Cleath & Associates
Engineering Geologist
Ground Water
(805) 543-1413
1390 Oceanaire Drive
San Luis Obispo
California 93405

April 12, 1991

Mr. Brad Brechwald
John L. Wallace & Associates
1458 Higuera Street
San Luis Obispo, CA 93401

SUBJECT: WELL SITING STUDY - EMERALD BAY

Dear Mr. Brechwald:

As authorized in our February 4, 1991 proposal/agreement, we have performed a well siting study of the Black Lake Specific Plan Area. This is for the purpose of locating the most favorable site for a well to be constructed as a part of the "Emerald Bay" subdivision. Selection of one primary and three alternative well sites is based on available locations in the development plan area, and where the maximum ground water production and well depth, and the best water quality can be obtained. The required water production is for 350 gallons per minute. The water quality criteria are the State of California Title 22 standards.

We have reviewed the available information on driller's logs, exploratory oil well logs, ground water discharge and drawdown data, water level records, and water quality data. We have used the preliminary plans for development for guidance on where a well could be placed, minimizing inconvenience to lots, roads, and utilities, and vegetation. We have also visited the area to identify wells in the near proximity to the Black Lake golf course developments.

HYDROGEOLOGY

The ground water underlying the specific plan area is stored within three primary geologic formations: the dune deposits, the Paso Robles Formation, and the Careaga Formation.

Ground water in the dune sand deposits is perched and not normally used as more than a small domestic supply source. The dune sand deposits are deepest along the western edge of the property where they are found to an elevation above mean sea level of 100 feet. Along Pomeroy, the base of the dune deposits is 200 feet higher. The water quality of this perched water is good.

The ground water in the Paso Robles Formation is what was tapped in Black Lake Well #4 for the Black Lake Specific Plan. The production characteristics of the aquifers tapped in this well are most likely to be better than in the area available for another well because the Paso Robles Formation gets shallower to the north and east. It appears that the base of the Paso Robles Formation is 120 feet higher

at Black Lake Well #2 than in Black Lake Well #4 (thereby reducing the saturated thickness within the Paso Robles Formation by 50 percent).

The Careaga and Sisquoc Formations, underlying the Paso Robles Formation, hold ground water within marine sand beds. These beds rise to the north and east and also pinch out to the east near Pomeroy Road. Black Lake Well #2 (10G3) produced ground water from these formations. This well initially produced up to 500 gallons per minute (gpm), but the water has some undesirable water quality characteristics, including excessive concentrations of hydrogen sulfide and iron. These particular constituents can vary significantly with location and may need to be removed through treatment to acceptable levels, if excessive concentrations of iron, manganese and sulfides are produced.

Fine sands encountered in the Careaga and Sisquoc Formations also must be dealt with using fine gravel pack and a thin well casing slot size and, potentially, a sand separator. The deeper Sisquoc Formation sands appear to be finer grained than the Careaga Formation.

The cross sections shown on Figures 2 and 3 illustrate subsurface conditions in the vicinity of the Black Lake Specific Plan. Section A-A' is along Via Concha from Willow Road to Black Lake Canyon. The subsurface conditions have been interpreted based on lithologic logs and electric logs. One interesting thing to note is that the aquifers tapped by Black Lake Wells #2 and #4 are distinctly different despite the similar depth intervals of the perforations.

Section B-B' is located along Black Lake Canyon and shows that not only do the beds become shallower to the east, but the Careaga Formation also appears to thin to the east.

GROUND WATER PRODUCTION

The ground water production from wells in this area comes from any combination of water bearing formations. The production from a well varies dramatically with location, since the water bearing strata vary in depth and permeability from one location to the next. As can be seen on Figure 1, the wells in the southwestern corner of the specific plan area have the greatest productivity. In order to produce 350 gpm, a well would need to be located in the western one-third of the specific plan area and south of the canyon rim.

GROUND WATER QUALITY

Ground water quality appears to be generally good over the area of the specific plan, as long as the well produces from the Paso Robles Formation and the Careaga Formation. The possibility of finding excessive sulfides and iron and manganese concentrations increases with depth, but these constituents can not be directly associated with

particular formations or aquifers. Well "3R" in Black Lake Canyon and the Nipomo CSD Bevington well appear to have acceptable sulfides, iron and manganese concentrations while the Black Lake Wells #3 and #4 have initial spikes of high iron and manganese levels which lower within a few minutes of pump start-up. Whether this is due to naturally occurring concentrations, or due to chemical or bacterial corrosion of casing or pump materials is not known. The sulfide level in Black Lake Well #2 is considered to be natural, but the iron and manganese levels are probably due to corrosion.

WELL SITES

Cleath & Associates, after reviewing the information, considers that the vicinity of Black Lake Well #2 is the best location for productivity and quality (given a shallower well depth than the existing well there). We recommend that the Well #2 should not be considered for use as a domestic water source due to water quality, excessive depth, casing material and age. Another well placed 150 feet to the north of this well would not preclude pumping interference, but would be likely to avoid possible drilling problems associated with cavities due to washouts at depth around the existing well casing.

