Use of Recycled Materials in Highway Construction

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16. ABSTRACT

The major objectives of this study were to examine: (1) the types of recycled materials that are appropriate and feasible as alternative paving materials such as glass and tires; and (2) the types of recycled materials, such as mixed-plastics and compost, that can be utilized in all types of transportation applications other than pavements.

Seven key products are investigated: (1) tires; (2) glass; (3) asphalt concrete; (4) fly ash; (5) compost; (6) mixed plastics; and (7) aluminum sign stock. Performance and cost data for rubber-asphalt pavements is documented for both in-state and nationwide applications. The national experience with the use of waste glass as an additive to asphalt concrete and its use in unbound base materials is also highlighted.

Programs for experimental use of recycled materials are outlined. Recommendations for staffing and program changes to deal with recycling issues are also discussed.

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FINAL REPORT

USE OF RECYCLED MATERIALS IN HIGHWAY CONSTRUCTION

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INTRODUCTION

As directed in Section 16 of the Second Substitute Senate Bill 5143, the Department of Transportation, in consultation with the Department of Trade and Economic Development, has conducted a research study regarding the use of recycled materials for road construction.

The study objectives noted in the Bill included the following:

"(1) An analysis of the types of recycled materials appropriate and feasible as alternative paving material such as glass, tires or incinerator ash.

"(2) An analysis of uses for waste tires, such as erosion control mats, highway stabilization mats, ferry bumpers, highway crash attenuation barriers, road subbase materials or backfill.

"(3) An analysis of using recycled mixed-plastic materials for guard rail posts, right of way fence posts and sign supports.

"(4) Strategies to test and monitor the use of recycled content materials in road construction.

"(5) Product specifications for recycled materials.

"(6) Programs to demonstrate the feasibility of using recycled materials.

"(7) Identification of recycled material sources and vendors to ensure competitive product pricing and materials availability."

To accomplish this study, an agreement was developed between the Materials Laboratory and the Research Section within the WSDOT. The major products defined within the agreement were:

1. A data base containing types of recycled materials, uses for these materials, product specifications and sources and vendors.
2. A final report documenting the findings.

The agreement also contained a work plan which identified the following six major tasks:

Task A: Conduct a Literature Search
Task B: Conduct a Questionnaire Survey of the other State DOT's
Task C: Follow-up Telephone Interviews as needed
Task D: Develop Database
Task E: Analysis of Information
Task F: Prepare Summary Report

Because of the limited time available to complete this study (six months) it was limited to a very basic "paper" study.

The researchers involved in this study have also held meetings with, or attended presentations in the northwest by, representatives of the recycling industries, including:

* Recycle America, August 20, 1991
* Rouse Rubber Industries, Inc., September 4, 1991
* The GRCDA/SWANA Northwest Regional Solid Waste Symposium, September 23-25, 1991
* PaveTech Corp., (PlusRide), October 14, 1991
* Mr. Charles Valentine, Asphalt Recycling and Reclaiming Association, October 21, 1991
* Mr. Jeff Gage, Washington Organic Recycling Council, October 21, 1991

The rest of this report will address the project's objectives in order.

OBJECTIVE NO. 1 "Types of materials appropriate for paving"

The types of recycled materials that have been used as alternative paving materials, at least on a trial basis, include rubber derived from scrap tires, glass, incinerator residue, fly ash, magnetherm slag, reclaimed asphalt pavement, and crushed portland cement pavements or structures. These materials were generally used as substitutes for a portion of conventional aggregates or portland cement. Rubber products can also be used as additives to liquid asphalt.

The study was begun by conducting the survey of all other states to establish the following:

1. types of recycled materials used
2. recycled material uses
3. product specifications
4. sources
5. results of use
6. references

Thirty-five states responded to the survey, plus the Federal DOT and the District of Columbia. Most of the information contained in this study comes from the information gathered from this survey. Of particular value was a report regarding "Use of Waste Materials in Highway Construction", prepared by the Engineering Experiment Station, Purdue University, for the Indiana DOT and the Federal Highway Administration (FHA). This report was published in May, 1991.

As part of their study, Purdue University also conducted a survey of state DOT's to quantify their current waste material usage. Since their survey was more detailed and received somewhat better response than ours, it provides a more complete summary of states current use of recycled materials. A summary of the responses to Purdue University's survey, as presented in Section 2 of their report, is included as Appendix A.

TIRES

INTRODUCTION

The use of scrap tire rubber as an additive for asphalt cement has been developing for over 25 years. Initial experimental use of the scrap tire rubber focused on the possible added performance benefits that the rubber imparted to the pavements in which they were incorporated. These initial experiments were hampered by problems with the new application technologies for incorporating the rubber into the asphalt mixes, and by problems with the actual construction of the pavements using these unfamiliar blends of asphalt and rubber. These initial technology-related problems were compounded by enormous increases in the cost of the pavements constructed using the various types of rubber-asphalt pavements systems. The technology problems coupled with the high costs limited the number of experimental sections of pavements constructed throughout the U.S. (1) Research in this area continues nationally. (2)

The present interest in this technology has national environmental significance. Scrap tires are a visual, health and fire hazard, as well as a part of the solid waste management problem. Many states have enacted legislation to regulate the scrap tire problem, including the state of Washington. National legislation is in the development stage in regard to laws that would regulate the transportation and storage of scrap tires

and encourage the development of alternative uses. In fact, the recently passed 1991 Intermodal Surface Transportation Bill includes requirements for states to incorporate scrap tire rubber into pavements which are constructed using federal aid money.

The following sections explain the two processes for adding scrap rubber tires to asphalt paving materials, summarize WSDOT's experience with rubber-asphalt pavements, summarize the national experience with these materials and report on some concerns regarding the continued use of these products.

CONSTRUCTION PROCESSES FOR RUBBER-ASPHALT SYSTEMS

In order to understand construction practices regarding rubber-asphalt materials it is necessary to understand the processes by which the rubber is added to the pavement materials. There are two processes for adding scrap tire rubber to asphalt paving material. They are the wet process and the dry process. The term **wet process** defines any method that blends the rubber particles with the asphalt cement prior to incorporating the binder into the product. The **dry process** defines those methods that mix the rubber particles with the aggregate before the mixture is charged with asphalt binder. The wet process uses finely ground particles of rubber and the dry process uses particles 1/4-inch size and larger. The wet process is commonly called the "Arizona Process" after the state where it was first used. The dry process is also called the "PlusRide Process", after its first application.

WSDOT'S EXPERIENCE

The WSDOT has used three types of paving products from the wet process and one type from the dry process. Each of these paving products are defined in the following paragraphs.

SAM: A SAM, which stands for Stress Absorbing Membrane, is a surface treatment type pavement similar to a chip seal. The term SAM was coined by the producers of rubber-asphalt to refer to a chip seal with rubber-asphalt as the binder. It consists of a layer of rubber-asphalt (produced using the wet process) followed with an aggregate cover. The asphalt-rubber binder is sprayed onto the roadway and aggregate chips are then spread over the layer of rubber-asphalt and forced into the binder with a roller to form the new pavement surface. A SAM is used to provide a skid resistant surface and to repair minor distress in the underlying pavement.

SAMI: A SAMI is a Stress Absorbing Membrane Interlayer. It uses the same material and wet process as a SAM except that the SAMI is covered with another layer of pavement, thus making it an interlayer. The purpose of the SAMI is to seal and bind the underlying pavement together to prevent cracks in the underlying pavement from reflecting through the new overlay.

OPEN GRADED RUBBERIZED FRICTION COURSE: This is a type of asphalt mixture that has a special aggregate sizing which creates a very open texture in the final pavement. The open texture of the pavement results in less tire noise and much less spray during wet conditions. The recycled tire rubber is added to the asphalt using the wet process. The application process is, however, quite different than in the SAM and SAMI systems. The liquid asphalt (with rubber) and rock are mixed together in a conventional asphalt plant, fed through a conventional paving machine, and compacted with rollers.

PLUSRIDE: This is a proprietary paving system developed in Sweden in which a portion of the aggregate in the mix is replaced with particles of granulated tire rubber. The rubber particles are mixed with hot asphalt and aggregate in a conventional asphalt plant (dry process) and laid with a conventional paving machine. The rubber particles

which are up to 1/4 inch in size are not melted in this process and can be readily seen in the finished pavement. This is a dense graded pavement with very few voids as contrasted to an open graded friction course.

WSDOT has been constructing experimented projects using rubber-asphalt pavements for over 15 years. A tabulation of the projects and their performance history is included in Appendix B. Information provided by PaveTech Corporation regarding PlusRide projects throughout the United States and Canada is included as Appendix C.

The following paragraphs summarize WSDOT's construction experience with rubber-asphalt paving materials.

SAM PROJECTS

The initial use of rubber was with the wet process or "Arizona Process". Two SAM projects were constructed in 1978 and two in 1980 to assess the performance of these rubberized chip seals as a wearing surface. The two projects constructed in 1978 experienced problems almost immediately after construction. The aggregate chips became embedded in the rubber-asphalt binder to such a depth that the surface of the roadway took on the appearance of a sheet of asphalt with no rock. These two applications were termed failures for this reason. The two subsequent projects built in 1980 experienced no problems and performed acceptably until they were overlaid with another standard chip seal. The service life for these four trial sections ranged from a low of 3 years to a high of 7 years with an average of 5.75 years. The normal life span for chip seals in Eastern Washington is 6.5 years (average life determined using data from the WSDOT Pavement Management System). The rubber- asphalt SAM's were 2.5 to 3 times more costly to construct than the normal chip seals used in Eastern Washington. Appendix A also contains a cost accounting for all of the rubber-asphalt projects.

The experimentation with SAM applications ended in approximately 1987 when it was concluded that the performance of the pavements constructed with rubber-asphalt did not justify the added expense of their construction.

SAMI PROJECTS

A total of 6 projects were constructed with rubber-asphalt binders used as Stress Absorbing Membrane Interlayers in the years 1977 and 1978. The success of these applications was mixed. In general, the SAMI's were successful in retarding the reflection of alligator cracking, but were not successful in retarding reflection of longitudinal or transverse cracks.

One trial use is particularly important. The section from Wheeler Road to Adams County Line was designed as a rigorous experiment to determine the performance of the rubber-asphalt interlayers as compared with the performance of standard asphalt interlayers. The project included sections of each type of interlayer and a section with no interlayer to serve as a control. The control section experienced the reflection of all the underlying cracking very early in its life. The SAMI and the normal asphalt interlayers successfully retarded the reflection of alligator cracking, but were not successful in retarding longitudinal or transverse cracking. The SAMI was fractionally better at retarding the reflection of alligator cracking. The SAMI was 3.7 times as costly as the normal asphalt interlayer.

WSDOT has not constructed a SAMI since 1978 due to the much higher cost of the rubber-asphalt binder. The performance history has indicated that the SAMI is not a cure for the prevention of all types of reflection cracking, although it was successful in retarding the reflection of alligator type cracking. The Wheeler Road to Adams

County Line study showed that a interlayer constructed using normal asphalt binders was only slightly less effective than the more expensive SAMI. The SAMI, at a cost 3.7 times higher than a normal asphalt binder interlayer, was not cost effective when the life of the overlay placed on top of it was not increased over overlays constructed without interlayers. WSDOT continues to use normal asphalt interlayers under many of its overlays because of the added crack retarding benefit provided by this extra layer of pavement.

OPEN GRADED RUBBERIZED FRICTION COURSE PROJECTS

Five open graded friction course overlays have been constructed between 1982 and 1991 using the wet process to add the rubber to the pavement. The open surface texture characteristic of this type of pavement provides benefits in the form of decreased spray from vehicles under wet conditions and lower tire noise. They have the disadvantage of having a tendency to ravel. Ravelling is the gradual loss of the rock from the pavement due to the actions of traffic. The rubber-asphalt binder was used to increase the adhesion between the rock and the binder.

All of the projects are showing good to very good performance with the exception of the I-405 bridge deck overlay which is showing some distress in the wheel path areas. All of the projects are located on heavily traveled routes so the good performance of these pavements are especially noteworthy.

The Columbia River to 39th Street project is especially significant. This is a 2-mile section of I-5 just north of the Oregon border and located within the city limits of Vancouver. In addition to the rubber-asphalt binder used on this project, a section of polymer modified asphalt was also constructed. The polymer used to modify the asphalt was a synthetic rubber added in liquid form to the asphalt cement. A short section of standard non-rubberized open graded friction course pavement was also constructed to serve as a control for the rubber and polymer modified sections. Recent visual surveys of all three sections indicated virtually no difference in performance between the various pavements after 5 years of service.

The cost effectiveness of this use of the wet process is still undetermined due to the relative youth of the sections under study. If they are to compete on an equal basis with conventional pavement systems they will need to show a significant increase in service life for their cost, which ranged between 1.1 and 3.7 times more than conventional mixes.

PLUSRIDE PROJECTS

WSDOT's initial experimentation with PlusRide (dry process) began in 1982 with the paving of a very short section of SR-97 in Yakima near the District 5 headquarters offices. Many problems were encountered in the construction of this section with the result being that WSDOT did not continue a rigorous monitoring of the project beyond the initial construction phase. One additional project was paved in 1982 on a bridge deck located just north of Yakima on I-82. An adjacent bridge deck was also paved with an open graded rubberized friction course mix (wet process) to serve as a control. The PlusRide lasted 8.5 years as compared to the open graded friction course mix which lasted 7 years. PlusRide was also used on a ramp leading to SR-18 near Auburn. This was a successful installation but not a good choice for a test application, due to the low traffic volumes on the ramp. In 1985 the ramp was overlaid with conventional ACP as a part of the project which added additional lanes to SR-18.

Only one project was constructed in 1984 using PlusRide. The northbound bridge deck of the Renton S-Curves section of I-405 was constructed and a companion section of rubber-asphalt open graded friction course mix (wet process) was used on the southbound deck. Difficulties were encountered in achieving the required compaction

of the PlusRide mix, but representatives of PlusRide made the decision to leave it in place rather than replace it with new material, indicating that it would be satisfactory. The PlusRide section experienced ravelling and debonding of the pavement from the deck after only two years of service. The latest visual inspection revealed that the PlusRide mix was almost totally missing in the wheel paths and had been patched back with standard asphalt mix by our maintenance forces. The companion bridge is showing some signs of wear, a minor amount of ravelling and flushing, and one small area of debonding. The PlusRide was 2.3 times more costly than conventional pavements constructed in the same year in the Seattle area.

Two projects were constructed in 1985, one very successful and one a disaster. The Marine Division of the DOT chose PlusRide for a ferry dock at the Fauntleroy terminal on the Vashon Island route. The PlusRide mix was placed on a new section of the dock and traffic was switched over so that the older section of the dock could be repaired and made ready for a new overlay of the same PlusRide pavement. The PlusRide pavement proved to be unstable with large ruts developing under traffic loading almost immediately. WSDOT made the decision to remove the PlusRide and replace it with a standard paving mix. The cause of the failure is unknown. An investigation of other projects paved with asphalt from the same lot revealed no problems, which indicates that the asphalt was not the source of the problem. The pavement which replaced the PlusRide is still performing satisfactorily, which rules out the location as a possible cause of failure. The design of the asphalt mixture is proprietary in the PlusRide system so we must rely on those holding the licensing rights to supply us with the proper design. We, therefore, were unable to determine what went wrong with this design that would result in this magnitude of failure.

The other 1985 project was constructed on SR-530 near the town of Stanwood. The PlusRide section was placed along with a section of fiber reinforced pavement and a control section of standard mix pavement. The Federal Highway Administration is providing funding for the evaluation of these sections. In this case the PlusRide is doing slightly better then the standard mix and the fiber reinforced mix after 6 years of service. It is still too early to predict long-term performance or the cost-benefit ratio of the PlusRide as compared to the standard mix.

The final PlusRide project was built in 1986 on SR-513 between 35th Avenue and I-5. This is the largest project WSDOT had built to date with over 8 lane miles of the PlusRide pavement placed. The PlusRide was placed over a PCC pavement and a cracked ACP pavement. It exhibited transverse and longitudinal reflection cracking very soon after installation. Long-term performance is still undecided.

SUMMARY OF WSDOT'S EXPERIENCE

WSDOT has paved a total of nearly 237 lane miles with the various wet and dry processes of rubber-asphalt pavements. This represents an investment of about $1.6 million ($2.6 million in today's dollars) over the cost of conventional pavement mixes (see Appendix A). It is interesting to note that WSDOT has disposed of approximately 200,000 tires in our trial sections at a per tire cost of $12 in round figures. The following conclusions are drawn on WSDOT's experience to date:

1. The SAM and SAMI processes are not cost effective. Currently, more economical asphalt binders give equal performance with the rubber-modified binders at about 1/3 the cost.
2. The open graded rubberized friction course process looks very promising at this time, but a longer evaluation period is necessary in order to quantify the cost effectiveness of this type of pavement.
3. PlusRide looks to be the riskier choice at this time. Past performance has ranged from immediate failure to excellent. Construction problems which

may relate to the design of the mix have plagued several of the installations. The costs on the projects have averaged almost twice that of conventional mixes. Promises by new management to increase their efforts to produce a more consistent product and the addition of a 5-year performance guarantee have yet to be evaluated on a project constructed in Washington.

NATIONAL EXPERIENCE

A review of the current literature and a survey of the other states resulted in very few sources for well documented studies on rubber-asphalt applications. Many states have tried the various wet and dry process products, but few have set up and monitored rigorous experimental projects conducted to determine the long-term performance of these systems. A report published by Purdue University and sponsored by the Federal Highway Administration documents the experience of several states with rubber-asphalt products. (3) A brief summary from this report of these states' experiences is included below:

ALASKA

The state of Alaska has been a leader in the experimental use of PlusRide as a paving product. Six sections were constructed between 1979 and 1983 with a total length of 3.4 miles. They report no failures due to fatigue but some sections have experienced raveling problems. They liked PlusRide because of its ice shedding abilities, its ability to reduce tire noise, and its ability to resist flexural fatigue. An economic analysis conducted in 1988 showed PlusRide to be cost effective compared to conventional asphalt concrete pavements based on life-cycle costs.

ARIZONA

Arizona was the originator of SAM and SAMI applications using the wet process. They conclude that; (1) SAM applications control reflection of fatigue cracks and are an effective alternative to a major overlay, and (2) that SAMI applications effectively control all reflection cracking. A cost analysis indicated that although the SAM applications cost twice as much as conventional chip seals, they last twice as long. Hence, the life cycle costs are equal.

CONNECTICUT

Connecticut has experimented with various forms of rubber-asphalt products since 1980. Rubber asphalt used in thick overlays had mixed results as a reflection crack preventative measure. SAM applications were generally successful but SAMI applications showed no improvement in performance. They concluded that the rubber-asphalt products did not prove effective, with the exception of SAM applications.

KANSAS

SAMI applications were tried in the mid-1970's with no success reported in reducing reflection cracking. Current plans include the use of rubber-asphalt on two projects for overlays placed on distressed pavement sections. A 1990 study of the economic feasibility of rubber-asphalt products concluded that they were not cost effective. "Their economic analysis, based on current prices of various products in Kansas and the quantity of crumb rubber used per ton of HMA (i.e. a typical ton of asphalt-rubber hot mix contains approximately 25 lbs = 1.5 rejected tires) shows that the disposal of each tire by this method would cost $11 to the state." (3)

MAINE

A SAMI application placed in 1976 failed to reduce reflection cracking. A rubber-asphalt overlay could not be completed due to serious construction difficulties as a result of excessive material viscosity. A SAM application in 1988 showed superior performance on one section of roadway, but failed through excessive raveling on another section. A successful test section of SAM on an airport runway led to the coverage of the entire runway with the same material.

MINNESOTA

Minnesota indicates good performance from both SAM and SAMI applications but poor performance from rubber-asphalt hot mix. It was concluded that the rubber-asphalt hot mix was not cost effective due to its 100% increase in price over conventional hot mix.

They also constructed two PlusRide projects in 1984 and reached the following conclusions; (1) design procedures need additional development, (2) PlusRide is more susceptible to compaction problems if weather conditions deteriorate or problems occur with the compaction equipment, (3) the PlusRide pavement has lower friction numbers, rougher riding surfaces, equal deflections, and equal tire noise as compared with conventional pavements used as controls, and (4) no significant deicing benefits were observed. One test section ravelled severely and was replaced after 1 year of service. The other section is performing equal to the control section of conventional mix. The study concluded that the PlusRide material had not shown any significant performance benefits over conventional pavements at twice the cost, and recommended that further use of the material be discontinued.

NEW YORK

New York began experimenting with rubber-asphalt mixes in 1989. Their experience with mixes produced using the wet process was that these mixes tend to be "sticky". This tendency increased with greater percentages of added rubber. Using the dry process (PlusRide) they had difficulty producing an acceptable aggregate gradation to fit the gap graded condition necessary to accommodate the rubber particles. They were concerned about increased air pollution and higher mixing temperatures required during mixing of the asphalt-rubber materials.

PENNSYLVANIA

Pennsylvania has had a long history of working with rubber-asphalt materials. Performance results have been mixed. The Purdue report includes the following quote: "Pennsylvania has been evaluating the use of rubber-asphalt since the early 1960's. There have been numerous projects placed and evaluated without one major success."

VERMONT

Vermont has use SAM and SAMI applications and concluded that they were not cost effective based on annualized cost and quality of performance.

