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

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2 (cont'd)

		SAMPLES				LABORATORY TESTS		
ELEV. (feet)	DEPTH (feet)	Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION	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

A-8

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B2 (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
					CLAYEY SAND (SC): continued			
	50	10		55/6"				
					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.			
	51							
	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			MATERIAL DESCRIPTION	LABORATORY TESTS		
		Sample No.	Sample	Blows/ Foot	Surface Elevation:	Moisture Content (%)	Dry Density (pcf)	Other Tests
	0				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.	 Sample	 Blows/ Foot	MATERIAL DESCRIPTION		LABORATORY TESTS Moisture Content (%)	 Dry Density (pcf)	 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								
		4	NR	44	SANDY CLAY (CL): olive (5Y 5/3), ~60% fines, ~40% fine sand, low plasticity, locally hard/cemented				
	21								
	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

A-11

PROJECT: MOON CAMP EIR
Fawnskin, California

Log of Boring No. B3 (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			
	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

Table of Contents

Table of Contents

LIST OF TABLES

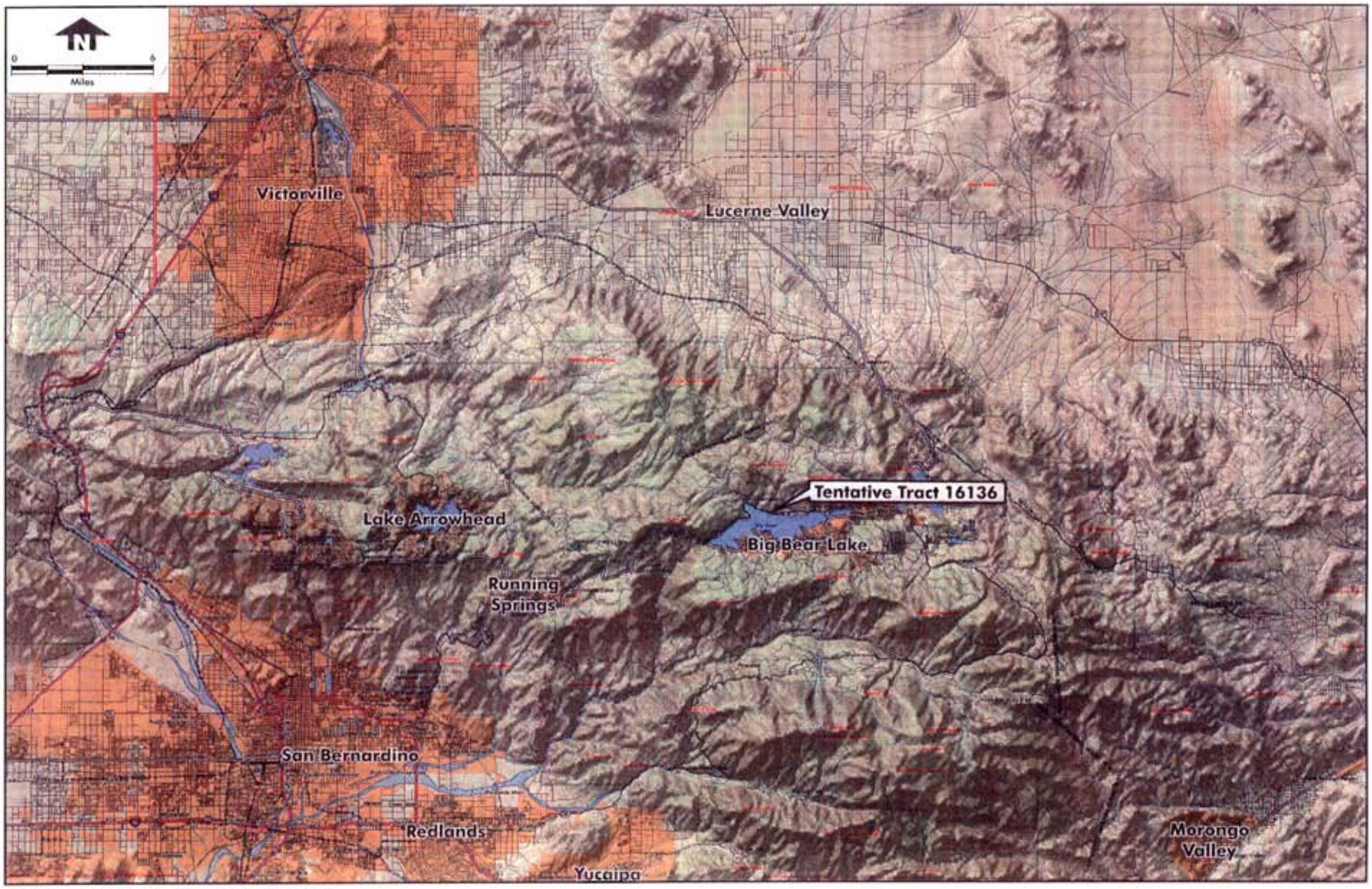
LIST OF FIGURES

LIST OF APPENDICES
(Appendices May Be Found Following Report)

