3.0 BASIS OF REVEGETATION DESIGN FIELD STUDIES

3.1 INTRODUCTION

To meet the revegetation design objectives of establishing a self-sustainable native plant community, a study was conducted of the soils and vegetation within reference sites, the revegetation area for the reconstructed slope, and at potential topsoil harvest sites. Information gathered during this baseline study was utilized to formulate the design of the soil preparation plan and the target plant species composition for the revegetation site. The planting palette was further refined based on plant species performance at the Pilot Revegetation Site.

3.2 CHARACTERIZATION OF REFERENCE SITES

3.2.1 Overview

The term reference site refers to an area of land that comprises a plant community similar to the desired plant community for a restoration project (SERG 2001, Bowler 2000, Read et al. 1996). The reference site provides a model of what the area to be restored should resemble once the revegetated plant community has established. In addition, the reference site provides information about the environmental characteristics that allow the desired vegetation type to grow. Ecological factors are compared between the reference site and the restoration site and typically include such variables as plant species composition, soil profile stratification, depth of topsoil, soil nutrient status, soil texture, soil organic matter content, the status of the soil microbial community, and the slope and aspect of the site. The goal of this comparison is to determine which factors control the composition of species within the desired plant community and to determine if any of these factors can be re-established within the restoration site to increase the probability of successful plant establishment.

To determine the appropriate target species composition and topsoil characteristics for the Leona Quarry revegetation project, six reference sites were identified and analyzed (Figure 3). In this report, reference sites are defined as areas adjacent to the project site where: 1) native vegetation is growing; 2) no quarry activities have occurred, with the exception of the disturbed sagebrush reference site (see below); and 3) the parent material consists of either tuff or rhyolite. The reference sites were then compared to proposed topsoil reuse areas (Section 3.2) and proposed cut and fill soils (Section 3.3) to determine the probability of successful plant establishment.

3.2.2 Methods

Data on the soils, vegetation, and other pertinent environmental characteristics were collected from the six reference sites. The six reference sites were selected based upon the plant species composition, parent material, and proximity to the project site. The reference sites are all located north/northwest of the revegetation site (Figure 3). Soil samples were collected from the sites by digging three to four soil pits (sub-samples) to a minimum depth of 12 inches (30 cm) at each

Leona Quarry Slope Revegetation Plan

site. Sub-samples from each site were composited to create an approximately one-gallon soil sample. All sub-samples were collected starting immediately below the soil litter layer and extending down to the bedrock layer. Large rocks, plant litter, and debris were removed. Data collected from each soil pit included general descriptions of such variables as the soil profile, the percent rock fragment, depth to bedrock, aspect (defined as the direction toward which the land surface is oriented), elevation, rooting zone, and plant community composition. Each variable was qualitatively evaluated and used to assess the environmental characteristics of the site. In addition, soil samples were sent to the Soil and Plant Laboratory (Santa Clara, CA) for nutrient, texture, organic matter content, and pH analysis.

3.2.3 Results

The reference sites are classified as central coastal scrub for the California sagebrush dominated sites and northern mixed chaparral for sites dominated by chamise *(Adenostoma fasciculatum)* (Holland 1986). In addition, soils within a patch of coast live oak woodland were sampled. The majority of the reference sites are outside of the previously disturbed quarry boundaries, with the exception of the disturbed sagebrush reference site (Figure 3). The disturbed site was previously part of the active quarry site, but has since been recolonized by California sagebrush. Because of the disturbed nature of this site, it provides a good reference in terms of the likely conditions present within some of the reconstructed slope locals.

The topography of the reference sites is very steep with gradients of 2H: 1 V and steeper. The reference sites have west to southwest aspects with the exception of the disturbed sagebrush site, which has an aspect that is more to the south. Elevation ranges from 700 feet above mean sea level (MSL) to approximately 1000 feet above MSL. The plant community types form a mosaic across the landscape with each plant community gradually grading into the next.

3.2.3.1 Undisturbed Chamise Reference 1 (Rhyolite). Undisturbed chamise reference site 1 is dominated by a dense cover of chamise with California sagebrush, coyote brush, deerweed *(Lotus scoparius)*, coast range melic *(Melica imperfecta)*, big squirreltail *(Elymus multisetus)*, creeping snowberry *(Symphoricarpos mollis)*, orange bush monkeyflower *(Mimulus aurantiacus)*, poison oak *(Toxicodendron diversilobum)*, and golden yarrow *(Eriophyllum confertiflorum* var. *confertiflorum)* growing in gaps within the chamise canopy. Little to no vegetation grows beneath the dense canopy of the chamise. The plant community type is located at elevations ranging from approximately 700 to 850 feet above MSL.

The parent material of this site is primarily rhyolite. The soil profile consists of a light brown, shallow mineral soil approximately 13 inches thick, overlying unconsolidated bedrock. The mineral soil contains approximately 30-35% rock fragments, with the chamise roots penetrating the unconsolidated bedrock.

3.2.3.2 Undisturbed Chamise Reference 2 (Tuff). Undisturbed chamise reference site 2 is similar to the first chamise reference site including the species composition, rooting characteristics, and aspect. The primary differences between the two sites are that the parent material of reference site 2 is tuff, the soil layer is thicker and the elevation is 750 to 1000 feet above MSL. A leaf litter layer (0.5-1 inch thick) was present underlain by an approximately 4-inch thick dark brown organic matter enriched layer. This was underlain by mineral soil to a

depth of at least 18 inches. Relatively well-developed soil aggregate structure was present in the upper 12 inches of the profile.

3.2.3.3 Undisturbed Sagebrush Reference (Rhyolite). The undisturbed sagebrush reference site is dominated by California sagebrush and has a relatively dense understory composed of deerweed, coast range melic, poison oak, golden yarrow, coyote brush, wild cucumber *(Marah fabaceus)*, California poppy *(Eschscholzia californica)*, and caterpillar phacelia *(Phacelia cicutaria)*. The site has less than 10% bare ground, on average. This plant community type occurs at elevations between approximately 500 to 650 feet above MSL.

The parent material associated with the undisturbed sagebrush reference site is composed primarily of rhyolite. The soil has a one-inch thick black organic soil layer on top of a well-developed dark brown mineral soil. The mineral soil is approximately 23 inches thick and contains 10-15% rock fragments overlying the unconsolidated bedrock. The roots of the plants at the site penetrate both the mineral soil and unconsolidated bedrock.

3.2.3.4 Undisturbed Chamise/Sagebrush Reference (Rhyolite). The undisturbed chamise/sagebrush reference site represents a transition, or ecotone, between the undisturbed chamise and undisturbed California sagebrush reference sites. The site occurs at elevations of approximately 650 to 750 feet and is composed of a relatively even mix of chamise and California sagebrush. Other native species occurring in this ecotone include deerweed, California figwort *(Scrophularia californica* ssp. *californica)*, wild cucumber, coast range melic, toyon *(Heteromeles arbutifolia)*, coyote brush, golden yarrow, poison oak, and blue elderberry. The percentage of bare ground is approximately 10-15%.

The chamise/sagebrush site occurs on rhyolite. The soil associated with the chamise/sagebrush reference site has a small, black, organic soil layer (less than a half inch deep) on top of a weakly developed brown mineral soil. The brown mineral soil overlies unconsolidated bedrock. The mineral soil contains approximately 20-25% rock fragments and is approximately 12 inches thick. The roots of many of the understory species penetrate to a depth of about 10 inches, while the roots of the shrubs penetrate both the mineral soil and the unconsolidated bedrock.

3.2.3.5 Disturbed Sagebrush Reference (Rhyolite). The disturbed sagebrush reference site occurs in an area that was previously quarried, but has since been recolonized by California sagebrush and other plant species such as pampas grass, red brome *(Bromus madritensis* ssp. *rubens)*, ripgut brome *(Bromus diandrus)*, deerweed, and coyote brush. Factors contributing to the re-establishment of vegetation at this site may have included moderate slopes, favorable soils, appropriate hydrology, and/or nearby seed source. The disturbed sagebrush reference site occurs at the same elevation and in close proximity to the undisturbed sagebrush reference site. The disturbed site is dominated by California sagebrush and contains a mostly bare ground understory with very little vegetation growing between the sagebrush plants.

The soil that occurs on the disturbed sagebrush reference site is a thin, poorly developed mineral soil approximately 1-2 inches thick that has 80-90% pea-size rocks overlying unconsolidated bedrock. The site is composed of rhyolite parent material. The roots of the California sagebrush penetrate the mineral soil and the unconsolidated bedrock to a depth of approximately 12 inches.

3.2.3.6 Undisturbed Coast Live Oak Reference (Rhyolite). The coast live oak reference site occurs adjacent to the undisturbed chamise and sagebrush reference sites along a small ridgeline at approximately 600 to 800 feet elevation. The site is dominated by coast live oak with an understory comprised of poison oak, wild-cucumber, and coast range melic and about 30-40% bare ground.

Approximately 6-inches of decomposing leaf litter occurs above the soil surface. The leaf debris layer serves as a food source for the soil microorganisms. A thick organic soil layer, which is being created in part by the soil microorganisms breaking down the above ground leaf debris, can be found in the first 2 to 3 inches of soil. Below the organic soil layer is an approximately 13- inch thick, well-developed gray-brown mineral soil, containing approximately 30-40 % rock fragments. The mineral soil overlies the unconsolidated bedrock. The parent material within the coast live oak reference site is rhyolite.

3.2.4 Soil and Plant Laboratory Results

The Soil and Plant Laboratory analysis results and report are presented in Appendix A and summarized below. The reference site soils were characterized as gravelly loam, gravelly clay loam, or gravelly sandy clay loam (Table 1). The soil analysis also indicated that the majority of the reference site soils have low concentrations of nitrogen (5 -13 ppm) and phosphorous (1 - 8 ppm) (Table 1). Potassium levels ranged from 170 - 430 ppm and were considered to be adequate for most plants. The ratios between calcium and magnesium were adequately balanced for all soils within the reference areas. The pH's of the soils were moderately acidic (5.3 - 5.9), with the exception of the disturbed sagebrush site (pH = 7.4). The organic matter contents were unexpectedly high at the undisturbed chamise and sagebrush reference sites (3.7 - 4.4%) and coast live oak site (7.2%). In contrast, the disturbed sagebrush site exhibited a relatively low to moderate percent organic matter (1.1%).

Table 1. Leona Quarry Soil Laboratory Analysis Results for Select Key Factors (See Appendix A for entire soil laboratory analysis results)

Sample ID	% OM*	Texture** (USDA)	% Clay	pH	NO_3 ppm	PO_4 ppm	K ppm	Ca ppm	Mg ppm
Reference Soils									
Undisturbed Chamise 1 (Rhyolite)	3.9	GL	22.9	5.5	13	1	290	1340	330
Undisturbed Chamise 2 (Tuff)	3.7	GL	24.5	5.5	7	2	250	1450	388
Undisturbed Sagebrush (Rhyolite)	4.4	GCL	22.9	5.9	6	4	400	2000	672
Undisturbed Chamise/Sagebrush (Rhyolite)	4.3	GL	20.9	5.9	7	2	250	1860	372
Disturbed Sagebrush (Rhyolite)	1.1	GCL	26.4	7.4	5	6	170	3050	402
Undisturbed Coast Live Oak (Rhyolite)	7.2	GSCL	23.9	5.3	6	8	430	2290	506
Cut and Fill Revegetation Soils									
Rhyolite 1	0.6	GL	24.9	6.9	5	7	70	1620	856
Rhyolite 2	0.6	GSL	16.9	7.3	4	1	120	1430	896
Tuff	0.1	GCL	22.3	5.3	6	6	90	190	828
Topsoils									
Topsoil 1 a (Grass)	0.5	GSCL	25.4	6.8	4	9	60	2140	2050
Topsoil 1 b (Shrub)	0.6	GSCL	21.5	6.7	4	9	70	2440	3220
Topsoil 1 c	0.5	GSL	18.5	6.7	4	4	90	3290	2300
Topsoil 2 – Oak Woodland	3.3	GL	26.8	5.0	6	5	310	1330	546
Topsoil 2 – Grass/Shrub	1.9	GL	26.4	5.7	10	1	120	1560	540
Topsoil 3	1.7	GL	26.5	7.3	4	16	110	2870	830
Topsoil 4	1.6	GCL	26.5	7.3	11	20	190	2330	668

* OM = Organic Matter

** G = Gravelly, S = Sandy, C = Clay, L = Loam.

3.3 ASSESSMENT OF SOIL SUITABILITY ON THE CUT AND FILL SLOPE AREAS

3.3.1 Overview

The parent material at Leona Quarry is primarily composed of two types of bedrock: tuff and rhyolite (Berlogar Geotechnical Consultants 2000). Rhyolite is further divided into rhyolite 1 and rhyolite 2 based on weathering and alteration of the bedrock. Following site grading, these parent materials will comprise the majority of the soil and sub-soil within the cut and fill slopes, and therefore, will need to support most of the plant growth. Analysis of these soils provides an understanding of the physical, chemical, and biological make-up of the soil and helped determine which, if any, soil amendments are needed to make the soils more suitable for native plant growth.

3.3.2 Methods

Samples of tuff and rhyolite were collected and analyzed using the same methods that were used for the soils from the reference sites (see Section 3.2.2). Three areas were sampled including a site composed of tuff, a site composed of rhyolite 1, and a site composed of rhyolite 2 (Figure 3). Soils were evaluated based on quantitative data obtained from Soil and Plant Laboratory and qualitative observations made in the field. The cut and fill revegetation soils were each compared to the reference site soils. Soil amendments were partially based on recommendations from the Soil and Plant Laboratory.

3.3.3 Soil Suitability for Vegetation Establishment

The tuff, rhyolite 1, and rhyolite 2 sample areas all occur within the active quarry and are primarily composed of sub-soil exposed by quarry excavation (Figure 3). The tuff sample area contains little vegetation, primarily due to the steep slopes. The rhyolite 1 and 2 sample areas comprise non-native ruderal species including wild oats *(Avena fatua)*, red brome, Italian thistle *(Carduus pycnocephalus)*, and French broom. The rhyolite 2 sample area is relatively flat, while the rhyolite 1 sample area has a steeper grade. Table 1 provides details about some of the most important soil factors for plant growth at Leona Quarry. The three cut and fill soil samples had low organic matter content (0.1% - 0.6%). The rhyolite 1 and 2 soils had relatively high pH (6.9 and 7.3, respectively), while the tuff sample had a pH of 5.3. Nitrate and phosphate concentrations were similar to the reference sites, while the potassium levels in all three soils were lower than the concentrations in the reference sites. The ratio of calcium to magnesium was also relatively low for all three samples compared to the reference sites indicating a lack of calcium and relatively high magnesium in these soils.

Although the tuff, rhyolite 1, and rhyolite 2 revegetation site soils share some of the same characteristics as the reference site soils (e.g. low nitrate and phosphate concentration), overall the soils do not match those found at the reference sites. Therefore, the cut and fill soils will require soil amendments and/or topsoil placement prior to seeding and planting. The goal of the amendment and topsoil additions is to establish a soil that more closely matches the reference site soils and is thus more appropriate for the establishment of the target habitat.

3.4 ASSESSMENT OF ON-SITE TOPSOIL SUITABILITY FOR POTENTIAL REUSE

3.4.1 Overview

Topsoil provides many benefits to native plantings including providing organic matter, nutrients, native plant seed, and soil microbes to otherwise harsh revegetation conditions (Holmes 2001). Therefore, the potential for topsoil salvage from on-site locations and reuse on the revegetation site was investigated. The primary objective of this investigation was to identify areas that are composed of topsoils that match, as much as possible, the soil found within the reference sites. If necessary, this may require the addition of soil amendments.

Potential topsoil salvage areas were chosen based on multiple factors including the footprint of grading, the characteristics of the soils, size of area, and the composition and density of vegetation. Five potential topsoil salvage areas were identified and are shown in Figure 3. These included an area along Campus Drive (Topsoil 1), an area composed of an oak woodland and grasses and shrubs occurring along the south border of the site (Topsoil 2 – Oak Woodland and Topsoil 2 – Grass/Shrub), an area within the quarry that is composed of fill material (Topsoil 3), an area composed of French broom in the central portion of the quarry (Topsoil 4), and a topsoil adjacent to existing gullies, which will be filled during grading operations (Gully Fill Topsoil).

The majority of the potential topsoil salvage areas are located within the footprint of former quarry activity. As such, the soil profile in these areas has been significantly altered. Therefore, the term topsoil is used loosely in this context to refer to the upper zone of the soil profile. Woody and herbaceous vegetation has recolonized these areas and reinitiated the process of topsoil development.

3.4.2 Methods

Samples from the potential topsoil salvage areas, excluding the Gully Fill Topsoil, were collected and analyzed using the same methods that were used for the soils from the reference sites (see Section 3.1.2). Soils were evaluated based on quantitative data obtained from Soil and Plant Laboratory and qualitative observations made in the field. The determination of which topsoil salvage areas provide suitable topsoil was based on a critical analysis of the similarity of each site's topsoil to the reference sites' topsoils. Soil amendments were based, in part, on recommendations from Soil and Plant Laboratory. The Gully Fill Topsoil was qualitatively assessed in the field to determine whether it was suitable for use within the gully repair sites. Quantitative data was not collected from this topsoil.

3.4.3 Results

The raw chemical and particle size analysis data is presented in Appendix A. Table 1 provides a summary of this data.

3.4.3.1 Topsoil 1. Topsoil 1 occurs at the top of the quarry at approximately 1000 feet above MSL (Figure 3). Topsoil 1 comprised fill from on-site that was placed along Campus Drive sometime in the early 1990's (Chapman 2001, pers. comm.). A sparse cover of predominantly

non-native grasses including wild oats and Italian ryegrass (*Lolium multiflorum*) has established. Native species such as coyote brush, poison oak, big squirreltail, and California poppy are sparsely distributed throughout this site. Three soil samples were taken from the Topsoil 1 location (Topsoil 1 a, b, and c). Topsoil 1a and 1b were sampled in January 2003 from areas comprising grasses and shrubs, respectively, while Topsoil 1c was sampled in May 2001 from both grass and shrub dominated areas. All samples had similar characteristics (Table 1). The organic matter content is relatively low (0.5-0.6%) and the pH is higher than that found in the majority of the reference sites (6.7-6.8). Nitrate levels are 4 ppm for all samples, while phosphate range from 4-9 ppm. These levels are similar to the reference sites' nitrate and phosphate levels (Table 1). The potassium levels (60-90 ppm) and the ratio of calcium to magnesium, on the other hand, are low compared to the reference sites.

Topsoil 1 will provide suitable topsoil for the cut slope if appropriate soil amendments are incorporated (see Section 4.3.2.1). It is recommended that the top 12 inches of topsoil be harvested from the site and appropriate amendments incorporated. The total volume of topsoil available at Topsoil 1 is approximately 7450 cubic yards.

3.4.3.2 **Topsoil 2.** Topsoil 2 is located at approximately 500 to 750 feet above MSL (Figure 3). The area was divided into two sections for topsoil analysis. The first area occurs in the southeast corner of the site and consists of an oak woodland composed primarily of mature coast live oak and valley oak (*Quercus lobata*). The understory is comprised primarily of a 2 to 3-inch thick layer of leaf litter with patches of grasses growing within gaps in the canopy. The second sample was taken from an area north of the oak woodland composed of open grassland with scattered patches of shrubs. The vegetation within this area consists of coyote brush, California sagebrush, poison oak, wild oats, Italian ryegrass, ripgut brome, squirreltail, and coast range melic. The oak woodland and grass/shrub topsoils have organic matter contents of 3.3% and 1.9%, respectively (Table 1). The pHs of the soils are 5.0 for the oak woodland and 5.7 for the grass/shrub, which are both similar to pHs of the reference sites. The nutrient statuses of the two topsoil samples are also similar to most of the reference sites. Nitrate levels for the oak woodland and the grass/shrub site are 6 ppm and 10 ppm, respectively, the phosphate levels are 5 ppm and 1 ppm, respectively, and the potassium levels are 310 ppm and 120 ppm, respectively. The ratios of calcium to magnesium are slightly low compared to the reference sites for both Topsoil 2 sites.

Because both Topsoil 2 samples are comparable to the reference sites, it is recommended that the topsoil from this site be considered for reuse. The total volume of topsoil available at Topsoil 2 is approximately 2856 cubic yards assuming that 1.5 vertical feet is available for harvest.

3.4.3.3 **Topsoil 3.** Topsoil 3 is located at approximately 480 feet above MSL (Figure 3) and is composed of many non-native ruderal species including wild oats, ripgut brome, red brome, and French broom. This soil was imported to the site from primarily two off-site sources (Chapman 2001, pers. comm.). The organic matter content is somewhat low (1.7%) and the pH is high (7.3) compared to the reference sites (Table 1). Although nitrate levels are similar to the reference soils (4 ppm), the phosphate level is extremely high (16 ppm). No literature was found concerning the role of phosphate in French broom growth and invasion, but it is hypothesized that the high level of phosphate within the topsoil is the main contributing factor in the success of French broom at this site. In addition, patches of French broom surround the site. The soil

potentially has a high number of viable French broom seeds that could germinate on the reclaimed slope, which could be detrimental to the revegetation of the target habitats.

Because Topsoil 3 is composed of fill material of unknown origin and the characteristics of the soil may encourage the expansion of French broom, it is recommended that Topsoil 3 not be used within the revegetation site.

3.4.3.4 **Topsoil 4.** Topsoil 4 is located along the southern portion of the active quarry at approximately 550 feet above MSL (Figure 3). The site is dominated by French broom and other non-native ruderal species. Soils at this location were high in nitrate (11 ppm), moderate in potassium (190 ppm), and very high in phosphate (20 ppm) (Table 1). This high phosphate level may lead to French broom invasion within the reclaimed slopes. Thus, Topsoil 4 is not recommended for reuse.

3.4.3.5 **Gully Fill Topsoil.** The topsoils located adjacent to the gullies within the northwest portion of the site, which will be filled with rock riprap and topsoil, were qualitatively analyzed in the field. Soil samples were not taken to the Plant and Soil Laboratory because the area in which the gully fill topsoil will be used will not be planted with native woody vegetation. Three soil pits were dug to a depth of 12 inches. The texture of the soil was found to be similar to the disturbed sagebrush reference soils with a gravelly loam texture. The depth of topsoil is approximately 12 inches. The areas are comprised of a moderate cover of vegetation including California sagebrush, deerweed, coyote brush, and grasses. Patches of French broom are present on the west side of the topsoil area. Based on the soil texture and the presence of desirable plant species on the site, this topsoil will be appropriate for use within the gully repair sites. The total volume of the Gully Fill Topsoil available is approximately 670 cubic yards.

4.0 GRADING AND SOIL PREPARATION PLAN

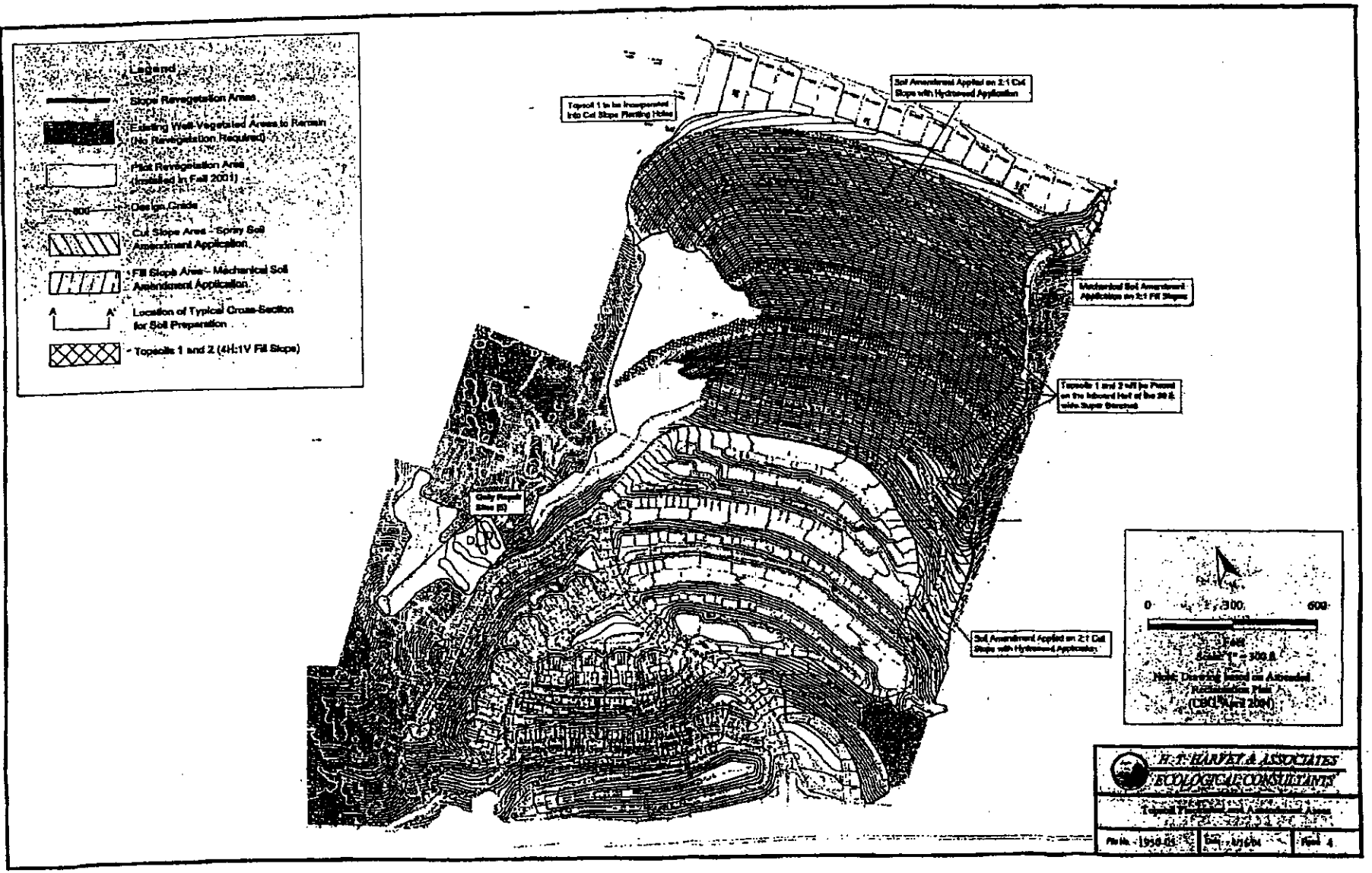
4.1 SLOPE GRADING PLAN

The Leona Quarry conceptual grading plan (Carlson, Barbee, & Gibson, April 2004) proposes to regrade/reconstruct the majority (37.5 acres) of the high quarry slope (Figures 2 and 4). The purpose of the proposed slope reconstruction and grading work from geotechnical and engineering perspectives is to create a stable slope that is safe for the lower development area proposed at the toe of the reconstructed slope. Accordingly, the conceptual grading plan proposes reconstruction of a 2H:1V, benched slope. The majority of the benches will be 10 feet wide and the plan also includes three, 30-foot wide benches (Figure 4). Slope drainage throughout the site would be controlled via a system of cement-lined V-ditches situated at the toe of each slope segment and connected to a network of drainage pipes.

The proposed slope gradient of 2H:1V represents a substantial reduction in steepness from the existing slopes. By cutting the upper portion of the slope and utilizing this cut material to fill the lower portion of the slope, a gentler slope will be constructed. The cut slope area to be revegetated is approximately 18.2 acres and is located across the upper 1/2 to 1/3 of the slope and within the southeastern margin of the site (Figure 4). An approximately 19.3-acre fill slope area is located in the central and lower portion of the revegetation planning area (Figure 4). The fill slope area will be constructed in lifts of up to approximately 160 vertical feet of compacted material harvested from the cut slope area (Berlogar 2003). Soil compaction is expected to be approximately 95% in the interior portion and approximately 85-90% in the upper one (1) foot of the fill slopes (Berlogar 2001, pers. comm.). Based on the surface geology map and borings, the material to be cut and utilized to construct the fill slope will be derived primarily from the Tuff bedrock type with some Rhyolite (Berlogar 2000). Thus, the revegetation site soil surface after slope reconstruction in both the cut and fill areas should be composed of primarily Tuff derived material with some Rhyolite. Since the Tuff is a relatively friable material, a significant component of finer grained soil particles should be generated from grading operations during fill slope construction (Berlogar 2001, pers. comm.).

