Brush Creek along I-84 near La Grande. This design included streambed material sizing specifically considering steep slopes by partially integrating methodology from Brohmann (1991). This research project will evaluate the post-construction, long-term design performance of this steep-slope methodology for sizing streambed materials. (status is ongoing).

- **Piloting the Use of Lidar for Monitoring Seasonal Streambed Material Movement** Many of ODOT’s installed flow structures have degraded with time, emphasizing the need for the development of an efficient methodology for monitoring the post-construction state of fish passage control structures so that ODOT continues to meet the full intent of Oregon’s fish passage statutes. Recently, ODOT addressed the need for fish passage during a road-widening
project on I-84 outside of La Grande Oregon. This project involved the artificial realignment of 3,500ft of Brush Creek through Ladd Canyon. This design involved the cutback of an existing landslide as well as the construction of stream simulation features along steep slopes with grades ranging from 1-12%. This research will pilot the use of Lidar based change detection analysis as a useful methodology for monitoring the long-term stability of engineered stream features for seasonal streams. (status is ongoing).

• **UTC project management** ODOT is providing project management and analysis for a NITC Tier for research Exploring Data Fusion Techniques to Derive Bicycle Volumes on a Network. The objective of this research is to 1) explore data fusion techniques to determine bicycle volumes on a network using a variety of sources, 2) explore which sources lead to the best results, and 3) determine the accuracy of the various techniques. The following tasks are proposed to arrive at this objective. (status is ongoing).

• **Exploratory Research Automated Traffic Signal Performance Measures.** ODOT has started to work on the Automated Traffic Signal Performance Measures, for example, just integrated ATSPMs into the Advanced Traffic Management System named MaxView. The ATSPMs provide signal performance measures, such as traffic delays and Purdue Coordination Diagrams, from the traffic controller data. This project is to understand using ATSPMs to improve signal timings, such as the timing adjustments of congested traffic corridors. The ATSPMs can show real-time performance before and after the signal timing adjustment. Currently, Synchro software is used to develop signal timing. The Synchro software estimates traffic performance by using deterministic models or computer simulations. The ATSPMs can improve this by using real-time field-collected traffic data and performance measures. The research objective is to understand using ATSPMs to improve signal timings. The research would compare ATSPMs with the Synchro models and computer simulations for the selected case studies, and provide recommendations for improvement. (status is ongoing).

**PROCEDURES FOR SMALL PROJECTS (304)**

The ODOT Research procedures manual will include procedures for selection and administration of 304 projects. These procedures will include the following limits:

• Quick Hit Research will need to be shorter than 2 years and cost less than $50,000 per year, not including potential departmental matches in resources. Any Research commitment more than $50,000 requires vote of the ODOT Research Advisory Committee.

• Any commitment over 2 years that requires more than $10,000 per year requires a RAC vote.

• All projects must be consistent with the Agency’s mission statement, strategic direction and the Oregon Research Advisory Committee Priorities

• Per 23 CFR 420.209 (a)(6) these projects will be documented through the preparation of final reports. As a minimum, the documentation must include the data collected, analyses performed, conclusions, and recommendation.
• Per 23 CFR 420.209 (a)(6) the research staff will work with Project Champions and use Technology Transfer to actively implement appropriate research findings and should document benefits.

RESPONSIBLE PARTIES
This activity is the responsibility of the ODOT Research Section, as well as members of the technical advisory committee formed to manage each project.

COST INFORMATION

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FY'14 through FY'19 expenditure values are actual. FY'20 expenditure values are actual plus estimated through the end of the fiscal year. FY'20 and FY'21 budget values are estimated based on forecasted project work.
RPE RESEARCH PEER EXCHANGE

OVERVIEW
As a part of the SP&R program, participation in peer exchanges focused on research development and technology transfer management process is required of each state.

OBJECTIVES
The purpose of a peer exchange is to give all participants a means to improve the quality and effectiveness of their research efforts, processes and programs.

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:

- Exchange Planning
- Paid travel, lodging, and food,
- Staff time
- Facilitation
- Reporting

Peer Exchanges are 100% federally funded and do not require state matching funds.

RESPONSIBLE PARTIES
ODOT Research Section
FHWA
### COST INFORMATION

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*FY’20 budget values are estimated based on forecasted project work.*
OVERVIEW
In spring and summer of 2020, the Transportation Needs and Issues Survey will randomly sample of Oregon residents their opinions on a number of issues related to transportation.

OBJECTIVES
This survey continues to provide data on transportation issues for research and planning purposes to many parts of ODOT.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:
- Literature review.
- Methods for analysis and design.
- Survey
- Data.
- Reporting.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
The research program has produced the Transportation Needs and Issues Survey every two years since 1996. The most recent report having been published in January 2019.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section

Oregon State University: Dr. Virginia Lesser as principal investigator (Agreement for $78,600 ending December 1 2020. Approximately $0 expended through May 2020.)
## COST INFORMATION

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*FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.*
OVERVIEW
U.S. Route 101 and other ODOT highways traverse numerous estuaries along Oregon’s coast. These roadways affect, and in turn are affected by, changes in the function of the estuary caused by both the presence of the roadway as well as changes in sea level. Likewise, future climatic changes may also affect the function of both the roadways and the estuaries. A great deal of money and effort continues to be focused on restoring estuaries to their more natural function. To validate present methods, develop improved future methods, and to adapt to changing future conditions it is important to monitor conditions in the estuaries and along the roadways.

OBJECTIVES
The objective of this research is to improve our understanding of the interactions of ODOT’s facilities with estuary system. Specifically the intent is to gather data to verify that changes in ODOT’s facilities and in the estuary produce the expected results or give new understanding to what really happened.

By monitoring conditions and changes in the Salmon River Estuary a better understanding will be gained of how the roadway/estuary system functions and how it responds to changes of all kinds. In general, ODOT will be able to make more informed responses to current and future changes to fulfill our agency mission.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in:

- Literature Review.
- Water quality, water level, and weather recording devices being used for this project may need to be replaced, in the event of failures, damage, or theft.
- Monitoring the hydrology of the estuary around the highway.
- Interim Reports.
- Final Report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section: Dr. Matthew Mabey as Principal Investigator
ODOT Geo-Environmental Section
ODOT District 4
US Forest Service
National Marine Fisheries Service
Oregon Department of Environmental Quality

COST INFORMATION

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FY’10 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 and FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW
The potential listing of the sage grouse as “endangered” by US Fish and Wildlife (expected in 2015) has the potential for significant impact to ODOT aggregate source operations. Oregon Department of Fish and Wildlife (ODF&W) has issued a whitepaper in 2012 that provides interim guidance for mitigation for sage grouse habitat from activities associated with industrial-commercial developments. Such developments include rock quarries. The interim guidance provides requirements for decibel thresholds, use of propagation models with output binned in 5-decibel contours, and recommended mitigation. It is unknown if activities from ODOT aggregate source sites comply with these very low noise thresholds. This uncertainty has potential impacts to development and delivery of projects in Regions 4 and 5 that depend heavily on material from ODOT quarries. Data are needed to determine compliance with the decibel thresholds and identify potential mitigation. There is also a great need to collect data for development of a methodology that can be applied throughout the state for determining noise impacts to sage grouse habitat and habitat for other noise sensitive species as well as other noise sensitive uses from rock quarries.

OBJECTIVES
The key objective of this project is to establish how noise produced by ODOT aggregate source operations compares to standards being put forward to protect sage grouse populations. This research project will be divided into two phases: 1) collection of ODOT aggregate quarry noise measurements, and 2) analysis of quarry noise measurements including production of noise contour maps.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
None

ACCOMPLISHMENTS
The project is complete and the final report published.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Geo-Environmental Section
SLR Consulting (Phase 1)
USDOT Volpe Center, (Phase 2)
## COST INFORMATION

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FY’15 through FY’19 expenditure values are actual.
OVERVIEW
Hundreds of bridges in the Oregon bridge inventory are supported on seismically deficient reinforced concrete columns. Reinforced concrete (RC) columns designed prior to the mid-1970’s have details which make them susceptible to premature failure during earthquakes. In particular, lap splices and widely spaced transverse reinforcement are insufficient to develop and maintain strength under repeated loading. Splices are typically located just above the footing elevation in hinge regions where there is significant ductility demand. Transverse reinforcement is often too widely spaced and insufficient to adequately confine the core area, prevent buckling of the longitudinal reinforcement within the flexural hinge region, and provide sufficient shear strength. These deficiencies have led engineers and researchers to develop different retrofitting methodologies to improve their seismic performance.

This research will evaluate the new retrofit methods that are proposed, which employ a novel use of continuous spirals of a high-strength titanium alloy bars, supplemental longitudinal titanium alloy bars, and are combined with low shrinkage concrete or grout to externally protect nonductile rectangular RC columns.

OBJECTIVES
A research program is proposed to develop seismic retrofits for nonductile rectangular RC columns using high-strength titanium alloy bars. The objectives of the proposed research project are to:

- Establish the structural effectiveness of titanium alloy bars for seismic retrofitting RC columns.
- Determine the economic feasibility of the retrofit methods.
- Develop analytical models to describe the behavior and performance of retrofitted nonductile RC columns.
- Develop design methods that can be used to achieve desired seismic performance for nonductile RC columns.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
None

ACCOMPLISHMENTS
The project is complete and the final report published.
**RESPONSIBLE PARTIES**
ODOT Research Section
ODOT Bridge Section
Oregon State University

**COST INFORMATION**

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*FY’16 through FY’19 expenditure values are actual.*
OVERVIEW

ODOT’s stormwater treatment program faces increasing pressure from existing and future permitting requirements from both the Endangered Species Act and the Clean Water Act. An integrated strategy for highway system level assessment of water quality within a watershed is needed to address strategic planning for stormwater treatment and facility placement. Considering that stormwater banks can be used both to off-set lack of complete treatment on projects due to constraints and as in-lieu treatment for small projects where treatment would not be cost effective, bank establishment should require demonstration of the level of benefit to the watershed. Implementing a stormwater banking strategy requires an understanding of highway impacts on watersheds that goes beyond single site analysis. Unfortunately, the impact of ODOT’s highway system on watershed water quality is currently very poorly understood. The Stochastic Empirical Loading and Dilution Model (SELDM), recently developed in cooperation with the FHWA by the U.S Geological Survey—and now FHWA’s preferred stormwater quality model—is intended for project specific analysis. Following the 2014 ODOT sponsored project to calibrate and test SELDM in Oregon, ODOT and the USGS realized that the model was capable of being used to calculate the watershed scale impacts of the highway system.

OBJECTIVES

The proposed research project aims to expand the usefulness of SELDM to watershed level analysis. The procedures to be developed will allow the practitioner to determine both the total and relative pollutant loading attributable to highway sources at any point on a watershed’s stream network. Specifically, the objectives of this proposed study are to:

1. Develop techniques and protocols for SELDM scale-up. The newly optimized SELDM model will enable impact analysis of water quality from multiple highway discharge points in a watershed as well as from specific points within the watershed.
2. Demonstrate SELDM scale-up protocols using empirical data from Oregon watersheds with highway runoff pollutant related TMDLs and multiple highway discharge points.
3. Develop a guidance manual and final report for watershed level analyses using SELDM, based on the results and experience gained in step 2.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

None

ACCOMPLISHMENTS

The project is complete and the final report published
RESPONSIBLE PARTIES

ODOT Research Section
ODOT Geo-Environmental Section
US Dept. of Interior: USGS

COST INFORMATION

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*FY’17 through FY’19 expenditure values are actual.*
OVERVIEW

Cracking is a common failure mechanism in asphalt concrete pavement structures. It is one of the main reasons for large road maintenance and rehabilitation expenditures, as well as reduced user comfort and increased fuel consumption due to high road roughness. The resistance of the pavement to this distress mechanism is dependent upon the ductility of the asphalt pavement mixture. The use of recycled asphalt materials in asphalt mixtures are also becoming increasingly common. A drawback of this practice is a reduction in ductility of the asphalt mixture, which causes a significant reduction in the fatigue life of the pavement in many cases. In Oregon, asphalt pavements are commonly failing prematurely due to cracking-related distresses, necessitating costly rehabilitation and maintenance at intervals of less than half of the intended design lives in some cases. For this reason, it is necessary to accurately quantify the impact of increasing the recycled asphalt content in asphalt pavement on the structural cracking and rutting resistance of the pavement through use of low-cost and efficient testing procedures that can be implemented easily.

OBJECTIVES

The objective of the research is to develop an optimal design tool to be used to modify mix design when the quality of RAP changes during the production so that the mixture remains within the acceptable performance range. The research will define threshold values for Flow Number (FN) tests used to determine cracking potential and a Flexibility Index (FI) number which indicates rutting potential. Utilizing those to parameters, a range of acceptable combined values will be developed for a balance mix design.

PROPOSED ACTIVITIES

None

ACCOMPLISHMENTS


RESPONSIBLE PARTIES

ODOT Research Section
Oregon State University
COST INFORMATION

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FY’17 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 billings to date and forecast of fourth quarter invoice.
OVERVIEW

Seismic design of new bridges and assessment of existing bridges in Oregon needs to consider two-levels of performance criteria; life-safety and operational. The life-safety performance criteria are intended to ensure that the bridge does not collapse under the design earthquake; however the bridge is expected to sustain significant damage. The operational performance criteria are intended to limit the seismic damage resulting from a specific demand level so that functionality of the bridge is minimally impacted. Within the Western parts of the state, the structural design of the substructure is often governed by the operational performance criteria and not the life safety criteria. The current design methodology for the operational performance criteria has two main components: use of a specific seismic hazard that has traditionally been lower than that used for life safety performance, and limit of the material strains to stricter levels than those used for life safety.

The operational criteria govern bridge bent design, but limited confidence exists in the selection of the appropriate material limits for achieving rapid return to operational condition. This lack of knowledge has cascading effects on the direct cost and on construction schedule of bridges, especially when considering the retrofit of existing bridges. This is currently being highlighted in retrofit assessment projects conducted on a select number of bridges where the designers are finding that the operational performance under the Cascadia Subduction Zone (CSZ) event governs the amount of retrofit required.

Current material strain limits are based on experimental data generated for reinforced concrete columns that are either based on 1) modern detailing requirements, 2) exhibit excessively poor detailing relative to those used in existing bridges in Oregon, or 3) do not consider the cumulative damage effects from the long duration CSZ event. Recently completed tests of a bent representative of ODOT detailing were completed as part of a project on earthquake duration effects (Dusicka et al 2015). One of the tangent results provided limited, but tantalizing, data that pointed to seismic performance that was better than anticipated, given the lack of modern detailing. The possible contributing factors of this surprising result may be the intermediate (between excessively short and modern) lap-splice lengths utilized in vulnerable ODOT bridges prior to the 1980s, the constant axial load considered and the slow rate of loading. Focused research is therefore needed to assess the influence of these variables; specifically on the types of detailing used in Oregon due to the potentially positive outcome on the overall seismic bridge design.

