GEOLOGIC AND HYDROLOGIC EVALUATION
PROPOSED LIBERTY QUARRY
RIVERSIDE COUNTY, CALIFORNIA

Prepared for:

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Prepared by:

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Kleinfelder Project No. 68188

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KLEINFELDER
An employee owned company

August 10, 2007
Project No. 68188

Mr. Gary W. Johnson
Granite Construction Company
38000 Monroe Street
Indio, California 92203

Subject: **Geologic and Hydrologic Evaluation**
Proposed Liberty Quarry
Riverside County, California

Dear Mr. Johnson:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this report summarizing our geologic and hydrologic evaluation for the Liberty Quarry project in Riverside County, California. The results of our study are presented in the attached report.

We appreciate the opportunity to be of service on this project. If you have any questions or require additional information, please do not hesitate to contact our office at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

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1.0 INTRODUCTION

Kleinfelder West, Inc. (Kleinfelder) was retained by Granite Construction Company (Granite) to conduct a geologic and hydrologic evaluation in support of a Draft Environmental Impact Report (EIR) for the proposed Liberty Quarry project in Riverside County, California. Kleinfelder's services were performed consistent with our proposal entitled Revised Proposal to Perform Hydrologic, Water Quality, and Drainage Study for use in Draft EIR, Proposed Liberty Quarry, Riverside County, California, dated December 21, 2005, Revised February 15, 2006. The following sections of this report present the results of the referenced study.

1.1 PROJECT DESCRIPTION

The project site is located in southwestern Riverside County, California approximately three miles southwest of the city of Temecula (Figure 1.1). The project property consists of approximately 414 acres of essentially undeveloped land located north of Rainbow Valley Road, west of Interstate 15 (I-15) (Figure 1.2). Granite is proposing to develop a quarry within the project property for mining aggregate materials; which will consist of a quarry excavation oriented north – south and result in the development of an area of approximately 155 acres. The maximum dimensions of the proposed quarry are approximately 2,100 feet wide by 5,500 feet long, as measured at the top of the proposed quarry walls. Maximum cuts are on the order of 1,000 feet, with a final quarry floor at an elevation of approximately 1010 feet above mean sea level (Lilburn, April 2007). The maximum height of proposed cut slopes is on the order of 1,000 feet at a design inclination of 0.58:1 (horizontal: vertical).

The purpose of this geologic and hydrologic evaluation is to investigate earth materials and conditions at and in the vicinity of the proposed Liberty Quarry to develop technical documentation for evaluation during the permitting process for the proposed quarry.

1.2 SCOPE OF WORK

The scope of work performed in support of the geologic and hydrologic evaluation included the following tasks:

Task 1 – Literature Review

A literature review was conducted for the project site to evaluate regional and site geology, geologic structure, and active faulting, as well as to assist in selecting potential boring locations and other field activities. In addition, hydrologic data including groundwater, surface water, groundwater basins and climate were evaluated. Sources included references from the California Geological Survey (CGS), United States Geological Survey (USGS), state and county governmental agencies, professional organizations, aerial photographs, published and unpublished geotechnical reports, and electronic data sources from the intranet. Additional literature review was performed to evaluate mine blasting designs and issues associated with rockfall, flyrock, and seismic stability. A list of references used for this evaluation is presented at the end of this document.

Task 2 – Aerial Photograph Review and Fracture Trace Analysis

A set of 2005 aerial photographs were obtained from the County of Riverside Flood Control District to conduct a fracture trace analysis of the bedrock within the adjacent areas and the proposed Liberty Quarry property. In addition to the aerial photograph review, regional geologic maps (USGS, 2000; Kennedy, 1977; Rogers, 1985) were reviewed to correlate fracture trace data with mapped geologic structure identified in the area.

The purpose of the fracture trace analysis was two fold: (1) To evaluate general structural jointing and fracture trends and select potential drill sites to conduct subsurface evaluations of site geology and hydrology; and (2) To assist in evaluating if fracturing and jointing trends observed in outcrop were present at depth within on-site borings.

Task 3 – Field Studies

Field studies conducted included geologic mapping, drilling three borings, and drawdown tests to evaluate groundwater encountered in the three borings.

- Geologic Mapping

Geologic mapping was performed, primarily on cut slopes along the existing access roads, to characterize geologic conditions and validate the results of the fracture trace analysis. The mapping effort concentrated on lithology, discontinuity orientations, vegetation, and erosion features.

- Drilling

  Three borings were drilled to further evaluate geologic conditions at depth and to investigate the presence/absence of groundwater in fractures and joint sets within the limits of the proposed quarry. The borings were drilled vertically to depths ranging from 570 to 930 feet below existing grades. Owing to the competent nature of the granitic materials penetrated and the variable depths that water was encountered in fractures during drilling, the completed borings were not converted to piezometers with well casing, filter pack, and sanitary seals. Instead, the borings were left in their original drilled condition and monitored for groundwater level changes during and after drilling. Locking monuments were emplaced to secure each boring and to allow additional, future testing and/or monitoring activities.

- Geophysical Survey

  The three borings were geophysically surveyed by a down-hole video camera and optical televiewer. Each borehole was initially logged with a video camera with downhole and side-scan capabilities. Following video logging, each boring was digitally scanned for geologic structural features with an optical televiewer at depth intervals selected during video logging.

- Pumping Tests and Groundwater Sampling

  Pumping tests were conducted in on-site borings in two separate events: (1) Limited drawdown testing immediately after drilling the borings to secure preliminary data on groundwater characteristics; and (2) A series of step-drawdown and constant discharge tests approximately one month after the initial tests to stress the groundwater system and evaluate groundwater characteristics; groundwater samples were recovered for laboratory analysis during the second pumping test event.

Task 4 – Preliminary Hydrologic Analysis

A hydrologic analysis was performed to evaluate peak surface water runoff under current and proposed development conditions at the project site. The analysis was performed consistent with the Riverside County Flood Control District; Hydrology Manual requirements. In addition, volumetric estimates of surface flow for sizing detention facilities were performed using the SCS Dimensionless Unit Hydrograph Method. The purpose of the analysis is to evaluate potential impacts of the proposed Liberty Quarry on surface water flow at and in the vicinity of the quarry property.

A hydrogeologic analysis was performed to evaluate the results of pumping tests and water quality analysis from the data generated from the three on-site borings installed for this evaluation. The purpose of the hydrogeologic analysis is to evaluate pre-development groundwater characteristics to assist in environmental evaluation efforts associated with the proposed Liberty Quarry.

Task 5 – Report Preparation

Preparation of this report based on the information obtained during this and previous field studies, and our experience with similar projects. This report presents a summary of the data, observations, and conclusions concerning geologic and hydrogeologic conditions at the proposed Liberty Quarry property and adjacent areas.

2.0 GEOLOGY

Section 2 presents a discussion of the site description and topography, regional geologic setting, regional geologic structure and seismicity, site geology, and geologic hazards for the proposed Liberty Quarry. The description of the geologic conditions are based on a review of the referenced reports, surface conditions observed during field mapping, aerial photography review, drilling, and the results of borehole geophysical surveys performed at the three borings advanced in support of this investigation.

2.1 SITE DESCRIPTION

The overall site consists of approximately 414 acres of essentially undeveloped hillside terrain located north of Rainbow Valley Road and west of Interstate 15 (I-15) in Riverside County, California (Figure 1.2). Access to the site is from an asphalt paved road near the California Highway Patrol truck scales. Access to the interior of the site is via limited dirt roads that transect the site.

In general, the ground surface on site is covered with rounded granite boulder outcrops with thick brush between the boulders. Topographically, the site consists of steep natural slopes with intervening ephemeral drainage courses. A prominent ridgeline oriented approximately north-south divides the property. The largest drainage is oriented north-south and is situated along the west side of the site. Smaller tributary drainages are oriented generally east-west with crests at the main ridgeline. Elevations within the proposed quarry site ranges from about 1,300 feet above mean sea level (MSL) in the southeast corner to about 2,100 feet above MSL near the northern boundary.

Natural slopes within the proposed quarry area are inclined at an overall 2.5:1 (horizontal:vertical) slope ratio, with local variations as steep as approximately 1.3:1. Locally, cut slopes adjacent to the access roads are near 1:1 slope ratios with some near vertical. Intermittent springs observed in May 2006 were present at various locations (Figure 2.1). However, these springs were not observed to be flowing during subsequent field activities in August 2006.

2.2 REGIONAL GEOLOGY

The project lies within the Peninsular Ranges geomorphic province of California. Northwest-trending faults and structural blocks, and intervening valleys characterize this physiographic region (CGS, 2002; Norris and Webb, 1990; Figure 2.2). This region extends approximately 900 miles from the Transverse Ranges north of Los Angeles, southward to the tip of Baja California. The total province varies in width from 30 to 100 miles including the off shore area to the Colorado Desert and Gulf of Mexico. The province contains extensive Cretaceous age igneous plutonic and Jurassic age volcanic and metamorphic rocks. The igneous plutonic rocks are part of the Southern California Batholith. Post-Cretaceous age rocks form a veneer of volcanic, marine and nonmarine sedimentary rocks with sections up to 40,000 feet thick (Norris and Webb, 1990). Typical Peninsular Ranges intrusive rock includes gabbro, quartz diorite or tonalite, and granodiorite. Within the limits of the proposed quarry, the predominate rock type is Rainbow Granodiorite (USGS, 2000) (Figure 2.3*)*. Granodiorite was encountered to the maximum depth drilled for this evaluation; refer to Appendix A for detailed boring logs.

The Peninsular Ranges Province is characterized by northwest-southeast trending faults of the greater San Andreas Fault Zone. These faults include the off shore faults, Rose Canyon fault, Newport Inglewood fault zone, Elsinore fault zone, San Jacinto fault zone, San Andreas fault and the Eastern California Shear Zone (Figure 2.4). The dominant fault structure near the project is the northwest-trending Elsinore Fault Zone located approximately 2 miles north–northeast of the proposed quarry (CGS, 1990) (Figure 2.5).

The Santa Ana Mountains are situated within the central portion of the Peninsular Ranges province. This mountain range is a complex region of Jurassic and Cretaceous age marine and nonmarine sedimentary rocks that were intruded and metamorphosed by granitic plutons of the Southern California Batholith. The eastern boundary of the Santa Ana Mountains is the Elsinore trough, which was formed due to faulting along the Elsinore Fault Zone (Figure 2.2).

The proposed Liberty Quarry is located within the southern Santa Ana Mountains, south of Temecula Valley, northwest of Rainbow Valley and Mount Olympus, and east of Gavilan Mountain. Regional geologic maps for the area indicate bedrock materials underlying the proposed Liberty Quarry are primarily Cretaceous age plutonic rocks of the Rainbow Granodiorite (USGS, 2000; Figure 2.3). Rocks west and northwest of the proposed quarry are mapped as undifferentiated mostly hornblende-biotite granodiorite; rocks northwest are mapped as Jurassic marine sedimentary rocks and Mesozoic basic intrusive rocks (USGS, 2000). The regional tectonic processes that formed these rock types and their distribution in Southern California are discussed in more detail in Appendix B.

2.3 SITE GEOLOGY

The proposed Liberty Quarry is situated in the southern portion of the Santa Ana Mountains approximately three miles south of the city of Temecula and approximately one-quarter mile west of the Interstate 15 freeway. The site occupies approximately 414 acres, primarily Section 36, as shown on the US Geological Survey (USGS) Temecula quadrangle topographic map (Figure 2.5).

The site is underlain by granodiorite of the Rainbow pluton (USGS, 2000) (Figure 2.3). This pluton is part of the regional plutonic complex of the Southern California Batholith. (Norris and Web, 1990). Widely scattered mafic intrusive dikes are present as narrow, dark out crops within the roads and rock-cut slopes across the site (Figure 2.1). Bedrock is generally exposed at the surface, except for a thin mantle of colluvial and alluvial soils across the site. Locally, there are thin layers of fill soils generated a part of grading access roads. These surficial colluvial, alluvial and fill units are generally thin and discontinuous, and are not presented as mapped units because of the thin nature of the deposits. A geologic map for the site is presented as Figure 2.1.

2.3.1 Descriptions of Geologic Units

Undocumented Fill (af), Colluvium (Qcol), and Alluvium (Qal)

Undocumented fill exists along isolated portions of the existing unpaved access roads that transect the site (Kleinfelder, 2005). The fill is primarily comprised of soil and rock derived from the surrounding terrain during construction of these dirt roads. The thickness of fill is unknown but, based on adjacent topography, is generally five feet or less in thickness. Small piles of debris (trash, wood, metal, and concrete) and soil are also located in the southern portion of the site adjacent to the main access road.

Colluvial soil deposits blanket most of the site on existing slopes, between boulder outcrops, and within secondary, ephemeral drainage channels. Thicknesses of colluvial deposits are less than four feet at boring locations, and anticipated to achieve thicknesses of ten feet within the larger drainage areas and toes of the natural slopes. The colluvial deposits primarily consist of loose mixtures of sand, silt, clay, and weathered rock.

Alluvium encountered at the proposed quarry property is limited to drainage channels within the study area. Alluvium primarily consists of sands, silts, and clays, with gravels and rock debris derived from surrounding hills. Alluvium thickness is unknown but, due to steep topography, abundant bedrock outcrops, and lack of perennial streams, the thickness is anticipated to be less than 10 feet in the main drainages and up to 5 feet in the tributary drainages (Figure 2.1).

