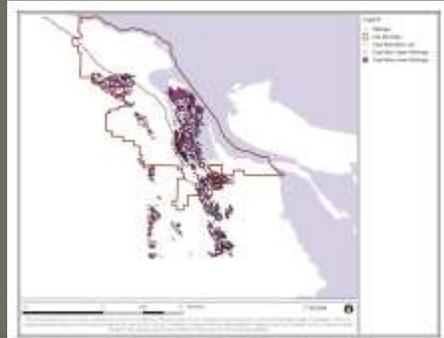


Developing Around Abandoned Coal Mine Workings in Nanaimo

Presented By:

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Map of Entire City / Mine Workings



Map of Upper & Lower Workings



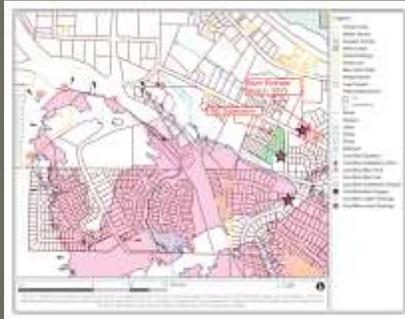
Photos of Mine Workings



Photos of Mine Workings cont.



General Area Around Case Study Area



Case Study Area - Coal Workings



Aerial Photo of Case Study Area (Coal Mine Workings Outlined)



Preliminary Layout Acceptance (PLA) Referral / Review Process

- Referrals to Internal Departments and External Agencies
- Identify concerns or additional requirements to complete review and establish PLA requirements
 - Requirement for a geotechnical evaluation prior to issuance of a PLA to confirm that the property could be developed
 - Inclusion of geotechnical requirements under Part 4 of the PLA

Guidelines for the Preparation of Geotechnical Reports

1. Identify any hazards which may affect the safe development of the land including, but limited to:

- | | |
|--------------------|-----------------------|
| a) Flooding | g) Ground Water Flows |
| b) Mud Flows | h) Rock Falls |
| c) Debris Flows | i) Subsidence |
| d) Debris Torrents | j) Avalanche |
| e) Erosion | k) Earthquake |
| f) Land Slip | |

Guidelines for the Preparation of Geotechnical Reports (cont.)

2. Provide recommendations to reduce the risk of damage to land, buildings and the Works and Service (W&S) in regards to:

- a) Identifying of any part of the W&S which may required inspection by specialized personnel and outline a recommended inspection program during the development of the land;
- b) Further geotechnical investigations and reports;
- c) Restricting the use of the land, buildings or the W&S
- d) Remediation of any unstable or potentially unsuitable soils; and
- e) Further reports during the maintenance period

Guidelines for the Preparation of Geotechnical Reports (cont.)

3. Evaluate the development plans for the property using the relevant City bylaws... ..to determine the suitability of the land to accommodate the use intended.

4. Establish a safe setback line from any watercourse, steep slope or hazard area to protect the land, buildings or inhabitants from the risk of injury or damage... ..The recommended setback cannot diminish the minimum setback requirements established in municipal bylaws.

5. Quantify the risks of a geotechnical or any substantial hazard.

6. Certify that "the land is safe for the use intended."

Guidelines for the Preparation of Geotechnical Reports (cont.)

The Engineer's recommendations and conclusions of the Report must:

1. Acknowledge that the City, its Approving Officer and Building Inspectors may rely upon the Report when making a decision on applications for the subdivision or the development of the land;
2. Certify the land is safe for the use intended with a probability of a geotechnical failure resulting in property damage of less than:
 - a) 2% in 50 years for geotechnical hazards due to seismic events...
 - b) 10% in 50 years for all other geotechnical hazards
3. Reference APEGBC "Guidelines for Legislated Landslip Assessments for Proposed Residential Development in British Columbia" ...
4. Identify any deficiency in the design of the buildings, W&S or the construction standards intended for the development; and
5. Prescribe the geotechnical works and any changes in the standards of design of the development which are required to:
 - a) Ensure the land, buildings, W&S are developed safely for the use intended; and
 - b) Maintain the safety of the land, buildings and any W&S as a condition of approval

Guidelines for the Preparation of Geotechnical Reports (cont.)

The Report and two duplicate copies shall be provided to the City for consideration of the approval of the application...
...the Report together with a Section 219 covenant may be required to be registered on the title of the property pursuant to the Land Title Act.

Registration of a covenant and/or the approval of an application does not warrant or represent that the land may developed and used safely without risk of damage from hazardous conditions. Notwithstanding the registration of a covenant, a further Report could be required by the City if there is a change in the conditions or if some other circumstances arise which are substantially different than those anticipated by the Report.

Case Study - PLA Excerpt

Part 4: Geotechnical

The Geotechnical Report prepared by Lewkovich Geotechnical Engineering, File No. G3088.03 (revised) as per "City of Nanaimo Guidelines for Geotechnical Reports" contains recommendations regarding the underlying coalmine workings as they impact the development. As conditions are contained and remedied geotechnically a new Geotechnical Report will be produced and submitted as an item in support of the application for Final Approval for the subdivision. This new report will be registered on the title of all affected lots as a Section 219 Covenant as a condition of Final Approval.

Initial Geotechnical Report

- Soil onsite consist of thin veneer of marine / alluvial soils underlain by dense glacial till on conglomeritic sandstone, finely graded sandstone, shale and localized interbeds of coal.
- Two layers of coal mine workings. (Upper within 15m of surface and lower at 20-25m from the surface)
- Coal seams are approximately 2.0m thick
- Room & Pillar type extraction
- Vertical ventilation shafts near proposed Lots 5 & 31
- Sloping mine entry near proposed Lot 17

Initial Geotechnical Report (1/2011)

3.3 Subsidence Risk Zonation

Zone A: Not impacted by abandoned coal mining
(no remediation works required)

Zone B: Low impact by abandoned coal mining
(subsidence likely have already occurred)

Zone C: Moderately high impact by abandoned mining
(remediation works required)

Final Geotechnical Report

- Found that the mining was actually completed using a "longwall" technique.
- Areas underlain by mine workings (Areas B & C) had voids filled with "birdseye" gravel in 100mm diameter air track drill holes on 7m spacing. (The report concluded that the gravel provided "sufficient infill as to reduce the level of potential subsidence to a "low" level of risk.")
- In Area C as a precautionary measure the report recommended that the foundation of the buildings "be provided with reinforcement to resist differential movement." and that "isolated pad footings should be avoided".

Subdivision Final Approval

- Final Geotechnical Report is registered on all affected properties.
- Final Geotechnical Report is registered on all adjacent properties.

Questions



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