PAVEMENT PRESERVATION PROGRAM

04/08/2022

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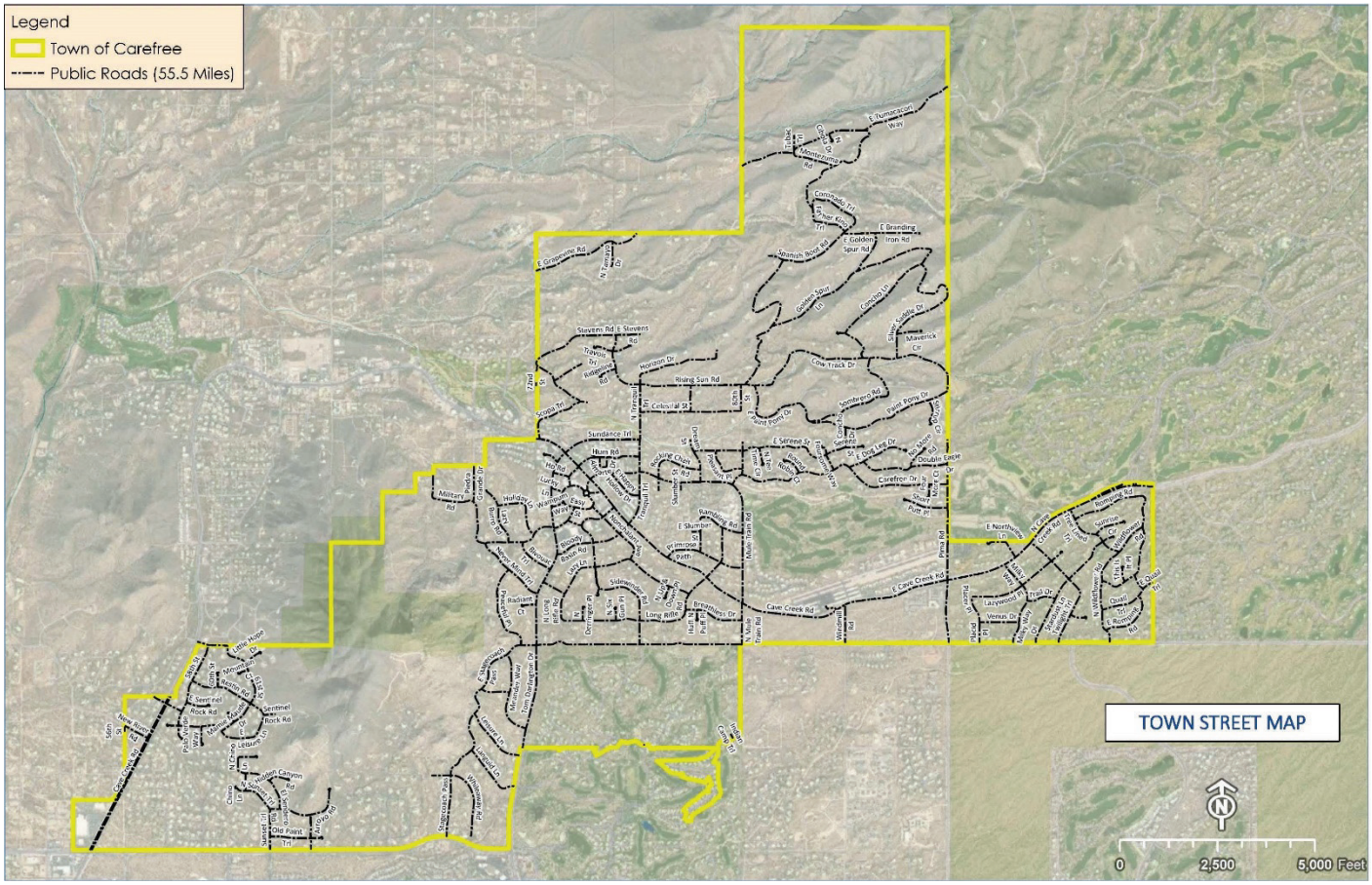
INTRODUCTION

The Town of Carefree has a 'Pavement Preventative Maintenance Plan 2012-2022' in place and in use. As this plan is 10 years old, the Town recognizes the need to update the pavement condition information, re-evaluate the pavement maintenance program, and adopt a new 'Pavement Preservation Program' for the community.

This 'Pavement Preservation Program' study effort and report is intended to address these needs. The study included completion of a compilation and review of available documents, an inventory of the Town streets, and an assessment of the street pavement conditions for the overall roadway network within the Town of Carefree. This data was then utilized to develop the pavement preservation program and implementation plan.

The study area includes the public streets within the Town limits as shown on the *Town Street Map* contained in the accompanying Appendix. A smaller version is shown below.



The effective life of an asphalt pavement is heavily dependent on its environment. Seasonal temperature fluctuations results in the expansion and contraction of the asphalt. The sun's ultraviolet light results in oxidation of the asphalt surface and an increase in the asphalt's rigidity. These two factors result in the eventual cracking of the asphalt. These cracks, if not properly sealed, can allow stormwater to penetrate into the pavement structure and degrade the supporting capabilities of its base and subgrade. The stresses induced by the weight of the passing vehicles and from their turning movements contribute to the continued distress of the asphalt. A preventative preservation and maintenance program is needed to mitigate these natural and physical factors and extend the life of the asphalt.

An effective multi-year pavement management plan offers a systematic approach to maintenance that provides long-term financial savings, protects the overall pavement system condition, extends pavement life, and to some extent

helps improve roadway safety. To its credit, the Town of Carefree has maintained a Preventative Maintenance Program for its streets. The previous program and this pavement preservation program contain a ten-year planning horizon that enables the Town to project the costs and address the recommended pavement preservation methods and measures.

Statistics:

Population	3,690 (2020 Census)
Elevation	2,620 feet
Length of Public Streets within Town Limits	110 lane miles
Area within Town Limits	8.8 square miles (approximate)

Acknowledgements:

Key members of the project study team include:

Gary Neiss, Town Administrator

Mark Milstone, PE, Town Engineer

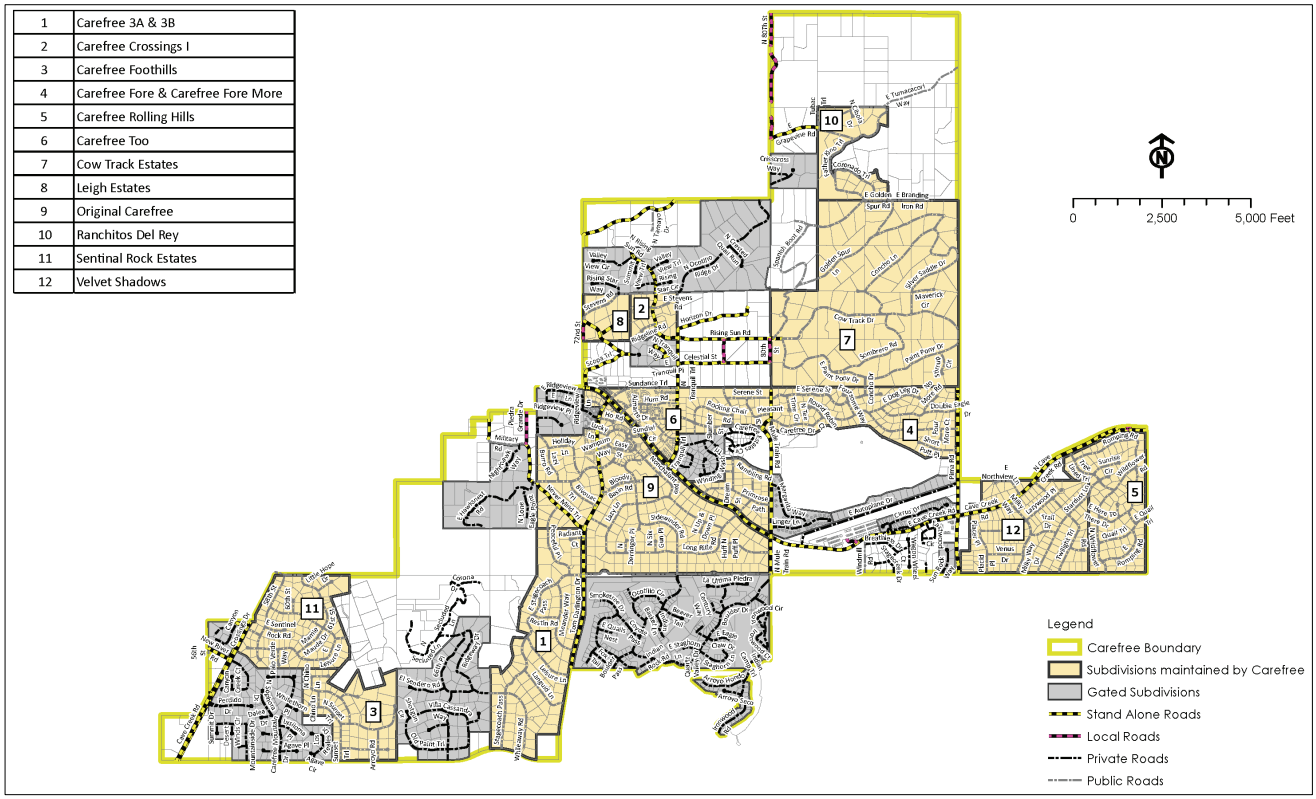
Stacey Bridge-Denzak, Town Planning Director

Dale Miller, PE, Project Manager, Rick Engineering Company

STREET SYSTEM INVENTORY

STREET SYSTEM INVENTORY

The *Town Street Map* referenced in the Introduction section provides an inventory of all the public streets maintained by the Town of Carefree. In addition, the Town has typically performed street maintenance and improvement by subdivision and for standalone streets. The subdivisions with public streets are shown on the *Town of Carefree Subdivision Map* contained in the accompanying Appendix. A smaller version is shown below.



