Governance & Services Committee Report

TO: Governance & Services Committee

FROM: Ron Fralick, Planning Manager

DATE: June 4, 2013

SUBJECT: Aggregate Supply and Demand Study Update (File: 6430-17)

RECOMMENDATION:

THAT the Governance and Services Committee receives the report of June 4, 2013 from the Manager of Planning and attached submission from EBA Engineering with respect to updating the Aggregate Supply and Demand Study (2000).

Purpose:

To provide the Governance and Services Committee with an update from our consultant, EBA Engineering Consultants Ltd., on status of the project to update the Aggregate Supply and Demand Study (2000).

IMPLICATIONS OF RECOMMENDATION:

Strategic Plan:

The RDCO Strategic Plan – Vision 2020 – Planning for the Future (2012 Program – High Level Initiatives Related to the Board’s Identified Priorities) includes the Aggregate Supply and Demand Study update to be completed in conjunction with review and update of the Regional Growth Strategy (RGS).

Organizational:

Board resolution #31/12 of February 9, 2012, approved the Aggregate Supply and Demand Study update to proceed in conjunction with the Regional Growth Strategy update. In accord with the Board approved Terms of Reference (Appendix D – Schedule), staff and the consultant were to report back to the Board at key milestones as the project moves forward.

Background:

The Regional Board endorsed the project moving forward late 2012 seeking a qualified consulting firm to update the status of supply and demand of aggregate in the RDCO, and provide an analysis of potential constraints and criteria for site selection.
The updated study will build on the supply and demand data contained in the Aggregate Supply and Demand 2000 Study and project forward supply and demand over the next 100 years.

Conclusion:

The updated Aggregate Supply and Demand Study will be an addendum to the RGS representing a valuable document for use by the Regional District, member municipalities, and producers to address future aggregate resource needs. As noted on page one of the report, staff and the consultant were to report back to the Board at key milestones (70% completion) as the project moves forward.

To this end, the RDCO consultant has prepared a package of information which is appended to the report (Executive Summary). A copy of the full report can be made available to Board members upon request. It is noted that the consultant will attend the June 13, 2013 Governance and Services Committee meeting to make a presentation on the work completed to date.

This is for your consideration.

Submitted by:

R. Fralick
Planning Manager

C. Radford
Director of Community Services

Attachments: Aggregate Supply and Demand Update & Analysis
(June 4/13 Executive Summary)

Considerations not applicable to this report:

General
Financial
Policy
Alternatives

Approved for Board's Consideration

Brian Reardon, CAO
EXECUTIVE SUMMARY

"Minerals are essential for development and through that, for our quality of life, and creation of sustainable communities. Minerals planning ensure that the need for minerals by society and the economy is carefully balanced against the impacts of extraction and processing on people and the environment."

The Local Government Act says the Regional Growth Strategy (RGS) should work towards maintaining the integrity of a secure and productive resource base and ensuring adequate inventories of suitable resources for future settlement. The intent of this study is to contribute to the planning and maintenance of a secure and productive aggregate resource, balanced with environmental and community considerations.

Aggregate in the Community

The development and maintenance of our communities as we know them are dependent upon aggregate, and its extraction, processing, and transportation. Approximately 65 percent of aggregate produced is used simply to maintain our current infrastructure. We need its products, such as concrete and asphalt, to build communities that have a greater population density, which in turn reduces the pressure on our natural landscape, road systems and greenhouse gas production.

Yet there can be neighbourhood and environmental concerns with aggregate pits and quarries. Issues of dust, noise, visual impacts and safety have been putting pressure on pits close to market. However, when operations are pushed further from market, the result is increased costs, road impacts and greenhouse gases. In addition, natural sand and gravel is the result of 10's of thousands of years of geological activity. As such, it is essentially a non-renewable resource, existing only where nature put it. We run the risk of sterilizing the resource by not using close to market deposits first.