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

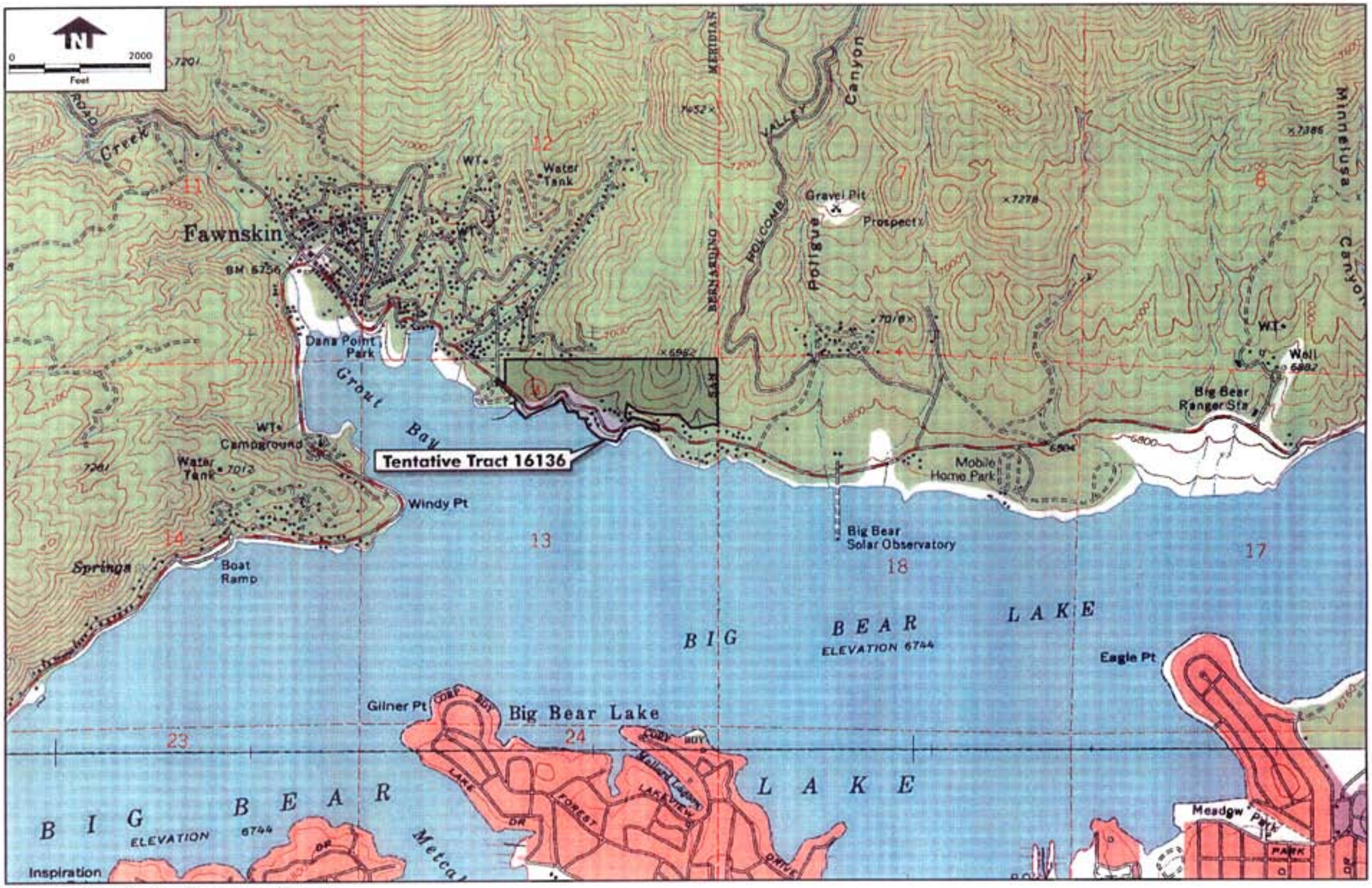
RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

05/02

JN 10-101901

Regional Vicinity Map



Source: Lilburn Corporation, August 20, 2001.

Local Vicinity Map

FIGURE 2

RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

05/02

JN 10-101901

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.

