Mount Polley Mining Corporation
2012 North Bell Dump Reclamation Update

Reclamation Summary

2011 Reclamation

Between July and October 2011, 11.6 ha the North Bell Dump (NBD) defined as Parcels 1 – 10 was re-sloped to a 2:1 ratio for long term stability, and 20 cm of manufactured soil containing a 1:2:1 mixture of biosolids, soil, and rock, respectively, was applied. Coarse woody debris was then scattered across the slope. Parcels 1 – 9 of the dump face was subsequently hydroseeded between October 27 and November 8, 2011 by a contractor Any Season Holdings Inc. Parcel 10 (southern-most parcel) was hand seeded on November 14, 2011.

The native seed mix applied to the NBD is outlined in Table 1. The seeding was done on snow without the use of mulch or adhesive at the prescribed application rate of 35 kg/ha.

Table 1. Native seed mixture applied to the NBD

Seed	%
Mountain Brome	20
Native Red Fescue	10
Rocky Mountain Fescue	15
Wheatgrass, Bluebunch	25
Blue Wildrye	25

2012 Reclamation

In spring 2012, a 1.3 ha area adjacent to the 2011 reclamation called the “South Triangle” was re-sloped. Glacial till was then spread to a depth of 20 to 40 cm across the surface. This area was the hydro-seeded with native seed mix (35 kg/ha), fertilizer (18-19-18, 75 kg/ha) and fiber mulch. Unsuccessful vegetation growth over the 2012 season led to the decision to re-seed the area on October 23.

From June 13 to 20, approximately 2.2 Ha of the dumps toe had glacial till cast over it. This work as completed by Peterson Contracting.

The hauling of waste rock to the top of the North Bell Dump ceased in July and sloping began shortly afterwards. 5 ha areas on both the north and south portions of the dump were re-sloped. Areas were designated for “features” to add terrain diversity to the slope (Figure 1). Shallow gullies and ridges were shaped.

Work continued with the preparation of staging areas for the eventual stockpiling, mixing and spreading of biosolids. Class A Annacis biosolids from Metro Vancouver were accepted from May 30 to July 31. The biosolids were mixed with an excavator rented from Peterson Contracting at a ratio of 3:1 till to biosolids from June 28 to October 3. This material was applied to a 2.2 ha are entitled Phase 1 (on North

end of the dump) at a uniform depth of 20 cm, with a final application rate of 138 /ha. Mixed biosolids were also applied to a 3.1 ha area entitled Phase 2 (on the South portion of the dump). The soil was applied using a horizontal windrow method to increase micro-topography (Figure 2), with an average depth of 20 cm. The final application rate was 135 dt/ha. These two parcels were hand-seeded between October 17 and 22 at a rate of 35 kg/ha. The seed mix for Parcel 1 is presented in Table 2, while the seed mix for Parcel 2 is the same as Table 1, except lupin seed was planted as well.

The map in Figure 3 shows the location of all the NBD reclamation sites.

Figure 1. Creation of a swale on the NBD

Figure 2. Horizontal windrows on Phase 2 of the NBD

Figure 3. Map of the North Bell Dump reclamation areas

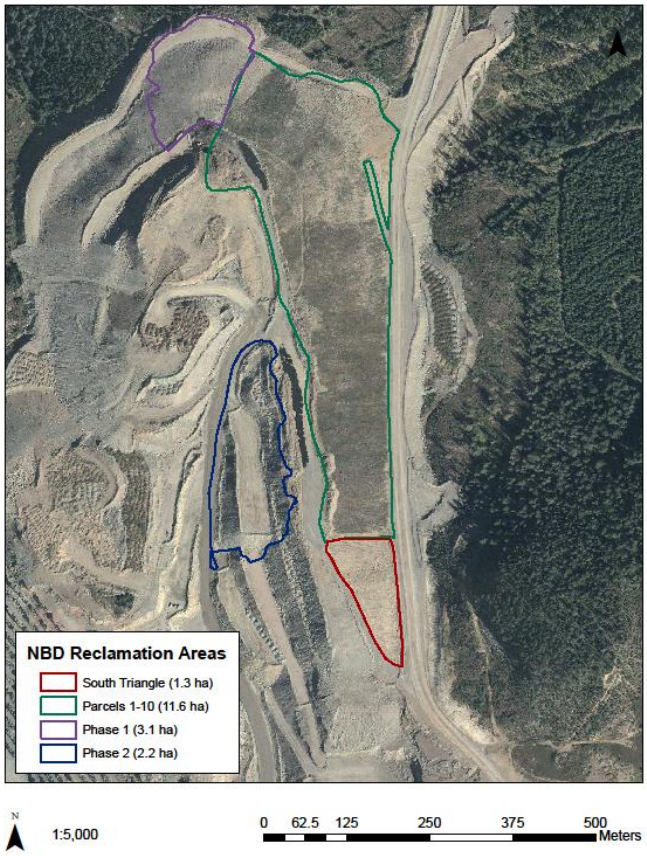

Table 2. Native seed grasses and forbes mix hand-seeded on Parcel 1

Species	%
Mountain Brome	20
Native Red Fescue	10
Rocky Mountain Fescue	15
Wheatgrass, Bluebunch	25
Blue Wildrye	25
Junegrass	3
Ticklegrass	1
Lupinus polyphyllus	0.97
Fireweed	0.03

