CITY OF LAWTON

PAVEMENT MAINTENANCE PROGRAM GUIDE

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Welcome to the City of Lawton's Pavement Maintenance Program – your comprehensive guide to the ongoing efforts to preserve and improve the City of Lawton's transportation network. At the heart of our mission is the commitment to providing safe, reliable, and efficient transportation infrastructure for all who call Lawton home.

In the bustling heart of Southwest Oklahoma, Lawton is a vibrant and growing community that prides itself on its rich history, diverse culture, and strong sense of community. We understand that well-maintained streets, roads and bridges are vital to our daily lives, connecting us to our workplaces, schools, shopping centers, parks, and neighborhoods. Thus, the City of Lawton is dedicated to ensuring our roadways remain in excellent condition to enhance safety, mobility, and the overall quality of life for our residents and visitors.

This program embodies key True North Culture principles such as Transparency and Trust, Efficiency, and a Commitment to Excellence. Serving as an introduction to our Pavement Maintenance Program, this document outlines our strategies for addressing various pavement issues, from routine maintenance to significant rehabilitation projects. We value open communication and community involvement, and this guide is designed to keep you informed about our ongoing initiatives.

As we embark on this journey to sustain and enhance our infrastructure, we invite you to be an active participant in our shared responsibility for maintaining Lawton's roadways. Your feedback, suggestions, and support are essential to our success, and we encourage you to get involved and stay engaged with our pavement maintenance initiatives. Together, we can ensure that Lawton continues to be a place where the streets are safe and reliable.

Aligned with our pursuit of excellence, we are committed to benchmarking against our peer cities, fostering a culture that is open for business and business progressive. Your partnership is invaluable as we work together to make Lawton an even better place to live, work, and play. We eagerly anticipate the road ahead, filled with collaboration, innovation, and an unwavering commitment to excellence.

Welcome to the journey.

Sincerely,

Stanley Booker
Mayor, City of Lawton

City of Lawton Pavement Maintenance Program Guide

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ABBREVIATIONS

ACC	Asphaltic Cement Concrete
CIP	Capital Improvement plan
CRCP	Continuously Reinforced Concrete Pavement
JCPC	Jointed Plain Concrete Pavement
ODOT	Oklahoma Department of Transportation
PCC	Portland Cement Concrete
PCI	Pavement Condition Index

PAVEMENT MAINTENANCE PROGRAM

INTRODUCTION

The City of Lawton Municipal Pavement Maintenance Program aims to provide a comprehensive framework for preserving, enhancing, and effectively managing the city's transportation infrastructure. The primary objectives of this program are to extend the lifespan of pavements; improve the quality of the transportation network; and to minimize pavement life-cycle costs.

PROGRAM OVERVIEW

This program outlines the strategies, methodologies, and procedures that the City of Lawton will employ to maintain and improve the pavement infrastructure throughout the city. It encompasses a wide spectrum of activities, from routine maintenance to major rehabilitation efforts, and is designed to ensure that the City of Lawton's roadways remain safe, reliable, and conducive to community well-being. This program is largely borrowed from the Oklahoma Department of Transportation's (ODOT) "proven transportation improvement plan".

INCORPORATE ODOT'S "PROVEN TRANSPORTATION IMPROVEMENT PLAN"

Small-scale projects are grouped together based on work type or function. Plans, material quantities, and contracts are then developed based on the individual project groups.

1. PAVEMENT ASSESSMENT

- Data Collection

A critical component of effective pavement management is data collection. The City of Lawton will regularly gather data on pavement conditions, observable traffic volumes, and other relevant parameters to inform decision-making and prioritize maintenance efforts.

- Condition Evaluation

Pavement condition assessments will be conducted to determine the state of the city's roadways, in a methodological, unbiased, technical-based method. Furthermore, we plan to conduct additional pavement forensic analysis (as needed) to determine pavement condition and recommend appropriate pavement treatments. These evaluations will help us identify areas in need of maintenance, rehabilitation, or reconstruction.

- Maintaining the Data

Maintaining pavement data is critical to the long-term success of the management program. The City should establish a centralized, standardized digital database, such as the *Public Works network drive*, for storing and managing pavement condition data. This database will facilitate ongoing evaluation and updates of pavement conditions, ensuring consistency and usability over time.

If contracted services are utilized for data collection, deliverables must adhere to a pre-established, uniform format to avoid time-consuming transcription or data integration issues, especially since different contractors may be engaged for future evaluations.

The use of a reliable, industry-standard database tool is highly recommended to ensure scalability, compatibility, and efficiency in managing the City's pavement data.

Examples of forensic pavement analysis include:

1.1 Measure Pavement Thickness

Coring sections of the pavement can help identify the thickness of the pavement and the condition of the subgrade beyond a visual assessment of a roadway. Sections of areas to cored should be carefully selected, so as to avoid excessive coring of the pavement.

1.2 Material Properties

Laboratory testing of pavement materials, such as asphalt binder content, gradation, and strength, provides objective data on the quality and properties of the materials used in the pavement construction. These tests can indicate life expectancy of the pavement and can drive decision makers to recommend specific maintenance or reconstructions of roadways.

1.3 Load-Bearing Capacity

Objective calculations based on pavement structural design principles, considering the pavement layer properties and the expected traffic loads, provide insights into the pavement's load-bearing capacity.

1.4 Pavement Condition Indices (PCI)

PCI is a numerical value (on a 100-point scale) that quantifies the overall condition of a pavement based on the severity and extent of different distresses. Distresses include cracking, the type/shape of the pavement cracks, potholes, rutting/heaving, depressions, spalling, etc. It is a widely used objective criterion to compare and prioritize maintenance and rehabilitation strategies. This index is also a snapshot in a moment of time. Pavement PCI scores typically decrease over time and are evaluated periodically.

1.5 Visual Appearance

The visual appearance of pavement is an essential aspect of pavement maintenance policy, though it is inherently subjective. This component of the policy considers several factors, including color, texture, and

uniformity. While these elements do not directly affect the structural integrity or functionality of the pavement, they significantly influence public perception and satisfaction. An aesthetically pleasing pavement can enhance the overall appeal of the area, contributing to a positive image for the City of Lawton.

Factors Influencing Visual Appearance:

1. **Color:**
    - **Consistency:** Uniform color across the pavement indicates well-maintained surfaces and proper construction practices. Variations in color may suggest patchwork repairs, wear and tear, or the use of varied materials.
    - **Cleanliness:** A clean pavement free from stains, debris, and discoloration from spills or other contaminants contributes to a better visual appeal.
2. **Texture:**
    - **Surface Smoothness:** A smooth surface without excessive roughness or irregularities indicates good quality and proper maintenance. Uneven texture can detract from visual appeal and suggest neglect or poor workmanship.
3. **Uniformity:**
    - **Seamless Repairs:** When repairs are needed, the goal should be to blend them seamlessly with the existing pavement to avoid noticeable patches that can detract from the overall look.
    - **Regular Maintenance:** Routine maintenance helps maintain uniformity by addressing small issues before they become large, noticeable problems. This includes sealing cracks, filling potholes, and repainting markings.

Benefits of Maintaining Good Visual Appearance:

1. **Public Perception:**
    - A well-maintained and aesthetically pleasing pavement can enhance public trust and satisfaction with the city.
    - It reflects positively on the community, suggesting a commitment to quality infrastructure and public well-being.
2. **Safety and Usability:**

- While visual appearance is subjective, it often correlates with safety and usability. For example, clear markings and a smooth surface improve driving conditions and pedestrian safety.
- A well-maintained appearance can reduce the likelihood of accidents caused by potholes, cracks, or uneven surfaces.

Implementation Strategies:

1. **Regular Inspections:**
    - Conduct regular visual inspections to assess the color, texture, and uniformity of the pavement. Document any changes or issues that need addressing.
    - Use these inspections to schedule routine cleaning, repairs, and maintenance tasks.
2. **Maintenance Best Practices:**
    - Employ best practices for cleaning and maintaining pavements, including pressure washing, stain removal, and debris clearance.
    - Use high-quality materials for repairs to ensure consistency in appearance and durability.
    - Apply sealants and coatings to preserve color and texture and protect against environmental damage.

Key Differences Between Sealants and Coatings

<u>Function</u>

- **Sealants:** Primarily used for filling cracks and providing a protective barrier against water and contaminants.
- **Coatings:** Used to provide a new surface layer that enhances appearance, improves skid resistance, and protects against wear and UV damage.

<u>Material Composition</u>

- **Sealants:** Typically asphalt-based or rubberized materials.
- **Coatings:** Can be acrylic, epoxy, polyurethane, or modified bitumen-based

2. MAINTENANCE STRATEGIES

As the City of Lawton strives to maintain and improve its vital transportation infrastructure, the adoption of effective pavement maintenance strategies becomes paramount. This comprehensive exploration provides insights into preserving and enhancing road surfaces, ensuring prolonged service life and sustainable infrastructure. By navigating through routine preventive measures, advanced rehabilitation techniques, and the integration of technology, the guide aims to equip the city with the knowledge needed to make informed decisions. Addressing distress factors, leveraging innovative materials, and embracing emerging technologies, this resource serves as a valuable tool for Lawton's engineers, policymakers, and industry professionals. The goal is to establish a holistic framework that aligns with the city's evolving needs, fostering the creation of resilient road networks crucial for the well-being and prosperity of the community.

Routine Maintenance

Regular inspections, cleaning, and minor repairs will be carried out to prevent small issues from developing into major problems. This includes activities such as pothole patching and crack sealing.

