RM AGGREGATE MANAGEMENT GUIDE

SARM

OUTLINE

This guide is intended to provide an overview of key sections and tools found in the **SARM AGGREGATE RESOURCE MANUAL**. The Aggregate Resource Manual highlights all relevant areas of Saskatchewan rural gravel planning and management, from guidance on opportunities and requirements on exploration, through planning and managing pits, and direction on cost planning, partnerships and innovative road maintenance techniques.

The guide provides insights into all relevant areas of the Manual, organized below:

1. THE GRAVEL LANDSCAPE
2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES
3. AGGREGATE MANAGEMENT CYCLE
4. COST CONSIDERATIONS
5. TOOLS, TEMPLATES & APPENDICES

1. THE GRAVEL LANDSCAPE

Rural roads are the backbone of the Saskatchewan economy and use aggregate on an annual basis to maintain the province's transportation system. Aggregate is defined as loose material particles such as cobbles, gravel, sand, silt and clay sized particles. It is a non-renewable resource and the natural depletion of supply that comes with annual maintenance needs has been further exacerbated in Saskatchewan by economic growth. This highlights the importance for RMs to optimize aggregate management through better management of existing gravel stocks, developing a long-term gravel sourcing strategy and applying technologies, processes and practices in constructing and maintaining rural infrastructure.

Economic growth has led to prosperity throughout Saskatchewan. However, it has also challenged RMs to be more strategic on aggregate and roadway management based on the key drivers to the right.

Increasing demand and competition has been especially noticeable throughout the last ten years. The economic boom led to increased investment in infrastructure in the province, requiring more aggregate-based products that have depleted local supplies and challenged RMs.

Decreasing supply is a natural extension of sharp demand increases and the non-renewable nature of the resource. This has led to depleted local reserves, longer hauling distances and less bargaining power for RMs in working with land owners and contractors.

The supply and demand issues have led to significant **price increases** over the past decade. Prices are also highly sensitive to local economic and roadbuilding activity and have led to significant fluctuations in annual prices that challenge RMs in financial and aggregate planning.

There has been an increase in **traffic and vehicle size** over the last several decades that has led to increasing wear and tear on roads and increased need for gravel. Road haul agreements designed to protect these assets have become outdated in terms of cost and enforceability, challenging RMs' road management programs.

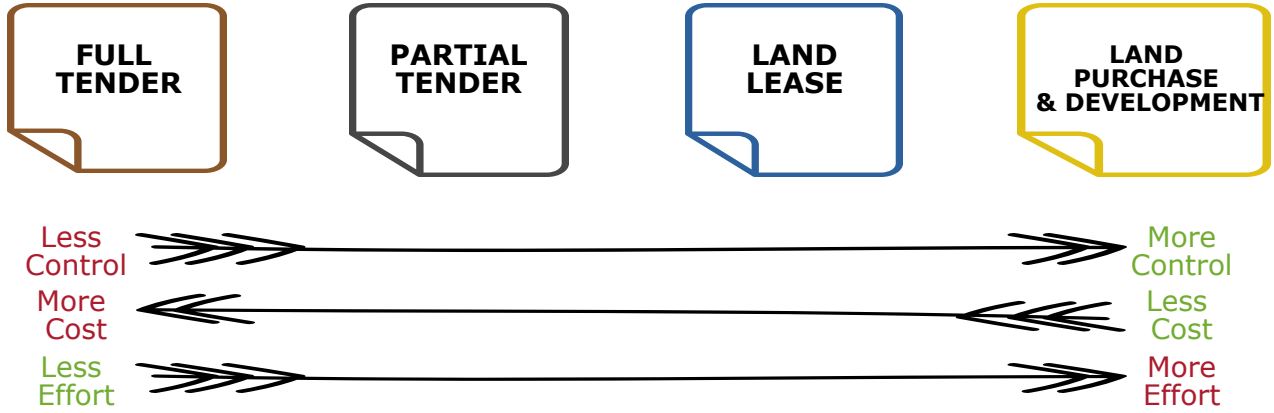
2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

Strategic gravel supply can come from a variety of different resources. RMs have different options available to them and it is not uncommon for an RM to use multiple different sources to cover their aggregate needs. These options include:

- Tendering the entire aggregate process (or certain pieces);
- Obtaining titles to property and manufacturing;
- Surface control by lease or permit;
- Obtaining quantity agreements with property owners;
- Damage agreements with the registered owner of the property; and
- Agreements on Saskatchewan Crown land.

There are many different factors that go into determining which option to choose, including:

- Availability of aggregate in the area;
- The type of material in the area;
- Who holds title to the property;
- Cost of aggregate in the area;
- Competition for aggregate in the area; and
- Expertise, know-how and capabilities of the RM.



