over-consolidated), contain medium to coarse-grained sand particles, and are thinly to thickly bedded. Based on observations within exploratory test pit excavations, these soils were difficult to excavate below a depth of several feet.

Near the north-central portion of the study area the older alluvium is represented by fanglomerate-type deposits. These materials labeled (Toa_f on the Geologic Map) represent the eroded remnants of an ancient alluvial fan, consisting largely of angular to subangular cobble to gravel size quartzite fragments with about 30% silty sand. Similarly to the underlying clayey sand deposits, the fanglomerate is light brownish-yellow, dense, and is difficult to excavate past a depth of about 3 feet. These deposits appear to have limited areal extent, and form a relatively thin veneer atop the more extensive, older clayey sand (Toa_s) deposits.

Overall, there does not appear to be any major geotechnical-related constraints associated with the older alluvial deposits, except perhaps where clay deposits prove to be moderately or highly expansive and where significant cut slopes are planned, as discussed below.

2.3 GEOLOGIC STRUCTURE

The geologic structure within the project area is defined by the orientation of bedding planes within the older alluvium (Toa_s). Where observed in the exploratory test pits TP-2 and TP-5, located within the northern portion of the study area, bedding planes exposed near the bottom of each pit varied in strike between North 65°West (N65W), and east-west (EW), and dip to the south-southwest at 10° and 18°. In test pit TP-1, located near the shoreline of Big Bear Lake, bedding within the older alluvium appeared to be essentially horizontal. If these bedding plane attitudes are representative of the upland and shoreline areas of the project site, it would appear that the older alluvium has been folded into a roughly east-west- trending synclinal fold, the southern limb of which has been eroded away during the formation of Bear Valley. If true, this folding is judged to have occurred over a period of hundreds of thousands of years as a result of San Andreas tectonics. Conversely, this apparent variation in the dip of bedding planes could be a result of ancient faulting associated with uplift of the San Bernardino Mountains. However, no evidence of faulting, active or otherwise, has been documented within or adjacent to the project area.

If the bedding planes observed in the exploratory test pits are representative of the orientation of bedding within upland areas of the site, south-facing cut slopes associated with construction for the new alignment for State Highway 38, as well as internal streets north of the new highway, could present concerns related to slope stability. If bedding planes near the shoreline area, south of realigned State Highway 38, are essentially horizontal (as depicted in test pit TP-1), gross slope stability problems would not be anticipated. However, where significant cut slopes are planned, a site-specific subsurface investigation should be performed in order to evaluate the nature and extent of bedding planes and the presence of any weak clay layers.

2.4 GROUNDWATER

The eastern two-thirds of the project area lie within what is known, hydrologically, as the North Shore Sub area of Big Bear Lake. The western one-third lies within the Great Creek Sub area. According to Brown (1976; *in* AEG Annual Spring Field Trip Guidebook) the North Shore Sub area is similar in several respects to the Great Creek Sub area; a considerable amount of the water bearing (older alluvial) materials present is above the known groundwater surface. Only a band of these materials adjacent to Big Bear Lake are continuously saturated (Brown, 1976).

According to a recent geohydrologic investigation of the Moon Camp Area by Geoscience Support Services (GSS, 2000), the older alluvial deposits represent the main water-bearing formation beneath the site. Groundwater-level data from two U.S. Forest Service wells located within the project area suggest that Big Bear Lake provides recharge to the aquifer beneath the project area. Additional groundwater recharge emanates from gravity drainage from the higher elevations north of the Moon Camp area.

Based on the studies by GSS (2000), the main water-bearing zones within the older alluvial deposits consist of intermixed and interlayered sand and gravels. However, lithologic data from the two U.S. Forest Service wells indicate that these sand and gravel aquifers are not continuous over wide areas and tend to follow subsurface channels (GSS, 2000). In mid 2000 groundwater beneath the southern margin of the site was about 5 to 10 feet below the level in the lake. More recent groundwater level observations from the three exploratory borings drilled for the liquefaction analysis appears to be similar with respect to the level of the lake.

The results from GSS's (2000) geohydrologic investigation indicate the recoverable amount of groundwater in the Moon Camp area is estimated at 230 acre-feet per year. Based on the nature of the aquifer materials, thickness of the aquifer and the discharge rate of existing wells in the Moon Camp area, the potential to develop a 100 gallon per minute (gpm) water well supply is considered by GSS (2000) to be good. Chemical analyses of the groundwater from the two wells indicates that the groundwater is of superior quality, except for one well where the iron concentration (0.69 mg/l) exceeds the state maximum concentration limit for iron (0.3 mg/l) (GSS, 2000).

According to a hydrologic report by So & Associates Engineers, Inc. (SAE) (2002), the proposed project requires two new wells designed in accordance with Big Bear Lake Department of Water and Power (DWP) standards, and be capable of delivering a minimum of 72.0 gallons per minute. However, it has been reported by GSS (2000) that at least one of the existing on-site wells was constructed in accordance with DWP standards and capable of producing 100 gpm.

In order to assess the amount of recoverable water, the likely interconnection of the aquifer with Big Bear Lake, and the sustained yield of the aquifer, pump testing of at least one, or both, of the two existing wells will be required by DWP.

No individual private irrigation wells will be permitted within the proposed tract (SAE, 2002).

2.5 MINERAL RESOURCES

There are no economic metallic or non-metallic ore deposits within or directly adjacent to the project area. The potential for oil and/or gas deposits beneath the site is considered remote.

3.0 GEOLOGIC HAZARDS

General

The primary geologic hazards within the project area are those associated with possible slope instability for new slopes, soil erosion, strong ground motion from earthquakes, and potential seiche along the shoreline.

The project area is not situated within the County of San Bernardino Geologic Hazard (GH) Overlay District. For informational purposes only, the GH Overlay District was created to provide greater safety by establishing review procedures and setbacks for areas that are subject to potential geologic problems such as ground shaking, earthquake faults, liquefaction and subsidence.

3.1 FAULTING AND SEISMICITY

Hazards associated with earthquakes include primary hazards, such as ground shaking and surface rupture; and secondary hazards, such as liquefaction, seismically-induced settlement, landsliding, tsunamis, and seiches.

In accordance with the California Department of Conservation Division of Mines and Geology, a fault is a fracture in the crust of the earth along which rocks on one side have moved relative to those on the other side. Most faults are the result of repeated displacements over a long period of time. An inactive fault is a fault that has not experienced earthquake activity within the last three million years. In comparison, an active fault is one which has experienced earthquake activity in the past 11,000 years. A fault which has moved within the last two to three million years, but not proven by direct evidence to have moved within the last 11,000 years, is considered potentially active. No active or potentially active faults are located within or project towards the project area.

The project area, like most of Southern California is part of a seismically active region. The Alquist-Priolo Act of 1972 (now the Alquist-Priolo Earthquake Fault Zoning Act, Public Resources Code 2621-2624, Division 2 Chapter 7.5) regulates development near active faults so as to mitigate the hazard of surface fault-rupture. Under the Act, the State Geologist is required to delineate "special study zones along known active faults in California". The Act also requires that, prior to approval of a project, a geologic study be conducted to define and delineate any hazards from surface rupture. A geologist registered by the State of California, within or retained by the lead agency for the project must prepare this geologic report.
A 50-foot setback from any known trace of an active fault is required. The project area is not currently known to be located within an Alquist-Priolo Fault Rupture Hazard Zone, according to the California Division of Mines and Geology.

The Modified Mercalli intensity scale was developed in 1931 and measures the intensity of an earthquake's effects in a given locality, and is perhaps much more meaningful to the layman because it is based on actual observations of earthquake effects at specific places. On the Modified Mercalli intensity scale, values range from I to XII. The most commonly used adaptation covers the range of intensity from the conditions of "I –not felt except by very few, favorably situate," to "XII – damage total, lines of sight disturbed, objects thrown into the air". While an earthquake has only one magnitude, it can have many intensities, which decrease with distance from the epicenter.

Ground motions, on the other hand, are often measured in percentage of gravity (percent g), where g = 32 feet per second per second (980 cm/sec^2) on the earth.

Ground shaking accompanying earthquakes on nearby faults can be expected to be felt within the project site. However, the intensity of ground shaking would depend upon the magnitude of the earthquake, the distance to the epicenter, and the geology of the area between the epicenter and the property.

A listing of active faults considered capable of producing strong ground motion at the site, their distances from the project site, and the maximum expected earthquake along each fault is presented in Table 1. Also presented are generalized evaluations of maximum ground shaking on site for the maximum earthquakes, and generalized predictions of the likelihood of such events occurring.

TABLE 1

SUMMARY OF FAULT AND GENERALIZED EARTHQUAKE INFORMATION FOR THE MOON CAMP PROJECT SITE

Name	Miles(direction from site)	Maximum Magnitude	Expected Level of Ground Shaking	Likelihood
North Frontal (Western Segment)	6.5 (north)	7.0	High	Moderate
Helendale	8.0 (east)	7.3	High	Moderate
San Andreas	14 (south)	7.3	High	High
Pinto Mountain	18 (southeast)	7.0	Moderate	Moderate
San Jacinto	25 (southwest)	6.7	Moderate	High

The most severe ground shaking would be expected to accompany a large earthquake on the North Frontal Fault. An earthquake magnitude of 7.0 on this fault could produce Modified Mercallli intensities in the range of VIII to X within the property, and a maximum horizontal ground acceleration between 0.6 and 1.22 (Hilltop Geotechnical 2001). Damage from ground rupture on-site is extremely unlikely because no known active faults cross the property.

