3.1 GEOLOGY AND SOILS

A. Setting

1. Introduction

The following section summarizes the geology, soils, and seismicity of the Harris Quarry project area. Included is a discussion of existing conditions and the constraints to quarrying posed by site geologic, soils, and seismic conditions. Certain conditions, such as weak or erosive soils, may be practically mitigated through suitable grading, geotechnical engineering, engineering geologic, drainage controls, and other measures. However, the unpredictable nature of some geologic hazards, such as strong or violent seismic shaking from an earthquake, may only be mitigated to an acceptable standard or level of risk. The geology and soils in the Mendocino County area are mainly a consequence of the long history of active tectonics near the margin between the Pacific and North American Tectonic Plates, patterns of climate change, and changing land use and vegetation patterns. Typical geologic and soils related impacts on quarry activities within Mendocino County include strong seismic shaking; slope instability that may cause landslides, debris flows, and other types of slope failure; and basic soil instability, including settlement, shrinking and swelling of expansive soil, and fissuring or cracking of the ground. These constraints are interrelated and may be exacerbated by periodic heavy rains causing soil erosion, saturation of the ground, and flooding.

The analysis was prepared by Questa Engineers based on: (1) Engineering Geology and Geohazards Report for Harris Quarry, Mendocino County, California, Blackburn Consulting, Inc. (BCI), December, 2004; (2) a review of regional geologic and seismic data for the area; (3) Cut Slope Evaluation for Harris Quarry Haul Road (BCI) September 2006; (4) Slope Stability Analysis for Harris Quarry Final Face, BCI, October 2006; (5) review of the potential effects of existing geologic hazards on proposed facilities; (6) analysis of the potential for new hazards to develop due to the proposed expansion of the quarry. (7) Final Grading, Reclamation, and Phased Erosion Control Plans for Earth Products Removal at Harris Quarry, Rau and Associates, Inc., December 2004; (8) Amended Reclamation Plans for Harris Quarry Expansion, Mendocino County, California, by Rau and Associates, Inc. of Ukiah, California, Prepared January 2005 and amended September 2006; (9) California Probabilistic Seismic Hazards Assessment, California Geological Survey, 2002, amended April 2003.

This section of the EIR describes the geologic conditions of the Harris Quarry project area and the potential adverse impacts to the facility infrastructure and local residents in regard to geologic hazards and conditions, along with appropriate mitigations to address identified significant or potentially significant impacts.

2. Regional Geologic and Seismic Setting

Harris Quarry is located approximately four miles south of the City of Willits within the Coast Range Geomorphic Province of Northern California. The Coast Range is a geologically complex and seismically active region characterized by a series of northwest-southeast trending mountain ranges with ridges and valleys that roughly
parallel the coast. The Franciscan Complex of Jurassic-Cretaceous age and the Great Valley sequence of Cretaceous age are the oldest bedrock units in the province. Subsequently, younger rocks such as the Tertiary-age Sonoma Volcanics, the Pli-Pleistocene age Clear Lake Volcanics and numerous sedimentary rocks were deposited throughout the province. Extensive folding and thrust faulting during late Cretaceous through early Tertiary time created the complex geologic conditions that underlie the highly varied topography today. The City of Willits is located within the Little Lake Valley, a north-south trending structural depression that roughly follows the Maacama fault zone. The project site is located to the south of this valley.

The Coast Range Geomorphic Province formed along the boundary between the North American and Pacific Crustal Plates. The contact between these two plates is currently the San Andreas Fault and subsidiary faults of the San Andreas Fault System. Subsequent compression, uplift, and faulting occurred during the Miocene and Pliocene epochs of the Tertiary Period (between five and 15 million years ago). The current tectonic setting is related to the movement along the northwest-southeast trending faults such as the San Andreas, Maacama, and Bartlett Springs faults, with movement of the Pacific Plate to the north and west relative to the North American Plate.

The regional geology consists of complexly folded, faulted, sheared and altered bedrock. The bedrock of the region is the Franciscan Complex of Upper Jurassic to Cretaceous age (65 to 190 million years old). The Franciscan Complex is comprised of a variety of rock types, predominately sandstone, shale, chert and conglomerate with hard, resistant meta-volcanic (greenstone) and meta-sedimentary rock in the project vicinity. Regional structural features (rock bedding/foliation) trend north-northwest, with highly variable dip. A geologic and hydrologic map of the site vicinity is presented as Figure 3.2-2. In the following Hydrology section.

3. Regional Faulting and Seismicity

Northern California is a seismically active region and has been subject to numerous large earthquakes during recorded history. The following is a list of historic >6.0 Richter magnitude earthquakes, which likely affected the project site. This list is not exhaustive, but is only meant to indicate the likelihood of the site experiencing seismically induced ground shaking in the future.

1868 – Hayward Fault. A 7.0 Richter magnitude earthquake struck near Hayward, California, on October 21, 1868. Known as “The Great San Francisco Earthquake” until that title was expropriated in 1906, strong ground shaking was pervasive throughout the San Francisco Bay Area, and a Modified Mercalli Intensity (MMI) of II to IV was estimated in central Mendocino County. 30 people were killed and an estimated $350,000 was lost to damages. An explanation of the MMI scale is given as Table 3.1-2.

1892 – Blind Thrusting along Great Valley – Coast Range border region. Two earthquakes on April 19 and April 21, 1892 struck in the Vacaville-Winters area. Richter

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17 California Division of Mines and Geology, 1960, Geologic Map of California, Ukiah Sheet.
18 Blackburn Consulting Inc (BCI), October 11, 2006, Slope Stability Analysis – Harris Quarry Final Face.
Magnitude 6.6 and 6.4 earthquakes led to a MMI of about IV in the Central Mendocino County area. The earthquakes resulted in three deaths and approximately $225,000 in damage.

1898 – San Andreas Fault. A Richter Magnitude 6.7 earthquake struck near Fort Bragg, Mendocino County on April 15 1898. Ground shaking intensity for central Mendocino County was estimated to be VII on the MMI scale. There were reports of considerable damage along the Mendocino coast, but no loss estimates are available.

1906 – San Andreas Fault. A Richter Magnitude 7.8 earthquake struck near San Francisco on April 18, 1906. Known as the Great San Francisco Earthquake, it (along with the fire it started) destroyed much of San Francisco, and MMI values of VII to VIII were felt as far as central Mendocino County. An estimated 3,000 lives and $524 million in property were lost.

1954 – East of Arcata. A Richter Magnitude 6.6 earthquake struck on one of the active faults directly east of Arcata (the Falor, Fickle Hill, Mad River, McKinleyville, Blue Lake, and Trinidad faults are all just east of Arcata). Ground shaking was likely experienced in central Mendocino County due to this earthquake.

1992 – Cape Mendocino. Three earthquakes of Richter Magnitudes 7.2, 6.6, and 6.6 occurred on April 25 and 26, 1992, near Cape Mendocino. These earthquakes likely caused at least moderate shaking in the central Mendocino County area.