Parcel 1 – 10 Field Assessment: July 17, 2012

To assess re-vegetative success on the NBD in the first growing season, percent ground cover, percent planted species present, and vigor (on a scale of 0 to 5, where 0=very poor, 5 = very good) were recorded for 10 metre sections along 7 transects (T1, T2, T3, T4, T5, T5-Upper, and T6) , as shown in Figure 4. The assessment extended 1 metre on either side of each transect. These transects were selected prior to the field assessment to avoid bias.

Tables 3 through 9 provide detailed results from the assessment. Note that "zero" metres is at the bottom of the slope, and data is presented from transect bottom to top. Table 10 provides average results from each transect and for the entire reclaimed parcel.

Figure 4. NBD assessment transects

Table 3. NBD Transect 1 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 10 m	40	40	3	Non-planted species: raspberries, timothy, clover, fireweed, thistles, scentless camomile, yellow pea species, pigweed, yellow hawkweed, equisetum, dandelion, white cockle, pineapple weed, unidentified species 1 and 2 (photos) - crawling species prominent at top of slope Observations: Section was hand seeded and is considerably less uniform and less successful growth than neighbouring hydroseeded area. (Transect 2). Crawling species choking out grasses?
10 - 20 m	30	40	3	
20 - 30 m	40	25	3	
30 - 40 m	50	40	3	
40 - 50 m	40	40	4	
50 - 60 m	40	40	3	
60 - 70 m	50	40	2	
70 - 80 m	50	30	3	

Table 4. NBD Transect 2 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 10 m	80	90	5	Non-planted species: thistles (sow, canadian), timothy, scentless camomile, yellow pea species, clover, fireweed, pigweed, yellow hawkweed, pineapple weed, unidentified crawling species 2 (photo), white cockle Observations: some grasses going to seed. Lower vigor plants have a slight yellow hue.
10 - 20 m	80	90	4	
20 - 30 m	90	80	4	
30 - 40 m	80	80	3	
40 - 50 m	70	80	5	
50 - 60 m	70	60	5	
60 - 70 m	90	80	5	

Table 5. NBD Transect 3 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 10 m	70	90	5	Non-planted species: thistles, yellow hawkweed, pigweed, scentless camomile (prominant 40 m to top), unidentified species 1, 2 and 3 (photos), pineapple weed, raspberry, dandelion, yellow pea species, elderberry, fireweed Observations: variable growth due to seeding? nutrifor and/or soil variability?
10 - 20 m	20	70	4	
20 - 30 m	25	90	5	
30 - 40 m	20	70	4	
40 - 50 m	70	50	5	
50 - 60 m	10	60	5	
60 - 73 m	70	40	4	

Table 6. NBD Transect 4 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 10 m	10	95	3	Non-planted species: thistles, raspberry, pineapple weed, dandelion, yellow hawkweed, yellow pea species, unidentified species 2 (crawling - photo) Observations: plants healthy, but not as tall as other transects. Lots of blue, oxidized rock.
10 - 20 m	5	100	3	
20 - 30 m	60	95	4	
30 - 40 m	50	80	4	

Table 7. NBD Transect 5 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 70 m	0	0	0	Observations: no plants on surface. Rocky substrate. Soil not viable? Improper biosolid and soil depths (this area was a long push from the top for equipment)?

Table 8. NBD Transect 5-Upper Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 10 m	40	90	3	Non-planted species: fireweed, pineapple weed, thistle, unidentified species 2 (crawling - 2), raspberry, clover Observations: some grasses starting to seed. Lower vigor (3) due to smaller plants with yellowish hue.
10 - 20 m	30	90	4	
20 - 30 m	30	95	4	
30 - 40 m	10	100	3	
40 - 50 m	10	95	4	
50 - 60 m	5	90	3	

Table 9. NBD Transect 6 Results

Site	% Cover	% Planted Species	Planted Species Vigor (0-5)	Transect Comments
0 - 40 m	2	20	3	Non-planted species: fireweed, yellow hawkweed, dandelion, clover, thistle, pineapple weed, pigweed, raspberry, unidentified species 1 (photo) Observations: grasses smaller, less foliage (especially in lower portion of transect). Slope levels out from 70 to 100 m.
40 - 50 m	20	10	3	
50 - 60 m	15	70	3	
60 - 70 m	15	70	3	
70 - 80 m	70	80	4	
80 - 90 m	70	90	4	
90 - 100 m	70	90	4	

Table 10. NBD Average Transect Results

Transect	% Cover	% Planted Species	Planted Species Vigor (0-5)
Transect 1	43	37	3.0
Transect 2	80	80	4.4
Transect 3	41	67	4.6
Transect 4	31	93	3.5
Transect 5	0	0	0.0
Transect 5U	21	93	3.5
Transect 6	37	61	3.4
Average (All Transects)	**36**	**62**	**3.2**
Average (Excluding T5)	**42**	**72**	**3.7**

As shown in Table 10, results differed among transects (i.e. across the slope). Ground cover ranged considerably among transects, with averages from 0% to 80%. Overall, the whole area has an average cover of 36% (42% if you exclude transects exhibiting zero growth). Transect 5 runs through a portion of the dump where little or no growth has been observed.

