

**To:** Mary Beth Marks, US Forest Service

**Cc:** Shane Matolyak, Tetra Tech

**From:** Nick Sovner, Tetra Tech

**Date:** May 4, 2017

**Subject:** 2016 New World Vegetation Monitoring (Contract AG-03430B-12-0001, AG-03430K-16-0020)

This memorandum presents the results of the 2016 Vegetation Monitoring Event that was conducted in accordance with the New World Response and Restoration Project, 2016/2017 Initial Activities Scope of Work. **Attachment A** presents Figures 1 through 11 which consist of aerial photos of each monitored site, **Attachment B** presents a copy of the field notes, **Attachment C** presents a photograph log, and **Attachment D** is the laboratory analytical report for a soil sample collected from non-vegetated area in the lower McLaren Pit.

Monitoring was conducted at 10 locations within the New World Mining District near Cooke City, Montana on September 1 and 2, 2016. Tetra Tech personnel observed each location to evaluate whether reclaimed sites were experiencing erosion or germination failures in areas of 250 square feet or more, and whether weed infestations are occurring. In one area where a vegetation failure occurred in an area larger than 250 square feet a soil sample was collected for analysis of soil fertility and phytotoxicity parameters. **Table 1** below presents a summary of the monitoring results.

Site Name	Bare Soil Present <sup>1</sup>	Revegetation Failure	Weeds Present	Action Recommended	Comments
Black Warrior	No	No	No	No	Erosion mats do not support grasses but are covered with moss in some areas.
Borrow Area	No	No	Yes - Common Dandelion	No	A sparsely vegetated ridge is present along the west side of the rock lined drainage channel. The ridge is approximately 3-6 ft wide by 100 ft long. 35 Whitebark pine seedlings were present along the perimeter possibly from adjacent seed trees.
Como Basin	Yes	Yes	Yes - Canada thistle <sup>2</sup> , Common dandelion	Yes - Continue to monitor this location	A 6,000 ft <sup>2</sup> area of bare soil is present, and is within footprint of semi-permanent snow drift. No soil sample was collected as this lack of vegetation is likely due to persistent snow cover.

**Table 1. Monitoring Summary**

Site Name	Bare Soil Present <sup>1</sup>	Revegetation Failure	Weeds Present	Action Recommended	Comments
Glengarry Waste Dump	No	No	Yes - Common dandelion, Common tansy <sup>2</sup>	No	Reclamation appears to have been successful.
Gold Dust	Yes	No	Yes - Canada thistle <sup>2</sup> along access road	Yes - Weed spraying along access road	Areas of bare soil do not appear to be associated with past revegetation activities. Sub-alpine fir seedlings observed.
Little Daisy	No	No	Yes - Goat's beard	No	12 Whitebark pine seedlings observed.
McLaren Upper	No	No	Yes - Common dandelion, Goat's beard	Yes - Weed spraying	Weeds primarily found along roadside.
McLaren Lower	Yes	Yes	Yes - Common dandelion, Goat's beard	Yes - Weed spraying, erosion monitoring	Weeds primarily found along roadside but were also significantly present below the road. A 2,000 ft <sup>2</sup> area of bare soil is present with gully forming below. Of the 32 Whitebark pine seed cards observed, only 12 contained live seedlings (38% germination rate).
McLaren Triangle	No	No	No	No	12 Whitebark pine seedlings observed.
Miller Creek	No	No	Yes - Canada thistle <sup>2</sup>	No	Some waste rock present in former erosion control area. Creek banks well established and constructed rock berms intact.
Repository	No	No	Yes - Canada thistle <sup>2</sup> , Common dandelion, Goat's beard	Yes - Weed spraying	The northern aspects of repository are sparsely vegetated compared to the southern aspects.

<sup>1</sup>Indicates and area >250 ft<sup>2</sup>

<sup>2</sup>Listed as Priority 2B on the Montana Noxious Weed List (DOA, 2015)

One soil sample was collected from an area of failed revegetation at the Lower McLaren site for analysis at Energy Laboratories, Inc. of Billings, Montana. The analytes and results are presented in **Table 2**.

<b>Table 2. Soil Analytical Results</b>				
<b>Category</b>	<b>Analysis</b>	<b>Result</b>	<b>Units</b>	<b>Method</b>
Physical	Texture	Loam	NA	ASA15-5
	Sand	49	%	ASA15-5
	Silt	32	%	ASA15-5
	Clay	19	%	ASA15-5
Saturated Paste	pH, sat. paste	3.9	s.u.	ASA10-3
	Conductivity, sat. paste	0.2	mmhos/cm	ASA10-3
	Sodium Adsorption Ratio (SAR)	0.51	unitless	Calculation
	Calcium, sat. paste	0.61	meq/L	SW6010B
	Magnesium, sat. paste	0.18	meq/L	SW6010B
	Sodium, sat. paste	0.32	meq/L	SW6010B
Chemical	Organic Carbon	2.4	%	ASA29-3
	Cation Exchange Capacity	23.7	meq/100g	SW6010B
	Nitrate as N, KCL Extract	4	mg/kg	ASA33-8
	Phosphorus, Olsen	2	mg/kg	ASA24-5
	Potassium	36	mg/kg	SW6010B
Metals	Cadmium	<1	mg/kg	SW6010B
	Copper	575	mg/kg	SW6010B
	Iron	156,000	mg/kg	SW6010B
	Lead	115	mg/kg	SW6010B
	Zinc	64	mg/kg	SW6010B

Tetra Tech makes the following conclusions based on the 2016 vegetation monitoring event:

