

City of Edmonton

# UNPAVED ROADS MAINTENANCE GUIDELINE





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# 1. Introduction & Background

The City of Edmonton (the City) is committed to taking a consistent, strategic approach to asset planning and asset management, so we deliver the services our customers need, while maximizing value-for-money. We use infrastructure assets to deliver services to our customers.

Operations and maintenance is a critical part of the asset life cycle. It is about ensuring that assets run effectively on a day-to-day basis to deliver value to customers. Typically, operations and maintenance activities do not increase the condition of an asset but are needed to provide a chosen standard of service.

The overarching process for the City's operations and maintenance is shown in Figure 1.1.



Figure 1.1 Operations and Maintenance Process

## Purpose of this Guideline

The City has Asset Maintenance Guidelines for specific programs that provide a detailed approach to planning and delivery of operations and maintenance. This Maintenance Guideline provides details of the operations and maintenance strategies for the City's Unpaved Roads.

The purpose of this Maintenance Guideline is to demonstrate how we are managing our assets by outlining:

- The key customer and technical focussed factors that are considered in determining maintenance requirements to ensure the City's assets deliver the right levels of service to the community
- Details for interventions throughout the life of the asset including: inspections, operations activities, planned maintenance and corrective maintenance
- Maintenance decision-making processes, including how activities are prioritized
- Delivery of maintenance services, including procurement
- Performance measures and operational data requirements

# Program Scope

The scope of this Maintenance Guideline includes 303.08 kilometres of unpaved roads, including the 80.91 kilometres gravel roads, 161.23.7 kilometres of surface treated roads, 61.25 kilometres of gravel alleys and 0.25 kilometres of surface treated alleys located throughout the City of Edmonton.

**Gravel roads** are constructed by using 25/63 mm base material on top of the existing subgrade base. The material is laid and spread by the grader and compacted with a roller. As there is no binder mix with these roads, the roads require frequent maintenance which includes grading, adding base material and reshaping the ditches alongside the roads.

**Surface treated roads** are constructed by using an oil mix, which consists of aggregate and cold asphalt binder. The material is laid using a grader and then compacted with a roller. This type of unpaved road reduces the need for regular maintenance and dust control. These roads are generally maintained through corrective maintenance, either by pothole filling or by zipping to mix material to keep it safe and in shape.

**Gravel alleys** are constructed in a similar way to gravel roads, as outlined above.

A summary of the unpaved roads assets owned by the City and covered under this Maintenance Guideline is included in Table 1.1.

*Table 1.1 Asset Inventory and Quantities*

Asset Category	Asset	Material	Quantity	Unit
Unpaved Roads	Roads	Gravel	80.91	km
	Roads	Surface treated	161.23	km
	Alleys	Gravel	61.26	km
	Alleys	Surface treated	0.25	km
<b>Total</b>			<b>303.08</b>	<b>km</b>

## Relationship to Other Documents

This Unpaved Roads Maintenance Guideline is an “Tactical-Operational Level” document. As shown in Figure 1.2, it provides the detailed operations and maintenance activities that help staff carry out hands on management of these assets. It also contributes to the overall Operations and Maintenance Strategies outlined in the City’s Unpaved Roads Asset Management Plan (AMP). There should be clear “line of sight” linking the City’s “top-down” organizational goals and objectives with the “bottom-up” operational activities.

