
State of Oregon
Department of Geology and Mineral Industries
Vicki S. McConnell, State Geologist

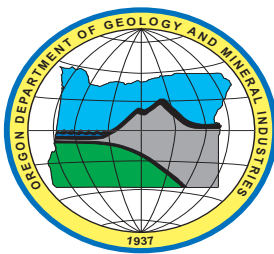
Open-File Report

OFR O-04-15

**REVIEW AND ANALYSIS OF THE WINSTON SLIDE
EVENT OF FEBRUARY 2, 2004**

By

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Mineral Land Regulation and Reclamation



2004

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1.0 INTRODUCTION

1.1 Incident

On February 2, 2004, a landslide originated above the active quarry site operated by Sundance Rock, Inc. (Sundance Rock) located one mile south of the town of Winston, Oregon. Landslide debris slid offsite down onto railroad track, destroying a section of track and depositing up to 25 feet of debris. The slide continued to spread onto over adjoining farmland, where debris covered approximately 8.5 acres. The volume of the slide is an estimated 150,000 cubic yards of mud, boulders, and other debris. Although there were several people in the area of the slide, no one was injured in this event and rail service has resumed.

Sundance operates under the Oregon Department of Geology and Mineral Industries (DOGAMI) Operating Permit ID No. 10-0197, which is required for mining in Oregon. The Department's Mineral Land Regulation and Reclamation (MLRR) program administers the permit for this and other mining operations. Oregon law does not allow the agency to unilaterally change the terms of the current Operating Permit, even after a landslide has changed some of the site conditions for permits issued prior to 1999. However when offsite impacts occur, DOGAMI has enforcement tools to bring a site back into compliance with the Operating Permit.

MLRR staff, DOGAMI geologists, and an engineering geologist from the Oregon Department of Forestry reviewed the conditions of the site after the landslide for information needed to consider any proposed future mining activity or mitigation measures needed post-slide. Aerial photographs (report attached) were used to establish pre-slide land-use and mining activity and to analyze the development of the quarry in relation to the landslide area.

This is not a geotechnical report and does not

quantify the contribution of various factors that might have contributed to the slide. To fully investigate the event and make that determination would take substantially more resources than are now available. However, it is critical to understand this event to be able to prevent future landslides in the same area. Contributing factors identified in this report will be used in analyzing any future development at this site.

1.2 General Landslide Characteristics

Landslides occur when a section of a hillside is out of equilibrium. Gravity is a constant stress, pushing the rock, soil, and ground cover down slope. To neutralize that stress, there must be enough frictional force on the potential slip-surfaces to equal the driving forces of gravity. A landslide may result if the driving forces increase (from precipitation or additional material on the slope) or if the resisting forces along potential slip-surfaces are reduced. The role of water in landslides is both to increase driving forces by increased weight in saturated soils and reducing the effective frictional forces along potential slip surfaces by buoyant force of increased pore-water pressure. Natural slope conditions can be made even worse when toe support is removed by excavation of soil or rock at, or near, the base of the slope.

Even though it can be difficult to quantify, or even identify, the contribution of various factors for a specific landslide, there are factors that are known to facilitate landslides. At Sundance Rock, these factors include natural features, (bed-rock geology, precipitation, and topography/geomorphology) and human influences (ground vibrations, land management practices, and mining activities). A rough evaluation of these factors is included.