2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

LEADING APPROACHES TO AGGREGATE SUPPLY

IDENTIFICATION & SOURCING

- **Strategic Identification:** Strategic identification includes a continuous search program. This can serve as a proactive approach to ensuring the RM will have continuous access to aggregate.
- **Seeking Partnerships:** Investigate potential partnerships with others to share costs.
- **Alternative Transportation Modes:** Close-to-market road hauling is still the most cost effective approach, but at some point, rail transport can become more cost effective.
- **Additional Strategies:** This includes working with consultants who may help test and suggest exploration areas. Additionally, desktop studies can be used to help find potential areas that may contain aggregate.

PIT LONGEVITY

- **Proper Planning:** The planned and systematic usage of an aggregate deposit including stripping of pits, placement of stripping, working of areas above and below the water table, dewatering, working of the pit to minimize reject materials, placement of reject materials and other factors that affect the production of a pit.
- **Selection of Materials:** The selection of materials within a pit area for the purpose for which they are best suited. As an example, the use of poorer pit areas for the production of subbase and traffic gravel is important so that higher quality aggregate pit locations can be utilized for production of base course aggregate.
- **Surveying:** A detailed survey is required to produce a plan for a new location or to update the plan of an existing location. The survey should include gravel boundaries, test holes, excavated areas, stripped areas, stripping piles, oversize rock piles, stockpiles, bush and fence lines, trails and roadways, waterways, topographic land features, utilities and structures located on site.
- **Reporting:** The systematic reporting of materials removed from a pit and the resulting change to the pit. This ensures that the pit status is current and up to date and planning for future projects will be efficient and remaining aggregate quantities are known.
- **Recycled Aggregates:** The use of recycled aggregates wherever possible and feasible. Some pit owners (RMs, MHI or private) may stockpile concrete rubble and recycled asphalt pavement at existing pit sites.

2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

LEADING APPROACHES TO AGGREGATE SUPPLY

ROADWAY DESIGN & LIFE CYCLE MAINTENANCE INNOVATIONS

1. Chemical Treatments

The use of chemical treatments is relatively new but has seen success in Australia, New Zealand and South Africa. They can be broken into seven categories. Deciding which category to choose is based on traffic, climate and cost. Chemical treatments are most effective when used during construction, rather than maintenance.

2. Clay Capping

Clay capping includes placing a layer of clay material on an existing road to stabilize the grade and improve the general ride quality of the road.

3. Geosynthetics Geotextiles & Geo Cells

Geo-synthetics are products that help to stabilize poor quality soils and are used in a variety of different construction activities, including roadway construction and de-watering activities.

4. Gravel Blading

The introduction of blading of graveled surfaces can help to extend the life of roads.

5. Road & Soil Stabilization

In general, stabilization is completed by stripping the shoulders that have extended outwards, bringing it all up and mixing in with different materials.

6. Recycling

RMs can promote the use of recycled aggregate (such as concrete and RAP) without compromising safety or durability of the infrastructure.

7. Spring Graveling

Spring graveling can be an alternative to graveling in the fall and risk having it bladed off in the fall/winter.

2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

GRAVEL PROCUREMENT

BEST VALUE PROCUREMENT

Traditionally, tendering processes have focused on low cost and most activities are straight-forward enough that there is a heavy emphasis on cost in evaluation and reward. Due to issues with low-bid procurement that does not account for experience, performance or ability to meet timelines, the Government of Saskatchewan pushed towards "best value procurement" through the Best Value in Procurement Act that amended The Highways and Transportation Act, 1997 and The Public Works and Services Act with the following:

> ***Subject to subsection (4), the minister shall: (a) obtain competitive prices for the construction or alteration of all public works through the public tender process mentioned in subsection (1); and (b) award the contract to the bidder whose bid, in the opinion of the minister, offers the best value taking into consideration all or any of the factors described in the tender documents."(4) The minister is not required to accept any tender".***

RMs with poor past experiences from simply accepting the low bid may look at integrating considerations for best value into procurement mechanisms. This can allow the RM to evaluate bids not only on cost, but experience, local knowledge and past performance.

MULTI-YEAR TENDERING

Additionally, RMs may consider multi-year tendering. Using a multi-year tender (such as two years vs. one) will provide the RMs with predictable pricing while providing the security of multi-year work for the outsourced resources.

GRAVEL SPECIFICATIONS

Gravel specifications for the following aggregate groups are provided in Section 3.3.2 "Common Gravel Specifications" in the Manual:

- **Sub-Base Gravel:** Gravel often used as a sub-structure beneath base gravel.
- **Base Gravel:** Gravel used for road structure gravel, often beneath asphalt.
- **Traffic Gravel:** Gravel often used in the gravelling of rural roads.