OBJECTIVES

The main objective of this research is to quantify the steel and concrete strain limits to be used for the seismic assessment of bridge bents considering the operational performance design criteria of existing reinforced concrete bridge bents. The proposed research is for experimentally evaluating large-scale reinforced concrete subassemblies representing critical parts of the bents. These primarily represent column-to-crossbeam and column-to-foundation aspects of the bent. Of key interest from the experiments are the monitoring of material strains and deformations as the column reaches target seismic performance levels.
More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
None

ACCOMPLISHMENTS

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Bridge Section
Portland State University

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FY’17 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2018 billings to date and forecast of fourth quarter invoice. FY’20 expenditure values are estimated based on forecasted project work project work.
PERFORMANCE OF HIGH STRENGTH STEEL REINFORCEMENT IN SHEAR FRICTION APPLICATIONS

OVERVIEW

High strength steel (HSS) reinforcing bars with nominal yield strengths greater than 60 ksi are commercially available and can provide economic and constructability benefits when used in shear friction interfaces in bridge structures. However, concerns arise due to lack of laboratory test results from members containing HSS reinforcement. Because of this, the current LRFD specifications limit the yield stress of the interface reinforcement to 60 ksi for the shear friction resistance calculations.

To date, only a limited number of tests (Harries et al. 2012, Zeno 2009) have been performed to characterize the shear friction resistance in members containing HSS reinforcement. Results from these tests indicate that using the full yield strength of the HSS reinforcing steel could overestimate the shear interface capacity of the specimens.

Completed in 2015, ODOT and Region X University Transportation Center (PacTrans) supported a focused research project to investigate the effects of HSS reinforcement on concrete shear interface behavior. The tests were performed at Oregon State University. Test results indicate that as long as the reinforcing bars yield, a stress higher than 60 ksi may be used to estimate the shear friction resistance. However, based on a group of other test specimens from the same project, it was found that when the reinforcing bars did not yield the results are in agreement with the findings in Harries et al. (2012). The reinforcement bar size and spacing between the bars may have played a role in this difference between the two sets of specimens.

To clarify the influence of bar size and bar spacing and to gain a better understanding of the effects of reinforcement bar strength on the performance of shear friction interfaces, further research is proposed. The proposed program will include test variables not considered in the previous phase of research, such as interface roughness, other high strength steel concrete strength, reinforcement grades with various stress-strain characteristics, reinforcing bar size, and reinforcing bar spacing.

OBJECTIVES

The objective of this research is to evaluate and define the performance of A706 Grade 80, ASTM A615 Grade 100, and ASTM A1035 (120 ksi) reinforcing steel performance in shear friction applications. Understanding the performance is crucial for evaluating and assessing the applicability of the current design equations for RC structures using HSS reinforcement. If successful, the research will provide necessary data for supporting a recent working agenda item (WAI) presented to the AASHTO-T10 committee by Oregon DOT.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

None
ACCOMPLISHMENTS

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Bridge Section
Oregon State University

COST INFORMATION

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FY’17 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice.
OVERVIEW

Rising seas and extreme coastal weather events pose significant risks for the safety, reliability, and effectiveness of ODOT infrastructure and operations along the coast. Coastal landslides and shore cliff erosion are particularly sensitive to climate drivers with sea-level rise, storm frequency and intensity, wave scour, and rainfall amounts influencing landslide movement and coastal bluff erosion. Coastal bluff retreat rate is also directly proportional to climate change effects and in many locations directly threatens disruption of ODOT’s coastal infrastructure. Though landslides and coastal bluff erosion are common processes that affect coastal highways every year, bluff retreat and rate of movement are not well characterized. In 2014, ODOT’s Coastal Climate Change Vulnerability Assessment identified this limited information regarding coastal bluff retreat as an issue of concern. Research to directly address this concern is needed in order to optimize ODOT infrastructure planning, secure lifeline routes, and address the climate change adaptation focus of the Oregon Transportation Commission work plan. In sum, given the limited research on coastal landslide movement and bluff retreat with respect to changing climate drivers, a more long-term and in-depth monitoring study with modeling potential is needed to provide useful information for ODOT infrastructure planning.

OBJECTIVES

The goal of this research for ODOT is to develop a more comprehensive data driven framework for prioritizing coastal asset management. This is new research for ODOT building upon recent smaller-scale foundational efforts and recommendations.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Select representative coastal landslide and bluff sites for monitoring; Literature review; Purchase of MEMS equipment, geophones, piezometers; Obtain and organize pre-existing geotechnical data; Establish protocol for 7 year monitoring project; Equip and monitor selected sites bi-annually for a 7 year duration; Analyze and model data; Deliver final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Geo-Environmental Section Oregon State University Dr. Ben A. Leshchinsky and Dr. Michael J. Olsen as Principal Investigators (OSU Agreement for $650,837 ending July 31, 2024, amended down to $556,209 to account for ODOT drilling costs of $94,628 for project. Additional amendment using available ODOT funds of $83,000 added to project for UAS Lidar and GNSS-RTK monitoring of coastal slides and bluffs after landslide and instrumentation loss. Current total $639,209). For OSU contract approximately $397,273 expended through March 31, 2020.

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FY’17 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 through FY’25 expenditure values are estimated based on forecasted project work.
OVERVIEW

With thousands of landslides saturating lifeline routes and overwhelming ODOT’s mitigation capacity, the development of a new tool to prioritize landslides is imperative for maintaining the safest and most efficient transportation system possible. Landslides are increasingly frequent hazards that affect the operation, maintenance, and construction of Oregon highways, resulting in negative economic, environmental, and social impacts for Oregon communities. To fully support optimized resiliency efforts, focused risk mapping that integrally considers landslide recurrence intervals, geotechnical properties, potential seismic events, and projections of extreme precipitation events is critical for informed selection of priority areas.

Predictive factors such as landslide activity, precipitation projections, and geotechnical properties can be used together with seismic models to specifically filter and select for seismic landslide “hot spots” localized along lifeline corridors for targeted mitigation. In general, large, young landslides are most likely to move during an earthquake or climatic event. Until recently, comprehensive corridor assessment of landslide age has been field intensive, subjective, and cost prohibitive. This research proposes use of a new, LIDAR-based technique that correlates landslide age with “rough” topography to inform calculations of landslide recurrence intervals. This data will be coupled with observed geometric properties, seismic modeling inputs representative of possible earthquake scenarios, and site-specific, back-calculated geotechnical and hydrological properties to optimize landslide susceptibility models for “hot spot” risk mapping along emergency routes.

OBJECTIVES

This proposed research will enable ODOT to identify landslide “hot spots” along lifeline routes to maximize long-range planning efforts in consideration of seismic and climatic events and focus mitigation accordingly. This proposed work is unique and builds upon previous advances in assessing landslide hazards by coupling climate projections and emerging methods for landslide age dating, forensic analyses, and seismic modeling. The synthesis of these Oregon-specific components enable a unique opportunity to develop a “hot spot” mapping tool that identifies landslide activity in context of seismic and climactic history.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Literature review; Purchase of MEMS equipment, geophones, piezometers; Selection of five representative sites along ODOT lifeline routes; Development of age-roughness models for selected corridors; Forensic analysis for geotechnical properties for selected corridors; Refined landslide susceptibility analysis and develop protocol for creating landslide risk maps with identified “hot spots”; Climate models and map projected landslide risk
areas to refine projected “hot spots”; a draft guidance manual for “hot spot” identification and final report; TAC presentations; and a final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

**ACCOMPLISHMENTS**

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

**RESPONSIBLE PARTIES**

ODOT Research Section
ODOT Geo/Environmental Section
ODOT Regions


**COST INFORMATION**

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
OVERVIEW

Given the negative economic and community impacts of rockfalls, a targeted method for identifying the highest-risk rockfall areas along state routes is crucial to ensure a safe, efficient transportation system that can function during emergency events such as a Cascadia earthquake, while also maximizing the use of ODOT’s limited mitigation funding. Oregon’s highways traverse particularly unstable terrain throughout the state. Steep slopes, weak soil and rock, high rainfall, and unfavorable geology result in frequent maintenance, system unreliability due to frequent closures and restrictions, and safety hazards due to landslides and rockfalls. With over 4,000 unstable slopes manually identified to date at an average mitigation cost of over $3 million per site, together with a permanent mitigation budget of only $6 million per biennium in the STIP, thorough mitigation of all unstable slopes is neither economically feasible nor realistic. Currently, rockfalls are rarely stabilized and addressed beyond initial cleanup, even though the safety risk from rockfalls is high. Further complicating rockfall mitigation planning, those sites currently mitigated are nearing the end of their design lives. Moreover, none of these installed mitigations are designed for seismic events—which greatly increase rockfall activities and associated damage. This proposed research will develop a method to predict seismic rockfall areas by integrating two new complementary research products: 1) a LIDAR database of terrestrial highway surveys of adjacent rock slopes that span multiple earthquake events and 2) a streamlined LIDAR based rockfall hazard assessment method called RAI (Rockfall Activity Index).

OBJECTIVES

Currently ODOT primarily relies on manual identification of high-risk rock slopes for selected mitigation—a time consuming and expensive process requiring expert judgement and advanced fieldwork with associated safety risks such as personnel scaling unstable slopes for manual mapping. The overall aim of this research proposal is to provide a comprehensive and targeted method for proactively identifying high risk rockfall areas for selected mitigation to ensure ODOT’s critical corridors remain open during emergency events.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Final Report Publication.

ACCOMPLISHMENTS


RESPONSIBLE PARTIES

ODOT Research Section
ODOT Geo/Environmental Section

ODOT Regions

Oregon State University Dr. Ben A. Leshchinsky, and Dr. Michael J. Olsen as principal investigators: (Agreement for $224,511 ending January 31, 2020. Amended with available ODOT funds to $284,511 for development of ready-to-use GUI. Approximately $273,629.80 expended through May of 2020.)

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice.
A FRAMEWORK TO EVALUATE CAUSES AND EFFECTS OF TRUCK DRIVER AT-FAULT CRASHES IN OREGON

OVERVIEW

Large truck crashes have a considerable impact on society and the economy. Although Oregon experienced a decrease in the number of truck driver at-fault crashes (757 to 709) in 2015, the number of fatalities associated with truck crashes increased from 34 to 54 for the same period. While most truck driver at-fault crashes result from poor driving habits (speeding, following too close, unsafe lane changes…) it is not clearly understood how driving habits have been affected by the increased presence of smartphones, on-board technologies, and other controllable distractions. A recent study by the Federal Motor Carrier Safety Administration found that distracted truck driving was a factor in 71 percent of all truck driving accidents.

OBJECTIVES

This research will evaluate the impact of distracted driving on truck driver at-fault crashes, examine the effectiveness of existing counter measures, and identify new counter measures. The research objectives will provide a framework to evaluate trends in truck driver at-fault crash injuries in Oregon and identify specific factors affecting crash fatalities. Furthermore, this study will provide a mechanism to assess the effectiveness of the different counter measures currently in place and help identify, if warranted, new counter measures.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Final Report Publication.

ACCOMPLISHMENTS


RESPONSIBLE PARTIES

ODOT Research Section

ODOT Motor Carrier Transportation Division

Oregon State University: Dr. Salvador Hernandez as principal investigator (Agreement for $187,280 ending June 30, 2020. Approximately $171,730 expended through May 2020.)
## COST INFORMATION

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*FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice.*
PROJECT PROGRESS TRACKING USING LIDAR AND 4D INFORMATION MODELS

OVERVIEW
Accurate and frequent construction progress tracking provides critical input data for project systems such as cost and schedule control as well as billing. Traditional progress tracking techniques mainly based on visual inspections are labor intensive, sometimes subject to negotiation, and often driven by arcane rules. Three dimensional (3D) LiDAR (static or mobile) data coupled with 4D information models (3D information models + project schedule) have been implemented and demonstrated significant time and cost savings for recording project status of building construction projects and thus support some categories of project progress tracking. Although both LiDAR and 3D information models are being used in multiple applications by DOTs, their potential for monitoring construction of transportation projects warrants more exploration.

Over the past few decades, several advanced technologies have been adopted in the transportation industry to improve accuracy and efficiency in design and construction, which includes GPS, LiDAR, and 3D /4D information modeling. ODOT has been a leader in effectively utilizing these technologies and rapidly integrating them into its operations. For example, ODOT has been using 3D information models for applications such as project planning, design, and construction. LiDAR technology is extensively used by ODOT for spatial data collection as it enables fast, accurate and safe data collection compared to traditional surveying methods.

This study aims to integrate LiDAR and 4D information models for tracking transportation construction projects, which would assist ODOT with schedule and cost control as well as payments.

OBJECTIVES
The primary research objective is to provide a framework for construction automation at ODOT. Specifically, this research will: (1) develop a progress tracking system (compatible with Bentley solutions) that is efficient, accurate, and objective to help ODOT better monitor their projects, and take timely actions when necessary (2) develop and refine a process for automated progress tracking of transportation projects by leveraging LiDAR and 4D information models; (3) identify the skills and resources needed at the construction project manager level; and (4) document needs for data processing, storage, sharing, etc. for efficient implementation.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
- None

ACCOMPLISHMENTS
The project is complete, and the final report is published.
RESPONSIBLE PARTIES
ODOT Research Section
ODOT Engineering Automation

COST INFORMATION

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FY’18 through FY’20 expenditure values are actual.
OVERVIEW
This proposed research aims to provide ODOT with a salt application management tool for predicting chloride exceedances. Providing a safe and efficient transportation system that supports environmental sustainability during adverse winter weather conditions is a pressing challenge for ODOT. To improve driving conditions while minimizing negative chloride impacts on the environment and infrastructure, corrosion inhibiting chloride based liquid deicer (magnesium chloride, MgCl₂) is proactively applied to the highway prior to a winter storm to prevent ice and snow from bonding to pavement. Using MgCl₂ in this way often means lower quantities of chloride are applied to the highway compared to traditional winter maintenance methods that utilize sodium chloride (NaCl) as a highway deicer. However, during extreme winter events optimized application of NaCl could be more efficient than MgCl₂ alone in controlling snow and ice. To improve estimates of pollutant loads and concentrations for better highway stormwater management, the United States Geological Survey (USGS) in cooperation with the Federal Highway Administration (FHWA) developed the Stochastic Empirical Loading and Dilution Model (SELDM). SELDM is a lumped parameter model that can facilitate scenario simulation and sensitivity analysis to determine the potential risk of water quality exceedances from runoff into surface waters. Through this project SELDM will be further enhanced to improve chloride specific modeling through 1) calibration with Oregon specific data, and 2) consideration of groundwater systems to account for future chloride inputs from flowpaths to streams.

OBJECTIVES
This research is presented as a two-phase research proposal. The following objectives are for research Phase 1:
1. Evaluate and adjust ODOT’s Winter Salt Pilot project data collection methods.
2. Evaluate SELDM model results, including probability of exceeding water quality standards in a given year and the effect of using BMPs.
3. Determine the preliminary degree of groundwater infiltration at Site 1 using previous and supplemental well/spring data.

If the results from Phase 1 reveal that chloride is reaching groundwater systems at high concentrations, Phase 2 will be initiated. For Phase 2 the main objectives are to evaluate chloride direction, mass, and rate of movement in groundwater systems for inclusion as baseflow input for SELDM chloride stream exceedance prediction. More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research. These activities will result in:
• Literature review.
• Regional analysis of chloride levels.
• Preliminary SELDM runs with stormwater facilities.
• Collect and evaluation of groundwater data and surface water measurements
• Construct or refine numerical groundwater model to evaluate pathways and travel times for chloride contaminated groundwater.
• TAC presentations and a final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Geo/Environmental Section

ODOT Maintenance and Operations Branch provided $65,000 in of funding to this project. These funds are not included in the SPR budge below.

FHWA Office of Project Development and Project Review provided $136,000 of funding to this project. These funds were authorized by memos which were received by ODOT in June of 2017 and February of 2018 and are included in the SPR budget below. (See Appendix B for copies of these memos).