1.3 Location

The slide is located in NE ¼ of SE ¼ and SE ¼ of

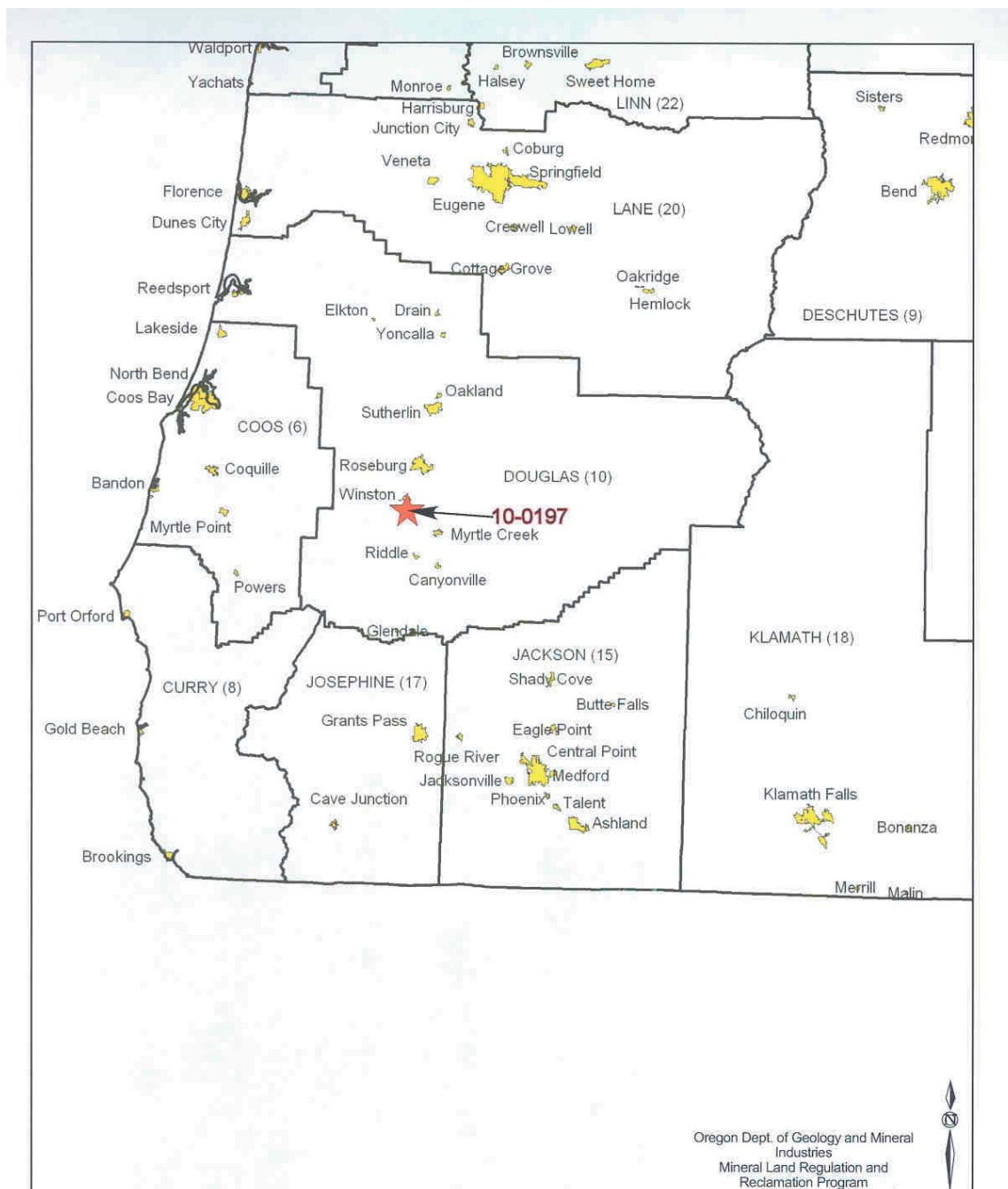


Figure 1. Site location map of Sundance Rock Inc., Dillard Site (DOGAMI ID# 10-0197).

NE ¼ of Section 28, Township 28 South, Range 6 West, just east of Highway 99 between Winston and Dillard, Oregon (Figure 1). Mining initially started on the site prior to 1972 when current statutes regulating such operations were enacted. The site was first operated by Douglas County

and that initial mining activity is outlined on the accompanying 1972 and 1995 aerial photographs. Sundance Rock Inc. obtained an Operating Permit from DOGAMI in 1996 and has been operating the quarry since that time.

2.0 BEDROCK GEOLOGY

2.1 Findings

1. Bedrock at the site is a mudstone-matrix *mélange*, meaning a mixture of several sizes and types of rock that are cemented in a matrix of fine-grained material. It is part of the Dothan Formation, which consists of blocks of bedded and deformed sandstone and mudstone as well as blocks of more competent (stronger) meta-volcanic rocks. The age of this formation is Early Cretaceous-Late Jurassic (approximately 140 million years old). Wells and others (2000) mapped the *mélange* in an east-northeast trending belt that includes the hill on which the landslide originated.

There are several mapped meta-volcanic (specifically, massive meta-basalt) blocks within the *mélange* and Sundance Rock mines rock from one of those blocks. Because the meta-basalt has been metamorphosed, it no longer has the same mechanical properties associated with volcanic rock. The meta-basalt is present across the entire base of the hill within the Sundance Rock permit boundary. It is exposed in both the quarry highwall and in road cuts. The meta-volcanic rock is limited in vertical extent, only occurring along the lower portions of the hill and is truncated by a fault toward the east near the location of the eastern margin of the slide.

2. *Mélanges* are notoriously unstable and are one of the reasons that landslides are common in Oregon's Coast Range. At this site, observations suggest that the contact between the meta-volcanic rocks and the *mélange* is irregular. *Mélange* sequences are extremely variable and projecting lithologic or engineering properties through the *mélange* on the basis of strikes and dips is not recommended. Rather, interpretations should be based on observations and review of pre-existing data.
3. The meta-volcanic rock is located along the bottom of the steep hill. The hillside itself appears to be broken and sheared mudstones and sandstones that are representative of the *mélange* sequence and the meta-volcanic rock appears to support the toe of the upper slope.
4. The failure itself appears to be associated with the weathering profile of the upper slope (Dave Michael personal communications). The basal slip-surface appears to be controlled by the permeability boundary between the partially decomposed rock material (more permeable) and the stained state rock material (less permeable).
5. It is important to look at the geology and the geometry of the different rock units, and the geometry of the slide to add to the understanding of the failure. This must be an inclusive review (which is not undertaken by this report) as the geologic setting can have a profound influence on slope stability. Over-steepened slopes characterize this area but just this condition alone does not necessarily translate to a greater potential for slope failure. Underlying geology can be such that stable configurations will be maintained even in areas of over-steepened terrain. That is not the situation at the Winston site where the underlying geology is not conducive to a stable environment with regards to slope stability and thus is considered an influencing factor in this setting. To assess and quantify the importance of bedrock geology in triggering the landslide, a geotechnical report is needed.

3.0 PRECIPITATION

3.1 Findings

1. Precipitation amounts are important because water content and pore-pressure within a zone of weakness can contribute to a landslide.
2. Meteorological data were collected. There were two days in the week before the failure where significant amounts of rain were recorded. On January 30, a total of 0.74 inches of rain was recorded and on January 26, the total was 0.56 inches.
3. These amounts are not unusual for this area. Records for the past two years reveal several periods where the weekly rainfall greatly exceeded that recorded just prior to the failure.
4. The monthly total for January (5.75 inches) was just over the monthly mean for the years between 1965 and 2003. The total for December 2003 (9.94 inches) was well over the mean of 5.86 inches.
5. Because rainfall during the two months preceding the failure was above average, it is reasonable to conclude that there was sufficient precipitation to have increased pore-water pressure and trigger this landslide. However, it is important to be aware that it is impossible to assess the full contribution of precipitation without site-specific data on rainfall. There are local differences due to storm cell path and intensity that may create significantly different amounts of rain locally.
6. To assess and quantify the importance of precipitation in triggering the landslide, a detailed analysis of regional precipitation in relation to regional landslides is needed.

4.0 TOPOGRAPHY AND GEOMORPHOLOGY

4.1 Findings

1. The hillside appears to be a Quaternary feature (formed within the last 2 million years) cut by the South Umpqua River. Wells and others (2000) map the field below as Holocene fluvial deposits (deposited in the last 10,000 years).
2. The topographic map shows that there is a 75% average slope at the site of the failure, rising 800 feet across a horizontal distance of 1,080 feet. Much steeper slopes occur locally on the hillside.
3. Several of the steepest slope features appear to be the head scarps of older slides. The margins of the past failures are often outlined by vegetation, which appears to prefer the less consolidated material within these areas. Other localized, near-vertical slopes are related to boulders, competent sandstone beds, or *mélange* blocks that resist erosion.
4. DOGAMI has published information concerning slope stability issues and hazards from rapidly moving landslides within Oregon. This information is available in IMS-22 (2003) and SP-34 (2000), both published after mining activities at the site had begun. IMS-22 shows this area to have steep slopes with transport potential.
5. To assess and quantify the importance of geomorphology in triggering the landslide, a geotechnical report is needed.