Four gullies that currently exist in the northwest portion of the development area will be excavated down to bedrock and backfilled with a subdrain system, filter fabric, and rock riprap (Figure 4). The riprap will be filled to the plane of the adjacent slope and will be placed in layers within the gullies. After each rock layer is set within the gullies, a layer of topsoil from the Gully Fill Topsoil area will be placed over the riprap to fill-in the gaps between the rocks to the extent possible. A fifth gully located west of the other gully sites will also be repaired (Figure 4). These repairs will include cleaning out loose soil, installation of a subdrain, and filling with a compacted fill to the grade of the surrounding areas.

The remainder of the slope revegetation area, which primarily occurs within the northern portion of the site, will not be graded, thus keeping its current steep (approximately 1H:1V) grade.


Legend
Slope Revegetation Areas
Existing Well-Vegetated Areas to Remain (No Revegetation Required)
Pilot Revegetation Area (installed in Fall 2001)
Design Grade
Cut Slope Area - Spray Soil Amendment Application
Fill Slope Area - Mechanical Soil Amendment Application
A
A'
Location of Typical Cross-Section for Soil Preparation
- Topsoils 1 and 2 (4H:1V Fill Slope)
Topsoil 1 to be Incorporated into Cut Slope Planting Holes
Soil Amendment Applied on 2:1 Cut Slope with Hydroseed Application
Mechanical Soil Amendment Application on 2:1 Fill Slopes
Topsoils 1 and 2 will be Placed on the Inboard Half of the 20 ft. wide Slope Benches
Soil Amendment Applied on 2:1 Cut Slope with Hydroseed Application
0
1" = 300 ft.
600
Note: Drawing based on Amended Revegetation Plan (CBCI, April 2004)
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

4.2 SOIL PREPARATION/AMENDMENT PLAN

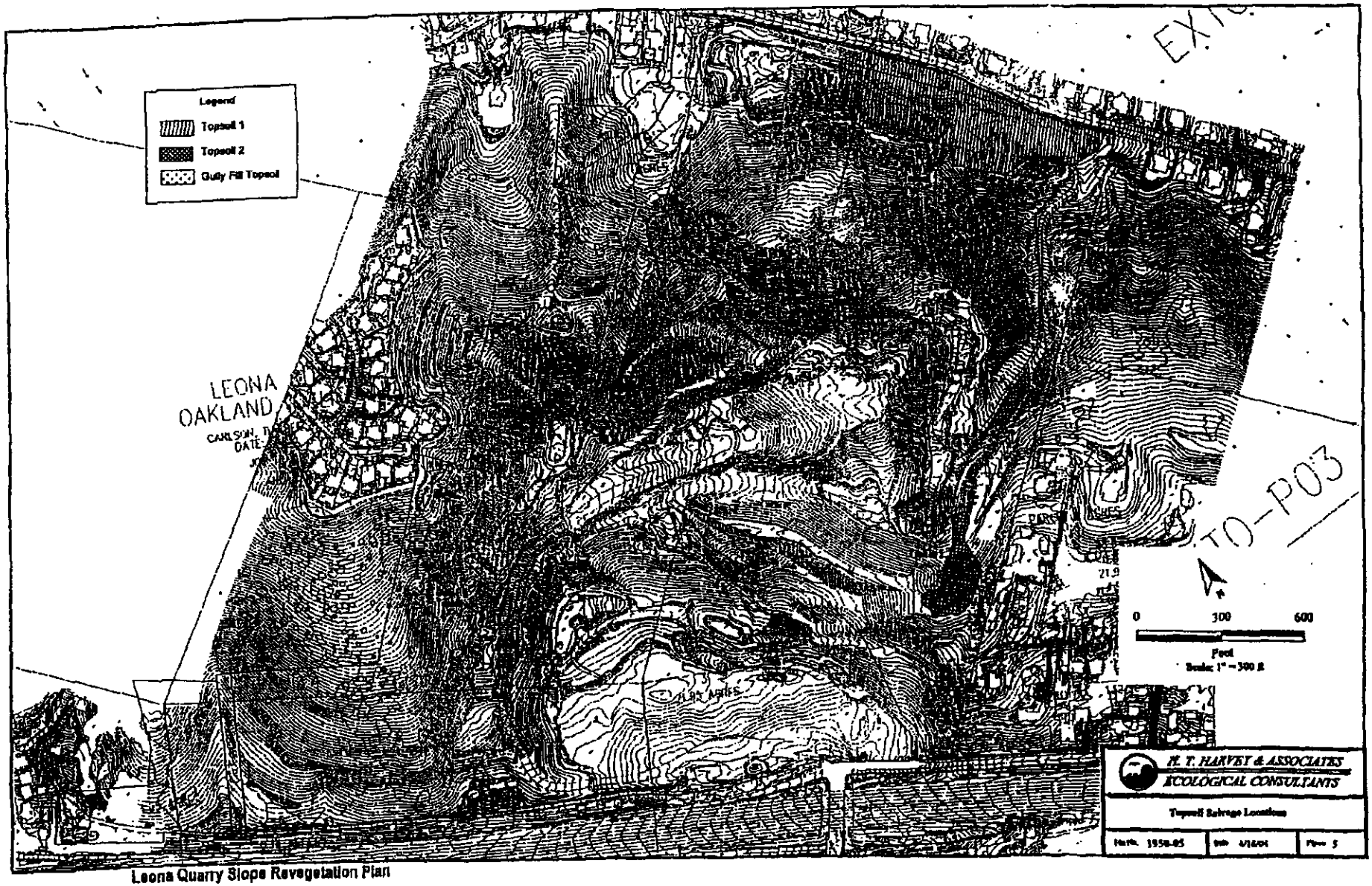
4.2.1 Overview

The proposed conceptual grading plan is a critical first step toward increasing the likelihood of revegetation success since it would transform the majority of the currently unstable, erosive slope into a physically stable soil surface suitable for vegetation colonization and establishment. However, the soil surface following regrading efforts will be composed of subsoil cut from depths far beneath the existing soil surface. Based on comparison of reference site soils to the revegetation site soils (Section 3.0) and on past restoration site experience, poor, slow vegetation establishment would be expected without soil amendments or respread topsoil (Holmes 2001). Subsoil that has not interacted over a substantial time period with vegetation and soil fauna typically exhibits low fertility. Generally, the low fertility of subsoils is due to a lack of plant available nutrients, low organic matter, absence of a functional soil microbial community, low soil aggregate formation, and low water holding capacity (Coleman and Crossley 1996, Jim 2001, Harris 1999). The process of vegetation colonization on newly exposed rock/soil surfaces is known as primary succession (Odum 1959). If left to occur without human intervention, the natural process of primary succession on the site's stable, regraded soil surface would occur over the course of decades and eventually lead to the improvement of soil structure and fertility along with a concomitant gradual increase in vegetative cover. Plant species composition would likely shift from an annual/perennial grass dominated community to a shrub dominated association, and depending on site conditions, potentially a tree dominated association (Connell and Slatyer 1977, Huston and Smith 1987). The soil preparation/amendment plan presented here, coupled with active seeding, planting, and short-term irrigation and weed control, should serve to greatly increase the rate of primary succession at the site.

The goal of the soil preparation/amendment plan is to create edaphic conditions suitable for initial establishment of seeded and planted native vegetation. In addition, the soil amendment and planting plans together are designed to promote the progressive, long-term improvement of edaphic conditions. Successful native plant establishment will lead to progressive soil development via the positive feedback between increasing plant productivity and development of a leaf litter layer (O Horizon), healthy soil microbial/faunal community, increased organic matter build-up and decomposition, soil aggregate formation, and improved water holding capacity. Composted organic matter will form a key component of the soil amendment strategy because it is well known that organic matter is critical to soil aggregate formation, soil microbial community development, plant available nutrient levels, and water holding capacity (Darwish 1995, Harris 1999).

4.2.2 Topsoil Harvesting and Stockpiling

Topsoils 1 and 2 will be harvested (stripped) and stockpiled as one of the first slope grading operations (Figure 5). A restoration specialist will work with the grading contractor prior to grading operations to determine the exact location of topsoil harvest from these sites. Topsoil 1 will be excavated to an approximate depth of 1 foot, and the upper approximately 1.5 feet will be harvested from Topsoil 2. Tree trunks, branches and root wads greater than 6 inches in diameter



Leona Quarry Slope Revegetation Plan

will be harvested and stockpiled separately for use as large woody debris habitat on the site (Section 5.0). In addition, native tree and shrub branches less than 6 inches in diameter could be chipped and stockpiled for use as wood chip mulch during plant installation (Section 5.0).

Grading operations should be scheduled to minimize the time that topsoil is stockpiled. Topsoil should be labeled and mapped on plans to allow the contractor to distinguish it from other soils. Topsoil piles should not exceed 10 feet in height and should be linear rather than one large heap. The stockpiles will be protected from erosion during the rainy season by hydroseeding in a one-step application. Table 2 lists the species to be used and the pounds of pure live seed (PLS) per acre that will be applied. In addition, wood fiber (700 lbs/acre), non-asphaltic tackifier (120 lbs/acre), and inorganic fertilizer (6N-20P-20K at 300 lbs/acre) will be applied with the seed in the first application. Topsoil stockpiles should be hydroseeded prior to October 15 of each year of storage to ensure that they are protected prior to the first rain event.

Table 2. Hydroseed mix for stockpiled topsoil.

Common Name	Scientific Name	Minimum % Purity	Minimum % Germination	Pounds of PLS/Acre	Total Pounds / Acre
California brome	*Bromus carinatus*	95	80	8	10.5
three week fescue	*Vulpia microstachys*	90	80	5	6.9
regreen sterile wheat	*Triticum* x *Elymus*	90	80	35	48.6
arroyo lupine	*Lupinus succulentus*	98	85	2	2.4
			Total	50	68.4

4.2.3 Topsoil Amendments

Topsoils 1 and 2 will be amended prior to reuse. Amendments should be incorporated into the salvaged topsoils immediately prior to applying the topsoil to their respective locations.

4.2.3.1 Topsoil 1 Amendment. Amendments for Topsoil 1 will be uniformly mixed into the topsoil prior to topsoil reuse. Table 3 provides the application rates for bulk blending with Topsoil 1. The blend of 50% yardwaste compost and 50% recycled wood fines is recommended as the organic amendment since it has an appropriately low C:N ratio of <23 and has lower phosphate concentrations compared to 100% yardwaste compost. High phosphate concentrations were associated with on-site topsoils dominated by French broom, an undesirable non-native plant.

Table 3. Topsoil 1 Amendments and Application Rates.

Amendment Type	Application Rates
Organic Compost Blend*	2 cy organic matter/10 cy soil
Soil Sulfur	6 lbs/10 cy soil
Potassium Sulfate *(0-0-50)*	6 lbs/10 cy soil
Agricultural Gypsum	22 lbs/10 cy soil

*Blend of 50% yardwaste compost and 50% recycled wood fines. Premium compost blend available from Z-Best Products.

4.2.3.2 Topsoil 2 Amendment. Topsoil 2 will not require additional inorganic amendments because its soil characteristics are similar to the reference site soils (Table 1). However, an organic compost blend shall be mechanically incorporated into Topsoil 2 at a rate of 0.9cy organic matter / 10cy soil prior to topsoil reuse to improve soil conditions. As for Topsoil 1, the organic compost blend of 50% yardwaste and 50% recycled wood fines is recommended.

4.2.3.3 Ordering Amendments. The organic amendment (Premium Compost Blend from Z-Best Products) should be ordered 8-12 months in advance of the installation date to ensure that adequate quantities are available.

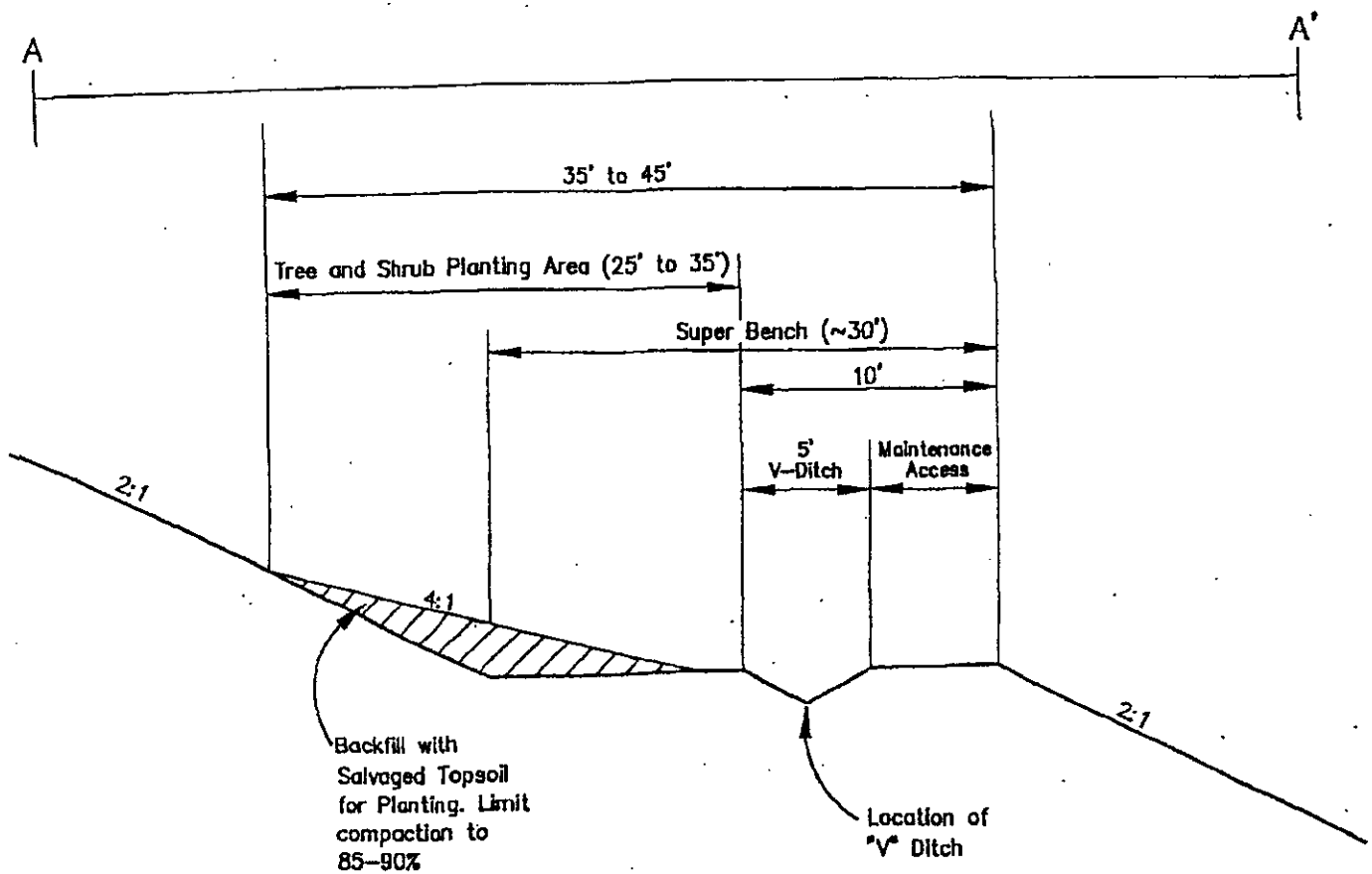
4.2.4 Soil Preparation on Super Benches

The conceptual grading plan shows the three super benches as uniform 30-foot wide benches bordered on either side by 2H: 1V slopes (Figures 2 and 4). The inside (i.e. upslope) portions of each super bench will be filled with Topsoil 1 and 2 to create an approximately 30-foot wide tree-planting area (Figure 6). The available amount of Topsoil 1 and 2 is approximately 9776 cubic yards, while the required amount will be approximately 7432 cubic yards (Table 4). The topsoil fill will be graded to form a 4H:1V slope that will begin at the center of each super bench and continue upslope until it intercepts the 2H:1V slope (Figure 6). The topsoil will be spread across the entire length of each of the super benches and will have a maximum depth of between 3 – 5 feet in the center and a maximum compaction of 85-90%. This configuration provides space for both the V-ditch and maintenance/hiking trail access (15-foot wide) and the revegetation area.

Table 4. Topsoil placement locations and the available and required amounts of topsoil for each location.

Location	Topsoil	Available Amount of Topsoil (cubic yards)	Required Amount of Topsoil (cubic yards)
Cut slope planting holes (2700 holes)	1	530*	530
Inboard half of three 30-foot wide super-benches	1 and 2	6920* + 2856	7432
Northwest slope gully repair sites	Gully Fill	670	350

* Topsoil 1 (7450 cy) will be divided between cut slope planting holes and super-benches



Leona Quarry Slope
Revegetation Plan

Note: Cross-Section Location Shown on Figure 4
Scale: 1" = 10'

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Topsoil Placement on Super Benches - Typical Section A-A'

File No. 1950-05	Date 4/16/04	Figure 6

4.2.5 Soil Preparation on Cut Slopes

4.2.5.1 Soil Surface Shaping and Amendment. Following site grading, the entire cut slope will be track-walked to create track marks running parallel to the contours (Figure 4). This soil surface modification will facilitate vegetation establishment by increasing water retention and water infiltration, slowing down surface runoff and by capturing litter, soil particles and seeds (Bainbridge 2000). Mechanical application of soil amendments will not be performed on the cut slope surface since these slopes will be too rocky to allow effective physical incorporation of the amendments. Instead, a soil amendment will be sprayed onto the site during hydroseed application (see Section 5.3.3.1) (Figure 4 and 7). This amendment will make the site more conducive for plant establishment.

4.2.5.2 Planting Hole Auguring and Topsoil Installation. Approximately 2700 planting holes will be augured throughout the cut slope. The dimensions of the planting holes will be approximately 1.5 feet in diameter by 3 feet deep (Figure 7). Each of the augured holes will be backfilled with amended Topsoil 1 prior to plant installation. Rough calculations of topsoil cut and fill volumes show that the volume of Topsoil 1 available should be more than adequate to fill each of the planting holes (Table 4). The total volume of topsoil needed to fill the planting holes on the cut slope is approximately 530 cubic yards.

4.2.6 Soil Preparation on 2H:1V Fill Slopes

Fill slopes will be constructed to ensure that compaction in the upper one (1) foot of soil is between 85 and 90% (Figures 4 and 8). In accordance with recommendations from the geotechnical engineer, topsoil will not be spread on the 2H: 1V fill slopes (Berlogar 2001, pers. comm.). Rather, the soil amendments specified in Table 5 will be mechanically incorporated into the upper 3 to 6 inches of the soil profile (Figure 8). Soil amendments will be incorporated as uniformly as possible using tracked equipment and tilling, if required. The soil will be amended such that the final soil surface will have equipment tracks that are parallel to the slope contours.

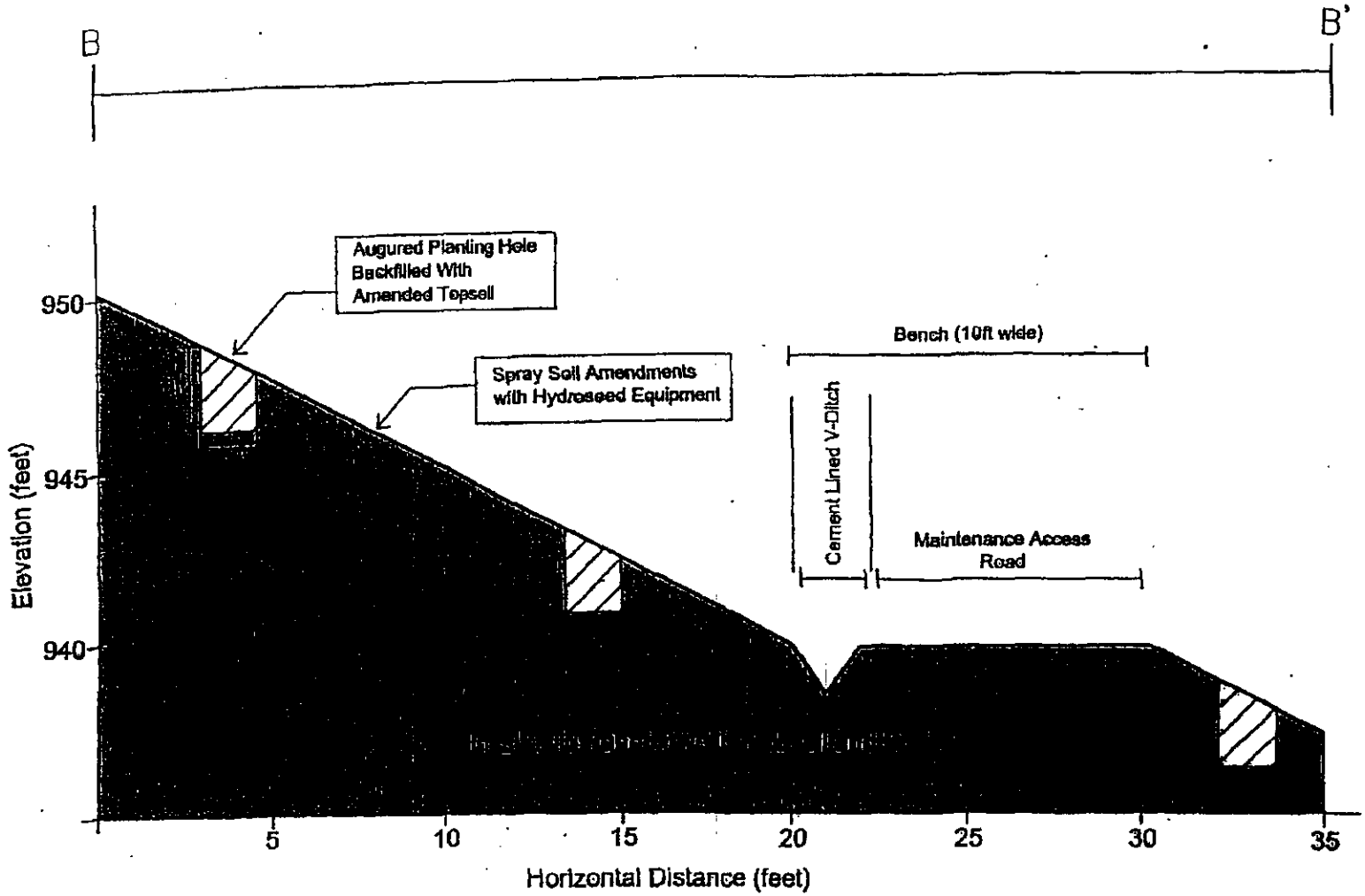
Table 5. Soil Amendments and Application Rates for 2H:1V Fill Slopes.

Amendment Type	Application Rates*
Organic Compost Blend**	166 cubic yards/acre
Potassium Sulfate (0-0-50)	350 lbs/acre
Agricultural Gypsum	1743 lbs/acre

* Incorporated into the upper 3 to 6 inches of soil.

** Blend of 50% yardwaste compost and 50% recycled wood fines (Premium Compost Blend available from Z-Best Products)

After the completion of fill slope construction, the upper 1-foot of soil will be sampled at representative locations to confirm/adjust the amendment protocol for the 2H: 1V fill slopes, to the actual post-construction soil chemistry.



Note: Cross-Section Location Shown on Figure 4

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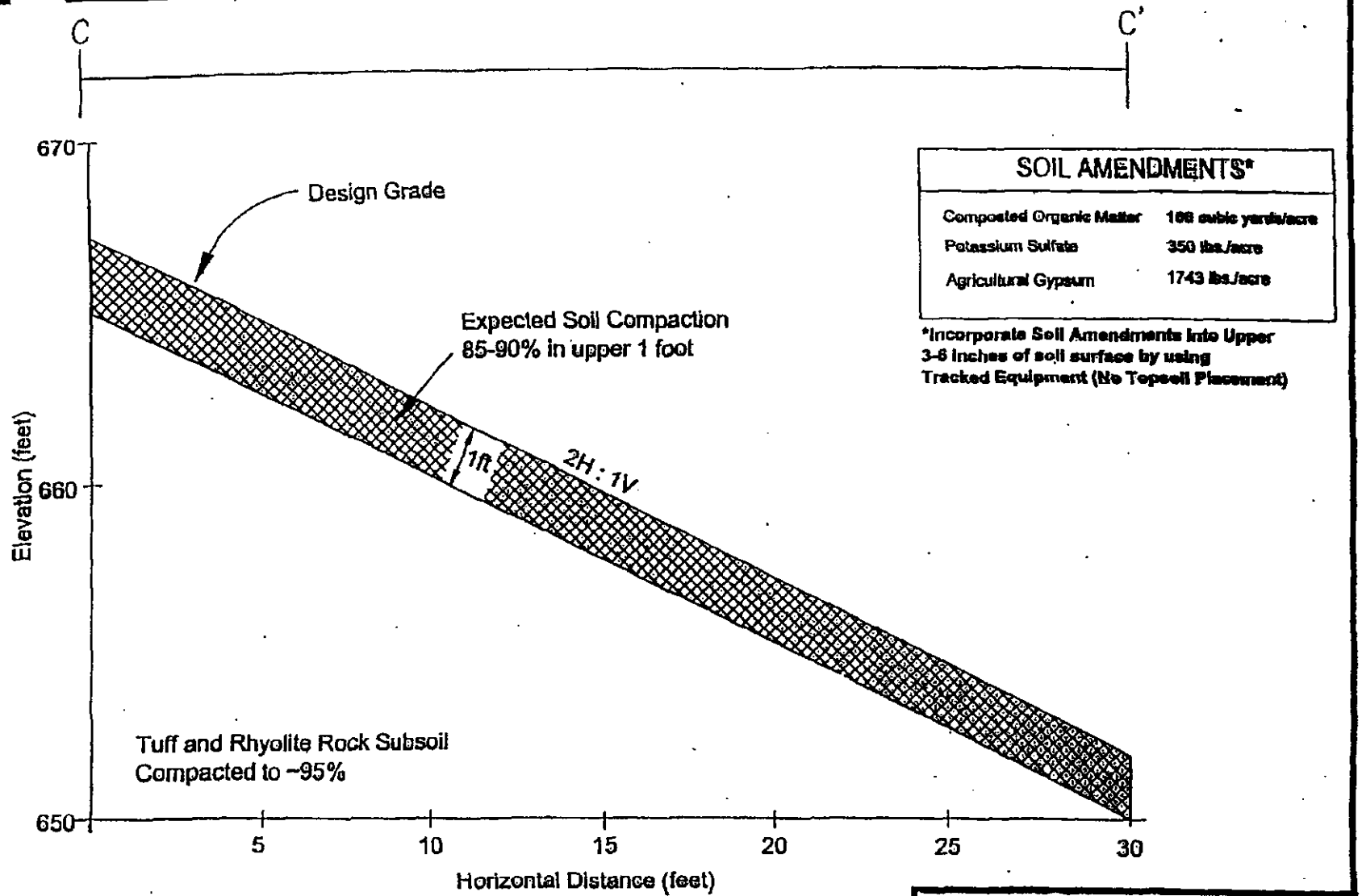
Cut Slope Soil Preparation and Planting Notes - Typical Section B-B'

File No. 1950-05 | Date 4/16/04 | Figure 7

Leona Quarry Slope Revegetation Plan



SOIL AMENDMENTS*	
Composted Organic Matter	166 cubic yards/acre
Potassium Sulfate	350 lbs./acre
Agricultural Gypsum	1743 lbs./acre