Preventative Maintenance

Proactive measures, such as surface treatments and sealcoating, will be employed to extend the life of pavements and delay the need for more costly repairs.

Rehabilitation and Reconstruction

In cases where the pavement has significantly deteriorated, rehabilitation or reconstruction projects will be undertaken. These will involve more extensive efforts to restore roadways to optimal conditions or current design requirements.

RECOMMENDED MAINTENANCE OPERATIONS		
RECOMMENDED MAINTENANCE	PCI RANGE	
Routine Maintenance	85	100
Preventative Maintenance	80	85
Surface Treatments/ Localizes and Joint Rehabilitation	60	80
Progressively Thicker Overlays (ACC) Panel Replacement (PCC)	25	70
Partial to Full Reconstruction	0	40

Table 1 Values and recommendations from the IMS Pavement Management Report 2023.

2.1 Routine Pavement Maintenance

Is crucial for preserving the integrity and functionality of roadways. There are several categories of routine pavement maintenance that are typically implemented to address common issues and extend the lifespan of the pavement. These categories include:

1. **Crack Sealing:**
    - *Purpose:* Prevents water infiltration and the expansion of cracks.
    - *Description:* Sealing or filling cracks in the pavement surface to prevent the intrusion of water and the progression of cracks, reducing the risk of further damage.
2. **Pothole Patching:**
    - *Purpose:* Repairs localized pavement failures.
    - *Description:* Filling and patching holes or depressions in the pavement caused by traffic wear, freeze-thaw cycles, or other factors.
3. **Surface Sealing/Overlay:**
    - *Purpose:* Restores surface integrity and provides a new wearing course.
    - *Description:* Applying a thin layer of asphalt or other materials to the existing pavement surface to improve ride quality, skid resistance, and overall durability.
4. **Routine Resurfacing:**
    - *Purpose:* Renews the pavement surface.
    - *Description:* Applying a new layer of asphalt or other suitable material over the existing pavement to address surface distress and restore the road's smoothness.
5. **Shoulder Maintenance:**
    - *Purpose:* Preserves road edge stability.
    - *Description:* Repairing and maintaining the shoulder area to prevent erosion, improve drainage, and ensure the stability of the road edges.
6. **Marking and Striping:**
    - *Purpose:* Enhances visibility and safety.
    - *Description:* Repainting or refreshing road markings, crosswalks, and other pavement +`

7. **Vegetation Control:**
    - *Purpose:* Prevents vegetation from causing pavement damage.
    - *Description:* Managing and controlling the growth of vegetation along roadways to prevent root damage, cracking, and other issues caused by plant intrusion.
8. **Routine Cleaning:**
    - *Purpose:* Removes debris and maintains drainage.
    - *Description:* Regularly cleaning road surfaces to remove debris, leaves, and other materials that can impede drainage and contribute to pavement deterioration.
9. **Joint and Crack Maintenance:**
    - *Purpose:* Addresses issues in pavement joints.
    - *Description:* Maintaining and repairing joints between concrete slabs or cracks in asphalt to prevent further deterioration and ensure a smooth, continuous surface.
10. **Structural Repairs:**
    - *Purpose:* Addresses more significant pavement damage.
    - *Description:* Repairing or replacing sections of the pavement structure that have experienced extensive damage, such as base failures or subgrade issues.
11. **Bridge Deck Washing:**
    - *Purpose:* To remove deicing salts and other debris to prevent corrosion and extend the lifespan of the bridge.
    - *Description:* Washing and rinsing the deicing salt deposits from the bridge deck to prevent the corrosion of the concrete and steel components.

Implementing a comprehensive routine pavement maintenance program that includes these categories helps ensure the longevity, safety, and functionality of roadways. Regular assessments and timely maintenance interventions can significantly extend the life of the pavement infrastructure.

2.2 Preventive Maintenance

Preventative maintenance involves proactive measures to minimize deterioration and extend the life of the road surface. Here are common categories of preventative maintenance for pavements:

1. **Sealcoating:**
    - *Purpose:* Protects against oxidation and water penetration.
    - *Description:* Application of a thin layer of protective coating (usually a coal tar or asphalt emulsion) to the pavement surface to shield it from the effects of weathering, UV rays, and water infiltration.
2. **Surface Treatment:**
    - *Purpose:* Enhances surface durability and skid resistance.
    - *Description:* Applying a thin layer of bituminous material and aggregate to the pavement surface to seal cracks, improve surface texture, and extend the life of the pavement.
3. **Crack Sealing and Filling:**
    - *Purpose:* Prevents water infiltration and stops cracks from spreading.
    - *Description:* Sealing or filling cracks in the pavement to prevent moisture penetration and inhibit the expansion of cracks, reducing the likelihood of further damage.
4. **Pavement Preservation:**
    - *Purpose:* Slows down the aging process and maintains pavement integrity.
    - *Description:* A comprehensive approach that combines various treatments, such as sealcoating, crack sealing, and surface treatments, to preserve and extend the life of the pavement.
5. **Chip Seal:**
    - *Purpose:* Seals the surface and improves skid resistance.
    - *Description:* Placing a layer of asphalt emulsion on the pavement surface and covering it with aggregate, creating a sealed surface that protects against moisture and enhances skid resistance.

1. **Joint and Crack Resealing:**
    - **Purpose:** Extends the life of joints and cracks.
    - **Description:** Involves the removal of existing sealant material from joints and cracks in concrete pavement, followed by the application of new sealant. This helps prevent water infiltration and extends the life of the pavement.

6. **Diamond Grinding:**
    - *Purpose:* Restores ride quality and corrects surface irregularities.
    - *Description:* Grinding the pavement surface using diamond-tipped blades to remove irregularities, improve ride quality, and extend the life of the pavement.

Implementing preventative maintenance practices helps minimize the impact of aging and environmental factors on pavement, ensuring cost-effective and sustainable road infrastructure. Regular inspections and timely application of preventive measures are key to maximizing pavement longevity.

2.3 Localized and Joint Rehabilitation

1. **Full-Depth Repair:**
    - **Purpose:** Addresses extensive pavement damage.
    - **Description:** Involves the removal and replacement of the entire pavement section, including the subbase. This is used for areas with severe structural damage or base failure.
2. **Partial-Depth Repair:**
    - **Purpose:** Addresses localized pavement distress.
    - **Description:** Involves the removal and replacement of a portion of the pavement, typically down to the depth of the concrete or asphalt layer. It is used for specific areas with surface distress or localized damage.
3. **Joint Sealing:**
    - **Purpose:** Preserves joints in concrete pavements.
    - **Description:** Seals joints in concrete pavements to prevent water infiltration, reduce the risk of joint deterioration, and extend the life of the pavement.
4. **Diamond Grinding:**
    - **Purpose:** Restores ride quality and corrects surface irregularities.
    - **Description:** Uses diamond-tipped blades to grind the pavement surface, removing irregularities and improving ride quality. It is effective for smoothing out bumps, ruts, and other surface imperfections.

Implementing a combination of these surface treatments and localized/joint rehabilitation techniques is essential for maintaining a resilient and long-lasting pavement infrastructure. Regular assessments and timely interventions contribute to the overall effectiveness of pavement maintenance programs.

2.4 Progressively Thicker Overlays (ACC)

1. **Thin Overlay:**
    - **Purpose:** Corrects surface irregularities and provides a thin protective layer.
    - **Description:** Application of a thin layer of new Asphaltic cement concrete (typically 1 to 2 inches thick) over the existing pavement surface. It helps smooth out surface imperfections, improves ride quality, and provides a protective layer.
2. **Medium Overlay:**
    - **Purpose:** Addresses more significant surface distress and improves structural capacity.
    - **Description:** Application of a thicker layer of Asphaltic cement concrete (typically 2 to 4 inches thick) over the existing pavement. This type of overlay is suitable for addressing moderate levels of distress, such as rutting, cracking, and surface wear.
3. **Thick Overlay:**
    - **Purpose:** Provides a new wearing surface without enhancing structural capacity.
    - **Description:** Application of a relatively thick layer of Asphaltic cement concrete (typically 4 inches or more) to renew the wearing surface. This type of overlay is not intended to enhance the structural capacity but rather to provide a fresh and durable surface.

2.5 Panel Replacement (PCC)

1. **Partial-Depth Panel Replacement:**
    - **Purpose:** Addresses localized distress in the upper layer of the concrete.
    - **Description:** Removal and replacement of a portion of the concrete slab, typically limited to the upper layer experiencing distress. It is suitable for addressing surface-related issues without affecting the full depth of the pavement.
2. **Full-Depth Panel Replacement:**
    - **Purpose:** Addresses extensive distress throughout the entire concrete slab.
    - **Description:** Removal and replacement of the entire concrete panel, including the full depth of the pavement structure. This method is used when the pavement experiences severe distress or structural issues that require comprehensive rehabilitation.
3. **Jointed Plain Concrete Pavement (JPCP) Reconstruction:**
    - **Purpose:** Complete reconstruction of jointed concrete pavement.

- **Description:** Involves the removal of the existing jointed concrete pavement, including the underlying layers, and the construction of a new pavement structure. This approach is taken when the existing pavement is beyond repair, and complete reconstruction is necessary.

4. **Continuously Reinforced Concrete Pavement (CRCP) Reconstruction:**

    - **Purpose:** Complete reconstruction of continuously reinforced concrete pavement.
    - **Description:** Similar to JPCP reconstruction but specifically addresses continuously reinforced concrete pavement. It involves the removal of the existing CRCP and the construction of a new pavement structure.

