NEW GOLD RAINY RIVER MINE
APPENDIX G
2023 VEGETATION TRIAL SUMMARY MEMO

Rainy River Mine - 2023 Vegetation Trial Summary

January 12, 2024

okane

Integrated Mine Closure and Relinquishment Solutions

Rainy River Mine - 2023 Vegetation Trial Summary

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EXECUTIVE SUMMARY

New Gold Inc. (New Gold) established a vegetation trial at the Rainy River Mine (RRM) to investigate the performance of locally common species with operationally feasible cover system configurations. It is anticipated that learnings from the trial will serve to inform the closure plan, and that this work will contribute to New Gold's commitment to demonstrate to government regulators and community stakeholders that vegetation can be re-established during progressive reclamation and closure.

The vegetation trial is designed as a randomized block study and is situated on the plateau of a dedicated trial area. Slopes surrounding the block study have been seeded with various methods and are used to qualitatively evaluate operational seeding techniques, vegetation establishment, and erosion. Construction at the trial was completed in September 2019, and many of the plots were planted in late October 2019. Hydroseeding of the slopes was completed in the Fall of 2020. The purpose of this memorandum is to summarize monitoring activities completed by Okane Consultants (Okane) in 2023, document baseline conditions observed, and provide a set of recommendations based off the conditions observed.

Sloped Areas

In 2023 no active erosion was observed, apart from a gully on one section of the south slope.

The historical erosion features from previous years were difficult to identify in 2023 due to dense vegetative ground coverage, all sloped areas had 100% vegetative ground coverage, except for a portion of the south slope which had 75% cover.

Species composition was comparable across the four different slopes, with Birdsfoot Trefoil, Sweet Clover, Canada Wild Rye, and Virginia Wild Rye representing the dominant species. Birdsfoot Trefoil and Sweet Clover are not native, and their dominance indicates sloped areas are highly prone to weed infestations that outcompete desirable species. On sloped areas where hydroseeding was conducted early, desirable graminoid species such as Canada Wild Rye, and Virginia Wild Rye were quick to establish and weed infestations have been slower to develop. Minor species observed across all slopes were a mixture of hydroseeded grasses, volunteer native species, undesirable weeds, and noxious weeds.

Plateau Plots

Overall, in 2023 the general health of the planted tree species in plots appeared to be comparable to previous years. Black Spruce, White Spruce, Eastern White Cedar, and Jack Pine are the least successful tree species with higher stress levels and mortality and less growth compared to Aspen, Birch, Pincherry, High Bush Cranberry, Willow, and Dogwood. Aspen, Birch, Pincherry, High Bush Cranberry, Willow, and Dogwood may prove to be ideal for widespread use in large scale reclamation across a variety of topographical settings at RRM. White Spruce may also prove to be ideal in reclamation if planted earlier in the spring.

Beginning in 2023, noxious weed density distribution was documented in most plots and noxious weeds were observed to densely populate most plots. Generally, plots with thin topsoil and tilled topsoil, regardless of vegetation type, had a higher density distribution than plots with fertilized overburden or control (overburden) soil. Community plots where no species appeared to have been planted often had a comparatively higher density distribution of noxious weeds compared to other vegetation treatments.

Plant available nutrients, organic parameters, and salinity parameters were measured in each of the soil treatments in all three blocks in 2023. Based on the analytical results, tree mortality appears to be unaffected by nutrient and organic matter and carbon concentrations in the immediate or short-term. The use of topsoil as a growth media appears to be highly beneficial to the establishment of herbaceous ground cover over the immediate and/or short-term but less so for trees and shrubs which generally had higher growth in fertilized and unfertilized overburden. Vegetation is not being impacted by salinity related issues and all soil treatments are considered suitable as a growth media with respect to salinity.

Destructive Plot

Minimal erosion was observed in the destructive plot, except for some down-slope erosion on the north edge of the plot. Vegetation was generally noted to be well established, with increases in vegetative ground coverage from 75% in 2020 to 100% in 2023.

Rooting depth did not extend into the compacted clay layer and remained within the overlying overburden.

Recommendations

Based on the vegetation trial conditions observed since 2020, eight recommendations for further assessing potential failure modes identified during the Failure Modes and Effects Workshop are provided.

1) Continue monitoring vegetation through field surveys to identify the most successful herbaceous plants on the slopes and plateau plots for application in large scale reclamation.

2) Design and implement a noxious weed management program, which may include:

    a. Manual weed removal; and/or

    b. Application of herbicides.

3) Design and carry out a revegetation plan in the existing plots and slopes where high levels of mortality and/or bare ground has been observed. The revegetation plan will utilize plant species that have been identified as being the most successful. For tree species, saplings should be used instead of established trees to better understand whether saplings can withstand competition from the herbaceous ground cover.

4) Continue monitoring for active erosion and institute mitigating measures if significant erosion is observed. Mitigating measures include the following:

    a. Reduce the slope angle to decrease the velocity of overland flow;

    b. Apply erosion prevention materials such hydroseeding with ProGanics® Biotic Soil Media;

    c. Spread mulch, straw, and woody debris, including logs, on the surface to slow the overland flow that occurs during periods of heavy precipitation and spring thaw;

    d. Install straw wattles to decrease velocity of overland flow;

    e. In the future, ensure that seeding activities are carried out immediately after landform construction; and/or

    f. Scarify the surface to create microsites with enhanced moisture retention, seed germination, and reduced rates of overland flow ideal for plant establishment.

5) Continue to monitor root depth and spread to assess if tree roots penetrate the compacted clay layer.

6) Continue the soil sampling program within the plots to assess any changes in soil nutrient concentrations. The sampling program will build off the information collected in 2023 on effects of vegetation on soil properties.

7) Apply additional fertilizer to the plots with fertilized overburden. This application will help to establish whether an increase in plant available nutrient concentrations in overburden will have any impact on increasing the organic matter content and more closely mimic the natural soil profile.

8) Design and implement a sampling program for soil treatment types and vegetation material within the plots to assess ecotoxicity effects and bioaccumulation of metals in vegetation materials. This sampling program will help better understand if any migration or leaching of toxic compounds from the overburden and/or underlying waste rock is occurring.

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1 INTRODUCTION

New Gold's Rainy River Mine (RRM) must demonstrate to government regulators and community stakeholders that vegetation can successfully be re-established as part of ongoing progressive reclamation and closure. Potential failure modes for re-vegetation strategies of the covered mine rock stockpiles were identified during a failure modes and effects analysis (FMEA). Uncertainties that remained following the identification of specific failure modes were scheduled to be addressed as part of a vegetation research program (Okane, 2018). The following report constitutes a summary of observations at the ongoing vegetation trials.

1.1 Project Objectives and Scope

The overall closure objective for establishing vegetation on closure landforms at RRM is to meet land use expectations for desired vegetation community structure to mimic the surrounding community types where feasible. A specific objective of closure revegetation is to establish a natural functioning vegetation community that supports local land use and wildlife. Therefore, the objective of the vegetation trial is to test the cover system configurations and vegetation mixes that are most likely to result in a self-sustaining ecosystem that is compatible with the surrounding area (Okane, 2018).

1.2 Report Organization

For convenient reference, this report has been subdivided into the following sections:

Section 2 – provides pertinent background information for this study;

Section 3 – provides the results of monitoring activities undertaken in 2023;

Section 4 – provides a detailed discussion of 2023 activities with respect to the identified failure modes and effects;

Section 5 – provides a summary of recommendations to continue assessing the failure modes and effects established at the start of the project; and

Section 6 – provides a list of references.

2 BACKGROUND

The requirement for conducting a vegetation trial was a result of a risk to the success of the closure system identified during the FMEA workshop. The FMEA workshop identified that a failure to establish vegetation on the final closure landform represented a sufficient risk such that a mitigation measure was required. Thus, the vegetation trial described herein is meant to serve as a means of mitigating these risks.

2.1 Vegetation Trial Design

The vegetation trial is designed as a randomized block study and is situated on the plateau of a dedicated trial area. Combinations of four soil treatments and nine vegetation treatments are arranged in three replicates totalling 108 plots. A destructive plot area is designated for destructive root sampling and investigation as the trial progresses. Slopes surrounding the block study have been seeded with various methods and are used to qualitatively evaluate operational seeding techniques, vegetation establishment, and erosion. Planned arrangement of the trial area is presented for reference in Figure 2.1Figure 2.1, Figure 2.2Figure 2.2, and Figure 2.3Figure 2.3.

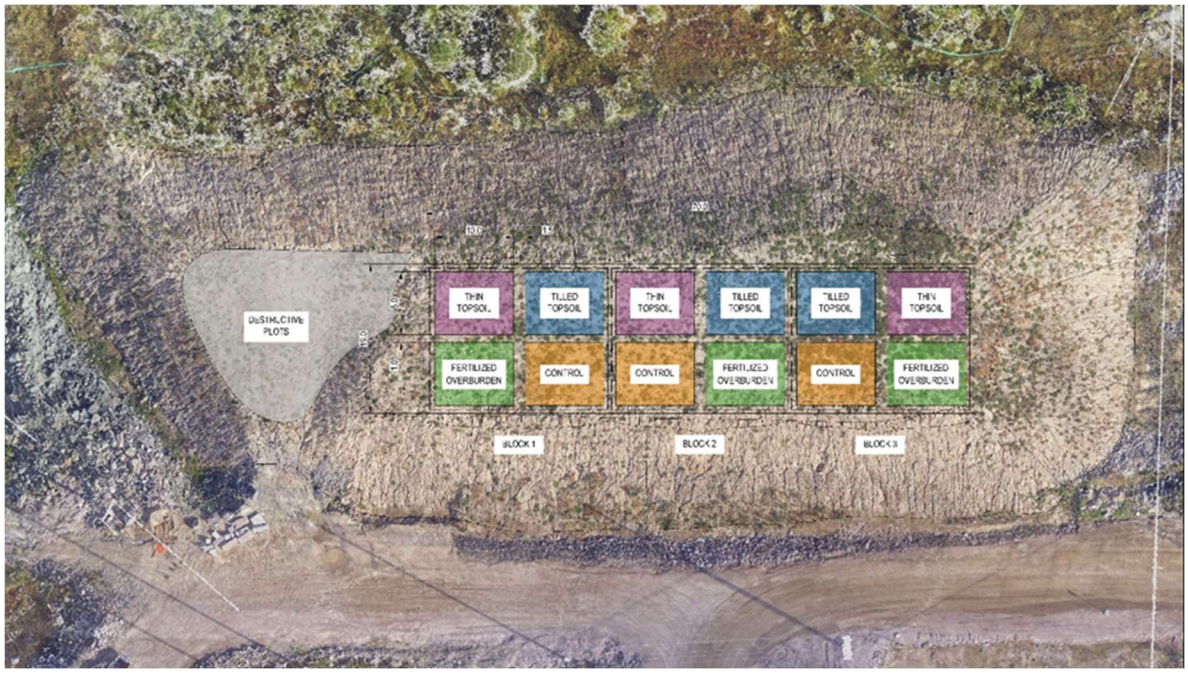


Figure 2.1: Arrangement of soil treatments in plots.

(Okane, 2019)

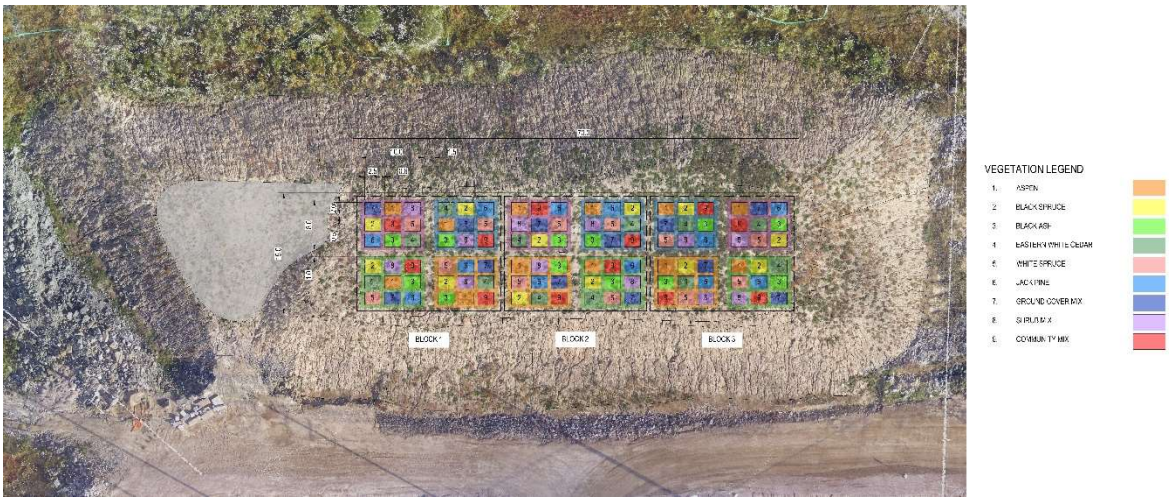


Figure 2.2: Arrangement of vegetation treatments in plots.

(Okane, 2019)

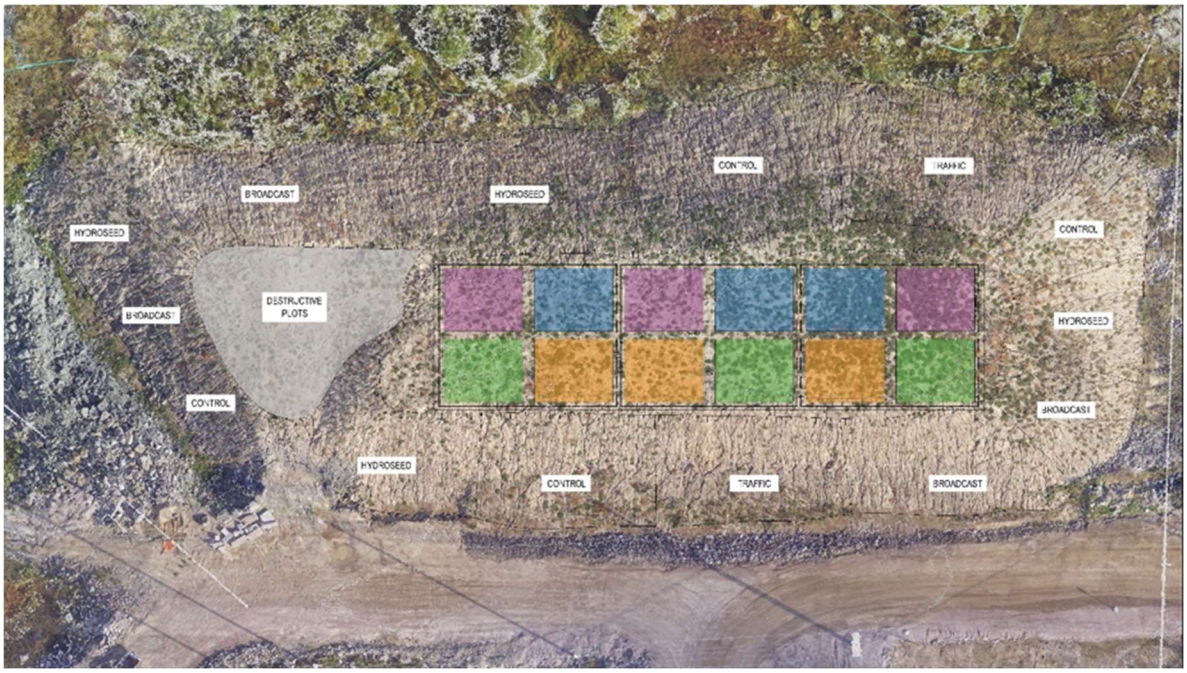


Figure 2.3: Arrangement of slope treatments.

(Okane, 2019)

The general cover system configuration planned for use on the RRM stockpiles consists of a 0.5 m barrier layer overlain by a 1.0 m growth medium layer, designed to limit net percolation (NP) and control oxygen (O_2) ingress to the mine rock. The enhanced cover system uses both moisture store-and-release and enhanced runoff principles to achieve reduced NP. The barrier layer within the cover system controls O_2 ingress by effectively eliminating advective gas transport.

The vegetation trial was constructed in 2019 using the same cover system design, with clay overburden used for both the barrier and growth medium layers. Four soil treatments applied to the plateau plot areas were chosen to represent potential options for operational revegetation (Figure 2.1):

1) Thin topsoil – a 0.15 m layer of topsoil was applied to the surface;
2) Tilled topsoil – a 0.15 m layer of topsoil was applied to the surface and then mixed into the overburden using a skid steer tiller;
3) Fertilized overburden – a commercial mix of fertilizer, mainly comprised of bonemeal, was applied to the overburden surface using a skid steer tiller; and
4) Control – no amendment or modification to the overburden surface.

The species chosen for inclusion in the trial represent locally common or significant species (Figure 2.2):

1) Aspen;
2) Black Spruce;
3) Paper Birch (formally referred to as Black Ash in previous reports);
4) Eastern White Cedar;
5) White Spruce;
6) Jack Pine;
7) Ground Cover Mix – may include species common to the local ecosystem, such as Bearberry, Blueberry, Ground Cedar, High Bush Cranberry, Pincherry, or Labrador Tea;
8) Shrub Mix – may include species common to the local ecosystem, such as, Saskatoon Berry, Beaked Hazelnut, Alder, Willow, or Red Osier Dogwood; and
9) Community Mix – culturally significant species selected by local communities, not necessarily found in the local area.