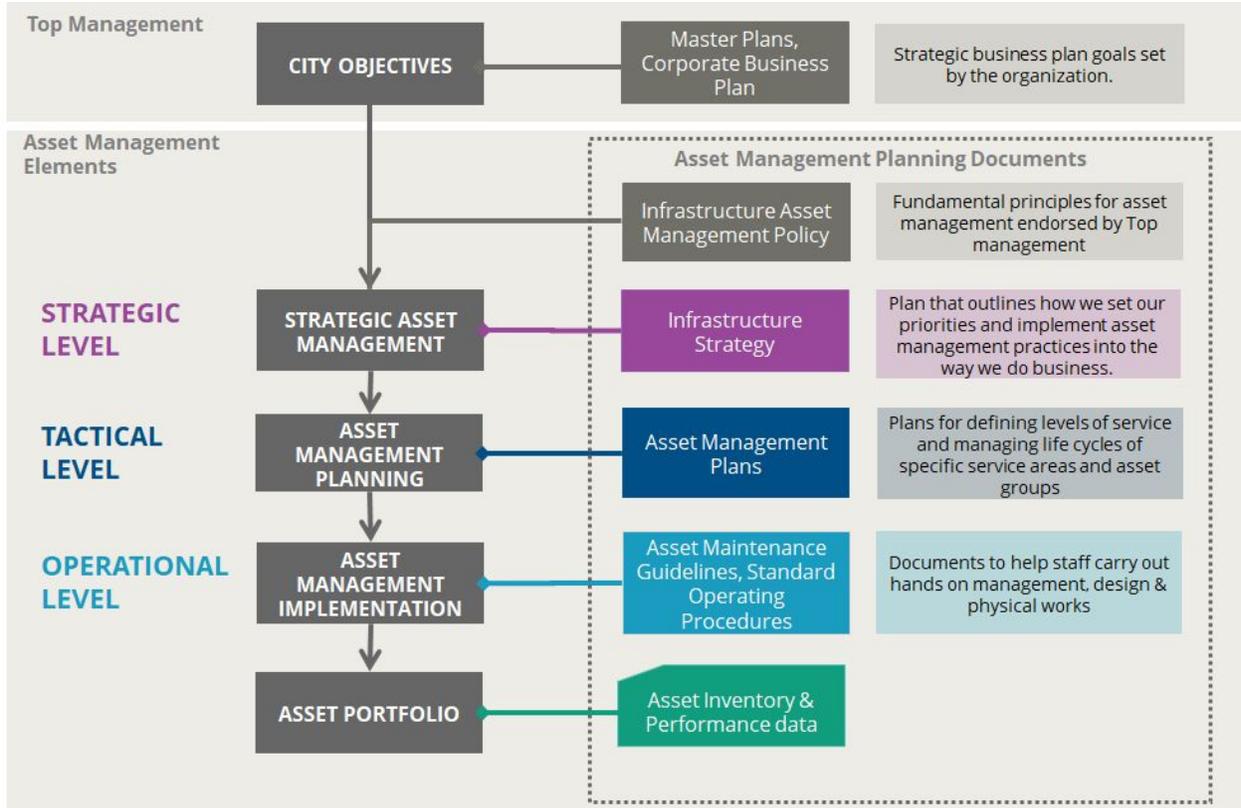


Figure 1.2 Relationship of Maintenance Guidelines to other Corporate Documents

## 2. Situational Awareness

This Section summarizes the key factors that can impact the delivery of maintenance activities from a **technical and customer perspective**.

### Critical Maintenance Factors

There are many factors that impact the condition of unpaved roads from a **technical perspective** so that it is often difficult to forecast the maintenance work that will be required. These include:

- Material properties
- Geology and topography
- Climate
- Drainage
- Construction quality and geometry
- Subgrade conditions
- Traffic usage

This section outlines the key factors that are considered critical to planning maintenance of the City's unpaved roads.

#### *External Environment*

The unpaved roads within the City are generally flat and straight. The City does not typically build new unpaved roads, and has not done so for some time. Unpaved roads are historic in nature, upgraded in the past from access tracks or have been inherited from neighbouring municipalities as part of land annexations required to support the City's growth.

Like all areas within Alberta, the climate significantly impacts maintenance activities, requiring different seasonal maintenance approaches.

- **During Winter**, the ground freezes and maintenance activities are limited. At this time of year activities are predominantly operationally focussed on snow removal and ice control. In the winter, frozen roads and culverts can also inhibit drainage by not allowing the drainage water to properly flow through the drainage network.
- **In Spring**, the melt of frozen roads significantly changes the material properties and drainage requirements. Maintenance needs focus on drainage initiatives like ditch clearing, as well as re-graveling. During this season, pavement moisture contents are likely to be high, with soft spots developing, so heavy grading and reshaping is not advised.
- **In Summer and Fall**, conditions can be dry and require maintenance to focus on dust control and keeping the surface free from surface defects such as washboarding and potholing. For best results, maintenance activities such as grading require the pavement to have optimum moisture content in the aggregates, so need to be completed after rain.

#### *Traffic usage*

Changing traffic demands impact on the suitability of the City's unpaved roads for road users. Some of the key traffic usage impacts that need to be considered in maintenance planning include:

- **Changing land-use** - Development of land that has previously been pastoral or farm based, into acreages and residential areas creates more traffic from increased commuter activity.

- **Changing vehicle types** - With the change in land use, also comes a change in the type of vehicles using unpaved roads. Generally road users associated with acreages drive conventional 'low riding' vehicles rather than 'farm' type vehicles which increases demand for smoother riding roads.
- **Detours** - A key impact on maintenance of unpaved roads in the City of Edmonton are detours set up by private contractors around new communities being developed throughout the City. These contribute increased axle loads from large trucks and exemptions from road bans.
- **Hours of work** - Working hours are often limited to off peak hours to reduce traffic disruption, which can also adversely affect the capacity and timelines to repair any issues.

## Levels of Service Factors

From a **customer perspective**, the key service level objectives of unpaved roads that influence maintenance activities are to provide:

- A fit-for-purpose pavement giving affordable access to property and best whole-of-life performance.
- A smooth ride and safe travel for users, free from potholes and deficiencies like subsidences that could potentially cause damage to their vehicles.
- Limited disruption to customer's travel plans by ensuring maintenance work is not being completed during peak hours.
- Limited air pollution and safety risk from dust.

# 3. Identifying Maintenance Needs

## Unpaved roads requirements

Understanding the correct shape and requirements for unpaved roads is critical to developing appropriate maintenance approaches for the entire area within the road's right-of-way. Figure 3.1 shows a typical cross section of an unpaved road, including three basic elements of construction:

1. A well formed road surface with appropriate material, a crowned shape (high point in the middle of the road) and shoulder area sloping away from the edge of the driving surface,
2. A well constructed and protected underlying pavement structure (base and subgrade), and
3. Good drainage, including ditches alongside the road and culverts.