USGS: Mr. Adam Stonewall, Hydrologist as principal investigator(Agreement for $362,000 (ODOT share) ending September 30, 2021. Amended to increase ODOT share to $396,450. Approximately $225,629 expended through May 2020. Of this $167,141 was billed to SPR funds) USGS is committed to contributing $195,000 to this project.

COST INFORMATION

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 through FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW

Transportation planning for people who walk and bicycle lacks clear data on usage. This lack of data makes understanding changes to safety and usage from infrastructure investments difficult for practitioners and decision makers. Collection of motorized vehicle volumes is a well-established practice with DOTs around the U.S. Vehicle volume data is an instrumental input for detailed analysis of travel activity and crash outcomes. Similar data collection programs for non-motorized systems are not yet established at the DOT level making clear understanding of performance of the system and detailed analysis of safety outcomes unachievable. Without necessary exposure information for non-motorized travel activity, safety analysis is often confounded because infrastructure improvements may induce non-motorized travel activity leading to a higher frequency of crashes making those infrastructure improvements appear more dangerous. Exposure data would allow analysts to control for changes in non-motorized traffic volume and more clearly understand how infrastructure improvements affect safety outcomes. In addition to crash analysis, non-motorized traffic volumes are needed to understand basic information regarding function of the transportation system.

The ODOT’s recently released Bicycle and Pedestrian Mode Plan recognized the lack of data in non-motorized transportation planning. Recent bicycle and pedestrian safety research completed by ODOT’s Research Section found it difficult to interpret final results for many elements of their efforts due to a lack of traffic counts for these modes.

OBJECTIVES

This research would seek to fill gaps in key measures of performance for walking and bicycling by furthering methods for estimating total activity for these modes. These measures of activity can fill basic measures of performance across the system and help monitor changes over time including those occurring in response to system upgrades. In addition to fundamental measures of travel activity for people who walk and bicycle, this research would seek to analyze safety outcomes for these modes by utilizing the activity measures in crash rate development. These crash rates would allow planners and practitioners to understand areas of higher risk, facility and street configurations with higher risk, and help deliver a key performance measure of safety outcomes. This research would also leverage nearly $80,000 that ODOT’s Safety Unit recently distributed to the Bend MPO to collect and analyze non-motorized traffic count data. Utilizing data collected through that effort with this research project will maximize that important investment.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:
- Literature review.
- Field testing and observation.
- Model Development.
- Data acquisition.
- Data analysis.
- TAC presentations.
- Final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section: Mr. Josh Roll, as principal investigator
ODOT Active Transportation Section
Bend MPO, MOU for $50,000 for data collection ending December 1, 2019. Approximately $21294 expended through December 2019.

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FY’18 through FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2019 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
OVERVIEW

Over the last decade, Oregon jurisdictions have systematically installed pedestrian crossing enhancements (PCEs) at crosswalks such as continental markings, median refuge islands, curb bulb outs, pedestrian activated flashing beacons, overhead signs, advanced stop bars and more recently Rectangular Rapid Flash Beacons (RRFB). RRFBs are proving to be a cost-effective way to improve driver yielding and hopefully safety. Oregon practitioners, however, desire guidance as to the value of pedestrian refuge islands and the placement of the RRFB beacons on highways with two-way left turn lanes (median vs. far side). The median island can lead to access management issues in urban and suburban areas. In some cases, installing median mounted beacons on three lane roadways (one lane in each direction with a two-way left turn lane) can lead to conflicts with over-dimensional freight (oversize loads on state highways may need 25 feet of clearance). Beacons are typically installed on median islands but it is not clear if they are needed, since left-side beacons can be seen by oncoming traffic unless occluded by large vehicles. It is also desirable to identify situations where there is a significant benefit to installing both treatments.

A recently completed ODOT research project (SPR 778) has collected data on many different types of PCEs on state and non-state highways in Oregon with an objective to establish the safety effectiveness of these improvements. The SPR 778 research data set includes 39 and 29 RRFB locations with and without a pedestrian refuge island, respectively (15 locations are on three-lane roadways). The data set includes detailed information about the installations. Using crash data from 2007-2015, a CMF of 0.64 +/- 0.26 was obtained for pedestrian crashes at RRFBs (i.e. installing a RRFB reduces pedestrian crashes by 36% on average). However, this was developed using only a simple before-after method due to insufficient data (primarily lack of pedestrian volumes and crash counts). The research was also not able to address the impact of median refuge islands directly.

OBJECTIVES

This research will seek to produce the guidance that practitioners need about the placement of RRFB beacons in combination with median refuges on three lane roadways. This research will provide empirical evidence about the effect of refuge medians on driver yielding and pedestrian crossing behavior. The research will also compare the effect of median-mounted RRFB displays versus far side-mounted RRFB displays with respect to these same performance measures. Finally, this project will enhance and reanalyze the SPR 778 RRFB data to produce more robust estimates of the safety effectiveness. With these measures well-quantified, ODOT will be able to improve the guidance for pedestrian crossing enhancements.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.
These activities will result in:

- Literature review.
- Develop Observational Video Collection Plan.
- Conduct Video Data Collection.
- Analyze Video for Yielding Behaviors and Pedestrian Volumes.
- Update Safety Effectiveness Evaluation.
- TAC presentations.
- Final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Traffic-Roadway Section
ODOT Active Transportation
Portland State University: Dr. Christopher Monsere as principal investigator (Agreement for $176,810 ending December 31, 2019. Approximately $175,294.12 expended through December 31, 2019.)

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
OVERVIEW
Penetration of moisture into the concrete bridge deck results in concrete steel-reinforcement corrosion. Waterproofing membranes are accepted to be an effective strategy to reduce infiltration of water into the concrete bridge deck (NCHRP Synthesis 425, 2012; NCHRP Synthesis 220, 1995). An asphalt layer is constructed on top of the membrane layer to protect the membrane from traffic. Although waterproofing membranes are effective in protecting the underlying bridge deck, the recent use of spray-on waterproofing membranes resulted in early failures of some asphalt concrete pavement overlays on bridge decks in Oregon. The lack of adhesion between the membrane (or the aggregate layer) and the asphalt surface and the properties of the asphalt overlay were considered to be the potential reasons for early asphalt overlay failures.

OBJECTIVES
This research would have six major objectives: i) determine the asphalt overlay failure mechanisms on bridge decks; ii) develop laboratory and field experiments to measure bond performance and delamination on bridge decks; iii) quantify the impact of bonding on asphalt overlay performance; iv) identify the most effective practices and materials to bond asphalt overlays to epoxy layers; v) determine the most effective asphalt mixture types for bridge decks; and vi) quantify the monetary benefits of suggested strategies.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
None

ACCOMPLISHMENTS
The project is complete and the final report published.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Pavement Services Unit
ODOT Structure Services Unit
Oregon State University
### COST INFORMATION

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*FY’18 through FY’20 expenditure values are actual.*
RESILIENT AND RAPID REPAIR MEASURES FOR SEISMICALLY VULNERABLE BRIDGES

OVERVIEW
Seismic retrofit or replacement of the entire ODOT vulnerable bridge inventory is unlikely in the foreseeable future. This leaves Oregon with a large bridge inventory of seismically vulnerable bridges. Simultaneously, the CSZ earthquake has a considerable probability of occurrence within the lifetime of these vulnerable bridges (~30% in next 50 years). One of the major issues facing the transportation infrastructure during and following the CSZ earthquake is not the intensity of shaking at any particular site, but the extensive and varied damage distributed throughout the western part of the state. Damaging aftershocks will likely continue for months to possibly years. Variability in the shaking intensity and individual bridge responses will mean that the extent of damage throughout the inventory will vary from minor to significant.

Bridge repair in lieu of replacement will be a necessity following the CSZ earthquake. Restoring mobility will be a priority and thus ODOT must implement repairs quickly. In many cases, these repairs will need to remain for the useful life of the bridge.

OBJECTIVES
The proposed research aims to identify practical post-earthquake repair methodologies that can be rapidly implemented and that incorporates low damage earthquake resilience for future shaking. Existing repair methods will be reviewed whilst considering rapid installation and susceptibility to future earthquake damage. These will be contrasted to alternative concepts that might utilize an external collar, which is secured to the non-damaged parts of the bent. Such collars might be fabricated shortly following the earthquake from standard drawings; or prefabricated and stock piled for common geometries. Researchers at PSU have developed a similar concept as retrofit of slender equipment support structures. New Zealand has proposed similar approach for new, precast, ABC bridge construction in New Zealand.

The proposed repair measure would be best suited for bents that have significant damage, yet have not lost gravity capacity. This might encompass a majority of bridges statewide. The difficulty is in repairing for ductility and providing future resiliency, which is a focus of this research. The collar concept might utilize externally attached ductile fuses to bypass the damaged zone and restore the lateral capacity. Such an approach offers the advantage of bypassing the internal rebar continuity within the damaged zone. Doing this could significantly simplify the repair. The number of replaceable fuses and their individual capacity could control the lateral behavior, leaving the rest of the repair to be relatively generic and conventional. Following capacity design, subsequent earthquake damage would be forced into the replaceable fuses and thereby provide significant resilience into the future.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.
These activities will result in:

- Literature review.
- Create of catalog of expected damages types and corresponding post-damage repair methods field testing and observation.
- Development and design of an example new repair measure that is rapidly deployable and can achieve operational performance in future earthquakes.
- Apply rapid repair measure to a damaged bent subassembly.
- Experimentally evaluate repair by selecting one of the repair strategies.
- Quantify and assess the overall performance of the repair measure.
- TAC presentations.
- A final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCcomplishments
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Bridge Section
Portland State University: Dr. Peter Dusicka as principal investigator (Agreement for $238,783 originally ending February 28, 2020, amended to end November 30, 2020. Approximately $167,939 expended through May 2020.)

COST INFORMATION

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
OVERVIEW

Maintenance and repair of concrete bridge decks is a costly and disruptive process for Oregon’s highways system. With limited funding available to keep all bridge decks in a state of good repair, analysis tools are needed to better understand what parameters drive concrete bridge deck deterioration and what the expected service-life is for a given set of parameters. These parameters may describe the design, detailing, construction, environmental exposure, traffic load, use of deicers, and other maintenance practices. Portland State University has already established and analyzed a nationwide data set based on NBI records and additional parameters from a recently completed FHWA-sponsored research project.

This proposed research will collect and integrate Oregon-specific data into their data set to address questions and practices specific to ODOT. One specific example of this Oregon specific data is the expanding use of deicers and their effects on the performance of concrete bridge decks in Oregon’s various climate zones.

OBJECTIVES

The main objective of the proposed research is to identify parameters and methods needed to assess and forecast the performance of concrete bridge decks. These parameters and methods will be integrated into a tool that will demonstrate how the results can be applied to comprehensive asset management and assessing the costs of various management practices.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

None

ACCOMPLISHMENTS

The project is complete and the final report published.

RESPONSIBLE PARTIES

ODOT Research Section
Portland State University
COST INFORMATION

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FY’18 and FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice.
OVERVIEW

Tack coats are the asphaltic emulsions applied between pavement lifts to provide adequate bond between the two surfaces. The adhesive bond between the two layers helps the pavement system to behave as a monolithic structure and improves the structural integrity. The absence, inadequacy or failure of this bond result in a significant reduction in the shear resistance of the pavement structure and make the system more vulnerable to distresses. According to the results of the study conducted by King and May (2003), fatigue life decreases by 50% when the bond is reduced by 10%. Using mechanistic-empirical design, Roffe and Chaignon (2002) also showed that pavement service life can reduce from 20 years to 7 years due to the lack of bond between two asphalt layers. Coleri et al. (2016) also showed that tack coat bond strength becomes extremely important when the thickness of the overlay is less than 2 inches. Thus, premature thin overlay failures can be observed if high tack coat bond strengths cannot be achieved. To achieve high strength levels, best tack coat application practices and materials need to be used during construction. In general, decisions on tack coat types, curing times, application rates, and application uniformity are based on experience, judgment, and convenience (Mohammad et al. 2012). For this reason, unacceptable bond performance and tack coat related premature failures are inevitable due to the lack of quality-control and quality-assurance (QC/QA) procedures.

OBJECTIVES

This research would have six major objectives: i) implement Oregon Field Torque Tester (OFTT) (developed in SPR 782) as a tool to monitor the long-term post-construction tack coat performance; ii) implement Oregon Field Tack Coat Tester (OFTCT) (SPR 782) as a tool to be used for quality control during construction; iii) improve and implement ODOT wheel tracking device and smart phone app (SPR 782) to reduce tracking; iv) test and evaluate the performance of new tack coat types that are tracking less; v) develop an imaging system to measure tack coat application uniformity; and vi) develop guidelines for distributor truck certification and control.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

None

ACCOMPLISHMENTS

The project is complete and the final report published.

RESPONSIBLE PARTIES

ODOT Research Section
Oregon State University
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FY’18 through FY’20 expenditure values are actual.
DEVELOPMENT OF RELIABLE GEOTECHNICAL METHODS AND STANDARDS FOR DESIGN AND CONSTRUCTION OVER DIATOMACEOUS DEPOSITS

OVERVIEW

Due to the lack of reliable geotechnical engineering standards of practice for building in diatomaceous silt, engineering difficulties and associated costly project delays are often encountered during ODOT construction in this soil type. Further complicating engineering design, the liquefaction susceptibility of these materials is also unknown—presenting significant public safety risk in the face of an impending Cascadia seismic event. Diatomaceous silt is composed of highly abrasive diatom microfossils that contain substantial intra-particle porosity. These unique properties of diatom microfossils strongly impact the engineering properties of the material relative to other “textbook” soils. Though many common geotechnical designs use typical assumptions of “sand-like” or “clay-like” soil behavior to determine engineering properties, these empirically-based equations are not suitable for predicting the behavior of diatomaceous soils. Oregon has at least twenty-five lake-bed basins with diatomaceous silts at engineering depths of interest to ODOT. Numerous ODOT bridges have been constructed in diatomaceous soils. Engineering standards of practice are needed for this soil type.

Multiple studies with diatomaceous silt confirm the incongruity of using existing engineering equations for estimating diatomaceous soil parameters; however, design correlations have yet to be developed or validated. Field-based studies on diatomaceous soils also report that engineering behavior varies between deposits, consistent with ODOT observations of diatomaceous material ranging from “pudding-like” to “chalk-like”. Targeted field and lab based research together with advanced computational modeling is essential for developing quality standards of practice for diverse ODOT project sites containing diatomaceous soils.

OBJECTIVES

Current design standards do not provide guidance for selecting engineering properties, anticipated behavior, or construction quality control in diatomaceous material. The goal of this proposed research is to provide ODOT needed engineering design parameters for Oregon’s diatomaceous silts. Specific objectives include:

1. Develop a site-specific predictive model for estimating geotechnical properties of diatomaceous silt, leveraging available data from existing ODOT diatomaceous projects together with targeted field-directed geotechnical testing.

