APPENDIX E: GEOPHYSICAL

GEOTECHNICAL ASSESSMENT

PEER REVIEW OF GEOTECHNICAL REPORTS

REVISED GEOTECHNICAL ASSESSMENT
FOR THE ENVIRONMENTAL IMPACT REPORT (EIR) OF THE
PROPOSED REDEVELOPMENT OF SANTA BARBARA COTTAGE HOSPITAL
CITY OF SANTA BARBARA, CALIFORNIA

Prepared for:

LSA ASSOCIATES, INC.
1998 Santa Barbara Street, Suite 120
San Luis Obispo, California 93401

September 22, 2004

Project Number 600388-001

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

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A LEIGHTON GROUP COMPANY

September 22, 2004

Project Number 600388-001

To: LSA Associates, Inc.
1998 Santa Barbara Street, Suite 120
San Luis Obispo, California 93401

Attention: Ms. Jill O'Connor

Subject: Revised Geotechnical Assessment for the Environmental Impact Report (EIR) of the Proposed Redevelopment of Santa Barbara Cottage Hospital, City of Santa Barbara, California.

At you request and authorization, Leighton Consulting, Inc. (Leighton) is pleased to present the results of our revised geotechnical assessment for the Environmental Impact Report (EIR). We previously submitted a Geotechnical Assessment report dated July 13, 2004, for the project. This revised report addresses comments from the City of Santa Barbara regarding the July 13, 2004, report and incorporates information contained in an additional report for the project that was provided to us.

The proposed project is the Redevelopment of Santa Barbara Cottage Hospital (SBCH). The purpose of this study is to assist LSA in preparation of the Geology and Soils Sections of the EIR for the project. The geotechnical assessment included:

- Earth units onsite and their engineering characteristics;
- Geologic structure;
- Faults and seismicity;
- Secondary seismic hazards;
- Existing landslides;
- Stability of proposed slopes;
- Groundwater conditions;
- Subsidence; and
- Mineral resources.

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This report summarizes our findings and conclusions, identifies potential adverse impacts, and presents possible mitigation measures. Our review has incorporated published geologic information, including published consultant reports by others describing subsurface investigations on the project site.

During the course of this study, we have not identified any geologic or geotechnical condition that would preclude development of the proposed project. However, further site specific investigations and analyses of onsite conditions may reveal the need for remedial grading or design constraints. Numerous options, some of which are presented herein, are available for mitigation of the potentially significant impacts. The details of these mitigation measures should be studied and refined during future detailed geotechnical analyses.

We appreciate the opportunity to provide our services for this project. If you have any questions, please contact this office at your convenience.

Respectfully Submitted,

LEIGHTON CONSULTING, INC.

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1. INTRODUCTION

1.1 Purpose and Scope of Work

The purpose of this study is to provide a preliminary assessment of the potential geologic, geotechnical, and seismic conditions that may impact the design and construction of the proposed redevelopment of the Santa Barbara Cottage Hospital (SBCH) in the City of Santa Barbara (Figure 1). The information provided herein is intended for use as part of the Environmental Impact Report for the project. We have identified several potentially significant impacts to the development, and where applicable, provided possible remedial measures. The base map used for our analysis of the site is the Geotechnical Map (Figure 2) prepared by Fugro West, Inc. (Fugro, 2003b).

Our scope of work consisted of the following:

- A preliminary geotechnical assessment of the site including the review of available published and unpublished relevant geologic, seismic, and geotechnical literature, reports, and historic aerial photographs.

- The preparation of this report addressing the general geologic and geotechnical conditions at the site, including a discussion of our findings and conclusions as to the suitability of the site and preliminary recommendations for site development.

1.2 Methodology

This study was conducted in accordance with the guidelines set forth by the California Geological Survey (CGS, formerly know as the California Division of Mines and Geology, CDMG) in Notes 46 and 52, for preparation of Environmental Impact Reports (CDMG, 1982 and 2001) and in general accordance with the California Environmental Quality Act (CEQA) guidelines. The preliminary geotechnical assessment was conducted as follows:

- Review of available published and unpublished technical documents and reports, including consultant reports covering the known geologic and geotechnical conditions at the project site and vicinity. These data were analyzed with respect to the proposed redevelopment. This literature search also included a review and analysis of historical aerial photographs from numerous flights within the time period between 1972 and 1999. The references and aerial photographs reviewed are listed in Appendix A.

- Review of data collected during a previous geologic, geomorphic, and geotechnical studies of the site by Fugro West, Inc. (Fugro, 2003b). The Fugro studies included a geophysical survey, offsite field mapping, and the excavation of five sonic core drill holes and other geotechnical borings.

- Review of data collected during a previous geotechnical investigation for parking structures and daycare facility at the site by Geotechnical Professionals, Inc. (GPI, 2004). The GPI studies included drilling of nine geotechnical borings.

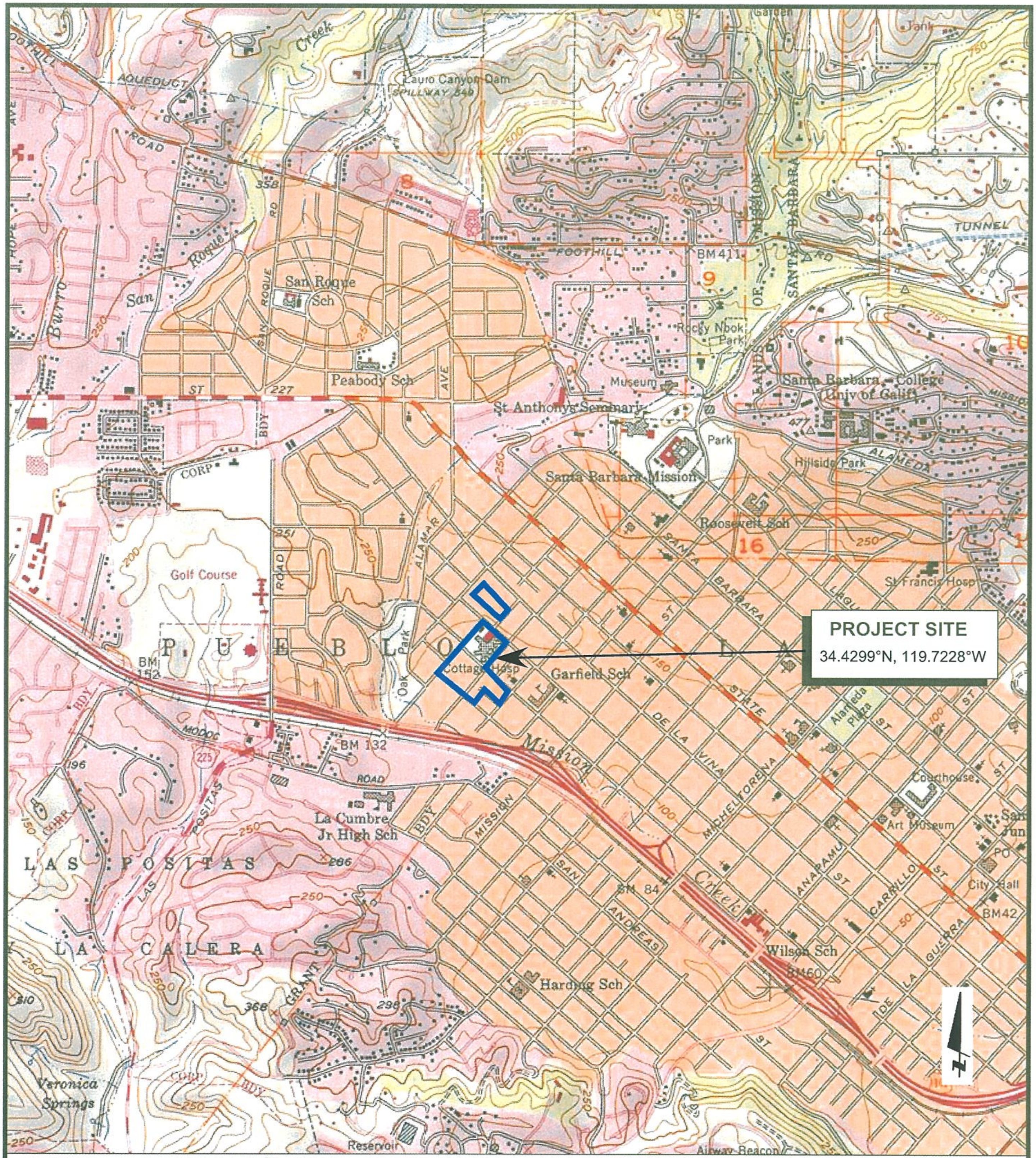
- The discussion of the geologic, seismic, groundwater, and soil engineering aspects of the site in this report is based on the data obtained from the above mentioned sources. The data were evaluated, and where appropriate, potential mitigation measures were provided. Representative geologic data of the project site and vicinity were compiled on a Geotechnical Map (Figure 2) by Fugro West, Inc., that accompanies this report.

1.3 Proposed Redevelopment

State Senate Bill 1953 (SB 1953) mandates that acute care facilities be brought up to current seismic standards. The existing Santa Barbara Cottage Hospital main medical facility does not comply to current seismic standards. To allow for continued operation of the hospital, it is proposed to sequentially demolish the existing main medical facility buildings and redevelop the site with a medical facility that conforms to current seismic standards. Also proposed is the construction of two new parking structures and other necessary ancillary site improvements. The project plan is currently in the conceptual phase.

1.4 Site Location and Description

The existing Santa Barbara Cottage Hospital (SBCH) is located in the low-lying Santa Barbara coastal plain region approximately ¼ mile north of Highway 101 at Bath Street and Pueblo Street near downtown Santa Barbara (Figure 1). This portion of the Santa Barbara Coastal Plain is drained by Mission Creek, located west of the project site. The medical facility area the site, is bound by Pueblo Street, Bath Street, Junipero Street, and Oak Park Lane. The northern parking structure is bound by Bath, Junipero, Quinito, and De La Vina Streets. The southern parking structure and daycare facility are bound by Pueblo, Castillo, and Los Olivos Streets, and Oak Park Lane. SBCH is located on a relatively flat portion of the plain in an area that ranges from approximately 130 to 165 feet above mean sea level (msl).



0 .5 1 MILE
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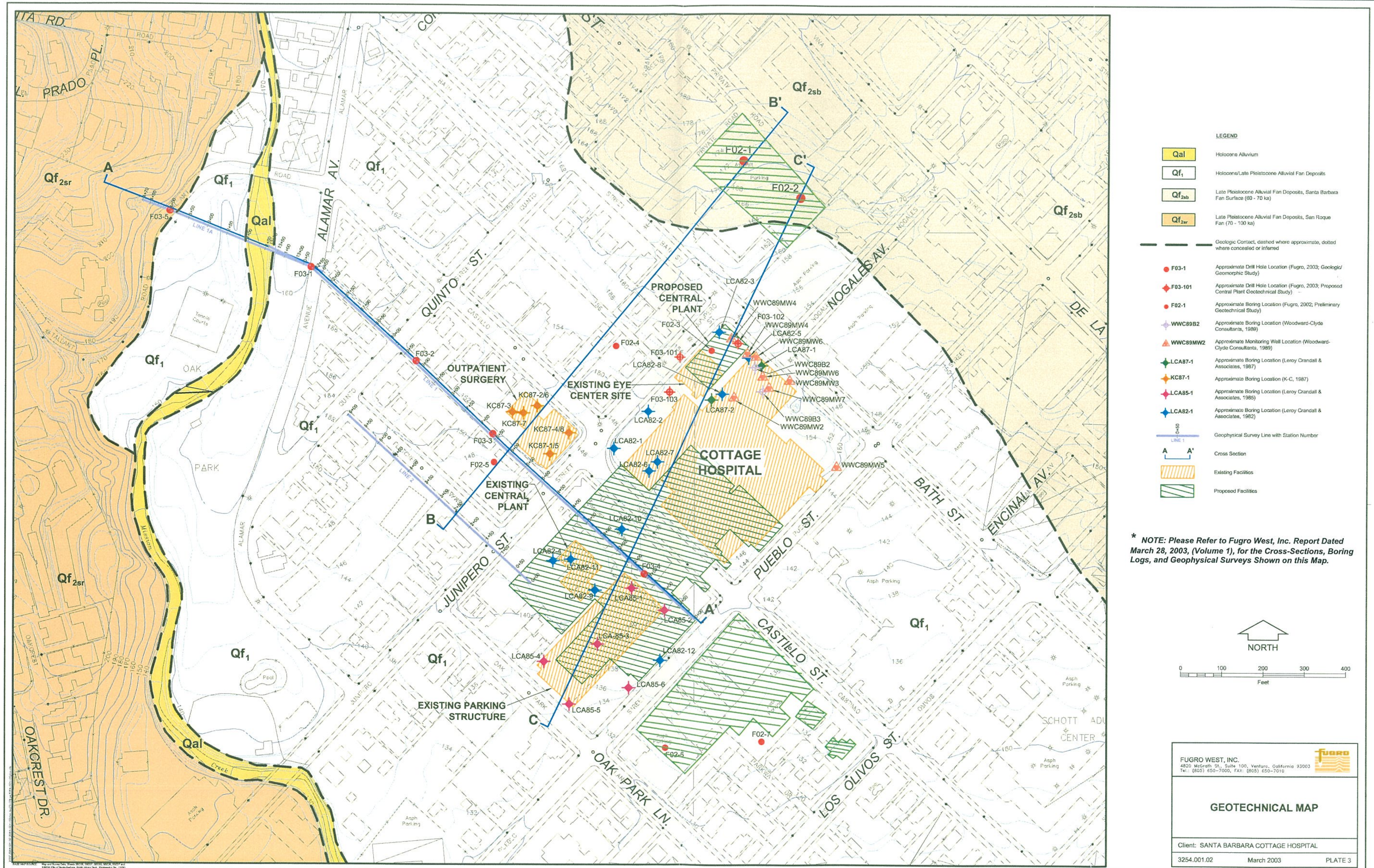
SITE LOCATION MAP

Santa Barbara Cottage Hospital
City of Santa Barbara, California

Project No.	600388-001
Scale	As shown
Drafted By	JMP
Date	September 2004

Leighton Consulting, Inc.