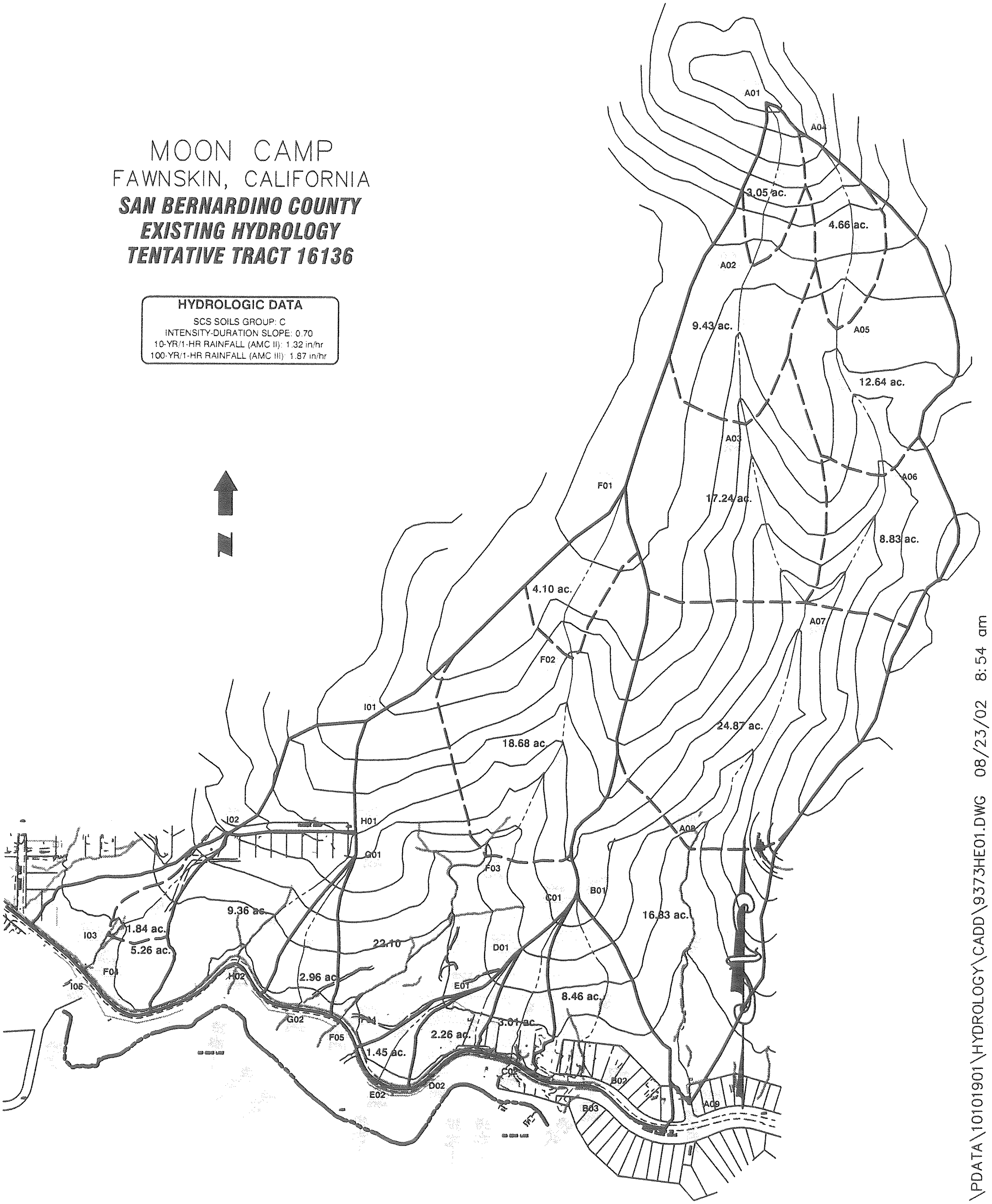
2.2.1 Existing Watershed Description

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



H:\PDATA\10101901\HYDROLOGY\CADD\9373HE01.DWG 08/23/02 8:54 am

SOURCE: HICKS & HARTWICK, INC. PRELIMINARY DRAINAGE STUDY

RBF
PLANNING ■ DESIGN ■ CONSTRUCTION
CONSULTING

14725 ALTON PARKWAY
IRVINE, CALIFORNIA 92618-2027
949.472.3505 • FAX 949.472.8373 • www.RBF.com

JOB No.
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.

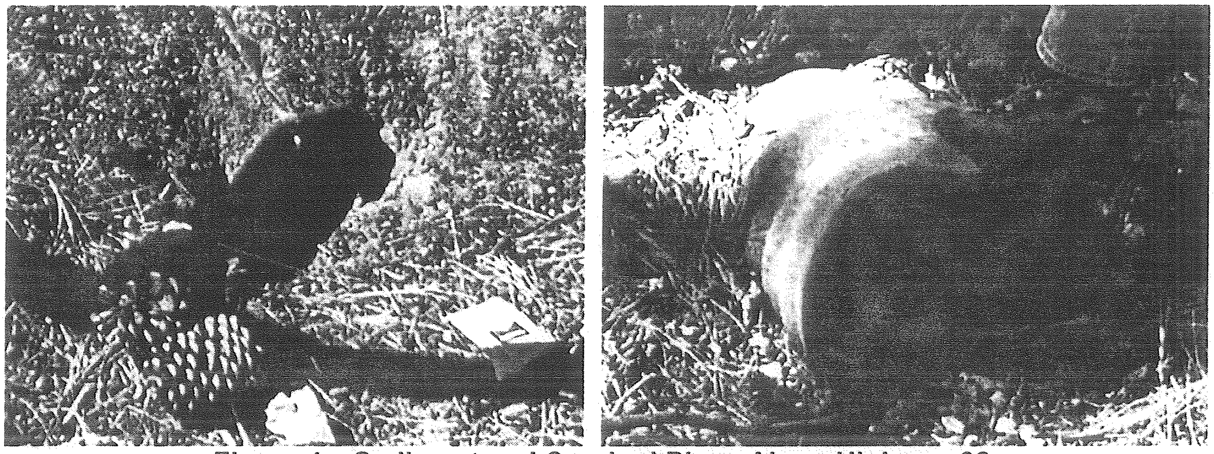


Figure 4 – Sediment and Crushed Pipes Along Highway 38.

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 runoff varies with the hardness of the receiving water. As total hardness of the water increases, the threshold concentration levels for adverse effects increases.

Oxygen-Demanding Substances - Aquatic life is dependent on the dissolved oxygen in the water and when organic matter is consumed by microorganisms then dissolved oxygen is consumed in the process. A rainfall event can deposit large quantities of oxygen demanding substance in lakes and streams. The biochemical oxygen demand of typical urban runoff is on the same order of magnitude as the effluent from an effective secondary wastewater treatment plant. A problem from low DO results when the rate of oxygen-demanding material exceeds the rate of replenishment. Oxygen demand is estimated by direct measure of DO and indirect measures such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), oils and greases, and total organic carbon (TOC).

Bacteria - Bacteria levels in undiluted urban runoff exceed public health standards for water contact recreation almost without exception. Studies have found that total coliform counts exceeded EPA water quality criteria at almost every site and almost every time it rained. The coliform bacteria that are detected may not be a health risk in themselves, but are often associated with human pathogens.

Oil and Grease - Oil and grease contain a wide variety of hydrocarbons some of which could be toxic to aquatic life in low concentrations. These materials initially float on water and create the familiar rainbow-colored film. Hydrocarbons have a strong affinity for sediment and quickly become absorbed to it. The major source of hydrocarbons in urban runoff is through leakage of crankcase oil and other lubricating agents from automobiles. Hydrocarbon levels are highest in the runoff from parking lots, roads, and service stations. Residential land uses generate less hydrocarbons export, although illegal disposal of waste oil into storm waters can be a local problem.

Other Toxic Chemicals - Priority pollutants are generally related to hazardous wastes or toxic chemicals and can be sometimes detected in storm water. Priority pollutant scans have been conducted in previous studies of urban runoff, which evaluated the presence of over 120 toxic chemicals and compounds. The scans rarely revealed toxins that exceeded the current safety criteria. The urban runoff scans were primarily conducted in suburban areas not expected to have many sources of toxic pollutants (with the possible exception of illegally disposed or applied household hazardous wastes). Measures of priority pollutants in storm water include - 1) phthalate (plasticizer compound), 2) phenols and creosols (wood preservatives), 3) pesticides and herbicides, 4) oils and greases, 5) metals.

2.5.2 Physical Characteristics of Surface Water Quality

Standard parameters, which can assess the quality of storm water, provide a method of measuring impairment. A background of these typical characteristics assists in understanding water quality requirements. The quantity of a material in the environment and its characteristics determine the degree of availability as a pollutant in surface runoff. In an urban environment, the quantity of certain pollutants in the environment is a function of the intensity of the land use. For instance, a high density of automobile traffic makes a number of potential pollutants (such as lead and hydrocarbons) more available. The availability of a material, such as a fertilizer, is a function of the quantity and the manner in which it is applied. Applying fertilizer in quantities that exceed plant needs leaves the excess nutrients available for loss to surface or ground water.