Experimental tree plot planting on the plateau commenced in late October 2019 but was not completed that year. Planting was completed in November 2020. Of note, Tobacco and Juniper species were not planted and are planned to be excluded from the trial. Commercial availability of Tobacco and Juniper species is limited and may not be feasible to include them in large-scale reclamation operations.

The vegetation trial plot is representative of an upland-type habitat on the closure landscape as per recommendations by the Ontario Ministry of Natural Resources and Forestry (MNRF) (Amec Foster Wheeler, 2015). Therefore, a general native seed mix was used for seeding the slopes. The general native seed mix composition is listed in Table 2.1.

Table 2.1: General native seed mix used for seeding the slopes.

Common Name	Species	Seed Species Composition[1] (%)
Slender Wheat Grass	*Elymus trachycaulus*	6.58
Big Bluestem	*Andropogon gerardii*	5.92
Canada Wild Rye	*Elymus canadensis*	5.26
Virginia Wild Rye	*Elymus virginicus*	8.55
Fowl Bluegrass	*Poa palustris*	1.58
Poverty Oatgrass	*Danthonia spicata*	1.05
Fringed Brome	*Bromus iliates*	3.95
	Total Grasses	**32.89**
Black-eyed Susan	*Rudbeckia hirta*	0.75
Blue Vervain	*Verbena hastata*	0.56
	Total Forbs	**1.31**
Annual Oats (nurse crop) (replace with winter wheat when applied Aug 15 to Oct 15)	*Avena Sativa*	65.79

[1] Seed species composition may vary based on commercial availability of seed at the time of construction. Species removed from the seed mix per MNRF comments received on May 21, 2015, include Showy Tick Trefoil (*Desmodium canadense*) and Wild Bergamot (*Monarda fistulosa*). Additional species diversity is expected through natural colonization.

The slope areas surrounding the trial were split into four separate seeding treatment options to inform on potential sediment and erosion control methods (Figure 2.3). These treatment options, executed in September 2019, consisted of hydroseeding, broadcast seeding, trafficked surface (compacted growth media), and a control section where no seeding occurred. The hydroseed method included the use of a commercially available product ProGanics® Biotic Soil Media from Profile Products. In September 2020, after high rates of erosion were observed on sloped areas across all seeding treatments, ProGanics® Biotic Soil Media was applied to all sloped areas.

Construction of the overburden destructive plot was completed in autumn 2019. Some species were planted on the plot in late October 2019, and planting was completed in November 2020.

3 MONITORING ACTIVITIES

3.1 Purpose and Approach

Okane personnel visited the vegetation trial on September 5 to September 7, 2023, to complete an erosion survey of the sloped areas of the trial, record growth indicator measurements for early plant growth trajectories, compile a species composition list, assess composition and density of noxious weeds, complete a root investigation at the destructive plots, and conduct a soil sampling program.

3.2 Sloped Areas Erosion Survey

In general, significant erosional features were observed on the sloped areas of the trial in previous years, however in 2023 no active erosion was observed, apart from a gully on one section of the south slope. Measured erosional features are included in Table 3.1. Historical erosion features were difficult to identify on most trial areas due to dense vegetative coverage. Photos of the sloped areas can be found below in Figure 3.1, Figure 3.2, Figure 3.3, and Figure 3.4.

Table 3.1: Major erosion features on sloped areas (S-sheet, R-rill, G-gully).

Slope Orientation	Hydroseed	Broadcast	Traffic	Control
North	No active erosion was observed in 2023, all historical erosion features remain but were fully vegetated and stable.			
East	No active erosion was observed in 2023, all historical erosion features remain but were fully vegetated and stable.			
South	No active erosion was observed in 2023, all historical erosion remains but was fully vegetated and stable.			**GULLY** Entire slope length Depth = 30 cm Width = 25 cm
West	No active erosion was observed in 2023, all historical erosion features remain but were fully vegetated and stable.			

Figure 3.1: Site photos of north slope. Broadcast (top left), hydroseed (top right), control (bottom left), and traffic (bottom right).

Figure 3.2: Site photos of east slope. Control (top left), hydroseed (top right), and broadcast (bottom).

Figure 3.3: Site photos of south slope. Broadcast (top left), traffic (top right), hydroseed (bottom right), control (bottom left).

3.2.1 Site Photos West Slope

Figure 3.4: Site photos of west slope. Control (top left), broadcast (top right), and hydroseed (bottom).

3.3 Plant Growth Measurements Slope Areas

Vegetation growth measurements were collected that can be used to quantify vegetation growth in the experimental tree plots at regular annual intervals. General observations were also noted along the slopes and at the destructive plot.

Vegetative ground coverage increased, across all sloped areas (Table 3.2). Of note, all slopes were treated with ProGanics® Biotic Soil Media in September 2020 to minimize further erosion. Ground coverage increased from 2022 with all slope treatment areas having 100% coverage, except for a portion of the south slope originally serving as the control plot, which had 75% coverage. Photos of slope vegetation ground cover can be found below in Figure 3.5, Figure 3.6, Figure 3.7, and Figure 3.8

Table 3.2: Percent vegetative ground coverage and dominant and minor species composition on sloped areas.

Slope Orientation	Hydroseed	Broadcast	Traffic	Control
North	**100%**	**100%**	**100%**	**100%**
	Dominant Species: Birdsfoot Trefoil (BT), Canada Wild Rye (CWR) **Minor Species:** Reed Grass (RG), Sweet Clover (SC), Plantain, Noxious Weeds[1]	**Dominant Species:** BT, SC **Minor Species:** CWR, Golden Rod, Virginia Wild Rye (VWR), Poplars	**Dominant Species:** BT, CWR **Minor Species:** Red Clover, Fowl Blue Grass (FBG), Plantain, RG, Noxious Weeds	**Dominant Species:** BT **Minor Species:** Red Clover, CWR, Golden Rod, FBG, Plantain, Poplars, Dandelion, RG, Noxious Weeds
East	**100%**	**100%**	n/a	**100%**
	Dominant Species: BT **Minor Species:** CWR, FBG, Plantain, RG, Slender Wheat Grass (SWG), Noxious Weeds	**Dominant Species:** BT, CWR **Minor Species:** Red Clover, RG, SW, Noxious Weeds		**Dominant Species:** BT, VWR **Minor Species:** CWR, Dandelion, SWG, Noxious Weeds
South	**100%**	**100%**	**100%**	**75%**
	Dominant Species: BT, SC **Minor Species:** CWR, VWR, Noxious Weeds	**Dominant Species:** BT, CWR **Minor Species:** Red Clover, Golden Rod, Plantain, SC, Noxious Weeds	**Dominant Species:** BT, CWR **Minor Species:** SC, Noxious Weeds	**Dominant Species:** BT, CWR **Minor Species:** VWR, Noxious Weeds
West	**100%**	**100%**	n/a	**100%**
	Dominant Species: BT, SC **Minor Species:** Red Clover, Golden Rod, VWR, Noxious Weeds	**Dominant Species:** BT, SC **Minor Species:** CWR, Golden Rod, Plantain, Noxious Weeds		**Dominant Species:** BT, SC **Minor Species:** Aster, CWR, Clover, FBG, Plantain, Golden Rod

1 - Noxious Weeds are composed of a mixture of Canada Thistle, Sow Thistle, Common Tansy, and Coltsfoot.

Figure 3.5: South slope vegetative ground coverage. August 26, 2020 (top left), August 18, 2021 (top right), August 9, 2022 (bottom left), and September 7, 2023 (bottom right).

Figure 3.6: East slope vegetative ground coverage. August 26, 2020 (top left), August 18, 2021 (top right), August 9, 2022 (bottom left), and September 7, 2023 (bottom right).

Figure 3.7: North slope vegetative ground coverage. August 26, 2020 (top left), August 18, 2021 (top right), August 9, 2022 (bottom left), and September 7, 2023 (bottom right).

Figure 3.8: West slope vegetative ground coverage. August 26, 2020 (top left), August 18, 2021 (top right), August 9, 2022 (bottom left), and September 7, 2022 (bottom right).

3.4 Plateau Plots

It was noted that in the Block 3 tilled topsoil treatment, Black Spruce was planted in the plot designated for White Spruce. The community mix plots were not planted, except for selected graminoid species in select plots. Paper Birch trees were planted in lieu of Black Ash and therefore in this report, Black Ash plots were renamed to Birch.

A general health check was performed during the survey. Planted tree species were rated on a qualitative 5-point scale to gauge if the tree/ shrub had established well:

- Healthy (H) – the specimen generally appeared to be in good health;

- Healthy / Struggling (H/S) – the specimen was not in prime condition, showing some sign(s) of poor health;
- Struggling (S) – the specimen was in poor condition, with the majority of the plant showing signs of wilting, lost leaves, or discolouration;
- Struggling / Dead (S/D) – the specimen was in very poor health or unclear if the plant had died; and
- Dead (D) – the specimen was clearly dead or had been completely uprooted.

Overall, the general health of the planted species appeared to be comparable to previous years. Some general observations for the various planted species include:

- Aspen and Birch – Mortality rates have remained relatively low with the lowest rates observed in the fertilized overburden and control soil treatments.
- Black Spruce – Mortality rates are highly variable across the different soil treatment areas. However, mortality rates appear to be highest in the thin and tilled topsoil soil treatments.
- White Spruce – Appear to be struggling and/or dead in all soil treatments.
- Eastern White Cedar – Mortality rates are very low however all trees are struggling, irrespective of the soil treatment.
- Jack Pine – Mortality rates of Jack Pine are very high across all soil treatments.
- Shrub mix – It is unclear as to which exact species were included in the shrub mix plots, however Willow and Dogwood appeared to have low rates of mortality across all soil treatments.
- Groundcover Mix – It is unclear as to which exact species were included in the groundcover mix plots, however High Bush Cranberry and Pincherry had variable rates of mortality with the highest rates being observed in the control soil treatment.

Error! Reference source not found. Table 3.3 provides a summary of general health observed during the experimental tree plot survey. A detailed summary of general health recorded during the 2023 Survey is provided in Appendix A. Photos of most tree plots across blocks and soil treatments are displayed in Appendix B.

Table 3.3 General health of planted trees and shrubs (H-healthy, H/S – healthy/struggling, S-struggling, S/D – struggling/dead, D-dead).

Species	Soil Treatment	Block 1				Block 2				Block 3			
		2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
Aspen	Thin Topsoil	9H, 1D	6H, 3S, 1D	5H, 1H/S, 1S, 3D	2H, 3S, 5D	6H, 1H/S, 3S/D	6H, 4D	7H, 3D	4H, 3S, 3D	10H, 1D	5H/S, 3S, 2D	8H, 2D	5H, 4S, 2D
	Tilled Topsoil	10H	5H, 1S, 4D	2H/S, 4S, 3D	3H, 3S, 4D	9H, 1S/D	10H	5H, 2S, 3D	1S, 6D	9H, 1S	10H	8H, 2D	6H, 2S, 2D
	Fertilized Overburden	9H, 1D	9H, 1D	9H, 1D**	5H, 2S, 1D	10H	10H	9H, 1D	6H, 3S, 1D	10H, 1D	10H	10H	5H, 5S
	Control	9H, 1D	9H, 1D	9H, 1D	5H, 3S, 1D	10H	10H	10H/S	7H, 3S	10H	10H	9H, 1S/D	6H, 4S
Black Spruce	Thin Topsoil	10H	2H, 3S, 5D	2H, 8D	3H, 5D	10H	3H, 3S, 4D	1H/S, 2S, 7D	8D	10H	10D	10D	9D
	Tilled Topsoil	9H, 1D	4H/S, 1S, 5D	3H, 7D	2 H, 9D	3H, 6S, 1D	10D	10D	2H, 1S, 5D	10H	1S, 9D	10D	10H, 1S*, 9D*
	Fertilized Overburden	10H	10H	10H	7H, 3S	10H	10H	10H	10S	9H, 1H/S	10D	10D	10D
	Control	10H	10H	10H	2H, 8S	10H	10H	8H, 2S	8H, 2S	10H	6H, 2S, 2D	8H, 1S, 1D	2H, 3S, 5D
Birch	Thin Topsoil	10H	10S	6H, 4H/S	3S, 6D	9H, 1H/S	10H	4H, 1H/S, 2S, 3D	10S	9H, 1D	9S, 1D	8H/S, 2D	5H, 3S, 2D
	Tilled Topsoil	10H	9S	4S, 1S/D, 5D	6S, 4D	9H, 1D	9H/S, 1D	3S, 7D	3S, 7D	10H	4H, 6S	8H, 2D	3H, 5S
	Fertilized Overburden	10H	10H	10H	8H, 1S	10H	10H	10H	4H, 6S	10H	10H	10H	7H, 2S, 1D
	Control	10H	10H	10H	5H, 5S	10H	10H	10H	10H	9H, 1H/S	9H, 1S	9H, 1S	5H, 5S
Eastern White Cedar	Thin Topsoil	10S	10S/D	4SD, 6D	9S	10H	10S	4S, 6D	7S, 2D	11H/S	11S/D	4S, 7D	10S
	Tilled Topsoil	10S	10S/D	10S/D	9S	10H	10S/D	3S, 7D	10S	10S/D	10S	3S, 7D	9S

Species	Soil Treatment	Block 1				Block 2				Block 3			
		2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
	Fertilized Overburden	10H	10H/S	10H	11S	10H	10H/S	10H/S	10S	11H/S	10S, 1D	5S, 6D	7S
	Control	10H/S	10S	10S	10S	10H	10H/S	10S	10S	11H/S	11S	11S/D	11S/D
White Spruce	Thin Topsoil	-	10D	10D	5D	-	10D	10D	5D	-	1H, 2S, 7D	1S, 9D	7D
	Tilled Topsoil	-	10D	10D	7D	-	10D	1S, 9D	10D	-	10D	10D	-
	Fertilized Overburden	-	3S, 7D	2H, 3S, 1S/D, 4D	8D	-	10S	1S, 9D	8D	-	1S, 9D	10D	1S, 4D
	Control	-	1S, 9S/D	1S, 9D	6S, 4D	-	3H, 3S, 4D	7S, 3D	6S, 4D	-	3S, 7D	2S, 8D	2S, 6D
Jack Pine	Thin Topsoil	-	-	-	-	-	-	-	-	-	-	-	-
	Tilled Topsoil	-	-	-	-	-	-	-	-	-	-	-	-
	Fertilized Overburden	-	-	-	-	-	-	-	-	-	-	-	-
	Control	-	-	-	-	-	-	-	-	-	-	-	-
Ground Cover Mix	Thin Topsoil	6H	4S, 2D	1H, 2 S/D, 2D	1H, 3S	6H	6S	1S, 5D	2H	6H	5S	1H/S, 1S, 4D	1H, 2D
	Tilled Topsoil	4S, 1S/D, 1D	1S, 3S/D, 2D	5D	-	5H, 1D	6S	6D	1S, 1D	6H/S	3S, 3D	1S/D, 5D	1H, 1S, 1D
	Fertilized Overburden	6H	6S	2H/S, 1S/D, 3D	1S	4H, 1H/S	6H/S	2H/S, 2S, 2D	3S, 1D	6H	6S	2H, 2S/D, 2D	1H, 1S
	Control	4H, 2S	6S	2H, 2S/D, 2D	2H	5H, 1H/S	6S	1S, 1S/D, 4D	1S, 1S/D, 4D	6H	6S	2S, 2S/D, 2D	2S, 2D
Shrub Mix	Thin Topsoil	4H	2S/D, 2D	2S/D, 2D	3H	4H	1S, 3D	4D	1H, 2S, 1D	4H	2S, 2D	2S, 2S/D	3H

Species	Soil Treatment	Block 1				Block 2				Block 3			
		2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
	Tilled Topsoil	4H	4S	4D	3H, 1S	4H	4S	4D	1D	H	3S, 1D	1H, 3D	2H, 2D
	Fertilized Overburden	4H	4H	4H/S	2H, 2S	4H	4H	1H, 2H/S, 1S	1H, 3S	4H	1H, 2S, 1D	2H, 2D	2H, 2S
	Control	4H	4H	4H/S	2H, 2S	4H	4H	4S	3H, 1S	4H	1H, 3S	4D	4H
Community Mix	Thin Topsoil	-	-	-	-	-	-	-	-	-	3H	-	-
	Tilled Topsoil	-	-	-	-		3H	-	-		3H	-	-
	Fertilized Overburden	2H	2H	-	-	-	-		-		3H	-	-
	Control	3H	3H	-	-		-		-	3H	3H	-	-

- No trees or shrubs identified in plot

* Planted in white spruce design plot;

** Dead aspen removed from plot in 2022

During the 2023 survey, three trees were randomly selected in each plot to measure the growth indicators. Several growth indicator measurements were recorded during the autumn survey for annual growth comparisons:

- Root Collar – the diameter of the tree base at the widest part of the root collar (where the root joins the stem), or just above the ground surface, whichever is higher;
- Total Height – the distance between the root collar and the base of the terminal bud (of the tallest stem). For leaning trees, this distance was measured along the slope of the stem;
- Diameter at Breast Height (DBH) – the diameter of the tree at 1.3 m above the base; and
- Crown Diameter – the average horizontal width of the crown.

A detailed summary of growth indicator measurements by plot are provided in Appendix A. Average indicator measurements by species are included in Table 3.4.

Table 3.4 Mean tree and shrub growth indicator measurements +/- standard deviation.

