ADDENDUM NUMBER ONE
FOR THE
FY20 PAVEMENT PRESERVATION PROJECT

DATE OF ADDENDUM: April 15, 2020

TO ALL BIDDERS BIDDING ON THE ABOVE PROJECT:

The following addendum shall be made part of the Project Specifications and Contract Documents. All other provisions of the Contract Documents remain unchanged. The Bidder shall acknowledge receipt of this Addendum on page 10 of the Bid Proposal form, in addition to signing below and returning this form with the bid package. The contents of this Addendum shall be given full consideration in the preparation of the Bid.

Changes to the Project Special Provisions


- END –

City of Prescott Public Works Department

Craig Dotseth, Public Works Director

4/15/2020

Date

Acknowledgement: (must be signed and turned in with the bid documents)

Company Name

Signature of Company Official

Date
CIP19-023
FY20 Pavement Preservation Project

Project Special Provisions

SPONSOR:
CITY OF PRESCOTT, ARIZONA
DEPARTMENT OF PUBLIC WORKS

ENGINEER:
CITY OF PRESCOTT

THE SPECIAL PROVISIONS SHALL MODIFY AND SUPERSEDE THE VARIOUS SECTIONS
OF THE CITY OF PRESCOTT (COP) SUPPLEMENT TO THE MARICOPA ASSOCIATION
OF GOVERNMENTS (MAG) UNIFORM STANDARD SPECIFICATIONS AND DETAILS FOR
PUBLIC WORKS CONSTRUCTION, TECHNICAL SPECIFICATIONS, DATED 2/14/2019.
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**ATTACHMENTS:**

**APPENDIX “A” - COLD IN-PLACE RECYCLED ASPHALT BASE LAYER TECHNICAL SPECIFICATIONS, CITY OF MESA**

**APPENDIX “B” – CITY OF PRESCOTT, PRELIMINARY EVALUATION OF COLD IN-PLACE RECYCLING MIXTURE AND LITHTEC TECHNOLOGIES SOIL STABILIZER**
104 SP  SCOPE OF WORK

104.1.1  General

Add the following to Section 104.1.1 of the MAG Technical Specifications:

1.  Project Description

   a.  The project generally consists of pulverizing in place the existing asphalt pavement, chip seal and millings and adding Lithified Technologies Lithtec or Cold in Place Recycled asphalt as shown on the Plans and in the Specifications and placing new chip seal and PMM and asphalt. The work includes pavement repairs, the adjustment of utility covers to finish grade and the restoration of disturbed traffic striping. This project is being bid with a Base Bid, an Additive Alternate “A” and Additive Alternate “B” bids. Only one or the other Additive Alternates Bid will be awarded along with the Base bid.

   b.  All construction elements, as identified in the Bid Schedule, shown on the plans or details or described in the Special Provisions, are required for construction and are to include all costs associated with base stabilization, base preparation, shouldering, trenching, appurtenances, bedding, finished surface and pavement replacement, hauling, placing, disposing of, mobilization, materials quality control testing and certification, or any other associated work and materials required for a complete in place and operable item of construction. All work items and materials not specifically itemized in the bid schedule and that are required for the construction are to be considered incidental to the total project bid amount.

104.3  Sequencing

ADD the following to Section 104 of the MAG Technical Specifications:

Sequencing on this project shall be as follows:

In general, on any given street all pavement repairs, curb replacements, curb additions, sidewalk replacements, driveway replacements and valley gutter replacements shall be completed prior to commencing with the base stabilization, paving and/or chip seal on the street for which these repairs are called for on the plans.

Sequencing and timing: Work in between intersections shall be completed prior to moving past the intersection. This applies to the specific phase being completed (e.g. base stabilization, cold in-place recycling, chip seal, etc.).

Scheduling of work:

The city will make every effort to maintain the time lines listed, however if the current situation with COVID-19 health crisis is beyond the control of the City and/or Contractor, then the City is prepared to partner with the awarded contractor to adjust the project timing as needed.
**105 CONTROL OF WORK**

*ADD the following to Section 105.8 of the MAG Technical Specifications:*

**105.8 Construction Stakes, Lines and Grades**

To assure the restoration of disturbed traffic striping in its current configuration except as noted on the plans, it shall be the Contractor’s responsibility to have all traffic striping surveyed in advance of the work and laid back out for placement of traffic striping by survey.

To assure that all utility covers are correctly located, identified, and correctly adjusted to finish grade, it shall be the Contractor’s responsibility to have all existing utility covers surveyed in advance of the work and laid back out by survey for final adjustment to finish grade. Survey monuments shall have the survey pin recorded prior to start of the project so that they can be verified as not disturbed after completion of the project.

To assure accurate computation of milling and asphalt concrete pavement quantities, it shall be the Contractor’s responsibility to have the areas surveyed that will be pulverized, stabilized, paved with Cold In-Place (CIR) recycled asphalt concrete or new asphalt concrete pavement.

At completion of paving and or chip sealing the Contractor shall submit to the City for approval a certified survey of the actual quantity of recycled of base material. The certified results shall be itemized per the project bid schedule. The surveyor shall provide the procedures used in obtaining the quantities.

Field notes and record drawings shall be provided to the City, to include certification as to the accuracy of the quantities installed.

**107 LEGAL REGULATIONS AND RESPONSIBILITY TO THE PUBLIC**

**107.15 Public Relations**

*ADD the following to Section 107.15 of the COP Technical Specifications:*

There will be no pre-construction public meeting.

**Pay Item: 107.15 – Public Relations (Allowance)**
310 SP  FULL DEPTH RECLAMATION, PLACEMENT AND CONSTRUCTION OF RECYCLED BASE MATERIAL

310.1 Description

*Remove MAG 310.1 in its entirety and replace with the following:*

This specification is for **Additive Alternate “B” only.**

This special provision covers the furnishing of all labor, tools, and equipment necessary to reclaim bituminous roadways, as specified below, to form a recycled and/or stabilized asphalt aggregate base course. Work under this item shall consist of pulverizing the in-place asphalt pavement, placement of additional recycled asphalt pavement as an aggregate base material, and the compaction of the reclaimed blended material.

310.2 Placement and Construction

*Remove MAG Section 310.2 in its entirety and replace with the following:*

### 310.2.1 Construction Equipment:

The recycled aggregate base material shall be manufactured onsite by the use of a pulverizing Full Depth Reclamation (FDR) shall consist of a self-propelled machine specifically designed to pulverize and blend the existing bituminous pavement and base materials in-place to a specific depth. Approved equipment that may be used for pulverizing and blending includes a CMI/Terex RS-500 or larger size machine (or equivalent reclaimer/stabilizer). The City shall approve the equipment to be used for the pulverizing and blending activities. The machine shall have automatic depth controls to maintain the cutting depth to within +/- 1/4 inch of the depth specified.

Equipment such as road planers or cold milling machines, which are designed to mill or shred the existing bituminous pavement surface rather than crush/fracture and blend it, are not considered capable of achieving the specified gradation and effective mixing, and therefore are *not* acceptable equipment for performing the pulverizing and blending reclamation activities of this project.

The equipment used for blending the pulverized material with additional recycled asphalt pavement, as well as any admixtures on the surface, shall be capable of producing a homogeneous and uniformly blended reclaimed mixture. The equipment used for placement of the reclaimed material shall be capable of placement to the proposed lines and grades.

The mixer/reclaimer shall be fitted with an integrated water injection system capable of introducing water into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of water to compensate for any variation in the amount of reclaimed material introduced in to the mixing chamber. Water added shall be applied from a calibrated meter capable of accurately measuring the amount of water calculated volumetrically based on width, depth and unit weight of processed material with automatic adjustment for working speed. The injection system shall have an automatic digital reading displayed for both the flow rate of water and total amount of reclaimed material in appropriate units of weight and time.
Compaction of the recycled asphalt aggregate base course shall be completed using self-propelled rollers, complete with properly operating scrapers and water spray systems as necessary. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire reclaimed thickness. Segmented padfoot, vibratory padfoot, pneumatic-tired, vibratory single or double drum rollers can be used for compaction. Any combination of rollers shall be allowed provided the compaction requirements are met.

310.2.2 Construction Methods:

Before any work begins, coordination, identification and location of all utilities within the pulverization operations should occur. Excess dirt, vegetation, standing water, raised roadway markings and other objectionable materials shall be removed by sweeping, blading, or other approved method. All affected utilities shall be identified and protected from damage prior to processing. The profile and cross-slope as shown on the plans shall be referenced for the finished surface. The pulverization sequence shall be constructed in a series of parallel lanes such that longitudinal and transverse joints are minimized.

The subgrade shall be firm and able to support, without yielding or subsequent settlement, the construction equipment and compaction of the recycled asphalt aggregate base course. Soft or yielding subgrade shall be made stable before pulverization construction proceeds.

The pulverization processing shall not be conducted when the asphalt pavement, base, sub-base or sub-grade is frozen, or when freezing temperatures are anticipated within 7 days of the end of pulverization and subsequent asphalt paving.

For the portion of Melville Road, Corsair Avenue and Stearman Road with concrete curb and gutter, once base material has been recycled and processed, the Contractor shall remove 3” of recycled base material up against the curb and utilize it as shouldering material on the west end of Melville Road.