2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

HERITAGE RESOURCES

HERITAGE PROPERTY ACT

Through The Heritage Property Act Section 63(1), 1980, the Province of Saskatchewan mandates that any activity that may result in the damage, alteration or destruction of a heritage property may be subject to an archaeological investigation.

The Saskatchewan Heritage Conservation Branch (HCB) bases their screening criteria on several factors common to heritage sites. This includes proximity to previously recorded heritage properties, landforms and topological features.

If the HCB flags a potential development as potentially disrupting heritage land, development cannot occur until approved by HCB.

PROCESS OVERVIEW:

The following two steps are recommended as part of a comprehensive due-diligence program for aggregate development in Saskatchewan.

Desktop Screening: Can be done using the Ministry of Parks, Culture and Sport Developers Online Screening Tool to access quarter sections in Saskatchewan that have previously been reviewed. This helps developers plan in advance, knowing the potential likelihood that there might be a conflict in certain potential development areas.

Follow-up Heritage Resource Field Evaluations: Mitigation measures will be determined by the HCB through consultation with an archaeologist. If something is found, the HCB will provide several mitigation measures.

ADDITIONAL INFORMATION:

Depending on the outcome of the evaluation, there may need to be on-site monitoring during the excavation. Additionally, if there is a discovery of a sensitive heritage resource during the project it may cause the temporary or permanent shut down of the project.

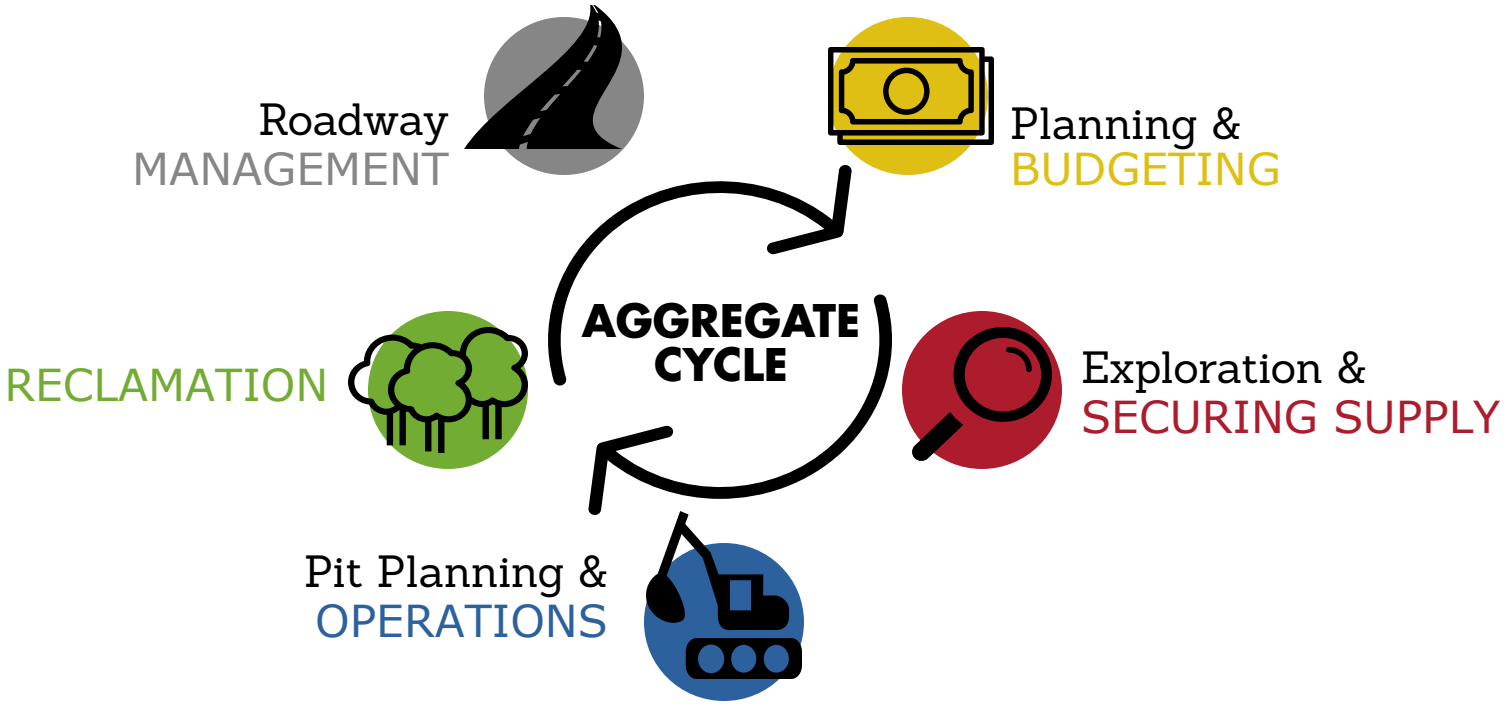
2. STRATEGIC GRAVEL SUPPLY BEST PRACTICES

PARTNERSHIP MODELS

Identified partnerships from across the province include partnerships with other governments, partnerships with private land owners and partnerships with First Nations.

