

DIVISION 300 - BASES

SECTIONS 301, 302, 303 - Vacant

SECTION 304 - AGGREGATE BASE AND SUBBASE COURSE

304.01 **Description** - This work shall consist of furnishing and placing one or more courses of aggregates on a prepared surface in accordance with the specifications in reasonably close conformity with the lines, grades, thickness and typical cross sections, as shown on the plans or established.

304.02 **Aggregate** - Aggregates shall conform to the requirements specified in the following subsections of Division 700 - Materials:

Aggregate Base	Type A & B	703.06 a
Aggregate Base	Type C	703.06 b
Aggregate Subbase	Type D & E	703.06 c

Aggregate for base or subbase courses shall be material meeting the aggregate type requirements specified in the following table:

Material	Aggregate Type (Subsection 703.06)
Base Course, Crushed	¹ A, B or C
Subbase Course, Gravel	² D
¹	Will be designated on the plans
²	When designated on the plans, Subbase Course, Gravel-Type E may be use below the top 9" of the subbase layer at Contractor's option.

For the various types of base and subbase, all shall conform to the gradation requirements of the Contract at the time it is deposited on the roadbed. The Department will obtain samples from the roadbed for Acceptance prior to compaction. Oversized stones shall be removed from the aggregate before depositing on the roadway. Oversized stones for the various types are as follows:

- Type A will not pass a 2" square mesh sieve
- Type B and Type C will not pass a 4" square mesh sieve
- Type D and E will not pass a 6" square mesh sieve

The top 3" of Aggregate Base Course-Type C shall consist of Recycled Asphalt Pavement (RAP) or Untreated Aggregate Surface Course-Type B.

304.03 **Placing** - The maximum compacted thickness of any base or subbase course layer shall not exceed 12" unless the Contractor demonstrates by a test section that the required compaction can be obtained. If compacted layers more than

12" are allowed, the Contractor shall agree to make the necessary excavations and backfilling in the course for the Resident to determine the density.

When layers are constructed of differently graded aggregate, fine grading of the lower layer will not be required except when millings are placed as the upper most layer. In this case the coarse graded base layer shall be fine graded to +/- 3/4" and compacted to the required specification prior to placing the layer of millings. The layer of millings shall then be placed, shaped, and compacted within the tolerances specified below.

Each layer of aggregate shall be placed over the full width of the section except, the Resident may authorize the Contractor to place less than full width layers, when existing traffic or other conditions restrict operations over the full width of the section. When the Contractor places material to complete the full width, the exposed edge of the previously placed aggregate shall be cleaned of all contamination before additional base or subbase aggregate is placed adjacent to it.

The material as spread shall be well mixed with no pockets of either fine or coarse material. Segregation of large or fine particles will not be allowed.

304.04 **Shaping, Compacting and Stabilizing** - Compaction of each layer of base and subbase shall continue until a density of not less than 95% of the maximum density has been achieved for the full width and depth of the layer. The maximum density shall be determined in accordance with AASHTO T 180, Method C or D, correcting for oversize particles except mixtures may have 40% or less retained on the 3/4" sieve. Field density tests will be performed by the Department in accordance with AASHTO T 310.

Compaction of each layer of base or subbase material that exceeds 40% retained on the 3/4" sieve shall continue until a density of not less than 98% of the maximum density has been achieved for the full width and depth of the layer. Density tests and the maximum density determined by a field proctor shall be performed by the Department.

The surface, compaction and stability, shall be satisfactorily maintained until the pavement course has been placed. If required, additional water and fine material shall be applied to prevent checking, raveling or rutting.

If the top of any layer becomes contaminated by degradation of the aggregate or addition of foreign material, the contaminated material shall be removed and replaced with the specified material.

All layers of base and subbase course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed unless otherwise authorized.

The Contractor shall bear full responsibility for and make all necessary repairs to the subbase course and the subgrade until the full depth of the subbase course

is placed and compacted. Repairs shall be considered incidental to other Contract items.

The top of any base or subbase course layer shall be scarified and loosened for a minimum depth of 1" immediately prior to the placing of the next layer of aggregate base or subbase. This scarifying shall be considered incidental to placing the course, and no separate payment will be made.

The surface of each layer shall be maintained during compaction operations in such a manner that a uniform texture is produced and the aggregate firmly keyed. The moisture content of the material shall be maintained at the proper percent to attain the required compaction and stability.

If voids remain on the surface after the subbase course has been constructed to grade, compacted, checked and approved, sand-leveling material shall be dumped and spread as directed. The quantity of sand leveling material shall be limited to the amount necessary to fill the voids and the minor low areas on the subbase surface. After the sand leveling material has been spread, it shall be completely rolled by a rubber-tired roller with water applied, if necessary. The surface of this material shall be maintained in its compacted and graded condition until the hot mix asphalt pavement has been placed. The furnishing, spreading, compacting and maintaining of sand leveling material will be considered included in the measurement and payment of the subbase course and no separate payment will be made.

If the Contractor wishes to route public traffic over the completed Aggregate Base-Type A and B or Aggregate Subbase Course for a period of time greater than 48 hours, the Aggregate Base and Aggregate Subbase Course shall be constructed with a minimum 2" surcharge above the design grade. Surcharge shall be constructed with material meeting the requirements of Section 703.06(b), Subbase Aggregate-Type D. Whenever the surcharge is used, it shall be placed on all the Aggregate Base and Aggregate Subbase Course subjected to public traffic. When the surcharge is removed, it may be placed in driveways, sidewalks, approach roads, or the outer portions of the shoulders. Removal of the surcharge shall be followed immediately in succession by the fine grading of the aggregate base or subbase and construction of the HMA base layer. As per Subsection 203.041 - Salvage of Existing Hot Mix Asphalt Pavement, Recycled Asphalt Pavement (RAP) may be used as the top 3" of aggregate. If RAP is utilized as the top 3", a surcharge is not required.

The furnishing, placing, maintaining, and removal of the surcharge will not be paid for directly, but will be considered incidental to the Aggregate Base or Aggregate Subbase course pay item.

- 304.05 **Surface Tolerance** - The completed surface of the subbase or base course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ".

304.06 **Method of Measurement** - Except as otherwise provided, base course subbase course to the level of subgrade will be measured by the cubic yard in place unless designated by pay item to be measured by truck measure. When measured in place, the width and thickness for measurement will be the width and thickness of base or subbase as shown on the plans or as modified. The length will be along the centerline unless modified by other methods generally recognized as conforming to good engineering practice. All measurements will be in accordance with Section 108.1 - Measurement of Quantities for Payment. When designated by pay item to be measured by truck measure, the measurement will be made in vehicles at the point of delivery as shown on delivery slips in accordance with Section 108.1.3 F - Delivery Slips.

As an alternative to in-place measurement, the Contractor and the Resident may agree in writing that the quantities of base or subbase for payment will be that shown in the Schedule of Items. If such an agreement is reached, no further measuring and computing of quantities will be required and the quantity referred to herein will be final.

Aggregate base course and aggregate subbase course designated by pay item to be measured in place and used for driveways and other locations difficult to accurately measure in place, may be measured in vehicles at 80% of the number of cubic yards accepted and used, at the point of delivery as shown by "Delivery Slips" in accordance with Section 108.1.3 F. The quantity so measured shall not exceed 1,250 yd³ per Contract, after shrinkage.

Pit measured items will be measured by the cubic yard in its' original position by ground modeling or other approved surveying methods. The final quantity will be the amount actually removed from the pit and used on the Project. Tailings, screenings, overburden, material used as other pay items, waste, and unauthorized use of the material will be deducted from the final quantity amount.

304.07 **Basis of Payment** - The accepted quantities of base course and subbase course of the type specified will be paid for at the respective Contract unit price per cubic yard complete in place.

When aggregate is required for slope blanket backfill, bedding under drainage structures and other foundations, it shall be paid for at twice the Contract unit price for the respective aggregate base or subbase course item used.

Payment for base and subbase courses shall be full compensation for purchasing material, stripping pits, excavating, crushing, screening, hauling, placing, compacting and other necessary processes which are required to furnish acceptable material under this item.

Water and/or fines added to material to aid compaction and stabilization to prevent raveling and rutting shall be incidental to the work.

The quantity for payment of base and subbase placed on rock subgrade shall include only that material placed above the normal subgrade line.

Furnishing and placing base and sub base backfill material between the rock and the normal subgrade line will not be paid for directly but shall be considered incidental to the work.

Payment will be made under:

Pay Item		Pay Unit
304.10	Aggregate Subbase Course-Gravel	Cubic Yard
304.103	Aggregate Subbase Course-Gravel, Truck Measure	Cubic Yard
304.104	Aggregate Subbase Course-Gravel, Plan Quantity	Cubic Yard
304.14	Aggregate Base Course - Type A	Cubic Yard
304.15	Aggregate Base Course - Type B	Cubic Yard
304.16	Aggregate Base Course - Type C	Cubic Yard

SECTION 305 – Removed

SECTION 306 - RECLAIMED MATERIAL FOR STABILIZED BASE - Reserved

SECTION 307 - FULL DEPTH RECYCLING (UNTREATED OR TREATED WITH EMULSIFIED ASPHALT STABILIZER)

- 307.01 **Description** - This work shall consist of pulverizing a portion of the existing roadway structure into a homogenous mass, adding an emulsified asphalt stabilizer (if required) to the depth of the pulverized material specified in the Contract, placing and compacting this material to the lines, grades, and dimensions shown on the plans or established by the Resident.

MATERIALS

- 307.02 **Pulverized Material** - Pulverized material shall consist of the existing asphalt pavement layers and 1" or more as specified of the underlying gravel, pulverized and blended into a homogenous mass. Pulverized material will be processed to 100% passing a 2" square mesh sieve.

- 307.021 **New Aggregate and Additional Recycled Material** - New aggregate, if required by the Contract, shall meet the requirements of Subsection 703.10 - Aggregate for Untreated Surface Course and Leveling Course, Type A. Aggregate Subbase Course Gravel Type D processed to 100% passing a 2" square mesh sieve and meeting the requirements of 703.06 – Aggregate for Base and Subbase may be used in areas

requiring depths greater than 2". New aggregate, will be measured and paid for under the appropriate item.

Recycled material, if required, shall consist of salvaged asphalt material from the Project or from off-site stockpiles that has been processed before use to 100% passing a 2" square mesh sieve. Recycled material shall be conditionally accepted at the source by the Resident. It shall be free of winter sand, granular fill, construction debris, or other materials not generally considered asphalt pavement.