Faults zoned as active, or conditionally active by the California Division of Mines and Geology (those experiencing surface rupture or seismic activity within the past 11,000 years, or 700,000 years, respectively) within 50 miles of the site are listed in Table 3.1-1.\(^\text{20}\) (CDMG, 1997).

The intensity of ground shaking felt in the site vicinity from future earthquakes will depend on several factors, including the distance of the site to the earthquake focus, the magnitude and the duration of the earthquake, and the response of the underlying soil and/or bedrock. The Modified Mercalli Intensity (MMI) Scale is commonly used to measure earthquake effects due to ground shaking. The Modified Mercalli Intensity scale is summarized in Table 3.1-2.

The California Geological Survey’s Probabilistic Seismic Hazards Assessment has predicted peak ground acceleration at the site to be approximately 60% of the acceleration due to gravity\(^\text{21}\), which correlates with a modified Mercalli intensity of VIII to IX, very strong to violent\(^\text{22}\). These values for peak ground acceleration are estimated by the California Geological Survey to have a 10 percent probability of being exceeded within the next 50 years.

\(\text{\textsuperscript{20}}\) C. W. Jennings, Fault Activity Map of California and Adjacent Areas, 1994, California Division of Mines and Geology.

\(\text{\textsuperscript{21}}\) California Geological Survey, Probabilistic Seismic Hazards Assessment, April 2003, obtained from http://www.consrv.ca.gov/CGS/rghm/pshamap/pshamain.html

### Table 3.1-1:
Active and Conditionally Active Faults Within 50 Miles of the Project Site

<table>
<thead>
<tr>
<th>Fault</th>
<th>Distance from Site (miles)</th>
<th>Direction from Site</th>
<th>Activity Status</th>
<th>Maximum Credible Earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maacama</td>
<td>0.3</td>
<td>East</td>
<td>Active</td>
<td>7.25</td>
</tr>
<tr>
<td>Bartlett Springs</td>
<td>20.3</td>
<td>Northeast</td>
<td>Active</td>
<td>6.75</td>
</tr>
<tr>
<td>Round Valley</td>
<td>32.2</td>
<td>North</td>
<td>Active</td>
<td>6.75</td>
</tr>
<tr>
<td>San Andreas</td>
<td>28.7</td>
<td>West</td>
<td>Active</td>
<td>8.0</td>
</tr>
<tr>
<td>Big Valley</td>
<td>36.5</td>
<td>Southeast</td>
<td>Active</td>
<td>6.25</td>
</tr>
<tr>
<td>Konocti Bay</td>
<td>40.4</td>
<td>Southeast</td>
<td>Active</td>
<td>6.25</td>
</tr>
<tr>
<td>Collayami</td>
<td>41.0</td>
<td>Southeast</td>
<td>Conditionally Active</td>
<td>6.5</td>
</tr>
<tr>
<td>Whale Gulch</td>
<td>50</td>
<td>Northwest</td>
<td>Conditionally Active</td>
<td>7.5</td>
</tr>
</tbody>
</table>

4. **Geology of the Quarry Area**

A geologic map of the site and vicinity is presented as Figure 3.1-1. This map shows Franciscan greenstone in the quarry face, a zone of apparently highly fractured and sheared rock roughly paralleling Black Bart Drive, and undifferentiated Franciscan Complex rocks elsewhere. The geologic map also shows the location of faults, landslides, and springs.

**Faulting**

No active faults are known to traverse the site, although BCI observed three minor faults within the quarry face. These faults strike northwest, and dip steeply (~60%-80%) to the northeast and southwest. These may be related to two lineaments mapped as crossing the site by Pampeyan and others. BCI interpreted these as possible, but inconclusive, recent fault breaks based on alignment of topographic features. A summary of fault and lineament features is shown on Figure 3.2-1.

**Slope Stability of the Quarry Area**

BCI did not identify any landslides as occurring within the Harris Quarry expansion project boundary or nearby areas during site reconnaissance or review of published geologic maps and aerial photographs. Although landslides are common within the weaker Franciscan rock near the site and landslides are mapped within the fault zone to

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25 BCI, *Engineering Geology and Geologic Hazards Report, Harris Quarry, Willits, California*, December 9, 2004


### Table 3.1-2

**Modified Mercalli Intensity Scale**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Intensity</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Felt by persons at rest, on upper floors, or favorably placed.</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Moderate</td>
<td>Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Objects fall off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and poorly constructed or weak masonry cracked. Trees, bushes shaken (visibly, or heard to rustle).</td>
</tr>
<tr>
<td>VII</td>
<td>Strong</td>
<td>Difficult to stand. Noticed by drivers of motorcars. Hanging objects quiver. Furniture broken. Damage to poorly constructed or weak masonry. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, and cornices. Some cracks in average unreinforced masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged</td>
</tr>
<tr>
<td>VIII</td>
<td>Very Strong</td>
<td>Steering of motorcars affected. Damage to average masonry and partial collapse. Some damage to reinforced masonry, but not to that specially designed for seismic loading. Fall of stucco and some masonry walls. Collapse of chimneys, factory stacks, monuments, towers, and elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>General panic. Poorly built or weak masonry destroyed; average unreinforced masonry heavily damaged, sometimes with complete collapse; reinforced masonry seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.</td>
</tr>
<tr>
<td>X</td>
<td>Very Violent</td>
<td>Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.</td>
</tr>
<tr>
<td>XII</td>
<td>Very Violent</td>
<td>Rails bent greatly. Underground pipelines completely out of service.</td>
</tr>
<tr>
<td>XII</td>
<td>Very Violent</td>
<td>Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.</td>
</tr>
</tbody>
</table>

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the east of the site\textsuperscript{27}, the hard, volcanic and meta-volcanic rock exposed along the natural slopes of the site and the quarry face typically preclude large slope failures. Minor wedge failures and rockfalls at fractures, joints, and bedding intersections, can be expected within areas of highly fractured rock. During strong seismic ground shaking events it is anticipated that additional wedge failures and rockfalls will occur.

\textit{Slope Stability of the Processing Facility Site}

No landslides have been mapped in the proposed processing facility area, but cuts and fills proposed for the area may be unstable. While the quarry project area is underlain by hard, massive, volcanic and meta-volcanic rock, the processing facility is proposed for an area of unknown subsurface conditions. The area is mapped as Franciscan and much of the Franciscan bedrock in the region consists of cohesive blocks of rock in a tectonically sheared mélange of weaker sandstone and/or shale. Native slopes in the area generally do not exceed 2:1.

5. \textit{Geologic Environment of the Site}

The following sections describe the observations of the existing quarry and proposed expansion areas and conclusions and recommendations by BCI as presented in the report titled \textit{Engineering Geology And Geohazards Report, Harris Quarry, Willits, California dated December, 2004}. A geologic map of the Harris Quarry site and vicinity adapted from several sources including the BCI map, work by Pampeyan, the California Division of Mines and Geology and others is presented as Figure 3.2-2.

