Proposal for the Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates

Nevada Department of Transportation

PREPARED BY

Applied Pavement Technology, Inc.
115 West Main Street, Suite 400
Urbana, Illinois 61801
(217) 398-3977
www.appliedpavement.com

JULY 1, 2024

applied pavement TECHNOLOGY

1. Title

Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates

2. Principal Investigator

Name: Greg Duncan, P.E.
Address: Liberty Business Center, Suite 200, 203 N. Washington St., Spokane WA 99201
Phone: (509) 890-0881; **Email:** gduncan@appliedpavement.com

3. Problem Description

The Nevada Department of Transportation (NDOT) uses surface treatments (ST), including chip seals and microsurfacing, as a large component of its pavement preservation program. Slurry seals are used to a lesser degree but are often employed by municipal public works agencies and regional transportation authorities. These treatments are low-cost, preventive maintenance solutions that improve the condition of the pavement and reduce the deterioration rate for flexible pavements. The typical materials used in these treatments include emulsified asphalt and aggregate. In recent years, reclaimed asphalt pavement (RAP) materials have been considered as an alternative source of aggregate (Duncan et al. 2020).

For these treatments to successfully use RAP as the aggregate source, agencies must permit its use in specifications and identify test method modifications that are required to standardize design methodologies. Currently, several agencies have permitted RAP to be used in STs, including chip seals, slurry seals, and microsurfacing. The aim of this research project is to identify specifications that will work with Nevada materials, methods, and construction expectations.

4. Background Summary

Several local and state transportation agencies have utilized RAP successfully in their pavement preservation programs. The impetus for using RAP varies by agency and include meeting sustainability goals, reducing costs, or increasing competition among material suppliers (Duncan et al. 2020).

a. NDOT's Current Practice

NDOT specifications for chip seal and microsurfacing are included in the *2014 Standard Specifications for Road and Bridge Construction* (2014 SS) and are supplemented with plan notes and revisions included in contract special provisions. The slurry seal specification is in a contract special provision document inserted into any applicable project.

Chip Seal

Chip seals have gradation requirements for the "screenings" with

	Percent Passing by Mass		
	12.5 mm (1/2 in.) Size		9.5 mm (3/8 in.) Size
Sieve Size	Grade 1	Grade 2	
12.5 mm (1/2 in.)	100	100	—
9.5 mm (3/8 in.)	90-100	50-80	100
4.75 mm (No. 4)	15-35	0-15	20-45
2.36 mm (No. 8)	—	0-5	—
1.18 mm (No. 16)	0-4	—	0-6
75 µm (No. 200)	0-2	0-2	0-2

Figure 1. Nevada DOT Chip Seal Grading Requirements

either a maximum aggregate size of 0.5 in or 0.375 in. The 0.5-in maximum aggregate size can be either Grade 1 or Grade 2 band, with Grade 2 being the coarser graded material. NDOT standard gradation bands are shown in figure 1.

Slurry Seal and Microsurface

Both the NDOT slurry seal and microsurface design methodologies rely heavily on the International Slurry Surfacing Association (ISSA) guidelines for mixture design. The NDOT slurry seal specification is found only in contract special provision section 408, while microsurfacing is covered in 2014 SS section 414. Aggregate quality and cleanliness requirements are located in 2014 SS section 705. NDOT specifies aggregate quality and asphalt emulsion standards and use the ISSA design documentation to complete the job-mixture process. For slurry seals, NDOT also annually recognizes mixtures designed and approved for use by the Regional Transportation Commission of Washoe County.

Quality Assurance Protocols

Requirements to specify and accept STs are identified in the construction specifications. Aggregate gradation is monitored and used for acceptance purposes, and the chip seal equipment must be calibrated to apply the correct amount of bituminous material and aggregate chips uniformly across the applied width and length. Material samples must be submitted to the agency prior to starting construction so that source properties may be verified. These characteristics ensure the contractor is placing approved materials at the specified rates. Much of the workmanship is verified through by project inspectors (e.g., equipment size, type, and function; material uniformity; traffic control and safety aspects).

b. Literature Search

According to the Federal Highway Administration (FHWA) Recycled Materials Policy, "the same materials used to build the original highway system can be re-used to repair, reconstruct, and maintain them" (accessed January 15, 2024). Building upon that policy and in support of an emerging technology, in 2016 the FHWA commissioned contract DTFH6116C00015 *Recycled Asphalt Pavement (RAP) Use in Pavement Preservation Surface Treatments* to document case studies, best practices, applicable testing, treatment costs, and specifications for the use of RAP in pavement preservation STs such as chip seals, micro surfacing, and slurry seals. The resultant report noted that several agencies use RAP in preservation as a matter of policy, and the use of RAP in pavement preservation treatments continues to grow; in addition to the southern California and New Mexico case studies presented, the report identified users in North Dakota, Pennsylvania, Ohio, and New York.

There are several reasons why the use of RAP in pavement preservation treatments is growing. Agencies have found RAP beneficial due to its availability as a surplus material. RAP aggregate (RAGG) has also been shown to be a cost-effective replacement for scarce virgin aggregate. When used in this manner, RAGG can help agencies implement more sustainable practices using recycled materials. Finally, RAP material-use specifications provide for additional aggregate supply chains and bidding competition for agencies, allowing economic benefits to be realized in the construction of preservation treatments. In addition to documenting examples of RAP use, the FHWA report summarized material and construction specifications and testing requirements that some agencies are using for the RAP treatments.

Since the completion of the FHWA research, an Ohio Department of Transportation (ODOT) project, "*Design of Microsurfacing and Chip Seal Mixes with RAP for Local Roadway Application*," evaluated local RAP materials and conducted laboratory testing to design a chip seal and microsurfacing treatment that could be used on local roads typical in Ohio. The report proposed that a local agency should

construct test sections to evaluate field performance using RAP in chip seals and micro surfacing, after which they should compare the results to the same treatments designed using virgin aggregate.

Aside from the sources mentioned in the RFP, Wang et al. evaluated mixture design testing properties and determined that an optimum percentage of RAP was observed when the full battery of tests was performed and rutting susceptibility was minimized. Li et al. showed that ST mixture design tests were successful in using RAP for measuring typical mixture design properties. The second FHWA RAP in Pavement Preservation project held an interim presentation where members of the Applied Pavement Technology, Inc. (APTech) team presented findings related to adjustments required for standard tests to make them more applicable to RAGG. These are discussed further in the Research Methodology section of the proposal.

c. Research Need

Because NDOT's bituminous mixtures and environment differ from those addressed in previous studies, this research is essential. Current NDOT aggregate specifications cannot be directly applied to the use of RAP for STs because RAP is comes partially coated with asphalt. Source properties are easily measured with virgin aggregate because the tests were developed for that purpose—not for characterizing RAP. To remove the RAP coating, it must be chemically extracted or the asphalt must be removed using heat, e.g., the ignition oven (Duncan et al. 2000). These processes change the applicability of the aggregate material in relationship to the test method by leaving a chemical film or altering the aggregate surface texture. Testing protocols must be adjusted and well understood to use typical ST design processes on RAP materials. This research will uncover the limits to which those typical tests should apply.

5. Proposed Research

a. Technical Objectives

The objective of this research is to develop test methods and procedures for using Nevada-specific RAP materials as aggregates for STs. These shall cover all aspects of materials selection, mix design, and quality assurance during construction. The following represents the specific proposed research objectives:

- Develop and conduct laboratory and field tests/methods for the evaluation of RAP materials as aggregates for ST using locally available sources from each of the three NDOT districts.
- Develop mix design methods and limiting criteria for ST with RAP aggregates.
- Develop test methods for quality assurance of ST during construction.
- Develop specifications for the material processing and construction of ST with RAP aggregates.
- Perform feasibility and economic analyses to understand the potential use of RAP in STs statewide.
- Produce a final report.

b. Research Methodology

APTech will conduct the research using the following approach to accomplish the project objectives.

Task 1 Kickoff Meeting and Project Management

Within 1 month of contract execution, APTech will conduct a 2-hour virtual kickoff meeting with the NDOT project panel, attended by Mr. Duncan, Mr. Peshkin, Mr. Espinoza, and Mr. Matthews. APTech will solicit input on the scope of the project, RAP sources to be investigated, and contacts for the source owners. To meet project objectives, APTech will work with existing RAP sources identified by NDOT. Any RAP that NDOT has salvaged from previous projects may be prioritized. Meeting notes will be

prepared and submitted within two weeks of the meeting. Additionally, periodic meetings will be held to summarize progress during the work. It is envisioned that these meetings will occur every 2 months.

Task 1 Deliverable: Kickoff meeting notes and periodic progress meetings**.**

Task 2 State of the Practice — Surface Treatment Design and Quality Assurance

APTech will conduct a thorough literature review of currently available information documenting the state of ST design for the following topics:

- The agencies that have constructed chip seals, slurry seals, and microsurfacing using RAP replacement for virgin aggregate.
- The use of standard tests to measure ST properties during design and construction and modifications that have been used with RAP aggregate replacement.
- The mix design targets used by agencies to design RAP STs, i.e., maximum loss for Wet Track Abrasion Testing.
- Quality assurance testing and sampling practices being used to accept and control STs.

APTech will summarize the literature findings, highlighting best practices used by agencies to include RAP in STs. Comments on the deliverables should be received within 2 weeks of delivery to NDOT and will be incorporated into the final literature summary. The literature review is anticipated to be completed by month four of the project. Mr. Duncan will lead this task, aided by Mr. Espinoza. Mr. Peshkin will provide technical guidance and a detailed technical review of the summary work products.

Task 2 Deliverable: Literature summary of RAP specified in STs.

Task 3 Propose NDOT Surface Treatment Design Specifications

Based on the literature review, modifications to existing specifications will be developed to include RAP materials testing guidelines for aggregate characterization and modifications for design standards for RAP treatments. Known modifications include the characterization of RAP for gradation (washed and extracted); consideration for how certain quality tests (like soundness) should be approached, and tolerances for gradation considering adhered fines to the coarse particles. ISSA technical bulletins will also require some modifications to address the Compatibility by Schulze-Breuer and Ruck Procedure to address the required asphalt content to mix into the test samples. These modifications are needed because RAP is an aggregate that is already partially coated with asphalt. Other findings in the literature review are expected to inform additional modifications to existing practices and specifications.

Task 3 Deliverable: Draft NDOT specification and test method revisions.