*Incorporate Soil Amendments into Upper 3-6 inches of soil surface by using Tracked Equipment (No Topsoil Placement)

Note: Cross-Section Location Shown on Figure 4

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Soil Preparation on 2H:1V Fill Slopes: Typical Section C-C'

File No. 1950-05 | Date 4/16/04 | Figure 8

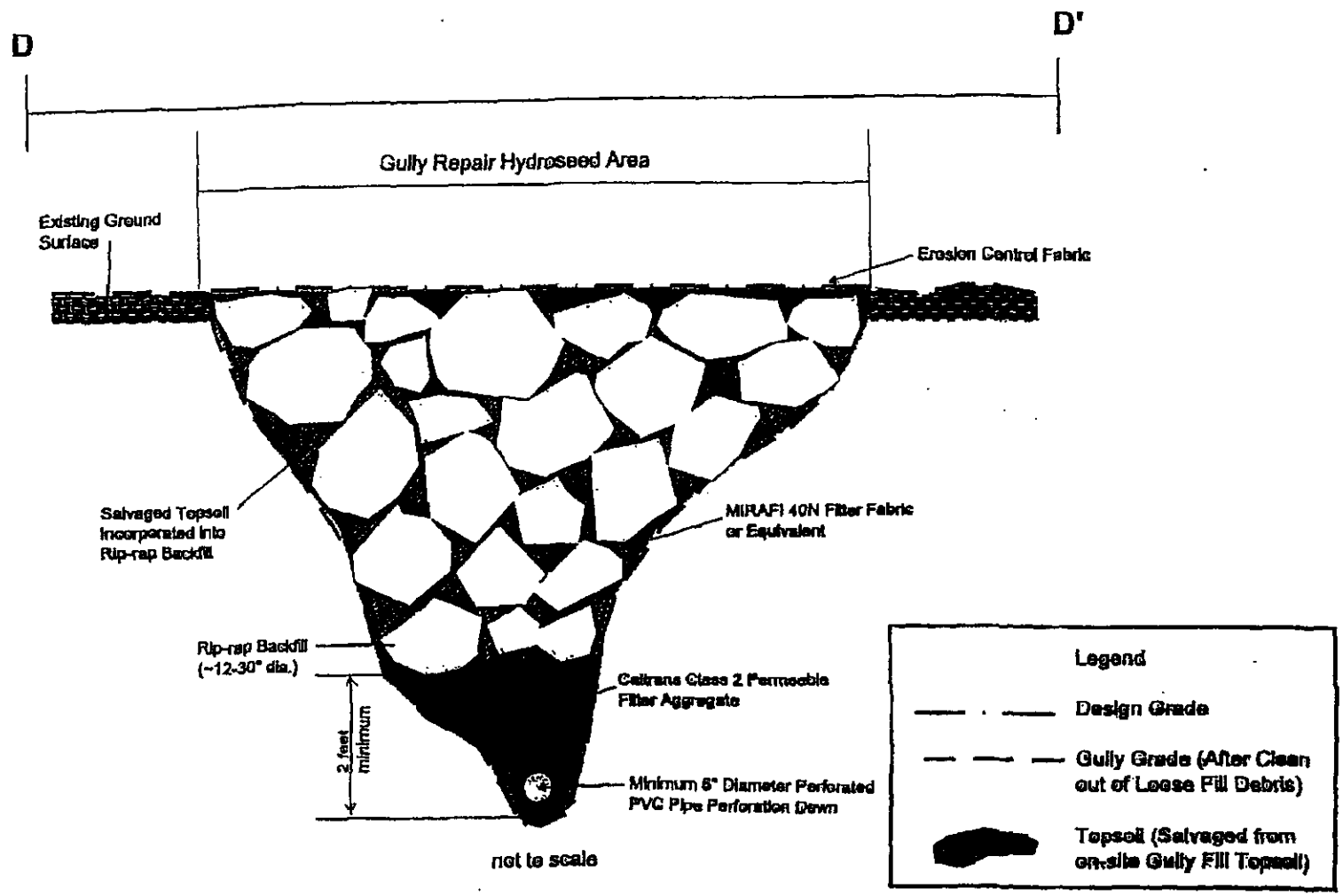
Leona Quarry Slope Regevetation Plan

4.2.7 Gully Repair Sites

Salvaged soil from the Gully Fill Topsoil will be spread in layers along with the rock riprap within the gully repair sites (Figure 4 and 9). After each layer of rock riprap is set in place, a sufficient quantity of soil will be spread across the rock and allowed to fill-in the voids between the rocks. This will continue until each gully is filled according to the conceptual grading plan. Approximately 670 cubic yards are available for use within the gully repair site, while approximately 350 cubic yards are required (Table 4). The topsoil used for the gully repair sites will not be amended prior to reuse because the site will receive a soil amendment during hydroseed application (see Section 5.3.4).

4.2.8 Invasive Species Removal From Slope Grading Area

Where the non-native invasive species French broom and pampas grass are cleared from the grading area, care should be taken to remove this vegetation from the site. This will help limit the inadvertent spread of propagules onto the revegetation site.



Note: Cross-Section Location Shown on Figure 4

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Topsoil Placement at Gully Repair Sites-
Typical Section D-D'

File No. 1950-05 | Date 4/16/04 | Figure 9

5.0 CONCEPTUAL REVEGETATION PLAN

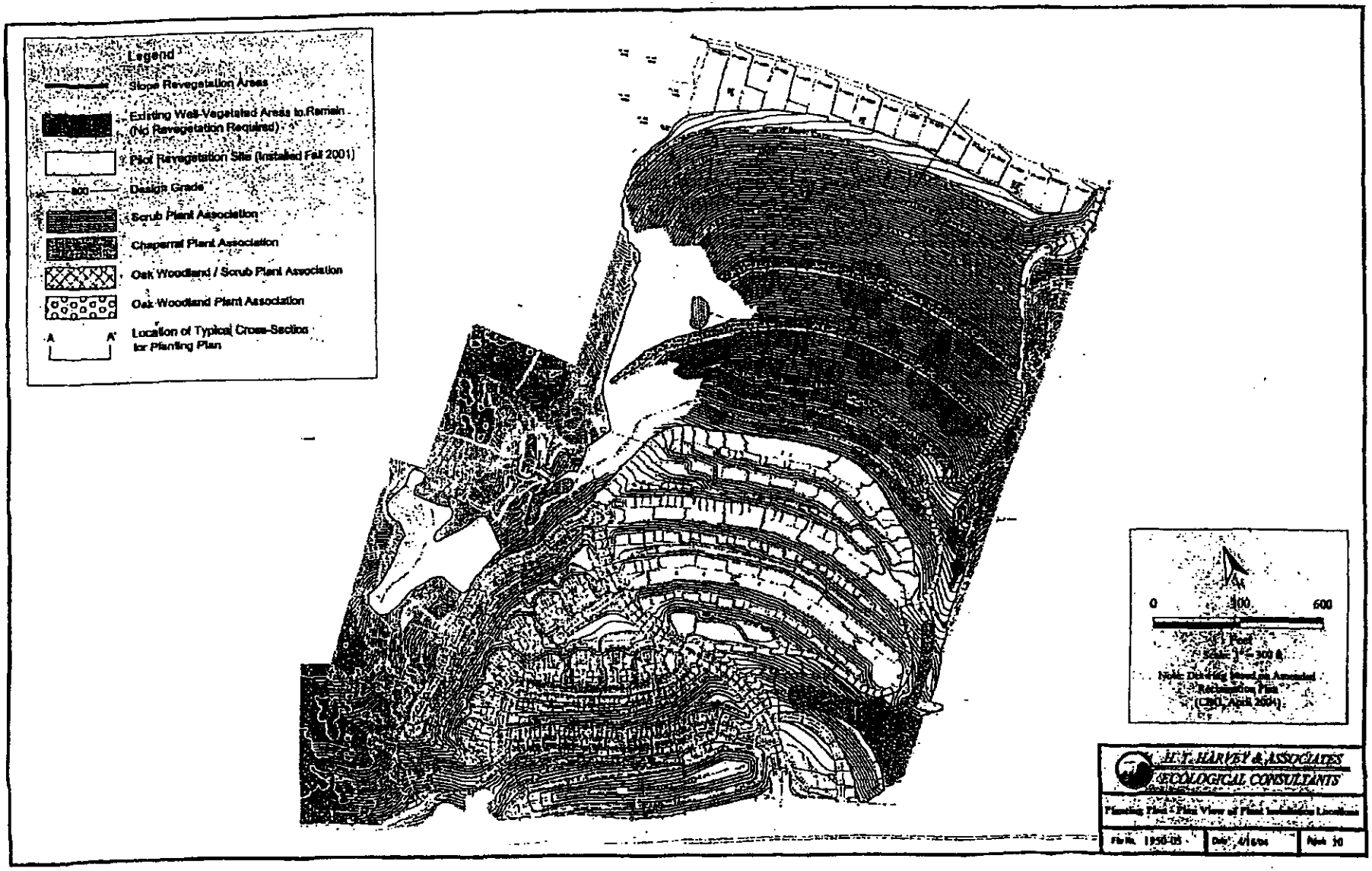
5.1 TARGET HABITATS

The target habitat mosaic for the reclaimed slope consists of patches of native shrub and tree dominated habitats interspersed with grassland (Figure 10). The shrub and tree dominated habitats consist of four plant associations modeled after the reference sites. These include a central coastal scrub (scrub) plant association dominated by California sagebrush, a northern mixed chaparral (chaparral) plant association dominated by chamise, an oak woodland plant association, and an oak woodland/scrub plant association (Figure 10). The scrub and chaparral plant associations are composed of relatively short-statured shrub species while the oak woodland association is dominated by tree species. The oak woodland/scrub association will be comprised of a mix of shrub and tree species. In addition, a diversity of native grasses and forbs are included in the hydroseed plan, which are expected to establish throughout the slope revegetation area. The combination of these species will provide a complex, multi-layered canopy structure that will control erosion, increase wildlife habitat, and enhance the aesthetic of the landscape.

The arrangement of the plant associations is based on the locations of the plant communities in the reference sites. The scrub plant association will occur at the lower elevations of the project site between 600 to 700 feet above MSL. The scrub and chaparral plant associations will overlap between 700 and 800 feet above MSL creating an ecotone between the two plant communities. The chaparral plant association will dominate from approximately 800 feet above MSL to the top of the revegetation area. The oak woodland plant association will occur along the 30-foot wide maintenance benches. The oak woodland/scrub association will occur within the southeast portion of the site at elevations between 350 and 600 feet above MSL.

California sagebrush will dominate the scrub association, whereas chamise will be the dominant species within the chaparral association. Additional native plant species will be planted within the gaps between the chamise and California sagebrush plants. Other shrub species to be planted include blue elderberry, coffeeberry *(Rhamnus californica)*, orange bush monkeyflower, coyote brush, silver bush lupine *(Lupinus albifrons)*, black sage *(Salvia mellifera)*, California buckwheat *(Eriogonum fasciculatum)*, and deerweed. Herbaceous grasses and forbs, including California poppy, arroyo lupine, golden yarrow, Purshings lotus *(Lotus purshianus)*, coast range melic, California brome, purple needlegrass *(Nassella pulchra)*, slender wheatgrass *(Elymus trachycaulus)*, blue wild rye *(Elymus glaucus)* and three-week fescue, will also be found within the scrub and chaparral plant associations. Both habitat types are expected in the long-term to form moderately dense canopies within localized patches throughout the reconstructed slopes.

The dominant species within the oak woodland habitat will be coast live oak. Species that will be associated with coast live oak will include valley oak, California buckeye *(Aesculus californica)*, Mexican elderberry, and California bay *(Umbellularia californica)*. An herbaceous layer consisting of California poppy, coast range melic, California brome, purple needlegrass, slender wheatgrass, and three-week fescue is expected to occur within the oak woodland habitat. At maturity, the oak woodland habitat will consist of multiple canopy layers, which will benefit


Legend
Slope Revegetation Areas
Existing Well-Vegetated Areas to Remain (No Revegetation Required)
Pilot Revegetation Site (Installed Fall 2001)
800
Design Grade
Scrub Plant Association
Chaparral Plant Association
Oak Woodland / Scrub Plant Association
Oak Woodland Plant Association
A
A'
Location of Typical Cross-Section for Planting Plan
0
300
600
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wildlife species and add to the diversity of the landscape.

The oak woodland/scrub association will comprise coast live oak and native shrub species. The shrub species will be the same as those found in the scrub plant association. This habitat type will provide a complex habitat that will blend into the surrounding native landscape.

An approximately 8.1-acre area located along the northern portion of the site will not be planted due to the steep (1H:1V) slopes and inaccessibility (Figure 10). These areas, however, will be seeded with a diverse mix of native shrub and herbaceous species.

A relatively large area (25.7 acres) within the northern portion of the Leona Quarry, which was not disturbed by past quarrying activities and is currently well-vegetated with oak woodland, mixed chaparral, and scrub habitats, will not receive any revegetation (Figure 2). These habitats currently consist of a dense cover of woody and herbaceous species that is self-sustainable without human intervention. Because these areas are well vegetated and will not be disturbed during grading operations, they will not require revegetation. This area however, will provide a long-term seed source for natural revegetation of the quarry slopes.

5.2 INTERIM CONSTRUCTION HYDROSEED PLAN

Grading of the reclaimed slope area will likely take place over two construction seasons. Consequently, the following interim construction hydroseed plan was developed as a component of the erosion control strategy to be employed between construction seasons. All areas throughout the project site that have been disturbed by grading activities and are composed of unvegetated soil at the beginning of the rainy season (mid-October) will be protected from erosion by hydroseeding in a one-step application. Table 6 lists the species to be used and the pounds of pure live seed (PLS) per acre that will be applied. The one-step hydroseed application will also consist of wood fiber (700 lbs/acre), non-asphaltic tackifier (120 lbs/acre), and inorganic fertilizer (6N-20P-20K at 300 lbs/acre). Hydroseed application shall occur prior to October 15 of each year to ensure that the areas are protected prior to the first rain event.

Table 6. Interim construction hydroseed mix.

Common Name	Scientific Name	Minimum % Purity	Minimum % Germination	Pounds of PLS/Acre	Total Pounds / Acre
California brome	*Bromus carinatus*	95	80	10	13.2
blue wild rye	*Elymus glaucus*	90	80	5	6.9
three weeks fescue	*Vulpia microstachys*	90	80	7.5	10.4
regreen sterile wheat	*Triticum* x *Elymus*	90	80	25	34.7
arroyo lupine	*Lupinus succulentus*	98	85	2.5	3
			Total	**50**	**68.2**

5.3 POST SLOPE CONSTRUCTION HYDROSEED PLAN AND EROSION CONTROL FABRIC

5.3.1 Introduction

The long-term success of habitat restoration at the project site is dependent upon effective stabilization of the reconstructed soil surfaces. This will be especially important during the first few years of plant establishment when the vegetation cover of shrubs and trees will be limited. To ensure proper erosion control, a hydroseed plan has been devised that will provide erosion control throughout the project site (Figure 11). The entire 45.6-acre site will be hydroseeded. In addition, it is anticipated that the hydroseed plan will contribute to the long-term stability of the site by "filling in" the gaps between the planted trees and shrubs, providing a stable surface for natural recruitment of plant species and hastening soil development.

Hydroseeding with a mixture of California native annual and perennial species, combined with the application of straw mulch and wood chips, will be the primary method of erosion control. The principal objective of the hydroseeding operation is to provide erosion control during the first rainy season after project construction. Secondarily, hydroseeded grasses, forbs, and shrubs will increase the diversity of native species cover at the site.

5.3.2 Seed Mix

Plant species for the hydroseed mix were selected to provide rapid germination and growth for effective erosion control during the first winter and to provide long-term soil stability throughout the project site. A combination of annual and perennial grasses, forbs, shrubs, and sub-shrubs was chosen for the hydroseed mix (Table 7).

Table 7. Hydroseed Mix for Slope Revegetation Area

Common Name	Scientific Name	Type	Approx Number of Seeds per Pound	Minimum % Purity	Minimum % Germination	Pounds of PLS/Acre (Slope Measurement)	Total Pounds/Acre
coast range melic*	*Melica imperfecta*	perennial grass	450,000	90	60	4	7.4
California brome	*Bromus carinatus*	perennial grass	95,000	95	80	10	13.2
blue wild rye	*Elymus glaucus* (Berkeley Hills ecotype)	perennial grass	120,000	90	80	7	9.7
purple needlegrass	*Nassella pulchra* (San Juan Baptista ecotype)	perennial grass	289,000	80	70	2	3.6

Common Name	Scientific Name	Type	Approx Number of Seeds per Pound	Minimum % Purity	Minimum % Germination	Pounds of PLS/Acre (Slope Measurement)	Total Pounds/Acre
slender wheatgrass	*Elymus trachycaulus* (San Juan Baptista ecotype)	perennial grass	146,000	90	80	4	5.6
three weeks fescue	*Vulpia microstachys*	annual grass	500,000	90	80	6	8.3
arroyo lupine	*Lupinus succulentus*	annual legume	15,000	98	85	8	9.6
Purshings lotus	*Lotus purshianus*	annual legume	120,000	98	60	2	3.4
golden yarrow*	*Eriophyllum confertiflorum*	sub-shrub	2,750,000	30	60	0.2	1.1
California poppy*	*Eschscholzia californica*	perennial forb	275,000	98	70	2	2.9
California sagebrush*	*Artemisia californica* (San Francisco Bay Area Source)	shrub	6,500,000	15	50	0.5	6.7
chamise*	*Adenostoma fasciculatum* (San Francisco Bay Area Source)	shrub	580,000	50	50	3**	12
Santa Barbara Island buckwheat*	*Eriogonum giganteum var. compactum*	shrub	900,000	30	60	1***	5.6
black sage*	*Salvia mellifera* (Northern California Collection)	shrub	625,000	70	50	2	5.7
deerweed*	*Lotus scoparius* (Northern California Collection)	shrub	450,000	90	60	3	5.6

Common Name	Scientific Name	Type	Approx Number of Seeds per Pound	Minimum % Purity	Minimum % Germination	Pounds of PLS/Acre (Slope Measurement)	Total Pounds/Acre
California buckwheat*	*Eriogonum fasciculatum* (Northern California Collection)	shrub	325,000	50	10	1	20
					Total	**55.7**	**120.4**

* Found in reference sites adjacent to quarry revegetation site
** Seed treated with 10% sulfuric acid solution for 15 minutes prior to hydroseeding
*** Seed applied only on the North Slope Area (slopes 1.5H:1V and steeper)

5.3.3 Erosion Control Fabric

In response to comments received by Lowney & Associates, erosion control fabric will be installed on all slope segments greater than 30 vertical feet tall (Figure 11). Thus, the majority of the slopes will receive erosion control fabric. The erosion control fabric will consist of a 100% coconut fiber matrix with natural fiber netting (North American Green C125BN or equivalent).

5.3.4 Hydroseed Application for 2H:1V Reconstructed Slopes/Benches

The hydroseed application will vary as follows for reconstructed slopes with and without erosion control fabric (Figure 11).

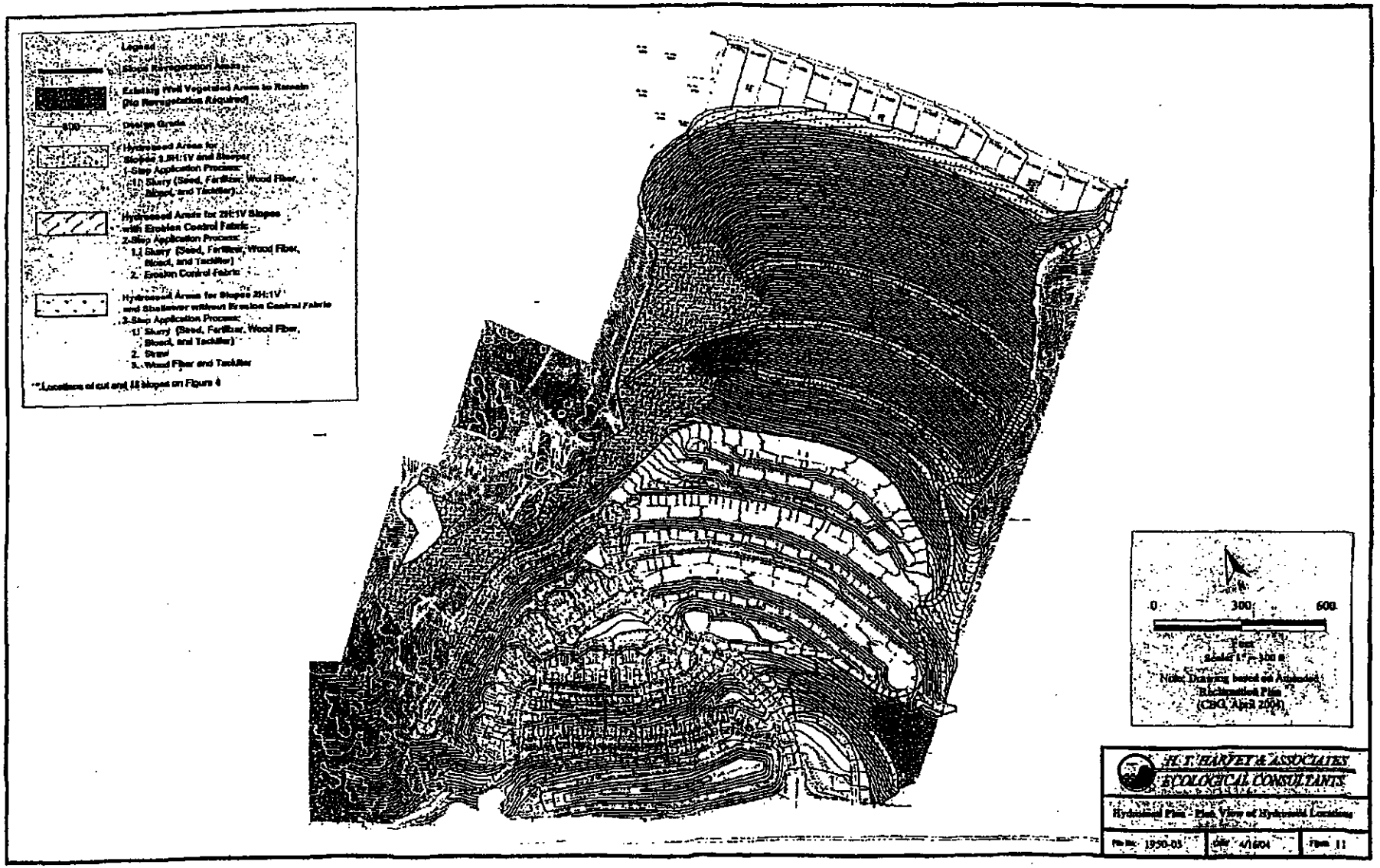
5.3.4.1 Reconstructed Slopes With Erosion Control Fabric. Reconstructed slopes taller than 30 vertical feet will receive erosion control fabric as stated above. These areas will receive a 1-step hydroseed treatment before the erosion control fabric is installed. It will be important to hydroseed the soil surface prior to fabric installation to ensure good seed to soil contact and adequate seed germination and growth. The 1-step hydroseed application will consist of the following:

> Seed mix (Table 7) + Wood fiber (800 lbs/acre) + Biosol (800 lbs/acre) + Potassium sulfate (175 lbs/acre) + Agricultural gypsum (1500 lbs/acre) + Non-asphaltic tackifier (120 lbs/acre)

Seed will be thoroughly mixed to ensure that they are broadcast at the pure live seed rates shown in Table 7.

5.3.4.2 Reconstructed Slopes Without Erosion Control Fabric. Reconstructed slopes equal to or less than 30 vertical feet tall will not receive erosion control fabric. These slope segments will be hydroseeded with a 3-step process as follows to utilize straw for additional erosion protection in lieu of fabric.

- Step 1: Seed mix (Table 7) + Wood fiber (800 lbs/acre) + Biosol (800 lbs/acre) +


Legend
Flood Revegetation Areas
Existing Well Vegetated Areas to Remain
(No Revegetation Required)
Design Grade
Hydroseed Areas for
Slopes 3:1H:1V and Steeper
1-Step Application Process:
1.) Slurry (Seed, Fertilizer, Wood Fiber,
Bioset, and Tackifier)
Hydroseed Areas for 2H:1V Slopes
with Erosion Control Fabric
2-Step Application Process:
1.) Slurry (Seed, Fertilizer, Wood Fiber,
Bioset, and Tackifier)
2. Erosion Control Fabric
Hydroseed Areas for Slopes 2H:1V
and Shallower without Erosion Control Fabric
3-Step Application Process:
1.) Slurry (Seed, Fertilizer, Wood Fiber,
Bioset, and Tackifier)
2. Straw
3. Wood Fiber and Tackifier
**Locations of cut and fill slopes on Figure 4
0
300
600
Note: Drawing based on Applicant's
Revegetation Plan
(CSO, April 2004)
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Hydroseed Plan - Plan View of Hydroseed Locations
File No. 1950-03
Date 4/1604
Plate 11

Figure 11. Hydroseed Plan – Plan View of Hydroseed Locations.

5.3.5 One-Step Hydroseed Application for North Slope Area

Slopes that are 1.5H:1V and steeper will receive only one hydroseed application. Only one step will be necessary for these slopes because it is assumed straw mulch would not stay on the steep slopes. The one-step application will consist of the following:

- Seed mix (Table 7) + Wood fiber (800 lbs/acre) + Biosol (6N-1P-3K, 800 lbs/acre) + Potassium sulfate (0N-0P-50K, 175 lbs/acre) + Agricultural gypsum (1500 lbs/acre) + Non-asphaltic tackifier (120 lbs/acre)

5.3.6 Mulching

Rice straw and/or wood fiber mulch will be included in the hydroseed application to minimize soil erosion during the early part of the rainy season prior to the development of herbaceous plant roots. In addition to providing erosion control, mulch provides a more conducive environment for native plant germination and growth by conserving moisture, regulating soil temperatures and increasing microbial activity (Zink and Allen 1998).

5.3.7 Timing of Hydroseed Application

The project site will be hydroseeded between September 15 and October 15 after slope grading work is complete and prior to the onset of winter rains. The entire 45.6-acre site will be hydroseeded after soil preparation, soil shaping, and irrigation system installation and prior to planting of shrubs and trees.

5.3.8 Irrigation

Irrigation will not be necessary for the hydroseeded vegetation since natural precipitation typically supplies sufficient water for the establishment of the grass, forb, and shrub species in the hydroseed mix (Table 7). In addition, irrigation may wash seeds off the slopes or cause the hydroseeded vegetation to fail if the plants become "dependent" on the supplemental water. Furthermore, non-native weed species may be given a competitive advantage over native species by the application of additional irrigation water.

5.4 MYCORRHIZAL INOCULATION

5.4.1 Introduction

Mycorrhiza refers to the symbiotic relationship that occurs in nature between a plant's roots and one of many types of specialized fungus (Smith and Read 1997). Mycorrhizal inoculation has been shown to have many beneficial effects on native plants in restoration projects (Chaudhary and Griswold 2001, St. John 1992). The mycorrhizal fungi attach to a plant's roots and essentially increase the volume of soil from which the roots can extract water and nutrients. This association provides the plant with increased water and nutrient uptake (particularly phosphorous) and may increase the plant's growth rate and long-term survival. At the same time, the fungi receive photosynthates, which are essential for their survival and growth. In addition, mycorrhizal fungi improve soil structure, which is beneficial to plant growth. Many of the species that will be planted and hydroseeded at Leona Quarry are mycorrhizal (Chaudhary

and Griswold 2001, Allen et al. 1999, St. John 1996).