\textit{Physiography}

The present operating quarry is situated along the southwestern edge of a steep sided, northwest-trending ridge. The quarry floor elevation is approximately 1,850 feet above mean sea level. The existing excavated slopes rise above the floor of the quarry as high as about 350 feet. From visual estimates and review of the site topographic maps, the quarry face slopes at an overall gradient of about 1.25:1 (horizontal to vertical). The native slopes along the southern edge of the ridge are steep and sparsely vegetated. They continue below the quarry floor to an ephemeral tributary of Forsythe Creek at about 1,600 feet in elevation. The native slopes north of the ridge are relatively flatter and more heavily vegetated with tanoak, true oaks, madrone, and Douglas fir.

\textit{Soils}

According to the United States Department of Agriculture’s Soil Survey for Eastern Mendocino and Southwestern Trinity Counties, the soil distribution in the project vicinity consists of the following regimes, with associated soil descriptions. The existing quarry area south of the ridge and much of the area south of the quarry between Forsythe Creek and US Highway 101 is comprised of the Squawrock – Witherell Complex, 50\% - 75\% slopes. It consists of 50\% Squawrock, 35\% Witherell and 15\% minor constituents.

\textsuperscript{27} Alquist-Priolo Fault Evaluation Report 123, Figure 3A, California Department of Conservation, California Geological Survey, July 8, 1981.
The Squawrock is a well-drained soil, made up of residuum weathered from sandstone, with a very low water capacity. Typical profile is as follows: 0-7 inches – cobbly loam; 7-16 inches, very cobbly clay loam; 16-12 inches, very gravelly sandy clay loam; 21-24 inches, un-weathered bedrock.

The Witherell is a somewhat excessively drained soil made up of residuum weathered from sandstone, with a very low water capacity. Typical profile is as follows: 0-7 inches, sandy loam; 7-12 inches, gravelly loam; 12-16 inches, un-weathered bedrock.

The slopes on the northern side of the ridge are of the Pardaloe – Kekawaka – Casabonne Complex, 50% to 75% slopes, which consists of 35% Pardaloe, 20% Casabonne, 20% Kekawaka, and 25% minor constituents.

The Pardaloe is a well-drained soil made up of residuum from weathered sandstone and shale, with a low available water capacity. Typical profile is as follows: 0-10 inches, gravelly loam; 10-27 inches, very gravelly sandy loam; 27-58 inches, very gravelly loam; 58-62 inches, un-weathered bedrock.

The Kekawaka is a well-drained soil made up of residuum from sandstone and siltstone, with a high available water capacity. Typical profile is as follows: 0-4 inches, loam; 4-35 inches, clay loam, 35-61 inches, clay.

The Casabonne is a well-drained soil made up of residuum from sandstone and shale, with a moderate available water capacity. Typical profile is as follows: 0-15 inches, gravelly loam; 15-43 inches, clay loam; 43-58 inches, gravelly clay loam; 58-62 inches, un-weathered bedrock.

**Processing Site**

Soils in the proposed processing area are of the Yorkville-Yorktree-Squawrock Complex, 30% to 50% slopes. This complex consists of approximately 45% Yorkville, 25% Yorktree, 15% Squawrock and 20% other soils.

The Yorkville is a moderately well drained soil made up of colluvium/residuum derived from greywacke, schist, and/or shale, with a very high available water capacity. Typical profile is as follows: 0-15 inches, loam; 15-41 inches, clay; 41-60 inches, gravelly clay loam, clay loam.

The Yorktree is a well drained soil made of colluvium derived from greywacke, schist, and/or shale, with a moderate available water capacity. Typical profile is as follows: 0-12 inches, loam; 12-24 inches, gravelly clay loam; 24-42 inches, clay; 42-51 inches, gravelly clay; 51-55 inches, bedrock.

6. **Groundwater**

Groundwater at the site is present primarily in bedrock fractures, and is encountered periodically in open fractures during quarrying. Groundwater flow is related to fractures, faults, joints, bedding surfaces and other structural features in the bedrock. In addition, surface colluvial soils and zones of weathered bedrock can contain some local,
seasonal, and often perched groundwater. The Franciscan Complex is a complexly folded, faulted and fractured sequence of rock materials. The Franciscan has experienced a long history of tectonic movement along the boundary of the Pacific and North American tectonic plates. The nearby Maacama fault, located 0.3 miles to the east generally follows a trough created by weakened rocks and occupied by Highway 101, and has deformed an area around the fault that includes the Harris Quarry site. According to mapping by Pampeyan and others,\(^{28}\) potentially active fault lineaments of the Maacama Fault Zone cross the subject property. Mapping by BCI has confirmed that steeply dipping faults are present within the quarry face that may be related to active or potentially active faulting along the Maacama Fault Zone. Fault and fracture features such as these can act as water barriers, creating high groundwater on one side of the fault or fracture and depressed groundwater on the opposite side of the fault trace. In addition, the more pervasively sheared and fractured rock along faults often provides the open joints where downward percolating groundwater can move and accumulate. Typically, the relative amount and size of fractures and openings in Franciscan bedrock decreases with depth, so drilling deeper wells does not often result in finding additional water where nearby shallow wells are dry. However, the volume of water stored in such rock fractures, the rate of recharge, and the direction and rate of movement are very difficult to predict even by pump testing. These water bearing fractured rock zones create springs where the rock fractures direct water to surface outcrops. The rock fracture and joint openings are also the primary source of water for hard rock wells in Franciscan terrain. Springs are typically common along such fault zones, where fault movement has offset or disrupted subsurface pathways of groundwater movement.

During their site reconnaissance, BCI did not observe any surface water at the site. No springs or other evidence of shallow groundwater was observed in the immediate quarry area. The locally fractured nature of the rock apparently allows it to readily infiltrate any surface water, which is consistent with reports from the quarry operator\(^{29}\).

A number of wells have been drilled in the quarry vicinity. There are several shallow wells (less than 35 feet deep) along the north side of the quarry. At the southeast side of the existing quarry, a 500-foot deep dry hole was drilled, indicating variable groundwater occurrence in the quarry vicinity. This dry hole is located on the east side of structural lineaments in the area. Two wells are present to the north of the existing quarry, listed as Shallow Well and Quarry Well on maps produced for the applicant (see hydrology section, Figure 3.2-2). Water levels within the Quarry Well are at a depth of approximately 29 feet below ground surface. These wells are located on the north-facing slope of the hill located to the north of the existing quarry. These wells are located in the vicinity of northwest-southeast structural lineaments that pass through the quarry area.

Several springs are present to the north and west of the quarry area, in an area mapped as having intensely fractured sedimentary and meta-sedimentary bedrock. These springs, which provide some residents of the Ridgewood Subdivision with water, are north of the hill located north of the quarry in an up-gradient surface water direction. Based on the location of the dry well to the south of the hill and the shallow groundwater

\(^{28}\) Pampeyan and others, 1981.

\(^{29}\) BCI, 2004.
levels to the north of the hill, there does not seem to be a connection of groundwater between the north side of the hill and the south side in the quarry vicinity.