Implementing progressively thicker overlays for ACC and panel replacement for PCC are strategic approaches to pavement rehabilitation, ensuring that maintenance interventions align with the severity of distress and structural requirements. These methods contribute to the overall durability and longevity of the pavement infrastructure. Regular assessments and effective rehabilitation strategies are essential components of a comprehensive pavement management plan.

3. ROADWAY SEGMENT SELECTION AND PRIORITIZATION

Criteria for Project Selection

A clear set of criteria will be used to prioritize pavement maintenance projects, considering factors such as pavement condition, observable traffic volumes, and equity across the City of Lawton.

1. **PCI Range 35 to 65 (Rehabilitation) 0 to 40 (Reconstruction) General Guidelines**
   Prioritization of pavements will be given to those that have received a Pavement Condition Index (PCI) score of 35 to 65 given by The Infrastructure Management services (IMS) field analysis report. The PCI score range of 35 to 65 can be broken up into three categories fair, marginal and poor.
    - Poor PCI Score 35-40
        - Greater area of severe alligator cracking, rutting, requires major reconstruction/rehabilitation
    - Marginal PCI Score 40-50
        - Smaller localized area but still contains severe alligator cracking and rutting, requires major habilitation
    - Fair PCI Score 50-65
        - Moderate severity of load distresses, severe transverse, and longitudinal cracking
        - Requires localized repairs or major rehabilitation

2. **Observable/Noted Traffic Volumes**

The points system used for these metrics will be categorized by roadway classification. Principal arterials will show consistently higher volumes of traffic as opposed to collectors and residential roadways. (if no traffic data is available all segments considered should be given 1-point)

3. **Critical Facility (i.e. hospitals, schools)**

Indicates distance (in miles) between the segment and a designated Critical facility.

- Hospital
  - Southwestern Medical Center, Commanche County Memorial Hospital, Lawton Indian Hospital
- Schools
  - Elementary schools, Central Middle School, Eisenhower Middle School, MacArthur Middle School, Lawton High School, MacArthur High School, Eisenhower High School

4. **Priority Record**
   - 5-points: Segment has been consistently highlighted in plans, have a high volume of public complaints.
   - 3-points: Important but may not have as immediate a need or impact as high-priority roads.
   - 1-point: minimal strategic importance or those in better condition compared to others, meaning they can wait longer for repairs
5. **PCI Record**
   - 5-Points: Indicates the rapid deterioration or consistently poor condition.
   - 3-Points: indicates moderate change.
   - 1-Point: indicates negligible signs of deterioration.

     (Documented pictures/ records from prior years)
6. **Repair Records**
   - 5-Points: Indicates the road is in poor condition despite previous efforts, requiring significant and ongoing maintenance.
   - 3-Points: Indicates the road has some issues that have required attention, but not as severe or frequent as higher-scoring segments.

- 1-Point: Indicates the road is relatively stable and has not required much maintenance, suggesting better overall condition or less critical issues

3.1 Priority Areas

The City of Lawton's Pavement Maintenance Program will identify priority areas for immediate attention, ensuring that the most critical needs are addressed promptly. The logic employed in this prioritization aims to maximize the impact of maintenance efforts, considering factors such as pavement condition, traffic volume, and budget constraints. The following key principles will be utilized to help guide the decision-making process.

1. **Pavement Condition Assessment:**
    - Conduct a comprehensive evaluation of the current pavement condition using advanced assessment techniques, such as pavement condition index (PCI) surveys.
    - Prioritize streets with the highest deterioration rates or those exhibiting severe distress to address urgent maintenance needs.
    - Perform targeted pavement forensic analysis on specific pavement segments to collect essential data points for in-depth assessment.
2. **Traffic Volume and Functional Classification:**
    - Analyze traffic volume data to identify streets with high vehicular and pedestrian activity.
    - Consider the functional classification of streets, emphasizing major arterials and collector roads that play a crucial role in the overall transportation network.
3. **Cost-Effectiveness:**
    - Optimize resource allocation by prioritizing streets where maintenance interventions are cost-effective and yield long-lasting results.
    - Consider bundling maintenance projects in geographically clustered areas to minimize mobilization costs.
4. **Budget Constraints and Funding Availability:**
    - Consider available budgetary constraints and funding sources to develop a realistic and sustainable maintenance plan.
    - Explore innovative financing options and form coalitions with Comanche County and Tribal nations to augment resources.

PAVEMENT CONDITION INDEX (PCI) SCALE			
Category	PCI Range		Typical Pavement Characteristics
Excellent	85	100	Like New
Very Good	70	85	Minor Cracking
Good	60	70	Minor to Moderate Cracking
Fair	50	60	More Extensive Cracking
Marginal	40	50	Localized high-severalty alligator cracking rutting
Poor	25	40	A greater extent of severe alligator cracking, rutting
Very Poor	0	25	Extensive and severe alligator cracking, more extensive and deeper rutting, and potholes

Table 2 Pavement Condition Index values from the IMS Pavement Management Report 2023.

4. PROJECT IMPLEMENTATION

Planning and Design

Projects will need to be meticulously planned and designed to minimize disruptions, optimize quality, and adhere to sustainability standards. Projects should be grouped into their respective pavement classifications i.e., Portland Cement Concrete (PCC) and Asphaltic Cement Concrete (ACC). Each pavement classification will categorized into one of the following categories and determined by the type of maintenance it will require.

Project Categories Examples:

Preventative Maintenance (Routine)

- Crack / Joint sealing
- Chip seal
- Fog seal
- Bridge deck washing

Special Maintenance (Infrequent)

- Bridge deck sealing
- Pothole repairs

5. QUICK TURN-AROUND ON SMALL-SCALE PLANS:

The following items will be typical of small-scale plan sets for efficient development of pavement maintenance projects.

- Title sheets with Centerline Miles and Segment Locations
- Typical pavement section illustration(s), if needed
- Typical detail of asphalt or subgrade patch repair
- Pay item quantities list and descriptions
- Pay quantity and construction notes
- Pavement summary sheets

Standard contract documents with any specific instructions to contractors (timing, notifications, road/lane closures, disposal of millings, utility adjustments, soft spot action plans, vegetation clearing, materials testing and payment, etc.

Project scheduling and timing considerations should include the following components.

- Develop list of project locations
- Internal coordination with City Departments (1 week)
- Initial engineers' opinion of construction costs (1 week)
- Streets, Roads and Bridges Committee approval (Scheduled)
- City Council approval of selected streets and authorization to initiate design (Scheduled)
- Development of Plans, Specifications, and Estimate (Time contingent of complexity)
- City Council authorization to advertise project. (Scheduled)
- Project advertising period (minimum of 21 days)
- Open bids (1 day)
- Perform bid tab analysis (1 day)
- City Council approve contract (Scheduled)
- Notice-to-Proceed

6. CONSTRUCTION MANAGEMENT:

Thorough project management and oversight will ensure that all projects are executed efficiently, and the contractors have performed the work as defined in the plans and technical specifications.

6.1 Quality Assurance (QA)

- Qualified Construction Inspection staff to enforce the quality outlined in the plans and contract specifications.
- Develop specifications detailing materials to be used and construction methods contractors will observe.
- Responsible documentation of the work performed to ensure correct and timely payment to the contractor.
- Updating records and project files associated with each project (i.e. roadway segment) to include:
  - Material certificates
  - Material tickets
  - Mix designs and test reports
  - Computations to validate material quantities installed
  - Inspection reports
  - As built/record drawing notations
  - Warranty inspection and repair follow-up

6.2 Follow Applicable Standards

The Construction Standards Component of the City of Lawton's Pavement Maintenance Program outlines the specifications and guidelines to ensure the consistent and high-quality implementation of pavement maintenance projects within the municipality. These standards aim to enhance the longevity, safety, and overall performance of the city's road infrastructure.

6.2.1 Materials and Specifications:

Asphaltic cement concrete (ACC):

- Use of materials compliant with Oklahoma Department of Transportation (ODOT) for hot-mix asphalt.
- Minimum thickness specifications based on traffic load and pavement type.
- Adherence to Marshall Mix Design for optimal durability.

6.2.2 Tack Coat

- Do not apply tack coat during cold, wet, or windy conditions as it causes the tack coat emulsion to drift.

Apply the tack coat rate as shown in Table 3, unless otherwise required by contract. Alter the application rate as directed by the Engineer (based on weather and surface type of layer). Use the highest rate in Table

3 for the surface type or layer (top or bottom). Ensure that the tack breaks before the application of the next surfacing layer.

Tack Application Rates		
Surface Type/Layer	Original Emulsion gal/yd^2 [L/m^2]	Residual gal/yd^2 [L/m^2]
New Asphalt (bottom)	0.060 [.270]	0.035 [0.160]
Old Asphalt (bottom)	0.085 [0.385]	0.050 [0.255]
Milled (bottom)	0.085 [0.385]	0.050 [0.255]
New Fabric (bottom)	-	0.200 [0.905]
PFC, OGFSC (top)	0.100 [0.455]	0.060 [0.270]
UTBWC (top)	0.200 [0.905]	0.120 [0.545]
PCC (bottom)	0.075 [0.340]	0.045 [0.205]

Table 3: Tack Application Rates, Values from ODOT specs 2019

Method of Measurement:

The Construction Inspector, or designee will measure the volume of Emulsion for Fog Seal, Tack Coat, and NT Tack - Material as delivered, before dilution. The Construction Inspector, or designee will measure bituminous material by gallon [liter] or ton [metric ton].

