AGGREGATE SUPPLY AND DEMAND ANALYSIS STUDY

Governance and Services Committee Meeting

June 13th, 2013
Regional Growth Strategy: under the Local Government Act, Section 849:

- ‘maintaining the integrity of a secure and productive resource base’ and
- ‘adequate inventories of suitable land and resources for future settlement’

Study Objectives:

- Supply and Demand up to 100 years;
- Analysis of potential constraints;
- Site suitability assessment checklist
- Public consultation and referral to agencies
# Schedule

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Projects Supply

- Sand & Gravel Mapping
- Hard Rock Mapping
- Producer’s Survey

Demand

- Aggregate consumption & demand literature (e.g. SAROS report)
- BC Stats & Census Data

Analysis

- Provincial and federal legislation, standards & BMPs
- Available mapping & inventory data
Sand & Gravel Potential Map

**Mapping**

Based on Provincial Terrestrial Ecosystem Inventory Database (TEI)
14 projects chosen from 49

**Gravel Potential**

- **Red – High**
  Deep*, clean, well drained glacial or modern river deposits

- **Orange – Moderate**
  Thinner, less well drained, more silt

- **Yellow – Low**
  Thin, silty, not well drained

- **Green – Till**
  Deep till deposits

*Based on conservative thicknesses – 5 m High Potential
Preliminary Results – Sand & Gravel – Net Results

Potential Net of
- Residential
- Rural Residential
- Commercial
- Institutional
- Parks & Open Space
- First Nations

Included:
- Agricultural
- Industrial
- Rural
- Rural Reserve
- Resort
- EDP/EHDP Areas
- Creeks*
- Lakeshores*
Agricultural Land Reserve
# Sand & Gravel Volume

## Borehole Data – Net Results

**Sand & 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></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Min</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>111</td>
<td>309,860,000</td>
<td>526,760,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>950,830,000</td>
<td>1,616,420,000</td>
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<tr>
<td>Moderate</td>
<td>129</td>
<td>110,270,000</td>
<td>187,450,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>308,200,000</td>
<td>523,930,000</td>
</tr>
<tr>
<td>Low</td>
<td>155</td>
<td>10,830,000</td>
<td>18,420,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200,890,000</td>
<td>341,520,000</td>
</tr>
<tr>
<td>Totals</td>
<td>395</td>
<td>430,960,000</td>
<td>732,630,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,459,920,000</td>
<td>2,481,870,000</td>
</tr>
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</table>

*Including:
- Agricultural
- Industrial
- Rural
- Rural Reserve
- Resort
- EDP/EHDP Areas
- Creeks & Lakeshores*

*Based on conservative general thickness estimates
Preliminary Results – Hard Rock Criteria

Aggregate Potential
• **Reds - High**
  Intrusive, feldspar, granodiorite, non-marine plateau basalts

• **Browns - Moderate**
  Olivine basalt flows

• **Yellows - Low**
  Mudstone, siltstone, shale fine, greenstone

*including overburden thickness
## Aggregate Producer’s Survey
Supply under Permit

<table>
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<tr>
<th>Survey Responses</th>
<th>Count</th>
</tr>
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<tr>
<td>Survey responses received</td>
<td>28</td>
</tr>
<tr>
<td>Permits with exhausted pits and / or have transitioned into other uses</td>
<td>7</td>
</tr>
<tr>
<td>Surveys sent and not yet received</td>
<td>10</td>
</tr>
<tr>
<td>No response and / or not able to contact</td>
<td>10</td>
</tr>
<tr>
<td>Chose not to respond</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
</tr>
</tbody>
</table>
Aggregate Producer’s Survey
Supply under Permit

Supply under Permit*
- 59 million tonnes of sand and gravel
- 9.5 million tonnes of rock

Average Annual Production
- Sand & Gravel - 1.4 to 1.6 million tonnes
- Quarried Rock – 165,000 tonnes

Average Annual Consumption - Adjusted
- Sand & Gravel & Rock - 1.9 million tonnes per year
- Per capita use of 10.6 tonnes per capita per year

Recycle – Annually
- Asphalt – 63,600 tonnes
- Concrete – 49,300 tonnes
- Together <8% of Annual Aggregate Volume

*with returned surveys, assuming 75% response rate on production
Aggregate Producer’s Survey
Trucking

Average Haul – 17 km
Range in Haul – 1 to 2500 km
Specialty products sent interior BC & Alberta
  • Landscape rock & stucco sand
Other products brought in
  • Pea gravel

Costs of Trucking Averages
  • Truck - $94
  • Truck & pup - $115
Aggregate Producer’s Survey

Suggestions

- Promote recycling through local or MMCD specifications changes, allowing more in road base & structural fill.
- Educate the public in CO2 emissions related to haul distances.
- Focus on monitoring unlicensed gravel operations.
- Focus on gravel supplies closest. The costs rise sharply with a longer haul, and incurs more wear and tear on the road.

Concerns

- Pits are not allowed due to a vocal minority, even though potential impacts can be mitigated.
- Competition with municipalities for aggregate sales.
- Bureaucracy makes it difficult to operate.
Demand

How much do we need and where does it all go?

