

APPENDIX A
SPECIAL PROVISIONS AND SPECIFICATIONS

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SPECIAL PROVISION

I-IR-15-3(18)121

Pre-Bid Conference

A Pre-bid Conference will be held to discuss with bidders the Special Provisions and job requirements that are somewhat unique with the project. This conference will be held in Room 614 of the State Office Building on September 19, 1978, at 9:00 a.m. All prospective bidders are requested to attend.

8/30/78

SPECIAL PROVISION

I-IR-15-3(18)121

Energy Consumption

One of the fundamental objectives of this project is to evaluate asphalt pavement recycling processes by collecting data pertaining to energy consumption. The contractor shall be required to furnish a breakdown of the total energy required for the recycling and conventional mix operation of this project, including energy required to manufacture the asphalt and softening agent at the refinery. The energy consumption for various fuels and electrical power usage shall be reported in gallons, cubic feet, and kilowatt hour.

The contractor shall supply this data on a monthly basis to the project engineer in consultation with the pavement design engineer of the Materials Section.

No separate payment shall be made to the contractor for submitting the above required information, the cost of which should be included in the bid prices for the various items of work.

8/25/78

SPECIAL PROVISION

I-IR-15-3(18)121

Stack Tests

Description: To determine compliance with air quality standards, the contractor shall arrange for six stack tests to be conducted on a schedule supplied by the project engineer in cooperation with the Executive Secretary, Utah Air Conservation Committee and the Pavement Design Engineer of the Materials and Research Sections. One stack test shall be required to be taken for the material produced for each of the test sections which are described in the Special Provision covering "Experimental Test Sections."

Construction Methods: Tests must be witnessed by the Utah Bureau of Air Quality and conducted by an approved stack testing firm such as, but not limited, to the following:

York Research Corporation
7100 Broadway
Building 3A
Denver, Colorado 80221

Air Pollution Technology, Inc.
4901 Morena Boulevard
Suite 402
San Diego, California 92117

Stephen W. Upson, Associates, Inc.
2361 Wehrle Drive
Buffalo, New York 14221

American Chemical and Research
32 East 335 South
Salt Lake City, Utah

Arthur Young & Company
Surety Life Building
Denver, Colorado 80202

Dames & Moore
605 Parfet Street
Denver, Colorado

Pollution Control Science, Inc.
6015 Manning Road
Miamisburg, Ohio 45342

Engineers Testing Laboratories, Inc.
2525 E. Indian School Road
Phoenix, Arizona 85016

Kimball Laboratories & Consulting
40 North 400 West
Salt Lake City, Utah

Ute Research Laboratory
Fort Duchesne, Utah

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Stack tests shall be performed in accordance with Method 5, described in 40 CFR, Part 60, and shall be reviewed by the Executive Secretary of the Utah Air Conservation Committee.

Method of Measurement: One complete testing procedure including required reporting of results shall constitute one stack test.

Basis of Payment: This item shall be paid for at the contract unit price per each for "Stack Tests," which payment shall be full compensation for all work, equipment, materials, and mobilization necessary to complete the item.

8/25/78

SPECIAL PROVISION

I-IR-15-3(18)121

AIR QUALITY REQUIREMENTS FOR STATIONARY SOURCES

The Contractor's mixing plant for production of bituminous mixes shall be required to meet the applicable air quality requirements for new stationary sources except as modified herein. Federal standards of performance for new stationary sources allow visual emissions not to exceed 20 percent opacity, and particulate matter emissions not to exceed 0.04 grains per dry standard cubic foot.

The Contractor will be allowed to exceed the above requirements as necessary for plant calibration and adjustment at the start of production, and for construction of test sections No. 5 and 6 as detailed elsewhere in these Special Provisions. This variance in air quality standards shall be limited to production of the initial 5300 cubic yards of paving mix produced on the project.

Prior to initiation of construction of any portion of this project, any mixing plant intended for use in production of bituminous paving mixes and associated air cleaning equipment must be approved by the Executive Secretary, Utah Air Conservation Committee in accordance with the provisions of Section 1.6, Utah Air Conservation Regulations. Such approval requires submission of equipment plans and specifications to the Executive Secretary for his review. The review and approval process requires a minimum of sixty days.

6/28/78

SPECIAL PROVISION

I-IR-15-3(18)121

Experimental Test Sections to be Constructed

To continue the development of hot-mix recycling technology, the contractor, as part of this contract, shall be required to construct six test sections. Each test section shall be 1600' in length and shall be constructed to the cross section and depth shown for "Recycled Asphalt Concrete Pavement" on the typical section.

The mix proportion chart included in the Special Provision titled "Recycled Asphalt Concrete Pavement" shall be used to determination and control the proportions of reclaimed material, softening agent, coarse aggregate, fine aggregate, and asphalt cement used in the test sections. The six tests shall be constructed in accordance with the proportions shown on the chart corresponding to the following percentages of reclaimed material.

<u>Test Section No.</u>	<u>% Reclaimed Material</u>
1	0
2	50
3	60
4	70
5	80
6	100

The contractor shall be required to meet air quality standards during production of the recycled bituminous concrete pavement to be placed in the test sections, therefore, test sections 5 and 6, corresponding to 80% and 100% reclaimed material, shall be constructed during the initial 5300 cu.yd. (approximately 10,000 ton) calibration period when variance from air quality standards is allowed.

The attention of the contractor is directed to the fact that all test sections in which air quality standards cannot be met, must be produced during this initial 5300 cu.yd. calibration period.

Construction of the six test sections shall be done as scheduled by the project engineer in cooperation with the pavement design engineer of the Utah Department of Transportation's Materials and Research Section.

Materials and Construction Methods: The Special Provision titled "Recycled Bituminous Concrete Pavement" shall control except as modified by this Special Provision.

Method of Measurement: This item shall be measured by the cubic yard. Quantities for payment shall be determined from the neat line cross sectional area shown on the typical section and labeled recycled asphalt concrete pavement, and the station to station limits, along the control line, of pavement placed and accepted.

Basis of Payment: This item shall be paid for at the contract unit price per cubic yard, for "Recycled Asphalt Concrete Pavement," which may be adjusted in accordance with the Special Provision for that item, which price shall be full compensation for all materials, equipment, labor and incidentals necessary to complete the item, except crushing and stockpiling of the existing pavement shall be paid separately.

SPECIAL PROVISION

I-IR-15-3(18)121

Remove, Crush, and Stockpile Existing Bituminous Pavement

Description: This item shall consist of scarifying and removing the existing bituminous pavement on the northbound lane and southbound lane including ramp tapers, crushing the material so removed, and stockpiling it at the site of the central mixing plant.

Construction Methods

Removal of Existing Pavement: All existing bituminous pavement of the northbound lane, southbound land, and ramp tapers within the project limits shall be removed from the roadway. Removal shall be done in a manner that will prevent unnecessary intermixing with the underlying portland cement treated base course. All existing bituminous pavement shall be removed down to the top of the portland cement treated base course within 1/2"±, regardless of the depth shown on the plans.

