June 2018 Environmental Update for SLEMA Board

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June 30, 2018

Outline

1. Mine Update
2. Inspection Update
3. Regulators' Update
4. Aboriginal Update
5. Stakeholders' Update
6. Agency's Activities
7. SLEMA Reviews

Acronyms

- AEMP – Aquatic Effects Monitoring Program
- ARD – Acid Rock Drainage
- DFO – Fisheries and Oceans Canada
- ECCC – Environment and Climate Change Canada
- ECM – Extended Care and Maintenance
- ENR – Department of Environment and Natural Resources, GNWT
- EQC – Effluent Quality Criterion
- GNWT – Government of the Northwest Territories
- INAC – Indigenous and Northern Affairs Canada (formerly Aboriginal Affairs and Northern Development Canada [AANDC])
- MVEIRB – Mackenzie Valley Environmental Impact Review Board
- MVLWB – Mackenzie Valley Land and Water Board
- PK – Processed Kimberlite
- SLEMA – Snap Lake Environmental Monitoring Agency
- SNP – Surveillance Network Program
- SSWQO – Site-Specific Water Quality Objective
- TDS – Total Dissolved Solids
- WEMP – Wildlife Effects Monitoring Program
- WTP – Water Treatment Plant
- WMP – Water Management Pond

1.1 Mine Update – May 2018

- The Snap Lake Mine remained in suspended operations (Extended Care and Maintenance)
  - 2,183 m^3 of water withdrawn from Snap Lake
  - 5,487 m^3 of treated water discharged into Snap Lake
- No reportable spills
- Water sampled in 12 monitoring stations

1.2 Responses to SLEMA Comments on “reasonable measures” for remote monitoring (I)

- Dated June 12, 2018
  - De Beers does not agree with SLEMA that this decision will set a precedent in the NWT. There are a number of sites currently being managed by Indigenous Affairs and Northern Development Canada and the Government of the Northwest Territories which are currently being managed utilizing a zero site occupancy during set periods of the year

1.2 Responses to SLEMA Comments on “reasonable measures” for remote monitoring (II)

- A project risk assessment was completed for the extended care and maintenance period. This assessment included extensive consultation with the Engineer of Record to determine the requirements for monitoring structures designed to withhold, retain or divert waste. This assessment was provided to the MVLWB on June 11, 2018 in support of the updated North Pile Management Plan package
- Response table attached

1.3 Notification- Annual Geotechnical Field Inspection

- Addressed to the Inspector on June 12, 2018
  - De Beers intended to carry out the annual Geotechnical Field Inspection the week of June 25th 2018
  - As per the license, a Field Inspection report will be provided within 60 days of the completion of the visit

1.4 Care and Maintenance Quarterly Update

- Dated June 12, 2018
  - “at this time the Snap Lake Mine remains in suspended operations and has initiated closure planning. De Beers continues to follow the Extended Care and Maintenance Plan (ECM) that was approved by the MVLWB on June 22, 2016. A water License application will be submitted in 2019 that will govern closure activities”

2. Inspection Update

- Inspector – Tracy Covey
- Water Licence Inspections
  - Inspected on May 25, 2018, and reported on June 7
  - Inspected on June 8, and reported on June

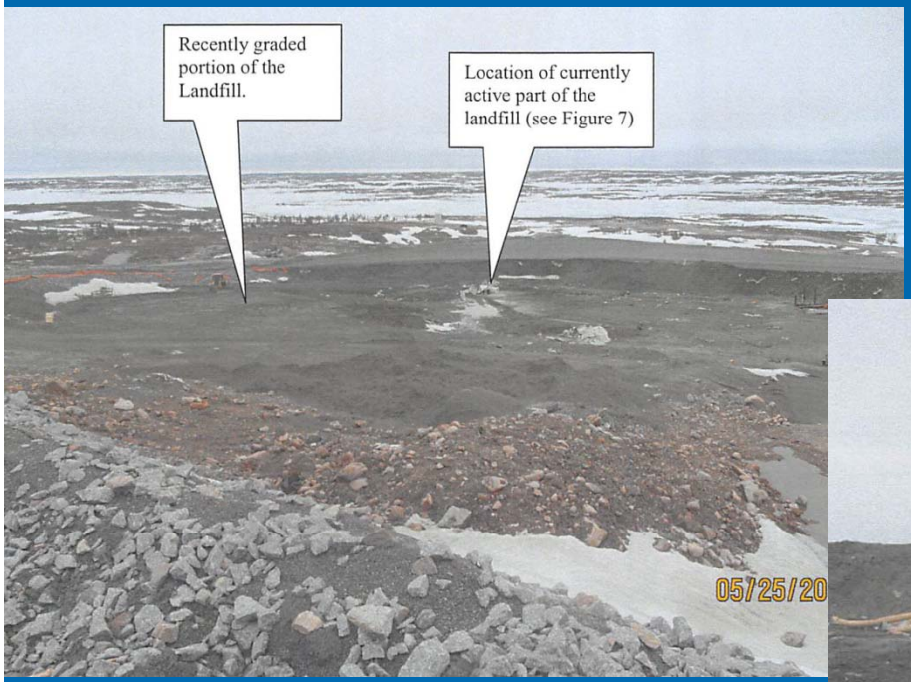
2.1 Water Licence Inspection on May 25, 2018