310.2.3 In-Place Pulverization:

During the first day of production, a control strip of the recycled asphalt aggregate base course, or the stabilized base material whichever additive alternate is awarded, shall be constructed in order for the owner agency to evaluate and approve the equipment, construction methodology and workmanship, and to verify that the construction process meets specification requirements. The control strip shall be of adequate size to demonstrate that the equipment, materials and processes proposed can produce a base course that conforms to specification requirements. The optimal rates for water and additional imported recycled asphalt pavement shall be established to determine procedures that result in optimum compaction. Passes with various combinations of rollers under static and/or vibratory mode shall be evaluated.

The pulverization and blending operations shall continue through the first day unless the equipment and process fails to meet the requirements for successful completion of recycled base material production. Pulverization and blending operations shall not continue beyond the first day unless a control strip has been approved by the owner agency. Control strips that do not meet specification requirements shall be reworked, recompacted, or removed and replaced. On acceptance of the control strip the same equipment, materials and construction methods shall be used for the remainder of the pulverization operations, unless adjustments made by the contractor are approved by the owner agency. If adjustments are made, a new control strip shall be constructed.
In lieu of a control strip, the owner agency may allow the contractor to provide proof, based on previous experience with the same equipment, personnel and materials, which the work will conform to specification requirements.

The full depth of existing asphalt material shall be pulverized. The pulverized and blended in-place asphalt material shall be thoroughly blended with additional passes of the reclaimer to produce a homogenous mixture.

Longitudinal joints between successive pulverization passes should overlap a minimum of 6 inches and transverse joints shall overlap a minimum of 2 feet.

Rubberized crack filler, pavement markers, loop wires, thermoplastic markers and other similar materials shall be removed from the roadway as observed during the pulverization process. Residual materials that cannot be completely removed from the processed materials may be incorporated into the reclaimed materials if it can be demonstrated that those added materials will not adversely affect the performance of the reclaimed layer. Any such materials retained in the mixture shall be appropriately sized and blended so as not to adversely affect the appearance or strength of the reclaimed layer.

The Contractor shall take all necessary precautions to insure that the FDR operation over existing drainage structures an utilities will not damage infrastructure. The Contractor shall verify the depth of all such structures prior to the FDR operation.

When used as base course beneath asphaltic concrete pavement, the top surface of the FDR shall require approval by “string line” prior to asphaltic concrete pavement installation, in accordance with MAG and City Supplement requirements. The Engineer shall be present and witness the string-line testing.

310.5 Payment

Remove Section 104 of the COP MAG Supplement and replace with the following:

For Additive Alternate “B”: Measurement for aggregate base course material will be per square yard furnished and placed. Payment shall be made at the unit price bid and shall be considered full compensation for this work item.

Pay Item: 310.5 SP Full Depth Reclamation, Placement and Construction of Recycled Base Material (SY)
312 SP SOIL STABILIZATION - LITHTEC TREATED BASE

312.1 Description

Add the following to MAG Section 312.1:

No cement will be added as a base stabilization admixture. This Special Provision (SP) Section is actually a specification for a soil stabilization method utilizing a Lithified Technologies Lithtec admixture. This Soil Stabilization method herewith is only for Additive Alternate “A”.

312.4.2 Placing Cement

Remove MAG 312.4.2 in its entirety and replace with the following:

The Lithtec admixture shall be applied at a rate of 3.5% by weight. The application method shall be in accordance with Lithifield Technologies recommendations.

The contractor shall supply a truck suitable for spreading the Lithtec product shall be added to the uniform pulverized surface by means of mechanized equipment which is capable of spreading the Lithified Technologies product at the manufactures required rate. For any section of roadway, the quantity of Lithified Technologies product placed by mechanical spreaders shall not deviate more than the manufactures specifications from the computed quantity for the section.

If storm or winds cause a loss of spread Lithtec, spreading operations shall be halted until such winds or storms subside and, at the first indication of losses, prompt action shall be taken to avoid further losses. If Lithtec losses are deemed excessive, the deficient quantity shall be furnished and added in the proper amount by the Contractor at no additional cost to the Contracting Agency.

For the production of the Lithtec Treated Base, the City shall have laboratory tests performed on the homogenous FDR blend to determine compliance with Lithified Technologies recommendations. This testing shall be performed by a laboratory certified to do soils analysis with an experienced Professional Engineer Registered in the proper discipline to do soils certification in the State of Arizona.

312.8 Measurement and Payment

Remove MAG 312.8 in its entirety and replace with the following:

For Additive Alternate “A”: Measurement for stabilized base course material will be per square yard furnished and placed. Payment shall be made at the unit price bid and shall be considered full compensation for this work item.

Pay Item: 312 SP Soil Stabilization – Lithtec Treated Base (SY)
MAG 320 shall be removed and replaced in its entirely with the following:

320.1 Description

The Cold in-Place Asphalt Concrete Pavement (CIR-ACP) is only a component of Additive Alternate “B”. The asphalt concrete millings to be utilized for this project are currently stored and stockpiled at 1970 Sundog Ranch Road, Prescott Arizona 86301 (approximate location: latitude +34.576378 & longitude -112.425666). These recycled millings have been utilized for the recommended CIR-ACP mix design.

Table 1: Recommended CIR-ACP Mix Design

<table>
<thead>
<tr>
<th>Mix Design Components</th>
<th>Mix Design Proportions</th>
<th>Mix Design Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimum emulsion content, (%) (by weight of dry RAP)</td>
<td>3.0</td>
<td>3.0 ± 0.5</td>
</tr>
<tr>
<td>Lab Mix Water, (%) (by weight of dry RAP)</td>
<td>4.5</td>
<td>As required</td>
</tr>
<tr>
<td>Field Mix Water, (%) (by weight of dry RAP)</td>
<td>3.5^1</td>
<td></td>
</tr>
<tr>
<td>Hydrated Lime, (%) (by weight of dry RAP)</td>
<td>0.0</td>
<td>NA</td>
</tr>
<tr>
<td>Natural Milling Water Absorption, (%) (by weight of dry RAP)</td>
<td>1.33</td>
<td>-</td>
</tr>
<tr>
<td>Dry Tensile Strength at 77 °F, psi</td>
<td>74</td>
<td>Min. 70 psi</td>
</tr>
<tr>
<td>Wet Tensile Strength at 77 °F, psi</td>
<td>46</td>
<td>-</td>
</tr>
<tr>
<td>Tensile Strength Ratio, %</td>
<td>62</td>
<td>Min. 60%</td>
</tr>
<tr>
<td>Raveling, 24 hours cure at 140 °F, %</td>
<td>2.1</td>
<td>Max. 5%</td>
</tr>
<tr>
<td>Raveling, 4 hours cure at 77 °F, %</td>
<td>2.8</td>
<td>Max. 5%</td>
</tr>
</tbody>
</table>

^1 Field Mix Water is 1% less than the Lab Mix Water to account for the water supplied by the milling operations

The Cold In-Place Asphalt Concrete Pavement shall consist of a mix design in accordance with Table 1 and Appendix “A” – Cold In-Place Recycled Asphalt Base Layer Technical Specifications, with the following revisions, below.

CIR.05 Equipment

The Cold In-Place Recycled Asphalt Base Layer Technical Specifications, section CIR.05 shall be modified as follows:

A Central Plant shall be utilized for this project, and shall be located on the City’s site where the Asphalitic Concrete Millings are currently stored.
CIR.14 Measurement and Payment

The Cold In-Place Recycled Asphalt Base Layer Technical Specifications shall be revised to contain Section CIR.14 as follows:

Measurement of the CIR-ACP shall be by the square yard (SY), which shall include the required quantities of mineral aggregates, asphalt binder, and any mineral admixture. Measurement shall include any material used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

The CIR-ACP measured as provided above will be paid for at the contract price per square yard (SY), which price shall be full compensation for the item complete, as herein described and specified.

Pay Item: 320 SP Cold In-Place Asphalitic Concrete Pavement (SY)

321 SP Placement and Construction of asphaltic Concrete Pavement

321.2 Materials and Manufacture

ADD the following to Section 321.2 of the COP Technical Specifications:

A reinforcing aramid fiber shall be added to the mix design and production of the asphalt concrete. The aramid fiber shall be FORTA-FI brand, or a City Engineer approved equal.

321.6 Mix Production

ADD the following to Section 321.6 of the COP Technical Specifications:

Asphaltic Concrete Hot Plant Reports shall be provided to the Owner.

Add aramid and polyolefin reinforcing fiber blends at a dosage rate of one (1) pound fiber per one (1) ton of asphalt.

Have the fiber manufacturer’s representative on site during mixing and production. This requirement can be waived if fiber manufacturer and asphalt producer can supply evidence of manufacturer’s brand of fiber being successfully produced a minimum of three times at the asphalt plant to be used for the project.

Batch Plant Production: When a batch plant is used, add fiber to the aggregate in the weigh hopper and increase both dry and wet mixing times. Ensure that the fiber is uniformly distributed before the injection of asphalt cement into the mixture.

Drum Plant Production: Inject fibers through the RAP collar manually or by feeding them with a metered air blown system to promote rapid and complete fiber dispersion. Rate the feeding of fibers with the rate the plant is producing asphalt mix. If there is any evidence of fiber bundles at the
discharge chute, increase the mixing time and/or temperature or change the angle of the fiber feeder line to increase dry mixing time.

Add fibers continuously and in a steady uniform manner. Provide automated proportioning devices and control delivery within ±10% of the mass of the fibers required. Perform an equipment calibration to the satisfaction of the fiber manufacturer’s representative to show that the fiber is being accurately metered and uniformly distributed into the mix.