Secondary earthquake hazards, which include liquefaction, ground lurching, lateral spreading, seismically induced settlement, tsunamis, and earthquake induced landsliding, are discussed in the following sections.

Liquefaction

Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. Liquefaction is caused by a sudden temporary increase in pore water pressure due to seismic densification or other displacement of submerged granular soils. Liquefaction more often occurs in earthquake prone areas underlain by young alluvium where the groundwater table is higher than 50 feet below the ground surface. The borings for this EIR were drilled in accordance with the "Guidelines for Evaluating and Mitigating Seismic Hazards in California, 1997" published by the Division of Mines and Geology (DMG) of the Department of Conservation. These guidelines are otherwise known as SP 117 (Special Publication 117). Our procedures for analyzing liquefaction potential at the site conform to the "Recommended Procedures for Implementation of DMG Special Publication 117" produced by the Southern California Earthquake Center (SCEC) in 1999. As mentioned in the introduction section of this report, rotary wash drilling techniques were used to advance the borings for this project and Standard Penetration Tests (SPTs) were conducted in general accordance with ASTM D1586. A standard sampler driven by automatic hammer was used to perform the SPTs. Previous measurements by the drilling company rated the hammer energy at 75 to 80 percent. The SCEC recommends the use of the 1985 simplified procedures by Seed and others to analyze liquefaction potential. Typically, the methodology is to determine a corrected blowcount $(N_1)_{60}$and use a recommended relationship between the corrected SPT blow count and the equivalent uniform cyclic stress ratio necessary to trigger liquefaction during a 7½-magnitude earthquake. The graphical summary of this relationship shows that for $(N_1)_{60}$ greater than 30, the potential for earthquake-induced liquefaction is practically non existent. Field SPT values were corrected for sampler type, drill rod lengths, hammer type and release system, and overburden stresses to generate the corrected value $(N_1)_{60}$.

SPT data for this project show generally high blowcount. Consequently, corrected SPT blowcounts yielded $(N_1)_{60}$ values that were greater than 30. Based on the results of the SPT data obtained from the exploratory borings, as well as observations within the exploratory test pits, there are no conditions within the project area that could promote liquefaction. Although shallow groundwater is present beneath the shoreline portions of the property, the lithologic character of the older alluvial materials that underlie the entire shoreline area of the project is such that the potential for liquefaction is considered remote.

The only possible exception could be very small areas directly at the lake-shoreline interface and the mouth of the major alluvial channels. However, only one of these areas lies within the project area (refer to Geologic Map). Given the nature of the lithologic conditions and high SPT blowcounts encountered in exploratory boring B-3 near the mouth of this channel, the lateral extent of any loose, saturated alluvial soils would be very limited. The likelihood of liquefaction-induced impacts in this area is considered low.

Ground Lurching

Certain soils have been observed to move in a wave-like manner in response to intense seismic ground shaking, forming ridges or cracks on the ground surface. Areas underlain by thick accumulations of colluvium and alluvium appear to be more susceptible to ground lurching than bedrock. Under strong seismic ground motion conditions, lurching can be expected within loose, cohesionless solids, or in clay-rich soils with high moisture content. Generally, only lightly loaded structures such as pavement, fences, pipelines and walkways are damaged by ground lurching; more heavily loaded structures appear to resist such deformation. Ground lurching may occur where deposits of loose alluvium exist on the project site, such as within the two major alluviated channels that transect the project area (see Geologic Map).

Lateral Spreading

Lateral spreading involves the lateral displacement of surficial blocks of sediment as a result of liquefaction in a subsurface layer. As previously stated the liquefaction potential within the project area, however, is considered to be remote.

Seismically Induced Ground Settlement

Strong ground shaking can cause settlement by allowing sediment particles to become more tightly packed, thereby reducing pore space. Unconsolidated, loosely packed alluvial deposits are especially susceptible to this phenomenon. Poorly compacted artificial fills may also experience seismically induced settlement. Unconsolidated soils such as modern alluvial soils within the two active stream channels are subject to seismically induced ground settlement.

Tsunamis

A tsunami is a seismic sea-wave caused by sea-bottom deformations that are associated with earthquakes beneath the ocean floor. The hazard from tsunamis is considered nonexistent, given the large distance from the Pacific Ocean.

Seiching

Seiching involves an enclosed body of water oscillating due to groundshaking, usually following an earthquake. Lakes and water towers are typical bodies of water affected by seiching. Because of the proximity of the subject site to Big Bear Lake, the site is susceptible to damage from seiching. The largest amplitude of ground motion associated with a seismic event in this area is anticipated to be related to a major earthquake along the North Frontal Fault zone.

Other Geologic Hazards

Landslides

No landslides are known to exist within the upgradient of the site. Field reconnaissance did not disclose the presence of older, existing landslides within or near the subject property. Aerial photographic analyses performed as part of this study also did not disclose any existing landslides or slumps in the project area.

4.0 THRESHOLDS OF SIGNIFICANCE

Earth resource and/or topographic impact resulting from the proposed project could be considered significant if any of the following occur:

- exposure of people or property to substantial geological hazards, such as landslides, mudslides, ground failure or similar hazards, or soil and/or seismic conditions so unfavorable that they could not be overcome by design using reasonable construction and/or maintenance practices;
- location of a structure within a mapped hazard area or within a structural setback zone;
- location of a structure within an Alquist-Priolo Fault-Rupture Hazard Zone, or within a known active fault zone, or an area characterized by surface rupture that might be related to a fault;
- triggering or acceleration of geologic processes, such as landslides or erosion that could result in slope failure;

- substantial irreversible disturbance of the soil materials at the site or adjacent sites, such that their use is compromised;
- modification of the surface soils such that abnormal amounts of windborne or waterborne soils are removed from the site;
- earthquake induced ground shaking capable of causing ground rupture, liquefaction, settlement, or surface cracks resulting in the substantial damage to people and/or property;
- deformation of foundations by expansive soils (those characterized by shrink/swell potential); and
- modification of the on-site (i.e., grading) in a manner that results in decreased stability for adjacent residential enclaves.

5.0 IMPACTS

The level of geotechnical and landform information contained herein is adequate to analyze the potential project effects on earth resources and landforms, and to determine appropriate mitigation measures. For certain items, the project geotechnical engineer should perform further testing and review of on-site conditions as part of the final design work. This additional work will further refine details for site design, but is not anticipated to alter the conclusions of significance contained herein. In accordance with CEQA case law, this later additional refinement is not a deferral of mitigation. Rather, it is a design refinement, consistent with the commitment to mitigation included in this EIR.

According to the County's RFP, the project proposes a 95-lot residential subdivision on the north shore of Big Bear Lake, in the community of Fawnskin, in the County of San Bernardino. The project site consists of approximately 62.43 acres in the north ½ of Section 13, Township 2 North, Range 1 West, San Bernardino Base Meridian. The Applicant proposes 92 numbered and 3 lettered lots. The lots are to be sold individually and development of lots and construction of homes will be by custom design. Numbered lots will range in size from 0.17 to 2.11 acres. Highway 38 will be realigned as part of the project. Furthermore, development will likely require a remedial grading plan.

The conceptual grading plan prepared by Hicks and Hartwick, Inc. (dated 6/6/01) indicates the creation of numerous, southerly-facing, 2:1 (horizontal to vertical) cut and fill slopes adjacent to the realigned portion of State Highway 38 and the two (2) roadways internal to the development. Based on the nature of bedding planes observed within the older alluvial deposits in test pits TP-2 and TP-5, southerly-facing cut slopes north of the realigned section of

State Highway 38 may be grossly unstable. If so, the lots adjacent to these cut slopes could be significantly impacted.

There are also a number of other short- and long-term impacts to the current physical/geological setting that can be generally expected from grading and development activities. These are described in the following impacts sections.

5.1 EFFECTS FOUND NOT TO BE SIGNIFICANT

Liquefaction

Based on the results of the data obtained from the exploratory borings and test pits, liquefaction is not considered to be a significant impact due to its low potential within the project site.

5.2 POTENTIALLY SIGNIFICANT IMPACTS

The most significant potential impacts to site development would be caused by changes in existing topography, erosion of surficial soil deposits, ground shaking from nearby seismic sources, and potential seiche along the shoreline properties. Impacts to the existing groundwater conditions beneath the site may include increased amounts of recharge to the underlying aquifer(s) as a result of widespread landscape irrigation or leaky buried water transmission lines. If groundwater from onsite wells is to provide the water supply to the project area, additional studies will be necessary to assess the impacts to the underlying aquifer as a result of groundwater withdrawals. In any event, no significant impact to groundwater quality is anticipated.

5.2.1 Slope Stability

Given the apparent southerly inclination of bedding planes within the older alluvial deposits, south-facing, manufactured cut slopes could be grossly unstable. If weak clay layers within the older alluvium were found to be dipping out-of-slope, in what is referred to as "daylighted bedding", slope failures could occur and encroach into adjacent lots.