Recycled material generated and salvaged from the Project shall be used within the roadway limits to the extent it is available as described in 307.09. No additional payment will be made for material salvaged from the Project.

Recycled material supplied from off-site stockpiles shall be paid for as described in the Contract, or by Contract modification.

- 307.022 **Emulsified Asphalt Stabilizer** - If required, the emulsified asphalt stabilizer shall be grade MS-2, MS-4, SS-1, or CSS-1 meeting the requirements of Subsection 702.04 - Emulsified Asphalt.
- 307.023 **Water** - Water shall be clean and free from deleterious concentrations of acids, alkalis, salts or other organic or chemical substances.
- 307.024 **Portland Cement** - If required, Portland Cement shall be Type I or II meeting the requirements of AASHTO M 85.
- 307.025 **Hydrated Lime** - If required, Hydrated Lime shall meet the requirements of AASHTO M 216.

EQUIPMENT

- 307.03 **Pulverizer** - The pulverizer shall be a self-propelled machine, specifically manufactured for full-depth recycling work and capable of reducing the required existing materials to a size that will pass a 2" square mesh sieve. The machine shall be equipped with standard automatic depth controls and must maintain a consistent cutting depth and width. The machine also shall be equipped with a gauge to show depth of material being processed.
- 307.04 **Liquid Mixer Unit or Distributor** - If treatment of the recycled layer with emulsified asphalt is required by the Contract, a liquid mixing unit or distributor shall be used to introduce the emulsified asphalt stabilizer into the pulverized material. The mixing unit shall contain a liquid distribution and mixing system which has been specifically manufactured for full-depth recycling work, capable of mixing the pulverized material with an evenly metered distribution of emulsified asphalt into a homogeneous mixture, to the depth and width required.

The mixing unit shall be designed, equipped, maintained, and operated so that emulsified asphalt stabilizer at constant temperature may be applied uniformly

on variable widths of pulverized material up to 6 ft at readily determined and controlled rates from 0.01 to 1.06 gal/yd² with uniform pressure and with an allowable variation from any specified rate not to exceed 0.01 gal/yd². Mixing units shall include a tachometer, pressure gages, and accurate volume measuring devices or a calibrated tank and a thermometer for measuring temperatures of tank contents.

- 307.041 **Cement or Lime Spreader** - If required by the Contract, spreading of the Portland Cement or Hydrated Lime shall be done with a spreader truck designed to spread dry particulate (such as Portland Cement or Lime) or other approved means to insure a uniform distribution across the roadway and minimize fugitive dust. Pneumatic application, including through a slotted pipe, will not be permitted. Other systems that have been developed include fog systems, vacuum systems, etc. Slurry applications may also be accepted. The Department reserves the right to accept or reject the method of spreading cement. The Contractor shall provide a method for verifying that the correct amount of cement is being applied.
- 307.05 **Placement Equipment** - Placement of the Full Depth recycled material to the required slope and grade shall be done with an approved highway grader or by another method approved by the Resident.
- 307.06 **Rollers** - The full depth recycled material shall be rolled with a vibratory pad foot roller, a vibratory steel drum soil compactor and a pneumatic tire roller. The pad foot roller drum shall have a minimum of 112 tamping ft 3" in height, a minimum contact area per foot of 17 in², and a minimum width of 84". The vibratory steel drum roller shall have a minimum 84" width single drum. The pneumatic tire roller shall meet the requirements of Section 401.10 and the minimum allowable tire pressure shall be 85 psi.

MIX DESIGN

If treatment of the recycled layer with emulsified asphalt is required by the Contract, the Department will supply a mix design for the emulsified asphalt stabilized material based on test results from pavement and soil analysis taken to the design depth. The Department will provide the following information prior to construction:

1. Percent of emulsified asphalt to be used.
2. Quantity of lime or cement to be added.
3. Optimum moisture content for proper compaction.
4. Additional aggregate (if required).

After a test strip has been completed or as the work progresses, it may be necessary for the Resident to make necessary adjustments to the mix design. Changes to compensation will be in accordance with the Mix Design Special Provision.

CONSTRUCTION REQUIREMENTS

- 307.06 **Pulverizing** - The entire depth of existing pavement shall be pulverized together with 1" or more of the underlying gravel into a homogenous mass. All pulverizing shall be done with equipment that will provide a homogenous mass of pulverized material, processed in-place, which will pass a 2" square mesh sieve.
- 307.07 **Weather Limitations** - Full depth recycled work shall be performed when;
- Recycling operations will be allowed between May 15th and September 15th inclusive in Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais. Recycling will be allowed between May 1st and September 30th inclusive in Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.
 - The atmospheric temperature, as determined by an approved thermometer placed in the shade at the recycling location, is 50°F and rising.
 - When there is no standing water on the surface.
 - During generally dry conditions, or when weather conditions are such that proper pulverizing, mixing, grading, finishing and curing can be obtained using proper procedures, and when compaction can be accomplished as determined by the Resident.
 - When the surface is not frozen and when overnight temperatures are expected to be above 32°F.
 - Wind conditions are such that the spreading of lime or cement on the roadway ahead of the recycling machine will not adversely affect the operation.
- 307.08 **Surface Tolerance** - The complete surface of the Full Depth Recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ".
- 307.09 **Full Depth Recycling Procedure** - New aggregate or recycled material meeting the requirements of Section 307.021 - New Aggregate and Additional Recycled Material, shall be added as necessary to restore cross-slope and/or grade before pulverizing. Locations will be shown on the plans or described in the construction notes. The Resident may add other locations while construction of the Project is in progress. The Contractor will use recycled material to the extent it is available, in lieu of new aggregate. The material shall then be pulverized, processed, and blended into a homogeneous mass passing a 2" square mesh sieve. Material found not pulverized down to a 2" size will be required to be reprocessed by the recycler with successive passes until approved by the Resident.

Should the Contractor be required to add new aggregate or recycled material to restore cross-slope and/or grade after the initial pulverizing process, those areas will require re-processing to blend into a homogenous mass passing a 2" square mesh sieve.

Sufficient water shall be added during the recycling process to maintain optimum moisture for compaction.

The resultant material from the initial pulverizing processes shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will also be responsible for re-establishing the existing profile grade. The completed surface of the full depth recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ". Areas not meeting this tolerance will be repaired as described in Section 307.091. The initial pulverizing process density requirements will be the same as Section 307.101 unless otherwise directed by the Resident.

Additives, if required, shall be introduced following completion of the initial pulverizing and blending process. Emulsified asphalt stabilizer shall be incorporated into the top of the processed material as specified in section 307.04 to the depth specified in the Contract by use of the liquid mixer unit or a distributor, at the rate specified in the mix design. The emulsified asphalt shall then be uniformly blended into a homogeneous mass until an apparent uniform distribution has occurred. The rate of application may be adjusted as necessary by the Resident. Cement or lime shall be introduced as described in section 307.041. The resultant material shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will also be responsible for re-establishing the existing profile grade.

After final compaction, the roadway surface shall be treated with a light application of water and rolled with pneumatic-tired rollers to create a close-knit texture. The finished final completed layer shall be free from:

- A. Surface laminations.
- B. Portions exhibiting Segregation of fine and coarse aggregate.
- C. Corrugations, centerline differential, potholes, or any other defects that may adversely affect the performance of the layer, or any layers to be placed upon it.

The Contractor shall protect and maintain the recycled layer until a lift of pavement is applied. Any damage or defects in the layer shall be repaired immediately. An even and uniform surface shall be maintained. The recycled surface shall be swept prior to hot mix asphalt overlay placement.

307.091 **Repairs** - Repairs and maintenance of the recycled layers, resulting from damage caused by traffic, weather or environmental conditions, or resulting from damage caused by the Contractor's operations or

equipment, shall be completed at no additional cost to the Department.

For recycled layers stabilized with emulsified asphalt, low areas will be repaired using a hot mix asphalt shim. Areas up to 1" high can be repaired by milling or shimming with hot mix asphalt. Areas greater than 1" high will be repaired using a hot mix asphalt shim. All repair work will be done with the Resident's approval at the Contractor's expense.

TESTING REQUIREMENTS

307.10 **Quality Control** - The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of Section 106.4 - Quality Control and this Section. The Contractor shall not begin recycling operations until the Department approves the QCP in writing.

Prior to performing any recycling process, the Department and the Contractor shall hold a Pre-recycle conference to discuss the recycling schedule, type and amount of equipment to be used, sequence of operations, and traffic control. A copy of the QC random numbers to be used on the Project shall be provided to the Resident. All field supervisors including the responsible onsite recycling process supervisor shall attend this meeting.

The QCP shall address any items that affect the quality of the Recycling Process including, but not limited to, the following:

- A. Sources for all materials, including New Aggregate and Additional Recycled Material.
- B. Make and type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers.
- C. Testing Plan.
- D. Recycling operations including recycling speed, methods to ensure that segregation is minimized, grading and compacting operations.
- E. Methods for protecting the finished product from damage and procedures for any necessary corrective action.
- F. Method of grade checks.
- G. Examples of Quality Control forms.
- H. Name, responsibilities, and qualifications of the Responsible Onsite Recycling Supervisor experienced and knowledgeable with the process.
- I. A note that all testing will be done in accordance with AASHTO and MaineDOT/ACM procedures.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the full depth reclamation process in accordance with the following minimum frequencies:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 1000 ft / lane	AASHTO T 310
Air Temperature	4 per Day at even intervals	
Surface Temperature	At the beginning and end of each Days operation	
Yield of all materials (Daily yield, yield since last test, and total Project yield.)	1 per 1000 ft/lane	

The Department may view any QC test and request a QC test at any time. The Contractor shall submit all QC test reports and summaries in writing, signed by the appropriate technician, to the Department’s onsite representative by 1:00 p.m. on the next Working Day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Department onsite.

The Contractor shall cease recycling operations whenever one of the following occurs:

- A. The Contractor fails to follow the approved QCP.
- B. The Contractor fails to achieve 98% density after corrective action has been taken.
- C. The finished product is visually defective, as determined by the Resident.
- D. The computed yield differs from the mix design by 10% or more.

Recycling operations shall not resume until the Department approves the corrective action to be taken.

