Water and Air Quality Effects of Saskatchewan Potash Mining

1. Mining Types

- Conventional (shaft based) mining - mechanical extraction of potash minerals
- Solution Mining - Use of water to dissolve salts in place and pump to surface
    - Primary - excavation of underground caverns in salt beds with water and pumping of both sodium and potassium salts (KCl) to surface for separation
    - Secondary (selective) - Use of sodium salt brine water to selectively dissolve potassium salts and process on surface

2. Use of Water in Different Mining Types

- Conventional: lowest use per tonne of produced KCl, for surface processing mainly
- Primary Solution: Highest use required to extract minerals from the salt beds and separate KCl from other dissolved salts
- Secondary Solution: Lower than primary, with only KCl minerals dissolved and other salts left in place
- Total industry water use will increase significantly if the approved new, solution mines go into operation.
- Existing mines (per year): 36 Mm^3; Proposed: 92 Mm^3; Regina (2018): 31.4 Mm^3; Saskatoon (2018) 41 Mm^3
- Percentage of net South SK River discharge at Gardiner Dam (5.23 Bm^3 per year):
    - Existing mines: 0.7%
    - New proposed mines: 1.76%
    - Total: 2.5%
    - Regina and Saskatoon: 1.39%

3. Water Sources

- Most existing and proposed mines using water from S. Saskatchewan River transferred into Qu'Appelle River at Buffalo Pound Lake
- Some existing operations using groundwater (Mosaic Esterhazy; Nutrien Allan, Lanigan and Rocanville; Western Milestone), or combinations of surface and groundwater
- Some proposed mines to use groundwater for secondary extraction methods (Gensource Vanguard)

4. Other Environmental Considerations

Risk Reduction Factors

- Liquid waste management for this industry relies on total containment and final disposal into deep salt formations; discharge to surface waters is prohibited.
- Water used is totally consumed, with varying degrees of re-use, but no treatment and return to sources.
- Secondary mining operations use less water and deposit little or no tailings on surface
- The potential for salt dust blowing off tailings piles is low, apparently because of the highly compacted and cemented nature of these mineral residues.
- Both emissions of tailings pile dust and leakage of salty water, of significance, can be expected to kill or damage vegetation in the vicinity of the potash facilities. These effects provide a visual means of assessing containment effectiveness in addition to other monitoring methods.
- Monitoring of groundwater quality and flows in wells placed around brine containment ponds is done to enable early detection of brine leakage.

Other Factors Affecting Risk

- Leakage of brine solution from storage ponds has been documented, but appears to be limited in frequency and extent.
- Subsidence of land surfaces that occurs due to excavation of sub-surface salt deposits, of up to 6m over mine life, can alter drainage patterns of surface waters and wetland distribution.
- Cumulative potash industry water use effects have not been assessed by either proponents or the provincial agencies. Potential impacts include water quality changes to Buffalo Pound Lake, from transferred Lake Diefenbaker water, and possible future conflicts with other water users from restricted QR flows, and drawdown of aquifers such as the Hatfield.
- Potential use of Quill Lakes water, to help relieve flooding risk in that terminal basin, has not been assessed.

5. Environmental Risks

Risks to Water Quality

- During Operations:
    - Seepage or failure of pond liners releasing salty water to local surface or groundwater sources
    - Breaks in brine water or diesel fuel pipelines from salt extraction well sites
    - Failure of deep well residual brine disposal system

- Note: Wells from many if not most potash mines, including solution mines and all brine disposal wells, perforate the Hatfield Valley Aquifer, so protection of this source relies on all aspects of good management and government oversight

- After Operations Cease:
  - Failure of brine pond liners
  - Failure of deep well brine disposal system
  - Abandonment of reclamation by owner (Provincial government assumes management.)

6. Suggested Improvements

- Impact Assessment

I. Environmental impact statements for proposed new potash mines should include analysis of the costs and benefits of alternate water sources. Allocations of water sources and quantities were already made by the Water Security Agency prior to release of the EIS's. How was water conservation assessed for these allocations?

II. Operating mines should be required to progressively research and implement additional water conservation measures to anticipate water supply constraints resulting from climate change.

III. Government should consider water price, or other financial incentives for water conservation.

IV. Proposed mines in the vicinity to the Quill Lakes watershed should be required to assess the feasibility of using water from either the Lakes or tributary watersheds.

V. Greater transparency should be provided by the provincial environment agencies in support of the environmental assessment process. Government technical specialists should attend public meetings for new mine proposals and advise the public on how they are assessing impacts for their Technical Review Comments.

VI. A joint industry-government report reviewing the environmental performance of existing mines should be prepared and released publically to assist the public and public advocacy groups in their new project reviews.

7. Air Quality Effects Including Greenhouse Gas Emissions

Conventional Air Pollutants

- Air emissions are covered by provincial permits.

- Largest emission sources are the product dryers.
- Most common pollutants are fine particulate matter and nitrogen oxides.
- Fine PM includes an inhalable (coarser) fraction and a very fine respirable component.
- Favourable mixing conditions in the open and flattish spaces of SK reduce the potential for ground level AQ effects. Processing plants in valleys or surrounded by trees would present greater risks.
- Risk would be greatest to any properties or communities within a few kilometers of sources.
- Potential for poor dispersion of fine PM with temperature inversions (cold surface) which allow trapping and sometimes later recirculation of pollutants down to the ground (fumigation).
- Also strong winds can knock plumes down to the ground.
- Emissions from dryer stacks are treated to remove fine particulate matter. Dust suppression is also practiced on roads and other disturbed surfaces.
- Permit limit on dryer PM emissions is high relative to other industrial operations in more sensitive jurisdictions.

Greenhouse Gases (CO_2 equivalents)

- Individual mines are significant users of energy.
- Electricity sources are provincial grid, still derived mainly from coal power, and natural gas combustion, not low carbon sources.
- Power use for mines with the production capacity of the proposed Albany project can emit up to 1 megatonne of CO_2. Nine new projects of varying sizes have been approved, although only K Plus S has been developed.
- The cumulative effect of these new mines, plus expansions to existing operations, could add significantly to the current SK emissions of about 75 MT.
- The provincial Prairie Resilience climate change plan requires only a 5% reduction in per tonne GHG emissions by 2030, not even a decrease in absolute emissions.
- Expanded potash development could cut into SK target of 50% renewable energy in the utility system by 2030.
- Destruction of wetlands and grasslands through potash well site development could add to GHG emissions.

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