CALIFORNIA

California was not included in the Purdue report. Details on their evaluations come from CALTRANS publications. They report very good results for wet and dry

process asphalt pavements as compared to conventional pavements on their Ravendale test section in northeastern California. The test section was built using both wet and dry process hot mix asphalt and SAM and SAMI seals. The pavement design called for 0.70-foot-thick overlay of conventional dense-graded hot mix asphalt concrete. Various depths of the wet and dry process hot mix were used with and without SAMI layers. All of the sections were paved thinner then the 0.70-foot design thickness due to funding limitations. This has resulted in a good experimental section to determine if the rubber-asphalt pavements will give equal performance at reduced thicknesses and thus be cost competitive with conventional mixes. (4)

SUMMARY OF NATIONAL EXPERIENCE

The information from the sample of states indicates a very mixed performance from the rubber-asphalt systems. Even within a particular state's experience the same system will give good results in one application and poor in another. The favorable performance of rubber-asphalt systems in tests in Arizona and California contrasts to the nationwide study results, suggesting that climatic conditions may be considerably important to the asphalt-rubber system performance. (4)(5) Alaska also strongly supports the use of the dry process (PlusRide) product for its deicing capabilities and high friction resistances. The majority of the states indicate that the rubber-asphalt products are not cost effective. Alaska and Arizona are the only states that claim that a rubber-asphalt system is cost effective. (3)

OTHER CONCERNS REGARDING RUBBER-ASPHALT PAVING MATERIALS

During the course of this study, several areas of concern were noted in several of the references regarding pavements constructed with rubber-asphalt products.

1. Cost. The Focus newsletter published by SHRP indicates that the cost of rubber-asphalt pavements is higher by 40 to 100 percent. (6) We have suggested some ways in which this problem could be mitigated and we will continue to work this issue with the suppliers of rubber-asphalt materials.

2. Recyclability. The Focus newsletter also points out the potential problems with recycling pavements which contain rubber. There is concern with meeting emissions standards and the possibilities that toxic gases may be emitted from the degradation of the rubber in the pavement under the higher temperatures at which pavements are recycled. (6) One of the caveats of the Transportation Bill concerns the ability to recycle pavement containing rubber at substantially the same rate as conventional pavement. The inability to recycle these modified paving materials would substantially reduce their benefit and also create a new waste problem.

CONCLUSIONS REGARDING RUBBER-ASPHALT PAVING MATERIALS

In spite of the past general evidence of the limited economic viability of rubber-asphalt paving materials, WSDOT recognizes that there is a continuing effort to improve the performance of these materials by both manufacturers and researchers. It is apparent that a considerable effort needs to be made on a national basis to investigate the technology of rubber-asphalt binders and how they perform both in the laboratory and in the field. The mixed field performance indicates that there are gaps in our knowledge of how these materials should be put together so that the pavements will perform in a consistently satisfactory manner. To continue to keep up with and support improvements in the rubber-asphalt technology, WSDOT has continued to construct

experimental sections of rubber-asphalt pavement. Such recent projects include the construction of a 5.13-mile section of SR-195 north of Pullman in 1990 and a 2.2-mile section of SR-101 within the city limits of Hoquiam in 1991 (see Appendix D for End of Construction Report).

Some isolated studies, such as that in California, have indicated the potential for success in providing reasonable service lives with much thinner sections of rubber-asphalt materials. The section of rubber-asphalt material construction this summer in Hoquiam was built in an attempt to confirm the performance reported by California. This project was built with a section of rubber-asphalt that was much thinner than design procedures indicated would support the predicted traffic loads.

WSDOT POSITION REGARDING TIRES IN PAVEMENTS

While WSDOT supports reducing the waste stream, it is concerned, along with other State Transportation agencies, about potential risks and increased construction costs resulting from the use of some waste materials in highway construction. The use of rubber tires in pavements poses such a problem.

All construction cost increases adversely impact WSDOT's construction and preservation program. For many years WSDOT has been directed to maintain current pavement conditions. This has been accomplished by emphasizing the preservation program. This program has maintained the fairly fine balance between normal pavement deterioration and needed pavement sealing, resurfacing and reconstruction through one of the first and most fully utilized pavement management systems in the country. This program is a very tenuous balance between preservation costs and pavement performance.

For WSDOT's preservation program not to be impacted by an increased use of rubber-asphalt requires that the added cost of rubber-asphalt (40% to 100% greater) must be accompanied by added service life of this specific paving material. There are many claims regarding improved performance from suppliers of this material, however, that added performance over standard paving materials has not been substantiated by the majority of the performance experience documented in this state or other states over the last fifteen years. The most likely net result of using all current forms of rubber asphalt materials and technology in the preservation program as currently funded would be higher construction costs with overall performance life similar to the existing trends. The consequences of this action to the state would be less miles paved per year with commensurate deterioration of the highway system.

This consequence may be mitigated somewhat by selective utilization of rubber-asphalt materials and technology to get better performance for the extra cost. This requires more development time working with the better performing rubber-asphalt materials, and has been the general direction the Department has taken to date.

In considering the incorporation of waste tires in highway construction, there are clearly additional cost savings to the State-at-large in avoided public costs such as existing tire pile risk costs, solid waste tipping fees, reduced landfill demand, etc. that, under current legislation, are not reflected in WSDOT's utilization of these materials. Actual transfer of these costs would make the use of these materials more cost competitive and reduce the potential adverse affect on the preservation program.

Waste Glass in Asphalt Concrete Pavement (Glasphalt)

There have been sporadic attempts to use waste glass in asphalt concrete pavement since the late 1960's. One of the most complete studies on the "Use of Domestic Waste Glass For Urban Paving" was conducted by Malisch, et al., from the University of Missouri-Rolla, for the U.S. Environmental Protection Agency and reported in 1975. (7) With the large increase in waste glass from the various recycling programs implemented across the nation, there has been a clear increase in interest and

activity in incorporating waste glass in ACP, particularly from the late 1980's on. Although there are quite a few short experimental sections of "glasphalt" constructed across the country, New York DOT has used a considerable amount of waste glass in their ACP in the New York City urban area over the last 4+ years. Connecticut (8), New Jersey, Virginia, and Florida DOT's have conducted smaller special studies on the use of waste glass in ACP over the last few years.

In reviewing all of this information there was a very common set of findings that governs the use of glass in highway construction:

1. Glass crushes more easily than construction-quality aggregate.
2. Asphalt does not adhere as well to the very smooth glass surface as it does to construction-quality aggregate.
3. Many east coast references indicated that waste glass sources contained as much as 20% "commingled" waste such as aluminum cans, soil and ceramics.

To mitigate these potential problems there is a fairly common set of recommendations or limitations in almost all of the references for the use of waste glass in highway construction:

1. To minimize the crushing problem associated with glass, its use is limited to a maximum of 15% of the total aggregate volume, using only glass crushed fine enough to pass a 3/8-in. sieve. Glass this size or smaller does not crush as easily as the larger sizes, and thus better meets the durability needs of construction aggregate.
2. To minimize stripping problems (adhesion loss of asphalt to glass or aggregate) all sources recommended the use of anti-strip agents, specifically the addition of hydrated lime, to the glass waste during ACP production. Hydrated lime is the most universally successful anti-stripping agent used by the paving industry today. WSDOT has a concern in this specific area. All of the references to stripping potential had judged that potential based on the conditioning of a laboratory sample in a warm water bath for 24 hours. This is a fairly easy conditioning process used in the southern and east coast states. WSDOT and most other northern tier states use a more aggressive conditioning process that requires freezing the sample for 24 hours before the warm bath. This conditioning correlates better to pavement distress found in the northern states from freeze-thaw cycles. It is likely that potential stripping problems associated with glass will be accentuated by this conditioning procedure.
3. WSDOT has been assured by representatives of the waste glass industry that contamination or commingling of other waste stream materials is not a problem in Washington State. Grading requirements such as the restriction to 3/8-in. maximum size, as mentioned above, and an additional requirement for a maximum of, say, 7% passing the number 200 sieve would likely insure that the waste glass material is reasonably contaminant free.

In addition to those specific items noted above, most references indicated a general concern, in varying degrees, about long-term asphalt stripping problems, loss of surface friction, rutting, etc. Because of these general concerns there is a fairly consistent consensus that "glasphalt" not be used on high-speed, heavy-volume highways. Its use is usually limited to wearing and base courses on lower-speed and lower-volume streets or highways, and only as base courses on high-speed or high-volume highways.

Conclusions

Waste glass could be used in asphalt concrete pavement in Washington for lower-speed and lower-volume streets and highways or in the asphalt base layers of higher-volume highways, or in bike paths or walkways, with the following limitations:

1. The waste glass be reasonably clean, with 100% passing the 3/8-in. sieve and no more than 7% passing the number 200 sieve.
2. A maximum of no more that 15 % by volume of waste glass should be used in ACP.
3. The use of any waste glass in ACP will require the use of an anti-strip additive such as hydrated lime slurry or equal.
4. The use of waste glass should be considered experimental at the present time.
5. The use of any waste glass in ACP will require a full laboratory workup.

Glass in Concrete

Alkali-silica reactivity (ASR) is a widespread problem in the United States. This is essentially a chemical reaction between certain forms of silica in glass (or some aggregates) and alkalies (sodium or potassium) from the cement. The result is a gel product that absorbs moisture and expands, which finally leads to the destruction or disintegration of the concrete.

Due to the alkali-silica reactions, the use of glass as an aggregate substitute in portland cement concrete is prohibited by many agencies. (3)(8)

Waste Glass in Unbound Surfacing

A number of agencies have adopted specifications for the use of glass in unbound base materials as an alternative to its use in pavements. (8) A General Special Provision has been developed by WSDOT which allows the use of glass chard in a wide range of untreated base materials in Washington State. A copy of this proposed GSP is included as Appendix E.

Fly Ash

As a result of WSDOT's laboratory research and field studies, fly ash may be used in all portland cement concrete pavements and in most structural concrete.

To promote the use of fly ash, Congress has authorized a Federal-aid share increase of "5 per centum" for projects that use 1,000 tons or more.

Fly ash has been used, as a contractor's option, in almost all PCCP constructed by WSDOT over the last several years, as it enhances the workability of the fresh mix.

Large amounts of fly ash will be used in the reconstruction of the Lacey V. Murrow Floating Bridge.

Magnetherm Slag

Decrepitated and granular forms of magnetherm slag produced at the Northwest Alloys plant at Addy, Washington, were evaluated for use as additives to asphalt concrete and as soil stabilizers. Decrepitated magnetherm slag was found to have significant potential for stabilizing clay-silt soil but limited possibilities as a mineral filler or stripping control additive in asphalt concrete.

Asphalt Concrete Pavement (ACP)

The WSDOT has aggressively developed specifications and processes to most fully use recycled ACP in its paving program. The Department has been actively recycling ACP since 1977 when the first asphalt concrete pavement in the state was recycled on a 4-mile section of I-90 near Ellensburg.

The use of recycled ACP began slowly through a series of experimental projects that required the use of a fairly high percentage of ACP millings that were produced on the individual projects. At the time, these experimental projects met significant

resistance from the paving industry as the recycling process did not fit their existing production equipment or processes very well. About five years after the first recycling project, following a series of several successful projects, the Department rewrote the existing ACP specifications to include the use of recycled ACP. The specifications made three specific changes from past practice:

1. A maximum of 10% recycled ACP from any source can be included in all new ACP without need for a specific recycle mix design. This has now been changed to a maximum of 20%.
2. All ACP materials removed from a project become the property of the contractor, for his use or disposal.
3. The contractor can utilize up to a maximum of 80% old ACP in any new ACP they produce, provided it meets standard recycle pavement design criteria. These criteria basically call for the rejuvenation of the old liquid asphalt to standards comparable to new liquid asphalt standards, with grading and density standards to be the same as new ACP.

These specification changes were designed primarily to make recycled material available to the contractors and to allow the contractors to compete at recycle percentages that best fit their own hot mix plant operations. Obviously those who could use more of the cheaper recycled ACP had a competitive edge.

At about this same time, as the specifications were changed, several of the state's paving contractors purchased new ACP hot mix plants that were specifically designed to incorporate recycled ACP in hot mixing process. Once a few contractors began competing using recycled ACP, which cost less than new materials, there was a general adoption of the process by the paving industry. Thus between 1977 and 1981 we had recycled only a little over 23,000 tons of ACP; by 1984 we had recycled well over 300,000 tons of ACP. (9)

WSDOT presently uses over 100,000 tons of recycled ACP per year in it's highway construction program. Because the specifications are used by many cities and counties, similar quantities are probably also used in their construction programs. Some obvious benefits of recycling ACP are a decreased dependence on oil for producing asphalt, a reduction in the amount of asphalt pavement that was formerly dumped in landfills, and diminished need to quarry new aggregate. This is all accomplished with out adversely affecting the pavement preservation program, as the performance of recycled ACP, as specified, is about the same as new ACP and the cost is a little less.

WSDOT is currently planning to research the CYCLEAN microwave process as a method of recycling ACP. Reportedly, this process heats ACP to about 300 degrees F. without damaging the asphalt cement binder or creating smoky, polluting exhaust.

Bottom Ash

Bottom ash from the coal plant in Centralia, WA has been used for a lightweight embankment to reduce settlement. This embankment was constructed on SR-507, approximately two miles north of Centralia.

Obviously, there are many other opportunities for using recycled materials in highway construction in addition to asphalt concrete. As noted previously, the Department has experimented with the use of recycled tire rubber and glass for pavements, fly ash for portland cement replacement in concrete, magnetherm slag for aggregate replacement, and soil stabilization and broken portland cement concrete pavement for aggregate base materials. Many materials, and many uses for these materials, remain unexplored by the Department.

OBJECTIVE NO. 2 "An analysis of uses for waste materials"

As a means of addressing the growing number of scrap tires, many agencies have focused on existing and emerging methods of using them, including rubber-asphalt, retreading, pyrolysis, artificial reefs, ferry bumpers, sludge composting, safety barriers, tires-to-energy, tire-derived fuel, erosion barriers, and backfill.

Rubber-Asphalt

As previously noted, construction of rubber-asphalt pavements continues on an experimental basis while their cost effectiveness and performance are further evaluated. We will continue to work with other state agencies and private industry. The use of rubber-asphalt as a liquid crack or joint filler has proved to be effective and will continue as general practice. Requirements for rubber joint sealers and rubberized asphalt crack sealers are included in Section 9-04 of our Standard Specifications.

Retreading

In addition to reclaiming rubber, tires can be retreaded. Retreaded tires extend the life of the original tire, postponing the problem of disposal. However, even retreads eventually have to be discarded. Presently, about 10 percent of passenger tires and 55 to 70 percent of truck and bus tires are retreaded. In fact, some major carriers retread tires two or three times, but their use is generally limited to the second or third set of wheels on a tractor trailer. This market could grow as new retreading equipment that can more effectively handle steel-belted tires is developed. (10)

Pyrolysis

The process of grinding tires for ACP requires a large amount of added energy, with additional energy needed to mix and react the rubber with liquid asphalt. During a recent presentation (September 4, 1991) attended by Mr. Keith Anderson of the WSDOT Research Office, Mr. Michael Rouse of Rouse Rubber Industries, Inc., a major producer of granulated reclaimed rubber, indicated that his company is one of the top ten consumers of energy on the electrical power grid the company uses in Mississippi. Pyrolysis, on the other hand, uses energy from the tires themselves and produces material that can be blended more easily with liquid asphalt, and with better control.

Pyrolysis, or thermal decomposition of tires in the absence of oxygen, has been applied to rubber products since the 19th century. Conrad Industries, Inc., of Centralia, Washington, reports a successful pyrolysis operation that can process 24 tons of tires per day. Their plant uses 2-inch tire chips in the process, and each ton of scrap tires produces 600 to 650 pounds of carbon black, 40 therms of gas, and approximately 90 to 110 gallons of oil. Roughly 15 to 25 percent of the gas is used to fuel the pyrolytic reaction. (10) Carbon black is sometimes used as an additive to asphalt cement, and the oil derived from this process could possibly be used as a fuel for asphalt concrete mix plants or processed into additives for asphalt cement. Additives derived in this manner would provide better control of AC mixes than those in which ground or chunk rubber was simply added. In either case, a large portion of each tire could contribute to roadway construction.

Tire Recycling Technology Corporation of Albuquerque plans to open a 60-ton-per-day scrap tire pyrolysis plant in Fort Worth in the coming months.

Artificial Reefs

The Goodyear Tire and Rubber Co. reports that more than 2,000 artificial marine reefs have been created from scrap tires. Used tires are punctured to reduce their buoyancy, compacted, bundled, and, if necessary, weighted with concrete. They are then placed in the ocean, where they become encrusted with marine growth and slowly evolve into artificial reefs. Goodyear views these reefs as potential "rubber mines" to be reclaimed when appropriate technology is developed. (10)

Ferry Bumpers

Waste tires may be cut or stamped and used to create other products such as dock bumpers. Approximately 3 to 5 million tires around the country are utilized in this manner each year.

Composting

Tire chips have been used with and as a substitute for wood chips in sewage-sludge composting. Chopped tires have been successfully used in waste water treatment sludge composting, most extensively in Windsor, Ontario. The recovery and reuse of the rubber chips makes this use more cost effective than wood chips that decompose and have to be replaced after three cycles. (**10**)

Safety Barriers

The Goodyear Co. is also promoting the use of waste tires as highway barriers. The tires are stacked and woven together with steel cables, then enclosed in Fiberglas and placed in front of bridge abutments, divider strips, support posts, and other fixed objects. In tests, these cushioning devices were reported to absorb the impact of a 71 mph car crash. Goodyear also supports the use of waste tires for erosion control and as breakwaters.

We will continue to follow the progress of research with these materials and use them as they become available.

Tires-To-Energy

Currently, the prominent approach to high-volume waste tire disposal, worldwide, is combustion. Like coal, tires are ideally suited for combustion processes because of their high BTU value. Each tire contains the energy equivalent of 2.5 gallons of oil.

In March 1988, Oxford Energy of New York opened the first U.S. tire burning plant in Modesto, California. The 14.4 megawatt plant burns up to 700 whole tires per hour, or 4.5 million per year, providing electricity for up to 15,000 households. The maintenance of the appropriate burn temperature (approximately 2,000 degrees Fahrenheit) maximizes the benefits of the pollution control system.

Decker Energy International, Winter Park, Florida, and Wheelabrator Environmental Systems Inc., Hampton, N.H., have formed a partnership to build a $60-million plant in Polk County, Florida that will use abandoned tires and wood waste as fuel.

As reported, the Ridge Generating Station will generate almost 40 Mw of electricity by burning 375,000 tons of tires and wood waste per year.

The high temperatures (generally 2,600 degrees Fahrenheit) that characterize cement kilns make them ideal furnaces for the complete combustion of tires, including the steel. Kiln operators report overall improvement in kiln operation. They also report a savings on the cost of iron ore, which is usually added during the process, because of the steel already present in the tires. The cement from these kilns may be used in the construction of concrete pavements and structures. This technology is widely used throughout Europe and is only beginning to be used in the United States. In Europe, the use of waste tires is much more economical, particularly in Germany, where cement manufacturers acquire waste tires free of charge. Many U.S. cement companies are owned by European interests, and they refuse to pay in this country for an item they can get in Europe for nothing. Companies that collect and sell waste tires as a commodity are not going to give away tires to cement manufacturers.

Tire-Derived-Fuel

Tire-derived fuel (TDF) includes shredded tires that have been added to increase the performance of the fuel. Reportedly TDF is much drier and produces far less ash and sulfur emissions than coal. (10)

Erosion Barriers

The California DOT has explored uses for discarded tires in highway maintenance. Pilot projects have included the installation of tires in an embankment to control shoulder erosion, the installation of tires in a drainage channel to control slope erosion, and the use of tires as temporary windbreaks for establishing vegetation. CalTrans reported that the use of discarded tires for shoulder reinforcement and channel slope protection provided an immediate and economical solution for minor contracts and projects initiated by maintenance personnel. The use of tires as windbreaks was determined not to be cost effective by a substantial amount. (11)

California has also experimented with tire-anchored timber retaining walls. Waste tire sidewalls were used as the anchors in this concept. Used railroad ties were utilized as timbers. CalTrans reported the performance of the wall to be satisfactory and cost effective. (12)

Backfill

The Oregon DOT has used shredded rubber tires as a lightweight fill to correct a landslide that occurred under a highway embankment. The force driving the slide was decreased by removing the soil embankment and replacing it with a lighter weight embankment constructed with shredded tire chips. Some 5,800 tons of shredded tires were used - approximately 580,000 tires. Surface monuments, settlement plates, and slope inclinometers have been installed to monitor the performance of the embankment. (13) WSDOT is aggressively pursuing a construction project that will require a lightweight fill so that we can try the shredded rubber tire material and evaluate its performance using our experimental features process.

Subbase Materials

This research revealed some concerns regarding the use of waste tires or material derived from tires in roadbeds. Twin City Testing Corporation (TCT), located in St. Paul, Minnesota, conducted a laboratory study of waste tires to evaluate the compounds that are produced by exposure to different leachate environments. TCT also conducted field sampling at two sites where waste tires were used in roadway subgrade construction.

On the basis of the results of its studies, TCT concluded that metals and hydrocarbons are leached from tire materials under certain conditions. They also found that drinking water recommended allowable limits (RALs) may be exceeded under "worst case" conditions for certain parameters.

On the basis of the results of its laboratory and field studies, TCT made the following recommendations regarding the use of shredded waste tires in roadway subgrade construction:

1. The use of waste tires should be limited to the unsaturated zone in a roadway that is designed to limit infiltration of water through the waste tire subgrade. Design of the roadway surface and ditches to promote surface water drainage away from the waste tire subgrade should be included in the design of the roadway.
2. Additional field studies should be performed to evaluate new or existing roadways where waste tires are used. Field studies should include sufficient numbers of monitoring wells in roadways and background areas to provide a statistically significant comparison of tire area and background area samples. (14)

WSDOT faced a similar leachate problem in using sawdust as lightweight fill material. In cooperation with the Department of Ecology, this problem was overcome and we assume the possible problem with waste tire materials can be solved in the same manner.

Conclusions

While WSDOT supports recycling, it is concerned, along with others in the industry, about potential problems resulting from the use of some recycled materials in highway construction. In particular, there is a general concern about rubber in pavements and what will happen during the possible recycling of this material in the future. The use of rubber in pavements may make the recycling of ACP more difficult or impossible. This area needs more complete study.

When the use of recycled materials results in decreased service life or requires more frequent maintenance, WSDOT will look to additional funding from those entities which are gaining the benefits of not landfilling these materials, to defray this additional cost. Likewise, the use of recycled materials that cost significantly more than normal materials must provide improved performance commensurate with the increased costs to be reasonably cost effective. Increased materials costs without accompanying improved performance will reduce the funds available for maintenance of the existing roadways.