Gradation: All existing bituminous material shall be removed and processed such that 95% of the material shall have a least dimension of 1-1/2". It shall also be required that this material before being introduced into the mixing plant be passed through a 2" scalping screen. Removal and processing shall be done in such a manner that degradation of the aggregate does not occur. If the engineer determines that crushing of the reclaimed pavement is, in fact, causing degradation of the aggregate to an extent that the proportion of course aggregate in the recycled asphalt concrete pavement must be increased to compensate for the increase in fines due to degradation, the Engineer shall revise the mix proportion chart for the recycled asphalt concrete pavement as required to provide the necessary increased proportion of course aggregate. The contractor shall then produce recycled asphalt concrete pavement in accordance with the proportions as revised, and no adjustments of the contract unit price for that item shall be made as a consequence of this revision.

The processed reclaimed pavement shall be acceptable for use in accordance with the proportions shown on the mix proportion chart if the gradation falls within the following specified limits when tested in accordance with Department Test Procedure 8-946 and 8-947.

<u>Sieve Size</u>	<u>Maximum % Passing</u>
3/4"	100
3/8"	98
No. 4	66
No. 16	36
No. 50	24
No. 200	13

Determination of compliance with the above gradation shall be based on the average of five samples taken from a test lot at the stockpile. A test lot shall be the quantity of reclaimed material in the stockpile at the time of sampling. The stockpile shall be sampled as often as deemed necessary by the engineer but a minimum of once a week during crushing and stockpiling of the reclaimed pavement.

Testing by the Department indicates the gradation of the existing bituminous pavement to be as follows:

<u>Sieve Size</u>	<u>% Passing</u>
1"	100
3/4"	99+1
1/2"	91+3
3/8"	82+3
No. 4	58+3
No. 8	43+2
No. 16	33+2
No. 50	18+1
No. 200	11.4+0.5

If a roto-mill or similar equipment is used in place of crushing, the above provisions shall apply. In addition, the equipment shall be capable of controlling dust created by the cutting and removing operation, and shall have a manual system for varying the depth of cut while the equipment is in motion.

Stockpiling: The reclaimed bituminous pavement removed and crushed in accordance with this Special Provision shall be stockpiled at the location selected by the contractor for his mixing plant. The stockpile shall be constructed and located so as to be readily available for use in the recycled bituminous surface course. The area where the stockpile is to be placed shall be cleared, graded and compacted or otherwise prepared to provide a firm level base for the stockpile and prevent contamination with soils or other deleterious materials. The stockpile site shall be approved by the engineer prior to stockpiling. Layer placing, stacking conveyors or other approved methods shall be used for stockpiling to prevent coning or segregation of the stockpiled material.

The Transportation Commission has obtained a free use permit on five acres of land located approximately 500' left of Station 1271+ southbound lane. This area will be available to the contractor as a site for his central mixing plant and for stockpiling materials. In the event the contractor chooses some location other than that described above for a plant site, all reclaimed pavement not used in the production of recycled asphalt concrete pavement shall be transported to and stockpiled at the above described location in the manner specified above prior to the notice of completion of the project. There will be no extra compensation for transporting and stockpiling materials from the contractor's plant site to the location designated above.

Method of Measurement: The quantity of this item shall be measured by the square yard of material in place on the roadway prior to removal. On the northbound lane and southbound lane, the width for payment shall be 41.0' as shown on the typical section, and the length shall be determined by the station to station limits, along control lines, of material actually removed and processed in accordance with this Special Provision. On ramp tapers, the quantity shall be determined by horizontal measurements, prior to removal, with measurements on side slopes taken to a line representing the average width of the course being removed.

Basis of Payment: This item shall be paid at the contract unit bid price per square yard for "Remove, Crush, and Stockpile Existing Bituminous Pavement," which price shall be full compensation for all labor, equipment, materials and incidentals necessary to complete the work.

9/19/78

SPECIAL PROVISION

I-IR-15-3(18)121

SCARIFYING AND RECONSTRUCTING EXISTING BASE COURSE

DESCRIPTION: This item shall consist of scarifying the upper 3 inches of the existing portland cement treated base course, processing the scarified material to reduce particle size to 1-1/2 inch maximum, watering, spreading, and compacting the processed material, overlaying the compacted material with Untreated Base Course as required to obtain a smooth riding surface, and finishing and compacting the reconstructed base course in conformance with the requirements below.

SCARIFYING: After removal of the existing bituminous pavement, the upper 3 inches of the existing portland cement treated base course shall be scarified and processed to reduce the size of the component particles to 1-1/2 inches or less.

If the method of scarifying and processing used by the contractor causes cracking, loosening or any other disturbance to the portland cement treated base course below the specified 3 inches depth, all of the disturbed portions of the portland cement treated base course shall be processed and reconstructed in the same manner as the upper 3 inch layer. No separate payment shall be made for necessary work below the specified upper 3 inch layer.

RECONSTRUCTING: The scarified and processed base material shall be uniformly mixed with water, placed on the roadway in its original thickness, finished to a relatively smooth surface and recompacted. Care must be taken to maintain a uniform thickness and maintain the original cross-slope of the roadway.

A leveling course of Untreated Base Course with an average thickness of 2 inches shall be placed over the reconstructed base material as required to provide a smooth riding surface. Areas of settlement will require sufficient Untreated Base Course to match the grade line of adjacent sections. The Untreated Base Course shall be mixed with water, compacted and finished to provide a smooth riding surface by means of a land plane at least 40 feet in length, or a similar leveling device approved by the engineer. The leveling device shall be capable of carrying sufficient material to fill low spots, shall be operated in conjunction with an approved finish roller and shall continue leveling operations until the roadway surface is approved by the engineer. Water shall be applied as needed to maintain the Untreated Base Course in a workable and compactable condition.

Prior to placing prime coat, the leveling course shall be fine graded by means of a motor patrol or other approved fine grading equipment, and rolled with an approved steel-wheel roller.

The scarified and processed portland cement treated base course shall be uniformly compacted to the density specified below. Maximum laboratory density shall be determined in accordance with AASHTO Designation T-180, Method D.

Acceptance with respect to density shall be based on the average of all density determinations made in a lot. A lot shall be the number of square yards completed and compacted each production day. The test lot shall be subdivided into sublots of approximately 1600 square yards. One density test, randomly selected by use of a suitable random number table, shall be taken within each subplot.

The lot shall be accepted when the mean of all density determinations made within the lot is not less than 96 percent of maximum laboratory density, and when no single determination is lower than 92 percent of maximum laboratory density.

If an individual determination falls below 92 percent of maximum laboratory density, the material represented by the determination will be considered defective and the contractor shall further compact the subplot. After further compaction, the original test site and one other randomly selected site, within the subplot, shall be tested. The average of the two test results shall be included in the computation of the mean density of the lot. The original test results shall not be included in that computation. If the subplot still does not meet the required density, the process of recompacting and retesting shall be repeated.