The property ownership and associated details are not known by Cleath & Associates, but we recognize that it is important. Other well sites are identified which have the potential to provide the desired yield and which are located in the areas outside of the golf course. Three sites hold some potential for a well, these sites are noted as "A", "B", and "C". Site "A" is located north of the 14th green in the common area along the westerly property line. Site "B" is located in the southwest corner of the "Golf Course E" area, next to the PG & E easement. Site "C" is located in the southwest corner of Common Area "C", adjacent to the 12th tee fairway. The precise locations and access roads required would need to be determined upon refinements of the well sites as arranged by all parties concerned.

All of the alternative well sites, A through C, would be relatively similar in total depth and design. Distance to the nearest adjacent well is at least eight hundred feet for "A" and "B" and more than 1500 feet for well site "C".

WELL DESIGN

Wells located at the sites identified herein would roughly be the same design, although the total depth and perforated interval could vary from site to site. The main difference between Black Lake Well #4 and this proposed design is the casing material and diameter. The 10" diameter casing was selected because of the high costs associated with the stainless steel casing. A 12" diameter casing would incur additional expense while both casings could be equipped with an 8"

diameter submersible pump with the necessary 350 gpm capacity and lift. Stainless steel is recommended in light of the water corrosivity and the collapse pressures associated with this deep setting. Stainless steel casing should be used below the static water level.

Surface facilities, including the layout of the sounding tube, gravel fill tube, pump base, well discharge piping, electrical hookup, and access area and road, are considerations to be made by the engineering firm designing the facility and water system. The well depth could vary by about 50 to 100 feet and the perforated interval could vary by 20 to 40 feet. In general, however, the well design described below is recommended:

(1) Total Test Hole Depth: 640 feet
(2) Electric Log
(3) Total Nominal 18-20" diameter Reamed Depth: 560 feet
(4) Casing Schedule
    10" diameter Mild Steel Blank Casing: 0-300 feet
    10" diameter Dielectric coupler at 300 foot depth
    10" diameter Stainless Steel Blank Casing: 300-380 feet
    10" diameter Stainless Steel Well Screen (0.040 slot): 380-560 feet
(5) "Lapis #3" annular gravel pack from base of sanitary seal to the total depth, installed by construction-tremie
(6) Sanitary seal placed in annulus by construction-tremie from 0-100 feet below ground surface
(7) One and a half inch diameter steel gravel fill tube: 0-105' in annulus, with threaded cap
(8) One inch diameter steel sounding tube joined at a 30" angle from vertical to the well casing with threaded cap

Note: Conductor casing to be installed as required by the contractor.