- Reported on June 7, 2018
  - Inspected the North Pile, Sumps and ditches, Dam 1 of the Water Management Pond, all active fuel tanks, Water Treatment Plant, Waste Transfer Area, Burn Pit and Landfill
  - No environmental risks noted

Starter Cell, Cell F (left photo) and South Quarry Cell, Cracks documented/investigated as part of regular Geotechnical Inspections

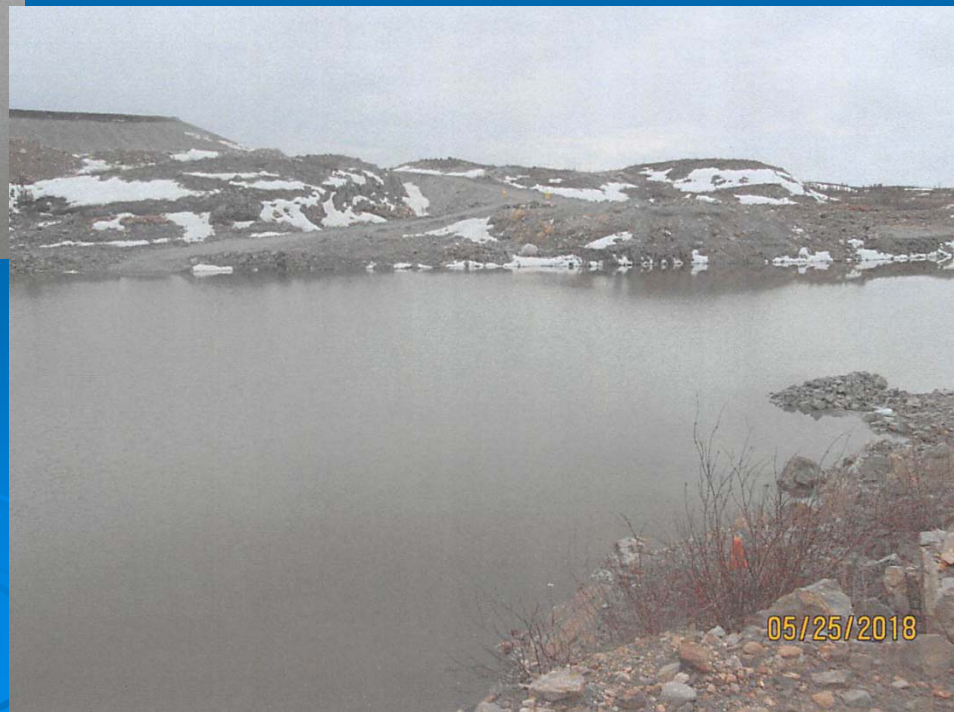
East Cell, Cell D, Dewatering

Landfill in East Cell, Cell 1



A flock of Canada Geese was observed feeding on the exposed sediment of the Water Management Pond

The Water Level in Sump 5 was high



The inspector reminded De Beers staff that industry best practices dictate that portable pumps, heaters, lights, etc. should have drip trays places underneath to capture any fuel or oil drips which might occur over time

Snow melt has created significant ponded water inside the following lined sumps at the minesite. Such water needs to be tested and removed from all bermed areas

Drum needing a new bung/labelling

2.2 Water Licence Inspection on June 8, 2018

- Reported on June 14, 2018
  - Inspected the North Pile, Sumps and ditches, Dam 1 of the Water Management Pond, all active fuel tanks, Fresh Air Raise, Waste Transfer Area, Burn Pit and Landfill
  - No environmental risks noted

Presence and absence of ponded water in the Starter Cell: pumping out of water has been happening intermittently

Landfill (left photo) and Burn Pit

Ponded water which was present in the Waste Transfer Area two weeks ago is no longer present

Water level of Sump 5 was high at the time of inspection

Day Tank 2 (spill 17-440 spill site): staining on the ground indicates the extent to which diesel overtopped the sump and infiltrated the ground. De Beers will remove this material soon

The sump for Day Tank 2 had been cleaned and was water-free

Maintenance/certification work at the Utility Tank (500,000 L diesel tank)