In addition to the above acceptance tests, the engineer may test any area which appears defective, and shall require further compaction and retesting of areas where test results show the density to be less than 92 percent of maximum laboratory density.

If the mean density of the scarified and processed portland cement treated base course in any lot does not equal or exceed 96 percent of maximum laboratory density, the lot may be rejected or accepted at the option of the engineer. If accepted it will be paid for at 90% of the contract unit price for "Scarifying and Reconstructing Existing Base Course." Acceptance at this reduced price must be requested, in writing, by the contractor.

FINISHING: The reconstructed base shall be finished to a smooth, uniform line and grade with surface deviations not exceeding 0.5 inches, plus or minus, in ten feet. The determination of compliance with smoothness tolerances may be made with a straight edge, chalk-line or surveying equipment at the option of the engineer.

The finished base shall be maintained to line and grade, and well compacted until covered by the prime coat and recycled asphalt concrete pavement. Any base course that becomes soft, washboarded, or distorted under public or construction traffic shall be corrected at the contractor's expense.

METHOD OF MEASUREMENT: This item shall be measured by the square yard of material in place on the roadway prior to scarifying and reconstructing. On the southbound lane and northbound lane the width for payment shall be 44.5 feet as shown on the typical section. The length shall be determined by the station to station limits, along control lines, of material actually scarified and reconstructed in accordance with this Special Provision. On ramp tapers the quantity shall be determined by horizontal measurement, prior to removal, with measurements on side slopes taken to a line representing the average width of the course to be scarified and reconstructed.

BASIS OF PAYMENT: This item shall be paid for at the contract unit price per square yard for "Scarifying and Reconstructing Existing Base Course", which price shall be full compensation for all labor, equipment, materials and incidentals including watering and compaction necessary to complete the work, except Untreated Base Course shall be paid for at the contract unit price per ton for that item.

June 22, 1978

SPECIAL PROVISION

I-IR-15-3(18)121

Recycled Asphalt Concrete Pavement

Description: This item shall consist of construction of a surface course composed of reclaimed bituminous pavement, softening agent, mineral aggregates and bituminous binder, mixed at a central mixing plant and spread and compacted on a prepared base in reasonably close conformance with the lines, grades, and dimensions shown on the plans, and in conformance with the Standard Specifications and this Special Provision.

Materials

Bituminous Material: The bituminous material shall be AC-10 Viscosity Graded Asphalt Cement conforming to the requirements of AASHTO Designation M-266, Table 2, with the following modifications: The viscosity at 135° C (274° F) for AC-5 shall be changed from 200 to 175. The loss on heating requirements on residue from Thin-Film Oven Test shall be deleted. Ductility at 25° C (77° F) shall be deleted and replaced with Ductility at 4° C (39.2° F) with values as detailed below:

	<u>AC-2.5</u>	<u>AC-5</u>	<u>AC-10</u>	<u>AC-20</u>
Ductility, 4° C (39.2° F.) ICM/MIM, CM.	50+	25+	15+	15+

The grade specified may be changed one step by the engineer at no change in the unit bid price for "Recycled Asphalt Concrete Pavement."

Hydrated lime shall be added to the total mix of the recycled asphalt concrete pavement material to serve as an anti-stripping agent. The lime shall be added at the rate of 1.00% by weight.

No separate payment shall be made for bituminous material or for the required hydrated lime. The cost of these materials shall be included in the contract unit price for "Recycled Asphalt Concrete Pavement."

Softening Agent: The softening agent shall conform to the following specifications:

Softening Agent Specifications

Kinematic Viscosity 100° F C.S.	1000-5000
Kinematic Viscosity 140° F. C.S.	150-300
Kinematic Viscosity 210° F. C.S.	10-30
Specific Gravity 60° F	1.00-1.040
Pounds/Gallon	8.33-8.66
Flash Point, C.O.C. ° F.	390 Minimum
R.T.F.O., Loss, %	3.0 Maximum
Mixed Aniline Pt., ° F.	75-100
Refractive Index / 20° C.	1.57-1.63
Rostler Analysis	
Asphaltenes	Less Than 1%
Nitrogen	15 Minimum
A1 + A2	67 Minimum
Saturates	15 Maximum

No separate payment shall be made for softening agent. The cost of this material shall be included in the contract unit price for "Recycled Asphalt Concrete Pavement."

RECLAIMED BITUMINOUS PAVEMENT: This material shall consist of reclaimed pavement from the northbound and southbound lanes within the project limits, removed crushed and stockpiled in accordance with the typical sections shown in the plans and the Special Provision titled "Remove, Crush and Stockpile Existing Bituminous Pavement."

MINERAL AGGREGATES: New material to be mixed with the recycled material shall conform to the following specifications:

(a) Coarse aggregate shall consist of crushed stone, crushed gravel or crushed slag composed of clean, hard, tough, durable and sound fragments, and shall be free from vegetable matter or other deleterious substances. That portion of the coarse aggregate retained on a No. 4 sieve shall have not less than 50 percent of particles by weight with at least one mechanically fractured face or clean angular face, when tested in accordance with Department Test Procedure 8-929.

Prior approval of the aggregate source is required. In addition to the routine project control requirements above, the following are necessary for approval of the aggregate source:

- (1) Crushed slag, if used, shall be of uniform density and quality and shall have a rodded weight of not less than 75 lbs. per cubic foot when tested in accordance with AASHTO Designation T-19.
- (2) The aggregate shall have a percentage of wear not exceeding 40 when tested in accordance with AASHTO Designation T-96.
- (3) The aggregate shall have a weighted loss not to exceed 16 percent by weight when subjected to fine cycles of sodium sulfate and tested in accordance with AASHTO Designation T-104.

Coarse Aggregate shall be uniformly graded and of such a size that it will meet the following gradation specifications when tested in accordance with AASHTO Designation T-27. That portion of coarse aggregate passing the No. 200 sieve shall be determined by washing with water in accordance with AASHTO Designation T-11. Samples for acceptance shall be taken from the conveyor belt leading to the stockpile.

<u>Sieve Size</u>	<u>% Passing</u>
3/4"	100
1/2"	60 + 22
#4	8 + 8
#16	4 + 4
#50	3 + 3
#200	2 + 2

(b) Fine aggregate may be either a natural or manufactured product. It shall be clean, hard grained and moderately sharp and shall contain not more than 2 percent by weight of vegetable matter or other deleterious substances. That portion passing the #40 sieve shall be non-plastic when tested in accordance with AASHTO Designation T-90.

Fine aggregate shall be uniformly graded, and of such a size that it will meet the following gradation specifications when tested in accordance with AASHTO Designation T-27. That portion of fine aggregate passing with No. 200 sieve shall be determined by washing with water in accordance with AASHTO Designation T-11. Samples for acceptance shall be taken from the conveyor belt leading to the stockpile.

