<table>
<thead>
<tr>
<th>OCI</th>
<th>Treatment Type</th>
<th>Estimated Cost per SY</th>
<th>Pavement Life Extension in Years</th>
<th>Ride Quality Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-80</td>
<td>Crack Seal (CR)</td>
<td>$0.63</td>
<td>2</td>
<td>No Change</td>
</tr>
<tr>
<td>100-80</td>
<td>Fog Seal (FS)</td>
<td>$0.70 - 0.85</td>
<td>3</td>
<td>No Change</td>
</tr>
<tr>
<td>100-80</td>
<td>Asphalt Rejuvenators (ARJ)</td>
<td>$1.50 - 2.00</td>
<td>3</td>
<td>No Change</td>
</tr>
<tr>
<td>100-80</td>
<td>High Density Mineral Bond (HA5) Residential Only</td>
<td>$1.80 - 2.00</td>
<td>5-10</td>
<td>No Change</td>
</tr>
<tr>
<td>79-60</td>
<td>Type 2 Slurry Seal (SS)</td>
<td>$2.70 - 3.70</td>
<td>3-5</td>
<td>Moderate to Good</td>
</tr>
<tr>
<td>79-60</td>
<td>Type 2 Micro-Surfacing (MS)</td>
<td>$5.00 - 6.00</td>
<td>5-7</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>79-60</td>
<td>Conventional Chip Seal (CCS)</td>
<td>$2.70 - 3.70</td>
<td>5-10</td>
<td>Moderate</td>
</tr>
<tr>
<td>79-60</td>
<td>Asphalt Rubber Chip Seal (ARC)</td>
<td>$4.75 - 8.50</td>
<td>7-10</td>
<td>Moderate to Good</td>
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<tr>
<td>79-60</td>
<td>Stress Absorbing Membrane (SAM)</td>
<td>$6.00 - 7.00</td>
<td>7-10</td>
<td>Moderate to Good</td>
</tr>
<tr>
<td>59-30</td>
<td>Scrub Cape Seal (CS)</td>
<td>$4.50 - 5.50</td>
<td>5-10</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>59-30</td>
<td>Asphalt Overlay (OL)</td>
<td>$6.50 - 7.50</td>
<td>10-15</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>59-30</td>
<td>Mill &amp; Overlay (MOL)</td>
<td>$7.10 - 10.10</td>
<td>10-15</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>29-0</td>
<td>Full Depth Mill &amp; Overlay</td>
<td>$12.00 - 15.00</td>
<td>20</td>
<td>Excellent</td>
</tr>
<tr>
<td>29-0</td>
<td>Full Reconstruct Including Base</td>
<td>$26.00 - 30.00</td>
<td>20</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

**METHODS AND TREATMENT OPTIONS**
<table>
<thead>
<tr>
<th>OCI</th>
<th>Visible Distresses</th>
<th>Suggested Treatment</th>
<th>Example Photo</th>
</tr>
</thead>
</table>
| 100-91 | Brand new pavement  
No distresses or overlay  
Age 0-1 year old                | Fog seal in 4-5 years  
Crack seal if needed  
Fix any distresses                  | ![Example Photo](image1.jpg) |
| 90-81  | Recent overlay (no distresses) or new pavement.  
Age >1 year old                   | Fog seal in 2-4 years  
Crack seal if needed  
Fix any distresses                  | ![Example Photo](image2.jpg) |
| 80-75  | Light cracking – one direction only (transverse OR longitudinal)  
Very light weathering              | Crack seal with fog seal                                                          | ![Example Photo](image3.jpg) |
| 74-61  | Cracking in both directions; no other major distresses  
Some weathering  
Block cracking is > 15’x15’         | Crack seal with Microsurface  
if improved roadway  
Crack seal, AR chip with fog seal if strip paved | ![Example Photo](image4.jpg) |
| 60-51  | Block cracking is about 15’x15’  
Some alligator present  
Weathering                           | Slurry seal or crack seal and overlay for MS&R’s.  
AR chip with fog if locals            | ![Example Photo](image5.jpg) |
| 50-45  | Block cracking is < 10’x10’  
And/or up to 50% alligator  
Weathering                           | Mill and inlay if MS&R, or overlay only  
AR chip with fog if locals  
(stopgap treatment)                  | ![Example Photo](image6.jpg) |
| 44-31  | 50% alligator  
No significant potholes  
Weathering                           | Mill and inlay if MS&R  
AR chip with fog if locals  
(stopgap treatment)                   | ![Example Photo](image7.jpg) |
| 30-21  | Up to 100% alligator  
Pavement chunks popping out  
Weathering                           | Reconstruct if MS&R  
Scarify & compact subgrade 6”  
AR chip with fog if locals  
(stopgap treatment)                  | ![Example Photo](image8.jpg) |
| 20-11  | Severe deterioration  
Numerous potholes                    | Reconstruct  
Full depth                                                                         | ![Example Photo](image9.jpg) |
| 10-0   | Reverting to its natural state (dirt)                                               | Reconstruct  
Full depth                                                                         | ![Example Photo](image10.jpg) |
TREATMENT DESCRIPTIONS