Include the following with the air blown system:

- Low level indicators
- No-flow indicators
- A printout of feed rate status in pounds/minute
- A section of transparent pipe in the fiber supply line for observing consistency of flow or feed.
- Manufacturer’s representative’s approval of fiber addition system

Plant Quality Control:

Aramid Dispersion Visual Test: Collect a 10kg sample of mix from the discharge chute during first 50 tons of production. Visually assess the state of aramid fibers in the sample according to Reference 4 (Section B of this specification) and rate the sample as “Pass” or “Fail”.

“Pass” = All fibers exist in an Individual State and no Undistributed Clips or Agitated Bundles of fiber are detected.

“Fail” = One or more Undistributed Clips or Agitated Bundles are detected.

If a sample is rated as “Fail”, adjust mixing operations to improve fiber dispersion and repeat Step 1 above. If Visual Test results in three consecutive “Fail” ratings, plant mix samples should be sent to a third party laboratory for complete ADSR testing before production is allowed to commence. In addition to Visual Test, use a shovel to inspect mix in the back of first three trucks and every tenth truck thereafter to confirm adequate blending of the fiber. Remove any observed fiber bundles from placed mixture and adjust operations per the manufacturer’s recommendation to eliminate future fiber bundle development, and repeat Steps 1 through 3 above to confirm adequate aramid fiber dispersion.

321.8.2 Joints

ADD the following to MAG Section 321.8.2:

The longitudinal joints shall coincide with the lane striping or shall run parallel to all lane striping no more than 6” from the ultimate stripe location.

321.10 Acceptance

ADD the following to MAG Section 321.10:
All ACCEPTANCE requirements, as per this section, shall be applicable for this project.

321.12 Measurement

REMOVE Section 321.12(A) of the COP Technical Specifications in its entirety and REPLACE with the following:

Asphalt concrete pavement will be measured by the TON, which shall include the required quantities of mineral aggregates, asphalt binder, and mineral admixture. Measurement shall include any tonnage used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

321.13 Payment

Revise and replace with the following to MAG Section 321.13:

The asphalt concrete measured as provided above will be paid for at the contract price per ton, as adjusted per Section 321.10, which price shall be full compensation for the item complete, as herein described and specified.

No payment will be made for any overrun in quantity of asphaltic concrete in excess of 5 percent of the bid schedule quantity, based on actual field measurement of area covered, design thickness, and the mix design unit weight. The accepted quantities of asphalt concrete pavement, measured as provided above, will be paid for at the contract unit price per the pay unit shown below, which price shall be full compensation for the item complete in place and as adjusted per Section 321.10, and as herein described and specified.

Pay Item: 321.13 SP Asphaltic Concrete Pavement, ¾” Mix, with Fiber (TN)

330 SP ASPHALT CHIP SEAL

330.2.1 Asphalt

MAG Section 330.2.1 shall be revised to include the following:

The Paving Asphalt Grade shall be a high volume binder, Polymer Modified Asphalt Rubber PG58-22, with 16% Tire Rubber and 3% SBS Polymer.

330.6 Measurement

MAG Section 330.6 shall be removed in its entirety and revised as follows:

Measurement of the asphalt Chip Seal shall be by the square yard (SY), which shall include the required quantities of mineral aggregates, asphalt binder, and any mineral admixture. Measurement shall include any material used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.
330.7 Payment

*MAG Section 330.7 shall be removed in its entirety and revised as follows:*

The Asphalt Chip Seal measured as provided above will be paid for at the contract price per square yard, which price shall be full compensation for the item complete, as herein described and specified.

**Pay Item: 330 SP Asphalt Chip Seal (SY)**

330.8 SP Warranty

*MAG Section 330.8 shall be added as follows:*

**Chip Seal Warranty** - All portions of the work under this contract shall be guaranteed for workmanship and materials for a period of two years from the date of final acceptance of the product by the Owner. Guarantee does not include workmanship or materials for subgrade work performed by others.

Stripping of cover material and/or bleeding of the chip seal asphalt or PMM on any portion of the chip seal area, as determined by the Owner, shall be defined as chip seal failure. Failure of the chip seal area and the severity of the failure shall direct the extent of the warranty repairs. Repair requirements for chip seal failure due to workmanship and/or materials shall be defined as follows:

a) If *Random* or *Strip* area(s) of chip seal failure occur(s) less than 20% by area, the Contractor shall fully repair the specific failure area(s) via reapplication of chip seal asphalt, aggregate and PMM in accordance with the technical specifications over the repair areas.

b) If *Random* or *Strip* area(s) of chip seal failure occur(s) over 20%, but less than 50%, by area, the Contractor shall fully repair the specific travel lane(s) where the failure exists via reapplication of chip seal asphalt, aggregate and PMM in accordance with the technical specifications over the repair areas.

c) If *Random* or *Strip* area(s) of chip seal failure occur(s) over 50%, by area, the Contractor shall fully repair all travel lane(s) where the failure exists via reapplication of chip seal asphalt, aggregate and PMM in accordance with the technical specifications over the repair areas.

If part of the contract work, all repaired failure areas shall receive all finish seal coats as well as paint striping application, in accordance with the contract documents.

*Random* chip seal failure is characterized by irregular patterns of missing cover chips and/or irregular patterns of bleeding areas. Random chip seal failure shall be weighted as the percent of chip seal failure spots within a given 1’ by 1’ area, either by stripping of cover material and/or bleeding of the asphalt/PMM. In the area of this failure, several random failure areas would be measured and the average would be calculated to assess the proportion of failure.
Strip chip seal failure is characterized by regular patterns of missing cover chips and/or regular patterns of bleeding areas. Strip chip seal failure shall be weighted as the percent of chip seal failure spots within the width of the travel lane, by stripping of cover material and/or bleeding of the asphalt/PMM. In the area of the failure, several strip failure areas would be measured and the average would be calculated to assess the proportion of failure.

All warranty period repairs by the Contractor shall be considered a non-pay item. Failure of the Contractor to coordinate warranty repairs within 45 days of written notice shall warrant the City to move forward with a formal complaint with the Arizona Registrar of Contractors. Furthermore, no future construction contracts shall be awarded to the Contractor if warranty repairs are unresolved.

334 PRESERVATION SEAL FOR ASPHALT CONCRETE

334.2 Materials

Add the following to MAG Section 334.2:

The Asphalt Surface Sealer shall be a Polymer Modified Masterseal (PMM) product.

334.3 Construction Method

Add the following to MAG Section 334.3:

The Polymer Modified Masterseal (PMM) product shall be spread at a rate of 0.20 GAL/SY, plus or minus, and as adjusted to meet the Asphalt Chip Seal Warranty—see Section 330.8.

345 SP ADJUSTING FRAMES, COVERS AND VALVE BOXES

345.1 Description

Remove second paragraph of MAG Section 345.1 in its entirety and replace with the following:

A. All frames, covers, valve boxes, manholes, etc., shall be adjusted to finished grade after placement of asphalt concrete surface course by the Contractor per COP Standard Details 270Q, 391Q, and 422Q. The Contractor shall provide and install new sewer rings, frames, and manhole covers when old ones cannot be reused. The City of Prescott inspector or project manager will determine which can be reused at the time of removal by the contractor. New sewer manhole covers shall have the City logo of Thumb Butte. Old rings and covers not reused shall be disposed of by the contractor.

B. To expedite the cure time of concrete collars on utility covers, survey monuments, and manholes, the Contractor shall utilize a high/early concrete mix equivalent to a minimum 5,000 psi 28 day strength. Traffic may not be allowed to traverse over the collars until the concrete has reached 3,000 psi. Payment for high/early concrete shall be considered incidental to the item being adjusted to grade.
C. New and reused valve caps and manhole covers shall be well seated and not result in objectionable noise when driven over, such as clanging or rattling. Any valve covers or manhole covers that result in objectionable noise when driven over shall be replaced at no additional cost to the City, to include replacing adjustment rings if needed to obtained acceptable results.

D. Existing water meter boxes in the roadway shall be replaced per the applicable COP standard detail, to include a traffic rated cover. Where existing water meter boxes in the roadway have a concrete collar, said collar shall also be replaced with new concrete collar to match existing. Water meter assembly is not to be disturbed.

E. During the raising of utility covers to finish grade, demolished material and left over concrete shall not be placed directly onto new pavement or slurry seal coat. Such material shall be stockpiled on tarps as a minimum and properly disposed of to avoid staining the new pavement surface.

F. Payment shall be made on a per each basis for adjusting manholes, cleanouts, and valves to finish grade.

G. Payment for new sewer manhole rings, frames, and covers if needed will be paid for separately per the bid schedule. Payment for new water valve risers, covers, and debris caps if needed will be paid for separately per the bid schedule.

H. Adjustment of sewer manholes using riser rings shall be per the manufactures recommendations. Payment shall be for each riser ring including all labor and materials for installation.