The total length of public street in each subdivision are reported in the following table.

CAREFREE SUBDIVISION STREET INVENTORY		
Subdivision	Street Length (feet)	Street Length (miles)
Carefree 3A & Carefree 3B	11,169	2.12
Carefree Crossings I	5,197	0.98
Carefree Foothills	9,940	1.88
Carefree Fore & Carefree Fore More	14,599	2.77
Carefree Rolling Hills	15,763	2.99
Carefree Too	21,172	4.01
Cow Track Estates	37,040	7.02
Leigh Estates	2,743	0.52
Original Carefree	41,845	7.93

CAREFREE SUBDIVISION STREET INVENTORY		
Subdivision	Street Length (feet)	Street Length (miles)
Ranchitos Del Ray	9,519	1.80
Sentinal Rock Estates	16,462	3.12
Velvet Shadows	15,666	2.97
Totals	201,115	38.11

The total length of public standalone streets and collective local streets are reported in the following table.

CAREFREE STANDALONE & LOCAL STREETS		
Street Name	Street Length (feet)	Street Length (miles)
Canyon Ridge Drive	858	0.16
Celestial Street	2,582	0.49
East Cave Creek Road	37,102	7.03
East Grapevine Road	5,123	0.97
Horizon Drive	2,166	0.41
New River Road	650	0.12
East Scopa Trail	1,170	0.22
Stagecoach Pass	12,233	2.32
Grapevine Road	1,380	0.26
80th Street	675	0.13
North Cave Creek Road	10,019	1.90
North Grapevine Road	877	0.17
Mule Train Road	4,161	0.79
Never Mind Trail	1,734	0.33
Pima Road	5,227	0.99
North Scopa Trail	426	0.09
Tom Darlington Drive	16,065	3.04
Tranquil Trail	1,688	0.32
Rising Sun Road	2,567	0.49
Scopa Trail	934	0.18
Spanish Boot Trail	3,574	0.68
Carefree Streets - Local	8,529	1.62
Totals	119,740	22.71

FUNCTIONAL CLASSIFICATIONS

Federal functional classification (FFC) is the grouping of highways, roads, and streets by the character of service they provide and was developed for transportation planning purposes. Basic to this process is the recognition that individual routes do not serve travel independently in any major way. Rather, most travel involves movement through a network of roads and streets. Comprehensive transportation planning, an integral part of total economic and social development, uses functional classification to determine how travel can be channelized within the network in a logical and efficient manner. Functional classification defines the part that any particular route should play in serving the flow of trips through a highway network.

Functional classification is used by transportation agencies in a number of ways, from design to maintenance. The hierarchal system correlates the purpose of a roadway with all the external factors transportation agencies handle. The functional classification of a roadway is often a factor in decision-making by transportation agencies.

Program and Project Prioritization: In a climate of constrained resources, functional classification often plays a role in the prioritization of expenditures. Transportation agencies have developed separate funding programs to support the roadway systems that serve their longest travel distance.

Asset Management: Functional classification plays a role in transportation agencies' asset management programs, as agencies generally work to preserve and protect their most important assets - those that serve the most people and goods.

Safety Programs: Functional classification is used by transportation agencies to evaluate the safety of their roadways and implement safety improvement programs. Agencies consider the classification of the roadway in evaluating the significance of crash rates.

Roadway Design: There is a correlation between functional classification and design. Lower class roadways typically have lower speed limits, narrower lanes, steeper curves, etc., while higher class roadways have higher speed limits, wider lanes, and fewer sharp curves.

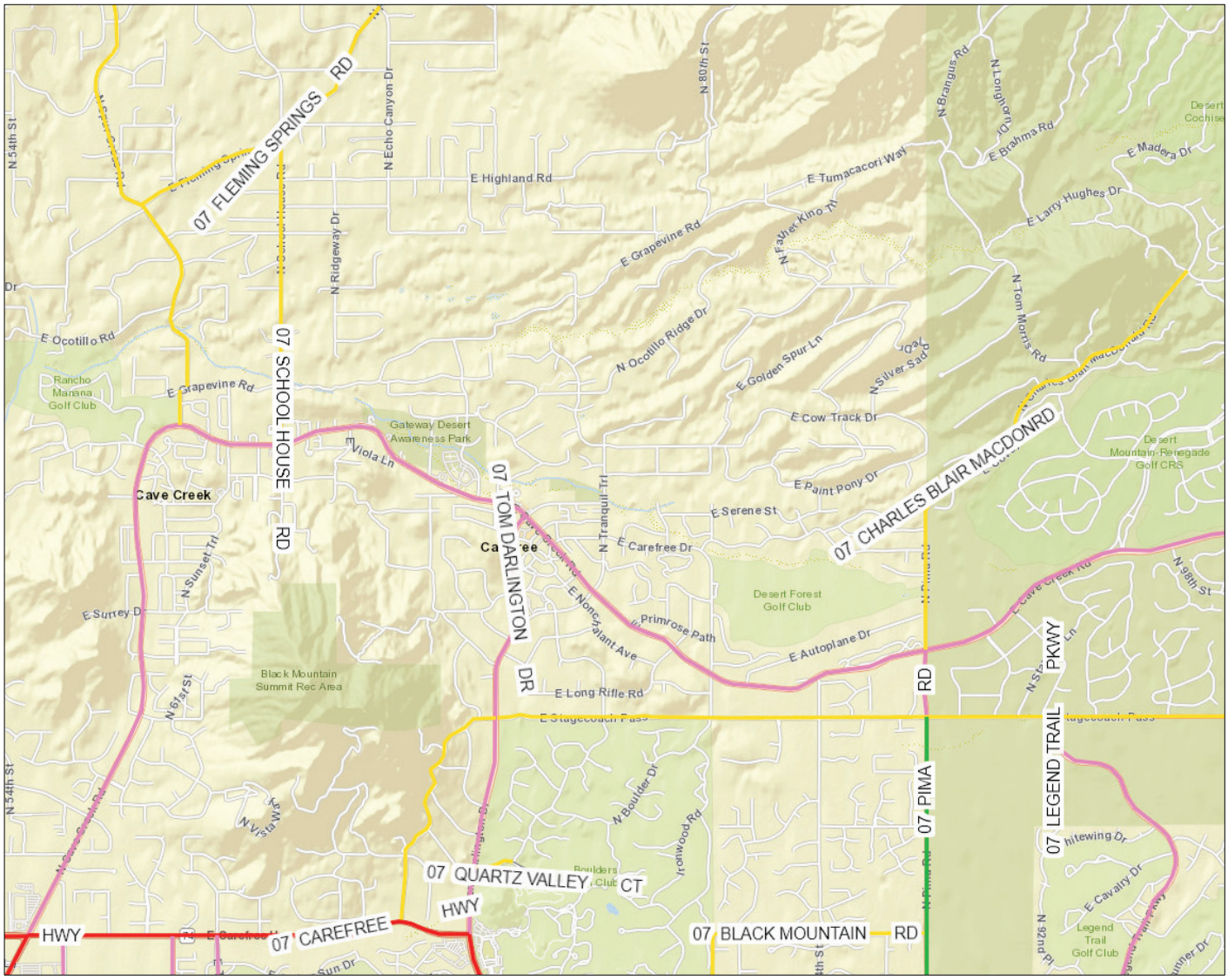
Traffic control: Transportation agencies look to functional class to determine the most appropriate intersection control measure to use.

Maintenance: Functional classification often plays a role in resurfacing cycles, which is related to asset management and project prioritization. The classification of a roadway may impact the prioritization of general maintenance work.

Factors assessed to determine the Federal Functional Classification of a street include the following.

- Function – mobility versus land access.
- Destination – serves public services, health/medical centers, parks, schools, commerce, and industry.
- Design – number and width of lanes, medians, number of ingress/egress points, speed, etc.
- Context – urban or rural and adjacent land uses.
- Topology – hierarchical connectivity.
- Quantitative – mileage range quotas.

Local roads should account for at least 65% of all road mileage in a jurisdiction while collectors and arterials combined should account for no more than 35% of all road mileage.



Federal Functional Classification Map

The above map shows the federal functional classified streets. All streets within the Town of Carefree are local streets except for the major streets denoted below.

Street	Functional Classification	Color Code Legend
Pima Road south of Cave Creek Road	Urban Minor Arterial	Green
Cave Creek Road	Urban Major Collector	Pink
Tom Darlington	Urban Major Collector	Pink
Pima Road north of Cave Creek Road	Urban Minor Collector	Yellow
Stagecoach Pass	Urban Minor Collector	Yellow

There are three primary functional classes as defined by the United States Federal Highway Administration:

Arterial: Arterial roads generally provide the fastest method of travel and typically have low accessibility from neighboring roads. They are usually designed with long-distance travel in mind and are not as common as the other two functional classes of roads. Examples include interstates, freeways, and major/minor highways.

Collector: Collector roads are the second most common and are used as a connection between local roads and arterial roads. They provide a balance between access and mobility.

Local: Local roads are the most common roads by far but are also the slowest for travel. They are designed specifically to have high accessibility, to connect to collector and arterial roads, and are typically not used for through traffic. The main functions of local roads are to allow for people who live in low density residential areas to connect to other residential areas or to collector roads.

Criteria used to functionally classify roads include:

- Traffic Counts
- Serving Major Activity Centers – schools, hospitals, sporting facilities, public services, etc.
- Connectivity – terminate at a road with the same or higher functional classification.

Local roads should account for no less than 65% of all road mileage in the jurisdiction while collectors and arterials should account for no more than 35% of all road mileage.

PAVEMENT CONDITION ASSESSMENT AND RATINGS

The pavement condition assessment and ratings for the Town's public street system were collected and analyzed using RoadBotics™ software and tools.