- Vegetation appears to be well established at each of the sites, with some areas of failure occurring at Como Basin and the Lower McLaren Tailings.
- Areas of bare soil greater than 250 feet<sup>2</sup> were identified at Como Basin, Gold Dust, and the Lower McLaren Pit. Bare soil in the Lower McLaren Pit appeared to be related to phytotoxic soil conditions while the bare soil in the other areas was due to persistent snow cover or non-mine related natural conditions. The Lower McLaren Pit also had gully erosion occurring along the western boundary.
- The soil sample collected at the Lower McLaren Pit indicates fertility deficiencies in the area where erosion is occurring. Acidic pH may be mobilizing elevated concentrations of iron and copper, and is considered below optimal to sustain plant life. Macronutrients including nitrogen, phosphorus, and potassium are also considered low for sustaining plants, while the result for zinc is considered toxic to plants. Other soil parameters that were analyzed for including conductivity, sodium adsorption ratio, organic carbon, and cation exchange capacity did not appear to be detrimental to soil fertility (Dinkins & Jones, 2013).
- Montana listed Priority 2B noxious weeds including Canada thistle (*Cirsium arvense*) and Common tansy (*Tanacetum vulgare*) were present at five of the sites. Non-native invasive weeds including Common dandelion (*Taraxacum officinale*) and Goat's beard (*Tragopogon dubius*) were observed at seven of the sites. Canada thistle at the Gold Dust site was only observed along the access road and was not present within the revegetation area.
- Whitebark pine (*Pinus albicaulis*) seedlings were observed at four of the sites, and Sub-alpine fir (*Abies bifolia*) was observed at one site.

Tetra Tech makes the following recommendations based on the 2016 vegetation monitoring event:

- The location of bare soil within the Como Basin is likely a function of wind drifted snow that typically persists into late summer. Additional monitoring is recommended to evaluate whether the extent of bare soil is increasing, decreasing, or remains constant. This monitoring can be conducted during the annual groundwater monitoring event.
- Additional erosion monitoring should be conducted at the area of bare soil at Lower McLaren site (below the road) to evaluate whether gullies are increasing in size. This monitoring can be conducted during the annual groundwater monitoring event.
- Soil at the Lower McLaren Pit should be further evaluated if another attempt to revegetate the area of bare soil is made. Evaluation may include comparative sampling between bare soil and nearby vegetated soil. Due to the low pH, utilization of the Bray method for phosphorus analysis should be considered, as well as total Kjeldahl nitrogen analysis for plant availability. The results of these analyses should also be compared to the historic fertilizer specifications that were used at this location.
- Weed spraying for noxious and invasive weeds should be conducted along Daisy Pass Road where it bisects the upper and lower McLaren sites, and along the access road for the Gold Dust site.
- Revegetation monitoring should continue as specified in the 2012 Long-Term Operations and Maintenance Plan with the next event scheduled for August 2021.

References:

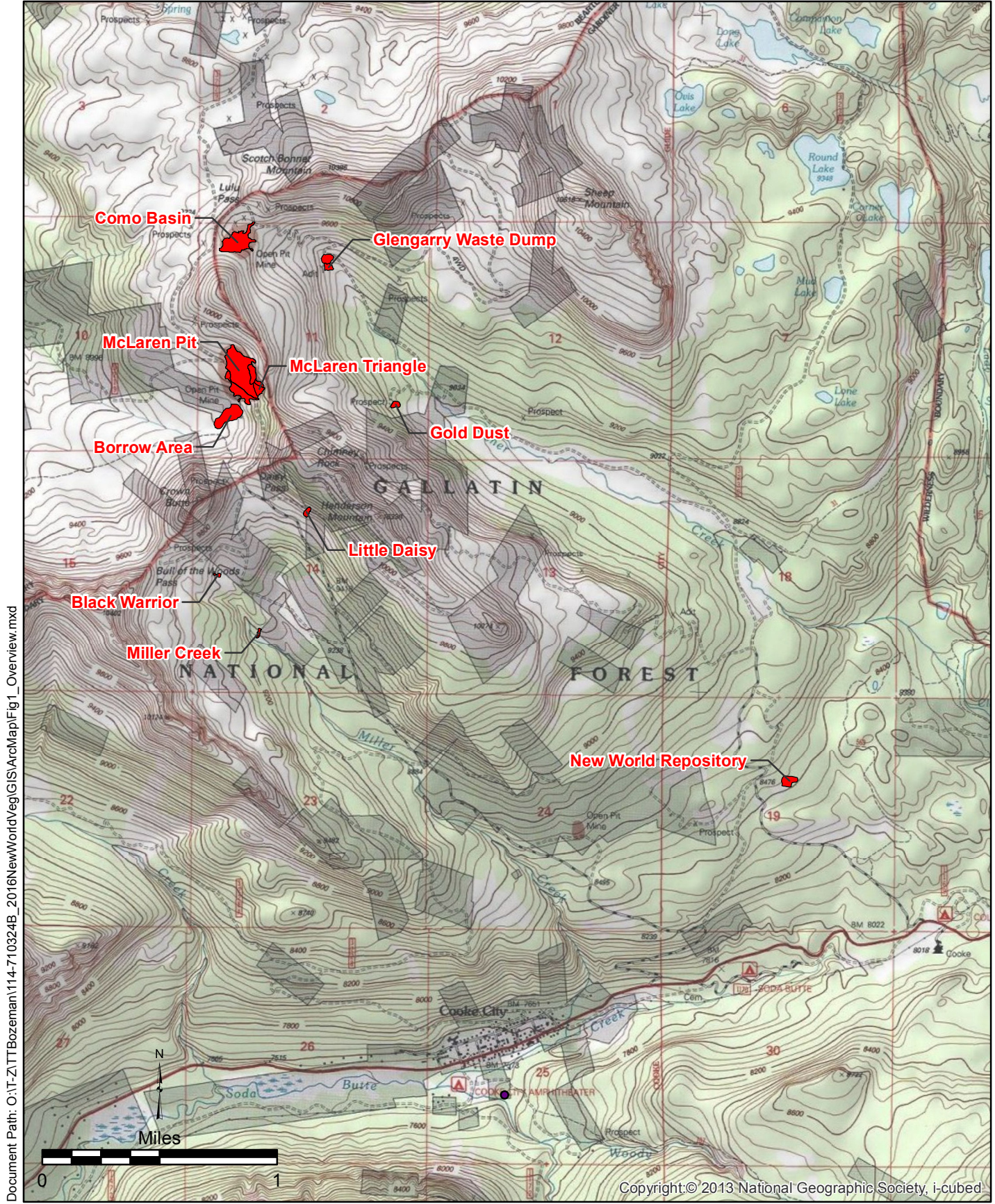
Dinkins, C.P. and Jones, C., 2013. Interpretation of Soil Test Reports for Agriculture, Montana State University Extension. Document No. MT200702AG. Bozeman, MT. Revised October 2013.