The most proven methods to mitigate such conditions would be to construct 2:1 (horizontal to vertical) buttressed slopes using on-site native soil materials, or constructing geotextile-reinforced soil buttresses where cut slopes are planned. Either of these methods, as well as a number of other forms of proven slope reinforcement methods would reduce this impact to a less-than-significant level.

5.2.2 Soil Erosion

The younger alluvial deposits within the two major stream channels are highly erodible. Adverse surface drainage could promote accelerated soil erosion which could undermine proposed structures and lead to increased sedimentation within Big Bear Lake. This impact would be considered significant if not mitigated.

Mitigation measures, such as the removal and recompaction of these soils, providing adequate surface drainage away from these soils, or covering them with a roadway would reduce this impact to a less-than-significant-level.

5.2.3 Ground Shaking

Given the highly seismic character of the Southern California Region, moderate to severe ground shaking can be expected within the project area due to moderate to large earthquakes on the nearby North Frontal, Helendale, or San Andreas fault zones. This impact would be considered significant if not mitigated. In order to reduce this impact a less-than-significant-level, all structures for human occupancy should be constructed in accordance with seismic design standards set forth in the latest edition of the Uniform Building Code.

5.2.4 Seiche

Seiche-induced run up along the shoreline properties adjacent Big Bear Lake could conceivably occur due to significant ground motion from a major earthquake on nearby faults. The amount of potential run up would be dependant on the slope of the near-shore environment (i.e. shoreline angle), the height of the lake level at the time of the seismic event, and the severity of oscillation of seismically-induced waves.

Prior to development, an adequate evaluation of seiche needs to be completed by the project geotechnical engineer.

5.3 CONSTRUCTION RELATED IMPACTS

Grading activities within the project area would create significant changes to the current landforms/topography. The greatest changes to existing topography would occur where grading of slopes and associated interior streets and the realignment of Highway 38 is planned. Only by avoidance can impacts to topography related to grading be mitigated and/or reduced to a less-than-significant level.

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AERIAL PHOTOGRAPH

Flight Identifier	Date	Flight Frame No.	Scale
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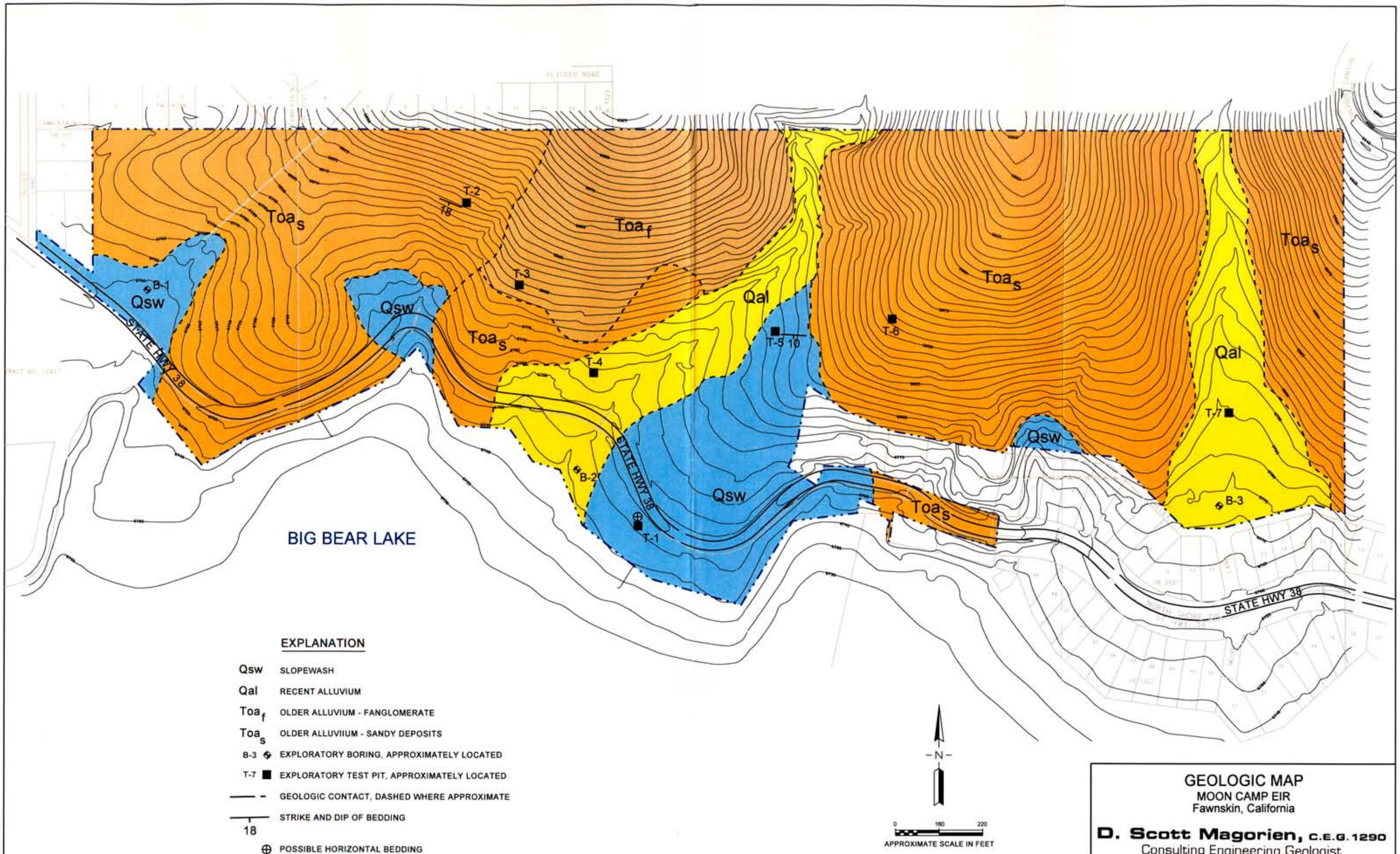

EXPLANATION

Qsw	SLOPEWASH
Qal	RECENT ALLUVIUM
Toa_f	OLDER ALLUVIUM - FANGLOMERATE
Toa_s	OLDER ALLUVIIUM - SANDY DEPOSITS
B-3 ⊕	EXPLORATORY BORING, APPROXIMATELY LOCATED
T-7 ■	EXPLORATORY TEST PIT, APPROXIMATELY LOCATED
—— -	GEOLOGIC CONTACT, DASHED WHERE APPROXIMATE
18	STRIKE AND DIP OF BEDDING
⊕	POSSIBLE HORIZONTAL BEDDING
— · · —	SITE BOUNDARY

BASEMAP MODIFIED FROM TOPOGRAPHIC BASE MAP
DRAWING PROVIDED BY HICKS & HARTWICK, INC., SEPTEMBER 2000

GEOLOGIC MAP

MOON CAMP EIR
Fawnskin, California

D. Scott Magorien, C.E.G. 1290
Consulting Engineering Geologist

Figure By	Project No.	Figure
mww	8178	1
Date 08/06/03		

APPENDIX A

BORING AND EXPLORATORY TEST PIT LOGS

MOON CAMP

EXPLORATORY TEST PIT LOGS*

TEST PIT NO.	DEPTH	LITHOLOGIC DESCRIPTION
TP-1	0 - 3.5'	*Slopewash*: Gravel and Cobbles (GP) in silty sand matrix, dark brown (10YR 3/3), 30% fine to medium sand, dry, nonplastic, loose to medium dense, porous, roots and rootlets in uppermost foot.
	3.5 - 6'	*Older Alluvium*: Clayey Sand (SC), yellowish brown (10YR 4/4), 90%fine and 10 % medium-grained sand, moist, dense, non porous thinly bedded, low plasticity.
TP-2	0 - 1.5'	*Slopewash*: Silty Sand (SM) w/ Gravel and cobbles, dark yellowish brown (10 YR 3/3), 30% fine to medium sand, dry, nonplastic, loose , porous, abundant roots .
	1.5 - 6'	*Older Alluvium*: Clayey Sand (SC), yellowish brown (10YR 4/6), 50% fine and 50 % medium to coarse -grained sand, occasional grussified granite clast, moist, dense, non porous, thinly bedded, low plasticity. Possible Bedding: N65W, 18SW. (Excavating difficult past 4.5')
TP-3	0 - 1.5'	*Slopewash*: Gravel and Cobbles (GP) in silty sand matrix (15%), dark brown (10YR 3/3), dry, nonplastic, loose to medium dense, porous, roots and rootlets.
	1.5 - 4'	*Older Alluvium (Fanglomerate)*: Cobbles (70%) and Gravel (30%) w/ silty sand matrix (30%), light brownish yellow (10YR 6/4, dense, moist, mainly angular quartzite clasts up to 1 foot in maximum dimension. (Excavating difficult past 3').
TP-4	0 - 3.5'	*Alluvium*: Silty Sand (SM) w/ scattered gravel (5%), fine to medium grained, dark yellowish brown (10YR 4/4), loose, dry, nonplastic loose to medium dense, porous, roots and rootlets throughout, highly erodible.
	3.5 - 4.5	*Slopewash*: Silty Sand (SM) w/ Gravel (10%) and Cobbles(90%), mainly fine-grained sand, dark yellowish brown (10YR 4/4), medium dense, dry to slightly moist, porous.