<u>Sieve Size</u>	<u>% Passing</u>
1/2 "	100
#4	92 ± 8
#16	44 ± 10
#50	27 ± 9
#200	10 ± 2

Adequate supplies of coarse aggregate and fine aggregate shall be produced and separately stockpiled sufficiently in advance of construction operations, to permit sampling and testing before use. The stockpiles shall be of such size as to adequately supply the mixing plant when it is operating at full capacity, and to provide continuous production of the paving mix.

Acceptance of aggregates with respect to gradation shall be based on individual test samples. At least 5 samples shall be taken for each production shift. The samples shall be chosen on a random basis through the use of a suitable random number table. In addition, the samples shall be uniformly distributed in time throughout the shift. If a test indicates the material is out of specification, no additional material will be incorporated into the stockpile until a passing test is obtained. Material produced while the retest is being performed shall be wasted. Marginal or borderline crushing operations will not be permitted.

CONSTRUCTION METHODS

EQUIPMENT: The mixing plant shall be capable of independently controlling and proportioning the reclaimed pavement, softening agent, coarse aggregate, fine aggregate, and asphalt cement in conformance with designated and approved proportions, and shall be equipped with means of independently and continuously displaying and recording the proportions or quantities of all materials being introduced into the mix. The plant shall be capable of compliance with all applicable air quality standards after the prescribed calibration and adjustment period.

If a continuous plant is used, continuous operation shall be required. If stopping and starting is inevitable, all improperly mixed material shall be wasted. Continuous plants shall have a positive means of wasting improperly mixed material.

Proportioning of Mix: Recycled Asphalt Concrete Pavement shall consist of reclaimed bituminous pavement, softening agent, coarse aggregate, fine aggregate, and asphalt cement containing the required additive, combined by weight, in accordance with the proportions shown on a designated line of the mix proportion chart as follows:

(1) It shall be the responsibility of the contractor to choose and designate the percentage of reclaimed material to be used in the Recycled Asphalt Concrete Pavement.

- (2) The contractor shall adjust and calibrate his mixing plant to produce Recycled Asphalt Concrete Pavement containing recycled material, softening agent, coarse aggregate, fine aggregate, and asphalt cement conforming to the applicable specifications, and proportioned, by weight, in accordance with the factors shown on the "Mix Proportion Chart" corresponding to the designated percentage of reclaimed material.
- (3) During the production of the initial 5300 cubic yards of Recycled Asphalt Concrete Pavement produced on the project, the contractor shall adjust his plant and change the designated percentage of reclaimed material in the mix as necessary to arrive at a product that can be produced in conformance with air quality requirements, that will contain a maximum proportion of recycled material, and that can be produced at a reasonable and desirable rate. Recalibration to conform to the factors shown on the "Mix Proportion Chart" will be required each time the designated percentage of reclaimed material is changed.
- (4) After production of the initial 5300 cubic yards of Recycled Asphalt Concrete Pavement, changes in the designated percentage of recycled material in the mix, and recalibration of the mixing plant to conform with proportion requirements shall be made only prior to the start of a days production and shall require concurrence of the Engineer.
- (5) If the Engineer determines that the contractor's operation is not in compliance with air quality requirements, he shall require the contractor to make appropriate changes in the designated percentage of reclaimed material or in his methods or procedures in order to obtain compliance.
- (6) If the Engineer determines that the proportions shown on the mix proportion chart are not producing a satisfactory product, he may prepare a new chart to adjust the proportions of softening agent and/or asphalt cement in the mix. The contractor shall then adjust and calibrate his mixing plant to conform to the proportions shown on the revised chart. Whenever Recycled Asphalt Concrete Pavement is produced in accordance with proportions shown on a revised proportions chart, the contract unit price for that item shall be adjusted in accordance with the following:

Adjusted Unit Price = Original contract unit price plus A plus B
 where A = unit price adjustment for softening agent
 B = unit price adjustment for asphalt cement.

The unit price adjustment for softening agent (A) shall be determined as follows:

$A = \$340 \times (\text{revised softening agent proportion} - \text{original softening agent proportion})$

The unit price adjustment for asphalt cement (B) shall be determined as follows:

$B = \$200 (\text{revised asphalt cement proportion} - \text{original asphalt cement proportion})$

All computations shall be made algebraically with the final unit price rounded to the nearest one cent, and may result in an increased or decreased unit price.

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WILDCAT TO PINE CREEK

Recycled Asphalt Concrete Pavement-Mix Proportion Chart

<u>% Reclaimed Material</u>	<u>Reclaimed Material</u>	<u>Softening Agent</u>	<u>Coarse Aggregate</u>	<u>Fine Aggregate</u>	<u>Asphalt Cement</u>
0	.0000	.0000	.4688	.4688	.0625
50	.4845	.0060	.3246	.1599	.0250
51	.4942	.0061	.3198	.1551	.0248
52	.5040	.0062	.3150	.1502	.0246
53	.5137	.0063	.3102	.1454	.0244
54	.5235	.0064	.3054	.1406	.0242
55	.5332	.0065	.3005	.1357	.0240
56	.5430	.0066	.2957	.1309	.0238
57	.5527	.0067	.2909	.1261	.0236
58	.5625	.0068	.2861	.1212	.0234
59	.5722	.0069	.2813	.1164	.0232
60	.5820	.0070	.2765	.1116	.0230
61	.5918	.0071	.2717	.1067	.0227
62	.6016	.0072	.2669	.1019	.0224
63	.6115	.0073	.2621	.0971	.0221
64	.6213	.0074	.2573	.0922	.0218
65	.6312	.0075	.2525	.0874	.0215
66	.6410	.0076	.2477	.0826	.0212
67	.6508	.0077	.2429	.0777	.0209
68	.6606	.0079	.2380	.0729	.0206
69	.6705	.0080	.2332	.0680	.0203
70	.6804	.0080	.2284	.0632	.0200
71	.6905	.0080	.2237	.0584	.0195
72	.7006	.0080	.2189	.0535	.0190
73	.7107	.0080	.2142	.0487	.0185
74	.7208	.0080	.2094	.0438	.0180
75	.7309	.0080	.2046	.0390	.0175
76	.7410	.0080	.1999	.0341	.0170
77	.7511	.0080	.1951	.0293	.0165
78	.7613	.0080	.1903	.0244	.0160
79	.7714	.0080	.1855	.0195	.0155
80	.7816	.0080	.1807	.0147	.0150
100	.9875	.0075	.0000	.0000	.0050

7/18/79

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Whenever a revised mix proportion chart is being used to proportion the ingredients in the recycled asphalt concrete pavement, a separate adjusted contract unit price shall be determined and applied each time a change in the designated percentage of reclaimed material is made.