Task 4 Confirm Laboratory Design Properties

Don Matthews and the Pavement Recycling Systems, Inc. (PRS) laboratory will lead the effort to confirm design parameters of the modified NDOT design and construction specifications. The APTech team will obtain five representative samples from RAP sources across the state, and at least one from each NDOT geographical District. Each of these sources will be processed into the appropriately sized material for evaluating the standard sizes of NDOT chip seals, Type 2 slurry materials, and Type 3 microsurfacing materials. However, these assumptions can be altered through negotiations with NDOT champions. The evaluations are summarized by the following categories:

- RAP aggregate properties.
- RAP asphalt characterization.
- Virgin emulsion characterization.
- Chip seal designs including the sweep test.
- Slurry seal design testing according to the ISSA guidelines.
- Microsurfacing design testing according to ISSA guidelines.

As testing is being conducted, the APTech team will evaluate the test and design trial results to develop trends and determine whether the RAGG have similar observed responses to the tests as are typical for virgin aggregates. The APTech team will also present the results to the NDOT champions so that the entire context of the mixture design is well understood and discussed.

Task 4 Deliverable: A summary presentation showcasing all relevant test measurements and identified trends from the laboratory evaluation.

Task 5 Prepare Final Materials, Design and Construction Specifications

At the completion of task 4, the APTech team will provide draft final materials, design, and construction specifications for NDOT's consideration. The revised documents may go beyond the assumed accommodations from task 4 and include revised test metrics and limits appropriate to accommodate RAGG materials into the treatments. The APTech team will also adjust any NDOT quality assurance protocols to include RAP as a source material during treatment design and construction.

Task 5 Deliverable: Final materials, mixture design, and construction specifications along with quality assurance guidance for RAP STs.

Task 6 Conduct Workshop

Based on the literature findings, laboratory validation, and the continued discussions with the NDOT project champions, the APTech team will prepare instructional workshop materials that show the process for including RAP in STs relevant to Nevada materials. The workshop will be interactive and use adult learning principles to convey the information in a way that can be quickly assimilated and practiced within the contact time allowed. The draft instructional plan will be submitted to the project champion for discussion and refinement. The 4-hour workshop will be delivered by Mr. Duncan in Reno or as directed by the NDOT champion and will be scheduled to fully ensure stakeholder participation.

Task 6 Deliverable: An in-person workshop to share the revised treatment specifications.

Task 7 Implementation Plan

To avoid redundancy in the proposal, the Implementation Plan is discussed in detail in section 7. Mr. Duncan will lead the development of the implementation plan, with the assistance of Mr. Peshkin, Mr. Seeds, and Mr. Matthews and input from the NDOT project champions.

Task 7 Deliverable: A project implementation plan.

Task 8 Prepare Final Report

Three months before the end of the contract, APTech will submit the preliminary draft final report (PDFR) and other final deliverables to the NDOT project champion. The PDFR will document the entire research effort and present the overall project findings, the rationale for validating or amending the agency material quality requirements, mixture design tests, and construction specifications. APTech will prepare and deliver:

- A final report documenting the project, incorporating all other specified deliverables of the research.
- A PowerPoint presentation showing project results that can be tailored for specific audiences.
- A one-page fact sheet for executives describing the value of the project.
- A final report chapter titled "Implementation of Research Findings and Products."

The PDFR will be prepared in accordance with NDOT's report preparation guidelines. Report comments will be submitted to APTech within 1 month from receipt of the PDFR and draft final deliverables. Mr. Duncan will attend a virtual summary meeting at the end of the project to provide a final project presentation to the NDOT champions and stakeholders. Any comments received within 1 week following the summary meeting will be incorporated into the final report. Mr. Duncan will lead the report development with assistance from Mr. Matthews, Mr. Seeds, and Mr. Espinoza. Mr. Peshkin will provide technical guidance and a detailed technical review of the work products.

Task 8 Deliverable: Final report documenting the entire research process, an Implementation Plan chapter within the final report, a PowerPoint presentation, and a one-page fact sheet for executives.

c. NDOT Staffing and Equipment

NDOT project champions will be integral to the research effort through collaboration with the APTech team for sourcing materials and for providing context to some of the material nuances encountered in the testing phase. Additional NDOT staff may be requested to assist in coordinating, obtaining, or transporting RAP sources to a central collection point, i.e., Headquarters Materials Lab in Carson City. NDOT laboratory facilities are not anticipated to be used during this research project.

d. Deliverables

The deliverables for the research project are listed in the Research Methodology section and described with each task.

6. Urgency and Anticipated Benefits

a. Preliminary Benefit Analysis

RAP is a commodity valued based on the materials it can replace. In plant mix asphalt, the maximum value that the RAP can attain per ton is the replacement value of the aggregate (typically 94.5 percent) plus the replacement value of the RAP asphalt (typically around 5.5 percent.) However, this value is reduced based on the cost for the RAP materials, which include any processing, storage, transportation, or degrading of the material from the time it is milled from a project. The value reduction based on the distance from alternative aggregate sources can completely negate the economic benefits of including RAP in materials. Thus, it may be economically feasible to stockpile RAP closer to the milling project and use it for nearby STs.

In addition to the potential cost differential of RAGG versus virgin aggregates, the benefit analysis of using RAP in STs will also include an increase in supplier competition where aggregate sources are scarce. By introducing market alternatives into the ST supply industry, NDOT may achieve significant savings and sustainability policy enhancements including higher quantities of reclaimed materials used in pavements, reduced stockpiles of RAP materials, and reduced transportation costs and emissions.

b. Implementation Cost

Implementing RAP in STs, excluding the research costs and trial mandatory use of the new specifications, should yield a cost-negative impact for ST projects. Most agencies that have permitted the use of RAP in STs have enjoyed lower material costs without performance reductions.

c. Savings Estimate

In the FHWA RAP in Pavement Preservation study, San Bernardino County identified a 44 percent savings in chip prices when RAP materials were permitted by specifications. New Mexico DOT identified up to 25 percent lower cost for delivered chips when they used RAP materials that had been stored near a milling project site (Duncan et al. 2020). Other agencies had difficulty calculating the cost savings since RAP use has become nearly ubiquitous in the local area and multiple bids are received sourcing RAP. A detailed estimate of savings for NDOT will be determined during the implementation plan task when market demands are better defined and local RAP sources can be located and quantified.

7. Implementation Plan

a. Implementation Stages

This research project is described best as “2. Laboratory Prototype Stage” in the Caltrans Research and Implementation Stages. The design specifications are developed, and laboratory confirmation is conducted to ensure that treatments meet the requirements of the proposed specifications using multiple RAP sources. Ideally, completion of this research positions NDOT with a viable specification to conduct pavement preservation trial projects using the design, construction, and quality assurance protocols and to monitor construction success and long-term performance of the experimental pavement sections. As project successes during construction are observed, the specifications and testing protocols may be adjusted based on early findings or perceived improvements. Because pavement preservation life cycles are relatively short, evaluation after 3 to 6 years under an additional research project, could provide validation that the field trials are successful and full implementation of RAP used in STs could continue. The implementation plan developed in task 7 includes the following considerations:

1. **A discussion of the target audience.** The target audience for the project report and implementation plan are likely to be the ST champions and the NDOT contractors who construct STs. Other stakeholders include emulsion suppliers, NDOT project inspection staff, and quality assurance managers in each district.
2. **A discussion of the benefits of change.** Project benefits have been presented in Section 6, considering that the project will produce recommendations for changes to specifications. The implementation plan developed during the project will describe the reasoning for the change, the benefits anticipated, and additional costs or efforts required by the agency.
3. **Recommendations for dissemination.** To facilitate the implementation of the project results, a communications plan will be developed, and a PowerPoint presentation of relevant topics will be delivered in task 8 to suppliers, contractors, and agency staff.

4. **A suggested process for gauging success.** The implementation plan will include evaluation of RAP used for STs and the anticipated impacts on the aggregate supply market.

b. Implementation of Deliverables

This project will provide specifications ready for implementation and trial projects in multiple areas of the state. APTech is prepared to participate in a preproposal meeting with contractors and agency representatives charged with bidding on and inspecting trial projects. While constructing the trial projects, updates to the Materials Division will provide situational awareness of project progress and elevate issues that may occur, whether anticipated or not. After construction, the projects will require routine monitoring and pavement condition data collection to verify that the treatments constructed using RAP provide similar or better performance than virgin mixtures.

8. Project Schedule

The project will be completed within 24 months of the contract date. Appendix C contains the schedule describing when each task will be conducted based on an anticipated start date of September 1, 2024.

9. Facilities and Expertise

a. Research Team

APTech has assembled a research team for this project focused on national pavement preservation expertise, cutting edge RAP research, and a local knowledge of Nevada DOT materials and construction practices. These team members have worked together on similar projects that have been verified and implemented by many transportation agencies.

Team Overview

APTech is an established national leader in pavement engineering and has worked with federal, state, and local agencies on related research, training, and implementation for nearly 30 years. APTech's team includes pioneers in the use of RAP for pavement preservation. In fact, three of the proposed team members wrote definitive literature on the subject. The proposed Principal Investigator, Greg Duncan, along with Steve Seeds and David Peshkin, drafted the Federal Highway Administration (FHWA) report, "Using Reclaimed Asphalt Pavement in Pavement Preservation Treatments."

APTech will be joined by PRS as a subconsultant for engineering support for pavement preservation treatments and laboratory services. Founded in 1989, PRS first provided cold milling services to the Southern California market. PRS has subsequently grown into the premier general engineering subcontractor for cold-milling, soil stabilization, roller compacted concrete, and cold-in-place asphalt recycling in California and Nevada, with a presence in Utah, Oregon, and Washington. In 2007, PRS acquired the highly regarded pavement preservation company, Pavement Coatings Company (PCC), adding pavement preservation services throughout California, and specializing in the use of RAP aggregates via the Reclaimed Aggregates division.

The following presents a brief overview of the proposed key staff, with resumes, including an overview and commitment letter for PRS, located in Appendix A.

Gregory (Greg) Duncan, P.E. – Principal Investigator

Greg Duncan is a Senior Engineer at APTech with 30 years of transportation engineering experience in the areas of pavement materials, construction, and roadway maintenance. Since joining APTech, Mr. Duncan's research has focused on pavement preservation and maintenance treatments—including

repairing distress at longitudinal paving joints and using RAP in pavement preservation treatments like chip seals, slurry seals, and microsurfacing. Mr. Duncan is currently serving as Project Manager for the FHWA project, *RAP Materials for Pavement Preservation: Material Specification, Storage, and* Testing, which is investigating the implementation of RAP in pavement preservation treatments and developing a framework for determining when to best use recycled materials for pavement. From 2016 to 2020, Mr. Duncan was also the Principal Investigator for the FHWA project, *RAP Use in Pavement Preservation Surface Treatments*. As the former bituminous engineer with the Tennessee DOT, Mr. Duncan is experienced with asphalt mixtures. He has taught the FHWA Highway Materials Engineering Course Asphalt Module and has recommended revisions to the Federal Aviation Administration P-401 asphalt mixture design specification for statewide use in Tennessee. Mr. Duncan has proven experience developing guidance that can be easily understood and deployed by pavement preservation practitioners.