The abundance of non-planted species varied significantly across the site. Based on the surveyed transects (excluding Transect 5, which had no growth), an average of 25% of the vegetation was not planted, with individual transect averages ranging from 7% to 63% non-planted species. This vegetation that was not planted includes native species, such as ivy, perennial rye-grass, timothy, raspberries, clover, fireweed, and equisetum. Unfortunately, there is also strong presence of invasive species, including scentless camomile, pigweed, Dalmatian toadflax, pineapple weed, yellow hawkweed, and dandelions.

Vigor was typically greater than "3" at all sites. Lower vigor on the site was generally due to less height and a yellowish hue to the plants.

No trends were observed in comparing plots along the bottom, middle and top of the slope. In addition, no clear correlations were observed between relative ground cover, proportion of planted species, and planted species vigor.

Field Assessment Discussion

Organisms including bees, ladybugs, a black wasp-like species, butterflies, ants, and spiders were observed, indicating that reclamation is progressing and habitats are forming.

The differences in re-vegetation across the slope (between transects) after one year can likely be largely attributed to soil quality variability. For example, growth was more uniform in Transect 2, while in Transects 5 and 6, it was more irregular. In addition, areas with little to no growth had much rockier soil, with virtually no topsoil (A horizon) and very little subsoil (B Horizon). These areas were generally at the lower portion of the slope, and likely did not receive the prescribed soil application, as it was a long "push" for equipment. Soil variability could also be responsible for the differences in invasive and non-planted species, as species and abundance of viable seed in the soil units applied can vary (Figure 5).

Figure 5. Variation in species and abundance of non-planted species across the reclaimed slope

Despite the hot weather prior to the assessment, areas exhibiting strong growth showed soil moisture just below the surface. Shorter plants and plants with a yellow hue were observed in some transects, possibly due to drought and heat (i.e. inability of the soil to hold moisture), and/or a lack of nutrients in the soil. The only dead plants observed were on the makeshift hydroseeding access road, where soils likely became too compacted.

Another difference observed was that the hand seeded parcel (assessed in Transect 1) showed more uneven, irregular growth compared to the neighbouring area (Transects 2 and 3). Findings on the NEZ dump, however, showed cover to generally increase and become more homogenous after a second season of growth, indicating that cover on the hand-seeded parcel (as well as across the slope), should be expected to improve.

The application of woody debris to the reclaimed surface proved successful and creating improved microsites for plants, as did any berms or areas surface roughness (Figure 6).

Figure 6. Improved growth in microsites created by surface roughness

Recommendations

For the North Bell Dump

- To address the poor growth areas on Parcels 1 -10 with less than 5% cover and the South Triangle, a high density deciduous plantation up to 3000 stems per hectare (SPH) (primarily Black Cottonwood, Paper Birch, Trembling Aspen, Sitka Alder and Willow) with a considerable component of Pine (up to 1200 SPH) to help restore soil productivity .
- Fertilize the South Triangle in spring 2013 (this parcel received no biosolids).
- The next phase of reclamation includes planting of trees and shrubs. To promote growth, vegetated cover should be reduced at tree and shrub microsites to prevent competition, and allow for initial establishment.

For New Reclamation Sites

- During the design phase, the reclamation surface should be designed with access for hydroseeding, etc. to prevent the need for makeshift road construction, which causes soil compaction. Any access roads should be ripped up and seeded as reclamation activities conclude. Slopes should also be designed with consideration of equipment constraints, and the inability to "push" soil long distances.
- Soil variability plays a key factor in re-vegetative success. To improve future reclamation results, procedures in the *Soil Salvage and Stockpile Protocol* (MPMC 1997) and the new *Soil Handling and Management Standard Operating Procedure* (MPMC 2012) should be adhered to.
- The preferred rooting depth zone for vegetation is 60 cm. It is recommended to spread till or C-horizon soil below topsoil on waste dumps to achieve this. While 20 cm of soil was used on majority of the NBD areas, site research from the tree plots shows tree growth improves with up to 40 cm of soil.
- Further research should be done to confirm the necessity of using soil amendments such as biosolids, char, or fly ash.
- Reclamation sites with a rougher surface, contours and debris will exhibit more successful plant growth. Efforts should be made to create natural landforms or features when re-contouring, and to use the horizontal windrow approach when applying soil.
- While hydroseeding may result in more uniform growth in the first year, hand-seeding appears to provide sufficient coverage, while being less expensive, and less invasive.