Figure No. 1



Base Map: Modified from the Geotechnical Map, Plate 3 of Fugro West, Inc. Report dated March 28, 2003, Volume 1 (Fugro, 2003c).

GEOTECHNICAL MAP Santa Barbara Cottage Hospital EIR City of Santa Barbara, California	Project No.	600388-001
	Scale	As shown
	Date	September 2004
	Leighton Consulting, Inc.	Figure No. 2

2. GEOLOGIC AND GEOTECHNICAL CONDITIONS

2.1 Regional Geologic Setting

SBCH is located in the coastal plain region of southern Santa Barbara County, in the western Transverse Ranges Geomorphic Province. The western Transverse Ranges province consists of the east-west trending Santa Ynez Mountain Range and coastal lowlands, both of which are comprised almost entirely of late Cretaceous to Holocene age (11,000 to 200 million years old) marine and non-marine sedimentary rocks and unconsolidated sediments. The coastal plain region of Santa Barbara County is a relatively flat alluvial plain area bounded by the Santa Ynez Mountains to the north and by the Santa Barbara Channel to the south. The low-lying coastal plain area contains younger and older surficial alluvial deposits. Older Miocene, Pliocene, and Pleistocene marine sedimentary rocks are exposed in the foothills of the Santa Ynez Mountains to the north and the coastal hills to the south and southwest.

The Transverse Ranges province is characterized by east-west trending landforms, such as mountain ranges and intervening valleys; and geologic faults and folds. Many active and potentially active folds and thrust faults of the Santa Barbara fold and fault belt underlie the Santa Barbara coastal plain. The generally east-west trending Santa Ynez Fault and Mission Ridge Fault System have this characteristic east-west trend. The general east-west structural pattern of the Transverse Ranges province is crossed to the east by the northwest trending San Andreas Fault.

2.2 Local Geology

The project site is located in the low-lying Santa Barbara coastal plain region, immediately east of Mission Creek near downtown Santa Barbara. Mission Creek originates from the local Santa Ynez Mountains to the north and flows through the alluvial plain southeast towards the ocean. The alluvial plain contains generally unconsolidated stream channel, flood plain, and fanglomerate deposits. Artificial fills are also present at the site as a result of previous site improvements. The Santa Barbara Formation bedrock is exposed in the coastal hill area to the south of the site.

2.3 Local Earth Units

2.3.1 Artificial Fill, Undocumented (Afu)

Undocumented artificial fill is present at the site as a result of previous site improvements. This fill material consists of silty sand to sandy clay. Fugro West (2003d) noted in Boring F03-4, that there are approximately 4 feet of fill in the vicinity of the project site. GPI (2004) reported up to 7½ feet of fill at the southern parking structure site; fill was not encountered at the northern parking structure site. The fills were either placed without oversight by a geotechnical engineer or the records of the geotechnical engineer can not be found.

2.3.2 Younger and Older Alluvium (Map Symbols: Qal, Qf_1, and Qf_2)

The surficial alluvium consists of stream channel deposits, alluvial fan deposits, and sediments that have been deposited in a flood-plain environment. The alluvial units are broken into three separate units based on age and are shown on Figure 2.

The youngest Holocene age alluvial unit (Qal) is found along the active Mission Creek to the west of the project site.

The next oldest Holocene to late Pleistocene age alluvial deposits (Qf_1) consists of unconsolidated floodplain and alluvial fan deposits. The near surface alluvial deposits in this region generally range in grain size from silt to gravel, however the near surface alluvium onsite predominantly consists of interlayered silty sand, silty gravel, sandy clay, and clay. A fairly prominent conglomeratic layer of gravel to boulder size clasts in a matrix of predominately silty sand also occurs within the Qf_1 unit.

The oldest alluvial unit is the late Pleistocene age (11,000 to 1 million years old) fanglomerate (Qf_2). The fanglomerate in this region generally ranges from silt to cobble and boulder in grain size. At the site, this earth unit has been encountered below the younger alluvial deposits and the artificial fills and generally consists of silty sands, silty gravels, sandy clays, and conglomeratic units consisting of gravels to boulders in a matrix of silty sand, sand, and silt.

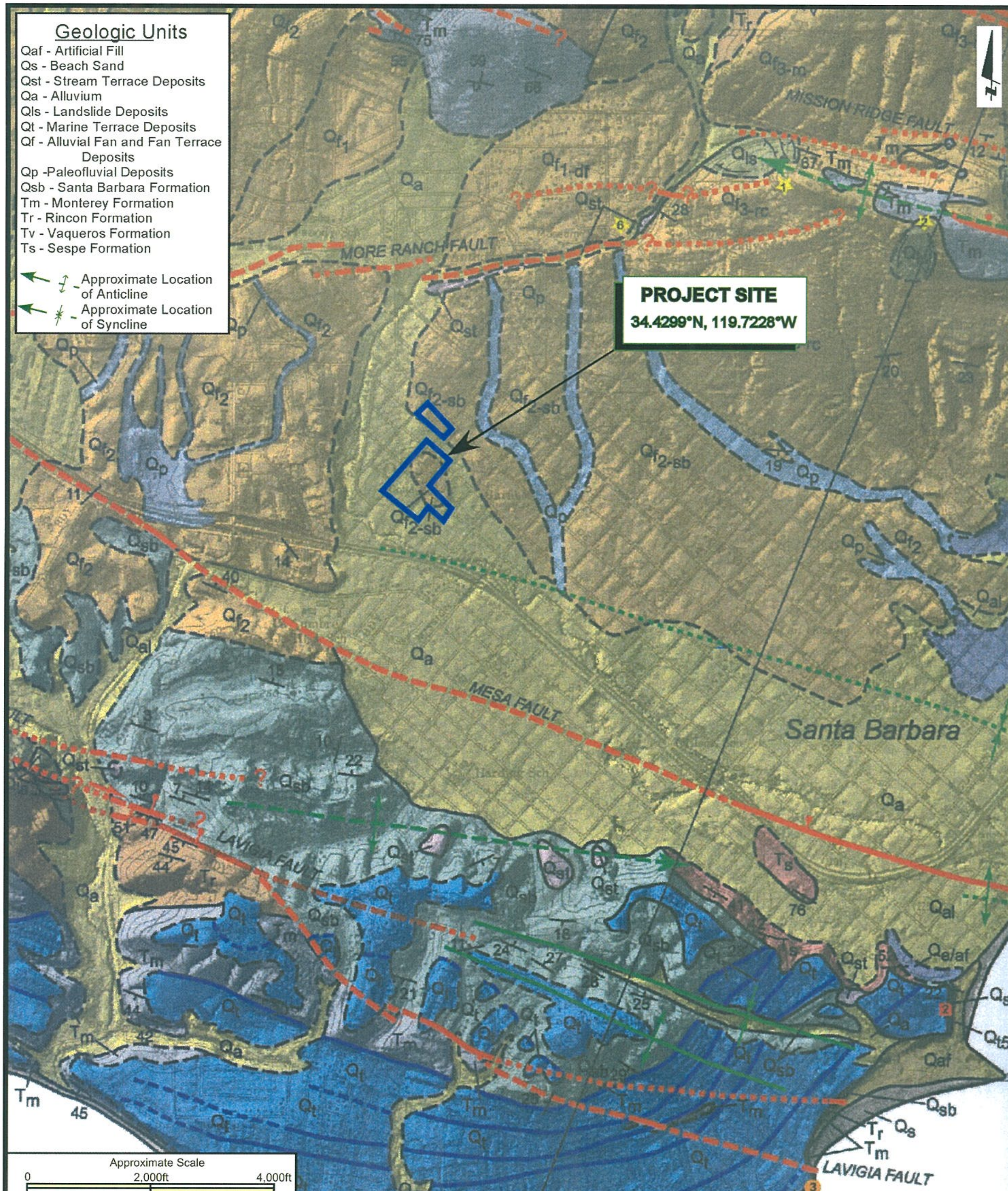
2.3.3 Santa Barbara Formation (Map Symbol: Qsb)

The middle Pleistocene age (around 1 million years old) Santa Barbara Formation bedrock in this area is a shallow marine formation consisting primarily of massive to bedded sandstones and siltstones, with occasional conglomerate beds. These rocks are typically tan to yellow and poorly to moderately consolidated. The Santa Barbara Formation is exposed in the coastal hills south of the project site (Figure 3).

2.4 Local Geologic Structure

The project site is located within the Santa Barbara Fold Belt (SBFB). The SBFB is an active linear belt of generally east-west trending folds and reverse faults located in the coastal plain of Santa Barbara and offshore in the Santa Barbara Channel. These folds and faults are the result of the ongoing crustal shorting across the western Transverse Ranges, which is associated with the right-slip and contraction in the vicinity of the "Big Bend" of the San Andreas fault.

The Mission Ridge Fault System and associated folds are the most prominent structural features within the SBFB.



Regional Geology Map

Santa Barbara Cottage Hospital
City of Santa Barbara, California

Base Map: Gurrola, L.D., 2004, Digital Elevation, Topographic, and Tectonic Geomorphology Map of the Eastern Santa Barbara Fold Belt, Santa Barbara, California, Oct. 2002, Revised Feb. 2004

Project No.	600388-001
Scale	As shown
Date	September 2004

Leighton Consulting, Inc.

Figure No. 3

2.5 Faulting and Seismicity

Southern California is a seismically active area. As such, the area is subject to seismic hazards from numerous sources in the area. The severity of the potential seismic hazards is related to the geology of the area, distance to the seismic source, and the magnitude of the earthquake generated by the seismic source. The principal seismic hazards that should be considered during the design are those that are generally investigated for most designs. These include: the potential for surface rupture along active or potentially active fault traces, the intensity of seismic shaking, and the potential to ground failure (such as liquefaction, lurching, and seismically induced slope failure).

2.5.1 Regional Active Faults

Numerous faults have been mapped within the southern California region, several of which are within about 62 miles (100 kilometers) of the site (the CGS requires that those faults within 100 kilometers that could effect the site or the proposed project be identified). The major active and potentially active fault systems that could produce significant ground shaking at the site include the Mission Ridge, Red Mountain, Santa Ynez, and North Channel Slope faults. The locations and distance of these faults with respect to the site are shown on the Regional Fault Map (Figure 4). Characteristics of the closest fault systems are discussed below, and a listing of the active and potentially active faults within 100 kilometers is provided in Appendix B.

North Channel Slope Fault

The North Channel Slope fault, located about 6.5 miles (10.4 kilometers) south of the site in the Santa Barbara Channel, is an east-west trending reverse fault that extends approximately 60 kilometers in length (Peterson et al., 1996). This northern dipping reverse fault is an offshore fault located in the channel between the Channel Islands and the Santa Barbara coastline. The North Channel Slope fault is estimated to be capable of generating a maximum earthquake of M_w 7.1.