ROADBOTICS DATA COLLECTION & STREET INVENTORY OVERVIEW

RoadBotics™ is an infrastructure technology company that uses artificial intelligence (AI) to assist local governments and engineering firms make data-driven pavement management decisions. The cloud-based software tool provides affordable and objective road inventories and pavement condition assessments. RoadBotics™ simplifies the data collection process by using a smartphone to capture images of the road. RoadBotics™ then uses machine learning algorithms (AI) to automate the road rating process.

The online RoadBotics™ database for the Town's study area includes the following information:

- Street System Inventory Map
- Photographic Image every 10-feet (time/dates stamped with GPS location)
- Appurtenant Facilities Presence (curb/gutter sections, sidewalks & ADA ramps, signage and striping, and storm drainage facilities)
- Street Pavement Condition Ratings (Scale 1 Excellent to 5 Critical)
- High-Definition Pavement Condition Index (HD-PCI)
- Individual Distress Identification (Type & Location)

PAVEMENT CONDITIONS RATINGS

Every public roadway within the Town of Carefree was inventoried and evaluated to assess the pavement conditions and determine pavement condition ratings for each paved street segment.

The collected data was evaluated by RoadBotics™ using an artificially intelligent algorithm that develops a numerical rating to describe the overall roadway condition for each segment. In addition, for each segment, a photographic image is produced and stored every 10 feet to document roadway conditions at the time of inspection. After identifying pavement surface distresses in an image, the RoadBotics™ algorithm automatically generates a numerical pavement condition rating from 1 (excellent condition) to 5 (critical condition) for each image, which represents a 10-foot longitudinal section of a roadway. This condition rating is generated based on the type, frequency, and density of distresses. Output from this program integrates pavement conditions, pavement distresses with a photo inventory of every street segment and stores the information on a single cloud-based platform, which makes it accessible to the Town from any computer or tablet in the office or in the field.

The table below sets forth the RoadBotics™ pavement condition rating system.

PAVEMENT CONDITION RATING SYSTEM				
RoadBotics™ Ratings		General Description	ASTM Rating	
Rating	Condition		PCI	Rating
1	Excellent	No surface damage and no critical issues	85–100	Excellent
2	Minor Defects	Beginning to show typical wear and tear. No critical issues.	70–85	Very Good
2.5	Moderate Defects	Aging pavement surface, moderate wear and tear, increased reflective cracking, slight rutting.	55–70	Good
3	Fair	Appearance of pervasive surface distresses. Important issues on the pavement surface are beginning to show.	40–55	Fair
4	Poor	Significant damage or emerging critical failures. The road damage is beginning to exacerbate.	25–40	Poor
4.5	Very Poor	Alligator cracking 10%-20% of pavement area, extensive longitudinal/transverse cracking, patches, & pavement edge cracking and failures.	10–25	Very Poor
5	Critical	Major surface damage and/or critical fatigue issues are present on the road surface.	00–10	Failed

The Pavement Condition Index (PCI) rating system refers to a pavement condition index that also identifies the general condition of roadway. PCI is a numerical rating of the pavement condition based on the type and severity of distresses observed on the pavement surface. The PCI value of the pavement condition is represented by a numerical index between 0 and 100, where 0 is the worst possible condition and 100 is the best possible condition (see the right column on the above table). This method is based on a visual survey of the number and types of distresses in a pavement. The type and extent of existing distresses and their severity level are collected, and the distress densities are calculated for each type of distress. This index process has been standardized in ASTM D6433-11, Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.

The *Pavement Condition Rating System* table above provides the RoadBotics™ rating system along with the PCI rating system. RoadBotics™ output provides the PCI ratings for each of the street segments as well as their corresponding 1 through 5 pavement condition rating.

Data Collection: The Town's streets were driven over a three-day period on Tuesday 08/31, Thursday 09/02, and Monday 10/04. The data was collected using a smartphone mounted to the vehicle dashboard. The phone, loaded with RoadBotics™ data collection software, recorded the roadway conditions and the collected photographic images every 10-feet. The data was then downloaded and analyzed by RoadBotics™ to provide the roadway inventory and pavement condition output.

See the *Pavement Condition Ratings Overall Town Map* and the *Pavement Condition Ratings Street Segment Table* contained in the accompanying Appendix for a complete listing and an overview (maps and table) of the RoadBotics™ data output. The data includes the street segment length, RoadBotics™ rating, HD-PCI rating, number of potholes and percent of pavement distresses per street segment.

A summary listing of the composite street pavement condition ratings by Subdivision and by Standalone Streets and Local Streets follow. The number of potholes found are also included in the summary tables.

PAVEMENT CONDITION RATINGS SUMMARY REPORT - CAREFREE SUBDIVISIONS					
Subdivision	Street Length (feet)	Street Length (miles)	RoadBotics Rating	HD-PCI Rating	# of Potholes
Carefree 3A & Carefree 3B	11,169	2.12	2.66	73	0
Carefree Crossings I	5,197	0.98	2.80	67	0
Carefree Foothills	9,940	1.88	2.98	64	0
Carefree Fore & Carefree Fore More	14,599	2.77	1.45	87	0
Carefree Rolling Hills	15,763	2.99	1.94	86	0
Carefree Too	21,172	4.01	1.69	87	0
Cow Track Estates	37,040	7.02	2.94	64	30
Leigh Estates	2,743	0.52	3.78	46	4
Original Carefree	41,845	7.93	2.15	81	1
Ranchitos Del Ray	9,519	1.80	2.20	74	2
Sentinal Rock Estates	16,462	3.12	2.84	67	0
Velvet Shadows	15,666	2.97	2.01	82	1
Totals	201,115	38.11			38

The *Pavement Condition Ratings Summary Report* for Standalone and Local Streets is shown on the next page.

PAVEMENT CONDITION RATINGS SUMMARY REPORT - STANDALONE STREETS & LOCAL STREETS					
Street Name	Street Length (feet)	Street Length (miles)	RoadBotics Rating	HD-PCI Rating	# of Potholes
Canyon Ridge Drive	858	0.16	2.50	73	0
Celestial Street	2,582	0.49	2.31	70	9
East Cave Creek Road	37,102	7.03	1.90	84	9
East Grapevine Road	5,123	0.97	2.21	73	5
Horizon Drive	2,166	0.41	2.53	71	2
New River Road	650	0.12	2.34	78	0
East Scopa Trail	1,170	0.22	3.95	47	0
Stagecoach Pass	12,233	2.32	2.29	72	0
Grapevine Road	1,380	0.26	2.07	74	0
80th Street	675	0.13	2.91	68	0
North Cave Creek Road	10,019	1.90	1.87	83	1
North Grapevine Road	877	0.17	3.57	51	1
Mule Train Road	4,161	0.79	1.32	94	0
Never Mind Trail	1,734	0.33	2.99	67	0
Pima Road	5,227	0.99	1.76	88	0
North Scopa Trail	426	0.09	3.35	51	3
Tom Darlington Drive	16,065	3.04	1.63	87	0
Tranquil Trail	1,688	0.32	2.98	62	0
Rising Sun Road	2,567	0.49	2.11	85	0
Scopa Trail	934	0.18	2.23	92	0
Spanish Boot Trail	3,574	0.68	3.06	63	1
Carefree Streets - Local	8,529	1.62	1.94	85	0
Totals	119,740	22.71			31

Information Access: The RoadBotics™ data mapping and information are available for online viewing by Town staff.

Ratings Summary: The pavement condition ratings for the Town of Carefree are summarized as follows.

- Network RoadBotics™ Score 2.23 (out of 5)
- Network HD-PCI Score 77 (out of 100)
- Total Centerline Miles Rated 61
  (rated mileage is greater than street centerline mileage as each side of divided streets is rated separately)
- Number of Potholes 69

Overall, the Town's street system is in good condition and well maintained.

See the pavement conditions rating mapping in the accompanying appendix for the pavement condition rating for each street segment in the individual subdivisions and for the overall Town.

PAVEMENT SURFACE DISTRESS CONDITIONS

The RoadBotics™ analysis provides an inventory of six (6) key pavement distress factors in addition to the average pavement condition rating for each roadway segment. These 6 categories of distresses are listed and described in the below table.

PAVEMENT DISTRESS CATEGORIES	
Distress Category	**Distress Types**
1 Potholes	1 Potholes 2 Lane Shoulder Drop-off
2 Fatigue Cracking	3 Alligator Cracking 4 Edge Cracking
3 Pavement Distortions	5 Rutting 6 Shoving 7 Corrugation 8 Depressions 9 Bumps and Sags
4 Patches & Sealant	10 Sealed Cracks 11 Hot Patches/Cold Patches
5 Transverse & Longitudinal Cracking	12 Transverse Cracking 13 Longitudinal Cracking 14 Block Cracking 15 Reflective Cracking 16 Slippage Cracking
6 Surface Deterioration	17 Bleeding 18 Raveling/Weathering

The distress categories and types identified in the evaluation process are further described below.

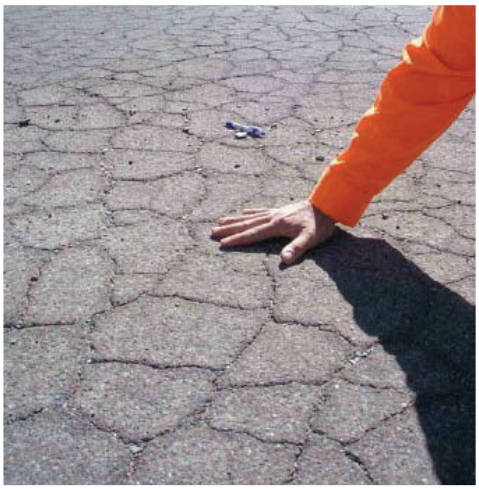
POTHOLES

Potholes are depressions or hollows of various sizes in the road surface where the pavement surface course is gone. Potholes occur when a small failure in the pavement is left unrepaired for some period of time.

