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TECHNICAL MEMORANDUM

DATE: January 31, 2005
TO: Mary Beth Marks, On-Scene Coordinator
FROM: Michael Cormier
RE: 2004 Reclamation Monitoring Results
New World Mining District Response and Restoration Project

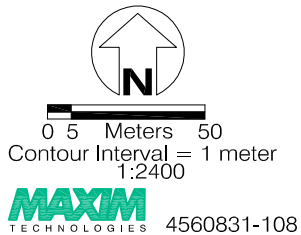
Maxim Technologies (Maxim) conducted area-wide reclamation monitoring at the New World Mining District on behalf of the United States Department of Agriculture (USDA) Forest Service during August 2004. This work was conducted in accordance with the scope of work detailed in the 2004/2005 Work Plan (Maxim, 2004a). This memorandum describes the methods and results of our monitoring.

BACKGROUND

The McLaren Pit cap area, McLaren triangle, and McLaren borrow area (Figure 1) were reclaimed in the fall of 2003 as part of the McLaren Pit Response Action. Reclamation involved incorporating compost and fertilizer in the upper four inches of soil at each area, seeding the sites, and covering the seeded areas with erosion control blanket. The seed mixture used at all sites contained tufted hairgrass (1.8 kilograms pure live seed per hectare (pls/ha)), alpine bluegrass (4.5 kilograms pls/ha), alpine timothy (3.5 kilograms pls/ha), and slender wheatgrass (28.6 kilograms pls/ha). In addition, a modest amount of lime was added to the soil at the McLaren triangle to amend acid conditions that had developed since the triangle area was initially regraded and revegetated in 1993. Because 2004 was the first growing season following seeding, area-wide monitoring was planned for these three sites to determine if problems with erosion or germination were present.

In 2001, ten mine waste removal areas were reclaimed as part of the Selective Source Response Action. Long-term monitoring of these areas began in 2002 with area-wide monitoring to document erosion problems (Maxim, 2002), and again monitored in 2003 for percent cover by species (Maxim, 2004b). The McLaren triangle was also monitored in 2003, leading to the composting, fertilizing, and re-seeding activities that were completed at the triangle in October 2003 (described above).

For sites reclaimed in 2001, revegetation treatments involved applying fertilizer, grass seed, and erosion mat at all the dump sites. An additional treatment was applied at the Spalding, Tredennic, and Small Como dumps by adding agricultural limestone at a rate of 42 metric tons per hectare to the excavated soil surface following dump removal and mixing the limestone into the upper 15 centimeters (cm) of the exposed soil surface, importing 15 cm of soil from the Selective Source Repository area, and thoroughly mixing this soil with the limestone treated soil. The seed mix used for revegetation was the same as described above for the McLaren Pit sites.



McLaren Pit Area
2004 Reclamation Monitoring
New World Mining District
Response and Restoration Project
Cooke City, Montana
FIGURE 1

METHODS

Maxim conducted revegetation monitoring according to area-wide observation methods described in the 2004/2005 Work Plan (Maxim, 2004a), the Long-Term Revegetation Monitoring Plan (Maxim 1999a), and the Site-Wide Sampling and Analysis Plan (Maxim 1999b). Monitoring was done on August 24 and August 26, 2004. Area-wide monitoring involved conducting a thorough walk-over of the McLaren Pit cap area, McLaren triangle, and the McLaren borrow area. Observations made during the walk-over included noting dominant species present, noting ocular estimates of vegetative cover, noting the locations and size of germination failures or erosion, and taking photographs. In addition, the 10 sites reclaimed in 2001 were visited and photographed. Table I lists the sites visited in 2004.

TABLE I LIST OF SITES VISITED 2004 Reclamation Monitoring			
Site Name	Year Reclaimed	Site Name	Year Reclaimed
McLaren Pit Cap Area	2003	Small Como Dump	2001
McLaren Triangle	2003	Rommel Tailings	2001
McLaren Pit Borrow Area	2003	Soda Butte Tailings	2001
Spalding Upper Dump	2001	Upper Tredennic Dump 1	2001
Spalding Middle Dump	2001	Upper Tredennic Dump 2	2001
Spalding Lower Dump	2001	Middle Tredennic Dump One	2001
Lower Tredennic Dump One	2001		