345.7 Payment

ADD the following to MAG Section 345.7:

Pay Item: 345.1a SP – Adjust Sewer Manhole Frame and Cover (EA)
Pay Item: 345.1b SP – Adjust Water Valve Box and Cover (EA)
Pay Item: 345.1c SP – Adjust Storm Drain Manhole and Cover (EA)
Pay Item: 345.1d SP – Adjust Sewer Cleanout (EA)
Pay Item: 345.1e SP – Adjust Blow-off (EA)
Pay Item: 345.1f SP – Replacement Sewer Manhole Frame and Cover (if needed) (EA)
Pay Item: 345.1g SP – Replacement Water Valve Box and Cover (if needed) (EA)

405 SP Monuments

405.1 Description

Add the following to the COP MAG Supplement:

Any monuments uncovered or found during the course of construction shall not be disturbed or removed until observed, measured and referenced by the Engineer.
405.3 Construction

*COP MAG Supplement shall be revised to add the following:*

Disturbed survey monument hand-holes shall be restored and adjusted to finish grade with Survey Monument Type “A” with cast iron frame and cover in accordance with Quad City Standard Detail 120Q and MAG Specifications Section 405. Refer to section 105.8.

405.5 Payment

*COP MAG Supplement shall be deleted in its entirety and is replaced with the following:*

Payment shall be based on a per unit (Each) complete in place.

**Pay Item: 405.5 SP Adjust Survey Hand-hole Frame and Cover (EA)**

710 SP     Asphalt Concrete

710.2.1      Asphalt Binder

*REMOVE Section 710.2.1 of the COP MAG Supplement in its entirety and REPLACE with the following:*

The asphaltic concrete shall have a PG70-22TR+ asphalt binder, otherwise known as a polymer modified asphalt tire rubber binder, which shall conform to the requirements of Table 711-2 for Type 1 – TR products, with the exception of AASHTO T-315 test shall be for 70 degrees Celsius.
Appendix “A”
COLD IN-PLACE RECYCLED ASPHALT BASE LAYER TECHNICAL SPECIFICATIONS

CITY OF MESA ARIZONA, USA

September 01, 2017
Abbreviations.

US Customary symbols.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ampere</td>
<td>electric current</td>
</tr>
<tr>
<td>ac.</td>
<td>acre</td>
<td>Area</td>
</tr>
<tr>
<td>BTU</td>
<td>British Thermal Unit</td>
<td>Energy</td>
</tr>
<tr>
<td>cu. in. or in^3</td>
<td>cubic inches</td>
<td>Volume</td>
</tr>
<tr>
<td>cu. ft., cf, ft^3 or CUFT</td>
<td>cubic feet</td>
<td>Volume</td>
</tr>
<tr>
<td>cu. yd., cy, yd^3 or CUYD</td>
<td>cubic yards</td>
<td>Volume</td>
</tr>
<tr>
<td>D</td>
<td>day</td>
<td>Time</td>
</tr>
<tr>
<td>deg. or °</td>
<td>degree</td>
<td>plane angle</td>
</tr>
<tr>
<td>Fc</td>
<td>foot-candles</td>
<td>luminous intensity</td>
</tr>
<tr>
<td>fl. oz.</td>
<td>fluid ounces</td>
<td>Volume</td>
</tr>
<tr>
<td>ft. or '</td>
<td>foot or feet</td>
<td>Length</td>
</tr>
<tr>
<td>gal. or GAL</td>
<td>gallon</td>
<td>Volume</td>
</tr>
<tr>
<td>H</td>
<td>Henry</td>
<td>Inductance</td>
</tr>
<tr>
<td>hr. or HR</td>
<td>hour</td>
<td>Time</td>
</tr>
<tr>
<td>Hz</td>
<td>hertz (s(^{-1}))</td>
<td>Frequency</td>
</tr>
<tr>
<td>in. or &quot;</td>
<td>inch or inches</td>
<td>Length</td>
</tr>
<tr>
<td>K</td>
<td>kelvin</td>
<td>Temperature</td>
</tr>
<tr>
<td>lb or LB, lbs</td>
<td>pound, pounds</td>
<td>Mass</td>
</tr>
<tr>
<td>Lbf</td>
<td>pound-force</td>
<td>Force</td>
</tr>
<tr>
<td>lnft or LNFT</td>
<td>linear foot</td>
<td>Length</td>
</tr>
<tr>
<td>mi.</td>
<td>miles</td>
<td>Length</td>
</tr>
<tr>
<td>min. or m</td>
<td>minute</td>
<td>Time</td>
</tr>
<tr>
<td>min. or '</td>
<td>minute</td>
<td>plane angle</td>
</tr>
<tr>
<td>°F</td>
<td>degrees Fahrenheit</td>
<td>Temperature</td>
</tr>
<tr>
<td>oz.</td>
<td>ounces</td>
<td>Mass</td>
</tr>
<tr>
<td>Psi</td>
<td>pounds/square inch</td>
<td>Pressure</td>
</tr>
<tr>
<td>Q</td>
<td>cubic feet/second</td>
<td>flow rate</td>
</tr>
<tr>
<td>sec. or s</td>
<td>second</td>
<td>Time</td>
</tr>
<tr>
<td>sec. or &quot;</td>
<td>second</td>
<td>plane angle</td>
</tr>
<tr>
<td>sq. in. or in^2</td>
<td>square inches</td>
<td>Area</td>
</tr>
<tr>
<td>sq. ft., sf, ft^2 or SQFT</td>
<td>square feet</td>
<td>Area</td>
</tr>
<tr>
<td>sq. yd., sy, yd^2 or SQYD</td>
<td>square yards</td>
<td>Area</td>
</tr>
<tr>
<td>Sta.</td>
<td>station</td>
<td>Length</td>
</tr>
<tr>
<td>T</td>
<td>short ton (2000 lbs)</td>
<td>Mass</td>
</tr>
<tr>
<td>V</td>
<td>volt (W/A)</td>
<td>electric potential</td>
</tr>
<tr>
<td>W</td>
<td>watt (J/s)</td>
<td>Power</td>
</tr>
<tr>
<td>YD</td>
<td>yard or yards</td>
<td>Length</td>
</tr>
<tr>
<td>Ω</td>
<td>ohm V/A</td>
<td>electric resistance</td>
</tr>
</tbody>
</table>
COLD IN-PLACE RECYCLED ASPHALT BASE LAYER

Description

CIR.01

This work consists of constructing a recycled asphalt base course using methods and equipment capable of cold in-place recycling and relaying the material in a one-pass operation.

Emulsified Asphalt grades for the cold in-place recycled (CIR) mixture are designated in the table below:

Table 1: Specifications for CIR Emulsified Asphalts.

<table>
<thead>
<tr>
<th>Emulsion Grade</th>
<th>HFMS-2SP</th>
<th>CSS Engineered Emulsion</th>
<th>PASS R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests on emulsion:</td>
<td>Minimum</td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol at 50°C, Sfs</td>
<td>50</td>
<td>---</td>
<td>20 (2)</td>
</tr>
<tr>
<td>Storage stability test, 24-hour, % (1)</td>
<td>---</td>
<td>1.0</td>
<td>---</td>
</tr>
<tr>
<td>Sieve test, % (3)</td>
<td>---</td>
<td>0.10</td>
<td>---</td>
</tr>
<tr>
<td>Residue by distillation, %</td>
<td>65</td>
<td>---</td>
<td>62.0</td>
</tr>
<tr>
<td>Oil distillate by volume of emulsion, %</td>
<td>---</td>
<td>7.0</td>
<td>---</td>
</tr>
</tbody>
</table>

Tests on residue from distillation test:

| Penetration, 25°C, 100 g, 5 sec | 100          | 300                     | 40         | 120         | 40      | 120       |
| Ductility, 25°C, 5 cm/min, cm | 75           | ---                     | 65         | ---         | 40      | ---       |
| Float test, 60°C, sec         | 1200         | ---                     | ---        | ---         | ---     | ---       |
| Performance Grade High Temperature, °C(3) | ---     | 64                     | 70         | ---         | --      | --        |

(1) This test requirement on representative samples is waived if successful application of the material has been achieved in the field.

(2) Perform test at 25°C.

(3) Based on the testing of the emulsion residue at its original state as per AASHTO M320.

Prior to starting work on the CIR base layer, a Job-Mix Formula (JMF) for the CIR mix must be approved, and a proposed construction schedule approved by the Engineer demonstrating how pulverizing and paving operations will be completed such that no portion of a pulverized surface is left unpaved for more than 14 days.

Materials

CIR.02 Conform to the following Subsections

<table>
<thead>
<tr>
<th>CIR Emulsified</th>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fog Seal Emulsified</td>
<td>MAG 713, Table 713-1</td>
</tr>
</tbody>
</table>

Water added to the CIR mix shall be potable, clean and free from deleterious concentrations of acids, alkalis, salts, sugar and other organic or chemical substances. The water shall not contain an amount of impurities that will cause a reduction in the strength of the recycled asphalt concrete.
pavement. If the water is of questionable quality, it shall be tested in accordance with AASHTO T26.

**Construction Requirements**

**CIR.03 Composition of Mix**

Collect representative samples of the existing Asphalt Concrete (AC) layer to be recycled by coring through the entire depth of the AC layer (depth varies see plans). Replace removed AC with asphalt concrete or approved cold patch material. The cores locations must be selected to obtain a combined representative sample of the in-place AC to be used as the reclaimed asphalt pavement (RAP) for the CIR base layer. It is strongly recommended that the design engineer and owner representative be present for the selection of these locations.

Design a mix according to the CIR Mix Design Parameters summarized in Table 2 and the steps that follows.