3. Regulators' Update – MVLWB (I)

- Granted the final clearance of Land Use Permits MV2010D0053 and MV2014D0010, on June 7, 2018
  - No land use fee owing or refundable for the operation
- Revised the security required by Licence MV2012L2-0004 to $27,844,664.00, as outlines in De Beers' 2018 Financial Security Estimate Report, Version 3, June 20

3. Regulators' Update – MVLWB (II)

- Amended Type A Land Use Permit MV2017D0032 on June 20, 2018
  - Revised security deposit to $51,118,424.00
  - Approved relevant management plans for Extended Care and Maintenance
    - Only under the Permit MV2017D0032 authorization
    - The Inspector has the authority to require more frequent in person site visits during periods of zero-occupancy
    - De Beers to submit the Final Closure and Reclamation Plan by January 30, 2019
    - De Beers to submit details about new remote monitoring systems at least 60 days prior to their implementation to replace a physical presence at Snap Lake, for approval

3. Regulators' Update – MVLWB (III)

- Invited reviewers to submit comments on Technical Memo - Instrumentation and water level monitoring frequencies for the North Pile & Water Management Pond Dams, on June 27, 2018
  - Comments due on July 13

4. Aboriginal Update

- No comments received in June 2018

5. Stakeholders' Update

- ECCC and ENR commented the 2017 Annual Closure and Reclamation Plan Progress Report on June 28, 2018

5.1 ECCC Comments on 2017 Annual Closure and Reclamation Plan Progress Report

- ECCC recommends that the Proponent clarify how they will mitigate potential overflow from the underground workings in the event of an extreme precipitation event.

5.2 ENR Comments on 2017 Annual Closure and Reclamation Plan Progress Report

- ENR recommends that DeBeers engage with stakeholders on the closure criteria prior to submitting the FCRP

6. Agency's Activities

- As requested by MVLWB Board staff via e-mail on June 6, 2018, SLEMA staff provided additional information on what is meant by "reasonable measures" and "provide clear directions in the amended Land Use Permit on remote monitoring" with regards to De Beers' Request to Amend the Land Use Permit MV2017D0032 to the MVLWB on June 7, 2018
- Core Group Meeting held in Yellowknife on June 18
- Sent out a comment letter on 2017 Annual Closure and Reclamation Plan Progress Report to the MVLWB on June 28

7. SLEMA Reviews

- 2017 Annual Closure and Reclamation Plan Progress Report
- AEMP Response Plan for Plankton

7.1 2017 Annual Closure and Reclamation Plan Progress Report

- Submitted on April 20, 2018
  - Required by Part I, Item 3 of the Type A Water Licence (MV2011L2-0004)
  - Appendices attached
    - Closure Criteria
    - 2017 Closure Studies and Reports
      - Closure Workshops including Traditional Knowledge
      - Revegetation Summary Report and 2017 Revegetation Field Program Summary Report

Implications to the ICRP from Variances in the Consolidated Project Description Schedule and Activities (I)

- The changes to underground and surface infrastructure are not considered variances that warrant reconsideration of the closure and reclamation activities for the mine
- The expansion of the North Pile and flooding of the underground was a previously planned activity, and removal of non-essential buildings is a typical progressive reclamation activity, which is not expected to require new or alternative closure methods to those that are currently planned

Implications to the ICRP from Variances in the Consolidated Project Description Schedule and Activities (II)

- Entering into care and maintenance, and early closure, is a change from operations; however, it is an activity that was accounted for in the ICRP as a possibility to occur
  - The completion of mine flooding and progressive reclamation of buildings during extended care and maintenance would preclude the completion of these activities for when the mine enters into final closure, thus reducing the timeline to complete closure activities

Community Engagement

- Engagement efforts with Snap Lake Mine's community partners relating to closure and reclamation reached various levels of the community in 2017, including Chiefs, community governments and local Environment departments, committees and working groups
- In 2017, De Beers provided funding to the four Impact Benefit Agreement signatories of the Environmental Agreement to participate the closure planning activities and discussions on Traditional Knowledge (TK)

Progressive Reclamation (I)

- Continuation of the revegetation test plots supporting reclamation research at the former AN Storage Pad with application of additional native shrub seeds and seedlings, as well as, monitoring of revegetation growth
- In 2017, additional erosion protection material was placed on the East Cell upstream slope and along cuts through the interior rib berms for surface water drainage
- Select non-essential buildings for mine operations were identified to be decommissioned (i.e., removed) during care and maintenance

Progressive Reclamation (II)