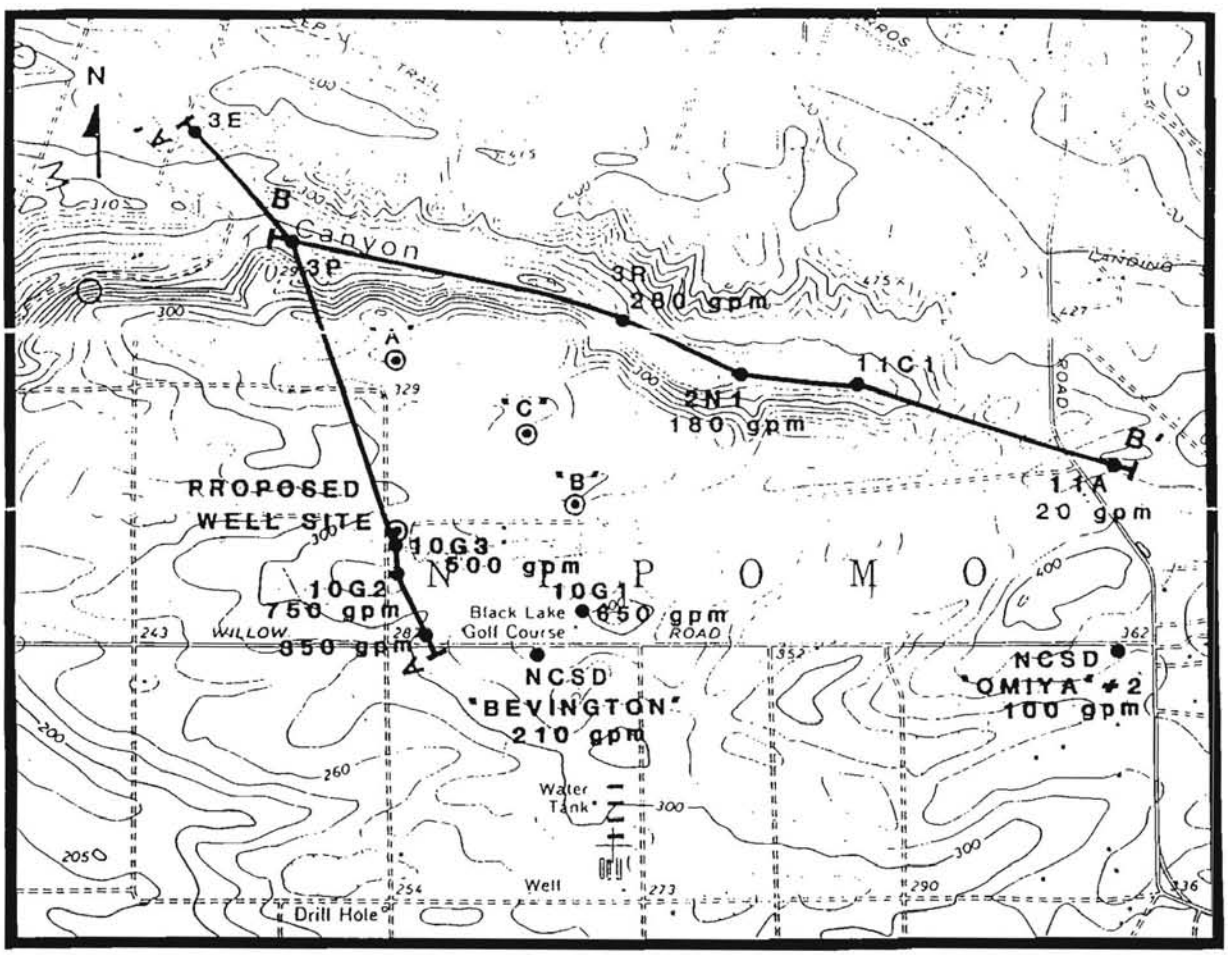
CLOSING

This report identifies a primary and three alternate well sites. We would be happy to discuss further our findings and recommendations, if desired.