The physical properties and chemical constituents of water traditionally have served as the primary means for monitoring and evaluating water quality. Evaluating the condition of water through a water quality standard refers to its physical, chemical, or biological characteristics. Water quality parameters for storm water comprise a long list and are classified in many ways. In many cases, the concentration of an urban pollutant, rather that the annual load of that pollutant, is needed to assess a water quality problem. Some of the physical, chemical or biological characteristics that evaluate the quality of the surface runoff are:

Dissolved Oxygen - Dissolved oxygen in the water has a pronounced effect on the aquatic organisms and the chemical reactions that occur. It is one of the most important biological water quality characteristics in the aquatic environment. The dissolved oxygen concentration of a water body is determined by the solubility of oxygen, which is inversely related to water temperature, pressure, and biological activity. Dissolved oxygen is a transient property that can fluctuate rapidly in time and space. Dissolved oxygen represents the status of the water system at a particular point and time of sampling. The decomposition of organic debris in water is a slow process and the resulting changes in oxygen status respond slow also. The oxygen demand is an indication of the pollutant load and includes measurements of biochemical oxygen demand or chemical oxygen demand.

Biochemical Oxygen Demand (BOD) - The biochemical oxygen demand (BOD) is an index of the oxygen-demanding properties of the biodegradable material in the water. Samples are taken from the field and incubated in the laboratory at 20°C, after which the residual dissolved oxygen is measured. The BOD value commonly referenced is the standard 5-day values. These values are useful in assessing stream pollution loads and for comparison purposes.

Chemical Oxygen Demand - The chemical oxygen demand (COD) is a measure of the pollutant loading in terms of complete chemical oxidation using strong oxidizing agents. It can be determined quickly because it does not rely on bacteriological actions as with BOD. COD does not necessarily provide a good index of oxygen demanding properties in natural waters.

Total Dissolved Solids (TDS) - TDS concentration is determined by evaporation of a filtered sample to obtain residue whose weight is divided by the sample volume. The TDS of natural waters varies widely. There are several reasons why TDS is an important indicator of water quality. Dissolved solids affect the ionic bonding strength related to other pollutants such as metals in the water. TDS are also a major determinant of aquatic habitat. TDS affects saturation concentration of dissolved oxygen and influences the ability of a water body to assimilate wastes. Eutrophication rates depend on total dissolved solids.

pH - The pH of water is the negative log, base 10, of the hydrogen ion (H^+) activity. A pH of 7 is neutral; a pH greater than 7 indicates alkaline water; a pH less than 7 represents acidic water. In natural water, carbon dioxide reactions are some of the most important in establishing pH. The pH at any one time is an indication of the balance of chemical equilibrium in water and affects the availability of certain chemicals or nutrients in water for uptake by plants. The pH of water directly affects fish and other aquatic life and generally toxic limits are pH values less than 4.8 and greater than 9.2.

Alkalinity - Alkalinity is the opposite of acidity, representing the capacity of water to neutralize acid. Alkalinity is also linked to pH and is caused by the presence of carbonate, bicarbonate, and hydroxide, which are formed when carbon dioxide is dissolved. A high alkalinity is associated with a high pH and excessive solids. Most streams have alkalinities less than 200 mg/l and ranges of alkalinity of 100-200mg/l seem to support well-diversified aquatic life.

Specific Conductance - The specific conductivity of water, or its ability to conduct an electric current, is related to the total dissolved ionic solids. Long term monitoring a project waters can develop a relationship between specific conductivity and TDS. Its measurement is quick and inexpensive and can be used to approximate TDS. Specific conductivities in excess of 2000 µohms/cm indicate a TDS level too high for most freshwater fish.

Turbidity - The clarity of water is an important indicator of water quality that relates to the alkalinity of photosynthetic light to penetrate. Turbidity is an indicator of the property of water that causes light to become scattered or absorbed. Turbidity is caused by suspended clays and other organic particles. It can be used as an indicator of certain water quality constituents such as predicting the sediment concentrations.

Nitrogen (N) - Sources of nitrogen in storm water are from the additions of organic matter to water bodies or chemical additions. Ammonia and nitrate are important nutrients for the growth of algae and other plants. Excessive nitrogen can lead to eutrophication since nitrification consumes dissolved oxygen in the water. Nitrogen occurs in many forms. Organic Nitrogen breaks down into ammonia, which eventually becomes oxidized to nitrate-nitrogen, a form available for plants. High concentrations of nitrate-nitrogen (N/N) in water can stimulate growth of algae and other aquatic plants, but if phosphorus (P) is present, only about 0.30 mg/l of nitrate-nitrogen is needed for algal blooms. Some fish life can be affected when nitrate-nitrogen exceeds 4.2 mg/l. There are a number of ways to measure the various forms of aquatic nitrogen. Typical measurements of nitrogen include Kjeldahl nitrogen (organic nitrogen plus ammonia); ammonia; nitrite plus nitrate; nitrite; and nitrogen in plants. The principal water quality criteria for nitrogen focus on nitrate and ammonia.

Phosphorus (P) - Phosphorus is an important component of organic matter. In many water bodies, phosphorus is the limiting nutrient that prevents additional biological activity from occurring. The origin of this constituent in urban storm water discharge is generally from fertilizers and other industrial products. Orthophosphate is soluble and is considered to be the only biologically available form of phosphorus. Since phosphorus strongly associates with solid particles and is a significant part of organic material, sediments influence concentration in water and are an important component of the phosphorus cycle in streams. Important methods of measurement include detecting orthophosphate and total phosphorus.

2.5.3 Existing Storm Water Quality

Water quality monitoring has been conducted on Big Bear Lake. The monitoring has resulted in Big Bear Lake being listed on the Santa Ana Regional Water Quality Board Section 303(d) list for impaired water bodies. Table 4 contains the 303(d) list of the pollutants found in the lake and the source of the pollutant.

Table No. 4 – Big Bear Lake Pollutant List[1]

Pollutant Stressors	Source	Priority
Copper	Resource Extraction	High
Mercury	Resource Extraction	High

---

[1] Draft 2002 Clean Water Act Section 303(D) List and TMDL Priority Schedule

Table No. 4 – Big Bear Lake Pollutant List[1]

Pollutant Stressors	Source	Priority
Metals	Resource Extraction	High
Noxious Aquatic Plants	Unknown Non-Point Source	High
Nutrients	Construction and Snow Skiing Activities	High
Sedimentation and Siltation	Construction, Snow Skiing Activities and Unknown Non-Point Source	High

The proposed project site lacks data on storm water runoff quality. In the absence of site-specific data, expected storm water quality can be qualitatively discussed by relating typical pollutants to specific land uses.