EXPLORATORY TEST PIT LOGS (con't)

	4.5 - 7.0	*Older Alluvium*: Clayey Sand (SC) w/ 10% quartzite cobbles, strong brown (7.5YR 4/6), 70% fine and 30 % medium to coarse - grained sand, moist, dense, non porous, low plasticity.

TEST PIT NO.	**DEPTH**	**LITHOLOGIC DESCRIPTION**
TP-5	0 - 1.5'	*Slopewash:* Silty Sand (SM) w/ angular Gravel (40%) and Cobbles (60%), mainly fine-grained sand and quartzite clasts , dark yellowish brown (10YR 4/4), medium dense, dry to slightly moist, porous, roots and rootlets.
	1.5 - 4.5	*Slopewash*: Sandy Silt (SM) w/ trace gravel, fine grained, strong brown (7.5 YR 5/6) loose to medium dense, slightly moist, porous, scattered rootlets.
	4.5 - 6.5	*Older Alluvium*: Clayey Sand (SC), yellowish brown (10YR 4/6), 50% fine and 50 % medium to coarse -grained sand, moist, dense, non porous, thinly bedded, low plasticity. Possible Bedding: EW, 10S. (Excavating difficult past 5.5')
TP-6	0 -4'	*Older Alluvium*: Clayey Sand (SC), yellowish brown (10YR 4/6), 70% fine and 30 % medium to coarse -grained sand, moist, dense, non porous, thinly bedded, low plasticity. (Excavating difficult past 3.0').
TP-7	0 - 7.5'	*Alluvium:* Silty Sand (SM) w/ gravel and scattered cobbles of quartzite, strong brown (7.5 YR 4/6), fine to medium sand, dry to slightly moist, loose, moderately porous, numerous root and rootlets to 6'.

* Refer to Figure 1 – Geologic Map for Location of Test Pits

MAJOR DIVISIONS		LTR	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixture, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SAND	SW	Well-graded sands or sand with gravel, little or no fines
		SP	Poorly-graded sands or sand with gravel, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

MAJOR DIVISIONS		LTR	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS LL<50	ML	Inorganic silts and very fine sand, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILTS AND CLAYS LL>50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of hogh plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

SAMPLE COLUMN SYMBOLS

▯ Standard penetration test (SPT) Sample: 1 3/8-inch I.D. with liners

⧄ California Split Spoon Sample: 2-inch I.D. with liners

⊠ Modified California Split Spoon Sample: 2 1/2-inch I.D. with liners

■ Sample Interval

☐ Piston Sample

▮ Continuous soil or rock core

NR No recovery

BLOWS/FOOT - Summation of blow counts for deepest 12 inches is sampling interval
RQD% - Rock quality destination in percent

DESCRIPTION COLUMN SYMBOLS

– – – Dashed lines separating soil strata represent inferred boundaries between sampled intervals or no recovery intervals and may be distinct or gradual transitions

—— Solid lines represent distinct or gradual boundaries observed within sampled intervals

]– Description right of bracket symbol represents soil conditions within the depth interval defined by the bracket length

↓ Description right of arrow symbol represents soil conditions to the next deeper boundary line unless otherwise noted

▽ Water level at time of drilling

▼ Water level after at least 12 hours from time of drilling

LABORATORY TEST ABBREVIATIONS

ATT	Atterberg Limits	CORR	Corrosion	SE	Sand Equivalent
COLL	Collapse Potential	DS	Direct Shear	SG	Specific Gravity
COMP	Compaction	EI	Expansion Index	TX	Triaxial Test
CON	Consolidation	S	Grain Size Analysis	UC	Unconfined Compression Test
R	R-Value	PERM	Permeability	#200	No. 200 Wash Sieve Analysis

NOTES

1. Soil descriptions are in accordance with the USCS as set forth by ASTM D2488-90 "Standard Practice for Description and Identification Soil (Visual-Manual Procedure)."
2. Soil color described according to Munsell Soil Color Chart. Rock color described according to Munsell Rock-Color Chart
3. Soil descriptions in these borings are generalized representations and based upon visual classification of cuttings and/or samples during drilling. Descriptions and related information in these borings depict subsurface conditions at the specific location and at the time of drilling only. Soil conditions at other locations may differ from conditions observed at the boring locations. Also, soil and groundwater conditions may change with time at these locations.

P:\8178.000.0\GINT\LOGS.GPJ 08/21/02

D. Scott Magorien, C.E.G. 1290
Engineering Geologist

EXPLANATION OF BORING LOGS

MOON CAMP EIR
Fawnskin, California

Project No.
8178.000.0

Figure
A-1

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B1

BORING LOCATION: ~115' N. Highway 38, ~290' E. Canyon Rd.

DATE STARTED: 6/10/02

DATE FINISHED: 6/11/02

DRILLING METHOD: Mud rotary

HAMMER WEIGHT: 140 lbs

DROP: 30 in.

SAMPLER: SPT

NOTES:
Drilling Contractor: Gregg Drilling & Testing, Inc.
Drilling Equipment: Mobil B-53
Logged By: A. Blanc

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot	Surface Elevation:	Moisture Content (%)	Dry Density (pcf)	Other Tests
	0				SILTY SAND (SM): dark brown (10YR 3/3), dry, ~70% fine to coarse sand~20% fines, nonplastic, ~10% gravel, scattered cobbles, trace roots [SLOPEWASH]			
	1.5				SANDY CLAY with GRAVEL (CL): strong brown (7.5YR 4/6) to brown (7.5YR 4/4), ~60% fines, ~25% fine to coarse sand, ~15% fine to coarse gravel, medium plasticity, scattered cobbles			
	4.5				CLAYEY SAND (SC): yellowish brown (10YR 5/4), ~65% fine to medium sand, ~35% fines, low plasticity, trace coarse sand [OLDER ALLUVIUM]			
	5	1		27				
	10	2		46	~80% fine to coarse sand, ~20% fines			
	14				▽ pale brown (10YR 6/3), ~25% fines, ~10% fine to coarse gravel, subangular to subrounded			
	15							

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B1 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot		Moisture Content (%)	Dry Density (pcf)	Other Tests
					CLAYEY SAND (SC): continued			
		3	NR	50/5"				
	16							
	17							
	18				SANDY CLAY (CL): yellowish brown (10YR 5/4), ~70% fines, ~30% fine sand, low plasticity, trace medium sand, trace calcium carbonate on fracture surfaces			
	19							
	20							
		4		50/5"				
	21							
	22							
	23				CLAYEY SAND (SC): pale brown (10YR 6/3) to yellowish brown (10YR 5/4), ~70-80% fine sand, ~10% coarse sand, and gravel size fragments (up to 1/2"), ~20% fines, low plasticity, locally poorly graded with ~10% nonplastic fines			
	24							
	25							
		5		54/6"				
	26							
	27							
	28				CLAYEY GRAVEL with SAND (GC): pale brown (10YR 6/3), ~65% gravel fragments up to 1", ~20% fine sand, ~15% fines, low plasticity			
	29							
	30							
		6		70/4"				
	31							
	32							

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B1 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot		Moisture Content (%)	Dry Density (pcf)	Other Tests
					CLAYEY SAND (SC): yellowish brown (10YR 5/4), ~70% fine to coarse sand, ~20% fines, ~10% fine gravel, low plasticity, locally gravelly			
	33							
	34							
	35	7		50/5"				
	36							
	37							
	38							
	39							
	40	8		50/2"				
	41							
	42							
	43							
	44							
	45							
	46							
	47							
	48							
	49							

MAGORIEN_GEO3

A-4

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B1 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot		Moisture Content (%)	Dry Density (pcf)	Other Tests
					CLAYEY SAND (SC): continued			
	50	9		70/3"				
	51				Bottom of boring at 50.75 ft bgs. Drilling mud bailed out. Water level measured ~14 ft bgs on 6/11/02 at 15:00. Boring backfilled with cement - bentonite grout.			
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							
	60							
	61							
	62							
	63							
	64							
	65							
	66							

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PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2

BORING LOCATION: South of Hwy 38 (near lake)

DATE STARTED: 6/11/02
DATE FINISHED: 6/11/02
DRILLING METHOD: Mud rotary
HAMMER WEIGHT: 140 lbs
DROP: 30 in.
SAMPLER: SPT

NOTES:
Drilling Contractor: Gregg Drilling & Testing, Inc.
Drilling Equipment: Mobil B-53
Logged By: A. Blanc

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	MATERIAL DESCRIPTION Surface Elevation:	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other Tests
	0–3.5				SILTY SAND (SM): dark brown (10YR 3/3), dry, ~50% fine to coarse sand, ~30% gravel, fine to coarse, angular to subrounded, ~20% fines, nonplastic, scattered cobbles up to 6", roots [SLOPEWASH]			
	3.5				CLAYEY SAND (SC): mottled strong brown and brown (7.5YR 5/4-5/6), ~75% fine to medium sand, ~25% fines, low plasticity, iron oxide staining [OLDER ALLUVIUM]			
	5–6.5		NR	45	trace decayed roots light brown (7.5YR 6/4) with white mottling, ~65-70% fine to medium sand, trace coarse sand, ~30-35% fines			
	8.5				POORLY GRADED SAND with SILT and GRAVEL (SP-SM): yellowish brown (10YR 5/4), ~80% fine to coarse sand, ~15% fine, subrounded gravel, ~5% fines, nonplastic, locally higher fines content			
	10–11.5	2		95				
	13.5				POORLY GRADED SAND with SILT (SP-SM): yellowish brown (10YR 5/4), ~90-95% fine to coarse sand, ~5-10% fines, nonplastic, trace gravel ▽			
	15							