Crack Seal (CR)

A method to fill and seal pavement surface cracks, preventing water and incompressible material from entering the pavement structure. Crack sealing is done routinely during the colder winter months when pavement cracks are most open and ambient temperatures are between 45°- 65° F. Hot sealants, consisting of asphalt cement, and cold sealants, comprised of emulsified asphalt, can be used. Backer rods or sand may need to be placed in wide cracks prior to sealing. Crack sealing can be done ahead of other pavement surface treatments.

Advantages: sealing cracks can prevent accelerated deterioration of the pavement structure at a low cost.

Disadvantages: slow process and time consuming. Often times work will take place at night to allow the least impact on traffic.

Fog Seal (FS)

A light application of relatively slow setting asphalt emulsion diluted with water to the proper consistency and sprayed for complete coverage onto a pavement surface, but not too thick to cause a slippery surface. A fog seal works better on a coarse aggregate surface where the asphalt emulsion has room to pond between the aggregate particles. Fog seals are used to delay weathering of the pavement, waterproof the pavement surface, improve the pavement’s ability to keep water from penetrating the base course or sub-grade, and reduce raveling. Fog seals are also used to renew aged asphalt surfaces, seal small cracks and surface voids, or adjust the quality of binder in newly applied chip seals. Fog seals are generally applied when ambient temperatures are at 60° F and rising. Fog seals are usually applied at 0.05 to 0.15 gallons/ square yard of the diluted asphalt emulsion.

Advantages: fog seals are inexpensive compared to other surface treatments and only a distributor truck is required to apply the fog seal in most cases.

Disadvantages: expected life of the fog seal is generally shorter than other surface treatments and re-application is recommended every 3-4 years. If applied too heavily, the fog seal could be slippery and hazardous for the road users. A dry choke cover, usually consisting of clean sand or aggregate less than 0.25 inches in diameter, can be applied to the surface to remedy this.
Asphalt Rejuvenators (ARJ)

Asphalt Rejuvenators are applied to existing aged or oxidized asphalt pavements to restore pavement flexibility. As pavement ages, asphalt cement becomes brittle and loses some of its binding qualities. Rejuvenating emulsions penetrate the asphalt pavement, soften the brittle asphalt, and improve the asphalt cement’s ability to bind with the aggregate. The rejuvenating agent is also known to heal small cracks in the pavement.

**Advantages:** surface rejuvenators are an inexpensive treatment to prolong pavement life and delay major maintenance or reconstruction.

**Disadvantages:** may soften existing surface treatment layers which can become loose and break up, may not evenly penetrate differing surface treatments and underlying asphalt.