Tree Species	Root Collar (mm)	Crown Diameter (cm)	Height (cm)				DBH (mm)			
	2020		2020	2021	2022	2023	2020	2021	2022	2023
Aspen	21.5 +/- 2.0	24.6 +/- 10.2	258.6 +/- 26	254.9 +/- 33.2	266.3 +/- 34.7	261.2 +/- 22.1	14 +/- 1.6	15.2 +/- 1.1	16.1 +/- 1.9	17.5 +/- 3.0
Black Spruce	22.5 +/- 3.1	26.7 +/- 7.5	99.5 +/- 17.8	107.8 +/- 16.8	117.0 +/- 12.3	144.2 +/- 55.4	n/a			9.5 +/- 4.7
Birch	21.6 +/- 2.4	29.9 +/- 9.0	219.6 +/- 30.4	213.4 +/- 31.3	226.4 +/- 28.7	208.9 +/- 41.7	10.8 +/- 2.2	11.3 +/- 2.4	11.1 +/- 2.4	10.2 +/- 3.3
Eastern White Cedar	22.0 +/- 4.7	16.3 +/- 6.1	99.4 +/- 10.8	96.5 +/- 16.5	100.2 +/- 14.5	100.0 +/- 11.1	n/a			
White Spruce	Not planted			68.1 +/- 16.7	69.4 +/- 19.9	50.3 +/- 19.5	Not planted	n/a		
Jack Pine	n/a									
Ground Cover Mix – Pincherry	n/a					175.1 +/- 67.9	n/a			16.3 +/- 4.2
Ground Cover Mix - High Bush Cranberry	n/a					65.5 +/- 35.4	n/a			

Tree Species	Root Collar (mm)	Crown Diameter (cm)	Height (cm)				DBH (mm)			
	2020		2020	2021	2022	2023	2020	2021	2022	2023
Shrub Mix	n/a					91.1 +/- 28.5	n/a			
Community Mix	n/a									

n/a = no trees or shrubs were identified in plot to measure height, root collar, crown diameter, and/or DBH or DBH was not measured because height was under 1.3 m.
Measurements expressed as mean +/- standard deviation.

Vegetative ground coverage was estimated at each plot during the surveys. During the 2023 survey, vegetative ground coverage increased across all plots, and most notably in some of the plots with control and fertilized overburden soil treatments (Table 3.5). Figure 3.9 displays vegetative ground coverage from 2020 to 2023 across all blocks and vegetation types by soil treatment type.

Table 3.5: Average vegetative ground coverage (%) observed in Autumn 2020, 2021, 2022, and 2023.

Soil Treatment	Block 1				Block 2				Block 3				Average			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
Thin Topsoil	67	75	93	100	75	75	95	98	75	75	100	100	72	75	96	99
Tilled Topsoil	75	75	95	93	75	75	97	88	64	75	100	89	71	75	97	90
Fertilized Overburden	17	19	30	50	17	19	33	81	25	19	65	100	19	19	43	77
Control	19	19	32	52	17	19	25	59	22	19	38	86	19	19	32	66

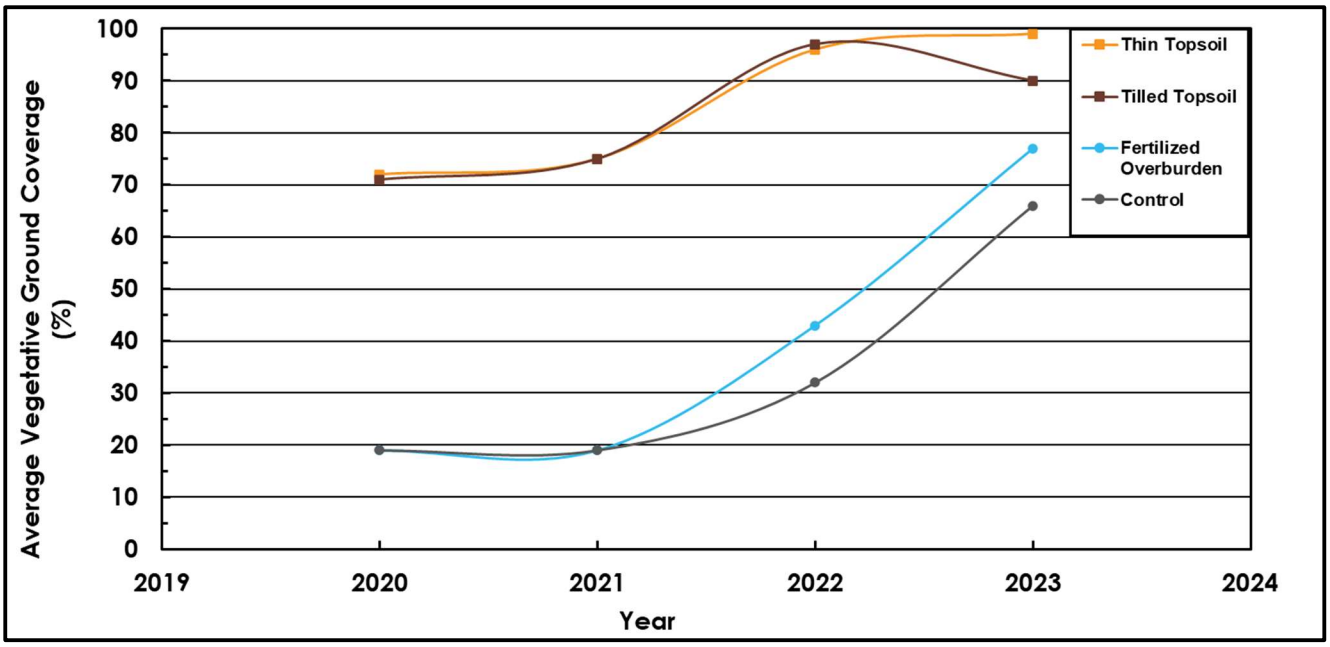
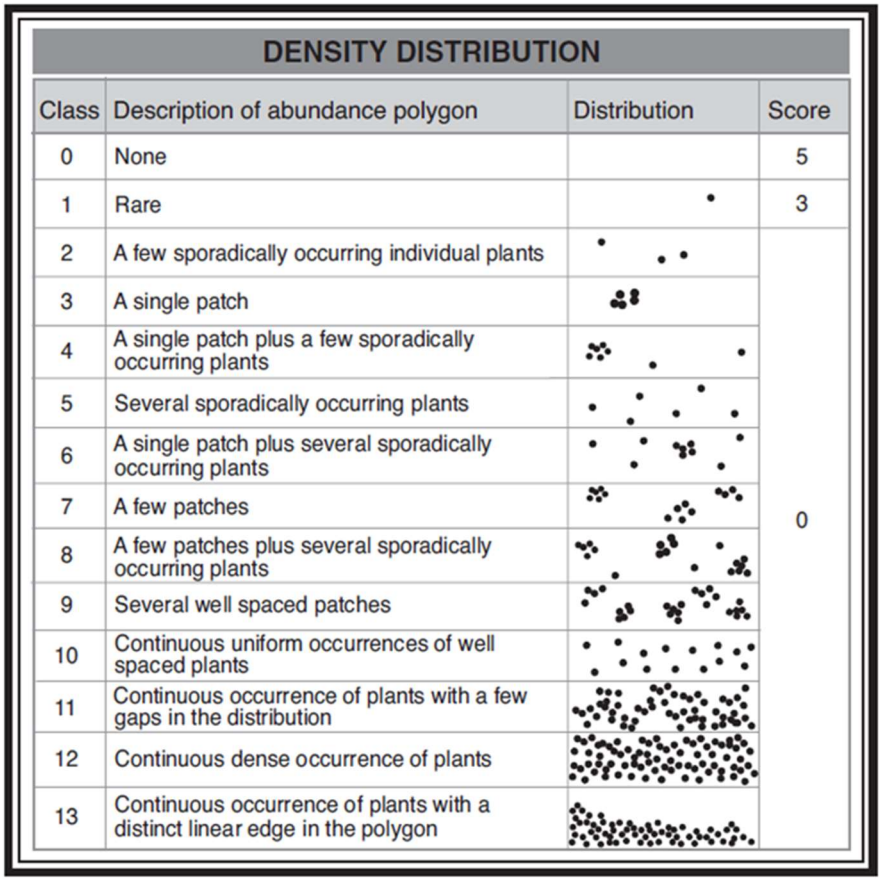


Figure 3.9: Average vegetative ground coverage.

An additional measurement of noxious weed density distribution was documented in most plots during the 2023 survey. Noxious weeds found in the plots included Canada Thistle, Sow Thistle, Coltsfoot, and Common Tansy. The density distribution was classified as per classes categorized in Figure 3.10. Table 3.6 displays the density distribution of noxious weeds identified during the 2023 survey. Figure 3.11 displays the average noxious weed density distribution class across soil treatment types identified during the 2023 survey. The highest average density distribution was found to occur in Black Spruce plots with thin topsoil while the lowest was in Aspen plots with control (overburden) soil. Generally, plots with thin topsoil and tilled topsoil, regardless of vegetation type, had a higher density distribution than plots with fertilized overburden or control (overburden) soil treatments.



DENSITY DISTRIBUTION			
Class	Description of abundance polygon	Distribution	Score
0	None		5
1	Rare		3
2	A few sporadically occurring individual plants		
3	A single patch		
4	A single patch plus a few sporadically occurring plants		
5	Several sporadically occurring plants		
6	A single patch plus several sporadically occurring plants		
7	A few patches		0
8	A few patches plus several sporadically occurring plants		
9	Several well spaced patches		
10	Continuous uniform occurrences of well spaced plants		
11	Continuous occurrence of plants with a few gaps in the distribution		
12	Continuous dense occurrence of plants		
13	Continuous occurrence of plants with a distinct linear edge in the polygon		

Figure 3.10: Classes of weed density distribution.

(Alberta Government, 2017)

Table 3.6: Noxious weed density distribution.

Vegetation Treatment	Soil Treatment	Block 1	Block 2	Block 3	Average
		2023	2023	2023	2023
Aspen	Thin Topsoil	8	7	11	8.7
	Tilled Topsoil	5	6	11	7.3
	Fertilized Overburden	n/a	n/a	5	5.0
	Control	4	4	4	4.0
Black Spruce	Thin Topsoil	10	10	11	10.3
	Tilled Topsoil	n/a	4	8	6.0
	Fertilized Overburden	4	7	6	5.7
	Control	n/a	4	8	6.0
Birch	Thin Topsoil	10	n/a	8	9.0

Vegetation Treatment	Soil Treatment	Block 1	Block 2	Block 3	Average
		2023	2023	2023	2023
	Tilled Topsoil	7	n/a	5	6.0
	Fertilized Overburden	4	n/a	11	7.5
	Control	n/a	n/a	n/a	n/a
Eastern White Cedar	Thin Topsoil	10	8	9	9.0
	Tilled Topsoil	n/a	5	8	6.5
	Fertilized Overburden	4	7	11	7.3
	Control	n/a	4	8	6.0
White Spruce	Thin Topsoil	11	2	4	5.7
	Tilled Topsoil	5	n/a	11	8.0
	Fertilized Overburden	n/a	8	7	7.5
	Control	5	4	8	5.7
Jack Pine	Thin Topsoil	10	2	8	6.7
	Tilled Topsoil	5	n/a	5	5.0
	Fertilized Overburden	8	n/a	6	7.0
	Control	9	4	6	6.3
Ground Cover Mix	Thin Topsoil	4	8	n/a	9.0
	Tilled Topsoil	10	5	11	8.7
	Fertilized Overburden	3	6	8	5.7
	Control	n/a	n/a	n/a	n/a
Shrub Mix	Thin Topsoil	11	7	4	7.3
	Tilled Topsoil	9	6	8	7.7
	Fertilized Overburden	n/a	5	7	6.0
	Control	4	4	7	5.0
Community Mix	Thin Topsoil	10	2	10	5.3
	Tilled Topsoil	5	n/a	5	5.0
	Fertilized Overburden	n/a	n/a	8	8.0
	Control	n/a	8	5	6.5

n/a = noxious weeds were noted to be growing in the plot, but the density distribution was not identified.

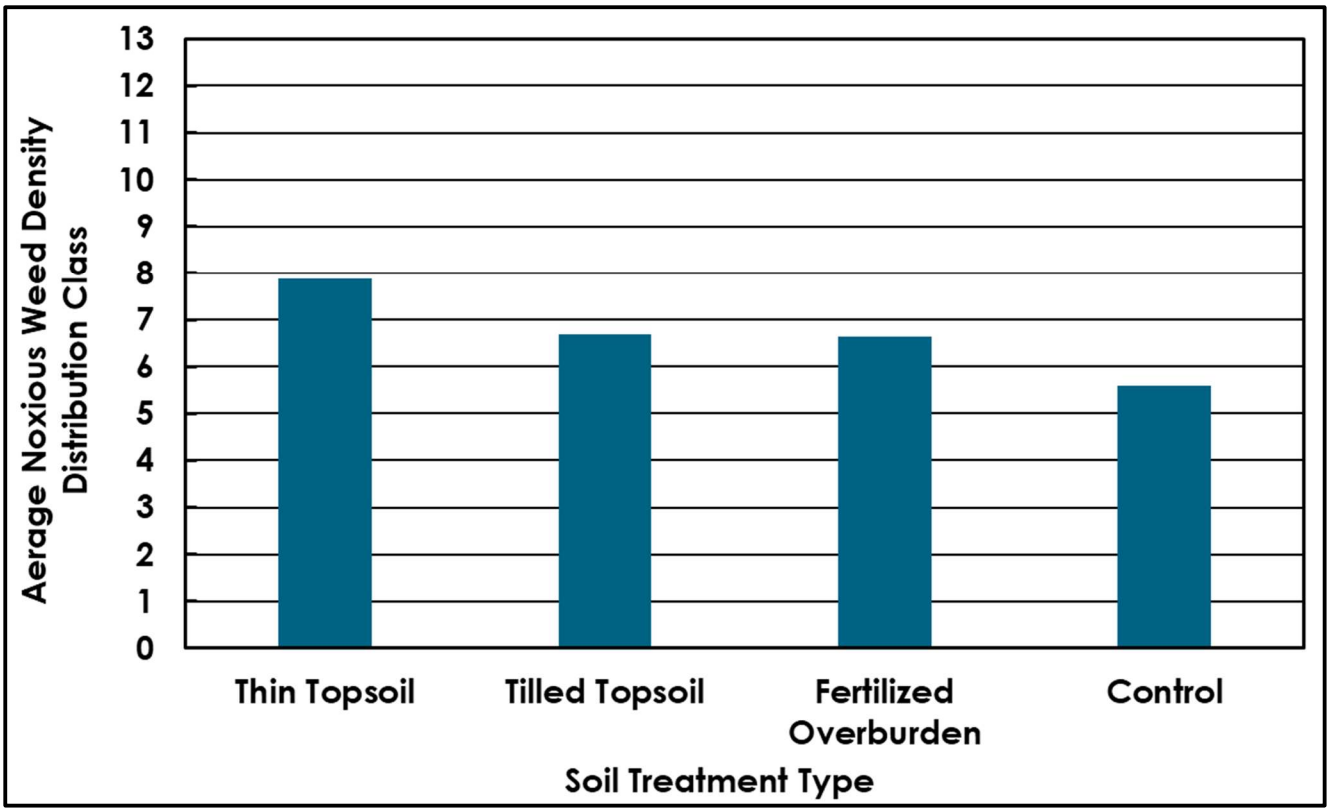


Figure 3.11: Average noxious weed density distribution class

3.5 Destructive Plot

Minimal erosion was observed in the destructive plot, except for some down-slope erosion on the north edge of the plot. Vegetation was generally noted to be well established, and ground cover has increased since the 2021 survey. Estimated percent ground cover has increased from 75% in 2020 to 100% in 2023. Table 3.7 provides a summary of general tree health observed during the destructive plot survey.

Table 3.7: General health of trees and shrubs planted in the Destructive Plot (H-healthy, S-struggling, D-dead).

Species	Destructive Plot			
	2020	2021	2022	2023
Aspen	8 H, **4 S**	7 H, 2 S, **3 D**	4 H, **2 S, 4 D**	1H, 3H/S, 2 S/D
Black spruce	14 H	5 H, 3 H/S, **6 D**	4 H, **3 S, 4 D**	1H, 1H/S, 2S, 1S/D
Black ash	21 H, **1 S**	1 H/S, **13 S, 1 S/D, 6 D**	5 H, 2 H/S, **2 S, 12 D**	4S, 3S/D
Eastern white cedar	**11 S**	**8 S/D**	**1 S/D, 5 D**	5S/D, 2D
White spruce	-	**6 D**	**6 D**	**-**
Jack pine	10 H, **1 S**	**1 S/D, 10 D**	**1 S/D, 8 D**	3S/D, 1D

Species	Destructive Plot			
	2020	2021	2022	2023
Shrub (1)	8 H	**8 S/D**	**2 S, 9 D**	
Shrub (2)	20 H			
Cherry				5S/D, 2D
Dogwood				5H, 3 H/S
Cranberry				2H
Willow				3H, 2H/S

Only struggling or dead trees were noted in the autumn survey **(bolded)**, all other specimens were labelled as healthy.
Shrub (1) assumed to be raspberry bushes; Shrub (2) unknown and not recorded in 2021.

Three random locations were selected, and 1.0 x 1.0 m grid area was set up at each location. At each grid a different tree species was chosen, and a root investigation was conducted which included root depth and spread (Table 3.8). In addition, the total ground coverage was estimated. Rooting depth did not extend into the compacted clay layer and remained within the overlying overburden. Photos of the three grids used for the root investigation on the destructive plot are found below in Figure 3.12.