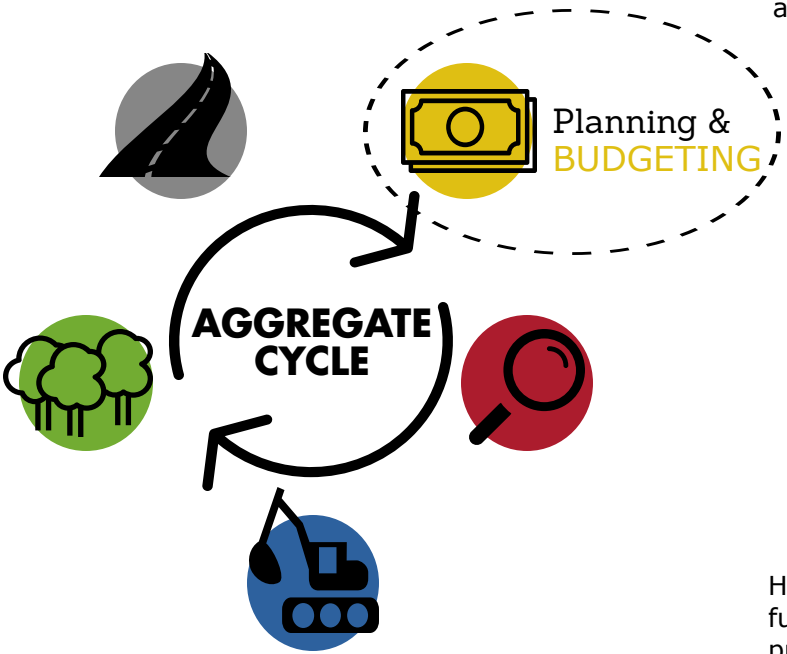
Partner	Examples
Other Governments	**Other RMs** • Sharing a gravel pit lease (or purchasing a pit) with another RM. • Allow other RMs to use the pits of a more aggregate-rich RM. • Purchasing equipment together to provide cost savings. • Developing gravel haul roads so that other RMs can transport aggregate from other areas to their RM. **Ministry of Highways & Infrastructure** • Partnering on decommissioned lands which have been stripped with minimal aggregate left over. • The exploration of crown lands. • The combined purchasing of materials from private sources.
Private Land Owners	• Quantity or yardage agreements for aggregate. • Damage agreements to remove aggregate. • Purchasing land to extract aggregate.
First Nations	• Excavate the gravel or purchase the aggregate directly from the various First Nations groups. • Source crushing capabilities from First Nation businesses.

3. THE AGGREGATE MANAGEMENT "CYCLE"



The aggregate management cycle can be broken into five parts from planning through to roadway management. RMs will have varying levels of involvement in each step depending on the longevity of their gravel sources and whether they choose to outsource or internalize various functions. However, working knowledge of all elements is essential for RM Administration to stay on top of an important aspect of their municipality.

3. THE AGGREGATE MANAGEMENT "CYCLE"



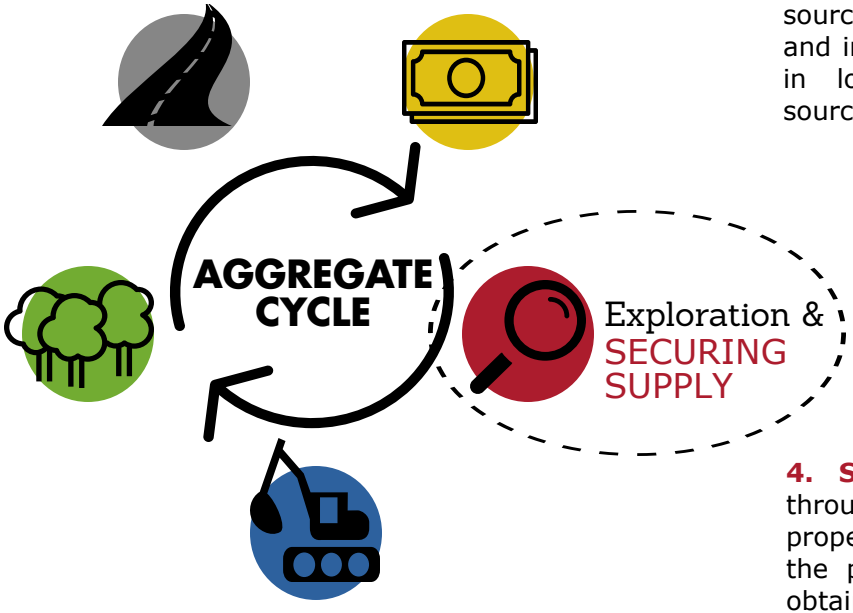
Planning and budgeting is the first step in an RM aggregate management program and includes the following key activities:

- Having an understanding of the existing and planned RM road system;
- Having an understanding of the existing source(s) of aggregate;
- Having an understanding of existing budget allocations to roads and the general level of service being provided through the maintenance program;
- Having an understanding of local economic and roadbuilding activity that could impact gravel demand and availability;
- Having an understanding of any existing agreements in place on aggregate supply;
- Recent ratepayer feedback on road management; and
- Understanding a short and long-term outlook for existing known aggregate sources.

Having a complete inventory of the present state and future outlook in your particular municipality and region will provide the foundation for the RM to develop a plan for aggregate sourcing, road management and budgeting. It will also highlight whether or not it's a pressing issue that requires increased attention or innovative solutions to establish a strong, long-term program.

3. THE AGGREGATE MANAGEMENT "CYCLE"

Determining the need for the amount of aggregate is an essential part of planning for any Rural Municipality. On an ongoing basis analyses are completed to understand a certain RM's current inventory, aggregate requirements and potential for exploration in order to secure the aggregate supply to meet their needs. These analyses include:



A "Practical Guide to Exploration" can be found on Page 46-47 of the Aggregate Resource Manual which outlines the best practices for exploring for aggregate.

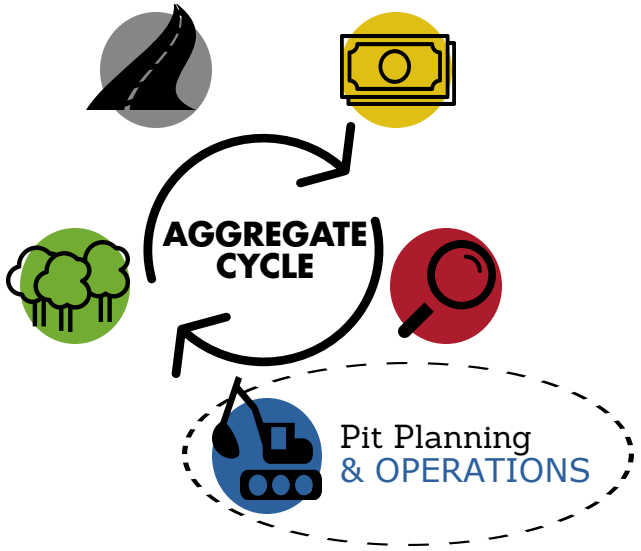
1. Understanding regional supply opportunities, such as if private operators, neighbouring municipalities or the Ministry of Highways & Infrastructure have excess supply.

2. Exploration and searches should be continuous, utilizing all potential avenues such as well drillers and industrial exploration. Searches around existing aggregate sources is also common practice. Making use of new and improved technology can also be extremely beneficial in locating new (or expanding existing) aggregate sources.

3. Testing potential aggregate sources should be done to determine if, in fact, the site contains aggregate. This can be completed using backhoes, drill rigs or any type of equipment that can extract samples from the proposed location. Once a site is confirmed to contain aggregate, further testing is required to determine the size and extent of the source.

4. Securing aggregate supply can be undertaken through several methods including obtaining title to the property, damage agreements with the registered owner of the property, surface control by lease or permit or by obtaining title to the property. The methodology will depend on various factors such as the quality and quantity of material in the pit, who holds title to the property, the competition in the area and the willingness of the landowner to enter into an agreement.

3. THE AGGREGATE MANAGEMENT "CYCLE"



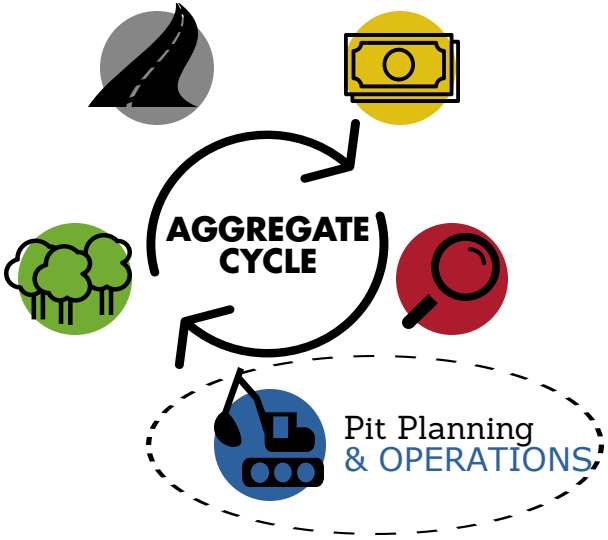
1. STRIPPING & EXTRACTION: The first step in pit utilization is the stripping of topsoil and overburden from potential aggregate sources. Sources with topsoil greater than 0.4 m in thickness should be reviewed further to better understand the reason for the extensive thickness. The overburden is the material between the topsoil and the aggregate. Extraction is one of the core activities that occurs when then aggregate is removed from the pre-determined area. There are several plans that are needed, focusing on both the short-term extraction and a master long-term plan.