Recycled materials must still meet applicable quality standards ranging from simple material cleanliness to more complex standards based upon engineering properties. It is also essential that a candidate recyclable be easily reprocessed in the future.

Recommendations

1. Rubber-asphalt as a joint/crack sealant has been found to be cost effective will continue to be used as a general practice.
2. Rubber tires may be used in subgrades/embankments as a lightweight fill material **above** the saturated zone. The drainage features of the design will become very important for this application. This use will be actively perused by the Department of Transportation.
3. Tires may be used for soil reinforcement in embankment construction in the unsaturated zone. However, standard designs for this application need to be developed.
4. WSDOT will continue to monitor the evolving rubber-asphalt technology. Additional projects will be constructed where engineering analysis indicates that the use of rubber-asphalt materials can be expected to be reasonably cost effective for the specific needs of such projects. WSDOT may also participate in research which may enhance the cost effectiveness of these materials. If it is found to be warranted, the same type of rigorous study should be directed toward rubber grindings and products from the pyrolysis process.

OBJECTIVE NO. 3 "An analysis of using recycled mixed-plastics"

A few states have begun to use dimensional lumber manufactured from recycled mixed plastic waste. While the material has been initially used for sign posts, plans are being developed to try other uses such as rest area tables and benches, rest rooms, and other buildings. Although this technology is relatively new, it appears to hold some promise for many areas of WSDOT operations. State parks, national parks, national forests and DNR facilities are other potential users of these products.

One such product, Syntal Synthetic Lumber, manufactured by Spokane Plastics, Inc., has been conditionally approved by the WSDOT New Products Evaluation

Committee. This approval is contingent upon provision of a tabulated working stresses chart to the Department.

According to the manufacturer, this synthetic lumber can be produced in various shapes and dimensions and can be painted, sawed, bored, milled, planed, and nailed. The Traffic Engineering Section is currently evaluating samples of recycled plastic sign posts and sign stock.

WSDOT Materials Laboratory has recently completed field testing plastic delineators which, according to the manufacturer, are comprised of 60 to 70 percent recycled material. These posts passed the field tests and are scheduled for immediate laboratory tests. These tests should be completed early in 1992.

Over a year ago, recycled polystyrene blocks were used to construct a lightweight fill to correct a slide on SR-508. The fill is performing satisfactorily. As a result of this trial usage, WSDOT plans to use this material to build approaches for a temporary bridge on the North Nemah River, SR-101, while the existing bridge is being replaced.

Other recycled plastic products that various agencies are evaluating include safety medians, barricades, and highway drainage pipes. Further testing and experimentation with these products is needed.

OBJECTIVE NO. 4 "Testing and monitoring the use of recycled materials"

WSDOT currently tests and monitors new products, including recycled materials, through two established methods. These are the WSDOT New Products Evaluation Committee and the FHWA Experimental Features Program. Initial use of these materials is carefully planned, extensively evaluated and systematically documented. Evaluations may be carried out over an extended period, in some cases 15 years or longer.

As an example, to assess the long-term performance of rubber-asphalt pavement used on I-5 in the Vancouver vicinity, monitoring will continue for a period of 15 years. The performance will be assessed by visually observing and recording the amount of deterioration of the pavement over time and by physically measuring the amount of wear in the wheel paths. The performance of the rubber-asphalt will be determined from comparisons with a control section of conventional asphalt pavement constructed on the same project.

The New Products Evaluation Committee membership consists of the following:

* Assistant Secretary - Operations (Chairman)
* Materials Engineer (Secretary)
* Design Engineer
* Traffic Engineer
* Bridge & Structures Engineer
* Research Director
* Chief Maintenance Engineer
* District Project Development Engineer
* Special Projects Manager (Staff Support)
* Technical Experts As Needed

Overviews of WSDOT's New Products Evaluation Procedure and the FHWA Experimental Features Program are included as Appendix F.

This procedure has worked very well to identify and evaluate new products, provide statewide awareness and promote the use of these products throughout WSDOT. This is an established procedure that emphasizes the testing, monitoring and utilization of new products in a very rigorous and currently successful process. This process has already been used for recycled content materials. The General Special Provision that was developed for the inclusion of glass in all unbound base materials, as

noted under Objective No. 1 and in Appendix D of this study, was not developed as a part of this study, but in response to a formal submittal through the new products evaluation procedure, concurrent with this study.

WSDOT proposes to extend this process to encourage the use of recycled content materials in all new products evaluated, and to develop a more specific monitoring and reporting process for the department's use of recycled content materials in road construction. The new products evaluation form will be modified to indicate the type and amount of recycled content material contained in all new products evaluated. An annual report will be prepared by the new products evaluation committee for the Deputy Secretary. This report will summarize all products with recycled content materials submitted to the committee, the disposition of all such submittals and the results of all tests and monitoring of the products, where applicable, in roadway construction.

If the volume of recycled-content products is too large for the existing new products evaluation committee, a special subcommittee will be formed to work only with recycled-content products. This subcommittee would be formed for an initial two-year period. If needed, its work would be extended beyond that period. This subcommittee would have roughly the same responsibility as the parent committee to adopt products for use by the Department. Special projects or experiments would require concurrence by the parent committee.

Obviously, these additional processes will require additional funding and work force beyond that already approved for the WSDOT by the legislature. These recommendations are made assuming that these additional commitments will be made by the legislature.

OBJECTIVE NO. 5 "Specifications for recycled materials"

The literature search and survey of the other states revealed numerous current or draft specifications regarding the uses or properties of various recycled materials. Many of these are adaptable to WSDOT. A representative cross section of these specifications, as well as WSDOT's, is included with this report as Appendix G. These specifications represent existing specifications from various sources. They may or may not provide reasonable performance without associated field testing. The development of reasonable and field tested specifications takes several years with normal materials. It will take several years with extensive interaction between the Department and recycling industries to develop a complete working set of specifications for recycled materials. This is a goal the Department expects to meet, but it will take much more time than the few months allowed for this study.

OBJECTIVE NO. 6 "Programs to demonstrate feasibility of using recycled materials"

The use of new products and recycled materials is not a new concept to the WSDOT. It has been using these items for over 20 years. In addition to its own research capabilities, WSDOT takes advantage of knowledge and ideas from national efforts and attempts to adapt them to Washington's unique conditions.

At the national level, WSDOT is an active participant in the National Cooperative Highway Research Program and the Strategic Highway Research Program, and with the Federal Highway Administration and the Transportation Research Board. These programs and organizations conduct and fund testing and experimentation in all aspects of highway/bridge construction. WSDOT can, and does, use any of their proven recommendations acceptable or applicable to this state. Each of these organizations, as well as WSDOT, has produced considerable work concerning

environmental preservation, in addition to concerted efforts to utilize solid waste in a productive and safe manner.

At the WSDOT, the Research Office concerns itself with testing materials that are sometimes unique to the state. The testing laboratory in Tumwater has the expertise and equipment to perform such tests and experiments in many areas. In addition, WSDOT utilizes the University of Washington, Washington State University, and others to perform research on a variety of construction/maintenance related activities.

An example of the Department's work with recycled materials is its experience with and documentation of PlusRide, rubber-asphalt open-graded pavements, and carbon black. This documentation is available from the WSDOT.

The Department has also experimented with the use of wood fiber waste for lightweight embankments. There are many of these embankments now in place and, generally, they are performing satisfactorily. They have been cost effective when compared to other alternatives, and in some cases have been the only reasonable alternative.

Recycled Sign Stock

The Department is also involved in recycling aluminum sign stock. In April 1990, the Department of Corrections purchased approximately $70,000 worth of equipment for this use at its facility in Walla Walla. All of the Department's damaged signs are taken down and sent to the State Sign Shop in Yakima. They are then bundled for shipment to Walla Walla, where they are recycled. In 1990, 184,271 sq. ft. of sign stock were recycled for WSDOT use. Cities and counties in this state also use this facility for their damaged sign stock, and neighboring states have expressed an interest in doing the same.

The savings derived from this recycling program are significant. Recycled sign stock costs the Department $0.55 per sq. ft., while new material costs $1.60 to $2.45 per sq. ft., depending on its thickness. Between August 1, 1990, and July 31, 1991, savings to the Department amounted to $204,480.97 after the scrap value of the recycled signs was considered.

Compost

The Landscape Maintenance Section of WSDOT has provided the following information regarding the use of compost products on WSDOT roadside planting projects and maintenance of planted areas.

"WSDOT uses organic materials for two major reasons within landscape projects and subsequent maintenance of planted roadsides. The first use is as an organic soil amendment to increase aeration of soil, increase water holding capacity and to retain nutrients within the root zone of desirable plants. The second use is for mulching the planted area to reduce water loss, suppress weed seed establishment, reduce soil temperatures, reduce erosion and improve aesthetic appeal of the planted area.

For two years WSDOT has worked with committees investigating and supporting use of recycled products on roadside landscape projects. WSDOT testified on the original SB 5143. The testimony was supportive of the concept, however, concern was voiced on the specifics of using composted yard waste. The bill changed dramatically in the legislative process. The final bill, which became Chapter 279, Laws of 1991, drops all reference to composted yard waste and expands the definition of "compost products" to include nearly any material derived from the biological or mechanical conversion of cellulose containing waste material. This definition would allow equal status (legally) to many products (i.e., composted yard waste, farm waste, bark, sawdust, other wood by-products, waste paper, etc.).

WSDOT's current use of bark and sawdust is in compliance with Chapter 279, Laws of 1991. The intent, however, is not being met without giving priority to products other than wood processing waste (i.e., composted yard waste). While we believe that many composted products will meet our needs, we intend to meet the spirit of the law and utilize products that have no market position, composted yard waste.

Current production of composted yard waste doesn't yield products that lend themselves to close specifications. WSDOT has specified on two projects, in the Seattle area, that the organic material incorporated into the soil will be composted wastes from one or more of four known sources in the East Puget Sound area. It is expected that in excess of 5,000 cubic yards of composted yard waste will be used by June 30, 1993. More projects which will use this product are pending finalization.

Section 14, which adds a new section to RCW 47.28 (CONSTRUCTION AND MAINTENANCE OF HIGHWAYS) specifically calls for 25% of the total dollar amount spent on landscape products such as mulch and soil amendment be composted products. This is easily met on a technical basis because essentially 100% of the products now used (bark and/or sawdust or chips) will meet the definition of compost products. Subsection (1)(b) does add some confusion in that it calls for identifying only the "materials value", and not include hauling, placing and incorporation into the soil. To isolate the "materials value" would necessitate a change in our standard bid item which includes haul, placement and incorporation. This change will be investigated, however, current products meet a 100% goal so no immediate change is needed.

WSDOT will continue to work with the Recycle Committee's compost section, in hopes of developing specifications for products that need market expansion to meet the goal of the original content of SB 5143."

WSDOT's current procurement specifications for compost and mulch are included as Appendix H.

OBJECTIVE NO. 7 "Identification of suppliers"

As a result of this study, we have identified many manufacturers and vendors of recycled materials and created a database of these suppliers. A list of these sources is included as Appendix I. Mr. Ed Lowe, editor of the "Official" Recycled Materials Guide, has kindly granted permission to include some of the Guide's copyrighted list for the purposes of this study only.

COMMENTS FROM THE RECYCLING COMMUNITY

The preliminary findings of the research were presented to representatives and advocates of the recycling community on December 17, 1991.

The meeting was facilitated by, and all comments were recorded by, Mr. Gregory D. Wright, Executive Director of the Washington State Recycling Association.

A formal summary of all comments, written and verbal, is included as Appendix J.

CURRENT PLANS

Conducting this study in the very short time provided, limited, in large part, the depth and detail that could be accomplished. Also, in looking over the results of this study, it appears that if more time had been available it would have simply resulted in more extensive documentation of limited performance data for recycled content materials used in roadway construction. The one issue that was common among most of the recycled materials mentioned in this study was the fact that the use and quality of recycled materials is a rapidly changing picture. The quality and quantity of most of these materials is rapidly improving and new uses are constantly evolving. Because of

the limited or somewhat negative performance information documented in this study, and the rapidly improving potential for many recycled materials, WSDOT is reluctant to develop detailed programs within this short time frame to demonstrate the feasibility of these materials.

If approved and funded, WSDOT will establish a full-time position whose primary responsibility will be to work with the various recycling industries to better utilize recycled content materials in road construction in Washington State. As envisioned, this position will be responsible for maintaining the most current information available regarding the performance of recycled content materials. It will serve as the primary contact for the recycling industry within the WSDOT and be responsible for developing programs in cooperation with the industry, if necessary, to demonstrate the feasibility of using recycled materials. The position will work through the new products evaluation committee to facilitate the processing of products with recycled content materials through the evaluation procedure.

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(14) Waste Tires in Sub-grade Road Beds, A report on the Environmental Study of the Use of Shredded Waste Tires For Roadway Sub-grade Support, Published by: Waste Tire Management Unit, Site Response Section, Groundwater and Solid Waste Division, Minnesota Pollution Control Agency, Study performed by: Twin City Testing Corporation, 622 Cromwell Ave., St. Paul, MN 55114, February 19, 1990

APPENDIX A.

Summary of responses to Purdue University's nationwide survey

Pages 18 and 19 of their report:

"USE OF WASTE MATERIALS IN HIGHWAY CONSTRUCTION"

Summary of Waste Materials and Their Current Uses in the United States Highway Industry

Waste Material	No. of States Using the Material[1]	Material is Used as Additive to[2]:				Material is Used as[2]:				Landscaping (see 2)	Others (see 2,3)
		Wearing Course	Base	Subbase	Subgrade/ Embankment	Wearing Course	Base	Subbase	Subgrade/ Embankment		
Reclaimed Paving Materials	41	23	26	14	5	8	16	8	5	-	3(sh)
Coal Fly Ash	31	20	5	6	4	1	2	-	2	-	9 (cc), 1(us)
Rubber Tires	29	21	6	1	2	-	1	-	3	-	11 (cs)
Blast Furnace Slag	15	4	2	-	-	3	5	3	2	2	4 (cc), 1(sb)
Steel Slag	9	4	2	1	-	1	2	-	2	1	1 (ic)
Coal Bottom Ash	7	2	2	1	1	-	1	1	1	-	3 (ic), 1 (sc)
Used Motor Oil	7	-	-	-	1	-	-	-	-	-	3 (recy), 3 (apf)
Boiler Slag	7	4	1	-	-	-	1	1	1	-	3 (ic), 1(sc)
Waste Paper	6	-	-	-	-	-	-	-	-	5	1 (recy)
Mine Tailings	5	-	-	-	-	-	-	-	5	-	
Sewage Sludge	3	1	-	-	-	-	-	-	-	1 (sa),2 (c/f)	-
Building Rubble	2	-	1	1	-	-	-	-	1	-	-
Waste Glass	2	1	2	-	-	-	-	-	-	-	-
Sawdust	2	-	-	-	-	-	-	-	2	-	-
Ceramic Waste	2	1	1	1	-	-	-	1	1	-	1 (pb)
Incinerator Residue	2	2	1	-	-	-	-	-	-	-	-
Highway Hardware	2	-	-	-	-	-	-	-	-	-	2 (recy)
Foundry Waste	1	1	1	-	-	-	-	-	-	-	-
Scrubber Sludge	1	-	-	-	-	-	-	-	1	-	-
Phosphate Slag	1	1	-	-	-	-	-	-	-	-	-
Straw	1	-	-	-	-	-	-	-	-	1	-
Plastic Waste	1	1	-	-	-	-	-	-	-	-	-
Lime Kiln Dust	1	-	-	1	1	-	-	-	-	-	-

Notes:

1. Of the 42 states who responded to the questionnaire.
2. The number under each column shows the total number of states that currently use the material in the respective application.
3. Abbreviations used: sh-shoulders, cs-crack sealer, cc-plain/structural cement concrete, us-under seal, ic-ice control, sc-seal coat, sb-sand blasting, recy-recycling, apf-asphalt plant fuel, pb-pipe bedding, f-fertilizer, c-compost, sa-soil aeration.

Table 1

Evaluation of Waste Products from Technical, Economic, and Environmental Factors

Waste Materials	Total States[1]	Economic				Performance					Environmental				
		Evaluation by	Cost Eff.	Equal	Uneconomical	Evaluation by	Very Good	Good	Satisfactory	Poor	Evaluation by	Good	Satisfactory	Not Acceptable	Doubtful
Reclaimed Paving Materials	41	31	19	12	-	34	2	15	17	-	33	15	14	-	4
Fly Ash	31	22	15	7	-	24	1	13	10	-	26	12	13	-	1
Rubber Tires	29	15	3	4	8	19	3	5	5	6	21	8	11	-	2
Blast Furnace Slag	15	11	5	6	-	11	3	5	3	-	11	2	7	1	1
Steel Slag	9	3	1	1	1	5	1	2	1	1	5	1	3	-	1
Bottom Ash	7	3	2	1	-	5	1	3	1	-	4	2	2	-	-
Used Motor Oil	7	3, recycle; 3, use as fuel for asphalt plant (concern expressed about adverse effects on air quality); 1, additive to subbase.													
Boiler Slag	7	3	1	1	1	3	1	2	-	-	3	1	2	-	-
Waste Paper	6	2, recycle; 4, use for landscaping as mulch.													
Mine Tailings	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewage Sludge	3	1	-	1	-	1	-	-	1	-	1	-	-	-	1
Building Rubble	2	1	1	-	-	-	-	-	-	-	1	-	1	-	-
Waste Glass	2	1	-	-	1	-	-	-	-	-	1	-	1	-	-
Sawdust	2	1	1	-	-	1	1	-	-	-	1	-	1	-	-
Ceramic Waste	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incinerated Residue	2	-	-	-	-	-	-	-	-	-	1	-	-	1	-
Highway Hardware	2	2, recycle.													

Notes:

1. Of the 42 states who responded to the survey questionnaire of this study.
2. The waste products whose use is reported by only one state highway agency are as follows: Foundry Waste, Phosogypsum, Recycled Steel in Rebar, Ground Shingle Manufacturing Scrap, Scrubber Sludge, Phosphate Slag, Atmospheric Fluidized Bed Combustion (AFBC), Plastic Waste, Straw, and Shredded Wood.
3. The information given in this Table is provided by the state highway agencies, based on their experience in the use of waste products, in response to the survey questionnaire of this study.

Table 2

APPENDIX B.

WSDOT RUBBER-ASPHALT PROJECTS

and

SUMMARY OF ADDITIONAL COSTS

WSDOT USES OF RECYCLED RUBBER TIRES IN HIGHWAYS

PROJECT TITLE (Report Number)	*LANE MILES*	*DATE CONSTRUCTED*	*PURPOSE FOR USE*	*PERFORMANCE EVALUATION*	*SUMMARY*
SAM					
Franklin Co. Line to Jct. SR-26 *	13.40	1978	Evaluate use of rubberized asphalt as a chip seal.	Failure due to loss of chips.	The average service life of these SAM's has been 5.75 yrs. Normal class C chip seals last 6.5 yrs. in Eastern Washington. The rubber-asphalt SAM's were 2.5 - 3 times as costly as class C chip seals.
Buena Loop Rd. to Roza Drive et al. *	34.20	1978	Evaluate use of rubberized asphalt as a chip seal.	Failure due to loss of chips.	
District 5 Rubberized Seal *	31.60	1980	Evaluate use of rubberized asphalt as a chip seal.	Performance was acceptable.	
37th Street to Rocky Reach Dam *	8.60	1980	Evaluate use of rubberized asphalt as a chip seal.	Performance was acceptable.	
Subtotal =	87.80 Lane Miles				
SAMI					
SR 5 to Napavine *	5.60	1977	Prevent reflection cracking.	Cracking reflected through overlay from underlying PCC pavement in 3 years.	The average service life of overlays with SAMI's has been 12.3 yrs. The average service life of 2 - 3 inch overlays statewide is 12.5 yrs.
Wheeler Road to Adams Co. Line (WA-RD 128.1)	36.80	1978	Prevent reflection cracking.	Successful in retarding alligator cracking but not long. or transverse. A test section with normal asphalt gave similar results.	
Jackson Highway to Beach Road (WA-RD 185.1)	22.20	1978	Prevent reflection cracking.	Successful in retarding the reflection of alligator cracking.	
Hillyard Jct. to M.P. 300.40 (Mats Lab Report 187)	4.60	1978	Prevent reflection cracking.	Successful in retarding cracking but did not totally prevent crack reflection.	
Morton to Packwood (WA-RD 185.1)	30.20	1978	Prevent reflection cracking.	Successful in retarding the reflection of alligator cracking.	
Paradise Road to Mullen Hill Road (Mats Lab Report 186)	6.60	1978	Prevent reflection cracking.	Not successful.	
Subtotal =	105.20 Lane Miles				

WSDOT USES OF RECYCLED RUBBER TIRES IN HIGHWAYS

PROJECT TITLE (Report Number)	*LANE MILES*	*DATE CONSTRUCTED*	*PURPOSE FOR USE*	*PERFORMANCE EVALUATION*	*SUMMARY*
OPEN GRADED RUBBERIZED FRICTION COURSE					
S-Curve/Cedar R. Bridge & RR Bridge (WA-RD 130.2)	0.60	1984	Used to increase binder to aggregate adhesion.	Successful after 7 years service under high traffic volumes.	The average service life of the three older open-graded pavements is 7 yrs. to date. They have performed well, but no better than standard open-graded pavements. It should take 8 - 10 yrs. to define performance.
Evergreen Point Br. to SR-908 (Report in preparation)	3.80	1982	Used to increase binder to aggregate adhesion.	Very good performance with only minor rutting noted and some pot holing after 9 years of heavy traffic volumes.	
Columbia River to 39th Street (WA-RD 131.1)	12.80	1986	Used to increase binder to aggregate adhesion	Very good performance after 5 years of service.	
Armstrong Road to Albion Road (No report to date)	10.26	1990	Used to increase binder to aggregate adhesion	No performance history to date.	
22nd St. to Little Hoquiam River Br. & Riverside Br. 101/125 (No report to date)	4.38	1991	Used to increase binder to aggregate adhesion	No performance history to date.	
Subtotal =	31.84 Lane Miles				
PLUSRIDE					
Main Street to South First Street (Mats Lab Report 184)	0.40	1982	First trial use of product in the state.	Flushing and rutting have occurred marring performance.	The performance of PlusRide pavements ranges from satisfactory to immediate failure and replacement with standard ACP. In WSDOT's experience, there is no indication of better performance or longer life. In fact, the opposite appears to be true. Maintenance forces note no savings in snow removal nor any less ice forming on rubber asphalt test section.
Bridge No. 82/205 et al. (WA-RD 127.1)	0.90	1982	Trial use of product as a bridge deck overlay.	PlusRide on Br. No. 82/114N lasted 8 1/2 yrs. ACP Class D control on Br. No. 82/115N lasted 7 yrs. PlusRide cost 50% more than ACP Class D.	
84th Avenue S. I/C and Auburn Ramps (Mats Lab Report 185)	0.50	1983	Trial use of product.	Performance has been excellent on this low traffic ramp.	
S-Curve/Cedar R. Br. & RR Bridge (WA-RD 130.2)	0.60	1984	Used because of claims by supplier of greater service life.	Large sections of overlay ravelled and debonded in wheel paths after only 2 years of service.	