Table 3.8: 2023 Destructive plot root investigation.

Grid	Tree Species	Root Depth	Root Spread	Ground Coverage (%)
1	Willow	45 cm	75 cm	100
2	Cherry	22 cm	18 cm	100
3	Aspen	37 cm	23 cm	100

Figure 3.12: Site photos of the destructive plot. Destructive plot grid 1 (top left), grid 2 (top right), and grid 3 (bottom).

4 DISCUSSION - FAILURE MODES AND EFFECTS

The requirement for conducting vegetation trials was a result of risks identified during the FMEA Workshop. As identified in the Detailed Design, the failure modes that would be assessed include:

- Establishment and persistence of vegetation
- Effects of vegetation on erosion
- Effects of roots on compacted clay layer
- Availability of plant nutrients in the overburden
- Toxicity effects of overburden constituents on vegetation
- Effect of density from vehicle traffic on plant establishment and survival

A summary with respect to each failure mode and one or more recommendation(s) to better assess and test the respective failure mode in future vegetation surveys has been provided below.

4.1 Establishment and Persistence of Vegetation

4.1.1 Sloped Areas

Vegetation on sloped areas continued to increase in 2023 compared to 2022 with ground coverage at 100% for all but the south slope control section where 75% ground coverage was observed.

Species composition was comparable across the four different slope treatments, with Birdsfoot Trefoil, Sweet Clover, Canada Wild Rye, and Virginia Wild Rye representing the dominant species. Birdsfoot Trefoil and Sweet Clover, although not considered as noxious weeds are not native to the area and were not part of the reclamation seed mix. This would indicate that the sloped areas are highly prone to weed infestations and if allowed to establish, are very effective at outcompeting the desirable species. On sloped surface where hydroseeding was conducted early, desirable graminoid species such as Canada Wild Rye, and Virginia Wild Rye were quick to establish and weed infestations have been slower to develop. Minor species observed across all slopes were a mixture of hydroseeded graminoids, volunteer native species, undesirable weeds, and noxious weeds.

4.1.2 Plateau plots

Across the plateau plots the establishment of ground coverage is directly correlated to the presence of topsoil. In 2023, where topsoil is present, ground coverage ranged from 88 to 100%, where topsoil is not present, ground coverage ranged from 50 to 100 %.

Error! Reference source not found. Figure 4.1 displays mortality rate in 2023 as a percentage (%) across blocks and for each tree or shrub species by soil treatment type. Mortality rate was calculated by dividing number of species dead in 2023 by the total number of species identified during the 2023 Survey, the mortality rate was then averaged across block 1, 2, and 3. Mortality rate for Jack Pine and community mix were omitted because no tree or shrubs were identified in the plots during the 2023 Survey. **Error! Reference source not found.**

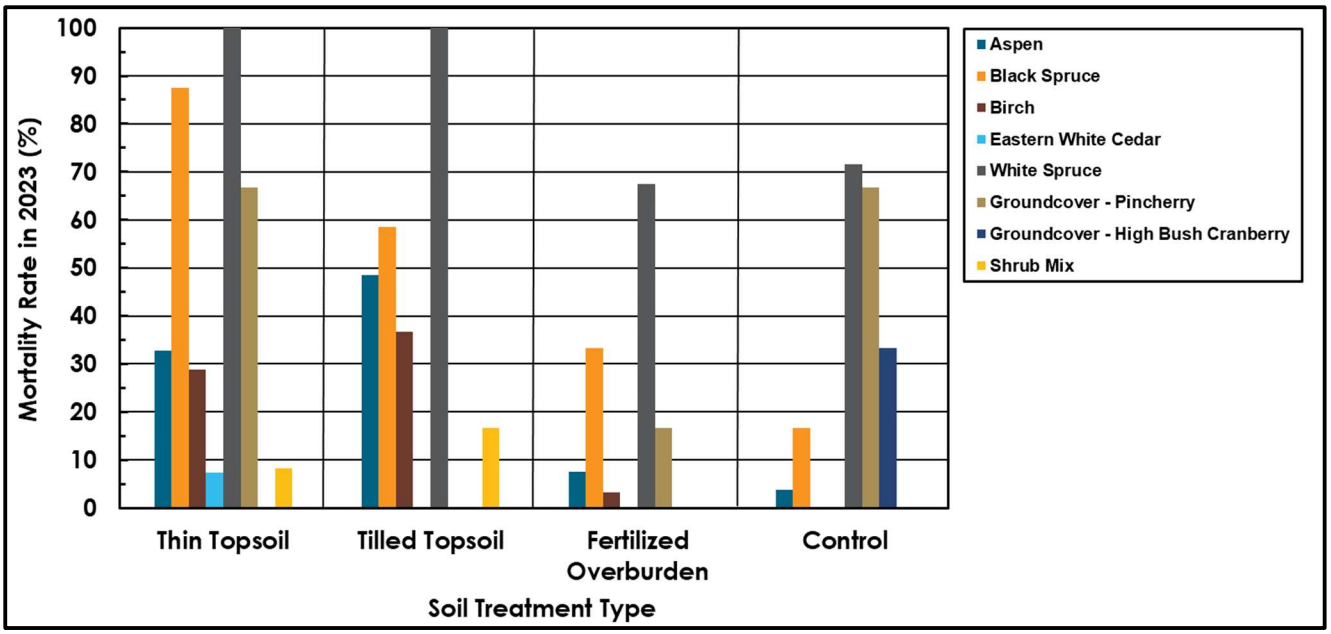


Figure 4.1: Average mortality rate in 2023.

Figure 4.2 displays average stress level rate in 2023 as a percentage (%) across blocks for each tree or shrub species by soil treatment type. Stress level rate was calculated by dividing the number of trees or shrubs in a struggling state in 2023 by the total number of species identified during the 2023 Survey, the stress level rate was then averaged across block 1, 2, and 3. Stress level rate for Jack Pine and community mix were omitted as no trees or shrubs were identified in the plots during the 2023 Survey.

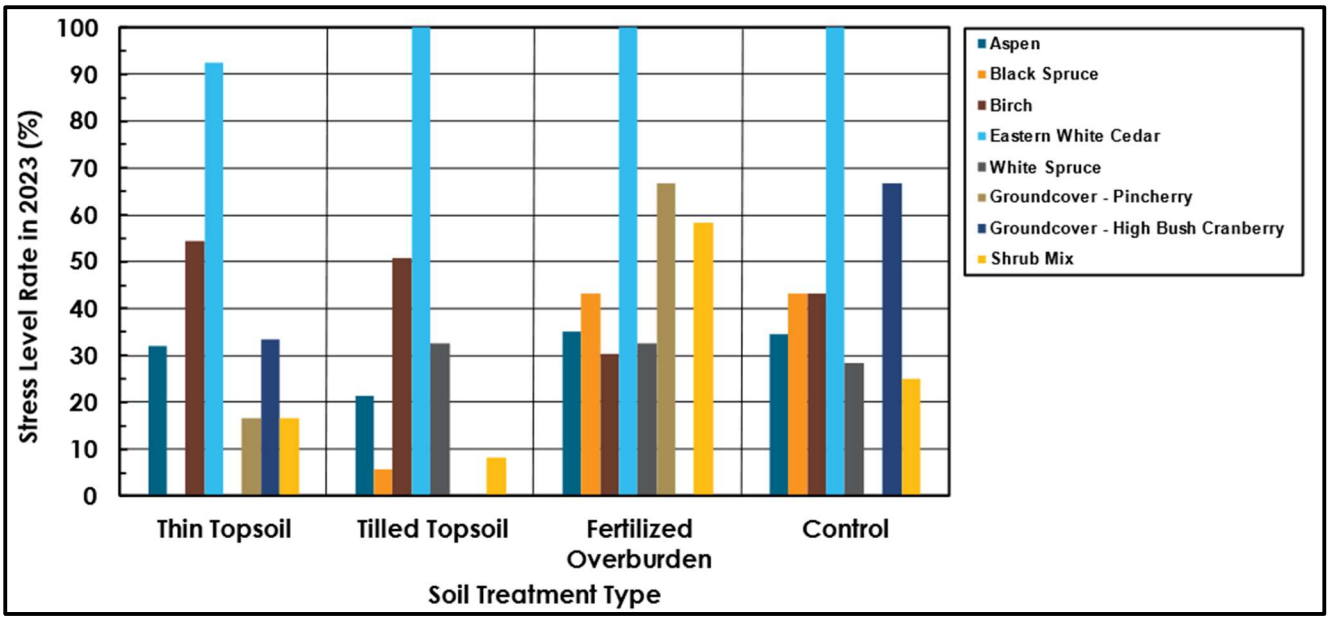


Figure 4.2: Average stress level rate in 2023 as a percentage (%) across blocks for each tree or shrub species.

Overall, Black Spruce, White Spruce, and Eastern White Cedar are the least successful tree species with higher stress levels and mortality, and less growth compared to Aspen and Birch. Black Spruce and Eastern White Cedar's poorer performance could be due to their preference to lowland swampy areas with ample water supply. Aspen and Birch are more tolerant of upland environments and a range of soil conditions as observed at the trial area. White Spruce is sensitive to frost damage when young and grows best in protected areas (Ministry of Natural Resources and Forestry, 2023). Therefore, the plateau plots with minimal protection and planted late in the growing season, may have not offered the coverage that promotes successful White Spruce establishment. Aspen and Birch may prove to be ideal for widespread use in large scale reclamation across a variety of topographical settings. White Spruce may also prove to be ideal in reclamation if planted earlier in the spring.

Pincherry and High Bush Cranberry were newly observed species in the ground cover plots during the 2023 Survey. When present, both species generally had low to moderate stress levels and mortality suggesting the species could be promising for use in large scale reclamation.

Willow and Dogwood Shrubs had low to moderate stress and mortality across the plots and could be good shrub species to consider for large scale reclamation.

Community plots, where no species appeared to have been planted, often had a comparatively higher density distribution of noxious weeds compared to other vegetation treatments.

Noxious weeds were observed to densely populate most plots, with a range of density distribution classes of 3 – 11 and an average density distribution class of 6.8 across all tree plots. The highest average density

distribution class, 10.3, was observed in the thin topsoil plot where Black Spruce had been planted but had experienced high mortality.

4.1.2.1 Thin Topsoil

Figure 4.3 provides a summary of the average number of healthy trees and shrubs across blocks in thin topsoil plots by year. Trees and shrubs were combined when counting healthy specimens in the ground cover mix as years prior to 2023 did not distinguish between Pincherry Trees and High Bush Cranberry.

- Black Spruce and White Spruce experienced high mortality (63 – 100%). Of the few surviving, moderate growth in both height and diameter for Black Spruce has been observed. Eastern White Cedar experienced low mortality (0 - 20%) but a high level of stress was observed (70-100%) with moderate growth in height.
- Aspen and Birch experienced low levels of stress (30 – 36%), low to moderate mortality (20-67%) and moderate increases in tree height and diameter.
- Ground cover communities were observed to have High Bush Cranberry and Pincherry with a range of mortality rates from 0 - 100%. Since none of these species were observed or measured in previous years, no conclusions can be drawn on height or diameter growth trends.
- Willow and Dogwood were observed in the shrub community plots and had low to moderate stress levels (0 – 50%), low mortality (0 – 25%), and moderate growth.
- Significant increase of herbaceous ground cover composed primarily of undesirable, non-native, and noxious weeds.

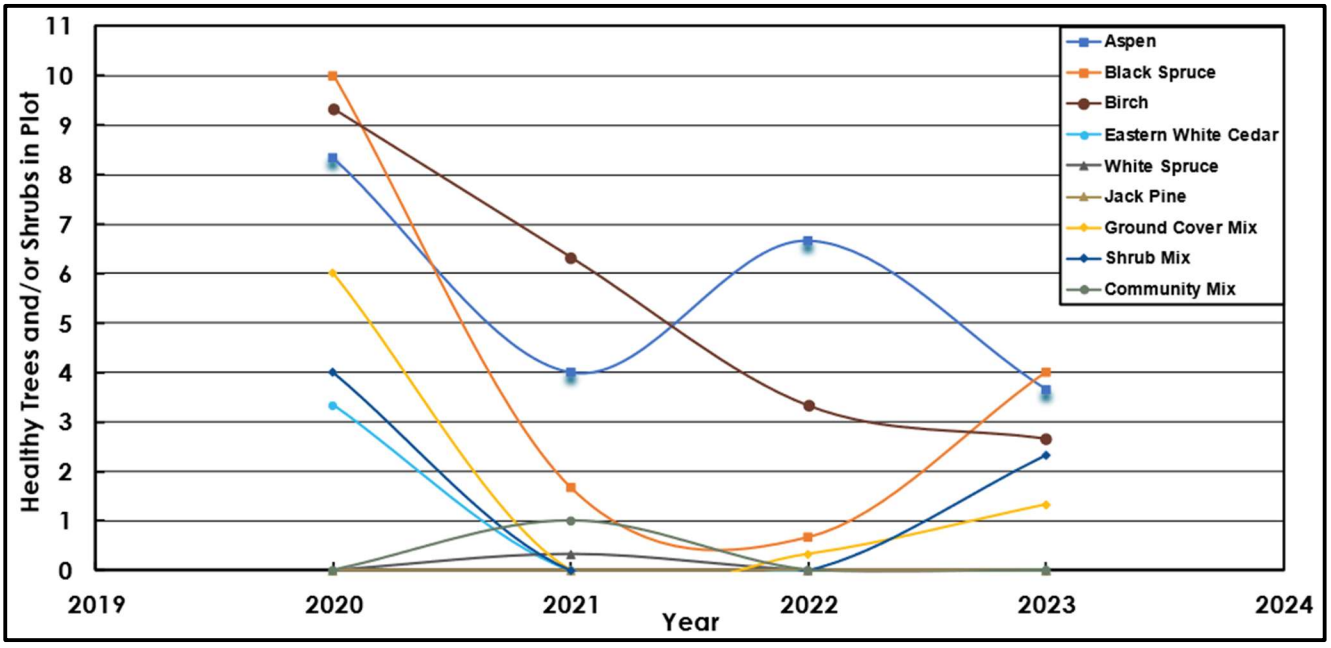


Figure 4.3: Average number of healthy trees and shrubs in thin topsoil plots.

4.1.2.2 Tilled Topsoil

Figure 4.4 provides a summary of the average number of healthy trees and shrubs across blocks in tilled topsoil plots by year. Trees and shrubs were combined when counting healthy specimens in the ground cover mix as years prior to 2023 did not distinguish between Pincherry Trees and High Bush Cranberry.

- Black Spruce had low levels of stress (0 – 13%), variable levels of mortality (0 – 90%), and minimal growth in height and diameter.
- White Spruce experienced 100% mortality.
- Eastern White Cedar were all found to be in a stressed state with no mortalities observed and minimal growth in height.
- Aspen had low levels of stress (14 – 30%), variable levels of mortality (20 – 86%), and moderate growth in height and diameter.
- Birch has moderate to high stress (30 – 60 %) and mortality (40-70%), and low growth.
- Ground cover communities were observed to have Pincherry trees with moderate mortality and stress levels (40%) and no High Bush Cranberry. Since none of these species were observed or measured in previous years, no conclusions can be drawn on height or diameter growth.
- Willow and Dogwood were observed in the shrub community plots and had low stress levels (0 – 25%). The original number of planted shrubs is unknown therefore, mortality rates could not be determined.
- Significant increase of herbaceous ground cover composed primarily of undesirable, non-native, and noxious weeds.

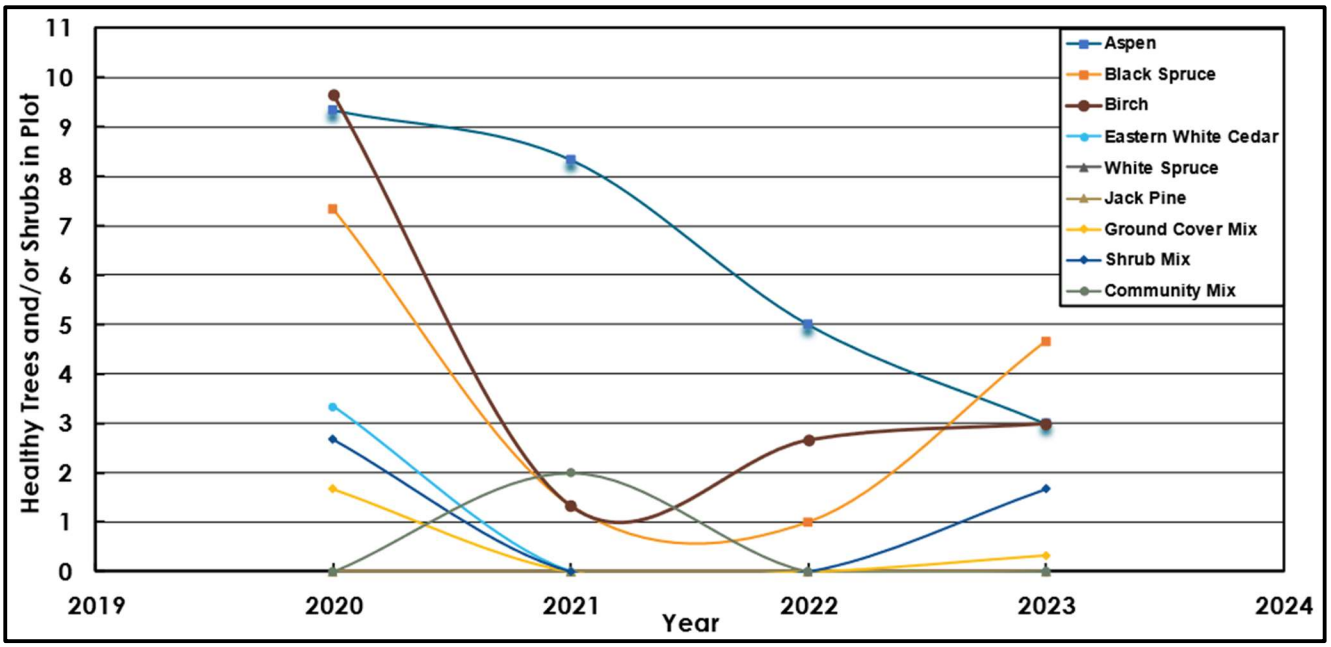


Figure 4.4: Average number of healthy trees and/or shrubs in tilled topsoil plots.