2. Develop a standard of practice for geotechnical design in Oregon’s diatomaceous silts, including suggested edits to ODOT’s Geotechnical Design Manual (GDM), a summary map with descriptions of Oregon’s diatomaceous basins and associated ODOT project sites, and a short-course reviewing the results of this research project.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx
PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In field and laboratory); Data Analysis for Multiple Sites; TAC Presentations, Drilling for samples, Final Report; Short Course and Travel; This project may include the purchase of Technical Equipment
More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT GeoEnvironmental
ODOT Regions 4 and 5: ODOT Region 4 will be supplementing this project with $50,000 with available non-SPR ODOT funds for additional drilling depth and testing in FY20.
Oregon State University: Dr. Matthew Evans as principal investigator (Agreement for $431,765 ending December, 2022. Approximately $109,485 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. Note that FY’20 in above Table does not include $50,000 in expenditures from ODOT Region 4 Contributions. FY’21 through FY’23 expenditure values are estimated based on forecasted project work. With Region 4 non-SPR contribution Project total funding is estimated at $603,294.
DEVELOPING NEW METHODS TO USE ODOT WEIGH-IN-MOTION DATA FOR PREDICTING FREIGHT FLOW AND/OR COMMODITY PATTERNS

OVERVIEW
Accurate and affordable data is necessary to model and predict truck freight moving on Oregon highways. ODOT truck data is currently an untapped source of information that when combined with supplemental data will enable analysts to use and improve current commodity flow estimates, long-range freight forecasts, and plan strategic investments to provide congestion relief at freight bottlenecks.

OBJECTIVES
About 75% of commodities in Oregon move by commercial motor vehicles. Oregon's economy has grown faster than expected since the last major recession of 2008-09 leading to rising congestion. Congestion relief is a major priority for freight stakeholders especially on freight bottlenecks. Funding large capacity-enhancement projects is not viable in the foreseeable future, making it more critical than ever to produce high-quality forecasts of transportation needs. Up-to-date data is key to understanding the current movement of freight as well developing useful analysis tools for strategic investment and long-range planning. The present data source used in Oregon and across the U.S. is the U.S. Census Bureau Vehicle Inventory and Use Survey (VIUS), which was discontinued in 2002 and is outdated. Even if we had current VIUS data, the sample is small for Oregon and of limited value. ODOT Weigh In Motion (WIM) scales provide a rich set of data over many years of time. This data has the potential to provide affordable real-world information to improve our understanding of truck freight attributes regarding truck configuration, operating weight, routes, and how trucks change routes for different conditions due to weather, congestion, etc.

The objective of this research is to evaluate the ODOT WIM data for use in ODOT performance monitoring, freight models, and analysis. This research will develop methods of using the data to produce information related to truck freight patterns, including the development of data processing R-scripts to generate current and future WIM summary statistics on trucks operating on Oregon highways. This research project will ultimately lead to improved freight analysis tools and methods based on current and emerging patterns of truck movement. The research will also evaluate other data sources (both public and private) with the potential to enhance the information generated using WIM data, such as truck speed data and commodity flow data.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Portland State University Dr. Avinash Unnikrishnan as principal investigator. (Agreement for $120,776.23 ending May 2020. Approximately $90,744 expended through April 2020.)

Oregon State University: Dr. Salvador Hernandez as principal investigator. (Agreement for $35,500 ending June 2020. Approximately $18,331 expended through May 2020.)

COST INFORMATION

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FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of April 2020 based on billings to date and forecast of fourth quarter invoice.
OVERVIEW

Vehicle speed is a significant factor that affects both motorist and worker safety, as well as mobility on the state's roadways. Past research by ODOT has explored ways to lower vehicle speeds, including in maintenance and construction work zones. However, in addition to lower speed, the difference in speed between adjacent vehicles has been identified as a factor in roadway crashes. The “Solomon curve” (Solomon 1974) provides a representation of how variation in speed from the average speed on the roadway, both slower and faster than the average speed, increases the risk of crashes. The greater the variation, the greater the probability of a crash (Kloeden et al. 2002). For work zones, the problem is potentially magnified. Within a work zone, there is a higher potential for differences in vehicle speed due to the presence of tapers, construction vehicles (e.g., asphalt trucks) entering/exiting the roadway, temporary speed reductions, and other unforeseen construction operational impacts. More information is needed that to understand why speed differentials occur in general, and to update our understanding of speed variation based on current driving behavior, distractions, and conditions. Furthermore, no information has been found regarding how differences in vehicle speed impact crash rates specifically within work zones, and how traffic control measures like variable message signs (VMSs) can be used to minimize variation in speeds from the average speed within work zones.

OBJECTIVES

The overall goal of this research is to develop additional knowledge and practices that can be used to improve driver and worker safety in, and mobility through, work zones on high speed roadways. To meet this goal, the proposed research focuses on variation in speed from the average speed in the work zone. Specifically, the objectives of the research are to: (1) understand the implications and prevalence of variation in speed from average speed in work zones; (2) determine the work zone conditions, traffic control measures, and driver behaviors that lead to variation in speed from average speed; and (3) develop means for both eliminating speed variation and mitigating the effects of speed variation in order to improve safety and mobility in work zones. When developing recommended traffic control measures, special consideration will be given to the potential use of smart work zone technologies that monitor the presence of slow-moving vehicles and queuing, and communicate these conditions to oncoming traffic. The integration of existing VMSs and display messaging options will also be studied in order to take advantage of the existing roadway infrastructure.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Oregon State University: Dr. John Gambatese as principal investigator(Agreement for $193,000 ending January 2021. Approximately $125,944.75 expended through May 2019.)

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FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
823 IMPROVING CONSTRUCTABILITY AND DURABILITY OF CONCRETE PAVEMENTS

OVERVIEW

This research proposes a comprehensive testing program to characterize concrete constituent materials and mixture proportions for use in slipform pavements so that specifications can be developed for long-lasting concrete pavements in Oregon.

Concrete pavements can be cost-effective as they can exhibit long service lives. Although the majority of pavements in Oregon are asphalt concrete, several projects are now being designed and constructed with portland cement concrete. To exhibit long service lives and cost-effectiveness, these pavements must be easily constructed. Some recent projects constructed with slipform concrete paving experienced issues with consolidation and edge slump of the concrete. As a result of this ODOT initiated a small testing program. The testing program indicated that the aggregate type and gradation could have a significant impact on the workability and consolidation of concrete mixture used for the slipform paving. The project also indicated that optimizing aggregate gradation could lead to reductions in the paste content of the concrete, which should then reduce shrinkage of the concrete pavement, and this could lead to improved service lives. Testing also indicated that improved workability, as measured by the box test, correlated with an increase in expected durability and service life. These preliminary results from the testing program are promising. However, only a select number of materials and concrete mixtures were assessed as part of the testing program. Before implementing these potential changes, a larger, more statistically significant research program is needed. This additional research will develop performance engineered mixtures (PEM) for concrete pavements in Oregon, thereby ensuring constructability and long-term performance of concrete pavements in Oregon. The objective of this research is to generate sufficient information on materials and concrete mixture proportions such that draft specifications can be developed for slipform paving mixtures using Oregon materials.

OBJECTIVES

The economy and performance of concrete pavements is dependent on the design, the materials used and construction methods used to construct the pavement. Concrete mixtures for slipforming concrete pavements must exhibit certain characteristics to be placed in an efficient manner. The constructability and long-term performance of these mixtures is dependent not only on the proportions of the mixture constituents but also on the characteristics of the materials used to make the concrete mixture (e.g., coarse aggregate gradation and texture). The objective of this research is to determine the influence of constituent material (e.g., fine aggregate, coarse aggregate) characteristics on the constructability and performance of concrete pavements. This research will investigate the influence of aggregate texture and shape, aggregate gradation, and mixture proportions on the fresh, hardened, and durability characteristics of concrete mixtures specifically designed for slipforming applications. This information will be used to identify ideal concrete mixtures for slipforming applications, will provide a methodology to assess mixture proportions and constituent materials used for these applications, and will provide guidance and crushing requirements for aggregates used in concrete pavements. In addition, critical criteria for
achieving low shrinkage, adequate workability and constructability, adequate strength, adequate edge slump (via the box test), and long-term durability will be identified and documented for inclusion into new specifications (if needed).

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Oregon State University: Dr. David Trejo as principal investigator. (Agreement for $285,008 ending January 30, 2021. Approximately $193,000 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 and FY’21 expenditure values are estimated as of May 2020 billings to date and forecast of fourth quarter invoice.
OVERVIEW
The Cascadia Subduction Zone (CSZ) earthquake has a high probability of occurrence within our lifetime (approx. 30% in the next 50 years) and subsequently ODOT has implemented this hazard explicitly as the operational design criteria for bridges in Western Oregon. In the absence of actual recorded earthquakes from the CSZ, the basis of this hazard characterization is rooted in knowledge from subduction zone earthquakes in Japan and Chile. A recently completed fundamental research project referred to as M9, funded by the National Science Foundation and conducted by the University of Washington (UW) and the United States Geological Survey (USGS), has considered relevant Pacific Northwest (PNW) geology in developing a detailed numerical model of the CSZ. This effort culminated in a large database of CSZ specific earthquake ground motions for the entire PNW, including Oregon.

Potential implications have thus far been only looked at for buildings and for the Puget Sound area. These initial findings have found that the CSZ ground motions can differ significantly from the anticipated current design; in some cases giving spectral values 2 to 3 times higher at the long periods. The largest differences have been observed within geologic basins, which also exist in Oregon’s highly populated, and economically sensitive, areas of Tualatin and Beaverton. These areas have regular highway bridges as well as major river crossings, which can exhibit long period response. Hence, there is a need for applied research to assess the implications of this new data on ODOT’s bridge design.

OBJECTIVES
The object of this project is to integrate the latest research about strong motions from subduction zone earthquakes into the ODOT design process.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Final Report Publication.

ACCOMPLISHMENTS

RESPONSIBLE PARTIES
ODOT Research Section
Portland State University: Dr. Peter Dusicka as principal investigator (Agreement for $178,594 ending September 30, 2020. Approximately $68,794 expended through May 2020.)
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*FY’19 expenditure values are actual. FY’20 expenditures are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.*
BICYCLE FEEDBACK DETECTION DEVICE AND THE ACCOMPANYING SIGN

OVERVIEW

Bicycling is increasing in the United States. The number of trips made by bicycle more than doubled from 1.7 billion trips in 2001 to 4 billion in 2009. With the increase in bicycling rates, there is a critical need for cycling infrastructure, which includes facilities, signs, markings, and signals. Investing in biking and walking can help create a safer, more connected, and accessible transportation system. One of the key goals in the Oregon Bicycle and Pedestrian Plan is to improve the mobility and efficiency of the entire transportation system by providing high quality walking and biking options for trips of short and moderate distances. Signal timing and bicycle detection are design elements that promote mobility and efficiency for cyclists. Investments in bicycle infrastructure can contribute to the overall improvements in health for Oregonians. Studies have shown that $1 investment in bicycling can yield $3.40 in health care savings and $100 in benefits, if the value of life is considered.

In a bicycle network, the crossing of high volume, high speed roadways is most often done at signalized intersections. At these intersections in Oregon, cyclists are primarily detected by inductive loops, often using the same inductive loops that are used for automobile detection. Improved detection for bicycles can be accomplished by proper loop placement, alternative detection technologies, or through the use of pavement markings that communicate the correct stopping location for bicyclists. While vehicles are almost always detected automatically due to their size and predictable stopping location, that is not the case for bicycles. For cyclists that do not position themselves for detection, there can be unnecessary delays which leads to a lower quality experience and may lead to increased risk taking behavior (i.e. signal non-compliance). Historically, pavement markings (the MUTCD 9C-7 bicycle stencil) have been used to communicate where a person on a bicycle should position themselves to increase the likelihood that they are correctly detected.

Recent work established a clear preference for one type of pavement marking. An additional improvement to the quality of the cycling experience would be presence detection confirmation and/or a countdown timer. These devices are similar to the pedestrian pushbuttons with confirmation lights. When a cyclist is detected and the input recognized by the traffic signal controller, the blue light is activated. In the case of the countdown timer (used in cycling friendly countries), the timer counts down the time until the green display. Countdown timers for other modes (pedestrians and drivers) have been explored in the research. For example, research by Islam and Hurwitz et al. on driver countdown timers for green and red signals (not currently allowed in the MUTCD) showed improved driver responses.

It is expected that confirmation feedback and countdown timers for cyclists help reduce the level-of-stress for waiting cyclists. Given the relatively low cost of installation, they could be tools for creating infrastructure that promotes mobility and efficiency for cyclists. Research is limited on the effect of the confirmation devices, accompanying informational signs, and countdown timers on the behavioral and psychological effects for bicyclists. One recent study has shown positive impacts of using a blue light feedback confirmation device along with an informational sign at signalized intersections to aid cyclist detection, with a significant decrease in the number of cyclists getting off their bicycle to use the pedestrian push button for detection. The city of Portland is planning to install a number of feedback confirmation devices at up to 10 signalized intersections, which provides an opportunity to research these devices.
OBJECTIVES
This research will seek to provide guidance to practitioners regarding the efficacy of alternate feedback confirmation devices with informational signs. This research will also test how well the alternate designs for feedback confirmation devices with signs are understood by the general public.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Portland State University: Dr. Christopher Monsere as principal investigator (Agreement for $83,715 ending December 2020. Approximately $58,612.75 expended through May 2020.)

Oregon State University: Dr. David Hurwitz as principal investigator (Agreement for $81,000 ending May 2020. Approximately $63,160.90 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 expenditures are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
CONSTRUCTING HIGH PERFORMANCE ASPHALT PAVEMENTS BY IMPROVING IN-PLACE PAVEMENT DENSITY

OVERVIEW
Asphalt concrete fatigue cracking has been accepted to be a major distress mode in Oregon. ODOT’s Pavement Management System has shown that asphalt mixes placed in the last 20 years have had a tendency to develop premature cracking after 6 to 8 years of service before reaching the structural design life of 15 years. ODOT research project SPR 785 (Coleri et al. 2017) showed that a 2% reduction in air-void content (increasing density by 2% during construction) increases the cracking resistance of asphalt mixes by 1.5 to 2 times. For this reason, producing asphalt mixtures that are easy to compact and utilizing intelligent compaction technologies that are currently being implemented in Oregon can potentially create a significant improvement in the cracking resistance of asphalt mixtures. Since the impact of high density on reducing asphalt aging (results in top-down cracking which is the major distress mode in Oregon) and moisture sensitivity (which is also a critical factor controlling pavement performance in Oregon) was not investigated in SPR785, improving asphalt compaction and increasing in-place density during construction is expected to result in a cracking performance improvement significantly higher than the benefits reported in the published SPR 785 ODOT research report.

In addition, several other recent research studies (Fisher et al., 2010; Tran et al., 2016) showed that increasing asphalt concrete pavement density by modifying mix design methods, using fibers in asphalt mixes, and following better construction practices can lead to significant performance improvements and cost savings (also given in SPR 785-Literature review section). Tran et al. (2016) concluded that a 1% decrease in air voids can create 33.8% and 66.3% improvement in the long-term fatigue cracking and rutting performance of asphalt pavements, respectively. However, suggesting an increase in density without providing guidelines on how to achieve them can result in a negative impact on asphalt mix durability. For instance, increasing mix density by using excessive amounts of fillers and asphalt binder can result in long-term durability issues. Thus, current mix design procedures and mix compaction processes should be improved to produce high density and high performance asphalt mixes during construction without creating a detriment to the overall performance of the pavement.