7. Geologic Reconnaissance, Surficial Geology, and Exposed Bedrock

Existing Quarry

Reconnaissance geologic mapping by BCI verifies that the existing quarry area consists of predominantly hard rock consistent with volcanic and meta-volcanic rocks of the Franciscan Formation. Rock in the active quarry face is greenstone, a variable term applied to altered, basic igneous rocks which owe their color to minerals such as chlorite, hornblende and epidote. There are also zones of very hard, dark red chert and pillow basalts. The quarry rock is intensely (0.1-0.3 ft spacing) to slightly (1-3 ft spacing) fractured. The slightly fractured rock has a blocky texture and excavates into boulders of hard, durable rock. The intensely fractured rock is, in many places, friable and readily breaks down into small fragments of angular rock. Calcite and quartz fracture fillings are common throughout the rock mass. Rock fracture and foliation planes strike predominantly to the northwest and northeast, with variable dip. These planes can lead to wedge and block failures where they daylight on the quarry cut faces. Along the southeast-facing slope, minor wedge failures have occurred within the fractured rock, but in general the rock fracture and foliation planes are steeper than the overall cut face, and BCI did not observe evidence of large block slides or large wedge failures.

Expansion Area

As shown on Figure 1.5-1, the proposed expansion area is north and west of the existing quarry. The existing slopes in the expansion area are typically very steep, with slope gradients in the range of about 3:1 north of the ridge, to about 1.5:1 in parts of the southern and western portions. The slopes are currently tree covered. Within the active quarry face, foliation planes strike predominantly northeast and northwest, dipping variably southeast, northeast and southwest. Minor faults are common, striking northwest and dipping steeply northeast and southwest. Bedrock in the expansion area is exposed mainly in road cuts and in scattered outcrops in ridge top areas. Bedrock in the western part of the expansion area, south of the ridgeline, consists predominantly of greenstone and related meta-volcanic rocks topped with approximately 20 feet of colluvium and intensely fractured sandstone. Bedrock in the northern part of the expansion area consists of sandstone and meta-sedimentary rocks. Sandstone bedrock is typically brown, intensely weathered, and fractured where exposed. The slopes on this side of the ridge are heavily vegetated with tan oak, Manzanita, hemlock and Douglas fir. Bedding and fracture orientations were found to vary throughout the expansion area, with no through-going or pervasive bedding or fractured orientations observed.

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8. Discussion and Conclusions of the BCI Report

Based on their initial evaluation, BCI concluded that with the incorporation of the guidelines provided in their report, the proposed reclamation plan is feasible from a geologic standpoint. Observations of the bedrock conditions exposed in the existing quarry indicate that the greenstone units generally perform well at inclinations as steep as 0.75 horizontal to 1 vertical (0.75h:1v), with no immediately obvious indications of slumping and failures.

While the bedrock units were found to be fractured throughout, BCI did not observe indications of a pervasive, adversely dipping fracture, bedding plane, or shear system that could be expected to create large-scale instabilities in the planned new quarry cuts. Conceivably, joint and fracture patterns may be present that could cause localized slab, toppling, or wedge failures in the quarried rock faces. In addition, failures of soil and weathered rock are possible at the top of the finished quarry slopes, if excavated to 0.75h:1v. However, the planned construction of intermediate benches on the completed slopes would provide catchments for localized failures, should they occur.

Given the wide variation noted in bedding and fracture orientations, predicting the likelihood or location of small failures would be problematic, even with extensive subsurface investigation. In addition, because rock slope failure is primarily controlled by discontinuities such as fractures or shear zones, obtaining meaningful numerical values for stability analysis of randomly fractured rock masses is also problematic. Based on the field data and comparisons to similar slopes in the existing quarry, BCI indicated that the potential for large, deep-seated failure of the bedrock in the planned 0.75h:1v finished quarry slopes appears low.

BCI recommended that along final cuts north of the ridge the uppermost 20 feet be cut at 1.5h:1v to account for weaker colluvium and intensely fractured sandstone. In addition, BCI recommended providing on-slope benches at 40-foot intervals, with a minimum bench width of 12 feet.

Interim cut slopes, including internal faces during individual phases of operations prior to final excavation, should be evaluated in accordance with current Mine Safety and Health Administration (MSHA) requirements as quarry operations progress. Additionally the Office of Mine Reclamation (OMR) recommends slope stability analyses be performed when the quarry face progresses to within 150 feet of the final face cut to provide an opportunity to modify the final cut configuration as specific rock exposures dictate.

The majority of surface runoff is expected to infiltrate the fractured rock exposed along the final cut faces and intervening benches. Locally, areas of hard rock may limit infiltration, but high volumes of concentrated runoff are not anticipated. BCI recommended that the intervening benches be out-sloped 2% to avoid concentrated flow and subsequent erosion of the benches. Additionally, disturbed slopes adjacent to the excavation should be protected from erosion by planting native vegetation, or other appropriate means.

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32 BCI, 2006.
The report prepared by BCI is acceptable for the preliminary analysis of the proposed quarry expansion. However, additional studies are required to provide the basis for additional mitigation measures for the quarry expansion project.

9. Regulatory Setting

Several regulatory acts and codes govern construction activities at the site and vicinity. These include the Alquist-Priolo Earthquake Fault Zoning Act, the Seismic Hazards Mapping Act, the Surface Mining and Reclamation Act, the California and Uniform Building Codes, the County of Mendocino General Plan, and the forthcoming Pre-Disaster Hazard Mitigation Program for Mendocino County.

Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act was signed into law in 1972 as the Alquist-Priolo Geologic Hazard Zones Act. The name was subsequently changed to the Alquist-Priolo Special Studies Zones Act in 1975 and finally to the Alquist-Priolo Earthquake Fault Zoning Act in 1994. This Act required the State Geologist to delineate zones of active faulting in the State and to require studies to be performed for projects located within the Earthquake Fault Zones (EFZs) delineated. The purpose of the act was to prohibit the location of most structures for human occupancy across active fault traces and to thereby mitigate the hazard of surface fault rupture. The site is located near, but not within, an Alquist-Priolo Earthquake Fault Zone. See Figure 3.2-1 for the location of the Maacama fault zone.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was developed to assist local government in protecting the public from the hazards of strong seismic ground shaking, liquefaction, landslides or other ground failure, as well as other seismic hazards caused by earthquakes. The Act supports a program of mapping areas subject to the secondary effects of earthquake ground shaking including zones of liquefaction and landslides. Local government, including Cities and Counties, then require studies to investigate and mitigate the potential seismic hazard zones identified on the maps. To date, mapping efforts have concentrated on the large urban population centers of Southern California and the San Francisco Bay Area. No Seismic Hazard maps have been produced for the site and vicinity.

The Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act of 1975 (SMARA) provides for reclamation of mined lands and directs the State Geologist to classify land within California according to the presence or likely occurrence of significant mineral deposits. The mineral land classification reports and maps are made available to the appropriate lead agencies, which are required to incorporate the information in their general land-use plans. Since

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33 California Geological Survey, Seismic Hazards Mapping Act, 2004, online at http://gmw.consrv.ca.gov/shmp/SHMPAct.htm#2690
1975, known and potential mineral deposits have been mapped in about one third of the State under this project. The primary intent of the act was to create effective and comprehensive reclamation policies and regulations to reduce the adverse environmental effects and ensure mined lands are reclaimed to a usable condition. The act also encourages the production and conservation of mineral resources.