Landslides (Qls)

No evidence of landslides was observed within the boundary of the proposed Liberty Quarry. The nearest mapped, bedrock landslide to the site is situated approximately 4,000 feet north (USGS, 2000; Hart, 1987) (Figure 2.3). This landslide is reported to be a bedrock failure associated with intersecting fault planes. The age of the landslide is uncertain but, based on geomorphic features, is considered to be as old as late Pleistocene (Hart, 1987).

The nearest seismic hazard zone to the site is approximately 2 miles north of the proposed Liberty Quarry boundary (CGS, 2007). This area is designated as a potential Earthquake-Induced Landslide Zone along the west side of the Temecula Valley. This landslide zone is primarily within an area with steep terrain underlain with metamorphic rock or weak sedimentary rock. These rock types are not present within or adjacent to the proposed Liberty Quarry.

As a part of the evaluation of landslides and existing slopes, an analysis of the potential for rockfall and flyrock due to the proposed blasting was also conducted. In summary, blasting conducted under the direction of competent, experienced blasting personnel following protocols like those presented in the proposed blasting plan for the quarry will optimize the use of explosives, restrict the limited potential for rockfall and flyrock to the interior of the quarry, (Appendix C).

Granodiorite (Kr)

Cretaceous-age granodiorite bedrock is exposed in outcrops throughout the project area and on cut-slopes bordering the I-15 freeway. The bedrock is part of the Southern California Batholith and is identified as part of the Granodiorite of Rainbow pluton (USGS, 2000) (Figure 2.3). Granodiorite was encountered in the three borings advanced to the maximum depth of 932 feet below the ground surface (or elevation of approximately 1000 feet above mean sea level) in MW-3 (Appendix A). Bedrock is tan where slightly weathered in the upper few tens of feet and along joints; light to medium gray, where unweathered, and is comprised primarily of medium- to locally coarse-grained quartz and feldspar with minor mafic minerals. Based on mineral composition, the rock is classified as a granodiorite (USGS, 2000). The rock is generally slightly to moderately weathered in outcrop and becomes less weathered with increasing depth.

Discontinuities are generally planar, smooth to slightly rough, and contain iron oxide staining along joint surfaces, as observed in downhole video and optical televiewer logs. Localized zones of subparallel joints were up to several feet wide, with joint spacing on the order of a few inches. Most joint sets were spaced on the order of feet to ten's of feet. Weathering along discontinuities was observed to the maximum depth explored in MW-3. The degree of weathering/iron oxide staining observed in the borehole video and optical televiewer logs adjacent to the joints generally decreased in width with increasing depth below ground surface (refer to Appendix A).

Rock in the far western portion of the site (Royal Oaks Ranch area) have been mapped as coarse grained, mostly biotite-hornblende-hypersthene gabbro (USGS, 2000) (Figure 2.3). Jurassic marine metasedimentary and metavolcanic rocks and low-grade greenschist rock are present north and northwest (USGS, 2000; Norris and Webb, 1990). These rock types were not observed at the proposed Liberty Quarry property.

Intrusive Dikes (d)

Intrusive mafic dikes are exposed in road cuts and limited outcrops in scattered areas across the project site. Dikes were also observed in borings as black, crosscutting features with high dip angles (60 to 70 degrees). Observed thicknesses of dikes in borings were generally less than 12 inches, but in road cuts been observed to be up to three-feet thick. The dikes typically consist of aphanitic (fine grained) massive mafic rock (Hyndman, 1972). Trends of some of these dike exposures are presented on Figure 2.1.

2.3.2 Geologic Structure

The regional geologic structural trend of the area including, elongation of the batholith, geologic contacts, recent faults, and the axes of the main mountain ranges is approximately N.35°W. (Larsen, 1948). The Elsinore Trough, dominated by faulting associated with the Elsinore fault, is roughly oriented N.51°W. (Larsen, 1948) (Figure 2.2). Structural and linear topographic features within the proposed Liberty Quarry site are generally controlled by jointing or faulting and emplacement of igneous dikes (Figure 2.6).

The granodiorite rock mass at the proposed quarry site is generally massive; devoid of significant bedding, foliation, or laminar features. Regionally, Rainbow Granodiorite is well jointed, which is expressed as large corestone boulder outcrops with continuous lineaments. The major lineaments within the boundary of the site were generally oriented in a N15E, N60W and N60E direction (Figure 2.6). Lesser lineaments included features that are associated with spalling of the boulder outcrops and dike emplacement in granodiorite bedrock. Jointing within granodiorite bedrock was observed in all the borings drilled for this investigation.

Based on the aerial photograph review, the largest linear through-going feature is interpreted to be a joint zone associated with pluton emplacement. The orientation and surface expression indicates it is high-angle feature, but does not off-set cross cutting lineaments. The second largest lineament is located in the northeast corner of the site, and is oriented approximately N60W. This feature does not appear to off-set or truncate crosscutting features (Figure 2.6). These features, along with shorter-length joint sets are interpreted to be associated with pluton emplacement. The orientation of most of the joint sets are not considered representative of parallel or subparallel stress that could be associate with the regional N35W Elsinore Fault trend that is located approximately two miles north of the site (Kleinfelder, 2007a) (Figure 2.4).

2.3.2.1 Aerial Photography and Fracture Trace Analysis

The granitic pluton that underlies the proposed Liberty Quarry site is cross cut with multiple prominent lineaments that vary in length from a few hundred feet to miles. These features are visible in aerial photographs as dark lines and represent fractures or weaknesses within the bedrock that have differentially eroded relative to hard, intact bedrock. These weaknesses are joints and/or faults associated with emplacement of the pluton and/or tectonic stresses related to the San Andreas Fault system.

A review of aerial photographs for the site indicates a pattern of steeply dipping, continuous northwest-southeast and northeast-southwest trending lineaments. A single, generally north-south lineament is present along the westerly boundary of the proposed quarry and crosses the southwest portion of the quarry boundary (Figure 2.6). Another prominent northeast-southwest lineament crosses the southern portion of the site roughly parallel to the highest ridge in the southern part of the project (Figure 2.6). These lineaments represent large-scale joint patterns in the rock mass and to lesser degree, intrusive mafic dikes.

2.3.2.2 Fracture Trace Analysis

The purpose of the fracture trace analysis was to evaluate bedrock for joints or weakness within the bedrock. These weaknesses within the bedrock can act as a conduit for groundwater migration or storage. Groundwater flow through fractured bedrock is controlled by several interrelated physical characteristics of the rock, including rock type and quality, and the density, roughness, shape, aperture, and connectivity of the fractures (Gates, 1997).

A fracture trace and lineament analysis of pronounced photo lineaments across the site was conducted to delineate steeply dipping joints, fractures, and/or faults (Kleinfelder, 2007a). A fracture trace is a natural linear feature visible on aerial photographs with a length generally less than one mile. A linear feature consists of straight streams, valleys and gaps in ridges, vegetation and soil tonal changes, and structural alignments that are generally greater than one mile in length (Gates, 1997). As part of this fracture trace analysis, a third category was utilized for linear features generally less than one-quarter mile long.

The results of the fracture trace and linear features analysis is presented on Figure 2.6. In addition to joint sets, intrusive mafic dike complexes are present within road cuts on the site. Some of the approximate dike locations are presented on Figure 2.1. These dike features were also observed in Optical Televiewer logs in borings drilled for this evaluation. Typical dikes observed within the boring were less that 18-inches wide and had high-angle dips (60 to 70 degrees).

2.3.2.3 Borehole Geophysical Surveys

Boreholes drilled for this investigation were advanced using an air-rotary percussion hammer drilling rig. Advancement of boreholes is accomplished by breaking the rock in contact at the bottom of the bit into gravel size or smaller fragments. To obtain detailed information of the rock that was drilled, two methods of downhole geophysical data acquisition were used; recording both a video log and a digital scan of bedrock.

Downhole geophysical surveys were conducted within the three borings drilled for this investigation. The equipment used to perform the downhole data acquisition consisted of a CCV Color Flip Camera (Video Camera Log) and a downhole Optical Televiewer.

The Video Camera log recorded a continuous downhole video recording using a view down hole with the option to switch to a side view camera located approximately 12 inches above the down view camera. The side scan camera could be rotated 360 degrees to review the borehole sidewalls.

The Optical Televiewer uses a digital optical scanner situated above a down hole light. The scanner recorded a continuous 360 degrees sidewall view as the Optical Televiewer descended the boreholes. Zones of fracture intervals observed during video logging were selected for Optical Televiewer surveys.

An Optical Televiewer log of a borehole is evaluated on observed discontinuities. Because the Optical Televiewer log is oriented on magnetic north, discontinuities can be evaluated for orientation and dip. In addition, the discontinuities were reviewed for general properties including spacing, roughness, aperture, and weathering. Dip data was collected and is presented as stereogram plots in addition to the Optical Televiewer Log. Copies of Video and Optical Televiewer Logs are provided in Appendix A.

Based on data developed from structural analysis of optical televiewer logs, rose diagrams were completed for each boring/monitoring well. Rose diagrams are graphical presentations that summarize the orientation of structural features; in this case fractures and joint sets. A composite rose diagram of data obtained from MW-1, MW-2, and MW-3 displays the prominent joint sets strike N4°E ± 20 degrees with two subsets striking N75°W ± 20 degrees and N45°W ± 20 degrees, respectively (Kleinfelder, 2007a) (Figure 2.6). These features are interpreted to be associated with pluton emplacement. The orientation of most of the joint sets are not considered representative of parallel or sub-parallel stress associated with the regional N35W Elsinore Fault; located approximately two miles north of the site.

2.3.2.4 Structural Isolation

Based on the data evaluated to date, the proposed Liberty Quarry site is believed to be structurally isolated from surrounding topographic lowlands. The results of a literature review and on-site geologic mapping indicate there are no known faults transecting the quarry property. The closest known fault is the Elsinore Fault Zone, approximately two miles north of the quarry property, which is considered a bounding structure for the eastern exposure of the Santa Ana Mountains.

The results of the fracture trace analysis are supportive of structural isolation for the quarry site. The primary orientation of the structural fabric of the Santa Ana Mountains, at and in the vicinity of the quarry site, was assessed to be N4°E ± 20 degrees from the fracture trace analysis, which is considered demonstrative of stresses associated with pluton emplacement. This orientation within the proposed quarry site does not evidence an influence of the nearby N35W Elsinore Fault, which is considered consistent with regional structural elements (Kleinfelder, 2007a). This suggests the portion of the Santa Ana Mountains where the quarry is proposed is structurally distinct from regional structural trends. This structural isolation has an apparent controlling influence on the presence and migration of water in fractures and joint sets.

2.4 GEOLOGIC HAZARDS EVALUATION

The proposed Liberty Quarry is situated in a highly seismic region of Southern California. Typical geologic hazards associated with earthquakes are surface rupture, ground shaking, ground deformation, landslides, liquefaction, tsunamis, and seiches. The primary geologic hazard of concern for the proposed Liberty Quarry is seismic shaking from earthquakes due to the site proximity to the Elsinore fault (Figure 2.5). A secondary concern is a potential for slope stability issues within the quarry, which is an issue associated with the magnitude of the seismic event and the state of excavation sequencing at the quarry when the event happens.

2.4.1 Seismicity

The Alquist-Priolo (A-P) Earthquake Fault Zoning Act was initiated in 1973 to delineate Earthquake Fault Zones considered active by the State of California (CGS, 2003). As part of the A-P Act, maps have been compiled to show zones that encompass traces of active and potentially active faults throughout the state. Properties that lie within A-P Zones are subject to certain restrictions for development and are required to perform detailed fault evaluations on the site prior to development.

The site is not located within an Alquist-Priolo Earthquake Fault Zone as designated by the State of California (CGS, 1990). The closest known fault is the Elsinore Fault Zone located approximately 2 miles north of the study area (CGS, 1990), which is considered an active fault by the State of California (Figure 2.5).

The proposed quarry is located in the highly seismic southern California region within the influence of several fault systems that are considered active or potentially active. An active fault is defined by the State of California Geological Survey (CGS) as a "sufficiently active and well defined fault" that has exhibited surface displacement within Holocene time (about the last 11,000 years). A potentially active fault is defined by the State as "a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago)." These active and potentially active faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated the proposed quarry will periodically experience ground acceleration as the result of small to large magnitude earthquakes. Other active faults without surface expression (blind faults) or other potentially active seismic sources that are also capable of generating an earthquake exist in the southern California region but are not currently zoned by the state of California.

A computer-aided search of known active and potentially active faults within a 62-mile (100-kilometer) radius of the site was performed, as was research of available literature to assess the maximum magnitude earthquakes expected to be generated on faults identified within the radius search (Figure 2.4). A summary of these parameters for nine of the thirty-one known active and potentially active faults within the searched radius of the site that, in our opinion, may have the greatest impact upon the site are presented on Table 2.4-1. Selection of the faults was based on their proximity to the site and their potential to generate moderate to severe ground motion at the site. Each of these significant faults is considered by the state to be capable of generating at least a 6.5 magnitude earthquake. Table 2.4-1 was generated using, in part, the EQFAULT computer program (Version 3.00) developed by Blake (rev. 2000) as modified using the fault parameters from CGS Open File Report 96-08 and the 1997 UBC fault maps (ICBO, 1998). This table does not identify the probability of reactivation, potential onsite effects from earthquakes occurring on these listed faults, or any of the other faults in the region.