<table>
<thead>
<tr>
<th>Sand &amp; Gravel</th>
<th>Percentage Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>30%</td>
</tr>
<tr>
<td>Concrete production</td>
<td>25%</td>
</tr>
<tr>
<td>Asphalt production</td>
<td>17%</td>
</tr>
<tr>
<td>Structural fill</td>
<td>16%</td>
</tr>
<tr>
<td>Landscaping</td>
<td>6%</td>
</tr>
<tr>
<td>Other uses</td>
<td>6%</td>
</tr>
</tbody>
</table>
How do we compare?

Primary Aggregate Consumption
2002-07 (tonnes)

Recycled Aggregates %
Demand
Averages across Canada

Consumption Per Capita

*per Altus Group (2009)
Demand
10 Tonnes per capita at 2% Growth Rate

20 Years: 46,752,200
Demand
14 Tonnes per capita at 2% Growth Rate

20 Years: 65,453,200
Demand

RDCO Demand by Community

Demand based on 1.5% growth & 12 tonnes per capita and consistent population growth through RDCO
Permitting

Mines Act & Mineral Tenure Act

- 30 day Inter-agency review
- First Nations referral - if interests are affected
- Assessments not required for sand & gravel / quarry (e.g. geotechnical, archaeological etc.) but can be required by the Chief Inspector, per the Code
Federal & Provincial Legislation

Federal
- Federal Fisheries Act
- Migratory Birds Convention Act
- Wildlife Act
- Species at Risk Act (SARA)
- Navigable Waters Act

Provincial
- Land Act
- Agricultural Land Reserve Act
- Soil Conservation Act
- Fish Protection Act (Riparian Areas Regulation)
- Migratory Birds Convention Act
- Water Act
- Wildlife Act
- Greenhouse Gas Reduction Targets Act
- Forest and Range Practices Act
- Heritage Conservation Act
- Environmental Assessment Act
- Environmental Management Act
- Transportation Act
- Drinking Water Protection Act
- Public Health Act
# Local Soil Removal & Deposit Bylaws

## Municipal Bylaws and Permits

| Local Government Act | • Zoning regulations  
|                       | • Development Permits – Environmental or Hazardous Areas  
|                       | • Soil Removal & Deposit Bylaws – City of Kelowna, District of Lake Country, District of West Kelowna, District of Peachland  
|                       | • Temporary Use Permits  
|                       | • Runoff Control  
|                       | • Tree Retention  
|                       | • Signs  
|                       | • Burning  
|                       | • Noise  
|                       | • Commercial Vehicle  
|                       | • Business License  
|                       | • Heritage Conservation |
Analysis - Environment

Potential Impacts

- Vegetation
- Wildlife Habitat
- Rare Ecosystems / Species
- Fish / Aquatic
- Sedimentation

Best Management Practices

- Aggregate Operator’s Handbook I and II (MEM, 2002)
- Environmental Objectives & BMPs (MWLAP, 2002)
- Reclamation Handbook (MEM, 1995)
Analysis - Groundwater

Key Factors

- Final depth distance to groundwater
- Proximity to water wells
- Metal Leaching / Acid Rock Drainage
- Fuel management & storage
- Septic (if applicable)
- Water demand (if applicable)
- Altering recharge rates

Best Management Practices

- Aggregate Operator’s Handbook I and II (MEM, 2002)
Analysis - Greenhouse Gases

Processing
- Natural sand and gravel (1912.81 kg CO2e / t)
- Recycled concrete (2885.40 kg CO2e / t)
- Recycled asphalt (5418.6 kg CO2e / t)
- Quarried rock (8,129.72 kg CO2e / t), due to the blasting process required

Hauling
- Varies by distance with some variation on fuel used
Impact of 1,000,000 MT of Aggregate Hauling on Pavements
Analysis - Noise

Projected Un-buffered Noise Levels for some Common Aggregate Machinery

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Measurements</th>
<th>Projected Noise Levels without Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>300 m</td>
</tr>
<tr>
<td>Primary and Secondary Crusher</td>
<td>89 dBA at 30 m</td>
<td>69.0 dBA</td>
</tr>
<tr>
<td>Hitachi 501 shovel, loading</td>
<td>92 dBA at 15 m</td>
<td>66.0 dBA</td>
</tr>
<tr>
<td>Euclid R-50 pit truck, loaded</td>
<td>90 dBA at 15 m</td>
<td>64.0 dBA</td>
</tr>
<tr>
<td>Caterpillar 988loader</td>
<td>80 dBA at 95 m</td>
<td>69.5 dBA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noise Level (dBA)</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>Jet Take-off (100 m distance)</td>
</tr>
<tr>
<td>105</td>
<td>Pneumatic Chipper</td>
</tr>
<tr>
<td>100</td>
<td>outboard motor, lawn mower, motorcycle, tractor</td>
</tr>
<tr>
<td>96</td>
<td>Use of Power Mower</td>
</tr>
<tr>
<td>90</td>
<td>Motorcycle at 8 m</td>
</tr>
<tr>
<td>88</td>
<td>Food Blender</td>
</tr>
<tr>
<td>84</td>
<td>Diesel Truck 65 km/h from 15 m</td>
</tr>
<tr>
<td>82</td>
<td>Pneumatic Drill from 15 m</td>
</tr>
<tr>
<td>80</td>
<td>Average Street Traffic</td>
</tr>
<tr>
<td>77</td>
<td>Passenger car at 7.5 metres</td>
</tr>
<tr>
<td>70</td>
<td>Vacuum Cleaner</td>
</tr>
<tr>
<td>65</td>
<td>Business Office</td>
</tr>
<tr>
<td>60</td>
<td>Conversation in restaurant, background music</td>
</tr>
<tr>
<td>40</td>
<td>Living Room</td>
</tr>
</tbody>
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- 87 dBA average 8 hours (Health & Safety Code, MEM)
- Local Noise Bylaws
## Analysis - Dust