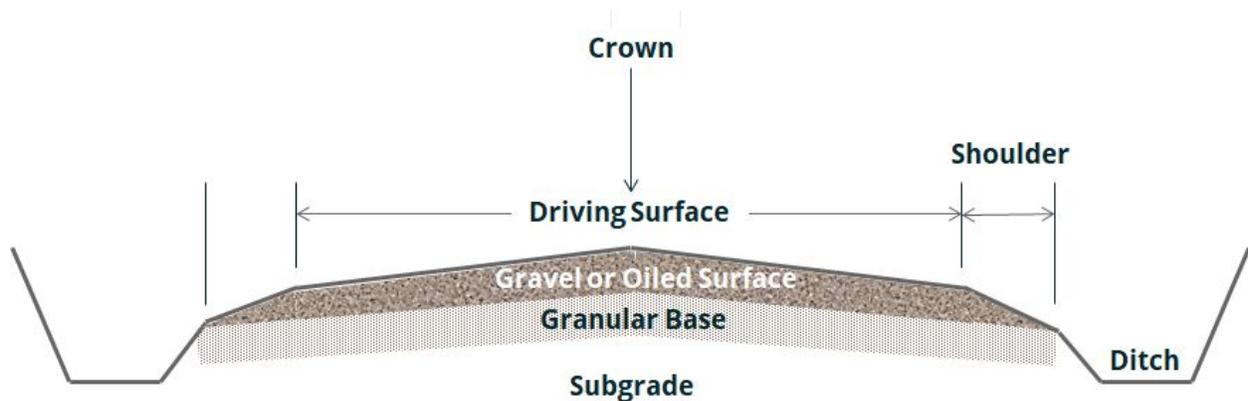


Figure 3.1 Unpaved roadway cross section

### Surface

The primary purpose for the road's surface and crossfall (with a crown at the centre) is to provide ride comfort and safety for road users, while getting water off the road and away from the traffic wheel paths.

For the surface shape to be sufficient, the crossfall of the road should typically be 6-8%. Where the crossfall is less than 6%, water is likely to remain on the surface and promote the formation of potholes and weakening of the pavement. A very steep crossfall promotes scour and loss of fines that binds the gravel surface together. If these fines are lost, washboarding forms.

The type of surface material is also important. An ideal material for a gravel road will have properties which result in an even, tight, relatively impermeable (erosion-resistant) and wear-resistant surface. Oiled roads must be surfaced with the appropriate gravel / oil mix to ensure a robust travelling surface is produced.

Developing knowledge of the different materials from the quarries that service the Edmonton area is integral to the effective and efficient management of unpaved roads. Understanding the type and quality of materials produced will help with understanding their performance in place and identify the need for any blending or modification to improve qualities such as dust reduction and durability, reducing the need for periodic grading and re-gravelling.

Road shoulders transfer accumulated surface water to drainage ditches, provide a safety zone and parking areas and support the road surface. Unpaved shoulder grades are approximately twice that of the driving surface cross fall and often consist of less suitable materials than those in the driving surface.

## Pavement Structure

The quality of the base aggregate and subgrade beneath the surface aggregate or oil mix is important for unpaved roads as it provides the road's structural integrity to carry traffic loading. The integrity of the subgrade can be compromised significantly if there is poor drainage, poor base materials (susceptible to freeze / thaw and moisture), and limited depth of the surface aggregates.

## Drainage

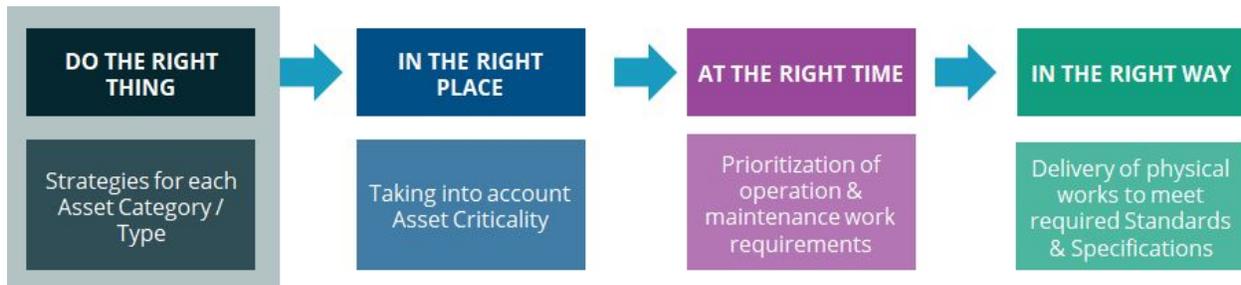
Good drainage is critical to the life of an unpaved road. Drainage facilities designed and maintained to keep the pavement and subgrade from becoming saturated are essential. The most important and common drainage feature needed on a rural road is the roadside ditch. They should be constructed such that the water is contained below the aggregate surface layers and at sufficient depth to provide drainage to the subgrade. Typically the invert level should be a minimum of 300mm below the driving surface at the edge of the road or 100mm below the subgrade whichever is the greater.

Culverts are also critical to carry the natural flow of water under the road or under accessways so that it may continue on its natural course.

Often there will be limited space for drainage ditches, particularly for unpaved roads and alleys in urban areas. However, it is important that roads are maintained in such a way that water can drain away from the driving surface.

# Typical Deficiencies & Maintenance Tasks

Understanding the types of unpaved road deficiencies and why they may be occurring, helps to identify the correct maintenance response and “do the right thing” as shown in the overarching process for maintenance shown below.



There are a number of sources of information used to assess the deficiencies within unpaved roads. As shown in Figure 3.2, this information can be used to understand the root cause of the deficiency. Once the root cause is understood, the most appropriate maintenance activity to remedy the deficiency can be confirmed.