OBJECTIVES
This research would have five major objectives: i) develop a mix design procedure and guidelines to increase density (compactibility) and to improve long-term performance of asphalt mixes; ii) quantify the impact of increasing density by using additives (rejuvenators, fibers, and warm mix technologies) and increasing binder and filler content on cracking performance; iii) based on the findings of recent ODOT research projects SPR 785 and SPR 797, determine the effectiveness of using high binder content fiber-reinforced asphalt mixes to improve compaction (density) and long-term cracking and rutting resistance; iv) using data from intelligent compaction (IC) technologies that are currently being implemented by ODOT and other standard field test procedures, quantify the impact of developed mix design procedures and guidelines on constructibility and density of asphalt pavements; and v) quantify the overall impact of increased density on performance of asphalt pavements by monitoring field performance.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx
PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel; More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Oregon State University (Agreement for $175,000 ending January 30, 2021. Approximately $92,635 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 and FY’21 expenditure values are estimated as of May 2020 billings to date and forecast of fourth quarter invoice.
OVERVIEW
Many Oregon cities are requesting a comprehensive review of speed zoning guidelines and existing procedures for streets with high volumes of active travelers. Cities are proposing speed zoning guidelines that are starkly different from existing guidelines based on the 85th speed distribution percentile. It is necessary to reevaluate existing procedures and consider the pros and cons of alternative procedures and criteria so as to set balanced, reasonable, and safe speed zones for all users.

OBJECTIVES
In Oregon, ODOT’s Traffic-Roadway Section is responsible for establishing speed zones on all highways in Oregon not governed by statute. Regional traffic engineering staff conduct engineering investigations to determine recommendations for safe speeds on local roads and streets. Studies are governed by ODOT’s Speed Zone Manual which details the procedures to collect speed data and perform a comprehensive speed study. One of the main factors that is still used to establish speed zones in most states and in Oregon is the 85th speed distribution percentile.

Many Oregon cities are implementing new speed zone guidelines for streets a high volume of active travelers utilize alternative criteria. For example, The City of Portland has developed a decision matrix based on planned prevalent travel mode (auto, cycling, or walking), sidewalk and bicycle lane width, motorized vehicle lane width, presence and type of separation barriers, roadway surface type, and other design elements that may affect the walking or cycling environment (e.g. curbs and swales). The City of Portland decision matrix does not utilize the 85th speed percentile as a key factor to set speed zones.

The alternative criteria for setting speed zones have not been yet thoroughly studied or evaluated. The main goal of this research is to develop recommendations for alternate criteria for speed zone setting in roadways with a high percentage of active travelers. The research would also recommend when conditions are appropriate to consider the alternate criteria. The scope of the research will include new recommended data collection procedures, analysis of variables that can be used to determine speed zones, and new tables or decision matrices that can be applied statewide.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Portland State University: Dr. Miguel Figliozzi, as principal investigator (Agreement for $185,000 ending August, 2020. Approximately $148,457 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 and FY’21 expenditure values are estimated as of May 2020 billings to date and forecast of fourth quarter invoice.
OVERVIEW

For the last two years, Oregon has had an increase in the fatality and serious injury crash rate for drivers and pedestrians 65 years and older. ODOT’s 2016-17 annual Highway Safety Improvement Program (HSIP) reports to FHWA have triggered the Special Rule for Older Drivers and Pedestrians (SRODP) in the “Fixing America's Surface Transportation (FAST)” Act. The rule requires Oregon to include strategies to address the increases in the subsequent State Strategic Highway Safety Plan (SHSP) update.

OBJECTIVES

The objective of this research is to identify where there is an over-representation of serious crashes involving drivers and pedestrians age 65 and older, to conduct a review of best practices with a local and national eye, and to map the best practices and countermeasures to Oregon such that significant improvements to improve older driver and pedestrian safety both in the long term and short term.

The safety of older road users (drivers and pedestrians) is a complex issue. The SRODP requires an analysis to determine whether the increase is attributable to 1) driver fatalities and injuries; 2) pedestrian fatalities and injuries, or; 3) a combination of the two. This analysis needs to determine whether the emphasis of the required safety programs and countermeasures should be focused on drivers and/or pedestrians and should identify specific evidence-based approaches. A total of 77 persons 65 years and older were killed in 2015 Oregon traffic crashes (the most recent year of data tabulated). Thirteen of those deaths were pedestrians (18% of total pedestrian fatalities). The fatal involvement rate of older drivers (94 fatal crashes/11,568 total crashes) is highest of any other age cohort tracked by ODOT. Relative to all drivers, Oregon drivers 65 years and older have more errors coded disregarding signs and signals and improper maneuvers than other drivers. Overall, however, crash involvement is lower per population (11% of all crashes, 21% of driving population) and they have fewer speed-related errors coded such as too fast for conditions, failure to stop for a vehicle, or reckless driving. Exposure data by age group is more difficult to obtain, though prior work by NHTSA established that fatality rates per VMT are higher for the older driver (for the U.S.).

A comprehensive approach to safety for older driver and pedestrians is complex and could include universal design, driver licensing, understanding driving performance degradation with age, and viable alternative mobility solutions. There are fundamental questions about social mobility and how design and operational guidance can influence safety (e.g. the selection of pedestrian walking speed, sign letter heights, minimum illumination levels, dynamic signs and messaging). Societal norms and trends such as the desire to age in place, shifts in mode use from driving to transit or walking mean that the older driver and pedestrian issue will be different in urban and rural areas. As the population ages—the National Association of Area Agencies on Aging reports that 25% of licensed drivers in the United States will be over the age of 65 by 2030 —improving safety for older road users will only become more important.

There are a number of guidance documents for improving design and reducing collisions such as FHWA’s Handbook for Designing Roadways for the Aging Population and the NCHRP 500 series (Volumes 9 and 10). For Oregon DOT to successfully respond to the SRDOP, however, it

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needs a 1) comprehensive understanding of the crash profiles, locations, and over-representation of older driver crashes and 2) a best practice inventory of safety efforts, design practices, and operational procedures as they relate to older drivers and pedestrians. This research project proposes to provide this important work.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Final Report Publication.

ACCOMPLISHMENTS

RESPONSIBLE PARTIES
ODOT Research Section
Portland State University: Dr. Christopher Monsere as principal investigator (Agreement for $97,103 ending April 2020. Approximately $97,103 expended through March 2020.)
Oregon State University: Dr. David Hurwitz as principal investigator (Agreement for $77,000 ending April 2020. Approximately $77,000 expended through March 2020.)

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FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 expenditure values are estimated based on forecasted project work.
RUMBLE STRIP DESIGN ANALYSIS TO CONTRIBUTE TO LOW EXTERIOR NOISE AND THE DURABILITY OF INLAID STRIPES

OVERVIEW

Rumble strips are an effective and relatively inexpensive safety treatment for the Oregon Department of Transportation (ODOT). Installation involves grinding/milling semi-circle ‘grooves’ at a set width with regular intervals (lengthwise) into the pavement. These can be installed in the median or on the shoulder and are designed to alert drivers when they depart the lane with both auditory and tactile (vibration) sensations. Recently, DOTs have been experimenting with different patterns, like an irregular or sinusoidal pattern, when installing rumble strips. Combinations of inlaid markings with rumble strips are called rumble “stripEs” (with “E”). Rumble stripEs are rumble strips cut into the pavement where the edge-line or centerline are to be placed and the pavement marking is then placed over the milled portions. Inlaid pavement markings are a continuous length of grooved pavement, which allows the pavement marking to be inset below the road surface level. This typically extends the pavement marking life.

ODOT has been looking at different milled patterns for more effectiveness to drivers and also to lessen external noise. In one instance on US 97, ODOT reported that one section of rumble strips was torn out due to an unacceptable exterior noise level to the nearby community and the expense of this task was high. Vehicle tires produce a noise spectrum while rolling over the uneven grooved surfaces that are the signature safety aspect of these strips. ODOT has completed prior research modeling noise characteristics for tires going over rumble strips as well as research to standardize methodology in capturing ‘ground-truth’ noise samples from traffic going over rumble strips.

Research is needed to evaluate rumble strip designs including rumble stripEs and potentially rumble strips with inlaid markings. Other variables which will be modelled that may affect noise outputs include wear patterns on older rumbles and rain water. Specifically, the research will focus on modelling implementable solutions (designs) that are acceptable to achieving similar safety benefits for drivers as well as reducing external noise for residential communities. A secondary aspect of the research will look at ranking those acceptable designs which modelling indicates would be longer-lasting lifespans of strips/stripEs or inlaid combinations.

OBJECTIVES

The goal of the research is for ODOT to identify an implementable rumble design (strip, stripe, or combination inlaid), which is acceptable in noise output to communities who live close to the highway, but without the rumble losing its safety benefit of alerting drivers when they depart the road. This work will produce:

- A literature review and interviews with ODOT staff will identify acceptable noise level limits for rumble noise and characteristics of rumble noise (e.g. frequency, pitch, tone, repetitive nature, etc). Literature will also review characteristics of noise and similar noise studies, which examine changes in public opinion over time of similar noises in communities.
- Documentation of strip design criteria for both noise and driver feedback that must be met to meet the goal of the project.
• Modeling with the goal to adjust the rumble design to affect external noise output, yet keep the safety aspect to alert drivers. This research work will model external noise spectrum characteristics from tires with a variety of variables related to rumble strips/stripEs/combinations.
• Roadside tire noise data and validation of the model predictions against roadside tire noise data.
• Documentation of rumble strip/stripE designs that meet the previously documented strip design criteria. This documentation will be delivered in the format of a proposed design specification for use by ODOT and other road authorities.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel; This project may include the purchase of Technical Equipment

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Oregon State University (Agreement for $295,000 ending January 2022. Approximately $172,912.18 expended through May 2020.)

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FY’19 expenditure values are actual. FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 and FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW

Hundreds of older bridges in the Oregon bridge inventory are supported on seismically deficient reinforced concrete substructures that consist of the supporting columns and foundations. Two types of foundations are commonly found in the inventory: spread footings and timber pile-supported pile caps, both of which were not designed to resist the forces produced during earthquakes with magnitudes and durations expected to affect Oregon. ODOT considers aging timber pile foundations to be highly uncertain and cannot be counted on to provide seismic resistance. Thus, they are not considered for retrofit and will not be directly considered in this study. In the case of spread footings, while they lack proper reinforcing details, significant cost savings can be achieved if they can be used as-is or moderately retrofitted to achieve required seismic performance. Efforts to evaluate whether replacement or retrofit of these substructures is more efficient have been complicated due to the lack of sufficient design guidelines for incorporating the effects of soil-structure interaction (SSI). Recent ODOT funded research has led to the development of a seismic retrofit solution for columns using titanium alloy bars that produced predictable response with high ductility and large energy dissipation when the foundation is considered rigid (typical structural assumption). As part of this same study, the influence of SSI was evaluated using a soil simulant and indicated that this effect produced a rocking response that increased overall system drifts but reduced the moment gradient along the column height and reduced the demands in the column at the footing elevation. This has practical and important ramifications for retrofit designs for the entire substructure, including both footings and columns. SSI can be both beneficial and deleterious across different criteria and improvements in understanding are needed to ensure desired seismic performance of retrofitted substructures. Mitigation of collapse risk of the Oregon bridge inventory requires investments to efficiently improve their seismic resilience. To make best use of limited resources, retrofit design guidance that can properly account for the potential benefit or detriment of SSI of bridge-column footings must be developed to support design guidance within the ODOT Bridge Design and Drafting and Geotechnical Design Manuals (BDDM and GDM). Such design guidance must include a clear decision matrix and corresponding analytical and design protocol, which in turn must be based on experimental evidence developed from the evaluation of full-scale specimens. In addition, directed retrofit approaches need to be advanced and structural models need to be developed for spread footings to permit estimation of force and moment capacity and demands to enable system seismic performance and eliminate needless and costly foundation retrofits. Although some test data based on previous research efforts exist, further SSI tests that include real soils under seasonally extreme conditions are necessary to help inform the design guidance that is required for the evaluation of appropriate retrofit/replacement options.

OBJECTIVES

The objectives of this research are to improve the experimental basis for assessing bridge column-footing performance with and without retrofits subject to SSI and to provide clear design guidance for the evaluation of retrofit/replacement alternatives, with full consideration of the moment capacity at the top of the columns as well as the evolution of the force flow within the spread footing. The proposed experiments will be coupled with numerical modeling to extend the experimental work, inform design guidance, and show the effect of various foundation soil conditions. Although the focus of this work is on spread footings, the outcomes may be applicable to retrofits of timber pile-supported substructures, if the pile caps can be retrofitted similar to spread footings under the assumption that deteriorated timber piles make the pile cap act like a spread footing under an extreme seismic event. The development and implementation of these guidelines in the BDDM and GDM will allow for improved, less conservative design recommendations and the potential for improved cost savings as ODOT improves the seismic resilience of its transportation infrastructure network.
More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments, Staff Time, Literature Review, Pilot Testing, Data Acquisition (Lab and possibly field), Data Analysis, TAC Presentations, Final Report; and Travel.
This project is under development in May of 2018. Once it begins, More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
Oregon State University: Dr. Armin W. Stuedlein as principal investigator. (Agreement for $470,000 ending October 31, 2022. Approximately $48,196 expended through May 2020.)

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21 through FY’23 expenditure values are estimated based on forecasted project work.
DESIGN AND LIFE CYCLE ASSESSMENT OF GABION BARRIERS FOR ROCKFALL MITIGATION USING NUMERICAL MODELING

OVERVIEW

For many rock slopes along ODOT corridors, gabion baskets are the preferred rockfall mitigation method from an economic, environmental, and maintenance perspective due to their low cost to build, more natural appearance, ability to be covered with landscaping, and ease of repair by maintenance crews. However, there is considerable risk in deploying gabion barriers without design criteria to support their use and assess their continued efficacy post rockfall impact. Design procedures for gabions as rockfall barriers do not currently exist because the science behind their performance under dynamic impact loading has not been fully investigated. In large part, this is due to the difficulty of quantifying repetitive impact loads and deformations. To-date, full-scale physical impact tests on gabion barriers have not been performed for this application. Thus, gabion barriers are currently designed by ODOT for the static loads associated with soil retention, similar to typical earth retaining walls. Clearly, this is not equivalent to (repetitive) impact loading. To initially address this deficiency, this project will use numerical modeling to assess the life-cycle of gabion rockfall barriers. Numerical modeling to determine gabion basket failure curves during progressive rockfall events will provide a science-based approach for development of design criteria and vet the efficacy, safety and design life of gabion rockfall barriers.

OBJECTIVES

Objectives for this research project include delivery of decision support tools for both design and life cycle assessment as well as delivery of design criteria for gabion rockfall barriers. Specifically, this research aims to provide Oregon engineers with a predictive and proactive tool to estimate gabion basket system response at impact based on various site conditions and design parameters, enhancing confidence in the safety and efficiency of the design, and will inform decisions to modify or replace existing gabion barriers. Gabion impact barrier design criteria will provide ODOT with an efficient tool for mitigating rockfall hazards, greatly improving safety along critical lifeline corridors. Most importantly, by providing Oregon engineers with a quantitative, science-based understanding of the performance of gabion baskets under impact conditions, the decision-making process during both design and remediation after a natural disaster will be more seamless and defensible.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, and other services and supplies. These activities will result in: a literature review; 2D preliminary model development; 3D simulation and parametric analysis; sequential impact and serviceability analysis; Graphical User Interface development; Training and Reporting; and Proposal for full-scale testing for model validation.
This project is under development with an anticipated start date of September 1, 2019. Once it begins, More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Geo/Environmental Section
ODOT Regions
Oregon State University (Agreement for $235,042 ending August 31, 2022. Approximately $28,323 expended to date).