5.4.2 Method of Mycorrhizal Fungi Inoculation

Many methods of inoculating restoration sites with mycorrhizal fungi exist. These include allowing natural colonization from surrounding undisturbed native habitats to occur, spreading native topsoil known to contain mycorrhizal fungi across the restoration site, adding native mycorrhizal fungi directly to container grown stock, or inoculating the plants or soil with some form of commercial inoculum (Chaudhary and Griswold 2001). The latter method involves either inoculating container stock while it is in the nursery or spreading the commercial inoculum across the project site either with a land imprinter or in a hydroseed mix.

Establishment of mycorrhizal fungi by means of natural colonization into a highly disturbed area such as Leona Quarry is a slow process that typically takes a few years or more to occur. This means that typically within the first year or two of plant establishment mycorrhizal fungi will not be present in the soil and therefore will not benefit the plants during their most stressful phase of establishment. The addition of native, undisturbed topsoil across the project site is probably the best means to inoculate the soil, but requires a substantial quantity of high quality, properly stored soils. Therefore, this method cannot be used at Leona Quarry due to the lack of available high quality topsoil. Commercial inoculum has been shown to work in some coastal sage scrub-chaparral restoration projects, but the fungi are typically not native species and little quantitative data exists about the long-term success of using the commercial inoculum. Therefore, commercial inoculum will not be used to inoculate the soils with mycorrhizal fungi at Leona Quarry.

Inoculation of the soils with native mycorrhizal fungi will occur at the project site by strategically placing inoculated container grown plants throughout the revegetation site. The nursery grown trees and shrubs will be inoculated by incorporating native duff from the reference sites into the potting material during nursery propagation. The inoculated trees and shrubs will be planted in patches throughout the site once they are ready for planting. In addition, a small amount of topsoil and duff from undisturbed chaparral and oak woodland habitats will be added to the planting holes within the cut and fill slopes at the time of planting to increase the probability of mycorrhizal inoculation. It is expected that within a short time period a network of mycorrhizae will form around each planting group. Species that were hydroseeded onto the site will quickly become inoculated as the mycorrhizal network spreads across the regraded slopes.

5.5 PLANTING PLAN

5.5.1 Introduction

Approximately 14.2 acres of the regraded slope (~ 40% of the reconstructed slope) will be planted with nursery grown trees and shrubs (Figure 10). The trees and shrubs will be divided into four plant associations including the chaparral, scrub, oak woodland, and oak woodland/scrub plant associations. The chaparral association will account for approximately 5.2 acres, the scrub association will cover 5.1 acres, the oak woodland habitat will be planted on approximately 2.6 acres, and the oak woodland/scrub association will cover approximately 1.3 acres. The planting plan is designed to successfully establish the three habitat types designated

for the site.

The addition of container grown trees and shrubs was chosen because planting trees and shrubs will give the site some immediate plant cover and structure. Moderate to high survival and growth rates of native trees and shrubs were observed at the Pilot Revegetation Site (H.T. Harvey & Associates 2003). In addition, because non-native annual plants reduce the natural recruitment of many native shrubs including California sagebrush, the addition of container grown plants will increase the likelihood of establishment and long-term sustainability of the project (Eliason and Allen 1997). Therefore, the planting of nursery grown trees and shrubs, which will be irrigated and maintained on-site for a minimum of 3 years during the plant establishment period, will increase the probability of success for the revegetation project.

Planting locations were based on the following criteria: slopes gentler than 1.5H:IV, sites accessible to manual laborers on foot, and soil depths greater than 10 inches. Therefore, portions of the northern, ungraded slope will not be planted with nursery grown trees and shrubs (Figure 10). These areas will, however, receive a hydroseed application of native shrub and herbaceous species.

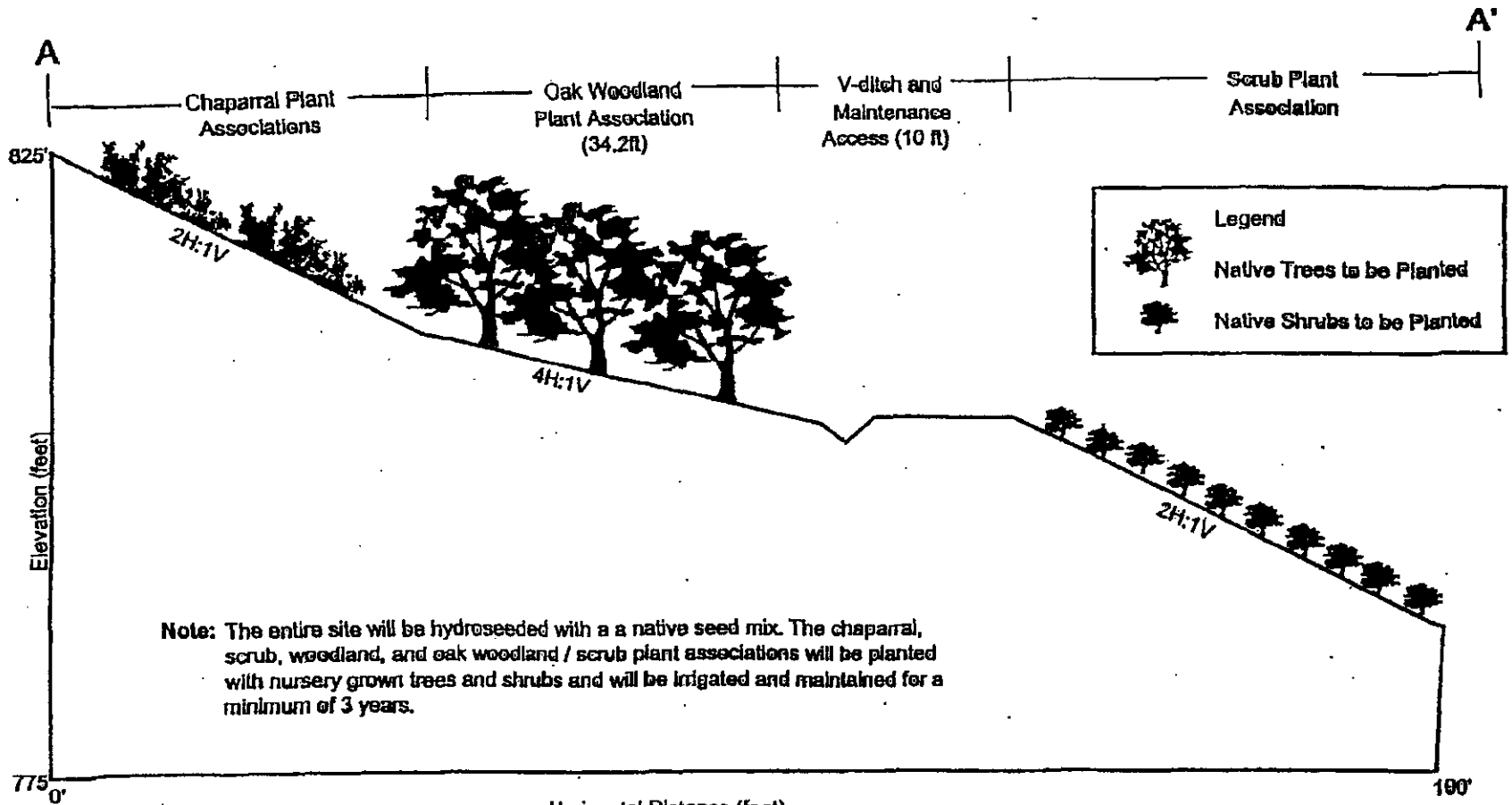
5.5.2 Plant Species Palette

Table 8 provides the plant species palette for each plant association. Based on the on-center spacings, approximately 500 plants per acre will be planted in the scrub and chaparral plant associations, 195 plants per acre will be planted in the oak woodland plant association, and 327 plants per acre will be installed within the oak woodland/scrub plant associates. The exact number of each species to be planted per acre shall be determined during preparation of restoration plans and specifications.

Table 8. List of Nursery Grown Trees and Shrubs for the Leona Quarry Slope Revegetation Areas Including On-Center Spacing, Container Size, and Percentage

Plant Association	Common Name	Scientific Name	On-Center Spacing (feet)	Container Size*	Approximate Percentage
Scrub	California sagebrush	*Artemisia californica*	10	deepot	35
	coyote brush	*Baccharis pilularis*	10	deepot	15
	blue elderberry	*Sambucus mexicanus*	10	deepot	10
	coffeeberry	*Rhamnus californica*	10	deepot	10
	silver bush lupine	*Lupinus albifrons*	10	deepot	10
	deerweed	*Lotus scoparius*	10	deepot	5
	California buckwheat	*Eriogonum fasciculatum*	10	deepot	5
	black sage	*Salvia mellifera*	10	deepot	5

Plant Association	Common Name	Scientific Name	On-Center Spacing (feet)	Container Size*	Approximate Percentage
	orange bush monkeyflower	*Diplacus aurantiacus*	10	deepot	5
Chaparral	chamise	*Adenostoma fasciculatum*	10	deepot	40
	coyote brush	*Baccharis pilularis*	10	deepot	15
	California sagebrush	*Artemisia californica*	10	deepot	10
	blue elderberry	*Sambucus mexicanus*	10	deepot	10
	silver bush lupine	*Lupinus albifrons*	10	deepot	10
	deerweed	*Lotus scoparius*	10	deepot	5
	orange bush monkeyflower	*Diplacus aurantiacus*	10	deepot	5
	coffeeberry	*Rhamnus californica*	10	deepot	5
Oak Woodland	coast live oak	*Quercus agrifolia*	16	acorn or treepot	50
	blue elderberry	*Sambucus mexicanus*	12	deepot	20
	valley oak	*Quercus lobata*	16	acorn or treepot	15
	California buckeye	*Aesculus californica*	16	treepot	10
	California bay	*Umbellularia californica*	16	deepot	5
	knobcone pine**	*Pinus attenuata*	16	treepot	NA
	foothill pine**	*Pinus sabiniana*	16	treepot	NA
Oak Woodland / Scrub	coast live oak	*Quercus agrifolia*	16	acorn or treepot	40
	California sagebrush	*Artemisia californica*	10	deepot	30
	coffeeberry	*Rhamnus californica*	10	deepot	10
	silver bush lupine	*Lupinus albifrons*	10	deepot	5
	deerweed	*Lotus scoparius*	10	deepot	5



Note: Cross-Section Location Shown on Figure 10

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Planting Plan: Typical Cross-Section A-A'

File No. 1950-05 | Date 4/16/04 | Figure 12

Leona Quarry Slope Revegetation Plan

Native duff from the reference sites will be incorporated into the potting material of the nursery grown trees and shrubs prior to planting the propagules in the nursery pots. The purpose of adding the duff to the potting soil is to establish the symbiotic relationship between the plants and the mycorrhizal fungi. The duff will be composed of topsoil and decaying organic matter, which will likely contain spores of the mycorrhizal fungi. The duff should be collected, mixed with the potting material, and placed within each planting pot at the time of planting. The trees and shrubs will be allowed to germinate and grow in the nursery for approximately 8-12 months. During this time, the plants and fungi will form the symbiotic relationship.

5.5.6 Plant Installation

Container grown plants will be installed between October and March, after the onset of winter rains. Prior to digging the planting hole, a 12 to 18-inch wide terrace, which slopes slightly back into the hillside, will be constructed at each planting location. The planting holes should be approximately 1-foot in diameter and 1 foot deep. All rocks greater than 3 inches in diameter will be removed from the excavated soils. A handful of topsoil and duff from undisturbed scrub, chaparral and oak woodland habitat will be added to each of the planting holes at the time of planting. In addition, a slow release fertilizer tablet (14N-14P-14K) will be added to the bottom of each planting holes to reduce transplant shock. The plants will be installed so that their root crowns are at or slightly above (up to ½ inch) grade following soil settlement that occurs after initial irrigation. The plants will also be installed so their root crowns are at the highest position within the irrigation basin. This will minimize standing water at the root crown and reduce root disease.

A 2 to 3-foot diameter irrigation basin with a 4-inch high, 4-inch wide earthen berm will be constructed around each tree and shrub. The basin will help to conserve water for use by the plant and will be kept weed free during the 3-year plant establishment period to reduce plant competition. The appropriate plant protection measure will also be installed immediately following planting.

A 3-inch thick layer of mulch will be spread throughout the bottom of each irrigation basin. Mulch will consist of wood chips, tree bark, or shredded bark. Mulch will be free of salt, leaves, soil clods, sticks, rocks, weeds, or weed seeds. Wood chip mulch that has been chipped and stockpiled from clearing of on-site native trees and shrubs will be used and will be supplemented, as needed, by imported mulch.

5.5.7 Plant Protection

Wildlife browse to the revegetation plantings could be severe if protective measures are not taken. Three foliage protection techniques will be utilized to protect the plants from wildlife browse.

5.5.7.1 Window Screen. Foliage protection cages fabricated from window screen will be installed for chamise and California sagebrush seedlings. Window screen cages will be 2 feet in diameter by 2 feet tall and will be supported by 3 rebar posts. The tops of these cages will be enclosed with window screen.

5.5.7.2. Chicken Wire Foliage Protection Cages. Foliage protection cages fabricated with chicken wire will be installed for all planted California buckeye and Mexican elderberry. Cylindrical foliage protection cages will be 4 feet in diameter by 5 feet tall. The top of the foliage protection cages will be covered with additional chicken wire. All seams in the fabricated cylinder and top will be fastened on 3-6 inch centers with baling wire or plastic ratchet-locking ties. The bottom of the foliage protection cages will be flush with the soil surface. Two 6 to 7-foot long rebar posts will support each foliage protection cage. The foliage protection cage will be fastened to the rebar with baling wire or plastic ratchet-locking ties.

5.5.7.3 Tree Shelters. Photodegradable tree shelters will be used to protect coast live oak and valley oak seedlings. The tree shelters will reduce browsing pressure and increase soil moisture in the vicinity of the oak plantings. Tree shelters have been shown to increase the percent survival and height increment for oak plantings when implemented in concert with weed control (McCreary and Tecklin 1997). Tree shelters should be 3.25 inches to 4.25 inches in diameter by 4 feet long and supported by a pressure-treated wooden tree stake. The tree shelters will be fastened to the tree stake with plastic ratchet-locking ties and the base of the shelter buried approximately 2 inches into the topsoil. Bailing wire will be woven across the top of the tree shelters to prevent birds from inadvertently falling into the shelters.

5.5.8 Coarse Woody Debris

Large woody debris including logs, branches, and root wads (greater than 6 inches diameter) removed during site grading may be incorporated into the planting plan, if practicable. The large woody debris should be randomly placed and partially buried within the oak woodland plant association on 4H:1V slopes. Coarse woody debris would function to increase the structural diversity of the habitat providing additional shelter and nesting sites for wildlife and would also help to establish long-term soil fertility.

5.6 IRRIGATION PLAN

A temporary drip irrigation system will be designed and installed to irrigate the planted trees and shrubs throughout the slope revegetation area. Planted trees and shrubs will be irrigated between April and October during the first 3 years following planting (i.e. plant establishment period). The goal of the irrigation program is to facilitate the development of the plant's root system during the 3-year plant establishment period, while at the same time eliminating the plant's need for a supplemental water source. Because the majority of the species that will be planted are drought tolerant, it is anticipated that limited irrigation will be required. In addition, root diseases may develop if too much water is given. The soils around each plant, therefore, shall be allowed to dry prior to initiation of subsequent irrigation. The quantity and frequency of irrigation will be greatest in Year-1 and will be reduced to an as-needed basis in subsequent years. By Year-3, the roots of the plants should be well developed and able to grow with little to no supplemental water. The exact quantity and frequency of irrigation during the remainder of the plant establishment period will be determined in the field by a qualified restoration ecologist.

Results from the pilot revegetation project are currently being used to determine the appropriate irrigation regime to be utilized for the planted trees and shrubs (H.T. Harvey & Associates 2001). The pilot revegetation project, which was installed in fall 2001, is testing the effectiveness of

irrigating the desired plants with 1 gallon of water versus 10 gallons of water every two weeks (H.T. Harvey & Associates 2001). Based on results from the first two years of monitoring it appears that plants receiving 1 gallon of irrigation water once every two weeks have similar growth and survival rates compared to those receiving 10 gallons of water once every two weeks (H.T. Harvey & Associates 2003).

Therefore, trees and shrubs installed from small (restoration sized) container stock will be irrigated with 2-4 gallons of water per event during the plant establishment period. The frequency of irrigation will be approximately 2 times per month during the first dry season after installation. This frequency will be gradually diminished over the three year establishment period to allow the plants to shift to a self-sustainable condition. Irrigation should not be required after year three.

5.7 MAINTENANCE PLAN

5.7.1 Overview

The planted trees and shrubs will be maintained during a 3-year plant establishment period. Adequate maintenance during the first 3 years after planting will be critical to revegetation success. Maintenance activities will include irrigation, weed control, maintenance of foliage protectors, and dead plant replacement.

5.7.2 Plant Replacement

All dead plants that were planted in the four plant associations will be replaced on a yearly basis in Years 1 and 2. In Year 3, all dead plants will be replaced if survival drops below 80%. An adaptive management approach towards plant replacement will be instituted, which will require a critical evaluation of the cause of death and the survival rate of other species. Those species that have high survival rates, and therefore are better adapted to the site, will generally be used to replace the dead plants.

5.7.3 Weed Control

Herbaceous vegetation will be controlled within the 3-foot diameter irrigation basin around each plant during the three-year plant establishment period. Weed control within the irrigation basins will primarily consist of hand-pulling the weeds to maintain the basins free of herbaceous vegetation.

Invasion of the revegetation site by invasive, non-native species can significantly impede the development of the plantings and may reduce the diversity of plants and the aesthetic of the site. Therefore, invasive, non-native species will be monitored and may be controlled within the plant installation areas. Species of concern include French broom, pampas grass, and yellow star thistle. Control of invasive species will be determined on an as needed basis and may include the use of an Environmental Protection Agency (EPA) approved herbicide or manual removal efforts.

5.7.4 Irrigation Basins

Irrigation basins will be maintained during the three-year plant establishment period. Earthen berms, which have failed, will be reconstructed to ensure that the plant receives an adequate amount of supplemental irrigation water. In addition, the 3-inch layer of wood chip mulch within the irrigation basins will be maintained during the plant establishment period.

5.7.5 Plant Protection

Protective cages and shelters will be regularly maintained during the 3-year plant establishment period. If a plant outgrows its cage or shelter prior to the end of the 3-year period, the plant protection will be removed as soon as possible to ensure that the tree or shrub grows unhindered. At the end of the 3-year period, all cages will be removed from the site to allow the plants to grow without obstruction.

All tree shelters will be maintained in a vertical orientation and the bottom buried 2 inches below the grade. The woven wire cover will be removed from the top of the tree shelter when each tree reaches the top of its shelter. Tree shelters and tree stakes will be removed when the tree's height has exceeded the top of the shelter for 2 years (~ 5 years after installation). Premature removal of tree shelters can damage trees if they have not attained sufficient stem girth to remain upright.

5.8 MONITORING PLAN

5.8.1 Overview

The purpose of the monitoring plan is to track vegetation establishment, assess the degree of revegetation success, and provide a basis for adaptive management recommendations. Site visits will be conducted every two months for the first three years during the growing season to qualitatively assess vegetation establishment and to monitor vegetation maintenance. In addition, quantitative monitoring will occur on an annual basis during the first 5 years of plant establishment. A qualified restoration ecologist will perform the site monitoring. The restoration ecologist will make recommendations for replanting and vegetation maintenance as needed based on the monitoring results.

5.8.1.1 Qualitative Growing Season Monitoring. Site visits will be made every two months during the growing season (April - October). Qualitative assessments of the site will be made and reported during these visits. The purpose of monitoring during the growing season is to assess the overall performance of the vegetation and the adequacy of vegetation maintenance. Assessment of the following factors will be made during site visits:

- Vegetation establishment with special attention paid to areas lacking vegetation
- Mortality of planted shrubs and trees
- Plant species composition
- Slope stability and erosion
- Formation of seeps
- Irrigation and maintenance of planted trees and shrubs

- Invasion of revegetation site by non-native, invasive weeds
- Other pertinent site conditions that may influence plant establishment

5.8.1.2 Quantitative Annual Monitoring. Annual monitoring will occur during Years-1, 2, 3 and 5 following plant installation and the field work will be conducted between October and December of each year. Site visits will be conducted to assess site conditions and the establishment of vegetation throughout the project site. Quantitative measurements of percent survival, percent vegetative cover, and plant health and vigor will be made.

5.8.2 Quantitative Annual Vegetation Monitoring Methods

5.8.2.1 Percent Shrub and Tree Survival. In Years 1, 2, and 3, the percent survival for all planted tree and shrub species will be estimated by counting a minimum of 25 % of the trees and shrubs installed. The trees and shrubs will be counted along 30-foot wide, 100-foot long randomly placed transect belts. Percent survival will be calculated by species and for the trees lumped and shrubs lumped. If the percent survival falls below 100% in Years 1 and 2 or 80% in Year 3, all dead trees and/or shrubs will be replaced. Species observed to perform well would be utilized to replace the dead individuals.

5.8.2.2 Percent Vegetation Cover. Vegetation cover is a good measure of vegetation establishment and plant community composition. Therefore, the percent vegetation cover will be quantitatively monitored in Years 1, 2, 3, and 5 to track the development of the vegetation. Detection of an increasing temporal trend in average percent shrub and a tree cover would serve as an indicator of successful vegetation establishment.

Permanent transects will be established at random locations throughout the four plant associations. Percent vegetation cover by species (herbaceous species may be lumped into one category) will be measured using the line intercept method (Bonham 1989). The percent cover of the shrub layer, tree canopy layer and herbaceous layer will be measured separately. The number of transects will be determined by evaluating the average cover values obtained over increasing numbers of transects. The number of transects used will be the point where additional samples do not substantially change the average cover values obtained (Kershaw 1973). The sample area may be slightly increased or decreased after initial data are collected and analyzed and the requisite sample surface area is re-assessed.

5.8.2.3 Average Tree and Shrub Health and Vigor. Average health and vigor will be determined by species for trees and shrubs on a yearly basis to determine which species are best adapted to site conditions. Individual plants selected for the survival tally (Section 5.7.2.1) will also be rated for health and vigor. Species with the highest health and vigor rating will likely be primarily used for dead plant replacement. The average health and vigor by shrub and tree species will be determined based on the following scale:

Rating		Health and Vigor
0	=	Dead
1	=	Very Low Vigor
2	=	Low Vigor

Rating		Health and Vigor
3	=	Moderate Vigor
4	=	High Vigor
5	=	Very High Vigor

5.8.3 Soils Monitoring

If plant survival and growth rates are low in localized areas, soils at various depths in the profile will be sampled and analyzed to help determine the reasons for poor growth and survival. Soil chemistry and structure at various depths would be compared between areas with high and low vegetation performance.

5.8.4 Reporting

Annual vegetation monitoring reports will be prepared in Years 1, 2, 3, and 5 documenting the progress of vegetation establishment and prescribing management recommendations as needed to meet the revegetation goals.

6.0 TREE REMOVAL MITIGATION AND MONITORING PLAN

6.1 INTRODUCTION

Native trees planted in the oak woodland plant association will mitigate for the loss of "protected" trees at the project site as defined by the City of Oakland's Tree Protection Ordinance. Mitigation measure B.10a in the project's Environmental Impact Report (EIR) requires mitigation for the removal of protected trees at a ratio of at least 1:1 (trees removed to trees replaced). A maximum of 151 protected, native, trees (149 coast live oak and 2 California bay) are permitted for removal and require mitigation per the tree removal permit (Tree Permit dated February 19, 2003). The slope revegetation plan presented herein calls for the placement of topsoil and the planting of native tree species (i.e. oak woodland plant association) on the inboard side of the three 30-foot wide super-benches (Figure 10). Approximately 545 trees will be installed within the oak woodland habitat (tree replacement mitigation site), which will encompass approximately 2.6 acres. Table 9 lists the species and number of each species to be installed along the super-benches. Therefore, implementation of this slope revegetation plan will significantly exceed the requirement to mitigate at 1:1 for the removal of the approximately 151 protected, native trees. In addition, hundreds more trees will be planted within the development area.

Table 9. List of tree species to be installed within oak woodland plant association.

Common Name	Scientific Name	On-Center Spacing (Feet)	Total Number
Quercus agrifolia	coast live oak	16	273
Quercus lobata	valley oak	16	82
Sambucus mexicana	blue elderberry	12	109
Aesculus californica	California buckeye	16	54
Umbellularia californica	California bay	16	27
		Total	**545**

The trees installed within the tree replacement mitigation site will be monitored in Year-1, 2, 3, and 5 during the annual monitoring of the revegetated slopes. Annual monitoring of the mitigation site by a qualified biologist will determine whether the project is fulfilling its mitigation obligations. By Year-5 of monitoring, the trees within the mitigation site should be sufficiently established to determine if they would eventually achieve the long-term goal of self-sustainability. The results of the final year of monitoring will be compared to the final success criteria presented below to determine if they have been met. If the success criteria for the mitigation site have not been met, adaptive management actions will be taken and monitoring will continue until the criteria has been achieved.

6.2 FINAL SUCCESS CRITERIA

The goal of the tree replacement mitigation is to establish a minimum of 151 trees (any combination of the species listed in Table 9) at the site. The minimum number of 151

replacement trees shall be healthy and capable of self-sustained growth in the absence of long-term human maintenance. The final success criteria were crafted to provide quantitative criteria that will indicate that the tree mitigation goal has been achieved.

6.2.1. Percent Survival

A minimum of 1.5 times the required number of replacement trees (1.5 x 151=227 trees) shall be alive within the tree replacement mitigation site two years after the cessation of irrigation and weed control (approximately in Year-5)

6.2.2 Tree Height

Average tree height will be used as an indicator of the growth of planted trees. In Years 1, 2, 3, and 5, the average height of tree species exhibiting relatively high percent survival will have a positive increasing trend. The average height by species will be increased during a minimum of 2 growing seasons following cessation of irrigation and weed control.

6.3. PERFORMANCE CRITERIA

6.3.1 Percent Survival

Percent survival of mitigation tree plantings will be tabulated by species within the mitigation site during Years 1-3. If the percent survival falls below 100% in Years 1 and 2 or 80% in Year 3, all dead trees within oak woodland plant association will be replaced.

6.4 MONITORING METHODS

6.4.1 Percent Survival

In Years 1, 2, 3, and 5, the percent survival for all tree species within the oak woodland plant association will be estimated by counting all individuals installed during the fall of each year. Percent survival will be reported by species. Percent survival will be calculated as follows:

Percent Survival of Species A = (Number of Individuals of Species A Alive During Monitoring Period / Total Number of Species A Alive at Installation) * 100

6.4.2 Tree Height

Tree height will be measured on a minimum of 30% of each tree species installed. Trees will be located throughout the site using a stratified random sampling methodology and will be tagged with a specific number for comparison purposes in later years. Height measurements will be taken along the main stem using a tape or telescopic pole. A clinometer will be used for individual trees that exceed the height of the pole. Average tree height will be determined by species.

6.4.3 Health and Vigor

A qualitative assessment of overall health and vigor of tree species will be made to determine which species are best adapted to site conditions. This assessment will be based on such factors as leaf size and color, bud development, fungal and insect infestation, drought, new growth, herbivory, and physical damage. Average health and vigor assessments will be made on individuals selected and tagged for height measurement and will occur during annual monitoring. Species with the highest health and vigor rating will be used for dead plant replacement. The average health and vigor by tree species will be determined based on the following scale:

Rating		Health and Vigor
0	=	Dead
1	=	Very Low Vigor
2	=	Low Vigor
3	=	Moderate Vigor
4	=	High Vigor
5	=	Very High Vigor

6.5 REPORTING

An annual tree monitoring report will be prepared in Years 1, 2, 3, and 5 documenting the progress of tree establishment and prescribing management recommendations as needed to meet the mitigation requirement including appropriate species replacement recommendations. The monitoring report will be submitted to the City of Oakland by December 31 of each monitoring year.

6.6 COMPLETION OF TREE MITIGATION

When the final success criteria are met, a final report will be submitted to the City of Oakland documenting the achievement of the final success criteria. Tree mitigation monitoring will be discontinued after achievement of the final success criteria.