Montana Department of Agriculture (DOA), 2015. Montana Noxious Weed List. July. <http://agr.mt.gov/Weeds>

Encl: Attachment A – Figures 1 - 11  
Attachment B – Field Notes  
Attachment C – Photograph Log  
Attachment D – Laboratory Analytical Report

# **Attachment A**

**Figures 1 - 11**



October 2016

Figure 1

**Project Overview  
Vegetation Monitoring  
New World Mining District**



Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig2\_BlackWarrior.mxd





November 2016

**Figure 2**

**Black Warrior  
Vegetation Monitoring  
New World Mining District**



**Legend**

-  Approximate Revegetation Area Boundary
-  Contour

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig3\_BorrowArea.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

November 2016



**Figure 3**

**Borrow Area**

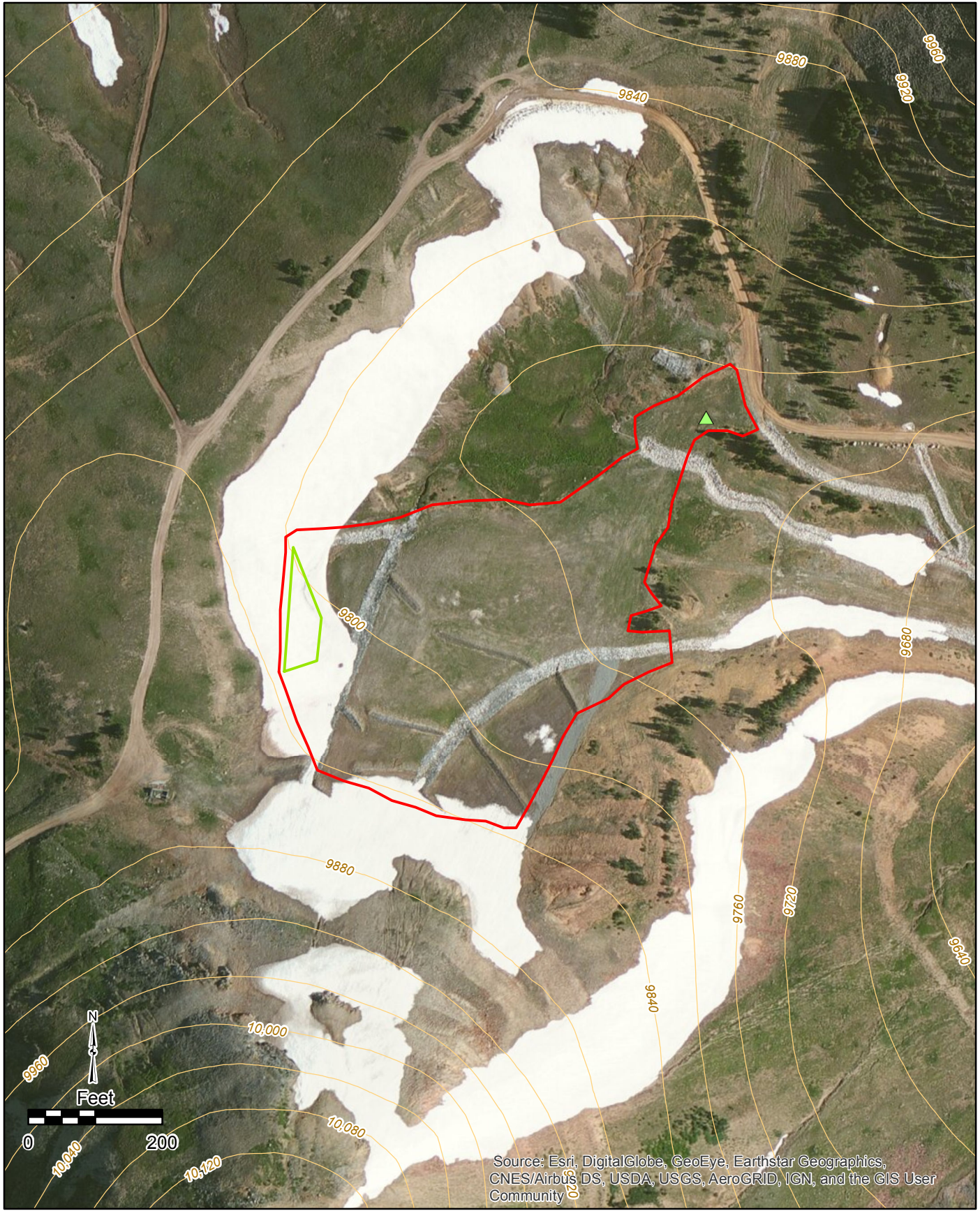
**Vegetation Monitoring  
New World Mining District**