David Peshkin, P.E. – Principal-In-Charge

As Principal-In-Charge, David Peshkin will support Mr. Duncan by providing administrative oversight to the project and working to ensure that all tasks progress in accordance with NDOT's expectations. Mr. Peshkin will also provide technical expertise based on his decades of work in pavement preservation. In addition to serving as an author in the previously mentioned FHWA RAP report, Mr. Peshkin also recently completed a study for the Strategic Highway Research Program (SHRP), SHRP 2 Project R-26, *Preservation Approaches for High Traffic Volume Roadways*.

Arturo Espinoza-Luque, P.E. – Lead Engineer

Arturo Espinoza-Luque, an engineering associate at APTech, will serve as the Lead Engineer for the proposed project and will assist Mr. Duncan in each task. Mr. Espinoza-Luque has been involved in research projects for federal and state clients, including FHWA and the Minnesota, Missouri, and Illinois Departments of Transportation. He has conducted research assisting in *Quality Assurance Procedures for Construction*, *Pavement Preservation Program Benchmarking*, and *Documenting FHWA Quality Assurance Assessments*. In addition to being an adept researcher and report writer, he also managed an asphalt mixture plant in Mexico for 18 months during his previous employment.

Steve Seeds – Engineering Consultant

With over 40 years of experience, Steve Seeds joins the proposed team as an Engineering Consultant. Mr. Seeds will advise the APTech team in several tasks, especially in sourcing and implementing RAP specifications. Mr. Seeds was a Senior Engineer at APTech, where he focused on pavement evaluation, design, management, research, and forensic investigations. He has an extensive background in pavement research and participated in the National Cooperative Highway Research Program (NCHRP) Project 1-54, *Guidelines for Limiting Asphalt Moisture Damage to Flexible Composite Pavements Due to the Presence of Water*. In 2020, Mr. Seeds served as a Senior Engineer for the update of the National Highway Institute (NHI) course, *Asphalt Pavement In-Place Recycling Techniques ILT.*

Mariela Solis – Engineering Associate

Mariela Solis is an Engineering Associate (EA) at APTech with nearly a decade of pavement engineering experience. She specializes in pavement management and pavement evaluation and conducts PCI surveys, performs visual inspections, analyzes data, updates pavement databases, develops M&R recommendations, and prepares reports. Ms. Solis regularly provides pavement engineering and management support for clients in Nevada and provides training through the Nevada Local Technical Assistance Program (NVLTAP). She will be a boots-on-the-ground EA in Reno.

Don Matthews, P.E. (PRS) – Senior Engineer

Don Matthews is the technical manager and senior engineer for PRS with over 40 years of experience in the industry. In that role, he provides engineering, technical, and laboratory services for all company projects as needed. Mr. Matthews has been active in promoting RAP use in pavement preservation treatments since 2007 when he first supplied a chip seal project using fractionated RAGG. Since then, he has designed and implemented RAP storage, handling, and fractionation systems in an industrial-production setting to provide thousands of tons of RAP and RAGG for numerous chip seal, cape seal, micro surfacing, slurry seal, and plant mix asphalt overlay treatments.

b. Equipment

Established in 2001, PRS's laboratory has concentrated on the research and development of RAP products used in cold recycling, slurry, micro surfacing, and chip seals. Additionally, they have the capabilities to conduct mix designs and quality control and assurance testing on aggregates, asphalt-based pavements, slurry seals, micro surfacing, and emulsions. Figure 2 shows representative microsurfacing (Multilayer Loaded Wheel Test) and chip seal testing equipment (Sweep Test).

Figure 2. PRS ST design and testing equipment.

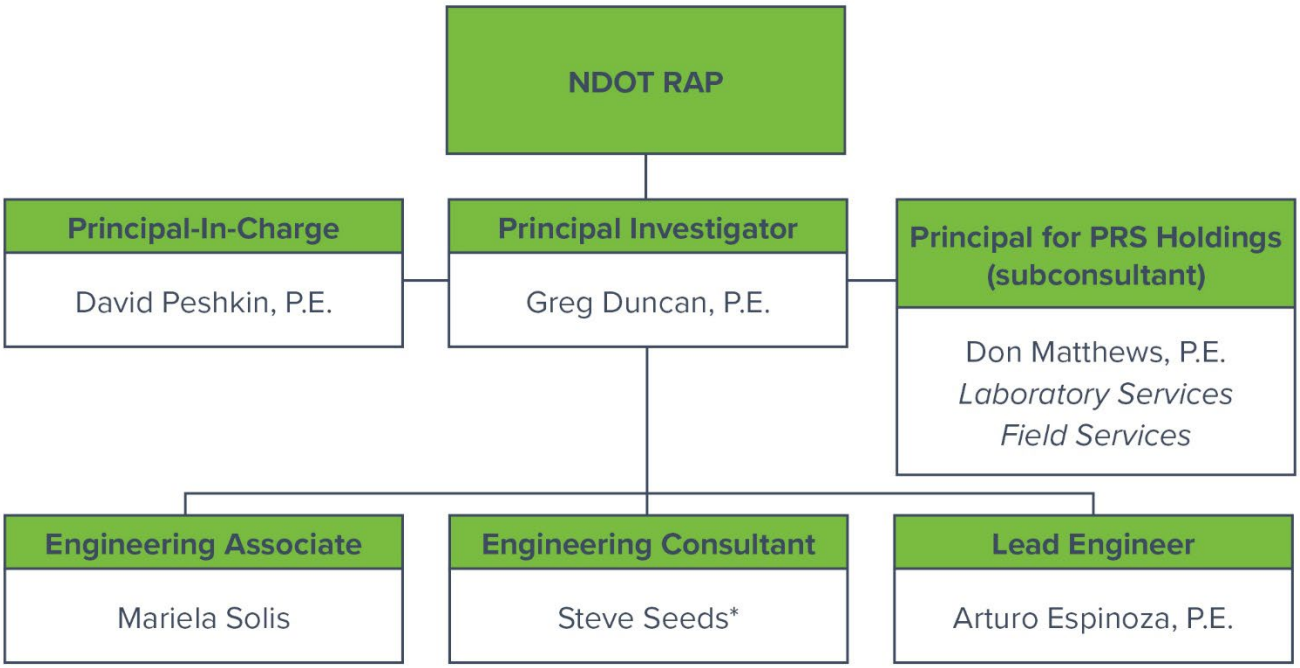
10. Budget

The proposed budget to complete this project is $254,069. A detailed schedule of costs is provided in Appendix B. The cost to prepare and submit the final report is shown as task 8 in table B-1. The value of preparing and submitting the final report is $27,755.

11. NDOT Champion, Coordination and Involvement

In preparation of this proposal, the Principal Investigator contacted Nevada DOT staff to learn more about the background and context of the study. Mr. Changlin Pan, Chief Materials Engineer, and Mr. Nathan Morian, Assistant Chief Maintenance and Asset Management Engineer, provided information about the current processes, plans, specifications, and opportunities for using STs and the implications using RAP may pose. Both Mr. Pan and Mr. Morian described the specification process as multilayered with the standard construction specifications, contract special provisions, and plans providing instruction describing expectations to the contractor. Mr. Pan described how the testing methods are developed and where Nevada methods govern, that standard AASHTO or ASTM testing is also used, and industry guidelines like the ISSA procedures are called upon for design of slurry systems.

Appendix A: Resumes



* Retired from APTech but does occasional subconsultant work

Gregory (Greg) Duncan, P.E.

Principal Investegator

Education

M.S., Civil Engineering, Auburn University, 1997

B.S., Civil Engineering, Tennessee Technological University, 1992

Professional Registration

Professional Engineer, Tennessee, 1997

Professional Affiliations

Member and Communications Coordinator, Transportation Research Board Standing Committee on Maintenance and Operations Management AKR10

INTRODUCTION

Mr. Duncan is a Senior Engineer at Applied Pavement Technology, Inc. (APTech). He has over 30 years of transportation engineering experience in the areas of pavement materials, construction, and roadway maintenance. As a transportation agency executive, he has a proven track record of solving organizational management issues and participating in the national dialogue for the advancement of transportation operations, performance-based maintenance management, and cost-effective pavement preservation.

Since joining APTech, Mr. Duncan's research has focused on pavement preservation and maintenance treatments including repairing distress at longitudinal paving joints and in using reclaimed asphalt pavement (RAP) in pavement preservation treatments like chip seals, slurry seals, and microsurfacing. In 2020, Mr. Duncan, along with his APTech colleagues, authored the Federal Highway Administration (FHWA) report, "Using Reclaimed Asphalt Pavement in Pavement-Preservation Treatments." His research has been successful through collaboration with professional pavement colleagues, along with innovative approaches to developing guidance and implementable solutions for clients.

Mr. Duncan is a Past Vice Chair for the American Association of State Highway and Transportation Officials (AASHTO) Sub-Committee on Maintenance – Roadway Roadsides Technical Working Group. He worked on the National Cooperative Highway Research Program (NCHRP) Project 20-07 Task 300: Methods for Estimating the Benefits of Winter Maintenance Operations. He has also contributed to the NCHRP 20-68a Domestic Scan Program, as Chair of 11-01: Privatization of Maintenance Functions, and as a member of 13-01: Developing a Cross Trained Workforce. He is a graduate of the Eastern Transportation Coalition *Operations Academy*, the AASHTO *Transportation Management Conference* and the *AASHTO National Transportation Leadership Institute*.

Awards

- Tennessee Society of Professional Engineers (TSPE) Professional Engineer in Government Award, 2005

BY THE NUMBERS

- **31** years of pavement engineering experience.
- Played a leading role in **17** pavement research projects.
- Project Manager or Principal Investigator for **15** pavement focused projects.