4.1.2.3 Fertilized Overburden

Figure 4.5 provides a summary of the average number of healthy trees and shrubs across all blocks in fertilized overburden plots by year. Trees and shrubs were combined when counting healthy specimens in the ground cover mix as years prior to 2023 did not distinguish between Pincherry Trees and High Bush Cranberry.

- Black Spruce had low to high levels of stress (0 – 100%), low to high levels of mortality (0– 100%), and minimal growth in height and diameter.
- White Spruce had low to high levels of stress (20 – 78%), low to high levels of mortality (22 – 100%), and minimal growth in height.
- Eastern White Cedar were all found to be in a stressed state with no mortalities observed and minimal growth in height.
- Aspen and Birch had low to moderate stress (11 – 60%), low mortality (0-10%) and Aspen had moderate growth in height and diameter while Birch had minimal growth.
- Ground cover communities were observed with one Pincherry in a stressed state. Since none of these species were observed or measured in previous years, no conclusions can be drawn on height or diameter growth.

- Willow and Dogwood were observed in the shrub community plots and had moderate to high stress levels (50 - 75%), no mortality, and minimal growth.

- Significant increase of herbaceous ground cover composed primarily of undesirable, non-native and noxious weeds.

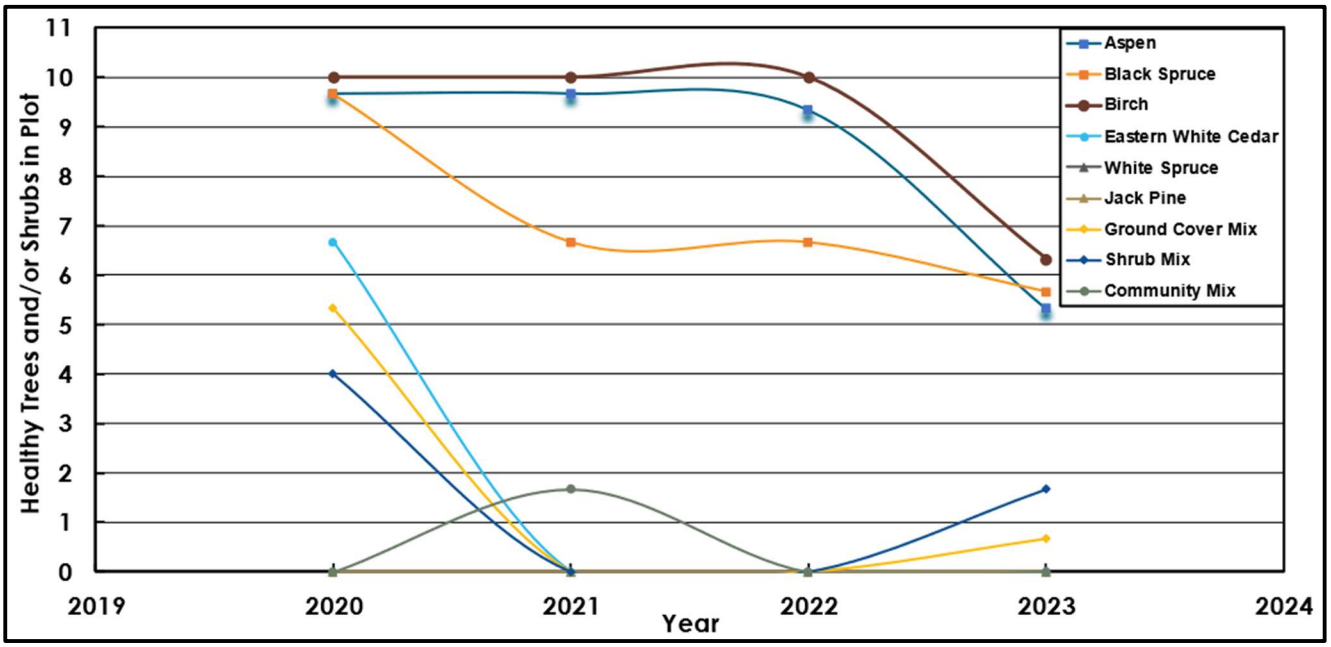


Figure 4.5: Average number of healthy trees and/or shrubs in fertilized overburden plots.

4.1.2.4 Control

Figure 4.6 provides a summary of the average number of healthy trees and shrubs across blocks in control (overburden) plots by year. Trees and shrubs were combined when counting healthy specimens in the ground cover mix as years prior to 2023 did not distinguish between Pincherry Trees and High Bush Cranberry. Black Spruce had moderate to high levels of stress (20 – 80%), low to moderate mortality (0 – 50%), and minimal growth in height and diameter.

- White Spruce had low to moderate levels of stress (33 – 60%), moderate to high mortality (40 – 100%), and minimal growth in height.

- Eastern White Cedar were all found to be in a stressed state with no mortalities observed and minimal growth in height.

- Aspen had low stress (30– 40%) and mortality (0-10%) and moderate growth in height and diameter.

- Birch had low to moderate stress (0 - 50%), no mortality, and minimal growth in height and diameter.
- Ground cover communities were observed to have High Bush Cranberry and Pincherry with low to moderate stress (0 – 50%) and mortality (0 – 50%). Since none of these species were observed or measured in previous years, no conclusions can be drawn on height or diameter growth.
- Willow and Dogwood were observed in the shrub community plots and had low to moderate stress levels (0 – 50%), no mortality, and minimal growth.
- Significant increase of herbaceous ground cover composed primarily of undesirable, non-native and noxious weeds.

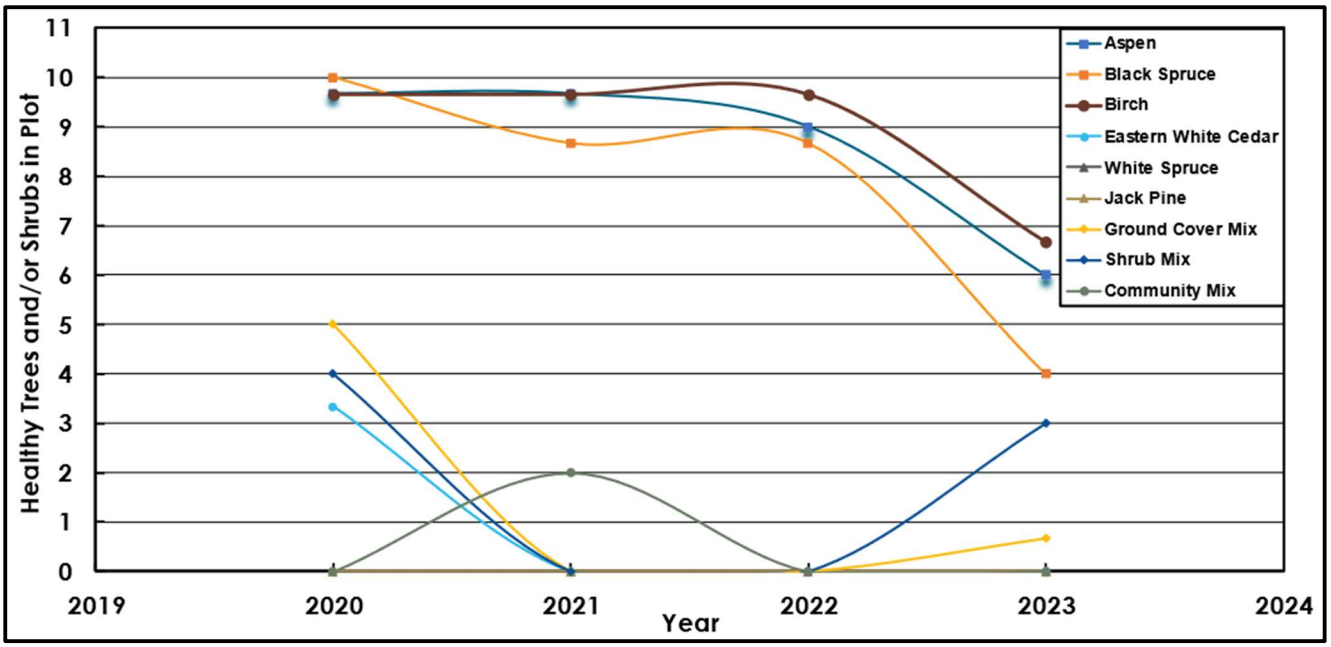


Figure 4.6: Average number of healthy trees and/or shrubs in control (overburden) plots.

4.2 Effects of Vegetation on Erosion

Vegetation on all sloped areas increased from 50 – 100% in 2022 to 75 – 100% in 2023. Sheet, rill, and gully formation has been observed on all slopes to a maximum depth of approximately 45 cm, most prominently on the lower slopes. However, all but one erosional feature appears to have developed early in the trials when ground coverage was minimal or non-existent and have been considered stable since 2022. The stabilization of erosional features correlates directly with the establishment of dense herbaceous ground cover.

Results form the immediate and short-term indicate that herbaceous ground cover is highly effective at reducing and eliminating effects due to erosion, especially when established immediately after landform construction.

4.3 Effects of Roots on Compacted Clay Layer

Tree root depth has not penetrated beneath the overburden into the compacted clay layer.

Aspen root depth and spread has moderately increased compared to previous years.

4.4 Availability of Plant Nutrients in the Overburden

Soil samples were collected from all soil treatment plots and at two depths, 0 to 0.2 and 0.3 to 0.5 metres below ground surface (mbgs). Samples were submitted to an accredited laboratory for analysis. Plant available nutrients, soil organic parameters, and physical parameters were measured in each of the soil treatments in all three blocks in 2023. A summary of plant available nutrients at a depth of 0 to 0.2 mbgs is displayed in **Error! Reference source not found.**, and at a depth of 0.3 to 0.5 mbgs in **Error! Reference source not found.**. Analytical lab tables can be found in Appendix C and Laboratory Data Reports can be found in Appendix D.

Nitrogen and phosphorus were found in significantly higher concentrations in thin topsoil and tilled topsoil compared to fertilized overburden or control (overburden) soil. Potassium was found to be in slightly higher concentrations in thin topsoil and tilled topsoil compared to fertilized overburden or control (overburden) soil. Background samples contained both the lowest concentrations of nitrogen and highest concentrations of phosphorus when compared to the samples collected from the soil treatment areas.

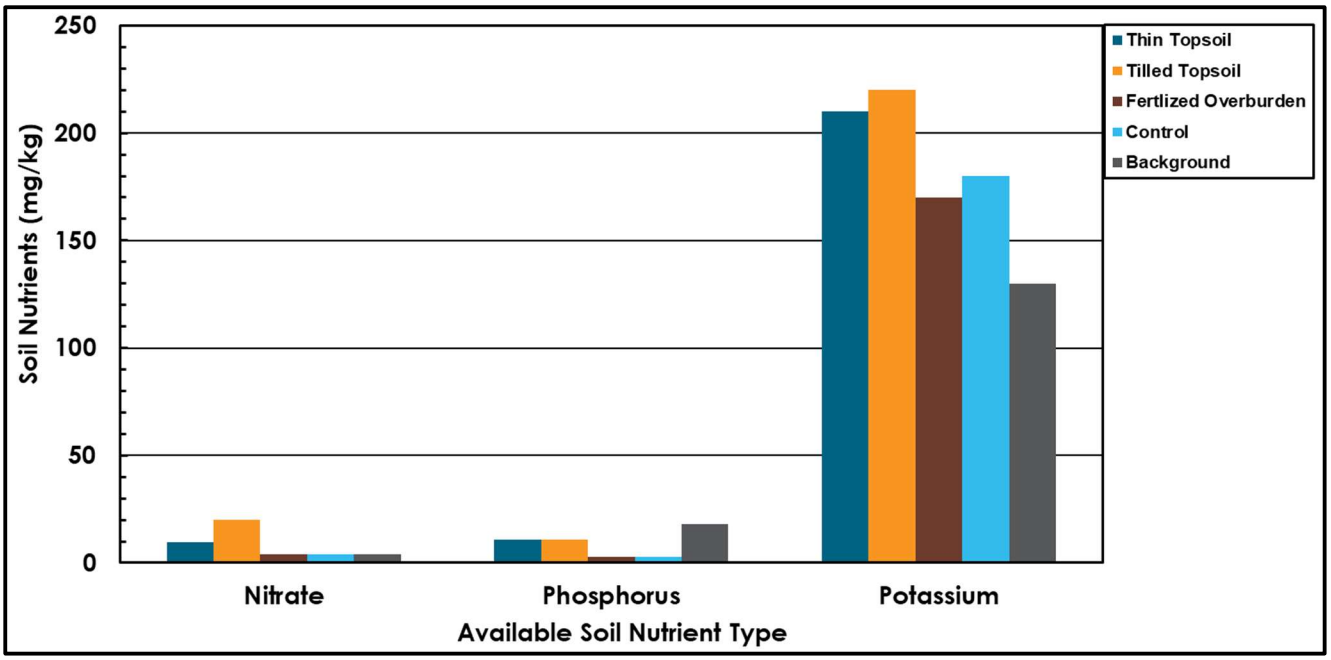


Figure 4.7: Plant available nutrient concentrations at a depth of 0 to 0.2 mbgs.

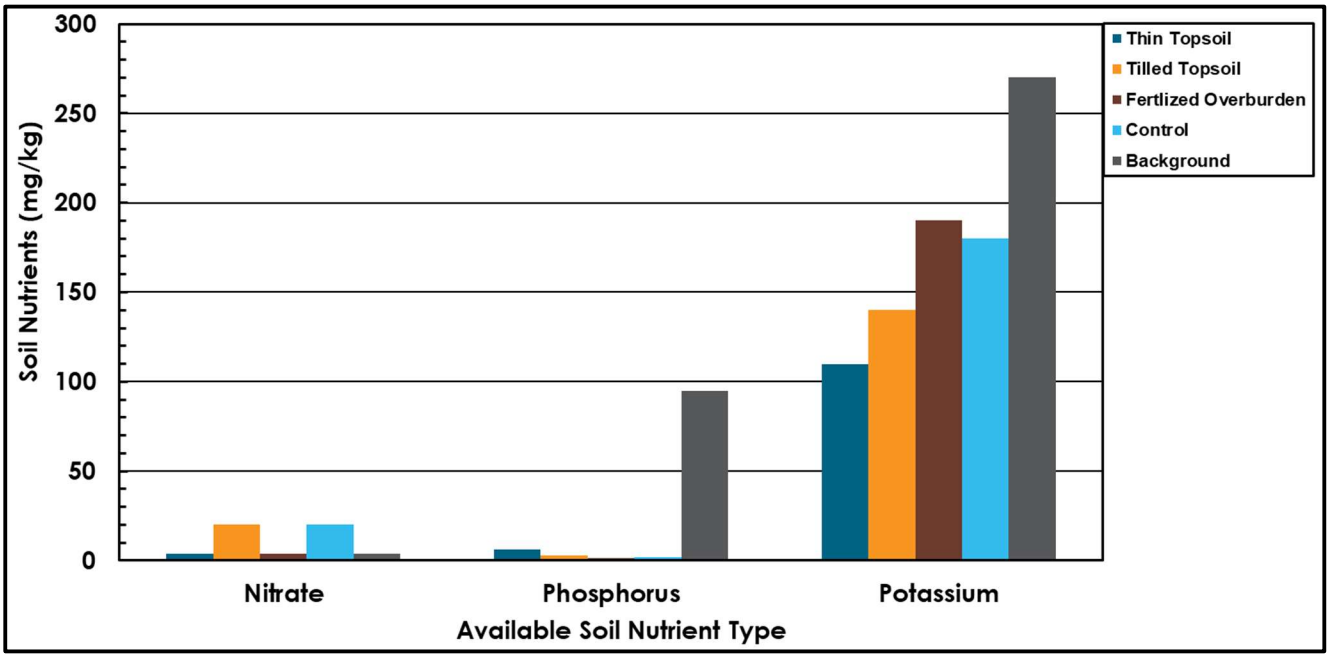


Figure 4.8: Plant available nutrient concentrations at a depth of 0.3 to 0.5 mbgs.

Total organic carbon and organic matter was found in much higher concentrations in thin topsoil, and tilled topsoil compared to fertilized overburden or control (overburden) soil. Background concentrations were found in moderate concentrations.

Moisture content was found to be higher in thin topsoil and tilled topsoil compared to fertilized overburden or control (overburden) soil. This would indicate the additional top topsoil has a positive impact on the water holding capacity. Background moisture content was comparable to fertilized overburden and control (overburden) soil.