5.0 GROUND VIBRATION

1. Ground vibrations at the site may have originated from past blasting activities at the quarry site and/or from increased railroad traffic.
2. Sundance Rock reported that it had not conducted any blasting within the two weeks prior to the failure.
3. Rail use on the tracks adjacent to the site significantly increased just prior to the failure because a fire in the Ashland tunnel closed a second line.
4. The distribution of rock units in this slide where the vibrations would have been in the lower igneous rock and the slide occurred in the upper sedimentary rock unit makes it unlikely that transfer of vibrations could be significant in slope stability.
5. To assess and quantify the importance of ground vibration in triggering the landslide, a geo-technical report is needed.

6.0 LAND MANAGEMENT PRACTICES

6.1 Findings

1. Removing vegetation on steep hillsides can add to the potential for failure. Tree roots help to stabilize shallow soil and overburden horizons, and help prevent shallow landslides. Tree canopies intercept precipitation, which reduces the amount of rain to directly hit the soil in storm events and reduces potential pore-water pressures on slopes (Dave Michael personal communications). This area has undergone several episodes of logging, the latest of which was in 1995 (according to the property owner).
2. This slide is much deeper than those slides typically associated with removal of vegetation. The basal slip surface is far below the depth of any vegetative root strength. The aerial photos show limited canopy covers over the slide area prior to the logging. Removal of vegetation would be necessary before any mining operation. Vegetation removal could not be ruled out as a potential contributor but it is unlikely to have been of any real significance.
3. Road building across a steep hillside can increase the likelihood of a failure occurring. Between 1995 and 1998, several roads were constructed across the area that failed. These roads were developed to provide access for the mining activity. Even small “cat roads” can remove toe support from critical areas and trigger slope movement.
4. The significance of the road-cut contribution to this landslide cannot be dismissed within the scope of this review. Slope stability calculations based on a field-developed profile and reasonable material strength assignments would be necessary to evaluate the effect on the factor of safety of the slope.

7.0 MINING ACTIVITY

7.1 Findings

7.1.1 Site History

1. The site was first mined prior to 1972. Sundance Rock applied for a DOGAMI Operating Permit in 1995 and the initial permit was issued in 1996. Mining progressed from 1 acre of disturbance in 1995 to a total of 14 acres by 2002. The mine developed from the base of the hillside upward. At the time of the failure, the quarry had developed a highwall within the competent meta-basalt unit that extended beneath the slide area.
2. Adjoining landowners reported that along the eastern edge of the failure there was movement over at least one year before the slide. The overburden material traveled down slope where it was collected and sold as fill material. This is supported by both a series of cracks which developed along the eastern margin of the slide between 2000 and the time of the failure (See Appendix A, Figures 6 and 7), and a DOGAMI inspection report dated 9/9/1998 which quoted Lyle Jefferies of Sundance Rock saying that a small slide of overburden had occurred along the eastern margin of the operations. The cracks are observable on the aerial photographs where they cut across both the access roads and the hillside (See Appendix A, Figure 7).
3. The removal of common soil material from the base of the sedimentary rock unit for fill appears to have been significant in scale and in the worst location in terms of reducing the resisting forces against the natural slope movement at this site (Dave Michael personal communications).
4. Within the scope of this review, the mining activity is judged significant in relation to the slope movement, at least in timing and likely in magnitude and impact as well. A natural geologic progression of the movement within this slope without the influence of mining activity would likely have been both slower to develop and probably smaller in volume and travel distance (Dave Michael personal communications).

7.1.2 Pre-slide Aerial Photography

1. An extensive investigation into the pre-slide land use and mining activity was conducted using aerial photographs and is attached to this report. The focus of this study was to look at the development of the quarry and the location of the failure in relationship to mining activity.
2. DOGAMI reconstructed the progression of mining activity to evaluate the relationship of the failure and the mining. It is important to look at the geology and the geometry of the different rock units, and the geometry of the slide to add to the understanding of the failure.
3. It is reasonable to interpret from the aerial photo history that this large-scale slope failure was developing through time. There are lineaments associated with the earlier photos that appear to develop into the lateral and head scarp limits of the landslide. However, this does not mean that a landslide of this same size and impact would have developed without the associated contributions of the human activity.

7.1.3 Slide Morphology

1. Witnesses report seeing the “whole thing go at once.” That suggests that failure occurred along the main scarp more or less everywhere at once. The toe of this slide was located immediately above the highwall of the quarry, along the upper contact of the meta-volcanic unit with the

mélange sequence. It is important to note that no failure occurred within the meta-volcanic unit being mined at Sundance Rock.

2. This slide would probably be classified as translational, a debris avalanche. A translational slide is a mass that moves down and outward along a relatively planar surface and has little rotation or backward tilting. It is depicted below in Figure 2.
3. There is some disagreement over the proper term for what happened to the translational slide after it passed the highwall. The block largely disintegrated as it went over the highwall of the quarry or as it slammed into the ground, so the mechanics of the slide changed down slope from the highwall. There might have been a small amount of backward rotation immediately above the highwall but a much closer study would be needed to make a determination.
4. A consulting geologist studying the area for Sundance referred to the slide as a debris flow. The typical debris flow mechanism is a small, wet initiating slide at the head of a drainage channel that liquefies and flows downhill, entraining additional material off the drainage walls. Witnesses did not report this type of top-to-bottom growth. We suggest the classification of debris avalanche best suits this slide.