REPRESENTATIVE EXPERIENCE

- Principal Investigator for the 2022 to 2024 FHWA project, *Recycled Asphalt Pavement Materials for Pavement Preservation: Material Specification, Storage, and Testing.* This project investigates the implementation of recycled asphalt pavement in pavement preservation treatments, including developing a framework for determining when to use recycled materials for pavement. Coordinating work plans and conducting meetings. Also served as the Principal Investigator for the 2016 to 2020 FHWA project, *Recycled Asphalt Pavement Use in Pavement Preservation Surface Treatments*.
- Senior Engineer for the 2019 to 2023 Nevada Local Technical Assistance Program. Providing technical assistance to municipalities by identifying needs, providing available resources, and implementing solutions in pavement management, construction practices, employee development, and partnering.
- Principal Investigator for the 2016 to 2018 Nevada Department of Transportation (DOT) study, *Adapting a Culture for Performance Management at the Nevada Department of Transportation*. Assessed the use of performance measurement monitoring and reporting within the Nevada DOT and provided tools that can affect agency culture at all levels within the business units.
- Senior Engineer for the 2019 to 2021 NCHRP 20-05 Topic 51-16 project, *Maintenance and Surface Preparation Activities Prior to Pavement Preservation Treatments*. Developed a synthesis of the types of maintenance and surface preparation activities performed by DOTs before pavement preservation treatments are applied through conducting interviews with agency officials and writing case studies.
- Project Manager for the 2022 to 2023 National Center for Asphalt Technology project, Improving Performance of Longitudinal Joints in Airfield Asphalt Pavements, as a part of the Airfield Asphalt Pavement Technology Program. Managing all aspects of the project including performing field inspections to develop performance characteristics for different treatments and developing guidance on the construction and maintenance of longitudinal joints using different techniques.
- Project Manager for the 2021 to 2022 Tennessee Department of Transportation's Highway Material Specification Comparison with FAA Material Specifications. This project involves identifying FAA pavement material specifications in FAA AC 150/5370-10H, which have comparable material specifications and that can be used instead, where permitted, as described in AC 150/5100-13C. Work includes identifying common bid items, reviewing relevant FAA guidance, developed state standards for construction, drafting a final white paper, and coordinating engagement with FAA officials.
- Panel Member of the 2016 to 2018 NCHRP Project 14-37: *Guide Construction Specifications for Pavement Preservation Treatments: Chip Seals, Microsurfacing, and Fog Seals*. Recommended prime contractor to conduct research study, reviewed the draft interim report, provided comments to the program officer regarding implementation and project acceptance.
- Principal Investigator for the 2016 to 2017 Ohio DOT Longitudinal Joint Repair Best Practices. Oversaw all aspects of the project which included evaluating the current longitudinal joint repair process, performing a comprehensive study of longitudinal joint repair practices by other state DOTs, developing a field playbook and treatment selection decision tree, and developing a construction guidance document.

SELECT PUBLICATIONS

- Duncan, G. M., L. V. Sibaja, S. B. Seeds, and D. G. Peshkin. 2020. *Using Reclaimed Asphalt Pavement in Pavement-Preservation Treatments*. No. FHWA-HRT-21-007. Federal Highway Administration, Office of Infrastructure.

David Peshkin, P.E.

Principal-In-Charge

Education

M.S., Civil Engineering, University of Illinois, 1987

B.S., Civil Engineering, University of Illinois, 1986

B.A., History, Swarthmore College, Pennsylvania, 1977

Professional Registration

Professional Engineer, Nevada, 2002; also sixteen other states

Professional Affiliations

Committee Chair, TRB Committee AKT30, Pavement Maintenance (2020 to 2023)

Member, Midwest Pavement Preservation Partnership (MPPP)

INTRODUCTION

Mr. Peshkin is a Vice President of Applied Pavement Technology, Inc. (APTech) with 36 years of pavement engineering experience. His technical efforts focus on the following areas: pavement management; pavement evaluation and design; technology transfer for pavement design, maintenance, and rehabilitation; forensic engineering and expert witness; and pavement research.

Mr. Peshkin has served as the Principal Investigator on several highway research projects focusing on pavement maintenance and preservation. Currently, he is leading the Federal Highway Administration (FHWA) effort, *Pavement Preservation Program Benchmarking, Data Collection, and Metrics Development*. For the National Cooperative Highway Research Project (NCHRP) Project 1-48, he developed procedures for incorporating pavement preservation into the *Mechanistic-Empirical Pavement Design Guide (MEPDG)* analysis process. He also completed a study for the Strategic Highway Research Program (SHRP), SHRP 2 Project R-26, *Preservation Approaches for High Traffic Volume Roadways*.

Mr. Peshkin is also closely involved with pavement-related research advances within the aviation community including projects on accelerated construction of portland cement concrete (PCC) pavements, the evaluation of PCC pavements with materials related distress (MRD) such as alkali-silica reaction (ASR), and the evaluation of HMA overlay design procedures. In 2019, his completed work on Airport Cooperative Research Program (ACRP) Project 09-17 was published as ACRP Report 203, *Collecting, Applying, and Maintaining Pavement Condition Data at Airports*.

BY THE NUMBERS

- **36** years of experience.
- Played a key role in **54** pavement research projects.
- Principal-In-Charge for **60** pavement engineering projects.

REPRESENTATIVE EXPERIENCE

- Principal-In-Charge for the 2022 to 2024 FHWA project, *Recycled Asphalt Pavement Materials for Pavement Preservation: Material Specification, Storage, and Testing.* This project investigates the implementation of recycled asphalt pavement in pavement preservation treatments, including developing a framework for determining when to use recycled materials for pavement. Coordinating work plans and conducting meetings. Also served as the Principal-In-Charge for the 2016 to 2020 FHWA project, *Recycled Asphalt Pavement Use in Pavement Preservation Surface Treatments*.

- Principal Investigator for the 2022 Federal Aviation Administration (FAA) Project, *In-Service Performance of Portland Cement Concrete Pavements Constructed Following State Specifications for Highway Materials,* as a subconsultant. This project involves documenting the in-service performance of PCC pavement constructed following state highway specifications and comparing that performance to the performance of pavements constructed following FAA standard specifications for aircraft less than 60,000 pounds. This project includes comparing performance and material requirements in state highway specifications versus FAA standard specification for rigid PCC pavement materials.
- Principal Investigator for the 2020 to 2022 Arizona Department of Transportation (DOT) project, Evaluating the Performance of Pavement Surface Treatments on Arizona Highways. The purpose of this project is to identify methods, guidance, and practices to evaluate the efficiency of surface treatments and developing a framework for long term monitoring and evaluation of pavement surface treatments in Arizona.
- Principal Investigator for the 2020 to 2022 FHWA project, *Pavement Preservation Program Benchmarking, Data Collection, and Metrics Development*. This project supported the FHWA in the development of standardized metrics to demonstrate state highway agency pavement preservation program performance. Work included conducting pavement preservation benchmarking surveys, performing a literature review and gap analysis, proposing and evaluating pavement preservation performance models.
- Senior Engineer for the FHWA IDIQ*, Technical and Program Support for Pavement Programs*, including the following task order:
  - 2020 to 2022 task order 14, *Successful Practices for Maintaining and Resurfacing Existing Composite Pavements.* The objective of this task order is to compile and disseminate a summary of best practices related to the effective maintenance and preservation of existing composite pavement structures. Attended visits to various states and developed the final presentation on findings.
- Principal Investigator for the 2021 to 2022 FAA Project, *Surface Treatment Relative to Airfield Locations*. This project includes a literature review, case studies, identifying test sites for experiments, determining material specifications, developing pre-construction evaluation, and site monitoring plans, determining material specifications, and developing construction contracting plans.
- Co-Principal Investigator for the 2020 to 2022 FAA Project, *sUAS for Pavement Inspection*, as a subcontractor. APTech's primary role on this project is to complete ground truth surveys at selected airports so that the results can be compared to data collected by sUAS. Work on this project includes executing the field plan and analyzing accumulated data, capturing and analyzing lessons learned from the collected data, and developing a draft guide and final report.
- Principal Investigator for the 2021 Tennessee DOT Airport Pavement Life Cycle Cost Analysis (LCCA) Framework. Developed a LCCA framework to compare feasible rehabilitation and reconstruction alternatives to assist with evaluating the most cost-effective options.
- Principal Investigator for the 2020 NCHRP Project 51-16, *Maintenance and Surface Preparation Activities Prior to Pavement Preservation Treatments*. Published as NCHRP Synthesis 565, this report includes a literature review, a survey of DOTs, and case examples based on in-depth interviews with six agencies.

Arturo Espinoza-Luque, P.E.

Lead Engineer

Education

M.S., Civil Engineering, University of Illinois, 2018

B.S., Mechanical Engineering, Instituto Tecnológico y de Estudios Superiores de Monterrey, 2012

B.S., Mechanical Engineering, Politecnico di Milano, 2011

Professional Registration

Professional Engineer, California, 2020; also Illinois

Professional Affiliations

Member, American Society of Civil Engineers (ASCE)

INTRODUCTION

Mr. Espinoza-Luque is an Engineering Associate at Applied Pavement Technology, Inc. (APTech). He has been involved in research projects for federal and state clients, such as the Federal Highway Administration (FHWA), Strategic Highway Research Program (SHRP), the National Cooperative Research Program (NCHRP), and state Departments of Transportation (DOTs). His work responsibilities center around pavement research and pavement evaluation and management, which commonly entail literature or records reviews, manual and automated pavement condition surveys, pavement testing, data processing and analysis, developing project reports, and presenting study results.

During his academic career, Mr. Espinoza-Luque served as a Graduate Research Assistant for the Illinois Center for Transportation. He served as the lead student researcher for an Illinois DOT-sponsored project to investigate the variability sources of hot-mix asphalt (HMA) Quality Assurance/Quality Control (QA/QC) tests. Some of his responsibilities included conducting performance testing for bituminous materials and analyzing data from nondestructive testing activities, such as ground penetrating radar (GPR) and falling weight deflectometer (FWD).

BY THE NUMBERS

- **7** years of pavement engineering experience.
- Involved with **15** pavement research projects.

REPRESENTATIVE EXPERIENCE

- Lead Engineer for the 2022 to 2024 FHWA project, *Recycled Asphalt Pavement Materials for Pavement Preservation: Material Specification, Storage, and Testing.* This project investigates the implementation of recycled asphalt pavement in pavement preservation treatments, including developing a framework for determining when to use recycled materials for pavement. Coordinating work plans and conducting meetings.
- Project Engineer for the 2022 New Jersey DOT Pavement Management Support contract, as a subcontractor.
  - » Task Order 3.3, *Establishing Distress-Based Triggers for Selection of Pavement Preservation Treatments in New Jersey*. Conducting data analysis to establish distress-based triggers for pavement preservation treatment selection.
- Project Engineer for the 2021 to 2022 for the Federal Aviation Administration's (FAA) study, *Surface Treatment Relative to Airfield Location.* Performing literature reviews and developing case studies in

support of the development of guidelines for airports for selecting surface treatments at different airfield pavement locations.