6.2.3 Concrete Pavement:

- Comply with Oklahoma Department of Transportation (ODOT) for Portland Cement.
- Minimum compressive strength requirements based on anticipated traffic loads.
- Reinforcement specifications according to ACI 360 for long-lasting performance.

Provide Portland cement concrete in accordance with AASHTO M 85 except as modified by the following:

- Ensure the tricalcium aluminate (C3A) content in Type I cement does not exceed 15 percent.
- Report the amount of Portland cement concrete retained on the No. 325 [45 µm] sieve in accordance with AASHTO T 192 on mill test reports.
- Ensure the total equivalent alkalis does not exceed 0.95 percent. The Construction Inspector, or designee may waive this limit on a per project basis if the proposed concrete mix design meets the expansion limits in Option R of ASTM C 1157 when tested in accordance with ASTM C 1260.
- Provide Type IV and Type V cements that meet the optional physical requirements.
- Supply supporting data for cement provided under optimum SO3 requirements, as described in footnote of Table 1 of AASHTO M 85.

6.2.4 of Concrete

Class AA. Use Class AA in superstructures.

Class A. Use Class A concrete for pavements and substructures (pier caps, columns, abutments, retaining walls, and reinforced concrete not requiring Class AA concrete).

Class AP. Use Class AP concrete in shoulders, merge area, and gore areas for Portland cement concrete (PCC) pavements.

Class C. Use Class C concrete for soil erosion control structures.

Class P. Use Class P concrete for precast prestressed concrete members.

Concrete Classes					
Class of Concrete	Minimum Cement Content, lb/yd^3 [kg/m^3]	Air Content %	Water/Cement Ratio[a], Lb/lb [kg/kg]	Slump[b] In [mm]	Minimum 28-day Compressive Strength[c] psi [MPa]
AA	564[335]	6.5 ± 1.5	0.25-0.44	2±1 [50 ± 25]	4,000 [27.6]
A	517 [307]	6 ± 1.5	0.25-0.48	2±1 [50 ± 25]	3,000 [20.7]
AP	470 [279]	6 ± 1.5	0.25-0.48	2±1 [50 ± 25]	3,000 [20.7]
C	395 [234]	6 ± 1.5	0.25-0.62	2±1 [75 ± 25]	2,400 [16.5]
P	564 [335]	5 ± 1.5	0.25-0.44	2±1 [75 ± 25]	As required by the contract

Table 4: Concrete Classes, Values from the ODOT Specs 2019

Concrete Classes
[a] Use the weight of each material to calculate the water to cement ratio (W/C) using the following equation: W/C = Water/ (Cement + Cement Substitutes) Determine the water use by adding the water measured into the batch, the water used in admixtures, and the free water on wet aggregate and subtracting the water absorbed by dry aggregate. [b] Ensure the slump reflects a workability appropriate for the application. If using a high-range water-reducing admixture, limit the slump to a maximum of 9 in [230 mm] provided no segregation occurs. [c] Compressive strength is based on the average of the results of three test cylinders. The contract documents specify Class P concrete compressive strengths.

Ensure Class A concrete for paving has flexural strength of at least 650 psi [4.5 MPa] at 28 days or 700 psi [4.8 MPa] at 56 days. Determine the flexural strength at the mix design stage and obtain certification from the concrete supplier

Table 5: Concrete Classes Values from the ODOT Specs 2019

6.2.5 Cement Substitution

- Will allow a substitution of a portion of the cement content at the concrete batch plant.
- Provide cement substitutes in accordance with ODOT standard specifications (2019) Section 702, "Supplementary Cementitious Materials." Make cement substitutions on a one-to-one basis by weight [mass] in accordance with Table 6, ODOT Table 701:2. Refer to Subsection 701.02.A(1), "Portland Cement," for Portland cement specifications.

Cement Substitutes for Portland and Hydraulic Cement	
Cement Substitutes	Maximum Percent by weight [Mass]
Fly ash or pozzolans only	20
Slag cement only	50
Silica Fume only	10
Combination of fly ash or pozzolans, and silica fume	30
Combination of fly ash or pozzolans, slag cement, and silica fume	50

Table 6: Cement Substitutes, Values from ODOT 2019

6.2.6 PCC Fine Aggregate

- This subsection covers fine aggregate quality and size for PCC pavements or bases, highway, bridges, and incidental structures. Provide mortar sand in accordance with AASHTO M 45.
- Provide fine aggregate that consists of a single-source natural sand in accordance with AASHTO M 6, Class A.

- Provide fine aggregate with a fineness modulus between 2.3 and 3.1, that is well graded from coarse to fine, and when assessed in accordance with AASHTO T 27 and AASHTO T 11 meets the requirements from Table 7.

Fine Aggregate Gradation	
Sieve Size	Percent Passing %
$^{3}/_{8}$ in [9.5 mm]	100
No. 4 [4.75 mm	95 - 100
No. 8 [2.36 mm]	80 - 100
No. 16 [1.18 mm]	50 - 85
No. 30 [600 µm]	25 - 60
No. 50 [300 µm]	5 - 30
No. 100 [150 µm]	0 - 10
No. 200 [75 µm]	0.0 - 3.0

Table 7: Fine Aggregate Gradation, Values from ODOT Specs 2019

The graduation requirements specified in Table 7 above represent the extreme limit of suitability. Ensure the gradation from one source does not have substantial changes in percentage of gradation. Use the average fineness modulus to determine the uniformity of the fine aggregate. The average fineness modulus is the average of the last tests by the Engineer and maintained by his office. The Engineer will not accept fine aggregate represented by a test result with a fineness modulus that deviates more than 0.20 from the average. Find the aggregate modulus dividing by 100.

- No. 100 [150 µm],
- No. 50 [300 µm],
- No. 30 [600 µm]
- No. 16 [1.18 mm]
- No. 8 [2.36 mm],
- No. 4 [4.75 mm],
- $^{3}/_{8}$ in [9.5mm].

6.2.7 PCC Coarse Aggregate

- This subsection covers coarse aggregate quality and size for use in PCC pavements or bases, highway bridges, and incidental structures.
- Provide coarse aggregate in accordance with AASHTO M 80, Class A, consisting of crushed gravel or stone, or when approved by Engineer in writing, a combination of crushed gravel or stone from various sources.

Coarse Aggregate Gradation					
Sieve Size	Percent Passing per processed Aggregate Size Number				
	No.357	No.57	No.67	No.7	No.8
2 ½ in [63 mm]	100	-	-	-	-
2 in [50 mm]	95 – 100	-	-	-	-
1 ½ in [37.5 mm]	-	100	-	-	-
1 in [25 mm]	35 – 70	95 – 100	100	-	-
¾ in [19mm]	-	-	90 – 100	100	-
½ in [12.5mm]	10 – 30	25 – 60	-	90 – 100	100
$^{3}/_{8}$ in [9.5mm]	-	-	20 – 50	40 – 70	85 – 100
No. 4 [4.75mm]	0	0- 10	0 – 10	0 – 15	10 – 30
No. 8 [2.36mm]	-	0 – 5	0 - 5	0 – 5	0 – 10
No.16[1.18mm]	-	-	-	-	0 – 5
No. 200[75µm]	0 – 1.5	0 – 2.0	0 – 2.0	0 – 2.0	0 – 2.0

Table 8 : Coarse Aggregate Gradation, Values from ODOT Specs 2019

Provide the specified sizes of coarse aggregate for the following types of concrete:

- No. 57 for Class A and Class AP concrete.
- No. 357 for massive Class A concrete.
- No. 57, No. 67, or No. 357 for Class C concrete.
- No. 7 or No. 8 for thin overlays, details, and thin sections if allowed by the Engineer.
- No. 67 for Class AA or Class P concrete; and
- No. 57, No. 7 or No. 8 for Class P concrete if the specified 28-day compressive strength is greater than 6,000 psi [41.4 MPa] or the Contract requires permeability limits.

Surface Treatment:

- Application of approved sealants and surface treatments for enhanced protection against environmental elements.
- Compliance with Oklahoma Department of Transportation (ODOT) for cationic emulsified asphalt.

6.2.8 Construction Practices:

Subgrade Preparation:

- Ensure proper compaction and grading of the subgrade to achieve optimal load-bearing capacity.
- Implementation of moisture control measures to prevent subgrade erosion.

Pavement Installation:

- Strict adherence to project-specific plans and specifications.
- Quality control measures during the laying and compaction phases to achieve desired density.

Joint Construction:

- Proper construction and sealing of joints in concrete pavements.
- Implementation of best practices to minimize the risk of joint failure.

Traffic Management:

- Development and implementation of a comprehensive traffic control plan during construction activities to ensure public safety.
- Coordination with relevant authorities to
- Minimize disruptions and optimize traffic flow.

6.2.9 Quality Assurance and Testing:

Materials Testing:

- Regular testing of construction materials to verify compliance with established standards.
- Independent laboratory testing for asphalt mix designs and concrete strength.

Field Quality Control:

- On-site inspections and quality control measures throughout the construction process.
- Immediate correction of any deviations from approved plans and specifications.

6.3 Striping

6.3.1 Traffic Stripe Paint- Acrylic Waterborne

- Applies waterborne yellow and white traffic paint on PCC, asphaltic concrete or existing traffic striping composed of waterborne, solvent-based paint or thermoplastic compounds. Acrylic Waterborne paint is applied with spray equipment, applications temperatures are required from 50°F to 150°F [10°C to 66°C]. Provided that the paint receives and holds glass beads to produce reflectorized traffic markings.