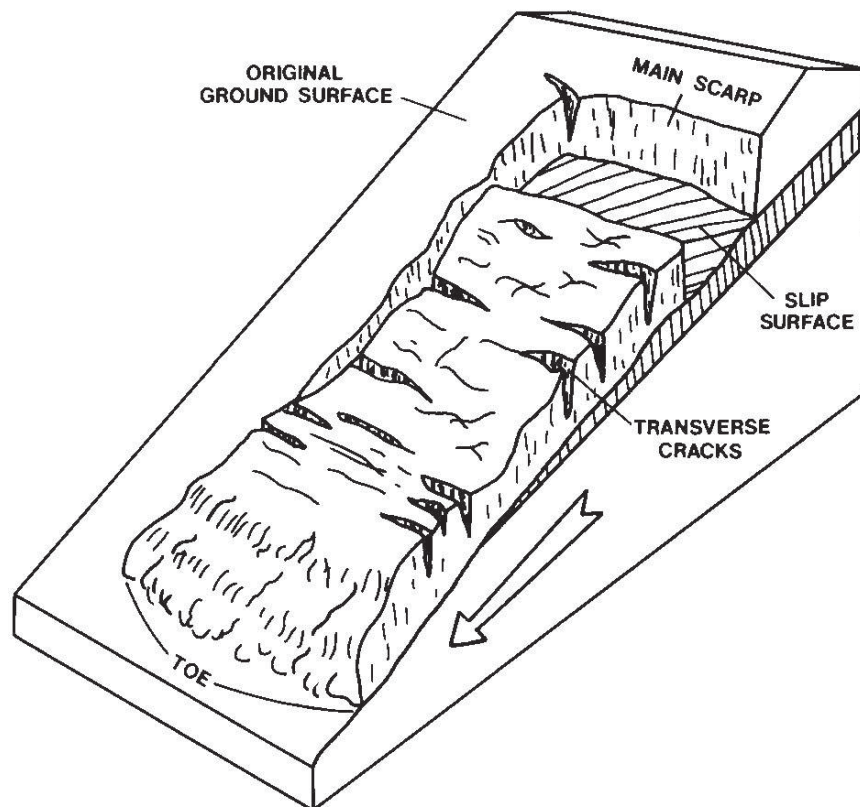


Figure 2. Schematic drawing of a typical translational slide

8.0 CONCLUSIONS

1. Bedrock can have a profound influence on slope stability. Underlying geology and land use practices can be managed so that stable configurations will be maintained even in areas of very steep slopes in most instances, but preventative measures may make certain land uses uneconomic..
2. At the Winston site, the underlying geology is conducive to various types of landslides. For this reason, all factors that influence stability must be investigated before approving land use activity like mining.
3. Rainfall during the two months preceding the failure was above average, which might have left the ground saturated and susceptible to landslides.
4. A long history of ground vibrations at or near the site, from both blasting and railroad traffic, might have weakened the cohesive structure of the remaining hillside but is of uncertain and dubious significance.
5. As mining progressed (as seen in the aerial photo sequence, Appendix A) some of the competent meta-basaltic unit at the base of the hill was removed. Much of the sedimentary sequence at the base of the steep slope was removed by the mining activity for fill material. By removing that material, some toe support of the upper-slope in the mélangé was removed and could have lead to a significant contribution by the mining activity to the slide event
6. It is beyond the scope of this report to determine the exact cause of this landslide. However, it is reasonable to conclude that this large-scale slope failure was developing though time. This does not mean that a landslide of this same size and impact would have developed without the associated contributions of the human activity.
7. Given the geology of the area and the history of this site, it will be critical to have a geotechnical report from either an engineering geologist or a geotechnical engineer assessing the potential on and off site effects of continued extraction before additional mining is done in the area.

9.0 ACKNOWLEDGMENTS

This report was reviewed internally by, Vicki S. McConnell, Tom Wiley, and J. Clark. Dave Michael, Oregon Department of Forestry, also reviewed the report.

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Michael, David L. C.E.G. 872 (geotechnical specialist NWOA, ODF).

PHOTOGRAPHS









APPENDIX A: AERIAL PHOTOGRAPH AND IMAGE ANALYSIS OF MINING RELATED ACTIVITY AND SLOPE STABILITY AT WINSTON QUARRY

Introduction and Scope of the Analysis

The following analysis of mining activity and slope stability at Winston Quarry, owned and operated by Sundance Rock Inc., is based on both rectified and unrectified aerial photographs and digital aerial images acquired by DOGAMI. Supporting information was also pulled from site inspection reports on file with DOGAMI. These aerial photographs and digital aerial images (referred to here after as “aerials”) span the time frame of recent mining activity from 1972, prior to site permitting in 1995 to after the 2004 slide and include aerials of the following dates; 5/1972, 6/25/1995, 3/18/1998, 7/13/2000, 4/23/2002, and 2/5/2004. The date, source, type and on-screen pixel resolution of these images are provided in Table 1. Of these aerials only the February 5th of 2004 aerial has been orthorectified and georeferenced.

For this analysis, aerial photographs, photo copied enlargements of aerial photographs, and slide photographs were scanned to create digital images. The digital images were orientated so that north was toward the top of the image and scaled so that one inch is approximately equal to three hundred feet. The images were then imported into Canvas 8 software to allow them to be stacked on top of each other in individual layers of a Canvas file or work space. Once the images were scaled and spatially referenced to each other, the outline of the 2004 slide scar and the axis (center line of the slide perpendicular to the hillslope) of the slide were overlain on all of the aerials in order to describe mine site development and mining related activity with respect to the 2004 slide scar and slide axis.

Care was taken during this process to optimize the resolution, orientation and scale such that photographic distortion and spatial distortion

related to topography were minimized across the bulk of the mine site. However, due to the fact that the most of these images are not orthorectified or georeferenced, there are both photographic distortions and distortions related to topography that affect the usefulness of these images for absolute spatial analysis. A relatively robust analysis of mine site activity and slope stability can be made despite these distortions. The following analysis uses the relative position of key landmarks in the images to provide a measure of spatial accuracy as well as approximate spatial measurements to describe mining related activity and slope stability at Winston Quarry.