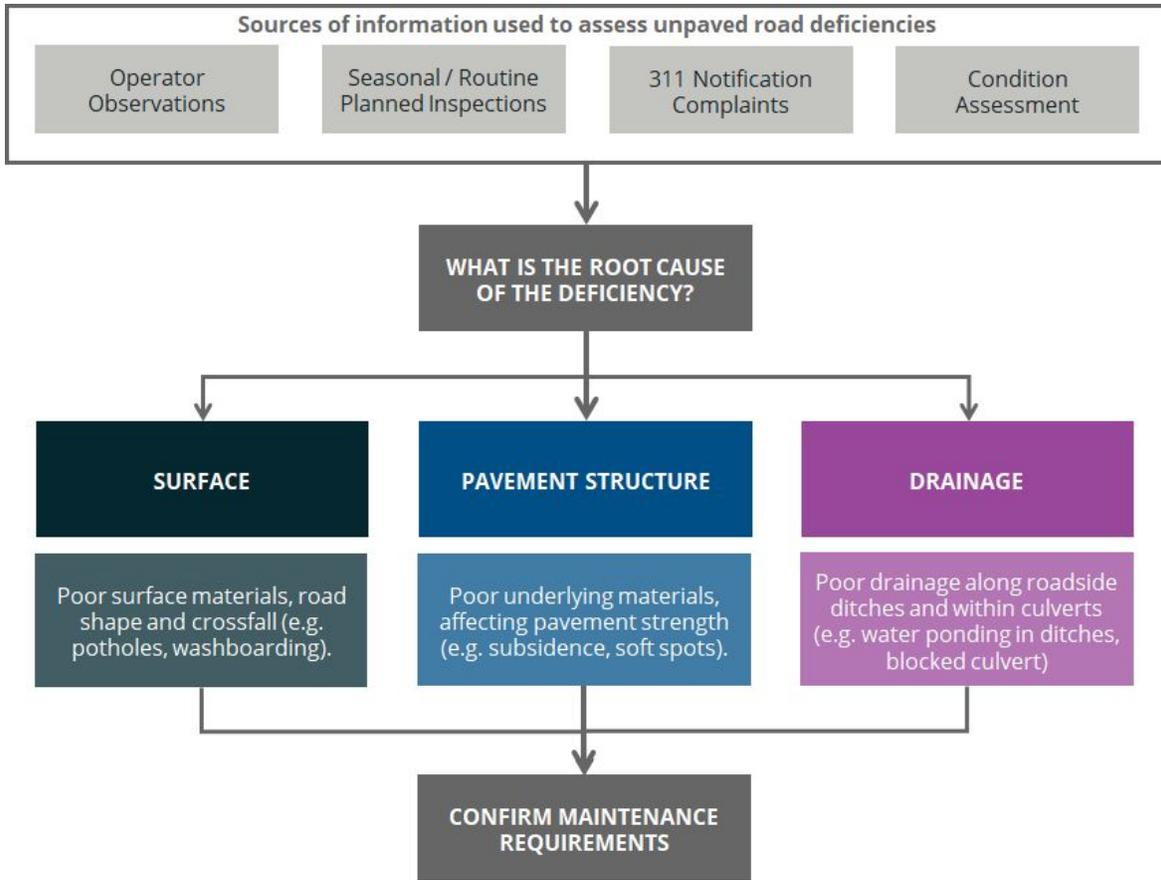


Figure 3.2 Determining the Maintenance Needs of an Unpaved Road

Outlined in the sections below are the most common unpaved road deficiencies, their causes, factors to consider when deciding on maintenance actions and the maintenance tasks the City uses to remedy them. Each maintenance task is further detailed in Section 4, Maintenance Delivery.

## Surface Deficiencies

Deficiency	Causes	Factors to Consider	Maintenance Tasks
<p><b>Washboarding</b> Formation of periodic, transverse ripples in the surface of gravel roads. Creates uncomfortable ride for drivers.</p> 	<ul style="list-style-type: none"> <li>Lack of moisture</li> <li>Poor quality surface aggregate</li> <li>Poor grading technique</li> <li>Poor surface shape / crossfall</li> <li>Driving habits of road users (braking, acceleration)</li> </ul>	<ul style="list-style-type: none"> <li>Are the washboards shallow, caused by movement of fine, dry material?</li> <li>Are the washboards deep due to vehicle action?</li> </ul>	<ul style="list-style-type: none"> <li>Continuous Grading (light grading to move material across surface to spread)</li> <li>Heavy Grading and Reshaping (for deep washboarding)</li> <li>Re-gravelling (to improve aggregate quality)</li> </ul>

<p><b>Potholes</b> Depressions in road surface. Continued traffic action ejects both surface material and the underlying soil material to create a hole in the pavement.</p> 	<p>Excessive moisture Poor quality surface aggregate Loss of surface aggregate Poor surface shape / cross fall Increased traffic volumes</p>	<p>Is the surface material gravel or oil mix? Are the potholes localised? Are potholes in large groups? Are potholes in flat areas with poor cross fall shape?</p>	<p>Pothole Repairs (for individual potholes) Spot Grading (for large groups of potholes) Spot Graveling (over localized areas) Heavy Grading and Reshaping (reinstate cross fall)</p>
<p><b>Dust</b> Excess soil dust, a pollutant that contributes to excess levels of particulate matter in the air and surrounding properties.</p> 	<p>Loss of binding aggregates Poor quality aggregate Lack of moisture High vehicle speeds</p>	<p>Does the existing aggregate have sufficient fines? Have there been any changes in traffic or travel speeds?</p>	<p>Spot Graveling (for isolated areas of poor quality aggregate) Dust Abatement Application</p>
<p><b>Raveling</b> Disintegration of an oiled road surface due to dislodgment of aggregate materials (gravel, sand, and crushed stone).</p> 	<p>Poor quality oil mix Poor compaction Excessive moisture High vehicle speeds</p>	<p>Does the existing oil mix have sufficient binder? Is the raveling in flat areas with poor cross section? Have there been any changes in traffic or travel speeds?</p>	<p>Zippering (remix surface material on oiled roads)</p>