Materials

- Paint is to be free of lead and chromium with a limited quantity of Volatile Organic Compounds (VOC). Provided finished paint formulated and manufactured from first-grade material listed in the standard formula. The Engineer must approve alternative materials before manufacture. Verify proposed materials equal the quality, composition, physical, and chemical behavior of the materials listed on standard formula after aging the finished product.

Pigment Composition

Acrylic Waterborne Pigment Composition		
Material	White	Yellow
Organic Yellow (65%) [a]	--	≥4.8
Titanium Dioxide	≥13.4%	≥2.6%
Calcium Carbonate	≤86%	≤93%
[a] To be determined by x-ray florescence, color spectrophotometry. This may be sent to an outside agency or organic pigment manufacturer. It also may include audit of the manufacture's invoices, batch tickets, inventory or other means determined by ODOT.		

Table 9: Acrylic Waterborne composition, Values from ODOT specs 20

Construction Methods

- Sweep the pavement area of foreign material ensuring maximum adhesion of paint.
- Apply the material to the pavement area at a wet firm thickness of 15 mils [0.381mm]. Evenly distribute a minimum of 6 lb of beads per gallon of wet paint [719 kg per cubic meter], unless otherwise specified by the Engineer. Use an automatic bead dispenser attached to the striping machine to immediately and uniformly dispense the beads on the completed paint line.
- Do not apply the traffic stripe paint on wet pavement. Apply traffic stripe when air temperature is 50°F [10°C] and rising.

No-tracking time field Test

- "No tracking" as the period when the line dries so a vehicle can run over the line at 40 mph [64 km/h] without tracking the reflectorized line when views from 50 ft [15 m away].
- Dry the paint to a non-tracking condition in no greater than 3 min if applied at 17 mil ± 1 mil [432 µm ± 25 µm] wet film thickness plus 45 lb/ft^3 [719 kg/m^3] of glass beads at the specified application temperature.

Dry through time

- Determine the dry through time in accordance with ASTM D 1640. The pressure exerted is the minimum amount to maintain contact with the film and thumb.
- Apply the paint to a non-absorbent substrate at a wet film thickness from 17 mil ± 1 mil [432 µm ± 25 µm]. Place the paint in a humidity chamber controlled 90 ± 5 percent relative humidity, from 72.5°F ±2.5°F [22.5°C ±1.4°C].

Method of Measurement

- The Engineer will measure the length of traffic stripe using a 4 in [100 mm] standard width.
- For traffic stripes narrower or wider than 4 in [100mm], the Engineer will make a proportional adjustment based on the 4 in [100 mm] standard width. The Engineer will measure arrows, words, and symbols by each unit, while counting arrows by each head.

Physical Properties

Acrylic Waterborne Physical Properties	
Property	Value
Total solids by weight [mass]	≥73%
Volume Solids	≥58%
Pigment by weight [mass]	49 – 54%
Vehicle by weight [mass]	46 – 51%
Non-Volatile in vehicle by weight [mass]	≥44%
Weight [mass] per unit volume, from theoretical	±0.3 lb/gal [±36 g/L]
Viscosity at 77°F [25°C]	83 KU – 98 KU
Grind (Hegman Gage)	≥3
Laboratory dry time, ASTM D 711	≤10 min
Dry through time	≤ 15 min of Standard Formula`

Table 10: Acrylic Waterborne Physical Properties, Values from ODOT Specs 2019

6.3.2 Traffic Strip (Thermoplastic)

- Thermoplastic consists of placing reflectorized pavement markings on Asphaltic cement concrete and Portland cement concrete surfaces.

Thermoplastic Composition			
Component	Test Method	White [1]	Yellow[1]
Binder	--	20% min	20% min
Titanium Dioxide TIO2, Type II Rutile	ASTM D476	10% min	-
Glass Beads	AASHTO T 250	40% min	40% min
Yellow Pigment	-	-	% min per Manufacturer
Calcium Carbonate and Inert Filler (-200 mesh sieve)	-	30% max	37.5% max
[1] Percentages are by weight			

Table 11: Thermoplastic Composition, Values from ODOT Specs 2019

Provide an alkyd/maleic binder consisting of a mixture of synthetic resins (requiring at least one synthetic resin must be solid room temperature) and have high boiling point plasticizers. One-half of the binder required must be 100% maleic-modified glycerol of rosin, while being no less than 15% by weight of the entire material formulation.

Construction Methods

Surface Preparation

- Remove foreign material from the road surface before applying plastic marking material ensuring the pavement surface is dry.
- For new PCC pavement, clean the pavement at stripe locations to remove curing compound at a minimum 1” beyond the width of the marking.
    - After removing curing compound, sweep and use high-pressure air spray. Perform curing compound removal at least 7 days after placing the new PCC pavement, unless otherwise stated by the Engineer.
- On ACC and PCC surfaces older than 12 months with existing or removed pavement markings apply a 50/50 blend of a two-part epoxy primer sealer to the area to be striped. Use a primer sealer compatible with the plastic striping material and pavement surface.
- Correct pavement markings that are non-uniform or not visible as direct by the Engineer.
- Obtain written approval from the Engineer before placing plastic markings over longitudinal joints.

- Use abrasive blasting or grinding to remove existing, temporary, or permanent traffic markings until at least 95 percent if the underlying pavement is visible, unless otherwise mentioned by the manufacture. Minimize interference between temporary pavement marking and the permanent dual-component pavement marking materials.
- When applying dual component markings to new PCC pavement, use high-pressure water jet, sandblasting, or other methods approved by the Engineer, to remove existing curing compound. Remove the curing compound at least 1 in [25 mm] beyond the width of the marking. Sweep and use a high-pressure air spray after removing the curing compound.

Application of Markings

When temperatures and conditions are not met to the installation of permanent pavement markings within the specified time period. The Engineer may allow and accept the installation of temporary pavement markings instead of permanent pavement markings. Maintain the temporary markings until temperatures and conditions are suitable for permanent striping.

Hot-Applied plastic Pavement Markings

- Use the extrusion method for hot applied pavement markings. Ensure the lines have sharp edges, uniform thickness, good adhesion, and uniform high reflectance. In accordance with the manufacturer's recommendations, melt the compound and install it at temperatures from 400 °F to 450 °F [204 °C to 232 °C], measured at the pavement surface.
- Apply hot thermoplastic markings on clean, dry pavement markings with a surface temperature of at least 55 °F [13 °C] and rising, and wind chill temperature of at least 45 °F [7 °C].
- The drying time for pavement markings as the minimum elapsed time after application when the stripe retains its reflectivity, shape and traffic will not damage the stripe. The City of Lawton defines minimum drying times in accordance with the following, at a maximum relative humidity of 70 percent and air temperature of 50 °F [10 °C]:
    - For stripes 188 mil [4.76] thick, 2 min; and
    - For stripes 70 mil [1.78 mm] thick, 1 min.
- Mix and apply thermoplastic pavement marking material to ensure that stripes retain the original characteristics of the bond to the surface, resistance to distortions by traffic of climate, and resistance to discoloration.
- Ensure the thickness of the dry thermoplastic material in accordance with Table 12.

Thermoplastic Specified Line Thickness		
Description	Standard line thickness, mil [mm]	Thin line thickness, mil [mm]
Lane and stop lines	120-188 [3 – 4.8]	70 – 125 [1.8 – 3.2]
Edge, gore, and diagonal lines	90 – 188 [2.3 – 4.8]	70 – 125 [1.8 – 3.2]
Words, arrows, and symbols	120 – 188 [3 –4.8]	70 – 125 [1.8 – 3.2]

Table 12: Thermoplastic Specified Line thickness, Values from ODOT Specs 2019

Cold-Applied Plastic Pavement Markings.

- For preformed pavement markings of reflectorized plastic material cold-applied to the pavement surface, coat with a factory-applied, pressure sensitive adhesive
- Apply the material to ACC and PCC surfaces in accordance with the manufacturer's recommendations when the surface temperature is at least 65 °F [18 °C] and rising. If applying the markings at surface temperatures from 65 °F to 50 °F [18 °C to 10 °C], apply the markings in accordance with the manufacturer recommendations, other special instructions, or both.
- Do not use heat, solvents, or extra adhesives to apply the reflectorized plastic markings, except for the surface sealers on PCC surfaces as required by the Contract.

Inlaid Installation of Preformed Plastic Tape

- Apply the marking on newly installed compacted ACC pavement, when pavement temperature is from 125 °F to 155 °F [52 °C to 68 °C].
- Use a mechanical roller to inlay the markings into the ACC surface. Ensuring the mechanical roller inlays the marking to a depth from 65 percent to 80 percent of the plastic tape thickness.

Application of Glass Beads

- Apply large glass beads at a coverage rate of at least 10 lb per 100 ft^2 [4.5kg per 10 m^2] before applying standard beads. Apply standard glass beads at coverage rate of at least 10 lb per 100 ft^2 [4.5 kg per 10 m^2]. For transverse and hand-machine applied markings, use a single drop of large beads at a rate of at least 10 lb per 100 ft^2 [4.5 kg per 10 m^2].

Retro reflectivity

- Measure stripes with a portable or mobile reflectometer that uses 30 m geometry in accordance with ASTM E 1710 and manufacture recommendations. Ensure the manufacturer calibrates the reflectometer annually. Keep the annual calibration certification with the reflectometer.
- Ensure longitudinal marking meets the minimum retro-reflectivity requirements within Table 13.