- Project Engineer for the 2019 to 2024 FHWA Indefinite Delivery Indefinite Quantity (IDIQ) contract, *Technical and Program Support for Pavement Programs.*
  - Task Order 4, *Quality Assurance Procedures for Construction.* Provided QA reviews for on-site record keeping.
  - Task Order 16, *Pavement Preservation Program Benchmarking, Data Collection, and Metrics Development.* Performing literature review and gap analysis.
  - Task Order 27, *Documenting FHWA Quality Assurance Assessment 2022.* Conducting kick-off meeting, developing assessment questions, and gathering information on state DOTs' QA programs.
- Project Engineer for the 2020 to 2022 FHWA project, *Support Demonstrations of Dielectric Profiling System for Asphalt Pavement Density Measurement.* Providing equipment training for FHWA staff and developing marketing presentations.
- Project Engineer for the 2020 Missouri DOT study, *Evaluating Performance of Concrete Overlays for Pavement Rehabilitation*. Assisted with project management; documented improvements to overall concrete overlay selection, design, and construction procedures; and developed interim and final reports and research summaries.
- Project Engineer for the 2019 to 2020 Iowa DOT Pavement Determination Process Evaluation. Reviewed the pavement type selection practices of the Iowa DOT and eight similar DOTs, and summarized FHWA, NCHRP, and American Association of State Highway and Transportation Officials (AASHTO) guidelines and recommendations on pavement type selection.
- Project Engineer for the 2014 to 2020 FHWA IDIQ contract, *Implementation of Best Practices for Concrete Pavements*, including the following task orders:
  - Task Order 6, *Implementation Support for the SHRP 2 Project R21, New Composite Pavement Systems*. Provided technical assistance for implementation activities, such as developing and providing a multi-state showcase demonstration of new composite pavement projects, developing and delivering training manuals, organizing and facilitating multi-state peer exchange meetings, and documenting lessons learned and specification revisions.
- Project Engineer for the 2019 FHWA EFLHD project, Development of Crosswalk and Reporting Procedures for Federal Lands Management Agencies (FLMAs) Paved and Unpaved Road Condition Ratings (Crosswalk 2), as a subcontractor to Kimley Horn and Associates, Inc. Conducted field and video surveys of selected FLMA roads using different condition rating procedures for use in developing updated correlations/crosswalks for FLMA rating procedures.
- Project Engineer for the 2018 to 2019 NCHRP 01-61 Project, Evaluation of Bonded Concrete Overlays on Asphalt Pavements, as a subcontractor to NCE. Processed, analyzed, and summarized automated pavement condition data collected from twenty U.S. sites containing bonded concrete overlays of asphalt pavement (BCOAs).
- Project Engineer for the 2018 to 2019 Wisconsin Highway Research Program, Non-Cementitious Repair Materials Study. Identified several Wisconsin sites for pavement coring and reviewed collected field data.

Stephen (Steve) Seeds

Education

M.S., Engineering, University of Texas at Austin, 1980

B.S., Civil Engineering with Honors, University of Texas at Austin, 1977

Professional Affiliations

Former Member, American Public Works Association.

Transportation Research Board (TRB)

Past Member, TRB Committee AFS60, *Subsurface Drainage*

Past Member and Past Chair, TRB Committee AFD60, *Flexible Pavement Design*

Past Member, TRB Committee AFD80, *Strength and Deformation Characteristics of Pavement Sections*

INTRODUCTION

Mr. Seeds formerly served as a Senior Engineer at Applied Pavement Technology, Inc. (APTech). He has well over 40 years of pavement engineering experience in the areas of pavement evaluation, design, management, research, and forensic investigations. As a Project Manager, he worked with a variety of government agencies including the Federal Highway Administration (FHWA), state departments of transportation (DOTs), and many local public works departments. His responsibilities included conducting pavement evaluations and forensic investigations, developing pavement maintenance and rehabilitation (M&R) recommendations, preparing pavement construction specifications and bid documents for pavement M&R treatments, providing technical assistance to local agencies, and providing quality assurance support for pavement construction projects.

Mr. Seeds applied his pavement design and research skills in studies for several federal agencies, state DOTs, local agencies, and private communities. He participated in the National Cooperative Highway Research Program (NCHRP) Project 1-54, *Guidelines for Limiting Asphalt Moisture Damage to Flexible Composite Pavements Due to the Presence of Water*. Mr. Seeds also has considerable experience in the development of performance-related specifications (PRS) for the FHWA and NCHRP. He served as Principal or Co-Principal Investigator for four research projects involving the development of PRS for both concrete and asphalt pavement. In the most recent PRS study, Mr. Seeds served as a Co-Principal Investigator for a research project in which a 1.75-mile long, full-scale test track was constructed and then loaded day and night using driverless trucks. The overall goal of the study was to develop a process by which paving contractors could be rewarded or penalized based on how well hot-mix asphalt (HMA) surface conformed to the mix specifications.

BY THE NUMBERS

- Over **40** years of pavement engineering experience.
- Played a key role in **21** pavement research projects.
- Project Manager for over **50** pavement engineering projects.

REPRESENTATIVE EXPERIENCE

- Senior Engineer for the 2020 to 2021 update of NHI Course 131050, *Asphalt Pavement In-Place Recycling Techniques ILT*. Performed minor updates to virtual courses and updates to course materials.
- Senior Engineer for the 2016 to 2020 FHWA study, *Recycled Asphalt Pavement Use in Pavement Preservation Surface Treatments*. Developed an interim report.

- Senior Engineer for the 2020 to 2022 FHWA IDIQ, *Technical and Program Support for Pavement Programs,* task order 09, *Pavement Roundabouts.* Developed technical briefs and PowerPoint Presentations to present research and hosting additional webinars and workshops.
- Project Manager for the 2020 to 2021 NCHRP Project 1-54A, *Guidelines for Limiting Damage in Flexible and Composite Pavements due to the Presence of Water.* Completed a revision of the software application, developed webinar and training materials, and prepared and submitted draft final report.
- Principal Investigator for the 2019 to 2021 NCHRP Project 1-54, *Guidelines for Limiting Damage to Flexible Composite Pavements Due to the Presence of Water.* Developed comprehensive guidelines to minimize asphalt moisture damage, developed an AASHTO Standard of Practice guide document as well as a 90-minute webinar and training materials for a 1-day course.
- Project Manager for the 2016 to 2019 FHWA Task Order, *Documentation of FHWA's Accelerated Implementation and Deployment of Pavement Technologies*, under the FHWA *Asset Management Blanket Purchase Agreement,* as a subcontractor to ICF Incorporated, LLC. Documented up to thirty of the FHWA's recent efforts to deploy new pavement technologies. Conducted interviews, collected information, and developed annual reports.
- Senior Engineer for the 2017 Ohio DOT Longitudinal Joint Repair Best Practices. Evaluated current Ohio longitudinal joint repair processes and developed a construction guidance document.
- Project Manager for the 2014 State of Washington Joint Legislative Audit Review Committee study, *Long-Term Highway Maintenance and Preservation Needs*, as a subcontractor to Scanlan Consulting. Gathered qualitative and quantitative data to assess Washington State DOT's pavement preservation and pavement management practices.
- Project Engineer in the 2012 to 2013 Development of Bridge and Highway Construction Technical Briefs for FHWA, as a subcontractor to Leidos, Inc. (formerly SAIC). Participated in a kickoff meeting, performed a literature review, and drafted three technical briefs on the topic of intelligent compaction.
- Senior Engineer for the 2010 to 2011 NCHRP Project 1-46, *Handbook for Pavement Design, Construction, and Management.* Assisted in developing the HMA pavement rehabilitation module.
- Project Engineer for the 2008 to 2013 NHI Course 131050, *Asphalt Pavement In-Place Recycling Technologies* Revisions. Helped develop the updated 2011 version of the course and served as the primary instructor. Also assisted in updating the 2002 version of the course
- Co-Program Manager for the 2019 to 2023 Nevada Local Technical Assistance Program (LTAP) Administrator Statewide. This project includes providing technical assistance and training of program managers to create, implement, and evaluate technical assistance and training delivery for all local transportation agencies within Nevada.
- Project Manager for the 2013 Nevada LTAP Center Pavement Distress and Maintenance Treatment Training. Developed a one-day training course on the topic of pavement distress and maintenance treatment and presented it to engineers and maintenance managers for the City of Elko and the Nevada DOT.

Mariela Solis

Engineering Associate

Education

B.S., Civil Engineering,
University of Nevada,
Reno, 2013

INTRODUCTION

Ms. Solis is an Engineering Associate at Applied Pavement Technology, Inc. (APTech) with 8 years of pavement engineering experience. Her technical efforts focus on pavement management and evaluation. Her responsibilities include conducting Pavement Condition Index (PCI) inspections, performing Pavement Surface Evaluation and Rating (PASER) inspections, collecting automated data using APTech's Enhanced Data Gathering Equipment (EDGE) vehicle, performing visual inspections, analyzing data, updating pavement databases, developing maintenance and rehabilitation (M&R) recommendations, preparing reports, and assisting with development of GIS-based, web-accessible data visualization tools such as APTech's interactive pavement management data visualization tool, IDEA.

Ms. Solis has supported pavement management system implementation for local agencies across the United States including the Cities of Peoria (Illinois), Glenwood Springs (Colorado), Miami (Florida), and Fort Wayne (Indiana), as well as Yavapai County (Arizona). In addition, Ms. Solis has updated airport pavement management system (APMS) projects for seventeen state aviation agencies. Her tasks on these statewide updates include updating pavement network definition, conducting PCI inspections at hundreds of airports, updating PAVER software databases, and updating IDEA.

Ms. Solis has quickly rose to be one of the leaders within APTech regarding the workstation survey processes. She ensures that fellow APTech staff are well trained and finds ways to help staff improve their work Ms. Solis routinely quality control (QC) reviews of workstation survey results and provides positive feedback, which provides a better product to our clients. Additionally, Ms. Solis has been providing training through the Nevada Local Technical Assistance Program (NVLTAP) to agencies in condition data collection so they can be self sufficient in pavement management.

REPRESENTATIVE EXPERIENCE

- Project Engineer for the 2020 to 2023 Nevada Local Technical Assistance Program (LTAP) Administrator Statewide. Provided in-person PAVER and PASER training to local staff.
- Project Engineer for the 2019 to 2021 National Cooperative Highway Research Program (NCHRP) Project 1-54, Guidelines for Limiting Damage to Flexible Composite Pavements Due to the Presence of Water. Developed comprehensive guidelines to minimize asphalt moisture damage.