**Table 2: CIR Mix Design Parameters.**

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation of Reclaimed Asphalt Pavement (RAP): AASHTO T 27</td>
<td>100% passing 1-inch sieve</td>
</tr>
<tr>
<td></td>
<td>≤5% passing No. 200</td>
</tr>
<tr>
<td>Asphalt Binder Content of RAP: AASHTO T164</td>
<td>Report</td>
</tr>
<tr>
<td>High Temperature PG at Original State per AASHTO M320 of the Recovered RAP Binder per ASTM D5404</td>
<td>Report</td>
</tr>
<tr>
<td>Optimum Emulsion Content (OEC), by dry mass of RAP, %</td>
<td>Report</td>
</tr>
<tr>
<td>Theoretical Maximum Specific Gravity of loose CIR Mix at OEC</td>
<td>Report</td>
</tr>
<tr>
<td>Bulk Specific Gravity of Compacted CIR Mix at OEC</td>
<td>Report</td>
</tr>
<tr>
<td>Air Voids of Compacted CIR Specimens at OEC, %</td>
<td>12 – 14</td>
</tr>
<tr>
<td>Marshall Stability of Compacted CIR Specimens at OEC: AASHTO T 245, 104 ºF, lbs</td>
<td>1250 Min</td>
</tr>
<tr>
<td>Ratio of Emulsion Residue to Cement †</td>
<td>3:1 Min</td>
</tr>
<tr>
<td>Lime Slurry ‡, %</td>
<td>Report</td>
</tr>
<tr>
<td>Dry Tensile Strength of Compacted CIR Specimens at OEC, 77ºF, psi</td>
<td>70 Min</td>
</tr>
<tr>
<td>Tensile strength Ratio at OEC, 77ºF, %</td>
<td>70 Min</td>
</tr>
<tr>
<td>Raveling Test of CIR Mix at OEC, ASTM D7196, 50ºF, %</td>
<td>5.0 Max</td>
</tr>
<tr>
<td>Dynamic Modulus (E*) Master Curve at 70ºF, AASHTO T379 and R84</td>
<td>Report</td>
</tr>
<tr>
<td>Flow Number (FN) at 140ºF, AASHTO T379 and R84</td>
<td>Report</td>
</tr>
</tbody>
</table>

† If Portland cement is used as additive
‡ If lime slurry is used as additive
1) Preparation of RAP
   a. Cut the cores to the depth of the CIR layer.
   b. Crush the cores to generate the RAP material by passing them through the crusher multiple times until all materials pass the 1-inch sieve.
   c. Mix all the RAP with a shovel, ensuring uniform distribution.
   d. Dry the RAP at 140°F (60°C) until constant mass (24 to 48 hours).
   e. Extract the RAP binder per AASHTO T164 and Recover the RAP binder per ASTM D5404.
   f. Measure the high temperature PG of the recovered RAP binder at original state per AASHTO M320.

2) Emulsified Asphalt
   a. Obtain 5-gallons sample of the approved asphalt emulsion with a shelf life of 6 months.

3) Optimum Water Content
   a. Typically, 1% water by dry mass of RAP is supplied by the milling operations.
   b. Optimum water content must be determined based on the moisture density curve of the RAP material using the modified proctor method (AASHTO T180).
   c. If lime slurry is used; the sum of slurry water and the 1% milling water should be incorporated in the mix. Typically, this amount of water is higher than the optimum water content.
   d. If portland cement or no additive is used, the optimum water content should be added in the lab while in the field the amount of water added should be reduced by the 1% milling water.

4) Mixing Time
   a. All mixing is conducted at room temperature of 77°F (25°C).
   b. Mix RAP with the additive (i.e., lime slurry or portland cement) for 2 minutes.
   c. Mix RAP+Additive with water for 1 minute (amount of water determined in step 3).
   d. Mix RAP+Additive+Water with emulsion (2-4%) for 1 minute.
   e. It should have a visible satisfactory coating.

5) Determination of Theoretical Maximum Specific Gravity ($G_{mm}$) (AASHTO T209)
   a. The minimum $G_{mm}$ sample, for a maximum size of 1.0 inch is 2500 g.
   b. Prepare CIR materials as described in Step 4. Cure at 140°F (60°C) until constant mass (24 hours).
   c. Determine dry weight of sample after curing at 140°F (60°C) and place into pycnometer with water.
   d. Remove entrapped air in the sample with vacuum (27.5±2.5 mmHG) and mechanical agitation for 15±2 minutes.
e. Container and content suspended in water bath (25±1°C) for 10±1 minutes. Measure underwater weight.

\[ G_{mm} = \frac{A}{A - (D - B)} \]

A: mass of dry sample (g)
B: mass of empty pycnometer underwater at 25°C (g)
D: mass of pycnometer + sample underwater at 25°C (g)

f. Two samples for each mixture should be mixed. Both samples should meet the AASHTO T209 specs for difference between the \( G_{mm} \) (for single-operator precision, less than 0.014) and for standard deviation between the \( G_{mm} \) (for single-operator precision, less than 0.0051).

The theoretical maximum specific gravity is measured at one emulsion content (3.0%) and calculated at other emulsion contents up to emulsion content of 4%, assuming a constant effective specific gravity (\( G_{se} \)).

\[ G_{se} = \frac{P_b}{100} \frac{G_{mb}}{G_{mm}} - \frac{G_b}{G_{mb}} \]

*\( P_b, G_b \): percent residue in the emulsion and specific gravity of residue binder, respectively.

6) Compaction in the Marshall Hammer

a. Compact the CIR mixtures in the Marshall Hammer at 77°F (25°C) for 75 blows per face.

b. Using the \( G_{mm} \), estimate the required mass of sample in grams (g) to obtain air voids 12-14% and a height 2.5±0.1in: \( (\pi(R)^2h(0.87)G_{mm}) \). Note: Radius (R) and Height (h) are in centimeters (cm).

7) Curing Time for Compacted CIR Samples

a. Cure the compacted CIR mixtures in the mold, in an oven at 140°F (60°C) for 24 hours.

8) Determination of Optimum Emulsion Content (OEC)

a. The OEC is obtained using a trial experimental matrix composed of samples mixed with additive (i.e. lime slurry or portland cement), water and 4 emulsion contents (2.5%, 3.0%, 3.5% and 4.0%) with 2 replicates for each combination. The samples have constant mass and are compacted at 75 blows/face. After curing for 24 hours at 140°F (60°C), the bulk specific gravity (\( G_{mb} \)) is obtained using the parafilm method (ASTM D1188). The compacted samples should meet the ASTM D1188 specs for difference between the \( G_{mb} \) (for single-operator precision, less than 0.079) and for standard deviation of the \( G_{mb} \) (for single-operator precision, less than 0.028).

b. The two best emulsion contents that meet the air voids (13±1%) and the height (2.5±0.1in) requirements are selected for performance evaluation of moisture sensitivity, cohesion strength, and raveling resistance. The OEC represents the
emulsion content that provides the best resistance to moisture damage and raveling as outline below.

8.1) Moisture Damage Resistance (AASHTO T283)
   a. The resistance to moisture damage is determined using the tensile strength ratio of the CIR mixture. Samples are tested at the wet and dry conditions following AASHTO T283 Standard.

8.2) Raveling Resistance (ASTM D7196) and Curing Time
   a. Determine the curing time following the Cohesion Strength (ASTM D3910) to identify the time required to allow traffic application on the CIR layer, based on the cohesion development of the mixture.
   b. Cure the CIR mixture to the time determined in step 1. The raveling resistance of the CIR mixture is obtained by simulating the abrasion similar to the early open traffic. The percentage of raveling is calculated from the mass loss of the specimen after the test. Raveling mass loss less than 5.0% is required to ensure good raveling resistance of the CIR mix.

Additional Performance Properties of the CIR Mix

9) Dynamic Modulus (AASHTO T378) at OEC:
   a. The dynamic modulus (E*) test is used to develop the dynamic modulus master curve of the CIR mixture per AASHTO R84. The test uses three temperatures (4°C, 20°C, and 45°C) and three loading frequencies (10Hz, 1Hz, and 0.1Hz). The master curve is referenced to a temperature of 20°C, using time-temperature superposition principle.

10) Flow Number Test (AASHTO T378) at OEC:
   a. The flow number (FN) test is used for characterize the response of a CIR mixture to permanent deformation. The test applies a haversine deviator stress on the CIR sample for a loading period of 0.1 s and a rest period of 0.9 s. The sample is subjected to a dynamic deviator stress of 70 psi and a static confining stress of 10 psi at 140°F. The result of the test is a relationship between accumulated vertical permanent deformation and number of load cycles. The FN is the number of cycles at which the transition between the secondary and tertiary regions occurs per AASHTO R84.

11) Submit the JMF for approval that includes the following information:
   a. Optimum emulsion content (OEC) based on dry mass of RAP
   b. Source and grade of emulsified asphalt as per Table 1 and two 1-quart samples
   c. Optimum moisture content based on dry mass of RAP and amount of moisture to be added in the field while accounting for the 1% milling water
   d. Theoretical maximum specific gravity of the CIR mix at the OEC
   e. Bulk specific gravity of the CIR mix at the OEC
   f. Dynamic Modulus Master Curve Flow Number Curve of the CIR mix at OEC
   g. Results of tests and applicable charts and graphs
Begin production only after the JMF is approved by the Engineer. Submit a new JMF if there is a change in a material source.