307.101 **Test Strip** - The Contractor shall assemble all items of equipment for the recycling operation on the 1st Day of the recycling work. The Contractor shall construct a test strip for the Project at a location approved by the Resident. The Responsible onsite Recycling Supervisor will work with Department personnel to determine the suitability of the mixed material, moisture control within the mixed material, and compaction and surface finish. The test strip section is required to:

- A. Demonstrate that the equipment and processes can produce recycled layers to meet the requirements specified in these special provisions.

- B. Determine the effect on the gradation of the recycled material by varying the forward speed of the recycling machine and the rotation rate of the milling drum.
- C. Determine the optimum moisture necessary to achieve proper compaction of the recycled layer.
- D. Determine the sequence and manner of rolling necessary to obtain the compaction requirements and establish a target density. The Contractor and the Department will both conduct testing with their respective gauges at this time.

The test strip shall be at least 300 ft in length of a full lane-width (or a half-road width). Full recycling production will not start until a passing test strip has been accomplished. If a test strip fails to meet the requirements of this specification, the Contractor will be required to repair or replace the test strip to the satisfaction of the Resident. Any repairs, replacement, or duplication of the test strip will be at the Contractor's expense.

After the test strip has been pulverized, and the roadway brought to proper shape, the Contractor shall add water until it is determined that optimum moisture has been obtained. The test strip shall then be rolled using the specified compaction equipment as directed until the density readings show an increase in dry density of less than 1 pcf for the final four roller passes of each roller. The Contractor and Department will each determine a target density using their respective gauges by performing several additional density tests and averaging them. The average of these tests will be used as the target density of the recycled material for QC and Acceptance purposes.

Following completion of the test strip, compaction of the material shall continue until a density of not less than 98% of the test strip target density has been achieved for the full width and depth of the layer. During the construction and compaction of the Full Depth Recycled base, should 3 consecutive Acceptance test results for density fail to meet a minimum of 95% of the target density, or exceed 102% of target density, a new test strip shall be constructed.

ACCEPTANCE TEST FREQUENCY

Property	Frequency	Test Method
In-place Density	1 per 2000 ft / lane	AASHTO T 310

307.102 **Curing** - No new pavement shall be placed on the full depth recycled pavement until curing has reduced the moisture content to 1% or less by total weight of the mixture, or a curing period of 4 Days has elapsed, whichever comes first.

307.11 **Method of Measurement** - Full Depth Recycled Pavement (Untreated or Treated with Emulsified Asphalt Stabilizer) will be measured by the square yard.

307.12 **Basis of Payment** - The accepted quantity of Full Depth Recycled Asphalt Pavement (Untreated or Treated with Emulsified Asphalt Stabilizer) will be paid for at the Contract unit price per square yard, complete in-place which price will be full compensation for furnishing all equipment, materials and labor for pulverizing, blending, placing, grading, compacting, and for all incidentals necessary to complete the work.

The addition of materials to restore profile grade and/or cross-slope in areas shown on the plans or described in the construction notes will be paid separately under designated pay items within the Contract. No additional payment will be made for materials salvaged from the Project.

Payment will be made under:

Pay Item		Pay Unit
307.331	Full Depth Recycled Pavement (Untreated)	Square Yard
307.332	Full Depth Recycled Pavement (with Emulsified Asphalt Stabilizer) 5" depth	Square Yard
307.33	Full Depth Recycled Pavement (with Emulsified Asphalt Stabilizer) 6" depth	Square Yard

SECTION 308 - FULL DEPTH RECYCLING WITH CEMENT

308.01 **Description** - This work shall consist of pulverizing a portion of the existing roadway structure into a homogenous mass, stabilizing the material with cement and placing and compacting this material to the lines, grades, and dimensions shown on the plans or established by the Resident.

MATERIALS

308.02 **Pulverized Material** - Pulverized material shall consist of the existing asphalt pavement and 1" or more as specified of the underlying gravel, pulverized, and blended into a homogenous mass. Pulverized material will be processed to 100% passing a 2" square mesh sieve.

308.021 **New Aggregate and Additional Recycled Material** - New aggregate, if required by the Contract, shall meet the requirements of Subsection 703.10 - Aggregate for Untreated Surface Course and Leveling Course, Type A. Aggregate Subbase Course Gravel Type D processed to 100% passing a 2" square mesh sieve and meeting the requirements of 703.06 – Aggregate for Base and Subbase may be used in areas requiring depths greater than 2". New aggregate will be measured and paid for under the appropriate item.

Recycled material, if required, shall consist of salvaged asphalt material from the Project or from off-site stockpiles that has been processed before use to 100% passing a 2" square mesh sieve. Recycled material shall be conditionally accepted at the source by the Resident. It shall be free of winter sand, granular fill, construction debris, or other materials not generally considered asphalt pavement.

Recycled material generated and salvaged from the Project shall be used within the roadway limits to the extent it is available as described in 308.09. No additional payment will be made for material salvaged from the Project.

Recycled material supplied from off-site stockpiles shall be paid for as described in the Contract, or by Contract modification.

308.022 **Portland Cement** - The Portland Cement shall be Type I or II meeting the requirements of AASHTO M 85.

308.023 **Water** - Water shall be clean and free from deleterious concentrations of acids, alkalis, salts or other organic or chemical substances.

EQUIPMENT

308.03 **Pulverizer** - The pulverizer shall be a self-propelled machine, specifically manufactured for full-depth recycling work and capable of reducing the required existing materials to a size that will pass a 2" square mesh sieve. The machine shall be equipped with standard automatic depth controls and must maintain a consistent cutting depth and width. The machine also shall be equipped with a gauge to show depth of material being processed.

308.031 **Cement Spreader** - Spreading of the Portland Cement shall be done with a spreader truck designed to spread dry particulate (such as Portland Cement or Lime) or other approved means to insure a uniform distribution across the roadway and minimize fugitive dust. Pneumatic application, including through a slotted pipe, will not be permitted. Other systems that have been developed include fog systems, vacuum systems, etc. Slurry applications could also be accepted. The Department reserves the right to accept or reject the method of spreading cement based on the concerns specified herein. The Contractor shall provide a method for verifying that the correct amount of cement is being applied.

Health and Safety/Right-to-Know - Portland Cement is considered a hazardous chemical under US OSHA Hazard Communication Rule 29 CFR 1910.120, therefore, all Contractors and Subcontractors are required to notify their workers of the potential health hazards associated with working with Portland Cement.

In no area of the work site, where cement or cement-pavement-gravel combination is being applied, re-worked with reclaimer, rolled or graded, shall respirable dust be allowed to exceed the NIOSH [1974] established respirable dust standard (RDS) recommended exposure limit (REL) of 0.05 mg/m³ (for up to a 10 hour workday during a 40 hour work week).

The Contractor shall notify the Resident before commencing any work that involves Portland Cement application, reclaiming, rolling, or grading.

The Contractor shall designate a Hazardous Waste Operations "Competent Person" to provide direct on-site supervision plus health and safety monitoring for work in the Portland Cement impacted sections of the Project. The Competent Person shall have certified training and experience in field implementation of the aforementioned regulations.

Submittals - The Contractor shall submit a site specific Health and Safety Plan (HASP) to the Resident at least 2 weeks in advance of any Portland Cement related work on the Project.

Health and Safety Monitoring - In any area of the Project where Portland Cement is being worked, the Contractor's designated Competent Person shall monitor the worker breathing zone for respirable dust. In the event the OSHA respirable dust REL is exceeded, the Contractor's Competent Person shall direct operations to cease. Operations will not recommence until the situation is corrected and respirable air returns to acceptable levels. The Contractor shall provide all required health and safety monitoring equipment.

- 308.04 **Placement Equipment** - Placement of the Full Depth recycled material to the required slope and grade shall be done with an approved highway grader or by another method approved by the Resident.
- 308.05 **Rollers** - The full depth recycled material shall be rolled with a vibratory pad foot roller, a vibratory steel drum soil compactor and a pneumatic tire roller. The pad foot roller drum shall have a minimum of 112 tamping foot 3" in height, a minimum contact area per foot of 17 in², and a minimum width of 84". The vibratory steel drum roller shall have a minimum 84" width single drum. The pneumatic tire roller shall meet the requirements of Section 401.10 and the minimum allowable tire pressure shall be 85 psi.

MIX DESIGN

The Department will supply a mix design for the recycling work based on test results from pavement and soil analysis taken to the design depth. The Department will provide the following information prior to construction:

1. Percent of Portland Cement to be used.
2. Optimum moisture content for proper compaction.
3. Additional aggregate (if required).

After a test strip has been completed or as the work progresses, it may be necessary for the Resident to make necessary adjustments to the mix design. Changes to compensation will be in accordance with the Mix Design Special Provision.

CONSTRUCTION

- 308.06 **Pulverizing** - The entire depth of existing pavement shall be pulverized together with approximately 1" or more of the underlying gravel into a homogenous mass. All pulverizing shall be done with equipment that will provide a homogenous mass of pulverized material, processed in-place, which will pass a 2" square mesh sieve.
- 308.07 **Weather Limitations** - When Portland Cement is used, full depth recycled work shall be performed when;
- a. Cement stabilizing operations will be allowed between May 15th and September 15th inclusive in Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais. Cement stabilizing will be allowed between May 1st and September 30th inclusive in Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.
 - b. The atmospheric temperature, as determined by an approved thermometer placed in the shade at the recycling location, is 50°F and rising.
 - c. When there is no standing water on the surface.
 - d. During generally dry conditions, or when weather conditions are such that proper pulverizing, adding, mixing, and curing can be obtained using proper procedures, and when compaction can be accomplished as determined by the Resident.
 - e. When the surface is not frozen and when overnight temperatures are expected to be above 32°F.
 - f. Wind conditions as such that the spreading of cement on the roadway ahead of the recycling machine will not adversely affect the operation (cement will not be blown away).

308.08 **Surface Tolerance** - The complete surface of the Full Depth Reclamation course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ".

308.09 **Full Depth Recycling Procedure** - New aggregate or recycled material meeting the requirements of Section 308.021 - New Aggregate and Additional Recycled Material shall be added as necessary to restore cross-slope and/or grade before pulverizing. Locations will be shown on the plans or described in the construction notes; the Resident may add other locations while construction of the Project is in progress. The Contractor will use recycled material to the extent it is available, in lieu of new aggregate. The material shall then be pulverized, processed, and blended into a homogeneous mass passing a 2" square mesh sieve. Material found not pulverized down to a 2" size will be required to be reprocessed by the recycler with successive passes until approved by the Resident.