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*FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.*
EXAMINING THE OREGON MOTOR CARRIER SAFETY ACTION PLAN:
DEVELOPING BEST RETURN ON INVESTMENT TOOLS

OVERVIEW
In July of 2016, the Motor Carrier Transportation Division in collaboration with Oregon State University implemented a state-funded pilot program called the ‘Oregon Motor Carrier Safety Action Plan’ (OMCSAP). The program provided state funds to participating law enforcement agencies to conduct Level 2 truck inspections and identify unsafe driver behaviors in high-crash locations along I-5 (Portland area) and the I-205 corridor. The benefits of the program were both clear-cut and strikingly effective. Continuing and expanding this program will require additional state funds, and the best use of this funding requires research on the optimum level of effort required to achieve the results observed from the pilot program: what level of law enforcement is needed to achieve best value in the reduction of truck-at-fault crashes?

OBJECTIVES
This research seeks to develop an optimal methodology to expand the OMCSAP to viable corridors statewide. Focusing on the leading causes of truck crashes from previous and current ODOT research studies with increased enforcement activities along with education outreach will provide users of the Oregon Roadway System a safer roadway environment.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. These activities will result in: Literature review and Data Assembly; Descriptive Statistical Analysis; Perform law enforcement and other state agency surveys; Identify viable corridor locations through spatial analyses; Assess the viability for implementation at identified; Determine optimal cost allocation for the continuation of the OMSCAP program; a Final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Motor Carrier
Oregon State University (Agreement for $113,341 ending September 2021. Approximately $2,492.68 expended through March 2020.)

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*FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.*
IMPACTS OF INTERSECTION TREATMENTS AND TRAFFIC CHARACTERISTICS ON BICYCLIST SAFETY

OVERVIEW

In urban and suburban locations, intersections are where a variety of transportation modes converge, thus leading to an increased potential for conflicts, including those between bicyclists and motor vehicles. A common crash type involving bicycles at intersections is the “right/left-hook” where a right/left-turning vehicle collides with a through bicyclist. In the 5-year period from 2012-2016 alone, 39 bicyclists were killed and 4,853 were injured in Oregon traffic crashes (source: https://www.oregon.gov/ODOT/Data/Pages/Crash.aspx), and the great majority of these injuries occurred in municipalities with populations over 50,000 where there are likely to be greater numbers of signalized intersections where right/left hook vehicle-bicycle crashes can occur. While various geometric treatments and signal control strategies have been used in attempts to mitigate right-left/hook conflicts, agencies often face questions about optimal treatments and when to use these treatments at intersections. To date, very sparse research has been conducted to analyze how certain treatments (e.g. bike boxes, mixing zones, leading bike interval (LBI), split LBI, and others) along with traffic characteristics (e.g. bicycle, pedestrian, and vehicle volumes) impact the frequency of bicycle-vehicle conflicts, as well as the severity of such conflicts (i.e. how ‘close’ a conflict is to resulting in an actual crash). Research is needed to ascertain the safety impacts of these different treatments, and to provide practitioners guidance on when and where to install such treatments.

OBJECTIVES

This research aims to accomplish three key objectives. The first objective is to determine which factors affect the frequency and/or severity of bicycle vehicle-conflicts at intersections with different bicycle-related treatments (as well as those with no treatments) through analysis of video-recorded field observations and statistical modeling. The second objective would provide data-driven guidance as to the efficacy of certain intersection treatments in mitigating vehicle-bicycle conflicts (thereby improving bicyclist safety by this surrogate measure), including consideration of how traffic and site characteristics impact these conflicts through statistical modeling. Lastly, this research would develop a ‘toolbox’ which describes the performance (in terms of bicycle-vehicle conflicts) of bicycle-specific intersection treatments under different geometric and traffic conditions, and when/where to consider such treatments. An additional objective of the ‘toolbox’ will be to provide what can be considered “conflict modification factors” for different treatments and a network screening tool/process.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments, Staff Time, Literature Review, Pilot Testing, Data Acquisition (Lab and possibly field), Data Analysis, TAC Presentations, Final Report; and Travel.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Northern Arizona University: Dr. Brendan Russo, Dr. Edward Smaglik as principal investigators. (Agreement for $67,500 ending August 2021. Approximately $0.00 expended through May 2020.)

Portland State University: (Agreement for $47,500 ending September 2021. Approximately $3,873.90 expended through May 2020.)

Oregon State University: (Agreement for $42,500 ending September 2021. Approximately $0.00 expended through May 2020.)

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW

Horizontal drains stabilize unstable slopes by decreasing the quantity of water in the ground. These drains are the only practical method for mitigating excessive slide movement for many of the large landslides impacting ODOT infrastructure. Effective design and performance criteria do not exist for horizontal drains, resulting in rare delivery of Operations and Maintenance (O&M) manuals and associated budgets to Maintenance teams who are ultimately responsible for their upkeep. Frequently, drain systems are installed with limited means of estimating or measuring how long they will effectively function. Maintenance of horizontal drains is critical for maintaining the integrity of these landslide mitigation systems. Without maintenance, these systems will cease to function and excessive slope movement will resume. To ensure long-term slope stability and driver safety on ODOT right-of-way, development of drain design criteria to inform maintenance operations and projected design life is essential. This research will leverage existing ODOT data and sponsored research (SPR807 and SPR808), including extensive drain data from ODOT’s Pioneer Mountain-Eddyville (PME) project, together with targeted instrumentation of horizontal drains and evaluation of maintenance records to generate horizontal drain design and performance criteria, which will in turn be used to inform maintenance schedules and methodologies.

OBJECTIVES

This proposed research will develop a methodology for preparation of O&M manuals for horizontal drains. Building upon existing ODOT and agency partner data, instrumentation and monitoring will be performed on a series of landslide sites with varying soil/rock conditions and drain ages.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Literature review and agency outreach; Purchase of flowmeters, data loggers, horizontal drain material, and other equipment to measure pressure; Collection of existing piezometer and drain-weir data; Analysis of long-term drain performance; Graphical user interface development for predicting drain performance and maintainability; Cost efficiency analysis; Compilation of recommendations in a final report

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.
RESPONSIBLE PARTIES

ODOT Research Section
ODOT Geo/Environmental Section
ODOT Regions

Oregon State University: Dr. Ben Leshchinsky as principal investigator. (Agreement for $451,779 ending March 31, 2024. For the OSU Contract approximately $50,858 expended through May of 2020).

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’24 expenditure values are estimated based on forecasted project work.
OVERVIEW
Moisture damage (stripping) in asphalt mixtures can result in early cracking and rutting failures due to the internal damage accumulated by the hydrostatic pressures created at the aggregate-binder interface and/or within the binder phase by heavy traffic loads. Adhesion between the aggregate and the binder is generally expected to be the major factor controlling moisture sensitivity of the asphalt mixture. Due to the high precipitation levels and frequent rain events, distresses originating from moisture damage are commonly observed on highways in Oregon. ODOT has been mostly using hydrated lime to combat distresses related to moisture damage while the effectiveness of new chemical anti-strips and warm-mix technologies has also started to be investigated. However, a reliable moisture conditioning method and moisture susceptibility test need to be developed and implemented for Oregon to determine the possible long-term impact of several new additive technologies on pavement longevity.

OBJECTIVES
The objective of this research is to determine the most effective moisture susceptibility test that can identify the impact of chemical anti-stripping agents, warm-mix additives, and lime on stripping resistance, develop a detailed test procedure for the selected experiment, determine test parameter thresholds for Oregon mixes to identify asphalt mixtures with acceptable stripping resistance and determine the impact of different anti-stripping agents and warm-mix additives on moisture susceptibility of Oregon asphalt mixtures.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:
- Literature review
- Selection of candidate test and conditioning methods
- Mixture preparation and testing for several asphalt mixtures with antistripping additives will be performed.
- Field sampling and testing will be performed on both poor preforming asphalt sections as well as good performing sections
- TAC presentations
- Prepare final report
More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Oregon State University: Dr. Erdem Coleri as principal investigator. (Agreement for $225,000 ending November 30, 2021. Approximately $12,967 expended through May 2020.)

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.
INTEGRATING WILDLIFE CORRIDOR MAPPING WITH COLLISION HOTSPOT DATA TO PRIORITIZE CROSSING PROJECTS

OVERVIEW
Large mammals cross highways to access core habitat areas, presenting significant safety hazards for Oregon drivers. In 2017, more than 7,400 wildlife-vehicle collisions resulting in more than 700 serious injuries and two fatalities occurred throughout ODOT’s highway system. Though ODOT has documented progressively increasing animal-vehicle collisions over several years, ODOT lacks a statewide, science-based approach for identifying and prioritizing the most effective project sites for wildlife collision mitigation. Instead, crossing sites are considered on a project-by-project basis, risking both effectiveness for the traveling public and inefficient use of public funds. For migratory animals such as mule deer and elk, current and future projections of road crossing zones can be approximated through computational modeling of movement between core habitats. Using wildlife collision data, telemetry data, and available high resolution spatial data together with recent advancements in statistical methods for connectivity assessment, this research aims to develop landscape-scale habitat connectivity maps for highway corridor project planning.

OBJECTIVES
For effective crossing site project prioritization, integrating collision mapping data together with wildlife corridor models, predicted traffic models, and climate resiliency mapping is required. The specific aim of this research work is the delivery of wildlife corridor maps statewide that consider future traffic scenarios and climate resiliency, with the ability to highlight priority zones along highways.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research. These activities will result in:

- Targeted literature review
- Identification and transformation of available datasets
- Generation and validation of corridor models
- Development of wildlife crossing prioritization maps
- Distribution of results across ODOT
More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

**ACCOMPLISHMENTS**
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

**RESPONSIBLE PARTIES**
ODOT Research Section
ODOT Geo/Environmental Section
ODOT Regions
Oregon Department of Fish and Wildlife
Portland State University
ODFW (Agreement in process for $180,000 ending December 2022).

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’23 expenditure values are estimated based on forecasted project work.
OVERVIEW

Proper operation of transportation facilities is dependent upon reliable, accurate traffic sensing equipment; faulty detection equipment can result in unsafe or inefficient operation. A recent ODOT project, SPR-781 entitled, "Improving Adaptive / Responsive Signal Control Performance: Implications of Non-Invasive Detection and Legacy Timing Practices" uncovered wide spread issues of data quality irrespective of sensor technology. Given this, and what is currently known about the operational performance of non-invasive detection units, it is apparent that there is a need for policies, procedures, and techniques to identify malfunctioning detection equipment and evaluate the quality of data developed by detectors. Current tools, including those available through the new ATC standard, are able to detect complete detector failures by looking at the presence or absence of data being sent by a sensor, but these tools may not be able to assess the quality of the information sent; therefore, the health of the sensor is commonly unmonitored. For example, detrimental detector behaviors at signalized intersections such as a flickering loop or video zone may not send a phase into recall, which is easily identified, but the flickering, termed an incomplete failure, would likely go unnoticed, leading to poor performance and potentially unsafe operations. Similar operational issues can take place with detection on free-flow facilities as well. Complete failure of a detection zone is identified, but if the detector is operating, it can be hard to discern the quality of the data provided. To address this issue, it is important to develop sensor health monitoring procedures, including a digital process that is stand-alone, technology agnostic, and can be deployed permanently or in a mobile fashion to identify detection performance issues beyond complete detector failure.

OBJECTIVES

To assess the quality of data provided by traffic sensors, and therefore sensor health, research is necessary to bridge the gap between existing traffic theory and pattern recognition that can identify poor performance (through comparison of data to expected norms) and field ready tools and procedures that can be used to improve operations with prioritized effort by the managing agency.

There are two objectives that need to be achieved to address this problem. First, a reliable robust method of determining poor performance of an individual detector must be developed. This method must not rely on input from other sensors for comparative analysis; it must function based solely on historical data and traffic flow theory, a concept that has been shown to be doable through existing work. Second, a strategy for monitoring performance information from sensors across the state through a management tool, available to ODOT practitioners, must be produced to allow for effective use of this new detector performance information in the prioritization of detection maintenance and repairs.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx
PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:

- Literature and Practice Review
- Data Collection
- Algorithm Development: a set of algorithms that can identify sensor malfunctions will be developed.
- System Interface: determine the preferred method of deployment, develop a set of procedures and interface to apply these algorithms to various ODOT facilities
- Deployment Plan: develop an implementation plan for ODOT applying the algorithms and interface.
- Final Report

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section, ODOT Traffic-Roadway Section, and ODOT ITS Unit

Northern Arizona University: Dr. Edward Smaglik as principal investigator. (Agreement for $113,000 ending June 2022. Approximately $5,700 expended through May 2020.)

Oregon State University: Dr. David Hurwitz as principal investigator. (Agreement for $32,000 ending June 2022. Approximately $0 expended through May 2020.)

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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW
This research proposes to evaluate and quantify the impacts of centerline rumble strips (CLRS) installation on pavement performance and to identify methods to mitigate those impacts. CLRS have high motorist safety benefits and are generally low cost, but involve grinding grooves into the pavement often where the pavement is weakest (at the centerline joint). There are often unintended consequences associated with the installation, particularly in rural, mountainous areas, or snow zones. These consequences include the accumulation of water and ice on or in the CLRS and the potential early deterioration of the pavement centerline paving joint, both of which present concerns.

OBJECTIVES
This research would have three major objectives: i) quantify the impacts of CLRS installation on the performance and maintenance of all the pavement types currently used in Oregon, including in mountainous areas or snow zones; ii) identify the best construction practices for CLRS installation to avoid any negative impacts on pavement performance; and iii) Identify, evaluate, and compare the effectiveness of potential surface treatment options to mitigate any pavement performance issues pre- and post-installation of CLRS by considering performance, cost, and safety.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Methodology Review; Data Acquisition (In-Field); Numerical Modeling; Purchasing and fabrication of asphalt slabs; Lab Testing; TAC Presentations, Pilot Site Selection and Installation, Final Report; Research Note, and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
Oregon State University: Dr. Erdem Coleri as principal investigator. (Agreement for $226,350 ending June 2022. Approximately $0 expended through May 2020.)
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FY’20 expenditure values are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY’21-FY’22 expenditure values are estimated based on forecasted project work.
OVERVIEW

Past ODOT research studies related to safety in construction and maintenance work zones have focused on the traffic control measures in place during the work operations. The studies collected and analyzed data (typically vehicle speed data) after the traffic control was in place and while the construction and maintenance work was being conducted. The prior studies, however, did not address safety during the placement, removal, and modification of traffic control measures. During these periods of time, the workers installing/removing/modifying the traffic control devices are often exposed to additional risk and/or different risk than during the course of the work after the traffic control is set up. In addition, during these periods, passing motorists are transitioning from the normal traffic flow and patterns to the temporary traffic flow and patterns. These transition periods can be difficult for both drivers and workers when thinking about the driving path, distracted drivers, and when congestion accumulates to form a temporary queue causing both safety and mobility concerns.

The safety issues created during these transition periods were mentioned in a recent ODOT Industry Staging Meeting involving ODOT staff, contractors, the Oregon Trucking Association, and other stakeholders in Fall 2019. During the meeting there was discussion about the prevalence of crashes, near misses, risky driver behavior, and hazardous worker exposures during the periods of time when traffic control measures are being put in place and removed from the roadway. Recent worker fatalities on Oregon roadways have occurred during the operations undertaken to set up or modify the traffic control. Prior research has not focused on best practices for the periods of time when the traffic control is being set up, removed from the roadway, and modified during the work operations (this aspect is the contractor’s responsibility). There is research looking at locations surrounding the work zone when considering risks (e.g., transition area). Due to the potential increased risk exposures, research is needed to identify best practices to reduce the risk associated with these traffic control transition periods.