- Major structures, fixed and mobile equipment and hazardous materials were removed from underground as preparation for flooding in 2016 and 2017
  - Removal of select materials from site over the winter road
  - Sequential flooding of the underground workings commenced in January 2017 and continued throughout 2017

Reclamation Research Update (I)

- Research was continued at the former AN Storage Pad **revegetation** test plots in 2017 to evaluate active revegetation methods. Seeding of native shrubs was carried out in spring and fall 2017, with the addition of shrub seedlings during the former event
- An assessment of vegetation cover at the test plots was also completed in spring and fall 2017 for future comparison and to help evaluate the different revegetation methods. Additionally, a visual preliminary evaluation of plant type (e.g. grass, shrub) and species growing naturally on disturbed surfaces around the mine site was conducted in spring and fall 2017

Reclamation Research Update (II)

- Ground temperature and seepage monitoring at the North Pile continued throughout 2017 to provide useful information for the assessment of implications to post closure discharge and the development of more detailed water quality predictions in the future
- The continued stability of the North Pile throughout 2017 was confirmed through on-going deformation monitoring. Air quality and dust fall monitoring in 2017 has also continued to provide useful information to assess if potential control measures for the North Pile are required. Final Engineering to inform the North Pile cover design and surface water management was initiated in 2017 and will continue in 2018 to inform final designs that will be presented in the FCRP

Financial Security

- The financial security held at the end of 2017, with deposition of PK having occurred in the Starter Cell, East Cell and West Cell (for construction use only), was $80,401,918 and is broken down as follows:
  - Class A Land Use Permit MV2010D0053, $21,335,671 (MVLWB, 2011);
  - Type A Water Licence MV2011L2-0004, $39,066,247 (MVLWB, 2015); and,
  - Environmental Agreement – Additional Security Deposit, $20,000,000
- In 2018, since the Mine currently in ECM, De Beers will discuss with the signatories of the Environmental Agreement the need to post the final additional security payment of $3,500,000 in 2019

Proposed Changes to the Closure Planning Process and Timelines

- Final closure planning process and timelines will be captured in the updated FCRP that is to be submitted to the MVLWB in 2019 to fulfill Part I, Item 3 of the Water Licence

Record of Revisions to Be Made within the ICRP (I)

- Potential primary changes to the updated FCRP (to be submitted in 2019) compared to the 2013 Interim Closure and Reclamation Plan include the following:
  - Conformance with the finalized CRP Guidelines (INAC et al., 2013);
  - Incorporate relevant information collected from community and stakeholder engagement, with particular focus on feedback regarding closure criteria;
  - Updated to include closure criteria for MVLWB approval;

Record of Revisions to Be Made within the ICRP (II)

- Updated reclamation research plan based on monitoring and research completed since 2013
- Updated to address the amended Environmental Assessment (EA1314-02) and current Water Licence (MV2011L2-0004)
- Updated to current site conditions;
- Updated to address the Extended Care and Maintenance Plan (De Beers, 2017a);
- Incorporate recommended additions and modifications from the 2019 FCRP review process that is anticipated to be administered by the MVLWB

7.1.1 Revegetation Summary Report

- The following research topics are summarized
  - Best management practices with regards to revegetation of dry disturbed areas as documented through successful revegetation practices at comparable mine sites
  - Options for surface preparation (e.g. re-contouring, roughening, erosion control, salvaged soil spreading, etc.) to promote natural growth in dry upland areas
  - Metrics applied to measure revegetation success
  - Potential for metals uptake in vegetation at processed kimberlite (PK) areas post closure

Natural/Passive Revegetation

- Passive revegetation refers to the natural colonization and succession of disturbed sites by local native plant species. Main outcomes from this research include:
  - Passive recovery is effective at small disturbed sites consisting of reclaimed overburden and esker material and located directly adjacent to undisturbed areas
  - Plant coverage of between 9% and 22% and species diversity of 26 to 40 was achieved after approximately 8 to 14 years; and,
  - Percent cover and species diversity can be effective measures of revegetation success,

Active Revegetation (I)

- Active revegetation refers to manually initiating plant establishment by means of seeding, transplanting or related activities
  - A desktop review was completed to identify a list of candidate species to be used in revegetation, as well as, examine the potential methods for developing seed stock for these species to support revegetation research, progressive reclamation, and for final revegetation of Mine components a closure

Active Revegetation (II)

- The main outcomes from this research include:
  - Mid-August to mid-September collection is a suitable period for harvesting most candidate shrub species
  - Initial results indicate there is better vegetative performance with topsoil and fertilizer amendments
  - Vegetation performance is greater in soils that are finer, organic-rich, moist, loosely compacted and sheltered
  - Grasses have the greatest success with regards to percent coverage relative to other candidate species planted
  - Natural succession by surrounding endemic vegetation can achieve similar levels of growth and/or initially outperform species applied through active revegetation techniques