CIR.04 General
Clear, grub, and remove vegetation and debris within 12 inches of the pavement to be recycled as needed. Clean the pavement and edge of pavement of loose material, dirt, vegetation, and other deleterious material. Maintain the integrity of existing curb and gutter as applicable.

CIR.05 Equipment
Furnish a self-propelled recycling train with the following major units:

1) **Pavement milling machine**
   a. Automatic depth controls to maintain the cutting depth to within plus or minus ¼ inch;
   b. Positive means cross slope elevation control;
   c. Capability of milling the existing asphalt pavement material to the required depth as noted in plans and specifications in a single pass; and
   d. 12 feet minimum cutter width.

2) **Crushing unit**
   a. Capable of screening and crushing material to the required size before mixing with emulsified asphalt.

3) **Pugmill and proportioning equipment.**
   a. Capable of continuously mixing the milled material with emulsified asphalt, water, and other additives to produce a uniform and homogenous mixture;
   b. Belt scale for continuous weighing of milled and sized material with an interlocked computer controlled liquid metering device capable of automatically adjusting the flow of asphalt emulsion to the mass of milled material coming into the mixer;
   c. Proportioning equipment capable of applying emulsified asphalt and water to within plus or minus 0.2 percent of the required quantity by mass of milled material;
   d. Proportioning equipment with a digital meter for monitoring the flow rate and total milled material, emulsified asphalt, and water applied; and
   e. Capable of placing the mixture in a windrow without segregation.

4) **Paver**
   a. Provide a paver that is capable of picking up the entire windrow and feeding it into the paver hopper. Do not heat the screed.

5) **Rollers**
   a. Provide double-drum steel wheel and pneumatic-tire rollers in sufficient quantity and size to obtain the required density. Provide pneumatic-tire rollers weighing a minimum 25 tons.

CIR.06 Weather Limitations
Do not begin work when fog, showers, rain, frost, temperatures below 35 ºF are anticipated within 24 hours.

Place cold in-place recycled asphalt base on a dry, unfrozen surface when the air temperature in the shade and the road surface temperature are 50 ºF and rising.

CIR.07 Production Start-Up Procedures.

1) **Preparatory phase meeting.** Conduct a pre-recycling preparatory phase meeting at least 7 days before the start of recycling operations.

2) **Control strip.** Provide 7 days notice before beginning production.
   a. Construct the control strip on the project at an approved location by the Engineer.
   b. Recycle a 1500-foot long control strip, one-lane wide, and at the designated thickness. Use the construction procedures intended for the entire project. Cease production after construction of the control strip until the recycled base layer and the control strip are evaluated and verified for acceptance.
   c. Acquire two random samples of milled material from the control strip after the material has passed through the crushing unit.
   d. Acquire two random samples of the final CIR mix.
   e. Acquire one sample of the emulsion.
   f. Verify that the gradation and oil content of the milled material is still representative of the material used in the mix design. Measure Marshall Stability and bulk specific gravity of the compacted CIR mix to assure the obtained samples are still representative of the JMF. The emulsion should be tested to % residue, penetration, ductility, viscosity, and high temperature PG of residue to assure emulsion is representative of emulsion used during mix design.
   g. During Production of the control strip, take density readings behind each roller pass to determine the roller pattern necessary to achieve the maximum in-place density (break point of compaction curve) according to ASTM D2950. Use the bulk specific gravity value from the mix design as a benchmark for evaluating the maximum in-place density achieved. The in-place material should be compacted to 12 – 15% air voids.
   h. Repeat the control strip process until an acceptable control strip is produced. If unacceptable, remove and replace work that does not conform to the contract, or to prevailing industry standards where no specific contract requirements are noted, at no cost to the Agency. Accepted control strips may remain in place and will be measured as a part of the completed base course.
   i. Full production may begin when a control strip is verified. Provide the Engineer with the maximum in-place density achieved, application rates of the emulsified asphalt, water, and other additives used on the accepted control strip.
   j. Use these start-up procedures when changing construction procedures, when resuming production after a termination of production due to unsatisfactory quality, or the beginning of a new construction season.

CIR.08 Pavement Recycling and Mixing
a. Mill the existing pavement to the required depth and width. Reduce oversize particles to a maximum size of 1-inch.
b. Combine milled material with emulsified asphalt, and water at the approved application rates to produce a homogenous and uniformly-coated mixture. Maintain the emulsified asphalt temperature within the range recommended by the supplier.
c. Minimize the disturbance to underlying material. Synchronize the recycling rate to allow for continuous operation of recycling train equipment.
d. Continuously monitor and evaluate the milling, mixing, and placing operations to assure optimum quality of the recycled asphalt base course. Adjust application rates based upon material variations. Notify the Engineer of any changes.

CIR.09 Spreading, Compacting, Finishing and Fog Seal

1) Spreading
   a. Spread, and finish the recycled mix to the required line, grade, and elevation per plans.

2) Compacting
   a. Begin compaction within 30 minutes of spreading.
   b. Use pneumatic-tire rollers until no displacement is observed.
   c. Use steel-wheel rollers, either in static or low-amplitude vibratory mode, to achieve final density and eliminate pneumatic-tire roller marks.
   d. Do not park or idle rollers on un-compacted material.
   e. Use roller patterns established during the control strip. Compact the recycled mix to obtain 12 – 15% in-place air voids. Measure in-place density according to ASTM D2950. If an area fails to meet required density, rework and re-compact the area.
   f. If applications rates of the emulsified asphalt from the approved mix design are changed by more than ±0.4% by mass of RAP, or if other material conditions distinctly change, reestablish roller pattern according to Subsection CIR.07(b).
   g. Compact the material with approved tampers or compactors along curbs, headers, walls, and places not accessible to the roller.

3) Finishing
   a. Produce a surface that is smooth, dense, and free of ruts, ridges, and loose material.
   b. Measure pavement surface using a 10-foot metal straightedge at right angles and parallel to the centerline. Defective areas are deviations between the surface and the bottom of the straightedge in excess of ⅜ inches measured between a two contacts of the straightedge, or at the end of the straightedge.
   c. After completion of the finishing no traffic, including that of the Contractor, shall be permitted on the surface for 2 hours. This may be reduced if sufficient care is taken so as traffic does not initiate raveling.

4) Fog seal
   a. Place a fog seal on the surface of the recycled asphalt base following the 2-hour time period noted in section CIR.09(c).
b. Use emulsified asphalt diluted to 50 percent by volume with water and apply it at a rate of 0.05 to 0.15 gallons per square yard. When necessary, place blotter material.

c. Protect the surfaces of nearby structures and objects to prevent spattering or marring. If spattering or marring occurs clean or repair.

CIR.10 Construction Joints

1) Longitudinal joints
   a. Make longitudinal joints coincide with each change in cross-slope.
   b. Provide a minimum longitudinal overlap of 4 inches.

2) Transverse joints
   a. At the beginning of each day’s recycling operations or after extended work stoppages, ensure continuity across transverse joints by cutting back into the completed work for a distance recommended by the manufacturer of the cold recycling equipment.

CIR.11 Curing and Maintenance

Keep traffic and construction equipment off of the CIR layer for at least 2 hours after completing compaction and until it is sufficiently stable to withstand raveling, marring, and permanent deformation. Route hauling and other construction equipment uniformly over the full width of the recycled asphalt base to minimize non-uniform compaction. After Fog Seal emulsion has broken, traffic may be placed on roadway.

Maintain the CIR layer to the correct line, grade, and cross-section. Provide additional rolling to maintain the control strip density as described in Subsection CIR.07(b). Remove roller marks left in the surface after additional rolling is complete with a steel wheel roller to maintain a dense surface. Use a power broom to remove loose particles.

If the CIR layer loses stability, density, or finish, reprocess and re-compact as necessary to restore the strength of the material.

Place the next course or final surface when the moisture content of the CIR layer is reduced to 2.0 percent or less according to AASHTO T 255, but within 14 days after recycling regardless of moisture content.

CIR.12 Performance Verification

Thirty days after construction is completed, the following plan shall be executed:

   a. Obtain two sets of six cores from two representative locations
   b. Measure the bulk specific gravity of the cores
   c. Measure the dry and wet tensile properties of the cores as per AASHTO T283
   d. Crumble the tested cores and measure the theoretical maximum specific gravities
   e. Determine the air voids of the cores and the tensile strength ratios
   f. Extract and recover the asphalt binder and measure its high temperature PG at original state per AASHTO M320

CIR.13 Acceptance
See Table 3 for sampling, testing, and acceptance requirements.
Table 3: Sampling, Testing and Acceptance Requirements