## Pavement Structure Deficiencies

Deficiency	Causes	Factors to Consider	Maintenance Tasks
<p><b>Rutting</b> Depression or groove worn into the road by the travel of vehicle wheels.</p> 	<p>Freeze / thaw causing settlement</p> <p>Excessive moisture in subgrade</p> <p>Poor/weak subgrade materials</p> <p>Heavy traffic loads</p>	<p>Have changes in underlying ground temperature occurred?</p> <p>Is water penetrating through the pavement or subgrade?</p> <p>Is the underlying base or subgrade poor strength material?</p> <p>Is the existing pavement depth appropriate for the traffic?</p>	<p>Structural Base Repairs (for isolated severe rutting)</p> <p>Heavy Grading and Reshaping (reinstate cross fall)</p> <p>Re-gravelling (to top up pavement aggregate and increase pavement depth)</p> <p>Zipping (top up surface material on oiled roads)</p>
<p><b>Soft Spots / Subsidence</b> An area of pavement that sinks lower level than the surrounding pavement.</p> 	<p>Freeze / thaw causing settlement</p> <p>Excessive moisture in subgrade</p> <p>Poor/weak subgrade materials</p>	<p>Have changes in underlying ground temperature occurred?</p> <p>Is water penetrating through the pavement or subgrade due to inadequate drainage?</p> <p>Is the underlying subgrade poor strength material?</p>	<p>Structural Base Repairs</p> <p>Heavy Grading and Reshaping (reinstate cross fall)</p>

## Drainage Deficiencies

Deficiency	Causes	Factors to Consider	Maintenance Tasks
<p><b>Surface Water</b> Ponding water on road surface, water flowing across the road, ditches filled with water soaking into the base and road edge.</p> 	<p>Poor surface shape / crossfall</p> <p>Build-up of debris and vegetation stopping water from flowing into ditches</p> <p>No ditches or shallow ditches</p> <p>Blocked culverts</p>	<p>Are there low spots where outlet paths are blocked or restricted?</p> <p>Is the ditch capacity insufficient to cope with runoff and ponding water is saturating pavement layers?</p>	<p>Wide Grading (shaping for drainage of gravel roads)</p> <p>Shoulder Shaping (for drainage of oiled roads)</p> <p>Heavy Grading and Reshaping (reinstate cross fall)</p> <p>Ditch Maintenance (periodic cleaning of ditches in moisture sensitive areas)</p>

## 4. Maintenance Delivery

Maintenance tasks have been grouped into the following maintenance delivery concepts:

- **Inspections** – there are different types of maintenance inspections. Some are formalized regular inspections to check that the asset is operating as planned and can provide early warning of conditions that may warrant corrective maintenance or further inspection. Other less formal inspections are completed by Operators on-site or in response to a public complaint.
- **Preventive Maintenance** – these are regularly scheduled activities, completed while the asset is still in an “operational” condition. The purpose of Preventive Maintenance is to assist in maintaining the life of the asset (i.e. not consuming the life of the asset) by identifying and repairing smaller deficiencies before they develop into major defects or failures. Getting preventive maintenance right will both reduce total overall maintenance cost and improve service performance to customers.
- **Corrective Maintenance** – these activities are physical repairs to an asset that is not functioning as required. The repair reinstates the asset to its normal “operating” condition, but does not significantly extend the overall life of the asset (i.e. it is a repair not a full rehabilitation). Corrective maintenance repairs are expected to increase as assets age, and can be considerably more expensive than preventive maintenance repairs.

## Inspection Concept

As shown in Figure 3.2, inspections is a primary source of information used to assess maintenance requirements for unpaved roads. Some inspections are regular, planned inspections, while others are in response to customer feedback. Table 4.1 outlines our inspections for the unpaved roads.

Table 4.1 Unpaved Roads Inspections

Inspection Type	Asset Types Inspected	Requirements	Completed by	Frequency
<b>Seasonal Planned</b>	All assets	Seasonal planned inspection to determine required preventive maintenance activities	Road Maintenance Supervisor	4x per year
<b>Routine Planned</b>	All assets	Regular Planned inspection to review impacts of external environment and traffic on road condition and any resulting changes needed to Preventive Maintenance Program	RMS / District Inspectors	Monthly
<b>Operator Observations</b>	Unpaved surface Drainage ditches	Visual condition noted - acts as the maintenance team’s eyes while out grading. Identify need for any corrective maintenance.	Grader Operator	Daily
<b>311 Notification Complaints</b>	All assets	Investigate source of complaint and identify need for any corrective maintenance	TBC	As required
<b>Condition Assessment</b>	All assets	Detailed inspection and assessment to determine overall condition	TBC	Annually

# Preventive Maintenance Concept

**Preventive maintenance programs** ensure that maintenance tasks are completed “in the right place” and are prioritized to be completed “at the right time”, as shown in the figure below.



Preventive maintenance programs are completed on a seasonal basis (four times per year), to take into account the seasonal variability of unpaved roads. Programs may be further refined on a monthly basis, when external conditions change significantly. Separate programs are developed for Gravel and Oiled roads.

District Inspectors combine information from various inspections, historical customer notification information, in conjunction with planned rehabilitation areas, to identify the planned preventative maintenance areas scheduled for each season.

The seasonal preventive maintenance programs are then prioritized using a number of factors including:

- Traffic volumes and heavy commercial vehicles per day
- Road condition
- Seasonal conditions i.e. winter freeze, summer drought conditions
- Organizational objectives and directives
- Procurement strategy, including availability of required materials
- Level of service requirements.

The regularly scheduled activities completed for both Gravel and Oiled roads are included below.

## Gravel Roads

Table 4.2 outlines the maintenance activity requirements and planning considerations for preventive maintenance work for the gravel roads.