Should the Contractor be required to add new aggregate or recycled material to restore cross-slope and/or grade after the initial pulverizing process, those areas will require re-processing to blend into a homogenous mass passing a 2" square mesh sieve.

The resultant material shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will also be responsible for re-establishing the existing profile grade. The completed surface of the full depth recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ". The initial reclaiming process density requirements will be the same as Section 308.101 unless otherwise directed by the Resident.

Following completion of the initial reclaiming process cement shall be spread uniformly over the full width of roadway to be recycled just prior to each pass of the stabilizing operation, in a continuous process by means of a mechanical spreader. Dry stabilizing agents shall be spread at the prescribed rate in the mix design as provided by the Department. These additives shall then be uniformly blended into a homogeneous mass until an apparent uniform distribution has occurred. The Resident may adjust the rate of application as necessary.

Sufficient water shall be added through the recycler head during the recycling process to ensure thorough blending to meet the optimum moisture for compaction as specified. Water shall be added only by means of a controlled system on the recycling machine. Care shall be taken to prevent any portion of the work from excessive wetting. A second water truck may be required during recycling operations to assist in the compaction and water control efforts. The rate of water supplied shall be kept constant unless changed due to Project material changes.

The resultant material shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will

also be responsible for re-establishing the existing profile grade. The completed surface of the full depth recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ". Areas not meeting this tolerance will be repaired as described in Section 308.091.

After compaction, the roadway surface shall be treated with a light application of water, and rolled with pneumatic-tired rollers to create a close-knit texture. The finished final completed layer shall be free from:

- A. Surface laminations,
- B. Portions exhibiting segregation of fine and coarse aggregate,
- C. Corrugations, centerline differential, potholes, or any other defects that may adversely affect the performance of the layer.

The Contractor shall protect and maintain the recycled layer until a lift of pavement is applied. Frequent light watering shall be performed to keep the finished cement stabilized material moist for at least 48 hours. Watering will continue from 48 hours to 1 week if the equipment is available on-site. Any damage or defects in the layer shall be repaired immediately. An even and uniform surface shall be maintained. The recycled surface shall be swept prior to hot mix asphalt placement.

308.091 **Repairs** - Repairs and maintenance of the recycled layers, during and after the curing period, resulting from damage caused by traffic, weather or environmental conditions, or resulting from damage caused by the Contractor's operations or equipment, shall be completed at no additional cost to the Department.

Low areas will be repaired using a hot mix asphalt shim. Areas up to 1" high can be repaired by either milling the high area or shimming the low areas adjacent to the high area with hot mix asphalt areas greater than 1" high will be repaired by shimming the low areas adjacent to the high area with hot mix asphalt. All repair work will be done with the Resident's approval at the Contractor's expense.

TESTING REQUIREMENTS

308.10 **Quality Control** - The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of Section 106.4 - Quality Control and this Section. The Contractor shall not begin recycling operations until the Department approves the QCP in writing.

Prior to performing any recycling process, the Department and the Contractor shall hold a Pre-recycle conference to discuss the recycling schedule, type and amount of equipment to be used, sequence of operations, and traffic control. A copy of the QC random numbers to be used on the Project shall be provided to

the Resident. All field supervisors including the responsible onsite recycling process supervisor shall attend this meeting.

The QCP shall address any items that affect the quality of the Recycling Process including, but not limited to, the following:

- A. Sources for all materials, including New Aggregate and Additional Recycled Material.
- B. Make and type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers.
- C. Testing Plan.
- D. Recycling operations including recycling speed, yield monitoring, procedures for avoiding recycling and curing in inclement weather, methods to ensure that segregation is minimized, procedures for mix design modification, grading and compacting operations, and methods to introduce water throughout the cement treated layer, and cement application procedure.
- E. Methods for protecting the finished product from damage and procedures for any necessary corrective action.
- F. Method of grade checks.
- G. Examples of Quality Control forms.
- H. Name, responsibilities, and qualifications of the Responsible Onsite Recycling Supervisor experienced and knowledgeable with the process.
- I. A note that all testing will be done in accordance with AASHTO and MaineDOT/ACM procedures.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the full depth reclamation process in accordance with the following minimum frequencies:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 1000 ft / lane	AASHTO T 310
Air Temperature	4 per Day at even intervals	
Surface Temperature	At the beginning and end of each Days operation	
Yield of all materials (The daily yield, yield since last test, and total Project yield.)	1 per 1000 ft / lane	

The Department may view any QC test and request a QC test at any time.

The Contractor shall submit all QC test reports and summaries in writing, signed by the appropriate technician, to the Department's onsite representative by 1:00 p.m. on the next Working Day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Department onsite.

The Contractor shall cease recycling operations whenever one of the following occurs:

- A. The computed yield differs from the mix design by 10% or more.
- B. The Contractor fails to follow the approved QCP.
- C. The Contractor fails to achieve 98% density after corrective action has been taken.
- D. The finished product is visually defective, as determined by the Resident.

Recycling operations shall not resume until the Department approves the corrective action to be taken.

308.101 **Test Strip** - The Contractor shall assemble all items of equipment for the recycling operation on the first Day of the recycling work. The Contractor shall construct a test strip for the Project at a location approved by the Resident. The Responsible Onsite Recycling Supervisor will work with Department personnel to determine the suitability of the mixed material, cement dispersion within the mixed material, moisture control within the mixed material, and compaction and surface finish. The test strip section is required to:

- A. Demonstrate that the equipment and processes produce recycled layers to meet the requirements specified requirements.
- B. Determine the effect on the gradation of the recycled material by varying the forward speed of the recycling machine and the rate of rotation rate of the milling drum.
- C. Determine the optimum moisture necessary to achieve proper compaction of the recycled layer.
- D. Determine the sequence and manner of rolling necessary to obtain the compaction requirements and establish a target TMD. The Contractor and the Department will both conduct testing with their respective gauges at this time.

The test strip shall be at least 300 ft in length of a full lane-width (or a half-road width). Full recycling production will not start until a passing test strip has been accomplished. If a test strip fails to meet the requirements of this specification, the Contractor will be required to repair or replace the test strip to the satisfaction of the Resident. Any repairs, replacement, or duplication of the test strip will be at the Contractor's expense.

After the test strip has been pulverized, and the roadway brought to proper shape, the Contractor shall add water until it is determined that optimum moisture has been obtained. The test strip shall then be rolled using the specified compaction equipment as directed until the density readings show an increase in dry density of less than 1 pcf for the final four roller passes of each roller. The Contractor and Department will each determine a target density using their respective gauges by performing several additional density tests and averaging them. The average of these tests will be used as the target density of the recycled material for QC and Acceptance purposes.

Following completion of the test strip, compaction of the material shall continue until a density of not less than 98% of the test strip target density has been achieved for the full width and depth of the layer. During the construction and compaction of the Full Depth Recycled base, should three consecutive Acceptance test results for density fail to meet a minimum of 95% of the target density, or exceed 102% of target density, a new test strip shall be constructed.

ACCEPTANCE TEST FREQUENCY

Property	Frequency	Test Method
In-place Density	1 per 2000 ft / lane	AASHTO T 310

308.11 **Miscellaneous** - No new pavement shall be placed on the full depth recycled pavement until a curing period of 48 hours has elapsed. If inclement weather occurs, the Department reserves the right to extend the curing period. Between 24 and 48 hours after compaction, the finished course shall be vibrated with between 2 and 4 passes of a 12 ton minimum weight steel-wheel vibratory roller, traveling at a speed of approximately 2 mph and vibrating at maximum amplitude (or as directed by Resident). The section shall have 100% coverage exclusive of the outside 1 ft to induce minute cracks in the treated base course. Additional passes may be required to achieve the desired crack pattern or section modulus as directed by the Resident.

308.12 **Method of Measurement** - Full Depth Recycled Pavement with Cement will be measured by the square yard.

308.13 **Basis of Payment** - The accepted quantity of Full Depth Recycled Asphalt Pavement with Cement will be paid for at the Contract unit price per square yard, complete in-place which price will be full compensation for furnishing all equipment, materials and labor for pulverizing, blending, placing, grading, compacting, and for all incidentals necessary to complete the work.

The addition of materials to restore profile grade and/or cross-slope in areas shown on the plans or described in the construction notes will be paid separately under designated pay items within the Contract. No additional payment will be made for materials salvaged from the Project.

Payment will be made under:

Pay Item		Pay Unit
308.36	Full Depth Recycling with Cement	Square Yard

SECTION 309 - FOAMED ASPHALT

FULL DEPTH RECYCLED PAVEMENT (With Foamed Asphalt)

- 309.01 **Description** - This work shall consist of pulverizing a portion of the existing roadway structure into a homogenous mass, treating the pulverized material with the foamed asphalt process, and placing and compacting this material to the lines, grades, and dimensions shown on the plans or established by the Resident.

MATERIALS

- 309.020 **Pulverized Material** - Pulverized material shall consist of the existing asphalt pavement and 1" or more as specified of the underlying gravel, pulverized and blended into a homogenous mass. Pulverized material will be processed to 100% passing a 2" square mesh sieve.

- 309.021 **New Aggregate and Additional Recycled Material** - New aggregate, if required by the Contract, shall meet the requirements of Section 703.10 - Aggregate for Untreated Surface Course and Leveling Course, Type A. Aggregate Subbase Course Gravel Type D processed to 100% passing a 2" square mesh sieve and meeting the requirements of 703.06 – Aggregate for Base and Subbase may be used in areas requiring depths greater than 2". New aggregate required to restore grade and/or cross-slope shall be measured and paid for under the appropriate item. Crusher dust required as part of the job mix shall be considered part of the 309 item and will not be measured for payment.

Recycled material, if required, shall consist of salvaged asphalt material from the Project or from off-site stockpiles that has been processed, prior to use to 100% passing a 2" square mesh sieve. Recycled material shall be conditionally accepted at the source by the Resident. It shall be free of winter sand, granular fill, construction debris, and other materials not generally considered asphalt pavement.

Recycled material generated and salvaged from the Project shall be used within the roadway limits to the extent it is available as described in 309.06. No additional payment will be made for material salvaged from the Project.

Recycled material supplied from off-site stockpiles shall be paid for as described in the Contract, or by Contract modification.