OBJECTIVES

The overall goal of this research is to develop additional knowledge and practices that can be used to improve driver and worker safety in set-up, removal, and modification of temporary work zones on high speed roadways. The research will focus on temporary construction and maintenance operations on multi-lane, high-speed roadways from freeflow conditions to one or two lane restrictions (e.g., repaving or restriping on Interstates 5, 205, and 84) during daytime and nighttime conditions. Appropriate AADT levels for such cases will be reviewed with ODOT and considered within the research. To meet this goal, the proposed research will involve examining the conditions and practices during traffic control set-up, removal, and modification to assess the associated risk and identify potential risk reduction measures. Specifically, the objectives of the research are to:

1. Document the guiding principles, common work practices, and corresponding risk exposures during traffic control transition periods;
2. Identify promising practices to improve safety during the transition periods;
3. Compare differences in risk and implementation feasibility associated with current and promising practices through both quantitative and qualitative measures; and

4. Develop guidance for ODOT and contractors to enhance safety during the transition periods.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Interviews, Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report, Guidance Document, Research Note; and Travel.

This project will utilize existing ODOT equipment, which is used to count traffic and measure speed and lane occupancy. However, due to use and age of existing inventory, additional equipment purchases may be needed. Costs for similar devices are approximately $4k and it is anticipated no more than two units would be needed. An assessment of inventory and their operational status will be done before final budgets are approved and contract signed.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Work Zone Traffic Engineer

COST INFORMATION

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Budget values are estimated based on forecasted project work.
OVERVIEW

ODOT’s ADA settlement agreement requires that two curb ramps will be provided at each street corner for pedestrian use. At many locations, providing two curb ramps will require crosswalks to be set back a significant distance from the apex of the intersection corner. Concerns have been raised that setback crossings may be less safe because drivers expect to see pedestrians waiting to cross the intersection at the corner. However, the assumption that this is less safe is not based on empirical evidence.

As ODOT prepares to reconstruct thousands of curb ramps over the next 13 years as part of the ADA settlement agreement, research is needed to help understand how curb radii and crosswalk placement interact to produce the desired interactions between right and left-turning drivers and pedestrians at intersections.

OBJECTIVES

This research will identify the relation, if any, between pedestrian safety and the lateral offset of crosswalks and document those findings in a clear manner. The influence of intersection design factors (traffic controls, markings, curb radius, sight distance…) will be addressed.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Methodology Review; Survey Development, Data Acquisition (In-Field); Data Acquisition (By Survey); Data Acquisition (Subject testing in Driving Simulator); Data Analysis; TAC Presentations, Pilot Site Selection and Installation, Final Report; Research Note, and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Statewide Project Delivery Branch
Oregon State University (contract under development).
## COST INFORMATION

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*Budget values are estimated based on forecasted project work.*
OVERVIEW

Pedestrian traffic crash injuries in Oregon have increased significantly since the early 2000s. During the five year period between 2002 and 2006 there were on average 610 pedestrians injured while in the years 2012 to 2017 that figure has grown to 914, an increase of 50 percent. Fatal injuries have grown quickly too, rising from an annual average of 48 pedestrian deaths in the earlier period to an annual average of 65 per year, an increase of 36 percent. Pedestrian fatal injuries now represent 16 percent of all fatal injuries, up from 10 percent. These pedestrian injuries are occurring at a disproportionate rate in lower-income communities and communities with more people of color, both in Oregon and nationally. Possible contributors to these disparate outcomes include higher population densities, rates of walking, and lower auto ownership, along with higher speeds, fewer sidewalks or safe crossings opportunities, and poor lighting, among other factors. This research will investigate the underlying infrastructure and behavioral conditions in Oregon that are leading to these disparate outcomes.

OBJECTIVES

The primary research objectives for this project are as follows:

- Understand the difference in pedestrian injury disparities across the state and measure the impact that socio demographics, traffic characteristics, infrastructure, and the built environment have on explaining these disparities in order to inform mitigation strategies for infrastructure and program interventions.
- Measure how these disparities have changed over time.
- Develop standardized outputs for use in existing crash screening methods used in ODOT safety and active transportation programs.
- Inform updates of the Oregon Transportation Safety Action plan (TSAP), Oregon Transportation Plan, and Oregon Highway Plan.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant payments; staff time; literature review; data management, data acquisition (by procurement and/or field observations); data analysis; technical advisory meetings, presentations, report writing, interim report publication, and final report editing and publication.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section, Mr. Josh Roll, as Principal Investigator.
Portland State University (Inter-governmental agreement is being negotiated as of May, 2020)

COST INFORMATION

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Budget values are estimated based on forecasted project work.

On May 19, 2020, the Oregon DOT received authorization under 23 CFR 420.115(a) to use a portion of previously authorized SPR funds to start this project early.
CONSTRUCTING HIGH-DENSITY LONGITUDINAL JOINTS TO IMPROVE PAVEMENT LONGEVITY

OVERVIEW

When hot-mix asphalt (HMA) is placed next to the previously constructed lane (cold mat) during construction, a longitudinal joint occurs between the newly constructed lane and the old one. Due to the particles in the HMA bouncing back from the stiff-cold mat under heavy compactor loads during compaction, proper compaction around the joint generally cannot be achieved and density of the longitudinal joint is generally lower than the constructed lane. For this reason, fatigue cracking generally occurs around the longitudinal joints before the pavement structure reaches its design life. Centerline rumble strips (CLRS) constructed on longitudinal joints with lower densities are also more likely to crack in a shorter period of time. Cracking from a longitudinal joint generally propagates to the rest of the mat and results in localized failures around the pavement section. High permeability of longitudinal joints (due to high air void content) can also result in subgrade saturation, which can eventually cause structural failures on the roads.

In this study, a detailed longitudinal joint construction specification will be developed. This research will also produce information and guidelines for ODOT to implement in asphalt pavement construction to improve longitudinal joint performance. Recommendations to improve longitudinal joint performance will also be provided. Pilot sections with the developed specification will be constructed to determine the impact of developed strategies on longitudinal joint density and performance.

OBJECTIVES

This research has three major objectives: i) determine the factors that control the longitudinal joint density; ii) develop a test method for more accurate quality control testing of the longitudinal joints; and iii) develop a specification for longitudinal joint construction based on the findings of the research project.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.
RESPONSIBLE PARTIES
ODOT Research Section
ODOT Construction Section, Pavement Services

COST INFORMATION

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*Budget values are estimated based on forecasted project work.*
OVERVIEW
US 101 is a vital economic and emergency lifeline that connects coastal communities and provides access to numerous coastal destinations for Oregonians and tourists. Though sections of this highway are highly susceptible to coastal hazards such as erosion, wave action, storm surge, and rising sea levels, structural mitigation of these susceptible areas is challenging due to the extensive regulatory exceptions process required by the Department of Land Conservation and Development (DCLD) through Statewide Planning Goal 18 (which prohibits shoreline armoring of highway infrastructure). The need to revisit Goal 18 for maintaining and protecting public infrastructure has been recognized, with ODOT recently participating in a DCLD led Shoreline Armoring Focus Group. This Group identified that research providing a comprehensive and prioritized coastal highway vulnerability and risk assessment is key to informing upcoming DCLD Goal 18 policy updates. To proactively position ODOT to effectively manage risk and support Goal 18 updates, development of a coastal highway hazard prioritization matrix that includes vulnerability, risk assessment, mitigation options, and management strategies for planning and project development is critical.

OBJECTIVES
A comprehensive coastal hazard vulnerability and risk assessment for US 101 does not exist. The goal of this research is to develop a hazard prioritization matrix for at-risk public infrastructure along US 101 that can both directly support DCLD Goal 18 policy changes as well as inform STIP project development.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: a focused literature review; review of existing data, including agency outreach; development of an erosion model; development of a hazard assessment model; development of an economic model; a recommended prioritization list, and compilation of recommendations in a final report

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.
RESPONSIBLE PARTIES
ODOT Research Section
ODOT Geo/Environmental Section
ODOT Climate Change Section
ODOT Regions 3 and 4

COST INFORMATION

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FY’21-FY’23 expenditure values are estimated based on forecasted project work.
EVALUATION OF CURB RAMP COMPLIANCE

OVERVIEW
ODOT agreed to a settlement in late 2016 to inventory and remediate all curb ramps identified in the 2017 inventory, which consists of approximately 25,000 ramps. Although ODOT has made progress toward their goals, ODOT has had to re-construct several curb ramps after initial construction. ODOT acknowledges other factors that can contribute to non-compliance since very precise slope and size measurements are conducted without an “industry standard” of tolerance.

From observations in the field, there is much difficulty in obtaining reproducible QA/QC measurements in the exact same place, orientation, etc. over time. This research will not assess the accuracy of existing measures; rather it will comprehensively evaluate the compliance assessment process for curb ramps to generate best practices for success in increased precision and compliance.

The American Disabilities Act (ADA) guidelines for ramps also require that slopes not vary along a ramp run or turning space. In the absence of accepted construction tolerances, public agencies are forced to reject curb ramps when any measurement reading is greater than the allowed maximum slopes or where the slope readings themselves are inconsistent without acknowledging the inherent lack of precision with tools, variability of constructed surfaces, or understanding the error ranges of the measurement device. ODOT needs an improved understanding of the magnitude of local variations in flatness on sloped, planar concrete surfaces in standard industry construction practices to designate and apply an achievable tolerance to measurements of constructed curb ramps. These aspects were detailed as further research in US Access Board’s publication.

ADA compliance is critical to ODOT’s mission to provide a safe and reliable multimodal transportation system by allowing equal access to infrastructure, particularly for those with disabilities.

OBJECTIVES
This research enables ODOT to reliably and systematically evaluate the methods and tools used in the inspection process to achieve successful ADA compliance by:

- Investigating alternative technologies used for ADA compliance assessments such as laser scanning.
- Developing a database of existing and newly-constructed curb ramps, acquiring measurements over time using several tools and methods to determine their precision and repeatability,
- Identifying ideal combination(s) of tools and methods to achieve higher precision and reproducibility but still maintain efficiency and cost-effectiveness.
- Help ODOT identify an appropriate overall flatness index measure, when localized outlier variations from existing measurements indicate non-compliance (i.e., outside of existing specified slope limits), and
• Establishing the expected variance for (1) instruments used measure the ramps, (2) flatness of the concrete material itself, and (3) movement or settlement of a ramp to determine an industry tolerance for concrete sloped planar surfaces.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; Literature Review; Calibration setup; Site scanning; Method/Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; Database creation and delivery; TAC Presentations, Final Report; Research Note; and Travel.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS
This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT ADA Program

COST INFORMATION

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FY’21-FY’23 expenditure values are estimated based on forecasted project work.
OVERVIEW

ODOT’s Maintenance Districts are responsible for maintaining and operating Oregon’s State Highway System. The Maintenance and Operations Branch has developed “Desired Conditions of Maintenance Features on State Highways” (DCMFSH). Each year the Districts evaluate segments of highways based on how the highway segments compare to the level of service guidance shown in the DCMFSH.

Evaluating how the safety performance of specific highway segments relates to how well the highway segments meet the level of service guidance for specific elements within the DCMFSH would allow maintenance decision makers to most effectively prioritize the use of limited maintenance funds.

OBJECTIVES

Researchers will incorporate guidance on safety effectiveness and project prioritization from the AASHTO Highway Safety Manual (HSM) as appropriate to examine crash records for varied sections of Oregon highways and compare those records to the conditions proscribed by the DCMFSH. Specific maintenance functions may then be prioritized with regard to their impact on road safety.

Researchers will also identify characteristics of highway sections that modify the priority of maintenance functions, such as traffic speed, congestion, grade, number of intersections, number of horizontal curves, weather conditions, etc.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Literature Review; Select highway sections for study and obtain crash records; Review the consistency of the DCMFSH data across districts and regions; Match crash sites to DCMFSH data and determine the conditions at the time and place of crashes; Reconcile DCMFSH conditions with HSM recommendations for safety improvement; Evaluate Benefit/Costs of changing the level of service in the Desired Conditions; Prepare final report and Research Note.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS
This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Maintenance and Operations Branch
Texas Transportation Institute (contract under development)

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Budget values are estimated based on forecasted project work.
OVERVIEW

The Federal Motor Carrier Safety Administration (FMCSA) defines a Commercial Motor Vehicle (CMV) under 49 CFR 390.5 as “any self-propelled or towed motor vehicle used on a highway in interstate commerce to transport passenger or property when the vehicle has a gross vehicle weight or gross combination weight of 10,000 pounds or greater”. However, Commercial Driver License (CDL) requirements set by the FMSCA under 49 CFR 383.5 only require operators of motor vehicles greater than 26,000 pounds to obtain a CDL.

The rise in medium-duty truck VMT over the last ten years potentially indicates there is an increasing number of truck drivers operating without a CDL. Shifting reliance on medium trucks for a growing freight sector may be increasing safety impacts from non-CDL drivers, who are not subject to DOT drug and alcohol testing requirements, or to DOT and OSHA training that includes defensive driving, accident reporting, hazardous materials management, vehicle inspections and maintenance.

OBJECTIVES

The primary goal of this initiative is to provide the agency with a comprehensive understanding of increased medium-duty truck operation, identification of potential areas of risk, forecast of future operational growth and monetization of the costs associated with these changes. To meet this goal, the research methodology must meet the following objectives:

• Estimate of the number of medium-duty trucks operating in Oregon, including general categorization by industry and/or commodities/services utilizing the trucks, general trip characteristics and logistic patterns, and regional patterns by population density;
• Evaluate safety data to compare and contrast crash rates, incidents and other relevant safety data involving medium trucks compared to heavy trucks requiring CDL drivers in order to determine whether there is a statistical difference between the two populations after controlling for other factors;
• Develop a gap analysis to determine if ODOT is meeting FMCSA safety standards around medium-duty truck operations currently and into the future five and ten years out;
• Recommend a monitoring methodology for ODOT to implement in order to track medium-duty truck safety and performance into the future.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; TAC Presentations, Final Report; and Travel.
Researchers will: Conduct a literature review, Determine data sources for medium trucks, safety, fuel taxes paid, counts by location; Create methodology to analyze the data selected; and Present results to ODOT and publish report, including data used and code for analysis.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Commerce and Compliance
ODOT Economic Analysis Unit

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</table>

Budget values are estimated based on forecasted project work.
OVERVIEW

ODOT’s bridge inventory is continuing to age, and with that, ODOT needs to be proactive in its approach to bridge maintenance. With increasing traffic volumes and public/political involvement, bridge projects have been put into tighter and tighter constraints. ODOT cannot afford to construct diversion structures for every structural overlay project, and traffic volumes have gotten to the point where daytime lane closures have become nearly impossible except for the most remote areas.

As bridge decks continue to wear, there will be a need to replace the existing structural overlays. There is also a need to strengthen some bridges due to higher demands, which can include increasing deck thickness through a structural overlay. As salt is introduced at higher and higher rates, PPC overlays will not be feasible because they will not address the salt issue, leaving structural overlays as the only option. High Early Strength Concrete (HESC) Overlays have the potential to be placed in a single overnight lane or bridge closure, with wet cure times as low as 3 hours.