Table 4.2 Gravel Roads Preventive Maintenance

Maintenance Activity	Requirements	Planning Considerations
<b>Continuous Grading</b>	Continuous grading involves full length road grading to maintain the gravel surface in a smooth condition, and remove roughness from potholes and corrugations without major change to the pavement profile shape. Regular surface grading prevents the shape and crown profile from deteriorating to	Continuous grading will primarily be carried out in Summer and Fall.  Frequency of continuous grading is primarily dependent on traffic volumes and weather. Higher

	facilitate proper drainage and to maintain a safe driving surface for users.	traffic volume roads will require more frequent grading cycles.
<b>Wide Grading (including Shoulder)</b>	Wide grading involves grading from drainage ditch to drainage ditch, and bringing in aggregate material from the shoulders up onto the pavement surface. This enables aggregate lost to the edge of the pavement to be recycled and shoulders to be reformed. Any built-up of gravel material (windrows) and vegetation stopping water from flowing into the ditch should be periodically removed with the grader.	This maintenance task is best completed in the Summer or Fall prior to Winter so drainage remains functional.  Any vegetation removal required should be completed prior to wide grading of shoulder areas.
<b>Heavy Grading &amp; Reshaping</b>	Using a grader and tandem the gravel surface is reshaped and uneven areas levelled out. Sometimes additional aggregate material is needed to achieve the appropriate shape and cross fall. The use of rollers (and water truck if necessary) in conjunction with the grader or a rolling attachment fixed to the rear of the grader compacts the surface to provide a smooth ride and minimise washboarding.	During Fall, when the pavement has optimum moisture content in the aggregates, is the best time to do heavy grading and reshaping.  The optimum time for heavy grading is after rain. However, during periods of heavy rainfall or spring melt, the road material may be over saturated and moisture can penetrate the “crust” of the gravel surface causing soft spots to be generated. Grading should be avoided during these periods.
<b>Re-gravelling</b>	Re-gravelling involves full length application of 50-100mm of gravel layer to the pavement surface. This can be placed and compacted in conjunction with the routine grader cycle or as a separate maintenance task. The use of rollers (and water truck if necessary) in conjunction with the grader or a rolling attachment fixed to the rear of the grader compacts the surface to provide a smooth ride and minimise washboarding.  Quality gravel material with a good binding characteristic should be used for longer lasting condition.	During Fall, when the pavement has optimum moisture content in the aggregates, is the best time to do re-gravelling.  Key considerations when planning this activity include: <ul style="list-style-type: none"> <li>• What type of material should be used?</li> <li>• How much material should be placed?</li> </ul>
<b>Ditch Maintenance</b>	Keeping ditches open for drainage water to flow properly so water doesn't erode or washout road, road edge, culverts crossing under the roads. Ditches are to be kept free of vegetation so flow of water is unrestricted. Ditch maintenance includes cleaning out excess material blocking the ditch and	This maintenance task is best completed in the Summer or Fall prior to Winter so drainage remains functional.

	ensuring culvert ends are exposed for proper drainage water flow.	Any areas of significant vegetation may need brushing prior to ditch maintenance.
<b>Dust Abatement</b>	Dust abatement materials to be used include: calcium chloride, DL10, magnesium chloride, biobrine / SolNat, DustMAG, and DowFlake Xtra. The grader is used to blade and level the surface gravel, prior to application of the dust abatement material through a flusher. The grader operator will, then mix in the abatement material with the gravel, re-level. The re-levelled surface is then rolled for compaction.	Completed once in June and once in September.

## Oiled Roads

Table 4.3 outlines the maintenance activity requirements and planning considerations for preventive maintenance work for the oiled roads.

Table 4.3 Oiled Roads Preventive Maintenance

Maintenance Activity	Requirements	Planning Considerations
<b>Continuous Grading (with addition of oil mix)</b>	Application of additional material and grading to restore surface shape and strength. This treatment will be used for full length treatment of roads to ensure surface integrity is not compromised.	Continuous grading (with addition of oil mix) will primarily be carried out in Summer and Fall.
<b>Shoulder Shaping</b>	Blading is recommended for shoulder shaping maintenance with the blade adjusted so that the inside edge of the shoulder is at the same height as the outside edge of the oiled surface. This allows free drainage of surface water to constructed ditches.	This maintenance task is best completed in the Summer or Fall prior to Winter so drainage remains functional.
<b>Ditch Maintenance</b>	Keeping ditches open for drainage water to flow properly so water doesn't erode or washout road, road edge, culverts crossing under the roads. Ditch maintenance includes cleaning out excess material blocking the ditch and ensuring culvert ends are exposed for proper drainage water flow.	This maintenance task is best completed in the Summer or Fall prior to Winter so drainage remains functional.  Any areas of significant vegetation may need brushing prior to ditch maintenance.

# Corrective Maintenance Concept

Corrective maintenance is generally made up of more localized repairs to “discrete” locations, rather than a treatment of a full section of road. These repairs are likely to be required where budget restrictions limit full sections of road being preventively maintained or rehabilitated. Corrective maintenance will generally be identified through operators on-site and customer complaints.

Customers log their complaints through the COE 311 system which are then inspected to ensure the problem is valid. Once the complaint has been confirmed it is placed in our queue for repair execution. Five separate districts of the city have their own dedicated resources to allow execution of corrective repairs, including Pavement Operations who has a Complex Repair group to attend to any vibration issues, heaves, and base repair issues, etc.

Unpaved road maintenance is predominately seasonal. As the roads freeze in Winter they are difficult to grade and limited preventive maintenance is possible. In the case of any issues arising during Winter, a temporary fix will likely be used to make the road safe for the public. Completion of such repairs will be weather dependent.

Corrective maintenance repairs for unpaved roads need to factor in each road’s use and the demands placed on it. This will help determine the extent of reactive repair required to ensure a fit for purpose pavement is maintained.

## Gravel Roads

Table 4.4 outlines the maintenance activity requirements for corrective maintenance work for the gravel roads.