Currently, the site contains a few homes, but is primarily open space with trees and shrubs. The watershed is primarily open land with 83.7% of the watershed 100% pervious (natural area), 4.7% is 80% pervious (1 dwelling unit per acre), 9.2% is 70% pervious (2.5 dwelling units per acre) and 2.4% is 60% pervious (4 dwelling units per acre). The expected existing pollutants in the existing condition storm water runoff from the residential area is trash, nutrients, bacteria, oil and grease, and household hazardous wastes from the residential development. There is also oil and grease associated with automobile use on site and on Highway 38. The natural areas that make up most of the site will contribute suspended solids.

Currently, the site does not contain any structural Best Management Practices (BMP), which would potentially decrease the amount of pollutants in storm water runoff. It is likely that portions of potential pollutants are removed through the use of natural conveyance. Conveying flows overland through vegetation affords some infiltration and biofiltration of runoff and thus, potential pollutant removal. However, the residential areas are on the lakeshore end of the site, providing little natural conveyance. A draw back to conveying flows overland is that it tends to create erosion problems and thus increase suspended solids in the runoff. Problems associated with suspended solids and erosion is evident on site (See Figure 5).

Figure 5 – Cross Culvert with Sediment and Silt Fence for Erosion Control

2.6 Groundwater

3.0 PROPOSED PROJECT

This section discusses the proposed project evaluation, which is then compared to the existing conditions analysis to determine impacts associated with the development of the property. Proposed conditions investigated include: land use, proposed storm drain configuration, hydrology, floodplain mapping, and surface water quality. Hicks and Hartwick, Inc conducted a preliminary drainage study on the proposed development.

3.1 Proposed Land Use Plan

The proposed project involves the development of residential subdivision on 62.4 acres along the north shore of Big Bear Lake. The project proposes a 95-lot residential subdivision. Each lot will be sold and developed on an individual basis. The proposed site will contain a Tentative Tract Map for 92 numbered and three lettered lots. The three lettered lots are identified as follows: (1) Lot "A" is a private street designed to provide access to the southernmost lots; (2) Lot "B" is a 1.4-acre strip of land that will remain between the relocation of State Highway 38 and the private Street, Lot "A"; and (3) Lot "C" is a gated entrance to the project, including a proposed boat dock, consisting of 100 boat slips, which would be available for use by residents of the tract and accessible by Lot "C". See Figure 6 for proposed site plan for Tentative Tract #16136.

In addition to the new development, the project will include the relocation of North Shore Drive to allow development of lake front lots. A segment of approximately 2,498 feet of road will need to be relocated. The maximum distance of relocation, as designed, is 207 feet to the north. The design includes a 76-foot road width, with 14-foot shoulder/bikeway access, resulting in a 104 feet of right-of-way. Project access includes a loop road for the northerly project area, allowing 64 lots to access North Shore Drive. Thirty-one lots, south of North Shore Drive, would be accessed via another loop road, which includes five separate cul-de-sac drives to access lakefront lots.

3.2 Hydrology

Project hydrology was completed by Hicks & Hartwick, to determine the impacts that the new development will have on runoff. 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 Advanced Engineering Software (AES), in accordance with San Bernardino County Hydrology Manual. The watershed subarea boundaries were delineated according to physical constraints from the topography, existing drainage facities and proposed developments. The Proposed Conditions Hydrology Map can be found in Figure 7. Hydrologic parameters used in the analysis, such as rainfall and soil classification, are as presented in the *San Bernardino County Hydrology Manual*.

CONTOUR INTERVAL = 1'
DATE OF PHOTOGRAPHY 10-25-00

H:\PDATA\10101901\HYDROLOGY\CADD\9373TT15.DWG 06/10/02 10:24 am

SOURCE: HICKS & HARTWICK, INC. PRELIMINARY DRAINAGE STUDY

RBF
CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION

14725 ALTON PARKWAY
IRVINE, CALIFORNIA 92618-2027
949.472.3505 • FAX 949.472.8373 • www.RBF.com

JOB No.
10–101901

SCALE
1" = 400'

MOON CAMP
LAND USE MAP
PROPOSED CONDITION

FIGURE
6

3.2.1 Proposed Watershed Description

The drainage pattern for the areas follow the natural topography, south to north with the flow draining into Big Bear Lake. The proposed project has some redirection of flow and the elimination of sheet flow across Highway 38. All cross-culverts are to be designed to handle the 100-year storm event.

Due to onsite drainage patterns, the proposed project site was split into ten areas (A through J). Area "A" is on the eastern portion and area "J" is on the western end of the watershed. In the proposed condition the watershed delineation slightly changes from the existing condition, due to grading and adding of impervious areas.

Table No. 5 – Proposed Condition Drainage Area Breakdown

Drainage Area	**Area (acres)**	**Number of Subareas**
A	96.9	9
B	6.6	1
C	2.3	1
D	9.6	3
E	0.2	1
F	1.0	1
G	39.7	3
H	0.3	1
I	0.2	1
J	14.2	4

The subareas for the eight drainage areas are illustrated in Figure 7.

Table No. 6 – Proposed Subwatershed Characteristics

Nodes	**Area (acres)**	**Length (feet)**	**Soil Type / Development Type**
Watershed A			
A1 – A2	3	779	D / Natural
A2 – A3	12.5	730	D / Natural
A3 – A7	29.7	869	D / Natural
A4 – A5	4.7	890	D / Natural
A5 – A6	17.3	719	D / Natural
A6 – A7	26.1	719	D / Natural
A7 – A8	79.0	1261	C / Natural
A8 – A9	91.0	462	C / 2.5 AC
A9 – A10	96.9	671	C / 1D AC
Watershed B			
B1 – B2	6.6	603	C / 1D AC
Watershed C			
C1 – C2	2.3	407	C / 2D AC
Watershed D			
D1 – D2	2.4	579	C / 2.5 AC
D2 – D3	7.6	620	C / 1D AC
D3 – D4	9.6	322	C / 1D AC