Very truly yours,

Timothy S. Cleath
CEG 1102

REGISTERED GEOLOGIST
TIMOTHY S. CLEATH
No. 1102
CERTIFIED ENGINEERING GEOLOGIST
CEG 6/31/97
STATE OF CALIFORNIA



SCALE 1 inch = 2000 feet

3E Boring or Well

Possible Well Sites

Cross Section

FIGURE 1

WELL LOCATION MAP

BLACK LAKE SPECIFIC PLAN VICINITY

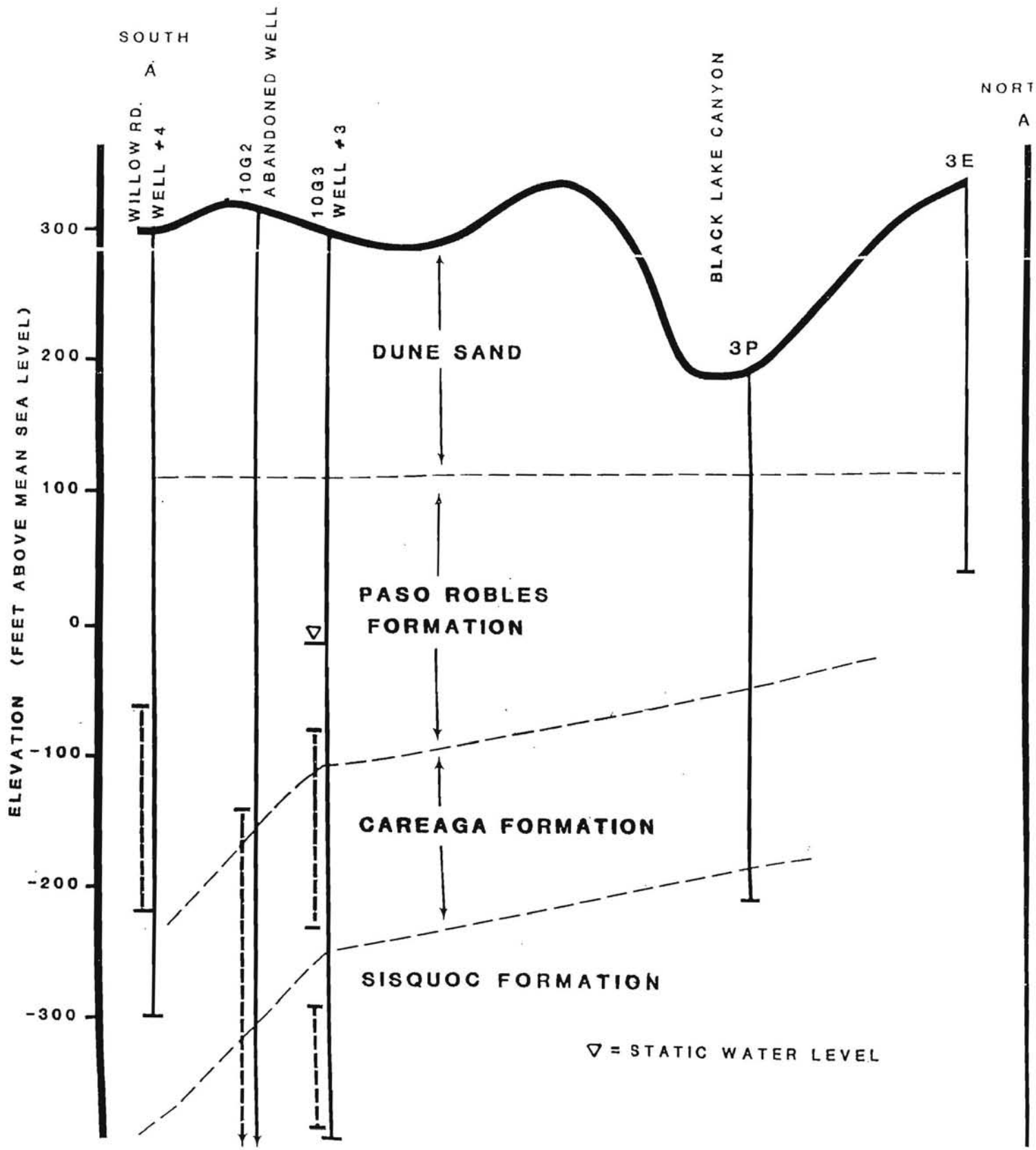


FIGURE 2

CROSS SECTION ALONG WESTERN BOUNDARY

BLACK LAKE SPECIFIC PLAN AREA

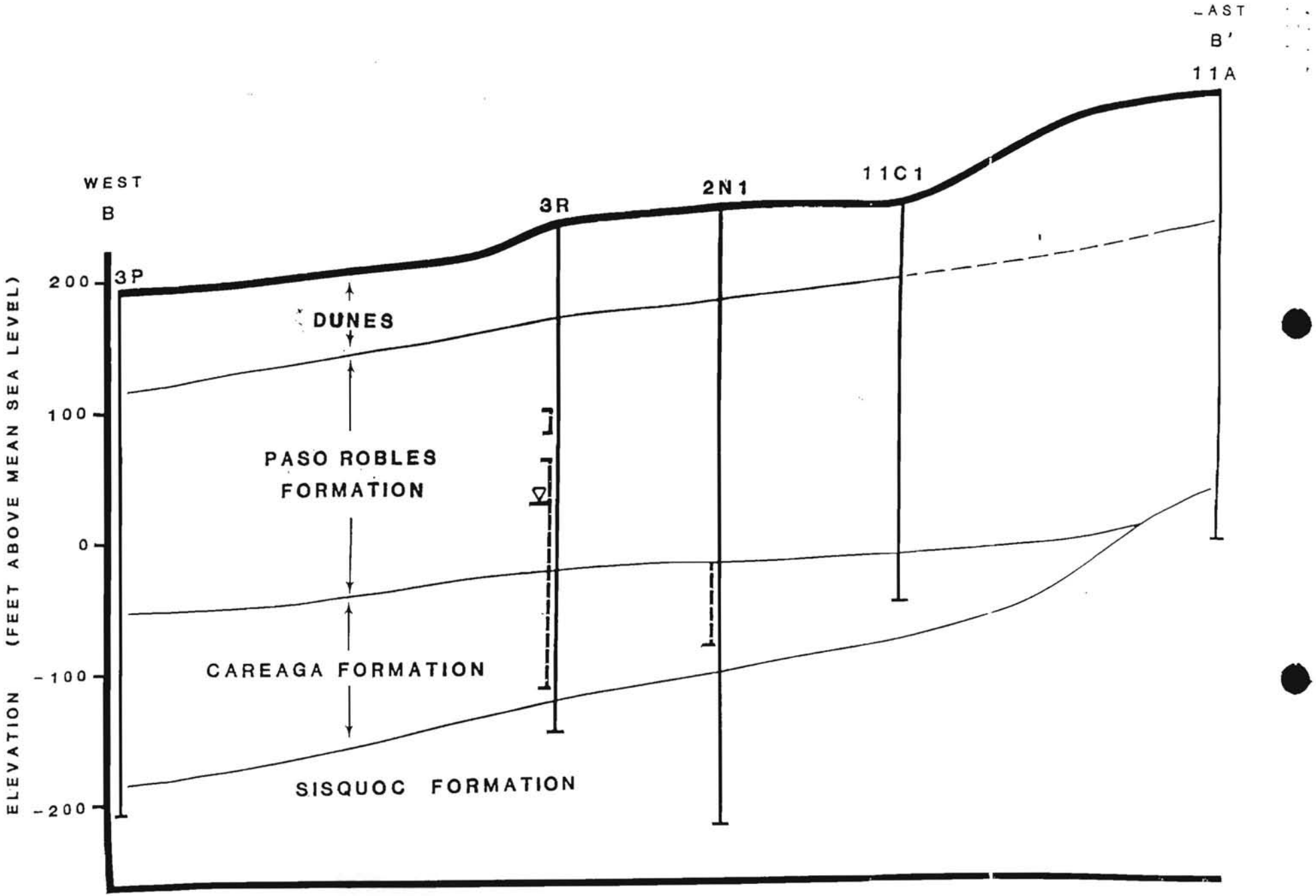
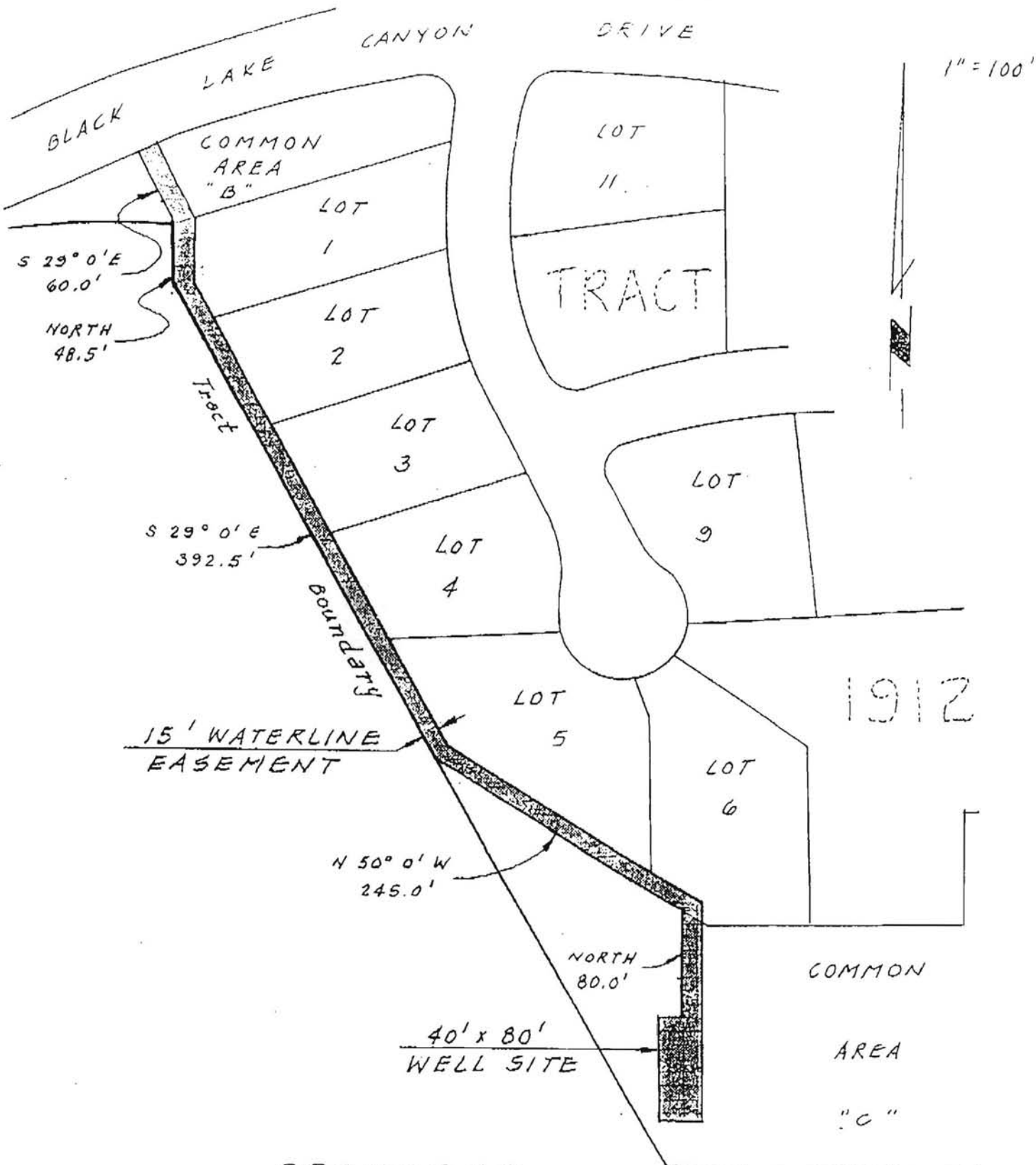