Neighbourhood concerns have resulted in conflicts, and citizens and local governments are seeking active involvement in the permitting process. In consultation with local governments, we have developed a Site Suitability Assessment process that addresses environmental and neighbourhood issues. The intent is a process that:

- Provides consistency through the Regional District of the Central Okanagan (RDCO) for each Mines Act application referral.
- Addresses truck routes, land use, environmental and adjacency factors.
- Provides recommendations based on existing provincial Best Management Practices (BMPs).
- Facilitates communication processes between the Ministry of Energy, Mines and Natural Gas and Responsible for Housing (MEMNG) and local governments.

To provide the basis for this approach, we set out to find the answers to:

- Where are aggregate sources in the RDCO?
- How much natural sand and gravel is available within the RDCO boundaries?
- How much aggregate will communities within the RDCO need over the next 20, 50 and 100 years?
• What are potential impacts to the environment and groundwater from extraction, and how can these be mitigated?
• What are the impacts of dust, noise and visual quality, and how can these be mitigated?
• What are the resulting greenhouse gases, and how do these change based on pit location?
• What are the road impacts, and how do these change based on pit location?

Report Structure

The executive summary includes the key findings and recommendations of the project. The report body includes background, methods, supply and demand results, and analysis of environmental and groundwater factors, infrastructure impacts, greenhouse gas emissions, noise, health (dust and radon), and visual quality. Detailed recommendations are included at the end of the report. Mapping results follow in the figures. Background information and the Site Suitability Assessment is included in the appendices. A summary of key findings and recommendations follow in the executive summary.

Supply

Aggregate comes to us through three main supply sources:

- Natural sand and gravel;
- Bedrock;
- Recycled aggregate.

Each of these sources has been reviewed for this study. Mapping of natural sand and gravel deposits, as well as bedrock, has been prepared for the District. Figure 8 illustrates and gravel deposits outside of existing residential, institutional and commercial land use areas.

Through our survey, local producers have provided a snapshot of current supply under permit, as well as aggregate composition, use, transportation routes and cost. Recycled concrete and asphalt provide yet another source of aggregate. Each component is assessed for potential supply.

Table 1 outlines potential sand and gravel volumes based on surficial geology mapping and borehole data. Areas along creeks and lakeshores are included in this estimate.

### Table 1. Sand and Gravel Quantities Based on Borehole Data

<table>
<thead>
<tr>
<th>Aggregate Potential</th>
<th>Area (km²)</th>
<th>Volume Estimated (m³)</th>
<th>Tonnage (tonne)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>High</td>
<td>111.84</td>
<td>309,860,000</td>
<td>950,830,000</td>
</tr>
<tr>
<td>Moderate</td>
<td>128.52</td>
<td>110,270,000</td>
<td>308,190,000</td>
</tr>
<tr>
<td>Low</td>
<td>154.52</td>
<td>10,830,000</td>
<td>200,890,000</td>
</tr>
<tr>
<td>Totals</td>
<td>394.87</td>
<td>430,960,000</td>
<td>1,459,920,000</td>
</tr>
</tbody>
</table>

*Based on unit weight conversion of 1.7 tonnes / m³
Evaluating Bedrock Aggregate Potential

The classification of hard rock aggregate potential for this study was based on two key parameters, rock type and overburden thickness. Overburden thickness provides an idea of how economical the rock will be to mine. That is, a thin overburden will be more economical, with less waste, than areas of thick overburden. The results are shown in Figure 5 - Aggregate Potential Bedrock Polygons with Overburden, attached.

Producer’s Survey

Table 2 shows details of supply currently under permit, based on the local producer’s survey.

<table>
<thead>
<tr>
<th></th>
<th>Sand &amp; Gravel</th>
<th>Quarryed Rock</th>
<th>Recycled Asphalt</th>
<th>Recycled Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Production (2012)</td>
<td>1,500,000</td>
<td>165,000</td>
<td>63,300</td>
<td>49,300</td>
</tr>
<tr>
<td>Supply Under Permit</td>
<td>59,000,000</td>
<td>9,500,000</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Based on 2013 Producer’s survey, in metric tonnes

Table 3 illustrates typical hauling distances and costs, based on the local producer’s survey.