Table No. 6 – Proposed Subwatershed Characteristics

Nodes	Area (acres)	Length (feet)	Soil Type / Development Type
Watershed E			
E1 – E2	0.2	280	C / Commercial
Watershed F			
F1 – F2	1.0	831	C / Commercial
Watershed G			
G1 – G2	4.1	848	C / Natural
G2 – G3	33.8	1298	C / Natural
G3 – G4	39.7	537	C / 1D AC
Watershed H			
H1 – H2	0.3	511	C / Commercial
Watershed I			
I1 – I2	0.2	248	C / Commercial
Watershed J			
J1 – J2	4.3	1050	C / 4D AC
J2 – J3	1.2	400	C / 1D AC
J3 – J4	7.2	212	C / 1D AC
J4 – J5	14.2	210	C / 1D AC

In the proposed condition drainage area "A" would be composed of 9 subareas. Approximately 80 acres of drainage area "A" would consist of natural area. Of that about 56 acres are on a soil type of D and the remaining is on a soil type of C. In the proposed condition approximately 18 acres would contain development proposed on the lakeshore side of the watershed. Approximately 12 acres will consist of 2.5-acre lots and the remaining 6 acres will contain one dwelling per acre.

Area "B" would consist of 1 subarea. This area would contain one dwelling unit per acre in the proposed condition.

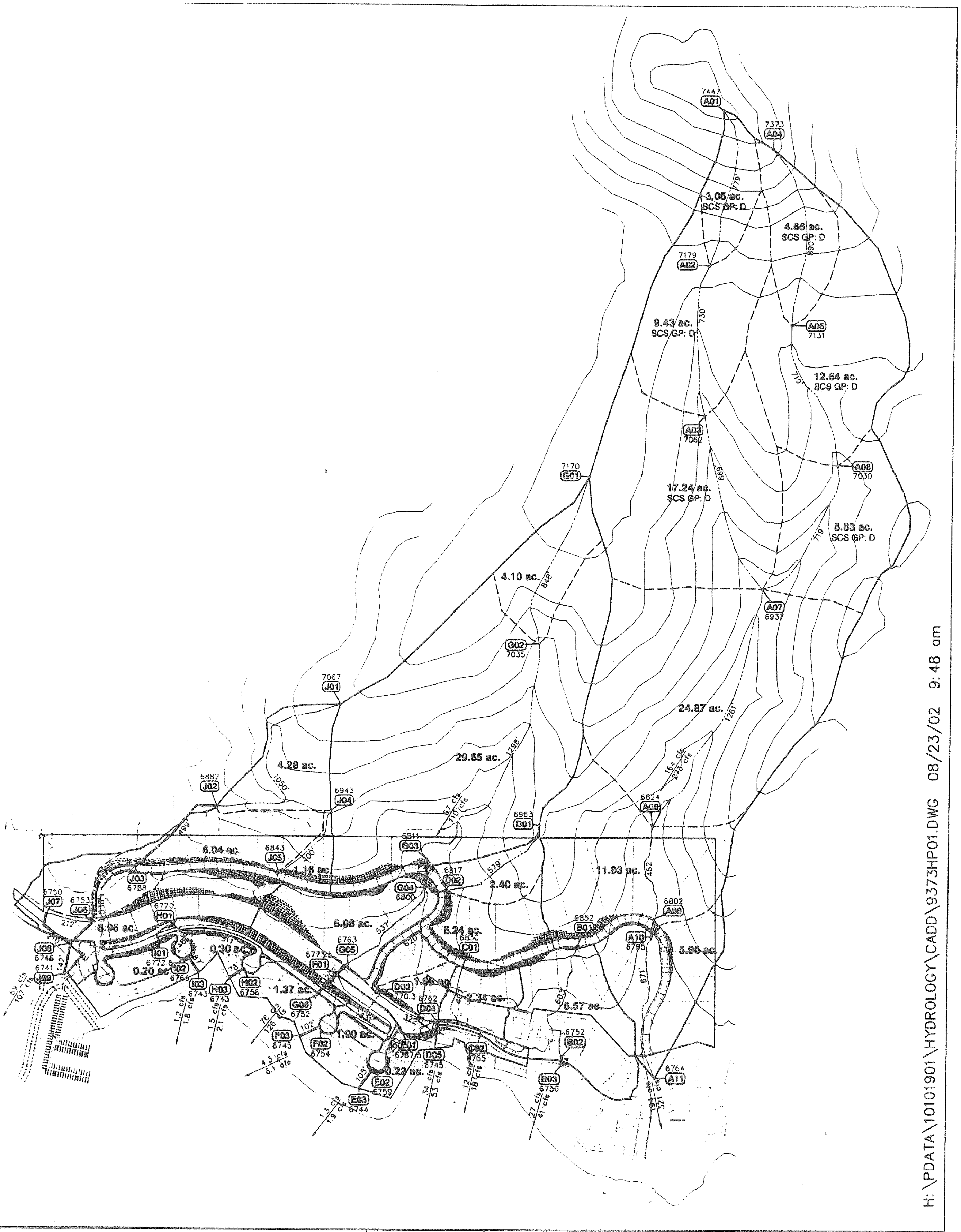
Area "C" would also contain 1 subarea. Within this drainage area the land would be composed of 2 dwellings units per acre.

Area "D" would be composed of 3 subareas. The upper subarea would contain 2.5 dwelling units per acre. The remaining subareas would contain one dwelling unit per acre.

Areas "E", "F", "H" and "I" would be composed of 1 subarea. These drainage areas would contain commercial dwellings.

Area "G" would be composed of 3 subareas. Approximately 34 acres would be natural land with no proposed development. On the remaining 6 acres, the land would consist of approximately one dwelling unit per acre.

Area "J" would be composed of 4 subareas. The upper 4.3 acres would contain 4 dwelling units per acre. The remaining 14.2 acres would contain approximately one dwelling unit per acre.



H:\PDATA\10101901\HYDROLOGY\CADD\9373HP01.DWG 08/23/02 9:48 am

SOURCE: HICKS & HARTWICK, INC. PRELIMINARY DRAINAGE STUDY

RBF
CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION

14725 ALTON PARKWAY
IRVINE, CALIFORNIA 92618-2027
949.472.3505 • FAX 949.472.8373 • www.RBF.com

JOB No.
10-101901

SCALE
1" = 600'

MOON CAMP
PROPOSED CONDITION
HYDROLOGY MAP

FIGURE
7

Approximately 35% of the overall watershed that contains Moon Camp will be developed. The 95-lots will contain custom homes along the north shore of Big Bear Lake. Table 7 shows the percent impervious values for the types of land uses on the project site. The values presented are from the *San Bernardino County Hydrology Manual*.