FIGURE 3

CROSS SECTION ALONG BLACK LAKE CANYON



PROPOSED
WATER SYSTEM EASEMENT
BLACK LAKE

Cleath & Associates
Engineering Geologists
Ground Water
(805) 543-1413
1390 Oceanaire Drive
San Luis Obispo
California 93405

April 2, 1992

Doug Jones
Engineering Department
County of San Luis Obispo
County Government Center
San Luis Obispo, CA 93408

SUBJECT: Response to Comments on monitoring well design for Black Lake Well #5 made by Luhdorff and Scalmanini to the County

Dear Mr. Jones:

We have received verbally the comments made by Luhdorff & Scalmanini to the County regarding the design of the monitoring well for Black Lake Well #5. Our response to the comments is submitted herein.

The proposed design was prepared by State of California certified engineering geologist and registered engineers and meets both state and AWWA standards. Some of the modifications recommended by Luhdorff & Scalmanini can be followed without compromising our design criteria while others are not deemed appropriate. The items at issue are: (1) casing material, (2) casing connections, (3) annular seals, and (4) casing centralizers. A formation sieve analysis was requested to design well screen slot size and gravel pack gradation. Each of these items are discussed below.

CASING MATERIAL

Casing material recommended by Luhdorff & Scalmanini is the Schedule 80 PVC for the entire length of blank and slotted well casing rather than using the Class 200 casing in the screened section. This is acceptable and will be used.

CASING CONNECTIONS

Casing connections are recommended by Luhdorff & Scalmanini to be threaded rather than the solvent weld and stainless steel screw method. The proposed connection using solvent weld and stainless steel screws are industry standard for water well casings and acceptable under state standards.