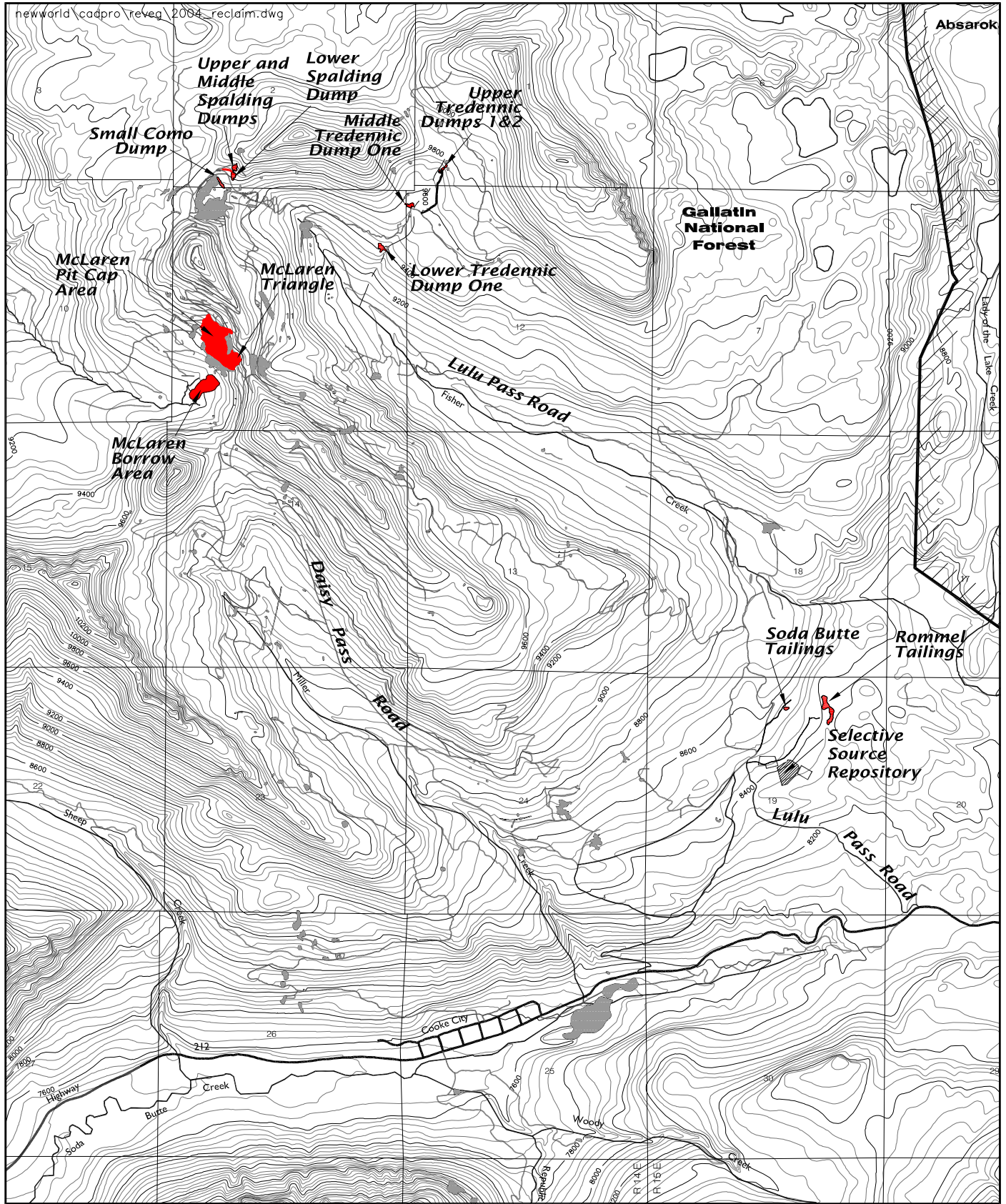
RESULTS

This section presents area-wide observations made at the McLaren Pit cap area, McLaren triangle, and McLaren borrow area. Attachment A contains photographs of these three sites as well as the 2001 reclaimed sites visited. Figures 1 and 2 show the locations of the reclaimed sites.

MCLAREN PIT CAP AREA

Revegetation response on the McLaren Pit cap area was very good on much of the area but ranged to fair in certain places and was poor within the footprint of the former location of the multicolor dump (Figure 1). (The multicolor dump was relocated under the cap area during construction.) The predominant species present on the cap area was slender wheatgrass (*Agropyron trachycaulum*) with a minor number of alpine bluegrass (*Poa alpina*) plants observed on the benches located above the Daisy Pass road. A very small number of weedy, non-native plants were also noted in several places on the cover.

Total vegetative cover varied from less than 1% on the footprint of the former multicolored dump (about ½-acre area) to over 50% on much of the cover above the Daisy Pass road. On all areas where vegetation had established, plants were vigorous and leaf growth was several inches in length.