Extraction and pit utilization should be done using a systematic approach to the use of an aggregate source. There should be considerations to 'production-related' plans focusing on the actual extraction of the aggregate, while 'non-production' plans focus on other considerations, such as the noise and dust externalities.

2. PROCESSING: A processing plant typically includes crushers (primary and/or secondary), screens, conveyor belts, feeder bins, generators and other heavy equipment. Due to the nature of the equipment it can create some concerns among ratepayers, especially with regards to noise, dust and visual impacts.

3. STOCKPILING: In some cases, stockpiles can take up as much as half of the land that the operation is based on and often is one of the most negative visual externalities. The number of stockpiles that exist in any operation may vary and different materials (traffic gravel versus base course) should be well separated to prevent contamination. Ensuring that the stockpile location and sizes are conducive for future extraction is critical.

3. THE AGGREGATE MANAGEMENT "CYCLE"



4. TRAFFIC PLANNING: In some instances, hauling and transport can represent the highest costs in the production of aggregate for an RM. Hauling of aggregate can also be one of the bigger sources of negative externalities, as it can be loud, congest the roads and lead to premature deterioration of the road structure. Considerations should be made to both on and off-site traffic planning.

5. STORMWATER & EROSION CONSIDERATIONS: It is important to plan for and understand the effect of stormwater since it can lead to erosion and/or collect other sediments or pollutants. The goal of planning for stormwater management is to control the flow of water across a site, control erosion by stormwater, manage sedimentation caused by stormwater and ensure that any discharge from the site is free of pollutants or sediment.

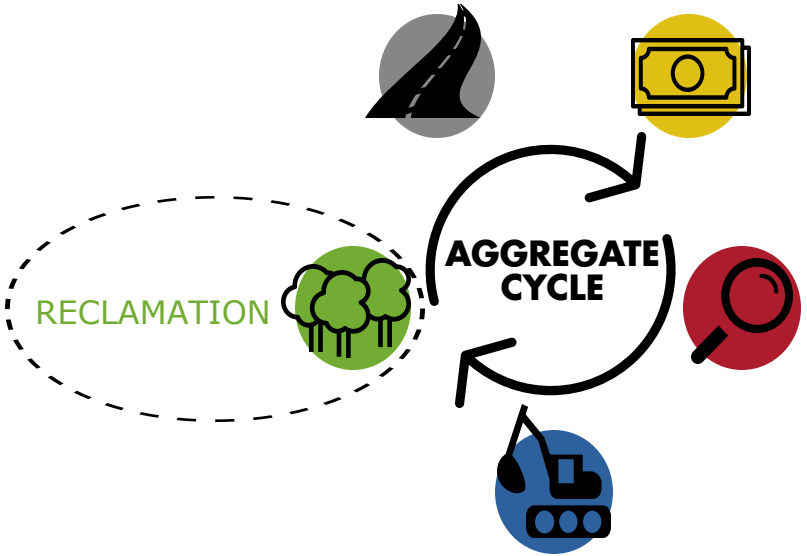
6. BY-PRODUCTS & WASTE CONSIDERATIONS: By-products and waste have no added value to the aggregate production so cost recovery for removal of these materials is generally included in the aggregate production costs.

7. SITE LAYOUT PLANNING: In general, there are three major negative externalities that may become issues as an RM develops an aggregate pit (although in actuality there are many others). These externalities are noise, dust and visual (or aesthetic). Proper planning in advance will help to limit these externalities and help mitigate potential issues with community members.

8. RISK MANAGEMENT: Risk management looks at several of the major risks and ways to mitigate or even eliminate them. The risk considerations discussed include emergency spill response plans, employee training, environmental risks and community relations.

3. THE AGGREGATE MANAGEMENT "CYCLE"

Reclamation and restoration is an integral part of the extraction process and as such should always be included in the pre-extraction planning process. The main objective of reclamation and restoration is to return the land disturbed through mining into the most appropriate and productive condition after use of the site. The planning process for reclamation should include all stakeholders including landowners, operators, approving agency, local authorities and any others with a vested interest in the property.