Mixing: The five material elements of the mix; reclaimed material, softening agent, coarse aggregate, fine aggregate, and asphalt cement, properly proportioned, shall be heated and mixed in a central mixing plant. Mixing time shall be sufficient to meet temperature requirements, and to produce a uniform product, free of cold lumps, rich or lean spots, and to coat all aggregate with bitumen. The aggregate shall be considered satisfactorily coated when all particles passing the #4 sieve and 98 percent of the particles retained on a #4 sieve are coated with bitumen as determined visually by the engineer. The moisture content of the recycled asphalt concrete pavement, sampled behind the paver prior to compaction, shall not exceed 1 percent by weight.

If a continuous plant is used by the contractor, it shall be equipped with an adequate and approved surge bin, capable of discharging the mix directly into hauling equipment. The surge bin shall be loaded in such a manner that segregation will be kept to a minimum. Dumping of the bituminous mixture on the ground and reloading will not be permitted.

Temperature Control: The temperature of the bituminous mixture at discharge from the mixing plant shall not be less than 220° F. nor greater than 265° F. Spreading and compaction shall be completed before the temperature of the mixture falls below 180° F.

Spreading and Compaction: The bituminous mixture shall be spread with self-propelled mechanical spreading and finishing equipment capable of spreading at least a 20' width. The mixture shall be spread and struck off in such a manner that the finished pavement, including side slopes conforms to the dimensions shown on the typical section, and meets smoothness and density requirements.

The bituminous mixture shall be placed in three lifts with no lift exceeding three inches in total compacted thickness. Longitudinal joints in succeeding lifts shall be offset at least six inches transversely from the longitudinal joint in the preceeding lift.

Full width or echelon paving shall be required for the multi-lane portions of this project. Echelon paving being defined as two or more paving machines moving in the same direction, concurrently at a desirable maximum separation distance of 200', such that the entire width of the roadway is covered with surfacing material. In case of breakdown of one of the machines when paving in echelon, the entire paving operations shall be suspended until the full width operations can be continued.

Where echelon paving cannot be performed, such as at ramp tapers, and crossovers, the following requirements shall be applied:

Immediately prior to making a subsequent pass of the paving machine, 0.5 foot of the previously layed and compacted surfacing material shall be cut off. The cut shall be vertical and follow a smooth line. The material cut off shall be removed and placed in the reclaimed pavement stockpile. The longitudinal joint shall only need to be cut back on the top lift. The lower lifts of surfacing material shall be fully rolled and tack coat applied along the longitudinal joint prior to making the additional passes of the paving machine. Traffic, including construction vehicles, shall be prevented from crossing the vertical joint cut. Tack coat shall be applied to the vertical edge prior to placing the adjoining material.

Equipment used to make the vertical cut joint shall be capable of making a smooth even cut, without any tearing, and shall be approved by the Engineer prior to use.

Pavers shall be equipped with a control system capable of automatically controlling the paver screed at the required cross-slope and at an elevation necessary to obtain the required thickness. The control system shall be automatically actuated from reference surfaces on both sides of the paver through a system of mechanical sensors or sensor directed mechanisms or devices. The control system shall be capable of working in conjunction with a short ski or shoe for matching the pavement placed by a previous pass of the paver, and/or a ski-type device or travelling stringline at least forty feet in length.

On the initial paver pass of each lift, elevation and cross-slope shall be controlled by means of ski-type devices or travelling stringlines operating on both sides of the paver. On the succeeding pass, elevation and cross-slope shall be controlled by means of a joint matching shoe on the side of the paver adjacent to the longitudinal joint and a ski-type device or travelling stringline operating on the opposite side of the paver.

Should the automatic control system become inoperative during a production day, the contractor shall take immediate and diligent action to repair or replace the defective system. During the time that repairs are in progress, the contractor will be permitted to use manual controls. The use of manual controls shall not be permitted to continue beyond the end of the shift in progress when the control system becomes inoperative.

If, in the opinion of the Engineer, the contractor does not take immediate and diligent action to repair and replace an inoperative automatic control system, or if the contractor's control system is found to be unsatisfactory due to poor results, frequent breakdowns, or any other cause, the Engineer shall order the paving operation discontinued until an automatic control system capable of continuous satisfactory operation is provided.

Smoothness tolerances specified herein shall apply whether using automatic or manual controls.

After the paving mix has been spread, the surface shall be longitudinally rolled, beginning at the outside edge or lower side and proceeding toward the higher side. Each pass of the roller shall overlap the preceding pass by at least one-half the width of the roller. Rolling operations shall be conducted in such a manner that shoving or distortion will not develop beneath the roller. A rolling pattern shall be developed and followed that will result in a uniform pavement meeting smoothness and density requirements.

The forward speed of pavers shall be adjusted to the plant production and delivery so that a continuous, uninterrupted forward paving operation is obtained. Unnecessary stopping and starting of the spreading machine will not be permitted.

Acceptance of Recycled Asphalt Concrete Pavement with respect to density shall be based on the average of all density determinations made in a lot. A lot shall equal the number of cubic yards of Recycled Asphalt Concrete Pavement placed and compacted each production day. The test lot shall be divided into sublots of approximately 1600 square yards. One density test, randomly selected by use of a suitable random number table, shall be taken within each subplot.

The lot shall be accepted when the mean of all density determinations made in sublots is not less than 96 percent of maximum laboratory density or 93 percent of Measured Maximum Density (Rice Method), and when no single determination is lower than 92 percent of the maximum laboratory density or 89 percent of Measured Maximum Density (Rice Method).

If an individual test result falls below 92 percent of maximum laboratory density or 89 percent of Measured Maximum Density, the surface course material represented by that test will be considered defective, and the contractor shall further compact the subplot. After further compaction, the original test site and one other randomly selected site within the subplot shall be tested. The average of the two test results shall be included in determining the mean density for the lot. The original test result shall not be included. If the subplot still does not meet the required density, the process of recompacting and retesting may be repeated until the minimum compaction temperature is reached.

In addition to the above acceptance tests, the engineer reserves the right to test any areas which appear defective and to require further compaction of areas that do not meet at least 92 percent of maximum laboratory density or 89 percent of Measured Maximum Density.

If the mean density of the surface coarse placed on any production day does not equal or exceed 96 percent of maximum laboratory density or 93 percent of Measured Maximum Density, but is not below 92 percent of maximum laboratory density or 89 percent of Measured Maximum Density, the lot may be accepted at a reduced price upon written request from the contractor. The computation of the adjusted unit price for the Recycled Asphalt Concrete Pavement with respect to density shall be based upon a pay factor of 0.90. Any lot or subplot with a density below 92 percent of maximum laboratory density or 89 percent of Measured Maximum Density shall be considered defective. The engineer may order the removal of any or all of the bituminous mix in that lot or subplot. The pay factor for any such surface course which is allowed to remain in place shall be 0.50.