Mission Ridge Fault Zone

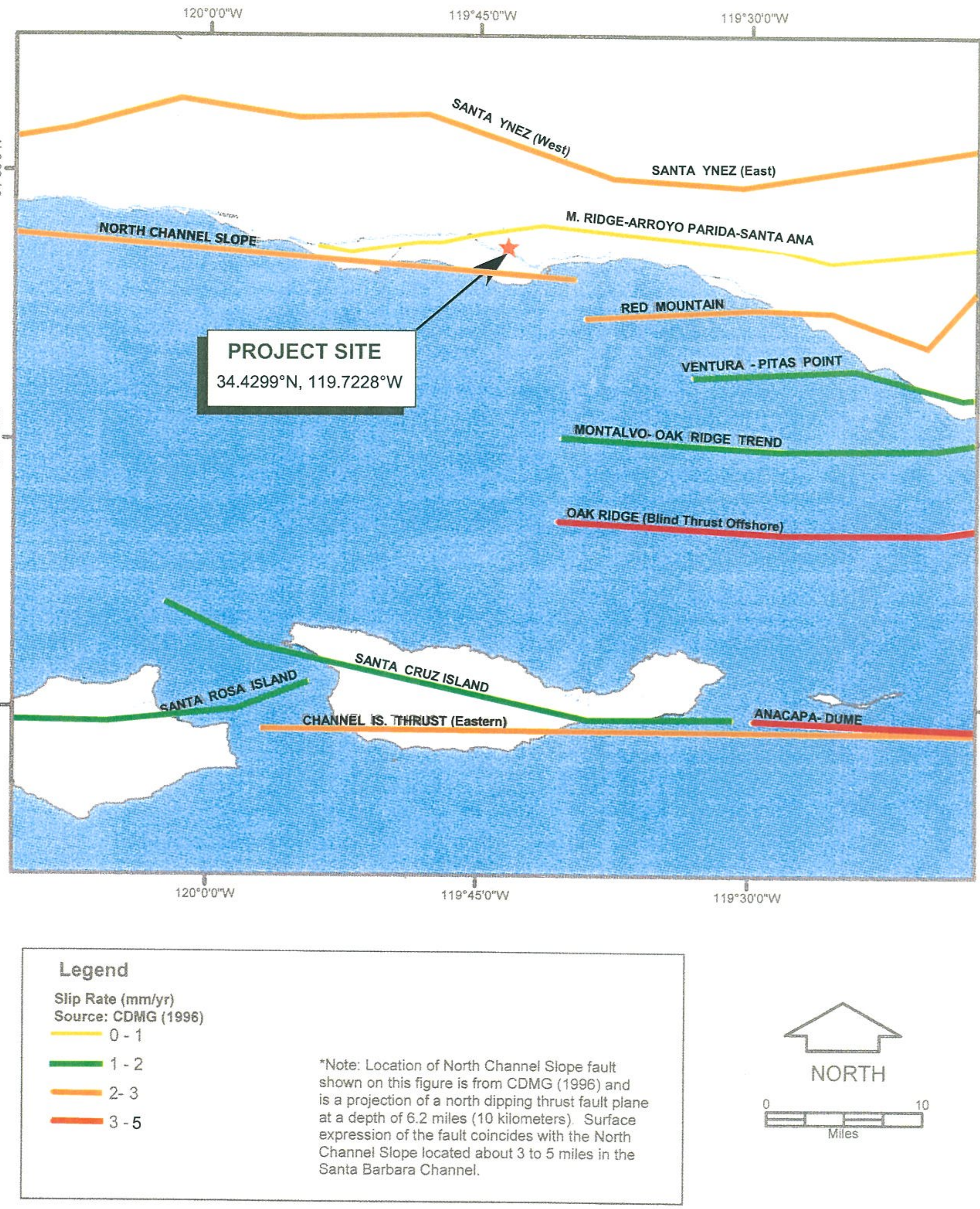
The Mission Ridge Fault System (MRFZ) includes several fault segments that flank the coastal plain region of Santa Barbara. The three discontinuous east-west trending and south-dipping reverse fault segments that make up the Mission Ridge Fault Zone include the Arroyo Parida segment in the east, the Mission Ridge segment in the central region, and the Moore Ranch segment in the west. The Arroyo Parida segment extends approximately 37 kilometers west from its intersection with the San Cayetano thrust fault. The Mission Ridge segment, the closest segment to the site, extends east-west approximately 8 kilometers through the Santa Barbara urban corridor, and the More Ranch segment extends approximately 14 kilometers near the coast south of Goleta (Peterson et al., 1996). The MRFZ is approximately one mile (1.6 kilometers) north of the site. This fault system has an estimated maximum moment magnitude of M_w 6.7.

Red Mountain Fault

The Red Mountain fault is located about 5.7 miles (9.1 kilometers) southeast of the site in the Santa Barbara Channel and extends approximately 39 kilometers to the east (Peterson et al., 1996). This northerly dipping reverse fault extends from the Ventura area offshore and into the Santa Barbara Channel. The Red Mountain fault is estimated to be capable of generating a maximum earthquake of M_w 6.8.

Santa Ynez Fault

The Santa Ynez fault is made up of two east-west trending reverse fault segments that extend approximately 130 kilometers along the Santa Ynez Mountains north of the Santa Barbara Cottage Hospital (Peterson et al., 1996). The western segment comes to within 6.0 miles (9.7 kilometers) of the site, and the eastern segment comes to within 6.8 miles (11 kilometers) of the site. The western segment of the Santa Ynez fault has an estimated maximum moment magnitude of M_w 6.9. The eastern segment has an estimated maximum moment magnitude of M_w 7.0.



Base Map: Modified from the Regional Fault Map, Plate 3a of Fugro West, Inc. Report dated March 14, 2003 (Fugro, 2003b)

Regional Fault Map

Santa Barbara Cottage Hospital
City of Santa Barbara, California

Project No.	600388-001
Scale	As shown
Date	September 2004

Leighton Consulting, Inc.

Figure No. 4

2.5.2 Local Faulting

No active faults are known to be present on the project site and the site is not in an Alquist-Priolo Earthquake Fault Zone.

An inferred north-south trending fault, as shown on the Preliminary Geologic Map of the Santa Barbara Coastal Plain, has been mapped by the USGS in the immediate vicinity, and to the west of, the project site (Minor et al., 2002). This was a preliminary release of the map. This fault shown on the preliminary map was based on indirect evidence and was not observed in surface exposures, borings, or trenches. The inferred fault shown on the map appeared to offset the More Ranch and La Mesa Faults (Minor et al., 2002). A north-south photo-lineament was identified during a preparation of a digital elevation map (DEM) of the City of Santa Barbara (Keller and Gurrola, 2000). This photo-lineament was projected through the existing SBCH.

Fugro West Inc. (Fugro) conducted a geologic and geomorphic study to evaluate the inferred north-south trending fault (Fugro, 2003c). Their study included a review of the preliminary tectonic geomorphology and lineament investigation by Mr. Larry Gurrola and Dr. Ed Keller (Gurrola et, al., 2003). Fugro's study also included review of selected published and unpublished geologic reports, maps, and well-water data; review of historical aerial photographs; review of historic topographic maps, geophysical survey in the area of the inferred fault and photo lineament; geologic surface mapping, and a subsurface exploration program. Based on their review of the data obtained during their study, Fugro concluded that there was insufficient data to document the inferred north-south trending fault or the photo-lineament.

The California Geological Survey/CGS (OSHPD's engineering geology and seismology reviewer) reviewed Fugro's report (Fugro, 2003c) along with several other consulting reports and prepared a review letter dated January 13, 2004, (CGS, 2004a). With respect to the north-south striking inferred fault, this letter concludes that the engineering geology and seismology issues at the site have been adequately addressed by Fugro, and no further information is requested from the consultants for the project.

Mr. Scott Minor of the United States Geological Survey (USGS) also reviewed Fugro's geologic and geomorphic draft report (Fugro, 2003c) and prepared a review letter dated April 23, 2003, (USGS, 2003). In this letter, Mr. Minor indicated that the inferred fault was going to be removed from the final geologic map of the Santa Barbara coastal plain based on Fugro's findings and conclusions.

Leighton Consulting, Inc. (Leighton) performed a geotechnical peer review of Fugro's geologic and geomorphologic study (Leighton, 2004a). Leighton's peer review identified a few irregularities in the available subsurface data in the general locations of the inferred fault and photo-lineament that may suggest a potential structural discontinuity (i.e., faulting). The identified subsurface irregularities were specifically related to the change of ground water gradient, the structural and thickness variations of a blue-colored earth unit ("Blue Estuarine Horizon") encountered in the drilled borings, and the apparent anomalies of the geophysical surveys. However, while these irregularities may suggest a potential structural discontinuity, there are other possible subsurface conditions that can also explain the identified anomalies, such as lateral variation of the stratigraphy, erosion, or due to the original depositional environment of the stratigraphic horizons in the general area of the project site. Leighton (2004a and 2004b) were reviewed by CGS (2004b) and the specific issues raised by Leighton regarding the subsurface data were examined.

Therefore, considering Fugro's findings and conclusions as well as the findings and conclusions of the CGS and USGS reviews, there is insufficient scientific evidence to suggest that there is a north-south fault within the proposed redevelopment area of the SBCH and that the existence of such a fault is unlikely.

2.6 Seismic Hazards

Potential seismic hazards at the site consist of surface rupture, ground shaking, and secondary effects occurring as a result of ground shaking.

2.6.1 Surface Rupture

To protect structures from the hazard of surface ground rupture along a well-defined fault line, the California Geological Survey (CGS), under the State-mandated Alquist-Priolo Act of 1972, has delineated "Earthquake Fault Zones" along active and potentially active faults (Hart and Bryant, 1999). A fault is considered active if there is either directly observable or inferred evidence of movement along one or more of its segments in the last 11,000 years. A well-defined fault is one in which "its trace can be clearly detectable by a trained geologist as a physical feature at or just below the ground surface." A well-defined fault may be identified by either direct or indirect methods. If a site is located within an Earthquake Fault Zone, a detailed fault investigation is required prior to construction. We have reviewed the Alquist-Priolo Earthquake Fault Zone maps for the area. The project site is not located within an Earthquake Fault Zone and there are no active or potentially active faults known to cross the site.

2.6.2 Ground Shaking

The intensity of ground shaking at a given location depends on several factors, but primarily on the earthquake magnitude, the distance from the epicenter to the site of interest, and the response characteristics of the soils or bedrock units underlying the site. The North Channel Slope Fault extends beneath the site at depth. The estimated maximum moment magnitude for an earthquake on the North Channel Slope Fault is 7.1. The Mission Ridge Fault System is located approximately one mile to the north of the project site. An estimated maximum moment magnitude for an earthquake on the Mission Ridge fault is 6.7. Appendix B shows the seismic parameters estimated for the site from various local and regional causative faults.

The California Building Code, 2001 Edition, (CBC) specifies that probabilistically determined peak horizontal ground acceleration (PHGA) values are to be used in the design of structures. Two levels of ground motion are required for the design of structures: the Design-Basis Earthquake ground motion (DBE) which is defined to have 10 % chance of exceedance in 50 years (with a statistical return period of approximately 475 years) and the Upper-Bound Earthquake ground motion (UBE) which is defined to have 10 % chance of exceedance in 100 years (with a statistical return period of approximately 949 years). For hospitals, the UBE ground motion is used to check for structural collapse, seismic compression of alluvial soils, and liquefaction analysis.

Another level of ground motion is the Maximum Considered Earthquake (MCE). The MCE ground motion is defined to have 2 % chance of exceedance in 50 years, with a statistical return period of approximately 2,475 years. The MCE is generally used for seismic retrofit of older hospital facilities and older state-owned buildings.

Using the FRISKSP program Version 4.0 by Thomas F. Blake gives the following site-specific PHGAs:

Earthquake Event	Risk of Exceedance	Return Period in Years	PHGA in % Gravity (g)		
			This Study	Fugro 2003b	GPI 2004
Design Basis	10% in 50 years	475	0.49	0.47	0.51
Upper Bound	10% in 100 years	949	0.61	0.59	---
Maximum Considered	2% in 50 years	2,475	0.83	0.79	---

To obtain the above accelerations, the attenuation relationship developed by Boore, et al (1997) with a shear wave velocity of 450 meters per second (m/s), site coordinates of 34.4299 North and 119.7228 West were used with the CDMG fault set supplied with the FRISKSP program (Blake, 2000) by this study and Fugro (2003b). The coordinates were taken from Fugro (2003b) and the shear wave velocity is the median value between the 395 and 510 m/s velocities given in Fugro (2003b). The differences in the PHGAs calculated for this report and Fugro's PHGAs are a result in slight differences in the fault source models used and are not significant.