Some Lessons from Other Northern Mines

- Organic soil and treated sewage sludge was effective substrate for vegetative cover development
- Fertilizer aided growth early on, but difference was negligible after two years.
- Gravel is an effective substrate in the short-term, but not as good over time relative to till, topsoil, lake sediment or sewage without the addition of another substrate (e.g. topsoil) or amendment (e.g. fertilizer, scarification)
- Regrowth at actively reclaimed sites is faster than for natural recovery, but still takes upwards of 2 to 3 years for soil and plant development
- Plant growth is better in soils prepared with the rough and loose method
- Plant diversity is better in areas prepared with the rough and loose method

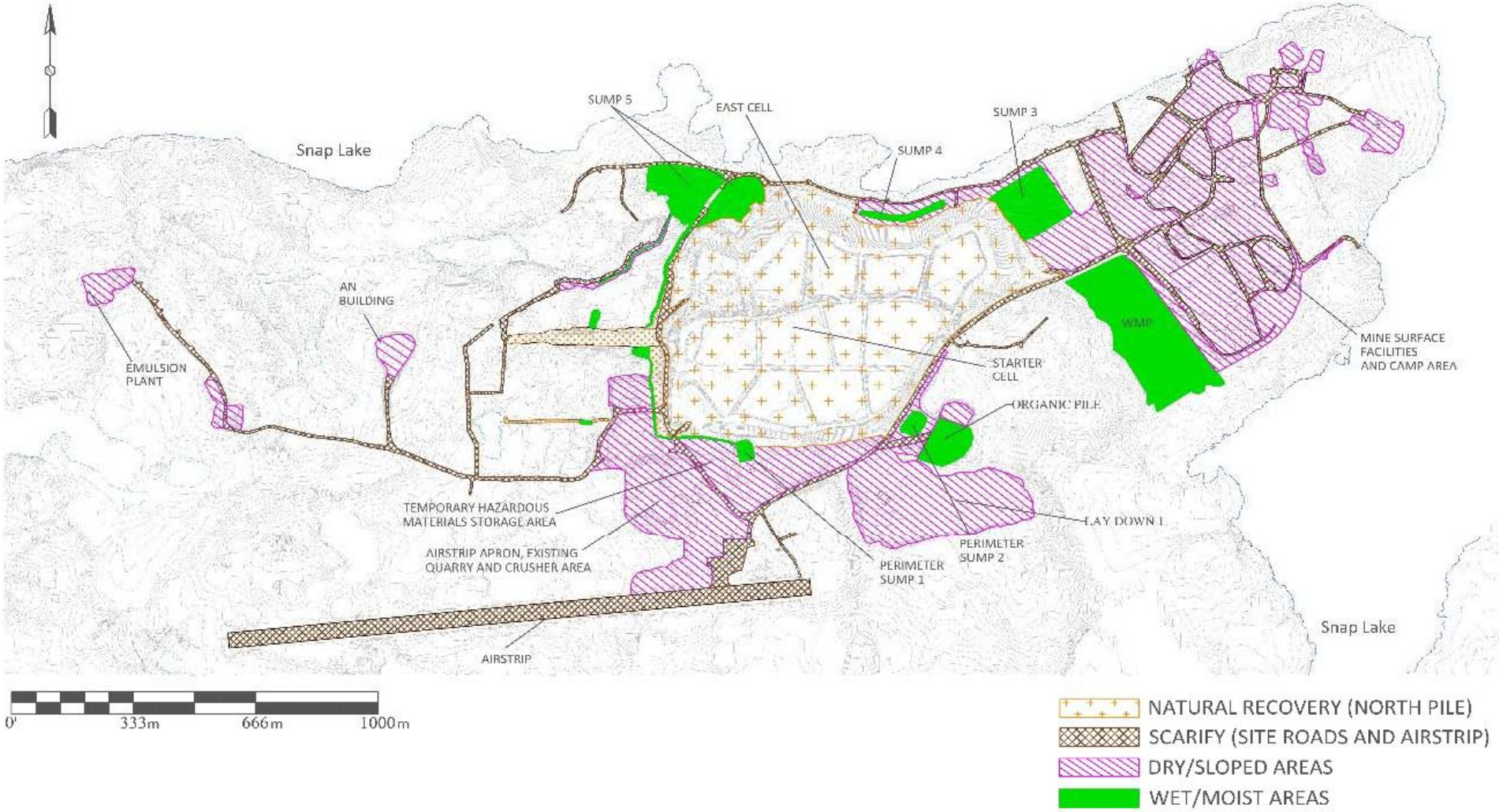
Common Recommendations from Yukon Revegetation Manual