MAGORIEN_GEO3

A-6

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot		Moisture Content (%)	Dry Density (pcf)	Other Tests
					POORLY GRADED SAND with SILT (SP-SM): continued			
		3		50/5"				
	16							
	17							
	18							
	19							
	20							
	21	4		72				
	22							
	23							
	24				POORLY GRADED SAND with CLAY (SP-SC): brown (7.5YR 5/4), ~90% fine to coarse sand, ~10% fines, low plasticity			
	25							
		5		50/5"				
	26							
	27							
	28							
	29				POORLY GRADED SAND with SILT and GRAVEL (SP-SM): brown (7.5YR 5/4), ~60-65% fine to coarse sand, ~30% fine, subrounded gravel, ~5-10% fines, nonplastic to low plasticity			
	30	6		60/6"				
	31							
	32							

MAGORIEN_GEO3

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PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot		Moisture Content (%)	Dry Density (pcf)	Other Tests
					POORLY GRADED SAND with SILT and GRAVEL (SP-SM): continued			
	33							
	34							
	35	7		50/4"				
	36							
	37							
	38				POORLY GRADED SAND with GRAVEL (SP): yellowish brown (10YR 5/4), ~80% fine to coarse sand, ~15% fine gravel, ~5% fines, nonplastic			
	39							
	40	8		60/6"				
	41							
	42							
	43				CLAYEY SAND (SC): yellowish brown (10YR 5/4), ~85% fine to coarse sand, ~15% fines, low plasticity, trace fine gravel, trace mica			
	44							
	45	9		50/6"				
	46							
	47							
	48							
	49							

MAGORIEN_GEO3

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES Sample No.	 Sample	 Blows/ Foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	 Dry Density (pcf)	 Other Tests
					CLAYEY SAND (SC): continued			
	50	10		55/6"				
	51				Bottom of boring at 50.5 ft bgs. Groundwater estimated at ~14 ft bgs following bailing of mud out of the borehole. Boring backfilled with cement grout with 5% bentonite.			
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							
	60							
	61							
	62							
	63							
	64							
	65							
	66							

MAGORIEN_GEO3

A-9

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B3

BORING LOCATION: Off Moon Lane (east)
DATE STARTED: 6/10/02
DATE FINISHED: 6/11/02
DRILLING METHOD: Mud rotary
HAMMER WEIGHT: 140 lbs
DROP: 30 in.
SAMPLER: SPT

NOTES:
Drilling Contractor: Gregg Drilling & Testing, Inc.
Drilling Equipment: Mobil B-53
Logged By: A. Blanc

ELEV. (feet)	DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION Surface Elevation:	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other Tests
					SILTY SAND with GRAVEL (SM): brown (10YR 5/3), ~60% fine to coarse sand, ~20% fine to coarse gravel up to 1.5", angular to subrounded, ~20% fines, nonplastic [RECENT ALLUVIUM]			
	1							
	2							
	3							
	4							
	5							
	6	1		37				
	7							
	8				CLAYEY GRAVEL with SAND (GC): yellowish brown (10YR 5/4), ~50% fine to coarse subrounded gravel, ~35% fine to coarse sand, ~15% fines, low plasticity			
	9							
	10							
	11	2		42	CLAYEY SAND with GRAVEL (SC): light olive brown (2.5Y 5/4) with white and dark olive gray mottling, ~60% fine to coarse sand, ~20% fine gravel, ~20% fines, low plasticity			
	12							
	13							
	14							
	15							

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B3 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other Tests
		3	NR	50/4"	SILTY SAND (SM): pale olive (5Y 6/4), ~75% fine sand, ~25% fines, nonplastic [OLDER ALLUVIUM]			
	16							
	17							
	18				CLAYEY SAND (SC): olive brown (7.5Y 4/4), ~70% fine to medium sand, ~30% fines, low plasticity			
	19							
	20							
					SANDY CLAY (CL): olive (5Y 5/3), ~60% fines, ~40% fine sand, low plasticity, locally hard/cemented			
	21	4	NR	44				
	22							
	23							
	24							
					~55% fines, ~45% fine sand			
	25							
		5		57/6"	CLAYEY SAND (SC): olive (5Y 5/3), ~75% fine sand, ~25% fines, low plasticity ▽			
	26							
	27							
	28							
	29				fine to medium sand, trace coarse sand, locally cemented			
	30	6		50/4"	cemented, gravelly			
	31							
	32							

MAGORIEN_GEO3

Project No. 8178.000.0

D. Scott Magorien, C.E.G. 1290 - Engineering Geologist

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B3 (cont'd)

ELEV. (feet)	DEPTH (feet)	SAMPLES Sample No.	 Sample	 Blows/ Foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	 Dry Density (pcf)	 Other Tests
					CLAYEY SAND (SC): continued			
	33							
	34							
	35	7		50/4"				
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45	8		50/2"	Bottom of boring at 45 ft bgs. Drilling mud bailed out of hole. Water measured at ~26 ft bgs on 6/11/02 at 0730. Boring backfilled with cement-bentonite grout.			
	46							
	47							
	48							
	49							

MAGORIEN_GEO3

A-12

15.9 Hydrology Data

MOON CAMP TENTATIVE TRACT 16136
HYDROLOGY AND WATER QUALITY
TECHNICAL APPENDIX

Prepared For:

San Bernardino County

Prepared By:

RBF
CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION

Contact Person:
Rebecca Kinney, RCE 58797
Seema C. Shah

Revised

August 2002
June 20002

JN 10101901

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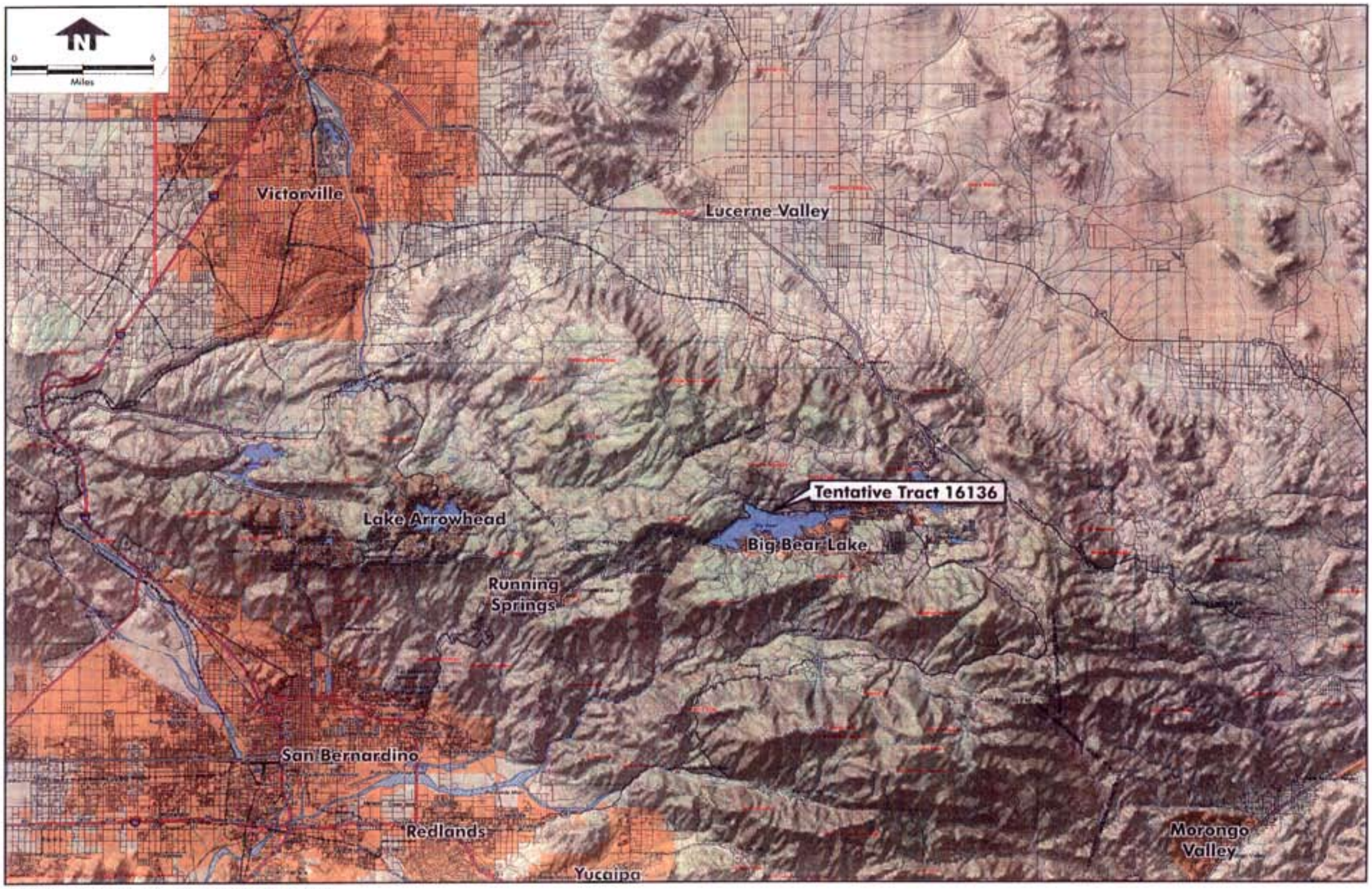
1.0 INTRODUCTION

The following study is the Hydrology and Drainage Technical Appendix prepared as part of the *Moon Camp Tentative Tract 16136 Environmental Impact Report (EIR).* The Moon Camp project encompasses approximately 62.4 acres along the north shore of Big Bear Lake, in the community of Fawnskin, San Bernardino County (refer to Figure 1, Regional Vicinity Map). The Big Bear Lake area serves as a destination resort community and many of the residences are second homes. As many as 50,000 people visit the area on peak holiday weekends.