GPI calculated its PHGA by averaging the PHGAs obtained by considering attenuation relationships of Boore et al (1997), Campbell (1997), and Sadigh (1997). Since their report was not prepared for use in design of hospital structures, the PHGA was determined only for the Design Basis Earthquake. GPI also calculated a Magnitude-Weighted PHGA of 0.40g for a magnitude of 7.5 for use in analyses. The GPI results are not significantly different from those determined for this study or presented in Fugro, 2003b.

All structures in California are required to conform to the requirements of the current CBC. For hospitals, the CBC includes special versions of Chapter 16, Structural Design Requirements; and Chapter 18, Foundations and Retaining Walls. These special chapters are designated Chapters 16A and 18A, respectively. Among the special design provisions in Chapter 16A is the requirement that the building be designed to not collapse from the motions from an "upper bound earthquake."

The site is located within the Seismic Zone 4 as delineated in the CBC. There are two seismic zones in California, Zone 3 and Zone 4. All coastal portions of California are within Zone 4. The Zones are based on the expected peak ground accelerations in rock with a 10 percent probability of being exceeded in 50 years (same probability criteria as the Design Basis Earthquake). Zone 4 has the highest seismicity of the zones, with an expected peak ground acceleration of 0.3g or greater.

2.6.3 Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density, fine, clean sandy soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose and medium dense, near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. Effects of liquefaction on level ground can include sand boils, settlement, and bearing capacity failures below structural foundations. Lateral spreading can also occur in areas of sloping ground. Liquefaction analyses are required to be prepared in accordance with SP 117 CDMG (1997) and Southern California Earthquake Center (SCEC, 1999).

State of California Seismic Hazard Zones Maps have not yet been prepared for the Santa Barbara. Based on the review of the seismic safety element report and maps for the City of Santa Barbara (1979), the project site is not located within an area susceptible to liquefaction.

Fugro has performed site a specific evaluation for the liquefaction potential at the site of the proposed central plant (Fugro, 2003a). Based on Fugro's findings and conclusions, the potential for liquefaction affecting the central plant structure is considered low. Fugro's study was reviewed by CGS (2004a, and 2004b). The CGS has approved Fugro's studies (Fugro, 2003a, 2003b, and 2003c) with respect to the engineering geologic and seismologic conditions of the central plant site. Therefore, the liquefaction potential at the central plant site is considered low.

The GPI (2004) report indicates a low potential for liquefaction at the northern parking structure site. The report also indicates that a 2-foot-thick layer at the southern parking structure could potentially liquefy. The layer is reported to be discontinuous. Since private parking structures and daycare facilities are within the jurisdiction of the City of Santa Barbara and not that of CGS, CGS has not reviewed the GPI (2004) report.

Comprehensive liquefaction studies have not yet been performed for the remainder of the medical facility site, though available data suggests that the liquefaction potential at the site is generally low, though with some relatively thin potentially liquefiable layers.

2.6.4 Seismic Settlement

Seismic settlement occurs when loose to medium dense cohesionless soils and soft clayey soils are densified by shaking. Seismic settlements are relatively small except where there are thick deposits of loose soils or liquefaction occurs. Fugro (2003a) estimated less than ¼ inch below the foundation level of the central plant and about ½ inch outside of the central plant building footprint. GPI (2004) indicated less than ½ inch of localized settlement due to liquefaction.

2.6.5 Seismically-Induced Landslides

Seismically-induced landslides and other slope failures are common occurrences during or soon after earthquakes. No State of California Seismic Hazard Zones Maps for the Santa Barbara area are available at this time. In addition, no natural slopes exist within, or in the vicinity of, the project site. Therefore, the potential for seismically induced landslides impacting the site is considered low.

2.6.6 Lateral Spreading

Seismically-induced lateral spreading primarily involves lateral movement of earth materials due to liquefaction occurring in loose soils due to ground shaking. It differs from slope failure in that complete ground failure involving large down-slope movement does not occur due to the relatively shallow gradient of the initial ground surface. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. The potential for liquefaction occurring at the site has not been fully addressed, though it appears to be low. However, liquefiable soils are not necessarily subject to lateral spreading. The on-site soils appear to have sufficient strength to resist lateral spreading. Therefore, the potential for lateral spreading occurring at the site is considered to be low.

2.6.7 Ground Lurching

Certain soils have been observed to move in a wave-like manner in response to intense seismic ground shaking, forming ridges or cracks on the ground surface. At present, the potential for ground lurching to occur at a given site can be predicted only generally (Ziony and Yerkes, 1985). Areas underlain by thick accumulations of alluvium or colluvium appear to be more susceptible to ground lurching than bedrock. Under strong seismic ground motion conditions, lurching can be expected within loose, cohesionless soils, or in clay-rich soils with high moisture content. Generally, only lightly loaded structures such as pavement, fences, pipelines and walkways are damaged by ground lurching; more heavily loaded structures appear to resist such deformation.

Based on the available site specific studies conducted by Fugro at the site (Fugro, 2003d), relatively dense and generally granular soils exist at the site. In addition, the majority of the redevelopment improvements at the site will consist of relatively heavy loaded structures. Therefore, the potential for ground lurching affecting the site is considered low.

2.6.8 Tsunamis

Tsunamis are tidal waves generated in large bodies of water by fault displacement or major ground movement. Damage from tsunamis is confined to coastal areas that are 10 feet or less above sea level. Based on the location of the project site (approximately 2.5 miles from the coastline) and its ground elevation (approximately 140 feet above mean sea level), the potential for tsunamis impacting the site is not considered a hazard.

2.6.9 Seiches

Seiches are large waves generated in enclosed bodies of water (such as reservoirs, pools, lakes, etc.) in response to ground shaking. Since there are no confined bodies of water on or near the site, the potential for seiches impacting the site is not considered a hazard.

2.6.10 Earthquake-Induced Inundation

Strong seismic ground motion can cause dams and levees to fail, resulting in damage to structures and properties located downstream. Flood control and water-storage facilities can also fail as a result of flaws not recognized in the feasibility studies, design, or construction phases of the facilities. Since no dams, large bodies of water, or water storage facilities are located upstream of the project area, earthquake-induced inundation impacting the project site is considered low.

2.7 Subsidence

In California, subsidence related to man's activities has been attributed to withdrawal of subsurface fluids such as oil and ground water. Ground surface effects related to subsidence can include earth fissures, sinkholes or depressions, and disruption of surface drainage. No oil fields or groundwater pumping wells are located within the general area of the site and differential subsidence as a result of oil and water withdrawal has not been documented to have occurred in this area.

2.8 Existing Slope Stability

There are no existing slopes on or directly adjacent to the project site. The site is located in an area designated as having a very low landslide potential (Bezore and Wills, 2000).

2.9 Groundwater

It is reported by LeRoy Crandall and Associates (LCA, 1982) that groundwater at the site was at 56 feet below ground surface in June 1982, and varied only about one foot from that elevation between 1979 and 1982. However, perched groundwater conditions were encountered locally at higher elevations (LCA 1982, and Fugro, 2003c). GPI (2004) encountered groundwater seeps at depths below 29 feet at the southern parking structure site.

Based on the review of the U.S. Geological Survey Ground-Water Data for the Nation database, three groundwater-monitoring wells (well nos. 4N27W16C1, 4N27W16C2, and 4N27W17J1) are located within approximately 1,500 feet to the northeast and southwest of the project site. The historic high groundwater elevations recorded in these wells are approximately 108 feet mean sea level (msl) in well 4N27W17J1 and 113 feet msl in wells 4N27W16C1 and 4N27W16C2.

2.10 Soil Engineering Characteristics

2.10.1 Compressible Soils

Alluvium and uncompacted fills are present at the site and range from slightly to moderately compressible. Uncompacted fills are not suitable for support of fills or structures, and can often contain trash and debris. Uncompacted fill soils should be removed down to competent native soils.

2.10.2 Expansive Soils

Based on preliminary laboratory testing on samples from borings drilled within the project site, the expansion index within the alluvium is typically in the low to medium range (Fugro, 2003d and GPI, 2004).

2.10.3 Corrosive Soils

Corrosive soils contain chemical constituents that may cause damage to construction materials such as concrete and ferrous metals. One such constituent is water-soluble sulfate, which, if high enough in concentration, can react with and damage concrete. Initial laboratory test results on a limited number of samples from the project site (Fugro, 2003d) indicate sulfate concentration in the onsite soils is below the level considered by the California Building Code (California Building Standards Commission, 2001) to be potentially damaging.

Electrical resistivity, chloride content and pH level are indicators of the soil's tendency to corrode ferrous metals. Initial laboratory test results on a limited number of samples from the project site (Fugro, 2003d) indicate that the soils are at least mildly corrosive to ferrous metals.

2.10.4 Rippability and Oversize Rock

The alluvial materials are generally considered to be readily rippable. However, the fanglomerate contains numerous oversize boulders that will be encountered during excavations. Oversize rock is defined as rock fragments over about 8 inches in diameter, though the oversize rock within the fanglomerate should be expected to be several feet in size (Fugro, 2003d).

2.10.5 Suitability as Fill Material

The alluvial on-site soils will be suitable for fill provided organics and other deleterious materials are removed. However, the oversize rocks will need to be crushed prior to placement in fills or be disposed of offsite.

2.10.6 Erosion

Erosion is most prevalent in unconsolidated deposits such as alluvium and colluvium, which are prone to rills, sheet wash, and slumping and bank failures during and after heavy rainstorms. The site is currently covered with buildings, hardscape, and landscaping so the affected soils are not currently exposed and will only be exposed temporarily during construction.

2.11 Mineral Resources

Oil exploration and production has occurred in the Santa Barbara Channel region for hundreds of years. The onshore Mesa oil field is located to the south of the project site (Yerkes et al., 1969), however no occurrences of oil production are known to have existed on the project site.

3. SUMMARY OF POTENTIAL GEOTECHNICAL IMPACTS AND MITIGATION MEASURES

This section summarizes the principal geologic and geotechnical conditions that occur in the study area. The potential impact that each condition may have on the site is subjectively rated as less-than-significant or potentially significant. The California Division of Mines and Geology has prepared guidelines for geologic and seismic considerations in environmental impact reports in order to identify potential geologic hazards and assist in recognizing data needed for design analysis and mitigation measures. These guidelines have been used in preparing this report.

3.1 Seismic Hazards

3.1.1 Fault-Induced Ground Rupture

No Alquist-Priolo Earthquake Fault Zones have been designated that include the site vicinity. The nearest known active or potentially active fault to the site is the Mission Ridge fault located approximately one mile (1.6 km) to the north. The Mesa fault is located approximately 0.5 miles southwest of the project site, however, this fault is not considered active.

An inferred north-south trending fault has been mapped by the USGS in the immediate vicinity, and to the west of, the project site (Minor et al., 2002). This fault was mapped based on indirect evidence resulting from the existing geologic, geomorphologic, and structural conditions in the general vicinity of the site. In addition, a north-south photo-lineament was identified during a preparation of a digital elevation map (DEM) of the City of Santa Barbara (Keller and Gurrola, 2000). A study conducted by Fugro (Fugro, 2003c) to evaluate the inferred fault and photo-lineament concluded that the inferred north-south trending fault or the photo-lineament are not of sufficient activity or well defined enough to warrant further evaluation.

Fugro's study was reviewed by CGS (OSHPD's engineering geology and seismology reviewer) and by Mr. Scott Minor of USGS. The CGS has approved Fugro's study with respect to the engineering geologic and seismologic conditions of the project site. Based on USGS review of Fugro's study, the inferred fault will be removed from the final geologic map of the Santa Barbara coastal plain, which is currently being prepared by USGS.

Therefore, given the preceding discussion and based on the data presently available, the possibility of fault-induced ground rupture at the site is considered low and the hazard of potential fault-induced ground rupture is consider to have a **less-than-significant impact.**

Mitigation Measures: None required.

3.1.2 Seismic Ground Shaking

In the project site area, the hazard posed by seismic shaking is considered to be high, due to the proximity of known active faults capable of generating strong ground motions. Therefore, seismic shaking at the site is considered to be a **potentially significant** impact.