Table No. 7 – Percent Impervious Based on Land Use

Land Use	Percent Pervious
One Dwelling per Acre	80%
Two Dwellings per Acre	60%
Four Dwellings per Acre	50%
2.5 Acre Lots	90%
Commercial	10%
Natural Area – Soil Type C	100%
Natural Area – Soil Type D	100%

3.2.2 Rational Method

The hydrologic calculations to determine the 10-year and 100-year peak flow rates were performed by Hicks & Hartwick Inc using the *San Bernardino County Hydrology Manual* dated May 1983. The Rational Method is an empirical computation procedures for developing 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 Method:

1. The Rational Method hydrology includes the effects of infiltration caused by soil surface characteristics. The soils map from the *San Bernardino County Hydrology 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 proposed condition ranged from 0% for natural open areas, 10% to 50% for single family housing and 90% for commercial use.

3. The time of concentration (T_c) is determined from 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.*

3.2.3 Proposed Condition Surface Water Hydrology

Appendix B displays the results from the Hicks & Hartwick analysis for the 10-year and the 100-year storm events for the proposed condition. Results of the proposed condition hydrologic analysis are summarized in the following table.

Table No. 8 – Proposed Condition Peak Flow Rate

Subarea	**Area (acres)**	**Total Area (acres)**	**Tc (min)**	**Total 10-Yr. Peak Q (cfs)**	**Total 100-Yr. Peak Q (cfs)**
Watershed A					
A1 – A2	3.0	3	16.6	7.8	12.2
A2 – A3	9.4	12.5	17.8	30.3	48.4
A3 – A7	17.2	29.7	18.8	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	20.1	57.4	91.6
A7 – A8	24.9	79.0	1.4	170.1	277.3
A8 – A9	11.9	91.0	0.7	189.9	311.6
A9 – A10	6.0	96.9	1.0	194.3	321.0
Watershed B					
B1 – B2	6.6	6.6	8.7	27.5	41.5
Watershed C					
C1 – C2	2.3	2.3	6.8	11.9	17.7
Watershed D					
D1 – D2	2.4	2.4	8.2	10.4	15.8
D2 – D3	5.2	7.6	9.8	29.1	45.1
D3 – D4	2.0	9.6	10.7	34.1	53.5
Watershed E					
E1 – E2	0.2	0.2	5.8	1.3	1.9
Watershed F					
F1 – F2	1.0	1.0	9.5	4.3	6.1
Watershed G					
G1 – G2	4.1	4.1	20.0	8.6	14.1
G2 – G3	29.6	33.8	21.4	66.7	110.2
G3 – G4	6.0	39.7	22.3	76.1	126.0
Watershed H					
H1 – H2	0.3	0.3	7.6	1.5	2.1
Watershed I					
I1 – I2	0.2	0.2	5.7	1.2	1.8
Watershed J					
J1 – J2	4.3	4.3	9.4	17.3	25.7
J2 – J3	1.2	1.2	6.8	5.9	8.7
J3 – J4	6.0	7.2	9.6	28.0	43.6
J4 – J5	7.0	14.2	10.3	51.9	81.3

The proposed condition has more impervious areas than the existing condition. The change in impervious area would have the potential to cause significant downstream impacts. In the proposal for Tract # 16136 Hicks & Hartwick have proposed to upsized the cross culverts to contain the 100-year storm water flow along Highway 38 and eliminate sheet flow across the highway. They have also proposed to add catch basins and cross culverts along the residential roads. All flow would be directed into the Big Bear Lake, similar to current condition. From the existing condition, the overall watershed flow rate in the proposed condition increases 8.7 cfs in the 10-year storm event and an 9.5 cfs in the 100-year storm event. This was determined by subtracting the total runoff in the proposed condition from the existing condition.

3.3 Floodplain Mapping

Since the project is not in a floodplain, the proposed development will not impact any existing floodplains.

3.4 Jurisdictional Waters

Based on a field survey conducted on March 15, 2002 by RBF Consulting, it was determined that of 0.15 acres of jurisdictional waters, 0.04 acres will be impacted.

3.5 Storm Water Quality

At the time of the analysis there was no storm water quality plan for Moon Camp Tentative Track # 16136. A Water Quality Management Plan will need to be developed for the Moon Camp property under the guidelines in the *Water Quality Management Plan (WQMP) For Urban Runoff* prepared by San Bernardino County. The WQMP conforms to the new National Pollutant Discharge Elimination System (NPDES) permit requirement for San Bernardino County effective as of June 2004.

3.5.1 Construction

Construction of a project such as Moon Camp development typically produces potential pollutants such as nutrients, heavy metals, pesticides and herbicides, toxic chemicals related to construction and cleaning, waste materials including wash water, paints, wood, paper, concrete, food containers, and sanitary wastes, fuel, and lubricants.

3.6 Groundwater

3.7 Cumulative Projects

The basis for the cumulative analysis as presented in the Moon Camp TT # 16136 Environmental Impact Report. For the purposes of drainage and water quality analysis, commutative impacts are considered for projects in the same watershed as Moon Camp. Tract 12217 (Marina Point), Tract 15465 (Kelsch) and Relocation of the Moonridge Zoo adjacent to the Discovery Center are all in the same watershed or adjacent watersheds as Moon Camp. All 3 of these cumulative projects drain into Big Bear Lake and will have to comply with the same TMDL standards and the Water Quality Management Plan for Urban Runoff as outlined in the Santa Ana Regions NPDES Permit and Water Discharge Requirements. Therefore, the cumulative impacts and mitigation for the project would be limited to those associated with Moon Camp project.

4.0 PROPOSED MITIGATION

Mitigation is required to reduce impacts due to the development of Moon Camp Tentative Tract 16136. The following section discussed both storm water conveyance and storm water quality mitigation measures that will need to be addressed to bring the proposed impacts to a less than significant level.

4.1 Hydrologic Impacts

The Moon Camp Development will result in an increase in impervious areas on site. There is a net increase of 8.7 cfs in the 10-year storm event and 9.5 cfs in the 100-year storm will flow into Big Bear Lake. The developer plans on placing cross culverts and catch basins along the road to catch the storm water, to prevent flooding and erosion onsite. In addition, the cross culverts under Highway 38 will be sized to contain the 100-year storm event. All runoff flows would be outleted into Big Bear Lake.