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8.0 PERSONAL COMMUNICATION

Berlogar Geotechnical Consultants. 2001. Personal communication between Frank Berlogar (Berlogar Geotechnical Consultants) and Max Busnardo (H. T. Harvey & Associates).

Chapman, D. 2001. Personal communication between David Chapman (The DeSilva Group) and Max Busnardo (H.T. Harvey & Associates).

APPENDIX A.
Soil Analysis Laboratory Testing Results

Soil and Plant Laboratory, Inc.
www.soilandplantlaboratory.com

352 Mathew Street
Santa Clara, CA 95050
408-727-0330 phone
408-727-5125 fax

SANTA CLARA OFFICE
May 18, 2001
Lab. No. 26396

H. T. HARVEY & ASSOCIATES
3150 Almaden Expressway, Suite 145
San Jose, CA 95118

Attn: Ernst Strenge

RE: LEONA QUARRY – PROJ. NO. 1950-01, P. O. NO. 01-390

BACKGROUND

The following evaluation has taken into account the thorough background information that accompanied the samples.

SUMMARY

Characteristics common to the reference soils that may also help preclude invasive species include moderate acidity and low phosphorus availability. Adjustment to soil chemistry is needed for both the *fill and potential topsoil* to lower pH, increase potassium and improve the balance between calcium and magnesium.

All of the reference soils have substantial organic content while the soils for new planting are low in organic. The incorporation of composted organic matter would offer advantages such as introducing a microbial population, improving soil structure and providing some nutrients. There is a significant concern here though because this could increase the phosphorus level beyond what is typical at the reference sites. Since higher phosphorus is a distinguishing characteristic in the sample from the Broom area this might not be desirable. There would still be an advantage to soil structure from incorporating a more inert source of organic such as nitrogen stable sawdust.

REFERENCE SITES

The slightly alkaline pH of sample 1 deviates from the moderate acidity at all the other areas. Correlating with the higher pH are lower levels of the micronutrients. Based on levels in 2 it appears the goal should be to have a lower pH.

All of these sites show favorably low salinity, and sodium. SAR values indicate sodium is adequately balanced by calcium and magnesium.

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Particle size makeup is diverse and if it were not for the abundance of organic matter these soils would be susceptible to consolidation as the various size particles intermingle. The predominate classification is gravelly sandy clay loam. Infiltration rates are estimated to be in the range of 0.22 to 0.26 inch per hour.

Available nutrient levels show all low in nitrogen and phosphorus. Potassium is barely adequate in 1 but well above sufficiency in the others. All show a proper balance between calcium and magnesium. Sample 1 shows lower micronutrient levels with zinc and iron deficient. In the other areas levels are higher with manganese particularly abundant. Sulfate levels vary from low to fair.

RHYOLITE FILL SOILS

Characteristics of 2 deviate significantly from 1 and are also more dissimilar from the reference soils. While salinity of 2 would not typically be restrictive it is much higher than in any of the other samples. This reflects high soluble levels of calcium, magnesium and sulfate. This is also associated with a slightly alkaline pH. If this is readily distinguishable from 1, then its use for the root zone should be minimized. If it will be blended with 1, then at least there will be some dilution bringing salt content closer to that found in the reference soils. Either will need pH adjustment. Sodium levels are favorably low.

Sample 1 has more silt and clay than 2 but both show a broad range of coarse particles similar to the reference soils. Organic levels are very low and infiltration rates are estimated at 0.23-inch per hour.

Available nutrient levels match the low nitrogen and phosphorus of the reference soils but potassium levels are much lower and in deficiency ranges. Calcium levels are lower than desired relative to the abundance of magnesium. Micronutrients are not deficient but are much lower than in the reference samples. The adjustment of pH may compensate for this sufficiently. Sulfate is deficient in 1 and very high in 2.

POTENTIAL TOPSOILS

Characteristics of these two samples are significantly different and the higher pH and higher phosphorus level in 2 makes it particularly undesirable. All characteristics of 2 are very similar to the undesirable Broom soil.

Sample 1 will need to have pH lowered but it does show favorably low nitrogen and phosphorus. Potassium is very deficient and needs aggressive supplementation to bring it in line with the reference soils. The pH adjustment should improve micronutrient levels. Iron is deficient at this time. The characteristic of this that still deviates from all the other samples is its high magnesium level. This cannot be altered by the amendment program even though the addition of calcium and potassium will improve the cation balance. The abundance of magnesium might be a significant enough deviation that use of this source should be reconsidered.

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Texture of 2 is fairly similar to the reference soils but organic content is lower. It is still in a fairly normal range for a topsoil horizon. The infiltration rate is estimated at 0.28-inch per hour.

BROOM SOIL – INVASIVE, NON-NATIVE HABITAT

Characteristics that deviate mostly from the reverence sites are slight alkalinity and an adequate phosphorus level. While micronutrient levels are lower, none are in a deficiency range. Sulfate is marginal at best. Salinity, sodium and boron are safely low and comparable to the reference soils.

Texture is similar to the others except that more gravel is present. Organic content is normal for native topsoil and the infiltration rate is estimated at 0.21 inch per hour.

RECOMMENDATIONS

Because of the steepness of planting areas you might consider blending amendments with the fill or topsoil before that is spread. It would be difficult to obtain the desired degree of pH adjustment without being able to blend sulfur with these soils. The efficiency of improving the calcium to magnesium balance would also be compromised if materials were just applied to the surface.

FILL SOILS

In order to most closely match characteristics of the reference soil the preference would be to minimize use of soil represented by samples 2. For bulk blending amendments the following formula would apply:

Amount Per 10 Cubic Yards

7 pounds	Soil Sulfur
5 pounds	Potassium Sulfate (0-0-50)
16 pounds	Agricultural Gypsum

If materials are incorporated to 6 inches after the soil has been spread then the equivalent rates would be:

Amount / 1000 Square Feet

13 pounds	Soil Sulfur
9 pounds	Potassium Sulfate (0-0-50)
30 pounds	Agricultural Gypsum

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-4-

H. T. HARVEY & ASSOCIATES
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Lab. No. 26396

POTENTIAL TOPSOILS

It is suggested that #2 not be used. For bulk blending amendments with #1 the following formula would apply:

Amount Per 10 Cubic Yards	
6 pounds	Soil Sulfur
8 pounds	Potassium Sulfate (0-0-50)
22 pounds	Agricultural Gypsum

If materials are incorporated to 6 inches after the soil has been spread then the equivalent rates would be:

Amount / 1000 Square Feet	
11 pounds	Soil Sulfur
14 pounds	Potassium Sulfate (0-0-50)
40 pounds	Agricultural Gypsum

As noted above, this topsoil would still have much higher magnesium availability than the reference soils. The additions of calcium and potassium should be sufficient that the magnesium level would not interfere with the plants ability to utilize either of these nutrients.

Jim West
JIM WEST

Fax 7 pages and mail.

Soil and Plant Laboratory, Inc.

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COMPREHENSIVE SOIL ANALYSIS
(AO5-1, AO5-2 or AO5-3)

Santa Clara Office
Lab No. 26396
LEONA QUARRY

Samples Taken: Samples Rec'd: 5/ 7/01

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	NO3 N	NH4 N	PO4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
				Parts Per Million Parts Dry Soil											
1	22 189	7.4 Low	0.6	5 0.3	6	6 0.2	170 0.6	3050 1.0	402 1.0	2.0 0.5	3 0.3	22 1.1	13 0.1	1.1	CA, Sage Disturbed Reference 0.9901-A10610 23 4
2	20 166	5.9	0.4	6 0.3	7	4 0.2	400 2.1	2000 0.9	672 2.2	4.6 1.7	11 1.6	54 3.6	68 1.0	4.4	CA, Sage Undisturbed 0.8301-A10611 23 4
3	18 102	5.5	0.6	13 0.8	15	1 0.1	290 2.3	1340 0.9	330 1.7	2.8 1.6	9 2.0	90 9.2	52 1.2	3.9	Chamise Undisturbed 0.8701-A10612 23 4
4	22 130	5.9	0.3	7 0.4	10	2 0.1	250 1.3	1860 0.9	372 1.3	3.2 1.2	11 1.7	82 5.7	47 0.7	4.3	CA, Sage / Cham. Undisturbed 1.0101-A10613 23 4

Sample #	Saturation Extract Values Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO4 me/l	SAR	Percent of Sample Passing 2 mm Screen: Gravel Coarse 5-12	Gravel Fine 2-5	Sand Very Coarse 1-2	Sand Coarse 0.5-1	Sand Med. to V. Fine .05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
1	2.9	1.2	1.1	0.2	0.11	0.7	0.8	14.2	14.6	11.9	11.4	27.6	22.7	26.4	Gravelly Sandy Clay Loam
2	1.1	0.8	0.9	0.3	0.14	0.8	0.9	7.7	15.9	19.2	11.6	21.0	25.3	22.9	Gravelly Sandy Clay Loam
3	1.7	1.4	1.0	0.7	0.13	1.7	0.8	11.3	14.1	15.2	9.8	23.8	28.3	22.9	Gravelly Loam
4	1.0	0.7	0.7	0.3	0.13	0.8	0.8	10.5	16.0	15.8	11.4	22.6	29.3	20.9	GravelLoam

5/10/01

Sufficiency factor (1.0=sufficient for average crop) below each nutrient element. N factor based on 200 ppm constant feed. Half Saturation %=approx field moisture capacity. Salinity ECe (dS/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Cu, Zn, Mn & Fe by DTPA extraction. SAR=Sodium adsorption ratio. Na=Sodium (meq/l). TEC (listed below Half Sat.)=Estimated Total Exchangeable Cations (meq/kg) Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm (1/2 inch) sieve. Particle sizes in millimeters.

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COMPREHENSIVE SOIL ANALYSIS
(AO5-1, AO5-2 or AO5-3)

Santa Clara Office
Lab No. Z6396
LEONA QUARRY

Samples Taken: Samples Rec'd: 5/ 7/01

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	NO3 N	NH4 N	PO4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
				Parts Per Million Parts Dry Soil											
5	22	5.3	0.5	6	11	8	430	2290	506	5.6	25	106	142	7.2	Coast Live Oak Undisturbed
	167			0.4		0.3	2.1	1.0	1.6	2.0	3.6	6.9	2.1		0.8201-A10614 23 4
6	16	6.9	0.3	5	6	7	70	1620	856	1.4	3	33	23	0.6	RH 1 Fill
	155	None		0.3		0.3	0.4	0.8	3.3	0.6	0.5	2.5	0.4		0.7801-A10615 23 4
7	15	7.3	3.2	4	6	1	120	1430	896	3.3	5	18	39	0.6	RH 2 Fill
	136	None		0.3		0.1	0.8	0.8	3.9	1.6	0.9	1.5	0.8		0.7801-A10616 23 4
8	17	6.7	0.5	4	5	4	90	3290	2300	2.2	1	24	23	0.6	Top Soil 1
	358	Low		0.3		0.2	0.3	0.9	4.7	0.5	0.1	1.0	0.2		0.6401-A10617 23 4

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO4 me/l	SAR	Percent of Sample Passing 2 mm Screen: Gravel: Coarse 5-12	Gravel: Fine 2-5	Sand: Very Coarse 1-2	Sand: Coarse 0.5-1	Sand: Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
5	1.8	1.1	1.0	0.6	0.34	1.6	0.8	6.2	10.6	21.2	12.8	18.8	23.3	23.9	Gravelly Sandy Clay Loam
6	1.0	0.8	1.1	0.1	0.13	0.6	1.2	11.0	14.5	13.4	10.0	21.7	30.0	24.9	Gravelly Loam
7	18.2	25.5	1.9	0.2	0.09	47.1	0.4	11.1	16.1	18.1	16.1	30.4	18.5	16.9	Gravelly Sandy Loam
8	1.7	2.0	1.0	0.1	0.07	1.0	0.7	3.9	13.2	15.0	14.8	27.3	24.4	18.5	GravelSandy Loam

5/10/01

Sufficiency factor (1.0=sufficient for average crop) below each nutrient element. N factor based on 200 ppm constant feed. Half Saturation %=approx field moisture capacity. Salinity ECe (dS/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Cu, Zn, Mn & Fe by DTPA extraction. SAR=Sodium adsorption ratio. Na=Sodium (meq/l). TEC (listed below Half Sat.)=Estimated Total Exchangeable Cations (meq/kg) Graval fraction expressed as percent by weight of oven-dried sample passing a 12mm (1/2 inch) sieve. Particle sizes in millimeters.

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San Jose, CA 95118

COMPREHENSIVE SOIL ANALYSIS
(A05-1, A05-2 or A05-3)

Santa Clara Office
Lab No. 26396
LEONA QUARRY

Samples Taken: Samples Rec'd: 5/ 7/01

Sample #	Half sat%/ TEC	pH/ Qual Lime	ECe	NO3 N	NH4 N	PO4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
				Parts Per Million Parts Dry Soil											
9	20	7.3	0.7	4	6	16	110	2870	830	2.4	4	18	52	1.7	Top Soil 2
	217	Low		0.2		0.7	0.4	1.0	2.1	0.6	0.4	0.9	0.6		0.8601-A10618 23 4
10	20	7.3	0.7	11	14	20	190	2330	668	2.4	8	27	27	1.6	Broom Soil
	175	None		0.6		0.8	0.8	0.9	1.9	0.7	1.0	1.5	0.3		0.9401-A10619 23 4

Percent of Sample Passing 2 mm Screen

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO4 me/l	SAR	Gravel: Coarse 5-12	Gravel: Fine 2-5	Sand: Very Coarse 1-2	Sand: Coarse 0.5-1	Sand: Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
9	2.8	2.0	2.7	0.1	0.14	1.4	1.7	9.7	8.8	6.0	6.5	30.6	30.4	26.5	Gravelly Loam
10	3.4	2.7	1.1	0.3	0.14	1.3	0.6	21.5	14.0	11.4	11.7	29.0	21.4	26.5	Very GravSandy Clay Loam

5/10/01

Sufficiency factor (1.0=sufficient for average crop) below each nutrient element. N factor based on 200 ppm constant feed. Half Saturation %=approx field moisture capacity. Salinity ECe (dS/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Cu, Zn, Mn & Fe by DTPA extraction. SAR=Sodium adsorption ratio. Na=Sodium (meq/l). TEC (listed below Half Sat.)=Estimated Total Exchangeable Cations (meq/kg) Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm (1/2 inch) sieve. Particle sizes in millimeters.

Soil and Plant Laboratory, Inc.

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Santa Clara, CA 95050
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SANTA CLARA OFFICE
June 12, 2001
Lab. No. 26149

H. T. HARVEY & ASSOCIATES
3150 Almaden Expressway, Suite 145
San Jose, CA 95118

Attn: Ernst Strenge

RE: LEONA QUARRY – PROJ. NO. 1950-01, P. O. NO. 01-429

BACKGROUND

It is understood that displacement of the tuff soil from the upper portion of the slope will be used to fill the lower part to create a more gently grade. It was also indicated that some of the rhyolite soil evaluated 5/18 may be blended with this.

Specific questions raised in your 5/24 letter are addressed at the end of this report.

REFERENCE SITE - TUFF

Characteristics are similar to reference sites represented by samples 2 through 5, which apparently are of rhyolite origin. Characteristics that may be particularly important in establishing the desired plants are the moderate acidity, low phosphorus and abundance of potassium.

TUFF FILL

Reaction is just a little lower than the moderately acidic level seen in the reference sample. Fertility characteristics that need adjustment include correcting the extremely low calcium level and increasing potassium and organic content.

Texture may initially be coarser than the reference material but should break down with weathering. The presence of organic matter will also help compensate for this.

DISCUSSION

Comparing the tuff fill and the rhyolite fill to the reference soil, similarities include low potassium, high magnesium and low organic content. The two fill materials differ from each other in that the tuff is a little more acidic than the target and is extremely low in calcium. The rhyolite is more alkaline than desired but does show the desired calcium content.

H. T. HARVEY & ASSOCIATES
June 12, 2001
Lab. No. 26149

RECOMMENDATIONS

In order to most closely match characteristics of the tuff reference soil amendment needs would be:

	Amount Per 10 Cubic Yards	Amount / 1000 Square Feet to 6 inches	
100% Tuff Fill			
	2 cubic yards	3.8 cubic yards	Nitrogen Stable Organic
	5 pounds	10 pounds	Potassium Sulfate (0-0-50)
	5 pounds	10 pounds	Calcium Carbonate Lime
	22 pounds	45 pounds	Agricultural Gypsum
70% Tuff Fill 30% Rhyolite Fill			
	2 cubic yards	3.8 cubic yards	Nitrogen Stable Organic
	5 pounds	10 pounds	Potassium Sulfate (0-0-50)
	22 pounds	40 pounds	Agricultural Gypsum
100% Rhyolite Fill			
	2 cubic yards	3.8 cubic yards	Nitrogen Stable Organic
	5 pounds	10 pounds	Potassium Sulfate (0-0-50)
	16 pounds	30 pounds	Agricultural Gypsum
	7 pounds	13 pounds	Soil Sulfur

One of the items raised in your list of questions was the rate for amending an individual pit 2 feet in diameter by 1-foot depth. From the above rates listed for 10 cubic yards multiplying by 0.186 would result in units of ounces weight per pit.

MISCELLANEOUS QUESTIONS

Responses are numbered to correspond with your numbered questions.

1. Rh1 needs potassium and calcium and would still have much higher magnesium than the reference material. Rh2 would not need as much potassium but still needs calcium and would still have high magnesium and higher soluble salts.

2. The high magnesium in both makes it even more important to address the potassium and calcium levels. This balance of the cations may be playing a significant role in determining the plant population.

3. Initial corrections should bring current conditions to sufficient similarity. Maintenance of those conditions depends on the natural recycling of nutrients from microbial activity. Without organic matter being present this would be slowed significantly. Fungal innoculum referred to in 9 may also be beneficial in this respect.

H. T. HARVEY & ASSOCIATES
June 12, 2001
Lab. No. 26149

4. Check with Northern California Fertilizer Co. 408-453-7907.

5. Check with TMT Enterprises 408-432-9040.

6. Using less will just leave results farther from the target. Impact of that on maintaining the desired plants is not known.

7. If materials are only applied to the surface rates of sulfur and gypsum should be reduced by 30%. While the effectiveness of organic matter would be severely reduced if not incorporated, there would still be a long term benefit from applying some just as a top mulch if that is all that is possible.

8. As noted above 0.186 times the 10 cubic yard rate equals ounces weight per pit.

9. Mycorrhizal fungi use would not alter the amendments suggested and based on work done by others this may be beneficial. I do not have sufficient experience with their use and direction should be based on consultation with others.

10. Without organic matter these soils will be subject to consolidation which would mean less water penetration and more likely surface erosion concerns. Organic matter would help this a great deal.

11. The comment about phosphorus was only with respect to organic matter derived from yard waste. This is not a concern with sawdust.

12. Here again it is only the addition or organic matter than can create a condition similar to the reference soil. The organic matter will result in better water penetration and the ability to retain a better reserve for the plants. Estimated infiltration rates noted are not at field capacity. I have no familiarity with rain patterns.

Jim West

JIM WEST

Fax 4 pages and mail.

P.03
(408) 727-5125
Jun-12-01 12:55P

Soil and Plant Laboratory, Inc.

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COMPREHENSIVE SOIL ANALYSIS
(AOS-1, AOS-2 or AOS-3)

Santa Clara Office
Lab No. 26149
Leona Quarry
1950-01

Samples Taken: Samples Rec'd: 5/30/01

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	NO3 N	NH4 N	PO4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
				Parts Per Million Parts Dry Soil											
1	22	5.5	0.4	7	6	2	250	1450	388	4.6	8	22	85	3.7	Tuff Reference
	111			0.3		0.1	1.6	0.8	1.6	2.1	1.4	1.8	1.6		1.0101-A12162 25 4
2	16	5.3	0.4	6	13	6	90	190	828	2.4	2	9	32	0.1	Tuff Fill Soil
	87			0.6		0.3	0.9	0.2	5.2	1.7	0.6	1.1	0.9		0.8001-A12163 25 4

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO4 me/l	SAR	Percent of Sample Passing 2 mm Screen: Gravel Coarse 5-12	Gravel Fine 2-5	Sand Very Coarse 1-2	Sand Coarse 0.5-1	Sand Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
1	1.2	0.9	0.7	0.3	0.08	0.9	0.7	12.4	13.8	11.0	10.4	19.7	34.4	24.5	Gravelly Loam
2	0.3	0.4	1.9	0.1	0.08	0.7	3.1	21.7	21.0	19.3	16.7	24.6	17.1	22.3	Very GravSandy Clay Loam

6/ 5/01

Sufficiency factor (1.0=sufficient for average crop) below each nutrient element. N factor based on 200 ppm constant feed. Half Saturation t=approx field moisture capacity. Salinity ECe (dS/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Cu, Zn, Mn & Fe by DTPA extraction. SAR=Sodium adsorption ratio. Na=Sodium (meq/l). TEC (listed below Half Sat.)=Estimated Total Exchangeable Cations (meq/kg) Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm (1/2 inch) sieve. Particle sizes in millimeters.

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COMPREHENSIVE SOIL ANALYSIS
(AO5-1, AO5-2 or AO5-3)

Santa Clara Office
Lab No. 26149
Leona Quarry
1950-01

Samples Taken:
Samples Rec'd: 5/30/01

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	Parts Per Million Parts Dry Soil: NO3 N	NH4 N	PO4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
1	22 111	5.5	0.4	7 0.3	6	2 0.1	250 1.6	1450 0.8	388 1.6	4.6 2.1	8 1.4	22 1.8	85 1.6	3.7	Tuff Reference 1.0101-A12162 25 4
2	16 87	5.3	0.4	6 0.6	13	6 0.3	90 0.9	190 0.2	828 5.2	2.4 1.7	2 0.6	9 1.1	32 0.9	0.1	Tuff Fill Soil 0.8001-A12163 25 4

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO4 me/l	SAR	Percent of Sample Passing 2 mm Screen: Gravel: Coarse 5-12	Gravel: Fine 2-5	Sand: Very Coarse 1-2	Sand: Coarse 0.5-1	Sand: Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
1	1.2	0.9	0.7	0.3	0.08	0.9	0.7	12.4	13.8	11.0	10.4	19.7	34.4	24.5	Gravelly Loam
2	0.3	0.4	1.9	0.1	0.08	0.7	3.1	21.7	21.0	19.3	16.7	24.6	17.1	22.3	Very GravSandy Clay Loam

Sufficiency factor (1.0=sufficient for average crop) below each nutrient element. N factor based on 200 ppm constant feed. Half Saturation t=approx field moisture capacity. Salinity ECe (dS/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Cu, Zn, Mn & Fe by DTPA extraction. SAR=Sodium adsorption ratio. Na=Sodium (meq/l). TEC (listed below Half Sat.)=Estimated Total Exchangeable Cations (meq/kg) Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm (1/2 inch) sieve. Particle sizes in millimeters.

6/ 5/01

APPENDIX C

GEOBRUGG

Service/Maintenance Manual
Rockfill Barrier - 30 ft-ton
June 28, 2002

Service/Maintenance Manual
Rockfill Barrier - 74 ft-ton to 295 ft-ton
July 1, 2002

Service / Maintenance Manual – 30 ft-ton Rockfall Barrier
GEOBRUGG Technical Department

GEOBRUGG

NOTE: Rockfall, Landslides, Debris Flows or Avalanches are sporadic and unpredictable. Causes range from human (construction, etc.) to environmental (weather, earthquakes, etc.) Because of the multiplicity of factors affecting such an event, it is not and cannot be an exact science that guarantees the safety of individuals and property. However, by the application of sound engineering principles to a predictable range of parameters, and by the use of properly designed protection measures in identified risk areas, the risk of injury and property loss can be substantially reduced. Inspection and maintenance of such systems is necessary to insure the desired protection level. It can also be degraded by impact damage, which exceeds the design limits of a particular system or by corrosion caused by pollution or other man-made factors.

SERVICE / MAINTENANCE OF ROCKFALL PROTECTION BARRIERS:

GEOBRUGG Rockfall Protection Barriers are designed to require little or no maintenance when impacted by rocks with kinetic energy within the design load rating of the system (please refer to the GEOBRUGG Impact Load Chart). However, minor maintenance is occasionally required after such impacts, depending on frequency. Other repairs may be necessary if rock impacts with kinetic energy beyond the design load rating are experienced. The most common (though infrequent) maintenance tasks required are outlined below. Please refer to the layout and design drawings for the particular installation for specific detail on assembly as needed.

Infrequent rockfall will obviously require less maintenance than frequent rockfall events. If frequent events (daily) take place well within the energy absorption design load of a system, the service efforts will generally be limited to routine checking as outlined below. Major events such as rockfalls with energies around system design load may necessitate some minor repairs. Major events such as rockfalls beyond system design load may necessitate repairs that are more significant.

ROUTINE CHECKING:

- Periodic "quick" checking of the systems once to twice per year for major events:
  - are any bigger rocks lying in the nets?
  - have any braking elements responded?
  - is the effective height reduced due to sagging ropes?
  - re-checking of the wire rope clips (using a torque wrench)

- Does chainlink have any holes requiring repair? Chainlink material may become tattered from frequent rockfalls or may acquire holes from bigger rockfall events. Any holes or tears should be repaired to prevent rocks smaller than the mesh size of the nets from passing through the nets or to improve the aesthetics of a system.

- Clearing out of soil, rubble, dead leaves, etc. behind a system as necessary to prevent the formation of jump platforms. Such accumulations result in a reduced effective barrier height and reduced system flexibility and thus reduced energy dissipating capability. For such reasons, debris should never be allowed to accumulate behind the systems to more than 1/4 to 1/3 the height of the nets.

- Periodic checking of the anchorage condition after approximately 10 years.

CHECKING MAJOR EVENTS:

If a major event occurs (energy around the design load of the system), the following service work must be carried out:

- Braking Elements. Check whether one or more braking elements have responded. Braking elements need no maintenance unless they are fully deformed, in which case they need to be replaced. Testing has shown that these new braking elements perform as intended up to the point of full activation, even if by several separate events. However, once any single braking element activation has accumulated to ~40 cm. or more, it should be replaced in order to maintain the full energy absorption capacity of the system as a whole. Care must be taken in any case that the additional sagging of the nets caused by the responding of braking elements does not become excessive, as this has a strong influence on the effective height of the barrier. Re-tightening of the appropriate ropes can also be carried out without exchange of the braking elements.

- Support Rope Tightening. Braking element response will result in extra slack in the support ropes and thus sagging of the support rope and net(s). If braking elements have responded, but not enough to warrant replacement, a judgment needs to be made whether or not the sag and consequent reduction in effective height is acceptable. The sag can be reduced or eliminated without replacing the braking element(s) by simply re-tensioning the support rope. Support ropes can be tightened to obtain the original effective height if deemed necessary.

- Support Ropes & Shackles. Examine for possible damage or loss of strength. Crushed or broken rope wires may result from rockfall events. The rope should be repaired or replaced if more than approximately 10% of the rope cross section is affected. Severe buckling of ropes is also a reason to proceed with replacement. Shackles are used to connect adjacent ring net panels and end ring net panels to support rope structure.

- Ring Nets and Anchorages. Examine for possible damage. Damaged rings of the ring net should be repaired. Clips on the rings that have broken or moved significantly should be replaced. Significantly damaged nets should be replaced, though the need for this is quite rare. Examine the anchorages to ensure they do not appear to have been disturbed, weakened, or damaged. If a major event occurs (beyond design load but within the ultimate load), the following service work must be carried out:

- Replacement of braking elements as necessary (as above)

- Support Rope & shackle repair, replacement or tightening (as above)

- Net repair or replacement as necessary (as above)

- Anchorage repair

- Column repair or replacement as necessary. The fundamental function of the columns is to provide the nets with the necessary effective height. Direct rock impacts to the columns may bend or deform the columns, though such deformation is rare. Slightly bent columns do not

have to be repaired or replaced as long as their condition does not mean a significant loss of height or ill-fitting nets, or unless the deformation has aesthetic consequences. If so desired for aesthetic reasons, minor deformation can usually be pounded out and repainted. Column foundations should be examined to ensure that no damage exists and that the connections are sound.