WSDOT USES OF RECYCLED RUBBER TIRES IN HIGHWAYS

PROJECT TITLE (Report Number)	*LANE MILES*	*DATE CONSTRUCTED*	*PURPOSE FOR USE*	*PERFORMANCE EVALUATION*	*SUMMARY*
PLUSRIDE					
Fauntleroy Ferry Dock (Immediate failure, no report published)	0.60	1985	Prevent reflection cracking from underlying wood deck.	Total failure due to instability of mix. Replaced with dense graded ACP.	
Skagit Co. Line to Dalgren Rd. (WA-RD 147.1)	0.80	1985	Prevent reflection cracking from underlying PCC pavement.	Performance satisfactory after 6 years of service. Some longitudinal cracking present.	
35th Ave. NE to SR-5 *	8.16	1986	Prevent reflection cracking from underlying PCC and ACP pavements.	Exhibited transverse and longitudinal cracking very early.	

Subtotal =	11.96 Lane Miles				
Grand Total =	236.80 Lane Miles				

* Evaluations documented internally, no formal report published.

PROJECT TITLE	UNIT COST RUBBERIZED Per Ton	UNIT COST NON-RUBBER Per Ton	ADDED COST OF USING RUBBER	COST ADJUSTED FOR INFLATION (see note below)
SAM				
Franklin Co. Line to Jct. SR-26	$355.00	$114.00	$84,925.00	$178,172.65
Buena Loop Rd. to Roza Drive et al.	$300.00	$114.00	$105,090.00	$220,478.82
District 5 Rubberized Seal	$435.00	$191.00	$130,540.00	$211,996.96
	$545.00	$191.00	$46,374.00	$75,311.38
37th Street to Rocky Reach Dam	$470.00	$191.00	$54,963.00	$89,259.91
		TOTALS	$421,892.00	$775,219.72

Adjustment for inflation calculated using the Consumer Price Index for Seattle.

PROJECT TITLE	UNIT COST RUBBERIZED Per Ton	UNIT COST NON-RUBBER Per Ton	ADDED COST OF USING RUBBER	COST ADJUSTED FOR INFLATION (see note below)
SAMI				
Wheeler Road to Adams Co. Line	$426.00	$114.00	$355,056.00	$744,907.49
Jackson Highway to Beach Road	$330.00	$114.00	$75,600.00	$158,608.80
Hillyard Jct. to M.P. 300.40	$380.00	$114.00	$22,078.00	$46,319.64
Morton to Packwood	$415.00	$114.00	$34,615.00	$72,622.27
Paradise Road to Mullen Hill Road	$500.00	$114.00	$5,790.00	$12,147.42
		TOTALS	$493,139.00	$1,034,605.62

Adjustment for inflation calculated using the Consumer Price Index for Seattle.

PROJECT TITLE	UNIT COST RUBBERIZED Per Ton	UNIT COST NON-RUBBER Per Ton	ADDED COST OF USING RUBBER	COST ADJUSTED FOR INFLATION (see note below)
OPEN GRADED RUBBERIZED FRICTION COURSE				
S-Curve/Cedar R. Bridge & RR Bridge	$86.85	$23.25	$22,514.40	$29,358.78
Evergreen Point Br. to SR-908	$27.00	$24.00	$12,900.00	$17,711.70
Columbia River to 39th Street	$55.56	$36.80	$131,545.12	$165,746.85
Armstrong Road to Albion Road	$64.10	$35.00	$182,166.00	$192,913.79
22nd. St. to Little Hoquiam River Br. & Riverside Br. 101/125	$79.50	$35.00	$146,150.00	$146,150.00
		TOTALS	$495,275.52	$551,881.12

Adjustment for inflation calculated using the Consumer Price Index for Seattle.

PROJECT TITLE	UNIT COST RUBBERIZED Per Ton	UNIT COST NON-RUBBER Per Ton	ADDED COST OF USING RUBBER	COST ADJUSTED FOR INFLATION (see note below)
PLUSRIDE				
Main Street to South First Street	$41.00	$27.00	$5,600.00	$7,688.80
Bridge No. 82/205 et al.	$75.00	$50.00	$1,525.00	$2,093.83
84th Avenue S. I/C and Auburn Ramps	$53.60	$28.50	$12,550.00	$16,967.60
S-Curve/Cedar R. Br. & RR Bridge	$50.00	$21.80	$9,418.80	$12,282.12
Fauntleroy Ferry Dock	$68.50	$27.00	$36,769.00	$46,770.17
Skagit Co. Line to Dalgren Rd.	$55.00	$27.00	$18,060.00	$22,972.32
35th Ave. NE to SR-5	$52.50	$32.95	$60,253.10	$75,918.91
		TOTALS	$144,175.90	$184,693.73
		GRAND TOTAL ALL RUBBER PAVEMENTS	$1,554,482.00	$2,546,400.00

Adjustment for inflation calculated from the Consumer Price Index for Seattle.

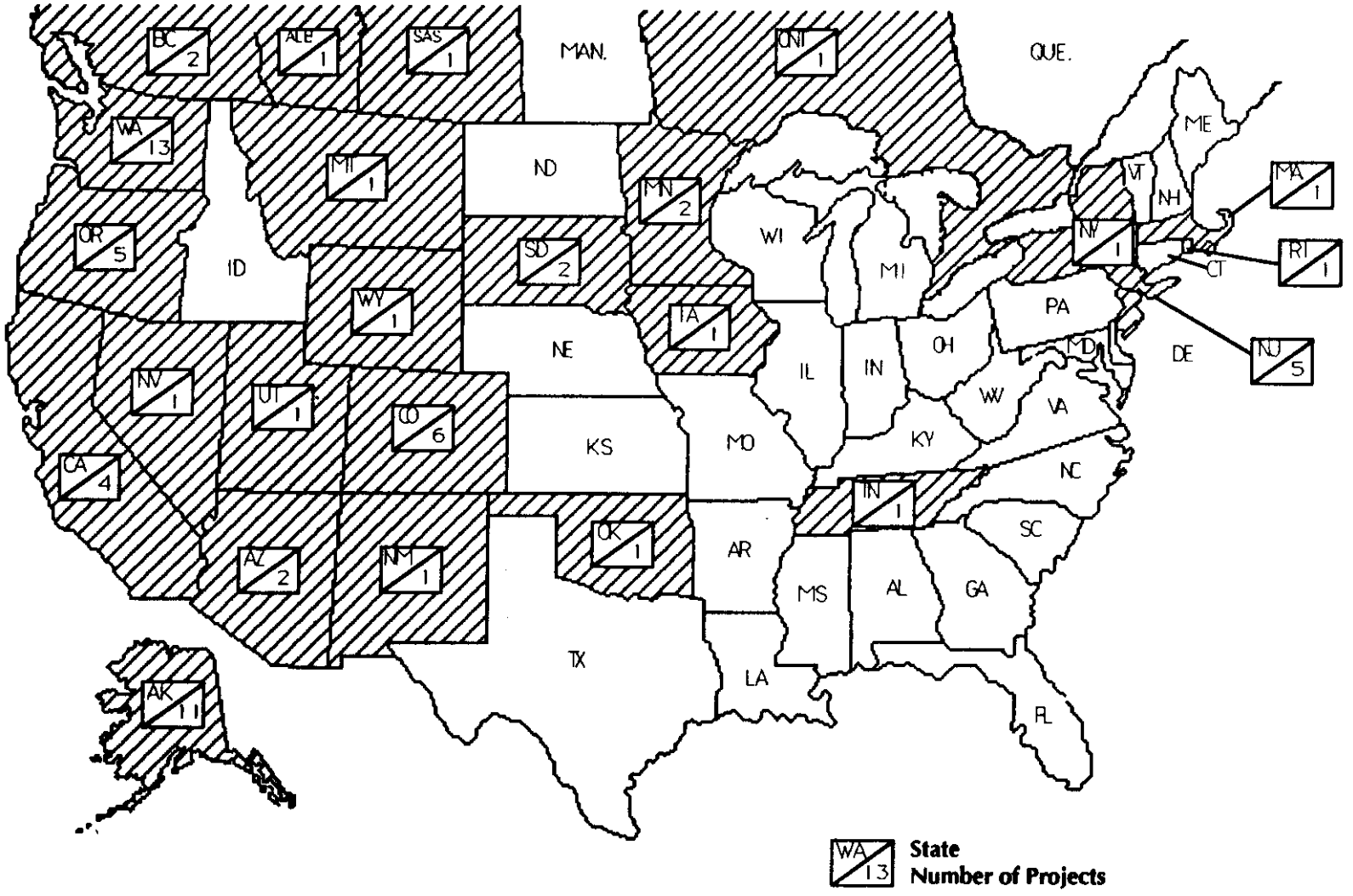
APPENDIX C.

PlusRide Projects throughout the U.S. and Canada

List provided by PaveTech Corporation

PlusRide Projects

October, 1991



PLUSRIDE PROJECTS
OCTOBER, 1991

Date	Project	Owner	Contractor	Tons
UNITED STATES				
Alaska				
1979	Carnation Road	DOT	Central Paving	90
1980	Old Seward HwY	DOT	Associated	1,700
1981	Peger Road	DOT	H & H Const	294
1981	Upper Huffman	DOT	Central Paving	690
1983	Lemon Road	DOT	Associated	2,279
1985	A.C. Couplet	DOT	Central Paving	3,206
1985	Richardson Hwy	DOT	Rogers & Babler	1,398
1985	New Seward Hwy	DOT	Wilder Const	1,384
1986	Minnesota Ave	DOT	Eastwind	6,065
1986	Airport Way	DOT	Earth Movers	14,114
1986	A/C Couplett	DOT	Central Paving	1,829
11	Alaska Projects and		33,049 Tons	
Arizona				
1985	Arizona 260	DOT	Corn Const	2,240
1985	Hwy. 97	DOT	Industrial Asph	1,685
2	Arizona Projects and		3,925 Tons	
California				
1983	Susanville	Caltrans	Frank W. Pozer	7,263
1988	I-40 Needles	Caltrans	Desert Const	2,446
1988	I-80 Donner Pass	Caltrans	Telchert Aggreg	5,833
1991	Inyo County	Caltrans	Nikolaus & Niko	395
4	California Projects and		15,937 Tons	
Colorado				
1986	Arvada	Arvada	Asphalt Paving	1,195
1986	Aurora	Aurora	Western Paving	450
1986	Boulder Airport	Boulder Air	Flatiron Paving	2,480
1985	Lamar Airport	Lamar	McAtee Renquist	610
1986	Airport	Monte Vista	Anderson Const	2,409
1985	Peterson AFB	U.S. Air Force	Brod & Gibbon	955
6	Colorado Projects and		8,099 Tons	
Iowa				
1985	Des Monies	DOT	Grimes Asphalt	460
1	Iowa Projects and		460 Tons	

PLUSRIDE PROJECTS
OCTOBER, 1991

Date	Project	Owner	Contractor	Tons
Massachusetts				
1986	Brockton	DOT	Simoinoe Corp	3,052
1	Massachusetts Projects and		3,052 Tons	
Minnesota				
1984	St. Cloud	DOT	Bauerly Bros.	854
1984	Forest Lake	DOT	Ashbach Const	752
2	Minnesota Projects and		1,606 Tons	
Montana				
1983	MacDonald Pass	DOT	American Asphal	2,919
1	Montana Projects and		2,919 Tons	
Nevada				
1982	Verdi	DOT	Granite Const	1,778
1	Nevada Projects and		1,778 Tons	
New Jersey				
1984	Rt 41 Cherry Hill	DOT	Trap Rock Indus	605
1988	Newark Overlays	Newark	R.A. Hamilton	4,492
1990	Newark Overlays	Newark	Mt. Hope Rock	4,289
1991	Newark Repair	Newark	Mt. Hope Rock	1,350
4	New Jersey Projects and		10,736 Tons	
New Mexico				
1984	Chama	DOT	T. Brown Const	9,775
1	New Mexico Projects and		9,775 Tons	
New York				
1990	Albany	DOT	Associated	550
1983	JFK Bridge	Port of NY&NJ	Edenwald Const	68
2	New York Projects and		618 Tons	
Oklahoma				
1982	Seiling	DOT	Broce Const	2,570
1	Oklahoma Projects and		2,570 Tons	

PLUSRIDE PROJECTS
OCTOBER, 1991

Date	Project	Owner	Contractor	Tons
Oregon				
1987	Springhill Ovly.	Benton County	Morse Bros	4,096
1988	26462-01-88 Ovly.	Benton County	Morse Bros	1,545
1990	Overlays	Benton County	Central Paving	1,213
1986	Corvallis	Corvallis	Morse Bros	3,103
1985	Lava Butte	DOT	R.L. Coats	656
5	Oregon	Projects and	10,613	Tons
Rhode Island				
1987	So. Country Trail	DOT	Tilcon Gammino	565
1	Rhode Island	Projects and	565	Tons
South Dakota				
1982	St. Patrick IC	DOT	J. E. Simon Co	441
1	South Dakota	Projects and	441	Tons
Tennessee				
1981	Tellico Plains	FHWA	Harrison Const	494
1	Tennessee	Projects and	494	Tons
Utah				
1984	Strawberry	DOT	Staker Paving	3,839
1	Utah	Projects and	3,839	Tons
Washington				
1982	118th Street	Bellevue	Hi-Line Asphalt	200
1983	Bellevue Streets	Bellevue	Watson Asphalt	795
1984	Bellevue Streets	Bellevue	Watson Asphalt	2,724
1986	Bellevue Streets	Bellevue	Watson Asphalt	4,086
1982	Union Gap	DOT	Yakima Asphalt	494
1982	Yakima R. Bridge	DOT	Yakima Asphalt	465
1982	Auburn Interchange	DOT	Lakeside Indust	465
1984	405 Renton S Curve	DOT	Hi-Line Asphalt	334
1985	Fauntleroy Ferry	DOT	M.A. Segale	561
1985	Dahlgren Rd	DOT	Associated	651
1982	Mt. St. Helens	DOT/FHWA	Morrill Asphalt	2,570
1986	Sand Point Way	Seattle	Watson	1,274
1985	Northgate P&R Lot	Seattle Metro	Hi-Line Asphalt	269
13	Washington	Projects and	14,888	Tons

PLUSRIDE PROJECTS
OCTOBER, 1991

Date	Project	Owner	Contractor	Tons
Wyoming				
1985	Rawlins Airport	Rawlins	McMurry Bros	5,619
1	Wyoming	Projects and	5,619 Tons	
60	UNITED STATES	Projects and	130,983 Tons	
CANADA				
Alberta				
1985	Edson	Alberta Trans	PCL Road Const	594
1	Alberta	Projects and	594 Tons	
British Columbia				
1982	B.C. Ferry Dock	B.C. Transport	Island Asphalt	19
1981	Victoria Streets	Victoria	Island Asphalt	1,522
2	British Columbia	Projects and	1,541 Tons	
Ontario				
1990	Toronto	Ontario Prov.	Meyer Const	860
1	Ontario	Projects and	860 Tons	
Saskatoon				
1986	Regina Hwy	Alberta Trans	Ramsay Asphalt	1,800
1	Saskatoon	Projects and	1,800 Tons	
5	CANADA	Projects and	4,795 Tons	

65	PROJECTS TOTALING	135,778	TONS
AVERAGE	2,089	TONS	
MAXIMUM	14,114	TONS	
MINIMUM	19	TONS	
85%	PROJECTS LESS THAN	1,500	TONS
94%	CONTRACTORS DID	1	PROJECT
75%	OWNERS DID	1	PROJECT
19	STATES IN U.S.	4	PROV. IN CANADA

APPENDIX D.

END of PROJECT REPORT

22nd St. to Little Hoquiam Br. & Riverside Br. 101/125E

Washington State Department of Transportation

Intra-Departmental Communication

RECEIVED
DEC 19 1991
[illegible]

Date: December 18, 1991

From: John L. Hart
325-9352

Subject: Contract 3913 SR 101
22nd Street to Little Hoquiam
Rv Br & Riverside Br 101/125E
F - 101 (117)

THRU: Dennis Jackson / Jim Brosio

To: R. G. Finkle / Newt Jackson

RE: ACP with Asphalt-Rubber Binder

This year we were the Project Engineer's Office for Contract 3919, 22nd Street to Little Hoquiam River Bridge. This contract included a 0.06' overlay with rubberized ACP Class D.

In summary the final product was excellent. The mix was easily handled and put down. The surface is quiet, self healing, and exhibits the other qualities of a good Class D overlay.

While the end product is what we paid for, we came very close to not getting specification mix. The problems were in three (3) areas: scheduling, equipment reliability, and the subcontractor's personnel.

The equipment was mobilized and set up the night before production. There was no time for problem solving and correcting deficiencies. Also, the equipment was not per the spec's. If the paving schedule had not been so critical, the operation would have been shut down. The Special Provision should be amended to:

1. Require the submittal of information on the Contractor's equipment and key personnel for approval. Our specifications for drilled shafts include this requirement. More than anything else, it gives the State the chance to come up to speed on how the Contractor intends to perform an unusual or specialized task. It also allows the Engineer to catch equipment not suitable for the task when there is still time to make changes.

2. Require mobilization a minimum of two (2) days prior to production to allow for problem solving.

The equipment used by our subcontractor, Eagle Crest, for producing the rubber-asphalt was out of spec, unreliable, and noticeably outdated. Flow meters did not read in gallons and were unreliable. Apparently they could not tolerate negative pressure on the pump intake.

Calibration of the flow meters should be required by the spec's. The specification should also require the flow meter to account for air pockets in the intake line.

One temperature gauge was faulty resulting in a low mixing temperature. Thermometers should also be calibrated or redundancy provided.

Oil transfer lines were not jacketed and froze up each night. Obviously, they should be jacketed. They used the batch plant's pump which was not designed for rubber-asphalt, causing breakdowns, low production rates, and necessitated replacing the pump after this job. State of the art set ups provide a separate pump compatible with the batch plant to avoid damaging the plant's pump.

Personnel setting up and operating the equipment did not appear to understand how to attain the proper mix ratios. They were unable to tell us how to adjust the mix ratio, gallons asphalt to pounds rubber, for different oil temperatures. Because of their incompetence and the critical time frame, we were forced to direct the mixing to assure specification rubber-asphalt.

Field testing of this material should be limited to:

Wet sieve and SE on the mineral aggregate with the sample taken from the cold feed.

Rubber-asphalt content from production (batch weights)

Extractions on this material gave inconsistent results on the 200 minus.

The total Class D Rubberized mix produced was 2,806.00 tons.

The total amount of rubber used 42.32 tons
16.0% total binder

The total amount of extender used 2.57 tons
0.97% total binder

The total amount of AR2000W used 219.35 tons

The total binder 264.24 / 2806 total mix = 9.4%

Street inspection:

Asphalt (CRS2) for tack coat was applied at an overall rate of .126 gals. per square yard. This amount worked well, but appeared excessive and the Contractor received many calls about tack on vehicles.

It was noted at the start of paving that clean rollers must be maintained to keep asphalt from adhering to the rollers. The rollers used had vibratory capabilities but any attempt to use vibratory resulted in the asphalt sticking to the roller drums.

Also critical to the roller pattern is the mix temperature behind the paver. Too hot or too soon after laydown and the mix adheres to the roller drums. The roller pattern was set at three (3) passes. (See attached notes from the density inspector)

Before paving, all lane edges were laid out by the survey crew, this helped the paving crew to place all meet lines at the lane edges. This and the Contractor's desire to provide a quality product resulted in a smooth driving surface that the Contractor and the State can be proud of.

If you have additional questions, feel free to call Neal Campbell at SCAN 325-9352.

JLH/NJC
jrm
acprub

Attachments

cc: Lakeside Industries

Contract 3913
22nd Street to Little
Hoquiam River Bridge
#F - 101 (117)

There were two (2) roller patterns tried on the Rubberized ACP Class D with the nuke gauge on a depth of +/- 0.07'.

On the first roller pattern all passes were non-vibratory (gauge readings: 129.4, 132.9, 136.6, and 135.6).

The second roller pattern was done with one (1) vibratory pass and three (3) static passes (gauge readings: IV - 135.4, IV 1S - 138.0, IV 2S - 139.6, and IV 3S - 136.2).

When the roller was in the vibratory mode it tore up the matte the same as it did if the roller did not stay far enough behind the paver.

JLH/KR
jrm
rollpat

Washington State Department of Transportation
District 3
Office of Project Engineer
4801 Olympic Highway
Aberdeen, Washington 98520
206-533-9352
FAX 533-9449

Duane Berentson
Secretary of Transportation

November 18, 1991

Lakeside Industries, Inc.
P O Box 928
Aberdeen, WA 98520

Contract 3913 SR 101
22nd Street to Little Hoquiam
River Bridge and Riverside
Bridge 101/125 E
F - 101 (117)

Gentlemen:

Per your subcontractor's request we have filled out his "Asphalt Rubber Evaluation" for the above referenced project.