<table>
<thead>
<tr>
<th>Material or Property</th>
<th>Type of Acceptance</th>
<th>Characteristic</th>
<th>QC/QA</th>
<th>Test Methods Specifications</th>
<th>Sampling Frequency</th>
<th>Point of Sampling</th>
<th>Split Sample</th>
<th>Reporting Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIR mix design</td>
<td>Measured and tested for conformance</td>
<td>All</td>
<td>QC</td>
<td>Subsection CIR.03 and ARRA</td>
<td>1 per submitted mix design</td>
<td>Existing roadway</td>
<td>---</td>
<td>Minimum 15 days before production</td>
</tr>
<tr>
<td>Emulsified asphalt <em>(1)</em> (source quality)</td>
<td>Quality</td>
<td>QC</td>
<td>Subsection CIR.01</td>
<td>1 per material type</td>
<td>Point of shipment or delivery</td>
<td>2 1-quart samples</td>
<td>Before incorporating into work</td>
<td></td>
</tr>
<tr>
<td>CIR Mix (Control Strip)</td>
<td>Measured and tested for conformance</td>
<td>Gradation, Bulk Specific Gravity, Max Specific Gravity</td>
<td>QC</td>
<td>Subsection CIR.07(b)</td>
<td>2 per day</td>
<td>In-Place at windrow</td>
<td>--</td>
<td>Immediately</td>
</tr>
<tr>
<td>RAP material (control strip)</td>
<td>Measured and tested for conformance</td>
<td>Gradation</td>
<td>QC/QA</td>
<td>AASHTO T 27 &amp; T 11 and Subsection CIR.08</td>
<td>3 per 1000 ft control strip</td>
<td>After passing through crushing unit</td>
<td>---</td>
<td>Before proceeding with production</td>
</tr>
<tr>
<td></td>
<td>Density</td>
<td>QC/QA</td>
<td>ASTM D 2950 and Subsection CIR.07(b)</td>
<td>3 per control strip</td>
<td>In-place after compaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material or Property</td>
<td>Type of Acceptance</td>
<td>Characteristic</td>
<td>QC/QA</td>
<td>Test Methods Specifications</td>
<td>Sampling Frequency</td>
<td>Point of Sampling</td>
<td>Split Sample</td>
<td>Reporting Time</td>
</tr>
<tr>
<td>----------------------</td>
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<td>-----------------------------</td>
<td>--------------------</td>
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<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>RAP material (production)</td>
<td>Measured and tested for conformance</td>
<td>Gradation</td>
<td>QC/QA</td>
<td>AASHTO T 27 &amp; T 11 and Subsection CIR.08</td>
<td>1 per 10,000 sqyds or Min. 1/day</td>
<td>After passing through crushing unit</td>
<td>---</td>
<td>Immediately</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Binder Content</td>
<td>QC/QA</td>
<td>AASHTO T308</td>
<td>1 per 10,000 sqyds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt for CIR (production)</td>
<td>Measured and tested for conformance</td>
<td>Quality</td>
<td>QC</td>
<td>Subsection CIR.01</td>
<td>1 per day</td>
<td>Point of shipment delivery</td>
<td>2 1-quart samples</td>
<td>---</td>
</tr>
<tr>
<td>CIR Mix (production)</td>
<td>Measured and tested for conformance</td>
<td>Gradation, Bulk Specific Gravity, Max Specific Gravity, Binder Content</td>
<td>QC</td>
<td>Subsection CIR.07(b)</td>
<td>2 per day</td>
<td>In-Place at windrow</td>
<td>--</td>
<td>Immediately</td>
</tr>
<tr>
<td>CIR Mix (production)</td>
<td>Measured and tested for conformance</td>
<td>Density</td>
<td>QC/QA</td>
<td>ASTM D 2950 and Subsection CIR.07(b)</td>
<td>Min 3 per day or 1/500LF /per pass</td>
<td>In-place after compaction</td>
<td>-</td>
<td>Immediately</td>
</tr>
</tbody>
</table>

(1) Applies to each emulsion grade furnished
Appendix “B”
CITY OF PRESCOTT

PRELIMINARY EVALUATION OF COLD IN-PLACE RECYCLING MIXTURE
AND LITHTECH TECHNOLOGIES SOIL STABILIZER

Peter E Sebaaly

Integer Consulting LLC
April 15, 2020

Steve Guzzo
City of Prescott
Prescott, AZ

Subject: PRELIMINARY EVALUATION OF COLD IN-PLACE RECYCLING MIXTURE
AND LITHTECH TECHNOLOGIES SOIL STABILIZER

Dear Mr. Guzzo;

The attached report summarizes the findings and recommendations of the preliminary evaluation of cold in-place recycling mixtures and LithTech Technologies soil stabilizer conducted by Integer Consulting, LLC for the above referenced project.

Should you have any questions concerning this report, or if we may be of any further assistance, please contact the undersigned.

Jose Ojeda
Project Manager

Peter E. Sebaaly, P.E
Pavement Specialist
PRELIMINARY EVALUATION OF COLD IN-PLACE RECYCLING MIXTURE AND LIHTTECH TECHNOLOGIES SOIL STABILIZER
APRIL 15, 2020

In March of 2020, the City of Prescott, AZ tasked Integer Consulting LLC to evaluate and compare the anticipated performance between the following two construction options.

1. Cold in place recycled mixture (CIR) composed of the following cross section:
   a. Process and compact the current in-place chip seal and 4.0 inches of millings
   b. Place 3 to 4 inches of Cold In-place Recycling (CIR) layer
   c. Place a chip seal surface course over the CIR later

2. Stabilization utilizing LithTech Technologies soil stabilizer:
   a. Process in-place the chip seal millings and subgrade to a total depth of 8.0 inches
   b. Stabilize the entire layer with the LithTech stabilizer at a 3.0% dosage
   c. Place a chip seal surface course over the treated layer

CIR EVALUATION:
The mix design for the CIR material was conducted by Integer Consulting LLC. Loose millings were sampled from the City of Prescott millings yard and delivered to Integer’s laboratory by staff from the City of Prescott. Once the mix design was completed it was compared to other CIR projects previously done in the City of Mesa, AZ for a correlation analysis of the expected performance characteristics. A job specific performance evaluation will be conducted at a future date. This report presents the data collected from the various tests and the analysis of the results. The following laboratory tests were conducted on the delivered samples:

1. Marshall Mix Design
2. Resistance to Moisture Damage
3. Estimated Dynamic Modulus (E*)
4. Estimated Resistance to Rutting (FN)

1. Marshall Mix Design
The mix design for the CIR material from the City of Prescott project was conducted by Integer Consulting LLC following the Marshall Mix Design Method at 75 blows with the following modifications:

- Aggregates: 100% recycled asphalt pavement (RAP) from the project site with maximum size of 1.0 inch.
- Binder and water contents: all binder and water contents are expressed in terms of percent (%) by dry weight of RAP.
- Binder: asphalt emulsion from Ergon Asphalt & Emulsion Company – Grade: CSS-1h
- Mixing time:
  - All mixing is conducted at room temperature of 77°F
  - Mix RAP with 4.5% water for 1 minute
  - Mix RAP+Water with emulsion (2-4%) for 1 minute
  - It should have a visible satisfactory coating
- Curing time: cure the compacted CIR materials in the mold at 140°F for 24 hours.
• Bulk specific gravity of the compacted samples is obtained using the parafilm method following ASTM D1188.
• Select the optimum emulsion content (OEC) at air voids level of 13±1% and compacted sample height of 2.5±0.1 inch.
• Measure the raveling resistance of the CIR at OEC following ASTM D7196 after 4 hours curing at 77°C and 24 hours curing at 140°F.

Table 1 summarizes the mix design for the CIR material obtained from this project. The data presented in Table 1 indicate that this CIR project correlates well with a previous CIR project done in Mesa, AZ on “Southern Avenue”, both CIR mixtures have an OEC of 3.0% by dry weight of RAP. The CIR mixtures for both projects met all the mix design criteria.

Table 1. Summary of Marshall Mix Designs for Southern Avenue in Mesa and for City of Prescott.

<table>
<thead>
<tr>
<th>Project</th>
<th>Water Content (%)</th>
<th>Air Voids (%)</th>
<th>Marshall Stability (lb)</th>
<th>Optimum Emulsion Content (%)</th>
<th>Raveling (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Avenue</td>
<td>4.0</td>
<td>13.0</td>
<td>1,630</td>
<td>3.0</td>
<td>2.1</td>
</tr>
<tr>
<td>City of Prescott</td>
<td>4.5</td>
<td>12.5</td>
<td>2,390</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Specifications</td>
<td>12 – 14</td>
<td>&gt;1,250</td>
<td></td>
<td>5max</td>
<td></td>
</tr>
</tbody>
</table>

2. Resistance to Moisture Damage

The resistance of the CIR mixture at OEC of 3.0% to moisture damage was measured following the AASHTO T283; “Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage” with some exceptions as briefly summarized below:

• The CIR mixtures are compacted to 12 – 14 % air voids.
• The compacted CIR materials are cured in the mold at 140°F for 24 hours.
• Separate the compacted samples into two groups with similar air voids: unconditioned and moisture-conditioned.
• Measure the tensile strength (TS) of the unconditioned group at 77°F.
• Subject the moisture-conditioned samples to the following:
  o 70-80% saturation
  o Submerge the compacted samples in water at 77°F for 24 hours
  (NOTE: this is an exception to the AASHTO T283 which requires the compacted samples be subjected to one freeze-thaw cycle)
  o Measure the TS after the water submersion at 77°F
• The tensile strength ratio (TSR) is calculated as the ratio of the average moisture-conditioned TS over the average unconditioned TS times 100.

The TS properties were measured at 77°F on 4.0-inch diameter by 2.5-inch cylindrical specimens, mixed at the OEC and compacted in the Marshall compactor to 14 – 16% air voids. The tensile strength presents the ability of the CIR mix to resist tensile stresses generated by traffic loads. Table 2 summarizes the TS properties of the CIR mixtures from the Southern Avenue and the City of Prescott projects. The coefficient of variation (COV) represents the variability of the measured data calculated as the ratio of standard deviation over the average value times 100. COV values below 10% indicate excellent repeatability of the measured data.
### Table 2. Tensile Strength Properties of the CIR Mixtures.