High Density Mineral Bond (HA5)

Modern material and chemical engineering product addressing slurry seal bonding problems caused by incompatible particle charges between emulsion oils, aggregates, and pavement surface. Product resembles a fog coat when dry. Utilizes industrial grade aggregates including slate and corundum (aluminum oxide, ruby, sapphire type minerals) suspended in a neutral pH emulsion oil with superior adhesive properties to traditional positively or negatively (cationic or anionic) charged emulsions, forming a high density mineral bond mass. Product is designed to lock up the emulsion binder between the mineral aggregates very tightly and adhere to the pavement surface in a thin, dense, approximately 1/8” thick layer, sealing both the product and pavement from environmental element degradation. It will dry to 1/32” thick. Product is produced and mixed with aggregate prior to shipping in specialized agitating/recirculating applicator trucks to keep the aggregate in suspension and provide high degree of quality control of binder and aggregate proportions. Warranted by the manufacturer for 5 years to not lose more than 25% residual coverage or will be resurfaced free of charge.

**Advantages:** durability, longevity, warranty, quality control superior to all other emulsion products, reducing rate of pavement degradation and requiring less frequent applications. Has a fine grained even-textured surface without loose aggregate or excessive roughness, less expensive than slurry and about half the thickness.

**Disadvantages:** first applications performed in 2002, specialized equipment and manufacturing offer little market competition development to date.
**Slurry Seal (SS)**

A slurry seal is a mixture of quick setting asphalt emulsion, fine aggregate, mineral filler, additive, and water. There are three common sizes of slurry seal mixtures. The three mixtures are Type III (3/8-inch minus), Type II (1/4-inch minus), and Type I (1/8-inch minus). Generally, Type I slurry seals are used in parking lots and Type II and III seals are used on streets and higher traffic roads. The ingredients are carefully measured and combined on the project site and spread simultaneously in one pass over the existing pavement surface at a particular thickness. The slurry mix is applied at the thickness of the largest aggregate in the mix. The amount of aggregate, filler, additives, and water is based on the mix design, depending on the component materials, environmental conditions, and existing road surface. Typically, a specially designed vehicle mixes the ingredients and spreads the slurry with a squeegee device. Slurry seals will fill small surface cracks, stop raveling, and improve the skid resistance of the pavement. Cracks wider than 1/4” should be sealed prior to the slurry application. The life expectancy is 4 to 6 years.

**Advantages:** a finished surface of a slurry seal treatment is smoother than a chip seal treatment, while still skid resistant. Slurry seal treatments are commonly used in residential areas, where light to moderate traffic loads are anticipated.

**Disadvantages:** may not hold up well to heavier traffic loads and volume expected along main collector and arterial roadways. Industry lacks objective field test methods to verify quality during installation. Material is more brittle than flexible paving grade asphalt products, causing a tendency for small crazed surface cracking over time.

**Scrub Seal (SCS)**

The scrub seal process drags a brooming mechanism over the road surface after the asphalt emulsion has been applied to fill the pavement cracks and voids. A layer of sand or aggregate is applied over the emulsion, followed by another drag broom, forcing the sand into the emulsion-filled cracks and voids. A pneumatic tire roller is then used over the seal. The excess sand or aggregate is broomed off the roadway a few hours after application, depending on weather conditions. Emulsified asphalt is applied from 0.15 to 0.40 gallons/square yard. The sand or aggregate is applied at 10 to 20 pounds/square yard.

**Advantages:** will efficiently fill cracks up to 0.5 inch wide that would have normally been filled by crack sealing.

**Disadvantages:** tests may be needed to determine what type of emulsion or polymer-modified emulsion should be used for a particular application. Material is more brittle than flexible paving grade asphalt products, causing a tendency for small crazed surface cracking over time.
Micro Surfacing (MS)

Micro surfacing is similar in nature to a slurry seal operation, but allows a thicker layer to be placed (0.4 to 0.6-inch thick) and cures faster than a slurry seal. Micro surfacing can be used on high volume roadways to correct wheel path rutting up to 1.5 inches in depth with a single pass, and provides a skid resistant surface. Micro surfacing uses a polymer-modified emulsion mixed with crushed aggregate, mineral filler (cement, lime, limestone dust, fly-ash), water, and additives. The additives influence the mix time and set time.