- 309.022 **Asphalt Binder** - The asphalt binder used in the foamed asphalt process shall be Performance Grade 64-28 or 58-28 meeting the requirements of AASHTO M 320.
- 309.023 **Portland Cement** - The Portland Cement shall be Type I or II meeting the requirements of AASHTO M 85.
- 309.024 **Hydrated Lime** - Hydrated Lime shall meet the requirements of AASHTO M 216.
- 309.025 **Crusher Dust** - Crusher dust, if required by the mix design, shall be free from friable or deleterious material, including excessive mica, and shall meet the following gradation requirements:

Sieve Size	Percent Passing
12.5 mm [1/2"]	100
0.075 mm [No. 200]	10 - 20

- 309.026 **Water** - Water shall be clean and free from deleterious concentrations of acids, alkalis, salts or other organic or chemical substances.

EQUIPMENT

- 309.030 **Pulverizer** - The modified milling or recycling machine shall, as a minimum, have the following features:
 - a. A minimum power capability of 600 horsepower.
 - b. Two microprocessor-controlled systems, complete with 2" dependent pumping systems and spray bars, to regulate the application of foamed asphalt stabilizing agent, separate from water (for increasing the moisture content of the recycled material's moisture content), both in relation to the forward speed and mass of the material being recycled.
 - c. Two spray bars shall each be fitted with self-cleaning nozzles at a maximum spacing of one nozzle for each 6" width of the chamber.
 - d. The foamed asphalt shall be produced at the spray bar in individual expansion chambers into which both hot asphalt and water are injected under pressure through individual and separate small orifices that promote atomization. The rate of addition of water into hot asphalt shall be kept at a constant (percentage by mass of asphalt) by the same microprocessor.
 - e. An inspection (or test) nozzle shall be fitted at one end of the spray bar that produces a representative sample of foamed asphalt.

- f. An electrical heating system shall be incorporated that is capable of maintaining the temperature of all asphalt flow components above 300°F.
 - g. A single asphalt feed pipe installed between the modified milling or recycling machine and the supply tanker shall be employed. Circulating systems that incorporate a return pipe to the supply tanker shall not be used.
 - h. The recycler shall be fitted with a front breaker bar system to ensure that the reclaimed material is broken down to the sizing outlined in 309.020.
- 309.031 **Liquid Mixer Unit or Distributor** - Only tankers with a capacity exceeding ten 2,500 gal shall be used employed to supply the recycling machine with asphalt. Each tanker shall be fitted with two recessed pin-type tow hitches, one in front and the other behind, thereby allowing the tanker to be pushed from behind by the recycling machine, and to push a water tanker in front. No leaking tanker will be permitted on the job site. In addition, each tanker shall be equipped with the following:
- a. A thermometer to show the temperature of the contents in the bottom third of the tank.
 - b. A rear feed valve, with a minimum internal diameter of 3", that is capable of draining the contents of the tank.
 - c. Insulation to retain heat.
 - d. A calibrated dipstick marked at intervals of no more than 25 gal, for measuring the contents of the tank.
- 309.032 **Cement or Lime Spreader** - Spreading of the Portland Cement or Hydrated Lime shall be done with a spreader truck designed to spread dry particulate (such as Portland Cement or Lime) or other approved means to insure a uniform distribution across the roadway and minimize fugitive dust. Pneumatic application, including through a slotted pipe, will not be permitted. Other systems that have been developed include fog systems, vacuum systems, etc. Slurry applications may also be accepted. The Department reserves the right to accept or reject the method of spreading cement. The Contractor shall provide a method for verifying that the correct amount of cement is being applied.
- 309.033 **Placement Equipment** - Placement of the full depth recycled material to the required slope and grade shall be done with an approved highway grader or by another method approved by the Resident.
- 309.034 **Rollers** - The full depth recycled material shall be rolled with a vibratory pad foot roller, a vibratory steel drum soil compactor and a pneumatic tire roller. The pad foot roller drum shall have a minimum of 112 tamping foot 3" in height, a minimum contact area per foot of 17 in², and a minimum width of 84". The vibratory steel drum roller shall

have a minimum 84" width single drum. The pneumatic tire roller shall meet the requirements of Section 401.10 and the minimum allowable tire pressure shall be 85 psi.

MIX DESIGN

The Department will supply a mix design for the foamed asphalt based on test results from pavement and soil analysis taken to the design depth. The Department will provide the following information prior to construction:

1. Percent of asphalt to be used.
2. Percent of water to be used in the foaming process.
3. Quantity (if any) of crusher dust to be used.
4. Quantity of lime or cement to be added.
5. Optimum moisture content for proper compaction and dispersion of foamed asphalt.
6. Additional aggregate (if required).

After a test strip has been completed or as the work progresses, it may be necessary for the Resident to make necessary adjustments to the mix design. Changes to compensation will be in accordance with the Mix Design Special Provision.

CONSTRUCTION REQUIREMENTS

- 309.04 **Pulverizing** - The entire depth of existing pavement shall be pulverized together with approximately 1" or more of the underlying gravel into a homogenous mass. All pulverizing shall be done with equipment that will provide a homogenous mass of pulverized material, processed in-place, which will pass a 2" square mesh sieve.
- 309.05 **Weather Limitations** - When foamed asphalt is used, full depth recycled work shall be performed when;
- a. Foaming operations will be allowed between May 15th and September 15th inclusive in Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais. Foaming operations will be allowed between May 1st and September 30th inclusive in Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.
 - b. The atmospheric temperature, as determined by an approved thermometer placed in the shade at the recycling location, is 50°F and rising.
 - c. When there is no standing water on the surface.
 - d. During generally dry conditions, or when weather conditions are such that proper pulverizing, adding, mixing, and curing can be obtained using

proper procedures, and when compaction can be accomplished as determined by the Resident.

- e. When the surface is not frozen and when overnight temperatures are expected to be above 32°F.
- f. Wind conditions as such that the spreading of lime or cement on the roadway ahead of the recycling machine will not adversely affect the operation.

309.06 Full Depth Recycling Procedure - New aggregate or recycled material meeting the requirements of Section 309.021 - New Aggregate, and Recycled Material shall be added as necessary to restore cross-slope and/or grade before initial pulverizing. Locations will be shown on the plans or described in the construction notes; the Resident may add other locations while construction of the Project is in progress. The Contractor will use recycled material to the extent it is available, in lieu of new aggregate. The material shall then be pulverized, processed, and blended into a homogeneous mass passing a 2" square mesh sieve. Material found not pulverized down to a 2" size will be required to be reprocessed by the recycler with successive passes until approved by the Resident.

Should the Contractor be required to add new aggregate or recycled material to restore cross-slope and/or grade after the initial pulverizing process, those areas will require re-processing to blend into a homogenous mass passing a 2" square mesh sieve.

The resultant material from the initial pulverizing processes shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will also be responsible for re-establishing the existing profile grade. The completed surface of the full depth recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ". The initial pulverizing process density requirements will be the same as Section 309.08 unless otherwise directed by the Resident.

Following completion of the initial pulverizing and blending process the dry stabilizing agents (lime or cement) shall be spread uniformly over the full width of roadway to be recycled prior to each pass of the foaming operation, and in a continuous process by means of a mechanical spreader. Dry stabilizing agents shall be spread at the prescribed rate of application provided by the Department.

If required by the mix design, a uniform layer of crusher dust or other aggregate specified shall be spread over the full width of the roadway just prior to the foaming procedure. Foamed asphalt shall be incorporated into the material to a depth determined by the pavement design. These additives shall then be uniformly blended into a homogeneous mass until an apparent uniform distribution has occurred. The Resident may adjust the rate of application as necessary.

Asphalt binder shall be added to the milling or recycling process by pumping from a mobile bulk tanker that is pushed from behind by the recycling machine. Tankers shall be equipped with a built-in thermometer to ensure that the bituminous stabilizing agent is maintained at 375°F + 10°F. The system employed to add the foamed asphalt to the recycling process shall conform to the equipment requirements specified in this Section.

Sufficient water shall be added through the recycler head during the recycling process to ensure thorough blending to meet the optimum moisture for compaction as specified. Water shall be added only by means of a controlled system on the recycling machine. Care shall be taken to prevent excessive wetting. A second water truck may be required during recycling operations to assist in the compaction and water control efforts. The rate of water supplied shall be kept constant unless changed due to Project material changes.

The resultant material shall be graded and compacted to the cross-slope and profile shown on the plans or as directed by the Resident. The Contractor will also be responsible for re-establishing the existing profile grade. The completed surface of the full depth recycled course shall be shaped and maintained to a tolerance, above or below the required cross sectional shape, of $\frac{3}{8}$ ". Areas not meeting this tolerance will be repaired as described in Section 309.061.

After compaction, the roadway surface shall be treated with a light application of water, and rolled with pneumatic-tired rollers to create a close-knit texture. The finished final completed layer shall be free from:

- a. Surface laminations.
- b. Segregation of fine and coarse aggregate.
- c. Corrugations, centerline differential, potholes, or any other defects that may adversely affect the performance of the layer.

The Contractor shall protect and maintain the completed recycled layer until a lift of pavement is applied. In addition to frequent light watering shall be performed to prevent the surface from drying out. maintenance shall include the immediate repair of any damage to or defects in the layer and shall be repaired immediately repeated as often as it is necessary. Repairs shall be made so as to ensure that an even and uniform surface shall be maintained is restored after completion of the repair work. The recycled surface shall be swept prior to hot mix asphalt placement.

309.061 **Repairs** - Repairs and maintenance of the recycled layers, during and after the curing period, resulting from damage caused by traffic, weather or environmental conditions, or resulting from damage caused by the Contractor's operations or equipment, shall be completed at no additional cost to the Department.

Low areas will be repaired using a hot mix asphalt shim. Areas up to 1" high can be repaired by either milling the high area or shimming the low areas adjacent to the high area with hot mix asphalt. Areas greater

than 1" high will be repaired by shimming the low areas adjacent to the high area with hot mix asphalt. All repair work will be done with the Resident's approval at the Contractor's expense.

TESTING REQUIREMENTS

309.07 **Quality Control** - The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of Section 106.4 - Quality Control and this Section. The Contractor shall not begin recycling operations until the Department approves the QCP in writing.

Prior to performing any recycling process, the Department and the Contractor shall hold a Pre-recycle conference to discuss the recycling schedule, type and amount of equipment to be used, sequence of operations, and traffic control. A copy of the QC random numbers to be used on the Project shall be provided to the Resident. All field and plant supervisors including the responsible onsite recycling process supervisor shall attend this meeting.