Minimum Retro-reflectivity			
White		Yellow	
mcd/m^2/lx	Contract unit price adjustment	mcd/m^2/lx	Contract unit price adjustment
≥ 450	100%	≥ 300	100%
400 - 449	75%	275 – 299	75%
250 - 399	50%	225 – 274	50%
< 250	Remove and replace	< 225	Remove and replace

Table 13: Minimum Retro-reflectivity, Values from ODOT Specs 2019

Measurement

- Measure retro reflectivity of markings within thirty (30) calendar days of placement, after removing loose beads.
- Measure marking retro reflectivity in the direction of traffic, will allow yellow skip lines to be measured in either direction of traffic. One measurement (multiple readings) will represent each 2,500 ft [762 m] lot of a single-color longitudinal stripe. Will not allow readings for adjacent lots to be taken closer than 1,000 ft [305 m] from each other.
- For solid longitudinal stripes, one measurement represents the average of five readings per lot, taken at 3 ft [1m] intervals along a randomly selected 15 ft [4.5 m] section of solid stripe.
- For longitudinal skip stripes, one measurement represents the average of six readings per lot, two readings taken from each of three adjacent skip stripes. The Department of Transportation will not allow readings taken within the first or last 1 ft [0.3m] of skip stripes.
- For non-compliant measurements, the Engineer will require measurements to determine the extent of non-compliance.
- The City of Lawton does not require measurements of the following.
    - Stop bars, crosswalks, gores, words, symbols.
    - Longitudinal striping installed using hand line machines.
    - Projects less than 1 mi (1.6 km) long

Acceptance

- Submit final retro reflectivity measurements to the Engineer for acceptance. Include the time and date of reflectometer calibration, location (GPS coordinates), line color, and date of each measurement. The City of Lawton considers unmeasured stripes as non-compliant. The Engineer will notify of any non-compliance with the minimum retro reflectivity values.
- Measurement of retro reflectivity will take place with a Delta Light & Optics, Model LTL X portable reflectometer. The Contractor and The City of Lawton differ by greater than 10 percent, The City of Lawton will use its measurement for acceptance. The Engineer may accept striping quantities less than 2,500 ft [762 m] by visual inspection.

Method of Measurement

The Construction Inspector, or designee will measure the length of traffic stripe for 4 in [100 mm], 6 in [152.4 mm], 8 in [203.2 mm], 12 in [300 mm] and 24 in [609.6 mm] stripe and will count arrows by each head.

6.3.3 Traffic Stripe (Multi-Polymer)

- Multi-Polymer pavement marking work consists of Asphaltic concrete and Portland cement concrete pavement surfaces.

Physical Properties

- When properly applied with the required gradations and bead applications ensure the multi-polymer resin compound cures to a no-track condition within 45 min (at 70 °F [20 °C] or greater) or within 240 min (at 40 °F [4.4 °C]), assessed in accordance with ASTM D 711
- Ensure the multi-polymer resin material is free of heavy metals (defined by the EPA) approved by the Engineer. During the heating to application temperature, ensure the material does not exude toxic fumes.

Multi-Polymer Composition

Provide a two-component (Compound A and Compound B) multi-polymer resin material, 100 percent solids system with a volumetric mixing ratio of 2:1 (A: B) in accordance with Table 14.

Multi-Polymer Composition	
Pigment Composition	Percent by Weight
White:	
Titanium Dioxide Rutile (94% minimum purity, ASTM D476, Type III)	33 - 38
Multi-Polymer Resin	60.0 - 82.0
Yellow:	
Organic Non-Lead Yellow	7.0 – 8.0
Titanium Dioxide (ASTM D476, Type III)	14.0 – 79.0
Multi-Polymer Resin	77.0 – 79.0

Table 14: Multi-Polymer Composition, Values from Oklahoma Specs 2019

Ensure the pigment composition only consists of titanium dioxide.

Multi-polymer Content (Component A)

- Test the multi-polymer resin in accordance with ASTM D 1652 and calculate the weight per multi-polymer equivalent (WPE) for both white and yellow markings. Determine the multi-polymer content on a pigment free basis. Ensure the multi-polymer content meets the target value provided by the manufacturer, review by the City of Lawton's material division, and approved by the Engineer. The Engineer will apply a tolerance of ±50 WPE to the target value established the acceptable range.

Amine Value (Component B)

- Determine the amine value of the curing agent in accordance with ASTM D 2074. Ensure the total amine value meets a target value provided by the manufacturer, reviewed by The City of Lawton's material division, and approved by the Engineer.

Equipment

- Provide equipment capable of placing at least 40,000 ft [12,190 m] of the following types of marking per day to the alignment, spacing, and thickness shown on the plans:
    - Solid or skipped stripes 4 into 6 in [100 mm to 150 mm wide]
    - Markings other than solid or skipped lines.
    - Centerline and no-passing barrier stripe configuration consisting of one skip stripe with two solid stripes, simultaneously.
- Ensure the equipment places markings with clean edges of uniform cross section and thicknesses, with square ends, and an approximate stripe-to-gap ratio of 1:3.
- Ensure the equipment uniformly and instantly places the beads on the markings. When placing beads on two adjacent stripes, ensure each stripe has an equivalent bead coverage rate and embedment.
- Provide equipment that heats and places each component within the component mix tolerances in accordance with manufacturer recommendations.

Construction Methods

Surface Preparation

- Remove foreign material from the road surface before applying the dual component material. Ensure the pavement surface is dry.
- Use abrasive grinding, blasting or high-pressure water jet to remove existing, temporary, or permanent traffic markings until at least 95 percent of the underlying pavement is visible, unless otherwise specified by the manufacturer, Minimize interference between temporary pavement markings and the permanent dual-complete pavement markings materials.
- Remove the curing compound at least 1 in [25 mm] beyond the width of the marking. After removing the curing compound, sweep and use a high-pressure air spray.

Pavement Temperature and Condition

Apply dual component pavement markings to Portland cement concrete pavement surfaces at least 30 calendar days after paving, and new Asphaltic cement concrete pavement a minimum of three (3) calendar days after paving under the following conditions:

- On a dry roadway (no significant dampness or standing water)

- At an air and pavement surface temperature of at least 40 °F [4.4 °C] and rising, and Wind chill temperatures of at least 35 °F [1.7 °C]

Measure the pavement temperatures every 30 minutes before beginning striping installation. If critical temperatures exist, as determined by the Engineer, measure the pavement temperature surface every 1 hour to 2 hours, or at shorter intervals as directed by the Engineer until the end of day. Measure the pavement surface temperature with a standard surface temperature, infrared non-contact thermometer, or approved data logging system.

If conditions and temperatures are not conducive to the installation of permanent pavement markings within the specified time frame, including time for curing PCC pavement, the Engineer may allow and accept the installation of temporary pavement markings instead of permanent markings. The Engineer may suspend the contract and/or milestone time until temperatures and/or conditions improve, permanent markings can be placed.

Application

- Apply large glass beads at a coverage rate of at least 12 lb per 100 ft^2 [5.4kg per 10 m^2] before applying standard beads. Apply standard glass beads at a coverage rate of at least 12 lb per 100 ft^2 [5.4 kg per 10 m^2].
- For hand-machine applied markings, apply large glass beads at a coverage rate of at least 12 lb per 100 ft^2 [5.4 kg per 10 m^2] before applying standard beads. Apply standard beads at a coverage rate of at least 12 lb per 100 ft^2 [5.4 kg per 10 m^2].
- Alternatively, for Portland Cement Concrete pavement apply a non-reflectorized contrast marking, of the same dimensions as the white skip lines shown on the plans, immediate after each upstream white skip line.
- Prior to the start of striping operations, travel 100 ft to verify consistency of physical and electronic measurements of distance traveled.
- Ensure longitudinal and edge line markings meet the minimum mil thickness values in accordance with Table 15 for concrete pavement and Table 16 for asphalt pavement:

Multi-polymer Minimum Mil Thickness (PCC Pavement)	
Mils	Contract unit price Adjustment
≥ 20	100%
19 – 18	90%
17 – 16	75%
15 – 14	50%
< 14	Remove and replace

Table 15: Multi-Polymer Minimum Mil Thickness PCC, Values from ODOT Specs 2019

Multi-polymer Minimum Mil Thickness (ACC Pavement)	
Mils	Contract unit price Adjustment
≥ 25	100%
24 – 23	90%
22 – 21	75%
20 – 19	50%
< 19	Remove and replace

Table 16: Multi-Polymer Minimum Mil Thickness ACC, Values from ODOT Specs 2019

Retro reflectivity

Measure stripes with a portable or mobile reflectometer that uses 30 m geometry in accordance with ASTM E1710 and manufacture recommendations. Ensure the manufacturer calibrates the reflectometer annually. Keep annual calibration certification and all reflectometer readings must be in conjunction with line thickness gauge measurements.