Mitigation Measures: Most areas of California are subject to significant hazards from seismic shaking. The exposure of the project site to future ground shaking is no greater than at other sites in the vicinity or in other parts of California. It is not considered to be reasonably feasible to make structures totally resistant to seismic shaking. However, current building codes require that structures, especially hospitals, survive moderately large ground shaking and not collapse even under severe ground shaking. The effects of ground shaking on structures can be reduced through conformance with the recommendations of the geotechnical engineer and geologist for the project, and conformance with the California Building Code, especially the provisions of Chapters 16A and 18A, and/or other local governing agencies' codes or requirements. This is expected to reduce the effects of ground shaking to **less than significant.**

3.1.3 Secondary Effects of Seismic Shaking

Secondary effects are non-tectonic processes that are directly related to strong seismic shaking (Yeats et al., 1997). Ground deformation, including fissures, settlement, displacement and loss of bearing strength are common expressions of these processes, is the one of the leading causes of damage to structures during a moderate to large earthquake. Secondary effects leading to ground deformation include liquefaction, lateral spreading, seismic settlement, and landsliding. Other hazards indirectly related to seismic shaking are inundation, tsunamis, and seiches.

Liquefaction (Central Plant Site): Fugro (2003a) identifies potentially liquefiable layers at the site of the proposed central plant. However, these layers are expected to be above the level of the central plant foundations. CGS has reviewed the Fugro (2003a, 2003b and 2003c) reports and determined that they adequately address the liquefaction potential at the central plant site. Therefore the potential for liquefaction hazard at the central plant site is **less than significant**.

Mitigation Measures: None required.

<u>**Liquefaction (Remainder of the Medical Facility Campus)**</u>: The project site is underlain by alluvium, which may be susceptible to liquefaction. Fugro (2002) indicates that potential for liquefaction impacting the site is low; however, Fugro (2003a) identifies potentially liquefiable layers at the site of the proposed central plant and GPI (2004) identifies potential liquefaction beneath the southern parking structure site. The explorations and testing performed for the portion of the medical facility beyond the central plant do not fully assess the liquefaction potential at the site. The liquefaction potential of other construction should be evaluated (CGS, 2004b). The available data suggest that the liquefaction potential at the site is generally low; however, in the absence of conclusive analyses and the GPI findings, the potential for liquefaction hazard at the site is should be considered to be **potentially significant**.

Mitigation Measures: The geotechnical consultant should perform sufficient liquefaction studies for the balance of the medical facility to determine the liquefaction potential. Based the on results of the studies, the geotechnical consultant should develop mitigation recommendations, if needed. If liquefaction is determined to be a hazard, mitigation measures such as mat-type or deep foundations may be used, or removal and recompaction of the liquefiable soils may provide sufficient mitigation. With investigation of the balance of the medical facility and the implementation, if necessary, of the indicated mitigation measures, the hazard of liquefaction will be reduced to **less than significant**.

<u>**Lateral Spreading**</u>: The site is located in a relatively flat alluvial plain area. Furthermore, soils at the site have sufficient strength to be resistant to lateral spreading. The potential for lateral spreading affecting the site is therefore **less than significant.**

Mitigation Measures: None required.

<u>**Seismically Induced Settlement**</u>**:** The soils at the site are generally dense. However, significant seismic settlement can occur as a consequence of liquefaction. Therefore, until the liquefaction potential for site has been determined to be low, the hazard of seismically induced settlement is considered to be **potentially significant**.

Mitigation Measures: Implementation of the mitigation measures for liquefaction will reduce the impact of seismically induced settlement to **less than significant**.

<u>**Seismically Induced Landslides**</u>**:** Marginally stable slopes (including existing landslides) may be subject to landsliding caused by seismic shaking. The seismically induced landslide hazard depends on many factors including existing slope stability, shaking potential, and presence of existing landslides. The project site is located in a low-lying alluvial plain with no moderately steep slopes on or surrounding the site. The impact from seismically induced landslides is **less than significant**.

Mitigation Measures: None required.

Ground Lurching: Certain soils have been observed to move in a wave-like manner in response to intense seismic ground shaking, forming ridges or cracks on the ground surface. At present, the potential for ground lurching to occur at a given site can be predicted only generally (Ziony and Yerkes, 1985). Areas underlain by thick accumulations of alluvium or colluvium appear to be more susceptible to ground lurching than bedrock. Under strong seismic ground motion conditions, lurching can be expected within loose, cohesionless soils, or in clay-rich soils with high moisture content. Because of the relatively dense and granular are present at the site, the potential for ground lurching is considered to be **less-than-significant.**

Mitigation Measures: None required.

Seismically Induced Inundation: Strong seismic ground motion can cause dams and levees to fail, resulting in damage to structures and properties located downstream. Since no dams, large bodies of water, or water storage facilities are located upstream of the project area, this hazard is **less than significant.**

Mitigation Measures: None required.

Tsunamis: Tsunamis are tidal waves generated in large bodies of water by fault displacement or major ground movement. Damage from tsunamis is confined to coastal areas that are 10 feet or less above sea level. Since the project is located approximately 140 feet above sea level, and approximately 2.5 miles inland from the coast, the risk of inundation from a tsunami is **less than significant**.

Mitigation Measures: None required.

Seiches: A seiche is an earthquake-induced wave in a confined body of water, such as a lake or reservoir. Since there are no confined bodies of water on or near the site, this hazard is **less than significant**.

Mitigation Measures: None required.

3.2 Subsidence

Conditions conducive to future ground subsidence are not present at the project site (see Section 2.7), therefore this potential hazard is **less than significant**.

Mitigation Measures: None required.

3.3 Slope Stability

3.3.1 Stability of Natural Slopes

Marginally stable slopes (including existing landslides) may be subject to landsliding during or shortly after prolonged, heavy rainfall or strong seismic shaking. In most cases these are limited to relatively shallow soil failures on the steeper natural slopes. There are no natural slopes onsite, therefore, the impact posed by unstable natural slopes is considered to be **less than significant.**

Mitigation Measures: None required.

3.3.2 Stability of Proposed Slopes

Based on the preliminary grading plans for the project, prepared by Penfield and Smith Engineers (2004), it appears that grading will generally consist of overexcavation of the existing site material for the building footprints. Since, there are no proposed slopes in the preliminary development plans for the SBCH, stability of the proposed slopes is considered **less than significant.**

Mitigation Measures: None required.

3.3.3 Stability of Temporary Slopes

Slope or side wall failure in temporary excavations for basements and underground utilities could occur in unconsolidated surficial soils, particularly if the cut face exposes seepage from shallow or perched ground water. Since basements are planned for the project and underground utilities accompany most developments, this hazard is **potentially significant.**

Mitigation Measures: To reduce the potential for localized slope failures occurring during construction, the specific locations of underground excavations into native soils should be evaluated by the project geologist and geotechnical engineer, both prior to and during construction. Areas where excavation is required into the water-bearing zone can be temporarily dewatered, or the excavation walls can be flattened to safe gradients. Where there is insufficient room for sloped excavations, shoring will be required. Excavation spoils should not be placed immediately adjacent to excavation walls unless the excavation is shored to support the added load. Other measures used to reduce the potential for slope failure include cutting and backfilling excavations in sections, and not leaving temporary excavations open for long periods of time. All Cal-OSHA regulations must be observed for excavations that will be entered by people. With proper design and conformance with proper construction procedures, the impact of hazards from temporary slopes will be reduced to **less than significant**.

3.4 Perched Ground Water

Excavation for the basement level of the proposed central plant is expected to extend below the elevation at which perched ground water has historically been encountered. Depending on the final design, excavations for other buildings comprising the medical facility may also extend below perched ground water levels. If water is encountered during excavation for the hospital buildings or parking structures, dewatering may be required to allow excavation to the planned foundation level. Furthermore, permanent dewatering or hydrostatic design may be required for subterranean walls. Since basements are planned for the project, perched ground water may be encountered and affect construction and the permanent design of the buildings. Therefore, the potential of perched ground water impacting the proposed development is considered to be **potentially significant**.

Mitigation Measures: The excavations for the proposed buildings should be observed by the geotechnical engineer for evidence of seepage. Based on these observations, the geotechnical consultant should provide recommendations for dewatering of the excavation. The recommendations may range from no mitigation to gravel-filled trenches with pump-equipped sumps to deep well-points. Fugro (2003a) anticipates "that perched ground water, if encountered, can be controlled with localized drains and sump pumps." Either a permanent dewatering system or a hydrostatic design for the subterranean walls should be provided to mitigate potential hydrostatic pressure. Discharge permits may be required if water is proposed to be disposed of into the storm drain system. Subterranean walls should be waterproofed. Using the indicated mitigation measures, the impact of perched water will be reduced to **less than significant**.

3.5 Foundation Stability

3.5.1 Compressible Soils

When a load, such as fills or a building is placed, the underlying soil layers undergo compression. This compression is due to the deformation and relocation of the soil particles, and expulsion of water or air from the void spaces between the particles. Compression of the soils results in settlement of the ground surface and structures. Some of this settlement occurs immediately after a load is applied, while some occurs over a period of time after placement of the load. For engineering applications, it is important to estimate the total amount of settlement that will occur upon placement of a given load, and the rate of consolidation.

The native alluvial soils at the site are slightly to moderately compressible. Uncompacted fills are compressible, but since they are not suitable for foundation support, current construction practices do not allow them to remain below structures. Differential hardness of the rock and matrix soils within the fanglomerate could result in distress to foundations. Therefore, compressible soils are **potentially significant**.

Mitigation Measures: Settlement can be controlled by appropriate sizing of foundations. Within the fanglomerate, overexcavation of the fanglomerate to allow placement of a compacted fill cushion can be used to mitigate for differential hardness between the rock and matrix materials. Individual buildings should be evaluated as necessary by the project geologist and soils engineer both prior to and during construction. With the implementation of appropriate grading and foundation sizing, this impact can be reduced to a **less than significant.**

3.5.2 Expansive Soils

Soils expand and shrink with changes in their moisture content. Some clayey soils are expansive, while sandy soils are generally non-expansive. In expansive soils, the volume changes with moisture content are significant and can cause damage to the structures, including cracking, heaving and buckling of the foundations, and differential movement in the building, resulting in damage to floors and walls. The on-site alluvial soils contain variable amounts of clay with an expansion potential ranging from low to medium (Fugro, 2003d and GPI, 2004). Consequently, expansive soils are **potentially significant.**

Mitigation Measures: Mitigation of expansive soils consists of replacing the expansive soils with non-expansive soils, maintaining the expansive soils at a constant moisture content, deepening foundations to depths where the moisture content of the soils remains constant, and/or designing the structure to span across affected areas. Implementation of these measures will reduce the impact of expansive soils to **less than significant.**

3.5.3 Corrosive Soils

Corrosive soils contain constituents or physical characteristics that attack concrete (water soluble sulfates) and/or metals (chlorides, ammonia, nitrates, low pH levels and low electrical resistivity). The laboratory tests performed by Fugro (2003d) for the medical center and GPI (2004) for the parking structures at the site indicate the onsite soils have a negligible sulfate content and they have a low to moderate potential to corrode ferrous metals. Since only limited testing was performed over most of the site, the test results may not be representative of conditions elsewhere at the site. Therefore, hazards due to corrosive soils impacting the project are **potentially significant.**

Mitigation Measures: Testing to confirm the corrosion potential of the soils should be performed when final rough grades are achieved. Where potentially adverse concentrations of sulfates are found, the California Building Code includes mitigation requirements that consist of requiring sulfate-resistant cement, decreasing the water/cement ratio, and designing the concrete mix for a higher compressive strength. For metals in contact with the soils, a corrosion specialist should evaluate the needed for and type of mitigation required. The corrosion mitigations can range from coating the metals or otherwise isolating them from the soils to cathodic protection. Compliance with the California Building Code and the recommendations of the corrosion specialist will reduce this hazard to **less than significant.**

3.5.4 Erosion

Most native soils have a moderate susceptibility to erosion. The site is to be developed with either building, hardscape, or landscaping and the on-site soils will not be exposed. However, the on-site soils will be locally exposed during the proposed construction. Therefore, erosion at the site during construction is **potentially significant**.