A review of the proposed blasting for the quarry and the proximity to the Elsinore fault was conducted to evaluate the potential impacts on the fault. Based on that review, the evidence indicates blasting at the proposed Liberty Quarry will not cause an earthquake on the Elsinore fault (Appendix C).

2.4.2 Landslides and Existing Slopes

Evidence of deep-seated landslides in the area of the proposed quarry was not observed during site reconnaissance or aerial photograph review. A large, ancient landslide in granitic terrain is located approximately 4,000 feet north of the proposed quarry, adjacent to the west side of Interstate 15 (Hart, 1988) (Figure 2.3). This failure is reported to have been attributed to faulting (Hart, 1987). Shallow erosion and surficial instability are present locally on existing natural slopes blanketed with colluvium. Rock fall along existing cut slopes and natural slopes were also observed, and are to be expected within the steep, bouldery terrain.

The nearest seismic hazard zone to the site is approximately 2 miles north of the proposed Liberty Quarry boundary (CGS, 2007). This area is designated as a potential Earthquake-Induced Landslide Zone along the west side of the Temecula Valley. This landslide zone is primarily within an area with steep terrain underlain with metamorphic rock or weak sedimentary rock. These rock types are not present within or adjacent to the proposed Liberty Quarry.

As a part of the evaluation of landslides and existing slopes, an analysis of the potential for rockfall and flyrock due to the proposed blasting was also conducted. In summary, blasting conducted under the direction of competent, experienced blasting personnel following protocols like those presented in the proposed blasting plan for the quarry will optimize the use of explosives, restrict the limited potential for rockfall and flyrock to the interior of the quarry, and reduce ground shaking outside the quarry property to a level not perceptible to most people (Appendix C).

2.4.3 Asbestos-Type Minerals

In California, asbestos-containing rock types are predominately, but not exclusively, found in serpentinite and ultramafic rocks, which are common in the Sierra Nevada, Coast Ranges, and Klamath mountains (Appendix B, Kleinfelder 2006). Asbestos-type minerals are formed from the alteration of preexisting rock minerals by heat and pressure into different minerals. Asbestos is a term applied to a group of minerals that can be separated into thin, strong, flexible fibers that are heat resistant (CGS, 2002; USGS, 2001). The most common asbestos naturally occurring fibrous variety of mineral found is called chrysotile.

Geochemical analysis was performed on rock core specimens collected from borehole number 6 drilled for a previous investigation conducted at the site (Kleinfelder, 2005). The purpose of the analysis was to evaluate the quality of the rock from a crushing and durability standpoint. The primary metals present in order of highest concentrations are: aluminum, potassium, sodium, iron and calcium (McClelland Labs, 2004). These metals are the most common found on the surface of the earth.

Based on the mineral assemblages from a petrographic analysis of rock thin sections, from eight boreholes advanced in 2004, the rock is made up of quartz and feldspars (Micro-Chem Laboratories, 2005). Speciation of different feldspars was not conducted. However, based on concentrations of sodium and potassium from the geochemical analysis, visual observations of rock cores, and drill cuttings, the predominate feldspars are plagioclase (likely oligoclase) and orthoclase.

Ultramafic igneous rocks that are metamorphosed or altered into serpentinite generally contain 90 percent of dark-colored silicate minerals rich in iron and magnesium (Churchill, et. al., 2000). Relative proportions of iron and magnesium were low, 11 g/kg and 0.6 g/kg, respectively, compared to the results of the more common metals in four samples analyzed from borehole number 6. This indicates the rock samples are not ultramafic igneous rocks, and thus are not conducive to the formation of serpentine minerals (Appendix B, Kleinfelder, 2006).

Regional and site geologic data indicate the intrusive plutonic rock present at the proposed quarry property formed under a pressure and temperature environment that does not form ultramafic minerals that can be altered to form asbestos-type minerals. Geochemical analyses indicate the plutons were formed from subducted oceanic crust and in pressure – temperature conditions different than conditions required to allow the formation of asbestos-type minerals. The conditions for formation of ultramafic minerals, which are subducted, metamorphosed, and altered to asbestos type minerals, are not evidenced in the rocks found at the site (Appendix B).

3.0 SURFACE WATER HYDROLOGY

Surface water issues potentially associated with the proposed Liberty Quarry focus on how surrounding properties and drainage infrastructure may be affected by surface runoff resulting from precipitation events. These potential impacts have been evaluated based on the proposed, permit-level plans for quarry construction, as well as readily available average annual and storm-related rainfall data from Riverside County, the Natural Resources Conservation Service (NRCS), and the National Oceanic and Atmospheric Administration (NOAA). This information was used in combination with hydrologic design analyses consistent with the 1978 Riverside County Flood Control and Water Conservation District (RCFCWCD) *Hydrology Manual,* and other relevant hydrology references.

The surface water hydrology evaluation examines the two end member surface water hydrology conditions for the proposed Liberty Quarry:

1. Pre-development with the property in its current, relatively undisturbed state; and
2. Full development of the proposed quarry where the maximum proposed surface footprint has been developed.

These two end members present the anticipated lower and upper range of impacts the proposed quarry may have on surface water hydrology. Potential impacts to surface water hydrology between these two end members will be relative to rate at which the proposed quarry is developed, which in turn depends on factors outside the scope of this evaluation.

3.1 SITE DESCRIPTION

The proposed Liberty Quarry site is characterized by scrub vegetation consisting predominantly of a narrow leaf Chaparral with a uniform cover condition. The slopes of the topography within the property boundaries are steep, ranging from about 15 percent to over 40 percent. The quarry property has significant rock outcroppings that are estimated to comprise approximately 20 percent of the surface area. Based on field exploration conducted at the site and on a review of Plate C-1.60 in the *RCFCWCD*

Hydrology Manual, the soil cover consists of a thin mantle of primarily Type D soils over the subsurface bedrock and, thus, will have a low infiltration capacity and a high runoff potential.

The footprint of the fully developed quarry and access road will occupy approximately 165 acres, with just under half of that impacting surface water flows in the Gavilan sub-watershed of the Santa Margarita Basin and the remainder impacting surface water in the Vallecitos sub-watershed.

3.2 REGIONAL HYDROLOGY

The proposed Liberty Quarry site is situated in the lower one-third of the Santa Margarita Watershed, with its southern property line on the boundary between Riverside and San Diego Counties. A small parcel of property has been acquired in San Diego County for construction of the quarry access road connection to the I-15 interchange off-ramp. The location of the proposed quarry within the Santa Margarita Watershed is shown on Figure 3.1.

Stormwater surface runoff from the east side of the quarry (Vallecitos sub-watershed) will discharge into normally dry swales, or in some cases, sheet flow down hillsides toward I-15 and then into Rainbow Creek; eventually reaching the Santa Margarita River approximately 12 miles downstream. Surface flows from the west side of the quarry (Gavilan sub-watershed) discharge into a well-defined but unnamed drainage (herein named Royal Oak Ranch Draw) that flows into the Santa Margarita River about four miles downstream of the proposed quarry's southwest property corner.

The total Liberty Quarry property area is approximately 414 acres, and about 37 percent of that area will comprise the actual quarry footprint of approximately155 acres. The aerial ratios of the proposed Liberty Quarry property and quarry footprint on the Vallecitos and Gavilan sub-watersheds and the Santa Margarita Watershed are summarized in Table 3.2-1. As evident in that table, the proposed Liberty Quarry property occupies approximately 0.09 percent, and proposed quarry footprint approximately 0.03 percent of the overall Santa Margarita Watershed, respectively.

3.3 LOCAL HYDROLOGIC CONDITIONS

The proposed Liberty Quarry site is situated on a ridge that forms a drainage divide between the Vallecitos and Gavilan sub-watersheds within the Santa Margarita Watershed. Of the approximate total 155 acres of the fully built out quarry footprint, about 53 percent of that area (82 acres) is normally tributary to the Vallecitos sub-watershed; the remaining approximately 47 percent (73 acres) is normally tributary to the Gavilan sub-watershed.

The areas in the western portion of the property, west of the Royal Oak Ranch Draw, either drain offsite or into the draw. Surface water drainage in those areas remains unaffected by quarry construction, and were not evaluated for pre- and post-project stormwater runoff. Likewise, there are portions of the eastern property areas that will unaffected by quarry construction, and were similarly not evaluated for pre- and post-project stormwater runoff impacts. Unaffected areas are shown with a crosshatch pattern on Figure 3.2.

3.4 EVALUATION OF SURFACE WATER RUNOFF

The storm-related hydrology for the site has been completed consistent with the guidelines presented in the *RCFCWCD Hydrology Manual*. There are two accepted methodologies presented in the *RCFCWD Hydrology Manual* for computing peak discharges for site hydrology:

(1) The Rational Method, and
(2) Synthetic Unit Hydrograph Method

According to the *RCFCWCD Hydrology Manual*, a Synthetic Unit Hydrograph is not applicable to the Liberty Quarry site because the sub-basin areas are well under the minimum 200 to 300 acres recommended in that document. However, the Rational Method is also not suitable to evaluate pre- and post-project stormwater hydrology at the property boundaries or at key design points within the property because it can only compute peak discharges, and does not compute a hydrograph or runoff volume estimate. While the RCFCWCD has developed a computer program for application of the Synthetic Unit Hydrograph Procedure, including a “short cut” method for smaller sub-basins, it is not available for public use. However, the SCS Dimensionless Unit

Hydrograph method is appropriate and is used for evaluating this site because it is widely accepted nationwide and can generate runoff volume estimates for sizing detention facilities.

3.4.1 Precipitation Data

Precipitation data were obtained directly from the NOAA website using the Precipitation Data Frequency Server. These data are computed for a specific location by entering the latitude and longitude for the site interactively on the website. The NOAA data available at the various stations identified on the website provide the basis for *NOAA Atlas 14, Vol. 1*, which are more current than the *NOAA Atlas 2, Vol. XI* rainfall isohyetal values that are presented in the *RCFCWCD Hydrology Manual*. The *NOAA Atlas 14*, *Vol. 1* rainfall database also contains approximately 35 more years of precipitation data than *NOAA Atlas 2*. The proposed Liberty Quarry site, located just within the *NOAA Atlas 14* coverage area, was evaluated using the more current precipitation data. The rainfall intensity values for a specific duration and frequency that are available from the NOAA website are also higher than the rainfall intensity values obtained from *NOAA Atlas 2, Vol. XI*. Therefore, the hydrologic analysis is considered more conservative.

The cumulative precipitation data for 10-, 20-, and 100-year frequencies are presented in Table 3.4-1, and are based on an NRCS Type 1 Storm Distribution. The NOAA precipitation data that provide the 1-hour, and 24-hour rainfall depths, respectively, in Table 3.4-1 are presented in Appendix D.

3.4.2 SCS Unit Hydrograph – Peak Discharge Evaluation

The SCS Unit Hydrograph Method is a widely accepted method nationally and was used to evaluate pre- and post-project hydrology for the proposed Liberty Quarry site because it is consistent with the recommended method outlined in the *RCFCWCD Hydrology Manual*. The SCS Method is pre-programmed for use in the U.S. Army Corps of Engineers HEC-1 computer program. The user only needs to estimate basin area, lag time (which is based on the readily computed time of concentration), a runoff curve number, and percent impervious cover. The program will compute initial abstractions as well as infiltration losses over the duration of the storm, and thus a volume of runoff for each sub-basin can be computed. In the case of the proposed Liberty Quarry, where some of the sub-basin hydrographs will need to be routed in a channel section and combined with other hydrographs, that can also be readily accomplished. It is stressed the hydrology estimates for the pre- and post-project analyses are comparative in nature, and thus any imprecision in parameter estimates would be consistent between the models, with the main difference being the change in sub-basin areas and resulting lag times.

The comparative analysis nature of the SCS Method is also well suited for the current, permit-level design for the proposed Liberty Quarry. Specifically, the pre-quarry topography is known, and while conceptual phasing of quarry excavation has been developed, detailed, design-level mine sequencing plans for the proposed Liberty Quarry cannot be practically developed until the permitting process has been completed. Therefore, the SCS Method analysis presents for a “before and after” evaluation of potential effects of the proposed quarry on surface drainage, with intermediate steps being a scalable factor of the progression of quarry activities. It is anticipate that upon completion of Phase 1 excavation limits, offsite drainage flow impacts of subsequent Phases 2 through 4 will not be materially different.

The *RCFCWCD Hydrology Manual* contains a detailed discussion on the theory and procedure for computing Synthetic Unit Hydrograph Method flows. Other engineering references, including *Applied Hydrology* (Chow, et al, 1988) and the *Handbook of Hydrology* (Maidment, 1993) contain detailed discussions on the application of the SCS Dimensionless Unit Hydrograph Method.