The monitoring well is to be used for water quality sampling with the main constituents of concern being metals and general mineral ions. The solvent use does not mask analytic results for the constituents to be tested and even with the organic constituents, the solvent consists of tetrahydrofuran which can easily be identified on organic constituent analysis.

Our experience has been that the threaded casing connections result in a weakened point in the casing and a potential for casing failure. Therefore we do not accept the recommended casing connections.

ANNULAR SEALS

Annular seals recommended by Luhdorff & Scalmanini include the aquifer isolation seals placed 20 feet above the screen intervals; and the sanitary seal, consisting of cement grout slurry placed in the borehole/monitoring well casing annular space from ground surface to a depth of 230-240 feet. We concur with the placement recommendation for the aquifer isolation seals.

We don't agree with the sanitary seal recommendation for the following reasons. The use of a cement grout slurry in the borehole/casing annulus to a 230-240 foot depth would result in higher collapse pressures than the normal hydraulic gradient and a significantly higher heat of hydration which could weaken the PVC casing. The potential for interaquifer water flow could be precluded by a seal placed at the appropriate depth and would not need to be taken to the surface. If the appropriate depth is at and above 240 feet depth, a seal could be placed there, similar to those placed deeper in the annulus.

We continue to recommend that the conductor casing be placed to a depth of 50 feet with an exterior annular seal as the appropriate sanitary seal for this monitoring well. The conductor casing will protect the monitoring well casing and ensure that the upper portions of the hole are stabilized while construction of the well is in progress. Cost considerations have been dealt with and are not a factor in this special design requirement.

CASING CENTRALIZERS

Annular casing centralizers will be placed as recommended by Luhdorff & Scalmanini.

SIEVE ANALYSIS

Formation material sieve analysis will be performed as recommended by Luhdorff & Scalmanini.

CONCLUSION

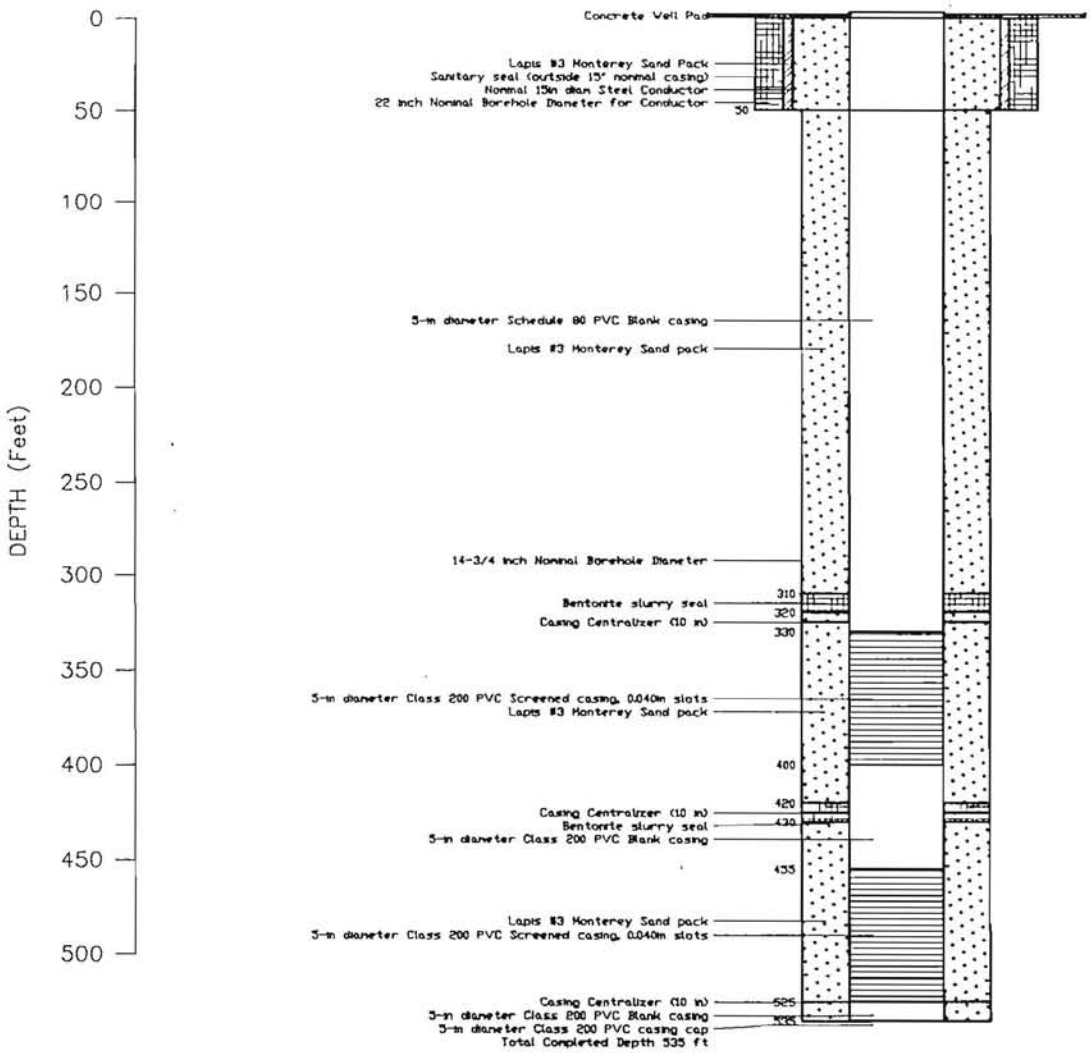
We appreciate the design review comments and it is our intent to provide the County with a high quality monitoring well for long term use.