Minimum Retro-reflectivity (PCC Pavement)			
White		Yellow	
mcd/m^2/lx	Pay adjustment	mcd/m^2/lx	Pay adjustment
≥ 450	100%	≥ 300	100%
400 – 449	75%	275 – 299	75%
250 – 399	50%	225 – 274	50%
< 250	Remove and replace	< 225	Remove and replace

Table 17: Multi-Polymer Minimum retro-reflectivity PCC, Values from ODOT Specs 2019

Minimum Retro-reflectivity (ACC Pavement)			
White		Yellow	
mcd/m^2/lx	Pay adjustment	mcd/m^2/lx	Pay adjustment
≥ 400	100%	≥ 250	100%
350 – 399	75%	225 – 249	75%
200 – 349	50%	175 – 224	50%
< 200	Remove and replace	< 175	Remove and replace

Table 18: Multi-Polymer Minimum retro-reflectivity ACC, Values from ODOT Specs 2019

Acceptance

- Submit final retro reflectivity measurements to the Engineer for acceptance. Include the time and date of reflectometer calibration, location (GPS coordinates), line color, and date of each

measurement. The City of Lawton will consider unmeasured stripes as non-compliant. The Engineer will notify of any non-compliance with the minimum retro reflectivity values.

- Measure retro reflectivity with a Delta Light & Optics, Model LTL X portable reflectometer. The Engineer may accept striping quantities less than 2,500 ft [762 m] by visual inspection.

Method of Measurement

- The Engineer will measure the length of traffic stripe for 4 in [100 mm], 6 in [152.4 mm], 8 in [203.2 mm], 12 in [300 mm] and 24 in [609.6 mm] stripe and will count arrows by each head.

6.3.4 Permanent Pavement Marking Tape

- Plastic striping tape free of cracks with straight unbroken edges. Provide material in rolls with no greater than three splices per 150 ft [45.7 m]

Composition

- Distributed uniformly and firmly bond plastic materials, pigments, and glass beads on the top surface of retroreflective, preformed pavement marking film. Provide pre-coat performed plastic film with a pressure-sensitive adhesive that is compatible with bituminous concrete and Portland cement.

Thickness

- Thickness from 0.06 in to 0.09 in [1.52 mm to 2.29 mm] for preformed plastic film, without adhesive for lane and edge lines.

Application

- Ensure the material adheres to Asphaltic cement concrete and Portland cement concrete (PCC) surfaces when applied to manufactures recommendations to a surface temperature of at least 65°F [18.3°C].
- Applying the marking when surface temperature is from 50°F to 65°F [10°C to 18.3°C], apply in conjunction with manufacturer's recommendations other special instructions or both.

6.3.5 Removable Pavement Marking Tape

- Removable pavement marking tape with white or yellow all-weather, traffic resistant film on a reinforced conformable backing.
- Ensure the film adheres to Asphaltic cement concrete and PCC surfaces without heat, solvents, additional adhesives, or activators. Provide adhesives that bond to pavement surfaces if applied at temperatures of at least 50°F [10°C] without pickup or distortion by vehicular traffic.

6.3.6 Non-Removable Temporary Pavement Marking Tape

- Traffic striping material with white or yellow weather and traffic resistant reflective film on a comfortable backing pre-coated with a pressure-sensitive adhesive.
- Ensure the material adheres to Asphaltic cement concrete and Portland cement concrete surfaces when applied with manufacture recommendations at a surface temperature of at least 35°F [1.7°C], does not require protective devices.

6.3.7 Construction Zone Pavement Markings

- Consists of providing, placing, and removing pavement markings on detours and roadways accessed by traffic during construction.
- Use equipment for removing pavement markings that will not damage the pavement surface or pavement material texture.

Hydro blasting

- Use pavement markings removal or cleaning equipment capable of removing 100% of the pavement marking using high-pressure water. Ensure equipment can maintain 36,000 psi water pressure at a maximum flow rate of 16 gpm. The removal of the head must be capable of rotation 1,500. Verify the equipment can remove at least 1,200 linear feet of 4 in strip per hour.
- Use equipment capable of removing the traffic stripe from surface, including cracks, to thoroughly remove all dust, dirt, and other foreign materials without causing damage to the surface by etching or exposing coarse aggregate. Use a wet vacuum in conjunction with the removal head to remove all debris.

Construction Methods

- Install removable pavement marking tape and pavement markings in accordance with the manufacturer's recommendations, or as approved by the Engineer. At the time of marking application, ensure a dry pavement surface, an atmospheric temperature above 50 °F [10 °C], and a wind chill factor above 40 °F [4 °C]. Remove dirt, debris, loose particles, curing compound and heavy oil residues from the road surface application area before installing pavement markings.
- Ensure visible uniform removable pavement marking tape and pavement markers for traffic control. Correct pavement markings that are not clearly visible and not uniform as approved by the Engineer.

Detours

- Complete pavement markings on detours, including lane end edge lines, before opening the detour to traffic. The Engineer directs maintenance, restoration of pavement markers, or re-striping of detours.

- If detour or permanent pavement markings conflict with the permanent pavement markings of the next traffic control phase, remove as approved by the Engineer before switching traffic. Remove existing pavement marking and replace with temporary before roadway opens to traffic. Remove temporary pavement marking before installing final striping.
- Remove pavement markings without damaging the pavement surface, or pavement material texture. Pavement material texture will be considered damaged if more than 5 mils are removed below the original stripe.
- Do not paint over or blot out the existing pavement markings. When removing pavement markings, immediately remove the residue using a vacuum attachment operated concurrently with the operation, or by other methods approved by the Engineer.

7. CYCLICAL, ROUTINE, AND TYPICAL MAINTENANCE OPERATIONS:

7.1 Pothole Repairs

7.1.1 Primary Materials used for Patching.

1. Hot-Mix Asphalt (HMA) – preferred
2. Cold-mix Asphalt – temporary fix
3. Warm-mix asphalt – colder conditions when hot-mix is not applicable.

Patching is best carried out during clear moderate weather conditions. In case of emergency, repairs may be required during poor winter conditions. Winter patch should only be temporary as the poor winter conditions will cause it to be weak.

7.1.2 Spring Patching

Patches applied in the spring have a longer life expectancy than those in the winter due to better weather conditions and reduced stress. Materials used during winter patching are still viable; however, the workability of the material in the spring may be sticky and difficult to work with. Like winter patching crushed aggregate with few fines, mixed with emulsifying asphalt should still be used, as well consider an antistripping agent. Higher temperatures allow for the mixture to be slower setting as supposed to that in winter. Spring Patching can be done by throw-and-roll, semi-permanent, spray injection, and edge seals.

7.1.3 Winter Patching

Winter Patching occurs during periods of snow melt, where maintenance crews do not have to apply abrasives, salt or plow. Aggregates used for winter patching conditions should be high quality, crushed aggregates with few fines. Binder is to be emulsified with at least one anti-stripping additive. Potholes are highly likely to contain water; therefore, anti-stripping additives are important. The mixture will need to be workable at low temperatures for easier compaction and handling. The goal of winter patching is to restore the rideability and safety as quickly as possible.

7.1.4 Throw and Roll

Used for temporary patches. It is appropriate when weather conditions are too poor for semi-permanent patch to be installed or the road is being rehabilitated soon.

1. Patching material is shoveled in with or without cleaning and drying of the hole.
2. Material is next compacted using the maintenance truck tires.
3. The completed patch should have a 1/8 in to 1/4 in (3 mm to 6 mm) crown to aid in preventing ponding.
4. Clean-up is usually not required.
5. Clear the area of workers and equipment. Open the repaired section to traffic.

7.1.5 Semi-Permanent Patches

Semi-Permanent patching is an effective patching method. It is wise to plan out more Semi-permanent repair when moderate weather conditions allow.

(Before completing removal and replacement of the failed area.)

1. Mark boundaries of affected area, making sure to encompass larger area than that of the affected area. The boundaries of the repair should be rectangular. Consider the dimensions of the equipment being used for the removal of old material and addition of compacted new material.
2. Cut the boundaries of the patch square using equipment of choice, such as diamond saw or pneumatic hammer with a spade bit.
3. Square up the sides of the hole until edges of the hole are sound pavement. This step is simplified if the repair area is cut with a diamond saw, jack hammer, or established with cool milling equipment. It is required when manual techniques are used for material removal.
4. Remove debris and water from the hole. Depending on the size of the hole, may use pick and shovel or combination of power equipment. May able to use pneumatic hammer, shovel, backhoe, front end loader or cold milling equipment.
5. Place the patch material in hole, if placed manually, use a shovel) to place hot mix asphalt material, be weary to avoid segregation. The hole needs to be overfilled by 20 to 25 percent of its depth to provide sufficient material for compaction. An asphalt rake should be used to blend or feather patch edges.
6. Compact the patched material with a hand device or small vibratory roller. It is preferred to use compaction equipment whose surface area is smaller than the size of the patch. It will be more difficult if the equipment's surface area is larger than that of the patch.
7. The patched area is to be compacted thoroughly with proper compaction equipment. Between 3 mm and 6mm
8. Clear the area of workers and equipment. Open the repaired section to traffic.

7.1.6 Spray Injection

Spray injection is a rapid method of patching that requires specialized equipment. One advantage of this method is rolling the patch is not necessary after patching has been completed.

1. Prepare the pothole site by blowing water and debris with the application nozzle.
2. Spray a tack coat of emulsion on the sides and bottom of the hole.
3. Blow asphalt/aggregate mixture into the hole, filling the hole.
4. Complete with a layer of dry aggregate. It is not necessary to roll the patched pothole.
5. Clear the area of workers and equipment. Open the repaired section to traffic.

7.1.7 Edge Seal

Edge seal should be used to improve the durability of the patch. Doing so prevents the intrusion of water and/or other debris. After being set water cannot penetrate the patched seam.