Please note our concerns and feel free to add any of your own.

Sincerely yours,

JOHN L. HART, P.E.
Project Engineer

cc: Jim Brosio w/attach.

JLH/NJC
jrm
asrubev

Attachments

Asphalt-Rubber Evaluation

Project Contract 3913 - 22nd St. to Little Hog. Rv Br

Project Type ACP overlay

Location SR 101 - MP 86.75 to MP 88.94

Size In 12' Lane Miles 8.3

Year & Month 09-12-91 to 09-14-91

Asphalt-Rubber Mix

% Rubber		16% of binder
Rubber Gradation		9% oil & Rubber
	16	(See mix design on Pg. 3)
	30	
	50	
	80	
	100	
	200	
Extender Oil %		1%
Kerosene %		0
Mixing Temperature		350%
Viscosity		
Time Temperature Data		

Any additive beyond rubber such as polymer.
Anti-strip Agent PBS

Type of Application

SAM	
SAMI	
Membrane Liner	

Asphalt-Rubber Hot Mix

Open	X
Gap	
Dense	
Thickness Placed	.06 to .10

Road Type

Concrete	
Asphalt	X
Other	

Surface Condition

Oxidized or Dry	
Preleveled ~~Raveled~~	X
Open	
Bleeding	

Crack Type & Percentage	Type	Percentage
Transverse		
Longitudinal		
Block		
Shrinkage		
Alligator		

Climate General

Warm ~~Hot~~ Dry	X
Hot Wet	
Cold Dry	
Cold Wet	

Detailed climate condition during construction

Dry temperature 50° to 70°

Mostly sunny conditions.

Mix Design Data

Type of Aggregate	
Limestone	
River Agg	H 107
Granite	
Sandstone	
Trap Rock	
Lightweight	
Shells	
Other	

Aggregate Gradation

Sieve Size	Mix Design % Passing
1 1/2"	
1"	
1/2	100
3/8	99
#4	45
#8	12
#30	
#200	2.5

SAM OR SAMI Precoating

% Asphalt _____

Type Asphalt _____

Temperature of Precoating _____ °F

Mix Properties

Air Void (SEE ATTACHED

Aggregate Voids TEST REPORTS)

Marshall Stability _____

Hveem Stability _____

Flow _____

Mix Temp _____

Unit Weight _____

Densities

Required None Required %

Obtained _____ %

Problems:

Equipment was not reliable.

1. Flow meters did not meet specs.
   a. Did not read gallons
   b. Were unreliable. Apparently could not tolerate negative pressure on intake.
2. Temperature gauge was faulty resulting in low mixing temperature. No redundant temperature gauge.
3. Oil transfer lines were not jacketed and froze up each night.
4. Utilized batch plant pump not designed for rubber ACP. This caused breakdowns.

Equipment was mobilized and set up the night before production. There was no time for solving problems. If the paving schedule had not been so critical the operation would have been shut down.

Personnel setting up and operating the system seemed unconcerned about problems and forced the State personnel to solve their problems.

Recommended Solutions:

Equipment was noticeably out-dated. Upgrade to state of the art. Provide separate pump to batch plant.

Mobilize two (2) days ahead of production.

Bring in a professional to set up equipment and oversee initial production.

Additional Comments:

We are more than happy with the final product. The Rubber ACP was easy to put down and handle. We will probably have to modify the specification to prevent the problems from reoccurring.

WASHINGTON STATE DEP/ ENT OF TRANSPORTATION - ERIALS LABORATORY
PO BOX 167 OLYMPIA / 1655 S 2ND AVE TUMWATER / WA 98504

BITUMINOUS SECTION TEST REPORT — WORK ORDER NO: 003913
TEST OF: ...{ D } RUBBER — LAB ID NO: 0000017183
DATE SAMPLED: 09/12/91 — TRANSMITTAL No: 15739
DATE RECVD HQS: 09/25/91 — BITMIX LAB NO: B911401
SR NO: 101 COUNTY: — BID ITEM NO:
SECTION: 22ND ST. TO LITTLE HOQUIAM RIVER BR. & RIVERSIDE B
Pit Number : H-107
Field Number: 1 *IAS*

INDEP. ASSUR. SAMPLE

SIEVES	PERCENT PASSING HEADQUARTERS	FIELD	DISTRICT	SPECIFICATIONS
---				---
---				---
---				---
---				---
1/2	100	100	100	100
3/8	98	98	98	97-100
4	46	43	45	30-50
8	17	14	17	5-15
200	2.0	1.7	3.8	2-5
ASPH %	7.4	9	8.0	

TESTS		RESULTS	RECOMMENDATIONS
Stabilometer	:	27	---
Max. Density (Rice)	: TESTED	159.3	
Bulk Density	:	146.3	---
% Voids	:	8.2	---

RECEIVED
OCT 11 1991

DISTRIBUTION

Mat. File_____x General File_____x
Project Engineer:
JOHN L. HART x(2)
Dist Administrator_3___x
Dist. Mat'l. Engr._3___x
Const. Engr._____x
Q.C._____x
T171-1
T155-1
T157-1

COMMENTS

FIELD ASPH PERCENT IS AVG FROM PRODUCTION.

Rodney G. Finkle, P.E.
Materials Engineer
By: James P. Walter, P.E. [ ]
Date:10/07/91 (206) 753-7107
Scan 234-7107

WASHINGTON STATE DEP. .MENT OF TRANSPORTATION - . .TERIALS LABORATORY
PO BOX 167 OLYMPIA / 1655 S 2ND AVE TUMWATER / WA 98504

BITUMINOUS SECTION TEST REPORT — WORK ORDER NO: 003913
TEST OF: ...{ D } RUBBER — LAB ID NO: 0000016789
DATE SAMPLED: 09/13/91 — TRANSMITTAL No: 118848
DATE RECVD HQS: 09/19/91 — BITMIX LAB NO: B911336
SR NO: 101 COUNTY: — BID ITEM NO:
SECTION: 22ND ST. TO LITTLE HOQUIAM RIVER BR. & RIVERSIDE B
Pit Number : H-107
Field Number: 3

SIEVES	PERCENT PASSING HEADQUARTERS	PERCENT PASSING FIELD	SPECIFICATIONS
---			---

---			---
1/2	100	100	100
3/8	[illegible]	98	90-100
#4	30	29	30-50
8	6	5	5-15
200	1.0	4.0	2-5
ASPH %	7.0	8.9	

TESTS		RESULTS	RECOMMENDATIONS
Stabilometer	:	27	---
Max. Density (Rice)	: TESTED	154.8	
Bulk Density	:	147.9	---
% Voids	:	4.4	---
Lottman Stripping	:	NONE	Pass
140 F. Visc. (Poise)	:	3889	---

RECEIVED
OCT 11 1991

DISTRIBUTION — COMMENTS

Mat. File_____x General File_____x
Project Engineer:
JOHN L. HART x(2)
Dist Administrator_3___x
Dist. Mat'l. Engr._3___x
Const. Engr._____x

T171-1 — T156-1 — T133-1 —
T155-1 —
T149-1 — T167-1 —

D-11

Rodney G. Finkle, P.E.
Materials Engineer
By: James P. Walter, P.E. [ ]
Date: 10/03/91 (206) 753-7107
Scan 234-7107

APPENDIX E.

PROPOSED GENERAL SPECIAL PROVISION FOR RECYCLED GLASS (MIXED WASTE CULLET) IN BASE AGGREGATES

DRAFT

PROPOSED GSP

Recycled Glass (Mixed Waste Cullet) Additive to Aggregates

Aggregate base shall conform to the provisions in Section 9-03 of the Standard Specifications and these Special Provisions. Aggregate base blended with reclaimed glass may be processed and used as:

9-03.9(1)	Ballast
9-03.9(2)	Shoulder Ballast
9-03.9(3)	Crushed Surfacing Base Course
9-03.10	Aggregate for Gravel Base
9-03.12(1)A	Gravel Backfill for Foundations, Class A
9-03.12(1)B	Gravel Backfill for Foundations, Class B
9-03.12(2)	Gravel Backfill for Walls
9-03.12(3)	Gravel Backfill for Pipe Bedding
9-03.12(4)	Gravel Backfill for Drains
9-03.13	Backfill for Sand Drains
9-03.13(1)	Sand Drainage Blanket
9-03.14	Gravel Borrow
9-03.15	Bedding Material for Rigid Pipe
9-03.16	Bedding Material for Flexible Pipe
9-03.17	Foundation Material Class A and B
9-03.18	Foundation Material Class C
9-03.19	Bank Run Gravel for Trench Backfill

Blended material must conform to all specifications in Section 9-03 for these items except that the Los Angeles Wear requirement for Ballast, Shoulder Ballast and Crushed Surfacing Base Course is waived.

These blended materials shall not be used within 1 foot of finished grade under the traveled lanes of a roadway.

No more than 15% of a blended material shall consist of reclaimed glass. When tested as a mixture, no more than 10% of the material retained on a specified sieve 1/4 inch or larger shall be glass, based upon visual examination and weight.

APPENDIX F.

WSDOT's NEW PRODUCTS EVALUATION PROCEDURE

and

THE FHWA EXPERIMENTAL FEATURES PROGRAM

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION NEW PRODUCTS EVALUATION PROCEDURE

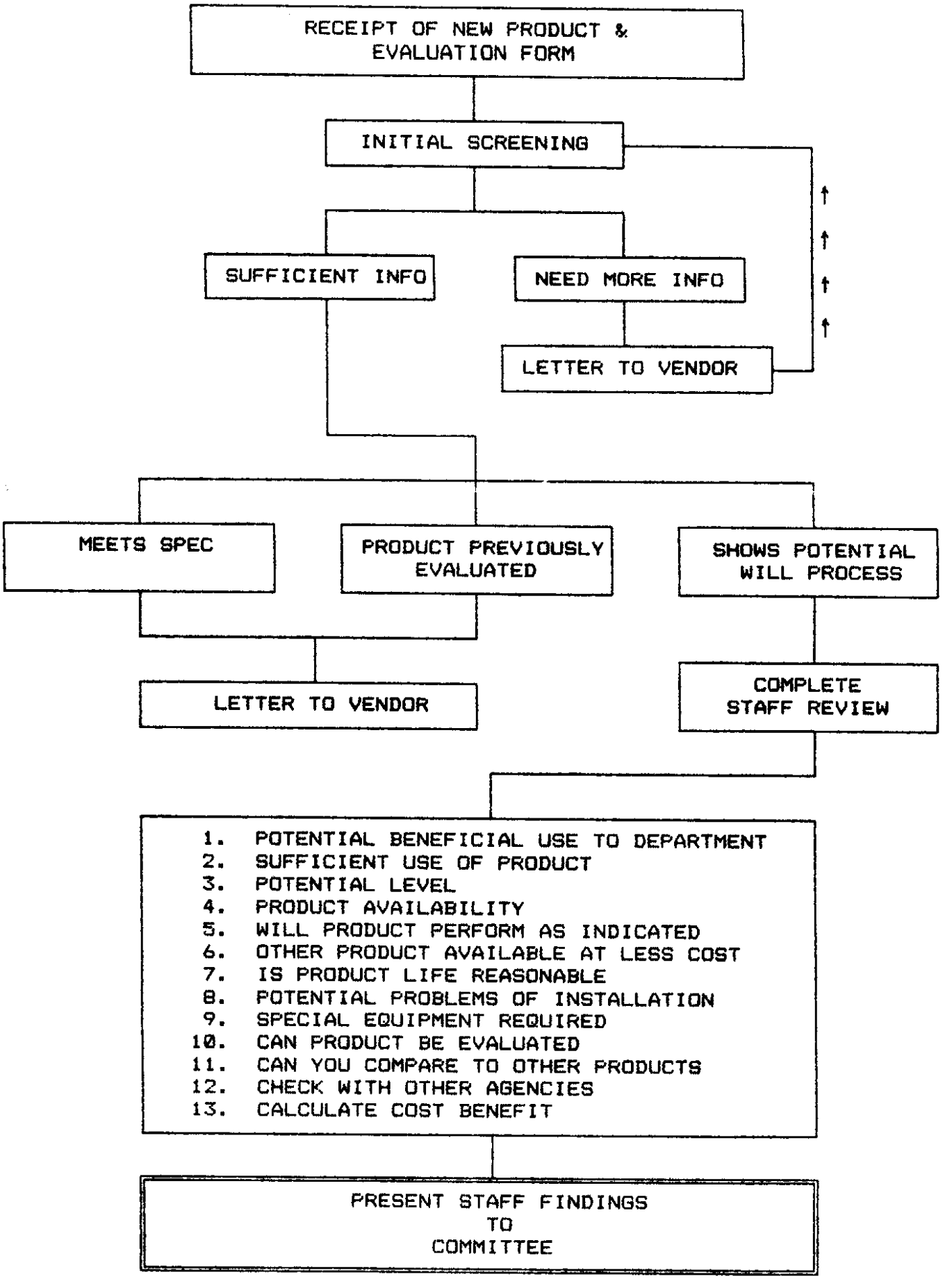
WSDOT
NEW PRODUCTS EVALUATION COMMITTEE

ASSISTANT SECRETARY - OPERATIONS (Chairman)
MATERIALS ENGINEER (Secretary)

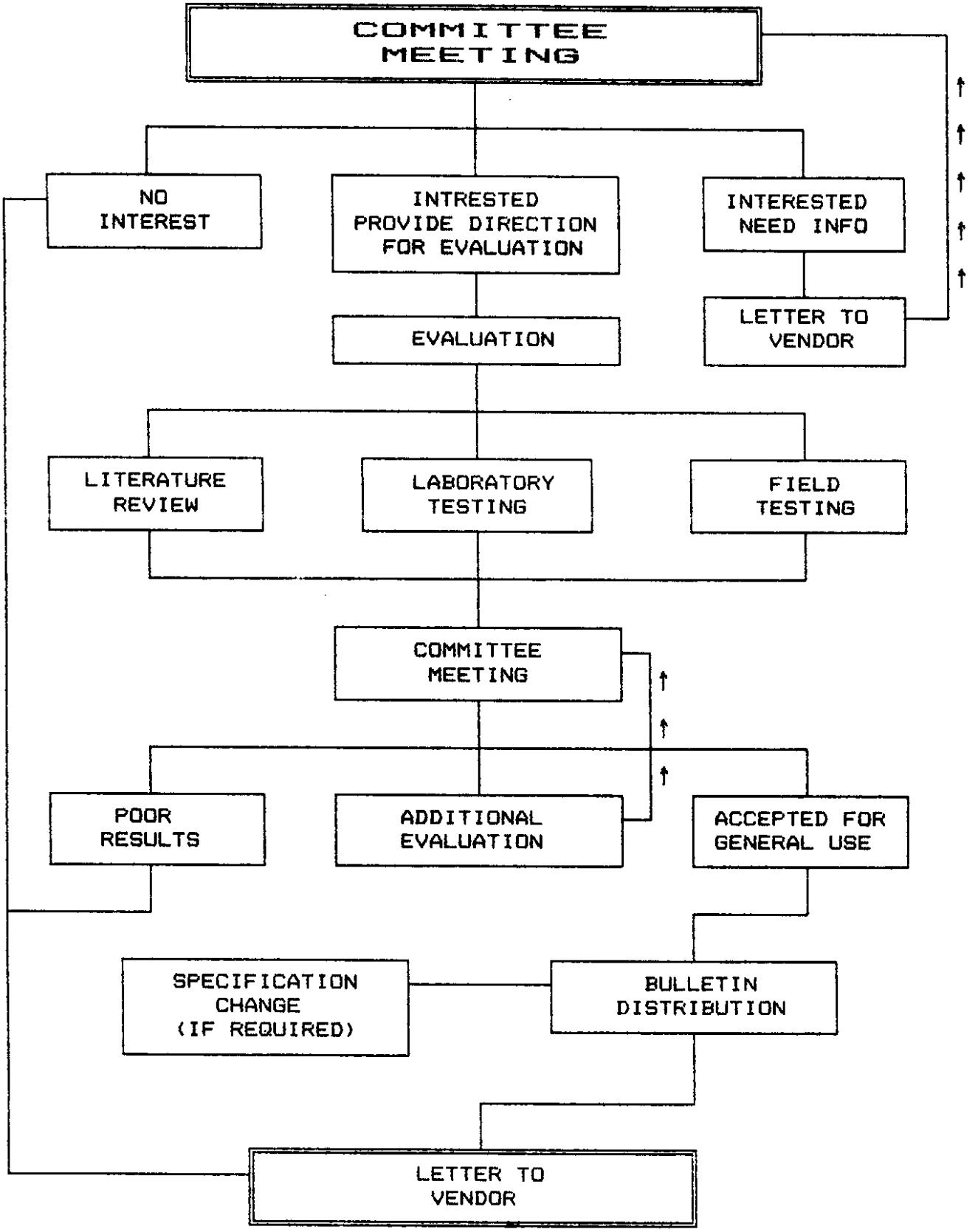
DESIGN ENGINEER
TRAFFIC ENGINEER
BRIDGE & STRUCTURES ENGINEER
RESEARCH DIRECTOR
CHIEF MAINTENANCE ENGINEER
DISTRICT PROJECT DEVELOPMENT ENGR.

SPECIAL PROJECTS MANAGER (Staff Support)

TECHNICAL EXPERTS AS NEEDED


RECEIPT OF NEW PRODUCT & EVALUATION FORM
INITIAL SCREENING
SUFFICIENT INFO
NEED MORE INFO
LETTER TO VENDOR
MEETS SPEC
PRODUCT PREVIOUSLY EVALUATED
SHOWS POTENTIAL WILL PROCESS
LETTER TO VENDOR
COMPLETE STAFF REVIEW
1. POTENTIAL BENEFICIAL USE TO DEPARTMENT
2. SUFFICIENT USE OF PRODUCT
3. POTENTIAL LEVEL
4. PRODUCT AVAILABILITY
5. WILL PRODUCT PERFORM AS INDICATED
6. OTHER PRODUCT AVAILABLE AT LESS COST
7. IS PRODUCT LIFE REASONABLE
8. POTENTIAL PROBLEMS OF INSTALLATION
9. SPECIAL EQUIPMENT REQUIRED
10. CAN PRODUCT BE EVALUATED
11. CAN YOU COMPARE TO OTHER PRODUCTS
12. CHECK WITH OTHER AGENCIES
13. CALCULATE COST BENEFIT
PRESENT STAFF FINDINGS TO COMMITTEE

FORM NP1


COMMITTEE MEETING
NO INTEREST
INTRESTED PROVIDE DIRECTION FOR EVALUATION
INTERESTED NEED INFO
LETTER TO VENDOR
EVALUATION
LITERATURE REVIEW
LABORATORY TESTING
FIELD TESTING
COMMITTEE MEETING
POOR RESULTS
ADDITIONAL EVALUATION
ACCEPTED FOR GENERAL USE
SPECIFICATION CHANGE (IF REQUIRED)
BULLETIN DISTRIBUTION
LETTER TO VENDOR

FORM NP2

NEW PRODUCT EVALUATION PROCEDURE

1. Receipt of new product evaluation form by the Materials Engineer.

2. The Materials Engineer will acknowledge receipt of the form, review the submitted information, and conduct an initial screening of the product.

   A. Acknowledgment review will indicate:

      1. The date the form was received.
      2. Whether sufficient information has or has not been supplied by the vendor.

   B. Based on the initial review, the product will be placed in one of the following:

      1. Whether the product meets Section _____ of the WSDOT specifications.

         Note: If it does meet our specifications, then the course of action by the vendor is to propose use of the product to a contractor.
      2. The product shows potential and will be processed through the initial screening process.
      3. The product has been submitted previously and is now being evaluated.
      4. The product has been submitted previously and will not be considered at this time.

C. Initial screening for product considered to have potential (Category 3, above) will consist of providing answers to the following. This will be done by lab staff and/or department staff.

1. Does the product have a potential beneficial use to the department?
2. Is there sufficient use of the product to warrant evaluation
3. What is the potential level of use?
   a. Very limited.
   b. Low.
   c. Medium.
   d. High.
4. Is the product readily available? If not, does it appear the product has the potential to be available in the quantities needed?
5. Is the product likely to perform as the supplier indicates?
6. Are there other products available at less cost that will perform the same function?
7. Does it appear the product's life is reasonable?
8. Are there potential problems with the installation of the product?
9. Is special equipment needed to install the product? If so, is the equipment available to local contractors?
10. Can the product be evaluated? If yes, consider how,

what problems exist and the cost.

11. If possible, compare the product to other products.
12. Check with other agencies or contacts listed on the form for input on their experience.
13. If possible, calculate life cycle cost or cost benefit.

3. First committee action: Present the findings of the review and of the initial screening if conducted by lab staff.

   A. Committee agrees with the findings of lab staff to not consider the product. A letter is sent to the vendor explaining the reasons for no interest.

   B. Committee disagrees with the findings of lab staff to not consider the product and requests more information in order to decide on the course of action.

   C. Committee reviews the information on the products recommended by the lab staff for evaluation and provides direction on the level of interest and the appropriate level of evaluation.

   D. Committee is interested in additional information and requests a more detailed presentation by appropriate Department staff and/or the supplier.

4. Formal evaluation: This will depend on the product and the potential level of use and will consist of one or all of the

following based on Committee direction.

A. Literature review.

B. Lab testing.

C. Field testing.

Note: The committee will have to set priorities based on the available funding and FTE's. It may be appropriate in the case of a large scale effort to refer the evaluation to the research program.

5. Second Committee action: Review the results of the evaluation and decide on the appropriate action from the following:

A. Not to consider further.

B. Proceed to more detailed analysis.

C. Accept on a trial basis.

D. Accept for general use.

PROCEDUR

Introduction

WSDOT participates in the FHWA program that includes experimental, demonstration, implementation, and administrative projects. Exhibit 4-A overviews the characteristics of these programs.

Responsibility

Federal Programs Management is responsible to Program Management for coordinating the Department's participation in the various projects available under the program. This requires Federal Programs Management to work closely with Program Management, Project Management, WSDOT office managers, Principal Investigators, FHWA, and other personnel involved with the projects.