**Legend**

-  Approximate Revegetation Area Boundary
-  Contour

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig4\_ComoBasin.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Figure 4**





**Como Basin**

**Vegetation Monitoring**

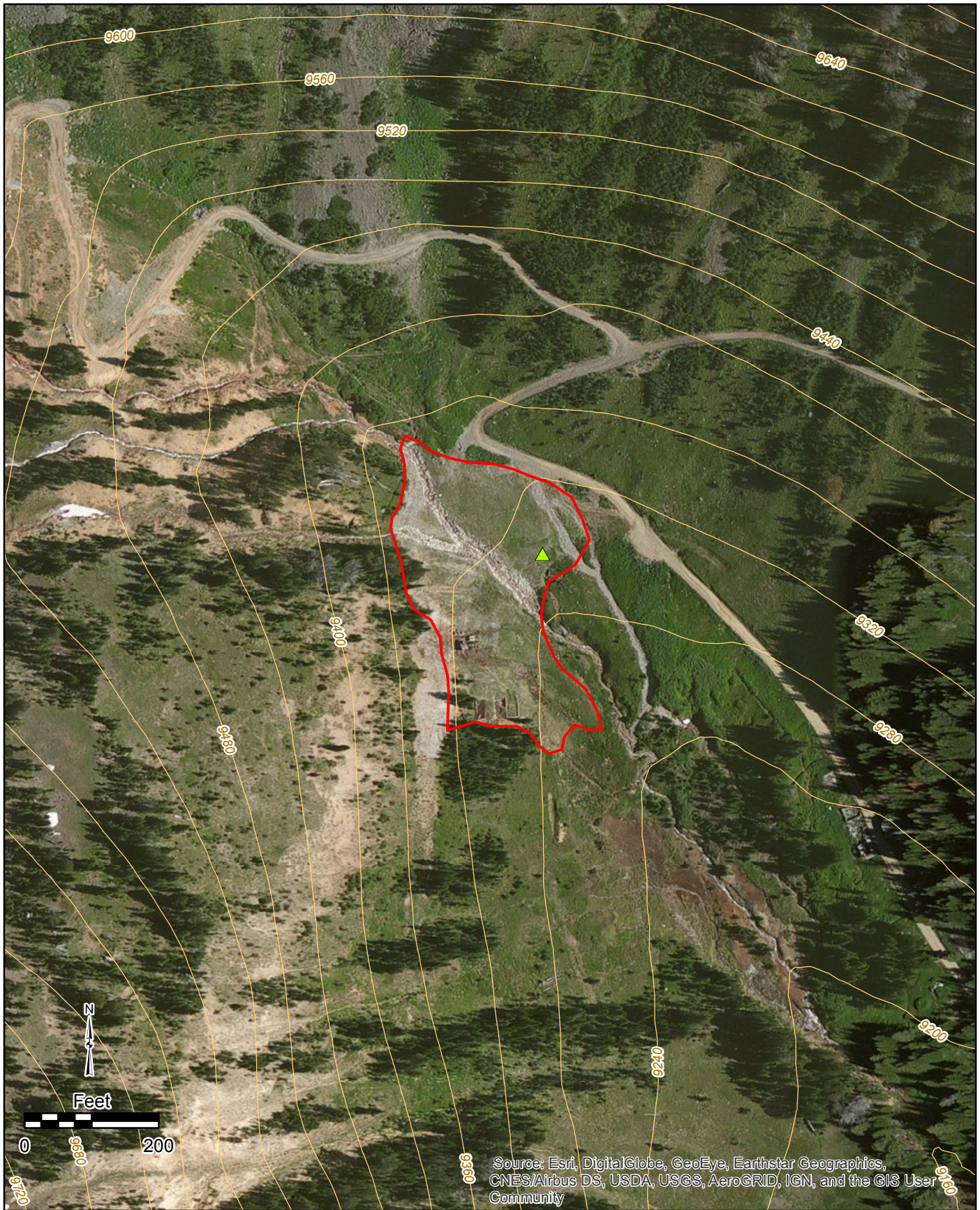
**New World Mining District**






**Legend**

-  Confirmed Weed Location
-  Bare Soil
-  Contour
-  Approximate Revegetation Area Boundary