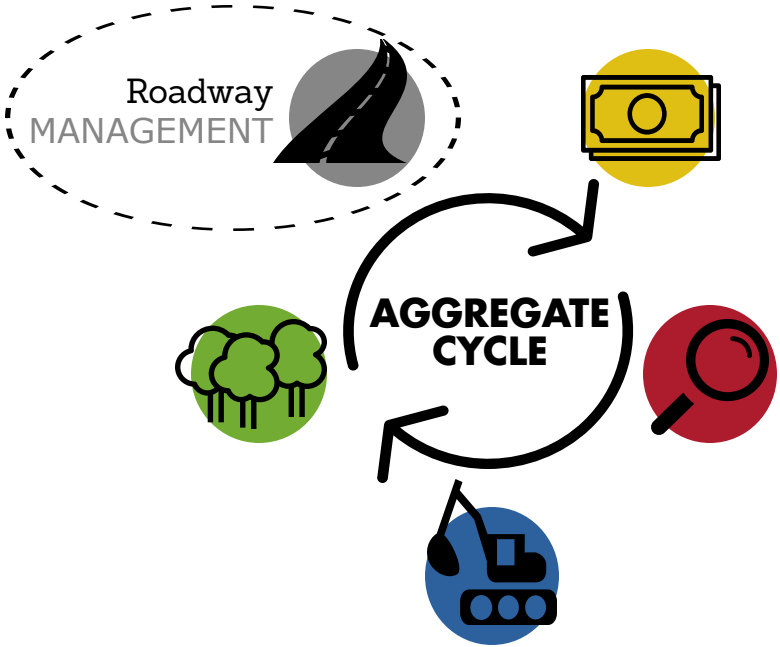


Reclamation and restoration should occur during mining operations (progressive restoration) or as soon as possible after mining has been completed (post excavation). Some of the main concepts to consider when planning for and completing reclamation include:

- **Extraction is Temporary:** Operators should ensure not to limit post-extraction land uses and act to move land back to its primary state. In general, agriculture lands should be reclaimed to similar soil quality as before and native prairie and wetlands should be replaced in approximately the same amounts as before.
- **Plan the End Use First:** A specific land use can be determined during permitting. It may be difficult the longer the crusher is expected to be in operation.
- **Plan for Reclamation:** Operator, landowner, approving agency/local authority should plan for reclamation jointly. This planning can reduce costs by decreasing double handling and will ensure all stakeholders have input in the planning process.
- **Account for Uniqueness of the Pit:** This includes pit locations, the grade, the scale of the operation, the geometry of the deposit, the surface geometry, the grade distribution of the deposit, surrounding area, zoning and other restrictions.

3. THE AGGREGATE MANAGEMENT "CYCLE"

Routine maintenance and rehabilitation activities are a factor in aggregate management. Standard activities such as maintaining a proper cross section and shoulder of roadways are important to promote proper drainage from rainfall events. Standing water on existing roads leads to loss of surface aggregate through softening of the grade causing failures which in turn forces gravel out. Improper blading techniques for gravel roads such as improper operating speed, improper mold board angle and pitch and motograder stability may also cause issues. Mowing of shoulders is very important as properly mowed shoulders will make the recovery of gravel that has drifted to the edge of the roadway much easier. Proper failure repair techniques, incorporation of adequate drainage in ditches and culverts, and proper use of "good surface gravel" are all important. Dust control programs will lead to cost savings through reduced gravel loss, reduced blade maintenance requirements and reduced overall maintenance requirements. Finally, innovation in gravel road maintenance is extremely important due to the changes in the type of traffic coupled with constant pressure on funding and staffing resources.



Some of the key required actions to maintain roads include the list to the right:

- ***Routine Maintenance and Rehabilitation of Gravel Roads***
- ***Ensuring Quality Surface Gravel***
- ***Utilizing Dust Control and Stabilizations***
- ***Innovations***

4. COST CONSIDERATIONS

COST COMPONENTS OF GRAVEL

There are several different components which make up the overall cost of gravel, including:

- **EXCAVATION COSTS**
- **CRUSHING COSTS**
- **HAULING COSTS**

If an RM has chosen to tender out their gravel needs to a private contractor, these additional fees may be part of the cost:

- **GRAVEL EXTRACTION FEES**
- **ROAD MAINTENANCE AGREEMENT FEES**

ALL-IN COSTS OF GRAVEL

All-in Costs for Aggregate, by Aggregate Type (Yards)

Aggregate Type	Average	Low	High	Number
Traffic Gravel	$10.87	$2.00	$29.66	40
Sand	$6.93	$1.00	$17.19	8
Pit Run/Raw Aggregate	$5.35	$1.00	$14.37	29
Base	$13.52	$1.00	$24.19	8
Other	$7.77	$0.12	$34.19	10

All-in Costs for Aggregate, by Division (Yards)