Mitigation Measures: Reduction of the erosion potential can be accomplished by implementing erosion control measures during construction. These measures can include construction of berms at the tops of slopes to prevent surface water from flowing over the slope faces and, if warranted by severe weather, covering the slope faces with plastic sheeting. Implementation of erosion control measures will make the potential impact of erosion **less than significant.**

3.5.5 Rippability and Oversize Rock

Most of the earth materials at the site are expected to be rippable with modern earthmoving equipment. However, the fanglomerate contains numerous oversize boulders that will require special handling during excavation. Also, drilling through the boulders will be difficult. Oversize rock can not be used in fills without special consideration. Therefore, the rippability/excavation of oversize rock and its disposition may have a **potentially significant impact.**

Mitigation Measures: Equipment of suitable size and capacity for excavation and drilling of the boulders should be available at the site. Oversize materials should be reduced in size until they are suitable for use on site or should be removed from the site. The project Geotechnical Consultant should provide recommendations for use of the oversize rock in fills. Implementation of the indicated mitigation measures will reduce the potential impact from oversize rock to **less than significant.**

3.6 Changed Conditions and Quality Control

During construction, confirmation that the on-site materials and conditions are as anticipated in the geotechnical investigations should be provided. Appropriate recommendations to changed or otherwise unexpected conditions should be provided. Also needed during construction are observation and testing to confirm that the construction is conforming to the Geotechnical Consultant's recommendations and project specifications. Failure to identify changed or otherwise unexpected conditions and to provide appropriate recommendations, observations, and testing may have a **potentially significant impact.**

Mitigation Measures: Continuous monitoring by the project Geotechnical Consultant should be provided during installation of shoring, grading, and backfilling. Installed subdrains should be observed prior to being covered and completed foundation excavations should be observed prior to placing reinforcing steel or concrete. Appropriate modifications to recommendations presented in the investigation reports, and supplementary recommendations based on the observed field conditions should be provided. The modifications should be submitted to the City of Santa Barbara for review prior to implementation. Testing to confirm the observations should be performed. The results of the monitoring and testing should be presented in a written report to be submitted to the City of Santa Barbara and other regulatory agencies. Implementation of the indicated recommendations will reduce the potential impact of changed or unexpected conditions to **less than significant**.

3.7 Loss of Mineral Resources

The primary mineral resource in the region of the project is petroleum, which is withdrawn from several oil fields in the Santa Barbara Channel region. The coastal plain area in the immediate vicinity of SBCH has never been developed as a petroleum resource. Therefore, the loss of mineral resources due to development of the site is **less than significant.**

Mitigation Measures: None required.

GEOLOGIC HAZARD		DEGREE OF HAZARD		POSSIBLE MITIGATION MEASURE		
Hazard	**Activity Causing Problem**	**Less Than Significant Impact**	**Potentially Significant Impact**	**Code Conformance**	**Code Conformance + Special Work***	**Advance Planning, Avoidance, Restrictions**
EARTHQUAKE DAMAGE	Fault Movement	*X*			*N/R*	
	Liquefaction	*X*	*X*	*X*	*X*	
	Landslides	*X*			*N/R*	
	Differential Compaction / Seismic Settlement	*X*			*N/R*	
	Ground rupture	*X*			*N/R*	
	Ground shaking		*X*	*X*		
	Tsunami	*X*			*N/R*	
	Seiches	*X*			*N/R*	
	Flooding (Dam or levee failure)	*X*			*N/R*	
LOSS OF MINERAL RESOURCES	Loss of access	*N/A*				
	Deposits covered by changed land use	*N/A*				
	Zoning restrictions	*N/A*				
SLOPE AND/OR FOUNDATION INSTABILITY	Landslides and mudflows	*X*			*N/R*	
	Unstable cut and fill slopes	*X*			*N/R*	
	Collapsible and expansive soil		*X*		*X*	
	Trench-Temporary wall stability		*X*	*X*		
PERCHED GROUND WATER	Construction Dewatering		*X*		*X*	
	Permanent Dewatering		*X*		*X*	
	Basement Waterproofing		*X*		*X*	
EROSION, SEDIMENTATION, FLOODING	Erosion of graded areas		*X*	*X*		
	Alteration of runoff		*X*		*X*	
	Unprotected drainage ways	*N/A*				
	Increased impervious surfaces	*N/A*				
LAND SUBSIDENCE	Extraction of ground water, gas, oil, geothermal energy	*X*			*N/R*	

* "Special Work" can include additional investigation, special site preparation, or special foundations
N/R= None Required;
N/A= Not Applicable

TABLE 1. CHECKLIST OF GEOLOGIC & GEOTECHNICAL HAZARDS & POTENTIAL MITIGATION MEASURES (modified from California Division of Mines and Geology, CDMG Note 46, 1982)

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Leighton

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APPENDIX A

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APPENDIX A

REFERENCES (Continued)

Aerial Photographs

Date	Flight	Frames	Scale	Agency
4-20-72	107-7	6, 7	~1"=3500'	Continental Aerial Photo, Inc.
3-77	SBJ	8, 9	~1"=2500'	Continental Aerial Photo, Inc.
6-7-90	C82-1	52, 53	~1"=2800'	Continental Aerial Photo, Inc.
5-9-93	C87-31	80, 81	1"=2000'	Continental Aerial Photo, Inc.
6-12-95	C111-15	160, 161	1"=2000'	Continental Aerial Photo, Inc.
2-22-99	C132-15	109, 110	1"=2000'	Continental Aerial Photo, Inc.

APPENDIX B

EARTHQUAKE FAULT DATA

APPENDIX B

EARTHQUAKE FAULT DATA

FAULT NAME	APPROXIMATE DISTANCE		MAXIMUM EARTHQUAKE MAGNITUDE
	miles	kilometers	Mw
NORTH CHANNEL SLOPE	0.0	0.0	7.1
MISSION. RIDGE ARROYO PARIDA-SANTA ANA	1.1	1.7	6.7
RED MOUNTAIN	3.8	6.1	6.8
SANTA YNEZ (West)	4.7	7.5	6.9
SANTA YNEZ (East)	6.0	9.6	7.0
MONTALVO-OAK RIDGE TREND	7.1	11.4	6.6
CHANNEL IS. THRUST (Eastern)	11.0	17.7	7.4
VENTURA – PITAS POINT	11.4	18.4	6.8
OAK RIDGE(Blind Thrust Offshore)	17.9	28.8	6.9
ANACAPA-DUME	22.9	36.8	7.3
LOS ALAMOS-W. BASELINE	23.9	38.4	6.8
BIG PINE	24.4	39.3	6.7
SANTA CRUZ ISLAND	28.3	45.5	6.8
SANTA ROSA ISLAND	30.0	48.2	6.9
SAN CAYETANO	31.6	50.8	6.8
OAK RIDGE (Onshore)	32.1	51.6	6.9
LIONS HEAD	34.5	55.6	6.6
SIMI-SANTA ROSA	34.7	55.9	6.7
PLEITO THRUST	37.8	60.8	7.2
SAN ANDREAS - 1857 Rupture	39.5	63.6	7.8
SAN ANDREAS - Carrizo	39.5	63.6	7.2
SAN LUIS RANGE (S. Margin)	41.2	66.3	7.0
CASMALIA (Orcutt Frontal Fault)	45.7	73.6	6.5
MALIBU COAST	51.1	82.3	6.7
SAN JUAN	51.4	82.7	7.0
SAN GABRIEL	52.1	83.8	7.0
GARLOCK (West)	53.6	86.3	7.1
NORTHRIDGE (E. Oak Ridge)	54.5	87.7	6.9
WHITE WOLF	54.6	87.9	7.2
SANTA SUSANA	54.7	88.0	6.6
HOLSER	55.2	88.9	6.5
LOS OSOS	60.0	96.5	6.8
SAN ANDREAS - Cholame	61.3	98.7	6.9

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

March 29, 2004

Project No. 600388-001

To: LSA Associates, Inc.
1998 Santa Barbara Street, Suite 120
San Luis Obispo, California 93401

Attention: Ms. Jill O'Connor

Subject: Report of Peer Review (Part 1) of Geologic and Geotechnical Reports Prepared by Fugro West, Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan, City Of Santa Barbara, California.

References: See Appendix A

Introduction

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) has prepared this letter report to present the findings of our peer review (Part 1) of the available geologic and geotechnical reports prepared by Fugro West Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan (Project), in the City of Santa Barbara, California.

Fugro West, Inc. (the Project Geotechnical Consultant) has prepared two report volumes to evaluate the geologic and geotechnical conditions of the site and vicinity with respect to the proposed modernization improvements for the Santa Barbara Cottage Hospital; Volume 1, Draft Geologic and Geomorphic Study and Volume 2, Previous Geotechnical Reports.

We have divided our peer review of the Fugro's reports in two parts (Part 1 and Part 2) based on following two conditions: first, the availability of Fugro's reports to Leighton (Leighton did not receive the complete set of reports at one time, rather, the report volumes and associated appendices have been received by us at different times) and second, the available references (Volumes 1 and 2) are considered, for the most part, self-contained and can be reviewed independently.

At this time, Leighton is providing the findings and opinions of our peer review of Fugro West, Inc.'s Draft Geologic and Geomorphic Study, Volume 1, dated March 2003 (Fugro West, Inc., 2003) and other related documents associated with this study (see Appendix A). We are currently conducting our review of Volume 2, Previous Geotechnical Reports, which was received by our office on March 24, 2004. Our findings and review comments of Volume 2 will be forthcoming in a separate letter at a later date.

This report presents our opinions regarding the adequacy of the geologic, seismic, and geotechnical information gathered by Fugro West, Inc., with respect the project site and proposed modernization improvements for the Cottage Hospital. Site specific investigations and/or analyses were beyond our scope of work and were not provided.

Our peer review was performed in general accordance with Section IV. Scope of Work as outlined in the LSA's Proposal for Services, Cottage Hospital Modernization Project Environmental Impact Report dated November 17, 2003 (and later revised on January 22, 2004). Additionally, our review of the technical reports prepared by Fugro West, Inc. was performed in general accordance with the California Geological Survey (CGS) - Note 48. The CGS is the agency for engineering geology and seismology review purposes on behalf of the Office of Statewide Health Planning & Development (OSHPD), which is the jurisdictional agency for hospitals and skilled nursing facilities in California. CGS – Note 48 outlines the minimum requirements to determine the adequacy and completeness of engineering geology and seismology, and geotechnical reports for the siting of public schools, hospitals, and essential services buildings under California Code of Regulations, Title 24, California Building Code.

Purpose

In general, the purpose of Leighton's peer review was to evaluate the adequacy of the existing available geologic and geotechnical data for the Project, as gathered by Fugro, to support the EIR and to identified any major technical deficiencies or constrains that may required additional studies and/or analyses in order to provide positive support to the EIR.

Findings and Discussions of Volume 1 Report, dated March 2003:

General

The focus of the subject report was to evaluate the potential for fault rupture impacting the project site, specifically associated with the inferred north-south-striking fault mapped in the vicinity of the project site as shown on a recently published preliminary geologic map of the Santa Barbara area by the United States Geologic Survey (USGS) (Minor et al., 2002).

In order to evaluate the existence, or non-existence, of the inferred north-south-striking fault, Fugro conducted a review of available site specific subsurface data and published geologic maps and literature for the site and vicinity coupled with a field exploration program and a geomorphologic study. The field exploration consisted of drilling 5 continuous-core borings and conducting geophysical surveys. Mr. Larry Gurrola and Dr. Edward Keller were retained by Fugro to conduct the geomorphic study.

We understand that this draft report is currently being review by CGS.

Items of Inconsistencies and Omissions in Fugro's Report:

- Page 12 – Section 2.7.8 – Inconsistent and unclear terminology used in delineating between the More Ranch and Mission Ridge faults as shown on the Plate 4.
- Page 14 – Section 3.1.2 – The approximate distance to the More Ranch fault is noted as 2 kilometers from the project site. Based on the review of the geologic map(s) that the More Ranch and La Mesa faults are approximately 1 kilometer to the north and south of the project site, respectively.
- Page 19 – Section 4.3 – Discussed a perched groundwater condition in the area of the SBCH site, however, the geologic units depicted in geologic cross-section A-A' do not show a perched groundwater condition. The groundwater surface on the cross-section transcends several lithologic layers (e.g., silt, clayey silt and sand layers) indicating that the groundwater as illustrated on the cross-section is not in a perched condition.
- Page 20 – Section 5.1 – Plate 1 of Appendix F could not be located.
- Page 20 – Section 5.2 – The reproduced 1:2,400 scale DEM is Plate 13, not Plate 10.
- Page 27 – Section 7.3 – Groundwater – states that the perched groundwater depicted along cross-section A-A' has a relatively constant gradient. The groundwater level drawn through Boring F03-3 is drawn at the incorrect level based on the boring log in Appendix A. The corrected position of the groundwater on cross section A-A' at Boring F03-3 reveals an inconstant gradient, indicating the possibility of a subsurface feature affecting the groundwater gradient in the vicinity of the "inferred fault" and lineament locations. See *Discussion of Conclusions* below.
- Plates 8.2 and 8.3 (cross-sections B-B' and C-C') are labeled incorrectly. The Labels and plate numbers should be swapped.
- Plate 9 – 1928 Aerial Photograph - The locations of the SBCH, State Street, and Alamar Avenue/State Street intersection are all identified incorrectly.
- Appendix F – Geomorphology Section – Table 1 could not be located.
- Appendix F – Subsurface Stratigraphy – Log of Boring CH-3 could not be located in Appendix A, as discussed in the text.
- Appendix F – Cross-Faults and Laterally Growing Anticlines – Figure 11 could not be located.