### Dust Concerns and Typical Travel Distances by Particle Size

<table>
<thead>
<tr>
<th>Dust Categories</th>
<th>Size μm</th>
<th>Concerns</th>
<th>Distance Traveled</th>
<th>Typical % from Aggregate Pits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Dust (a)</td>
<td>30 – 75 μm</td>
<td>Nuisance</td>
<td>100 m</td>
<td></td>
</tr>
<tr>
<td>Large Dust (b)</td>
<td>10 – 30 μm</td>
<td>Nuisance</td>
<td>200 – 500 m</td>
<td>94%</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>2.5 – 10 μm</td>
<td>Health (respiratory)</td>
<td>1000 m</td>
<td>3%</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>&lt; 2.5 -μm</td>
<td>Health (respiratory)</td>
<td>&gt; 1000 m</td>
<td>3%</td>
</tr>
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### Efficiency of Dust Control Measures

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<tr>
<th>Activity</th>
<th>Control Method</th>
<th>Control Efficiency</th>
</tr>
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<tr>
<td>Loading Stockpile</td>
<td>Reducing drop height</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Telescopic chutes</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Conveyor sprays</td>
<td>75%</td>
</tr>
<tr>
<td>Wind Erosion from Stockpile</td>
<td>Regular watering</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Surface crusting agent</td>
<td>Up to 99%</td>
</tr>
<tr>
<td></td>
<td>Vegetative wind break</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Lower pile height</td>
<td>30%</td>
</tr>
<tr>
<td>Speed Control</td>
<td>Chemical surface treatment</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Speed control: 50 km/h</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Speed control: 32 km/h</td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td>Speed control: 16 km/h</td>
<td>80%</td>
</tr>
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* MEM, 2002; Thomas, 2000*
Health Concern

- Uranium – weakly radioactive
- Commonly found in rocks and soil at some concentration
- Releases radon gas as it decays, which emits by products that are respired
- Radon by products – contributes to lung cancer - in enclosed spaces
- BC Building Code recent updates – requiring ventilation rough-ins new housing for BC Interior
- BC Housing standards – 200 Bq/m3
- CCME sets standards for soil and water (0.02mg/L)

Testing

- as part of Whole Rock Elemental Analysis
- Leaching Tests – to test how easily it is transmitted into the environment
Analysis - Visual Impact Mitigation (VIM)

- Analysis – Key Viewpoint Landscape Approach
- Mitigation
  - Concentrate activities and equipment together
  - Curve road access
  - Sink pit
  - Use topography for natural screening
  - Concealment (fences, berms, vegetation)
  - Camouflage
  - Design internal haul roads in low points
  - Good housekeeping
  - Outreach – Viewpoints, interpretive signs and tours
Site Suitability Assessment

- Land Use - Zoning
- Environmental Sensitivity
- Groundwater
- Visual Sensitivity
- Land Use Adjacency
- Health / Air Quality
- Noise Control
- Transportation Route / Road Condition
- Greenhouse Gas Emissions
Costs

- **Trucking**
  - Average distance increased from 12 km to 17 km (41%) from 2000 to 2012
  - Current hauling costs approximately $10/tonne per hour

- **Scarcity**
  - Saskatoon average haul for natural gravel is 100 km ($32 tonne to market)

- **Sterilization**
  - Kelowna aggregate prices rose 50% after transition of 3 pits (1990s)

- **BC consumption**
  - 60 % is for various levels of governments
Recommendations

- Site Suitability Assessment - Process Guide
- Coordination of Permitting Process
- Recycling
  - Identify and Zone Aggregate Recycling Sites in Perpetuity
  - Review and Revise Specifications
  - Establish a Technical Group
  - Tender Policies and Construction Techniques that Encourage Recycling
- BMPs (MWLAP, MEM) for environment, groundwater, dust, noise, traffic, visual impacts
Planning Recommendations

- **Plan for Near Market Extraction**
  - Use close to market resource first
  - Use resource prior to sterilization by other land use
  - Plan for recycling facilities near market in perpetuity

- **Near Highways and Arterials**
  - As close to main roadways as possible
    - Reduces infrastructure impacts
    - Reduces neighbourhood conflicts
    - Reduces greenhouse gases
    - Reduces relative noise impacts
    - Reduces costs
# Next Steps

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Planning for Aggregate

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