OBJECTIVES

The objective of this research project is to identify the obstacles of impediments to successful and reliable use of HESC for structural bridge deck overlays on Oregon bridges and to develop the standards, specifications, processes, and practices necessary to using them on ODOT bridges.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Test Specimen Materials; Expendable Monitoring Instruments, Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
ODOT Bridge Section
## COST INFORMATION

<table>
<thead>
<tr>
<th>SPR 847</th>
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<td>REVISED BUDGET</td>
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*Budget values are estimated based on forecasted project work.*
OVERVIEW
Truck platooning, an autonomous vehicle technology where multiple heavy trucks operate at close spacing (headspacing), has been authorized for use in Oregon under HB 4059 Section 40 without requiring permitting or notification to the agency. This allows groups of trucks traveling very close to each other, increasing the weight stress on bridges, with potential to exceed stress levels the current bridge formula accounts for, which would reduce the lifespan of a bridge. In order to preserve the life of existing bridges and ensure structural safety of bridges on highways where truck platooning is expected, it is important to gain an understanding of the potential impact of truck platooning on existing bridge inventory.

Current and ongoing research from other states focuses more on how to design new bridges, rather than estimate impacts on extant bridges. Given the aging condition of Oregon bridges, there is a concern from bridge engineers in ODOT that the agency will be reacting to wear and tear of new truck configurations and platooning software. In order to preserve and maintain Oregon’s vast investment in bridges, it is prudent to take a proactive approach by understanding potential issues and implement the results of this research to craft policies and plans that can be used to have conversations with fleet owners, regulators, and others to avoid damaging bridges and increasing the costs associated with our infrastructure.

OBJECTIVES
The goal of this research is to determine what combination of truck configurations (axle weight and spacing) and platooning headspace may exceed acceptable levels of stress for bridges carrying heavy loads. Results from the modeling will be used to create a set of policy and regulatory recommendations that could be used to update load ratings on Oregon’s bridges.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES
Consultant Payments; Staff Time; TAC Presentations, Final Report; and Travel.

Researchers will: Conduct a literature review; Determine what configurations of trucks and bridges will be modeled; Model the effects of platoons; and Present and write up results, include assumptions and code used in models

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.
ACCOMPLISHMENTS
This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES
ODOT Research Section
ODOT Bridge Section
ODOT Commerce and Compliance Division

COST INFORMATION

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<th>SPR 848</th>
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</table>

Budget values are estimated based on forecasted project work.
OVERVIEW

ODOT is tasked with providing a safe, efficient transportation system. Improving roadway safety continues to be at the forefront of all stages of project development, including planning, alternatives analysis, design, construction, and operations. However a lack of clear guidance on data driven safety analysis in project development (planning, project analysis/design/delivery, work zone etc.) results in greater costs to Oregon and missed opportunities.

Performance Based Practical Design (PBPD) modifies the traditional highway design process by taking a "design up" approach where transportation decision makers build up improvements from existing conditions to meet both project and system objectives. Developing a comprehensive PBPD project prioritization framework from a safety performance perspective based on crash and roadway data would allow the agency to focus safety improvements at locations where the improvement will be the most cost-effective.

OBJECTIVES

The proposed research is focused on providing data driven safety analytical support in the project delivery lifecycle process. Data driven safety analysis during the design phase can evaluate multiple design options and compare the safety and cost of each solution from a safety perspective. The research will identify data needs, tools, methods, policies, potential software solutions and required structural changes needed to implement a data driven safety approach for the project delivery process. The implementable product of the research will be a decision matrix supporting a restructure of ODOT’s project development process to incorporate and prioritize safety.

This project is under development. Once it begins, more detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; ODOT practice and data-source review; Data Acquisition; Data Analysis; TAC Presentations, Final Report; and Travel.

This project is under development. Once it begins, more information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

This project is under development. Once it begins, information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.
RESPONSIBLE PARTIES
ODOT Research Section
ODOT Project Development Section
ODOT Roadway and Traffic Section
Oregon State University

COST INFORMATION

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WORK PLAN BUDGET
SPENT TO DATE
REVISED BUDGET

Budget values are estimated based on forecasted project work.
## APPENDIX A - SPR SUBPART B PROGRAM COMPLIANCE

<table>
<thead>
<tr>
<th>Regulatory Basis</th>
<th>SPR Subpart B Program compliance requirement</th>
<th>Compliance Mechanism</th>
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</thead>
<tbody>
<tr>
<td>23 CFR 420.117 and 420.205</td>
<td>The Program must be implemented in compliance with its approved work program.</td>
<td>TEAMS accounting system Program Oversight by ODOT management</td>
</tr>
<tr>
<td>23 CFR 420.115, 23 CFR 420.209</td>
<td>Documentation that describes the State DOT's management process and the procedures for selecting and implementing RD&amp;T activities must be developed by the State DOT and submitted to the FHWA Division office for approval. Significant changes in the management process must be submitted by the State DOT to the FHWA for approval.</td>
<td>ODOT Research Procedures Manual Approval: March 2010</td>
</tr>
<tr>
<td>23 CFR 420.209</td>
<td>Periodic reviews of the State DOT’s Management Process of the RD&amp;T.</td>
<td>FHWA Division Office participation in the November 2020 Research Peer Exchange and other oversight of work program</td>
</tr>
<tr>
<td>23 CFR 420.207</td>
<td>The State DOT's RD&amp;T work program must, as a minimum, consist of a description of RD&amp;T activities to be accomplished during the program period, estimated costs for each eligible activity, and a description of any cooperative activities including the State DOT's participation in any transportation pooled fund studies and the NCHRP. The State DOT's work program should include a list of the major items with a cost estimate for each item. The work program should also include any study funded under a previous work program until final report has been completed for the study.</td>
<td>Work Program Contents</td>
</tr>
<tr>
<td>23 CFR 420.207</td>
<td>The State DOT's RD&amp;T work program must include financial summaries showing the funding levels and share (Federal, State, and other</td>
<td>Work Program Contents</td>
</tr>
<tr>
<td>Regulatory Basis</td>
<td>SPR Subpart B Program compliance requirement</td>
<td>Compliance Mechanism</td>
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<td>sources) for RD&amp;T activities for the program year.</td>
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<tr>
<td>23 CFR 420.209 (a)(2)</td>
<td>The State must use all FHWA planning and research funds set aside for RD&amp;T activities… to the maximum extent possible.</td>
<td>Work Program Budget and Active project management</td>
</tr>
<tr>
<td>23 CFR 420.209 (a)(3)</td>
<td>The State must have procedures for tracking program activities, schedules, accomplishments, and fiscal commitments.</td>
<td>Budget tracking spreadsheet, TEAMS system and project quarterly reports.</td>
</tr>
<tr>
<td>23 CFR 420.209 (a)(4)</td>
<td>The State must use support and use of the TRIS database for program development, reporting of active RD&amp;T activities, and input of the final report information.</td>
<td>ODOT Research Procedures Manual, and administrative staff Desk Manual</td>
</tr>
<tr>
<td>23 CFR 420.209 (a)(5)</td>
<td>The State must have procedures to determine the effectiveness of the State DOT's management process in implementing the RD&amp;T program, to determine the utilization of the State DOT's RD&amp;T outputs, and to facilitate peer exchanges of its RD&amp;T Program on a periodic basis.</td>
<td>Program Performance Measures, RD&amp;T implementation program, Research Annual Report contents</td>
</tr>
<tr>
<td>23 CFR 420.209 (a)(6)</td>
<td>The State must have procedures for documenting RD&amp;T activities through the preparation of final reports. As a minimum, the documentation must include the data collected, analyses performed, conclusions, and recommendation. The State DOT must actively implement appropriate research findings and should document benefits.</td>
<td>Publication of research reports, Research Notes, and Annual Report</td>
</tr>
<tr>
<td>Regulatory Basis</td>
<td>SPR Subpart B Program compliance requirement</td>
<td>Compliance Mechanism</td>
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<tr>
<td>23 CFR 420.209</td>
<td>The State DOT must include a certification that it is in full compliance with the requirements of this subpart in each RD&amp;T work program. Note, the language to be used for this certification is specified in the regulation.</td>
<td>Work Program transmittal letter</td>
</tr>
<tr>
<td>23 CFR 420.117</td>
<td>Suitable reports that document the results of activities performed with FHWA planning and research funds must be prepared by the State DOT or subrecipient and submitted for approval by the FHWA Division Administrator prior to publication. The FHWA Division Administrator may waive this requirement for prior approval.</td>
<td>March 2015 Division Prior Approval Waiver Letter</td>
</tr>
<tr>
<td>23 CFR 420.117</td>
<td>The FHWA's approval of reports constitutes acceptance of such reports as evidence of work performed but does not imply endorsement of a report's findings or recommendations. Reports prepared for FHWA-funded work must include appropriate credit references and disclaimer statements.</td>
<td>March 2015 Division Prior Approval Waiver Letter, Report disclaimer</td>
</tr>
<tr>
<td>23 CFR 420.121(c)</td>
<td>The State DOT must administer the RD&amp;T program consistent with their overall efforts to implement section 1001(b) of The Transportation Equity Act for the 21st Century and 49 CFR Subpart B6 regarding disadvantaged business enterprises.</td>
<td>ODOT procurement and contracting process.</td>
</tr>
<tr>
<td>23 CFR 420.121(h)</td>
<td>The nondiscrimination provisions of 23 CFR 200 etc. with respect to Title VI of the Civil Rights Act of 1964 and the Civil Rights Restoration Act of 1987 apply to all programs and activities of recipients, subrecipients, and contractors receiving FHWA research funds, whether or not those programs or activities are federally funded.</td>
<td>Annual Title VI reporting, Research Annual Report contents</td>
</tr>
<tr>
<td>23 CFR 420.121(j)</td>
<td>Procedures for the procurement of property and services with FHWA research funds must be in accordance with 49 CFR and/or other applicable regulations.</td>
<td>ODOT Research Procedures Manual, TEAMS accounting system,</td>
</tr>
<tr>
<td>Regulatory Basis</td>
<td>SPR Subpart B Program compliance requirement</td>
<td>Compliance Mechanism</td>
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<td>(a) Costs are eligible for FHWA participation provided that the costs: 1) are for work performed for activities eligible under the Section of title 23 applicable to the class of funds, 2) are verifiable from the State DOT's or the subrecipient's records, 3) are necessary and reasonable for the proper and efficient to accomplish of project objectives and meet the other criteria for allowable costs in the applicable cost principles, 4) are included in the approved budget or amendments thereto, 5) were not incurred prior to FHWA authorization, and (B) indirect costs are allowable if supported by a cost allocation plan and indirect cost proposal prepared, submitted and approved as required.</td>
<td>ODOT Research Procedures Manual TEAMS accounting system Program Oversight by ODOT management</td>
</tr>
<tr>
<td>23 CFR 420.113</td>
<td>(b) The State DOT must submit performance and expenditure reports, including a report from each subrecipient, that contain as a minimum: (i) Comparison of actual performance with established goals; (ii) Progress in meeting schedules; (iii) Status of expenditures in a format compatible with the work program, including a comparison of budgeted (approved) amounts and actual costs incurred; (iv) cost overruns or underfunds; (v) Approved work program revisions; and (vi) other pertinent supporting data.</td>
<td>Project Quarterly Reports Annual Work Program Research Annual Report contents</td>
</tr>
</tbody>
</table>
Memorandum

HEPE-0517-Z445-0001

Subject: ACTION: Authority to Obligate Funds

From: Emily Biondi, Director
Office of Project Development and Environmental Review

To: Phillip Ditzler
Division Administrator
Salem, OR

Brian Bezio
Chief Financial Officer
Office of the Chief Financial Officer

Date: June 14, 2017

In Reply Refer To:
HEPE-30

This memorandum allocates $100,000 to the Oregon State Department of Transportation (ODOT) to conduct “Modeling Chloride Accumulation in Streams from Winter Road Salt Application for Federal Compliance” to be conducted by the Oregon Department of Transportation. This research is presented as a two-phase research proposal. The following objectives are for research Phase 1:

1. Evaluate and adjust ODOT’s Winter Salt Pilot project data collection methods to provide data deemed most useful for accurate predictions of surface chloride transport using the SELDM model for development into a framework than can be applied for MgCl2 or NaCl application in any watershed.

2. Evaluate SELDM model results, including probability of exceeding water quality standards in a given year and the effect of using BMPs such as hydrograph extension to mitigate chloride. As SELDM provides mass-balance results, chloride soil seepage into groundwater as well as chloride creek levels will also be estimated.

3. Determine the preliminary degree of groundwater infiltration at Site 1 using previous and supplemental well/spring data. SELDM mass balance together with these physical results will determine whether further study is needed to include chloride groundwater contributions for modeling stream exceedances.

If the results from Phase 1 reveal that chloride is reaching groundwater systems at high concentrations, Phase 2 will be initiated. For Phase 2 the main objectives are to evaluate chloride direction, mass, and rate of movement in groundwater systems for inclusion as baseflow input for SELDM chloride stream exceedance prediction.
By copy of this memorandum, we are requesting that the Office of the Chief Financial Officer, FHWA Office of Budget FMIS Team make $100,000 available for obligation by the ODOT using FY 2016 funds. The funds are authorized under the FAST Act. The funds must be obligated through the Fiscal Management Information System using program code Z445 and paid through the State’s current billing. The State’s obligation limitation will be increased by the amount of this allocation. The Federal share of this project shall not exceed 80 percent. The State should obligate these funds by September 2, 2017. These funds are specifically allocated for this effort and may not be used for other purposes.

Susan Jones is the Office of Project Development and Environmental Reviews contact for this effort and can be reached at Susan.Jones@dot.gov or 202-493-2139. Local contacts are Emily Cline with the FHWA Oregon Division Office who can be reached at emily.cline@dot.gov or 503-316-2547 and Jon Lazaras, Research Coordinator, ODOT at Jon.M.Lazarus@odot.state.or.us or 503-986-2852. Please send a copy of the final statement of work and project agreement to Susan Jones (HEPE-30) and Deborah Johnson at DeborahR.Johnson@dot.gov (HEPH-40).
Memorandum

HEPE-0218-Z445-0002

Subject: ACTION: Authority to Obligate Funds (CFDA: 20.200)  

From: Emily Biondi  
Director, Office of Project Development and Environmental Review

To: Mr. Philip Ditzler  
Division Administrator (HDA-OR)  
Salem, OR

Mr. Brian Bezio  
Chief Financial Officer (HCF-1)  
Office of the Chief Financial Officer

Date:

In Reply Refer To: HEPE-30

This memorandum allocates $36,000 to the Oregon Department of Transportation (ODOT) to conduct continuing efforts for Additional Project Scope and Budget for ODOT SPR 812: “Assessing the Impact of the ODOT Winter Salt Pilot Project on Neighboring Streams and Groundwater”. The additional three tasks are: 1) Additional Manual Samples, 2) Data Conversion, and 3) Installation of an Additional Auto Sampler.

By copy of this memorandum, we are requesting that the Office of the Chief Financial Officer, FMIS Team make $36,000 available for obligation by the ODOT using FY 2017, FAST Act, HRD funds for this research. The funds should be obligated through the Fiscal Management Information System using program code Z445 and paid through the State’s current billing. The State’s obligation limitation will be increased by the amount of this allocation. The Federal share of this project shall not exceed 80 percent. The State should obligate these funds by September 14, 2018. These funds are specifically allocated for this effort and may not be used for other purposes.

Susan Jones is the Office of Project Development and Environmental Review’s contact for this effort and can be reached at Susan.Jones@dot.gov or 202-493-2139. Local contacts are Emily Cline with the FHWA Oregon Division Office who can be reached at Emily.Cline@dot.gov or 503-316-2547 and Jon Lazarus, Research Coordinator, ODOT at Jon.M.Lazarus@odot.state.or.us or 503-986-2852. Please send a copy of the final statement of work and project agreement to Susan Jones (HEPE-30) at susan.jones@dot.gov and Deborah Johnson (HEPH-40), deborah.johnson@dot.gov.