For the proposed Liberty Quarry SCS Method hydrology analysis, the steps outlined below were completed to estimate appropriate parameters for input into the pre- and post-project HEC-1 models, and are consistent with the stepwise analysis outlined in Plate D-1 of the *RCFCWCD Hydrology Manual* for obtaining those parameters. However, refinements in the stepwise procedure have been made where appropriate to better reflect the current state-of-the-practice and to utilize formulas suitable for programming into a spreadsheet instead of reading a nomograph. For example, computing the travel time for channel flow ($t_{channel}$) discussed in Step 3 below uses a formula for computing channel velocity developed by Dr. James Guo of the University of Colorado, and is based on various conveyance element flow velocities originally published by the NRCS for the *TR-55* computer program (1975) for small basin urban hydrology and is applicable nationwide. That formula is contained in the Urban Storm Drainage Criteria Manual (*USDCM)* developed by the Denver-area Urban Drainage and Flood Control District (a nationally recognized stormwater management agency) and is a defensible refinement to the procedure outlined in the *RCFCWCD Hydrology Manual* because the formula is independent of discharge in the channel (which would be unknown). The same step in the *RCFCWCD Hydrology Manual* would require an estimate be made of the discharge, and then a velocity value would be read off of a nomograph (Plate D-6.3) based on the channel slope.

The *USDCM* procedure for estimating channel flow travel time is judged to be a more robust, defensible method, and also offers the benefit of being programmable into a spreadsheet, thus reducing the potential for errors by misreading a nomograph. Other than that refinement for channel flow, all Plate references below are from the *RCFCWCD Hydrology Manual*.

SCS Method Hydrology Parameter Estimation Procedure:

1. Delineate sub-basins in the Vallecitos and Gavilan sub-watersheds with hydrologic design points at the property boundaries where appropriate, and as indicated on Figure 3.2.
2. Measure the various sub-basin parameters required for the analysis, including
    - Area (A, in acres).
    - Elevations and flow lengths for the upper basin overland flow.
    - Elevations and flow lengths for the remaining basin shallow concentrated or channel flow.
3. Using parameter data from step 2, compute initial overland flow time (t_i) and channel flow time ($t_{channel}$) in minutes using the following design procedures or formulas:

    t_i: Read directly from Plate D-3 using elevation difference of initial flow area and flow length (varies, typically 500 feet maximum) and adjust for “undeveloped, fair cover” land use. Otherwise, compute t_i using Fig. RO-1 from *USDCM* to estimate overland flow velocity in combination with flow length if Plate D-3 is not applicable because parameters are off Plate D-3 limits.

$$t_{channel} = (L_{channel}/V_{channel})/60$$

Where:

$L_{channel}$ is channel length in feet and measured directly from the project map.

$V_{channel} = C_v(S_{effective})^{0.5}$ (equation RO-4 in *USDCM*), and C_v is a conveyance coefficient and is obtained from Table RO-2 in the *USDCM* and $S_{effective}$ is the actual slope measured from the project map (i.e., the difference in elevation divided by the flow length) and adjusted in accordance with Plate D-6.2.

4. Compute time of concentration (T_c) by adding t_i and $t_{channel}$.

5. Compute basin Lag Time as 0.6(T_c).

6. Using Plate D-5.5 (1 of 2), select Runoff Index No. 86 for “Chaparral, Narrowleaf” for natural covers in fair condition for Antecedent Moisture Condition (AMC) II, as estimated from site visits and photographs, for Type D soils (as noted on Plate C-1.60).

7. With the aid of site photographs and Plate D-5.7 (11 of 12), estimate a 20 percent impervious cover from rock outcrops.

8. Input above parameters for each sub-basin into the HEC-1 pre- and post-project hydrology models, along with appropriate 10- and 100-year rainfall data.

9. Develop appropriate channel routing parameters (length, slope, roughness, shape, bottom width, and side slopes) for Muskingum-Cunge channel routing in HEC-1.

The above steps were completed for both the pre-project and post-project conditions. Sub-basins used in this analysis are shown on Figure 3.2. In total, five sub-basins in the Vallecitos sub-watershed, and six sub-basins in the Gavilan sub-watershed, were evaluated for pre-project hydrology for both 10-year and 100-year frequency precipitation events. The access road construction in the post-project analysis required the subdivision of two of the Vallecitos sub-basins because of changes in where flow hydrographs were routed to resulting from the interception of flows by a roadside ditch. As such, the post-project hydrologic analysis for the Vallecitos sub-watershed included seven sub-basins.

3.4.3 Results of Surface Water Evaluations

The results of surface water evaluations presented in Table 3.4-2 illustrate that stormwater runoff from the proposed Liberty Quarry site will decrease as the quarry is constructed because drainage area will be removed as the quarry is mined below existing grades and begins to function as an engineered excavation. The tabular post-project results reflect full quarry build-out, although these post-project results would be similar with the completion of Phase 1 improvements.

As quarry mining operations are completed in phases, surface stormwater runoff would decrease from the reported pre-project discharge proportionally to the amount of each sub-basin being brought below grade (with the exception of the two Vallecitos sub-basins where the access road will be constructed, as discussed in more detail below). Therefore, some adjacent properties will experience an evolving reduction in stormwater flows as quarry construction progresses, except in those locations where the offsite drainage areas were outside of the quarry excavation limits. In those locations, the pre- and post project stormwater flows would remain unaltered. It can also be concluded that stormwater-related flows into Rainbow Creek and Royal Oak Ranch Draw derived from within the proposed Liberty Quarry footprint would decrease through time in relation to the reduction in drainage area contributing to stormwater runoff.

The pertinent plates from the *RCFCWCD Hydrology Manual*, and pertinent figures and tables from the *USDCM* used in the hydrology calculations, as well as spreadsheet calculations for the 10-year and 100-year pre- and post-project HEC-1 model input parameters and HEC-1 model output are presented in Appendixes D-2 and D-3, respectively.

Peak discharges in Vallecitos sub-basins V-4 and V-5 will increase for the post-project condition, as the amount of sub-basin area removed by quarry construction is small, and the increased impervious cover resulting from a paved access road coupled with the increased hydraulic routing efficiency of roadway drainage conveyances result in an increase in peak discharge near the I-15 off-ramp location.

Post-project sub-basins V-4A and V-5A (Figure 3.2) can be collected and stored in a detention basin to be designed adjacent to the proposed pull-out area, and the volume slowly released at a rate that would result in a total discharge at the I-15 off-ramp at or below the pre-project level. It is estimated that an approximately 13 ac-ft storage capacity would be required to contain this discharge. The estimated runoff volume from a 20-year frequency, 1-hour duration precipitation event is 4 ac-ft, which can be contained within this detention basin.

3.4.4 Internal Quarry Drainage

Precipitation within the quarry excavation boundary will need to be collected and conveyed to designated storage areas within the footprint. A sedimentation basin has been shown conceptually in the extreme southwest corner of the quarry. That basin will be sized during the final design process to accommodate the runoff volume for a minimum 20-year event.

The final grading details of the quarry at various phases will be used to evaluate how much of the quarry can be gravity drained to that location, as well as the need for and locations of other potential sedimentation basins inside the quarry. Stormwater inside the quarry footprint will remain within the quarry and is not anticipated to adversely impact surface runoff outside those limits.

Based on the estimated 12 inches of annual rainfall, approximately 155 ac-ft of surface runoff could be collected on average annually within the quarry sedimentation basins for reuse in the gravel washing operations or for dust control, but the majority of this water is anticipated to be lost through evaporation.

3.4.5 Water Balance

Quarry operations are anticipated to import up to 500 acre-feet (ac-ft) of water annually via pipeline for various uses in quarry operations. The breakdown of uses for the 500 ac-ft per year was provided by Granite Construction and is discussed in this section. Three primary on-site uses for imported water include:

1. Aggregate processing plant
2. Concrete plant

3. Dust suppression at quarry roads and facilities

Of the total 500 ac-ft of water imported annually, approximately 64 percent would be used in the aggregate plant area for washing crushed rock and sand (Table 3.4-3). An estimated 7 percent of that wash water would be permanently lost from the wash process by residing in voids of the aggregate and sand; either evaporating or being transported offsite with the washed material. The remainder of the wash water would be collected onsite in the sedimentation pond for settling, clarifying, and reuse. Of the water collected in the pond, an estimated 8 percent would be lost to evaporation. An additional 74 ac-ft, or about 15 percent, would be used annually in the aggregate plant area for dust control during operation of crushers and material handling, and thus would all be lost mainly to evaporation. The aggregate plant is located within the proposed quarry footprint; water usage associated with the aggregate plant remains on site and does not influence surface water off site.

According to the water balance presented in the spreadsheet model, the concrete plant will use about 15.5 percent of the imported water, or about 77 ac-ft annually. Production of concrete ready mix will consume nearly all this water. Like the aggregate plant, concrete production is located within the proposed quarry footprint; water usage associated with concrete production remains on site and does not influence surface water off site.

The remaining 8 percent of the annual imported water, or about 41 ac-ft, will be used for dust suppression on quarry haul roads and stockpile areas, all within the quarry footprint. Dust suppression water will ultimately be lost to evaporation from the road base material and material stockpiles. Because all of the water will be applied within the quarry footprint, no surface water runoff impacts outside the quarry are anticipated. The quarry access road from I-15 will be paved, and thus will not require any water for dust control. Should a small quantity of water be used outside the quarry footprint (e.g., revegetation or landscaping), the annual usage and resulting application rates would be low and generation of surface runoff leaving the property is not anticipated.

In summary, the entire 500 ac-ft of water imported annually for use in quarry operations will remain within the quarry footprint, with substantial amounts of it being recycled for reuse. There are no anticipated surface water runoff impacts outside the quarry footprint or property lines resulting from imported water being used for normal quarry operations discussed above.

3.5 STORMWATER CONSIDERATIONS AND SWPPP

Stormwater runoff is a natural part of the hydrologic cycle. However, human activities such as agriculture, construction, forestry, mining, and activities associated with urbanization can alter natural drainage patterns and add pollutants to rivers, lakes, and coastal areas. Urban runoff is a significant source of water pollution, and is considered a reason for some declines in fisheries, and local restrictions or limitations to the public's ability to use this nation's extensive water resources.

Urban runoff and stormwater runoff are terms that are often used interchangeably (California Stormwater BMP Handbook – Industrial and Commercial, 2003), and in this context includes all flows discharged from urban land uses (i.e., land not in its natural, undisturbed state) into stormwater conveyance systems and receiving waters; including both dry weather non-stormwater sources as well as wet weather stormwater runoff.

For many years the effort to control stormwater discharges focused on quantity (i.e., drainage and flood control), and to a limited extent on quality of the stormwater (e.g., sediment and erosion control). In recent years, awareness of the need to improve water quality has increased; federal, state, and local jurisdictions have established programs to pursue the goal of reducing pollutants contained in stormwater discharges. The emphasis of these programs is to promote the concept and practice of pollution prevention at the source, before it can cause environmental problems (California Stormwater BMP Handbook – Industrial and Commercial, 2003).

There are several excellent sources of information concerning stormwater runoff and associated impacts to receiving waters. A full treatment of stormwater-related issues on water quality potentially pertaining to the proposed Liberty Quarry can be found in two California Stormwater BMP Handbooks: (1) Construction (January 2003, Errata 9-04); and (2) Industrial and Commercial (January 2003). The following sections present a discussion of those aspects pertinent to the proposed Liberty Quarry.

3.5.1 Common Categories of Stormwater Pollutants

Stormwater runoff naturally contains numerous constituents. Without engineering controls and Best Management Practices (BMPs), human activities in the natural environment can increase constituent concentrations to levels that impact water quality. Pollutants typically associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, gross pollutants (floatables), vectors, and miscellaneous waste (California Stormwater BMP Handbook – Industrial and Commercial, 2003) (Table 3.5-1).

- Erosion and Sedimentation

  Soil erosion is the natural process by which soil particles are removed from the land surface by wind, water, or gravity. Most erosion occurs at slow rates. However, the rate of erosion increases when land is cleared or altered and left unprotected. Construction activities, agricultural practices, and industrial applications can lead to soil erosion at rates many times the natural background rate for undisturbed land.

  Sediment resulting from excessive erosion is considered a pollutant. Sedimentation is defined as the settling out of particles transported by water. Sedimentation occurs when the velocity of water is slowed sufficiently to allow suspended soil particles to settle. Larger particles, such as gravel and sand, settle more rapidly than fine particles such as silt and clay. Effective sediment control begins with proper erosion control, which minimizes the availability of particles for settling downstream.

  The potential for erosion and sediment generation at the proposed Liberty Quarry is higher during access road construction, initial clearing and grubbing of the property for Phase I operations, and during Phase I operations until inward drainage is achieved as the engineered excavation is advanced below existing surface elevations. Sediment generation during mining activities will take place within the quarry during processing and on-site movement of aggregate products. Controlling erosion and sedimentation are routine development considerations and can be achieved with engineering controls and best management practices (BMP).

- Other Pollutants

  Pollutants such as nutrients, bacteria, viruses, oil, grease, metals, organic compounds such as herbicides and pesticides, gross pollutants, and vectors are important environmental considerations, as they can be associated with both acute and chronic problems in receiving waters. The majority of the “other pollutants” category are not associated with quarry operations, and those such as oil and grease will be controlled through BMPs within the quarry operations environment. Table 3.5-1 presents a matrix that identifies typical sources of these other pollutants.

3.5.2 Regulatory Requirements

The Federal Clean Water Act, as amended in 1987, is the principal vehicle for the control of stormwater pollutants. Other programs that directly or indirectly deal with the control of stormwater pollutants includes: Federal Coastal Zone Act Reauthorization Amendments of 1990; the Porter-Cologne Act; and the State Hazardous Waste Source Reduction and Management Review Act. The implementation of stormwater programs occur at several levels: federal, state, local, and industrial.