- Project Engineer for the 2019 Carson Area Metropolitan Planning Organization (CAMPO) (Nevada) Pavement Management Services. Analyzed pavement condition data collected by APTech's EDGE automated data collection vehicle.
- Project Engineer for the 2022 City of Tuscola (Illinois) Pavement Management System Implementation. Collecting automated condition data with APTech's EDGE vehicle.
- Project Engineer for the 2022 Grand Island (Nebraska) PMS Update. Collecting automated condition data with APTech's EDGE vehicle and provided distress data for Cartegraph OMS.
- Project Engineer for the 2022 Lynnwood (Washington) Data Collection and Cartegraph Implementation, as a subcontractor. Collecting automated condition data using APTech's EDGE vehicle, providing distress data for Cartegraph to load into OMS, and providing a summary report detailing existing conditions.
- Project Engineer for the 2022 Fort Bend (Texas) Pavement Management System Support, as a subcontractor to SHI International, Inc. Collecting automated condition data using APTech's EDGE data collection vehicle, processing data to produces distress and profile summaries by road segment, loading the distress data into Cartegraph, and assisting with the configuration of the software for budget scenario analysis.
- Project Engineer for the 2022 Knoxville-Knox County (Tennessee) Regional Transportation Planning Organization, Phase 2 Services. Implementing a PMS for participating agencies and collecting condition data collection.
- Project Engineer for the 2021 to 2022 Northlake (Texas) Condition Data Collection and Cartegraph Implementation, as a subcontractor. Performing PCI inspections.
- Project Engineer for the 2021 to 2022 City of Newcastle (Washington) Pavement Management Services. Performing data collection and reviews.
- Project Engineer for the 2021 to 2028 Champaign (Illinois) Pavement Management Support. Performing pavement condition surveys. Also served as a Project Engineer for the 2015 to 2020 Pavement Management Support.
- Project Engineer for the 2021 Eastman Plant, Longview (Texas) PCI Inspection. Performed PCI inspections and reported the results.
- Project Engineer for the 2021to 2022 Chicago (Illinois) Metropolitan Agency for Planning (CMAP) Pavement Management Implementation project. Collecting automated pavement condition data using APTech's EDGE automated data collection vehicle and developing PCIs in the Villages of Oakwood Hills, Huntley, Algonquin, Itasca, Berkeley, and the City of Marengo.
- Project Engineer for the 2021 Rockford (Illinois) Condition Data Collection. Performed PCI inspections and processing the data.
- Project Engineer for the 2021 Bozeman (Montana) Pavement Condition Assessment and Analysis. Collected automated pavement condition data using APTech's EDGE.
- Project Engineer for the 2020 Knox County (Tennessee) Automated Data Collection and Pavement Management System Implementation. Conducted network and segment review and performed condition survey.
- Project Engineer for the 2019 to 2020 Yavapai County (Arizona) Pavement Management System Implementation. Analyzed pavement condition data collected by APTech's EDGE automated data collection vehicle and conducted PCI surveys.
- Project Engineer for the 2019 to 2020 Kane County (Illinois) Pavement Management System Implementation. Analyzed pavement condition data collected by APTech's EDGE automated data collection vehicle and conducted PCI surveys and roadway asset extraction.

DONALD M. MATTHEWS

EDUCATION:

BS Civil Engineering **June 1986**
California State Polytechnic University, Pomona, Cum Laude, Dean's List, President's List

MS Civil Engineering with Geotechnical Emphasis **May 1991**
California State University, Long Beach

Enrolled in Ph.D. Program in Engineering Mathematics **September 1994-June 1996**
California State University, Long Beach and Claremont Graduate School. Research focused on the reuse of contaminated soils and recycled asphalt pavement into new pavement commodities. Took leave of absence for business development.

REGISTRATIONS:

Registered California Civil Engineer: RCE 45956
Registered California Geotechnical Engineer: GE 2256
Registered Arizona Civil Engineer: 29012

TEACHING EXPERIENCE:

Instructor of Soil Mechanics and Foundations **September 1991-April 1995**
California State Polytechnic University, Pomona

Instructor of Soil Mechanics **January 1995-June 1997**
California State University, Long Beach

Lecturer on Soils, Foundations and Engineering Economics **October 1993-2006**
California Civil Engineers Review Course
Presented by Cal Poly, Pomona, Civil Engineering Educators

PROFESSIONAL EXPERIENCE:

Caltrans California Pavement Preservation Task Group **2004 – 2021**
Cochairman for Recycling Subtask Group

Named Caltrans Pavement Preservation Individual of the Year **2009**

Asphalt Recycling and Reclamation Association **2006 – 2012**
Chairman for Committee On Recycling Education
Board of Director

Primary Co Author – Basic Asphalt Recycling Manual Rewrite (BARM II) **2010 - 2015**

Review Panel Member Transportation Research Board **2008 – 2010**
NCHRP Project 20-5, Topic 40-13-"Recycling and Reclamation of Asphalt Pavements using In-Place Methods"

Review Panel Member National Highway Institute **2010 – 2011**
NHI Course No. 131050 - "Asphalt Pavement Recycling Technologies"

Pavement Recycling Systems, Inc.
Technical Manager and Senior Engineer **April 2003-Present**
Provide engineering, technical and laboratory services for all company projects, as needed. Provide pavement consulting, education and value engineering services internally as well as to a variety of Public and Private Clients. Including assistance with Pavement Management Systems and the implementation of appropriate Pavement Preservation strategies using both RAP and conventional aggregates as well as Rehabilitation strategies incorporating green technologies to optimize cost effectiveness and timing.

Reclaimed Aggregates, Inc., President, Chief Operating Officer **January 2006 - Present**
In conjunction with Pavement Recycling Systems, Inc. in charge of the recycling facilities, "urban quarries" which accept reclaimed asphalt pavement (RAP). Oversee the design and manufacturing of the reclaimed aggregates into recycled products included cold asphalt pavement and recycled bases. In addition, implemented the widespread use of RAP Slurry and RAP chip in the Pavement Preservation Surface Seal industry.

CDE Resources, Inc., President, Chief Executive Officer **July 1997-April 2003**
Responsible for the overall management and development of all company activities, including financial, human resources, project management and development. Increased average annual revenues from $3.75 million to $10 million while decreasing administrative overhead by 50%. Increased diversity of company activities from a specialty environmental construction and design firm to include conventional pavement construction and design.

CDE Resources, Inc., VP Research & Development, Operations **February 1995-July 1997**
Responsible for the management and development of the Company's proprietary remediation technologies and new product development. Responsible for treatability, development of project mix designs and end product performance.

C.H.J., Incorporated, Vice President **September 1990- February 1995**
Responsible for overseeing the geotechnical and pavement engineering operations for a firm with over 65 employees, including foundation and preliminary soils investigations, percolation studies, rigid and flexible pavement design and evaluation, slope stability studies, engineering calculations and grading and construction observation analysis.

PUBLICATIONS:

Recycling Petroleum Hydrocarbon Contaminated Soils into Useable Commodities: In Public Works and the Human Environment, Proceedings of the International Symposium of the American Public Works Association, Seattle, Washington, April 19-21, 1995, pp. 549-553.

Case Study: Recycling Contaminated Soils into High Stability Asphalt Concrete at California Rail Intermodal Facility (with Hardin, M. E., Dickson G. F.): In Proceedings of 11th Annual Conference on Contaminated Soils, University of Massachusetts, Amherst, October 21-24, 1996.

Converting Waste into Commodity (with Hardin, M. E., Dickson G. F.): The Asphalt Contractor, April 1997, pp. 18-25.

Green Plant Life: Roads and Bridges, February 2009, pp. 38-41.

DAVID FORD
2113 W Hill Ave.
Fullerton, CA 92933
714-336-7589 davidford@pavementrecycling.com

==========

INTRODUCTION

I am currently Staff Engineer at Pavement Recycling Systems getting design, data analysis and field experience. I excel in math related tasks and am frequently recognized for my professionalism in the work environment. I am skilled in computer use and have experience with CAD, MATLAB, SSI Profiler, Magnet Suite software, and Microsoft Office software.

EDUCATION

Graduated with Bachelor of Science in Civil Engineering
California State University Long Beach

EMPLOYMENT HISTORY

- June 2014 - August 2014: Internship at Vector USA, Torrance, CA.

  Vector is a prominent networking and cabling company where I was introduced to various sectors of the company. I was able to see the running of this company from many different angles - I spent time in the offices learning finances and estimating, did stocking and storage in the warehouse, and spent time in the field to see how everything came together. It was a great learning experience for me.

- May 2017 – January 2018: Project Engineer at Avalon Bay Communities Hollywood, CA.

  Avalon Bay is a company that is a builder/owner of apartment complexes. As project engineer, I worked onsite on the construction of a 700 unit apartment complex. I would have to handle communication between current subcontractors, our engineering/architectural consultants, and potential subcontractors. This would include RFIs on any changes to current plan sets, takeoffs for upcoming bids, accruing estimates, and more. This gave me both in office and onsite experience on a daily basis.

- January 2018 – Present: Staff Engineer at Pavement Recycling Systems (PRS) Jurupa Valley, CA.

  PRS is a road construction company that does various scopes of work. As staff engineer, I work in the Intelligent Construction division where we implement technology to improve quality in construction. I have worked with GPS based survey equipment and machine control, operated an inertial profiler, processed and designed roadway models, done data analysis, estimated projects, and more. Recently I have taken a management role in our laboratory services where we conduct several QC and QA tests on aggregates, asphalt based pavements, slurry, micro surfacing, and emulsions.

Mike Concannon, P.E.

Pavement Recycling Systems, Inc.
951-790-3430
mconcannon@pavementrecycling.com

EDUCATION

California Polytechnic State University, San Luis Obispo
Bachelor of Science in Civil Engineering, June 2013

CA P.E. License # C87432
NV P.E. License # 027448

WORK EXPERIENCE

Pavement Recycling Systems, Inc. – Jurupa Valley, CA

Engineering Support Manager - January 2020 – Present

- Develop engineered pavement solutions for agencies, owners, and other stakeholders for any pavement requirements ranging from preservation to full reconstruction or new construction
- Provide educational workshops/seminars for local engineers and pavement design professionals in both public and private sector on recycled pavement products including RAP based preservation and rehabilitation products
- Provide technical support on construction operations during project construction for in-place recycling and other RAP-based processes
- Oversee mix design testing and development for Cold Recycling and Full-depth Reclamation projects

ReNew Division Manager - March 2018 – January 2020

- Oversee all ReNew operations, which included all Cold Recycling, Paver-laid Full-depth Reclamation, and Roller Compacted Concrete projects
- Monitor financial performance of division and make adjustments where necessary while maintaining safety and quality standards

Project Engineer/Project Manager - February 2015 – March 2018

OTHER QUALIFICATIONS

Caltrans Pavement Materials Partnering Committee (PMPC)

Member - RAP in Bituminous Seals Working Group – September 2023 - Present

- Responsible for developing specifications in collaboration with Caltrans and other industry leaders to design and administer RAP Slurry and RAP Chip Seal projects

Industry Lead - Partial Depth Recycling (PDR) and Cold Central Plant Recycling (CCPR) Working Groups – Completed in 2021 and 2022 respectively

- Developed specifications for both PDR and CCPR for Caltrans use in collaboration with other recycling contractors and Caltrans stakeholders

Mike Concannon, P.E.