<table>
<thead>
<tr>
<th>Aggregate Product</th>
<th>Hauling Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of Typical Area of Service</td>
<td>Site to 70 km</td>
</tr>
<tr>
<td>Average Hauling Distance for road fill, structural fill, concrete and asphalt</td>
<td>17 km</td>
</tr>
<tr>
<td>Extent of Hauling Distances for specialty products (e.g. landscape rock &amp; masonry sand)</td>
<td>Site to 2500 km</td>
</tr>
<tr>
<td>Average Cost – Truck per hour</td>
<td>$94</td>
</tr>
<tr>
<td>Average Cost – Truck and Trailer per hour</td>
<td>$115</td>
</tr>
</tbody>
</table>

*Based on 2013 Producer’s survey

Recycled Aggregates

Recycled concrete and asphalt present an additional source of aggregate for the RDCO. Asphalt and concrete waste comes from the demolition of roads, sidewalks, bridges and buildings. Other materials that can be incorporated into aggregate materials include asphalt shingles, crushed glass, brick, fly ash, and blast furnace slag.

The utilization of recycled aggregate varies between jurisdictions, as does the demand per capita of aggregate in general. Below is a selection of recycling rates relative to total consumption of aggregate per year:

- RDCO - 7.8% (2012, based on producer’s surveys, not including MOTI figures)
- Ontario MOT - 18-19% (for highways in 2006)
- England (UK) - 28%
The Master Municipal Construction Documents (MMCD) indicates that recycled concrete may be used for road base and sub-base material, with the approval of the Contract Administrator. The MMCD states that hot-mix asphalt concrete paving may contain up to 20% of recycled asphalt in a new asphalt mix, without a special mix design. The Ministry of Transportation and Infrastructure (MOTI) has a specification for hot-in-place asphalt recycling, but no reference specifically to recycled concrete use.

Demand

"The only substance people consume more of than concrete is water; every year one ton of concrete is produced for each person on earth."v

Demand figures were used based on Canada Census and BC Stats data, using consumption figures based on published literature and projected growth rates.

Table 4 illustrates projected consumption over 20, 50 and 100 years for individual demand areas, and the RDCO as a whole, at an average consumption rate of 12 tonnes per capita, and an average growth rate of 1.5%.

<table>
<thead>
<tr>
<th>Area</th>
<th>0-20 Years</th>
<th>21-50 Years</th>
<th>51-100 Years</th>
<th>0-100 Years Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelowna</td>
<td>34,658,200</td>
<td>75,779,000</td>
<td>232,496,900</td>
<td>342,934,100</td>
</tr>
<tr>
<td>West Kelowna</td>
<td>9,126,600</td>
<td>19,955,000</td>
<td>61,223,900</td>
<td>90,305,500</td>
</tr>
<tr>
<td>Lake Country</td>
<td>3,459,000</td>
<td>7,562,900</td>
<td>23,203,700</td>
<td>34,225,600</td>
</tr>
<tr>
<td>Peachland</td>
<td>1,536,300</td>
<td>3,359,000</td>
<td>10,305,700</td>
<td>15,201,000</td>
</tr>
<tr>
<td>Electoral Areas</td>
<td>1,696,400</td>
<td>3,709,100</td>
<td>11,379,900</td>
<td>16,785,400</td>
</tr>
<tr>
<td>First Nations</td>
<td>2,654,500</td>
<td>5,804,000</td>
<td>17,807,100</td>
<td>26,265,600</td>
</tr>
<tr>
<td>RDCO (Total)</td>
<td>53,131,000</td>
<td>116,169,000</td>
<td>356,417,200</td>
<td>525,717,200</td>
</tr>
</tbody>
</table>

Figure A, below, illustrates the demand by area, based on existing population and a consistent growth rate of 1.5% through the RDCO over the next 20, 50 and 100 years.
Permitting - *Mines Act*

Sand and gravel operations and rock quarries must be permitted by the MEMNG under the requirements outlined in the *Mines Act*. A mine permit is required for both sand and gravel operations and rock quarries whether on private or Crown Land. Applications are subjected to a 30 day, inter-agency review process as well as a public review/comment period, which may include a public information meeting(s). Proposals deemed to be sensitive maybe referred to the local Regional Mine Development Review Committee (RMDRC). The RMDRC is comprised of representatives of both federal and provincial government agencies whose interests may be affected by the proposed mine. Local government and First Nations may also invited to participate as members of the RMDRC. Usually, draft copies of the *Mines Act* permit are circulated to the RMDRC members as an opportunity for final comments subsequent to the Committee's review. Generally, First Nations are consulted on where First Nation interests may be impacted.