Lane shoulder drop-offs typically occur due to stormwater runoff flowing along the edge of the pavement and scouring out a depression. They can also be created by vehicles running off the edge of the pavement when ground conditions are wet and saturated.

FATIGUE CRACKING

Alligator cracks are a form of interconnected cracks that commonly occur in asphalt pavements. They are called alligator cracks as the cracking patter resembles the scales of an alligator.



Edge cracking are continuous cracks located within 2 feet +/- of the pavement edge and typically occur along unpaved shoulders. As the cracks worsen, they start from the edge and spread towards the center. Severe edge cracks tend to look like alligator cracks, however, note that they have a crescent-shaped pattern.

PAVEMENT DISTORTIONS

Rutting is a linear surface depression formed on the road along the wheel path. Ruts, due to their shape, hold water and cause hydroplaning, leading to safety problems. Severe ruts can lock vehicles in the rutted path and create difficulties for drivers attempting to steer out of them (e.g., when trying to change lanes). Rutting can occur on asphalt, gravel, and dirt roads.

Shoving is the deflection and bulging of the road surface due to traffic loads. Typically, it occurs parallel to the direction of traffic.

Corrugation or washboarding is the formation of ripples or waves on the flexible pavement generally perpendicular to the traffic flow. It typically occurs at the points where traffic starts and stops.

Depressions are low areas of pavement that do not penetrate the asphalt. They are typically caused by poor compaction during the paving process. If not promptly fixed, water and debris that typically collect in depressions can wear on the asphalt surface and weaken its integrity.

PATCHES AND SEALANT

A patch is an area of pavement that has been removed and replaced with newer material. A patch is considered a defect no matter how well it performs.

Sealed cracks are locations where individual pavement cracks were filled to prevent further water penetration and damage to the road surface. The reported average performance life of crack sealant ranges from 3 to 8 years.

TRANSVERSE AND LONGITUDINAL CRACKING

Longitudinal cracks are formed parallel to the pavement centerline. Longitudinal cracks can occur on both asphalt and concrete pavements. They indicate the onset of alligator cracks (in the case of asphalt pavements) and possible structure failure.

Transverse cracks are unconnected cracks that run across a pavement, perpendicular to the direction of the road. They are also known as intralaminar cracks or thermal cracks. Transverse cracks can occur on both asphalt and concrete pavements.

SURFACE DETERIORATIONS

Bleeding is the movement of the asphalt binder in the asphalt pavement to its surface. A thin shiny and reflective film of asphalt binder is formed reducing skid resistance and affecting the visibility of the road. Typically, the binder is almost in liquid form. Bleeding is also referred to as flushing.

Raveling is the disintegration of an asphalt road surface due to the dislodging of the aggregate materials (gravel, sand, and crushed stone). It reduces skid resistance, makes the road surface rough, and exposes the layers underneath to further deterioration. It also results in loose gravel that can be damaging to vehicles.

OTHER PAVEMENT DISTRESS & DAMAGE

Edge Damage

Oxidation (Aging)

Stripping

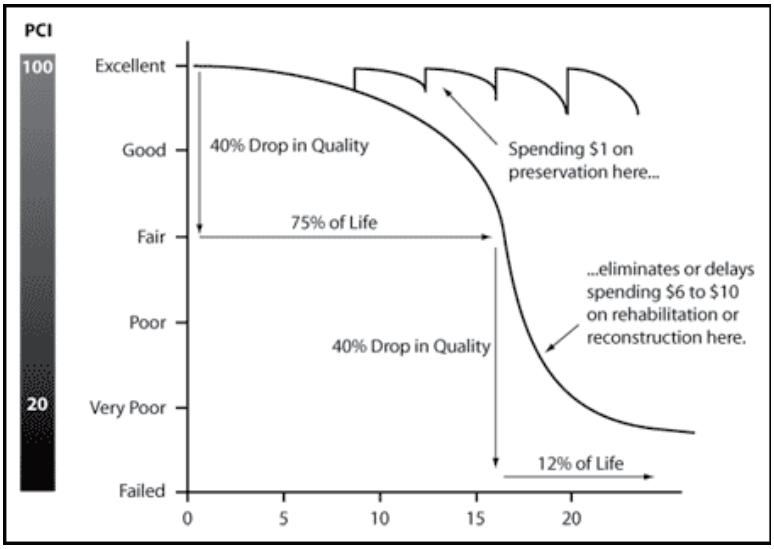
Edge Erosion from Stormwater Runoff

PAVEMENT REHABILITATION STRATEGIES

PAVEMENT DETERIORATION

Routine and preventative maintenance of roadways is integral to maximizing the life expectancy of the pavement. The typical surface treatments used for street maintenance are describe in more detail within this section of the report.

The chart to the right displays the typical street pavement deterioration progress over time if the pavement is not properly maintained. The pavement performs in excellent condition for the first 10-years or so. However, note the steep decline in the pavement condition over the next 10-years +/- as the pavement degrades from fair to poor condition.



Timely preventive maintenance treatments are essential to extending and maximizing the pavement life. For every $1 dollar spent early in the pavement's life, it can eliminate or delay spending $6 to $10 on the same road pavement in the future.

PAVEMENT REHABILITATION STRATEGIES

Good pavement conditions can best be sustained by providing regular maintenance throughout the life of the pavement. When routine or preventive maintenance are not implemented, the pavement deteriorates at a faster rate and, when left untreated, pavement reconstruction/replacement may be the only effective option at that point.

The FHWA defines three components of good pavement maintenance as:

Preventive Maintenance

A planned strategy of cost-effective surface treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system without increasing its structural capacity. Preventive maintenance treatments include crack sealing, fog sealing, and thin asphalt treatment including slurry seals, chip seals, and microseals.

Routine Maintenance

Consists of work that is planned and performed on a routine basis to maintain and preserve the condition of the roadway system or to respond to specific conditions and events that restore the roadway system to an adequate level of service. Examples of pavement-related routine maintenance activities include cleaning of roadside ditches and structures, maintenance of pavement markings, crack filling, pothole patching, and isolated areas of thin asphalt overlays. Routine maintenance is often times performed "in house" by Town Public Works staff.

Pavement Rehabilitation

Rehabilitation projects extend the life of existing pavement structures or by improving/strengthening the existing pavement section to accommodate projected traffic loading conditions. Rehabilitation techniques include restoration treatments and structural asphalt overlays (with or without milling of the existing pavement surface).

Two subcategories are directly related to the pavement restoration work or increase in structural capacity work.

Minor Rehabilitation / Pavement Preservation

Consists of non-structural enhancements made to the existing pavement sections to eliminate age-related top-down surface deterioration and cracking that develops in flexible pavements due to environmental exposure. Because of the non-structural nature of minor rehabilitation techniques, these types of rehabilitation techniques are placed in the category of pavement preservation.

Major Rehabilitation / Asphalt Overlays & Reconstruction

Consists of structural enhancements that both extend the service life of an existing pavement and/or improve its load-carrying capability.

Emphasizing preventive maintenance will help prevent or prolong the need for more expensive major pavement rehabilitation.

There is a variety of surface treatments used for pavement maintenance and preservation. The Town has continually evaluated the various options over the years and selected those that offer the greatest quality and cost effectiveness. This approach has contributed to the Town's ability to maintain its current level of service and the longevity of the Town's pavements.

Fog Seal: There are a variety of fog seals which are applied with commercial distributors/sprayers. The goal of the fog seal is to rejuvenate the oils in the top layer of the asphalt and reduce the oxidation and eventual cracking of the asphalt pavement.

MTR, MTR Plus, TRMSS: MTR, or Modified Tire Rubberized Sealcoat, has the capacity to seal, prolong the life, and enhance the appearance of the pavement at a relatively low cost. It is a fog seal emulsion mixed with clay material, tire rubber, and chemicals that penetrate into the asphalt, fill small voids between the aggregate, and restore the asphalt adhesion and resistance to aging.

MTR Plus contains additional fine sand and is reinforced with special polymers which are an additional benefit in extending the service life of streets. MTR Plus is only an incrementally higher price than MTR.

TRMSS, or Tire Rubber Modified Surface Seal, is related to MTR that serves as a less expensive treatment. It is better quality than many of the other fog seals available in the market and is very commonly used in the metropolitan area.

Slurry Seal: This surface treatment is a mixture of fine aggregate, water, and specified additives which are proportioned, mixed, and spread over the street. This creates a wearing surface as a result of the aggregate added to the treatment. This wearing surface can cause a rougher ride or vibration in vehicle tires as the result of the exposed aggregate. However, the aggregate is pushed into the asphalt and becomes more worn, making the surface appear and ride smoother over time.

Chip Seal: This surface treatment is a compacted aggregate layer a little thicker than slurry. A thick layer of emulsified asphalt and specified additives is applied to the pavement surface with the aggregate (chips) spread over the asphalt layer and rolled. This creates a friction wearing surface as a result of the embedded aggregate material and is a little more expensive than slurry seal. This wearing surface can cause a rougher ride or vibration in vehicle tires as the result of the exposed aggregate. By nature, the rocks may become dislodged from the chip seal. The loose aggregate can be alleviated by proper construction and rolling, applying the right balance of aggregate to emulsified asphalt, and thorough sweeping following construction. The dislodging of aggregate has been partially reduced as a result of new technologies and rubber additives.

Microsurfacing: Microsurfacing is similar to slurry seal consists of the application of a mixture of water, asphalt emulsion, aggregate (very small, crushed rock), and chemical additives applied to an existing asphalt concrete

pavement surface. Polymer is commonly added to the asphalt emulsion to provide better mixture properties. This type of surface may be applied in multiple layers with multiple stone thicknesses, while slurry contains one course of stone thickness. Microsurfacing has a stronger wearing surface but is more costly than a slurry seal or chip seal.