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig5\_GlengarryWaste.mxd



**Legend**

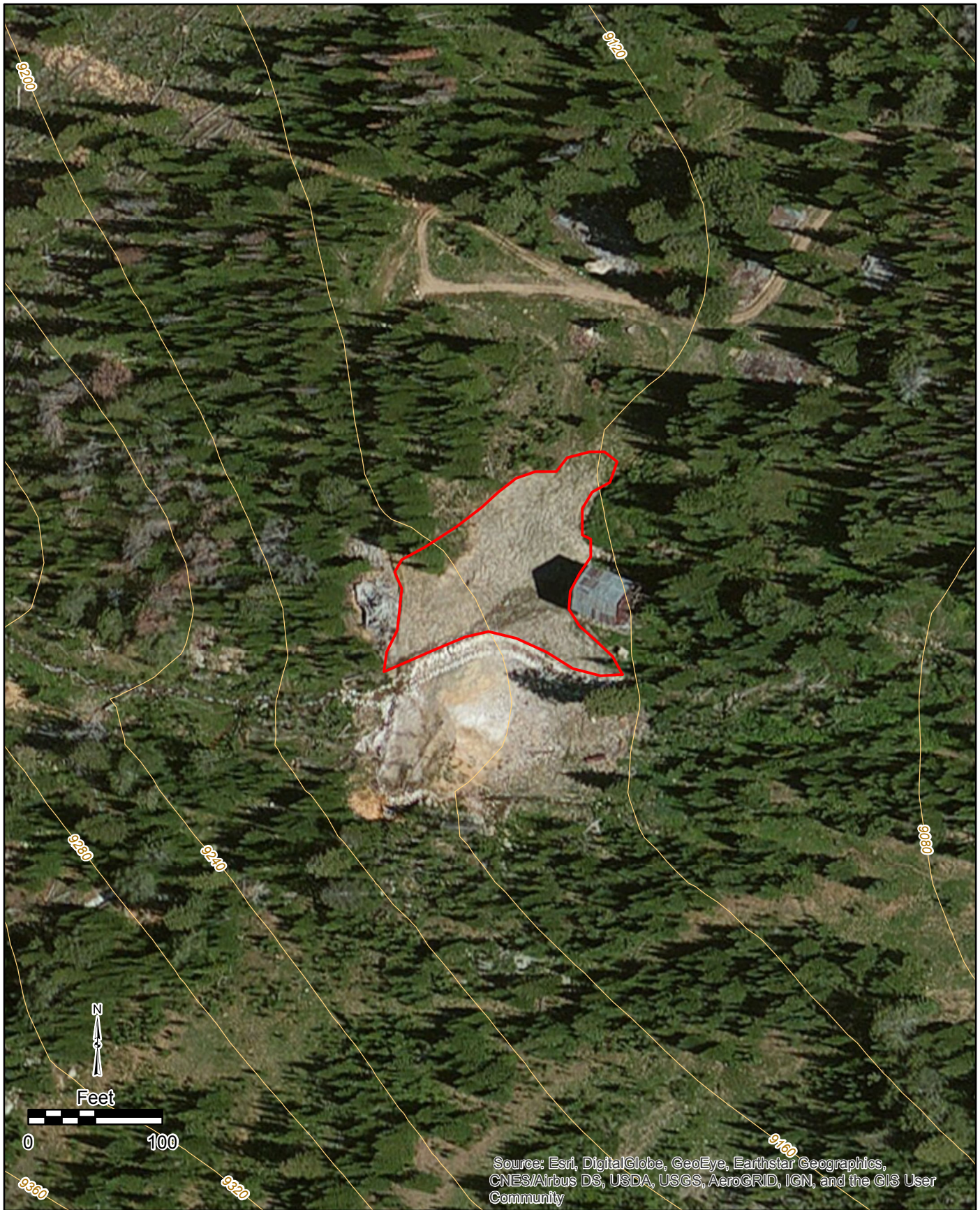
-  Confirmed Weed Location
-  Approximate Revegetation Area Boundary
-  Contour

November 2016

**Figure 5**  
**Glengarry Waste Dump**  
**Vegetation Monitoring**  
**New World Mining District**



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**Figure 6**



**Gold Dust**

**Vegetation Monitoring**

**New World Mining District**



**Legend**




-  Approximate Revegetation Area Boundary
-  Contour

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig7\_LittleDaisy.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

### Legend

-  Confirmed Weed Location
-  Approximate Revegetation Area Boundary
-  Contour

November 2016

**Figure 7**

## **Little Daisy Vegetation Monitoring New World Mining District**



Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig8\_McLaren.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 8

McLaren Pit

Vegetation Monitoring

New World Mining District



Legend

Bare Soil

Approximate Revegetation Area Boundary

Confirmed Weed Location

Contour

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig9\_McLarenTriangle.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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**Figure 9**