- Surface contouring to limit slopes and control erosion;
- Soil decompaction through scarification and ripping, except for permafrost areas;
- Application of organic materials, with priority areas being erosion-prone areas, clay-rich areas, and
- slopes;
- Application of fertilizer based on soil chemistry; and,
- Lower seeding rates for flat, organic rich areas and higher rates for bare mineral soils or steep slopes

Revegetation Options for Snap Lake

- One of the following or a combination of these revegetation options will be implemented at closure
  - Leave as constructed
  - Scarification of areas
  - Scarification and seeding/fertilizer application
  - Scarification, topsoil placement and seeding/fertilizer application

Snap Lake Mine Revegetation Areas



Selection of Revegetation Metrics to Use as Closure Criteria

- Re-establishment and/or dominance of native species is a common metric proposed to evaluate revegetation success
- Average percent plant coverage of vegetation is also a common method

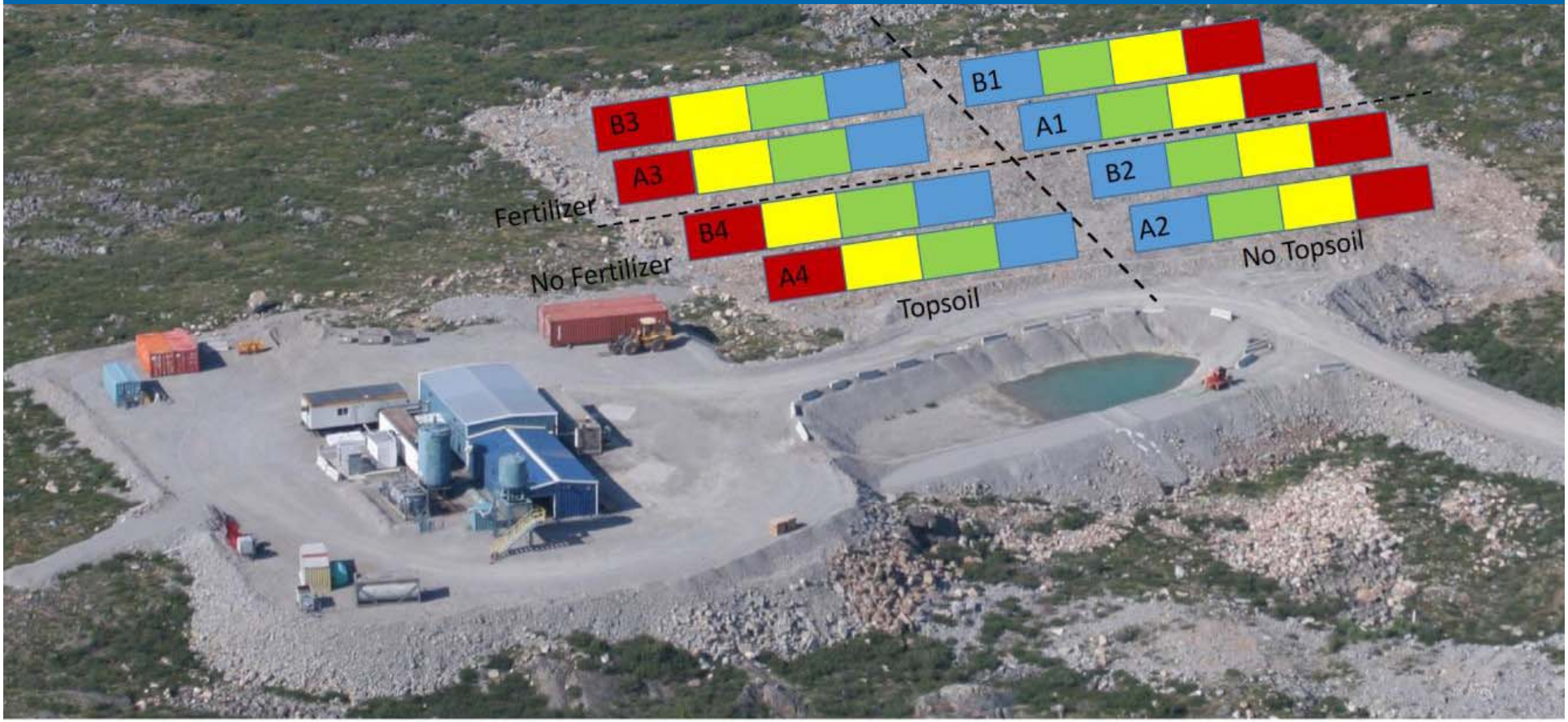
Metal Uptake in Plants

- Research at the Snap Lake, Ekati and Diavik mine sites indicate plants can uptake metals from PK; however, the risk for bioaccumulation and potential for harmful effects in receptors is unclear. The Mackenzie Valley Environmental Impact Review Board (MVEIRB) ruled that the proposed 0.5 m thick granite cover over PK and waste rock at the North Pile would sufficiently mitigate any potential metal uptake by vegetation growing on the North Pile