Pavement Recycling Systems, Inc.
951-790-3430
mconcannon@pavementrecycling.com

OTHER QUALIFICATIONS (cont.)

Asphalt Recycling and Reclaiming Association (ARRA)

Member – Board of Directors - October 2023 – Present
Co-Chairman – Sustainability Committee - August 2023 – Present

- Committee tasked with developing Environmental Product Declarations (EPD's) for products represented by ARRA

Chairman – Cold Recycling Committee - February 2016 to February 2021

- Organized meetings and maintaining direction of committee to expand knowledge and awareness of Cold Recycling throughout the country

Roadresource.org Super User

- Trained in all aspects of Roadresource.org use for sustainable pavement management. Roadresource.org is a tool created by ARRA to provide a singular source of reliable information on sustainable pavement management practices including but not limited to the use of RAP preservation treatments, Cold Recycling and Full-depth Reclamation.

Recycling and Stabilizing Association of California (RSA)

President - January 2024 – Present
Vice President - January 2021 – December 2023
Founding Member (established 2021)

- RSA is a collaboration between asphalt recycling contractors in California, and was established as a non-profit association to further improve specifications and knowledge of recycling strategies throughout the State.

JORGE CAMPOS

· (951) 295-7561
jcampos@pavementrecycling.com

Jorge has been working with Pavement Recycling Holdings Inc. for twelve years, six of those specifically working in researching materials and equipment for Pavement Recycling Holdings Inc.

Jorge has led the creation of a well-equipped and functional Research and Development laboratory for testing materials and processes that keeps our company a top-performing leader in the industry.

Jorge was part of the team that obtained the first design patent for our company.

EXPERIENCE

JANUARY 2017 – PRESENT

RESEARCH AND DEVELOPMENT DIRECTOR, PAVEMENT RECYCLING SYSTEMS, INC. (PRSI)

- Provides expert direction and guidance toward improving the company's processes. Mentoring to direct employees and implementing and enforcing established company policies.
- Interacts with our divisions & outside organizations to create practical solutions involving green alternatives for pavement preservation and rehabilitation
- Provides people-care management for our team members, including hiring, setting, and monitoring of annual performance plans, coaching, and career development; ensures that proper knowledge and career development tools are in place to support ongoing team member and process development
- Stays abreast of the latest technologies, techniques, and practices.
- Implements the best practices regarding project management and new product development
- Establishes teamwork to define strategies and procedures to determine the best method for accomplishing goals
- Creates new work relationships with suppliers and manufacturers that can be beneficial to assist the RDD with the development of new products, techniques, and processes, as well as improve our safety or quality issues
- Evaluate new mix designs involving HMA, CIR, CCPR, or any other preservation and/or rehabilitation process
- Participates in the improvement of new acquisitions, including Hot Plants, Emulsion plants, and seal coat plants.
- Lead the efforts to become an AASHTO and CalTrans material laboratory certified
- Part of the team awarded the first complete patent for our company and working towards a second one (patent pending status)

FEBRUARY 2010 – TO DECEMBER 2016

MANAGER AT RECLAIMED AGGREGATES, INC. (RAI) AND AUTOMATION PROJECT ENGINEER FOR PRSI, RECLAIMED AGGREGATE INC. A DIVISION OF PAVEMENT RECYCLING SYSTEMS, INC.

- Management of the day-to-day operations of our concrete and reclaimed asphalt pavement site
- Participation in the research and development of new or existing preservation and/or rehabilitation processes involving the use of Reclaimed Asphalt Pavement (RAP)
- Design and implementation of new automation on PRSI's equipment, systems, or processes that help in improvement or achieving excellence at our jobs

JUNE 1996 – TO DEC 2009

MOLDING AND MAINTENANCE ENGINEER, R&K PLASTIC INJECTION SYSTEMS

- Responsible for the management of all the resources and activities of both departments
- Responsible for the coordination of schedules and project management
- Provided an annual business plan to the senior management
- Implemented and enforced their safety policy
- Zero downtime in a safe environment practices

EDUCATION

JUNE 1995

BS INDUSTRIAL ENGINEER AUTOMATION FOCUSED, TECHNOLOGICAL INSTITUTE IN MEXICO

Graduated with recognition from our director for a senior project presented at the national automation fair.

SKILLS

- HMA Mix Design technologies certified by the Asphalt Institute
- Asphalt Emulsion technologies
- Asphalt Recycling and Reclaimed processes
- Airfield Asphalt Certificate by the NCAT
- Automation technology using PLC's
- Industrial Electrical projects
- Continuously researching self-improvement

ACTIVITIES

- Team leader achieving company's first patent for a new recycling process using road surface
- Implementing the first fully automatized robot inspection cell to classify milling tools for asphalt
- The Engineer responsible for the electrical project on our first emulsion plant that is scheduled to open in August 2022
- Caltrans and AASHTO certificated in HMA and aggregates

PRS Holdings Inc. Laboratory Services

10240 San Sevaine Way
Jurupa Valley, CA 91752
Office Number: 951-682-1091

==========

INTRODUCTION

Established in 2001, PRS Holdings Inc.'s laboratory has concentrated on the Research and Development of RAP products used in Cold Recycling, Slurry, Mirco Surfacing and Chip Seals. In addition, we have the capabilities to conduct mix designs as well as quality control and quality assurance testing on aggregates, asphalt-based pavements, slurry seals, micro surfacing, and emulsions. The lab and its technicians have multiple AASHTO and Caltrans accreditations for aggregates and asphalt-based pavements as listed below.

LAB ACCREDITATIONS

AASHTO T11: Sieve Analysis (Washing) - Fine Aggregates (JTCP)
AASHTO T27: Sieve Analysis - Fine and Coarse Aggregates (JTCP)
AASHTO R47: Reducing Samples of HMA (JTCP)
AASHTO R76: Reducing Samples of Agg (JTCP)
AASHTO T166: Bulk SpG of Compacted HMA - SSD (JTCP)
AASHTO T176: Sand Equivalent (JTCP)
AASHTO T209: Max SpG and Density - HMA (JTCP)
AASHTO T255: Evaporable Moisture Content (JTCP)
AASHTO T269: Percent Air Voids - HMA (JTCP)
AASHTO T275: Bulk SpG - HMA (JTCP)
AASHTO T283: Moisture Induced Damage (TSR)
AASHTO T308: AC Content (Ignition Oven) - HMA (JTCP)
AASHTO T324: Hamburg Wheel-Track
AASHTO T329: Moisture Content (Oven Method) - HMA (JTCP)
AASHTO T335: Percentage of Fracture (JTCP)
CT 105: Calculations - Gradings (JTCP)
CT 125 AGG: Sampling - AGGREGATES
CT 125 BIT: Sampling - BITUMINOUS
CT 125 CEM: Sampling - CEM
CT 125 GEN: Sampling - GENERAL
CT 125 HMA: Sampling - HMA
CT 201: Sample Preparation - Soil and Aggregates (JTCP)
CT 202: Sieve analysis - Fine and Coarse Aggregates (JTCP)
CT 205: Percent Crushed Particles (JTCP)
CT 216: Relative Compaction - Soils and Aggregates (JTCP)
CT 217: Sand Equivalent (JTCP)
CT 226: Moisture Content - Soils and Aggregates (JTCP)
CT 227: Cleanness Value (JTCP)
CT 229: Durability (JTCP)
CT 306: Reducing Samples of Asphalt Mixtures (JTCP)

LAB TECHNICIAN ACCREDITATIONS

AASHTO T11: Sieve Analysis (Washing) - Fine Aggregates (JTCP)
AASHTO T27: Sieve Analysis - Fine and Coarse Aggregates (JTCP)
AASHTO R47: Reducing Samples of HMA (JTCP)
AASHTO R76: Reducing Samples of Agg (JTCP)
AASHTO T166: Bulk SpG of Compacted HMA - SSD (JTCP)
AASHTO T176: Sand Equivalent (JTCP)
AASHTO T209: Max SpG and Density - HMA (JTCP)
AASHTO T255: Evaporable Moisture Content (JTCP)
AASHTO T269: Percent Air Voids - HMA (JTCP)
AASHTO T275: Bulk SpG - HMA (JTCP)
AASHTO T308: AC Content (Ignition Oven) - HMA (JTCP)
AASHTO T329: Moisture Content (Oven Method) - HMA (JTCP)
AASHTO T335: Percentage of Fracture (JTCP)
CT 105: Calculations - Gradings (JTCP)
CT 125 AGG: Sampling - AGGREGATES (JTCP)
CT 125 HMA: Sampling - HMA (JTCP)
CT 201: Sample Preparation - Soil and Aggregates (JTCP)
CT 202: Sieve analysis - Fine and Coarse Aggregates (JTCP)
CT 205: Percent Crushed Particles (JTCP)
CT 216: Relative Compaction - Soils and Aggregates (JTCP)
CT 217: Sand Equivalent (JTCP)
CT 226: Moisture Content - Soils and Aggregates (JTCP)
CT 227: Cleanness Value (JTCP)
CT 229: Durability (JTCP)
CT 306: Reducing Samples of Asphalt Mixtures (JTCP)

January 8, 2024

Mr. Gregory M. Duncan
Applied Pavement Technology, Inc.
115 W. Main Street, Suite 400
Urbana, Illinois 61801

SUBJECT: Nevada Department of Transportation Research Proposal 23-02-E3: **Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates Letter of Cooperation**

Dear Mr. Duncan,

This Nevada DOT solicitation has been brought forward to develop specifications for RAP to be used in surface treatments. I am aware that you are preparing a proposal on behalf of Applied Pavement Technology, Inc. for this solicitation. Making more efficient use of RAP is of considerable interest to the pavement preservation community. The project will require significant laboratory services and the engagement of multiple segments of regional industry. Having "lived RAP in pavement preservation for the past 18 years", I am able to assist you in the academic pursuit as an industry representative in gathering information.

Please rest assured that if the APTech team is successful in your proposal and selected to perform the research, that you will have my full cooperation to apply my previous experiences of Pavement Recycling Systems, Inc. using RAP in chip seal, slurry seal, and microsufacing applications; to conduct laboratory services to evaluate RAP sources and conduct trial designs; and interpret the laboratory data to assist in developing material, design, and construction specifications for incorporating RAP into Nevada surface treatments. I have served in industry associations during my career that have provided an understanding of the regional industry, and I can provide insight for the implementation of this project.

Best wishes in the pursuit of this project, and I look forward to working with your team. Please contact me if you require any additional information.

Sincerely,

Don Matthews
Senior Engineer
Pavement Recycling Systems, Inc.