**Figure A.** Consumption at 1.5% Growth Rate and 12 Tonnes per Capita by Demand Area
Legislation

Federal and provincial legislation protecting species at risk, migratory birds, and fish and fish habitat, has the potential to affect aggregate extraction. In addition, provincial legislation with respect to land tenure, the Agricultural Land Reserve, soil conservation and forest practices may need to be addressed as part of the application.

Soil Removal and Deposit Bylaws

To date, the City of Kelowna, District of Lake Country, District of Peachland, and District of West Kelowna have bylaws for soil removal and deposit. The fees, conditions and permit requirements vary between jurisdiction. Regional Districts are not allowed to implement volume based deposit or removal fees, because road maintenance is done by the Ministry of Transportation and Infrastructure (MOTI). As such, the RDCO has not pursued a Soil Removal and Deposit Bylaw to date.

Analysis

Within the framework of the environmental and groundwater conditions, community concerns, greenhouse gas impacts and road and traffic impacts, there are many considerations with respect to aggregate operations. The following sections outline considerations regarding environment, groundwater, greenhouse gas generation, land use, noise, dust, visual impacts and road and traffic.

Environment

Environmental sensitivities have the potential to constrain aggregate production, and in turn, aggregate production has potential to impact the environment. Federal, provincial and local legislation and guidelines are in place to safeguard the environment. According to the Aggregate Operator’s Best Management Practices (BMP) Handbook:

"All aggregate production must be carried out in an environmentally sensitive manner. This can be accomplished through careful planning and BMP use on the property, and through coordinating on-property activities with the environmental activities of the immediate neighbouring area."

Aggregate extraction has the potential to impact the environment in a number of ways, including terrestrial and aquatic habitat loss through vegetation removal, sedimentation of water-bodies, dust, changes to surface hydrology and groundwater through water pattern changes and/or water use, and potential acid rock drainage.

Groundwater

Groundwater resources can potentially be impacted due to aggregate operations. While gravel and its removal is inert, ground water impacts are possible due to the removal of vegetation, topsoil, overburden, due to the handling of fuel on-site, or through the use of groundwater, if required by the operation. Issues of consideration with respect to groundwater include:

- Location and final excavation depth with respect to vulnerable groundwater aquifers;
- Proximity to water wells;
• Metal leaching and acid rock drainage from site;
• Fuel storage siting and design;
• Septic system siting and design (if applicable);
• Water demand for operations (if applicable); and
• Removing/stockpiling overburden or aggregate.

Greenhouse Gas Emissions

To prepare an assessment for greenhouse gas (GHG) emissions, a GHG calculator was prepared specifically for aggregate production, which could be used for any operation, with a variety of processing activities. The calculator also includes transportation inputs. However, assuming the same trucks are used, transportation emissions of the aggregate material are generally going to vary only by the distance travelled. The calculator also allows the user to select different fuel types, to demonstrate the different emission associate with fuel choice. It may or may not be possible to utilize some trucks with different fuel choices. Transportation emissions are equally as important to overall emissions as processing emissions, and obviously the less the distance travelled from aggregate extraction place to mixing area, the lower will be the emissions.

For processing emissions, natural sand and gravel has the lowest associated emissions (1912.81 CO2e kg CO2e / t) followed by recycled concrete (2885.40 kg CO2e / t). Recycled asphalt is more intensive (5418.6 kg CO2e / t) with quarried rock being the most emissions intensive aggregate to process (8,129.72 kg CO2e / t), due to the blasting process required.