Initial Site Conditions 5/1972 and 6/25/1995 Aerials

The site was originally mined prior to 1972 though no date has been established for the initial excavation at this site. The mining related disturbance visible on the 1972 aerial (Figure 3) consists of the initial development of a minor high wall, quarry floor, haul road and small stockpile area. This disturbance was approximately 1 acre in area and was confined to the base of the hill. Except for the noted disturbance, the site had a significant amount of vegetation at the base of the hill. This vegetation appears to consist of trees, shrubs and grasses and/or ground cover. On the hillslope there appears to be an older partially vegetated road cut above which vegetation, especially trees, are not as abundant indicating that the hill may have been logged several years prior to the date that this aerial was taken. There are also patches of bare soil and an interesting arcuate “gap in vegetation” visible above the road cut on the hillslope. The arcuate “gap in vegetation” appears to be located in approximately the same location as the 2004 slide scar and may be an indication that the slope had experienced or was experiencing some form of mass movement or instability prior to May 1972.

TABLE 1. DATE, SOURCE, TYPE AND PIXEL RESOLUTION OF AERIAL IMAGES USED IN THIS ANALYSIS.

Date	Source	Image Type
5/1972	Oregon Department of Forestry	Digital scan of photo copy enlargement
6/25/1995	Spencer B. Gross Inc.	Digital scan of standard photographic print
3/18/1998	David Shear (Eagle Images)	Digital scan of slide photograph
7/13/2000	David Shear (Eagle Images)	Digital scan of slide photograph
4/23/2002	David Shear (Eagle Images)	Digital scan of slide photograph
2/5/2004	David Shear (Eagle Images)	Digital image

On Screen Pixel Resolution

Date	(ft/pixel)
5/1972	6.8
6/25/1995	9.2
3/18/1998	0.75
7/13/2000	0.9
4/23/2002	2
2/5/2004	0.9

Based on the 1995 aerial and inspection report, the site remained inactive or had very little activity between 1972 and 1995 (Figure 4). The only significant change was in the extent and type of vegetation cover. During this period ground cover vegetation has encroached on to the quarry floor and is clearly visible in ground photos taken during the initial site inspection of 12/12/1995. The quarry high wall is also clearly visible in the ground photos taken during the initial site inspection and was approximately 20-30 feet high prior to site permitting. The hillside appears to have a greater amount of vegetation especially trees and shrubs at the time of the inspection. The road cut on the hillslope and the “gap in vegetation” noted in the 1972 aerial are no longer visible partly due to the increase in vegetation and the fact that this aerial is of poor resolution as it had to be significantly enlarged to match the scale of the other aerials (see Table 1).

Mine Site Development and Expansion of Mining Related Activity 6/25/1995 to 3/18/1998:

DOGAMI permitted the site for operation by Sundance Rock Inc. in 1986. During this period, between the initial permitting of the mine site in 1996 and the date of the 1998 aerial (Figure 5), mine site development consisted of expanding the initial quarry high wall and quarry floor, creating a larger stockpile area, constructing a series of access roads, the initial development of a secondary high wall or bench and the stripping of vegetation. The original quarry high wall was mined further into the hill and expanded to the west, away from the 2004 slide area. The bulk of quarry floor expansion occurred within and to the north of the 1972 disturbance footprint out onto the Umpqua River valley floor. Expansion activities that directly impacted the portion of the hillslope within the confines of the 2004 slide scar include; expansion of the original high wall into the hillslope and slightly to the east of the origi-