**Advantages:** can be placed in a thicker layer than a slurry seal and therefore, can be used to fill wheel ruts and correct minor leveling problems. It has a quicker cure time, so traffic can be allowed on the road sooner than a slurry seal. It is a cold system with a temperature limitation of 50 °F and rising. This allows many micro surfacing operations to be done at night, when traffic is least affected. The life expectancy is 6 to 8 years. Also provides a much smoother riding surface.

**Disadvantages:** requires special equipment that is heavier and sturdier than a slurry machine. The cost is higher than a slurry or chip seal treatment. Material is more brittle than flexible paving grade asphalt products, causing a tendency for small crazed surface cracking over time.

Conventional Chip Seal (CCS)

Chip seals are the most common surface treatment for low-volume roads. A chip seal is an application of asphalt, followed by an aggregate cover. The asphalt is usually applied as hot asphalt cement, cutback asphalt, or emulsified asphalt. After the hot asphalt cement, cutback asphalt, or asphalt emulsion is applied to the pavement surface, aggregate is immediately applied over the asphalt before the hot asphalt cement cools, or the asphalt emulsion breaks. Chip seals should be placed when the ambient temperature is 70 °F and rising. Pneumatic rollers are used to reorient, or seat, the aggregate particles and tighten the rock matrix. After the asphalt cures, the excess aggregate is removed by “brooming”. A distributor truck dispenses the asphalt emulsion, asphalt cement, or cutback asphalt, a rock spreader applies the aggregate, pneumatic rollers reorient or seats the aggregate particles, and a mechanical broom removes the excess aggregate. Emulsified asphalt is applied from 0.30 to 0.50 gallons/ square yard. The type and size of the aggregate particles vary, but usually they are between 3/8 to 1/2 inch in size, and are uniformly graded and free of fines (dust particles too large to pass through a sieve). The aggregate is applied at 25 to 50 pounds/ square yard. A chip seal application corrects raveling and seals small cracks on the old pavement surface, while providing a new skid resistant surface. Chip sealing may also be used following crack sealing. The expected life of a chip seal is 4 to 6 years.

**Advantages:** chip-sealing equipment and methods are common to most paving contractors and can be applied at a reasonable cost.
Disadvantages: requires constant attention and frequent adjustment of application rates of aggregate, and especially asphalt, to minimize chip loss, fly rock, bleeding, and other problems. Making these adjustments takes considerable experience and knowledge. Windshields can be damaged by the loose aggregate before the excess is removed, and dust is created during the brooming of the loose aggregate.

Stress Absorbing Membrane (SAM)

This is a chip seal application normally associated with Asphalt-Rubber (AR) or Polymer Modified Asphalt Rubber (PMAR). These are elastomeric binder materials and both contain high percentages of recycled tire rubber, SBS polymer and other modifiers, as required by individual project specifications, which result directly in improved physical and chemical properties, along with a very high viscosity, allowing for increased application rates (0.55 to 0.75 gallons/square yard). A fog seal coat is applied to the surface after final sweeping has been completed. These improvements lead to resistance to aging, which means a lower oxidation rate due to the presence of carbon black and various antioxidants, which are present in recycled tire rubber. There is also improved cohesive strength, which means that the binders can support greater loading when stretched, allowing for improved deformation and crack resistance. Improved elasticity and resilience results in additional resistance to cracking and flushing (higher softening points), allowing the pavement surface to be more stable in hot weather and improved flexibility and crack resistance in cold weather. The same equipment and process are used as the conventional chip seal.

Advantages: increased life cycle cost benefits (+6 years).

Disadvantages: substantially increased cost when compared to a conventional chip seal and the same process related concerns as those associated with a conventional chip seal. Material is more brittle than flexible paving grade asphalt products, causing a tendency for small crazed surface cracking over time.

Asphalt Rubber Chip Seal (ARC)

Utilized in the same manner as the SAM application above, but the rubberized asphalt is applied at a lower rate (0.30 to 0.50 gallons/square yard) depending on the existing pavement condition, which is usually in a higher range.