Federal NPDES Programs

In 1972 the Federal Water Pollution Control Action (also referred to as the Clean Water Act [CWA]) was amended to provide the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with an NPDES permit. The 1987 amendments to the CWA added Section 402(p), which establishes a framework for regulating municipal and industrial stormwater discharges, including discharges associated with construction activities, under the NPDES program.

On November 16, 1990 the U.S. Environmental Protection Agency (USEPA) published final regulations that established stormwater permit application requirements. The regulations provide that discharges of stormwater to waters of the United States from construction projects that encompass five or more acres of soil disturbance are effectively prohibited unless the discharge complies with an NPDES permit (California Stormwater BMP Handbook – Construction, 2003).

Stormwater regulations associated with the Clean Water Act (CWA) require specific categories of industrial facilities which discharge industrial stormwater to obtain an NPDES permit. Those facilities that discharge industrial stormwater either directly to surface waters (e.g., rivers, lakes, etc.) or indirectly, through separate municipal storm drains, must be covered by a NPDES permit. This includes the discharge of sheet flow through a drainage system or other conveyance.

Federal law directs that industrial stormwater discharges meet the provisions of the CWA in order to control pollutant discharges. These provisions require the use of best available technology (BAT) economically available and best conventional pollution control technology (BCT) to reduce pollutants and any more stringent controls necessary to meet water quality standards (California Stormwater BMP Handbook – Industrial and Commercial, 2003).

State NPDES Program

In California, the State Water Resources Control Board (SWRCB), through nine Regional Water Quality Control Boards (RWQCB), administers the NPDES stormwater-permitting program. For industrial facilities and construction activities, the SWRCB elected to issue statewide general permits that apply to all stormwater discharges requiring an NPDES permit.

In addition to the stormwater industrial General Permit, the RWQCB may, at their discretion, issue an industry-specific General Permit. Industries may also request an individual NPDES permit. RWQCBs typically only consider individual permits where an individual facility has unique characteristics or poses a significant threat to water quality.

The General Permit requires facility operators to:

1. Eliminate unauthorized non-stormwater discharges;
2. Develop and implement a stormwater pollution prevention plan (SWPPP);
3. Perform monitoring of stormwater discharges and authorized non-stormwater discharges.

Municipal NPDES Program

Municipalities are also required to develop programs to monitor and control pollutants in stormwater discharges from their municipal systems. Such control may include regulating stormwater discharges from industrial and commercial facilities that the municipality determines are contributing pollutants to the municipal storm drain system.

3.5.3 Stormwater Pollution Prevention Planning

The development of a stormwater pollution prevention plan is an important part of a business' efforts to reduce pollutants in its stormwater discharges. All facility operators subject to the General Permit must prepare, retain on site, and implement a SWPPP. The SWPPP has two major objectives:

- Help identify sources of pollution that affect the quality of industrial stormwater discharges and authorized non-stormwater discharges.
- Describe the development and implementation of BMPs to reduce or prevent pollutants in industrial stormwater discharges and authorized non-stormwater discharges.

Facilities covered by the General Permit and required to prepare a SWPPP include the following:

- Facilities subject to stormwater effluent limitations, new source performance standards, or toxic pollutant effluent standards.
- Manufacturing facilities
- Oil and gas / mining facilities
- Hazardous waste treatment, storage, or disposal facilities
- Landfills, land application sites, and open dumps
- Recycling facilities
- Steam electric power generating facilities
- Transportation facilities
- Sewage or wastewater treatment works

- Manufacturing facilities where industrial materials, equipment, or activities are exposed to stormwater.

The specific facilities included in each of the aforementioned categories are provided in Appendix D-4.

The decision whether a facility is required to obtain coverage under the General Permit is determined by what activity takes place on the site. It is the industrial activities at the facility site (SIC classification) that determines whether coverage under the General Permit is required, not the primary business of the facility owner.

There are several categories of businesses and activities that are explicitly excluded from the requirements to develop a SWPPP under the commercial and industrial category, as these businesses are not required to obtain coverage under the General Permit:

- Facilities that have other NPDES permits containing stormwater provisions
- Facilities determined ineligible by RWQCBs
- Facilities that do not discharge stormwater to waters of the United States (including facilities that discharge stormwater to municipal sanitary sewers and facilities that do no discharge stormwater to surface waters or separate storm sewers)
- Most silvicultural activities
- Facilities on Indian Lands

The RWQCB may require particular facilities to obtain an individual NPDES stormwater permit, in which case it is likely the permit will specify the preparation of a formal SWPPP. Local jurisdictions may also require a business that fall outside the SIC list prepare a stormwater pollution control plan (SWPCP).

3.5.4 SWPPP Preparation

This section presents a discussion identifying the components required in a Stormwater Pollution Prevention Plan (SWPPP). A SWPPP is not presented in this document because details necessary to submit a complete SWPPP are not developed in the permit-level documents currently prepared for the proposed Liberty Quarry. It is fully recognized that a SWPPP will be required for quarry operations; which will be prepared in cooperation with the California Regional Water Quality Control Board – San Diego Region when operational, design-level documentation has been developed.

An overview of the process to develop a SWPPP consists of six phases, summarized in Table 3.5-2, and briefly described below.

Phase 1 – Planning and Organization Phase

The SWPPP must identify a specific individual or individuals within the facility organization as members of the Pollution Prevention Team (PPT). The size and composition of the team should be appropriate to the complexity of the facility, and should consist of representatives from all departments that will have a role in implementing the SWPPP. Members of the PPT oversee SWPPP preparation, assist in implementing the SWPPP, and manage monitoring activities.

Phase 2 – Assessment Phase

The PPT team is responsible for assessing the facility, identify key activities or activity areas, inventory significant materials and chemicals, identify non-stormwater discharges, identify existing BMPs, and assess potential pollution sources. The assessment phase is used to refine the team's understanding of the facility and potential stormwater issues for use in the SWPPP.

Phase 3 – BMP Identification Phase

The third phase of preparation of the SWPPP is to identify BMPs. The General Permit requires the description of BMPs in three categories:

1. Existing BMPs
2. Existing BMPs to be revised and implemented
3. New BMPs to be implemented.

After identifying existing and new BMPs, an implementation plan for all BMPs will be developed.

Phase 4 – Assemble the SWPPP

The final phase, before implementation, is to assemble the SWPPP, obtain signatures including the title of the person responsible for the SWPPP, and date of initial preparation. The California Regional Water Quality Control Board – San Diego Region will be consulted during the preparation of the SWPPP, and their feedback sought on the document for efficacy and completeness, and a copy of the final SWPPP submitted for the record.

Phase 5 – Implement the SWPPP

Implementing the SWPPP consists of training on-site personnel, implementing BMPs, and terminating non-allowable non-stormwater discharges, consistent with the implementation plan developed in Phase 3, which includes a schedule for BMP maintenance, inspection, and on-going evaluation.

Phase 6 – Monitoring, Reporting, and Program Evaluation

As required by the General Permit, frequent inspections will be performed to check BMP implementation and effectiveness, which involves conducting a monitoring and reporting program, including review of monitoring information, evaluation of BMPs, record keeping and reporting, and review and revision of the SWPPP.

As evident in the foregoing discussion, the process of preparing a facility-specific SWPPP requires detailed information on a facility's actual layout, operations sequencing, equipment types and operating parameters, materials and chemicals used and stored on site, and the development of BMPs focused on the operational characteristics of the facility. A SWPPP will be prepared for the proposed Liberty Quarry when design-level planning and preparations are completed.

3.6 WATER QUALITY MANAGEMENT PLANS

This section presents a discussion identifying the components required in a Water Quality Mangement Plan (WQMP). A WQMP is not presented in this document because details necessary to submit a complete WQMP are not developed in the permit-level documents currently prepared for the proposed Liberty Quarry. It is fully recognized that a WQMP will be required for quarry operations; which will be prepared consistent with Riverside County requirements and in consultation with the San Diego RWQCB

3.6.1 Regualtory Requirements

Congress amended the Federal Clean Water Act (CWA) in 1987 to require public agencies that serve urbanized areas with a population greater than 100,000 and other designated areas to obtain permits to discharge urban stormwater runoff from municipally owned drainage facilities including streets, highways, storm drains, and flood control channels. In 1990, the U.S. Environmental Protection Agency (EPA) promulgated regulations for Municipal Stormwater Permit requirements under the National Pollutant Discharge Elimination System (NPDES) program. In California, EPA delegated NPDES permitting authority to the State Water Resources Control Board (SWRCB), which issues and enforces NPDES Municipal Separate Storm Sewer System (MS4) permits through nine California Regional Water Quality Control Boards (CRWQCB).

The Riverside County Flood Control and Water Conservation District (District) service area encompasses portions of three major watersheds, including the Santa Ana and Santa Margarita Watersheds, in which the proposed Liberty Quarry is located. The discharge of stormwater from municipal storm drainage systems within this watershed is regulated pursuant to an NPDES MS4 Permit administered by the San Diego RWQCB. In the case of the Santa Margarita Watershed, the District, along with the County of Riverside and the Cities of Temecula (Permittees) submitted and early “Developmental Permit;” which later added the City of Murrieta (RCFCWCD, 2007).

In July 2004, the San Diego RWQCB adopted Order No. R9-2004-001, the Third-term Santa Margarita Region (SMR) MS4 Permit, which required additional or enhanced elements, such as control on new developments, enhancements to construction, industrial, and commercial inspections, and an emphasis on water quality monitoring and program effectiveness. The County of Riverside utilizes Water Quality Management Plans (WQMP) for new developments to fulfill the requirements of the Third-term SMR Permit.

A Drainage Area Management Plan (DAMP) was developed by the Permittees and approved by the Executive Officers of the Santa Ana and San Diego RWQCB to address and translate MS4 Permit requirements into programs and implementation plans. The DAMP is used by the Permittees in the development of individual ordinances, plans, policies, and procedures to manage urban runoff (DAMP, July 2005).

The Santa Margarita Watershed Benefit Assessment Area (SMWBAA) was established by District Ordinance No. 14 in 1991 to offset the District's program and administrative costs associated with development, implementation, and management of identified stormwater management activities required by the NPDES Permit Program. The District must continue to develop and implement stormwater management activities in order to legally operate and maintain its flood control and drainage facilities (RCFCWCD, 2007).

3.6.2 WQMP Preparation

This section presents a discussion identifying the components required in a Water Quality Management Plan (WQMP). A WQMP consists of seven sections, which are summarized below:

Section I – Project Description

Section I includes general project information such as the name and address of the project owner and the WQMP preparer. It also requires a narrative of the project including descriptions of activities, the types of materials to be used at the site, delivery and storage of the materials, types of wastes generated, and site maps. Other data included in this section are the Standard Industrial Classification (SIC) codes, watershed and receiving water bodies, and lists of required permits/approvals for the project. Maps showing both the general project location and site-specific details such as paved areas, landscaped areas, structures, storm drains, tributary flows onsite and offsite, and topography are also required.

Section II – Site Characterization

Section II considers items such as land use designation, property uses, soils data, Phase I site assessment information, and receiving waters listings are summarized. Information regarding the receiving waters is available online through the Basin Plans on the RWQCB website.

Section III – Pollutants of Concern

Section III addresses anticipated potential pollutants that may enter the stormwater stream as a result of new activities. At each of the proposed discharge points, the WQMP must identify the proximate receiving waters using hydrologic basin numbers for identification, a list of pollutants identified in the proximate receiving water, and comparison of the list of the proximate receiving water pollutants to the list of those anticipated to be generated by site activities.

Section IV – Hydrologic Conditions of Concern

Section IV deals with the potential issues of increased runoff, and decreased infiltration, resulting from site development. Changes to flow frequency, duration, volume, and velocity may impact downstream channels through increased sediment loads. Unless the project meets one of three criteria, a hydrologic study is required. Those exemption conditions are:

1. The project runoff waters discharge directly to a publicly owned, operated, and maintained municipal separate storm sewer system (MS4);

2. The project disturbs less than one acre; or

3. Runoff from the developed project does not exceed pre-development conditions for the 2-year, 24-hour, and 10-year, 24-hour rainfall events.

Under Condition 3, hydrologic modeling must be conducted meeting the requirements of the RWQCB as the co-permittee. Engineering calculations and support data are required under this section.

Section V – Best Management Practices

Section V addresses three types of BMPs: Site Design, Source Control, and Treatment Control. Analyses for Site Design and the Source Control BMPs consist of checklists of items that will of will not be used at the site and do not require design data packages. Treatment Control BMPs, however, utilizes a selection matrix from which the owner/preparer chooses BMPs that are of medium or high effectiveness for reducing contaminants of concern to the receiving waters. Detailed descriptions on the implementation of the BMPs including location, preliminary design calculations, installation, and long-term operation and maintenance are required.

Section VI – Operation and Maintenance (O&M) Responsibilities

Section VI requires each Source and Treatment Control BMP (Section V) with O&M be addressed for items such as startup dates, frequency of the O&M, identification of responsible parties including a written agreement attesting to the responsibilities, inspection and record-keeping, and description of the water quality monitoring.

Section VII – Funding

Section VII requires identification of source(s) of funding for the continued O&M of each Treatment BMP identified in previous sections.