The QCP shall address any items that affect the quality of the Recycling Process including, but not limited to, the following:

- a. Sources for all materials, including New Aggregate and Additional Recycled Material.
- b. Make and type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers.
- c. Testing Plan.
- d. Recycling operations including recycling speed, yield monitoring, procedures for avoiding recycling and curing in inclement weather, methods to ensure that segregation is minimized, procedures for mix design modification, grading and compacting operations, and cement and lime application procedure.
- e. Methods for protecting the finished product from damage and procedures for any necessary corrective action.
- f. Method of grade checks.
- g. Examples of Quality Control forms.
- h. Name, responsibilities, and qualifications of the Responsible Onsite Recycling Supervisor experienced and knowledgeable with the process.
- i. A note that all testing will be done in accordance with AASHTO and MaineDOT/ACM procedures.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the full depth reclamation process in accordance with the following minimum frequencies:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 1000 ft / lane	AASHTO T 310
Air Temperature	4 per Day at even intervals	
Surface Temperature	At the beginning and end of each Days operation	
Yield of all materials (The daily yield, yield since last test, and total Project yield.)	1 per 1000 ft / lane	

The Department may view any QC test and request a QC test at any time.

The Contractor shall submit all QC test reports and summaries in writing, signed by the appropriate technician, the Department’s onsite representative by 1:00 p.m. on the next Working Day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Department onsite.

Penalties for QCP non-compliance will be in accordance with Standard Specification 106.4.6

The Contractor shall cease recycling operations whenever one of the following occurs:

- a. The computed yield differs from the mix design by 10% or more.
- b. The Contractor fails to follow the approved QCP.
- c. The Contractor fails to achieve 98% density after corrective action has been taken.
- d. The finished product is visually defective, as determined by the Resident.

Recycling operations shall not resume until the Department approves the corrective action to be taken.

309.08 **Test Strip** - The Contractor shall assemble all items of equipment for the recycling operation on the first Day of the foamed asphalt work. The Contractor shall construct a test strip for the Project at a location approved by the Resident. The Responsible Onsite Recycling Supervisor will work with Department personnel to determine the suitability of the mixed material, bitumen dispersion within the mixed material, moisture control within the mixed material, and compaction and surface finish. The test strip section is required to:

- A. Demonstrate that the equipment and processes produce recycled layers to meet in requirements specified requirements.
- B. Determine the effect on the gradation of the recycled material by varying the forward speed of the recycling machine and the rotation rate of the milling drum.

- C. Determine the sequence and manner of rolling necessary to obtain the compaction requirements and establish a target density. The Contractor and the Department will calibrate their respective gauges at this time.

The test strip shall be at least 300 ft in length of a full lane-width (or a half-road width). Full recycling production will not start until a passing test strip has been accomplished. If a test strip fails to meet the requirements of this specification, the Contractor will be required to repair or replace the test strip to the satisfaction of the Resident. Any repairs, replacement, or duplication of the test strip will be at the Contractor’s expense.

After the test strip has been pulverized, and the roadway brought to proper shape, the Contractor shall add water until it is determined that optimum moisture has been obtained. The test strip shall then be rolled using the specified compaction equipment as directed until the density readings show an increase in dry density of less than 1 pcf for the final four roller passes of each roller. The Contractor and Department will each determine a target density using their respective gauges by performing several additional density tests and averaging them. The average of these tests will be used as the target density of the recycled material for QC and Acceptance purposes.

Following completion of the test strip, compaction of the material shall continue until a density of not less than 98% of the test strip target density has been achieved for the full width and depth of the layer. During the construction and compaction of the Full Depth Recycled base should three consecutive Acceptance test results for density fail to meet a minimum of 95% of the target density, or exceed 102% of target density, a new test strip shall be constructed.

ACCEPTANCE TEST FREQUENCY

Property	Frequency	Test Method
In-place Density	1 per 2000 ft / lane	AASHTO T 310

- 309.09 **Miscellaneous** - No new pavement shall be placed on the full depth recycled pavement until a curing period of 48 hours has elapsed. If inclement weather occurs, the Department reserves the right to extend the curing period.
- 309.10 **Method of Measurement** - Full Depth recycled material (with Foamed Asphalt) will be measured by the yd².
- 309.11 **Basis of Payment** - The accepted quantity of Full Depth Recycled Pavement with Foamed Asphalt shall be paid for at the Contract unit price per yd², complete in-place to the specified limits, which price shall be full compensation for furnishing all equipment and labor for pulverizing, blending, placing, grading, compacting and for all incidentals necessary to complete the work including asphalt binder, water, Portland Cement, lime, and crusher dust.

The addition of materials to restore profile grade and/or cross-slope in areas shown on the plans or described in the construction notes will be paid separately

under designated pay items within the Contract. No additional payment will be made for materials salvaged from the Project.

Payment will be made under:

Pay Item		Pay Unit
309.35	Full Depth Recycled Pavement with Foamed Asphalt - 5" depth	Square Yard
309.36	Full Depth Recycled Pavement with Foamed Asphalt - 6" depth	Square Yard

SECTION 310 - PLANT MIXED RECYCLED ASPHALT PAVEMENT

- 310.01 **Description** - This work shall consist of the removal of all bituminous pavement from the existing roadway, hauling the bituminous pavement to an approved location, and processing as per Section 310.020. The gravel base of the existing roadway shall be regraded and compacted to the tolerances shown on the typicals, or as directed by the Resident.

All plant mixed recycled asphalt pavement shall be placed in one or more courses on an approved base and in accordance with these specifications, and in reasonably close conformity with the lines, grades and thicknesses indicated on the plans, or as established by the Resident. Excess recycled material not used in the PMRAP process will become the property and responsibility of the Contractor.

- 310.020 **Composition of Mixture** - The mixture shall be composed as directed in the job mix formula. The recycled asphalt pavement shall be processed by the Contractor so all material will be no larger than 1½" and stockpiled so as to minimize segregation. The stockpile shall be free of any materials not generally considered to be asphalt pavement. If additional material is required, the material will be supplied by the Department or acquired from the Contractor through the Contract Modification process.

A job mix formula shall be furnished by the Department establishing the percentage of emulsified asphalt cement, Portland Cement, aggregate, and water to be used in the mixture. The JMF additive proportions will be verified by taking a second recycled material sample once the stockpiles have been constructed.

Emulsion, water, aggregate and Portland Cement shall be added in percentage by weight and verified by tank checks done in accordance with the minimum quality control frequencies. Cement additive may be done in dry form or introduced as a cement slurry.

- 310.021 **Emulsified Asphalt** - The emulsified asphalt shall be grade MS-2, MS-4, CSS-1, or HFMS-2 meeting the requirements of Section 702.04 - Emulsified Asphalt.

- 310.02 **Portland Cement** - Portland Cement shall be Type I or II meeting the requirements of AASHTO M 85.
- 310.023 **Water** - Water shall be clean and free from deleterious concentrations of acids, alkalis, salts or other organic or chemical substances.
- 310.024 **New Aggregate** - New aggregate, if required by the Contract or job mix, shall meet the requirements of Section 411.02 - Untreated Aggregate Surface Course.
- 310.030 **Mixing Plant** - The mixing plant shall be of sufficient capacity and coordinated to adequately handle the proposed construction. Either a continuous pugmill mixer or a continuous drum type mixing plant shall be used. If a drum mixing plant is used it shall meet the requirements of Section 401.07. The mixing plant shall be capable of producing a uniform mixture meeting the requirements of the job mix formula.
- 310.031 **Hauling Equipment** - Trucks used for hauling the mixture shall meet the requirements of Section 401.08.
- 310.032 **Pavers** - Pavers shall meet the requirements of Section 401.09.
- 310.033 **Rollers** - Rollers shall meet the requirements of Section 401.10.
- Mix Design** - The Department will supply a mix design for the PMRAP material prior to construction which includes the following information:
1. Percent of emulsified asphalt to be used.
 2. Quantity of cement to be added.
 3. Optimum moisture content for proper compaction.
 4. Additional aggregate (if required).
- After a test strip has been completed or as the work progresses, it may be necessary for the Resident to make necessary adjustments to the mix design. Changes to compensation will be in accordance with the Mix Design Special Provision.
- 310.040 **Mixing** - The recycled asphalt pavement shall be delivered to the mixer at a temperature of not less than 50°F. The emulsified asphalt shall meet the mixing temperature requirements listed in Section 702.05 - Application Temperatures. Recycled pavement and emulsified asphalt, and cement shall be proportioned and the mixing time set to produce a mixture in which uniform distribution of the emulsified asphalt and coating of the recycled pavement is obtained.
- If a drum type mixing plant is used, the recycled asphalt pavement may be heated prior to being mixed with the emulsified asphalt to a temperature not to exceed 195°F.

Following mixing, the recycled asphalt pavement material shall be stockpiled and incorporated into the work. The material must be stockpiled, but not for longer than 48 hours.

310.041 **Weather Limitations** - The plant mixed recycled asphalt pavement shall be performed when:

- a. PMRAP operations will be allowed between May 15th and September 15th inclusive in Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais. PM-RAP will be allowed between May 1st and September 30th inclusive in Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.
- b. The atmospheric temperature, as determined by an approved thermometer placed in the shade at the recycling location, is 500°F and rising.
- c. When there is no standing water on the surface.
- d. During generally dry conditions, or when weather conditions are such that proper pulverizing, adding, mixing, and curing can be obtained using proper procedures, and when compaction can be accomplished as determined by the Resident.
- e. When the surface is not frozen and when overnight temperatures are expected to be above 320°F.

310.042 **Spreading and Finishing** - The mixture shall be spread and finished in accordance with Section 401.15. Total layer thicknesses greater than 4" shall be placed in 2 lifts.

310.043 **Compaction** - Compaction of the mixture shall be in accordance with Section 401.16. Rolling may be delayed to avoid lateral displacement as directed by the Resident. See also Section 310.051.

310.044 **Joints** - Joints shall be constructed in accordance with Section 401.17.

310.045 **Surface Tolerances** - The surface tolerances shall be as specified in Section 401.101, except that the maximum allowable variation shall be $\frac{3}{8}$ ". The surface tolerance in existing gravel areas covered by PMRAP, with no additional gravel, shall be $\pm \frac{3}{8}$ ".

310.050 **Quality Control** - The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of Section 106.4 – Quality Control and this Section. The Contractor shall not begin recycling operations until the Department approves the QCP in writing.