Infrastructure Impacts

As part of this study, the potential impact of aggregate hauling on existing roads was also undertaken. For this assessment, the exact location of the aggregate sources, volumes of aggregates, duration of aggregate hauling and the haul routes were not available. The analysis, therefore, was completed based on hypothetical scenarios to illustrate the potential impacts resulting from the hauling of the aggregate.

The aggregate hauling operation would result in increased traffic volumes on the roads included in the haul route. Typically, pavement structures are designed for specific traffic volumes and an increase in the traffic volume or truck size would result in the consumption of the pavement service life. This may result in premature failure of the pavement structure and required earlier rehabilitation interventions or reconstruction.

The results of the infrastructure assessment indicate that road impacts are directly related to existing road condition. While a Type A pavement structure, such as that on main arterials and highways, results in a small impact of service life under a similar trucking impact, Type B (collector roads, typically) has an additional impact and the service life of Type C roads (local roads) is significantly impacted under the same loads.

Figure B illustrates the relative impact of having 1,000,000 tonnes of aggregate over a Type A, Type B and Type C pavement structure.
Figure B. Impact of 1,000,000 MT of Aggregate Hauling on Pavements

Noise

A key community concern of aggregate operations is noise. Noise can be caused by a number of sources, including crushers, screeners, trucks, generators, loaders, scrapers, and for quarry operations, hydraulic hammers and blasting. Noise levels depend on distance from the source, direction, and the amount of reflection, absorption or deflection present.

The Health, Safety and Reclamation Code (the Code) recommends mufflers be installed on machinery and sets maximum permissible noise exposure limits of $L_{eq} = 85$ dBA average for 8 hours or equivalent, plus additional peak noise impulse restrictions. In addition, each local government has a noise control bylaw that regulates hours of construction.

Dust

The dust created by an aggregate operation will vary, depending on site conditions, weather, nature of the material and operations. Dust becomes airborne through a number of activities, including surface stripping, handling, crushing or screening, loading, and blasting of materials, if present. Dust can also be released by truck traffic over unpaved surfaces, and wind over stockpiles.

Dust is defined as any particle up to 75 microns ($\mu m$) in size. Dust can come from a variety of sources including vehicle exhaust, agriculture, domestic and forest fires, and tire wear. Small particles of dust travel farther than larger particles. Particulate matter, less than or equal to $10\mu m$, are referred to as PM$_{10}$ also...
present a greater health risk than larger particles. The dust indices typically described in the news and air quality reports usually refer to dust smaller than 10 μm. Particulate matter less than 10 microns is divided up into two categories. The Environmental Protection Agency (EPA) uses the following definitions:

- **PM<sub>10</sub>**  ‘Inhalable coarse particles’ – are from 2.5 to 10 microns in size, and can be found near roadways and dusty industries.

- **PM<sub>2.5</sub>**  ‘Fine particles’ - are less than 2.5 microns in size, such as those found in smoke and haze. Typical sources include forest fires, or when gases from power plants, industries and automobiles react in the air.\(\text{**III**}\)

PM<sub>10</sub> dust and smaller is a health concern because these particles can pass through the nose and throat into the lungs. PM<sub>2.5</sub> is considered the most significant health concern, as they are most apt to be trapped in the lungs\(\text{**III**}\). It is for PM<sub>2.5</sub> that standards for air quality are established in Canada and the United States.

Larger particles will fall out more quickly than small ones, which travel farther. Most aggregate dust is over 30 μm, which will fall out within 100 m of its source. Intermediate particles will fall out between 200-500 m of its source. Particles under 2.5 μm can travel over 1000m\(\text{**IV**}\). Particles under 10 μm are considered a health concern, as these are not removed by normal respiration. Approximately 94% of the dust created by aggregate operations is dust with particle size over 10 μm. This component is not typically inhalable or respiratory, and as such, is not considered a health concern.