**California and Uniform Building Codes**

The California Building Code, also known as California Code of Regulations (CCR) Title 24, Part 2, is a portion of the California Building Standards Code. All building standards in California are centralized in Title 24, which is administered by the California Building Standards Commission.

The California Building Code incorporates the Uniform Building Code (UBC) of 1997, a widely accepted model building code in the United States, which is published by the International Conference of Building Officials (ICBO). The California Building Code also includes necessary California amendments as required by Title 24. The UBC of 1997, which has been adopted by Mendocino County, requires extensive geotechnical studies and has specific engineering requirements for grading, setbacks, benches, and drainage requirements for cut and fill slopes. Quarry construction shall be performed in accordance with building code requirements.

**County of Mendocino General Plan**

The County of Mendocino General Plan is designed to identify natural hazards such as earthquakes, flood, wildland fires, and other natural hazards. This plan includes seismic and safety elements which analyze impacts of hazards. The plan identifies policies and actions that may be implemented by the County to reduce the potential for loss of life and property damage in these areas based on an analysis of earthquakes, floods, wildland fires and landslides in terms of frequency, intensity, location, history, and damage effects. The Plan serves as a guide for decision-makers as they commit resources to reduce the effects of natural hazards.

**Mendocino County Code**

The following Mendocino County Code standards for Surface Mining and Reclamation apply to hydrology and groundwater resources related to the Harris Quarry study area.\(^{35}\)

**Surface Mining and Reclamation Standards**

The County of Mendocino fully adopts the Surface Mining and Reclamation Act of 1975 and all the provision thereof. These provisions require that:

Adverse environmental effects of surface mining operations are minimized, or, if possible, prevented, and that mined lands are reclaimed to a usable condition which is readily adaptable for appropriate alternative land uses;

\(^{35}\) Title 20 Mendocino County Zoning Ordinance.
The production and conservation of minerals is encouraged, while giving consideration to values relating to recreation, watershed, wildlife, fisheries, range and forage, and aesthetic enjoyment;

Residual hazards to the public health and safety are eliminated. (Ord. No. 4031 (part), adopted 1999.)

Pre-Disaster Hazard Mitigation Program

The Robert T. Stafford Disaster Assistance and Emergency Relief Act authorized the Pre-Disaster Hazard Mitigation Program. Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist State and local governments in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. 44 Code of Federal Regulations (CFR) part 201, Hazard Mitigation Planning, establishes criteria for State and local hazard mitigation planning authorized by the Stafford Act. The County of Mendocino has made an agreement with URS corporation for them to provide a Pre-Disaster Hazard Mitigation Plan (PDM) that meets the requirements for a Local Hazard Mitigation Plan (LHMP) and a Flood Mitigation Plan (FMP) for Mendocino County, the cities of Fort Bragg, Willits, Ukiah, and Point Arena.36

B. Potential Impacts and Mitigations

1. Criteria Used for Determining Significance

According to CEQA Guidelines, exposure of people or structures to major geological hazards is considered a significant adverse impact. The potential geologic, soils, and seismic effects of the proposed project can be considered from two points of view: (1) construction disturbance impacts (in this case rock quarrying and processing); and, (2) geologic hazard exposure to people or structures. The basic criterion applied to the analysis of construction impacts is whether construction of the project will create unstable geologic conditions that would last beyond the typically short-term construction period. However, in this case, since the project involves quarrying, construction related ground disturbance will be long-term. The analysis of geological hazards is based on the degree to which the site geology could produce hazards to people or structures from earthquakes, ground shaking, ground movement, fault rupture, or other geologic hazards, features or events.

According to CEQA Guidelines, the proposed project would have a significant environmental impact if it were to result in:

3.1a The exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;

36 Agenda for Mendocino County Board of Supervisors Meeting, May 22, 2007.
3.1b The exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving strong seismic ground shaking;

3.1c The exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving seismic-related ground failure, including liquefaction and seismic-induced landslides;

3.1d The exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving landslides;

3.1e Development located on a geologic unit or soil that is unstable (or that would become unstable as a result of the project) and which could potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;

3.1f The exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving volcanic hazards;

3.1g The loss of topsoil resulting in substantial soil erosion;

3.1h Development located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life and property;

3.1i Development in areas where soils are incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater;

3.1j The loss of availability of a known Mineral Resource important to the State of California or the local economy;

3.1k The loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan; or

3.1l The alteration or destruction of a unique geological feature.

2. Project Impacts

The project site is not within an Alquist-Priolo Earthquake Fault Zone (EFZ) (Criterion 3.1a). There are no active volcanoes in the project vicinity therefore this is not a significant impact (Criterion 3.1f).

Expansive soils are often associated with Franciscan bedrock, however the quarrying activities will remove the soil and there will be no structures built upon it, therefore expansive soils are not a significant impact. In the processing plant area, some minor amounts of expansive clay soils may be present. However, the presence of these soils will be a less than significant impact when grading the pad for the processing materials (Criterion 3.1h).
The project is a quarry intended to extract the known mineral resource, therefore this is not a significant impact (Criterion 3.1j). The project would not result in the loss of a mineral recovery site (Criterion 3.1k). The project will remove much of an entire ridge, however the ridge in question is not a unique geological feature, therefore this is not a significant impact (Criterion 3.1l).

**Quarry Unstable Slopes**

**Impact 3.1-A**  Quarry activities could result in unstable slopes.

Rau and Associates, Inc. prepared a Final Grading Plan, Sections and Details for the site. In the Final Grading Plan dated December, 2004, the plan includes excavation of the quarry to a final lowest elevation of 1,650 feet. The working face slopes of the quarry are proposed to be as steep as 1h:1v, or 45 degrees. This includes 0.75h:1v slopes with 12-foot benches every 40 feet. The benches are to have a 2% out-grade to prevent water build-up. The uppermost 25 feet, where the quarry face daylights, is to be constructed at a gradient of 1.5h:1v to accommodate weaker colluvium and friable sandstone layers. The proposed Grading Plan includes three phases of extraction. Phase 1 will extract approximately 12,210,000 cubic yards, and maintain the quarry floor at an elevation of 1,850 feet. Phase 2 will extract approximately an additional 4,250,000 cubic yards and bring the quarry floor to an elevation of 1,750 feet. Phase 3 will extract an additional 2,230,000 cubic yards and bring the final quarry floor to an elevation of 1,650 feet. The plan also includes a 24-foot wide, two-way road that connects the quarry with Highway 101 and the processing facility. Construction of this road will require cuts into the hillside. The plan includes erosion control plans for each phase of extraction. These plans include the use of berms, out slopes on benches, and sedimentation and infiltration ponds.