Cape Seal: A cape seal is a combination pavement surface treatment consisting of a chip seal covered with a slurry seal or microsurfacing. Once the chip seal has been placed, the road should be reopened to traffic until a full cure has been obtained before placing the slurry seal or microsurfacing. Cape seals provide the benefits of both the chip seal and the slurry seal or micro surfacing treatment, namely sealing moderate cracks, providing skid resistance, sealing the pavement against moisture intrusion, protecting the structure from further oxidation and raveling, and restoring a uniform black asphalt appearance.

Asphalt Mill & Overlay: Mill and overlay is the process of grinding off the top layer of existing asphalt pavement by means of a large milling machine and replacing this layer with a new compacted hot mix asphalt riding surface. The Town typically uses a 2" depth of mill and overlay for low volume residential streets and a 3" depth of mill and overlay for heavier volume collector streets.

Reconstruction: Pavement reconstruction consists of full-depth removal of the existing asphalt pavement and replacing it in-kind. This is the costliest form of pavement rehabilitation. It entails removing the existing asphalt pavement and its base material, preparing the subgrade, placing, and compacting new aggregate base material, and placing and compacting new hot mix asphalt surfacing material to the required thicknesses.

Pavement Patches: Pavement defects can reach the point where it is necessary to remove and replace the defective asphalt. It is a method for repairing alligator cracked areas, potholes, edge damage, trench patches in poor condition, and other similar isolated areas of pavement defects. Removal and replacement work involves sawcutting and removing the asphalt pavement layer, usually 2 to 4 inches in thickness, applying a tack coat to the exposed surface, placing the new asphalt material, and rolling and compacting it flush or slightly higher than the existing pavement.

Pavement patching work is often completed in a sequence of preventative maintenance together with crack sealing and fog seal application. When done properly, pavement patches can last many years (10+ years). Patching work is labor intensive and costly, but in most cases only small areas of streets require this treatment. When the percentage of major defects exceed a certain threshold, other measures with a lower total costs should be considered such as mill and overlay.

Other Maintenance: There are additional maintenance procedures associated with preparing a street for one of the pavement preservation methods mentioned above, and other procedures required after the treatment is applied. Such procedures and related materials need to be taken into consideration when estimating the costs for a street maintenance program. Before a treatment is applied, cracks are to be sealed with an asphalt concrete sealant. Major defects, such as alligator cracking or edge breaks, should be removed and replaced. Additionally, drainage structures or other structures may need to be adjusted or repaired, such as culverts, reflectors, water valves, survey monuments, and manholes. After a preservative seal is applied, any striping, stop bars, and other pavement markings have to be reapplied to the new street surface.

The *Pavement Rehabilitation Strategy Comparison* table presented below provides a summary of various pavement treatment strategies and the expected life of the pavement maintenance treatments.

PAVEMENT REHABILITATION STRATEGY COMPARISON			
Treatment Type	**Description**	**Pros / Cons**	**Anticipated Life**
Crack Sealing	Use a router to clean 1/4" cracks or wider in pavements. Seal AC or PCC pavements to prevent the passage of water through the surface crack into the pavement structure or subgrade.	**Pros:** Crack filling and sealing is probably the most important and cost-effective preventive maintenance strategy. **Cons:** Crack sealing operations can be very labor intensive and hard to estimate segment cost.	3 to 5 Years
Slurry Seal	A mixture of emulsified asphalt, fine aggregate, and additives applied in a very thin layer to renew surfaces and protect against moisture and air intrusion.	**Pros:** The seal prevents moisture and air intrusion in the pavement and improves skid resistance, corrects surface profile, and fills potholes. **Cons:** A slurry surface is only a protectant layer on top of the existing surface and does not form a permanent bond with the underlying pavement. A slurry will oxidize quickly and lose its black color within the first several months. Requires sealing cracks > 1/4" prior.	3 to 7 Years
Chip Seal	An application of asphalt emulsions or liquid paving grade asphalts (with additives) and then covering them with aggregate and rolling. Chip seals renew and protect pavements and restore skid resistance.	**Pros:** Chip-sealing equipment is common in most areas. The roadway can be opened to low-speed traffic just after the application of the aggregate. **Cons:** Requires constant attention and frequent adjustment of application rates of aggregate and asphalt to minimize chip loss, bleeding, and other problems. Windshields can be damaged by the loose aggregate. Requires sealing cracks > 1/4" prior and brooming loose rock.	4 to 8 Years
Microsurfacing	Microsurfacing is a protective seal coat which extends the life of pavement. It is a thin, tough layer of asphalt emulsion blended with finely crushed stone for traction.	**Pros:** Cost-effective method to renew the road surface and seal minor cracks and other irregularities. **Cons:** Requires special equipment for application which makes it more expensive than a slurry or chip seal treatment. Its success is dependent on having an experienced contractor and the proper mix of ingredients.	6 to 10 Years
Cape Seal	A combination slurry seal or microsurfacing applied over the top of a chip seal.	**Pros:** Provides more protection and durability than provided by the individual treatments alone and provide a smoother finished surface. **Cons:** Longer construction time than a single slurry or chip seal layer. Requires sealing cracks > 1/4" prior.	8 to 12 Years

PAVEMENT REHABILITATION STRATEGY COMPARISON			
Treatment Type	**Description**	**Pros / Cons**	**Anticipated Life**
Thin Asphalt Overlay	A thin (up to 1-1/2") layer of hot mix is applied to the existing surface.	**Pros:** Long service, low lifecycle cost, can better preserve grade and slope, seals the surface, and can be constructed quickly, minimizing traffic delays. **Cons:** Cannot be applied over badly distressed pavements, are dependent on good bond development, and otherwise the pavement could be structurally inadequate. Requires sealing cracks > 1/4" prior.	10 to 15 Years
Asphalt Mill & Overlay	The process of removing a portion or all the existing asphalt surface and repaving with a new asphalt surface of various thicknesses, preserving the base and sub-base.	**Pros:** Mill and overlay can greatly extend the life of a pavement at a lower cost than removal and replacement or reconstruction. **Cons:** Relatively expensive compared to surface treatments.	15 to 25 Years
Reconstruction	Removal of the existing pavement followed by fixing subgrade and drainage problems; then construction of a new pavement.	**Pros:** Completely remove the pavement section, base, and possibly subgrade. Used only if there is complete failure of the pavement or base/subgrade failure. **Cons:** Most costly alternative	40 Years+

Determination of Optimum Surface Treatment Solutions:

As outlined in the above table, a variety of pavement rehabilitation strategies are available for repairing and preserving asphalt pavements. When determining which treatment to apply, consideration should be given to the existing pavement condition, its distress level, distress types, and budgetary constraints.

In addition to the roadway pavement condition, consideration should also be given to the roadway's functional classification and purpose, the amount and mix of traffic the street carries, the significance of the route to the community, the cost of repair, and its forecast lifespan. These factors should be considered when determining the optimum pavement rehabilitation treatment option.

Routine Maintenance: Routine preventive maintenance strategies are best applied to roadways with no structural distress or significant cracking present. Preventive maintenance is predominately a "top down" application that focuses on repairing and sealing the pavement surface to extend its life.

Typically, the Town seals the cracks within the street surface and then applies a fog seal to rejuvenate the oils on the pavement surface. These routine maintenance treatments help to reduce oxidation and the resultant drying of the surface. This approach minimizes the expansion of cracks to help ensure the road surface is not compromised and not subject to water penetration and deterioration.

On a case-by-case basis, the Town has and should replace portions of streets where there are a high number of cracks in close proximity such as alligator cracked areas. In those areas, the substrate may also need to be replaced, compacted, and new asphalt pavement surfacing installed per the pavement patching discussion above.

Chips seals, slurry seals, fog seals, and the like are generally not cost-effective for more severely damaged roadways. If applied to such a pavement, typically they would extend the life of the pavement by only a few years.

More expensive pavement rehabilitation strategies include full depth patching, overlays, mill and overlays, and complete pavement reconstruction, and those are recommended for pavements with extensive cracking and areas showing base failure and significant distress.

PAVEMENT PRESERVATION PROGRAM

PAVEMENT REHABILITATION METHODS

Selection of the method of pavement rehabilitation for each subdivision, standalone street, and local street is based on the RoadBotics™ pavement condition assessment rating, which correlates to its PCI rating.

For this program, the following table reflects the pavement rehabilitation strategy selected based on the range of scores for the particular streets. Note that a score of 1 reflects pavements in excellent condition while a score of 5 reflects pavements in failed condition. This pavement rehabilitation strategy was reviewed with the Town, meets their needs, and has been approval.

PAVEMENT REHABILITATION METHOD SELECTION	
Strategy	*RoadBotics Score Range*
Fog Seal	0.00 - 1.25
Surface Treatment - Microsurfacing	1.26 - 3.00
Surface Treatment – Cape Seal	1.26 - 3.00
2" Asphalt Mill & Overlay	3.01 - 4.00
Pavement Reconstruction	4.01 - 5.00

The following table shows a summary of the pavement rehabilitation method assigned to each subdivision, standalone street, and local streets based on its RoadBotics™ pavement condition assessment rating.