Prior to performing any recycling process, the Department and the Contractor shall hold a Pre-recycle conference to discuss the recycling schedule, type and amount of equipment to be used, sequence of operations, and traffic control. A copy of the QC random numbers to be used on the Project shall be provided to the Resident. All field and plant supervisors including the responsible onsite recycling process supervisor shall attend this meeting.

The QCP shall address any items that affect the quality of the Recycling Process including, but not limited to, the following:

- a. JMF(s).
- b. Mixing details, pugmill type, production rates, material processing.
- c. Make and type of paver(s).
- d. Make and type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers.
- e. Testing Plan.
- f. Transportation including process for ensuring that truck bodies are clean and free of debris or contamination that could adversely affect the finished product, type of release agent used (if required)
- g. Laydown operations including procedures for mix design modification, avoiding recycling and curing in inclement weather, material yield monitoring, methods to ensure that segregation is minimized, longitudinal joint construction, procedures to determine the maximum rolling and placing speeds based on field quality control, and achieving the best possible smoothness.
- h. Methods for protecting the finished product from damage and procedures for any necessary corrective action.
- i. Method of grade checks.
- j. Examples of Quality Control forms.
- k. Name, responsibilities, and qualifications of the Responsible Onsite Recycling Supervisor experienced and knowledgeable with the process.
- l. Method for calibration/verification of density gauge.
- m. A note that all testing will be done in accordance with AASHTO and MaineDOT/ACM procedures.
- n. Stockpile procedures including method of moisture control.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the PMRAP process in accordance with the following procedures and minimum frequencies:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 1000 ft / lane	ASTM D2950
Air Temperature	4 per Day at even intervals	
Surface Temperature	At the beginning and end of each Days operation	
Yield of all materials (Both the daily yield and yield since last test)	4 per Day at even intervals	

The Department may view any QC test and request a QC test at any time. The Contractor shall submit all QC test reports and summaries in writing, signed by the appropriate technician, to the Department's onsite representative by 1:00 p.m. on the next Working Day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Department onsite.

Penalties for QCP non-compliance will be in accordance with Standard Specification 106.4.6

The Contractor shall cease recycling operations whenever one of the following occurs:

- a. The computed yield differs from the approved Job Mix Formula by 10% or more.
- b. The Contractor fails to follow the approved QCP.
- c. The Contractor fails to achieve 98% density after corrective action has been taken.
- d. The finished product is visually defective, as determined by the Resident.

Recycling operations shall not resume until the Contractor and the Department agree on the corrective action to be taken.

310.051 **Test Strip** - The Contractor shall assemble all items of equipment for the recycling operation on the first Day of the recycling work and process a section of the roadway to the Contractor shall construct a the test strip control section on for the Project at a location approved by the Resident. The Responsible Onsite Recycling Supervisor will work with Department personnel to determine the suitability of the mixed material, moisture control within the mixed material, and compaction and surface finish. The control section:

- a. Demonstrate that the equipment and processes that are proposed to be can be employed are capable of constructing the produce recycled layers to meet in conformance with the specified requirements;
- b. Determine the effect on the grading of the recycled material by varying the forward speed of the paving machine; and

- c. Determine the sequence and manner of rolling necessary to obtain the compaction requirements and establish a target density. The Contractor and the Department will both conduct testing with their respective gauges at this time.

The demonstration section test strip shall be at least 300 ft in length of a full lane-width (or a half-road width). Full PMRAP production will not begin until an acceptable test strip has been constructed. If a test strip control section fails to meet the requirements of this specification, the Contractor will be required to repair or replace the control section control section to the satisfaction of the Resident. Any repairs, replacement, or duplication of the control section control section will be at the Contractor’s expense.

The test strip shall be rolled using the specified compaction equipment as directed until the density readings show an increase in dry density of less than 1 pcf for the final four roller passes of each roller. The Contractor and Department will each determine a target density using their respective gauges by performing several additional density tests and averaging them. The average of these tests will be used as the target density of the recycled material for QC and Acceptance purposes.

Following completion of the test strip, compaction of the material shall continue until a density of not less than 98% of the test strip target density has been achieved for the full width and depth of the layer. During the construction and compaction of the PMRAP, should three consecutive Acceptance test results for density fail to meet a minimum of 95% of the target density, or exceed 102% of target density, a new test strip shall be constructed.

ACCEPTANCE TEST FREQUENCY

Property	Frequency	Test Method
In-place Density	1 per 2000 ft / lane	ASTM D2950

310.052 **Repairs** - Repairs and maintenance for the PMRAP layers, during and after the curing period, resulting from damage caused by traffic, weather or environmental conditions, or caused by the Contractor’s operations or equipment, shall be completed at no additional cost to the Department.

Low areas will be repaired using a hot mix asphalt shim course. Areas up to 1" high can be repaired by milling or shimming with hot mix asphalt. Areas higher than 1" will be repaired using a hot mix asphalt shim. All repair work will be done with the Resident’s approval at the Contractor’s expense.

- 310.06 **Curing** - No new hot mix asphalt pavement or additional layers of PMRAP shall be placed on the recycled asphalt pavement until a curing period of 4 Days has elapsed. The curing period starts once the PMRAP has been placed in the roadway. When weather conditions are unfavorable, the curing period may be extended by the Resident.
- 310.07 **Method of Measurement** - Plant Mixed Recycled Asphalt Pavement shall be measured by the square yard.
- 310.08 **Basis of Payment** - The accepted quantity of Plant Mixed Recycled Asphalt Pavement will be paid for at the Contract unit price per square yard, complete in-place which price will be full compensation for furnishing all equipment and labor for removing existing pavement, regrading and compacting existing gravel base, processing, mixing, testing, placing, and compacting, excess material relocation, and for all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
310.23	3" Plant Mixed Recycled Asphalt Pavement	Square Yard
310.24	4" Plant Mixed Recycled Asphalt Pavement	Square Yard
310.25	5" Plant Mixed Recycled Asphalt Pavement	Square Yard
310.26	6" Plant Mixed Recycled Asphalt Pavement	Square Yard

SECTION 311 - COLD IN-PLACE RECYCLED ASPHALT PAVEMENT (Traveling Pugmill)

- 311.01 **Description** - The Contractor shall construct a Cold In-place Recycled Pavement base course in accordance with the Contract documents and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or as established by the Resident. This work will consist of milling 3 to 7" of existing bituminous pavement, pulverizing and sizing the millings, the addition of emulsified asphalt and Portland Cement or hydrated lime to the proportions specified, the mixing and placement of the mixture full width as required in the Contract, (including shoulders) and compacting the mixture as one continuous operation to the lines, grades and thicknesses indicated on the plans or as established by the Resident. Excess recycled material not used in the CIP process will become the property of the State.

MIX DESIGN

- 311.02 **Composition of Mixture** - The Contractor shall provide the Resident with a proposed mix design a minimum of 2 weeks prior to commencing work. The proposed mixed design shall include the emulsified asphalt binder application percentage, type and supplier, the percentage of Portland Cement or hydrated

lime to be added, and the percentage of any supplemental aggregates to be added.

- a. The aim for air voids in the final product is 8 to 11%.
- b. The Contractor may add water as needed to the sized material to facilitate uniform mixing and compaction.
- c. Included in the mix design will be the product information from the supplier of the asphalt emulsion binder and any product information regarding the Portland Cement or hydrated lime.
- d. The Contractor will be responsible for deciding and conducting investigative work to determine the properties of the existing in place bituminous mixes which the Contract documents do not describe. Any cores or laboratory testing the Contractor performs to establish the recycled mix design will be incidental to the Cold in Place Recycle pay item and not paid for separately. A copy of all test results on the pavement samples shall be included with the mix design.

The addition of hydrated lime, or Portland Cement at 0.50% to 1.0% by weight is required and is to be included in the mix design criteria. Emulsion, water, aggregate, cement shall be added in percentage by weight and verified by tank checks according to the Quality Control Plan. Cement or lime may be added in dry form or in a slurry.

MATERIALS

311.030 **Pulverized Material** - Recycled bituminous pavement, after milling and sizing, will meet the following gradation requirements:

Sieve Size	% Passing Limits
1½"	100
1"	95-100

- 311.031 **Emulsified Asphalt** - The emulsified asphalt binder shall be a high float asphalt emulsion grade HFMS-2, or a cationic slow-set grade CSS-1H, that meets the requirements of Section 702.04.
- 311.032 **Portland Cement** - The Portland Cement shall be Type 1 or 2 that meets the requirements of AASHTO M 85.
- 311.033 **Hydrated Lime** - The hydrated lime shall meet the requirements of AASHTO M 216.
- 311.034 **Added Aggregates** - New aggregate, if required by the Contract or job mix, shall meet the requirements of Section 411.02 - Untreated Aggregate Surface Course.

- 311.035 **Added Water** - Water shall be clean and free from deleterious concentrations of acids, alkalis, salts or other organic or chemical substances.

EQUIPMENT

- 311.040 **Equipment** - The existing bituminous pavement shall be recycled in a continuous operation using a recycling train consisting of the following major components. The recycling equipment and operations may be combined onto one unit:

311.041 **Mainline Cold Milling Machine** - The unit shall be self-propelled with a down cutting drum, or an approved up-cutting drum, and be automated to continuously adjust and maintain treatment depth and cross slope. The cutting drums shall be a minimum of 10 ft in width, with the ability to add 1 or 2 ft extensions to the drum or have hydraulically extendable milling heads with a 12 ft width. Dust suppression systems are required. The unit should be capable of recycling the pavement for the entire lane width to the required dimensions in one pass.

311.042 **Shoulder Cold Milling Machine** - If required, the shoulder unit shall have a minimum cutting drum of 6½ ft in width or equal to the shoulder width to be recycled. This unit shall precede the larger mainline milling machine to remove existing pavement off any existing paved shoulders. The material will be placed via a lift conveyor onto the existing mainline roadway surface to be incorporated and processed by the mainline milling machine.

311.043 **Screening and Sizing Unit** - This unit shall be capable of reducing and sizing the recycled asphalt pavement to the specified gradations prior to mixing with the asphalt emulsion, and cement or lime additives. Oversize particles shall not be included in the final mix. The manufacture of excessive waste through the screening process will be prohibited. If more than 5% of the recycled material is screened off as waste, the Contractor will be required, at no additional compensation, to re-introduce the material ahead of the train to be reprocessed.

311.044 **Portable Mixing Unit** - The unit shall be capable of producing a uniform, thoroughly mixed, cold mix asphalt product.