7.1.2 2017 Revegetation Field Program Summary Report

- The purpose of this report is to document the following revegetation research completed in 2017
  - Continuation of the revegetation test plots that are designed to evaluate active revegetation methods. Specifically, in 2017 spring and fall seeding events occurred, as well as, monitoring of revegetation growth
  - Preliminary assessment of vegetative natural recovery about the mine site where there has been land disturbance due to operations

Test Plot Layout within the Study Site



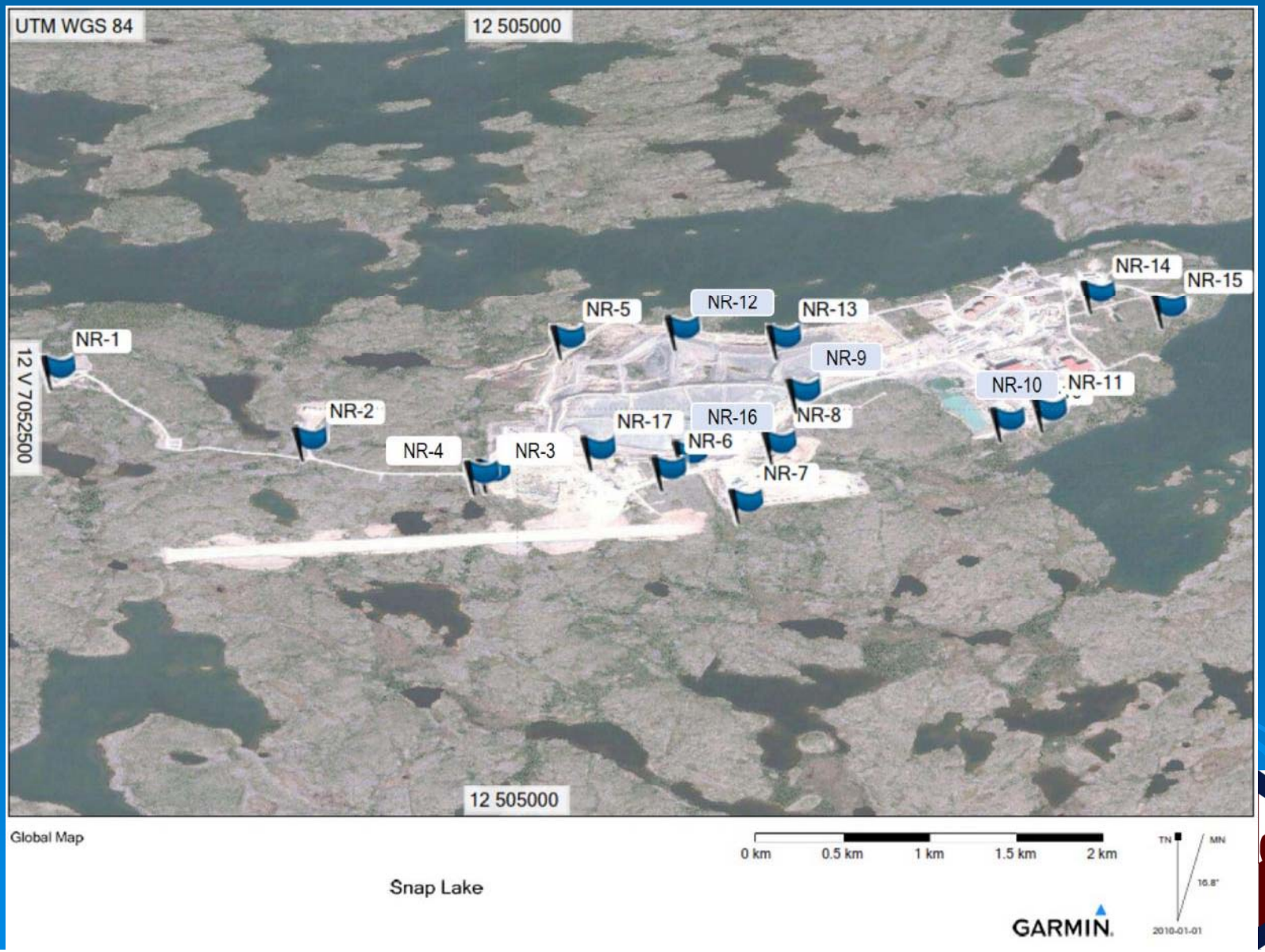
Revegetation Test Plots (I)