1. Remove all water and debris from existing pothole.
2. Place cold mixed material into pothole using a shovel until hole is filled.
3. Compact patching using the truck tires.
4. Once the repaired section has dried, place a ribbon of asphaltic tack material on the patch edge.
5. Place a layer of sand on the tack material to prevent tracking by vehicle tires.
6. Clear the area of equipment and workers, open the repaired section to traffic.

(This procedure may require a second visit to the repaired section by the crew to allow water to dry before placing the tack.)

7.1.8 Partial-Depth Repairs PCC

Partial-Depth work consists of spalls, popouts, scaling, or other surface distress in Portland cement concrete pavements. The repair area should be prepared by removing current broken, damaged, or disintegrated concrete from the area located.

Repair Mixtures approved by Federal Highway Administration

- Accelerated Strength Portland Cement Concrete Mixture
  - Use Type I or Type III Portland cement and calcium chloride or other accelerator
  - Obtain a minimum strength of 3,000 psi (20.7MPa) in 24 hours.
  - Slump shall be 1 to 3 in (50 to 150 mm) at time of placement.
- Portland Cement Concrete Mixture
- Rapid Setting Repair Materials
  - Minimum compressive strength of 3,000 psi (20.7 MPa)

- Epoxy Resin Repair Mortars
    - Be prepared in accordance with manufacturer's recommendations regarding aggregates and gradation of aggregate
    - Preconditioned to produce a blended liquid at temperature between 75° F (24° C) and 90° F (32° C)

Construction Methods

The area in question for repair shall be determined by the Engineer. The extent of the repair area shall be marked. Areas less than 6 in (150 mm) in length and 1.5 in (35 mm) in wide at the widest point shall be repaired under these specifications but shall be filled with a join sealant material.

Preparation of Partial - Depth Areas

- A saw cut shall be made around the perimeter of the scheduled repair area to provide a vertical face at the edges and sufficient depth for the repair.
- The saw cut is to have a depth of 1 to 2 in (25 – 50 mm)
- Concrete within the repair is to be broken out to a depth of 1 to 2 in (25 – 50 mm) with pneumatic tools until sound and clean concrete is exposed.
- The maximum size pneumatic hammer shall be 30 pounds (13.5 kg)
- The exposed faces of concrete shall be sandblasted free of loose particles, oil, dust, and traces of Asphaltic cement concrete before placement of repair material.
- All sandblasting residues must be removed just prior placement of the concrete bonding agent.

Conditions

- Portland cement concrete shall not be placed when air or pavement temperatures are below 40° F (4° C). At temperatures below 55° F (13° C), a longer cure period may be required. Insulation can be used to improve the rate of curing.

7.2 Pavement Crack Sealing

- Applied to both concrete and asphalt street pavements greater than 3 years old
- Pavement Condition Index (PCI) rating above 40 as listed in the Infrastructure Management Pavement Management Plan
- Typical application frequency:
    - Arterial – 5-year cycle
    - Collector and Local – 7-year cycle
- The best time for crack sealing is the winter season, November through January.

Asphalt Cement Concrete

- Ambient and surface temperatures meet manufacturer and agency requirements (typically 40°F minimum and rising) for routing and sealing.
- Application does not begin if there is any moisture on the surface or in the crack.
- Application should be avoided when dew may develop within the crack.
- Sealing does not proceed if rain is imminent.

Portland Cement Concrete

- Review manufacturer instructions for requirements specific to sealant used.
- Air and/ or surface temperatures shall meet manufacturer and all agency requirements. (typically, 40°F and rising) for sawing and sealing.
- Sealant should not be installed when temperatures are at or below the dew point.
- Sealing should not proceed if rain is imminent or commences during installation.
- Application does not begin if there is any sign of moisture on the surface or in the joint.

7.3 Monitoring and Updating PCI Ratings

- Perform PCI laser crack survey of street pavement on a 5-year cycle
- Perform visual surface inspections annually to monitor trends in pavement conditions.
- Update to verify PCI range each year of all roadway segments along with bridge decks.

7.4 Diamond Grinding Concrete Pavement

Restores drainage and riding characteristics to Portland Cement Concrete pavement surface.

Construction Method:

- Grinding Pavement
    - Make multiple passes as necessary to achieve acceptable results.
      Grind areas shown on plan longitudinally, beginning and ending at lines transverse to the pavement centerline.
    - Allow less than 100 percent grinding within specified areas if minor depressions occur in the pavement.
    - Ensure pavement surface grinding results in a uniform, finished surface. Eliminate joint and crack faults while maintaining a constant cross – slope between the edges of grinding to provide lateral drainage
    - Feather-grind adjacent lanes or paved shoulders to maintain motorist safety and proper drainage for pavement grinding deeper than ¼ in [6 mm]
    - Surface texture and Grooving

- Griding surface to a uniform appearance with a texture composed of longitudinal ridges and grooves
- Create surface grooves from 0.09 in to 0.15 in [2 mm to 4mm] wide, spaced up to ¼ in [3mm] apart
- Ridge peaks are to be at least 1/16 in [1.5 mm] higher than the bottom if the grooves.

- **Slurry removal**
  - Remove grinding slurry or residue by vacuum or any continuous method.
  - Slurry does not enter drainage inlets and watercourses.
  - Prevent slurry from flowing across lanes used by traffic, gutter or any other drainage facilities
- **Profiling Pavement Surfaces**
  - Profile ground in accordance with ASTM E 1274. Provide a profilograph with wheels variable spaced
  - Pavement with a profile index of 5 in [125 mm] or less per mile using a 0.2 in [5 mm] blanking width. Profile ground surfaces in two passes one at 3 ft [0.9m] and one at 9 ft [2.7m] from the edge of the driving line
  - Average the profilograph readings from two passes to obtain the profile index for each lane
  - Profile index exceeds 5 in [125 mm] per mile, grind individual high points in excess 0.3 [8mm] across the entire lane width. Perform additional grinding to reduce file index to the specified values.
- **Straight Edge Tolerance**
  - Use a 10 ft [3 m] straightedge to measure surface smoothness.
  - Ensure maximum distance from bottom edge of the straightedge does not exceed ¼ in 10 ft [3mm in 3m].
  - The elevation difference between passes does not exceed 1/8 in [3 mm]. After completing diamond grinding saw and seal joints.

8. COMMUNITY ENGAGEMENT

Public Outreach and Notifications

The City of Lawton is committed to engaging with the community, providing information on upcoming projects, and providing notification[s] of construction activities which may interrupt daily commute.

- The contractor is to Provide prior (5 days) notification to impacted residents (letter, fliers etc.)
- Place information of City of Lawton website (aerial map and project narratives)
- Utilize City of Lawton social media outlets

This notification should include reminders to park off the pavement, move recreational activities, any impacts to trash or mail, and how long construction would last and a point-of-contact for questions.

9. SAFETY AND TRAFFIC MANAGEMENT

Work Zone Safety

Incorporate Plan notes to provide guidance of strict safety protocols that will be enforced in work zones to protect workers, pedestrians, and motorists.

Traffic Flow Management

Efforts should be made to manage traffic flow during construction to minimize disruptions and inconvenience to the public, trash service, mail service, and emergency vehicle access. Periodic progress meetings can assist the coordination of anticipated construction activities between multiple contractors and stakeholders operating within the City of Lawton's rights-of-way.

10. PERFORMANCE METRICS AND REPORTING

Key Performance Indicators (KPI's)

Key performance indicators will be established to measure the success of the program and the condition of the pavement network relative to the City of Lawton's monetary investments in the program.

Program goals will be established by the City's Streets, Roads, and Bridges Committee as recommended by the Pavement Program Management staff. Pavement Program recommendations will need to be data-driven, so that objectives can be tracked and measured.

Pavement Maintenance Performance Measures	
Goal	Key Performance Indicators (KPI's)
Address *x* % of roadways per year	**Percentage of Roadways Addressed:** Annual percentage of roadways that have undergone maintenance or rehabilitation compared to the City's total transportation network. (miles of rehabilitation activity / network miles (per roadway classification)
	Implementation Timeline Adherence: Program's success in adhering to the planned timeline for addressing the x% of roadways, minimizing delays and disruptions.
	Budget Utilization: Efficiency of budget utilization by comparing actual expenses to the allocated budget for pavement maintenance activities.
Increase average PCI by *x* points per year	**Condition Improvement Index (CII):** Measure the overall condition improvement of the road network by tracking changes in the Pavement Condition Index (PCI) by x points per year.
	Pavement Quality Index (PQI): Assess the quality of the pavement by calculating an index that considers various distress types and severity levels, with the goal of increasing the PCI.
Reduce Backlog by x % per year	**Asset Management Performance:** Evaluate how well the program aligns with the municipality's asset management plan, ensuring prioritization based on the condition of the pavement and reduction of backlog.
	Quality of Workmanship: Assess the quality of workmanship in pavement maintenance projects by monitoring the incidence of post-maintenance issues and the need for rework, contributing to backlog reduction.

Table 19: Pavement Maintenance KPI

Progress Reporting

Regular (monthly/quarterly) reports will be made available to the City of Lawton, by the Program Management staff. The reports will detail the progress and outcomes of pavement maintenance efforts.

11. FUNDING AND BUDGET ALLOCATION

Priority transportation projects to be carried out within the Fiscal Year (FY). As project estimates and/or funding formulas change, the total expenditure estimates are updated accordingly—The adopted model for developing this program.

Identify funding sources and their budgetary amounts for the Pavement Maintenance Program include federal grants, state allocations, CIP Fund, and other revenue streams such as development and impact