SUBDIVISION AND STANDALONE STREETS PAVEMENT REHABILITATION METHOD SUMMARY						
Subdivision / Standalone Street	**Construction Type**	Total Street Length (feet)	Street Length (miles)	RoadBotics Rating	HD-PCI Rating	# of Potholes
Carefree 3A & Carefree 3B	Cape Seal (Slurry Seal on Chip Seal)	11,169	2.12	2.66	73	0
Carefree Crossings I	Cape Seal (Slurry Seal on Chip Seal)	5,197	0.98	2.80	67	0
Carefree Foothills	Cape Seal (Slurry Seal on Chip Seal)	9,940	1.88	2.98	64	0
Carefree Fore & Carefree Fore More	Microseal	14,599	2.77	1.45	87	0
Carefree Rolling Hills	Microseal	15,763	2.99	1.94	86	0
Carefree Too	Microseal	21,172	4.01	1.69	87	0
Cow Track Estates	Cape Seal (Slurry Seal on Chip Seal)	37,040	7.02	2.94	64	30

Subdivision / Standalone Street	Construction Type	Total Street Length (feet)	Street Length (miles)	RoadBotics Rating	HD-PCI Rating	# of Potholes
Leigh Estates*	Cape Seal (Slurry Seal on Chip Seal)	2,743	0.52	3.78	46	4
Original Carefree	Microseal	41,845	7.93	2.15	81	1
Ranchitos Del Ray	Cape Seal (Slurry Seal on Chip Seal)	9,519	1.80	2.20	74	2
Sentinal Rock Estates	Cape Seal (Slurry Seal on Chip Seal)	16,462	3.12	2.84	67	0
Velvet Shadows	Microseal	15,666	2.97	2.01	82	1
Canyon Ridge Drive	Microseal	858	0.16	2.50	73	0
Celestial Street	Microseal	2,582	0.49	2.31	70	9
East Cave Creek Road	Mill & Overlay Microseal	37,102	7.03	1.90	84	9
East Grapevine Road	Microseal	5,123	0.97	2.21	73	5
Horizon Drive	Cape Seal (Slurry Seal on Chip Seal)	2,166	0.41	2.53	71	2
New River Road	Microseal	650	0.12	2.34	78	0
East Scopa Trail	2" Mill & Overlay	1,170	0.22	3.95	47	0
Stagecoach Pass	Microseal	12,233	2.32	2.29	72	0
Grapevine Road	Microseal	1,380	0.26	2.07	74	0
80th Street	Cape Seal (Slurry Seal on Chip Seal)	675	0.13	2.91	68	0
North Cave Creek Road	Microseal	10,019	1.90	1.87	83	1
North Grapevine Road*	Cape Seal (Slurry Seal on Chip Seal)	877	0.17	3.57	51	1
Mule Train Road	Microseal	4,161	0.79	1.32	94	0
Never Mind Trail	Cape Seal (Slurry Seal on Chip Seal)	1,734	0.33	2.99	67	0
Pima Road	Microseal	5,227	0.99	1.76	88	0

Subdivision / Standalone Street	**Construction Type**	Total Street Length (feet)	Street Length (miles)	RoadBotics Rating	HD-PCI Rating	# of Potholes
North Scopa Trail*	Cape Seal (Slurry Seal on Chip Seal)	426	0.09	3.35	51	3
Tom Darlington Drive	Microseal	16,065	3.04	1.63	87	0
Tranquil Trail	Cape Seal (Slurry Seal on Chip Seal)	1,688	0.32	2.98	62	0
Rising Sun Road	Microseal	2,567	0.49	2.11	85	0
Scopa Trail	Microseal	934	0.18	2.23	92	0
Spanish Boot Trail*	Cape Seal (Slurry Seal on Chip Seal)	3,574	0.68	3.06	63	1
Carefree Streets - Local	Microseal	8,529	1.62	1.94	85	0
Totals		320,855	38.11			38
* denotes an exception to the pavement rehabilitation method as the Town has opted to plan for a cape seal in lieu of a mill & overlay for these street segments.						
Color Code Legend		Subdivision Streets			Standalone Streets	

There are no subdivisions or standalone streets that rank to warrant a fog seal only, although there are a few street segments within these classifications that do. Fog seals are an important part of the Town's routine maintenance program and are to be used to rejuvenate the asphalt surface as needed on an approximate 5 -year interval.

For the microsurfacing construction type category, the Town may elect to do a cape seal, slurry seal or chip seal in lieu of microsurfacing should the current situation warrants this; for example, if funds are limited.

It is recommended that a 3" depth of asphalt mill and overlay be used for Cave Creek Road, Pima Road, and Tom Darlington when needed due to the higher traffic volumes and more frequent use by heavier vehicles. For this program, however, these streets do not warrant the thicker asphalt mill and overly depth as shown in the above table.

BUDGETARY COSTS

Budgetary level costs for each pavement rehabilitation strategy were determined and are set forth in the following table.

PAVEMENT REHABILITATION BUDGETARY COSTS						
Pavement Rehabilitation Strategy	Method Cost/SY	Add Crack Sealing	Mobilization & Traffic Control (+10%)	Contingency (+20%)	Total	**Budgetary Cost**
Crack Filling & Sealing	$0.00	$2.00	$0.40	$0.48	$2.88	**$ 3.00**
Fog Seal	$1.00	$2.00	$0.60	$0.72	$4.32	**$ 5.00**
Slurry Seal	$4.00	$2.00	$1.20	$1.44	$8.64	**$ 9.00**
Chip Seal	$5.00	$2.00	$1.40	$1.68	$10.08	**$ 10.00**
Microsurfacing	$6.00	$2.00	$1.60	$1.92	$11.52	**$ 12.00**
Cape Seal (Slurry Seal on Chip Seal)	$11.00	$2.00	$2.60	$3.12	$18.72	**$ 19.00**
Asphalt Mill & Overlay - 2" Local Streets	$23.00	$2.00	$5.00	$6.00	$36.00	**$ 36.00**
Asphalt Mill & Overlay - 3" Major Streets	$35.00	$2.00	$7.40	$8.88	$53.28	**$ 54.00**
Reconstruction 3" AC / 8" ABC	$60.00	$0.00	$12.00	$14.40	$86.40	**$ 87.00**
Note: For major streets, an allowance for striping and markings at $2/SY needs to be added to the cost.						

These budgetary costs are based on current (2022) dollars on typical bid prices for comparable projects. Construction costs can vary considerably and can be higher or lower than those shown due to current economic conditions, inflation, and other factors.

It is recommended that for program years beyond FY2022, an adjustment be made to the total budgetary amount of 2% per year to account for inflation.

EVALUATION CRITERIA

STREET PAVEMENT EVALUATION & RANKING CRITERIA		
Functional Classification	Street Segment	Functional Classification Factor
Urban Minor Arterial	Pima Road S of Cave Creek Rd	120%
Urban Major Collector	Cave Creek Road	115%
	Tom Darlington	
Urban Minor Collector	Pima Road N of Cave Creek Rd	110%
	Stage Coach Pass	
Local Streets	All except for the above streets	100%
Note: Factor increases RoadBotics pavement rating for Functional Classification.		
The adjusted RoadBotics Rating is 80% of the Subdivision/Street Segment Ranking.		
Construction Cost	Cost per Square Yard	Cost Factor
Crack Filling & Sealing	$3.00	0.33
Fog Seal	$5.00	0.20
Slurry Seal	$9.00	0.11
Chip Seal	$10.00	0.10
Microsurfacing	$12.00	0.08
Asphalt Mill & Overlay - 2"	$36.00	0.03
Asphalt Mill & Overlay - 3"	$54.00	0.02
Reconstruction 3" AC / 8" ABC	$87.00	0.01
Note: Factor gives weight to less costly construction methods.		
The Construction Cost Factor is 15% of the Subdivision/Street Segment Ranking.		
Safety		Safety Factor
Number of Crashes	Crash Count last 5-years	% Total Crashes x 5
Note: Factor gives weight to subdivisions/streets experiencing crashes.		
The Safety Factor is 5% of the Subdivision/Street Segment Ranking.		

The above criteria were used to evaluate each subdivision and standalone street segment to prioritize the improvement projects. See the *Subdivision & Standalone Streets Evaluation Ranking & Prioritization* table in the accompanying Appendix for application of the evaluation criteria to determine the rankings.

The following paragraphs are a brief discussion of the evaluation criteria.

Pavement Condition Rating: Each subdivision, standalone street, and local streets are rated based on the pavement condition assessment as scored by RoadBotics™. The highest numeric pavement condition rating down to the lowest numeric pavement condition rating is used as the basis of the subdivision and street ranking. Note that the RoadBotics™ ratings are based on pavements in excellent condition at a 1 out of 5 rating while pavements in failed condition receive a 5 out of 5 rating.

However, a "worst first" approach to road repair is often not the best value to the public nor the most effective use of limited capital improvement and/or maintenance funds. The Town needs to optimize their funding by utilizing a pavement management approach that prioritizes road rehabilitation where the need is greatest and identifies the best maintenance strategy for each roadway segment. Consequently, the ranking system used included the additional factors of street functional classification, construction cost, and traffic safety to determine the final numeric rating value and improvement program ranking.

Functional Classification: Considers the level of street classification of the particular street segment. Traffic volumes are typically proportional to the street's functional classification. The higher the functional classification the higher the impact of pavement conditions on traffic and users. Local roads are considered to have lower impact, collector streets have medium impact, and arterial streets are higher impact. The respective factors used were 100% for local roads, 110% for minor collectors, 115% for major collectors, 120% for minor arterials. These percentages are applied to the RoadBotics™ pavement condition ratings to determine the 'weighted' ratings based on functional classification and level of impact.

The pavement condition rating as weighted by the functional classification factor is 80% of the total ranking value.

Construction Cost: This criterion is based on the cost to implement the recommended pavement treatment for each subdivision, standalone street, or local street segments. The factor is the inverse of the unit cost budget for each pavement treatment type. As such, surface treatments with lower budgetary cost value (e.g., Microseal) receive a higher rated value than streets with a higher budgetary cost value (e.g., Reconstruction). The construction cost factor provides an emphasis to timely preventative maintenance over waiting until more expensive options are needed.