No landslides are shown on published geologic mapping and BCI did not identify any landslides during their site reconnaissance or review of aerial photos. Landslides are common within weaker areas of the Franciscan Complex in the vicinity of the site, and landslides are mapped in the fault zone to the east. However, the overall hard, durable rock exposed on the native slopes as well as the quarry face generally preclude large scale slope failures such as transitional or rotational rock slides, earthflows and debris flows. Small-scale slope instabilities are expected to occur following excavation of slopes to the 0.75h:1v steepness. The upper portions of cuts will be excavated in the soil and weathered rock creating instabilities at the soil/rock interface.

A stability analysis of the finished quarry slopes has been performed by BCI. They used the computer program RockPack III and proposed cut orientations to evaluate potential plane failures and/or out of slope wedge failures. They evaluated the cut slopes at both the overall 1:1 and localized 0.75:1 gradients. Considering rock type and the generally tight and irregular nature of most discontinuities at the site, BCI stated actual strengths are likely to be higher than those used for the analysis. Based on that analysis, rock cuts are expected to be stable at the proposed slopes without reinforcement. However,
there may be isolated, thin slabs of rock (generally less than about 5 feet thick) that will release onto the proposed benches during and/or after excavation.\textsuperscript{37}

The State Mining and Geology Board Reclamation Regulations establish minimum standards for the stability of reclaimed mining slopes. Section 3704(f) of the Surface Mining and Reclamation Act and Associated Regulations requires that “cut slopes, including high walls and quarry faces, shall have a minimum slope stability factor of safety that is suitable for the proposed end use and conform with the surrounding topography and/or approved end use.”\textsuperscript{38} Factors of Safety of 1.3 to 1.5 are generally considered to be appropriate for permanent quarry faces. The factors of safety for the cut slopes proposed for the project have been analyzed by BCI, who found that for the proposed 0.75:1 slopes, the Factor of Safety (FOS) against plane failure ranges from 0.7 to 0.9, depending upon the orientation of the cut face.\textsuperscript{39} Therefore, following the proposed plans is likely to result in plane failures on cut slopes, especially during seismically induced ground shaking. The slabs of rock released by plane failures on the proposed 0.75h:1v final slopes will likely be up to about half as thick (~five feet) as the intervening benches are wide. This will lead to a final cut face that will be very hard to reclaim, as the numerous small-scale plane failures will lead to a large-scale scree slope lacking a foothold for re-vegetation. Mitigation of the potential for slope failure is required to reduce this potentially significant impact. This is considered a \textit{potentially significant impact}.

\textbf{Mitigation Measures}

3.1-A.1 The applicant shall mine the quarry in a manner that is safe and prevents unstable slopes. Prior to the start of the second year of grading in the quarry expansion area, and annually thereafter, a licensed Geotechnical Engineer and Certified Engineering Geologist shall inspect the slopes of the quarry excavation and perform a slope stability evaluation. This evaluation shall be submitted to the Mendocino County Department of Planning and Building Services before October 15 of each year. The evaluation shall determine whether the excavated quarry face meets the slope stability performance criteria, which are a minimum pseudo-static factor of safety of greater than or equal to 1.1, and a static factor of safety of greater than or equal to 1.3. The pseudo-static factor of safety was derived from the California Geological Survey SP117, while the static factor of safety of 1.3 is based upon a common engineering standard for stability of temporary slopes. The evaluation shall include a determination that the factor of safety is consistent with the requirements of Section 3704(d) of the State Mining and Geology Board Reclamation Regulations. The evaluation of potential static and dynamic quarry slope conditions shall be consistent with the provisions of the California Division of Mines and Geology Guidelines for Evaluating and Mitigating Seismic Hazards (CGS Special Publication [SP] 117, 1997). In the event that the evaluation determines that the slopes do not meet the slope

\textsuperscript{37} BCI, 2006.
\textsuperscript{39} BCI, 2006.
stability performance criteria, the evaluation shall include recommendations for revisions to the grading plan that will ensure compliance with the criteria. The slope stability evaluation shall be submitted to the Mendocino County Department of Planning and Building Services no later than October 15th of each year following the second year of mining.

3.1-A.2 The uppermost 20-foot quarry cut shall be sloped no steeper than 1.5h:1v in accordance with recommendations of the report prepared by Blackburn Consulting;

3.1-A.3 Final cut slopes on the quarry walls shall be cut at the gradient required to attain a factor of safety of 1.3, with intervening 12-foot benches every 40 vertical feet.

**Impact Significance After Mitigation**

Incorporation of the mitigation measures listed above will ensure stable quarry slopes during mining operations and at the completion of mining. The measures reduce the impact of unstable slopes to a *less than significant* level.

**Unstable Slopes at the Processing Facilities Site**

**Impact 3.1-B** Unstable geology and slopes at the processing facility site could cause failure of improvements at that site.

A Grading and Drainage Plan has been prepared by Rau and Associates dated March 2005 for the processing facilities. The grading element shows 1h:1v cut slopes and 1.5h:1v fill slopes to create the level plant working area. There would be very large fills ranging from 10 to 75 feet high in the southeast corner of the site. A Geotechnical Evaluation of the proposed Harris Quarry Processing Facilities by Blackburn Consulting, Inc., dated March 28, 2005, concluded that the project is feasible provided that a design level geotechnical study is performed during final design and improvements are built per the recommendations of that report.

An Interim Erosion Controls Plan by Rau and Associates dated March 2005 includes measures for erosion control of the processing plant area. These measures include silt fences, straw wattles, surface storm drains, and other measures typically included as best management practices for erosion control measures.

The quarry project site is located on massive, hard, Franciscan Complex volcanic and meta-volcanic bedrock. This type of material is generally not considered an unstable geologic material. However, the proposed concrete and asphalt facilities area is located in an area of unknown subsurface conditions. Unstable sheared bedrock including sandstone, meta-sedimentary and mélange materials could be present in the area underlying the 4+-acre processing plant area. Proposed cut slopes are as steep as 1h:1v and proposed fill slopes are 1.5h:1v. Native, undeveloped slopes in the site area are generally not steeper than 2h:1v. The proposed slopes are potentially unstable if constructed in areas of unstable geologic materials such as sheared sandstone, meta-
sedimentary and mélange rock units and could fail during and following construction leading to mass wasting and landsliding of the pad supporting the processing facilities. The proposed slopes could also be unstable if not correctly designed and constructed, and settlement could be expected in the up to 75-foot thick fill slopes. This could result in cracking or other damage to concrete foundations, pavements, and other improvements.

When large cuts and fills are constructed there is a potential for slope instability, settlement, and other unstable conditions to result. This can be mitigated by careful design and knowledge of the existing soil, rock, and groundwater conditions. During and following construction, cut slopes can fail, engineered fills can settle or slump, and retaining structures can fail if inadequately drained or constructed with insufficient foundation support to resist both sliding and overturning motion.

Slope failures can occur where inadequately constructed sliver fills abut native slopes and peel off or slump at the boundary between native and fill material. Differential settlement may occur when fill materials of differing thickness or type settle at different rates. On slopes, increased pore pressure in soils is a principal cause of slope failure. Therefore, it is very important that fills be adequately drained.