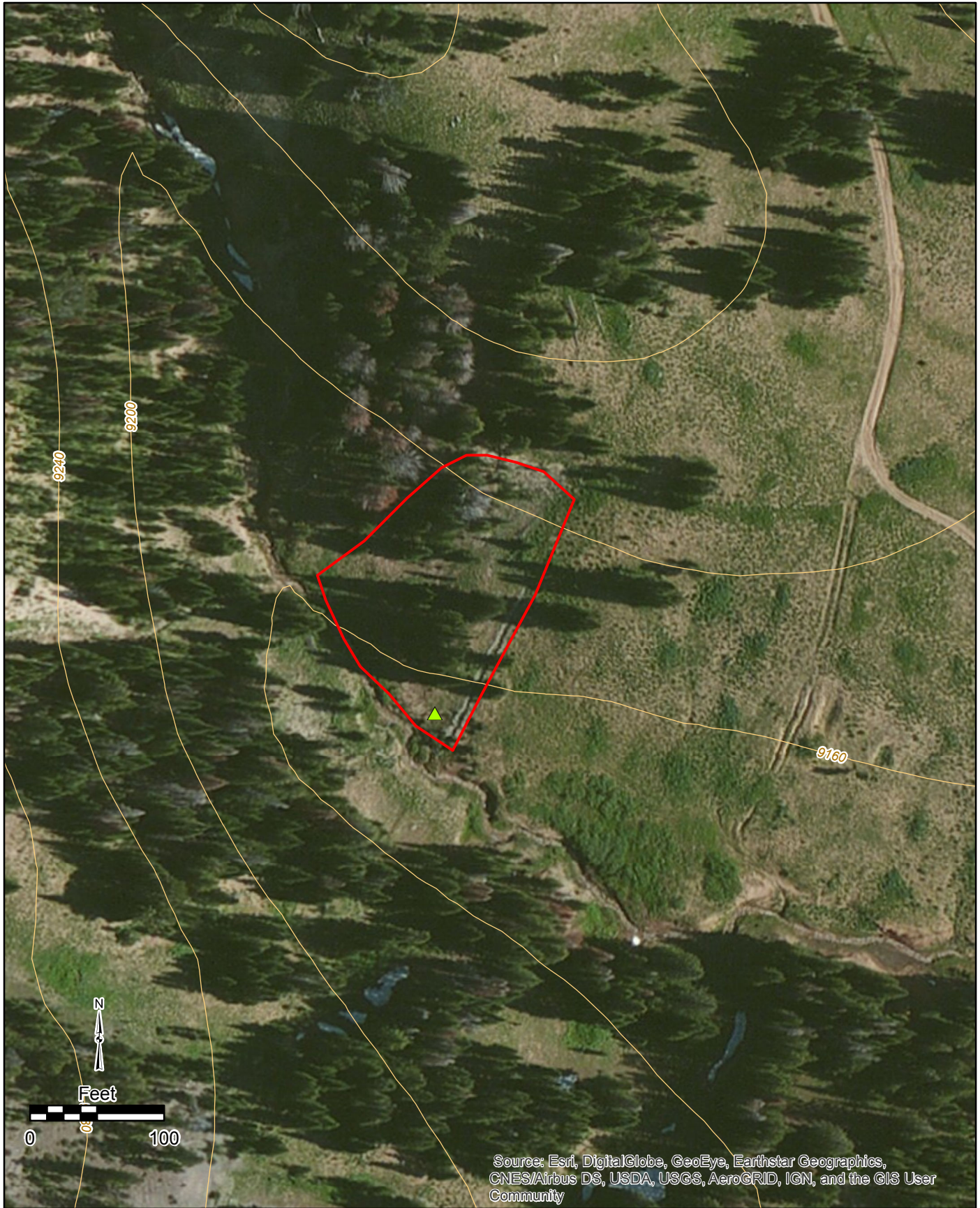
**McLaren Triangle  
Vegetation Monitoring  
New World Mining District**