The Local Vicinity Map (Figure 2) shows the project site being adjacent to the north shore of Big Bear Lake in the relatively undeveloped eastern portion of Fawnskin. The site is located more specifically in the north half of Section 13, Township 2 North, Range 1 west, San Bernardino Base and Meridian. The property is bounded by Oriole Lane and Canyon Road to the west, Polique Canyon Road to the east and Flicker Road to the north. Regional access is provided from State Highway 38, which bisects the property.



Source: Lilburn Corporation, August 20, 2001.

FIGURE 1

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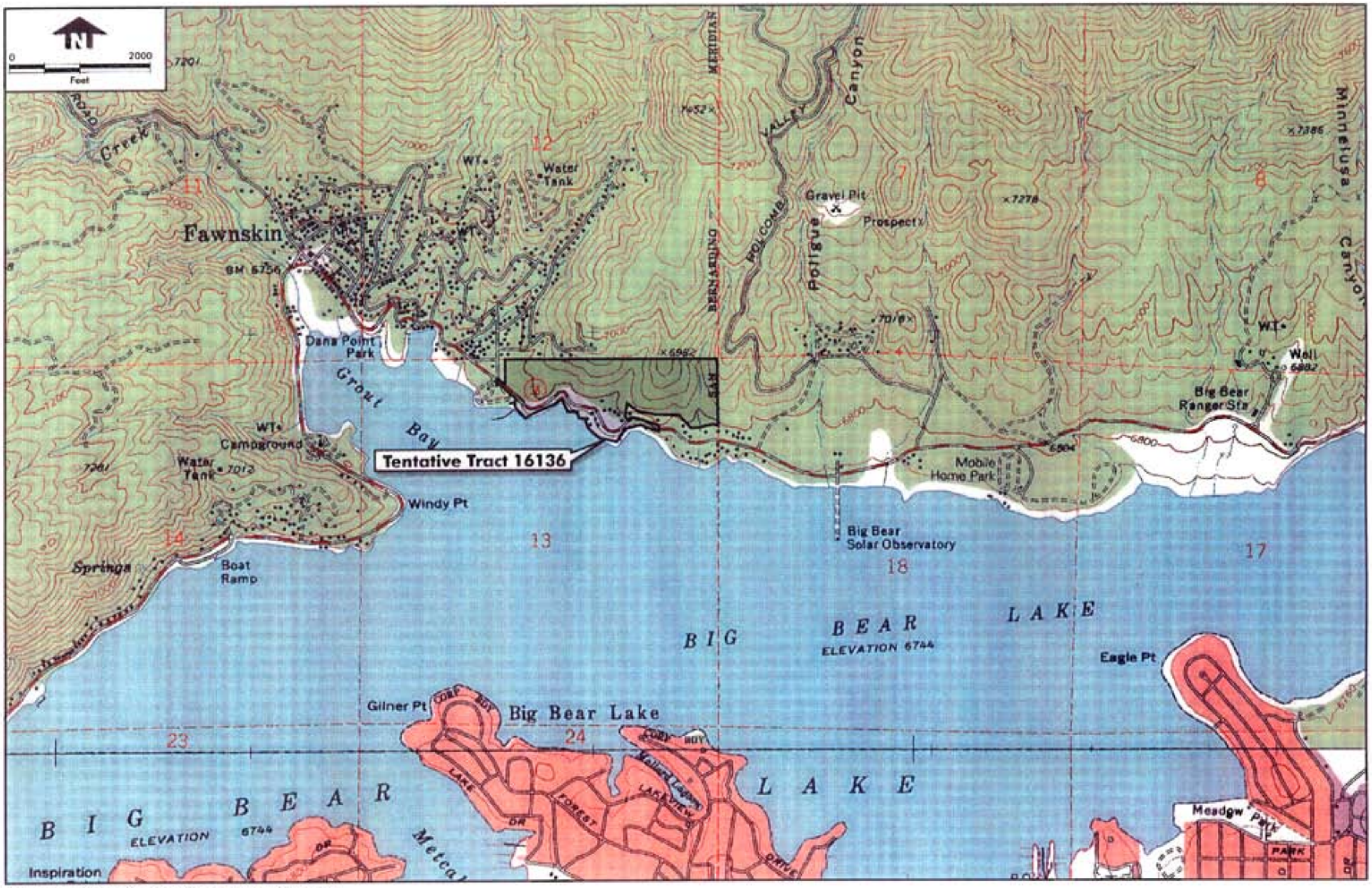
05/02 JN 10-101901

Regional Vicinity Map



Source: Lilburn Corporation, August 20, 2001.

Local Vicinity Map

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
05/02
JN 10-101901

FIGURE 2

1.2 Definition of Level of Significance

The purpose of this technical evaluation is to determine the impact of the proposed development of Moon Camp on surface water drainage and storm water quality within San Bernardino County and Big Bear Lake. Should the analysis determine that the proposed project significantly impacts surface water drainage or storm water quality, appropriate mitigation will be identified to minimize the project impact to a less than significant level.

Federal, state and local drainage laws and regulations govern the evaluation of impacts to surface water drainage. For this evaluation, impacts to surface water drainage would be considered significant if the project alters the drainage patterns of the site, which would result in substantial erosion, siltation, or increase runoff that would result in increased flooding. Increase in the amount of runoff could be considered significant if it impacts State Highway 38 or downstream storm drain facilities.

The evaluation of impacts to storm water quality is of growing concern throughout Southern California. In response to the growing concerns and implementation of the Clean Water Act, the Santa Ana Regional Water Quality Control Board has a National Pollution Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for San Bernardino County. The Order Number is R8-2002-0012. The current NPDES number for San Bernardino County is CAS618036.

Development Planning for Storm Water Management:

The requirement to implement a program for development planning was based on federal and state statutes including: Section 402 (p) of the Clean Water Act. The Clean Water Act amendments of 1987 established a framework for regulating storm water discharges from municipal, industrial, and construction activities under the NPDES program. The primary objectives of the municipal storm water program requirements are to:

1. Effectively prohibit non-storm water discharges, and
2. Reduce the discharge of pollutants from storm water conveyance system to the Maximum Extent Practicable.

For this evaluation, impacts to storm water quality would be considered significant if the project did not attempt to address storm water pollution to the maximum extent practicable. Currently, there are no definitive water quality standards that require storm water quality leaving a project site to meet standards for individual pollutants. Therefore, impacts to storm water quality will be considered less than significant if they meet the requirements of the Water Quality Management Plan (WQMP). Starting January 2004 permittees (San Bernardino County) are required to revie their existing BMPs for new developments and submit to Executive Officers for Review. Based on Order No. R8-200-0012 for San Bernardino County all new developments must follow the following guidelines:

> A new development is defined as projects for which tentative tract or parcel map approval was not received by June 1, 2004. However, projects that have not commenced grading by the initial expiration date of the tentative tract or parcel map approval shall be deemed a new development project as defined in this section. New development does not include projects receiving map approval after June 1, 2004 that are proceeding under a common scheme of development that was the subject of a tentative tract or parcel map approval that occurred prior to June 1, 2004.

The WQMP requirements for on-site and or watershed based BMPs include the following:

1. The pollutants in post-development runoff shall be reduced using controls that utilize best available technology (BAT) and best conventional technology (BCT).
2. The discharge of any listed pollutant to an impaired waterbody on the 303(d) list shall not cause or contribute to an exceedance of receiving water quality objective.

2.0 EXISTING CONDITIONS

The purpose of this existing conditions evaluation is to establish a baseline for comparison of the pre-project and the post-project conditions. Baseline conditions investigated include: land use, hydrology, floodplain mapping, and surface water quality.

2.1 Existing Land Use

The 62.4-acre Moon Camp site is located on the north shore of Big Bear Lake. San Bernardino County currently designates the site as Rural Living. The site has a variety of natural ground cover and is forested with Oaks, Pines and Juniper trees. There is some development on the lake front portion of the site. The rest of the area around the project site is undeveloped forest.

The watershed tributary to the site can be broken up into nine drainage areas composed of approximately 177 acres. Flows enter Big Bear Lake via cross culverts under Highway 38 and direct sheet flow over Highway 38. The drainage areas are labeled A through I. Area A, located on the eastern end of the project contains a natural channel passing through the center of this sub-watershed. It is the largest drainage area composed of 98 acres.