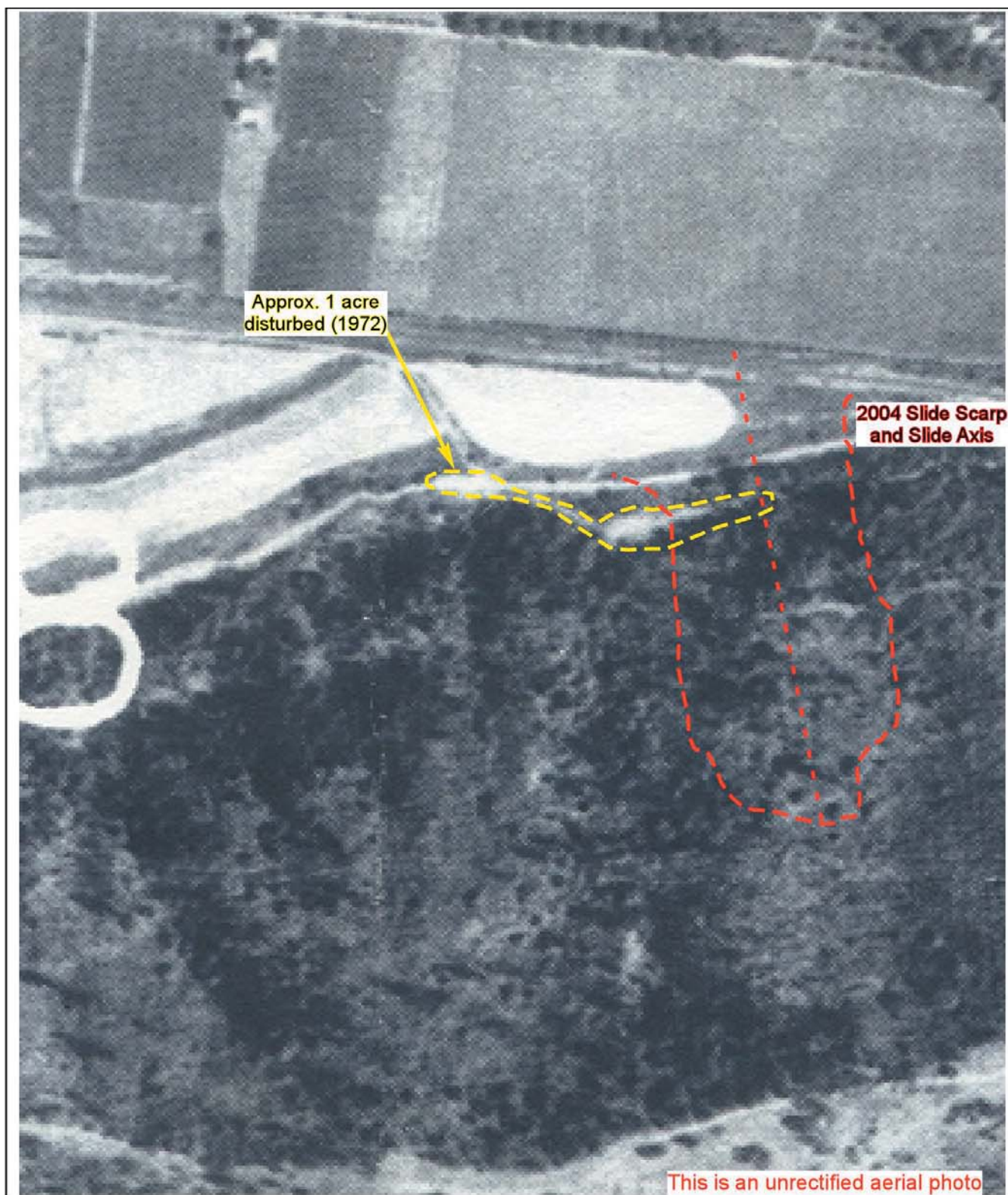


Figure 3.
 DOGAMI ID#: 10-0197
 Permittee: Sundance Rock Inc.
 Site Name: Winston
 Photo Source / Date: ODF? / 5-1972
 Prepared By / Date: V. Balzer / 3-23-2004

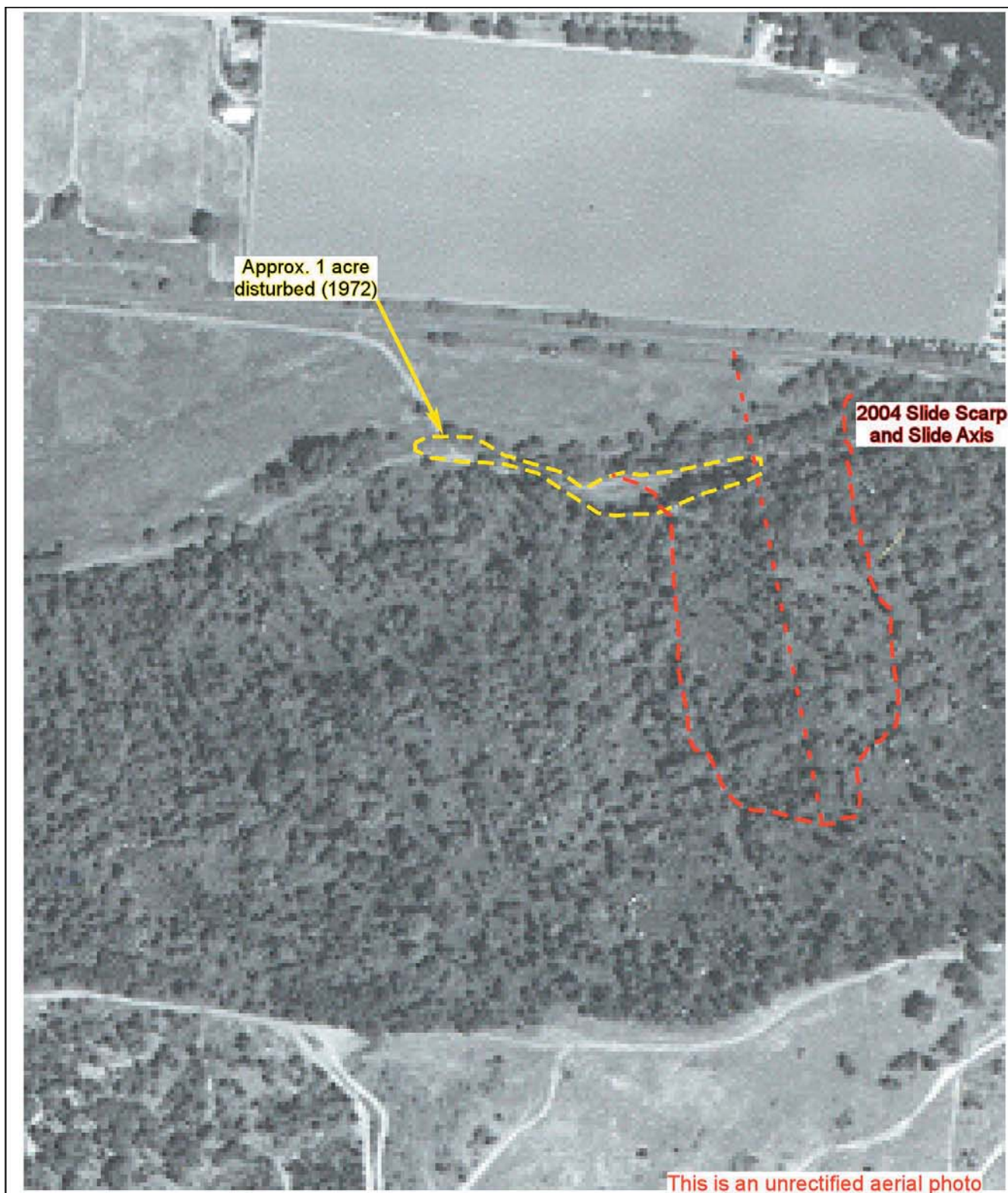


Figure 4.

DOGAMI ID#: 10-0197

Permittee: Sundance Rock Inc.

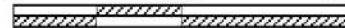
Site Name: Winston

Photo Source / Date: SBG Inc. / 6-25-1995

Prepared By / Date: V. Balzer / 3-23-2004

File Name: S:\10Douglas\10-0197\10-0197 Aerial(8.5X11).CNV

0 300 600 ft



Approx. scale 1 in = 300 ft

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nal high wall, construction of access roads on the hillslope, the initial development of the secondary high wall or bench approximately 80 feet above and slightly east of the original high wall (the approximate elevation of this bench is noted in the site inspection report of 9/9/1998), and the clearing of trees and shrubs on the hillslope. By the time of the 1998 aerial vegetation cover on the hillslope within the confines of the 2004 slide scar was reduced by approximately 20% as a result of mining activity when compared to the 1995 aerial.