The design of the well needs to be completed expeditiously and we would appreciate it if the County would provide the direction to submit these modifications to the contractor so that the well could be completed without further delay.

Thank you in advance for your rapid response.

Very truly yours,

Timothy S. Cleath
CEG 1102



Monitoring Well

Emerald Bay Properties

Black Lake Well #5

March 30, 1992
CLEATH & ASSOCIATES

LUHDORFF & SCALMANINI
Consulting Engineers

Eugene E. Luhdorff, Jr., P.E.
Joseph C. Scalmanini, P.E.

March 11, 1992
File No. 89-2-012

Mr. Doug Jones
County of San Luis Obispo
County Government Center
Room 207
San Luis Obispo, CA 93408

SUBJECT: WELL DESIGN AND SPECIFICATION REVIEW
BLACK LAKE WELL NO. 5
COUNTY OF SAN LUIS OBISPO

Dear Mr. Jones:

In response to your request, we have reviewed the production and monitoring well drawings and specifications for the Black Lake Well No. 5, Emerald Bay Properties forwarded to us by recent facsimile transmittal. On behalf of the County, we have reviewed the documents and have prepared the enclosed summary of comments on the design as submitted. In general, our comments are focused on general design parameters and construction features and practices which the County has been implementing into generally standard conditions for wells over the last three years. Since certain key well design parameters have not been submitted for review or are not yet available, we are unable to comment on them. For example, since the selection of gravel envelope material should properly be based on the size of aquifer materials to be retained, it is not possible to confirm the specified Lapis #3 gravel until formation samples are collected and analyzed. Similarly, it is not possible to confirm screen placement until the locations of aquifer materials are identified by formation sampling and geophysical logging.

Should you have any questions or require additional details regarding the enclosed comments, please feel free to call.

Sincerely,

LUHDORFF AND SCALMANINI
CONSULTING ENGINEERS

William A. Gustavson

WAG/js

500 First St. • Woodland, CA 95695 • 916-661-0109 • FAX 916-661-6806
Ground-Water Hydrology, Development and Management

Review Comments on
General Technical Specifications
for
Drilling, Construction and Testing
of
One Production Well and One Monitoring Well

Emerald Bay Property
Black Lake Well No. 5
February 14, 1992

As a general comment, compared to technical specifications which the County has been using, the specifications are too abbreviated and lack sufficient descriptive detail to ensure proper quality control for the successful completion of both the monitoring well and the production well. Specific comments include the following:

A. Specifications

1. No minimum drilling equipment specifications, method of construction, or drilling fluid control program is specified; all should be.
2. Reference is made to a pilot hole, which implies that a final borehole will be reamed for monitoring well construction; however, it also appears that the full diameter (12 inches) borehole will be drilled on the first pass.
3. It is more important to caliper log the production borehole (possibly excluded in the specifications but not clear) than the monitoring borehole prior to casing/screen installation.
4. There are no well casing specifications that specify grade of pipe, ASTM or other standard, or minimum well thickness. For production wells, the County has been utilizing a better casing grade than mild steel for increased corrosion resistance.
5. The "Lapis #3" sand material should be indicated to be a preliminary design, subject to verification after formation sampling and analysis.
6. The specified "neat cement grout" seal need not be neat cement and should include additives to prevent shrinkage. Provisions should also be included for stage cementing as necessary, to avoid collapse of the PVC monitoring casing.
7. The 1 inch sounding tube must be at least 3 inches in diameter to conform with State Department of Health Services standards. Additionally, the tube should be welded at a 45° angle to permit the necessary well pump surface plate clearances. Neither the sounding pipe nor the specified gravel fill pipe is shown on the plans.

8. No well development procedures are specified for the production well. Air-jet development, as specified for the monitoring well, is not acceptable for proper development of the production well screened sections.
9. Specifications for the type, depth or capabilities (capacity, head, horsepower) of the test pump are not set forth.
10. No well performance guarantees such as well efficiency, sand production or plumbness and alignment are included. All those parameters are critical and the County should insist on minimum standards as it has for other wells recently constructed for County operated systems.