Soil textures appear to be comparable across all soil treatment areas which included loam, clay loam, and clay. These textures are comparable to what is reported in background samples.

Trees planted in thin topsoil and tilled topsoil had comparable mortality levels to those planted in fertilized overburden and control (overburden) soil treatments. Therefore, tree mortality appears to be unaffected by nutrient and organic matter and carbon concentrations in the immediate to short-term.

Aspen had the highest cumulative average growth in height since 2020 in control (overburden) soil and the highest growth over the past year in fertilized overburden soil. Birch had the highest cumulative average growth in height since 2020 in fertilized overburden soil and the highest growth over the past year in thin topsoil. Black Spruce had the highest cumulative average growth in height since 2020 and over the past year in thin topsoil. Eastern White Cedar had the highest cumulative average growth in height since 2020 in control (overburden) soil and the highest growth over the past year in tilled topsoil. White Spruce had the highest cumulative average growth in height since 2020 and over the past year in control (overburden) soil.

Shrub species, including Dogwood, Willow, Pincherry, and High Bush Cranberry were only measured in the 2023 Survey and not in previous years. Therefore, the growth rate across years could not be assessed and only trends in height across plots during 2023 were identified. Dogwood and Willow heights were highest in fertilized overburden soil. Pincherry heights were highest in control (overburden) soil. High Bush Cranberry heights were highest in thin topsoil.

Over the immediate and short-term, the use of topsoil as a growth media appears to be highly beneficial to the establishment of herbaceous ground cover but less so for trees and shrubs, which generally had higher growth in fertilized and unfertilized overburden.

4.5 Toxicity Effects of Overburden Constituents on Vegetation

Toxicity to vegetation in the form of metal leaching has yet to be assessed at the vegetation trials. Salinity, although often naturally occurring, can have a toxic effect on vegetation at certain levels.

Soil samples were collected at two depths (0 to 0.2 and 0.3 to 0.5 mbgs), and from each of the soil treatment plots. Samples were submitted to an accredited lab for analysis of salinity parameters.

Analytical lab tables can be found in Appendix C and laboratory data reports can be found in Appendix D. Electrical conductivity and the sodium absorption ratio values reported in the all the soil treatment plots are considered low and comparable to background values. This would indicate that vegetation is not being impacted by salinity related issues at the vegetation trials and that all the soil treatment options are considered suitable as a growth media in the immediate to short-term with respect to salinity.

4.6 Effect of Density from Vehicle Traffic on Plant Establishment and Survival

Lower vegetative coverage compared to the other sloped areas in 2020, prior to hydroseeding the trafficked slopes, suggests that vegetative coverage is slower to establish on traffic sloped areas.

By 2023, the vegetative ground coverage on the traffic sloped areas increased to 100%, comparable to all other sloped areas. It is likely that the hydroseeding of all slopes in 2020, including on trafficked slopes, played a significant role in increasing the vegetative ground coverage.

In 2020 some grasses and weeds were present, similar to other sloped areas, but it is unclear what species composition were present in the traffic sloped area compared to the other sloped areas. In 2023, the traffic sloped area had a comparable prevalence and composition of undesirable weed species and seeded species to other slopes, with Birdsfoot Trefoil, Sweet Cover (undesirable weed species) and Canada Wild Rye, and Viginia Wild Rye (seeded graminoid species) identified as the dominant species present. The composition of vegetative ground coverage, both before and after hydroseeding, on traffic sloped areas has been comparable to the other sloped areas.

In 2020, both the north and south traffic slopes had undergone less immediate-term erosion compared to the surrounding sloped surfaces. However, over the short to medium-term, erosion across all sloped surfaces has developed comparably. By 2023, both north and south traffic sloped areas had no signs of active erosion, similar to surrounding sloped surfaces.

5 SUMMARY OF RECOMMENDATIONS

1) Continue monitoring vegetation through field surveys to identify the most successful herbaceous plants on the slopes and plateau plots for application in large scale reclamation.

2) Design and implement a noxious weed management program, which may include:

    a. Manual weed removal; and/or

    b. Application of herbicides.

3) Design and carry out a revegetation plan in the existing plots and slopes where high levels of mortality and/or bare ground has been observed. The revegetation plan will utilize plant species that have been identified as being the most successful. For tree species, saplings should be used instead of established trees to better understand whether saplings can withstand competition from the herbaceous ground cover.

4) Continue monitoring for active erosion and institute mitigating measures if significant erosion is observed. Mitigating measures include the following:

    a. Reduce the slope angle to decrease the velocity of overland flow;

    b. Apply erosion prevention materials such hydroseeding with ProGanics® Biotic Soil Media;

    c. Spread mulch, straw, and woody debris, including logs, on the surface to slow the overland flow that occurs during periods of heavy precipitation and spring thaw;

    d. Install straw wattles to decrease velocity of overland flow;

    e. In the future, ensure that seeding activities are carried out immediately after landform construction; and/or

    f. Scarify the surface to create microsites with enhanced moisture retention, seed germination, and reduced rates of overland flow ideal for plant establishment.

5) Continue to monitor root depth and spread to assess if tree roots penetrate the compacted clay layer.

6) Continue the soil sampling program within the plots to assess any changes in soil nutrient concentrations, and the effects of vegetation growth on soil properties.

7) Apply additional fertilizer to the plots with fertilized overburden. This application will help to establish whether an increase in plant available nutrient concentrations in overburden will have any impact on increasing the organic matter content and more closely mimic the natural soil profile.

8) Design and implement a sampling program for soil treatment types and vegetation material within the plots to assess ecotoxicity effects and bioaccumulation of metals in vegetation materials. This sampling program will help better understand if any migration or leaching of toxic compounds from the overburden and/or underlying waste rock is occurring.

6 REFERENCES

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7 CLOSURE

We trust information provided is satisfactory for your requirements. Please do not hesitate to contact the undersigned at 825-945-3691 for further information or questions.

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Appendix A

Plot Growth Indicator Measurements & General Health

Table A.1: Plot Growth Indicator Measurements & General Health for 2023 Survey.

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
1	Thin Topsoil	Aspen	2023-09-05	272.4	18.1	18.7	0.5	2	-	3	-	5	10	100%	8	
1	Thin Topsoil	Black spruce	2023-09-05	158.0	2.2	8.2	1.5	3	-	-	-	5	8	100%	10	
1	Thin Topsoil	Black ash	2023-09-05	199.1	19.0	7.9	2.5	-	-	3	-	6	9	100%	10	
1	Thin Topsoil	Eastern white cedar	2023-09-05	-	-	-	-	-	-	9	-	-	9	100%	10	
1	Thin Topsoil	White spruce**	2023-09-05	-	-	-	-	-	-	-	-	5	5	100%	11	
1	Thin Topsoil	Jack pine	2023-09-05	-	-	-	-	-	-	-	-	-	0	100%	10	
1	Thin Topsoil	Ground Cover Mix	2023-09-05	171.9	6.0	18.5	0.5	1	-	1	-	-	2	100%	4	Trees
			2023-09-05	110	0	n/a	-	-	-	2	-	-	2			Shrubs
1	Thin Topsoil	Shrub Mix	2023-09-05	85.1	15.0	n/a	-	3	-	-	-	-	3	100%	11	
1	Thin Topsoil	Community Mix	2023-09-05	-	-	-	-	-	-	-	-	-	0	100%	10	
1	Tilled Topsoil	Aspen	2023-09-05	262.7	12.7	19.2	2.4	3	-	3	-	4	10	100%	5	
1	Tilled Topsoil	Black spruce	2023-09-05	118.0	1.0	n/a		2	-	-	-	9	11	100%	n/a	
1	Tilled Topsoil	Black ash	2023-09-05	245.1	24.6	10.3	0.5			6		4	10	100%	7	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
1	Tilled Topsoil	Eastern white cedar	2023-09-05	102.1	7.0	n/a				9			9	100%	n/a	
1	Tilled Topsoil	White spruce**	2023-09-05									7	7	100%	5	
1	Tilled Topsoil	Jack pine	2023-09-05										0	100%	5	
1	Tilled Topsoil	Ground Cover Mix**	2023-09-05										0	100%	10	Trees
			2023-09-05			n/a							0			Shrubs
1	Tilled Topsoil	Shrub Mix**	2023-09-05	84.5	25.1	n/a		3		1			4	100%	9	
1	Tilled Topsoil	Community Mix	2023-09-05										0	40%	5	
1	Fertilized Overburden	Aspen	2023-09-05	241.1	9.5	13.2	1.7	5		2		1	8	5%	n/a	
1	Fertilized Overburden	Black spruce	2023-09-05	115.2	9.7	n/a		7		3			10	65%	4	
1	Fertilized Overburden	Black ash	2023-09-05	216.5	28.2	12.1	3.7	8		1			9	55%	4	
1	Fertilized Overburden	Eastern white cedar	2023-09-05	92.9	4.5	n/a				11			11	60%	4	
1	Fertilized Overburden	White spruce	2023-09-05	69.4	5.4	n/a				7		2	9	60%	n/a	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
1	Fertilized Overburden	Jack pine	2023-09-05										0	65%	8	
1	Fertilized Overburden	Ground Cover Mix	2023-09-05	258.0	0	15.6	0			1			1	60%	3	Trees
			2023-09-05			n/a							0			Shrubs
1	Fertilized Overburden	Shrub Mix	2023-09-05	91.3	18.7	n/a		2		2			4	30%	n/a	
1	Fertilized Overburden	Community Mix	2023-09-05										0	50%	n/a	
1	Control	Aspen	2023-09-05	288.3	24.6	20.6	4.9	5		3		1	9	5%	4	
1	Control	Black spruce	2023-09-05	103.5	9.8	n/a		2		8			10	5%	n/a	
1	Control	Black ash	2023-09-05	218.3	32.3	12.4	2.5	5		5			10	100%	n/a	
1	Control	Eastern white cedar	2023-09-05	105.6	2.5	n/a				10			10	75%	n/a	
1	Control	White spruce	2023-09-05									7	7	75%	5	
1	Control	Jack pine	2023-09-05										0	75%	9	
1	Control	Ground Cover Mix	2023-09-05	270.0	4.0	18.2		2					2	30%	n/a	Trees
			2023-09-05			n/a				2		2	4			Shrubs
1	Control	Shrub Mix	2023-09-05	72.3	41.6	n/a		2		2			4	30%	4	
1	Control	Community Mix	2023-09-05										0	75%	n/a	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
2	Thin Topsoil	Aspen	2023-09-05	265.6	5.2	16.0	0.8	4		3		3	10	100%	7	
2	Thin Topsoil	Black spruce	2023-09-05									8	8	100%	10	
2	Thin Topsoil	Black ash	2023-09-05	208.5	7.8	7.6	0.9			10			10	100%	n/a	
2	Thin Topsoil	Eastern white cedar	2023-09-05	111.3	8.3	n/a				7		2	9	100%	8	
2	Thin Topsoil	White spruce**	2023-09-05									5	5	100%	2	
2	Thin Topsoil	Jack pine	2023-09-05										0	95%	2	
2	Thin Topsoil	Ground Cover Mix	2023-09-05									2	2	95%	8	Trees
			2023-09-05	68.4	19	n/a		2					2			Shrubs
2	Thin Topsoil	Shrub Mix**	2023-09-05	108.7	19.3	n/a		1		2		1	4	95%	7	
2	Thin Topsoil	Community Mix	2023-09-05										0	95%	2	
2	Tilled Topsoil	Aspen	2023-09-05	249.0	0.0	21.0	0.0			1		6	7	100%	6	
2	Tilled Topsoil	Black spruce**	2023-09-05	134.8	11.4	4.9	1	2		1		5	8	100%	4	
2	Tilled Topsoil	Black ash	2023-09-05	207.3	3.7	8.3	2.1			3		7	10	95%	n/a	
2	Tilled Topsoil	Eastern white cedar	2023-09-05	94.5	14.6	n/a				10			10	100%	5	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
2	Tilled Topsoil	White spruce**	2023-09-05									10	10	100%	n/a	
2	Tilled Topsoil	Jack pine	2023-09-05										0	75%	n/a	
2	Tilled Topsoil	Ground Cover Mix**	2023-09-05	235	0	15	0			1		1	2	100%	5	Trees
			2023-09-05			n/a							0			Shrubs
2	Tilled Topsoil	Shrub Mix**	2023-09-05	75.0	0.0	n/a		1					1	25%	6	
2	Tilled Topsoil	Community Mix	2023-09-05										0	100%	n/a	
2	Fertilized Overburden	Aspen	2023-09-05	241.8	8.8	16.7	0.5	6		3		1	10	85%	n/a	
2	Fertilized Overburden	Black spruce	2023-09-05	109.6	4.2	n/a				10			10	75%	7	
2	Fertilized Overburden	Black ash	2023-09-05	196.2	12.8	9.9	1.4	4		6			10	50%	n/a	
2	Fertilized Overburden	Eastern white cedar	2023-09-05	86.8	12.3	n/a				10			10	90%	7	
2	Fertilized Overburden	White spruce	2023-09-05									8	8	85%	8	
2	Fertilized Overburden	Jack pine	2023-09-05										0	90%	n/a	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
2	Fertilized Overburden	Ground Cover Mix	2023-09-05	129.0	0.0	n/a				1		1	2	95%	6	Trees
			2023-09-05	104.5	1.5	n/a				2			2			Shrubs
2	Fertilized Overburden	Shrub Mix	2023-09-05	101.0	11.7	n/a		1		3			4	75%	5	
2	Fertilized Overburden	Community Mix	2023-09-05										0	85%	n/a	
2	Control	Aspen	2023-09-05	262.1	22.2	16.6	1.1	7		3			10	45%	4	
2	Control	Black spruce	2023-09-05	118.3	2.4	n/a		8		2			10	50%	4	
2	Control	Black ash	2023-09-05	205.9	40.9	9.5	1.7	10					10	25%	n/a	
2	Control	Eastern white cedar	2023-09-05	104.3	2.5	n/a				10			10	80%	4	
2	Control	White spruce	2023-09-05	67.9	4.2	n/a				6		4	10	70%	4	
2	Control	Jack pine	2023-09-05										0	75%	4	
2	Control	Ground Cover Mix	2023-09-05	50.0	0	n/a						2	2	25%	n/a	
			2023-09-05			n/a				1	1	2	4			
2	Control	Shrub Mix	2023-09-05	109.8	31.5	n/a		3		1			4	65%	4	
2	Control	Community Mix	2023-09-05										0	100%	8	
3	Thin Topsoil	Aspen	2023-09-05	253.9	14.5	19.2	1.9	5		4		2	11	100%	11	
3	Thin Topsoil	Black spruce**	2023-09-05									9	9	100%	11	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
3	Thin Topsoil	Black ash	2023-09-05	243.1	10.0	12.7	2.0	5		3		2	10	100%	8	
3	Thin Topsoil	Eastern white cedar	2023-09-05	112.9	5.4	n/a				10			10	100%	9	
3	Thin Topsoil	White spruce	2023-09-05	-	-	-	-	-	-	-		7	7	100%	4	
3	Thin Topsoil	Jack pine	2023-09-05										0	100%	8	
3	Thin Topsoil	Ground Cover Mix	2023-09-05									2	2	100%	n/a	Tree
			2023-09-05	41.0	0.0	n/a		1					1			Shrubs
3	Thin Topsoil	Shrub Mix	2023-09-05	81.5	14.4	n/a		3					3	100%	4	
3	Thin Topsoil	Community Mix	2023-09-05										0	100%	10	
3	Tilled Topsoil	Aspen	2023-09-05	269.6	26.7	18.4	2.3	6		2		2	10	100%	11	
3	Tilled Topsoil	Black spruce**	2023-09-05	263.8	11.2	16.0	1.0	10					10	65%	8	
3	Tilled Topsoil	Black ash	2023-09-05	206.7	54.8	8.7	5.7	3		5			8	100%	5	
3	Tilled Topsoil	Eastern white cedar	2023-09-05	92.1	6.9	n/a				9			9	100%	8	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
3	Tilled Topsoil	White spruce**	2023-09-05	135	0	6.2	0			1		9	10	100%	11	Black Spruce was planted instead of White
3	Tilled Topsoil	Jack pine	2023-09-05										0	100%	5	
3	Tilled Topsoil	Ground Cover Mix	2023-09-05	176.2	77.5	26.4	0.0	1		1		1	3	100%	11	Trees
			2023-09-05			n/a							0			Shrubs
3	Tilled Topsoil	Shrub Mix	2023-09-05	79.5	1.5	n/a		2				2	4	100%	8	
3	Tilled Topsoil	Community Mix	2023-09-05										0	40%	5	
3	Fertilized Overburden	Aspen	2023-09-05	246.0	0.0	18.8	0.0	5		5			10	100%	5	
3	Fertilized Overburden	Black spruce**	2023-09-05									10	10	100%	6	
3	Fertilized Overburden	Black ash	2023-09-05	184.9	63.4	10.0	1.3	7		2		1	10	100%	11	
3	Fertilized Overburden	Eastern white cedar	2023-09-05	104.8	5.7	n/a				7			7	100%	11	
3	Fertilized Overburden	White spruce**	2023-09-05	52.0	0	n/a				1		4	5	100%	7	