2.2 Hydrology

Hicks & Hartwick, Inc conducted the hydrology analysis that provides the basis for the existing condition hydrology for Moon Camp development. Hydrologic calculations to evaluate surface runoff associated with 10-year and 100-year hypothetical design storm frequencies from the tributary drainage areas were performed using 1983-1994 Advances Engineering Software 1983-1994 (AES). The computer software (AES) creates an inactive watershed system to compute hydraulic and hydrological information for a given watershed. The watershed subarea boundaries were delineated in their *Preliminary Drainage Study*. Hydrologic parameters used in the analysis, such as rainfall and soil classification, are presented in the *San Bernardino County Hydrology Manual* dated May 1983. Figure 3 contains the hydrology map for the existing condition.

2.2.1 Existing Watershed Description

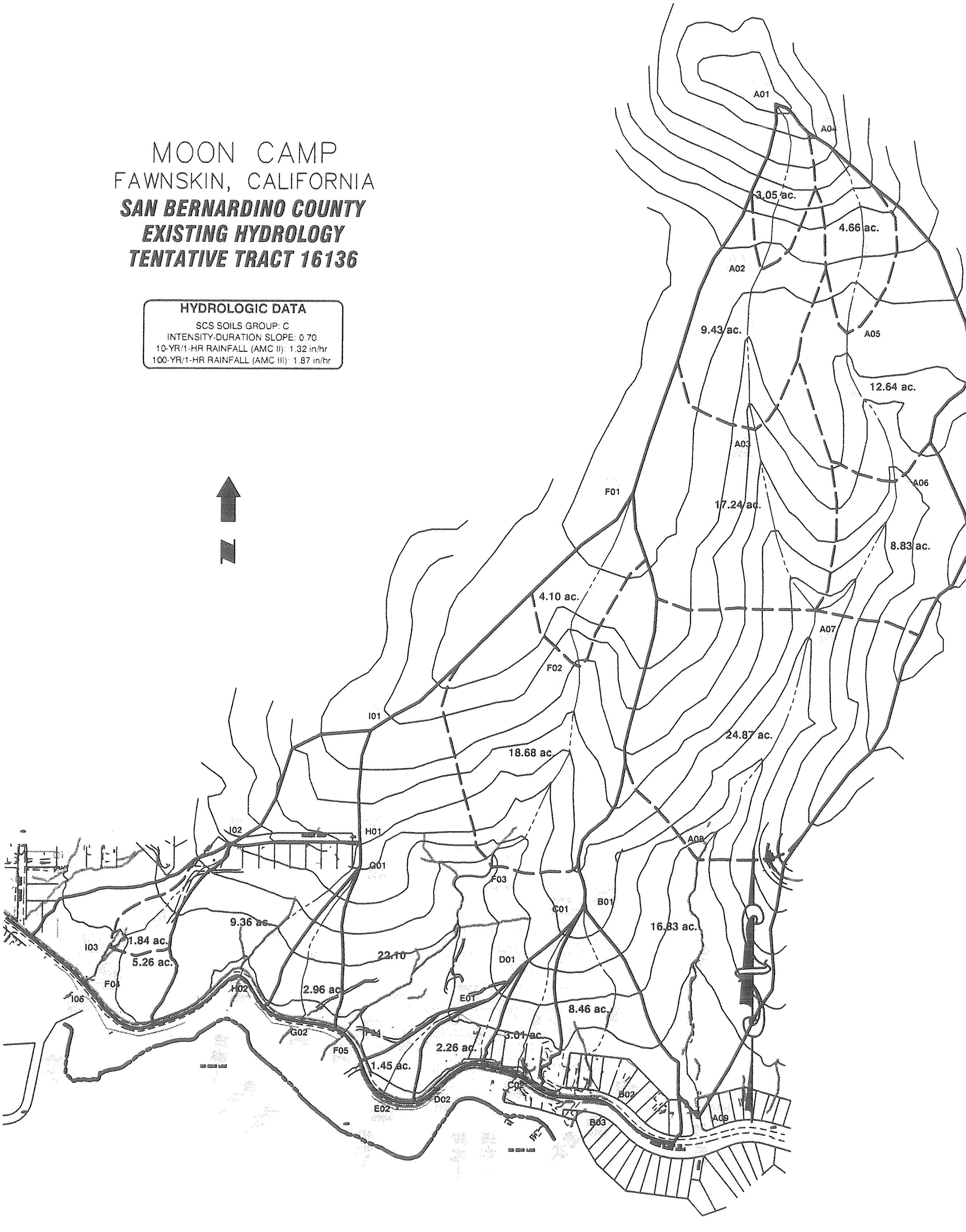
The historic drainage pattern for the areas follow the natural topography, south to north with the flow outleting to Big Bear Lake.

The maximum elevation differential of the watershed is approximately 213 feet (from elevation 2,960 at the northeast boundary to 2,747 feet at the lakefront). The site has slopes of five to 40 percent. Due to onsite drainage patterns, the project site was split into nine areas (A through I). Area "A" is on the eastern portion and area "I" is on the western end of the watershed.

MOON CAMP
FAWNSKIN, CALIFORNIA

SAN BERNARDINO COUNTY
EXISTING HYDROLOGY
TENTATIVE TRACT 16136

HYDROLOGIC DATA
SCS SOILS GROUP: C
INTENSITY-DURATION SLOPE: 0.70
10-YR/1-HR RAINFALL (AMC II): 1.32 in/hr
100-YR/1-HR RAINFALL (AMC III): 1.87 in/hr



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SOURCE: HICKS & HARTWICK, INC. PRELIMINARY DRAINAGE STUDY

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10-101901

SCALE
1" = 600'

MOON CAMP
EXISTING CONDITION
HYDROLOGY MAP

FIGURE
3

Table No. 1 – Drainage Area Breakdown		
Drainage Area	Area (acres)	Number of Subareas
A	95.4	8
B	8.5	1
C	3.0	1
D	2.3	1
E	1.5	1
F	44.9	3
G	3.0	1
H	9.4	1
I	11.4	3

The nine drainage areas and subareas for the existing condition are illustrated in Figure 3.

Table No. 2 – Existing Subwatershed Characteristics			
Nodes	**Area (acres)**	**Length (feet)**	**Soil Type / Development Type**
Watershed A			
A1 – A2	3	779	D / Natural
A2 – A3	9.4	730	D / Natural
A3 – A7	17.2	869	D / Natural
A4 – A5	4.7	890	D / Natural
A5 – A6	12.6	719	D / Natural
A6 – A7	8.8	719	C / Natural
A7 – A8	24.9	1261	C / Natural
A8 – A9	16.8	1233	C / Natural
Watershed B			
B1 – B2	8.5	997	C / 1D AC
Watershed C			
C1 – C2	3.0	794	C / 2.5 AC
Watershed D			
D1 – D2	2.3	774	C / 2.5 AC
Watershed E			
E1 – E2	1.5	683	C / Natural
Watershed F			
F1 – F2	4.1	848	C / Natural
F2 – F3	18.7	1044	C / Natural
F3 – F4	22.1	1109	C / Natural
Watershed G			
G1 – G2	3.0	781	C / Natural
Watershed H			
H1 – H2	9.4	833	C / 2.5 AC
Watershed I			
I1 – I2	4.3	1050	C / 4D AC
I2 – I3	1.8	705	C / 2.5 AC
I3 – I4	5.3	292	C / Natural

Area “A” is composed of 8 subareas. Currently all land in area “A” is natural. There is a natural channel running down the center of watershed “A”. Approximately 50 percent of the land on the north end of sub-watershed “A” is composed of soil type “D”, while the remainder is composed of soil type “C”.

Area “B” is composed of 1 subarea. Area “B’s” land use includes 1 dwelling unit per acre.

Areas “C”, “D”, and “H” are all composed of 1 subarea. Within these subarea, the land use includes 1 dwelling unit for every 2.5 acres.

Areas “E” and “G” are also composed of 1 subarea each. Within these subareas, the land use is natural.

Area “F” is composed of 3 subareas. The land use for the entire drainage area is natural.

Area “I” is composed of 3 subareas. In the upper drainage area the land use is 4 dwelling units per acre. In the second drainage area, land use includes 1 dwelling unit per 2.5 acres. The downstream drainage area in subarea “I” is considered natural.

During a site visit, it was noticed the existing culverts, crossing the state highway were either plugged with sediment, had crushed inlets, or both. These deficiencies result in little to no capacity in the existing culverts. The deficiencies cause ponding and overtopping of the highway. Figure 4 contains current condition of the culvert crossings across Highway 38.