- Observations regarding the revegetation at test plots B1 through B4 in 2017 were similar to that of 2016, as follows:
  - Encroaching endemic vegetation from the surrounding area appears to dominate the existing ground cover relative to the candidate species applied through active revegetation
  - Vegetation ground cover was substantially greater in test plot B3 which had fertilizer added and topsoil compared to the test plots that had no fertilizer or topsoil

Revegetation Test Plots (II)

- Grasses have the greatest success when looking at percent coverage in all test plots compared to the other candidate species planted. Common reed (*Phragmites australis), a species that was not* planted, was found in high concentration in the test plots in the fall monitoring assessment
- Within the topsoil plots, areas with darker, more organic rich soil support more vegetation relative to areas with lighter, finer grained soil
- For plots with no topsoil, vegetation growth is greater in areas with finer, sandy material, moist ground, and/or in the shelter of depressions and boulde with Rocky Mountain Fescue being the predon species

Natural Recovery Assessment Locations



Natural Revegetation Recovery

- Initial observations regarding the natural revegetation disturbed areas were as follows:
  - Seventeen locations were assessed. Thirteen of those had at least 30% plant coverage
  - Species most found included: dwarf birch, fireweed, moss, grasses and crowberry
  - NR-10 (WMP shore) and NR-16 (Starter Cell, south ditch) both had areas with 100%plant coverage and NR-3 (Quarry-wet) had 85% plant coverage. These three areas also had the highest percent of organics observed in the soil with 30 to 40%

Natural Revegetation Recovery

NR-2 (AN Storage) vs. NR-3 (Quarry-wet)

Natural Revegetation Recovery

NR-8 (north slope organics pile) vs. NR-10 (WMP shore)

Comments from the Environmental Analyst

- The 2017 Annual Closure and Reclamation Plan Progress Report and its appendices are well presented, except editing issues
  - NSMA December 3, 2017 TK Workshop minutes is attached for three times (Page 29, 36, 56 out of 143), but the minutes for NSMA November 24, 2017 TK Workshop is missing
- No concerns are raised

7.2 AEMP Response Plan for Plankton

- Submitted on May 29, 2018
  - A Low Action Level for nutrient enrichment in the plankton community was triggered under the Response Framework in the approved 2013 AEMP Design Plan Update for Care and Maintenance, during the 2017 AEMP
  - Technical Memorandum is provided
    - 2017 AEMP – Response Plan for Plankton Community Low Action Level Trigger

Trigger (I)

- The Low Action Level was triggered by three consecutive years of increasing phytoplankton biomass in the main basin of Snap Lake
  - Phytoplankton biomass increased from 2014 to 2017
    - 380 µg/L – 777 µg/L – 1244 µg/L – 1503 µg/L
  - This increase suggests a potential Mine-related nutrient enrichment response, which is consistent with predictions that phytoplankton biomass would increase in Snap Lake during the Environmental Assessments
    - Not of immediate concern

Trigger (II)

- The Low Action Level was also triggered by a shift in phytoplankton community composition in the main basin of Snap Lake
  - Between 2004 and 2016, dinoflagellate relative biomass has been relatively low, ranging between 1% and 10% in Snap Lake, which is typical for freshwater phytoplankton communities. From 2016 to 2017, dinoflagellate biomass increased by four-fold in the main basin of Snap Lake
  - This increase in dinoflagellate relative biomass was not observed in Northeast Lake

Phytoplankton Edibility Assessment

- Overall, the edibility assessment indicates that edible taxa comprise the majority of the phytoplankton community in Snap Lake, which suggests that the plankton ecosystem is “healthy” and efficiently transferring primary production from phytoplankton to zooplankton

Possible Causes of Action Level Trigger

- The Low Action Level trigger for phytoplankton biomass is consistent with the EAR predictions that mine-related activities would cause an increase in phytoplankton biomass in Snap Lake; therefore, an increase in biomass is not of immediate concern
- The community-level changes from a chrysophyte-cyanobacteria dominated community to a diatom-dominated community were likely the result of increases in available silica related to mining activities in Snap Lake

Action to be Taken

- Further sampling is needed to confirm the shift in community composition and to monitor potential changes in phytoplankton biomass. This is planned for 2018
- It is not suggested that the medium and high action levels be set at this time, because a new AEMP design plan for Closure, which is planned for submission in early 2019, requires a re-evaluation of the action levels. An assessment of the action levels for plankton will occur at that time and be provided for review

Comments from the Environmental Analyst

- No concerns are raised
  - The analysis is well done, and the actions to be taken are reasonable