SERVICE / REPAIR WORK:

After performing any repair work to the system, re-assembly should be done in accordance with the original design drawings (i.e. with correct wire rope clip torques, clip orientation on the rope, etc.)

- Cleanout: Cleanout procedures for the systems will depend on the quantity of material in the nets and may require at least partial disassembly to allow material to be removed by hand or with heavy equipment. Some alternatives include:

  1) For systems alongside roads or with easy access, cleanout will be most easily accomplished by driving behind the fence (where space allows) with heavy equipment such as a backhoe or loader.

  2) If there is insufficient space behind the barriers to allow equipment passage, and jersey barriers are used for traffic protection with the nets being elevated off the ground, cleanout may be possible without requiring any degree of fence disassembly. After moving any jersey barrier that may be in front of any particular section, accumulated rocks can be removed through the 2'-8" high gap between the bottom of the nets and the ground, taking care not to "snag" the bottom of the net or bottom support rope with the equipment that is being used.

  3) If better access is still required or desired, varying degrees of partial system disassembly can be undertaken as follows (with or without temporarily moving jersey barrier that may or may not be in place):

     a) loosening the bottom support rope where it is attached to the anchor by removing the wire rope clips, and then sliding the bottom support rope through the affected nets to allow the nets to hang freely. Or,
     b) it may be possible to unbolt the bottom cable guide assembly(s) from the columns, thereby allowing the bottom support rope and bottom of the nets to swing outward and/or be lifted.
     Please note that the nets can withstand being driven over with rubber tires, but should not be driven over with track rigs.

- Chainlink: Holes or tears in the chainlink fabric can be patched or entire panels can be replaced. Chainlink should be reattached to the nets with galvanized hog rings.

- Braking Element replacement: If the braking element tube is not too badly deformed, the tube can simply be slid off the rope and a new tube can be slid onto the rope and into place. If the rope will no longer freely slide through the tube, the braking element will need to be cut out and a new braking element (tube with a prefabricated sling with presses at both ends) is spliced back into place.

- In a top support rope: First secure the support rope from moving through the cable guides by attaching one end of a come-along to the rope between the column and the braking element, and the other end to the anchor. Alternatively, a vise-grip or cable clip can be applied to the rope at the column cable guide, whatever works, to prevent the rope from passing through the cable guide when tension on the rope is relieved. Next, detach the support rope from the anchor by removing the wire rope clips. Finally, slide the old tube off the rope, slide a new tube onto the rope, and re-secure the rope to the anchor, and remove whatever restraining device was used. If the tube does not want to stay in place and instead wants to slide down the rope, a small piece of baling wire can be tied around the rope at the end of the tube to prevent it from sliding.

  If the tube will not freely slide off the rope, the old braking element will need to be cut out of the rope and replaced with a spare. This is accomplished by cutting the support rope on each side of the old braking element and removing the old braking element. A new braking element is then spliced into place using loop splices (as shown in the design drawings) on each side of the replacement. Then, re-secure the rope to the anchor, and remove whatever restraining device was used.

- In a bottom support rope: Same as above, except the support rope does not need to be secured prior to disconnecting it from the anchor.

- Required material / tools:
  - spare braking element
  - wire rope cutter
  - wire rope clips of appropriate size
  - come-along (or vise-grips, cable clips),
  - set of socket wrenches with torque setting ability
  - ladder

- Repairing damaged Support Ropes: Broken or damaged support ropes can be spliced back together using wire rope clips and a small length of the same diameter wire rope, per the splicing detail in the design drawings. First, remove the net section in question from the support rope. Next, attach the ends of a come-along to the support rope on each side of the damaged section of rope, and tension. Cut the support rope on either side of the damaged section. Attach a new piece of wire rope to the two cut ends of the support rope by using a clipped splice per the design drawings. Remove the come-along and shackle the net(s) to the support rope. Alternatively, the repair cable can be spliced over the damaged section of cable without cutting out the damaged section.

  Replacement of a support rope will necessitate removal of the net(s) from the support rope section in question. The support rope is then removed by unfastening the cable guides from the columns, and removing the wire rope clips from the anchors. The new rope is then installed (per design drawings) by putting it into place, re-attaching the cable guides, tensioning the rope as necessary and re-attaching to the anchors.

- Support Rope tightening. If the net sag is undesirable, and no braking elements are fully activated, the sag can be eliminated by re-tightening the support rope where it is attached to the anchor. First, attach a come-along to the anchor at one end and to the rope at the other end. Using the come-along, apply more tension to the rope as necessary. Next, detach the support

rope from the anchor by removing the wire rope clips. Refasten the clips at the attachment to the anchor after removing any of the resultant slack. Remove the come-along.

Tension on these ropes should be such that it is only enough to eliminate the undesirable sag. Any more tension will inhibit the proper operation of the system.

- Repairing or replacing damaged Nets: Single rings that are broken can be replaced. Damaged rings should be cut and a new ring spliced back into place, eliminating the damaged portion.

  If an entire net needs to be replaced, the chainlink mesh material must first be removed and carefully stored. Next, proceed as in section "Cleanout – 3a" (above)(top and bottom support ropes). The new net is now fastened again by sliding the support ropes through the ring nets. The support ropes are then fastened to the anchors with cable clips. Adjacent nets are shackled together. Finally, the chainlink is fastened to the new net again using galvanized hog rings on 2' centers vertically and horizontally.

- Column replacement or repair: Columns can be detached from the foundations after removal of support ropes, retaining ropes and nets by removing the four base plate nuts and lifting the column up off the foundation bolts.

Service / Maintenance Manual - 74 ft-ton to 295 ft-ton Rockfall Barrier(s) - Ring Nets
GEOBRUGG Technical Department

GEOBRUGG

NOTE: Rockfall, Landslides, Debris Flows or Avalanches are sporadic and unpredictable. Causes range from human (construction, etc.) to environmental (weather, earthquakes, etc.) Because of the multiplicity of factors affecting such an event it is not and cannot be an exact science that guarantees the safety of individuals and property. However, by the application of sound engineering principles to a predictable range of parameters, and by the use of properly designed protection measures in identified risk areas, the risk of injury and property loss can be substantially reduced. Inspection and maintenance of such systems is necessary to insure the desired protection level. It can also be degraded by impact damage, which exceeds the design limits of a particular system or by corrosion caused by pollution or other man-made factors.

SERVICE / MAINTENANCE OF ROCKFALL PROTECTION BARRIERS:

GEOBRUGG Rockfall Protection Barriers are designed to require little or no maintenance when impacted by rocks with kinetic energy within the design load rating of the system (please refer to the GEOBRUGG Impact Load Chart). However, minor maintenance is occasionally required after such impacts, depending on frequency. Other repairs may be necessary if rock impacts with kinetic energy beyond the design load rating are experienced. The most common (though infrequent) maintenance tasks required are outlined below. Please refer to the layout and design drawings for the particular installation for specific detail on assembly as needed.

Infrequent rockfall will obviously require less maintenance than frequent rockfall events. If frequent events (daily) take place well within the energy absorption design load of a system, the service efforts will generally be limited to routine checking as outlined below. Major events such as rockfalls with energies around system design load may necessitate some minor repairs. Major events such as rockfalls beyond system design load may necessitate more significant repairs.

ROUTINE CHECKING:

- Periodic "quick" checking of the systems once to twice per year for major events:
  - are any bigger rocks lying in the nets?
  - have any braking elements responded?
  - is the effective height reduced due to sagging ropes?
  - re-checking of the wire rope clips (using a torque wrench)

- Does chainlink have any holes requiring repair? Chainlink material may become tattered from frequent rockfalls or may acquire holes from bigger rockfall events. Any holes or tears should be repaired to prevent rocks smaller than the ring diameter of the nets from passing through, or to improve the aesthetics of a system.

- Clearing out of soil, rubble, dead leaves, etc. behind a system as necessary to prevent the formation of jump platforms. Such accumulations result in a reduced effective barrier height and reduced system flexibility and thus reduced energy dissipating capability. For such reasons, debris should never be allowed to accumulate behind the systems to more than 1/4 to 1/3 the height of the nets.

- Periodic checking of the anchorage condition after approximately 10 years.

CHECKING MAJOR EVENTS:

If a major event occurs (energy around the design load of the system), the following service work must be carried out:

- Braking Elements: Check whether one or more braking elements have responded. Braking elements need no maintenance unless they have been fully deformed, in which case they need to be replaced. Testing has shown that these new braking elements perform as intended up to the point of full activation, even if by several separate events. However, once any single braking element activation has accumulated to ~40 cm. or more, it should be replaced in order to maintain the full energy absorption capacity of the system as a whole. Care must be taken in any case that the additional sagging of the nets caused by the responding of braking elements does not become excessive, as this has a strong influence on the effective height of the barrier. Re-tightening of the appropriate ropes can also be carried out without exchange of the braking elements.

- Support Rope(s) and Retaining Rope(s) tightening: Braking element response will result in extra slack in the support ropes, and thus sagging of the support rope and net(s). If braking elements have responded, but not enough to warrant replacement, a judgment needs to be made whether or not the sag and consequent reduction in effective height is acceptable. The sag can be reduced or eliminated without replacing the braking element(s) by simply re-tensioning the support rope. Support ropes can be tightened to obtain the original effective height if deemed necessary. Similarly, braking element response in tieback ropes will result in tieback ropes being slack. Slack tieback ropes should always be free of any slack, and thus need to be re-tightened if necessary.

- Support Ropes & Shackles and Retaining Ropes: Examine for possible damage or loss of strength. Crushed or broken rope wires may result from rockfall events. The rope should be repaired or replaced if more than approximately 10% of the rope cross section is affected. Severe buckling of ropes is also a reason to go ahead with replacement. Shackles are used to connect the ring nets to the support rope.

- Ring Nets and Anchorages. Examine for possible damage. Damaged rings of the ring net should be repaired. Clips on the rings that have broken or moved significantly should be replaced. Significantly damaged nets should be replaced, though the need for this is quite rare. Examine the anchorages to ensure they do not appear to have been disturbed, weakened, or damaged. If a major event occurs (beyond design load, but within the ultimate load), the following service work must be carried out:

- Replacement of braking element(s) as necessary (as above)

- Support Rope(s) & shackle repair and Retaining Rope(s) repair, replacement or tightening (as above)

- Net repair or replacement as necessary (as above)

- Anchorage repair

- Column repair or replacement as necessary. The fundamental function of the columns is to provide the nets with the necessary effective height. Direct rock impacts to the columns may bend or deform the columns, though such deformation is rare. Slightly bent columns do not have to be repaired or replaced as long as their condition does not mean a significant loss of height or ill-fitting nets, or unless the deformation has aesthetic consequences. If so desired for aesthetic reasons, minor deformation can usually be pounded out and re-painted.

  For columns with the column breakaway assembly at the base, extremely large impacts may cause the breakaway assembly to engage, allowing the column to rotate (tieback ropes prevent the column from laying all the way down). In this case, the breakaway shear bolts will need to be replaced after the column has been righted, and the retaining rope braking elements will need to be replaced. Foundations should be examined to ensure that no damage exists, and that the connections are sound.

  For columns without the column breakaway assembly at the base, foundations should be examined to ensure that no damage exists, and that the connections are sound.

SERVICE / REPAIR WORK:

After performing any repair work to the system, re-assembly should be done in accordance with the original design drawings (i.e. with correct wire rope clip torques, clip orientation on the rope, etc.)

- Cleanout: Cleanout procedures for the systems will depend on the quantity of material in the nets, and may require at least partial disassembly to allow material to be removed by hand or with heavy equipment. Some alternatives include:

  1) For systems alongside roads or with easy access, cleanout will be most easily accomplished by driving behind the fence (where space allows) with heavy equipment such as a backhoe or loader. Prior to driving equipment behind a system, the retaining ropes need to be detached from the top of the columns by opening the top cable guide on the column, and slipping the pressed loop of the rope off the top of the column. Alternatively, the retaining rope can be detached from the anchors by removing the wire rope clips on the clip loop attachments to the anchors.

  2) If there is insufficient space behind the barriers to allow equipment passage, and jersey barriers are used for traffic protection with the nets being elevated off the ground, cleanout may be possible without requiring any degree of fence disassembly. After moving any jersey barrier that may be in front of any particular section, accumulated rocks can be removed through the 2'-8" high gap between the bottom of the nets and the ground, taking care not to "snag" the bottom of the net or bottom support rope with the equipment that is being used.

  3) If better access is still required or desired, varying degrees of partial system disassembly can be undertaken as follows (with or without temporarily moving jersey barrier that may or may not be in place):

a) unshackle the bottom of the net from the bottom support rope, allowing the bottom of net to be raised (please note that the bottom support rope will still be in place, and care must be taken not to "snag" it with the equipment being used). Or,
b) loosening the bottom support rope by removing the wire rope clips at the clipped loop end of the rope with no unshackling, and then pulling up the bottom support rope slightly, net and all. Or,
c) it may be possible to open the bottom cable guide assembly(s), thereby allowing the bottom support rope and bottom of the nets to swing outward and/or be lifted. Or,
d) unshackling the affected net from the support ropes. The net will then fall to the ground, allowing the rock to be removed. Again, please note that the support ropes will still be in place, and care must be taken not to "snag" them with the equipment being used. The net can then be lifted back into place, and be re-shackled to the support ropes and adjacent nets as before. Please note that the nets can withstand being driven over with rubber tires, but should not be driven over with track rigs.

- Chainlink: Holes or tears in the chainlink fabric can be patched or entire panels can be replaced. Chainlink should be re-attached to the nets with galvanized hog rings as necessary.

- Braking Element replacement: Attach the ends of a come-along to the support rope on each side of the old braking element, and tension. Cut the support rope on each side of the old braking element to remove the old braking element. A spare braking element (tube with a prefabricated sling with pressed loops at both ends) is then spliced back into the support rope by using loop splices (as shown in the design drawings) on each side of the replacement. Remove the come-along, re-shackle the net (as necessary) to the support rope.

- In a retaining rope: These braking elements are most easily replaced by simply replacing the entire retaining rope. Alternatively, the retaining rope can be disconnected from the anchor, and if the tube is not too badly deformed, the tube can be slid off the rope. A replacement tube (spare braking element with rope sling removed) is then slid back into place, and the retaining rope is reconnected to the anchor. If the tube does not want to stay in place and instead wants to slide down the rope, a small piece of baling wire can be tied around the rope at the end of the tube to prevent it from sliding. If the tube will not freely slide off the rope, it will need to be cut out and replaced with a braking element spare using loop splices.

- Required material / tools:
  1. spare braking element
  2. wire rope cutter
  3. wire rope clips of appropriate size
  4. come-along (or vise-grips, cable clips),
  5. set of socket wrenches with torque setting ability
  6. ladder

- Repairing damaged Support Ropes: Broken or damaged support ropes can be spliced back together using wire rope clips and a small length of the same diameter wire rope, per the splicing detail in the design drawings. Attach the ends of a come-along to the support rope on each side of the damaged section of rope, and tension. Cut the support rope on either side of the damaged section of support rope. Attach a new piece of wire rope having the same diameter, to

the two cut ends of the support rope by using a clipped splice per the design drawings. Remove the come-along and re-shackle the net (as necessary) to the support rope.

Replacement of a support rope will necessitate removal of all shackles and netting from the support rope section in question. The support rope is then removed by loosening and opening the cable guide assemblies, and removing the wire rope clips from the clipped loop end of the rope. The new rope is then installed (per design drawings) by putting it into place, re-attaching the clip loop on one end after tensioning the rope as necessary, and re-securing the cable guides.

- Support Rope tightening. If the net sag is undesirable, and no braking elements are fully activated, the sag can be eliminated by re-tightening the top support rope at the clipped loop. First, attach a come-along to the cable, then loosen the clips, and using the come-along, apply more tension to the rope as necessary. Then re-fasten the clips at the clip loop to the cable guide after removing any of the resultant slack. Remove the come-along.

  Tension on these ropes should be such that it is only enough to eliminate the undesirable sag. Any more tension will inhibit the proper operation of the system.

- Repairing or replacing damaged Nets: Single rings that are broken can be replaced. Damaged rings should be cut and a new ring spliced back in place, eliminating the damaged portion.

  If an entire net needs to be replaced, the chainlink mesh material must first be removed and carefully stored. Next, remove the shackles from the net panel. The new net is now fastened again to the support ropes and adjacent nets using the shackles. Finally, the chainlink is fastened to the new net again using galvanized hog rings on 2' centers vertically and horizontally.

- Column replacement or repair: Columns can be detached from the foundations after removal of support ropes, retaining ropes and nets by removing the four base plate nuts and lifting the column up off the foundation bolts.

  If the breakaway assembly has engaged, the column can be placed back in a vertical position and two new shear bolts can be attached in the breakaway assembly per the design drawings. In such an instance, the retaining rope braking elements will also need to be replaced.

APPENDIX D

Legal Description
Geologic Hazard Abatement District (GHAD) Property
Leona Property, Oakland California

5188.1.001.02
August 13, 2004
Latest Revision March 9, 2005

AUGUST 11, 2004
JOB NO.: 1020-00

LEGAL DESCRIPTION
GEOLOGIC HAZARD ABATEMENT DISTRICT (GHAD)
LEONA PROPERY
OAKLAND, CALIFORNIA

REAL PROPERTY, SITUATE IN THE INCORPORATED TERRITORY OF THE CITY OF OAKLAND, COUNTY OF ALAMEDA, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

BEING ALL OF THAT CERTAIN PARCEL OF LAND GRANTED TO LEONA, LLC, BY DEED RECORDED JUNE 2, 2004, IN DOCUMENT NO. 2004-244483 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF ALAMEDA COUNTY, AND BEING ALL OF CROWN RIDGE COURT, AS SAID CROWN RIDGE COURT IS SHOWN AND SO DESIGNATED ON THE AMENDED MAP, TRACT 5018, RECORDED FEBRUARY 11, 1988, IN BOOK 175 OF MAPS AT PAGE 1, IN SAID OFFICE OF THE COUNTY RECORDER OF ALAMEDA COUNTY, AND BEING ALL OF EDENVALE PLACE, AS SAID EDENVALE PLACE IS SHOWN AND SO DESIGNATED ON THAT CERTAIN PARCEL MAP NO. 7106, RECORDED DECEMBER 1, 1997, IN BOOK 232 OF PARCEL MAPS AT PAGE 88, IN SAID OFFICE OF THE COUNTY RECORDER OF ALAMEDA COUNTY, AND BEING A PORTION OF MOUNTAIN BOULEVARD, AS SAID MOUNTAIN BOULEVARD IS SHOWN AND SO DESIGNATED ON THAT CERTAIN MAP ENTITLED "LEONA HEIGHTS ADDITION," RECORDED FEBRUARY 27, 1925, IN BOOK 4 OF MAPS AT PAGE 64, IN SAID OFFICE OF THE COUNTY RECORDER OF ALAMEDA COUNTY, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE WESTERN CORNER OF PARCEL THREE, AS SAID PARCEL THREE IS DESCRIBED IN SAID DEED (2004-244483);

THENCE, FROM SAID POINT OF BEGINNING, ALONG THE BOUNDARY LINE, THE FOLLOWING FIFTY-THREE (53) COURSES:

1) NORTH 41°14'29" EAST 110.65 FEET,

2) NORTH 50°02'49" EAST 58.46 FEET,

3) SOUTH 55°28'54" EAST 316.09 FEET,

4) NORTH 41°07'43" EAST 136.86 FEET,

5) NORTH 23°07'33" EAST 261.93 FEET,

6) SOUTH 49°47'02" EAST 298.00 FEET,

7) NORTH 31°20'49" EAST 23.54 FEET,

8) SOUTH 58°07'51" EAST 50.00 FEET,

9) SOUTH 55°34'31" EAST 525.86 FEET,

10) NORTH 49°21'05" EAST 687.70 FEET,

11) NORTH 33°51'34" EAST 95.01 FEET,

12) SOUTH 38°18'32" EAST 156.87 FEET,

13) NORTH 51°41'28" EAST 564.93 FEET,

14) SOUTH 32°37'35" EAST 401.98 FEET,

15) NORTH 51°41'28" EAST 533.65 FEET,

16) NORTH 38°18'32" WEST 300.70 FEET,

17) NORTH 41°34'59" EAST 296.00 FEET,

18) SOUTH 48°25'01" EAST 225.00 FEET,

19) NORTH 84°18'52" EAST 130.97 FEET,

20) SOUTH 51°31'37" EAST 41.79 FEET,

21) ALONG THE ARC OF A NON-TANGENT 25.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE CENTER OF SAID CURVE BEAR NORTH 66°10'29" EAST, THROUGH A CENTRAL ANGLE OF 147°11'42", AN ARC DISTANCE OF 64.23 FEET,

22) ALONG THE ARC OF A REVERSE 10.00 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE CENTER OF SAID CURVE BEARS NORTH 33°22'11" EAST, THROUGH A CENTRAL ANGLE OF 81°47'12", AN ARC DISTANCE OF 14.27 FEET.

23) NORTH 41°34'59" EAST 187.36 FEET,

24) SOUTH 48°25'01" EAST 158.94 FEET,

25) ALONG THE ARC OF A NON-TANGENT 770.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE CENTER OF SAID CURVE BEARS SOUTH 40°44'59" WEST, THROUGH A CENTRAL ANGLE OF 11°16'08", AN ARC DISTANCE OF 151.44 FEET,

26) SOUTH 37°58'53" EAST 646.89 FEET,

27) ALONG THE ARC OF A TANGENT 670.00 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 10°22'12", AN ARC DISTANCE OF 121.26 FEET;

28) SOUTH 27°36'41" EAST 197.00 FEET,

29) ALONG THE ARC OF A TANGENT 730.00 FOOT RADIUS CURVE TO THE LEFT, THROUGH A CENTRAL ANGLE OF 10°22'59", AN ARC DISTANCE OF 132.29 FEET,

30) SOUTH 52°00'20" WEST 1.00 FEET,

31) SOUTH 37°59'40" EAST 371.73 FEET,

32) SOUTH 52°04'51" WEST 349.00 FEET,

33) NORTH 37°59'40" WEST 124.69 FEET,

34) SOUTH 51°57'18" WEST 1,854.61 FEET,

35) SOUTH 51°03'42" EAST 328.48 FEET,

36) SOUTH 37°06'48" WEST 93.00 FEET,

37) NORTH 56°17'57" WEST 346.14 FEET,

38) ALONG THE ARC OF A TANGENT 7,958.61 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 02°46'18", AN ARC DISTANCE OF 385.00 FEET,

39) ALONG THE ARC OF A REVERSE 210.02 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE CENTER OF SAID CURVE BEARS SOUTH 36°28'21" WEST, THROUGH A CENTRAL ANGLE OF 13°34'36", AN ARC DISTANCE OF 49.77 FEET,

40) ALONG THE ARC OF A NON-TANGENT 42.00 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE CENTER OF SAID CURVE BEARS SOUTH 84°42'52" WEST, THROUGH A CENTRAL ANGLE OF 64°33'32", AN ARC DISTANCE OF 47.32 FEET,

41) NORTH 69°50'40" WEST 225.02 FEET,

42) ALONG THE ARC OF A TANGENT 962.07 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 08°56'53", AN ARC DISTANCE OF 150.25 FEET,

43) NORTH 60°53'47" WEST 110.81 FEET,

44) ALONG THE ARC OF A TANGENT 508.04 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 13°20'10", AN ARC DISTANCE OF 118.25 FEET,

45) ALONG THE ARC OF A REVERSE 492.04 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE CENTER OF SAID CURVE BEARS SOUTH 42°26'23" WEST,

THROUGH A CENTRAL ANGLE OF 13°27'25", AN ARC DISTANCE OF 115.56 FEET,

46) NORTH 61°01'02" WEST 416.40 FEET,

47) ALONG THE ARC OF A TANGENT 2,008.15 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 04°25'01", AN ARC DISTANCE OF 154.81 FEET,

48) NORTH 56°36'01" WEST 753.45 FEET,

49) ALONG THE ARC OF A TANGENT 1,208.09 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 09°57'19", AN ARC DISTANCE OF 209.91 FEET,

50) NORTH 46°41'34" WEST 135.31 FEET,

51) SOUTH 34°19'40" WEST 32.55 FEET,

52) NORTH 51°50'59" WEST 131.94 FEET,

53) ALONG THE ARC OF A TANGENT 5,959.45 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 02°29'06", AN ARC DISTANCE OF 258.47 FEET TO SAID POINT OF BEGINNING.

CONTAINING 134.11 ARCES OF LAND, MORE OR LESS.