The material feed system to the mixing unit shall be equipped with a computer controlled weigh bridge that will determine the mass of recycled material, by weight, being deposited into the mixing unit prior to the addition of the emulsified liquid asphalt. The scales shall be calibrated to the manufacturer's tolerance at the start of the Contract and will be checked for conformance to Section 401.074.

This mixing unit shall be of a dual shaft pugmill design, equipped with a metering device which will continuously meter and maintain the amount of emulsified asphalt being added to the process to a tolerance of + 0.25% of the total, by weight.

The emulsion control unit shall be equipped with a flow meter and a total delivery meter. A positive displacement pump capable of accurately metering the required quantity of emulsion down to a rate of 4 gal/min into the recycled material is required.

The pump shall be equipped with a positive interlock system that will shut off automatically when material is not present in the mixing chamber.

Each mixing machine shall be equipped with a meter capable of registering the rate of flow and total delivery of the emulsion introduced into the mixture.

The unit shall be designed to either deposit the mixed product onto the roadway in a sized windrow, or capable of depositing the product directly into a paver hopper.

Only tankers with a capacity exceeding ten 2,500 gal shall be used employed to supply the recycling machine with bitumen. No leaking tanker will be permitted on the job site. In addition, each tanker shall be equipped with the following:

- a. A thermometer to show the temperature of the contents in the bottom third of the tank.
- b. Insulation to retain heat.
- c. A calibrated dipstick marked at intervals of no more than 25 gal, for measuring the contents of the tank.

311.045 **Placing Equipment** - If a pick up conveyor is to be utilized to transfer the windrow into a paver hopper, the pickup conveyor machine shall be capable of removing the entire windrow down to the underlying material. The paver utilized to place the recycled product shall conform to Section 401.09.

311.046 **Compaction Equipment** - Compaction equipment shall meet the requirements of Standard Specification 401, Subsection 401.10 – Rollers, with the following additional requirements:

- a. Minimum compaction equipment shall consist of two 10 ton double drum steel wheel vibratory rollers; and
- b. one 20 ton pneumatic tired roller. The minimum allowable tire pressure shall be 85 psi. The Contractor shall furnish a suitable tire gauge for determining air pressure in the tires.

Additional equipment may be required in sufficient numbers and weight to obtain the required compaction.

CONSTRUCTION REQUIREMENTS

311.05 **Removal of Existing Pavement** - The existing pavement surface, including cracks, shall be visibly free from all foreign matter before recycling commences. The Contractor is responsible for removing any deleterious materials or crack sealants decided to be an interference with the cold recycle process. In areas where paved shoulders exist, the shoulders will be milled just ahead of the mainline milling and removed material incorporated into the recycle process.

When areas of the pavement surface are inaccessible because of the physical constraints of the equipment, the pavement shall be removed by other means and replaced by an approved source of hot mix asphalt.

311.06 **Weather and Temperature Limitations** - The Cold In-Place Recycled process shall be performed when:

- a. CIP operations will be allowed between May 15th and September 15th inclusive in Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais. CIP operations will be allowed between May 1st and September 30th inclusive in Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.
- b. The atmospheric temperature, as determined by an approved thermometer placed in the shade at the recycling location, is 500F and rising.
- c. When there is no standing water on the surface.
- d. During generally dry conditions, or when weather conditions are such that proper pulverizing, adding, mixing, and curing can be obtained using proper procedures, and when compaction can be accomplished as determined by the Resident.
- e. When the surface is not frozen and when overnight temperatures are expected to be above 32°F.
- f. Wind conditions as such that the spreading of lime or cement on the roadway ahead of the recycling machine will not adversely affect the operation.

311.061 **Curing** - No new hot mix asphalt pavement or additional layers of CIP shall be placed on the recycled asphalt pavement until a curing period of 4 Days has elapsed. The curing period starts once the CIP process has been completed in the roadway. When weather conditions are unfavorable, the curing period may be extended by the Resident.

311.07 **Surface Tolerances** - The completed recycled pavement surface will be shaped, compacted, smoothed and true to required line and grade. Deviations in the

finished surface shall not exceed $\frac{3}{8}$ in in any direction using a 10 ft minimum straight edge. Any repairs required to correct surface deviations are at the Contractor's expense using Department approved material and methods.

The Contractor shall protect the completed surface from damage caused by construction vehicles and equipment. The recycled pavement surface shall be protected and closed to traffic until it is determined that surface damage no longer occurs when a test vehicle is passed over it. The contractor is responsible for determining when the completed surface is suitable for traffic loading without damage. Any repairs to correct damage will be at the Contractor's expense.

311.071 **Joints** - Joints shall be constructed in accordance with Section 401.17.

311.08 **General Procedure** - Mainline milling is to be accomplished full width, one pass, and the material will be conveyed into a sizing and crushing unit. Once sized, the material is conveyed to a mixing unit where the specified percentage of asphalt emulsion, Portland Cement, or lime is introduced for the coating and mixing process.

The thoroughly mixed recycled product will either be deposited, (a) in a windrow behind the mixing unit and picked up via a conveyor, or (b) directly conveyed into a paver hopper for laydown. The mix will be laid full width, including shoulders where paved shoulders existed, to the specified grade and slope.

Water shall be used as necessary to assist the compaction effort.

TESTING REQUIREMENTS

311.09 **Quality Control** - The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of Section 106.6 - Acceptance and this Section. The Contractor shall not begin recycling operations until the Department approves the QCP in writing.

Prior to performing any recycling process, the Department and the Contractor shall hold a Pre-recycle conference to discuss the recycling schedule, type and amount of equipment to be used, sequence of operations, and traffic control. A copy of the QC random numbers to be used on the Project shall be provided to the Resident. All field and plant supervisors including the responsible onsite recycling process supervisor shall attend this meeting.

The QCP shall address any items that affect the quality of the Recycling Process including, but not limited to, the following:

- a. JMF(s).
- b. Make and type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers.
- c. Make and type of equipment in recycling train.

- d. Testing Plan.
- e. Laydown operations including joint construction, yield monitoring, procedures for avoiding recycling and curing in inclement weather, methods to ensure that segregation is minimized, and procedures for mix design modification.
- f. Methods for protection the finished product from damage and procedures for any necessary corrective action.
- g. Method of grade checks.
- h. Examples of Quality Control forms.
- i. Name, responsibilities, and qualifications of the Responsible Onsite Recycling Supervisor experienced and knowledgeable with the process.
- j. Method for calibration/verification of density gauge.
- k. A note that all testing will be done in accordance with AASHTO and MaineDOT/ACM procedures.
- l. Description of the Cold In-place recycled verification procedure.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the cold in-place recycling process in accordance with the following minimum:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 1000 ft / lane	ASTM D2950
Air Temperature	4 per Day at even intervals	
Surface Temperature	Beginning and end each Day	
Yield of all materials (daily)	1 per 1000 ft/ lane	
New Aggregate Gradations	2 per Day	AASHTO T 30

The Contractor shall submit all QC test reports and summaries in writing, signed by the appropriate technician, and present them to the Department’s onsite representative by 1:00 p.m. on the next Working Day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Department onsite.

During the Cold in-place recycling procedure the Contractor shall take verification samples of the recycled material prior to adding the emulsion at a rate of one per 26,000 lane ft, or a minimum of one per Project. The samples will mixed to the proportions specified in the job mix formula, and tested by the Contractor for conformance to the Contract specifications.

Penalties for QCP non-compliance will be in accordance with Standard Specification 106.4.6

The Contractor shall cease recycling operations whenever one of the following occurs:

- a. The computed yield differs from the approved Job Mix Formula by 10% or more.
- b. The Contractor fails to follow the approved QCP.
- c. The Contractor fails to achieve 98% density after corrective action has been taken.
- d. The Contractor's verification samples show the air void content of the recycled product is outside the 8-11% range.
- e. The finished product is visually defective, as determined by the Resident.

Recycling operations shall not resume until the Contractor and the Department agree on the corrective action to be taken.

311.10 **Control Section** - The Contractor shall assemble all items of equipment for the recycling operation on the first Day of the recycling work. The Contractor shall construct a control section for the Project at a location approved by the Resident. The Contractor shall have on site a pavement engineer expert in CIP work to direct construction of the control section, advise on suitability of mixed material, bitumen dispersion within the mixed material, moisture control within the mixed material, compaction and surface finish. The control section is required to:

- a. Demonstrate that the equipment and processes can produce recycled layers to meet the requirements specified in these special provisions.
- b. Determine the effect on the grading of the recycled material by varying the forward speed of the recycling machine and the rotation rate of the milling drum.
- c. Determine the sequence and manner of rolling necessary to obtain a target TMD. The Contractor and the Department will calibrate their respective gauges at this time.

The control section shall be at least 750 ft in length of a full lane-width (or a half-roadway section width).

The Contractor shall repeat the control section process until parameters of the material properties conform to the requirements specified herein and as directed by the Resident. If a control section fails to meet the requirements outlined in this Special Provision, the Contractor will be required to take corrective action to remedy the test strip defect to the satisfaction of the Resident at no additional cost to the Department. The repeated process of the control section construction shall be done at the Contractor's expense. The corrective method shall be determined by the Contractor, as directed by the Resident.

Quality Assurance densities of the recycled material will be determined by the Department using the nuclear method. The test strip section will be rolled as directed until the nuclear density readings show an increase in dry density of less than 1 pcf for the final four roller passes. This density will be used as the target density for the recycled material. The remaining full depth recycled material shall be compacted to a minimum density of 98% of the target density as determined in the control section.

ACCEPTANCE TEST FREQUENCY

Property	Frequency	Test Method
In-place Density	1 per 2000 ft / lane	AASHTO T 310

311.11 **Measurement and Payment** - The accepted quantity of Cold in Place Recycled Pavement will be measured and paid for by the square yard complete and in place to the limits specified in the Contract documents. The unit price shall include all materials, equipment, supervision, and labor and tools incidental thereto.

No additional payment will be made for hot mix required to replace material that cannot be compacted to the specified density, or used to replace damaged or raveled sections. The removal of existing pavement, placement, and compaction of any hot mix asphalt required in areas that are inaccessible due to the limitations of equipment shall be paid for as Cold in place Recycle mix per square yard.

Payment to be made under:

Pay Item		Pay Unit
311.33	3" Cold in-Place Recycled Asphalt Pavement	Square Yard
311.34	4" Cold in-Place Recycled Asphalt Pavement	Square Yard
311.35	5" Cold in-Place Recycled Asphalt Pavement	Square Yard