Block	Soil Treatment	Vegetation Treatment	Date	Total height		DBH		Health Check					Total Count	Ground Cover	Noxious Weeds	Comment
				Mean (cm)	+/- SD (cm)	Mean (mm)	+/- SD (mm)	H	H/S	S	S/D	D	(#)	(%)	Density Distribution	
3	Fertilized Overburden	Jack pine	2023-09-05										0	100%	6	
3	Fertilized Overburden	Ground Cover Mix	2023-09-05	252.0	4.0	14.0	1.0	1		1			2	100%	8	Trees
			2023-09-05			n/a							0			Shrubs
3	Fertilized Overburden	Shrub Mix	2023-09-05	116.0	2.0	n/a		2		2			4	100%	7	
3	Fertilized Overburden	Community Mix	2023-09-05										0	100%	8	
3	Control	Aspen	2023-09-05	267.2	21.6	15.9	1.7	6		4			10	80%	4	
3	Control	Black spruce	2023-09-05	121.6	16.1	6.9	0.0	2		3		5	10	80%	8	
3	Control	Black ash	2023-09-05	172.1	57.3	10.7	2.1	5		5			10	35%	n/a	
3	Control	Eastern white cedar	2023-09-05	96.7	7.8	n/a					11		11	100%	8	
3	Control	White spruce	2023-09-05	55.5	10.5	n/a				2		6	8	100%	8	
3	Control	Jack pine	2023-09-05										0		6	
3	Control	Ground Cover Mix	2023-09-05	208.0	0.0	12.0	0					2	2	100%	n/a	Trees
			2023-09-05	24.0	1	n/a				2			2			Shrubs
3	Control	Shrub Mix**	2023-09-05	97.6	35.3	n/a		4					4	100%	7	
3	Control	Community Mix	2023-09-05										0	95%	5	

- No trees or shrubs identified in plot

* Only one tree measured or tall enough for DBH, no SD given

** Dead species were not measured

Appendix B

Photos of Tree Plots by Block and Soil Treatment

Block 1 – Thin Topsoil

7 – Ground Cover Mix

1 – Aspen

8 – Shrub Mix

2– Black Spruce

9 – Community Mix

5 – White Spruce

5 – White Spruce

3 – Birch

4 – Eastern White Cedar

Block 1 – Tilled Topsoil

4 – Eastern White Cedar

2 – Black Spruce

6 – Jack Pine

1 – Aspen

7 – Ground Cover Mix

5 – White Spruce

3 – Birch

8 – Shrub Mix

9 – Community Mix

Block 1 – Fertilized Overburden

2 – Black Spruce

8 – Shrub Mix

9 – Community Mix

4 – Eastern White Cedar

1 – Aspen

3 - Birch

5 – White Spruce

7 – Ground Cover Mix

6 – Jack Pine

Block 1 – Control

No Picture Available

No Picture Available

5- White Spruce

2 – Jack Pine

7 – Ground Cover Mix

No Picture Available

No Picture Available

2 – Black Spruce

8 – Shrub Mix

4 – Eastern White Cedar

No Picture Available

No Picture Available

3 – Birch

1 – Aspen

9 – Community Mix

Block 2 – Thin Topsoil

1 – Aspen

9 - Community Mix

6 – Jack Pine

8 – Shrub Mix

7 – Ground Cover Mix

5 – White Spruce

4 – Eastern White Cedar

2 – Black Spruce

3 – Birch

Block 2 – Tilled Topsoil

1 – Aspen

6 – Jack Pine

2 – Black Spruce

8 – Shrub Mix

5 – White Spruce

4 – Eastern White Cedar

3 – Birch

7 – Ground Cover Mix

9 – Community Mix

Block 2 – Control

1 – Aspen

8 – Shrub Mix

3 – Birch

5 – White Spruce

6 – Jack Pine

7 – Ground Cover Mix

2 – Black Spruce

4 – Eastern White Cedar

9 – Community Mix

Block 2 – Fertilized Overburden

No Picture Available

1 – Aspen **9 – Community Mix** **6 – Jack Pine**

2 – Black Spruce **3 – Birch** **8 – Shrub Mix**

4 – Eastern White Cedar **5 – White Spruce** **7 – Ground Cover Mix**

Block 3 – Tilled Topsoil

1 – Aspen

2 – Black Spruce

9 – Community Mix

7 – Ground Cover Mix

4 – Eastern White Cedar

3 - Birch

5 – White Spruce

8 – Shrub Mix

6 – Jack Pine

Block 3 – Thin Topsoil

1 – Aspen

7 – Ground Cover Mix

6 – Jack Pine

9 – Community Mix

4 – Eastern White Cedar

3 - Birch

8 – Shrub Mix

5 – White Spruce

2 – Black Spruce

Block 3 – Control

1 – Aspen

2 – Black Spruce

7 – Ground Cover Mix

3 - Birch

4 – Eastern White Cedar

6 – Jack Pine

9 – Community Mix

5 – White Spruce

8 – Shrub Mix

Block 3 – Fertilized Overburden

1 – Aspen

2 – Black Spruce

4 – Eastern White Cedar

5 – White Spruce

6 – Jack Pine

3 - Birch

8 – Shrub Mix

9 – Community Mix

7 – Ground Cover Mix

Appendix C

Analytical Lab Tables

Table C.1. Soil Characterization - Physical Parameters and Soil Nutrients
New Gold Corp.

Rainy River Mine - Vegetation Trials
Project #: 1003-228
Lab Report(s): C371213V1

Sample Description			Physical Paramters					Soil Nutrients					
Sample Name	Depth (mbgs)	Date	% sand by hydrometer	% silt by hydrometer	Clay Content	Texture	Moisture	Available (NH4F) Nitrate (N)	Available (NH4F) Phosphorus (P)	Available (NH4OAc) Potassium (K)	Available (CaCl2) Sulphur (S)	Organic Matter	Total Organic Carbon (C)
			%	%	%	N/A	%	mg/kg	mg/kg	mg/kg	mg/kg	%	%
Plateu Trial Plots													
THIN TOPSOIL	0 - 0.2	2023-09-07	34	27	39	CLAY LOAM	19	9.7	11	210	5.6	6.6	3.8
THIN TOPSOIL	0.3 - 0.5	2023-09-07	47	30	23	LOAM	8.7	<4.0	6.0	110	3.0	0.54	0.31
TILLED TOPSOIL	0 - 0.2	2023-09-07	34	27	39	CLAY LOAM	23	20	11	220	9.0	5.8	3.4
TILLED TOPSOIL	0.3 - 0.5	2023-09-07	34	33	33	CLAY LOAM	11	20	2.8	140	6.4	2.0	1.2
FERTILIZED OVERURDEN	0 - 0.2	2023-09-07	29	35	37	CLAY LOAM	15	<4.0	2.6	170	5.6	1.0	0.59
FERTILIZED OVERURDEN	0.3 - 0.5	2023-09-07	30	29	41	CLAY	15	<4.0	1.6	190	16	0.79	0.46
CONTROL	0 - 0.2	2023-09-07	38	29	34	CLAY LOAM	14	<4.0	2.6	180	190	0.98	0.57
CONTROL	0.3 - 0.5	2023-09-07	37	29	34	CLAY LOAM	14	<20	1.9	180	42	0.73	0.43
BKG 0-0.2	0 - 0.2	2023-09-07	43	29	27	LOAM	14	<4.0	18	130	4.1	3.1	1.8
BKG 0.3-0.5	0.3 - 0.5	2023-09-07	34	19	47	CLAY	12	<4.0	95	270	2.1	0.30	0.17

Table C.2. Soil Characterization - Salintiy Parameters
New Gold Corp.

Rainy River Mine - Vegetation Trials
Project #: 1003-228
Lab Report(s): C371213V1

Sample Description				Salinity Paramaters																		
				Calculated Parameters									Soluable Parameters									
Sample ID	Depth (mbgs)	Date	Anion Sum	Cation Sum	Cation/EC Ratio	Calculated Calcium (Ca)	Calculated Magnesium (Mg)	Calculated Sodium (Na)	Calculated Potassium (K)	Calculated Chloride (Cl)	Calculated Sulphate (SO4)	Soluble Chloride (Cl)	**Soluble Conductivity**	Soluble (CaCl2) pH	**Sodium Adsorption Ratio**	Soluble Calcium (Ca)	Soluble Magnesium (Mg)	Soluble Sodium (Na)	Soluble Potassium (K)	Saturation %	Soluble Sulphate (SO4)	Theoretical Gypsum Requirement
			meq/L	meq/L	N/A	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	dS/m	pH	N/A	mg/L	mg/L	mg/L	mg/L	%	mg/L	tonnes/ha
THIN TOPSOIL	0 - 0.2	2023-09-07	0.64	9.1	12	62	21	9.8	3.6	<5.9	18	<10	0.78	7.29	0.36	110	36	17	6.2	59	31	<0.20
THIN TOPSOIL	0.3 - 0.5	2023-09-07	0.51	3.7	11	12	3.8	9.0	1.2	<3.6	8.7	<10	0.33	7.54	0.98	33	11	25	3.4	36	25	<0.20
TILLED TOPSOIL	0 - 0.2	2023-09-07	1.3	8.3	12	55	18	11	4.1	6.9	27	12	0.71	7.34	0.45	95	31	20	7.1	58	47	<0.20
TILLED TOPSOIL	0.3 - 0.5	2023-09-07	1.4	4.9	11	20	6.7	8.7	1.3	5.4	21	13	0.43	7.50	0.67	50	16	21	3.3	41	50	<0.20
FERTILIZED OVERURDEN	0 - 0.2	2023-09-07	1.2	3.7	11	16	5.0	9.6	1.3	6.9	16	15	0.34	7.51	0.79	36	11	21	2.8	45	36	<0.20
FERTILIZED OVERURDEN	0.3 - 0.5	2023-09-07	2.8	5.1	11	23	8.0	13	2.0	<4.9	64	<10	0.45	7.51	0.88	48	17	28	4.1	49	130	<0.20
CONTROL	0 - 0.2	2023-09-07	21	23	12	130	47	15	3.1	<4.8	480	<10	1.9	7.53	0.42	270	97	32	6.4	48	1000	<0.20
CONTROL	0.3 - 0.5	2023-09-07	6.2	8.1	11	41	13	13	2.1	<4.6	140	<10	0.75	7.64	0.64	89	29	27	4.6	46	300	<0.20
BKG 0-0.2	0 - 0.2	2023-09-07	0.64	5.4	12	21	10	6.4	1.8	<4.1	13	<10	0.45	6.46	0.45	52	24	16	4.4	41	31	<0.20
BKG 0.3-0.5	0.3 - 0.5	2023-09-07	0.34	1.1	11	2.8	1.0	7.4	<0.63	<4.8	7.9	<10	0.10	6.79	1.4	5.8	2.1	15	<1.3	48	16	<0.20

Appendix D

Laboratory Data Reports

Your Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Your C.O.C. #: 1/1

Attention: Scott Prodahl

Okane Consultants
#1900 - 736 6 Ave SW
Calgary, AB
CANADA T2P 3T7

Report Date: 2023/10/02
Report #: R3404130
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C371213
Received: 2023/09/08, 12:22

Sample Matrix: Soil
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Cation/EC Ratio (1)	10	N/A	2023/09/17		Auto Calc
Chloride (Soluble) (1)	10	2023/09/16	2023/09/17	AB SOP-00033 / AB SOP-00020	SM 24-4500-Cl-E m
Conductivity @25C (Soluble) (1)	10	2023/09/17	2023/09/17	AB SOP-00033 / AB SOP-00004	SM 23 2510 B m
Sum of Cations, Anions (1)	10	N/A	2023/09/17		Auto Calc
Potassium (Available) (1)	10	2023/10/02	2023/10/02	CAL SOP-00153 / AB SOP-00042	EPA 6010d R5 m
Moisture (1)	10	N/A	2023/09/15	AB SOP-00002	CCME PHC-CWS m
Available NO3 (N) (1)	10	2023/09/11	2023/10/02		Auto Calc
Organic Matter by combustion (1)	7	N/A	2023/09/15		Auto Calc
Organic Matter by combustion (1)	3	N/A	2023/09/18		Auto Calc
Phosphorus (Available by ICP) (1)	9	2023/09/28	2023/09/28	CAL SOP-00152 / AB SOP-00042	EPA 6010d R5 m
Phosphorus (Available by ICP) (1)	1	2023/09/28	2023/09/29	CAL SOP-00152 / AB SOP-00042	EPA 6010d R5 m
pH @25C (1:2 Calcium Chloride Extract) (1)	10	2023/09/14	2023/09/14	AB SOP-00033 / AB SOP-00006	SM 24 4500 H+B m
Sodium Adsorption Ratio (1)	10	N/A	2023/09/17		Auto Calc
Soluble Ions (1)	10	2023/09/16	2023/09/17	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Sulphur (Available) (1)	10	2023/09/13	2023/09/13	AB SOP-00029 / AB SOP-00042	EPA 6010d R5 m
Soluble Paste (1)	10	2023/09/16	2023/09/16	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Ions Calculation (1)	10	N/A	2023/09/14		Auto Calc
Total Organic Carbon LECO Method (1)	10	N/A	2023/09/15	CAL SOP-00243	LECO 203-821-498 m
Texture by Hydrometer (1)	10	N/A	2023/09/14	AB SOP-00030	Carter 2nd ed 55.3 m
Texture Class (1)	10	N/A	2023/09/14		Auto Calc
Theoretical Gypsum Requirement (1, 2)	10	N/A	2023/09/17		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

Your Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Your C.O.C. #: 1/1

Attention: Scott Prodahl

Okane Consultants
#1900 - 736 6 Ave SW
Calgary, AB
CANADA T2P 3T7

Report Date: 2023/10/02
Report #: R3404130
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C371213
Received: 2023/09/08, 12:22

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Calgary, 4000 - 19 St. , Calgary, AB, T2E 6P8
(2) TGR calculation is based on a theoretical SAR of 4. Salt Contamination and Assessment and remediation guideline 2001 recommended SAR is ranging 4-8. TGR is reported in tonnes/ha.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bureauveritas.com
Phone# (204) 772-7276
==========
This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Scott Cantwell, General Manager responsible for Manitoba Environmental laboratory operations.

Bureau Veritas Job #: C371213
Report Date: 2023/10/02

Okane Consultants
Client Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Sampler Initials: SP

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BYR143		BYR144		BYR145		
Sampling Date		2023/09/07		2023/09/07		2023/09/07		
COC Number		1/1		1/1		1/1		
	UNITS	THIN TOPSOIL 0-0.2	RDL	THIN TOPSOIL 0.3-0.5	RDL	TILLED TOPSOIL 0-0.2	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	0.64	N/A	0.51	N/A	1.3	N/A	B102969
Cation Sum	meq/L	9.1	N/A	3.7	N/A	8.3	N/A	B102969
Cation/EC Ratio	N/A	12	0.10	11	0.10	12	0.10	B102962
Available (NH4F) Nitrate (N)	mg/kg	9.7	4.0	<4.0	4.0	20	4.0	B103014
Organic Matter	%	6.6	0.035	0.54	0.035	5.8	0.035	B103015
Calculated Calcium (Ca)	mg/kg	62	0.88	12	0.53	55	0.87	B102977
Calculated Magnesium (Mg)	mg/kg	21	0.59	3.8	0.36	18	0.58	B102977
Calculated Sodium (Na)	mg/kg	9.8	1.5	9.0	0.89	11	1.4	B102977
Calculated Potassium (K)	mg/kg	3.6	0.76	1.2	0.46	4.1	0.75	B102977
Calculated Chloride (Cl)	mg/kg	<5.9	5.9	<3.6	3.6	6.9	5.8	B102977
Calculated Sulphate (SO4)	mg/kg	18	2.9	8.7	1.8	27	2.9	B102977
Nutrients								
Available (NH4F) Phosphorus (P)	mg/kg	11	1.0	6.0	1.0	11	1.0	B128422
Available (NH4OAc) Potassium (K)	mg/kg	210	2.0	110	2.0	220	2.0	B133862
Available (CaCl2) Sulphur (S)	mg/kg	5.6	2.0	3.0	2.0	9.0	2.0	B106139
Soluble Parameters								
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	12	10	B111208
Soluble Conductivity	dS/m	0.78	0.020	0.33	0.020	0.71	0.020	B111288
Soluble (CaCl2) pH	pH	7.29	N/A	7.54	N/A	7.34	N/A	B105967
Sodium Adsorption Ratio	N/A	0.36	0.10	0.98	0.10	0.45	0.10	B102975
Soluble Calcium (Ca)	mg/L	110	1.5	33	1.5	95	1.5	B111261
Soluble Magnesium (Mg)	mg/L	36	1.0	11	1.0	31	1.0	B111261
Soluble Sodium (Na)	mg/L	17	2.5	25	2.5	20	2.5	B111261
Soluble Potassium (K)	mg/L	6.2	1.3	3.4	1.3	7.1	1.3	B111261
Saturation %	%	59	N/A	36	N/A	58	N/A	B105965
Soluble Sulphate (SO4)	mg/L	31	5.0	25	5.0	47	5.0	B111261
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	<0.20	0.20	B102983

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Bureau Veritas Job #: C371213
Report Date: 2023/10/02

Okane Consultants
Client Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Sampler Initials: SP