0 Feet 4000

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Revegetation Monitoring Site
Mine Disturbance Area
Repository Site
Road

Monitoring Sites
2004 Reclamation Monitoring
New World Mining District
Response and Restoration Project
Cooke City, Montana
FIGURE 2

Some areas had only moderate cover (10 to 20% range) including the upper bench at the northern-most edge of the cover, along the diversion channel at the base of the highwall, and in the area by well DCGW-105 (Figure 1). In these areas, snow cover had just recently receded, and the lower cover observed is believed to be a result of the colder soil temperatures and shorter time for germination and growth. Areas with poor vegetation (less than 10% cover) included the footprint of the former multicolor dump, the area between the multicolor dump and Bench No. 5, and about 110 feet of the diversion channel below the highwall (less than 0.05 acres).

Due to the poor vegetation response in the area of the former multicolor dump, three soil samples were collected and submitted to the laboratory for analysis of soil pH, conductivity, acid-base analysis, organic matter content, and fertility. Soil sample results are summarized in Table 2 and laboratory analytical results are included in Attachment B.

TABLE 2 SOIL ANALYTICAL RESULTS – FORMER MCLAREN PIT MULTICOLOR DUMP AREA 2004 Reclamation Monitoring						
Sample No.	pH (standard units)	Conduc- tivity (mmhos/cm)	Neutral- ization Potential (tons/1000 tons)	Acid Potential (tons/1000 tons)	Lime Require- ment (tons/1000 tons)	Organic Matter Content (%)
DCSI-04-01-0-2	2.4	6.23	<0.5	101	146	1
DCSI-04-02-0-2	3.2	1.88	<0.5	10.9	33	5.48
DCSI-04-03-0-2	4.3	0.36	0.8	14.7	28.5	1.54

Laboratory soil analysis indicates that the soil in the area of the former multicolor dump is extremely acidic with a pH of 2.4 standard units (su). There is essentially zero neutralization potential in the soil to balance an acid potential of over 100 tons/1000 tons (t/1000t). This highly acidic soil likely results from the leaching of acid from the former multicolor dump, which had overlain the area shown in Figure 1 since the early 1950's when it was placed at the site during the development of the McLaren Mine (aka Winter Tunnel). The multicolor dump was removed in 2002 and placed in the McLaren cap area.

Sample DCSI-04-02-0-2, which is located just to the south of the toe of the former multicolor dump also has an acidic pH (3.2 su) but with a much lower acid potential and lime requirement than DCSI-04-01. Located even further away from the former multicolor dump, sample DCSI-04-03-0-2 still exhibits very acidic conditions (pH 4.3) but also has a much lower acid potential and lime requirement than DCSI-04-01. Acidic conditions in this lower portion of the area below the former multicolor dump likely result from acid runoff from the historic dump materials or the McLaren Mine adit discharge.

Fertility results for all three samples (see lab sheets in Attachment B) reflect the fertilizer added to the soil prior to seeding the area in 2003. Nitrate+Nitrite nitrogen, phosphorus, and potassium concentrations are high enough that germination would not be limited by fertility. Organic matter content (Table 1), ranges between 1.0 and 5.48%, reflecting the compost added to the soil prior to

seeding. Organic matter at the low end of the range (1.0%) is not optimum, but is at a level that is generally equal to or higher than natural organic matter content in high altitude mineral soils.

MCLAREN TRIANGLE

Cover in the McLaren triangle was much improved over the previous cover of 10.7% measured in 2003. Germination of seeded plants was good, with slender wheatgrass dominant to sub-dominant over the area. Slender wheatgrass was not recorded in the triangle in 2003. Because the reseeding effort in the triangle preserved the existing vegetation, established plants of tufted hairgrass provided for this species to be sub-dominant in places along with established plants of alpine bluegrass. In the area of the triangle nearest the Daisy Pass road, germination was noted to be good but plant growth of the seeded species was noted to be less than in the upper area of the triangle. As with the low cover areas in the McLaren Pit cap area, slow to recede snow cover, colder soil temperatures, and shorter time for germination are postulated as the reason for less vigorous plant growth.

MCLAREN BORROW AREA

The borrow area had notably less cover of seeded species than the McLaren Pit cap area, with slender wheatgrass the dominant species across the site. Generally germination was uneven across the site and cover ranged from none to 30%. Most of the more south facing slopes in the borrow area exhibited moderate cover (20-30%) with good germination and growth. The borrow area had numerous wet areas on August 24, and these wetter soils tended to have less germination and plant growth. Areas on the more south-facing slopes with less than 20% cover may have also been affected by the slow to recede snow cover.

Slopes with a more westerly aspect in the borrow area had an average of about 15% cover. There were many native forbs colonizing these slopes, including species of aster and *Mentensia*.

Notable in the borrow area in the lower third were numerous springs. These springs were exposed where a considerable depth of borrow was removed. At many of these springs, a white precipitate had formed on the erosion blanket (see photo in Attachment A). Water from one of the springs was sampled and exhibited a pH of 4.7 standard units and had a flow rate of about three gallons per minute. The water was highly mineralized with elevated concentrations of aluminum, sulfate, copper, iron, and zinc. This white precipitate is presumed to be an aluminum sulfate.