Procedures for Federal Programs Management

Experimental Features

1. **Description:** The experimental features program is sponsored by FHWA to allow state highway/transportation departments to innovatively use new materials, processes, methods, etc., with a relatively low investment and with a minimum of preconstruction planning. An experimental feature is defined as a material, process, method, equipment item, traffic operation device, or other feature that meets the following criteria:

   a. **Has not been sufficiently tested** under actual service conditions to merit acceptance, without reservation, for normal transportation construction; or

   b. **Has already been accepted but** includes alternate acceptable features which need testing to determine their relative merits under comparable conditions.

   Experimental features are incorporated into federal aid highway construction projects to determine the suitability of the features as regular construction items. Exhibit 4-B shows the process by which WSDOT participates in the experimental feature program.

2. **Initiation:** Headquarters or Districts originate an experimental features project by deciding to construct, install, or otherwise incorporate an experimental feature into an existing construction contract. The initiating District or Headquarters office notifies Program Management of its intent to develop such a project.

3. **Work Plan Development:** Federal Programs Management works with the District or Division office manager to develop a work plan for the proposed experimental feature. Work plan elements are identified in Exhibit 4-C.

4. **Assignment of Responsibility:** The District or Division office submits a standard form "Research Project Letter of Understanding" (Exhibit 6-G) with the work plan to Program Management. This agreement outlines the responsibilities of each office involved in the evaluation of the experimental feature.

5. **Work Plan Approval:** Program Management approves the work plan.

6. **Notification:** Federal Programs Management submits the work plan to FHWA for approval and notifies the Highway Project Development Office that an experimental feature will be incorporated into a particular construction contract. FHWA will not approve plans, specifications, or estimates (PS&E) for a project that incorporates an experimental feature until a work plan is submitted and approved. Federal Programs Management notifies Program Management and Implementation Management of FHWA's approval.

7. **Funding:** Construction project funds are used for incorporating an experimental feature into a Federal Aid highway construction project.

8. **Inspections and Reports:** The Principal Investigator is responsible for all inspections and reporting during the active phase of the experimental features project. Reports specified in the work plan and the annual experimental project report form FHWA 1461 (Exhibit 4-D) are submitted to Federal Programs Management.

9. **Annual Report:** Each year Federal Programs Management notifies all Principal Investigators that an annual experimental project report is due. Federal Programs Management reviews all reports before submitting the information to FHWA.

10. **Terminations and Extensions:** Federal Programs Management may request the FHWA Division Administrator to terminate a project if it becomes evident that no additional valuable information is likely to develop. The FHWA may also terminate a project for this reason or for failure to submit a final report. FHWA approval is required for project time -extensions.

11. **Implementation:** The final reports of all experimental features projects are reviewed by Program Management for the appropriate implementation action. (Reference: Section 5 Implementation Management).

Federal Programs Characteristics

Type of Project	Project Origin	Guide Work Plan Provided	Project Approval Level (FHWA)	Funds Provided for Construction	Funds Provided for Evaluation	Reporting Requirements
Experimental Feature	WSDOT	No	Regional Office	No*	No**	• Post-Construction • Annual • Final
Experimental Project	FHWA	Yes	Headquarters Office, Wash., DC	No*	Yes	• Post-Construction • Annual • Final
Demonstration Project	FHWA	No	Headquarters Office, Wash., DC	Yes (Limited)	Yes	• Post-Construction • Annual (or as specified) • Final
Implementation Project	FHWA	Yes	Headquarters Office, Wash., DC	Yes (Total)	Yes (Total)	• Quarterly • Others specified in contract
Administrative Contracts	FHWA	Yes	Headquarters Office, Wash., DC	Yes	Limited	• Quarterly • Others specified in contract

* Construction funded by WSDOT and FHWA using normal Federal-aid participation ratios.

** Evaluation funded from preliminary engineering or construction engineering funds from active Federal-aid project where the planned construction is similar and the performance of the completed work is related to the ongoing work.

Project Work Plan Elements

1. TITLE

   The title of the project and the type of project (i.e., implementation).

2. OBJECTIVES

   Statement of the objectives (i.e., desired results).

3. PROJECT DESCRIPTION

   a. Project location including location or contract numbers.

   b. Feature to be constructed.

   c. Reasons for selection of the particular type or brand of feature.

   d. Methods that will be used to construct the feature which differ from normal construction practices.

4. CONTROL SECTION

   A description of the control sections or other alternatives that are mandatory to provide for performance comparisons.

5. STAFFING

   The name and title of the Principal Investigator, and the names and positions of the individuals who will actualy monitor the projects, complete the required field inspections, and provide all reports, if other than the Principal Investigator.

6. TESTS AND OBSERVATIONS

   A description of the tests and observations that will be conducted to measure the performance of the feature as compared to the control section.

7. REPORTING

   A description of the required reports and the planned dates for their submission. An evaluation period of three years is usually specified, but longer evaluation periods may be specified if the feature's performance cannot be verified in a shorter period.

8. EQUIPMENT

   A list of the equipment that will be used in the evaluation of the project.

9. CONSTRUCTION COSTS

   The estimated cost of the project's construction.

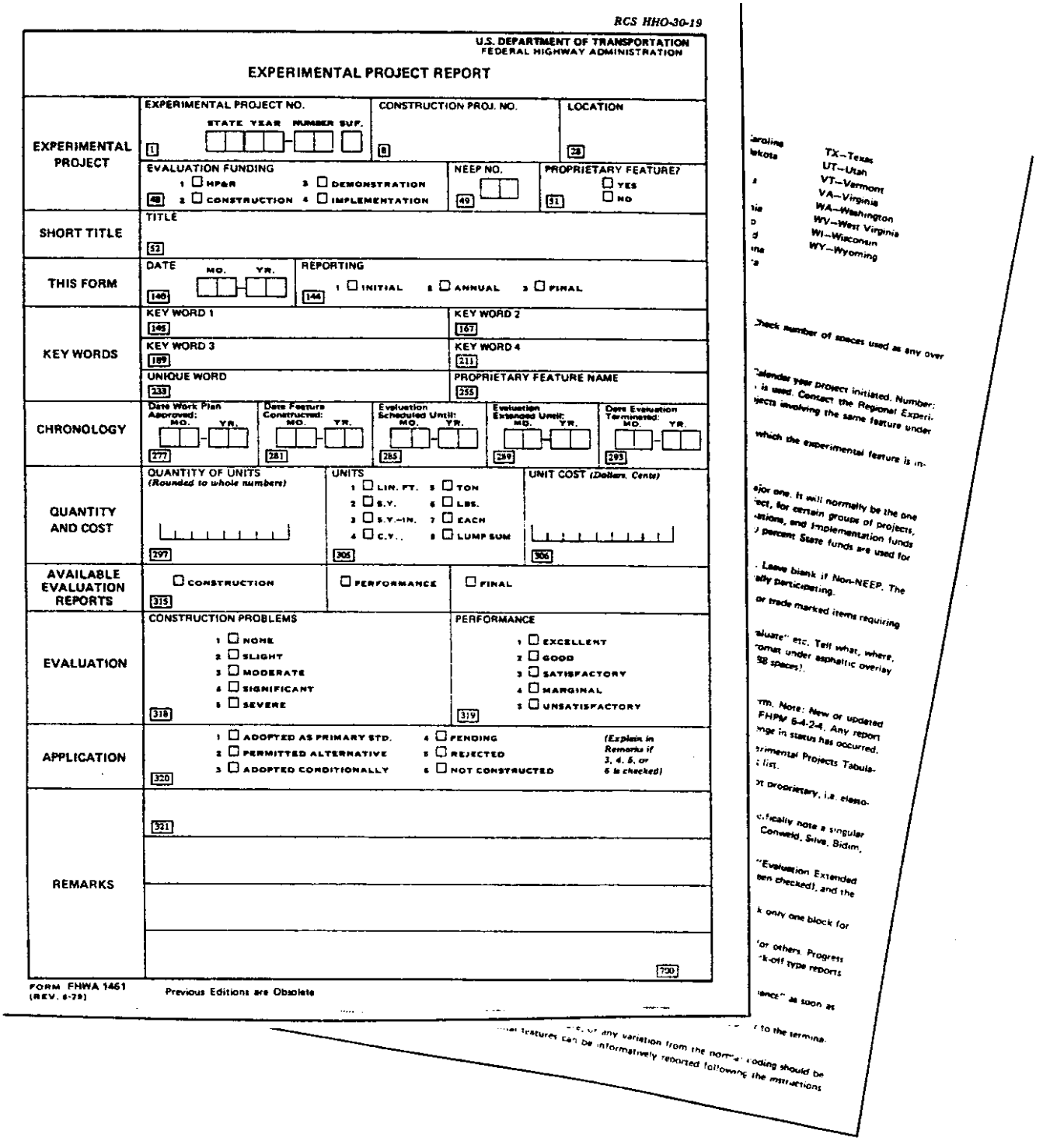
10. EVALUATION BUDGET

    A schedule of completion dates and a cost estimate for various testing phases of the project, including the source of funds.

11. DELIVERABLES

    A list of the deliverable items that will result from the project.

FHWA Form 1461



RCS HHO-30-19

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT
- EXPERIMENTAL PROJECT NO. [1] STATE YEAR NUMBER SUF.
- CONSTRUCTION PROJ. NO. [8]
- LOCATION [28]
- EVALUATION FUNDING [48]: 1 ☐ HP&R 2 ☐ CONSTRUCTION 3 ☐ DEMONSTRATION 4 ☐ IMPLEMENTATION
- NEEP NO. [49]
- PROPRIETARY FEATURE? [51]: ☐ YES ☐ NO

SHORT TITLE
- TITLE [52]

THIS FORM
- DATE [140] MO. YR.
- REPORTING [144]: 1 ☐ INITIAL 2 ☐ ANNUAL 3 ☐ FINAL

KEY WORDS
- KEY WORD 1 [165]
- KEY WORD 2 [167]
- KEY WORD 3 [189]
- KEY WORD 4 [211]
- UNIQUE WORD [233]
- PROPRIETARY FEATURE NAME [255]

CHRONOLOGY
- Date Work Plan Approved: MO. YR. [277]
- Date Feature Constructed: MO. YR. [281]
- Evaluation Scheduled Until: MO. YR. [285]
- Evaluation Extended Until: MO. YR. [289]
- Date Evaluation Terminated: MO. YR. [293]

QUANTITY AND COST
- QUANTITY OF UNITS *(Rounded to whole numbers)* [297]
- UNITS [305]: 1 ☐ LIN. FT. 2 ☐ S.Y. 3 ☐ S.Y.-IN. 4 ☐ C.Y. 5 ☐ TON 6 ☐ LBS. 7 ☐ EACH 8 ☐ LUMP SUM
- UNIT COST *(Dollars, Cents)* [306]

AVAILABLE EVALUATION REPORTS [315]
☐ CONSTRUCTION ☐ PERFORMANCE ☐ FINAL

EVALUATION
- CONSTRUCTION PROBLEMS [318]: 1 ☐ NONE 2 ☐ SLIGHT 3 ☐ MODERATE 4 ☐ SIGNIFICANT 5 ☐ SEVERE
- PERFORMANCE [319]: 1 ☐ EXCELLENT 2 ☐ GOOD 3 ☐ SATISFACTORY 4 ☐ MARGINAL 5 ☐ UNSATISFACTORY

APPLICATION [320]
1 ☐ ADOPTED AS PRIMARY STD. 2 ☐ PERMITTED ALTERNATIVE 3 ☐ ADOPTED CONDITIONALLY 4 ☐ PENDING 5 ☐ REJECTED 6 ☐ NOT CONSTRUCTED
(Explain in Remarks if 3, 4, 5, or 6 is checked)

REMARKS [321] [700]

FORM FHWA 1461 (REV. 6-79) Previous Editions are Obsolete

TX—Texas
UT—Utah
VT—Vermont
VA—Virginia
WA—Washington
WV—West Virginia
WI—Wisconsin
WY—Wyoming

WSDOT Research Procedures Manual Exhibit
January 1989

Research Project Letter of Understanding

RESEARCH PROJECT LETTER OF UNDERSTANDING

Project Name:

Description:

Work Items: The * will complete the following items on the above-named research project:

Products: The * will deliver the following products at the completion of this research project:

Funding: Manpower, Materials, Installation, Evaluation and Reporting Costs:

Principal Investigator:
Title:

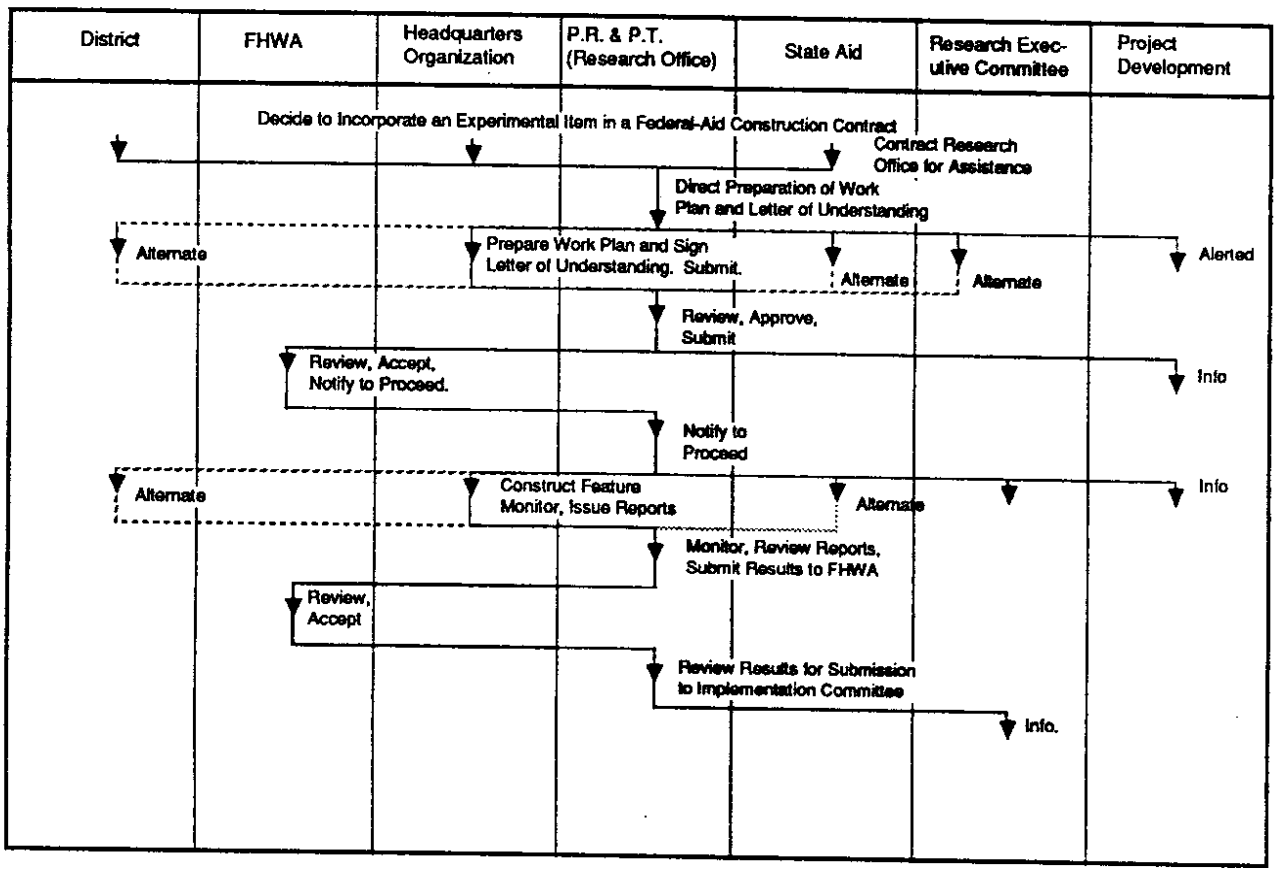
The Research Office will manage the project and provide liaison services with FHWA for all reports. The Research Office will complete any portion of this research project if the * fails to fulfill the work proposed and agreed to. The * will be billed for all costs incurred by the Research Office for completing the project.

Assistant Secretary, Planning, Research and Public Transportation	Assistant Secretary/ District Administrator
Research Director	Principal Investigator
Research Project Manager	

* Variable to be filled in at time of contract preparation.

WSDOT Research Procedures Manual Exhibit
January 1989

Experimental Features
WSDOT Source



WSDOT Research Procedures Manual Exhibit
January 1989

APPENDIX G.

SPECIFICATIONS FOR RECYCLED MATERIALS

Appendix G has not been reproduced for this report due to its size (190 pages). It can be made available upon written request to the following address:

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
RESEARCH OFFICE
TRANSPORTATION BUILDING
OLYMPIA WA 98504

Please ask for report number WA-RD 252.2.

APPENDIX H.

PROCUREMENT SPECIFICATIONS FOR COMPOST AND MULCH

PROCUREMENT SPECIFICATIONS FOR THE PHYSICAL PARAMETERS OF COMPOST AND MULCH*

COMPOST:

Compost (is) shall be a well decomposed, humus like, material derived from the aerobic decomposition of organic plant matter. The compost shall have an earthy odor, shall be free of viable weed seeds and other plant propagules (except airborne weed species**) and shall have a moisture content that has no visible free water or dust produced when handling the material.

** (weed seed test sample must be taken from the center of the pile)

And has the following physical criteria:

1. shall have maximum particle size of 1 inch;
2. shall pass a standard cress test for seed germination;
3. shall have a ph range between 5.0--8.5;
4. shall have a minimum organic matter of 30 percent;
5. shall have a maximum electrical conductivity of 10 mhos/cm.;
6. and shall not contain more than 2 percent foreign matter on a dry weight basis.

WOOD MULCH:

1. shall consist of woody material;
2. shall be ground so that a minimum of 95 percent of the material will pass through a 3-inch sieve and no more than 50 percent by loose volume, will pass through a 1/4-inch sieve;
3. shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life;
4. shall not contain any treated or painted woods;
5. and shall not contain more than 2 percent foreign matter, other than pieces of wood, on a dry weight basis.

*** The procurement specifications will be updated as necessary as new information becomes available.**

APPENDIX I. *

DATABASE OF RECYCLED MATERIALS SUPPLIERS AND VENDORS

* Special thanks to Mr. Ed Lowe, editor of the "OFFICIAL" Recycled Products Guide, who allowed us to use some of their listings for purposes of this study only.

Appendix I has not been reproduced for this report due to its size (174 pages). It can be made available upon written request to the following address:

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
RESEARCH OFFICE
TRANSPORTATION BUILDING
OLYMPIA WA 98504

Please ask for report number WA-RD 252.3.

APPENDIX J.

COMMENTS FROM RECYCLING COMMUNITY

WASHINGTON
STATE
RECYCLING
ASSOCIATION

COMMENTS FROM THE RECYCLING COMMUNITY REGARDING THE STUDY ON THE USE OF RECYCLED MATERIALS FOR PUBLIC HIGHWAYS

December 17, 1991

Prepared for:

STATE OF WASHINGTON
DEPARTMENT OF TRANSPORTATION

and

THE CLEAN WASHINGTON CENTER
DEPARTMENT OF TRADE AND ECONOMIC DEVELOPMENT

Meeting facilitated
&
comments recorded by:

WASHINGTON STATE RECYCLING ASSOCIATION

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Olympia, WA 98501

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MEETING MINUTES

1. Introduction of Participants. The participants in the hearing on the Washington State Department of Transportation (DOT) "Study on the Use of Recycled Materials for Public Highways" were introduced by:

Gregory Wright, Washington State Recycling Association

Representatives in attendance from the DOT who compiled the study were:

Jim Buss, Assistant Director of Operations
Newton Jackson, Pavement & Soils Engineer
Keith W. Anderson, Research Specialist

Formal comments participants were:

Dale Clark, Washington State Department of Ecology
Lauris Davis, U.S. Environmental Protection Agency
David Dougherty, Clean Washington Center, Washington State Department of Trade & Economic Development
Jeff Gage, Washington Organic Recycling Association
Jan Glick, Washington Citizens for Recycling
Rod Hansen, King County Solid Waste
Ray Hoffman, City of Seattle
Don Kneass, Waste Management
Brian McMorrow, Washington State Legislative Transportation Committee
Gary Wilburn, Washington State Senate Environment & Natural Resources Committee

2. Opening Comments:

David Dougherty
Jim Buss

3. Presentation of Study Findings:

Newton Jackson

4. Summary of Formal Comments. The following is a summary of the verbal recommendations made on the Study compiled from the comments of those who had been invited to make formal comment to the DOT:

* Consider that statutory authority to state government gives up to a 10% preference for recycled content material.

* Outline what DOT is doing and develop a vision of what DOT can do. Include what is working, what areas promise to be most fruitful in the future, and what will be necessary to meet the new federal regulations.

* Rethink the philosophy and direction of the DOT keeping in mind the concepts of "closed loop recycling" and of "avoided solid waste disposal costs."

* Meet the intent of SB 5143 by incorporating into the study the intent which is to target procurement policies and goals towards those recycled products for which there are significant market development needs, to develop strategies to increase recycled product purchases and to develop specific goals for the procurement of these recycled products so that the DOT may substantially contribute to solutions to the state waste management problems.

* Recognize that allocating a significant portion of DOT's budget and/or tonnage of materials will have a significant impact on solving the state's solid waste management problems without adversely affecting DOT's bottom line.

* Recognize that government, in addition to having responsibility to utilize its power to impact the marketplace directly through purchasing recycled content materials, also has the responsibility to provide leadership to both private citizens and private industry in demonstrating the feasibility and practicality of using recycled content materials.

* "Seize the moment" by following through on the commitment to develop a process that will manage, evaluate, test and bring on line new products and applications of transportation uses for secondary materials with the assistance of the Clean Washington Center.

* Recognize that counties and cities depend upon the state DOT to develop transportation specifications for materials and applications. Take advantage of the opportunity to become a nationally recognized leader in the development of recycled materials testing and specifications development for transportation applications.