Placing of the bituminous mix shall be as continuous as possible. Rollers shall not pass over the unprotected end of freshly placed mix unless authorized by the engineer, and if so authorized and the end will be subjected to traffic, the end shall be left at a level of approximately 50:1 (horizontal to vertical). Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the layer or course. A light coat of bituminous material shall be applied on contact surfaces just before fresh bituminous mix is placed against previously compacted mix. At bridge ends or at ends of other rigid type structures, compaction shall be in transverse as well as longitudinal directions, as directed by the engineer.

The Recycled Asphalt Concrete Pavement shall be finished to a smooth, uniform line and grade. The use of any equipment that leaves defects in the finished surface which cannot be eliminated shall be discontinued.

Construction joints shall be measured with a 10-foot straightedge. When tested longitudinally across the joint, the surface shall not vary more than 0.013' in 10'. The joint shall be brought into specification tolerance immediately after the paving machine has moved away. The repair of the joint shall be diligently pursued by an adequate crew or the contractor will not be allowed to continue his paving operation.

The pavement surface shall be tested for smoothness as the work progresses, and shall be accepted in lots equal to the number of square yards placed each day. A lot shall be tested at selected locations longitudinally and transversely. Longitudinal and transverse measurements shall be made with a 25-foot stringline and 10-foot straightedge, respectively.

The variation of the surface from the testing edge of the stringline between any two contacts with the surface shall at no point exceed 0.025 feet for longitudinal measurements. The variation of the surface from the testing edge of the straight-edge between any two contacts with the surface shall at no point exceed 0.01 feet for transverse measurements. All humps or depressions exceeding the specified tolerances shall be corrected at the expense of the Contractor as directed by the Engineer.

On projects where more than one course of Recycled Asphalt Concrete Pavement will be placed, only the top course shall be tested for smoothness. Leveling courses, overlays, and cushion courses shown on the plans or designated by the Engineer, will not require smoothness determinations.

Spot leveling, when required, shall be placed, spread, and compacted prior to placing subsequent pavement courses.

Acceptance of the completed Recycled Asphalt Concrete Pavement with respect to thickness shall be on the basis of test areas selected by the Engineer, not to exceed 50,000 square feet in size. Thickness determinations shall be made, after placing of the top lift of pavement, by coring in a random pattern, with not less than four cores per test area. A test area shall be accepted when the average thickness of all cores taken within the area is equal to or greater than the designated thickness, with the tolerance specified below, and when no test shows a deficient thickness of more than 3/4 inch.

Test areas where the average thickness is less than the designated thickness shall be subject to the following price reduction:

Deficiency in Average Core Thickness <u>In Inches</u>	Pay Factor To Be Applied To The <u>Unit Price</u>
0 To 0.375	1.00
0.376 To 0.500	0.90
0.501 To 0.750	0.85

The pay factors above shall be applied to the unit price for the full thickness of the pavement. The unit price for this item, after any other required price adjustments have been applied, shall be multiplied by the appropriate factor listed above to arrive at the final unit price for the deficient test area.

No payment shall be made if the average core deficiency of a test area exceeds 3/4 inch. Any such test area shall be corrected by the contractor, at his expense, by applying a tack coat in accordance with the specifications for that item and an additional lift of Recycled Asphalt Concrete Pavement not less than 1/2 inches in thickness.

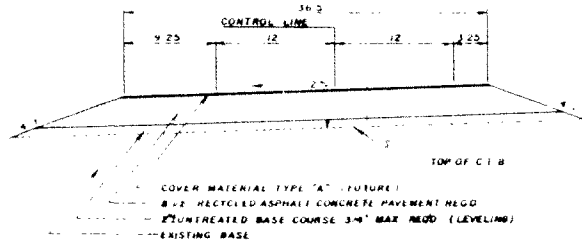
Weather and Seasonal Limitations: This subsection shall be changed to read as follows: Recycled Asphalt Concrete Pavement shall be placed only between April 15th and October 15th, and when the air temperature in the shade and the roadbed temperature are above 50°F. Recycled Asphalt Concrete Pavement shall not be placed during rain, when the roadbed is wet or during other adverse weather conditions. Recycled Asphalt Concrete Pavement placed after October 15th shall be placed only upon written authorization from the engineer, and then only when a proper review has determined that it is in the best public interest of the Department and the public.

Method of Measurement: This item shall be measured by the cubic yard in place. Quantities for payment shall be determined from the neat line cross sectional area shown on the typical section and the station to station distance, along the control line of pavement placed and accepted. On tapers, ramps or other locations not detailed on the typical section, quantities shall be determined from the actual dimensions of material placed and accepted.

Basis of Payment: This item shall be paid for at the contract unit price per cubic yard, or at an adjusted unit price per cubic yard, adjusted in accordance with this Special Provision for accepted quantities of "Recycled Asphalt Concrete Pavement." This price shall be full compensation for all aggregate, softening agent, asphalt cement, including the required hydrated lime, and all other materials, equipment, labor, and incidentals necessary to complete the item, except that removal, crushing and stockpiling of the existing pavement shall be paid for separately in accordance with the Special Provisions for that work.

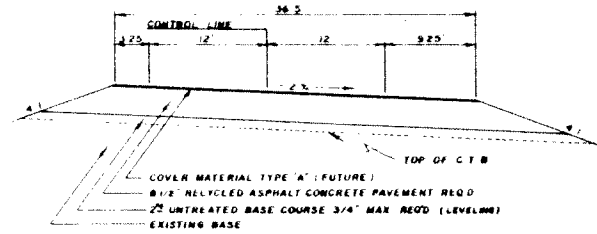
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TYPICAL CROSS SECTIONS

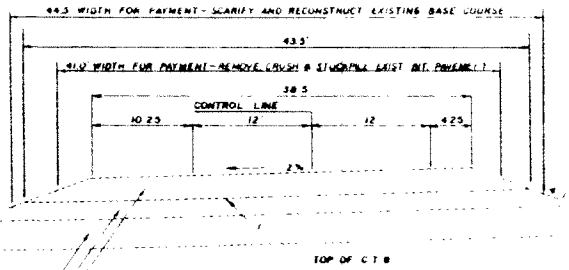


TYPICAL SECTION NO 1
 SBL
 STA 1031+68.77 TO STA 1272+00.0

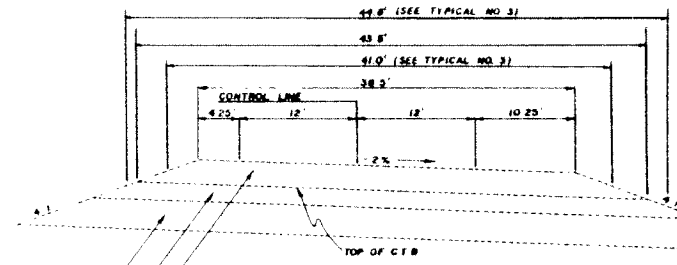
NOTE: SCARIFY & RECONSTRUCT THE TOP 3" OF EXISTING CEMENT TREATED BASE



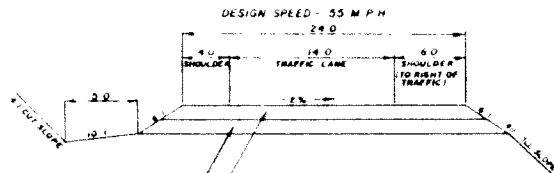
TYPICAL SECTION NO 2
 NBL
 STA 1028+48.8 TO STA 1272+00.0



TYPICAL SECTION NO 3
 EXISTING SBL
 STA 1031+68.77 TO STA 1272+00.0



TYPICAL SECTION NO 4
 EXISTING NBL
 STA 1028+48.8 TO STA 1272+00.0



TYPICAL SECTION NO 5
 TEMPORARY CONNECTIONS
 SEE SHEETS 12 & 13 FOR ELEVATIONS

NOTE: SEE SHEET 3 FOR SLOPE FLATTERING TYPICAL SECTIONS.