Table 4.4 Gravel Roads Corrective Maintenance

Maintenance Activity	Requirements
<b>Pothole Repairs</b>	Where potholes are isolated to a small number in a localized area(s), or are in areas planned for rehabilitation in the near future, potholes will be filled with gravel by a hand crew.
<b>Spot Grading</b>	Grading of road sections (not entire road) to address isolated poor areas.
<b>Spot Gravelling</b>	Isolated gravel loss and surface deficiencies occur when the pavement cover over a subgrade has reduced to a point where there is no visible aggregate. This is a sign the traffic load over the pavement material has worn or pushed the aggregate down into a soft (normally wet) subgrade foundation. Where a loss of material is causing deficiencies in isolated areas, an overlay of aggregate material in patches is required. Sometimes this is placed and compacted in conjunction with routine grader cycle or spread and rolled by trucks.
<b>Dust Abatement</b>	Localized dust abatement application in areas with particularly heavy traffic and dry conditions, between normal preventive maintenance cycles.
<b>Structural Base Repairs</b>	Soft spots are often attributed to loss of gravel surface over the subgrade or poor drainage causing the subgrade foundation to weaken in a localised spot rather than through the full section of the road.

Where there is deep seated failure of the underlying pavement base or subgrade, a base crew will complete a dig out repair. This involves excavating poor / soft material and replacing it with good quality graded aggregate then compacting well. There should be some restoration of good crossfall in conjunction with the digout to ensure adequate drainage. In some cases in flat low lying areas subsoil drainage should be considered to reduce the chance of water entering the pavement.

## Oiled Roads

Table 4.5 outlines the maintenance activity requirements for corrective maintenance work for the oiled roads.

Table 4.5 Oiled Roads Corrective Maintenance

Maintenance Activity	Requirements
<b>Pothole Repairs</b>	Where potholes are isolated to a small number in a localized area(s), or are in areas planned for rehabilitation in the near future, potholes will be filled with gravel / oil mix by a hand crew.
<b>Structural Base Repairs</b>	Soft spots are often attributed to loss of gravel surface over the subgrade or poor drainage causing the subgrade foundation to weaken in a localised spot rather than through the full section of the road.  Where there is deep seated failure of the underlying pavement base or subgrade, a base crew will complete a dig out repair. This involves excavating poor / soft material and replacing it with good quality graded aggregate then compacting well. There should be some restoration of good crossfall in conjunction with the digout to ensure adequate drainage. In some cases in flat low lying areas subsoil drainage should be considered to reduce the chance of water entering the pavement
<b>Zippering</b>	Heavy maintenance of existing pavement using existing material and addition of new material to restore pavement depth and strength, completed on defined sections of pavement with significant surface failure.

## Roles & Responsibilities for Maintenance Delivery

Table 4.6 describes the key people who are responsible for the delivery of operations and maintenance of the City's unpaved roads.

Table 4.6 Roles and Responsibilities for Maintenance Delivery

Role at the City	Operations and Maintenance Responsibility
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Road Maintenance Supervisor (RMS)	<p><b>Inspections</b> - all oiled and gravel roads in each district inspected on a frequency dependent on Asset Maintenance Category, checking the problematic areas</p> <p><b>Seasonal Preventive Maintenance Programs</b> - Develop programs based on inspections and prioritize</p>
District Inspectors	<p><b>Inspections</b> - all oiled and gravel roadways in each district inspected on a frequency dependent on Asset Maintenance Category, checking the problematic areas</p> <p><b>Repair Plan</b> - determine repair method, properly placing the repair in line with safety hazards, planned work in area with contractors, following road bans, etc.</p> <p><b>Quality Assurance</b> - random locations inspected to ensure quality of work completed.</p>
Leader 1	<p><b>Implement Repair Plan</b> - complete work on site, following proper Standard Operating Procedures (SOPs)</p> <p><b>On-site Quality Control</b> - check work is being completed in accordance with all SOPs throughout the duration of the task</p>
Operators	<p><b>Implement Repair Plan</b> - complete work on site, following proper Standard Operating Procedures (SOPs)</p>

## Procurement Requirements

The table below outlines the aspects of unpaved roads maintenance that are outsourced to other service providers. Predominantly this is associated with materials supply.

Table 4.7 Operations & Maintenance Activities

Operational or Maintenance Activity	Outsourced (Y/N)	Contract Name or Reference	Annual Cost (\$000)*	Duration (Start / End Dates)
Supply of Gravel (20mm)	Y	TBC	TBC	2019 - 2022
Supply of Gravel (63mm)	Y	TBC	TBC	2019 - 2022
Supply of Oil Mix (12.5 / 20 mm)	Y	TBC	TBC	2019 - 2022
Gradall	N	TBC	TBC	2019 - 2022
Vacuum Truck	N	TBC	TBC	2019 - 2022

\* Annual cost will either be estimated or actual depending on the status of the contract. Contract start and end dates will either be target or actual dates based on whether contract is currently in place.

# Maintenance Service Levels

Levels of Service are based on the Asset Maintenance Categories. These categories are based on the Functional Classifications outlined in the City's Complete Streets Design Standards (June 2018). Roads with higher traffic use will have shorter inspection and repair cycles.