Mine Site Development and Expansion of Mining Related Activity 3/18/1998 to 7/13/2000

This was a very significant period for mine site development and expansion with the area disturbed by mining more than doubling to 12.5 acres (Figure 6). During this period, mine site development was accomplished by expanding of the original quarry high wall, development of an additional high wall at the toe of the hillslope to west of the original high wall, expanding of the benched high wall, stripping of overburden, and continued stripping of vegetation. The original high wall continued to be mined into the hillside, however, the bulk of mine site development during this period occurred both up slope and to the east of the original high wall. One exception to this was the development of an additional high wall at the base of the slope to the west of the original high wall and outside of the confines of the 2004 slide area. Mine site development both up slope and to the east of the original high wall was well within the confines of the 2004 slide scar and included expansion of the benched high wall into the hillslope and a substantial amount of vegetation and overburden stripping. Both material mined from the benched high wall and material (overburden) stripped from the hillslope above the benched high wall to the east of the original high wall was side cast down to the of the original quarry floor. Places where material was side cast are clearly visible in the 2000 aerial

as bare slope material at the angle of repose. By the time of the 2000 aerial vegetation cover on the hill within the confines of the 2004 slide scar had been reduced by approximately 50 % as a result of mining activity when compared to the 1995 aerial. Also visible in the 2000 aerial is an arcuate “gap in vegetation” at approximately the same location as both the arcuate “gap” in vegetation” noted in the 1972 aerial and the location of the 2004 slide scar. This observation suggests that the hillslope was unstable by the date of the 2000 aerial photo.

Mine Site Development and Expansion of Mining Related Activity 7/13/2000 to 4/23/2002

During this period, the aerial extent of land disturbed by mining increased only modestly from 12.5 acres to 14 acres (Figure 7). Despite this fact there was a significant amount of mine site development. Both the original high wall and the benched high wall were worked into the high slope and expanded to the east. By the date of the 2002 aerial the benched high wall had been expanded to the east across axis of the 2004 slide scar (Figures 8 and 9) and overburden directly above this high wall had been stripped down to bedrock almost all the way to the eastern margin of the slide scar. Only minor amounts of vegetation stripping on the hillslope occurred during this period of mine site development. The arcuate gap in vegetation noted on the 2000 aerial is not as visible as it was in the 2000 aerial and ground cover vegetation has grown over portions of this feature.

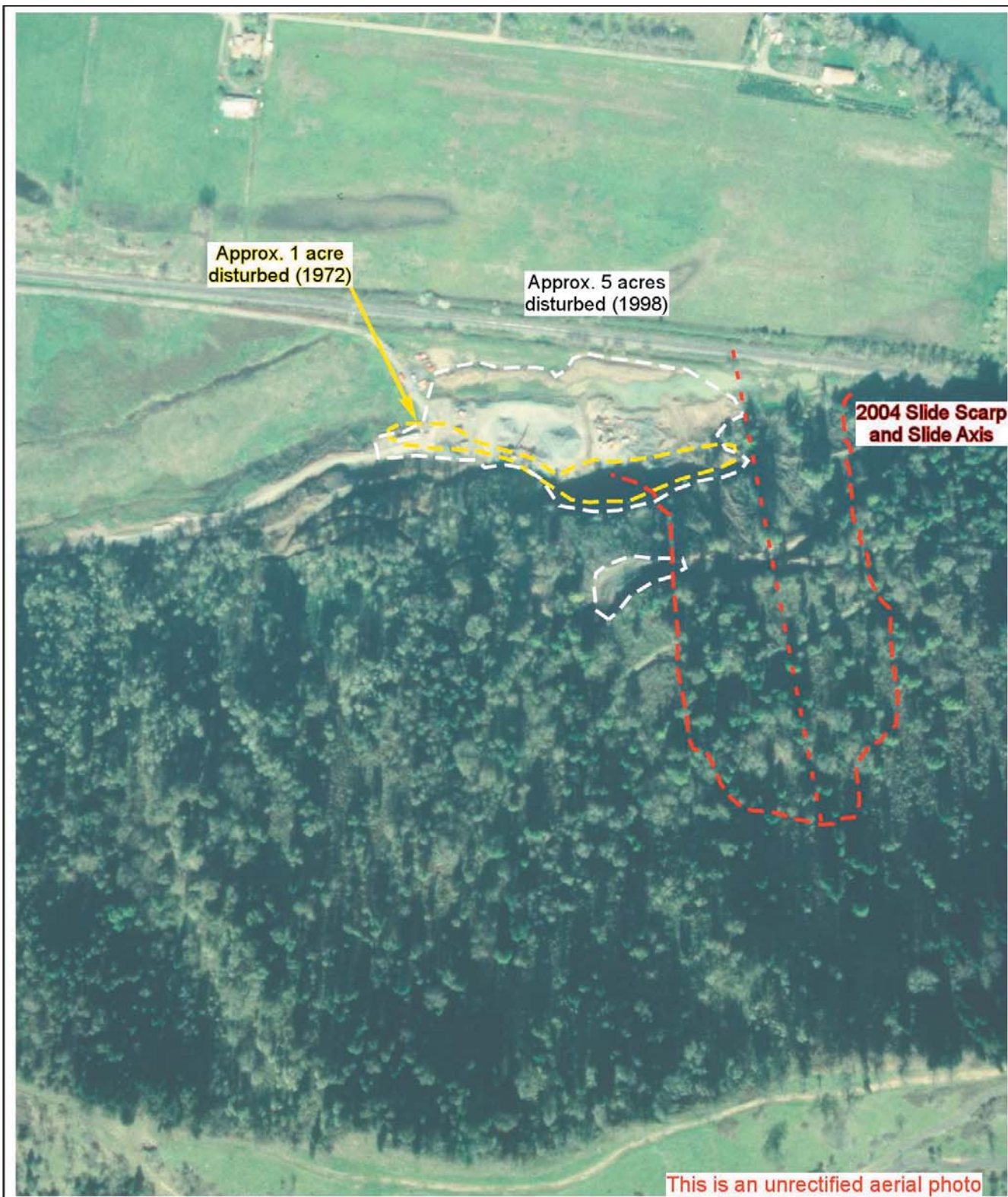


Figure 5.

DOGAMI ID#: 10-0197

Permittee: Sundance Rock Inc.