Discussion of Conclusions:

Fugro's study provides significant surface and subsurface data to evaluate the existence, or non-existence, of the inferred north-south-striking fault mapped by the USGS and the possible implications of the identified photo-lineament being associated to faulting. However, it is our opinion that the study does not conclusively disprove the existence of the inferred north-south fault or that the photo-lineament is not associated with a subsurface geologic structure. The basis of our opinion is outlined as follows:

- One line of evidence offered by Fugro to support an explanation of no faulting in the project area is the relatively constant hydraulic gradient of the groundwater as indicated on Cross-Section A-A'. However, upon closer inspection of the groundwater surface depicted on Cross-Section A-A', its hydraulic gradient substantial steepens in the general location of the inferred fault and photo-lineament. The groundwater's hydraulic gradient between borings F03-5 and F03-1 is 0.0081 (over a horizontal distance of approximately 370 feet). However, between F03-1 and F03-2 (distance of 340 feet) the gradient steepens to 0.04 (an order of magnitude steeper than between F03-5 and F03-1). This trend continues to the next boring, F03-3, and at some point past Boring F03-3 the gradient flattens out. Something in the subsurface may be affecting the hydraulic gradient of the groundwater in the vicinity of the inferred fault, photo-lineament, and the vicinity of the project site. Although this change in the groundwater's gradient can be attributed to differing subsurface stratigraphy or lithology across the area, it could also be due to structural discontinuities (i.e., faulting).

- Additional evidence offered by Fugro to support an alternative explanation other than faulting, is the continuity of the "Blue Estuarine Horizon" encountered in the five borings. Cross-Section A-A' depicts this marker bed as having a relatively constant southerly dip beneath the site and vicinity. Based on the review of the boring logs and Plate 11, is quite evident that the elevation the "Blue Estuarine Horizon" drops significantly between Borings F03-1 and F03-2. The gradient of this marker bed between F03-1 and F03-2 is approximately 0.06 or about 3° (degrees) over a horizontal distance of 340 feet. In comparison, its gradient between Borings F03-1 and F03-5 (to the northwest) is 0.005 or about 0.3°. Additionally, Boring F03-1 penetrated the bottom of the "Blue Estuarine Horizon", whereas the other four borings to the southeast and northwest of F03-1 did not. The thickness of the blue deposits encountered in Boring F03-1 is approximately 2 feet in contrast with the much thicker sections observed in the other borings (up to at least 15 feet thick as encountered in Boring F03-3). These apparent irregularities of the blue silt deposits coincide with the apparent anomalies of the groundwater gradient discussed above, which is in the general vicinity of the inferred fault and lineament.

- Fugro also discusses the relative continuity of the subsurface horizons identified on the geophysical profiles along the same line of Cross-Section A-A'. Based on the review of the seismic refraction profiles, the purple horizon of Line 1A does not coincide with the purple horizon of Line 1 at the matching point in the vicinity of Boring F03-1. The green horizon, which was interpreted to be the bottom of the Qf_1, was not picked up in Line 1A, to the northwest of F03-1. Additionally, the brown horizon appears to have a distinctive down spike deflection in the vicinity of Boring F03-1. These particular anomalies appear to occur in the general vicinity of the inferred fault, as previously discussed above. Another possible anomaly of the subsurface horizons is shown on the profile of Line 1 in the vicinity of Junipero Street where there is an apparent down deflection of the green, purple, and brown horizons.

Although the evidence and discussion presented by Fugro is favorable for supporting an explanation that faulting does not contribute to the geomorphic expression seen at the project site and vicinity, the existence, or non-existence, of the inferred fault and the photo-lineament, and any associated potential for fault rupture impacting the project site have not been conclusively addressed in this study (based on the aforementioned apparent irregularities of the available subsurface data).

Furthermore, in the detailed geomorphic study conducted by Mr. Larry Gurrola and Dr. Ed Keller (Appendix F of Volume 1), they concluded that there is no definitive evidence to indicate that the photo-lineament is a strike-slip cross fault, but also they cannot definitively rule out the possibility that the photo-lineament is not a fault due to the lack visual exposure at the site. We agree with this conclusion as well.

The ideal way to further evaluate, and more conclusively rule out the possibility of fault rupture associated with the existence of the inferred north-south-striking fault and the lineament, would be to expose those areas by trenching. However, that may not be a viable option due to the current developed conditions of the project site and vicinity. Therefore, in our opinion, additional borings between borings F03-1 and F03-4 should be drilled in order to understand the nature of the anomalies of the available subsurface data at the site and vicinity. It would be prudent to extend the subsurface exploration to the southwest of Boring F03-4, beyond Pueblo Street, to confirm the mapped relationship between the lithologic units Qf1 and Qf_2 as show on Plate 13.

Although, the additional borings may continue to provide inconclusive evidence with respect to the existence of the inferred fault and lineament, they will provide better correlation of the subsurface geology and interpreted structure, and the groundwater gradient at the project site to further support Fugro's conclusions of the low potential for fault ground rupture impacting the site. Furthermore, these additional borings may be used to provide additional subsurface information required for the design and construction of the proposed modernization improvements.

Closure

As stated earlier, the objective of Leighton's peer review was to evaluate the adequacy of the existing available geologic and geotechnical data for the Project, as gathered by Fugro, to support the EIR and to identified any major technical deficiencies or constrains that may required additional studies and/or analyses in order to provide positive support to the EIR.

Leighton is not the geotechnical reviewer for the jurisdictional agency (OSHPD). CGS is the geologic and geotechnical reviewing agency for the OSHPD. Our findings and opinions may differ from CGS findings and review comments.

If you have any questions regarding this report, please contact us at 805-383-3051. We appreciate this opportunity to be of service.

Respectfully Submitted,
LEIGHTON CONSULTING, INC.

Jose Sanchez, CEG 2221
Senior Project Geologist

Robert Lemmer, CEG 2265
Project Geologist

JMP/JGS/REL/GWS/kse

Distribution: Addressee (2 copies)

Attachments: Appendix A – References

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

California geological Survey, 2004, Note 48, Check List for the Review of Engineering Geology and Seismology Reports for the California Public Schools, Hospitals, and Essential Services Buildings, Dated January 1, 2004.

Fugro West, Inc., 2003a, Draft Geologic and Geomorphic Study, Santa Barbara Cottage Hospital, Pueblo at Bath Street, Santa Barbara, California, Volume 1, Excluding Appendices D and E, and Volume 2, Project No. 3254.001.02, dated March 2003.

_____, 2003b, Response to Development Application Review Team (DART) Comment 3, Project No. 3254.001.06, dated August 29, 2003.

United States Geological Survey, 2003, Review Letter Regarding Fugro's Geologic and Geomorphic Study of the Santa Barbara Cottage Hospital Site, dated April 23, 2003.

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

April 19, 2004

Project No. 600388-001

To: LSA Associates, Inc.
1998 Santa Barbara Street, Suite 120
San Luis Obispo, California 93401

Attention: Ms. Jill O'Connor

Subject: Report of Peer Review (Part 2) of Geotechnical Reports Prepared by Fugro West, Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan, City of Santa Barbara, California.

References: See Appendix A

Introduction

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) has prepared this letter report to present the findings of Part 2 of our peer review of the available geologic and geotechnical reports prepared by Fugro West Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan (Project), in the City of Santa Barbara, California.

Fugro West, Inc. (the Project Geotechnical Consultant) has prepared two report volumes to evaluate the geologic and geotechnical conditions of the site and vicinity with respect to the proposed modernization improvements for the Santa Barbara Cottage Hospital; Volume 1, Draft Geologic and Geomorphic Study and Volume 2, Previous Geotechnical Reports.

Leighton previously submitted the findings and opinions for Part I of our peer review of Fugro West, Inc.'s Draft Geologic and Geomorphic Study, Volume 1, dated March 2003 (Fugro West, Inc., 2003) and other related documents associated in a report dated March 29, 2004. This current submittal presents the findings pertaining to Leighton's peer review of the Fugro West reports included in Volume 2 of their March 2003 report for Santa Barbara Cottage Hospital.

This report presents our opinions regarding the adequacy of the geotechnical information gathered and interpreted by Fugro West, Inc., with respect the project site and proposed

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modernization improvements for the Cottage Hospital. Site specific investigations and/or analyses were beyond our scope of work and were not provided.

Our peer review was performed in general accordance with Section IV. Scope of Work as outlined in the LSA's Proposal for Services, Cottage Hospital Modernization Project Environmental Impact Report dated November 17, 2003 (and later revised on January 22, 2004). Additionally, our review of the technical reports prepared by Fugro West, Inc. was performed in general accordance with the California Geological Survey (CGS) - Note 48. The CGS is the agency for engineering geology and seismology review purposes on behalf of the Office of Statewide Health Planning & Development (OSHPD), which is the jurisdictional agency for hospitals and skilled nursing facilities in California. CGS – Note 48 outlines the minimum requirements to determine the adequacy and completeness of engineering geology and seismology, and geotechnical reports for the siting of public schools, hospitals, and essential services buildings under California Code of Regulations, Title 24, California Building Code.

Purpose

In general, the purpose of Leighton's peer review was to evaluate the adequacy of the existing geotechnical data for the Project, as gathered by Fugro, to support the EIR and to identified any major technical deficiencies or constrains that may required additional studies and/or analyses in order to provide positive support to the EIR.

Findings and Discussions of Volume 2 Report, dated March 28, 2003:

General

Since Fugro is now the Geotechnical Consultant of Record for the redevelopment of the hospital, this review comments on their 2002 and 2003 reports, specifically Fugro 2002, 2003d, and 2003e. The previous reports prepared by other consultants were reviewed solely for comparison of the data obtained and recommendations presented. The strictly geologic aspects of the site presented in Fugro's 2002 and 2003 reports were taken as being superceded by Fugro's March 28, 2003 report (Fugro, 2003a). We understand that the draft of the March 28, 2003, report is currently being review by CGS.

Our comments are presented in two sections. The first section contains comments that should be addressed as part of the preparation of the EIR. These comments should also be addressed, possibly more thoroughly, prior to construction. The second section contains comments that should be addressed prior to or during construction but do not need to be addressed as part of the EIR.

Comments for EIR Consideration

- Fugro, 2002 report, Page 7, Groundwater Conditions – Groundwater seepage observed at depths of 23 to 49 feet below the existing ground surface by LeRoy Crandall and Associates

(LCA) in 1982 is cited. Groundwater was reportedly not encountered by Fugro in their borings drilled to approximately 31½ feet below the existing ground surface. Fugro concludes that the seepage reported by LCA is due to perched water flowing within granular layers within the fanglomerate that underlays the site and that groundwater conditions will vary seasonably due to several factors. Not discussed by Fugro is the groundwater level data from the Woodward-Clyde (WC) sections. The WC sections show groundwater approximately 50 feet below the ground surface.

The report indicates that the proposed hospital will probably not be underlain by basements, and that the proposed central plant and parking structure may or may not be underlain by one basement level. Groundwater levels below 50 feet, and their possible affects on liquefaction potential, would not usually be of major consequence to structures supported at the existing grade or underlain by one shallow basement level. However, the existing hospital is indicated to be underlain by a 12- to 15-foot deep basement and a deep basement is shown to be planned beneath the central plant in Fugro's March 14, 2003, report (Fugro, 2003d). There is an approximately 30-foot drop in elevation across the hospital campus that may result in water being at shallower depths. The groundwater level conditions should be more thoroughly assessed considering the change in ground elevation across the proposed hospital campus and the possibility of deep basements under some of the proposed structures. The effects of groundwater level on the liquefaction potential of the deposits underlying the fanglomerate should be considered. For liquefaction analyses, it may be appropriate to use the floor elevation of basement as the "ground surface".

- Fugro, 2002 report, Page 7, Liquefaction and Seismic Settlement Leighton agrees that the fanglomerate beneath the site has a low potential for liquefaction or significant seismic settlement. However, explorations should extend to sufficient depths beneath the proposed basement floor elevations to confirm that liquefaction is unlikely to occur in the deposits underlying the fanglomerate. Leighton expects the potential for liquefaction occurring beneath the site to be low, but considering the proposed use of the site, additional explorations, or research, and analyses to confirm this seem appropriate.