Soil and rock materials that move during mass wasting and landsliding could potentially enter Forsythe Creek, which is located at the toe of the slope below the proposed processing area. This would increase sedimentation of the creek and other downstream receiving bodies and could potentially block the creek with soil and rock. In addition, petrochemicals and other hazardous materials will be stored on the site. A mass failure of the pad could result in toppling or rupturing of storage facilities, allowing escape of hazardous materials outside the planned spill detention areas. These materials could enter Forsythe Creek with consequent adverse impacts on water quality and fish and aquatic species, as well as potentially on human health.

The area to be graded for the processing facility pad could have expansive soils, and these soils would need to be treated accordingly when preparing the new fills. The potential for slope failure is a potentially significant impact.

Mitigation Measures

3.1-B.1 A Certified Engineering Geologist and a Geotechnical Engineer shall be identified to conduct the mitigation measures recommended below. The choice of Certified Engineering Geologist and Geotechnical Engineer shall be approved by the Mendocino County Department of Planning and Building Services.

3.1-B.2 The applicant shall construct the building pad and other grading for the processing facility in such a manner that new cut and fill slopes are stable and will not fail prior to the establishment of the proposed concrete and asphalt facilities. A design level Geotechnical Report shall be performed in the area of the proposed concrete and asphalt processing area that will identify design measures needed to ensure building pad stability, including for the design
seismic event. The following will be included in the design level Geotechnical Investigation.

a. The investigation shall specifically address the feasibility and long-term stability of 1h:1v cut slopes and 1.5h:1v fill slopes. A slope stability analysis of proposed cut and fill slopes will be performed. Recommended maximum gradients for cut slopes and engineered fill slopes will be determined.

b. The potential for generating landslides and other mass wasting in the underlying geologic materials from loading with fill soils on slopes and removal of toe support in cut slopes shall be evaluated.

c. The potential for settlement shall also be addressed and the analysis shall include characterization of gross settlement, differential settlement, and dynamic (earthquake induced) settlement within and between adjacent materials. The study will include design recommendations for structural footings and foundations to minimize future settlement.

d. Given the above investigations, specific design level mitigation measures for long-term stability of the cut and fill slopes shall be developed. These mitigation measures are anticipated to include construction of bedrock keyways underlying all fill slopes, installation of subsurface drainage measures to drain the contact between underlying bedrock/soils and overlying engineered fill soils, the use of Geogrid stabilization fabrics in the engineered fill to allow for construction of stable slopes at slope steepness greater than 2h:1v, and other design measures as identified by the Certified Engineering Geologist and Geotechnical Engineer of record for the project.

e. The Mendocino County Department of Planning and Building Services shall review and approve plan sheets to ensure conformance with the recommendations of the Geotechnical Investigation and all County grading requirements.

f. During construction the geotechnical expert shall review and inspect construction to ensure conformance with design requirements and geotechnical recommendations.

3.1-B.3 The proposed fills in the west-northwestern section of the quarry expansion area will also be evaluated in the required Design Geotechnical Report and appropriate measures to stabilize proposed fills shall be determined and incorporated into project design, consistent with the requirements of Section 3704(d) of the State Mining and Geology Board Reclamation Regulations. Proposed fills shall be properly compacted to a minimum 90% compaction relative to the maximum dry density and shall be no steeper than 2h:1v unless measures to reinforce the fills are included in project plans and a slope stability analysis is completed by the Project Geotechnical Engineer and Certified Engineering Geologist which finds that proposed fills will be stable.
Impact Significance After Mitigation

The site contains challenging slopes. However, if the recommended geotechnical engineering practices are applied, it would result in a stable processing pad. Implementation of these mitigation measures will reduce the impact of unstable geologic units to a less than significant level.

Seismic Hazards

Impact 3.1-C The project site is subject to seismic events and strong seismic ground shaking.

An earthquake in the area could cause the failure of quarry slopes and fill pad slopes.\textsuperscript{40} Due to the large, very hard, resistant rock exposed along natural slopes of the site and within the active quarry face, large failure forms such as transitional or rotational rock slides, earthflows and debris slides are not expected; however, small-scale (<5 feet) failures of the cut slopes are anticipated to occur in the finished quarry, as noted in impact 3.1-A. Numerous small-scale failures would be expected to occur in the event of seismically induced ground shaking. Small-scale failures may also occur in response to the use of explosives in the quarrying process. Benches to be constructed as part of the reclamation process will catch the majority of the small-scale failures.

The State Mining and Geology Board Reclamation Regulations establish minimum standards for the stability of reclaimed quarry slopes. Section 3704(f) of the regulations requires that cut slopes including high walls and quarry faces, shall have a minimum slope stability factor of safety that is suitable for the proposed end use and conform to the surrounding topography and/or approved end use\textsuperscript{41}. The factor of safety against wedge failure for proposed cut slopes has been determined to range between 5 and greater than 14, depending upon the orientation of the cut. Factor of safety against plane failure is about 0.7 to 0.9, indicating the likelihood of the release of thin slabs onto benches during and/or after excavation\textsuperscript{42}.

The potential for major seismic events and strong ground shaking could lead to failures in quarry faces. Failures could threaten the health and safety of construction workers and future open space users. Existing off-site landslides located near the margins of the quarry could also be affected if quarry walls or quarry margins fail or become unstable.

Major seismic events and ground shaking could also jeopardize the proposed fill slopes at the processing facilities site. As noted in the previous impact, failure of this pad could result in significant water quality and biological impacts.

These are potentially significant impacts.

\textsuperscript{40} The California Geological Survey's Probabilistic Seismic Hazard Assessment anticipated that peak ground accelerations for the site during a seismic event are approximately 60 percent that due to gravity, with a 10\% chance of being exceeded in 50 years.
\textsuperscript{41} California Department of Conservation, Office of Mine Reclamation, Surface Mining and Reclamation Act, 1975, page 61, obtained from http://www.consrv.ca.gov/OMR/smara/010107Note26.pdf
\textsuperscript{42} BCI, 2006.
Mitigation Measures

The mitigation measures recommended for Impacts 3.1-A and 3.1-B also apply to this impact. For the processing facility structures the following mitigation measures shall be implemented.

3.1-C.1 The project will comply with the California Building Code. Project development shall meet the requirements of the most recent California Building Code as amended by any amendments, additions and deletions adopted by the County of Mendocino.

3.1-C.2 The project will comply with all recommendations and requirements set forth in a design level Geotechnical Investigation report prepared by a Registered Civil/Geotechnical Engineer and with Structural Design Plans as prepared by a Registered Civil/Structural Engineer. Proper foundation engineering and construction shall be performed in accordance with the recommendations of a Registered Civil/Geotechnical Engineer and a Registered Civil/Structural Engineer.

The structural engineering design shall incorporate seismic parameters as outlined in the California Building Code. The project Geotechnical Investigation shall verify the seismic design parameters in accordance with requirements of the California Building Code.

3.1-C.3 The applicant shall obtain a building permit and complete final design review. The project applicant shall obtain a building permit through the County of Mendocino Building Division. Final Designs of planned buildings and structures shall be completed by a licensed civil/structural engineer. Structures shall not be subject to catastrophic collapse under foreseeable seismic events, and will allow egress of occupants in the event of damage following a strong earthquake.