Similar to the SWPPP discussion, the process of preparing a facility-specific WQMP requires detailed information on a facility's actual layout, operations sequencing, equipment types and operating parameters, materials and chemicals used and stored on site, and the development of BMPs focused on the operational characteristics of the facility. A WQMP will be prepared for the proposed Liberty Quarry when design-level planning and preparations are completed.

4.0 GROUNDWATER HYDROLOGY

Groundwater hydrology was primarily evaluated based on the results of drilling three deep borings on the proposed Liberty Quarry property, performing pumping tests on encountered groundwater in the borings to evaluate hydraulic characteristics, and groundwater sampling and analysis of samples collected from the three borings and a private, off-site water supply well. The following subsections present a discussion concerning the various aspects of this portion of the hydrologic evaluation.

4.1 REGIONAL GROUNDWATER HYDROLOGY

4.1.1 Regional Hydrogeologic Setting

In general, the ground surface at the proposed Liberty Quarry is expressed with Rainbow Granodiorite exposures with thick brush between outcrops. Topographically, the site consists of steep natural slopes with intervening ephemeral drainage courses.

The proposed Liberty Quarry property is located on a prominent northwest-southeast trending uplifted mountain block containing the Santa Ana Mountains, Santa Rosa Plateau to the northwest, and the Palomar Mountains to the southeast. Uplift of this resistant bedrock terrain resulted from regional tectonic stresses, which also resulted in the Elsinore fault zone that borders the uplifted mountain block on the northeast.

Movement along the Elsinore fault zone has resulted in the formation of a topographic lowland and structural depression bordering the Santa Ana Mountains, called the Elsinore Graben. The Elsinore Graben is the western margin of a larger structural lowland referred to as the Perris Block, which extends eastward to the San Jacinto and Santa Rosa Mountains. The adjacent lowlands of the Elsinore Graben and Perris Block generally contain a thin veneer of Tertiary and Quaternary sediments on a basement complex composed of crystalline granitic and metamorphic rocks (DWR, 1956).

The resistant granitic upland containing the proposed Liberty Quarry site is bordered on the southeast, west, and south by shallow intermontane valleys resulting from erosion along fractures and joints in the crystalline bedrock. Such areas include Rainbow Valley on the southwest, an unnamed valley containing the Kirkpatrick well on the west, and the drainage of Rainbow Creek on the south.

The proposed quarry site is located in the Santa Margarita River Watershed, an approximately 750 square mile watershed that drains portions of southwestern Riverside County and northwestern San Diego County (Figure 3.1). The watershed extends from the San Jacinto and Santa Rosa Mountains on the east, westward to the Pacific Ocean. This watershed is drained by De Luz, Murrieta, Rainbow, Temecula, Tucalota, Warm Springs, and Wilson creeks, and the Santa Margarita River.

The Santa Margarita River is formed near the City of Temecula at the confluence of Temecula and Murrieta creeks. The watershed is largely underlain by granitic and metamorphic rocks and locally by a limited thickness of consolidated and/or unconsolidated Tertiary and Quaternary sediments in the interior lowland areas of the watershed in southwestern Riverside County and the interior lowland and coastal areas of the watershed in San Diego County.

The proposed quarry site is located in rugged mountainous bedrock terrain not associated with a groundwater basin. The closest groundwater basins to the project site are the Temecula Valley Groundwater Basin and the Rainbow Valley Groundwater Basin (DWR, 1956). The Temecula Valley Groundwater Basin is located northeast of the project site in the Elsinore Graben and Perris Block and primarily occurs in southwestern Riverside County with a small portion located in northwestern San Diego County. The basin is drained at its western end by the Santa Margarita River (DWR, 1956). The Rainbow Valley Groundwater Basin is located adjacent to and southeast of the project site and occurs entirely within San Diego County. The northern two-thirds of the basin is drained by Rainbow Creek which discharges into the Santa Margarita River approximately 3.5 miles to the west near Fallbrook. The southern third of the basin is drained by three south flowing unnamed drainages which discharge into the San Luis Rey River in the San Luis Rey River Watershed.

4.1.2 Groundwater Occurrence and Movement

Groundwater primarily occurs in Quaternary alluvial sediments in the Temecula Valley Groundwater Basin and Rainbow Valley Groundwater Basin and to a lesser extent in the more consolidated Tertiary sediments in the Temecula Valley Groundwater Basin

(DWR, 1956, 1971, 2003). Groundwater also occurs to a much lesser extent locally in the crystalline bedrock, but is primarily limited to fracture and joint systems and/or in deeply weathered areas overlain by saturated Quaternary or Tertiary deposits. Groundwater, where observed at the proposed quarry site, is limited to joints and fractures as the massive crystalline bedrock underlying the site is considered non-water bearing (DWR, 1956, 2003). As discussed in Section 2.0, there is limited hydraulic connection between groundwater encountered in bedrock fractures and joints at the proposed quarry site.

Groundwater flow in the Temecula Valley Groundwater Basin, absent the influence of pumping by wells, generally flows in the direction of the surface gradient of the individual drainages (Kleinfelder, 2007b). The ultimate destination of groundwater flow (prior to the onset of pumping) was toward the Santa Margarita River (DWR, 1956). Groundwater flow in the Rainbow Valley Groundwater Basin is toward the south and southwest (DWR, 1956, 2003).

4.1.3 Groundwater Production

Surface water and groundwater production in the Temecula Valley Groundwater Basin is managed by the Santa Margarita River Watermaster, a court-appointed entity created as the result of water rights litigation commencing in 1951, with subsequent judgments in 1963 (Final Judgment and Decree), 1966 (Modified Final Judgment and Decree) and most recently, 1989, with re-appointment of a Watermaster. Water purveyors in the basin deliver water consisting of pumped groundwater, imported water, and to a much lesser extent, highly treated recycled water to meet local water demands. Imported and recycled water have been used to meet growing municipal, industrial, and agricultural water demands while at the same time offsetting historic overproduction of alluvial groundwater supplies, the latter resulting in groundwater overdraft.

Groundwater production in the Rainbow Valley Groundwater Basin is presently unknown but is estimated to be very low, approximately 10 acre-feet per year (Dudek, 2005). Groundwater is generally pumped for domestic use and/or irrigation of crops. Except for the estimated minor production of groundwater noted above, the local water purveyor, Rainbow Municipal Water District purchases and distributes imported water from San Diego County Water Authority within their service area for agricultural use and to a lesser extent, for domestic and commercial use.

There is presently no groundwater production at the proposed quarry site, nor is groundwater production anticipated for proposed Liberty Quarry operations due to the paucity of exploitable groundwater at this property. The closest production well to the site is the Kirkpatrick well, located immediately to the west in an apparently structurally-bound intermontane valley bordering the site. Groundwater production from this well is limited and restricted to occasional domestic use. Estimated groundwater production from this well is probably less than one acre-foot per year based on land use. The well presumably pumps groundwater from fractures and/or joints in the crystalline bedrock as the overlying alluvium is relatively thin in the well site area.

4.2 LOCAL GROUNDWATER HYDROLOGY

Groundwater was encountered at the site in three deep vertical borings drilled into the underlying granitic bedrock as part of this investigation during August 2006 (Figure 2.6). The three borings were located based on the results of geologic mapping and the fracture trace analysis in areas that: (1) Demonstrated evidence of multiple or intersecting fracture patterns to increase the potential for encountering fractures containing water, if present; and (2) Were spread across the proposed Liberty Quarry footprint, to the extent practical, to confirm or refute the continuity of fractures and joint sets and evaluate the homogeneity of the rock type at the quarry site.

Groundwater was observed seeping from joints and fractures within the granitic bedrock into the borings. Groundwater was initially encountered in the borings at depths of approximately 40 feet below ground surface (bgs), 209 feet bgs, and 373 feet bgs in borings MW-1, MW-2 and MW-3, respectively, corresponding to approximate groundwater surface elevations of 1,660, 1,706, and 1,557 feet above mean sea level (msl), respectively. On September 18 - 21, 2006, static groundwater levels were measured at 9, 206, and 84.7 feet bgs at MW-1, MW-2 and MW-3, corresponding to groundwater surface elevations of 1,691, 1,709, and 1,840 feel msl, respectively.

Groundwater monitoring during drilling included observing drill cutting exhaust for increased moisture and measuring and recording the depth to groundwater with an electric water level indicator prior to resumption of drilling each morning and at the end of each day during drilling. Groundwater level measurements obtained during drilling indicated seepage from fractures and joints was entering the boring and causing a rise in groundwater levels in the boreholes. As a result, a rough estimate of the initial rate of groundwater inflow, or drainage under the influence of gravity into each boring was made. The estimated rate of initial inflow varied considerably among the three borings and stabilized at relatively low rates following boring completion, largely due to the nature of the bedrock. The highest rate of initial inflow was observed at MW-2 with an estimated rate of approximately 25 gallons per minute (gpm). At MW-1, the estimated rate of initial inflow was about 6 gpm, and at MW-3, the initial inflow rate was less than 6 gpm (Table – 4.2-1).

Estimated rates of inflow and volumes of water as recorded in the field during drilling activities are presented on the boring logs in Appendix A. In summary:

- MW-1 had a inflow rate of approximately 0.18 gpm after 1 day and decreased to 0.01 gpm after 8 days; the depth to groundwater stabilized at approximately 40 feet bgs (1,660 msl).
- MW-2 had an estimated inflow rate of 0.02 gpm during the first day, and stabilized at 0.01 or less over the next 11 days. The depth to groundwater stabilized at approximately 209 feet bgs (1,706 msl) after 12 days.
- MW-3 had estimated inflow rates that were somewhat variable due to the stoppage and re-commencement of drilling resulting from observed seepage at relatively shallow depths. For example, on August 8, 2006, the estimated recharge rate after 40 minutes was 13 gpm resulting in a groundwater level rise in the boring of about 288 feet. However, after the boring was drilled to total depth the estimated rate of recharge was considerably less and ranged from about 0.26 gpm after the completion of drilling to 0.03 gpm after 4 days. The depth to groundwater stabilized at approximately 363 feet bgs (1,567 msl).

The initially high variability of inflow and the stabilized low rate of inflow over a day or less following completing drilling are attributed to the degree of jointing and fracturing encountered in each boring and the generally limited interconnectedness of the joints and fractures within the granitic bedrock (Appendix E).

Following completion of borings to total depth and conducting of video surveys, short-term step-drawdown tests were conducted on August 15 and 16, 2006. During the step-drawdown tests, groundwater was withdrawn from borings MW-1 and MW-2 using a submersible pump. A summary of the step-drawdown data is presented in Table 4.2-1.

Short-term step drawdown tests and constant rate tests were also performed over the period September 18 - 21, 2006. During each set of testing events, groundwater level measurements were recorded at each boring prior to and during the step-drawdown and constant rate tests. The data collected were used to estimate the specific capacity of the well. The water level in an existing well on the adjacent Kirkpatrick property (hereinafter, the Kirkpatrick well) was measured prior to and upon conclusion of the step-drawdown tests to observe and document possible change in the groundwater level that may be attributable to performance of the step-drawdown and constant rate tests (Appendix F).

Groundwater in the form of surface seeps was observed on site during an initial site reconnaissance (May 2006) within the main access road and along one of the on-site roads in the southwest portion of the site. These seeps did not evidence flow during subsequent field activities associated with drilling and pumping tests (September 2006). The locations of observed springs and seeps are shown on Figure 2.1. Fluctuations of the groundwater level, localized zones of perched water, where present, rates of spring and seepage flow and variations in soil moisture content should be anticipated during and following the rainy season.

4.2.1 Groundwater Occurrence and Movement

Based on occurrence and characteristics of groundwater encountered during drilling and testing performed at the three borings advanced for this evaluation, groundwater occurs in relatively limited quantities within localized joints and fractures in otherwise impermeable rock beneath and in the immediate vicinity of the proposed Liberty Quarry. DWR (1956, 1971) shows this area to be underlain by non-water bearing rocks. However, groundwater appears to occur locally in sufficient quantities to meet the minimal water supply demands of nearby residences, which are primarily located at topographically lower elevations (compared to the quarry property) in structurally controlled valleys that are expected to have a thicker cover of alluvium. Or, in the case of the Kirkpatrick well, located at a higher topographic elevation than other nearby residences in the primary drainage of structurally controlled valley, with the pump assembly set a 500 feet bgs in a 1,000 foot deep well (i.e., deep enough to provide sufficient storage capacity).

As evidenced during drilling and testing of three borings advanced for this evaluation, groundwater occurs at widely varying depths and elevations suggesting there is limited hydraulic connection between fractures. Further, and as described below, the results of step-drawdown and constant rate tests performed at the three deep borings underscore the limited nature of groundwater present in and apparent lack of continuity of joints and fractures within the granitic bedrock underlying the project site. As such, no distinct groundwater surface, aquifer, or gradient occurs beneath the project site.

4.3 PUMPING TESTS

Pumping tests were conducted at each of the three boring to collect data for an evaluation of the hydraulic characteristics of the bedrock, and in particular, to estimate how much water might drain into the quarry on a long-term basis. The tests included short-term step-drawdown tests and longer-term constant rate tests.