**Legend**

-  Approximate Revegetation Area Boundary
-  Contour

Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig10\_MillerCreek.mxd



**Legend**

-  Confirmed Weed Location
-  Approximate Revegetation Area Boundary
-  Contour

November 2016

**Figure 10**

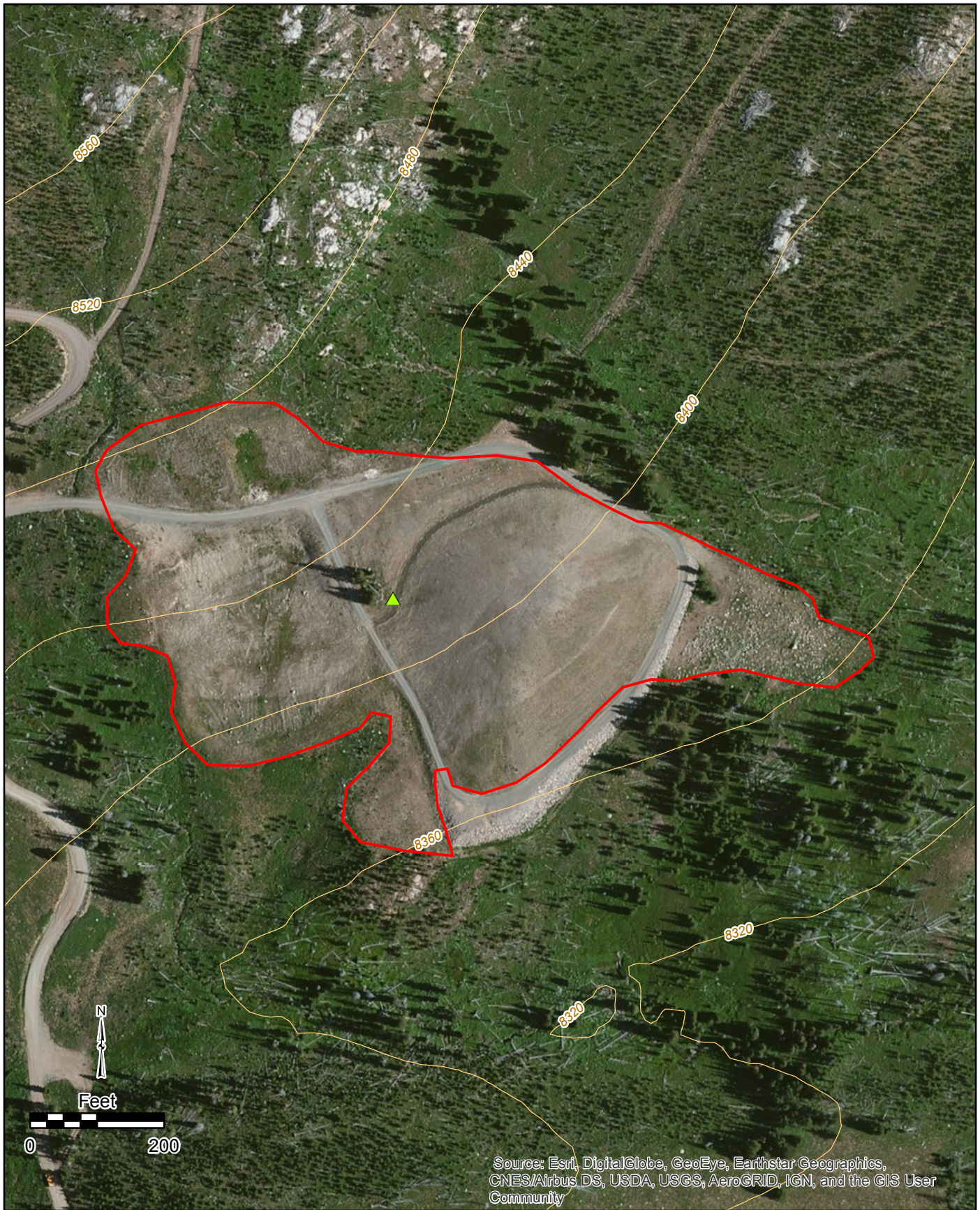
**Miller Creek**

**Vegetation Monitoring**




**New World Mining District**



Document Path: O:\T-Z\TTBozeman\114-710324B\_2016NewWorldVeg\GIS\ArcMap\Fig11\_NewWorldRepository.mxd



**Legend**

-  Confirmed Weed Location
-  Approximate Revegetation Area Boundary
-  Contour

November 2016

**Figure 11**

**New World Repository  
Vegetation Monitoring  
New World Mining District**



# **Attachment B**

## **Field Notes**

9-1-16

New World Veg Monitoring  
 Cloudy 70°F  
 N Somer, S. Medley

1300 - ~~Arr~~ Arr @ Miller Cr Site

1315 - observe waste rock area,  
 reveg area not discernable  
 observe established tuffed  
hairgrass as well as psuycos,  
carex spp, freemud, smc dandelion  
& young Canada Thistle,  
 small area approx 12x10'  
 adjacent to creek of bare  
 soil. unsure whether failed  
 veg or naturally bare,  
 however evidence of wattle  
 stakes present. Bank veg  
 well established.  
 subalpine fir dominant tree  
mountain timothy  
 Damage sock intact  
 lupine, arnica, goldenrod  
 whitebark pine  
 weathered waste rock present  
 on surface

natural areas of bare  
 soil also present

1400 - Arrive @ Black Warrior Site

Exposed veg mat of moss  
 well established  
 Established aster w/in main  
 removal area

Alpine Timothy & Alpine  
 Bluegrass present  
 slender wheatgrass?

1430 - Little Dancer Site  
 Hookers Thistle present

but not invasive  
 approximately 1 doz  
 1 bark pine seedlings  
 growing

Found goats beard on  
 lower slope

mountain timothy  
 otherwise well vegetated  
 deschampsia

1515 - Arr @ McClarin Triangle  
 observe approx dozen white  
 bark pine saplings  
 well est alpine tundra,  
 mountain bluegrass,  
 Deschampsia, Carex spp  
 max veg height approx 12"  
 fireweed, pussytoes, lupine  
 some subalpine fir  
 " Hooker's Thistle  
 no weeds observed

~~1515~~  
 1530 - Arr @ McClarin Basin  
 area, observe drummonds  
 or elk thistle (??)  
 other spp same as previous  
 Hooker's Thistle

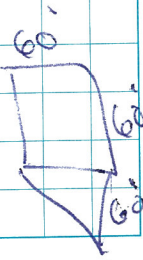
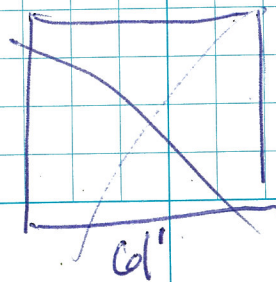
Bare ridge along rock  
 drainage 3 to 6' wide  
 by no! not consistently  
 vegetated  
 Since whitebark est., 6' along  
 bare ridge

Approx 35 planted  
 white bark saplings,  
 around perimeter

trees along west side  
 acting as seed trees  
 few regrowth  
 wild shrubbery  
 + shade casts of no  
 trees in them  
 No weeds or significant bare  
 spots

1625 - AN Como Basin  
 Small patch Canada  
 Thistle

Common dandelion in  
 same vicinity <sup>every</sup> ~~area~~ throughout  
 Field tundra present  
 Calamagrostis Canadensis?  
 Bare area along western  
 boundary, but w/in foot-  
 print of semi permanent  
 snow field.



Rite in the Rain

1724 Arr @ Glenngary WR  
 Common Dandelion  
 Carex, epilobium, willow  
 deschampsia, pussy toes

1810 New World Repository  
 Dandelion - all over  
 Goat's Beard - all over  
 Canada Thistle - just on north side  
 Northern aspects very  
 sparsely vegetated w/  
 large cobbles 15-25% cover  
 Goldeneye (??) across road  
~~Angora~~

9-2-16

New World Veg Monitoring

50°F, clear, windy  
 N Sooner, S Metoljak

0800 - Arr @ Gold Dust site  
 Majority of waste rock  
 pile does not appear  
 to have been seeded,  
 area north of rock ditch  
 was established <sup>veg</sup> growth  
 of sub-alpine fir naturally  
 established along South  
 side of ditch. 1-2  
 whitebark pine saplings  
 present. No weeds on  
 the site, but some Canada  
 thistle present along  
 access road before  
 Fischer Cr Crossing.

0900 - Arr upper McClain,  
 generally well established  
 veg, bare rocky area  
 above rock ditch no  
 likely a concern

Dandelion present throughout

W middle & lower areas  
 little in the rain.

Goats beard present in lower area

0940 - Arr lower McLann  
South end lower area  
along road has significant  
dandelion infestation  
recommend road spraying  
(both sides of road)

large rills in unvegetated  
are forming in western  
Cameer across ditch  
whitebark pine & siberian pine

Fir saplings throughout  
Collect soil sample #1

Approx 60' long bare area  
along east side of vertical  
ditch, has 2 whitebark  
pine & 2 aspen saplings  
in it.