<table>
<thead>
<tr>
<th>Project</th>
<th>Material Type</th>
<th>Unconditioned Tensile Strength at 77°F</th>
<th>Moisture-conditioned Tensile Strength at 77°F</th>
<th>TSR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Air Voids, %</td>
<td>Average (psi)</td>
<td>COV (%)</td>
</tr>
<tr>
<td>Southern Avenue</td>
<td>Mix Design</td>
<td>13.5</td>
<td>72</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Field Mix</td>
<td>14.8</td>
<td>106</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Cores</td>
<td>14.8</td>
<td>113</td>
<td>1.0</td>
</tr>
<tr>
<td>City of Prescott</td>
<td>Mix Design</td>
<td>12.5</td>
<td>74</td>
<td>2.0</td>
</tr>
</tbody>
</table>

A review of the tensile strength data presented in Table 2 leads to the following observations:

- The repeatability of the measured TS properties of all mixtures is good.
- The unconditioned TS properties of the field mixtures and cores were higher than the TS properties of the mix design for the Southern Ave project and can be expected to be higher for the City of Prescott project as well.
- In general, the CIR mixture for the City of Prescott project should yield similar TS properties to the Southern Avenue project.

### 3. Estimated Properties

*As discussed earlier, the mix design and tensile properties of the CIR material from the City of Prescott closely resembles those of the CIR material from the project on Southern Avenue in the City of Mesa. Therefore, for the purpose of the preliminary analysis presented in this report, the dynamic modulus property and the resistance to rutting of the CIR mixture from Southern Avenue will be assumed to represent a good estimate of the same properties for the CIR mixture form the City of Prescott.*

*Once the dynamic modulus property and the rutting resistance of the CIR mixture from the City of Prescott are measured, the analysis presented in this report will be revised to incorporate the actual properties.*

#### Dynamic Modulus

The AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG) uses the dynamic modulus ($E^*$) master curve to evaluate the structural response of the asphalt concrete pavement under various combinations of traffic loads, speed, and environmental conditions. The $E^*$ of the CIR mixture is evaluated under various combinations of loading frequency and temperature. The dynamic modulus is measured according to “AASHTO T378: Determining the Dynamic Modulus and Flow Number for Hot Mix Asphalt (HMA) Using the Asphalt Mixture Performance Tester (AMPT).” The $E^*$ tests are conducted on 4.0-inch diameter by 6.0-inch cylindrical specimens cored from the center of samples compacted in the Superpave Gyratory Compactor (SGC) to air voids of 14 – 16 (i.e. representing in-place air voids during the early life of the CIR layer). The test is conducted at frequencies of: 10, 1.0, 0.1, and 0.01 Hz and at temperatures of: 40, 68, and 104°F (4, 20, and 40°C). Using the visco-elastic behavior of the CIR mixture (i.e. interchangeability of the effect of loading rate and temperature) the master curve is
produced following AASHTO R84 and used to identify the appropriate E* for any combination of pavement temperature and traffic speed. Figure 1 shows the components and testing conditions of the dynamic modulus test.

![Dynamic Modulus Test Equipment]

**Figure 1. Components and Loading Conditions of the Dynamic Modulus E* Test.**

Magnitude of E* = \( \sigma_0 / \varepsilon_0 \)

Figure 2 presents the E* master curve and Figure 3 presents the magnitude of the E* property at multiple temperatures and frequencies for the CIR mixture from the Southern Avenue project. The E* property decreases with increased temperature and increases with increased loading frequency. A review of the E* master curves (Figure 2) and E* values at specific temperatures (Figure 3) leads to the following observations:

- The estimated E* values of the CIR mix for the City of Prescott are expected to be equal to the Southern Avenue project at all temperatures and loading frequencies.
- The estimated shape of the E* master curve for the CIR mixture to be utilized on the City of Prescott is similar to a typical master curve of an HMA mixture.
- Since the E* property provides an indication on the overall quality of the mix, the measured values of the E* property indicate that the CIR mix from the Southern Avenue project represents a good mix and it can be assumed that the CIR mix for the City of Prescott project will represent an good mix as well.
Figure 2. Dynamic Modulus ($E^*$) Master Curve of the CIR Mixture from the Southern Avenue Project.

Figure 3. Dynamic Modulus ($E^*$) Property of the CIR Mixture from the Southern Avenue Project.
Resistance to Rutting

The resistance of the CIR mixture to rutting is evaluated using the flow number (FN) test. The FN test is conducted according to AASHTO T378. The FN test is conducted on 4.0-inch diameter by 6.0-inch height cylindrical specimens cored from the center of samples compacted in the SGC to air voids of 14 – 16 (i.e. representing in-place air voids during the early life of the CIR layer). The samples are subjected to a dynamic deviator stress of 70 psi and a static confining stress of 10 psi. Figure 4 shows the components and testing conditions of the flow number test along with a typical curve for asphalt mixtures. The number of load repetitions at the start of the Tertiary Zone represents the FN of the mix. A higher FN value indicates a higher resistance to rutting.

The temperature of the FN test is selected to represent the critical temperature for rutting at the location of the project. Considering the location of the project and the location of the CIR layer within the pavement structure, it was determined that a test temperature of 60°C (140°F) is appropriate. The measured FN value at 60°C (140°F) for the CIR mix from the Southern Avenue project was 97. The FN for the CIR mix for the City of Prescott project has not yet been conducted but a similar FN value can be assumed. The FN of 97 at 60°C is considered excellent when compared to the established FN criteria for hot mix asphalt (HMA) shown in Table 3. Taking into consideration that the CIR mix will be capped with a chip seal layer and will be exposed to lower stresses, the CIR mix would meet the criteria for traffic level up to 20 million ESALs.

Figure 4. Flow Number Test and a Typical Permanent Strain Curve.
Table 3. Flow Number Criteria for HMA Mixtures.

<table>
<thead>
<tr>
<th>Traffic Level, million ESALs</th>
<th>HMA Minimum FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3</td>
<td>--</td>
</tr>
<tr>
<td>3 to &lt; 10</td>
<td>50</td>
</tr>
<tr>
<td>10 to &lt; 30</td>
<td>190</td>
</tr>
<tr>
<td>≥ 30</td>
<td>740</td>
</tr>
</tbody>
</table>

**LITHTEC SOIL STABILIZER EVALUATION**

Integer Consulting has reviewed and verified the mix design and performance properties for soils treated with the LithTech Stabilizing material. The design and performance testing were conducted by LithTech and the data were made available to Integer Consulting for the purpose of this review.

For the purpose of this comparison the properties of materials from Idyl Road tested with and without the LithTech Stabilizing agent, was used in efforts to show the improvement in performance after the treatment. The following information was obtained from the testing data provided by the LithTech USA:

1. Dosage amount: 3%
2. Dispersion
   a. Treated = Bound
   b. Un-Treated = Disintegration
3. CA Bearing Ratio
   a. Treated = 294
   b. Un-Treated = 59
4. CA Bearing Ratio Swell
   a. Treated = 0.044%
   b. Un-Treated = 0.087%
5. Strain at failure
   a. Treated = .950%
   b. Un-Treated = 1.395%
6. Unconfined Compression
   a. Treated = 474 psi
   b. Un-Treated = 23 psi
7. Modulus of Elasticity
   a. Treated = 916,876 psi
   b. Un-Treated = 5,848 psi
SUMMARY AND RECOMMENDATIONS

The overall objectives of this effort were to assess the performance improvements and life expectancy of the roadway cross section when treated with the LithTech soil stabilizer compared to the life expectancy of a CIR application. Based on the analysis of the data generated in this effort, the use of properties provided by the LithTech Co., and the estimated properties for the CIR mixture, the following recommendations can be made.

Based on the Data provided by LithTech the treated soils should provide a sound underlayment for the proposed chip seals. A correlation from that data can be made to equate a projected ESAL’s of approximately 20 million.

Based on the data obtained from the testing of the CIR materials from the City of Prescott project and the estimated properties based on the CIR mixture from the Southern Avenue project, the following recommendations can be made.

- The in-place air voids of the CIR layer on the Southern Avenue project were around 15%. If similar in-place air voids can be reproduced on the City of Prescott project, the CIR layer can be expected to perform as estimated in this report.

- The estimated E* property based on the evaluation of the CIR mixture from the Southern Avenue project anticipates that the CIR layer on the City of Prescott project will exhibit good to excellent overall engineering quality.

- The estimated FN based on the evaluation of the CIR mixture from the Southern Avenue project anticipates that the CIR layer on the City of Prescott project will exhibit excellent resistance to rutting.

- A correlation from that Prescott CIR mix design volumetric and data utilized in the Southern Ave project. A estimation can be made to equate an estimated ESAL’s of approximately 20 million.

The City of Prescott has expressed a concern of unknown shallow utilities and possible damages due to the outlined procedure of milling and processing up to 8.0 inch in depth. The available and estimated data at this stage of the evaluation, indicate that a structurally sound cross section can be expected to be produced utilizing either one of the two options. The City of Prescott must weigh out the pros and cons of utilizing the LithTech stabilization option as it pertains to construction availability, traffic impact, and the high possibility of reflective cracking due to shrinkage of the highly stabilized subgrade, in comparison to the utilization of the CIR option that will have virtually no excavation and allow for the utilization of the current stockpile of millings owned by the City and without the possibility of reflective cracking.