Cape Seal (CS)

An application of a Convention Chip Seal followed by a Slurry Seal, the term “cape” is derived from Cape Province of South Africa where this process was developed. A chip seal is applied to the road, and then the excess aggregate is removed after the asphalt has cured. The slurry is then applied over the chip seal treatment. The application process is the same as the chip and the slurry seals stated earlier. Life expectancy is 6 to 8 years.
**Advantages:** CS increases the life of a chip seal by enhancing binding of the chips and by protecting the surface. The cape-seal provides a much smoother riding surface, which does not have any loose aggregate and creates a dense mat.

**Disadvantages:** cost increase and equipment for both the chip-seal treatment and the slurry-seal application is required. The construction process is longer than either a chip-seal treatment or a slurry-seal application. Material is more brittle than flexible paving grade asphalt products, causing a tendency for small crazed surface cracking over time.

Asphalt Rubber Cape Seal (ARCS) or Polymer Modified Asphalt Rubber Cape Seal (PMAR)

Application of a SAM treatment followed by a Type II Slurry Seal applied in residential areas or a Micro Surface, which is applied on collector or major arterial streets.

**Advantages:** increased life of the stress absorbing membrane and the same as the Cape Seal above.

**Disadvantages:** same as Cape Seal.

**Stress Absorbing Membrane Interlayer (SAMI)**

An application of a SAM treatment utilized with an overlay of conventional hot mix asphalt.

**Advantages:** excellent at filling cracks, healing existing deteriorated asphalt surfaces and preventing existing cracks from reflecting through new overlay, restores to new and smooth asphalt surface.

**Disadvantages:** relatively expensive, cannot be used where drainage will be adversely affected by raising the roadway surface, requires shoulder build-up in uncurbed areas.

**Asphalt Overlay (OL)**

The process of covering the existing, severely distressed, pavement structure surface with a thin lift of hot mix asphaltic concrete to provide a “like new” surface with prolonged structural life. A hot mix asphalt lay down machine would be used for the placement of the new mat.

**Advantages:** restores roadway to new and smooth asphalt surface.

**Disadvantages:** same as SAMI, and does not prevent reflective cracking; however the use of rubberized asphalt increases the crack preventing qualities of the overlay.
Mill and Overlay (MOL)

The process of removing a portion (up to the full thickness) of the existing distressed asphalt pavement surface and covering the remaining surface with a new, thin (or full depth) lift of hot mix asphaltic concrete. A milling or pulverizing machine would be used in conjunction with loading equipment for the removal of the distressed asphalt layer. A hot mix asphalt lay down machine would be used for the new asphalt placement.

**Advantages:** restores roadway to new and smooth asphalt surface without raising pavement surface elevation, appropriate where curb reveal and surface drainage need to be maintained, and pavement substructure below are sound.

**Disadvantages:** cannot be used in subdivisions and other street sections where only 2” of asphalt are common; requires a thick enough existing asphalt to remain below the milled surface to support traffic during re-construction, relatively expensive.

Full Depth Mill & Overlay

The full thickness removal of distressed asphalt down to the aggregate base course by milling, minor grading and re-compaction of the aggregate base surface, then re-paving the original thickness of asphalt removed. Appropriate where asphalt failure is due to aging and surface damage only, and the original pavement thickness still meets the minimum design standards for traffic loading in that location.

**Advantages:** same as MOL, can be used in subdivisions and other thin asphalt sections.

**Disadvantages:** relatively expensive, disrupting to regular traffic and susceptible to traffic damage during construction; will not correct settlement or soil support deficiencies beneath the pavement section, and will not increase the traffic loading capacity.

Full Reconstruct Including Base

Complete removal and replacement of entire pavement section; asphalt, aggregate base course, reconditioning of existing sub-base soils, removal and replacement of unsuitable material and deficient utility backfill. Reconstruction may include thicker pavement section or alternative materials to compensate for problem soils or increased traffic loading than original design. May incorporate revised grading to improve drainage conditions.

**Advantages:** can incorporate new design and engineering solutions to deal with changed, anticipated, or inadequate conditions; can correct settlement or soil support deficiencies beneath the pavement section, increase the traffic loading capacity and improve drainage conditions. Roadway returned to new and smooth condition.

**Disadvantages:** very expensive and disruptive to regular traffic.