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BYR146		BYR147		BYR148		
Sampling Date		2023/09/07		2023/09/07		2023/09/07		
COC Number		1/1		1/1		1/1		
	UNITS	TILLED TOPSOIL 0.3-0.5	RDL	OVERURDEN 0-0.2	RDL	OVERURDEN 0.3-0.5	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	1.4	N/A	1.2	N/A	2.8	N/A	B102969
Cation Sum	meq/L	4.9	N/A	3.7	N/A	5.1	N/A	B102969
Cation/EC Ratio	N/A	11	0.10	11	0.10	11	0.10	B102962
Available (NH4F) Nitrate (N)	mg/kg	20	4.0	<4.0	4.0	<4.0	4.0	B103014
Organic Matter	%	2.0	0.035	1.0	0.035	0.79	0.035	B103015
Calculated Calcium (Ca)	mg/kg	20	0.61	16	0.68	23	0.73	B102977
Calculated Magnesium (Mg)	mg/kg	6.7	0.41	5.0	0.45	8.0	0.49	B102977
Calculated Sodium (Na)	mg/kg	8.7	1.0	9.6	1.1	13	1.2	B102977
Calculated Potassium (K)	mg/kg	1.3	0.53	1.3	0.59	2.0	0.63	B102977
Calculated Chloride (Cl)	mg/kg	5.4	4.1	6.9	4.5	<4.9	4.9	B102977
Calculated Sulphate (SO4)	mg/kg	21	2.0	16	2.3	64	2.4	B102977
Nutrients								
Available (NH4F) Phosphorus (P)	mg/kg	2.8	1.0	2.6	1.0	1.6	1.0	B128422
Available (NH4OAc) Potassium (K)	mg/kg	140	2.0	170	2.0	190	2.0	B133862
Available (CaCl2) Sulphur (S)	mg/kg	6.4	2.0	5.6	2.0	16	2.0	B106139
Soluble Parameters								
Soluble Chloride (Cl)	mg/L	13	10	15	10	<10	10	B111208
Soluble Conductivity	dS/m	0.43	0.020	0.34	0.020	0.45	0.020	B111288
Soluble (CaCl2) pH	pH	7.50	N/A	7.51	N/A	7.51	N/A	B105967
Sodium Adsorption Ratio	N/A	0.67	0.10	0.79	0.10	0.88	0.10	B102975
Soluble Calcium (Ca)	mg/L	50	1.5	36	1.5	48	1.5	B111261
Soluble Magnesium (Mg)	mg/L	16	1.0	11	1.0	17	1.0	B111261
Soluble Sodium (Na)	mg/L	21	2.5	21	2.5	28	2.5	B111261
Soluble Potassium (K)	mg/L	3.3	1.3	2.8	1.3	4.1	1.3	B111261
Saturation %	%	41	N/A	45	N/A	49	N/A	B105965
Soluble Sulphate (SO4)	mg/L	50	5.0	36	5.0	130	5.0	B111261
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	<0.20	0.20	B102983

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Bureau Veritas Job #: C371213
Report Date: 2023/10/02

Okane Consultants
Client Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Sampler Initials: SP

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BYR149		BYR150		BYR151		BYR152		
Sampling Date		2023/09/07		2023/09/07		2023/09/07		2023/09/07		
COC Number		1/1		1/1		1/1		1/1		
	UNITS	CONTROL 0-0.2	RDL	CONTROL 0.3-0.5	RDL	BKG 0-0.2	RDL	BKG 0.3-0.5	RDL	QC Batch
Calculated Parameters										
Anion Sum	meq/L	21	N/A	6.2	N/A	0.64	N/A	0.34	N/A	B102969
Cation Sum	meq/L	23	N/A	8.1	N/A	5.4	N/A	1.1	N/A	B102969
Cation/EC Ratio	N/A	12	0.10	11	0.10	12	0.10	11	0.10	B102962
Available (NH4F) Nitrate (N)	mg/kg	<4.0	4.0	<20	20	<4.0	4.0	<4.0	4.0	B103014
Organic Matter	%	0.98	0.035	0.73	0.035	3.1	0.035	0.30	0.035	B103015
Calculated Calcium (Ca)	mg/kg	130	0.72	41	0.69	21	0.62	2.8	0.72	B102977
Calculated Magnesium (Mg)	mg/kg	47	0.48	13	0.46	10	0.41	1.0	0.48	B102977
Calculated Sodium (Na)	mg/kg	15	1.2	13	1.2	6.4	1.0	7.4	1.2	B102977
Calculated Potassium (K)	mg/kg	3.1	0.62	2.1	0.60	1.8	0.53	<0.63	0.63	B102977
Calculated Chloride (Cl)	mg/kg	<4.8	4.8	<4.6	4.6	<4.1	4.1	<4.8	4.8	B102977
Calculated Sulphate (SO4)	mg/kg	480	2.4	140	2.3	13	2.1	7.9	2.4	B102977
Nutrients										
Available (NH4F) Phosphorus (P)	mg/kg	2.6	1.0	1.9	1.0	18	1.0	95	1.0	B128422
Available (NH4OAc) Potassium (K)	mg/kg	180	2.0	180	2.0	130	2.0	270	2.0	B133862
Available (CaCl2) Sulphur (S)	mg/kg	190	2.0	42	2.0	4.1	2.0	2.1	2.0	B106139
Soluble Parameters										
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	<10	10	<10	10	B111208
Soluble Conductivity	dS/m	1.9	0.020	0.75	0.020	0.45	0.020	0.10	0.020	B111288
Soluble (CaCl2) pH	pH	7.53	N/A	7.64	N/A	6.46	N/A	6.79	N/A	B105967
Sodium Adsorption Ratio	N/A	0.42	0.10	0.64	0.10	0.45	0.10	1.4	0.10	B102975
Soluble Calcium (Ca)	mg/L	270	1.5	89	1.5	52	1.5	5.8	1.5	B111261
Soluble Magnesium (Mg)	mg/L	97	1.0	29	1.0	24	1.0	2.1	1.0	B111261
Soluble Sodium (Na)	mg/L	32	2.5	27	2.5	16	2.5	15	2.5	B111261
Soluble Potassium (K)	mg/L	6.4	1.3	4.6	1.3	4.4	1.3	<1.3	1.3	B111261
Saturation %	%	48	N/A	46	N/A	41	N/A	48	N/A	B105965
Soluble Sulphate (SO4)	mg/L	1000	5.0	300	5.0	31	5.0	16	5.0	B111261
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	<0.20	0.20	<0.20	0.20	B102983

RDL = Reportable Detection Limit
N/A = Not Applicable

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Okane Consultants
Client Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
Sampler Initials: SP

PHYSICAL TESTING (SOIL)

Bureau Veritas ID		BYR143	BYR144		BYR145		
Sampling Date		2023/09/07	2023/09/07		2023/09/07		
COC Number		1/1	1/1		1/1		
	UNITS	THIN TOPSOIL 0-0.2	THIN TOPSOIL 0.3-0.5	QC Batch	TILLED TOPSOIL 0-0.2	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	34	47	B106202	34	2.0	B107269
% silt by hydrometer	%	27	30	B106202	27	2.0	B107269
Clay Content	%	39	23	B106202	39	2.0	B107269
Texture	N/A	CLAY LOAM	LOAM	B102840	CLAY LOAM	N/A	B102840
Moisture	%	19	8.7	B108214	23	0.30	B108214

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BYR146	BYR147		BYR148	BYR149		
Sampling Date		2023/09/07	2023/09/07		2023/09/07	2023/09/07		
COC Number		1/1	1/1		1/1	1/1		
	UNITS	TILLED TOPSOIL 0.3-0.5	OVERURDEN 0-0.2	QC Batch	OVERURDEN 0.3-0.5	CONTROL 0-0.2	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%	34	29	B106202	30	38	2.0	B107269
% silt by hydrometer	%	33	35	B106202	29	29	2.0	B107269
Clay Content	%	33	37	B106202	41	34	2.0	B107269
Texture	N/A	CLAY LOAM	CLAY LOAM	B102840	CLAY	CLAY LOAM	N/A	B102840
Moisture	%	11	15	B108214	15	14	0.30	B108214

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BYR150		BYR151	BYR152		
Sampling Date		2023/09/07		2023/09/07	2023/09/07		
COC Number		1/1		1/1	1/1		
	UNITS	CONTROL 0.3-0.5	QC Batch	BKG 0-0.2	BKG 0.3-0.5	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	37	B106202	43	34	2.0	B107269
% silt by hydrometer	%	29	B106202	29	19	2.0	B107269
Clay Content	%	34	B106202	27	47	2.0	B107269
Texture	N/A	CLAY LOAM	B102840	LOAM	CLAY	N/A	B102840
Moisture	%	14	B108214	14	12	0.30	B108214

RDL = Reportable Detection Limit
N/A = Not Applicable

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Okane Consultants
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Site Location: RAINY RIVER MINE - VEG TRIALS
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MISCELLANEOUS (SOIL)

Bureau Veritas ID		BYR143	BYR144	BYR145	BYR146		
Sampling Date		2023/09/07	2023/09/07	2023/09/07	2023/09/07		
COC Number		1/1	1/1	1/1	1/1		
	UNITS	THIN TOPSOIL 0-0.2	THIN TOPSOIL 0.3-0.5	TILLED TOPSOIL 0-0.2	TILLED TOPSOIL 0.3-0.5	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	3.8	0.31	3.4	1.2	0.050	B109604
RDL = Reportable Detection Limit							

Bureau Veritas ID		BYR147	BYR148	BYR149	BYR150	BYR151		
Sampling Date		2023/09/07	2023/09/07	2023/09/07	2023/09/07	2023/09/07		
COC Number		1/1	1/1	1/1	1/1	1/1		
	UNITS	OVERURDEN 0-0.2	OVERURDEN 0.3-0.5	CONTROL 0-0.2	CONTROL 0.3-0.5	BKG 0-0.2	RDL	QC Batch
Misc. Inorganics								
Total Organic Carbon (C)	%	0.59	0.46	0.57	0.43	1.8	0.050	B109604
RDL = Reportable Detection Limit								

Bureau Veritas ID		BYR152		
Sampling Date		2023/09/07		
COC Number		1/1		
	UNITS	BKG 0.3-0.5	RDL	QC Batch
Misc. Inorganics				
Total Organic Carbon (C)	%	0.17	0.050	B109604
RDL = Reportable Detection Limit				

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GENERAL COMMENTS

Results relate only to the items tested.

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Okane Consultants
Client Project #: 1002-228
Site Location: RAINY RIVER MINE - VEG TRIALS
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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
B105965	STB	QC Standard	Saturation %	2023/09/16		106	%	75 - 125
B105965	STB	RPD [BYR150-01]	Saturation %	2023/09/16	5.5		%	12
B105967	HAP	QC Standard	Soluble (CaCl2) pH	2023/09/14		100	%	97 - 103
B105967	HAP	Spiked Blank	Soluble (CaCl2) pH	2023/09/14		100	%	97 - 103
B105967	HAP	RPD [BYR150-01]	Soluble (CaCl2) pH	2023/09/14	0.16		%	N/A
B106139	VSC	Matrix Spike	Available (CaCl2) Sulphur (S)	2023/09/13		94	%	75 - 125
B106139	VSC	QC Standard	Available (CaCl2) Sulphur (S)	2023/09/13		102	%	75 - 125
B106139	VSC	Spiked Blank	Available (CaCl2) Sulphur (S)	2023/09/13		95	%	80 - 120
B106139	VSC	Method Blank	Available (CaCl2) Sulphur (S)	2023/09/13	<2.0		mg/kg	
B106139	VSC	RPD	Available (CaCl2) Sulphur (S)	2023/09/13	0.69		%	35
B106202	RDL	QC Standard	% sand by hydrometer	2023/09/14		97	%	75 - 125
			% silt by hydrometer	2023/09/14		105	%	75 - 125
			Clay Content	2023/09/14		101	%	75 - 125
B106202	RDL	RPD	% sand by hydrometer	2023/09/14	0.095		%	30
			% silt by hydrometer	2023/09/14	2.2		%	30
			Clay Content	2023/09/14	1.9		%	30
B107269	RDL	QC Standard	% sand by hydrometer	2023/09/14		97	%	75 - 125
			% silt by hydrometer	2023/09/14		112	%	75 - 125
			Clay Content	2023/09/14		94	%	75 - 125
B107269	RDL	RPD	% sand by hydrometer	2023/09/14	14		%	30
			% silt by hydrometer	2023/09/14	8.9		%	30
			Clay Content	2023/09/14	8.0		%	30
B108214	DVY	Method Blank	Moisture	2023/09/15	<0.30		%	
B108214	DVY	RPD [BYR152-01]	Moisture	2023/09/15	0		%	20
B109604	PL	QC Standard	Total Organic Carbon (C)	2023/09/15		96	%	75 - 125
B109604	PL	Spiked Blank	Total Organic Carbon (C)	2023/09/15		100	%	80 - 120
B109604	PL	Method Blank	Total Organic Carbon (C)	2023/09/15	<0.050		%	
B109604	PL	RPD [BYR143-01]	Total Organic Carbon (C)	2023/09/15	0.94		%	35
B111208	EBO	Matrix Spike [BYR150-01]	Soluble Chloride (Cl)	2023/09/17		98	%	75 - 125
B111208	EBO	QC Standard	Soluble Chloride (Cl)	2023/09/17		87	%	75 - 125
B111208	EBO	Spiked Blank	Soluble Chloride (Cl)	2023/09/17		99	%	80 - 120
B111208	EBO	Method Blank	Soluble Chloride (Cl)	2023/09/17	<10		mg/L	
B111208	EBO	RPD [BYR150-01]	Soluble Chloride (Cl)	2023/09/17	NC		%	30
B111261	VSC	Matrix Spike [BYR150-01]	Soluble Calcium (Ca)	2023/09/17		98	%	75 - 125
			Soluble Magnesium (Mg)	2023/09/17		102	%	75 - 125
			Soluble Sodium (Na)	2023/09/17		99	%	75 - 125
			Soluble Potassium (K)	2023/09/17		100	%	75 - 125
B111261	VSC	QC Standard	Soluble Calcium (Ca)	2023/09/17		89	%	75 - 125
			Soluble Magnesium (Mg)	2023/09/17		92	%	75 - 125
			Soluble Sodium (Na)	2023/09/17		97	%	75 - 125
			Soluble Potassium (K)	2023/09/17		100	%	75 - 125
			Soluble Sulphate (SO4)	2023/09/17		88	%	75 - 125
B111261	VSC	Spiked Blank	Soluble Calcium (Ca)	2023/09/17		97	%	80 - 120
			Soluble Magnesium (Mg)	2023/09/17		102	%	80 - 120
			Soluble Sodium (Na)	2023/09/17		97	%	80 - 120
			Soluble Potassium (K)	2023/09/17		99	%	80 - 120
B111261	VSC	Method Blank	Soluble Calcium (Ca)	2023/09/17	<1.5		mg/L	
			Soluble Magnesium (Mg)	2023/09/17	<1.0		mg/L	
			Soluble Sodium (Na)	2023/09/17	<2.5		mg/L	
			Soluble Potassium (K)	2023/09/17	<1.3		mg/L	
			Soluble Sulphate (SO4)	2023/09/17	<5.0		mg/L	
B111261	VSC	RPD [BYR150-01]	Soluble Calcium (Ca)	2023/09/17	6.7		%	30
			Soluble Magnesium (Mg)	2023/09/17	3.6		%	30

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Soluble Sodium (Na)	2023/09/17	7.8		%	30
			Soluble Potassium (K)	2023/09/17	7.9		%	30
			Soluble Sulphate (SO4)	2023/09/17	10		%	30
B111288	EBO	QC Standard	Soluble Conductivity	2023/09/17		102	%	75 - 125
B111288	EBO	Spiked Blank	Soluble Conductivity	2023/09/17		101	%	90 - 110
B111288	EBO	Method Blank	Soluble Conductivity	2023/09/17	<0.020		dS/m	
B111288	EBO	RPD [BYR150-01]	Soluble Conductivity	2023/09/17	1.9		%	20
B128422	MPU	Matrix Spike [BYR150-01]	Available (NH4F) Phosphorus (P)	2023/09/28		124	%	75 - 125
B128422	MPU	Spiked Blank	Available (NH4F) Phosphorus (P)	2023/09/28		119	%	80 - 120
B128422	MPU	Method Blank	Available (NH4F) Phosphorus (P)	2023/09/28	<1.0		mg/kg	
B128422	MPU	RPD [BYR150-01]	Available (NH4F) Phosphorus (P)	2023/09/29	9.8		%	35
B133862	VSC	Matrix Spike [BYR150-01]	Available (NH4OAc) Potassium (K)	2023/10/02		107	%	75 - 125
B133862	VSC	Spiked Blank	Available (NH4OAc) Potassium (K)	2023/10/02		118	%	80 - 120
B133862	VSC	Method Blank	Available (NH4OAc) Potassium (K)	2023/10/02	<2.0		mg/kg	
B133862	VSC	RPD [BYR150-01]	Available (NH4OAc) Potassium (K)	2023/10/02	4.4		%	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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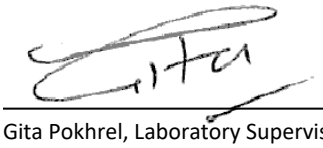
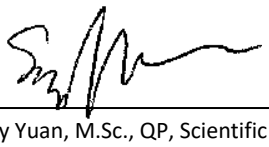
VALIDATION SIGNATURE PAGE

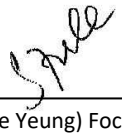
The analytical data and all QC contained in this report were reviewed and validated by:



Gita Pokhrel, Laboratory Supervisor



Sandy Yuan, M.Sc., QP, Scientific Specialist



Suwan (Sze Yeung) Fock, B.Sc., Scientific Specialist

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