END OF DESCRIPTION

Parcel name: GHAD

North: 9456.7293		East : 7597.9310	
Line	Course: N 41-14-29 E	Length: 110.65	
North: 9539.9314		East : 7670.8752	
Line	Course: N 50-02-49 E	Length: 58.46	
North: 9577.4720		East : 7715.6889	
Line	Course: S 55-28-54 E	Length: 316.09	
North: 9398.3533		East : 7976.1296	
Line	Course: N 41-07-43 E	Length: 136.86	
North: 9501.4411		East : 8066.1495	
Line	Course: N 23-07-33 E	Length: 261.93	
North: 9742.3236		East : 8169.0230	
Line	Course: S 49-47-02 E	Length: 298.00	
North: 9549.9132		East : 8396.5801	
Line	Course: N 31-20-40 E	Length: 23.54	
North: 9570.0171		East : 8408.8261	
Line	Course: S 58-07-51 E	Length: 50.00	
North: 9543.6180		East : 8451.2888	
Line	Course: S 55-34-31 E	Length: 525.86	
North: 9246.3373		East : 8885.0548	
Line	Course: N 49-21-05 E	Length: 687.70	
North: 9694.3176		East : 9406.8258	
Line	Course: N 33-51-34 E	Length: 95.01	
North: 9773.2145		East : 9459.7613	
Line	Course: S 38-18-32 E	Length: 156.87	
North: 9650.1217		East : 9557.0052	
Line	Course: N 51-41-28 E	Length: 564.93	
North: 10000.3223		East : 10000.2945	
Line	Course: S 32-37-35 E	Length: 401.98	
North: 9661.7731		East : 10217.0256	
Line	Course: N 51-41-28 E	Length: 533.65	
North: 9992.5831		East : 10635.7702	
Line	Course: N 38-18-32 W	Length: 300.70	
North: 10228.5364		East : 10449.3660	
Line	Course: N 41-34-59 E	Length: 296.00	
North: 10449.9428		East : 10645.8227	
Line	Course: S 48-25-01 E	Length: 225.00	
North: 10300.6092		East : 10814.1214	
Line	Course: N 84-18-52 E	Length: 130.97	
North: 10313.5842		East : 10944.4471	
Line	Course: S 51-31-37 E	Length: 41.79	
North: 10287.5847		East : 10977.1646	
Curve	Length: 64.23	Radius: 25.00	
Delta: 147-11-42		Tangent: 84.93	
Chord: 47.97		Course: N 49-46-20 E	
Course In: N 66-10-29 E		Course Out: N 33-22-11 E	
RP North: 10297.6834		East : 11000.0341	
End North: 10318.5619		East : 11013.7851	
Curve	Length: 14.27	Radius: 10.00	
Delta: 81-47-12		Tangent: 8.66	
Chord: 13.09		Course: N 82-28-35 E	
Course In: N 33-22-11 E		Course Out: S 48-25-01 E	

RP North: 10326.9133 East : 11019.2855
End North: 10320.2762 East : 11026.7654
Line Course: N 41-34-59 E Length: 187.36
North: 10460.4205 East : 11151.1172
Line Course: S 48-25-01 E Length: 158.94
North: 10354.9312 East : 11270.0034
Curve Length: 151.44 Radius: 770.00
Delta: 11-16-08 Tangent: 75.97
Chord: 151.20 Course: S 43-36-57 E
Course In: S 40-44-59 W Course Out: N 52-01-07 E
RP North: 9771.6037 East : 10767.3813
End North: 10245.4659 East : 11374.3035
Line Course: S 37-58-53 E Length: 646.89
North: 9735.5803 East : 11772.4031
Curve Length: 121.26 Radius: 670.00
Delta: 10-22-12 Tangent: 60.80
Chord: 121.10 Course: S 32-47-47 E
Course In: S 52-01-07 W Course Out: N 62-23-19 E
RP North: 9323.2586 East : 11244.3020
End North: 9633.7850 East : 11837.9967
Line Course: S 27-36-41 E Length: 197.00
North: 9459.2210 East : 11929.3007
Curve Length: 132.29 Radius: 730.00
Delta: 10-22-59 Tangent: 66.33
Chord: 132.11 Course: S 32-48-11 E
Course In: N 62-23-19 E Course Out: S 52-00-20 W
RP North: 9797.5557 East : 12576.1621
End North: 9348.1786 East : 12000.8706
Line Course: S 52-00-20 W Length: 1.00
North: 9347.5630 East : 12000.0826
Line Course: S 37-59-40 E Length: 371.73
North: 9054.6136 East : 12228.9140
Line Course: S 52-04-51 W Length: 349.00
North: 8840.1360 East : 11953.5954
Line Course: N 37-59-40 W Length: 124.69
North: 8938.4005 East : 11876.8381
Line Course: S 51-57-18 W Length: 1854.61
North: 7795.4411 East : 10416.2827
Line Course: S 51-03-42 E Length: 328.48
North: 7588.9968 East : 10671.7819
Line Course: S 37-06-48 W Length: 93.00
North: 7514.8345 East : 10615.6663
Line Course: N 56-17-57 W Length: 346.14
North: 7706.8926 East : 10327.6965
Curve Length: 385.00 Radius: 7958.61
Delta: 2-46-18 Tangent: 192.54
Chord: 384.96 Course: N 54-54-48 W
Course In: N 33-42-03 E Course Out: S 36-28-21 W
RP North: 14328.0267 East : 14743.5832
End North: 7928.1721 East : 10012.6918
Curve Length: 49.77 Radius: 210.02
Delta: 13-34-36 Tangent: 25.00
Chord: 49.65 Course: N 60-18-57 W
Course In: S 36-28-21 W Course Out: N 22-53-45 E
RP North: 7759.2861 East : 9887.8482
End North: 7952.7594 East : 9969.5579
Curve Length: 47.32 Radius: 42.00

Delta: 64-33-32 Tangent: 26.53
Chord: 44.86 Course: N 37-33-54 W
Course In: S 84-42-52 W Course Out: N 20-09-20 E
RP North: 7948.8904 East : 9927.7365
End North: 7988.3184 East : 9942.2084
Line Course: N 69-50-40 W Length: 225.02
North: 8065.8535 East : 9730.9685
Curve Length: 150.25 Radius: 962.07
Delta: 8-56-53 Tangent: 75.28
Chord: 150.10 Course: N 65-22-14 W
Course In: N 20-09-20 E Course Out: S 29-06-13 W
RP North: 8969.0069 East : 10062.4691
End North: 8128.4064 East : 9594.5274
Line Course: N 60-53-47 W Length: 110.81
North: 8182.3033 East : 9497.7081
Curve Length: 118.25 Radius: 508.04
Delta: 13-20-10 Tangent: 59.39
Chord: 117.98 Course: N 54-13-42 W
Course In: N 29-06-13 E Course Out: S 42-26-23 W
RP North: 8626.1990 East : 9744.8139
End North: 8251.2717 East : 9401.9813
Curve Length: 115.56 Radius: 492.04
Delta: 13-27-25 Tangent: 58.05
Chord: 115.30 Course: N 54-17-19 W
Course In: S 42-26-23 W Course Out: N 28-58-58 E
RP North: 7888.1522 East : 9069.9458
End North: 8318.5718 East : 9308.3621
Line Course: N 61-01-02 W Length: 416.40
North: 8520.3371 East : 8944.1098
Curve Length: 154.81 Radius: 2008.15
Delta: 4-25-01 Tangent: 77.44
Chord: 154.77 Course: N 58-48-31 W
Course In: N 28-58-58 E Course Out: S 33-23-59 W
RP North: 10276.9972 East : 9917.1523
End North: 8600.4921 East : 8811.7125
Line Course: N 56-36-01 W Length: 472.34
North: 8860.5043 East : 8417.3792
Line Course: N 56-36-01 W Length: 281.11
North: 9015.2488 East : 8182.6944
Curve Length: 209.91 Radius: 1208.09
Delta: 9-57-19 Tangent: 105.22
Chord: 209.64 Course: N 51-40-13 W
Course In: N 33-21-07 E Course Out: S 43-18-26 W
RP North: 10024.3775 East : 8846.8785
End North: 9145.2670 East : 8018.2374
Line Course: N 46-41-34 W Length: 135.31
North: 9238.0775 East : 7919.7742
Line Course: S 34-19-40 W Length: 32.55
North: 9211.1969 East : 7901.4183
Line Course: N 51-50-59 W Length: 131.94
North: 9292.6997 East : 7797.6616
Curve Length: 258.47 Radius: 5959.45
Delta: 2-29-06 Tangent: 129.26
Chord: 258.45 Course: N 50-36-26 W
Course In: N 38-09-01 E Course Out: S 40-38-07 W
RP North: 13979.1710 East : 11478.9699
End North: 9456.7204 East : 7597.9282

Line Course: N 40-38-07 E Length: 0.00
        North: 9456.7204   East : 7597.9282

   Perimeter: 13653.16   Area: 5,841,954 sq.ft. 134.11 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.0094   Course: S 17-20-16 W
  Error North: -0.00896   East : -0.00280
Precision 1: 1,452,461.70

14.2
ORA/COUNCIL
MAY 3 - 2005

BOARD OF DIRECTORS
LEONA QUARRY GEOLOGIC HAZARD ABATEMENT DISTRICT

RESOLUTION NO. _____

RESOLUTION APPROVING AMENDMENT 1 TO THE LEONA QUARRY GEOLOGIC HAZARD ABATEMENT DISTRICT PLAN OF CONTROL

WHEREAS, on December 3, 2002, the Oakland City Council adopted Resolution No. 77545, approving and ordering the formation of the Leona Quarry Geologic Hazard Abatement District (GHAD) as described in the petition dated October 25, 2002 and in the GHAD Plan of Control dated November 21, 2002.

WHEREAS, on December 3, 2002, the City Council appointed itself as the Board of Directors of the GHAD (GHAD Board).

WHEREAS, on March 15, 2005, the GHAD Board adopted Resolution No. 3 accepting the amendments to the Plan of Control, as set forth in Amendment 1 to the Plan of Control for Leona Quarry Geologic Hazard Abatement District (GHAD), dated March 9, 2005 (Plan of Control), and set a public hearing to consider those amendments. The Plan of Control as amended is attached hereto as Exhibit A and incorporated herein.

WHEREAS, the amendments to the Plan of Control have been made to reflect the following: (1) the annexation of four lots along Campus Drive into the existing Leona Quarry GHAD; (2) the Conditions of Approval related to the Leona Quarry project adopted by the Oakland City Council on February 17, 2004; and (3) revisions based on a review of the additional site development plans and reports available since the preparation of the existing Plan of Control dated November 21, 2002.

WHEREAS, the proposed amendments to the Plan of Control are exempt from the provisions of the California Environmental Quality Act (Pub. Res. Code §§ 21000 *et seq.*) in accordance with Public Resources Code sections 21080(b)(4) and 26559.

NOW, THEREFORE, the GHAD Board resolves and orders that:

1. The GHAD approves Amendment 1 to the Plan of Control for Leona Quarry Geologic Hazard Abatement District (GHAD), as set forth in the amended Plan of Control dated March 9, 2005, attached hereto as Exhibit A and incorporated herein.

14.2
ORA/COUNCIL
MAY 3 - 2005

2. This Resolution shall become effective immediately upon its passage and adoption.

OAKLAND, CALIFORNIA, _____

PASSED BY THE FOLLOWING VOTE:

AYES:

NOES:

ABSENT:

ABSTENTIONS:

ATTEST: _____
Clerk of the GHAD Board

Attachments: Exhibit A (Amendment 1 to the Plan of Control for Leona Quarry Geologic Hazard Abatement District (GHAD))

14.2
ORA/COUNCIL
MAY 3 - 2005

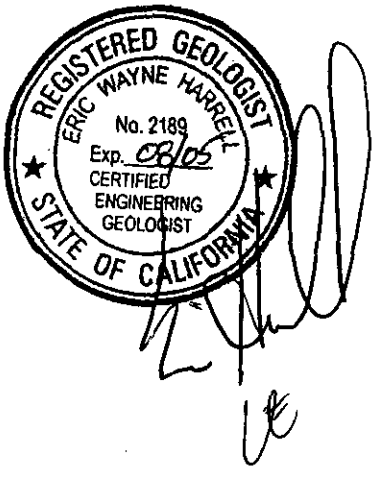
AMENDMENT 1 TO THE PLAN OF CONTROL FOR LEONA QUARRY GEOLOGIC HAZARD ABATEMENT DISTRICT (GHAD)

OAKLAND, CALIFORNIA

SUBMITTED

TO

LEONA, LLC



PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 5188.1.001.02

AUGUST 13, 2004
LATEST REVISION MARCH 9, 2005

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

I. Authority and Scope

The Oakland City Council formed the Leona Quarry Geologic Hazard Abatement District ("GHAD" or "District") on December 3, 2002, (Resolution 77544) under authority of the California Public Resources Code (Division 17, commencing with Section 26500). Formation of the Leona Quarry GHAD was accomplished in accordance with Condition of Approval No. 24 for the Leona Quarry Project.

Development of a Plan of Control, prepared by a California Certified Engineering Geologist, is a requirement for formation or amendment of a GHAD. Pursuant to Section 26509, this Plan of Control was prepared by an engineering geologist certified pursuant to Section 7822 of the Business and Professions Code and describes in detail the geologic hazards, their location, and who is affected by them. It also provides a framework for the prevention, mitigation, abatement, and control of identified or potential geologic hazards. As used in this Plan of Control, and as provided in Section 26507, "geologic hazard" means an actual or threatened landslide, land subsidence, soil erosion, earthquake, fault movement, or any other natural or unnatural movement of land or earth. In accordance with the requirements of the Public Resources Code, a proposed revision to the original Leona Quarry Plan of Control was submitted with the petition to annex the additional properties into the Leona Quarry GHAD. The scope of this Plan of Control and its implementation are described in more detail in Sections II, IV, VII, IX and X, below.

Property Identification

The proposed GHAD boundary is shown on Figure 1.

II. Background

The subject property is located northeast of the MacArthur Freeway (Interstate 580) at its intersection with Edwards Avenue, in Oakland, California. The site is about 133.2 acres in area and extends between the freeway and Campus Drive to the northeast and southwest, respectively (the "GHAD Property"). The GHAD Property includes all of the subdivided property shown on the Tracts 7351, 7492 and 7493, as well as approximately five acres of adjacent property owned by the Petitioner which is part of the overall slope stability and grading plan, although these adjacent parcels are not part of the subdivided property.

Pregraded Site Conditions

The GHAD Property is located on a southwest-facing hillside slope that had been extensively altered by quarrying operations. The excavation and filling work from the quarrying operations have resulted in slopes with typical gradients of about 1½:1 (horizontal:vertical) with some portions of the upper slopes in a nearly vertical condition. The flatter portions of the site were located in the southwestern portion of the site adjacent to the freeway. A ridge running northwest to southeast through the subject property divided the quarry pit from the lower portion of the site. Elevations ranged from a low of about 300 feet above mean sea level (msl) adjacent to Edwards Avenue to a high of about 1,075 feet above msl at the northern corner adjacent to Campus Drive.

Proposed Development

The Vesting Tentative Tract Map and Preliminary Grading Plan for the subject property, including Tracts 7351, 7492 and 7493, developed by Carlson, Barbee and Gibson, show that a total of 19 single family units and 404 multi-family units are to be developed. In addition, four

more single-family units will be constructed on parcels adjacent to Tracts 7351, 7492 and 7493 that are included within the GHAD. A Geotechnical Investigation was completed for the Leona Quarry site by Berlogar Geotechnical Consultants (BCG) and dated May 15, 2003, and supplemental letters. The four parcels proposed for annexation into the Leona Quarry GHAD were not included within the 2003 BCG Geotechnical Investigation report.

Grading plans for the subject site show that the lower half of the site will be developed to create building pads for 404 multi-family units. In addition to the residential building pads, streets, a detention basin and a community center are planned. Above the lower development area and below the 23 single-family lots along Campus Drive a 2:1 (horizontal:vertical) slope, up to approximately 450 in vertical height, is planned. A majority of the northern slope above the lower residential area will be substantially rebuilt as an engineered fill slope. Benches with concrete-lined ditches and storm drain systems are shown on both the northern and eastern rebuilt slopes.

A number of retaining walls are shown on the proposed grading plan. Included in the geotechnical investigation report are design recommendations for modular block walls, potential soil nail walls and conventional concrete walls. Final grading work at the site will have been completed prior to acceptance of the property by the GHAD.

Recommendations in the BGC Geotechnical Investigation include provisions for 7 settlement plates, 7 piezometers and 2 inclinometers. It is our understanding that additional settlement plates have been installed and are being monitored at the site. In addition, there are currently plans for 1 additional piezometer. It is anticipated in the geotechnical report that monitoring of the interim settlement plates will be performed during the residential construction period only. In addition, there will be approximately five dozen permanent survey monuments in streets for post-construction settlement monitoring. A monitoring schedule is described in the BGC report

for the piezometers and inclinometers and we understand that supplemental monitoring recommendations may be developed. We expect that the GHAD will continue a monitoring program for instruments as described in the Monitoring and Maintenance section.

Open Space

Title to Parcels A, C, E, F, R and X of the VTM and the adjacent parcels owned by the Petitioner, most of which is open space (the "Open Space Property"), will be conveyed to the GHAD approximately three years after the recording of the first final map affecting the GHAD Property. Since long-term maintenance and stability of the GHAD Property will protect the open space, which is an amenity that will benefit all of the current and future property owners, the funding for the GHAD's activities will be shared by all current and future property owners *within the GHAD's boundaries. All such activities shall be consistent with this Plan of Control.*

The GHAD will mitigate, prevent, abate or repair landslide or erosion hazards that could directly affect the GHAD Property, as necessary to implement this Plan of Control. The GHAD also will assume other responsibilities that are required by the Conditions of Approval for the Leona Quarry Project. These responsibilities will include vegetation management, habitat management, erosion control, vegetation removal (fire suppression), trail maintenance, irrigation and selected other maintenance associated with open space. In addition, maintenance, repair and replacement of detention ponds or creek improvements (only for the portion of Chimes Creek within the GHAD Property), including vegetation control and armoring of channels and desilting of detention basins, will be the responsibility of the GHAD.

The GHAD will assume monitoring and maintenance responsibilities for the following as appropriate.

- Detention basin on Parcel "C", including structures, vegetation and sediment removal

- Concrete-lined drainage ditches
- Storm drain inlets, outfalls and pipelines within the streets and open space areas
- Subdrains
- Debris bench maintenance
- Piezometers and inclinometers
- Settlement monuments
- Street sweeping
- Rock catchment fences
- Trail maintenance including trash removal
- Potential Alameda County Whipsnake habitat – fencing and sign maintenance
- Emergency vehicle access and maintenance roads
- Erosion management

In addition, the GHAD will have maintenance, monitoring and repair responsibilities for slopes, which will include natural, reconstructed or partially-reconstructed landslides as indicated within the BGC reports and discussed below.

III. Site Geology

Geologic Setting

The site is located within the Coast Ranges geologic province of California, a series of northwest-trending ridges and valleys. Bedrock in the province has been folded and faulted during regional uplift beginning in the Pliocene period, roughly 4 million years before present. Regional geologic maps of the area have been prepared by Radbruch (1969), Crane (1988) and Graymer (2000). The most recent regional map prepared by Graymer indicates that the site is underlain by Late Jurassic-age keratophyre and quartz keratophyre consisting of highly altered intermediate and silicic lavas and dike rocks.

Site Geology

With the exception of the southwestern portion of Tract 7351 and the four parcels adjacent to Tract 7351, detailed mapping of the property included within the GHAD boundaries was completed as part of the Geotechnical Investigations completed by Berlogar Geotechnical Consultants. The results of their investigations are included in the geologic descriptions.

The majority of the site has been altered by quarrying operations, which have resulted in the alteration of natural slopes and placement of artificial fills. Artificial fills on the site were documented in the BGC borings to be up to 90 feet in thickness. The thickest fills were encountered in the former Chimes Creek Ravine and in the southwestern portion of the site in the quarry floor adjacent to Interstate 580 and in the central quarry pit. Other fill areas, of lesser thickness, are located across the site and along Campus Drive.

Nilsen (1975) maps colluvium deposits in the west-southwestern portion of the site within two swales; one of which is located along the edge of the quarrying operations and the other in the area along Edenvale Place.

One landslide was mapped on the northern portion of the site adjacent to Ridgemont Drive (Nilsen, 1975). Nilsen's mapping does not include areas within the actively quarried portion of the site. Berlogar undertook more specific aerial photograph interpretations with field reconnaissance and subsurface explorations to map slope instabilities on the site. The BGC geology map shows five landslides within or adjacent to the quarried area. The treatments for these landslides are described below. Detailed mapping completed at the site by BGC, in general, shows beds striking to the northwest and dipping to the northeast.

Geologic Units

The geologic units mapped on the site include bedrock and surficial deposits consisting of artificial fill, colluvium, and landslides that are described below. The geologic units were described in the BGC Preliminary Geotechnical Investigation for the Leona Quarry dated September 26, 2000, and the BCG Geotechnical Investigation for the subject site dated May 15, 2003.

Artificial Fill. Artificial fill consisted predominately of rock fragments in a silty or sandy clay matrix. Some lenses of gravel were identified within the fill.

Colluvium. Mantling the unquarried bedrock and filling swales are colluvial deposits. These sediments are derived from weathering of the underlying bedrock and consist mostly of silty clay. This material generally is moderately expansive and has low strength. Where colluvium is

located on sloping ground, it may be characteristically unstable. Within swales, the colluvial deposits tend to be relatively thicker and may be subject to flow or slip downslope.

Landslides. Landslide deposits consist of masses of unconsolidated material and/or bedrock that have moved downslope by sliding, falling, or flowing. Many landslides, ranging in size from very small to large, occur on the site. The landslides include soil slips, earth flows, debris slides, areas of shallow slumps and gullying, large predominantly rotational slumps, and translational slides.

Shallow (less than 5 feet thick) to moderately deep (5 to 15 feet thick) earth flows and soil slips are the most prevalent types of landslide at the site. Shallow landslides occur on the steeper slopes, along drainages and in swales. Larger, deep (greater than 15 feet) landslides were also identified at the site.

Bedrock at the site was identified as the following (adapted from Berlogar):

Bedrock Type	Color	Strength	Fracturing	Weathering	Comments
Leona Rhyolite (Rh1)	Tan-Brown	Moderately Strong to Strong	Moderate to Crushed	Moderate to high	Some breccia zones and softer tuffaceous material.
Leona Rhyolite (Rh2)	Blue Gray to Gray	Moderately Strong to Strong	Moderate to Crushed	Slight to Moderate	Some fractures filled with tan-brown clay and soft tuffaceous material. Partially altered.
Rhyolite/Tuff Breccia (Rh/Tf)	White to Tan Brown	Friable	High to Crushed	High	--
Tuff (Tf)	White to Red-Brown	Friable to Weak	--	--	Inclusions of strong rhyolite and welded tuff.
Welded Tuff	White to Red-Brown	Moderately Strong	--	--	Small amounts mapped on northeast slope.
Knoxville Shale (Sh)	Dark Brown to Black	Friable to Weak	High	High	Moderately Sheared

Groundwater

At the time of subsurface work and as measured later by BGC, groundwater has been encountered between 2 to 190 feet below the ground surface. Artesian flow of groundwater has been observed in one boring located below a retention pond, but BGC has represented this as an artificial local condition. In general, the shallow groundwater conditions were encountered in the upper bowl and lower fill areas. Fluctuations in groundwater levels may occur seasonally and over a period of years because of precipitation, changes in drainage patterns, irrigation and other factors. Future irrigation may cause an overall rise in groundwater levels.

Seismic Sources

No faults are mapped by Crane 1998 or Graymer 2000 crossing the site. The nearest State of California-zoned, active[1] fault is the Hayward fault located about 1,000 feet southwest of the site. As discussed in the geotechnical investigations, there is a high probability that the site and any improvements will be subject to strong ground shaking and some deformation of the site slopes during the lifetime of the project.

[1] An active fault is defined by the State Mining and Geology Board as one that has had surface displacement within Holocene time (about the last 10,000 years) (Hart, 1994). The State of California has prepared maps designating zones for special studies that contain these active earthquake faults.

IV. Geologic Hazards

Geologic hazards identified for the site in the BGC reports include the following items.

- Slope instability
- Seismically-induced ground shaking
- Rockfall

Slope Instability

During mapping for the Geotechnical Investigation, five landslides were identified on the subject site. The geologic map showing the location of each of the landslides is included as Figure 2. The table below identifies each of the landslide areas and the proposed corrective measures. Potential GHAD monitoring or maintenance activities for the specific areas listed in the table below are discussed in Section VII.

Landslide Designation	Location	Proposed Corrective Measures	Unremediated Areas
A	North slope below Ridgemont Drive.	Complete removal.	None
B	West side of main quarry slope.	Removal of the lower portion of the landslide during design grading and construction of a catchment area.	Landslide material above the catchment area to remain.
C	Middle of main quarry slope.	Landslide material to be removed and replaced with engineered fill.	None
D	Lower quarry slope.	Removal of the landslide during design grading.	None
E	Lower quarry slope.	Removal of the landslide during design grading.	None

In addition to the landslides listed above, other areas of slope instability or landsliding will likely be identified during the life of the development. Since earth stability is the GHAD's prime geotechnical concern, this section describes several types of slope instability that may be within the GHAD's area of responsibility, subject to Section V of this Plan of Control. Slope instability is not unique to this project, but is of importance for hillside projects throughout the San Francisco Bay Area. Future stability of these areas depends on various factors, including any introduction of natural or artificial groundwater, future grading and earthquake ground shaking.

The cuts will be viewed by the Leona Quarry Project geologist during grading to provide mitigation schemes for unsuspected slope conditions which could decrease the slope stability. Such conditions include unfavorable bedrock attitudes and seepage conditions. A field-verified geologic map will be prepared by the project geologist for use by the GHAD.

A licensed land surveyor will record the location and elevation of subdrains and outlets. Each landslide subexcavation then will be reconstructed to final grade by keying and benching below the landslide plane with compacted, drained, engineered fill.

A landslide is defined as a mass of rock, soil and other debris that has been displaced downslope by sliding, flowing, or falling. Landslides include cohesive block glides and disrupted slumps that have formed by displacement along a planar slip surface or rotation (displacement along a curved slip surface). Undercutting and erosion of hillside slopes trigger many slope failures.

Slope failures are also often triggered by increased pore water pressure due to the infiltration of rainwater. The resulting decrease of shear resistance (internal resistance to deformation by shearing) can cause the slope to move. The level of the groundwater table varies with the amount of rainfall for the area. If rainfall is higher than average during the winter season, the

water table will be higher than average on a hillslope and groundwater pressures may become high. Under these conditions, hillside movement can be activated.

Areas of thicker soil cover on the hillslopes are known as colluvium (Qc). Colluvial deposits are typically the result of soil creep and may be in a weak, unconsolidated state, making them susceptible to landsliding if undercut. Colluvium is generally approximately ten to fifteen feet in thickness. Landslides and colluvial deposits located within open space areas are natural landforms that do not require mitigation except where they affect man-made improvements. Potential mitigation and repair measures for GHAD areas near development are discussed in Section VII.

Five erosion gullies were identified on the subject site in the geotechnical investigation prepared by BCG. The erosion gullies are located on the northwest slope. As proposed, the gullies would be filled during construction of a planned 2:1 (horizontal:vertical) engineered fill slope or be cleared of loose soil and the resulting depressions would be backfilled with engineered fill or riprap after the installation of a subdrain system.

Seismically-Induced Ground Shaking

As identified in the geotechnical report, an earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. Seismic slope stability has been considered in the BGC remedial grading plans for all engineered fill slopes. On unimproved open space slopes, seismically-generated slope failures may occur in open-space areas outside the development limits.

Rockfall

The potential for rockfalls has been identified on the subject site in the BGC Geotechnical Investigation report for the natural, quarry-altered and engineered fill slopes. As stated in the BGC report, rockfalls would most likely occur during earthquakes, but natural rock weathering, unusual rainfall events, freezing of water in the rock joints in natural rock outcrops or human activity could also cause or contribute to rockfalls at the site. Maintenance of the proposed rockfall barriers, one of the mitigation measures proposed to protect improvements on the site, as discussed in the in the Monitoring and Maintenance Section (Section X).

It is important to note that to preserve the natural topography, wildlife habitat, and vegetation of the site; stabilization of landslide masses is currently planned only for landslides that directly threaten the proposed improvements. Slope and creek instability in undisturbed open space parcels, which in the GHAD manager's opinion does not have the potential to affect directly the GHAD-accepted homesites, roadways, or other improvements will not be repaired, as provided in Section V.

V. Criteria for GHAD Responsibility

Prevention, Mitigation, Abatement and/or Control of Geologic Hazards

Subject to the following exceptions, the primary mission of the GHAD shall be the prevention, mitigation, abatement and/or control of geologic hazards within its boundaries that have damaged, or that pose a significant threat of damage to site improvements within the developed areas of the projects. As used herein, the term "site improvements" means buildings and outbuildings, roads, sidewalks, improved paths, utilities, improved trails, swimming pools, tennis courts, gazebos, cabanas, geologic stabilization features, or similar improvements.

Exceptions

The intent of this Plan of Control is not to extend the GHAD's responsibilities to every potential situation of slope instability. Specifically, the following are excluded from the GHAD's responsibilities:

Isolated or Remote Slope Instability

The GHAD shall not have responsibility to monitor, abate, mitigate or control slope instability that does not involve damage to or pose a significant threat to damage (a) site improvements or (b) off-site improvements if the threat of damage or damage is not caused by property or site improvements for which the GHAD is responsible.

Single Property

The GHAD will not prevent, mitigate, abate or control geologic hazards which are limited in area to a single parcel of property unless the geologic hazard has damaged, or poses a significant threat of damage, to site improvements located on other property within the GHAD boundaries. This exclusion does not apply to geologic hazards existing on common area property owned by the HOA or within the GHAD-owned Property.

Geologic Hazards Resulting From Negligence of Property Owner

The GHAD may, in the GHAD manager's sole discretion, decline to prevent, mitigate, abate or control geologic hazards which occurred or resulted from any negligence of the homeowner and/or the homeowner's contractors, agents or employees in developing, investigating, grading, constructing, maintaining or performing or not performing any post-development work on the subject property.

Property Not Accepted

The GHAD shall not have responsibility to repair damaged site improvements which are situated on a parcel of real property that the GHAD has not accepted in accordance with Section VII, below. The GHAD however, may monitor, abate, mitigate or control slope instability on a parcel of real property which (1) the GHAD has not accepted in accordance with Section VII, below, and (2) that is not excluded from GHAD responsibility by Paragraphs 1 and 2; provided that GHAD responsibility on such parcel shall be limited to the extent necessary to address damage or a significant threat to damage site improvements which are within a parcel of real property which the GHAD has accepted in accordance with Section VI, below.