**Radon**

Radon is naturally occurring radioactive gas that is produced in the ground by decay of uranium. Radon gas may accumulate in enclosed areas, particularly in confined areas such as the basement of a house. Long term exposure to high concentrations of radon increases a person's risk of developing lung cancer\(\text{**III**}\). For this study, the regional bedrock geology information was reviewed to evaluate if there is potential for uranium and radon gas in the areas of potential aggregate excavations. In addition, we identified testing protocols to identify uranium concentrations and radon potential in the resource.

Research on radon indicates that elevated levels of radon concentrated in water sources are far less harmful than radon inhaled as a gas. The current guideline value for acceptable levels of radon gas in a house is 200 Bq/m³ (bequerels per cubic meter). This guideline value was established by the Federal Provincial Territorial Radiation Protection Committee (FRTRPC). The Canadian guideline value is lower than or equal to that for most every other major industrialized country\(\text{**IV**}\). There are no guidelines for radon gas in an open space.

**Visual Impact Analysis**

Visual impacts from an aggregate operation may vary from one operation to another and may be caused by the landform or excavation themselves, mobile equipment, buildings and structures, or alteration of landforms and vegetation. The AO BMP Handbook\(\text{**IV**}\) suggests that operations close to urban areas undertake a visual landscape evaluation to assess potential visual impacts and affected areas, using a 'key viewpoint approach'. The Handbook outlines a four step approach to assessing visual impacts and modifying the design of the operation to reduce these impacts.
In the *Standardized Terms of Reference for Professional Reports and Technical Studies*\(^{xviii}\), the DWK requires that visual impact assessments within their jurisdiction be based on standardized methodology such as those used by the *Visual Impact Assessment Guidebook*\(^{xix}\) or the *Manual of Aesthetic Design Practice*\(^{xx}\). While not all the design techniques for forestry and highways apply to aggregate operations, there are some procedures and mitigation measures that can be borrowed from these references. The *Visual Impact Assessment Guidebook* outlines procedures on how to assess significant viewpoints and prepare assessment visuals. Mitigation measures for visual impact are outlined in the AO BMP Hanbook.

**Costs**

Aggregate, by nature, is heavy. As such, the cost of transportation adds significantly to its overall cost. In 2000, the average haul distance within the RDCO was 12 km. In 2012, the average haul distance has increased to 17 km, representing a 41 percent increase in average haul distance. Over time, tonnes and kilometers, this has an impact on overall cost to projects. It reflects ultimately on the taxpayer, as the various levels of government consume 60 percent of the aggregate produced in BC\(^{xxi}\).

**Site Suitability Assessment**

The Site Suitability Assessment was prepared based on the integration of current standards, inventories and regional land use and permitting areas. It incorporated considerations of:

- Roads and traffic;
- Land use;
- Environmentally Sensitive Development Permit (EDP) Areas;
- Environmentally Hazardous Development Permit (EHPD) Areas;
- Provincial Aquifer Mapping;
- Visual Sensitivity;
- Adjacency for dust and noise;
- Health, including radon gas exposure;
- Greenhouse gas; and
- Mitigation and reclamation plans.

The Site Suitability Assessment works through each component to assess potential suitability and impacts. If a potential concern or impact is noted, a corresponding assessment, with mitigation and/or compensation where appropriate, is recommended. If there are impacts that cannot be mitigated or compensated for, then a recommendation for non-support is proposed.

**Recommendations – Bedrock Sources of Aggregate**

The investigation of bedrock aggregate potential for this study is preliminary. Additional information will be required to support the classifications and to confirm aggregate potential in any one location. Any additional investigation should follow a step wise process of delineating the potential resource.
Recommendations - Recycled Aggregates

While the system of concrete and asphalt recycling in the RDCO is functioning, much can be done to improve on the efficiency and its resulting value within the District. Recommendations to improve the recycling of aggregate in the District are included below.

- Identify and zone aggregate recycling sites in perpetuity;
- Review and revise specifications;
- Establish a technical group to review recycling strategies and opportunities;
- Tender policies and construction techniques that encourage recycling; and
- Public education.