Short-term step-drawdown tests were performed at two of the three borings on August 15 and 16 and on September 18 and 19, 2006, to gain a better understanding of hydraulic conditions in the each boring, and to further evaluate the limited amount of groundwater seepage and inflow observed during and immediately after drilling. The step-drawdown tests were designed to identify a range of pumping rates for which each boring could be tested, with the intent to stress and observe changes in the hydraulic system resulting from variable rates of pumping over a short periods of time. Results of the step-drawdown tests are presented in Section 4.3.3 and Appendix F.

4.3.1 Description of Equipment and Monitoring Procedures

A 26-stage 5-horsepower Grundfos® submersible pump was used for the August 15 and 16, 2006 step-drawdown tests. The submersible pump was installed at 546 feet bgs (1,369 msl) in MW-2 and at two depths, 252 feet bgs (1,448 msl) and 462 feet bgs (1,238 msl), in MW-1. The pumping or discharge rate of the discharged water was controlled using a 1-inch inside diameter (ID) gate valve. Groundwater generated from the step-drawdown tests was discharged on-site.

Several submersible pumps were used to conduct the step-drawdown and constant rate tests on September 18 - 21, 2006 because of the wide range of static groundwater levels, boring depths, as well as observed and anticipated discharge rates.

The depth to groundwater was recorded immediately prior to the commencement of testing and upon starting each step-test using a water level indicator. The frequency of groundwater level measurements was as follows: every minute for a minimum of 15 minutes, then every 5 minutes until the test was complete. Due to the relatively slow recharge at MW-3 following completion of drilling, a step-drawdown test was not performed at that location.

4.3.2 Step-Drawdown and Constant Rate Tests

Step-drawdown tests were performed at MW-1 and MW-2 on August 16 and 15, 2006, respectively. At MW-2 the depth to groundwater was measured and recorded at 208.87 feet bgs (1,706.13 msl) prior to the start of the test. Upon commencement of the test, the flow rate was adjusted with a gate valve to 10 gallons per minute (gpm). The pump was operated at a flow rate of 10 gpm for 15 minutes, and depth to groundwater measurements were recorded every minute. At the end of this 15-minute step, drawdown was 11.63 feet. For the second step of pumping, the flow rate was increased to 20 gpm for 15 minutes. During this step, depth to groundwater measurements were taken every minute. After 15 minutes of pumping at 20 gpm the drawdown was 33.61 feet. The flow rate was further increased to 25 gpm after 30 minutes of pump operation and operated at this flow rate for 15 minutes. Depth to groundwater measurements were taken every minute. At the end of this 15-minute step, drawdown was 45.83 feet. The flow rate was increased to the pump's maximum discharge of 27 gpm after 45 minutes of pump operation. The pump was operated at a flow rate of 27 gpm for 75 minutes. Depth to groundwater measurements were taken every minute for the first 15 minutes and every 5 minutes for the remaining 60 minutes. At the conclusion of this final pumping step the drawdown was 90.08 feet (Appendix F).

On August 16, 2006, a step-drawdown test was performed on boring MW-1. Prior to commencement of the test depth to groundwater was measured and recorded at 22.83 feet bgs (1,677.17 msl). Immediately after the start of the test, the flow rate was adjusted with a gate valve to 13.5 gpm. The pump was operated at a flow rate of 13.5 gpm for 43 minutes. For the first 20 minutes of the test, depth to groundwater measurements were made every minute and every 5 minutes for the remaining 23 minutes. After 43 minutes, the pumping water level reached the pump intake and “broke suction” and the pump was shut down to prevent damage to the pump. Immediately prior to “breaking suction” the drawdown was 227.17 feet. The pump was then reset to a depth of 462 feet bgs (1,238 msl) and groundwater was measured at a depth of 222.8 feet bgs prior to re-commencement of pumping. The pump was then operated at a lower flow rate of 9 gpm for 45 minutes. Depth to groundwater measurements were taken every minute for the first 20 minutes and every 5 minutes for the remaining 25 minutes. At approximately 45 minutes, the flow rate had declined to 6.5 gpm and the pump continued operating at this self-adjusted flow rate for another 32 minutes until the pumping water level again reached the pump intake forcing the termination of the step-drawdown test. At the 45 minute pumping time, the drawdown was 336.49 feet. At the conclusion of the test, the drawdown was 437.17 feet (Appendix H).

Step-drawdown tests were again performed at MW-1 and MW-2 between September 18-20, 2006, and constant rate tests were performed at MW-2 and MW-3 between September 19 and 22, 2006. As described above for the August 2006 step-drawdown tests, MW-1 and MW-2 were pumped at three or more discharge rates for a select period of time. During each test groundwater levels in the boring were measured at short time intervals to monitor the hydraulic impacts observed due to pumping and to establish an appropriate discharge rate for the subsequent constant rate test. The results of the step-drawdown tests yielded the following findings:

- MW-1 was pumped at discharge rates of 4 gpm for two hours and 10 minutes, 5.7 gpm for one hour and 21 minutes, and 10 gpm for 43 minutes, with associated drawdowns of 185.6, 405.7 and 493.5 feet, respectively. After the third step, pumping was terminated when the pumping water level reached the pump intake.

- MW-2 was pumped at discharge rates of 20 gpm for one hour, 40 gpm for one hour and 60 gpm for 30 minutes with associated drawdowns of 75.5, 193.5 and 321.3 feet, respectively. After the third step, pumping was terminated when the pumping water level reached the pump intake. MW-2 was then pumped at a reduced discharge rate of 43 gpm for 30 minutes with an associated drawdown of 302.3 feet.

A constant rate test was conducted at MW-2 on September 19 and 20, 2006 immediately following completion of the step-drawdown test. The “well” was pumped for seven hours and 41 minutes at a declining discharge rate from 30 gpm (for the initial 66 minutes) to 20 gpm until the pumping groundwater level reached the pump intake and could no longer be continued. Drawdown at the end of the test was 317.3 feet.

Following the constant rate test, groundwater levels were allowed to recover for two hours. The pump was then turned on and ran for one minute at a discharge rate of 13 gpm when the pumping groundwater level reached the pump intake and the test could no longer be continued. The partially recovered depth to groundwater at the beginning of the test was 480.8 feet and dropped to 549.5 feet after one minute of pumping, the latter depth about 20 feet above the drilled bottom of the boring.

A constant rate test was performed at MW-3 on September 21 and 22, 2006. MW-3 was initially pumped at a discharge rate of 30 gpm for 37 minutes before the groundwater level reached the pump intake and forced termination of the test. Drawdown was 736.5 feet. Groundwater levels were allowed to recover for two hours before pumping re-commenced. MW-3 was then pumped at a discharge rate of approximately 35 gpm for four minutes when the groundwater level again reached the pump intake and the test could no longer be continued. Groundwater levels were allowed to recover for another 30 minutes then restarted at a discharge rate of 30 gpm. After seven minutes of pumping the pumping groundwater level reached the pump intake and the test could no longer be continued.

4.3.3 Results of Step-Drawdown and Constant Rate Tests

Results of the step-drawdown tests are summarized in Appendix F. The data obtained indicates the specific capacity or the water yielding character of the boring and by extension, the granitic bedrock, is very low based on the range of values calculated, which were 0.9 gpm per foot (gpm/ft) at the start of the test, and declined to 0.01 gpm/ft near the end of the test. The calculated specific capacities resulting from the constant rate tests performed at MW-2 and MW-3 were also very low, at 0.06 and 0.04 gpm/ft, respectively.

Translation of calculated specific capacity values to potential groundwater production are as follows, for each gallon of groundwater pumped per minute: for a specific capacity of 0.01 gpm/ft, the drawdown would be 100 feet for every one gpm of groundwater production. For the highest specific capacity reported, 0.9 gpm/ft, the drawdown would be 1.1 foot for every one gpm of groundwater production. However, it should be noted that specific capacity decreases as the length of time increases, and long-term specific capacity rates would be expected to be closer to 0.01 gpm/ft, or less.

The step-drawdown and constant rate tests revealed the variable and limited extent of groundwater within the joints and fracture of the underlying granitic bedrock. As indicated above and in Appendix F – Table F-3, pumping at discharge rates of 4 to 10 gpm at MW-1 would most likely temporarily drain or dewater the joints and fractures containing groundwater at this location within a relative short time span. Likewise, dewatering of MW-2 and MW-3 was also observed to occur within a few hours in the step-drawdown and constant rate tests at relatively low discharge rates. Also observed during the pumping tests was a lack of communication or connectivity between borings and fractures. Specifically, when a given “well” was undergoing either test, the remaining on-site wells and Kirkpatrick well were monitored as “observation wells” for changes in groundwater elevation, which was not observed. Therefore, it appears there is very little, if any, hydraulic continuity between the fractures and joint sets encountered in the three borings advanced for this evaluation, nor with the Kirkpatrick well.

Rates of flow in mountainous granitic terrain are dependent on the amount of groundwater contained in fractures and joint sets, the hydraulic continuity of those joints and fractures to yield water, and most importantly, precipitation (Fetter, 1994). In wet years, more groundwater from deep percolation may recharge joint sets and fractures. Conversely, in dry years, less groundwater would be present due to the lower amount of deep percolation. The results of the pumping tests indicate the factures and jointing encountered in the three borings contain limited, readily exhaustible amounts of water and did not demonstrate continuity between boring locations. These results also suggest:

- The lack of fracture and jointing continuity is considered indicative of a lack of hydraulic communication between the proposed quarry's upland topography and surrounding lowlands.
- There is insufficient water present in fractures and jointing at the proposed Liberty Quarry property to be considered an extractable resource for consumptive or industrial uses.
- The water present in fractures and jointing at the proposed Liberty Quarry property should not present an unacceptable engineering challenge to quarry operations.

4.4 GROUNDWATER SUPPLY AND DEMAND

As discussed in preceding sections, granitic bedrock underlying the project site and vicinity is considered non-water bearing (DWR, 1956, 1971). Groundwater was encountered in localized fractures and joint sets intersected by the three deep borings advanced for this evaluation. Groundwater was also observed to occur during the Spring months of 2006, at what are interpreted to be seasonal seeps, where the saturated portion of fractures and joints in the bedrock are exposed at or near the surface. As such, groundwater does not occur as a true "aquifer" but rather as isolated seams of saturation within fractures and joints. At the project site, groundwater is recharged by a combination of direct recharge from precipitation and overland runoff into exposed fractures and joints.

Because groundwater is limited to narrow joints and fractures, groundwater production from these areas is also limited. However, at locations removed from the proposed Liberty Quarry, at lower elevations in differing hydrologic environments, groundwater appears to occur in sufficient quantities to meet the minimal water supply demands of nearby residences, which are typically much less than one acre-foot (AF, approximately 325,830 gallons per acre-foot) per household per year. In urban and suburban settings the estimated annual water demand is about one AF per two households. Such water use translates to a continuous year-round groundwater production demand of 0.62 gallons per minute (gpm). By contrast, well yields in the Temecula Groundwater Basin, a large, alluvial aquifer in the lowlands east of the proposed Liberty Quarry, range from about 300 to 1750 gpm (DWR, 2003).

4.4.1 Hydraulic Isolation

Observations of groundwater levels and inflow during drilling and pumping tests indicate a general hydraulic isolation within the site. Although fractures and joints are observed in cores and boreholes to depths approaching 1,000 feet below ground surface, they are apparently not laterally extensive because they contain only small quantities of groundwater that are quickly depleted. During drilling of the boreholes, the rate of groundwater inflow declined substantially as the borehole depth increased, as fractures were dewatered. Pumping tests at each of the three boreholes showed a similar decrease in groundwater yield as time increased. Specific capacity values quickly fell into the range of 0.01 gpm/ft after only a few hours of pumping and were still dropping as the test ended.

The results indicated that, as fractures were dewatered, the sustainable yield fell dramatically. It appears there is insufficient water available in the fractures and joints to be considered an extractable resource for consumptive or industrial uses. During pumping tests at each of the “wells,” none of the other non-pumped “wells” showed any decline in groundwater level, a testament to the hydraulic isolation of the “wells.” Steady-state water level elevations in the three boreholes varied by approximately 150 feet; indicating a lack of hydraulic continuity between the boreholes.

The hydraulic isolation of the site is apparent on a larger scale, represented by the ephemeral nature of seeps and intermittent springs. These features were present in the southwestern portion of the site at the end of the rainy season in May of 2006, but were not present near the end dry season, in September. The disappearance of the seeps and springs during the dry season attests to the limited extent of groundwater, which is insufficient for sustainable seepage.

The hydraulic isolation of the site also has a surface water hydrology component. The lack of hydraulic communication of fractures and joint sets that control and limit groundwater migration off site will similarly affect surface water discharges or precipitation within the quarry.

4.5 GROUNDWATER QUALITY ANALYSIS

Groundwater sampling and analysis was performed at one off-site groundwater well and the three borings advanced as part of this geologic and hydrologic evaluation. The purpose of the groundwater sampling and analysis was to evaluate indicator analytes to assess water quality prior to potential development activities associated with the proposed Liberty Quarry, and to have a comparative basis for water samples recovered from existing private water supply wells in the vicinity of the proposed Liberty Quarry property.