2001 RECLAIMED DUMP SITES

The 10 dump sites that were reclaimed in 2001 were visited and photographed on August 26, 2004. The repository site was also visited and photographed. Photos are included in Attachment A. Vegetation at all sites was vigorous and cover was fair to excellent. No erosion problems were observed at any of the 2001 reclaimed sites or at the repository.

RECOMMENDATIONS

No erosion problems were noted at any of the sites that would warrant maintenance work. Based on the poor cover in the footprint of the former multicolor dump and results of soil sampling from this area, maintenance work is recommended. Maintenance would involve amending the soil with a neutralizing amendment and reseeding.

REFERENCES

- Maxim Technologies, Inc. (Maxim). 2004a. 2004/2005 Work Plan. New World Mining District Response and Restoration Project Prepared for USDA Forest Service Northern Region Missoula Montana, June.
- Maxim Technologies, Inc. (Maxim). 2004b. Technical Memorandum, 2003 Reclamation Monitoring (Revised). New World Mining District Response and Restoration Project Prepared for USDA Forest Service Northern Region Missoula Montana, April 9.
- Maxim Technologies, Inc. (Maxim). 2002. Technical Memorandum, 2002 Reclamation Monitoring. New World Mining District Response and Restoration Project Prepared for USDA Forest Service Northern Region Missoula Montana, November 8.
- Maxim Technologies, Inc. (Maxim). 1999a. Long-Term Revegetation Monitoring Plan. Appendix E of the Overall Project Work Plan. New World Mining District Response and Restoration Project Prepared for USDA Forest Service Northern Region Missoula Montana, November 10.
- Maxim Technologies, Inc. (Maxim). 1999b. Site-Wide Sampling and Analysis Plan. Appendix B of the Overall Project Work Plan. New World Mining District Response and Restoration Project Prepared for USDA Forest Service Northern Region Missoula Montana, November 10.

**ATTACHMENT A
PHOTOGRAPHS**

2004 RECLAMATION MONITORING
New World Mining District Response and Restoration Project



McLaren Pit Cover – August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Cover – DCNT#2 Location
2004 Reclamation Monitoring



McLaren Pit Cover – Looking SW from Bench #1
2004 Reclamation Monitoring



McLaren Pit Cover – Slender Wheatgrass in low cover area
2004 Reclamation Monitoring



McLaren Pit Cover – Near Well 105 looking North
2004 Reclamation Monitoring



McLaren Pit Cover – Low Cover at Base of Highwall
2004 Reclamation Monitoring



McLaren Pit Triangle Area – August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Triangle Area – August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Triangle Area – August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Cover – Bench #5 Below Daisy Pass Road
2004 Reclamation Monitoring



McLaren Pit Cover – Bench #5 Looking East
2004 Reclamation Monitoring



McLaren Pit Cover – Soil Slump on Bench #5
2004 Reclamation Monitoring



McLaren Pit Cover – Bench #6 Looking East
2004 Reclamation Monitoring



McLaren Pit Cover – Soil Slump Above Toe Berm
2004 Reclamation Monitoring



Former Multicolor Dump Area – August 24, 2004
2004 Reclamation Monitoring



Former Multicolor Dump Area – Sample DCSI-04-01
2004 Reclamation Monitoring



McLaren Pit Borrow Area – Run-on Ditch, August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Borrow Area – Drainage Channel
2004 Reclamation Monitoring



McLaren Pit Borrow Area – August 24, 2004
2004 Reclamation Monitoring



McLaren Pit Borrow Area – Aluminum Spring
2004 Reclamation Monitoring



Reclaimed Lower Spalding Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Small Como Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Middle Spalding Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Lower Tredennic Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Middle Tredennic Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Middle Tredennic Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Middle Tredennic Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Upper Tredennic Dump - August 26, 2004
2004 Reclamation Monitoring



Reclaimed Upper Tredennic Dump – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Rommel Tailings Site - August 26, 2004
2004 Reclamation Monitoring



Reclaimed Rommel Tailings Site – August 26, 2004
2004 Reclamation Monitoring



Reclaimed Rommel Tailings Site – August 26, 2004
2004 Reclamation Monitoring



Repository Site Final Cover – August 26, 2004
2004 Reclamation Monitoring



Repository Site Final Cover - August 26, 2004
2004 Reclamation Monitoring



Repository Site Final Cover – August 26, 2004
2004 Reclamation Monitoring

ATTACHMENT B
SOIL ANALYTICAL LABORATORY REPORTS

2004 RECLAMATION MONITORING
New World Mining District Response and Restoration Project