The construction cost rating is 15% of the total ranking value.

Safety: The safety factor considers the number of crashes over the 5-year period from 2016 through 2020 in the respective subdivision, standalone street, or local streets. The factor is determined by taking the percentage of crashes out of the total number of crashes and multiplying that by 5, the weight value/percentage for safety.

The safety rating is 5% of the total ranking value as it is recognized that crashes are not directly proportional to pavement conditions.

The sum of the 'weighted' adjusted RoadBotics™ rating, the construction cost score, and the safety score is the total score used to rank the subdivisions, standalone streets, and local streets with a priority from high score to low score. The ranking values add up to 100, but the total values for the subdivisions Cow Track Estates, Ranchitos Del Ray, and Sentinal Rock Estates were enhanced with 3 'bonus' points to group those subdivision as the highest priority projects. This is to show the projects at the top of the rankings as they are already programmed for FY 2022.

See the table entitled *Subdivision & Standalone Streets Evaluation, Ranking & Prioritization* in the accompanying Appendix for detailed information on the evaluation criteria and scoring methodology used for ranking purposes.

A summary table entitled *Implementation Plan* is included for reference in the subsequent section of this report.

PAVEMENT PRESERVATION PROGRAM

A pavement preservation program is a planned strategy of cost-effective pavement treatments to an existing street system that preserves the pavement, retards future deterioration, and maintains or improves the functional condition of the system.

The pavement preservation program for the Town of Carefree are based on a number of factors including payment condition, functional classification (relates to traffic volumes and street classification), relative construction costs, safety (relates to crashes and pavement defects), and other factors.

Nature of Improvements: Such a program can consist of pavement surface preparation, crack filling and sealing, and fog sealing streets or an application of a slurry seal, chip seal, or microsurfacing. The program also includes improvements such as asphalt pavement mill and overlay, and full pavement section reconstruction where needed.

The program could be set up to apply some type of surface treatment to the pavements on a 10-year cycle.

FY 2021-2022: During this fiscal year, the Town let an improvement project for East Cave Creek Road from Carefree Drive to Pima Road. From Carefree Drive to Mule Train Road, the improvements included a mill and overlay of the existing asphalt pavement. From Mule Train Road to Pima Road, the improvements included microsurfacing. Consequently, the roadway segments for this length of Cave Creek Road have been separated from the segments of Cave Creek Road west of Carefree Drive and east of Pima Road.

FY 2022-2023: The Town has programmed the improvement of the streets in Cow Track Estates for this fiscal year. The project will involve the application of a cape seal to the pavement surface to rehabilitate the streets.

FY 2023-2024: The Town has programmed the improvement of the streets in the Sentinal Rock Estates subdivision for this fiscal year. The project will involve the application of a cape seal to the pavement surface to rehabilitate the streets.

FY 2024-2025: The Town has programmed the improvement of the streets in the Ranchito Del Ray subdivision for this fiscal year. The project will involve the application of a cape seal to the pavement surface to rehabilitate the streets.

FY 2025-2026 through FY 2033-2034: The balance of the subdivision streets and standalone streets will be apportioned to the subsequent ten fiscal years based on their overall priority ranking. Those programs are presented in more detail within this report.

The Town has budgeted approximately $7 million for the improvement of the streets within Cowtrack Estates, Ranchito Del Ray, and Sentinal Rock Estates. The balance of the subdivision and is spread over the next 10 fiscal years.

RoadBotics™ Tool: The analysis of pavement conditions utilizing RoadBotics™ software provides the Town of Carefree with a convenient on-line method of viewing their street system from anywhere at any time supplemented by both visual and objective data to evaluate street conditions.

Periodic reassessment of the streets collecting new data and using the RoadBotics assessment tool is recommended at an interval of every 5-years +/- to maintain relatively current data and to better monitor performance of the various pavement treatments that were constructed in the interim.

Related Improvements: On a case-by-case basis, the Town may opt to improve and/or reconstruct other related improvements together with the selected asphalt pavement surface treatment. These improvements may include, but not be limited to, drainage facilities, sidewalk, sidewalk curb ramps, curb and gutter, traffic control devices, traffic signage, pavement markings, bus stops, and other such facilities. Those items will need to be identified and their cost estimated and added to the pavement preservation program cost.

Economies of Scale Approach: The pavement preservation program includes street improvement for entire subdivisions to take advantage of 'economies of scale'. This process also minimizes the inconveniences to the residents caused by construction activities to a single infrequent occurrence versus more frequently by completing street improvements piecemeal over time.

IMPLEMENTATION PLAN

An *Implementation Plan* has been developed for the Town of Carefree and is presented below.

IMPLEMENTATION PLAN							
Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
East Cave Creek Road, Carefree Dr to Pima Rd	AC Mill & Overlay + Microseal	N/A - The Town has already programmed.	M&O 31,752 MICROSEAL 31,752	M&O 36 MICROSEAL 12	M&O $1,143,067 MICROSEAL $381,022	**FY 2021-2022**	**$ 1,524,090**
Cow Track Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.23**	111,120	$ 19	$ 2,111,280	**FY 2022-2023**	**$ 2,111,280**
Sentinal Rock Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.07**	49,386	$ 19	$ 938,334	**FY 2023-2024**	**$ 938,334**
Ranchitos Del Ray	Cape Seal (Slurry Seal on Chip Seal)	**2.47**	28,557	$ 19	$ 542,583	**FY 2024-2025**	**$ 542,583**
Leigh Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.96**	8,229	$ 19	$ 156,351	**FY 2025-2026**	**$ 911,040**
East Scopa Trail	2" AC Mill & Overlay	**3.94**	3,510	$ 36	$ 126,360		
North Grapevine Road	Cape Seal (Slurry Seal on Chip Seal)	**3.76**	2,631	$ 19	$ 49,989		
Tom Darlington Drive	Microseal	**3.74**	48,195	$ 12	$ 578,340		
East Cave Creek Road East of Pima Road	Microseal	**3.74**	36,538	$ 12	$ 438,453	**FY 2026-2027**	**$ 1,123,353**
North Scopa Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.56**	1,278	$ 19	$ 24,282		
Tranquil Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.37**	5,064	$ 19	$ 96,216		
Spanish Boot Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.28**	10,722	$ 19	$ 203,718		
North Cave Creek Road	Microseal	**3.23**	30,057	$ 12	$ 360,684		

Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
Never Mind Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.22**	5,202	$ 19	$ 98,838	**FY 2027-2028**	**$ 1,340,526**
Carefree Foothills	Cape Seal (Slurry Seal on Chip Seal)	**3.21**	29,820	$ 19	$ 566,580		
80th Street	Cape Seal (Slurry Seal on Chip Seal)	**3.14**	2,025	$ 19	$ 38,475		
Carefree 3A & Carefree 3B	Cape Seal (Slurry Seal on Chip Seal)	**3.07**	33,507	$ 19	$ 636,633		
Original Carefree	Microseal	**3.04**	125,535	$ 12	$ 1,506,420	**FY 2028-2029**	**$ 1,506,420**
Carefree Crossings I	Cape Seal (Slurry Seal on Chip Seal)	**3.04**	15,591	$ 19	$ 296,229	**FY 2029-2030**	**$ 871,800**
East Cave Creek Road West of Carefree Dr	Microseal	**3.03**	11,265	$ 12	$ 135,183		
Stagecoach Pass	Microseal	**3.00**	36,699	$ 12	$ 440,388		
Canyon Ridge Drive	Microseal	**2.98**	2,574	$ 12	$ 30,888	**FY 2030-2031**	**$ 819,018**
New River Road	Microseal	**2.83**	1,950	$ 12	$ 23,400		
Pima Road	Microseal	**2.81**	15,681	$ 12	$ 188,172		
Celestial Street	Microseal	**2.80**	7,746	$ 12	$ 92,952		
Horizon Drive	Cape Seal (Slurry Seal on Chip Seal)	**2.78**	6,498	$ 19	$ 123,462		
Scopa Trail	Microseal	**2.73**	2,802	$ 12	$ 33,624		
East Grapevine Road	Microseal	**2.71**	15,369	$ 12	$ 184,428		
Rising Sun Road	Microseal	**2.64**	7,701	$ 12	$ 92,412		
Grapevine Road	Microseal	**2.57**	4,140	$ 12	$ 49,680		

Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
Velvet Shadows	Microseal	**2.55**	46,998	$ 12	$ 563,976	**FY 2031-2032**	**$ 1,131,444**
Carefree Rolling Hills	Microseal	**2.48**	47,289	$ 12	$ 567,468		
Carefree Streets - Local	Microseal	**2.45**	25,587	$ 12	$ 307,044	**FY 2032-2033**	**$ 1,069,236**
Carefree Too	Microseal	**2.25**	63,516	$ 12	$ 762,192		
Carefree Fore & Carefree	Microseal	**2.02**	43,797	$ 12	$ 525,564	**FY 2033-2034**	**$ 675,360**
Mule Train Road	Microseal	**1.90**	12,483	$ 12	$ 149,796		
TOTALS		**104.59**	899,062		$ 13,040,395		**$ 13,040,395**
Color Code Legend		Subdivision			Standalone Street		

Implementation Strategies

With limited funding available, low-cost improvement strategies allow more street segments to be addressed to extend their functional lives. As a result, The Town of Carefree Pavement Preservation Program is summarized in the above table entitled *Implementation Plan*.

The Town currently has the improvement of Cave Creek Road from Carefree Drive to Pima Road under construction. Also programmed is the improvement of the three subdivisions: Cow Track Estates, Sentinal Rock Estates, and Ranchitos Del Ray.

The balance of the streets slated for pavement preservation have been spread over the next nine fiscal years from FY 2025-2026 though FY 2033-2034. The total cost of improvements (in 2022 dollars) is $9,450,000. The annual program size to complete balance of the work over nine years is approximately $1,050,000 per year.