NO.	BY	DATE	TYPE	REMARKS
1	RLB/BBE			ADDED NOTES TO TYP 3, 4 & 5

UTAH DEPARTMENT OF TRANSPORTATION			
DISTRICT 8 - GLENN CITY, UTAH			
PROJECT NO. 1028+48.8 TO 1272+00.0			
WILDCAT TO PINE CREEK			
TYPICAL SECTIONS			
DESIGNER	CHECKER	DATE	REVIEW
RLB/BBE	RLB/BBE	3/11/11	RLB/BBE
DESIGNED BY	CHECKED BY	DATE	REVIEWED BY
RLB/BBE	RLB/BBE	3/11/11	RLB/BBE
APPROVAL	DATE	BY	COUNTY
RLB/BBE	3/11/11	RLB/BBE	BEAVER
PROJECT NUMBER	DATE	BY	COUNTY
1028+48.8 TO 1272+00.0	3/11/11	RLB/BBE	BEAVER
PROJECT NO. 1028+48.8 TO 1272+00.0	3/11/11	RLB/BBE	BEAVER
PROJECT NUMBER	DATE	BY	COUNTY
1028+48.8 TO 1272+00.0	3/11/11	RLB/BBE	BEAVER

APPENDIX B

PRELIMINARY INVESTIGATION AND MARSHALL DESIGN

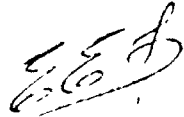
	<u>Page</u>
Preliminary Investigation	1
Marshall Designs	18

Memorandum

UTAH DEPARTMENT OF TRANSPORTATION

DATE: August 24, 1977

TO : Alex E. Mansour, District Five Director

FROM : Edwin E. Lovelace, Engineer of Materials and Research SUBJECT: IR-15-3()116, Manderfield Interchange to Sulphurdale Interchange
Flexible Pavement Design - Overlay or Recycling

Attached are pavement designs and a proposal to recycle the existing bituminous pavement on the above I-15 project.

We are proposing to remove, stockpile, and recycle the existing bituminous surface. This specific project is 8.8 miles long, 38 feet wide, and consists of sections 6.25 inches and 5.0 inches thick, respectively. It represents approximately 120,533 tons of pavement, composed of 113,301 tons of aggregate and 7232 tons of asphalt. At an average contract price, the asphalt and aggregate have a total value of \$1,205,330.

The existing flexible pavement has extensive thermal cracking. Too many overlays cause problems with width and slope and do not eliminate the cracking problem.

ENERGY COSTS OF "ROUGH" PAVEMENTS

Pavements can have many kinds of defects, which in turn may range widely in magnitude, all contributing toward what engineers and the public call "roughness". It seems fairly clear that when pavement conditions begin to bother the user, his entire perception comes from the effects "bothering" his vehicle. It is not generally realized, however, that these actions on the vehicle cause a diversion of useful energy into wasteful tasks, rather than producing forward motion of the vehicle. More energy, that is fuel, is required to maintain the vehicle's forward speed, compensating for that lost in undesired, "destructive" activities -- wearing out tires, pounding suspensions, moving the vehicle up and down, and of course, thumping the pavement, in addition to other undesirable consequences. The wasted energy goes to work in raising maintenance costs for the user's vehicle. Figure 1 shows the relationship of PSI to the percent increase in fuel consumption as the PSI degrades. NCHRP report 111, Running Costs of Motor Vehicles as Affected by Road Design and Traffic, 1971 HRB.

The Dynaflect data indicates that the pavement system is weak and possible reconstruction is suggested. An overlay of 7.0 inches (SLB) and 8.0 inches (NBL) is needed to improve the structural capability. But an overlay of this magnitude causes problems with width, slope guardrail and bridge structures, and doesn't eliminate the two real problems --- the cracking and the depletion of existing materials.

The experts believe that by recycling, the absorption and shrinkage phenomenon which takes place in pavements, will have already taken place and the new recycled pavements will not be subject to thermal cracking.

The benefits inherent in this proposal are expected to be a cost savings to the Department through the preservation of natural resources, especially as related to asphalt products associated with the energy situation. Also, there is not the oxidation from the catalytic action of the aggregates comparing recycled mix and conventional mix. This was evident from the recycled test section on I-70 near Cove Fort and a recent study by Dr. J. Claine Petersen at the Laramie Energy Research Center in Wyoming.

The existing flexible pavement will require close-cycle crushing to minus one inch material and stockpiling. This material has to be crushed to insure uniformity when mixed with the softening agent. Also, special attention should be given to removing from the roadbed and stockpiling, so that bituminous aggregate is not lost or contaminated with underlying soils. Approximately 1.48 miles must be surfaced with regular mix, because the existing tonage will not accommodate the required pavement thickness.

The existing subbase consists of 6 inches of cement treated base. This course is just below the existing BSC. This CTB will have to be scarified and recompact and 2 inches of UBC added for leveling and reshaping the grade line.

SAMPLING AND TESTING

The existing roadway was cored every half mile with three 6-inch cores taken at each location. These specimens were measured for height and density. It should be noted that approximately one half inch of untreated base gravel was included with the bituminous cores. After measurements and densities were taken, the cores were crushed to minus one inch, the material was then mixed and twenty-four representative samples taken for asphalt content, gradation, and asphalt recoveries. Marshall designs and Immersion compressions were based on repetition of nine samples after the percentage of softening agent had been determined.