Impact Significance After Mitigation

Incorporation of these mitigation measures will reduce the impact of seismic events and strong ground shaking to a less than significant level.

Access Road Cuts

Impact 3.1-D The new access road could potentially fail if not properly constructed.

The new access road connecting the quarry to the processing facility site requires a large road cut north of the quarry’s entrance road at Highway 101. Bedrock in this location is friable sandstone and meta-sedimentary rocks, which underlie about 5-10 feet of soil/colluvium. Excavation will expose weak bedrock and soil to the erosive forces of wind and water.
The cut section is into a northeast-facing slope with cut depths (measured from ground surface to road grade) of about 35 to 40 feet. Road cuts are planned to be at a gradient of 1.5h:1v, with a 12-foot wide mid-slope bench on the higher, upslope side. These slopes would be constructed in Franciscan Complex rock materials that are potentially unstable at this steepness. Failures of the road cuts could potentially block the access to the quarry and de-stabilize slopes in the area. This is a potentially significant impact.

Mitigation Measures

To mitigate for the weak bedrock and erodible soils present in the proposed road cuts the following mitigation measures have been identified.

3.1-D.1 Prior to the construction of the new access road connecting the quarry to the processing facilities, a Certified Engineering Geologist and a Geotechnical Engineer shall be identified to conduct the mitigation measures recommended below. The choice of Certified Engineering Geologist and Geotechnical Engineer shall be approved by the Mendocino County Department of Planning and Building Services.

3.1-D.2 The applicant shall construct the access road in a manner that it will not fail and cause landsliding. A design level Geotechnical Investigation shall be performed in the area of the proposed road cuts at the quarry entrance road that will identify design measures needed to ensure building pad stability, including for the design seismic event. The investigation shall specifically address the feasibility and long-term stability of 1.5h:1v cut slopes. The potential for generating landslides and other mass wasting in the underlying geologic materials from removal of toe support in cut slopes shall be evaluated. Specific design mitigation measures for long term stability of the cut slopes shall be developed. These mitigation measures are anticipated to include construction of bedrock keyways underlying all fill slopes, installation of subsurface drainage measures to drain the contact between underlying bedrock/soils and overlying engineered fill soils, the use of Geogrid stabilization fabrics in the engineered fill to allow for construction of stable slopes at slope steepness greater than 2h:1v, and other design measures as identified by the Certified Engineering Geologist and Geotechnical Engineer of record for the project.

3.1-D.3 The Geotechnical Investigation shall include slope stability analysis for the proposed road cuts to confirm that the proposed slopes meet minimum standards of stability such as factor of safety calculations. This study shall be performed by a Certified Engineering Geologist or Geotechnical Engineer.

3.1-D.4 Anticipated recommendations from the geotechnical investigation and slope analysis will include maximum proposed cut slope steepness which may vary from the proposed design, slope stabilization measures such as retaining walls, and other methods that may be identified during the slope stability analysis. Recommendations may also include alternative designs such as
biotechnical engineering techniques, gravity walls, buttress fills, reinforced fills, and other slope stabilization techniques.

3.1-D.5 A Geotechnical Engineer shall design any required retaining walls, gravity walls, buttress fills or other slope stabilization technique in accordance with recommendations of the geotechnical investigations and slope stability analysis and in accordance with County and State Guidelines.

3.1-D.6 An erosion control plan and planting plan shall be developed for stabilization of any soils excavated or exposed during construction activities. This plan shall be submitted to the Mendocino County Department of Planning and Building Services for review and approval.

**Impact Significance After Mitigation**

Incorporation of these mitigations will reduce the impact of weak bedrock and erodible soils to a *less than significant* level.

**Soil Erosion**

**Impact 3.1-E** Project construction and operation could cause soil erosion.

Quarry expansion activities will result in the loss of topsoil and will expose soils and weathered rock to the possible effects of soil erosion. During construction of the 4+-acre processing plant area, site-grading activities will remove vegetative cover, disturb, and expose soil that could become mobilized by storm waters during construction activities. According to the Soil Survey of the area, the exposed soils are potentially erodible silty and sandy soils. These soils are subject to the effects of erosion during and following site grading activities. The existing north-south drainage that drains road runoff along the east side of the quarry outlets to an unprotected slope where erosion is occurring, which would be exacerbated by project-generated runoff. Runoff from the processing site will outlet to an unprotected hillside after traveling through the bioretention swale. Unprotected sandy soils will erode, including the formation of rills and gullies during heavy seasonal rainstorms. These impacts are discussed further in Impact 3.2-A.

The runoff from unprotected soil areas will include significant sediment loading that could cause increased turbidity and sedimentation in downstream receiving channels. Project impacts associated with soil erosion and topsoil loss are considered *potentially significant impacts*.

**Mitigation Measures**

3.1-E.1 The applicant shall prepare a final erosion control plan that will be incorporated into the water quality protection program required in Mitigation Measure 3.2-A.1 This plan shall include at least the following:

- The project shall comply with current Regional Water Quality Control Board guidelines and shall adopt acceptable best management practices
(BMPs) for control of sediment and stabilization of erosion on the subject site.

- Final erosion control plans shall be prepared and implemented for the processing plant development portion of the project, the quarry site, and other project elements including access roads, bio-retention basin outlets and other areas where stormwater could flow over disturbed soils and bedrock. The Erosion Control Plans shall be submitted to the Mendocino County Water Agency and the Mendocino County Department of Planning and Building Services for review and approval prior to issuance of a Grading Permit.

- The plan shall identify measures needed to address existing erosion problems downstream of the outlet of the culvert draining the north-south ditch on the east side of the site. This may include installation of energy dissipaters or extending a culvert to the Forsythe Creek tributary (with an energy dissipater at the outlet). The specific design criteria shall be submitted to the Mendocino County Department of Planning and Building Services and the Mendocino County Water Agency for review and approval.

- The plan shall include measures to reduce any erosion of the hillside at the outfall of the bioretention swale.

- The plan shall include measures needed to ensure that all stored topsoil is protected from erosion.

- The plans shall include the final locations and specifications of recommended soil stabilization techniques, such as placement of straw wattles, silt fence, berms, and storm drain inlet protection. The plans shall also include acceptable methods of installation of erosion control materials, and appropriate use of these materials, including the use of straw wattles or other materials on steeper slopes in lieu of silt fences. The plans shall also depict staging and mobilization areas with access routes to and from the site for heavy equipment. The plan shall include temporary measures to be implemented during construction, as well as permanent erosion control measures.

- County staff or representatives shall visit the site during grading and construction to ensure compliance with the erosion control plans, as well as note any violations, which shall be corrected immediately. A final inspection shall be completed prior to occupancy. Elements of this plan may be incorporated into the SWPPP, where applicable.

**Impact Significance After Mitigation**

Implementation of the above mitigation measures will reduce the impact from soil erosion and the loss of topsoil to a *less than significant* level.