Division	Average	Low	High	Number
1	$8.09	$1.75	$22.50	16
2	$10.73	$1.75	$25.50	8
3	$9.33	$1.00	$25.50	13
4	$7.23	$1.00	$29.66	12
5	$5.99	$0.12	$20.00	24
6	$11.99	$3.50	$34.19	22
Total	**$8.75**	**$0.12**	**$34.19**	**95**

4. COST CONSIDERATIONS

EVALUATION OF COST SURVEY

The results on the previous page show the wide variability of aggregate cost. The analysis of division costs showed less volatility than the 'by type' analysis but highlights that even in similar general areas, costs could vary as much as double. The following factors can be used to explain variation in costing from the MHI study:

- **Varying Supply within a Division**: Aggregate supply among RMs within a division can vary considerably with those RMs that own and/or manage pits within their own division having natural advantages over RMs that need to go outside of their own division for supply.
- **Proximity to Demand:** A deeper analysis of findings highlight that RMs closer to major population centres saw escalated costs, which is to be expected but does not get highlighted in summary level data tables.
- **Varying Cost Components:** MHI noted that cost information provided may have included some variation in all the costs that were included or on what components of costs RMs include in their total all-in price.
- **Selection Bias:** Although not confirmed in any way, there is a chance that there was some selection bias in responses. For example, some RMs may not have responded to the survey if they felt they may have high costs or similarly some RMs with very low costs may have preferred to keep that information confidential.

The data provided is good for general benchmarking, although comparison information, particularly among immediate neighbours, is a much better gauge of costs and whether your RM is getting value for money. This can be completed through a Cost Collaboration Model.

4. COST CONSIDERATIONS

COST COLLABORATION MODEL

There are some areas of the province that are currently working together to openly share information, which provides a roadmap for RMs to work together to significantly enhance their understanding of regional conditions and better articulate if they are receiving value for money for their aggregate. The benefits of developing an information-sharing environment include:

- **Understanding regional 'all-in' aggregate costs;**
- **Understanding component costs (such as crushing, loading, hauling);**
- **Knowing the different contractors that operate in the region;**
- **Understanding different employee structures and pay scales;**
- **Understanding the different equipment owned by adjacent RMs;**
- **Maintaining and understanding of the aggregate landscape in the area; and**
- **Becoming aware of different innovations used.**

In addition to the obvious benefits of being able to compare your RMs cost environment to that of comparable RMs in your region, some of these opportunities to work together may include utilizing innovative practices to source and conserve aggregate. An example/template can be found on page 97 of the Manual.

4. COST CONSIDERATIONS

COST BENEFIT ANALYSIS MODEL

A cost-benefit analysis (CBA) is a useful tool that can be used when looking at alternative investment options to achieve the same outcome. Specific to aggregate management in RMs, a CBA could be conducted to consider alternatives related to gravel sourcing, using innovative materials or using internal vs. outsourced resources. RMs have a responsibility to their ratepayers to provide services in the most efficient and cost-effective manner as possible. CBAs can be a powerful tool that can look at various different scenarios and how they affect the long-term economic outlook for an RM. CBAs analyze Net Present Values of different scenarios over long periods of time, such as 25 years for infrastructure analysis. One relevant example might be if an RM is considering the purchase of land for gravel compared to the option of seeking a quantity agreement.

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Cost Benefit Analysis

25 Year NPV	$0	Investment	$0
Discount Rate	4%	Rate	0%
Inflation Rate	2%	Periods (Yrs)	0

Item	Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
SUB-TOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Surplus (or Deficit)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

5. TOOLS, TEMPLATES & APPENDICES

The **Aggregate Resource Manual** also provides several tools, templates and appendices which can be used by different RMs to help with the management of their aggregate systems. These tools include draft agreements, draft tendering documents, draft bylaws and more. RMs must carefully read the templates before using. The following list outlines the tools and templates included in the Aggregate Resource Manual:

1. **Road Maintenance Agreement Template**
2. **Road Maintenance Agreement Template (Government of Saskatchewan)**
3. **Gravel Tender Template**
4. **Gravel Crushing Tender Template**
5. **Gravel Hauling Tender Template**
6. **Gravel Crushing Agreement**
7. **RM & Private Land Agreement**
8. **Extraction Fee Bylaw & Reporting Form**
9. **Fuel Tank Emergency Plan Template**
10. **History of Aggregate Deposit Form**
11. **Engineer Consulting Template**
12. **Cost-Benefit Analysis Model & Instructions**

Additionally, the following appendices are included:

1. **Specifications: Sub-Base Course**
2. **Specifications: Granular Base Course**
3. **Specifications: Traffic Gravel**
4. **Aggregate Exploration Tools**
5. **Sand & Gravel Lease Policy: Government of Saskatchewan**