Inflation Factor

Inflation increases the costs of construction to some extent each year. The table that follows entitled *Implementation Plan Amounts With Inflation Applied* provides an estimated future amount for pavement preservation improvements based on an increase in construction costs at 2% per year.

With the inflation factor applied, the total program cost increases from $13,040,395 in today's dollars to $14,448,613 over the length the 12-year program starting FY 2022-2023,

IMPLEMENTATION PLAN WITH INFLATION APPLIED							
Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
East Cave Creek Road, Carefree Dr to Pima Rd	AC Mill & Overlay + Microseal	N/A - The Town has already programmed.	M&O 31,752 MICROSEAL 31,752	M&O 36 MICROSEAL 12	M&O $1,143,067 MICROSEAL $381,022	**FY 2021-2022**	**$ 1,524,090**
Cow Track Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.23**	111,120	$ 19	$ 2,111,280	**FY 2022-2023**	**$ 2,111,280**
Sentinal Rock Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.07**	49,386	$ 19	$ 938,334	**FY 2023-2024**	**$ 957,101**
Ranchitos Del Ray	Cape Seal (Slurry Seal on Chip Seal)	**2.47**	28,557	$ 19	$ 542,583	**FY 2024-2025**	**$ 564,503**
Leigh Estates	Cape Seal (Slurry Seal on Chip Seal)	**3.96**	8,229	$ 19	$ 156,351	**FY 2025-2026**	**$ 966,796**
East Scopa Trail	2" AC Mill & Overlay	**3.94**	3,510	$ 36	$ 126,360		
North Grapevine Road	Cape Seal (Slurry Seal on Chip Seal)	**3.76**	2,631	$ 19	$ 49,989		
Tom Darlington Drive	Microseal	**3.74**	48,195	$ 12	$ 578,340		
East Cave Creek Road East of Pima Road	Microseal	**3.74**	36,538	$ 12	$ 438,453	**FY 2026-2027**	**$ 1,215,918**
North Scopa Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.56**	1,278	$ 19	$ 24,282		
Tranquil Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.37**	5,064	$ 19	$ 96,216		
Spanish Boot Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.28**	10,722	$ 19	$ 203,718		
North Cave Creek Road	Microseal	**3.23**	30,057	$ 12	$ 360,684		

Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
Never Mind Trail	Cape Seal (Slurry Seal on Chip Seal)	**3.22**	5,202	$ 19	$ 98,838	**FY 2027-2028**	**$ 1,480,075**
Carefree Foothills	Cape Seal (Slurry Seal on Chip Seal)	**3.21**	29,820	$ 19	$ 566,580		
80th Street	Cape Seal (Slurry Seal on Chip Seal)	**3.14**	2,025	$ 19	$ 38,475		
Carefree 3A & Carefree 3B	Cape Seal (Slurry Seal on Chip Seal)	**3.07**	33,507	$ 19	$ 636,633		
Original Carefree	Microseal	**3.04**	125,535	$ 12	$ 1,506,420	**FY 2028-2029**	**$ 1,696,530**
Carefree Crossings I	Cape Seal (Slurry Seal on Chip Seal)	**3.04**	15,591	$ 19	$ 296,229	**FY 2029-2030**	**$ 1,001,437**
East Cave Creek Road West of Carefree Dr	Microseal	**3.03**	11,265	$ 12	$ 135,183		
Stagecoach Pass	Microseal	**3.00**	36,699	$ 12	$ 440,388		
Canyon Ridge Drive	Microseal	**2.98**	2,574	$ 12	$ 30,888	**FY 2030-2031**	**$ 959,643**
New River Road	Microseal	**2.83**	1,950	$ 12	$ 23,400		
Pima Road	Microseal	**2.81**	15,681	$ 12	$ 188,172		
Celestial Street	Microseal	**2.80**	7,746	$ 12	$ 92,952		
Horizon Drive	Cape Seal (Slurry Seal on Chip Seal)	**2.78**	6,498	$ 19	$ 123,462		
Scopa Trail	Microseal	**2.73**	2,802	$ 12	$ 33,624		
East Grapevine Road	Microseal	**2.71**	15,369	$ 12	$ 184,428		
Rising Sun Road	Microseal	**2.64**	7,701	$ 12	$ 92,412		
Grapevine Road	Microseal	**2.57**	4,140	$ 12	$ 49,680		

Subdivision / Standalone Street	Construction Type	**Total Score - Rank High to Low**	Pavement Area (SY)	Budgetary Cost/SY	Construction Cost Budget	**Fiscal Year**	**Fiscal Year Construction Cost Budget**
Velvet Shadows	Microseal	**2.55**	46,998	$ 12	$ 563,976	**FY 2031-2032**	**$ 1,352,189**
Carefree Rolling Hills	Microseal	**2.48**	47,289	$ 12	$ 567,468		
Carefree Streets - Local	Microseal	**2.45**	25,587	$ 12	$ 307,044	**FY 2032-2033**	**$ 1,303,399**
Carefree Too	Microseal	**2.25**	63,516	$ 12	$ 762,192		
Carefree Fore & Carefree	Microseal	**2.02**	43,797	$ 12	$ 525,564	**FY 2033-2034**	**$ 839,743**
Mule Train Road	Microseal	**1.90**	12,483	$ 12	$ 149,796		
TOTALS		**104.59**	899,062		$ 13,040,395		**$ 14,448,613**
Color Code Legend		Subdivision			Standalone Street		

FUNDING

HURF Program: Street maintenance and pavement preservation projects have been funded through Highway User Revenue Funds (HURF) and the Town's General Fund. The use of HURF funds will continue to be the primary source of funds for the pavement preservation program.

HURF can be used for anything related to streets within the community. Article IX, § 14 of the Arizona Constitution stipulates: HURF distribution to …incorporated cities and towns to be used by them solely for highway and street purposes including costs of rights of way acquisitions and expenses related thereto, construction, reconstruction, maintenance, repair, roadside development, of county, city and town roads, streets, and bridges and payment of principal and interest on highway and street bonds.

Per the Town's budget, actual HURF funds received in FY2021 total $250,000. The estimated HURF funds for FY2022 is $261,000. The amount of these funds limits the Town's ability to use HURF funding for major projects while still performing needed routine street pavement maintenance.

The program set forth herein at roughly $1 million per year far exceeds available HURF funds. Consequently, the Town needs to allocate general funds or create new revenue sources to accomplish the pavement preservation program in full. Another option is to defer projects until sufficient funds accumulate to complete the work. Project deferral has a negative impact as inflation increases the cost of the work over time.

Sales Tax: The Town of Carefree levies a 3% local sales tax on all retail sales, advertising, and contracting conducted within the Town. This source of funds is available for use on the Town's street system with the approval of Town Council for such expenditures.

Property Tax: The Town of Carefree does not assess a property tax to fund street improvement projects.

Municipal Bonds: Many communities in Arizona have approved and use municipal bonds that are supported through a secondary property tax or sales tax to create a revenue stream to support their street improvement projects. Carefree has historically desired to minimize the size of government and the associated services and does not have a secondary property tax or sales tax for street improvements.

MAG, State, and Federal Grants: Additional funding may be available through MAG, state, and federal grants and loans. The federal government allocates a certain amount of grant money annually for roadway improvements on streets that are part of the federal highway system.

The Metropolitan Association of Governments (MAG) is the regional transportation planning authority. They have a variety of funds to support transportation projects. The Town has unsuccessfully applied for MAG Road Safety Funding several times recently but were not awarded funding due to the limited number of serious injury and fatal crash incidents reducing the overall benefit/cost ratio.

The Arizona Department off Transportation (ADOT) has various programs that can provide funding for street improvements. Like the federal government, these are primarily targeted for functionally classified streets other than local streets. ADOT occasionally has had special funding distributions to communities for special purposes like the relatively recent additional HURF fund distribution to partially offset the past sweeps of HURF funds by the State Legislature.

SYNOPSIS

This pavement preservation program establishes a prioritization of the public streets network to ensure the limited funds are appropriately spent to optimize the use of those funds. This approach divides the respective street preventative maintenance projects into a 10-year program. The size and timing of the fiscal year projects can be adjusted as needed based upon the availability of funding.

The Town began a pavement maintenance program in 1998. That program and subsequent programs implemented have resulted in an overall higher level of service for the street system. The on-going program has also been effective in minimizing and deferring the need for complete pavement reconstruction which is the costliest rehabilitation method.

The analysis of pavement conditions utilizing RoadBotics™ software provides the Town with a convenient on-line method of viewing their street pavements from anywhere at any time supplemented by both visual and objective data to evaluate street conditions. Periodic reassessment of the streets is recommended at an interval of every 5-years to maintain relatively current data and to better monitor performance of the various pavement treatments that were constructed in the interim.

A comprehensive assessment of all roadway segments was completed based on the condition evaluation from RoadBotics™ and paired with recommended preventive maintenance strategies and costs. All subdivisions and standalone streets were prioritized based on criteria that included the pavement condition rating, street's functional classification, cost of construction, and safety rating based on associated crashes.

Routine preventive maintenance strategies are best applied to streets with no structural distress or significant cracking present. Preventive maintenance is predominately a 'top down' application that focuses on repairing and sealing the pavement surface to extend its life and delay expensive reconstruction for as long a period of time as possible.

The Town can select the highest priority segments to maintain, repair, or reconstruct using the preferred repair strategy and the available funding. This pavement preservation program recommends a 12-year program of improvements to address all the Town's public street network. The program's timing can be adjusted should additional funds be secured through additional regional, state, or federal grant programs or implementation of special property assessments and/or secondary sales tax revenues. Municipal bonds can be utilized as needed to fund major project expenditures

PAVEMENT PRESERVATION PROGRAM