North Bound Lane

Percent Passing		
1"	100	
3/4	99 ± 1	
1/2	91 ± 2	
3/8	82 ± 2	
#4	58 ± 2	Average Asphalt Content
#8	43 ± 2	6.01 ± 0.27
#16	33 ± 1	
#50	18 ± 1	
#200	11.4 ± .5	

Penetration @ 77°F (100 gm)	37+7
Absolute Viscosity @ 140°F (poises)	5354
Kenematic Viscosity @ 275°F (cs)	464
Ductility @ 39.2°F (1cm/min)	2

South Bound Lane

Percent Passing		Average Asphalt Content 6.15 ± 0.15
1"	100	
3/4"	99 ± 1	
1/2"	90 ± 3	
3/8"	82 ± 3	
#4	58 ± 3	
#8	43 ± 2	
#16	33 ± 2	
#50	19 ± 1	
#200	11.0 ± .6	

Penetration @ 77°F (100 gm)	49+10
Absolute Viscosity @ 140°F (poises)	4122
Kenematic Viscosity @ 275°F (cs)	371
Ductility @ 39.2°F (1cm/min)	3

Recycled Asphalt

Penetration @ 77°F (100 gm)	90
Absolute Viscosity @ 140°F (poises)	1090
Kenematic Viscosity @ 275°F (cs)	200
Ductility @ 39.2°F (1cm/min)	40+

In reviewing the gradation, we feel it would be to the Departments advantage to add 15% plus 4 material. This would improve the gradation and more closely follow the new specification. It is believed this would also improve the performance of the bituminous material. (See Appendix "A")

SOFTENING AGENT

The particular softening agent used in the laboratory for this project was an aromatic oil with a coc flash point of 425°F. and a viscosity in the range of 200-300 cs at 140°F. The reason for selecting an aromatic oil was to reduce the difference in solubility parameters between the maltene fraction of the asphalt and the asphaltene fraction. In this manner, the rheological properties of the recycled asphalt could be adjusted to be essentially the same as virgin asphalt. See appendix "B" for Specification of Softening agent.

MARSHALL DESIGNS

Marshall Designs were made with and without the addition of a softening agent. The preliminary Marshall designs indicated that 0.75% softening agent and 0.50 AC-10 could be added with a total void content for the mix of 3.0 percent. Also, this would give an asphalt grade equivalent to an AC-10.

PAVEMENT RECOMMENDATIONS

Manderfield Interchange to Wildcat Interchange

1 " Plant Mix Bituminous Seal Coat
8.25" Bituminous Surface Course (Recycled)*
2 " Untreated Base Course (for reshaping grade)
11.25" Total

Wildcat Interchange to Sulphurdale Interchange

1 " Plant Mix Bituminous Seal Coat
8.0 " Bituminous Surface Course (Recycled)*
2.0 " Untreated Base Course (for reshaping grade)
11.0 " Total

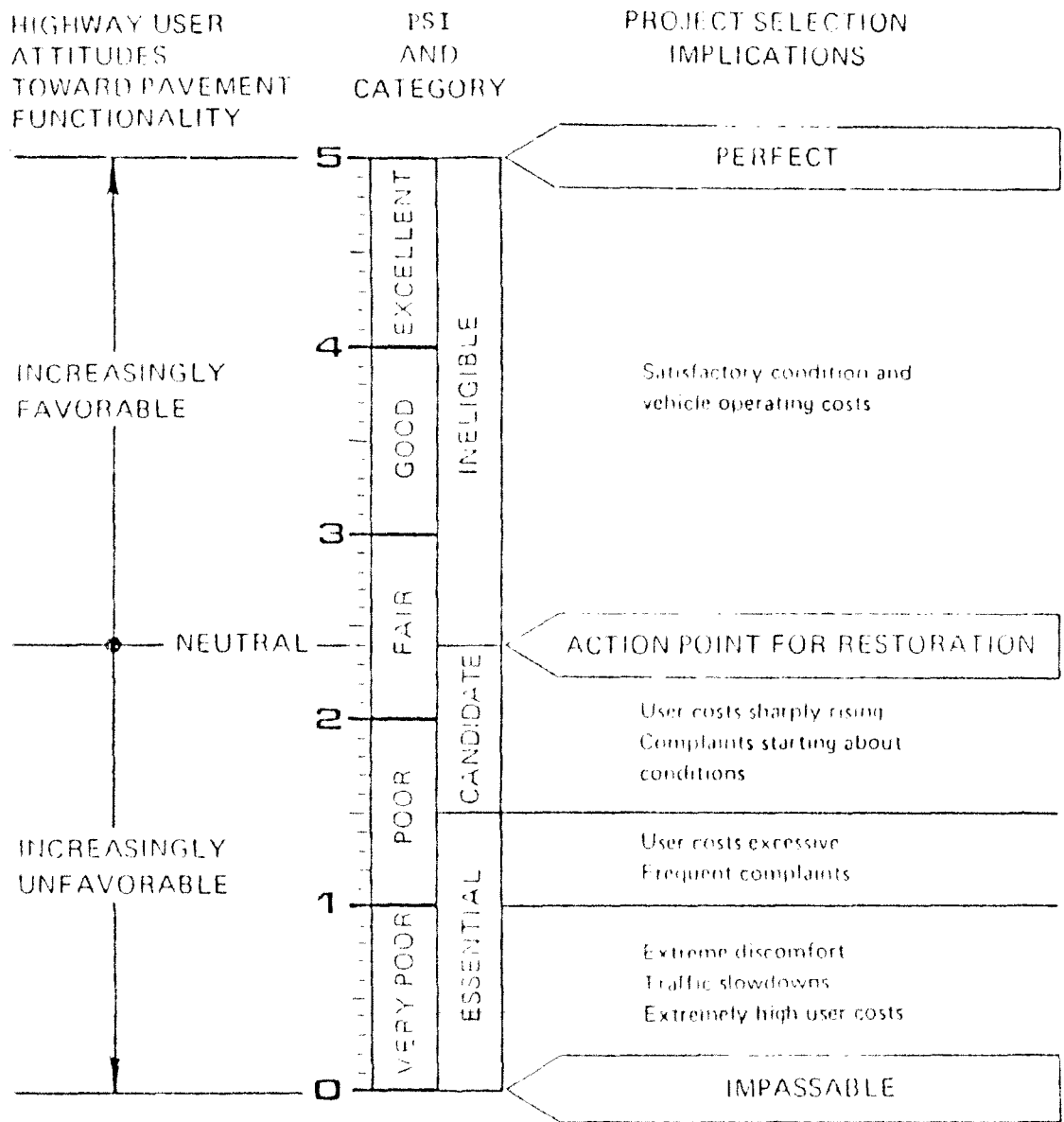
RECOMMENDATIONS

There will be no specification on gradation or AC content. However, the contractor must make every effort to produce a homogenous, uniform mix. There will be separate stockpiling for the existing crushed pavement and for the plus 4 material used to improve the gradation (see attachment "A" for plus 4 specification). There are two methods you might want to consider in placing the bituminous surface: stage construction with future surface or placing the ultimate. Of course, this will depend on the available funding. We hope this report covers the questions you might have about recycling flexible pavements.

Attachments
WBBetenson/ljm
cc: Sheldon McConkie

* 1.48 miles per lane will have to be conventional mix

Significance of the Present serviceability index (PSI) for effective pavement management.



NOTE All PSI values are dependent on travel speed which is taken to be the posted speed; both PSI and User Attitudes vary with travel speeds.