4.1.1 Hydrologic Mitigation

Provided that the proposed cross culverts are sized for 100-year burn and bulking flow rates. The burn and bulking method will increase the runoff from the natural areas. San Bernardino County Hydrology Manual does not contain a burning and bulking method, therefore the method found in the Los Angeles County Hydrology Manual is recommended. In addition, the cross culverts should all be designed with headwalls to prevent CMP crushing, and maintained adequately. No additional hydrologic mitigation is required.

4.2 Floodplain Impacts

The proposed development does not impact any mapped flood plains. Moon Camp is defined by the Federal Emergency Management Agency as an area outside of the 100-year and 500-year flood zones. No mitigation is proposed.

4.3 Jurisdictional Water Impacts

The project will impact the riparian habitat associated with the development of Tract #16136. This impact will require mitigation in the form of resource agency permitting.

4.3.1 Resource Agency Permitting

The project would likely have to obtain the following permits for the expansion project:

1. U.S. Army Corps of Engineers 404 Permit
2. Santa Ana Regional Water Quantity Control Board – Clean Water Act Section 401 Permit.
3. California State Water Resource Control Board – General Storm Water Permit for Construction and Storm Water Pollution Prevention Plan (SWPPP)
4. California Department of Fish and Game Section 1603 Streambed Alteration Agreement

4.4 Water Quality Impacts

The development of Tract # 16136 will increase the impervious area, which will impact storm water quality. The project will increase pollutant loading in Big Bear Lake, which is immediately offsite. The lake is impaired due to the following pollutants: copper, mercury, metals, noxious aquatic plants, nutrients, and sediment and siltation. The 303(d) list currently indicates that all of the listed pollutants are a "high" priority. A "high" priority indicates that the receiving water body will be subject to Total Maximum Loads (TMDL) by the year 2005. Based on the current Draft 303(d) list it appears that the Santa Ana Regional Water Quality Control Board is currently developing TMDLs for Big Bear Lake. Therefore, the proposed mitigation should focus on meeting potential TMDLs for Big Bear Lake. Mitigation is required for water quality impacts. Mitigation must include the development of a Water Quality Management Plan (WQMP) containing both structural and non-structural Best Management Practices (BMPs). The WQMP will be based on the San Bernardino County WQMP guidelines and NPDES permits that will be in effect as of January 2004(As discussed in Section 1.2).

4.4.1 Non-Structural and Source Control BMPs Mitigation

The Water Quality Management Plan must be developed, which includes both Non-Structural and Source Control BMPs. The development of the WQMP must conform to the San Bernardino County Draft NPDES permit and the WQMP standards.

The following are the minimum required mitigation from the *Water Quality Management Plan (WQMP) for Urban Runoff.*

Education for Property Owners, Tenants and Occupations – The Property Owners Association is required to provide awareness educational material, including information provided by San Bernardino County. The materials will include a description of chemicals that should be limited to the property and proper disposal, including prohibition of hosing waste directly to gutters, catch basins, storm drains or the lake.

Activity Restrictions – The developer will prepare conditions, covenants and restriction of the protection of surface water quality.

Common Area Landscape Management – For the common landscape areas ongoing maintenance consistent with County Administrative Design Guidelines or city equivalent, plus fertilizer and pesticide usage consistent with the instructions contained on product labels and with regulation administered by the State Department of Pesticide Regulation or county equivalent.

Common Area Catch Basin Inspection – Property Owners Associations are required to have privately owned catch basins cleaned and maintained, as needed. To prevent sediment, garden waste, trash and other pollutants from entering the public streets and storm drain systems.

Common Area Litter Control – POAs are required to implement trash management and litter control procedures to minimize pollution to drainage waters.

Street Sweeping Private Streets and Parking Lots – Streets and Parking lots need to be sweeped as needed, to prevent sediment, garden waste, trash and other pollutants from entering the public streets and storm drain systems.

The following are proposed mitigations from the *California Storm Water Best Management Practice Handbook - Municipal*:

SC10 Housekeeping Practices - This entails practices such as cleaning up spills, proper disposal of certain substances and wise application of chemicals.

SC32 Used Oil Recycling - May apply to maintenance and security vehicles.

SC72 Vegetation Controls – Vegetation control typically includes chemical (herbicide) application and mechanical methods. Chemical methods are discussed in SC10. Mechanical methods include leaving existing vegetation, cutting less frequently, hand cutting, planting low maintenance vegetation, collecting and properly disposing of clippings and cuttings, and educating employees and the public.

SC73 Storm Drain Flushing - Although general storm drain gradients are sufficiently steep for self-cleansing, visual inspection may reveal a buildup of sediment and other pollutants at the inlets or outlets, in which case flushing may be advisable.

4.4.2 Structural/Treatment BMPs Mitigation

The Water Quality Management Plan (WQMP) includes Structural or Treatment BMPs. The structural BMPs utilized should focus on meeting potential TMDL requirements for noxious aquatic plants, nutrients, sedimentation and siltation. The structural BMPs should conform to the San Bernardino County NPDES permit and the San Bernardino WQMP standards.

The WQMP guidelines contained in the *Draft National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements* for San Bernardino County states that Structural BMPs will be required for all new developments. They will be sized to comply with one of the following numeric sizing criteria or be considered by the permittees to provide equivalent or better treatment.

Volume Based BMPs shall be designed to infiltrate or treat either:

1. The volume of runoff produced from the 85th percentile 24-hour storm event, as determined from the local historical rainfall record; or
2. The volume of the annual runoff produced by the 85th percentile 24-hours rainfall event, determined as the maximized capture storm water volume for the area, from the formula recommended in Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual of Practice No. 87 (1998); or
3. The volume of annual runoff based on unit basin storage volume, to achieve 80% or more volume treatment by the method recommended in California Stormwater Best Management Practice Handbook – Industrial/Commercial (1993); or
4. The volume of runoff, as determined from the local historical rainfall record, that achieves approximately the same reduction in pollutant loads and flows as achieved by mitigation of the 85th percentile 24-hour runoff event.

OR