Recommendations - Environment

The framework for environmental recommendations is based on provincial BMPs and federal, provincial and local legislation, guidelines and permit requirements. The MEMNG will refer an application to federal or provincial agencies if it determines there is an environmental risk under their legislation, such as the *Fisheries Act* or the *Water Act*. Through the Site Suitability Assessment process, we propose that each potential site has an overview level environmental assessment conducted by a Qualified Environmental Professional (QEP), to identify any potential issues at a high level. This will ensure that environmental issues are being considered at the beginning of the process, and it corresponds with the Ministry of Environment's (MOE; formerly Ministry of Water, Land and Air Protection’s (MWLAP)) recommended BMPs for site inventory information. The MEMNG and MOE have detailed BMPs for the protection of habitat, aquatic areas and the environment. These should be followed through all stages of the operation.

Recommendations - Groundwater Assessment

As part of the Site Suitability Assessment, an overview groundwater assessment is recommended to be submitted with a Notice of Work (NoW) application.

The assessment should include depth to aquifer, soil permeability, and the following:

- Adjacent groundwater resources including adjacent wells upstream or downstream);
- Metal leaching and acid rock drainage (ML-ARD);
- Fuel management plan and spill response plan;
- Septic system design plan (if applicable); and
- Water demand assessment (if a well is proposed).

Recommendations - Roads and Traffic

The review of the data indicates that the roads with thinner pavement structures (Type C, local roads) would likely fail prematurely and not likely be able to meet their intended design life under aggregate hauling conditions.
It has been concluded that it would be economically beneficial to limit the hauling operation primarily to roads with thicker pavement structures (similar to Type A, arterial roads). It would also be better to evaluate the condition of the pavement for the road segments included in the haul route and complete any upgrading / rehabilitation prior to the start of the aggregate hauling operation. The proper selection of aggregate haul routes and road upgrading prior to the beginning of hauling, will present efficiencies with respect to time of travel, maintenance of vehicles and pavement performance.

**Recommendations – Noise Attenuation**

As noted in the *AO BMP Handbook - Volume I* there are a number of options and best management practices for noise control possible during site layout, operations and interception. Noise attenuation can be achieved by interceptors, site layout modifications, protecting the equipment, driving trucks slower and a number of mitigation measures. Mitigation starts at the planning stage, and continues through site layout, interceptors, and operating practices. The first step should be a Noise Attenuation Plan, to be submitted with a Notice of Work (NoW) application. The plan should include locations of noise generating activities, noise reflectors and absorption barriers, and an operational plan including speed control, mufflers, reducing drop height, keeping tailgates closed, and other noise reduction techniques.

**Recommendations – Dust Control**

As outlined in the *AO BMP Handbook*, dust control planning includes both site layout and operational procedures. Applicants should prepare a plan for dust control, and document it on a Site Layout Map. From the Handbook, the plan would best include:

- Dust generating activities;
- Off-site facilities that are sensitive to dust;
- Prevailing wind direction(s) and onsite wind patterns;
- Placement of berms, stockpiles and tree buffers to create or enhance wind shadows;
- Possible locations of dust-generating activities and haul roads in calm locations and far from dust sensitive facilities; and
- Location of existing trees and shrubs to create wind breaks.

The plan should also include dust reduction measures during operation.

**Recommendations – Radon**

The potential for radon gas would follow from the evaluation of uranium levels at the initial site assessment stage. Gas levels could be monitored as required in the field, or in enclosed sites, by way of radon gas detectors.

There are numerous analytical methods available to determine the total uranium concentration in various physical media (rock, soil, water, vegetation, biota). When evaluating a potential bedrock material for aggregate use, it will be important to first determine the total uranium concentration present in the rock by
way of whole rock elemental analysis, and secondly to determine the potential for uranium present in the rock to leach into water and soil, and ultimately influence biota and vegetation.

In order to determine the whole rock elemental concentration, various mass spectrometer applications, such as inductively coupled plasma mass-spectroscopy (ICP-MS), may be applied. Shake flask extraction analyses, or similar leaching tests, could be run to determine the potential for uranium leaching into the water column. These analyses are also required to characterize metal leaching and acid rock drainage potential of the bedrock sources, and would be run concurrently as part of the geochemical characterization program. When running these analyses, the proponent may select which elements they would like to test for to ensure that all potential contaminants of concern are evaluated.