- Fugro, 2003d report, Page 4 (This comment is tied to the above comment regarding Fugro 2002, page 7) – The borings for the proposed central plant are indicated to have been drilled to depths of 40 to 61 feet below the existing grade. With the proposed basement floor of the plant being approximately 27 feet below the existing grade, at least one of the borings should have been extended to at least 77 feet below the existing grade, i.e. 50 feet below the basement floor elevation (SCEC, 1999). In lieu of drilling a deeper boring, providing pertinent regional geologic data on the materials underlying the conglomerate may be sufficient to establish the nature of the materials underlying the fanglomerate. The deep borings drilled as part of Furgo, 2003a do not contain sufficient data to allow engineering evaluation of liquefaction.

- Fugro, 2003d, report Page 24, Construction Considerations – The installation of tie-back anchors can have significant affects on adjacent properties, especially in granular soils and potentially difficult conditions, such as occur at the site.

The feasibility of completing the anchors to the design lengths and the likelihood of ground loss during drilling should be addressed. The benefits and drawbacks together with attention to feasibility for the various options for bracing the excavation should be compared.

- Fugro, 2003d report – The Peak Horizontal Ground Accelerations and Seismic Response Spectra are in accordance with Leighton's independently calculated values. However, the analyses may need to be revised depending on Fugro's response regarding our comments (Leighton, 2003) regarding the existence, location, and potential for rupture of the inferred north-south trending fault and photo-lineament. Should the fault be determined to potentially exist, the deterministic ground motions at the site due to it and their probability of occurring would need to be addressed.

Comments for Consideration Prior to or During Construction

- Fugro, 2002 report, Page 1 – The word "not" should have been inserted into the sentence "... the existing hospital facility does ***not*** meet current seismic standards ..." The sentence was subsequently corrected in Fugro's March 14, 2003 report (Fugro, 2003d).

- Fugro, 2002 report, Page 3 – Page 3 is missing from the report. This page appears to cover Fugro's scope of work and provides a listing of the reports they reviewed. The absence of the page is not considered critical for the current peer review.

- Fugro, 2002 report, Pages 8 through 13, Summary of Findings – This section includes generalized conclusions and recommendations. The following comments pertain to issues raised by the presented conclusions and recommendations:

  The size of the boulders within the fanglomerate deposit will significantly affect construction at the site. Specifically, the following questions should be responded to and appropriate recommendations provided, either in a comprehensive report or in individual reports for each proposed structure:

  1. Is it reasonable to expect to be able to excavate ¾ horizontal to 1 vertical (¾H : 1V) temporary slopes in the fanglomerate?
  2. What is the feasibility of excavating level bottoms for the building footings in the fanglomerate?
  3. Is it reasonable to expect to be able to drill relatively large diameter holes in the fanglomerate for installation of piling?

- Fugro, 2003d report, Page 2, Site Description – The approximate lateral and vertical extents of the reported existing concrete slab, lean concrete backfill, and cut-off wall discussed in the *Site Description* section and shown on Plate 3 should be shown on the project excavation/shoring drawings. Also, the elevations of the foundations, floor slabs, and underpinning of the adjacent existing buildings should be shown on the drawings.

- Fugro, 2003d, report Page 11, Liquefaction Analyses – The California Geological Survey Note 48 specifies that the Youd et al, 2001 be used for the liquefaction analyses. However, reanalysis of the liquefaction potential using Youd et al, 2001 is not expected to significantly affect Fugro's conclusions regarding liquefaction potential. The liquefaction potential of silts should be evaluated using the "Chinese Criteria" (included in Youd et al, 2001). The referenced procedure by Pradel (1998) contains numerous type-setting errors; confirm that the corrected procedure was used in evaluating the seismic settlement.

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If you have any questions regarding this report, please contact us at 661-257-7434. We appreciate this opportunity to be of service.

Respectfully Submitted,
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Youd, T. L.; Idriss, I. M.; Andrus, Ronald D.; Arango, Ignacio; Castro, Gonzalo; Christian, John T.; Dobry, Richardo; Finn, W. D. Liam; Harder Jr., Leslie F.; Hynes, Mary Ellen; Ishihara, Kenji; Koester, Joseph P.; Liao, Sam S. C.; Marcuson III, William F.; Martin, Geoffrey R.; Mitchell, James K.; Moriwaki, Yoshiharu; Power, Maurice S.; Robertson, Peter K.; Seed, Raymond B.; and Stokoe II, Kenneth H, 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *Journal of Geotechnical and Geoenvironmental Engineering*, Vol. 127, No. 10, October, 2001.

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Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

April 19, 2004

Project No. 600388-001

To: LSA Associates, Inc.
1998 Santa Barbara Street, Suite 120
San Luis Obispo, California 93401

Attention: Ms. Jill O'Connor

Subject: Report of Peer Review (Part 2) of Geotechnical Reports Prepared by Fugro West, Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan, City of Santa Barbara, California.

References: See Appendix A

Introduction

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) has prepared this letter report to present the findings of Part 2 of our peer review of the available geologic and geotechnical reports prepared by Fugro West Inc., for the Santa Barbara Cottage Hospital Seismic Compliance and Modernization Plan (Project), in the City of Santa Barbara, California.

Fugro West, Inc. (the Project Geotechnical Consultant) has prepared two report volumes to evaluate the geologic and geotechnical conditions of the site and vicinity with respect to the proposed modernization improvements for the Santa Barbara Cottage Hospital; Volume 1, Draft Geologic and Geomorphic Study and Volume 2, Previous Geotechnical Reports.

Leighton previously submitted the findings and opinions for Part I of our peer review of Fugro West, Inc.'s Draft Geologic and Geomorphic Study, Volume 1, dated March 2003 (Fugro West, Inc., 2003) and other related documents associated in a report dated March 29, 2004. This current submittal presents the findings pertaining to Leighton's peer review of the Fugro West reports included in Volume 2 of their March 2003 report for Santa Barbara Cottage Hospital.

This report presents our opinions regarding the adequacy of the geotechnical information gathered and interpreted by Fugro West, Inc., with respect the project site and proposed modernization improvements for the Cottage Hospital. Site specific investigations and/or analyses were beyond our scope of work and were not provided.

Our peer review was performed in general accordance with Section IV. Scope of Work as outlined in the LSA's Proposal for Services, Cottage Hospital Modernization Project Environmental Impact Report dated November 17, 2003 (and later revised on January 22, 2004). Additionally, our review of the technical reports prepared by Fugro West, Inc. was performed in general accordance with the California Geological Survey (CGS) - Note 48. The CGS is the agency for engineering geology and seismology review purposes on behalf of the Office of Statewide Health Planning & Development (OSHPD), which is the jurisdictional agency for hospitals and skilled nursing facilities in California. CGS – Note 48 outlines the minimum requirements to determine the adequacy and completeness of engineering geology and seismology, and geotechnical reports for the siting of public schools, hospitals, and essential services buildings under California Code of Regulations, Title 24, California Building Code.

Purpose

In general, the purpose of Leighton's peer review was to evaluate the adequacy of the existing geotechnical data for the Project, as gathered by Fugro, to support the EIR and to identified any major technical deficiencies or constrains that may required additional studies and/or analyses in order to provide positive support to the EIR.

Findings and Discussions of Volume 2 Report, dated March 28, 2003:

General

Since Fugro is now the Geotechnical Consultant of Record for the redevelopment of the hospital, this review comments on their 2002 and 2003 reports, specifically Fugro 2002, 2003d, and 2003e. The previous reports prepared by other consultants were reviewed solely for comparison of the data obtained and recommendations presented. The strictly geologic aspects of the site presented in Fugro's 2002 and 2003 reports were taken as being superceded by Fugro's March 28, 2003 report (Fugro, 2003a). We understand that the draft of the March 28, 2003, report is currently being review by CGS.

Our comments are presented in two sections. The first section contains comments that should be addressed as part of the preparation of the EIR. These comments should also be addressed, possibly more thoroughly, prior to construction. The second section contains comments that should be addressed prior to or during construction but do not need to be addressed as part of the EIR.

Comments for EIR Consideration

- Fugro, 2002 report, Page 7, Groundwater Conditions – Groundwater seepage observed at depths of 23 to 49 feet below the existing ground surface by LeRoy Crandall and Associates

(LCA) in 1982 is cited. Groundwater was reportedly not encountered by Fugro in their borings drilled to approximately 31½ feet below the existing ground surface. Fugro concludes that the seepage reported by LCA is due to perched water flowing within granular layers within the fanglomerate that underlays the site and that groundwater conditions will vary seasonably due to several factors. Not discussed by Fugro is the groundwater level data from the Woodward-Clyde (WC) sections. The WC sections show groundwater approximately 50 feet below the ground surface.

The report indicates that the proposed hospital will probably not be underlain by basements, and that the proposed central plant and parking structure may or may not be underlain by one basement level. Groundwater levels below 50 feet, and their possible affects on liquefaction potential, would not usually be of major consequence to structures supported at the existing grade or underlain by one shallow basement level. However, the existing hospital is indicated to be underlain by a 12- to 15-foot deep basement and a deep basement is shown to be planned beneath the central plant in Fugro's March 14, 2003, report (Fugro, 2003d). There is an approximately 30-foot drop in elevation across the hospital campus that may result in water being at shallower depths. The groundwater level conditions should be more thoroughly assessed considering the change in ground elevation across the proposed hospital campus and the possibility of deep basements under some of the proposed structures. The effects of groundwater level on the liquefaction potential of the deposits underlying the fanglomerate should be considered. For liquefaction analyses, it may be appropriate to use the floor elevation of basement as the "ground surface".

- Fugro, 2002 report, Page 7, Liquefaction and Seismic Settlement Leighton agrees that the fanglomerate beneath the site has a low potential for liquefaction or significant seismic settlement. However, explorations should extend to sufficient depths beneath the proposed basement floor elevations to confirm that liquefaction is unlikely to occur in the deposits underlying the fanglomerate. Leighton expects the potential for liquefaction occurring beneath the site to be low, but considering the proposed use of the site, additional explorations, or research, and analyses to confirm this seem appropriate.

- Fugro, 2003d report, Page 4 (This comment is tied to the above comment regarding Fugro 2002, page 7) – The borings for the proposed central plant are indicated to have been drilled to depths of 40 to 61 feet below the existing grade. With the proposed basement floor of the plant being approximately 27 feet below the existing grade, at least one of the borings should have been extended to at least 77 feet below the existing grade, i.e. 50 feet below the basement floor elevation (SCEC, 1999). In lieu of drilling a deeper boring, providing pertinent regional geologic data on the materials underlying the conglomerate may be sufficient to establish the nature of the materials underlying the fanglomerate. The deep borings drilled as part of Furgo, 2003a do not contain sufficient data to allow engineering evaluation of liquefaction.

- Fugro, 2003d, report Page 24, Construction Considerations – The installation of tie-back anchors can have significant affects on adjacent properties, especially in granular soils and potentially difficult conditions, such as occur at the site.

The feasibility of completing the anchors to the design lengths and the likelihood of ground loss during drilling should be addressed. The benefits and drawbacks together with attention to feasibility for the various options for bracing the excavation should be compared.

- Fugro, 2003d report – The Peak Horizontal Ground Accelerations and Seismic Response Spectra are in accordance with Leighton's independently calculated values. However, the analyses may need to be revised depending on Fugro's response regarding our comments (Leighton, 2003) regarding the existence, location, and potential for rupture of the inferred north-south trending fault and photo-lineament. Should the fault be determined to potentially exist, the deterministic ground motions at the site due to it and their probability of occurring would need to be addressed.

Comments for Consideration Prior to or During Construction

- Fugro, 2002 report, Page 1 – The word "not" should have been inserted into the sentence "... the existing hospital facility does ***not*** meet current seismic standards ..." The sentence was subsequently corrected in Fugro's March 14, 2003 report (Fugro, 2003d).

- Fugro, 2002 report, Page 3 – Page 3 is missing from the report. This page appears to cover Fugro's scope of work and provides a listing of the reports they reviewed. The absence of the page is not considered critical for the current peer review.

- Fugro, 2002 report, Pages 8 through 13, Summary of Findings – This section includes generalized conclusions and recommendations. The following comments pertain to issues raised by the presented conclusions and recommendations:

  The size of the boulders within the fanglomerate deposit will significantly affect construction at the site. Specifically, the following questions should be responded to and appropriate recommendations provided, either in a comprehensive report or in individual reports for each proposed structure:

  1. Is it reasonable to expect to be able to excavate ¾ horizontal to 1 vertical (¾H : 1V) temporary slopes in the fanglomerate?
  2. What is the feasibility of excavating level bottoms for the building footings in the fanglomerate?
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