B. Drawings - Production Well

1. The production borehole should be deeper than the well depth to allow installation of the casing assembly in tension rather than in compression if installed to the bottom of the hole as shown. This is particularly critical if wire wrapped well screen is to be used as shown.
2. The gravel fill pipe and sounding pipe should be included as discussed above.
3. No casing or screen thickness or strength is depicted (or specified). This is critical as a thin-walled casing could collapse (or deform) during gravel/cementing operations, during development, or during later operation.
4. The specified slot size is too small for the specified Lonestar Lapis No. 3 gravel pack. Assuming that the Lapis No. 3 material is confirmed after formation sampling, acceptable design practice would be to retain 85 to 90 percent of that material, i.e. with a slot size of 0.050 inches.
5. The type of "dielectric coupler" is not specified.
6. Casing centralizers should be specified and illustrated.
7. We would question the 10 inch casing diameter for a design capacity of 350 gallons per minute. Assuming a pumping water level as deep as 250 feet with a discharge head of 115 feet (50 psi), a production of 350 gallons per minute would require a 40 to 50 horsepower unit (depending on bowl efficiency). Thus an 8 inch submersible motor (4 pole speed) would be required. If a deeper setting were to require a motor shroud, or if the well has to be "lined" for repair reasons in the future, the well pump would have to be replaced to accommodate the smaller casing. A minimum 12 inch diameter is recommended.
8. The type of end plate should be specified and not merely illustrated as a flat plate.

C. Drawings - Monitoring Well

1. The wall thickness of the class 200 PVC well casing is too thin for the depth of the well.
2. The intermediate seals (bentonite) are all too close to the screen sections. Such an installation results in ineffective sand control in addition to possibly affecting water quality.
3. No casing centralizers are depicted on the drawing but should be installed.

4. The well bore should be overdrilled to permit installation of the casing assembly in tension and not in compression if installed to the bottom of the borehole.
5. The cost of constructing a 5 inch well may be significant relative to the full diameter production well. The County, if ultimately responsible for construction costs, may want to explore alternate production well construction and testing methodologies, i.e. smaller diameter monitoring completions as installed at Los Osos and San Miguel; installation of intermediate annular seals in the production well, etc.

SAN LUIS OBISPO COUNTY

COUNTY GOVERNMENT CENTER • SAN LUIS OBISPO, CALIFORNIA 93408 • (805) 549-5252

CLINTON MILNE
County Engineer

GLEN L. PRIDDY
DEPUTY COUNTY ENGINEER
NOEL KING
SPECIAL DISTRICTS ADMINISTRATOR

COUNTY
ENGINEERING
DEPARTMENT

ROADS
TRANSPORTATION
TRANSIT
FLOOD CONTROL
WATER CONSERVATION
COUNTY SURVEYOR
SPECIAL DISTRICTS
SOLID WASTE

February 7, 1992

MEMORANDUM

To: Noel King, Deputy County Engineer

From: Percy Garcia, Water Quality Manager PMG

Subj: Black Lake Meeting of February 6, 1992

Per your request I attended a meeting on February 7, 1992 regarding new wells in the Black Development area. Also attending were Doug Jones of County Engineering, Brad Brechwald and Craig Taylor of John Wallace Associates, and Tim Clieth a private consultant.

Discussion during the meeting centered around the development of a new monitoring well and equipment requirements for future production wells in the Black Lake area.

It was agreed that developing a new monitoring well would be in the best interests of both the County and the developer (Pacifica Corporation).

In addition, we agreed that due to the new Coliform Rule all new production wells need to include: on-line chlorine and turbidity analyzers, chart recorders, alarm systems and associated phone dialers. It was also agreed that new production wells should utilize a liquid chlorine disinfection system rather than gaseous chlorine. As you are aware there is a considerable cost savings associated with liquid chlorine systems as well as being less hazardous than the chlorine gas.

Please feel free to call me at extension 5111 if you have any questions regarding this memorandum.

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cc Tony Boyd

Re: Tr. 1912
Tr. 1409
Tr. ~~1409~~ 1779

CSA 1-G
Black Lake

FYI -
Stan Sauda
P.G.
Rick
Butch
Mike J.

TO: Tony Boyd

From: Glenn Britton

Date: Mar. 30, 1992

Subject: PRODUCTION WELL MEASURE TUBE REQUEST

Tony
31 Mar 92

The major reason for installing an external or internal measure tube is very basic, you can get the measuring tape (electric or steel) down the tube any time and get an accurate water level. The wetted tape method is considered the most accurate method for measuring the water level in wells.

1. The well can be pumping, which allows us to check the condition of the well screens and pump in relation to actual ground water level. Just knowing the level inside the casing is not always enough information.

2. If the well has oil on top of the water then the inside of the casing will have oil on it and this means that the tapes will be extremely hard to get an accurate water level.

3. In some of our newer production well the annular space that is left after designing the casing and pump column is not sufficient to allow a tape to go down. It may look good on paper but in the field you get curving of the casing and pump column. Then more annular space is taken up by the threaded couplings that hold the pump column together every 20 feet or so.

Reasons for an external tube that enters the well casing (now internal) just above the first well screen area:

1. This tube would be 3 inches or so in diameter and a smaller diameter tubing could be inserted and water pumped from certain sections of the screen area allowing for water testing if needed.

2. A TV camera could be lowered down into the well casing and the screens would be observed under actual pumping conditions. Again, dollar savings would result in that the pump and column would not have to be removed and the system out of service for several days or weeks.

3. Also if needed in the future chemicals could be pumped down the smaller tube (see #1 above).

A tube (with appropriate screen locations) that would be left in the pilot hole, 10 to 15 feet away is better than an air line (plastic or metal) that is attached to the pump column when it is installed.