4.5.1 Off-Site Water Well Sampling

Two categories of off-site water supply wells were initially considered for groundwater sampling and/or analysis: (1) Municipal production wells; and (2) Private water supply wells. Because the proposed Liberty Quarry is located in a rural, topographic upland, the closest municipal production wells are located near populated communities (e.g., Temecula), located in the valleys below the quarry property several miles from the property. These municipal production wells are constructed in a very different geologic/hydrologic environment than is encountered at or in the vicinity of the quarry property, and due to the urbanization of these valley areas, environmental pollutants can be present. For these reasons, the data from these wells would not be representative of the water quality in the vicinity of the quarry property.

Several attempts were made to secure permission to sample identified, private water supply wells at properties in the vicinity of the proposed Liberty Quarry. Unfortunately, with the exception of the owners of the Kirkpatrick property (west of the quarry property), the owners of other off-site private water supply wells declined to allow sampling of their wells. Therefore, only one off-site groundwater sampling location was available for this evaluation.

The water sampling procedures utilized for sampling the Kirkpatrick well followed U.S. Environmental Protection Agency (EPA) protocols, including chain-of-custody procedures. A summary of the groundwater sampling activities at the Kirkpatrick well are presented below:

- Groundwater samples from the Kirkpatrick well were collected using the in-place pumping assembly present in the well. A separate sampling pump was not used;

to do so would require the removal of the pump house over the well, removal of the in-place pumping assembly, and deployment of a sampling pump. This would have been an unacceptable inconvenience for the well owner. Moreover, for the inorganic constituents that were analyzed, this sample collection procedure would not be expected to negatively impact the sample results.

- The in-place pump was engaged and operated at a pumping rate of approximately 10 gallons per minute (gpm) for one hour to draw formation water into the well bore. Groundwater was discharged directly to the ground surface in the adjacent drainage channel via a hose installed prior to the surge tank for this purpose.
- At the end of one hour, groundwater samples were collected by decanting groundwater from the discharge hose directly into the sample container, which were laboratory-clean containers provided by the state-certified laboratory selected to perform the analysis. Upon collection, groundwater samples were sealed, labeled, and placed under refrigerated conditions for transport to the laboratory. Sampling information was recorded on a chain-of-custody form, which accompanied the samples to the laboratory for analysis.

Groundwater samples from the Kirkpatrick well were analyzed for the suite of metals and inorganic constituents presented on Tables 4.5-1 and 4.5-2; copies of the analytical laboratory reports are presented in Appendix G.

4.5.2 Groundwater Sampling During Pumping Tests

Groundwater sampling at MW-1 through MW-3 was accomplished following similar procedures as those used for the Kirkpatrick well. The results are summarized below:

- Groundwater sampling was performed during the pumping tests conducted at MW-1 through MW-3 via a sampling port on the discharge line for the down-hole pump assembly.
- Two groundwater samples were recovered from MW-1 during the pumping tests at this location. The first sample was recovered approximately 30 minutes into the pumping tests; the second sample was recovered approximately 30 minutes prior to terminating the pumping tests. The sample

considered representative of groundwater quality outside the boring (i.e., deeper into the joint and fracture system) is the second sample because at least three well volumes of water had been purged prior to sampling. The first sample was collected for comparison purposes, and to evaluate the expected greater total suspended solids concentrations.

- Groundwater samples were recovered from MW-2 and MW-3 approximately 30 minutes prior to terminating pumping tests at each location.
- All groundwater samples recovered during pumping tests were decanted directly from the sampling port installed in the discharge line of the pump assembly into laboratory-clean sample containers provided by the state-certified laboratory selected to perform the analysis. Upon collection, groundwater samples were sealed, labeled, and placed under refrigerated conditions for transport to the laboratory. Sampling information was recorded on a chain-of-custody form, which accompanied the samples to the laboratory for analysis.

Groundwater samples from MW-1 through MW-3 were analyzed for the suite of metals and inorganic constituents presented on Tables 4.5-1 and 4.5-2; copies of the analytical laboratory reports are presented in Appendix G.

4.5.3 Groundwater Sampling at Surface Seeps

Surface seeps were observed at three locations (Figure 2.1) during initial reconnaissance efforts (May 2006) at the proposed Liberty Quarry property. However, these seeps were not visibly flowing (only showing damp soil conditions) when subsequent groundwater sampling took place in September 2006. Therefore, no samples of groundwater from the surface seeps were recovered for analysis.

4.5.4 Results of Laboratory Analysis of Groundwater Samples

Groundwater samples recovered from the off-site Kirkpatrick well and MW-1 through MW-3 located on the proposed Liberty Quarry (Figure 2.6) were analyzed for the inorganic analytes and metals presented on Tables 4.5-1 and 4.5-2, respectively. The purpose of performing the inorganic and metals analyses was to evaluate a suite of standard water quality parameters as indicator analytes for water quality at and in the vicinity of the proposed Liberty Quarry. A review of the analytical results for the groundwater samples indicates:

- The inorganic and metals analyses show detected constituents and concentrations that are considered typical or representative of groundwater samples from a granitic host-rock environment.
- Concentrations reported for the detected analytes are typically variable within a relatively narrow range, which is interpreted as evidence of the natural spatial variability found in most geologic environments.
- Concentrations of detected inorganic analytes are less than applicable listed Water Quality Objectives (SDRWQCB, 1994), with the exception of fluoride in samples recovered from MW-1 and MW-2. Based on the data reviewed to date, and the lack of encountered anthropomorphic impacts at this relatively rural location, the detected concentrations are interpreted as naturally occurring.
- The distinctly elevated alkalinity and hardness concentrations (both reported as $CaCO_3$) in samples recovered during pumping tests represents longer rock-contact time for the water, which is consistent with the lack of fracture and jointing continuity observed during pumping tests (i.e., water infiltrating fractures and joints is “trapped” and mineral concentrations in water will approach equilibrium the host rock over time (Langmuir, 1997)).
- MW-1 (Sample ID IPDII689-01): This sample from MW-1 was recovered approximately 30 minutes after pumping tests commenced at this location. While the majority of the constituent concentrations are within the range of those evidenced in the other recovered groundwater samples, the distinctly greater concentration of Total Suspended Solids are expected from a sample recovered this early in the pumping test. This sample is not considered representative of groundwater conditions at this location, and was recovered for comparison purposes with the later sample recovered from this boring to evaluate changes in water chemistry during the pumping test.
- MW-1 (Sample ID IPII689-02): This sample from MW-1 was recovered approximately 30 minutes prior to terminating pumping tests, and is considered representative of groundwater conditions at this location.

- Concentrations of detected metals analytes in samples from the Kirkpatrick well, as well as MW-1 through MW-3 are less than applicable listed Water Quality Objectives (SDRWQCB, 1994), with the exception of iron, which is reported at concentrations exceeding Water Quality Objectives in samples recovered for analysis at the locations sampled for this evaluation. The first sample collected from MW-1 (Sample ID IPII689-01) is not considered, as the sample is not representative of groundwater at that location.

  The elevated iron concentration evidenced in the sample from the Kirkpatrick well is interpreted, in part, as a result of reaction of the water with the mild steel well casing utilized in well construction. The slightly elevated iron concentrations evidenced in the second sample recovered from MW-1, as well as the samples from MW-2 and MW-3, are interpreted as evidence of the naturally occurring background iron concentrations at these locations.

- Kirkpatrick Well (Sample ID IPD2057-01): The relatively elevated zinc concentration (Table 4.5-2) is interpreted as attributable to the galvanized pump-assembly discharge piping. There are also fewer metals detected in the sample recovered from this well, which is believed to be a result of the physical location of the well in relatively well-defined, structurally bound drainage course that will have relatively greater associated volumes of water/groundwater flow.

  The analyses for inorganic constituents from the sample recovered from the Kirkpatrick well show the greatest concentrations of the nitrate suite (Total Kieldahl Nitrogen, Nitrate-N, Nitrate-NO_3, and Total Nitrogen), which is interpreted as attributable to agricultural activities up-slope and in the vicinity of the well. The distinctly lower concentrations of alkalinity and hardness are believed to be representative of the physical location of the water well in well-defined, apparently structurally bound drainage course that will have relatively greater associated rates of water/groundwater flow.

  In granitic terrain, longer residence time is needed to dissolve constituents and yield alkalinity. The low alkalinity values in this well suggest a low residence time, which is consistent with a faster flow rate for groundwater at this location. It should be noted the Kirkpatrick well is located downhill from the proposed Liberty Quarry, in a local channel of alluvium, and is not considered to be representative of hydrologic conditions within the proposed quarry footprint.

5.0 POTENTIAL IMPACTS AND MITIGATION

5.1 POTENTIAL GROUNDWATER IMPACTS

Based on a review published literature, geologic and hydrologic assessment activities performed at the proposed Liberty Quarry site, and subsequent data analysis and evaluation performed to date, the proposed quarry site appears to be topographically, structurally, and hydraulically isolated from near-by, off-site intermontane valleys and topographic lowlands (e.g., Rainbow and Temecula Valleys). Operations at the proposed Liberty Quarry are not anticipated to adversely affect local or regional groundwater supplies for residents in the surrounding area, or Temecula or Rainbow Valleys.

Based on the evidence, the proposed quarry property does not have a groundwater aquifer as the term is classically defined. Rather, fractures and joint sets with limited hydraulic continuity have become saturated through infiltration of precipitation over time. Therefore, water encountered in fractures and joints on site appears to be “trapped”, with the exception of a limited number of ephemeral seeps, which appear to dry up after the wet season. Conversely, precipitation or imported water discharged in the proposed quarry during operations is expected to remain within the quarry footprint for the same reasons. As quarry operations advance into underlying bedrock, surface seeps adjacent to quarry operations are expected to decline or potentially cease ephemeral flow.

5.2 POTENTIAL SURFACE WATER IMPACTS

5.2.1 Potential Construction and Mine Operations Stormwater Impacts

Initial development of the proposed Liberty Quarry will involve establishing site access, installing utility corridors, and constructing other infrastructure and operational improvements for the facility; removing overburden material and exposing rock suitable for aggregate production; and initiating bedrock excavation consistent with mine development sequencing. These construction-related activities can create potential surface water impacts, such as erosion and sedimentation in natural drainages. Additional potential sources of surface water impacts associated with construction activities are infrastructure support services such as equipment fueling and maintenance.

After initial site development and Phase I mining operations are initiated, surface water drainage within the quarry will be progressively more inwardly directed as mining operations continue. Inward drainage of storm water within the quarry is anticipated to constrain potential surface water impacts from mining operations and limit impacts to those associated with controlling or maintaining natural and engineered drainages that convey stormwater off the quarry property.

Mitigation of potential surface water impacts related to construction and on-going mining operations can be address through SWPPPs implementing BMPs tailored to site-specific conditions and activities. It is anticipated that one SWPPP will be developed to address potential construction-related surface water issues, and a second SWPPP will be developed to address potential surface water issues associated with long-term operations of the proposed quarry.

5.2.2 Reduction in Surface Stormwater Runoff

As quarry mining operations are completed in phases, surface stormwater runoff would decrease from the reported pre-project discharge proportionally to the amount of each sub-basin being brought below grade (with the exception of the two Vallecitos sub-basins where the access road will be constructed), The results of the hydrology analysis indicate reductions is post-project peak surface flow in affected subbasins can exceed 50 percent.

The effect of a reduction in surface water runoff from the proposed quarry area is very small when considering the Santa Margarita Watershed (the proposed quarry footprint occupies approximately 0.03 percent of the watershed). Similarly, the footprint of the proposed quarry occupies only a small portion of the Gavilan and Vallecitos Basins (0.25 and 1.38 percent, respectively). The estimated reduction in surface stormwater runoff associated with the proposed Liberty Quarry footprint is considered too small to be meaningfully measured at this scale; and is greatly overshadowed by the significant increase in surface stormwater runoff resulting from the rapid urbanization of the Santa Margarita Watershed.

At the local level, some properties adjacent to the proposed quarry will experience an evolving reduction in surface stormwater flows as quarry construction progresses, except in those locations where the offsite drainage areas were outside of the quarry excavation limits. In those locations, the pre- and post project stormwater flows would remain unaltered. This reduction in surface stormwater runoff can be mitigated by utilizing water purchased for quarry operations to make up the incremental difference in what was lost due to quarry opperations

5.2.3 Potential Surface Water Impacts Associated with Access Road

Peak discharges in Vallecitos sub-basins V-4 and V-5 will increase for the post-project condition due to the increased impervious cover resulting from a paved access road coupled with the increased hydraulic routing efficiency of roadway drainage conveyances result in an increase in peak discharge near the I-15 off-ramp location. This localized increase in peak flow will be mitigated by engineered drainage and a detention basin at the lower end of the access road. It is anticipated the stormwater collected in the detention basin will be used for quarry operations and not discharged to Rainbow Creek.

5.3 OTHER POTENTIAL IMPACTS

The project description (Lilburn, 2007) indicates that on-site sanitary requirements will be addressed by a septic system for plant personnel and portable facilities for personnel working the in quarry. Based on the results of geologic and hydrologic evaluation it is unlikely there will be sufficient sediment development at the quarry location to support the planned septic system. This issue can be mitigated through the use of a sanitary holding tank that is routinely evacuated for off-site disposal at an appropriately licensed facility. Another mitigation alternative is the use of an on-site bioreactor-type waste treatment system, with effluent used as non-potable irrigation water.

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Date	Photos Nos	Scale
06-20-05 20-9, 20-10, 20-11,	06-20-06 1”-1600’	06-20-07
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