* Follow through with your commitment to create and fill a position to specialize in recycled material products and applications.

4. Summary of Formal Comments (cont.)

* Re-evaluate the use of glasphalt for what has worked and why. Take into consideration economies of scale when evaluating costs. Consider the use of glasphalt in shoulders, parking lots and other non-high speed applications.

* Examine the report for unsubstantiated opinion, particularly on the costs of using glasphalt. Include a cost assessment for using cullet glass in glasphalt, compound aggregate and other alternative uses.

* Utilize the information DOT Maintenance Department has gathered to develop a baseline for compost for current specifications, current volumes purchased, types of applications and performance results. Develop a long term testing strategy to develop product specifications and to determine product performance.

* The specifications for organic materials should be performance based rather than feedstock oriented, allowing all types of secondary materials to compete.

* Purchase compost from licensed facilities across the state, not just from Seattle area facilities.

* Give preferential treatment to post consumer materials over manufacturing wastes.

* Incineration of tires is not a directive of the report.

* Extend the $1 per tire disposal fee and use the revenue to develop and expand applications for crumb rubber such as working with the DOT to increase the number of miles of rubberized asphalt so a comprehensive testing data base can be developed.

* Legislators are most likely to consider the executive summary. Keep it concise and non-technical and take the necessary time to prepare a report that communicates your vision to the legislature.

5. Summary of General Comments. The following is a summary of the verbal recommendations made on the Study compiled from the comments of those who volunteered to give input to the DOT:

Rico Beroga, Department of Transportation
Preston Horne-Brine, Clean Washington Center, Department of Trade & Economic Development
Denise Kennedy, Waste Recovery
Carol Brown, PaveTech.

* Consider cooperating with Waste Recovery to do a rubberized asphalt project.

* Reflect the broad picture of PlusRide Rubber Modified Asphalt in the study which is generally per specification rather than the inconsistent experience of Washington State. Recognize that costs for materials and contractors will come down with expanded use. Take into consideration that Washington State will have to meet the mileage requirement of the federal mandate for rubberized asphalt and that it is prudent to expand into these products now to get the cost down and improve the experience and quality of these projects.

* Recognize that the crumb rubber industry manufactures many products from recycled rubber and develop programs that will assist this blooming business in all its facets rather than in just one use through business assistance and preferential purchasing.

* Consider treated petroleum contaminated soil for approved applications to help alleviate another waste management problem.

* When considering not utilizing an application of a materials because of exposure to hazardous waste materials make sure to be specific about which applications you're talking about.

Dale Clark, Department of Ecology

I've looked at the document in the parts that concern tires and incorporated comments from other individuals into a document that DOT can use for their report.

I'm not going to go into what we put in our document per se except for one section which I was asked to comment on and that's kind of out of my realm actually. It is in the area of composting and I will just read some of the suggestions that were offered in this section and follow it up with an overall view of how I see this report.

Specific comments on sludge composting concerning yard waste compost being specified. Compost can come from a variety of feedstocks some of the more common feedstocks are yard waste, sewage sludge and mixed municipal solid waste. DOT should consider use of compost from a variety of feedstocks provided that they originate from a permitted facility and meet health department quality standards.

I'll comment on Section 2 which is on page 21 is talking specifically about the Seattle area and the question is, "Is Seattle the only area that DOT is focusing on for compost applications when quality compost is available from a number of facilities across the state not just from the west side?" That is not clearly spelled out in the report and quite possibly should be.

Third comment. When large quantities of bark waste are being used the reference to large quantities suggest an imbalance in bark and compost. What are the estimated quantities? Are maybe some specific numbers possible? Bark and sawdust described in SB 1643 are manufacturing wastes, as Jeff pointed out, and qualify as recycled materials. However, it is not Ecology's intent that a manufacturing waste, which enjoys a steady healthy market, be given equal status with materials which can truly called post-consumer which are in need of market development. For example, compost can be used in place of bark and sawdust and mulch material in DOT's specifications for particle size, etc. Therefore DOT should consider to giving preferential treatment to materials that are not considered manufacturing waste.

For myself when I read through the report, basically what I saw was an opportunity missed. I think that basically what the legislature was looking for was a guideline document, giving them some guidance that would potentially show them some of the economics that are involved in putting these materials out and using them and possibly using the expertise that is involved not only in DOT but potentially in other agencies to put together some models that they can work from for determining the potential extra funding that may be required in order to deal with some of these projects. My sense is that one of the things that the report can look at that I think would be really useful would be to clearly show where DOT expertise conceives where these materials could be used, not where they cannot be used. Possibly on secondary road applications and lower speed arenas rather than just on the freeways and major highways and then possibly document how they could be used there and show possible funding source availability that could be assembled and looked at by the legislature. I guess what I'm getting at is that I see this

Dale Clark, Department of Ecology (cont.)

as a opportunity for a door opening rather than closing and I see this as a chance to look to the future as to where these applications have a realistic potential and offer some really expert guidance as to where we should be looking to obtain some uses of these materials and put together a larger base of research that we can work from to even future establish where we're going to go in the future.

I guess what I sensed when I read this document a kind of defensiveness and I don't think it is necessary. I think we have an opportunity to be really positive and open as to what we see are some of the weaknesses and then look and focus on some of the strengths. That's what I'd like to see us do. I think that we still have time.

Lauris Davis, U.S. Environmental Protection Agency

I work in Seattle in the office of the EPA in the Solid Waste Group and I specialize in recycling markets and in federal government recycled product procurement issues. I didn't try to evaluate this report in technical terms. I decided to come to you about some other observations that I have. I would like to say that I echo quite a few of the comments that were made today about the level of detail of the report and the supporting documentation. I found it a difficult report to comment on because of that and I don't need my entire 10 minutes to talk.

You seem to know quite a bit about Intermodal Transportation Act of 1991 which will be signed by the President tomorrow and does require quite a bit from the states and from the federal government in studying the problem and in going ahead and using this rubberized asphalt by 1994 on into 1997. What I would like to comment on is about the vision. Because I can give an example of why we're in the box that we're in right now where some of you are facing an act, new federal legislation on highways, which doesn't make you that happy yet when you talk to some of the federal highways people they seem to think that congress jumped the gun a little bit by requiring the use of rubberized asphalt by states as early as 1993 while the jury's still out on the performance of that I think there's a reason why congress went ahead and did that. Market development is a very important issue and is a very timely issue right now and this is certainly not the first time this has occurred.

In 1976 the federal government said that when there were recycling and solid waste problems at that time government can play an important role in market development for recycled products and so it is part of the Resource Conservation and Recovery Act (RCRA) They did require that the EPA promulgate and determine guidelines that federal agencies or any other agency including state and local government that uses federal funds remove any discrimination or bias towards recycled products as well as establishing an affirmative purchasing program for any product that EPA wrote a guideline for... Well, EPA has written a number of guidelines for products like paper, used oil and retread tires. And, in fact, EPA wrote up federal guidelines for rubberized asphalt in 1986. It was proposed and it met with a lot of opposition yet EPA wasn't required by Congress to write a guideline for that particular product. Instead what we did was research both the market

Lauris Davis, U.S. Environmental Protection Agency, (cont.)

need and whether or not the technology and the cost could bear buying and using that recycled product. Obviously we determined that the market could bear that kind of product and it could be used. The guideline was never finalized because it was met with so much opposition. The feds reasoning for why it wasn't finalized was that each of the states has different needs so let's let the states implement these guidelines on a state by state basis. Let them step out in front and, in fact, this has not occurred. EPA is considering finalizing that guideline because of the new federal legislation on highways. But we have been considering it for the last year because of the need and because of the fact that really the states, in many of the cases, have not been particularly aggressive in researching and developing the market for secondary materials including tires and rubberized asphalt products so we're in a box right now where you may say this is a premature use of this product. The cost is too high and we're not sure about performance but until we use this product we won't know how it adjusts to mass production and how performance can really be tested until we use it on a regular basis. I think that is why congress and I can't speak for congress but I think it is one of the reasons they went ahead and said someone has to get us out of this chicken and egg thing and we're going to require that starting in 1993 states will use it up to 5% and we'll see how it works and we'll keep increasing the percentage and then maybe we will have good data. So I would encourage you to think about vision in your report and set your own vision and not have it legislated on you as with rubberized asphalt where it may have been.

David Dougherty, Clean Washington Center, Department of Trade & Economic Development

Given we received the last draft last night we don't have written comments prepared. Preston has developed about 18 to 19 pages of comments which covered the last draft and we will go over the latest draft and edit our comments. Then Preston will sit down with the DOT staff and go over the comments.

I think that the DOT had a difficult task. Their report focused on what was available in a very short time. And that's what they had available. This is a quick snapshot and that's what they had to work with. What I heard the department say today is that they recognize that this is a big issue and that they recognize they can play an important role in this issue and they recognize that a report isn't the answer, that in fact having somebody developing a process wherein - as we all know who are in the business, this technology is moving, quite quickly so - a process where a new applications or new product can be brought into the Department, a process that will manage, evaluate and test it and if it meets standards put it on board. I think that this is a major step that we'll be happy to work with the DOT on. As they said in "Dead Poet Society," "Seize the moment!" The DOT has the opportunity to "seize the moment."

Jeff Gage, Washington Organic Recycling Association

Bear in mind that the comments that I am going to be making are as a representative of the group that represents the third largest producing segment that provides material to DOT. These are concerns that we don't want to get people irritated over. One of the things that we do feel that Washington organic waste stream is being handled by the same customers that provide you currently with horticultural products.

Overall our concern about the report is that the work that has been done to date with the Maintenance Section of DOT is not in here and I think that is a case of the right hand not telling the left hand what it is up to and I would hope and expect that most of our written comments are directed towards getting the information that we know Maintenance has considered into the record so it can be used as a baseline for what our current knowledge is or what the current specifications for products are, current volumes of product need purchased and what types of applications and how they perform so that we can take that next step and try using a substitute product such as composted paper waste or composted food waste. These things are very unique and have special properties and may be more advantageous in certain applications. We'd also like a steady, long term, well defined testing strategy developed so that we can learn about the net value of using these things. The product specifications need to be there and then the industry will step up and meet those specifications.

I was at the beginning of 1671 in Senate Select Subcommittee on Solid Waste, Art Sprinkle's bill to develop the procurement bill 5143. My intent with that committee and the reason that we have these procurement issues on the table is so that the folks that are looked to for the development of those specifications are really taking it seriously and softening up or widening up those specifications so they will not be strictly feedstock oriented but actually be performance oriented and then allow the industry to step up to the market and say this is what our product does and this is how it performs. Who care about whether it comes from sludge, food waste or from mixed waste. It meets the health standards developed by the Department of Ecology. It meets your performance standards and those are the issues we are trying to get to in our responses.

The specifications are really everything. We are really looking to DOT to provide a map work of how those specifications are to be developed over the next 5 to 10 years so that we have an understanding and working knowledge of how they perform, we have no large scale demonstration that has the ability to document as well as DOT does. Professionalism is being looked on as . You could feel proud that we're looking to you to give us those specs to provide the information. We could give you specs and I've been asked to give specs. We don't trust the work that's gone on before. Its been done by consultants who use study after study. No one has actually used it to determine what is best for them in different applications. We're giving you the challenge of working with us so that we can provide the material and you can use it and document how it has performed for you. Many organic waste processors believe that it performs better than what is currently being used as the standard which is wood waste by-products. Bearing that general statement in mind I want to get into specifics here. DOT is not being obstructive or secretive or anything. They're actually working hard, the Maintenance Section is. They have stated verbally to many of our members that they have goals for

1992 to procure a substantial amount of material from us for projects in the Seattle area We hope that would go statewide because there are a number of facilities statewide handling these new products. We're also asking that engineers give a report on what the maintenance section of horticulturists and landscape architects might know and we're just asking that we get together and learn from each other.

The specifics are that we would like to see documentation of the annual average volume of all organic products purchased now so that we can get an idea of what is being purchased so we can see what might be substituted. We don't have that at this time. We would like documented the applications the products are being used for. This will help develop a baseline of information to look at how well you're meeting procurement goals that have been set forth for you as well as a provide a boiler plate for some of the smaller municipalities that don't have the staff time to develop a report for what type of information to get and how they can map their procurement goals.

The next thing is that we'd like to ask you folks to provide the current specifications that are being used for these organic materials and also provide draft language for those specifications that would require revision to allow for organic products to be used. We understand the million dollar investments in plant material that are made and we feel that has to be born in mind. If you tell us what are important performance criteria and show us which ones are clipboard for the wood waste industry by-products we can try to beat those reports and exceed those performance standards and it just needs to be in the report so that it can be referenced and we can analyze the specs.

The report should also outline the laboratory field testing demonstration procedure for post-consumer organic waste products to prove that they're viable alternatives to the current use products. If that can be incorporated clearly into the procedures that you draw up, we'd be very pleased. We'd like to look at it in the long term.

There is one more thing that we think is very important that this report is stepping on dangerous ground. The intent of Senate Bills 5143 and 1671 is to develop markets for products that do not currently have markets or are immature or don't have an acknowledged need to be successful at this point--that is not to say that the products are inferior. There are two definitions for lightweight for wood waste products for that material and that is being used successfully and it is mentioned that they procure a whole lot of bark in objective six. This is quite dangerous in our opinion because, and there are two forms of this, we'd first like to ask that the first priority of government procurement be from products derived from organic solid waste stream and be from post-consumer sources rather than from manufactured sources. Manufactured source materials such as wood products are very important and we don't want to loose ground for those materials but as the wood waste industry is declining there is not as much material out there. It actually works out to your benefit. We can provide a better bang for your buck in that way. In addition, both those products should have priority over virgin materials such as sand or lime in procurement. When you define procurement and what your levels are you should also define the percentage. Let's say you have a topsoil mix with mostly sand in it with 20 % organic material. You should only define as your procurement goal that 20% of that total volume which is the organic portion, not the 100% which includes the sand

Jeff Gage, Washington Organic Recycling Association, (cont.)

and the organic mix. That will also help the industry in being able to get to reach its volume need that it is going to reach in the next five years.

Last but not least, Tom Burger and Dr. Russ Rosenthal out of maintenance have interpreted and this is vocally indicated, we don't have this as official but I want to put it on the table, that only yard waste would be considered for procurement in 1992. If that's the trend that's going to happen, we're going to be having some problems because there are yard waste composts that are produced with sludge or with mixed municipal solid waste or with animal manures. If they indicate only pure municipal yard waste is to be considered there is a whole abundance of materials that are produced by licensed producers that you also procure other materials from and that you have some trust in that provide consistent materials. We request that you loosen up into that definition saying we want to try all of these materials and we understand there might be some differences. We're concerned that you would only indicate and specify yard waste.

That's basically it. We're sorry that we haven't been able to provide the new information that you requested in a timely manner. We might have been able to make you look better. But this is a long term deal with maintenance and we want to work hand in hand with them to develop performance standards that everyone understands are valid. I've brought some background information so that you can improve this report but again we don't trust a lot of the information that is out there. We feel that these guys need to look at that and say ok this is it. Let's try to use this as the base point and move on and find what we really want.

Jan Glick, Washington Citizens for Recycling

I will try to assimilate what I have just heard and what I have read so if you will please bear with me, I will try to ad lib. The conversation that we have just had is a good summary of where the DOT is at in regards to their policy of recycling.

We were talking about a sign post and its design and how it was necessary to dispose of that post where, if that post were made up of plastic and designed as a breakaway post it could be used again and again. For us in recycling, that is closed loop recycling and it is an indication of the need for the rethinking of the philosophy of the Department of Transportation (DOT) and that is what we want to see which is a rethinking of the DOT philosophy.

What we would want to see is a rethinking of the direction of the DOT.

One of the key areas is cost. There is an avoided cost that is not shown in any of the calculations. Dollars are coming from citizens and there is a savings of disposal dollars when we use this material for roads instead of landfilling. There are other avoided costs such as environmental costs that have not been considered.

The other consideration is that history has shown that recycled content use in road construction has not worked. The fact remains, however, that there are other states where it has worked. We need to focus on those successes and determine why they are not working here.

Jan Glick, Washington Citizens for Recycling, (cont.)

I would like to now focus on a few specific in the report. You mention that some applications of glasphalt have worked in the past east of the mountains. We need to further study those applications and determine why they have worked.

Economy of scale, there have been no comments in regards to what will happen when the size of the projects grows and the price of the material will go down. We have looked at very small test projects.

Reference page 5. Glasphalt should be kept at fairly general use. We need a reasonable substitute. I don't hear that message reflected in this report.

Reference page 5. Reduced friction levels have not been thoroughly tested.

Reference page 7. We have not heard sufficient discussion of the use of glasphalt in shoulders parking lots, and other non-high speed applications.

Reference pages 1 & 13. Incineration is mentioned as a potential use of tires. That was not a directive of the report.In Summary,the focus that the DOT should maintain would be a rethinking of its philosophy and its incorporation into its program.

Rod Hansen, King County Solid Waste Utility

I view this as one public works agency coming here to make comments to another. I didn't make comments to the draft. I knew there was another report coming. My comments are similar to those offered by Gary Wilbur.

The report that I saw does not provide strategies for recycled product testing and monitoring that will result in the development of new specifications and expanded uses for products with recycled content. That's disappointing to us. We want to emphasize three points: 1. Finding uses for recycled materials is both the state and local responsibility that will increase in importance as more recycling programs gear up and as disposal options for materials narrow. 2. Although solid waste management is not DOT's central mission, certainly DOT as the states main materials testing agency, and as an agency that both makes and influences a significant volume of procurement, can play a crucial role in making sure that state and local recycling goals are met. 3. This is a golden opportunity for DOT to gain support, strategies and resources and to be a leader in solid waste problems that go beyond the narrowly defined missions in typical in state and local agencies.

We all agree that increasing the recycled products is very important. Under state law counties and cities are responsible for implementing recyclable materials collection programs. For collection programs to be successful markets for recycled products need to keep pace. Because government, in particular state and local government, have little direct control over what materials private sector manufacturers use, it is important for government to maximize its own use of recycled materials by specifying their use by public agencies with contractors wherever practical. In doing this we not only become consumers of these recycled products, the government can also provide leadership to the private sector by demonstrating the feasibility and practicality of recycled content procurement. And with it DOT's role is and can be crucial in all of this.

In King County we found that a major stumbling block to using recyclable material was the lack of specifications for specific materials and specific uses and this is both physical and performance specifications. In large part local governments depend on DOT to provide us with material specifications. This goes beyond transportation specifications. In all the time that I worked both in and out of county government we relied on the expertise and specifications developed by the DOT even in non-transportation projects. From our perspective there's a recycled content specifications gap here that needs to be filled. We think there's a tremendous opportunity here for DOT to fill that gap. DOT has the opportunity to be a nationally recognized leader in recycled materials testing and specifications development. There's an opportunity for DOT to marshall support for the necessary resources and as an engineer there's an opportunity for DOT to insure that uses of recycled materials are based on sound scientific principles and tested uses. And, I also can imagine that if DOT is not responsive to this opportunity when it really affects the public need, I can imagine the next efforts will be directed at the control of the testing and specifications development process.

I would like to conclude with a couple of anecdotal examples where I think we've been through some of these things before. One of them is the electric utility industry where it was not long ago that the debate between the environmentalists and the industry had to do with whether conservation investments could be used to offset or displace generation capacity investments. What was found was that where the generating capacity investments were made they turned out to be so surprisingly expensive that there was a price reaction and, it fact, it was found that there was a significant value to making conservation investments. Many of us wished we had made those before we found out how expensive generating capacity was. Now we see with the electric utilities conservation is at the heart of what they believe their mission is and what they're doing as their mission.

The second example I would point to is the I-90 project where the debate between the environmentalists way back when and industry was whether or not the environmental impact statement for the I-90 project had to consider within its scope of alternatives to that project alternatives that were not within the authority or mission of what was then the Highway Department to carry out. The ruling on that one which was imposed by a court from outside was that yes,you had to consider these other alternative missions. Just because they weren't within your specific mission was not enough to exclude them you still had to consider them part of the total transportation mission. I don't know if this is true or not but my perception was that, to a degree, this decision had an impact on or shifted the mission of what was then the highway department, now the DOT. I think that significant shifts in our missions as public agencies are inevitable. They're going to happen; they're going to happen.

This has clearly occurred in the King County Solid Waste Division which not long ago carried out a mission that was largely confined to solid waste transfer and disposal. Now our mission includes waste reduction, recycling, recycled product procurement and a number of other things that are far more than just reactive to the way things were. We want to learn from the lesson of the electric utilities before it happens to us. We want to establish and implement waste recycling and reduction programs before we're forced to

Rod Hansen, King County Solid Waste Utility, (cont.)

extremely expensive and unrecoverable investments in excessive disposal capacity that by their cost will cause recycling and waste reductions programs to occur in reaction to the cost. We're asking DOT, really, as a state public works agency with a potentially significant role in recycled product procurement to join us in this mission now before the inevitable consumes the DOT from outside sources. And so I, too, think that the real audience is the legislature, but I go beyond that to if something is going to happen its going to happen and this will happen.

Ray Hoffman, City of Seattle

.... with the help of the private sector in implementing programs whether commercial materials or residential materials and they're not going to go away primarily because it is cost effective to do so. It is cheaper for us to try to divert these materials to an alternative use rather than to continue to put them in the landfill whether they're tires or glass or what have you. We've reached the point where the very success of these programs has made them endangered, in a sense, where the supply has definitely outstripped demand. Because of this both state and local governments have taken the next step in developing the infrastructure which is developing markets for these secondary materials. And SSB 5143 is Washington's effort in this arena. Many of the speakers here today played an integral role in the drafting and passage of this bill.

The inclusion of Sections 14 and 16 of this bill which call on the DOT to use compost or conduct a study on the use of recycled materials in road construction is viewed as extremely important and in no small part is the purchasing power of this Department. What procurement ordinances are all about is leveraging the purchasing power of every governmental level in targeting towards the change in their purchasing policy. Roadway applications whether they're rubber, compost, glass or plastic products have the potential to make a significant dent in the variety of materials which suffer from over saturated or underdeveloped markets. It is my opinion that while this report meets the letter of Section 16 of 5143 it certainly does not meet the spirit of the bill in the total 5143.