**Recommendations – Visual Impact Mitigation (VIM)**

Visual impact planning and mitigation measures have been adapted from the *Visual Impact Assessment Guidebook*. Recommendations are based on the *AO BMP Handbook, Volume II* and the *Manual of Aesthetic Design Practice*.

**VIM Planning**

As outlined in the *AO BMP Handbook*, visual impact mitigation planning includes both site layout and operational procedures. Applicants should prepare a plan for visual impact mitigation, and document it on a Site Layout Map. From the *Handbook*, the plan would best include:

- Key viewpoints and viewscapes;
- Potential visual impacts (e.g., structures and equipment);
- Local landscape character.

**VIM Site Layout**

The *Manual of Aesthetic Design Practice* includes visual impact mitigation techniques that could be applied to aggregate operations for:

- earthworks;
- berm design;
- uphill and downhill slopes;
- blast cut surface treatment;
- integration with adjacent topography;
- near road screening;
- response and integration to adjacent natural vegetation;

---

- varying the vegetation edge; and,
- the use of bioengineering for erosion control on permanent slopes.
SITE SUITABILITY ASSESSMENT

Road and Traffic

IF Truck route uses a municipal road that is not a designated City of Kelowna truck route
THEN Traffic Assessment including proposed hauling hours of operation, routes, road conditions and school zones
THEN RECOMMEND: Improvements & or conditions be included into Permit
THEN Go to Land Use

Land Use

IF Park / Recreation / Open Space
Parks / Protect Areas
THEN Recommend Non-Support

IF Residential
Rural Residential
Commercial
Institutional
THEN Can Aggregate be extracted prior to development?
IF NOT
THEN Recommend Non-Support
IF YES
THEN Go to Environmental Sensitivity / Hazardous Areas

IF Rural Industrial
Rural Reserve
Future Urban Reserve Resort
Or if Outside OCP Area
THEN Go to Environmental Sensitivity / Hazardous Areas

IF Agriculture in ALR
To Agriculture Land Commission for Approval
IF YES
THEN Go to Environmental Sensitivity / Hazardous Areas

IF Agriculture not in ALR
To Agricultural Advisory Commission or Staff
Will the extraction improve land for agricultural Use?
IF no, then recommend Non-Support.
If yes, then go to Environmental Sensitivity / Hazardous Areas
SITE SUITABILITY ASSESSMENT

Visual Sensitivity

IF
Slopes over 20% and facing residential or urban areas or major roads or boating routes

THEN
Visual Impact Mitigation Plan using standard visual impact BMPS

IF
Potential Impacts / Risks can be mitigated

THEN
RECOMMEND: Including Mitigation Measures into Permit

THEN
Go to Adjacency

Adjacency

IF
Within 500 m of residence, institutional or commercial use

THEN
Dust Control Plan required using current provincial BMPs

THEN
Provide a Dust Control Plan based on Provincial BMPs. If potential impacts can be mitigated – e.g., to Canada Wide standards for Particulate matter (PM) and ozone (CWS, 2000) and Occupational Exposure Limits for crystalline silica adhered to

RECOMMEND: Dust Control Measures be included into Permit

THEN
Go to Noise Control

THEN
Noise Control Plan using current BMPs

THEN
Provide Noise Control Plan based on Provincial BMPs. If complying with local noise bylaws and times of work limits

RECOMMEND: Noise Reduction Measures be included into Permit

THEN
Go to Greenhouse Gases

Greenhouse Gases

IF
Provide a Greenhouse Gas Assessment and Reduction Strategy (using Assessment Tool for Aggregate Production online)

THEN
RECOMMEND: Reduction Measures be included into Permit

Mitigation and Reclamation Plans

All Mitigation and Reclamation Plans and Assessments

THEN
Circulated to the local government and information

THEN
Comments sent to the MEMNHG for consideration

THEN
Required Mitigation Measures of Permit be circulated back to local government for information