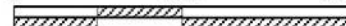
Site Name: Winston

Photo Source / Date: D. Shear / 3-18-1998

Prepared By / Date: C. Dickey / 7-29-1998

File Name: S:\10Douglas\10-0197\10-0197 Aerial(8.5X11).CNV

0 300 600 ft



Approx. scale 1 in = 300 ft

Oregon Dept. of Geology and Mineral Industries
Mineral Land Regulation and Reclamation Program

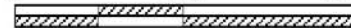




This is an unrectified aerial photo

File Name: S:\10Douglas\10-0197\10-0197 Aerial(8.5X11).CNV

0 300 600 ft



Approx. scale 1 in = 300 ft

Oregon Dept. of Geology and Mineral Industries
Mineral Land Regulation and Reclamation Program



Figure 6.

DOGAMI ID#: 10-0197

Permittee: Sundance Rock Inc.

Site Name: Winston

Photo Source / Date: D. Shear / 7-13-2000

Prepared By / Date: C. Arritt / 1-26-2001



Figure 7.

DOGAMI ID#: 10-0197

Permittee: Sundance Rock Inc.

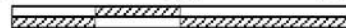
Site Name: Winston

Photo Source / Date: D. Shear / 4-23-2002

Prepared By / Date: V. Balzer / 2-3-2004

File Name: S:\10Douglas\10-0197\10-0197 Aerial(8.5X11).CNV

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Approx. scale 1 in = 300 ft

Oregon Dept. of Geology and Mineral Industries
Mineral Land Regulation and Reclamation Program



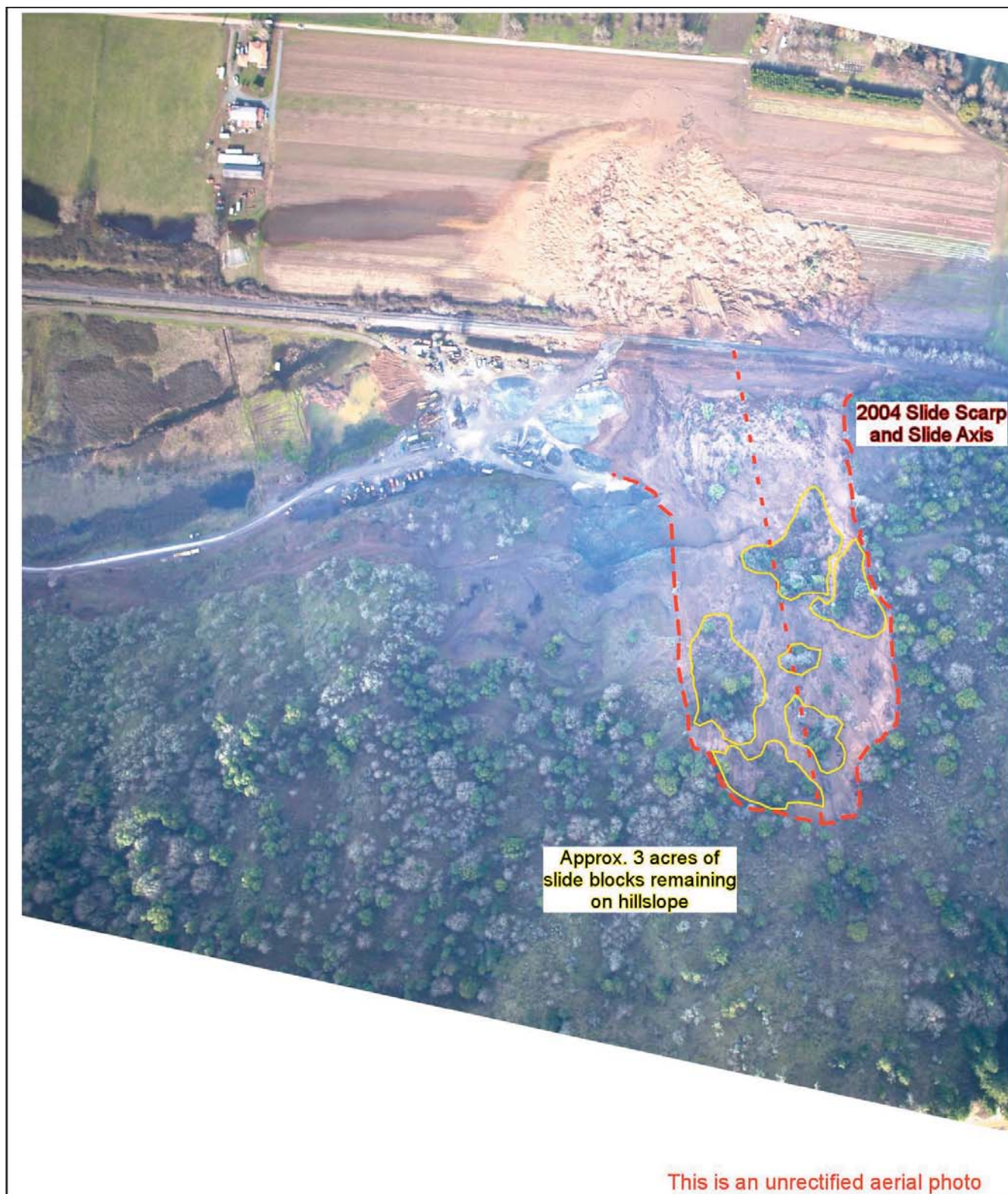


Figure 8.

DOGAMI ID#: 10-0197

Permittee: Sundance Rock Inc.

Site Name: Winston

Photo Source / Date: D. Shear / 2-5-2004

Prepared By / Date: V. Balzer / 2-10-2004

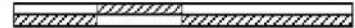


This is an unrectified aerial photo

Figure 9.
 DOGAMI ID#: 10-0197
 Permittee: Sundance Rock Inc.
 Site Name: Winston
 Photo Source / Date: D. Shear / 2-5-2004
 Prepared By / Date: V. Balzer / 2-10-2004

File Name: S:\10Douglas\10-0197\10-0197 Aerial(8.5X11).CNV

0 300 600 ft



Approx. scale 1 in = 300 ft

Oregon Dept. of Geology and Mineral Industries
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