In the initial part of the discussion there was talk that only two sections apply and I assume those are 14 which is Compost for Transportation Products and Section 16 . I would argue strongly that a couple other sections apply as well.

First is Section 1 which is the intent of the bill. I'd actually like to take a second to point out a couple of provisos in the intent that I think are very applicable to this report. The first is target procurement policies and goals towards those recycled products for which there are significant market development needs whether it may substantially contribute to solutions to the state waste management problems. We're looking at 2 to 3 materials that are included in the roads and transportation project study that are significant volume materials with little or no value that is tires, that is compost, and certain forms of glass such as green glass or mixed cullet. The second is to direct state agencies to develop strategies to increase recycled product purchases and to provide specific goals for the procurement of various organic recovered materials and recycled paper products.

Ray Hoffman, City of Seattle, (cont.)

If we look at this report it covers the required topics but it offers little to no hope for the Department's use of these materials in traditional applications. The Department gives us its perspective on current potential for use of these materials which is not optimistic, especially for tires, but fails to tell us what steps it will take to increase the use of secondary materials in its own construction projects. There is no plan of action. There is no visible commitment to addressing the challenges of incorporating secondary materials into roadway construction projects.

I'd like to point out to you a couple of areas where I think this applies. One, we had a very educational foray into rubberized asphalt pavement. It seems clear to me a couple things have come up - that cost effectiveness is a criteria and that, unless there are some ways of getting around them, we may be stymied in terms of future use of tires in rubberized asphalt. I propose that we can handle the current problem we have with the stockpiling of tires illegally through the $1 per tire fee for tires that's scheduled to sunset at the end of 1993 If we don't have markets for tires, I would argue that we should continue that $1 per tire fee and look at new applications, such as working with the state Department of Transportation to increase the number of lane miles that are done with rubberized asphalt so we can get a comprehensive testing data base. Tires are a big problems if anyone knows how to change crumb rubber back into tires I think they'll be the next quick millionaire not only here but across the country.

I have some concerns about compost too. It is my understanding that DOT is looking at a definition of compost which is based primarily upon yard waste. While that's a good start, yard waste is only one of the significant organics in either the commercial or residential waste streams. We also have other things such as food waste or MSW organics composting products or paper sludge or sewage sludge or mixed waste paper as a compostable product as well. While some of these don't have standards yet I believe the definition of compost should be embracing rather than restrictive and that we should look at whether or not these are acceptable substitute products for what I'll call post manufacture by-products such as sawdust or beauty bark or what have you.

What I would encourage in the long run is to see a more visible commitment on the part of DOT to incorporating secondary materials into its roadway construction projects. I heard good news here today. I think the addition of staff that works explicitly on this will go a long way to providing both the public and private sector who are involved with recycling issues a liaison so there is more direct and ongoing communication. I would offer a request to get more data in terms of what the current usage of secondary materials in terms of the overall DOT materials purchasing budget is. I firmly believe that with the size of the DOT budget and with the sheer tonnage of materials used that a small contribution by DOT could significantly impact positively some of the problems that we have. When we're talking about tires for instance we're dealing with thousands of tons, a rough calculation is 10 to 20 thousand tons of tires per year at 20 pounds per tire and a million tires. When we're dealing with glass that has low value, that can't be used as container glass, we may be dealing in the same arena. In short, it's not all or nothing. It may be that allocating a significant portion of the budget or of the tonnage of materials to these things could have a significant impact without unduly affecting DOT's bottom line.

Don Kneass, Waste Management

A couple of things. One I want to express my disappointment with this study. I think much more needs to be done. To me it reflects perhaps a lack of complete understanding of what it is we face. I looked at the study with a particularly strong concern about glass. Our company is a major recycling collector in Washington State.. We have a very serious problem with glass. Not only the mixed cullet residue which is a natural part of our processing system. Currently we have probably 5 to 6 thousand tons stockpiled with no market. But I am even more concerned by an announcement of the glass manufacturing plant, which is the only glass manufacturing plant in Washington in Seattle, Ball-Incon is nearing capacity. It appears that even if we meet their specifications at some point soon with the advent of new household collection programs, they will reach capacity for color separated glass. The only other glass plant in the state is in Portland, Oregon, and they are nearing capacity as well. This is a particularly acute problem.

I was taken somewhat back by the concern about economic considerations and I want to assure you, at least from our perspective, that it is not on our part to expect that the Washington State DOT subsidize the market for glass nor are we expecting the DOT to compromise quality or safety. All we're asking for is a fair shake and I don't think that the study at this point in the initial draft is in such a form that it gives us a fair shake.

For instance, I think that a number of things in the study represent opinion. There are also several unsubstantiated conclusions, for example, on page 6 the statement is made that the costs of using glasphalt will probably be higher than that of conventional mixes. My knowledge of economic studies being done. Our company's not been contacted about the cost of providing mixed cullet glass, or meeting building specifications or about meeting quality so I don't think that in that sense we've been giving a fair shake in that regard. Also, and I think that it was mentioned earlier, the issue in regard to trails, bicycle paths and other paths. I don't know the degree that you are responsible for these things, but it certainly wasn't in the report. In terms of quality, generally speaking, the marketplace doesn't assume that quality can't be met or that the material is going to be contaminated. In fact it's the reverse of that. They go out and publish a spec and then they expect the suppliers to meet the specification. We'll be able to tell you whether or not we can meet that spec and whether we'll be able to supply the material.

A couple of recommendations on the report itself. Granted the DOT was on a fairly short time line, however, our company had a college student who was a summer intern who in a period of less that a month prepared 23 pages of contacts, reports and specifications and in fact she did meet with representatives from the DOT and provided them that information. I see no reference to that information in the report, however, I haven't seen the documentation that goes along with the report.

There is no reference to the extent of the reports available. One of the reports - I know that you're very concerned with the quality considerations on glasphalt and cited the Connecticut report that was very negative. However, there are a number of reports contained in our summer intern's file for example, one that was done by an engineer with an engineering consulting firm, A. Reginado. His conclusion was that, "initial laboratory studies showed that the asphalt mixtures containing 20% to 25% glass satisfy design strength and stability requirements. Asphalt paving mixtures containing glass have

Don Kneass, Waste Management, (cont.)

performed acceptably from a structural standpoint and maintained skid resistance over an extended period of time as gaged by our history field test." So there are some more positive tests that were done. There are a number here everywhere from New York, from Los Angeles, New Jersey. There's a whole variety of information that is out there and if that was considered I'd like to see reference to it.

The other thing is I do think that there ought to be a cost assessment. We would be more than happy to cooperate in that effort. What is in fact the cost of using cullet glass in glasphalt, compound aggregate and a number of other alternative uses? The other thing I think that was missing from the report, and the information is readily available through a study commissioned by Washington Department of Trade and Economic Development, is a market assessment for recycled tires, oil and glass.

I, also, think there needs to be a problem assessment contained in the report. We need to know for instance what is the supply of the material? All of that information is contained here. We also need to know on the other side, what is the consumption potential of the Washington State Department of Transportation? Those are just a few of the comments I'd like to offer. Again, I offer our cooperation in working with you in getting this report. I think there are a number of other people in the room that you can use as resources. I know that your resources are limited and that your time frame is limited. I think that we're here because we want to help and we want to solve the problems of the glut of secondary materials in this state.

Gary Wilburn, Senate Environment & Natural Resources Committee

I thought it might be helpful to get a perspective on the genesis of the legislation. Senator Metcalf was the prime sponsor of the bill and directed the staff to work on this during the interim before the legislative session. He was involved in 1989 with the passage of the "Waste not Washington Act," which, in part, is the reason why we're having so many problems with recycling markets because it required programs and cities like Ray Hoffman's to start collecting more of this material. It was anticipated then that there was going to be a vast increase in materials that would have to be recycled and that eventually more than just what was collected at the curbside.

Staff came back to him with a lot of ideas about ways on the demand side to pull this material more into the marketplace, most of which was directed at you and I in our everyday life as private citizens. But, we also got to looking at what governmental agencies were doing at the state and local level and we found that there were a lot of opportunities that were being passed up, not just in the transportation sector, but even in some of the easier commodities such as paper in a state that has as much pulp and paper capacity and recycling capacity as we do. Our state agencies were not doing a very good job by comparison of using recycling and products that have recycled content.

Senator Metcalf's approach was that state and local government is close to 10% of the GNP of this country and that's a really big part of the marketplace. Its really important that government agencies be the leaders, not only in what they can do in terms

of the real impact in the marketplace, but because of the leadership and setting an example. It's really hard to push legislation that directs all of our individual habits as private citizens before government shows that it can be a good citizen. So, the procurement legislation was really focused on that. But the DOT is not alone in being addressed in that legislation. It is addressed to all state agencies and local governments, higher education institutions; all units of state and local government are included in that legislation. The Department of General Administration will be developing a statewide plan for state agencies in terms of increasing procurement of recycled contents materials. I assume the DOT will be working with them as with other agencies.

So, that is a step forward but it is not going to solve all of the problems that we have in this area and legislators will be the primary audience of this report. That is one thing that I want to emphasize, the legislature is the ultimate end for the buck in terms of addressing and balancing a number of issues in transportation policy as well as solid waste disposal policy and the costs are rising as they are for every important public activity. We are seeing it not just in the bills that we pay for solid waste collection at the end of the month but in a lot of other costs - the cleanup of failed landfills, the provision of alternate drinking water supplies for citizens that are downgrading from some of these landfills. We have a number of ordinances that address problems related to solid waste disposal both past practices and current practices and that cost element, while it may not be a part of the DOT's mandate, eventually has to get factored in ultimately in the legislature. It is one that the Department in its report could at least make reference to and remind the legislature that there are other costs associated such as avoided costs that Jan Glick mentioned.

On a positive note there were a lot of things mentioned today which I did not extract from the report that I think can be very useful to include in the it and include that up front and recognize that the legislators are busy individuals. I think that if you put your best foot forward and point out the programs that you do have in place and the materials that you are using and that this new employee will be put on board as a contact for these uses.

This report should be considered an opportunity to make your case to the legislature. You certainly have to answer the questions that were asked in that section but that doesn't say that's the only thing that can be addressed. You have some visions for how these programs can work better and if there are other elements that need to be brought to the legislature's attention I would certainly include them. I don't think that when that provision was drafted it was intended to be exhaustive of all possibilities in this area.

One particular subject which can be anticipated then are these new federal regulations and even though the new regulations have not be promulgated we know what the statute is going to say. It sets out some pretty ambitious goals. I think that this would be an appropriate report to at least signal to the legislature that there are these new federal requirements that you are waiting for from the federal department of transportation with further guidance. But, give some preliminary sense as to how the state is going to meet some pretty ambitious goals in order to retain federal funding.

Gary Wilburn, Senate Environment & Natural Resources Committee, (cont.)

On specifications, there's a terminology that's used in the transportation field that's very technical. However, probably from a lay persons standpoint, which I am and don't profess any technical knowledge in this area, I think a lot of people would think of some general factors. There's safety, maintenance, longevity of materials, costs, aesthetics, - factors in a general sense - and I'm not sure if the legislators really understand how the DOT weights all of those in its procurement decisions. I think some discussion of how those specifications work in procurement decision making is really important. I'm sure legislators would not want to sacrifice safety but they have said that in areas like costs they are willing to make sacrifices specifically for recycled content materials .

All state and local governments have statutory authority of give preference to recycled materials for state agencies that's up to 10%. In many cases the policy judgement has been made that it is worth the additional costs because of public policies and the savings in other costs related to solid waste disposal so I'm sure some discussion about where there is flexibility in specifications and even though there may be some costs in order to achieve these recycling goals that the state has set out would be important. Longevity is another example. If replacement of compost materials has to occur a few months earlier than with virgin materials that may be a cost that the legislature is willing to bear in order to avoid additional landfill capacity to take this material.

A final thought in terms of format and I don't want to suggest non-compliance with legislative deadlines. That Jan 1 deadline is to make sure it gets done and to make sure it gets funded. If you have an open ended report date it may make it a little tougher to convince the fiscal committee that the report should be funded this biennium instead of the next one. But if a couple of weeks makes a difference in getting a much more thorough report and one that's fine tuned and tailored to the primary audience, the legislators, take them. For a lot of folks the report and the appendices will be important but an executive summary is the most important part for your primary audience, the legislators. If it takes a few more days to have that done right, I think you should take the time. I think the input you take today will be useful for following up on it.

VERBATIM TRANSCRIPTION OF GENERAL COMMENTS

Rico Beroga, Department of Transportation

Earlier Mr. Hoffman has spoken about the spirit of this whole program and that we're basically looking at how DOT can help work out the difficult problems of waste management issues. One waste management issue which is particularly difficult over the last few years is that of petroleum contaminated soil. No one has wanted to deal with that, but recently we're seeing more regional treatment centers that can adequately treat these materials to below Ecology cleanup standards. There are a few in Pierce County but there's still somewhat of a stigma with the end soil and the landfills can't take it because most of those are Superfund Sites and their standards are extremely tight. Ecology has allowed in many cases for that type of soil, if it meets certain standards, to be used on certain road surfaces, parking lots and things like that. When we talk about uses for that material and additional projects that might be another type of waste management issue that you can deal with and help out with. I've only been working with DOT for a month.

Tom Bolser, Al Bolser Tire Stores, Inc.

I own a number of companies, one of which is Prison Tire Rubber which produces crumb rubber which can be used in the asphalt process. My basic question was the fact that you stated that the addition of rubber is about 3% yet the figures that you've got say the additional cost increased 50% to 60%. I was curious as to why the cost of adding the rubber was so much more expensive when the cost of the crumb rubber itself was a small portion of that. Something doesn't correlate as to cost .

My second comment is that there are a tremendous number, literally tens of thousands, of products made out of recycled rubber and I don't know what projects are in place but things that can be implemented as to the procurement side specifying either manufacturers of rubber products that try and use recycled material or if there are some assistance programs either from the recycling association or the DOT in helping small entrepreneurs to get involved. To me the key to recycling is to not look at one company that is going to use 50 billion tires but to look at many small bedroom industries, if you want to call them that, industries that are out there producing a variety of different potential products, not only for uses for the DOT but also for uses in a wide variety of other industries. I think that is where the future is going to be. I think it was on the organic side years ago we used to have literally tons and tons of sawdust and all kinds of other things sitting all over the place and this has become a developed industry. We're really in the crumb rubber business in a very developing stage and I think that when you take stronger looks at how we put together our information that will help develop that blooming business rather than trying to look at how one project is going to develop.

Carol Brown, PaveTech Corporation

PaveTech Corporation manufactures PlusRide Rubber Modified Asphalt, which is one of the two kinds of rubber asphalt applications that you've talked about. Quite a bit has been said here today about PlusRide there are a couple of comments that I want to make. It is clear that the experience in Washington State with Plus Ride has been inconsistent. What we hope the final version of the report will reflect is the broader picture of the demonstrated experience in other states most specifically California and Alaska which have some very, very severe paving applications. We contend that if PlusRide has performed per the specifications and per the enhanced and superior performance characteristics that we claim then in any circumstances, and it hasn't been any more than a handful of them, the challenge is to identify what the problems have been with quality control and with production so that we can achieve those kinds of results in Washington State, not just in California and in all the projects that are laid down.

PaveTech has done a lot and is committed to doing a lot to address some of these but we heard Newt say that even conventional asphalt is very susceptible to small variations and we have to accept that these alternative products may be even more susceptible. I sent the committee members some of the comments about specific projects from the engineers on these projects. They knew there were problems before they ever finished the job, problems with the rubber specs or the mix specs or the temperature specs or the lay down specs. That's our job as the company marketing the product but we need to develop paving contractors that have experience with a product. We need to develop rubber processors, we need to develop asphalt contractors so that each time that you do a project you're not starting over again on the learning curve. We can only gain that kind of experience by doing more projects. One thing that you wanted to be sure of that the information in the report on the recycling issues with the rubber and asphalt products was clarified and was correct and it is still an issue that needs work.

There was a major study done in Ontario, Canada in the last two years. The report should be on the street in the first quarter of 1992 and I personally call them every three weeks to say "Where is it what's your expected due date?" They looked at both the emissions with the PlusRide project during lay down and with also the recycling of PlusRide asphalt during the recycling stage and during lay down and the mixed recycled paving project. What we've heard from the Ontario project is that there were no significant emission differences, but until anyone sees that in writing we certainly can't stand on that. I want to be clear that it is something that the industry recognizes as an area that needs continued study. However, the rubber in the PlusRide process is not melted neither in the initial lay down and nor in the recycling. There are a lot of references out there and the comment in the DOT report implies that the rubber has to be heated to the point that it melts to be laid down and that could lead to toxic emissions. The rubber is not melted and there is no chemical change in the rubber in the modified rubber asphalt concrete product.

On the cost side the experience to date is that the cost differences have been significant. We feel that the costs of the rubber will come down significantly with volume and we also believe that costs that the asphalt producers and the paving contractors have charged will also come down significantly once they don't have to factor in that the new

Carol Brown, PaveTech Corporation, (cont.)

product is unknown. They're assuming the risk for it and all the other things that go along with a small sized project with a new technology and on a one time basis. And, again, with repeated experience with a contractor we believe that the costs will come down.

In the area of equivalency it does need continuing research and that's where immediate cost competitiveness can be achieved if the kinds of tests that California is doing can be repeated or if Washington DOT is willing to accept the results that come out of California and they hold up that PlusRide can be laid at a reduced thickness and achieve the same kind of performance result that's where the issue of cost will be addressed possibly. By 1994 there will have to be a significant rubber asphalt products laid. In the state of Washington, even if it costs more now, there is a real value in dollars in the DOT budget to work now to expand into these products so we can get the cost down and improve the experience and improve the quality of all the projects. If we wait until 1994 you're going to have to do enough projects to satisfy the federal mandate at perhaps the cost we're looking at now and without the benefit of the experience that will improve the performance and control the cost.

I'd like to reiterate what I think and also said that I hope this report can spur the legislature to close the loop in this state. We've been frustrated with the fact that no one agency has the control over the solid waste management problem and some of the potential end use markets. It seems that there's a real opportunity and a real need for this report as it goes to the legislature to perhaps spur a bigger picture look at the opportunity for some joint projects. I know the interest is there for them and there just hasn't been a method to facilitate that kind of cooperation developing in the end use market.

Preston Horne-Brine, Clean Washington Center, Department of Trade and Economic Development

I have a couple of comments. I was interested to hear Newt's discussion that you would include more information on some of the less critical commodities from a performance standpoint materials. It's ironic that a lot of those applications as well have the potential to consume and produce large quantities of material. That report really gave very nominal time to those applications. I think that you would be much more appropriately addressing the intent of the report if you gave more time to those applications. Those applications are compost and unbound materials which include recycled concrete cement that are really not as technically complicated and it was really not mentioned or featured in the report at all. They're not technically complicated and in some cases they are even more cost competitive than native materials. They have a number of technical advantages. I would suggest that the focus could be realigned a little bit and the report would play a lot better.

Finally, I have a little bit of concern with the tenor of the report in that the

Preston Horne-Brine, Clean Washington Center, Department of Trade and Economic Development, (cont.)

concern that a lot of the applications might not be utilized because of exposure to hazardous waste materials. Those are very legitimate concerns in concept but you have to be careful about which applications you're talking about. Its important to keep in mind that asphalt paving material is made from flux which is a residual material from the refining industry and is declared a hazardous waste material if it is not properly handled. Its use in asphalt is an appropriate application which transforms it into a very highly marketable, high performance product. So the tenor of the specifics of the application and the tenor of your discussion of each application is critical.

I'll give you one example of how that can play up very positively. You have a program announcement from the Strategic Highway Research Program, which is an international group that does very progressive research on highway applications. In their report they say in the projects that they're soliciting participation on the research projects, their projects should produce leapfrog technologies for utilizing waste products in highway practices. Such projects successfully developed and implemented would produce significantly - they're talking about more than average improvements, they're talking about quality and cost effectiveness and facilitating acceptance of waste products as highway construction materials. So that tone suggests again that there is a real opportunity here. I think given the timing of this report and given DOT's extensive work in this area there are a number of things that you have done with waste materials and testing capability is extensive and I certainly know that local and state governments are looking to DOT for guidance especially for uniform specification. You have a real opportunity to be a national leader.

Denise Kennedy, Waste Recovery

Waste Recovery processes about 400,000 tires a month out of Portland which have been collected from Washington, Oregon and now starting in Idaho. We have cleaned up or been contracted to clean up about a quarter of a million tires since May out of the state of Washington.

One of the reasons that I'm here is that we have talked to you about and what we're interested in doing is a rubberized asphalt project in the state of Washington. We know it is being done around the country. Right now with all the cleanup tires where the tires are being cleaned up there is the TDF market which is what we produce for, primarily, but we also produce a product which is bumpers which accounts for about 50,000 tires a year Basically, our concern is that the tire derived fuel (TDF) market is saturated. We developed, it we have invested millions of dollars in it and now people are coming in and trying to give it away. But no matter what, you can only take so many tires, you can only stockpile so many tires. So one of the ways the Cleanup Fund can help is being a qualified contractor or another one is to bid against us to do that big project. We go in and participate in the rubberized road asphalt projects and I believe personally that this is a good use of tires.

I'm not really technically knowledgeable but in every study that I've read about

projects across the country there are pluses that could be, if we took a positive approach, very good for this state. I've talked to other people in the industry who said Washington and Oregon are the toughest states to get into to do that kind of project. That's the reputation that I've heard from people in the rubberized asphalt industry and they say to stay away from it because it is hard. I'm not involved in that part of it.

My concern is that we must find other uses for tires. Every pile that's left has 500,000 tires plus left. We, right now, are the only ones that accept, except for someone else who's doing some road bed projects, that can handle that number of tires. Then there are entrepreneurs but they really need to work largely to collect those tires left by the side of the road. They don't all have the money but are trying to come in on the shirt of the contracts and are trying to get money that way. You do have to have money to survive in this business There is a need for a place to put these tires and we need to work together and with Ecology to solve these problems.