- **Arterial** - defined in the Transportation System Bylaw, these streets carry larger volumes of traffic between areas with relatively few and controlled access points. The target design speed for arterial streets is 70km/hr.
- **Collector** - provide neighbourhood travel between local and arterial streets with direct access to adjacent land. The target design speed for collector streets is 50km/hr.
- **Collector Industrial** - as above, but specifically servicing industrial areas.
- **Local** - provide direct access to adjacent lands and serve neighbourhood travel and include service roads. The target design speed for local streets is 50 km/hr.
- **Local Industrial** - as above, but specifically allowing access to frontage of industrial properties and businesses.
- **Alleys** - provide direct access to adjacent lands typically parallel to other classification of streets and are typically used for rare access, deliveries, and waste collection to residential and business properties. The target design speed for Alleys is 20km/hr.
- **Rural Roads** are generally low traffic roads with speeds up to 80 km/hr located in forested and rangeland settings that serve residential, recreational and resource management uses.

Table 4.8 outlines the corrective maintenance repair Service Levels used for unpaved roads. Times to repair are calendar days.

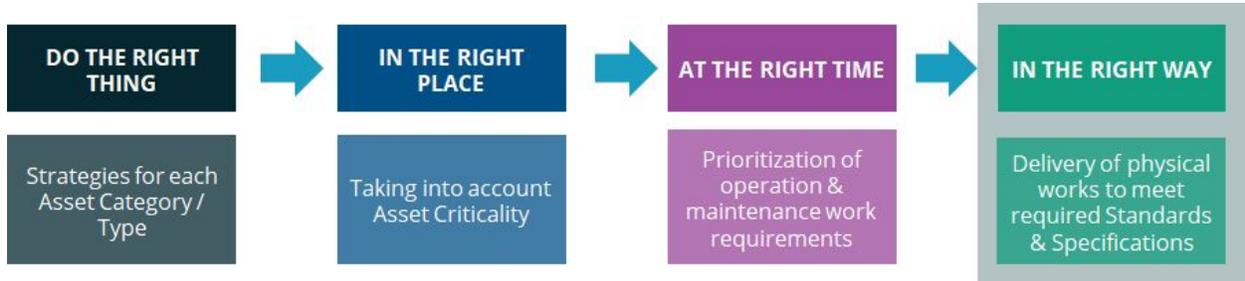
Table 4.8 Corrective Maintenance Service Levels

Asset Category	Time to Inspect	Time to Repair
Arterial Roads	24 hours	5 - 10 days
Collector Roads	24 hours	10 - 20 days
Local Roads	24 hours	20 - 60 days
Alleys	48 hours	60 - 180 days
Rural Roads (Annex)	48 hours	20 - 60 days

# 5. Supporting Processes

## Quality Processes

This Section outlines the specific quality control and quality assurance measures the City takes when completing unpaved roads maintenance. Quality control and quality assurance ensures that work is completed “in the right way” as shown in the figure below.



**On-site Quality Control** - check work is being completed in accordance with all regulatory and other adopted specifications and standards and Standard Operating Procedures (SOPs) throughout the duration of the maintenance task.

**Quality Assurance** - reviewing the quality of work completed at random locations and quality of materials used in the maintenance activities.

### Quality Control

Quality control processes are included in Table 5.1.

Table 5.1 Standards and Specifications

Asset Category	Asset	Quality Control Process
TBC	TBC	TBC
TBC	TBC	TBC

### Standards & Specifications

Maintenance activities are carried out in accordance with the Standards and Specifications in Table 5.2.

Table 5.2 Standards and Specifications

Asset Category	Asset	Regulatory Requirement or Standard
TBC	TBC	TBC
TBC	TBC	TBC

# Risk Management

Within the framework of the above developed plan, the following key risks to program delivery have been identified, along with mitigation measures.

Table 5.2 Risks and Mitigation Measures

Risk	Likelihood	Impact	Score	Mitigation Measures
<b>Not enough trained operators</b>	2	2	4	<ul style="list-style-type: none"> <li>Assess existing operator competencies, undertake gap analysis, and put training and development programme in place</li> <li>Develop a guideline for grader operators</li> <li>Training provided by approved tutor / instructor and performance monitored</li> </ul>
<b>Work not prioritized correctly</b>	2	4	8	<ul style="list-style-type: none"> <li>Develop Preventive Maintenance Program to help prioritize work by seasonal requirements.</li> <li>Develop a road condition assessment system to determine clear intervention requirements.</li> <li>Maintenance Service Levels in place to prioritize response to complaints.</li> </ul>
<b>Unseasonable and / or severe weather</b>	2	4	8	<ul style="list-style-type: none"> <li>Complete planned drainage maintenance during dry conditions.</li> <li>.</li> </ul>
<b>Equipment breakdown</b>	3	2	6	<ul style="list-style-type: none"> <li>Program of maintenance for all equipment, including seasonal equipment servicing.</li> <li>Have back up hire pool of equipment from external providers.</li> </ul>
<b>Insufficient aggregate material</b>	3	4	12	<ul style="list-style-type: none"> <li>Use Preventive Maintenance Program to establish likely seasonal material requirements ahead of maintenance completion</li> <li>Complete gravel loss study to determine average annual gravel loss and estimate annual gravel usage.</li> </ul>

# Stakeholder Management

**Identify key stakeholders in program planning and delivery.**

*Table 5.3 Key Stakeholders*

Position	Incumbent	Impact on Program
TBC	TBC	TBC
TBC	TBC	TBC
TBC	TBC	TBC

## *External Communication Key Messages*

Key messages to be communicated to citizen's and external stakeholders regarding the maintenance program for unpaved roads include:

- Repair methods and timing are weather dependent
- City of Edmonton utilizes a number of repair methods to ensure repairs can be completed both cost effective and strategically

## *Review of This Plan*

This Maintenance Guideline is treated as a live document, and where applicable, it has been updated as changes occur. The Maintenance Guideline will be reviewed and updated on a 4-yearly basis and submitted with the updated Asset Management Plan for unpaved roads.