Dandelions present across site  
consistently below road throughout  
Goats beard present but  
very limited.



In memo basically summarize  
my notes in writing, edit  
figures w/ GPS points.

Create a summary table  
w/ following columns:

- site names
- weeds present y/n
- severity hi/lo
- spraying recommended y/n
- bare spots y/n
- bare spots extent (#)
- Sample collected y/n
- Spraying method

back pack

ATV

truck mount

- whitebark present y/n
- other spp of note worth  
mentioning

whitebark pine seedlings  
 below low McClure,  
 8 live trees out of  
 22 seed cards = 36% survival  
 some trees up to 8 in before  
 mortality

found an additional  
 4 of the live tree  
 locations

New total 12/32

# **Attachment C**

## **Photograph Log**

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – BLACK WARRIOR  
COOKE CITY, MONTANA  
TETRA TECH PROJECT NO. 114-710324B



**PHOTOGRAPH 1** View of former exploration pit looking west



**PHOTOGRAPH 2** View of failed vegetation mats



**PHOTOGRAPH 3** View of moss covering vegetation mats



**PHOTOGRAPH 4** View of drainage ditch facing east

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – BORROW AREA  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of vegetation establishment, facing northeast



**PHOTOGRAPH 2** View of vegetation establishment, facing north



**PHOTOGRAPH 3** View of Whitebark Pine seedlings and adjacent seed trees along NW boundary, facing southwest



**PHOTOGRAPH 4** View of failed sapling shade card

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – COMO BASIN  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of established vegetation, facing southwest



**PHOTOGRAPH 2** View of established vegetation, facing west



**PHOTOGRAPH 3** View of former test plot, facing east



**PHOTOGRAPH 4** View of bare soil area, facing southwest



**PHOTOGRAPH 5** View of erosion occurring in bare soil area, facing south



**PHOTOGRAPH 6** View of established vegetation, facing west

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – GLENGARRY WASTE DUMP  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of established vegetation amongst historic mining equipment, facing west



**PHOTOGRAPH 2** View of established vegetation amongst historic mining equipment, facing north



**PHOTOGRAPH 3** View of Common Tansy



**PHOTOGRAPH 4** View of established vegetation on hillside facing southwest

**2016 VEGETATION MONITORING**  
**NEW WORLD MINING DISTRICT – GOLD DUST**  
**COOKE CITY, MONTANA**  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of bare soil



**PHOTOGRAPH 2** View of bare soil, rock ditch, with Sub-alpine Fir establishment

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – LITTLE DAISY  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View looking downslope at drainage rock, facing southwest



**PHOTOGRAPH 2** View looking upslope at revegetation area, facing northeast



**PHOTOGRAPH 3** Vegetation establishment mid-slope and along drainage rock



**PHOTOGRAPH 4** Goats beard observed at base of slope

**2016 VEGETATION MONITORING**  
**NEW WORLD MINING DISTRICT – UPPER MCLAREN**  
**COOKE CITY, MONTANA**  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of rock ditch and established vegetation, facing



**PHOTOGRAPH 2** View of established vegetation facing east



**PHOTOGRAPH 3** View of established vegetation facing west



**PHOTOGRAPH 4** View of Goat's Beard and Common Dandelion along roadside

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – LOWER MCLAREN  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of established vegetation from road looking downslope, facing southwest



**PHOTOGRAPH 2** View of Whitebark Pine seedlings



**PHOTOGRAPH 3** View of bare soil and gully erosion, facing south



**PHOTOGRAPH 4** View of bare soil and gully erosion facing west



**PHOTOGRAPH 5** View of gully erosion and bare soil, facing southwest



**PHOTOGRAPH 6** View of Whitebark Pine establishment adjacent to gully, facing west

**2016 VEGETATION MONITORING**  
**NEW WORLD MINING DISTRICT – LOWER MCLAREN**  
**COOKE CITY, MONTANA**  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 7** View of Common Dandelion establishment looking upslope towards road, facing northeast



**PHOTOGRAPH 8** View of Common Dandelion establishment along gully erosion

**2016 VEGETATION MONITORING**  
**NEW WORLD MINING DISTRICT – MCLAREN TRIANGLE**  
**COOKE CITY, MONTANA**  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of vegetation cover, facing southeast



**PHOTOGRAPH 2** View of berm (right) and vegetated area, facing south



**PHOTOGRAPH 3** View facing upslope of vegetated area, facing north



**PHOTOGRAPH 4** View of vegetated area with Whitebark Pine seedling in foreground, facing northwest

2016 VEGETATION MONITORING  
NEW WORLD MINING DISTRICT – MILLER CREEK  
COOKE CITY, MONTANA  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** View of drainage rock facing northeast



**PHOTOGRAPH 2** View of established grasses facing east



**PHOTOGRAPH 3** View of Miller Creek facing north



**PHOTOGRAPH 4** View of typical vegetation cover versus bare soil, facing northeast

**2016 VEGETATION MONITORING**  
**NEW WORLD MINING DISTRICT – REPOSITORY**  
**COOKE CITY, MONTANA**  
Tetra Tech Project No. 114-710324B



**PHOTOGRAPH 1** Stand of Canada Thistle



**PHOTOGRAPH 2** Small stand of Goat's Beard



**PHOTOGRAPH 3** View of south aspect facing north



**PHOTOGRAPH 4** View of southeast aspect facing northwest

# **Attachment D**

## **Laboratory Analytical Report**