Appendix B: Budget

Budget Considerations

The overall budget for this project is $254,069 and the cost for the Final Report Preparation and Delivery is $27,755. The budget for this 2-year research project was developed considering three components: Year 1 (Tasks 1, 2, 3, and 4); year 2 (Tasks 5, 6, 7, and 8); and the PRS Holdings Laboratory Services, which occur as part of Task 4 but be billed in the second year. The overall budget is summarized in Table B-1. The APTech audited overhead rate of 161.58 percent was used to calculate overhead direct costs shown in line I of table B-1. A fee of 10 percent was used to calculate profit subsequently in line K. Labor in year 2 was adjusted assuming a 3 percent cost increase for APTech staff.

The effort allocated to the project by task is listed in Table B-2. Tasks 1, 2, 3, and 4 will occur in the first year of the project and have a total estimated time of 639 hours. Tasks 5, 6, and 7 occur in the second year of the project with an estimated time of 289 hours of staff time. Task 8 covers the Final Report Preparation and Delivery and accounts for 202 hours of staff time, also occurring within the second year.

The expense for PRS Holding Laboratory Services occurs in Year 1 of the budget. The testing requirements for the project include receiving five unique sources of RAP from within the three Nevada DOT Districts. The sources are anticipated to be sampled with coordination from NDOT and to be transferred for testing to the PRS Holdings Laboratory by APTech. The testing costs are listed in Table B-3

Travel

Project-essential travel is anticipated as a part of tasks 1, 4, and 6. Travel will be conducted in accordance with applicable NDOT travel requirements and be preapproved before occurring. Tables A2-4, A2-5, and A2-6 show anticipated travel costs associated with the three tasks and are based on 2024 fiscal year per diem rates.

Table B-1. Overall project budget for Project 22-02-E2.

Attachment E

Standard Budget Itemization for Department Research Projects

Project Title: 23-02-E3 NDOT Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates

Project Duration: September 2024 - August 2026

Name and/or Position[1]	Hourly Rate	Hours of Effort	Total Year 1
Greg Duncan, Project Manager	$ 73.59	180	$ 13,246
David Peshkin, Principal in Charge	$ 100.68	18	$ 1,812
Arturo Espinoza-Luque, Lead Engineer	$ 40.80	164	$ 6,691
Mariela Solis, Engineering Associate	$ 37.92	106	$ 4,020
Jessica Snyder, Graphic Design	$ 41.64	10	$ 416
Lilia Dobos, Techinical Editor	$ 31.03	28	$ 869
RoseMary Evans, Document Compliance	$ 42.50	4	$ 170
Steve Seeds, Senior Engineer, Subcontract	$ 150.00	50	$ 7,500
Don Matthews or Michael Concannon, Senior Engineer, Subcontract	$ 150.00	59	$ 8,850
David Ford, Staff Engineer, Subcontract	$ 105.00	20	$ 2,100
Year 1 Totals		**639**	**$ 45,674**

Name and/or Position[1]	Year 2 Hourly Rate	Hours of Effort	Total Year 2
Greg Duncan, Project Manager	$ 75.80	104	$ 7,883
David Peshkin, Principal in Charge	$ 103.70	6	$ 622
Arturo Espinoza-Luque, Lead Engineer	$ 42.02	72	$ 3,026
Mariela Solis, Engineering Associate	$ 39.06	16	$ 625
Jessica Snyder, Graphic Design	$ 42.89	12	$ 515
Lilia Dobos, Techinical Editor	$ 31.96	12	$ 384
RoseMary Evans, Document Compliance	$ 43.78	4	$ 175
Steve Seeds, Senior Engineer, Subcontract	$ 150.00	32	$ 4,800
Don Matthews or Michael Concannon, Senior Engineer, Subcontract	$ 150.00	16	$ 2,400
David Ford, Staff Engineer, Subcontract	$ 105.00	15	$ 1,575
Pavement Recycling Systems Holdings - Laboratory Services			$ 60,025
Year 2 Totals		**289**	**$ 82,029**

	Year 1	Year 2	Year 3	Year 4
A. Personnel	$ 45,674	$ 13,229	$ -	$ -
B. Travel[2]	$ 5,500	$ 1,900	$ -	$ -
C. Operating Costs	$ -	$ -	$ -	$ -
D. Final Report Preparation and Submission (Direct Labor Only)	$ -	$ 9,646	$ -	$ -
E. Equipment	$ -	$ -	$ -	$ -
F. Other Costs	$ 1,000	$ -	$ -	$ -
G. Subcontractors and Consultants (1st $25,000 w/Indirect Cost)	$ -	$ -	$ -	$ -
H. Subtotal of Direct Costs (sum of A through G)	$ 52,174	$ 24,775	$ -	$ -
I. Total Direct Costs (for items A, C, and D) at current OH rate **161.58%**	$ 43,989	$ 22,783	$ -	$ -
Ja. Pavement Recycling Systems - Laboratory Services		$ 60,025		
Jb. Subcontract (w/o Indirect Cost)	$ 18,450	$ 8,775	$ -	$ -
K. Profit (Items H, I, and J) **10%**	$ 11,461	$ 11,636	$ -	$ -
L. TOTAL PROJECT COSTS PER YEAR (sum of H thru L)	**$ 126,075**	**$ 127,994**	**$ -**	**$ -**
TOTAL PROJECT COST[3]		**$**		**254,069**

Notes:

(1) Categories can be added and, with the exception of personnel and fringe, removed as best fits the proposed research.

(2) Department only pays for travel that is essential for the completion of the project and at costs per GSA rates and Department policies. Travel costs to professional and other meetings are not allowed. Travel outside of Nevada requires written Department approval in advance.

(3) The budget will be tracked according to the categories identified herein. Invoicing is expected to match, within reason, these categories for accurate budget tracking.

Table B-2. Overall project Estimated Labor Hours by Task.

NDOT Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates
23-02-E3

Applied Pavement Technology, Inc.
July 01, 2024

Name	Title	Estimated Labor Hours								Total	% Time
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8		
Greg Duncan	Principal Investigator	40	48	32	60	32	48	24	48	332	8
David Peshkin	Principal in Charge	6	6	2	4	2	2	2	6	30	1
Arturo Espinoza-Luque	Lead Engineer	24	60	32	48	32	16	24	80	316	8
Mariela Solis	Engineering Associate	16		10	80		16		24	146	4
Jessica Snyder	Graphic Design		10				8	4	10	32	1
Lilia Dobos	Technical Editor	6	12	10			8	4	24	64	2
RoseMary Evans	Document Compliance		4				2	2	10	18	0
Total APTech Hours		92	140	86	192	66	100	60	202	938	
Steve Seeds	Senior Engineer	10			40	8	8	16		82	2
Don Matthews or Concannon	Senior Engineer	11	4	4	40	4	4	8		75	2
David Ford	Staff Engineer	10			10	4	4	7		35	1
Total Contractor Hours		31	4	4	90	16	16	31		192	
Total Staffing Hours		123	144	90	282	82	116	91	202	1130	

Year 1 Total hours: 639 Year 2 Total hours excl. Task 8: 289

Table B-3. Itemized costs for laboratory services.

	Number	Unit	Unit Costing	Extended
RAP Aggregate properties	5	EA	$ 615.00	$ 3,075.00
RAP asphalt characterization	5	EA	$ 1,175.00	$ 5,875.00
Virgin emulsion characterization	5	EA	$ 1,475.00	$ 7,375.00
Chip seal designs including the sweep test	5	EA	$ 395.00	$ 1,975.00
Slurry seal design testing according to the ISSA guidelines	5	EA	$ 3,795.00	$ 18,975.00
Microsurfacing design testing according to ISSA guidelines	5	EA	$ 4,550.00	$ 22,750.00
Total				**$ 60,025.00**

Table B-4. Anticipated travel expenses for Task 1 Kickoff Meeting and Project Management.

Trip Description	Trip Item	Unit	Item Cost
Travel anticipated to Carson City for an interim progress meeting	No. of Travelers	1	
	No. of Travel Days	3	
	No. of Hotel Nites	2	
	Airfare	595	595
	Per Diem	69	207
	Lodging	174.8	350
	Rental Car	75	225
	Ground Transp.		40
	Parking		50
	Personal Auto Miles	50	
	Rate ($/mi)	0.67	
	Cost		34
TOTAL TRIP COST			1500

Table B-5. Anticipated travel expenses for Task 4 Confirm Laboratory Design Properties.

Trip Description	Trip Item	Unit	Item Cost
Travel required for sampling RAP sources and transporting it to PRS Holding Laboratory in Jurupa Valley, CA	No. of Travelers	2	
	No. of Travel Days	6	
	No. of Hotel Nites	5	
	Airfare		0
	Per Diem	69	828
	Lodging	174.8	1748
	Rental Car		0
	Ground Transp.		
	Parking		
	Personal Auto Miles	2125	
	Rate ($/mi)	0.67	
	Cost		1424
TOTAL TRIP COST			4000

Table B-6. Anticipated travel expenses for Task 6 Conduct Workshop.

Trip Description	Trip Item	Unit	Item Cost
Travel to Carson City or desginated city to conduct the Workshop to stakeholders	No. of Travelers	1	
	No. of Travel Days	3	
	No. of Hotel Nites	2	
	Airfare	1000	1000
	Per Diem	69	207
	Lodging	174.8	350
	Rental Car	75	225
	Ground Transp.		
	Parking		85
	Personal Auto Miles	50	
	Rate ($/mi)	0.67	
	Cost		34
TOTAL TRIP COST			1900

Appendix C: Schedule

As shown in table C-1, task 1 will consist of the kickoff meeting at the beginning of the project and periodic progress meetings designed to keep NDOT and the APTech team current on project and program activities. Task 2 is anticipated to begin in month 2 of the project and take approximately 4 months to complete. Task 3 occurs as task 2 ends and requires significant collaboration with the NDOT champions. Task 3 is required before laboratory testing in task 4 begins. Task 4 will require significant coordination to obtain RAP samples and deliver them to the PRS laboratory site in Jurupa Valley, California. The schedule anticipates this activity beginning during early- to mid-winter when other project demands will be less on the laboratory. Task 5 will be completed after NDOT and the APTech team evaluate the laboratory testing data generated during task 4. Tasks 6, 7, and 8 follow subsequently after the development of draft final specifications. The workshop, implementation plan development, and final report are complementary and specific dates to deliver the workshop can be adjusted as the NDOT champions recommend.

Table C-1. Anticipated project schedule for Nevada RAP Study.

Schedule

Task		2024			2024			2025			2025			2025			2025			2026			2026			2026		
A	**Planning Phase**	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Kickoff Meeting and PM																											
2	Literature Review																											
3	Propose NDOT Guidance																											
B	**Data Collection**																											
4	Confirm in Laboratory																											
5	Prepare Final Guidance																											
C	**Reporting**																											
6	Conduct Workshop																											
7	Dev. Implementation Plan																											
8	Prepare Final Report																											

Main Task