GHAD Funding or Reimbursement for Damaged or Destroyed Structures or Site Improvements

In the event a residence, or any other structure, site improvement or landscaping is damaged or destroyed due to, or as a result of, a geologic hazard, the GHAD may fund, or reimburse the property owner for the expenses necessary to repair or replace the damaged or destroyed structure, site improvement or landscaping. Unless authorized by the Board of Directors, the dollar amount of the GHAD funding or reimbursement may not exceed an aggregate of ten percent (10%) of the costs incurred by the GHAD in preventing, mitigating, abating or controlling the geologic hazard responsible for the damage.

Slope Revegetation Plan Monitoring and Maintenance

The developer of the site will be responsible for all activities included in the Maintenance Section of the Leona Quarry Revegetation Plan (Appendix B) prepared by H. T. Harvey and Associates until the mitigation plan is judged to be successful. At a minimum the maintenance and monitoring program is required for 5 years.

The responsible party will supply in writing to the Leona Quarry GHAD, prior to the time of transfer, a report stating that the revegetated open space areas are in compliance with the recommendations and requirements of the approved maintenance and monitoring plan. The report shall be prepared under the direction of and signed by a qualified botanist as defined in the Leona Quarry Mitigation, Monitoring and Reporting program.

At the discretion of the GHAD, and prior to the transfer for the monitoring and maintenance responsibility of the revegetated open space areas, the GHAD may inspect the areas independently and will advise the responsible party, in writing, of any deficiencies that might exist to facilities that are to be maintained by the GHAD. Any deficiencies will be corrected

prior to the GHAD accepting maintenance or monitoring responsibilities for the revegetated open space areas.

VI. Acceptance

Activation of Assessment

An annual assessment shall be fully authorized, prior to recordation of the first Final Map in accordance with the Conditions of Approval, on all residential parcels in the GHAD and may be increased as provided by law to achieve the purposes of the GHAD and this Plan of Control. The assessment shall be levied by the GHAD on each individual residential parcel beginning the first fiscal year following issuance of a building permit for that parcel.

Responsibility for GHAD Activities

Except as provided for in Section V, the party that, on the date each Final Map within the boundaries of the GHAD is recorded in the Official Records of Alameda County, owns the developable parcels shown on that Final Map shall have the responsibility to perform all the activities of the GHAD on property within that Final Map prior to transfer of such property to the GHAD. Pursuant to this Plan of Control, such responsibility shall automatically transfer to the GHAD at 9:00 a.m. on the day exactly two years after completion and city approval of the GHAD-maintained improvements. The reserve at the time of transfer will be, at a minimum, $1,000,000.00. *The reserve amount will include cash and receivables from the Alameda County* Tax Collector. This transfer date may be extended at the sole discretion of all owners of the GHAD Property to be transferred, provided that the owners continue to perform the GHAD's activities and that the assessments continue to be levied during the extension period and that notice of such extension is delivered to the GHAD manager at least 30 days prior to the transfer date. The approximate two-year period between the levying of the GHAD assessment and the GHAD transfer will allow the GHAD to accumulate reserve funds without incurring significant expenses.

VII. Leona Quarry GHAD Plan of Control

The GHAD will be authorized to maintain the geologic stabilization features (e.g. ditches, benches, walls, etc.) in the open space, and the unimproved areas including the hillside slopes extending uphill from debris benches and common areas outside of the private lot boundaries. The GHAD's maintenance responsibilities include prevention, abatement, and control of landslide and erosion hazards within the subdivision open space and hillsides, as provided in Section VI.

In addition, the GHAD will be responsible for habitat and vegetation management within the open space areas including, but not limited to, weed and invasive species control, irrigation and maintenance of plants in revegetated areas which will also act as fire control and maintain the visual quality of the open space. Trails within the open space area will be maintained by the GHAD. Debris removal associated with the use of the trails and street cleaning of the subdivision's streets will also be responsibilities of the GHAD.

At the successful conclusion of the monitoring and maintenance program conditions provided in Section V and the Leona Quarry Slope Revegetation Plan included in Appendix B, the GHAD will maintain the revegetated areas in a manner which promotes slope protection, long-term slope revegetation goals and benefits property owners within the Leona Quarry GHAD.

General maintenance of the surface drainage improvements in the open space and on the hillsides, such as the concrete V-ditches, will be the GHAD's responsibility. The GHAD is also responsible for general maintenance of the storm drain inlets and outlets in open space and creek corridors and subdrain outlets. Potential geologic hazards such as landslides and slope erosion within the open space, including the unimproved hillsides, shall be the responsibility of the GHAD. Clearing of fire breaks and general maintenance of the open space (other than hazard abatement) will be performed by the GHAD. The GHAD's creek maintenance duties will include only the repair of

substantial bank failures that directly damage or threaten actual site improvements (including buildings, utilities, and roads). Such creek bank improvements, including armoring of channels with rock or other materials, will be undertaken by the GHAD as necessary, and only to abate actual or threatened impact to site improvements.

Landslide Mitigation for Existing Landslides and Erosion Features

For existing landslide areas and erosion gullies the following mitigation measures have been proposed within the geotechnical investigation report. The GHAD monitoring or maintenance activities listed in the table below are potential tasks that would occur only after GHAD acceptance of the parcels. As provided in Section VI, GHAD acceptance can occur a minimum of 2 years after the City Approval of the GHAD-Maintained Improvements. General landslide mitigation measures are shown below.

Landslide Designation	Proposed Corrective Measures	Unremediated Areas	Potential GHAD Maintenance or Monitoring Activities
Landslide A	Complete removal.	None	Routine observation during periodic site monitoring events.
Landslide B	Removal of the lower portion of the landslide during planned grading and construction of a catchment area.	Landslide material above catchment area to remain.	Observation of this area during periodic site monitoring events. Higher potential for corrective work in future if landslide debris movement impacts rebuilt portion of slope or site improvements. See Section VII for potential landslide mitigation techniques.
Landslide C	Remove and replace with engineered fill.	None	Routine observation during periodic site monitoring events.
Landslide D	Removal of the landslide during design grading.	None	Routine observation during periodic site monitoring events.
Landslide E	Removal of the landslide during design grading.	None	Routine observation during periodic site monitoring events.

Landslide Designation	Proposed Corrective Measures	Unremediated Areas	Potential GHAD Maintenance or Monitoring Activities
Erosion Gullies A through D	Remove loose debris, install subdrain and backfill with riprap and/or engineered fill.	None	Routine observation during periodic site monitoring events.
Erosion Gully E	Remove loose debris, install subdrain and backfill with engineered fill.	None	Routine observation during periodic site monitoring events.

Geotechnical Techniques for Mitigation of Landslide and Erosion Hazards

The techniques which may be employed by the GHAD to prevent, mitigate, abate, or control geologic hazards include, but are not necessarily limited to:

A. Removal of the unstable earth mass.

B. Stabilization (either partial or total) of the landslide by removal and replacement with compacted, drained fill.

C. Construction of structures to retain or divert landslide material or sediment.

D. Construction of erosion control devices such as gabions, riprap, geotextiles, or lined ditches.

E. Placement of drained engineered buttress fill.

F. Placement of subsurface drainage devices; (e.g. underdrains, or horizontal drilled drains).

G. Slope correction (e.g. gradient change, biotechnical stabilization, slope trimming or contouring).

H. Construction of additional surface ditches and/or detention basins, silt fences, sediment traps, or backfill or erosion channels.

Potential landslide and erosion hazards can be mitigated best by controlling soil saturation and water runoff and by maintaining the surface and subsurface drainage system. Maintenance shall be provided for lined surface drainage ditches and drainage terraces including debris benches or drop inlets.

VIII. Priority of GHAD Expenditures

Emergency response and scheduled repair expenditures by the GHAD are to be assigned a priority at the discretion of the GHAD manager based upon available funds and the approved operating budget. GHAD expenditures shall be prioritized as follows in descending order of priority:

A. Prevention, mitigation, abatement or control of geologic hazards that have either damaged or pose a significant threat of damage to residences, critical underground utilities or paved streets.

B. Prevention, mitigation, abatement or control of geologic hazards which have either damaged or pose a significant threat of damage to ancillary structures, including but not limited to the detention basin, pool cabanas or community buildings.

C. Prevention, mitigation, abatement or control of geologic hazards which have either damaged or pose a significant threat of damage to open space amenities including vegetation that is part of the Leona Quarry Revegetation Plan.

D. Prevention, mitigation, abatement or control of geologic hazards existing entirely on open-space property and which have neither damaged nor pose a significant threat of damage to any site improvements.

E. Prevention, mitigation, abatement or control of geologic hazards which have either damaged or pose a significant threat of damage limited to loss of landscaping (except landscaping that is part of the site-specific revegetation plan for slope restoration) or other similar non-essential amenities.

IX. Biotechnical Recommendations for Prevention and Mitigation of Existing or Potential Erosion Hazards

Maintenance of vegetative cover in accordance with the site-specific re-vegetation plan developed by H.T. Harvey and Associates is important on all slopes cut or fill. Vegetation provides a protective role on soil and exposed rock. It absorbs the impact of raindrops, reduces the velocity of runoff, and retards erosion. It is expected that the site developer will perform the elements of the revegetation maintenance plan which is expected to occur over the first 5 years after installation. The H.T. Harvey and Associates report is included in Appendix B for future reference.

Adequate erosion protection for the slopes should be accomplished with implementation of the site-specific revegetation plan. However, if the GHAD manager determines that additional vegetation is needed for erosion protection, the GHAD may plant carefully selected and placed biological elements (plants). In addition, if the GHAD manager determines that it is necessary, biotechnical slope protection may also involve the use of mechanical elements or structures in combination with biological elements to provide erosion control and help prevent small-scale slope failures. Locally, crib walls, welded-wire walls, gabion walls, rock walls, riprap, and reinforced earth walls used in combination with carefully selected and planted vegetation can provide high quality slope protection. The vegetation may be planted on the slope above a low retaining structure or toe wall, or the interstices of the structure can be planted.

X. Maintenance and Monitoring Schedule

Geologic features and GHAD maintained facilities should be inspected by GHAD staff or GHAD-assigned consultants as presented below. The detention basin monitoring and maintenance recommendations are included in Appendix A. The annual budget should be calculated so that inspections will be scheduled to occur two times per year and as necessary after heavy rainfall events that is defined as greater than 1 inch of rainfall in a 12-hour period. The inspections should be scheduled to take place in October, prior to the first significant rainfall; mid-winter as necessary during heavy rainfall years or events; and in early April, at the end of the rainy season. The frequency of the inspections should be increased in years of higher than average rainfall intensity and recurrence. The timing, frequency and other details regarding such maintenance, inspection and similar activities will be set forth in the Management Plan prepared by the GHAD manager.

The GHAD shall obtain copies of geologic or geotechnical exploration reports related to site development and keep these reports on file in the records of the GHAD. In addition, copies of any earthwork-related testing and observation reports that will be finalized at the completion of grading, when as-built drawings are available, shall be maintained as part of the GHAD records.

Following are guidelines for a monitoring plan. The actual scope and frequency of monitoring events shall be at the discretion of the GHAD manager.

- The General Manager's engineer and/or geologist should inspect the lined surface ditches on a regular schedule. Inspections should be scheduled twice each year. One inspection should be in the fall prior to the onset of winter rains. The inspector should check for sedimentation, cracking or shifting of the concrete-lined ditches. Repairs and maintenance should be performed on a regular schedule. Excess silt or sediment in ditches should be removed and cracked or broken ditches should be patched or repaired as required prior to the beginning of the next rainy season.

- Several types of rock barrier structures are planned along the northern slope. At a minimum, repairs and maintenance should be performed according to the manufacturer's recommendations. Recommendations for the proposed GEOBRUGG products have been included in Appendix C. During the twice-yearly scheduled site monitoring events any barriers should be viewed for debris or larger rocks against the barrier and for sagging ropes. In addition, the braking elements and wire rope clips should be checked.

- Subsurface drain outlets and horizontal drilled drain outlets, if any, should be inspected on a regular basis. Water flowing from these outlets should be measured and recorded during each inspection. Inspections should be scheduled twice each year, preferably in the fall and spring. Any suspicious interruption in flow should signal a need to unplug or clean the affected drain.

- Piezometers, used to measure groundwater levels, should be monitored as recommended. As recommended, the piezometers should be monitored during periods of rainfall or if potential seepage is observed in the area of the Parcel "C" Detention Basin. If future piezometers are installed they should be monitored on a regular schedule or as recommended during installation.

- Inclinometers have been recommended by BGC for the subject site. The inclinometers should be monitored annually between 3 to 5 years after installation (so long as the GHAD is responsible for monitoring activities at this time). In addition, monitoring of the inclinometers should occur when abnormally wet seasons are experienced or if surface slope deformation is observed or a significant seismic event occurs. If other inclinometers are installed they should be monitored on a regular schedule or as recommended during installation.

- As appropriate, settlement monitoring devices should be monitored on a regular schedule. In the event of anomalous readings or excessive settlement, the monitoring frequency should be increased.

- Inlets, outfalls or trash racks, if used, must be kept free of debris and spillways maintained. Attention should be given to plantings or other obstructions which may interfere with access by power equipment.

- The detention basin on Parcel "C" should be monitored 4 times each year, as appropriate. The monitoring schedule should occur in January, April, July, October, and as necessary during heavy rainfall events. A more detailed schedule of monitoring items and sample monitoring report forms are included in Appendix C.

- The creek corridors should be inspected twice a year. One inspection should be in the fall prior to the onset of winter rains. A second inspection should be undertaken during the rainy season to monitor potential on-site creek bank failures which could imminently threaten or damage site improvements. The maintenance program should include the monitoring of the subdrain outfalls from the mass grading operations which may outlet to the creek or lower detention basin.

An annual inspection shall be made by the engineer and/or engineering geologist to assess the effectiveness of the instrumentation and preventive maintenance programs and to make recommendations as to which landslide or erosion measures should be undertaken in the next fiscal year. Any appropriate site-specific study of landslide or erosion conditions shall be determined at that time. Consultants, if necessary, will be retained to undertake the needed studies. An annual inspection report shall be prepared by the GHAD Engineer and/or engineering geologist for the GHAD. Distribution of the annual report along with the budget information shall include City of Oakland Public Works Director and the Executive Director of the Community and Economic Development Agency.

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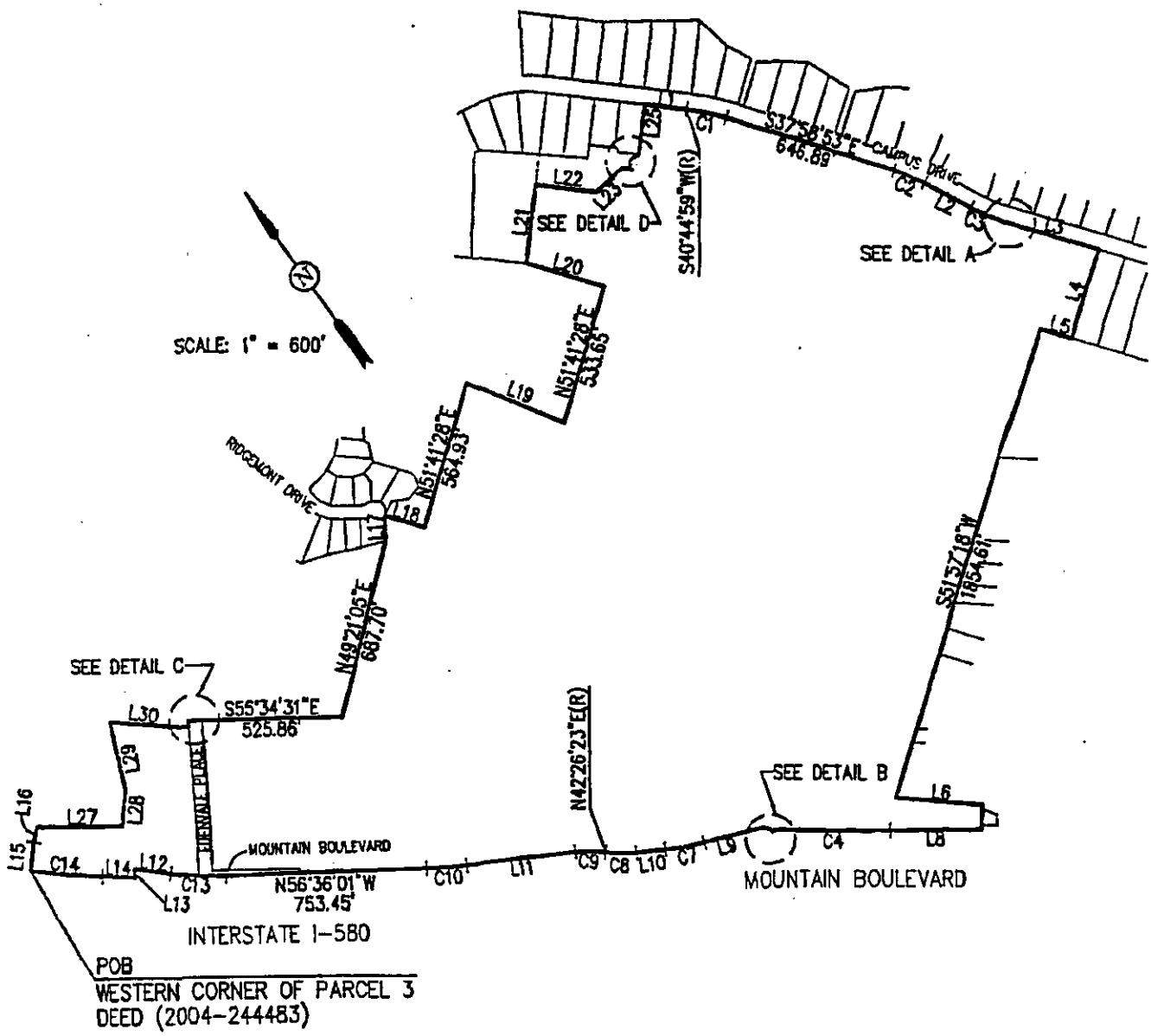

FIGURE 1

PLAT TO ACCOMPANY LEGAL DESCRIPTION

G.H.A.D. BOUNDARY

CITY OF OAKLAND, ALAMEDA COUNTY, CALIFORNIA

DATE: AUGUST 2004

SHEET 1 OF 2

Carlson, Barbee, & Gibson, Inc.

CIVIL ENGINEERS • SURVEYORS • PLANNERS

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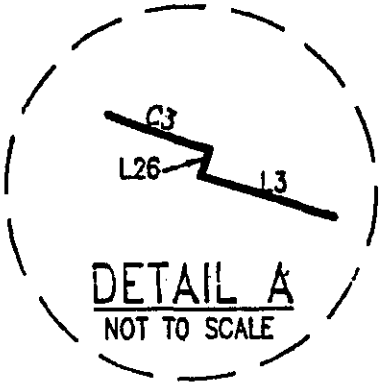
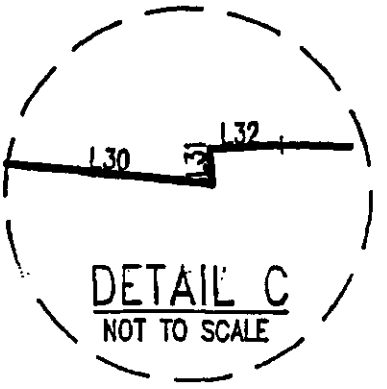


DETAIL A
NOT TO SCALE



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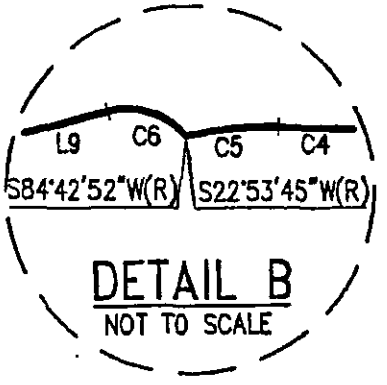

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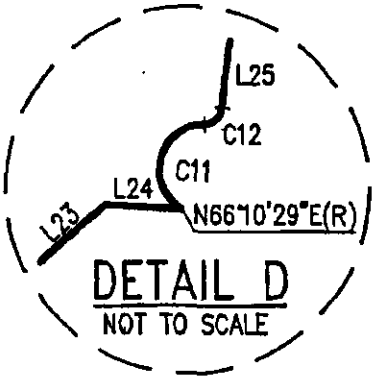

DETAIL D
NOT TO SCALE

CURVE TABLE			
NO.	DELTA	RADIUS	LENGTH
C1	11°16'08"	770.00'	151.44'
C2	10°22'12"	670.00'	121.26'
C3	10°22'59"	730.00'	132.29'
C4	02°46'18"	7958.61'	385.00'
C5	13°34'36"	210.02'	49.77'
C6	64°33'32"	42.00'	47.32'
C7	08°56'53"	962.07'	150.25'
C8	13°20'10"	508.04'	118.25'
C9	13°27'25"	492.04'	115.56'
C10	04°25'01"	2008.15'	154.81'
C11	147°11'42"	25.00'	64.23'
C12	81°47'12"	10.00'	14.27'
C13	09°57'19"	1208.09'	209.91'
C14	02°29'06"	5959.45'	258.47'

LINE TABLE		
NO.	BEARING	LENGTH
L1	S48°25'01"E	158.94'
L2	S27°36'41"E	197.00'
L3	S37°59'40"E	371.73'
L4	S52°04'51"W	349.00'
L5	N37°59'40"W	124.69'
L6	S51°03'42"E	328.48'
L7	S37°06'48"W	93.00'
L8	N56°17'57"W	346.14'
L9	N69°50'40"W	225.02'
L10	N60°53'47"W	110.81'
L11	N61°01'02"W	416.40'
L12	N46°41'34"W	135.31'
L13	S34°19'40"W	32.55'
L14	N51°50'59"W	131.94'
L15	N41°14'29"E	110.65'
L16	N50°02'49"E	58.46'
L17	N33°51'34"E	95.01'
L18	S38°18'32"E	156.87'
L19	S32°37'35"E	401.98'
L20	N38°18'32"W	300.70'
L21	N41°34'59"E	296.00'
L22	S48°25'01"E	225.00'
L23	N84°18'52"E	130.97'
L24	S51°31'37"E	41.79'
L25	N41°34'59"E	187.36'
L26	S52°00'20"W	1.00'
L27	S55°28'54"E	316.09'
L28	N41°07'43"E	136.86'
L29	N23°07'33"E	261.93'
L30	S49°47'02"E	298.00'
L31	N31°20'49"E	23.54'
L32	S58°07'51"E	50.00'

FIGURE 1

PLAT TO ACCOMPANY LEGAL DESCRIPTION

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CITY OF OAKLAND, ALAMEDA COUNTY, CALIFORNIA

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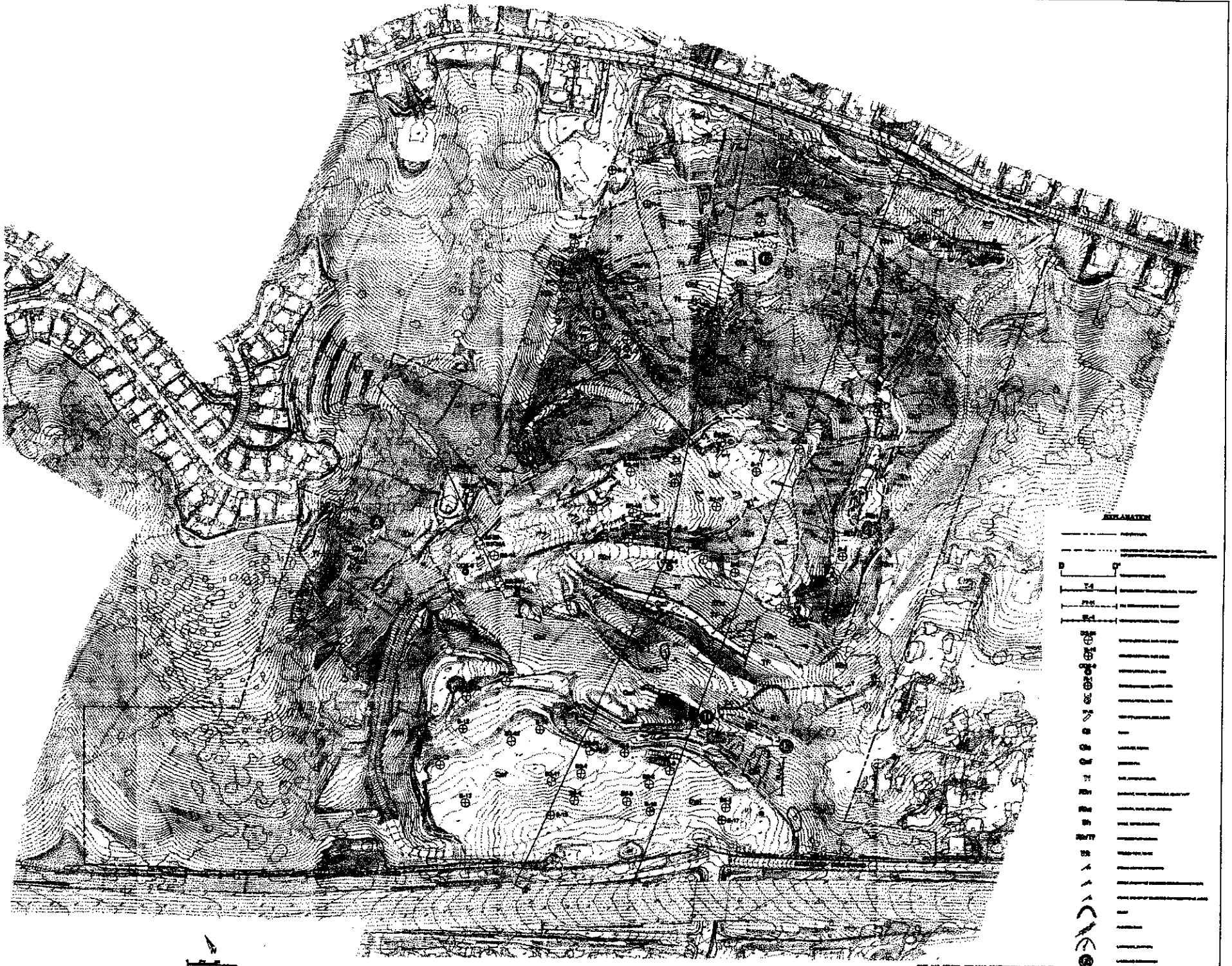

ENGEO

GEOLOGIC MAP
LIENA QUARRY
OAKLAND, CALIFORNIA

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APPENDIX A

ENGEO INCORPORATED

Detention Basin Parcel "C"
Monitoring and Maintenance
Leona Quarry, Oakland, California
August 2, 2004

5188.1.001.02
August 13, 2004
Latest Revision March 9, 2005

ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Project No.
5188.5.001.01

August 2, 2004

Mr. David Chapman
The DeSilva Group
P.O. Box 2922
Dublin, CA 94568

Subject: Water Quality/Detention Pond, Parcel "C"
Leona Quarry
Oakland, California

WATER QUALITY/DETENTION POND MONITORING AND MAINTENANCE

Dear Mr. Chapman:

As requested, we have prepared monitoring and maintenance recommendations for the Parcel "C" Water Quality/Detention Pond planned for the Leona Quarry site in Oakland, California. This is intended as a working document for use during maintenance of the detention basin. The basin is designed as a water detention facility to control peak flood flows. Maintenance of the basin will include, but not be limited to, erosion/slope protection, vegetation management, sediment removal, trash/debris removal and inspections of the inlet and outlet structures. In addition, the pond liner will be monitored and recommendations are provided for liner maintenance and groundwater monitoring. The detention basin will be owned and maintained by the Leona Quarry Geologic Hazard Abatement District (GHAD).

We are pleased to have been of service to you on this project and are prepared to consult further with you and your design team.

Very truly yours,

ENGEO INCORPORATED

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eh/ue/ls:basinparcelc

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