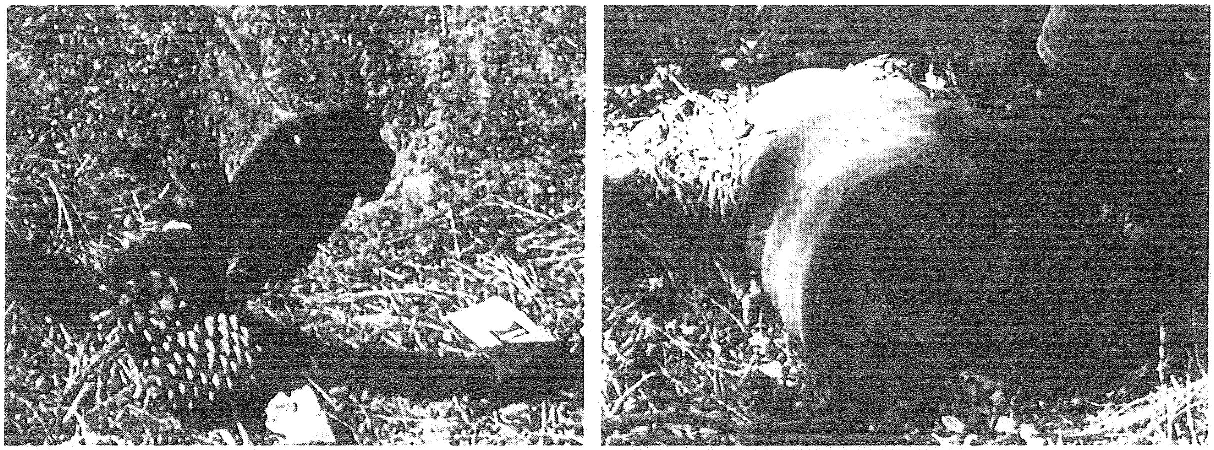

Figure 4 – Sediment and Crushed Pipes Along Highway 38.

2.2.2 Rational Method

Hicks & Hartwick performed the hydrologic calculations to determine the 10-year and 100-year peak flow rates using the *San Bernardino County Hydrology Manual* dated May 1983. The Rational Method is an empirical computation procedure used to develop a peak runoff rate (discharge) for storms of a specific recurrence interval. Rational Method equations are based on the assumption that the peak flowrate is directly proportional to the drainage area, rainfall intensity, and a loss coefficient, which describes the effects of land use and soil type. The design discharges were computed by generating a hydrologic "link-node" model, which divides the area into drainage subareas. These subareas are tributary to a concentration point or hydrologic "node" point determined by the existing terrain and street layout. The following assumptions/guidelines were applied for use of the Rational Methods:

1. The Rational Method hydrology includes the effects of infiltration caused by soil surface characteristics. The soils map from the *San Bernardino County Manual* indicates that the study area consists of soil types "C and D."

2. The infiltration rate is also affected by the type of vegetation or ground cover and percentage of impervious surfaces. The amount of imperviousness used for the existing condition ranged from 0% for natural open areas and 10% to 20% for single family housing.

3. The time of concentration (T_c) is determined utilizing the *San Bernardino County Hydrology Manual.*

4. The gutter flow option was used to model the natural channel since the side slopes and Manning's "n" values can be changed.

5. Standard Intensity-Duration Curve data was obtained from the *San Bernardino County Hydrology Manual.*

2.2.3 Existing Condition Surface Water Hydrology

To establish the baseline hydrologic conditions for Moon Camp, both 10-year and 100-year frequency storm were analyzed by Hicks & Hartwick. The flows for the 10-year storm are used to determine local storm drain sizing, while the 100-year analysis is used for larger master plan facilities and floodplain mapping. The predominant hydrologic soil classification of the natural watershed is soil type "C" and "D", which corresponds to a high runoff potential, with the soil having slow infiltration rates consistent with clay soils.

Appendix A contains the Hicks & Hartwick existing condition analysis utilizing the 1983-1994 Advanced Engineering Software. Table 3 summarizes the results.

Table No. 3 – Existing Conditions Peak Flowrates

Subarea	**Area (acres)**	**Total Area (AC)**	**Tc (min)**	**Total 10-Yr. Peak Q (cfs)**	**Total 100-Yr. Peak Q (cfs)**
Watershed A					
A1 – A2	3	3	16.6	7.8	12.2
A2 – A3	9.4	12.5	17.4	30.3	48.4
A3 – A7	17.2	29.7	18.3	69.0	111.0
A4 – A5	4.7	4.7	18.4	11.0	17.4
A5 – A6	12.6	17.3	19.2	39.4	62.5
A6 – A7	8.8	26.1	20.0	57.4	91.6
A7 – A8	24.9	79.0	19.6	170.1	227.3
A8 – A9	16.8	95.9	21.2	191.5	317.3

Table No. 3 – Existing Conditions Peak Flowrates

Subarea	Area (acres)	Total Area (AC)	Tc (min)	Total 10-Yr. Peak Q (cfs)	Total 100-Yr. Peak Q (cfs)
Watershed B					
B1 – B2	8.5	8.5	10.3	31.1	47.3
Watershed C					
C1 – C2	3.0	3.0	9.4	11.7	17.9
Watershed D					
D1 – D2	2.3	2.3	10.0	8.3	12.8
Watershed E					
E1 – E2	1.5	1.5	19.9	3.1	5
Watershed F					
F1 – F2	4.1	4.1	20.0	8.6	14.1
F2 – F3	18.7	22.8	21.1	45.6	75.2
F3 – F4	22.1	44.9	22.5	84.4	141.1
Watershed G					
G1 – G2	3.0	3.0	18.1	6.7	10.9
Watershed H					
H1 – H2	9.4	9.4	9.6	35.7	54.6
Watershed I					
I1 – I2	4.3	4.3	9.4	17.3	25.7
I2 – I3	1.8	6.1	10.2	22.9	34.7
I3 – I4	5.3	11.4	10.7	40.2	61.9

2.3 Floodplain Mapping

The County of San Bernardino is a participant in the National Flood Insurance Program (NFIP). Communities participating in the NFIP must adopt and enforce minimum floodplain management standards, including identification of flood hazards and flooding risks. Participation in the NFIP allows communities to purchase low cost insurance protection against losses from flooding. The published Flood Insurance Rate Maps (FIRMs) for the project site are included on Community Panel Number 060270 7295B. The FIRMs indicated that there are no existing flood hazards within the project site.

2.4 Jurisdictional Waters

Based on a field survey conducted on March 15, 2002 by RBF Consulting, it was determined that 0.15 acres of jurisdictional waters exist on site.

2.5 Storm Water Quality

As indicated in Section 1.2, storm water quality is a significant concern in Southern California. This section discusses typical pollutants found in storm water runoff and discusses what sort of contaminants maybe found in existing storm water runoff. Based on the Clean Water Act a 303 (d) list has been developed, which includes Big Bear Lake. For a specific discussion concerning the status of the 303(d) listing for Big Bear Lake refer to Section 2.5.3.

2.5.1 Nonpoint Source Pollutants

A net effect of urbanization can be to increase pollutant export over naturally occurring conditions. The impact of the higher export can be on the adjacent streams and also on the downstream receiving waters. However, an important consideration in evaluating storm water quality from the project is to assess if it impairs the beneficial use to the receiving waters. Nonpoint source pollutants have been characterized by the following major categories in order to assist in determining the pertinent data and its use. Receiving waters can assimilate a limited quantity of various constituent elements, but there are thresholds beyond which the measured amount becomes a pollutant and results in an undesirable impact. Background of these standard water quality categories provides understanding of typical urbanization impacts.

Sediment - Sediment is made up of tiny soil particles that are washed or blown into surface waters. It is the major pollutant by volume in surface water. Suspended soil particles can cause the water to look cloudy or turbid. The fine sediment particles also act as a vehicle to transport other pollutants including nutrients, trace metals, and hydrocarbons. Construction sites are the largest source of sediment for urban areas under development. Another major source of sediment is streambank erosion, which may be accelerated by increases in peak rates and volumes of runoff due to urbanization.

Nutrients - Nutrients are a major concern for surface water quality, especially phosphorous and nitrogen, can cause algal blooms and excessive vegetative growth. Of the two, phosphorus is usually the limiting nutrient that controls the growth of algae in lakes. The orthophosphorous form of phosphorus is readily available for plant growth. The ammonium form of nitrogen can also have severe effects on surface water quality. The ammonium is converted to nitrate and nitrite forms of nitrogen in a process called nitrification. This process consumes large amounts of oxygen which can impair the dissolved oxygen levels in water. The nitrate form of nitrogen is very soluble and is found naturally at low levels in water. When nitrogen fertilizer is applied to lawns or other areas in excess of plant needs, nitrates can leach below the root zone, eventually reaching ground water. Orthophosphate from auto emissions also contributes phosphorus in areas with heavy automobile traffic. As a general rule of thumb, nutrient export is greatest from development sites with the most impervious areas. Other problems resulting from excess nutrients are 1) surface algal scums, 2) water discolorations, 3) odors, 4) toxic releases, and 5) overgrowth of plants. Common measures for nutrients are total nitrogen, organic nitrogen, total Kjeldahl nitrogen (TKN), nitrate, ammonia, total phosphate, and total organic carbon (TOC).

Trace Metals - Trace metals are primarily a concern because of their toxic effects on aquatic life, and their potential to contaminate drinking water supplies. The most common trace metals found in urban runoff are lead, zinc, and copper. Fallout from automobile emissions is also a major source of lead in urban areas. A large fraction of the trace metals in urban runoff are attached to sediment and this effectively reduces the level, which is immediately available for biological uptake and subsequent bioaccumulation. Metals associated with the sediment settle out rapidly and accumulate in the soils. Also, urban runoff events typically occur over a shorter duration, which reduces the amount of exposure, which could be toxic to the aquatic environment. The toxicity of trace metals in