TO: BOARD OF DIRECTORS

FROM: MICHAEL LEBRUN MSL

DATE: MARCH 4, 2010

AGENDA ITEM
E-2
MARCH 10, 2010

FUGRO CONTRACT AMENDMENT FOR PASQUINI PROPERTY HYDROGEOLOGIC INVESTIGATION AGREEMENT

ITEM

AUTHORIZE EXECUTION OF AMENDMENT TO FUGRO HYDROGEOLOGIC AGREEMENT IN THE AMOUNT OF $30,200 FOR ADDITIONAL SERVICES REQUIRED [RECOMMEND APPROVAL].

BACKGROUND

In 2009, your Honorable Board selected Fugro West Inc. to provide hydrogeologic services to investigate the feasibility of the Pasquini property as an alternate effluent disposal site for the Southland Wastewater Treatment Facility (WWTF). Fugro issued the attached draft report in February 2010, in accordance with the scope of work that was authorized by the Board. The only change from the approved scope of work was that Fugro had planned to drill several monitor wells to obtain water quality data but did not have to install the wells since Mr. Pasquini allowed the District to sample the two agricultural water wells on the property to obtain the background water quality data needed for the study.

Fugro's latest field work and modeling detailed in the attached report indicates a layer of fine-grained sediments located at a depth of approximately 65-feet below ground surface would not result in a mound that would break out through the bluff face nor the ground surface if the site was used for wastewater effluent disposal using a pond system. However, the report references two additional low permeability layers, that may exist at depths below the sampling methods previously utilized. Fugro recommends the presence and nature of these deep layers be investigated. The presence of deep low-permeability layers was reported in water well completion logs provided by Mr. Pasquini. The logs indicate the presence of low-permeability layers at 120-feet below ground surface and 180-feet below ground surface. Fugro is recommending additional field work to verify the presence and evaluate the characteristics of the two reported deep clay layers.

Staff met with Fugro to discuss tasks that were beyond the original scope of services but are necessary to move forward with the hydrogeologic investigation. As set forth in the attached work plan, Fugro is willing to perform this work on a time-and-materials basis with a not-to-exceed expenditure limit of $73,200. The field work will involve the drilling of three deep boreholes to investigate the presence and lateral continuity of the deep clay layers utilizing the sonic drilling method. This method allows the collection of an "undisturbed" soil samples at the required depths.

FISCAL IMPACT

The original contract amount was for $128,800 and the cost to date is $85,800 since the District realized a savings of approximately $43,000 in not having to drill the monitor wells to obtain the water quality data. The execution of the proposed amendment would increase the not-to-exceed agreement expenditure limit $30,200 from $128,800 to $159,000. The FY 09-10

Budget includes $8,000,000 in Town Sewer Capacity Charges Fund (Fund #710) for design services, environmental review services and construction.

RECOMMENDATION

Staff recommends that your Honorable Board authorize the General Manager to execute an amendment in the amount of $30,200 to the existing Fugro Pasquini Hydro-geologic Investigation Agreement.

ATTACHMENTS

- Fugro Interim Report Pasquini Property Hydrogeologic Investigation dated February 2010
- Fugro Work Plan for Additional Field Work Related to the Hydrogeologic Investigation of the Pasquini Property

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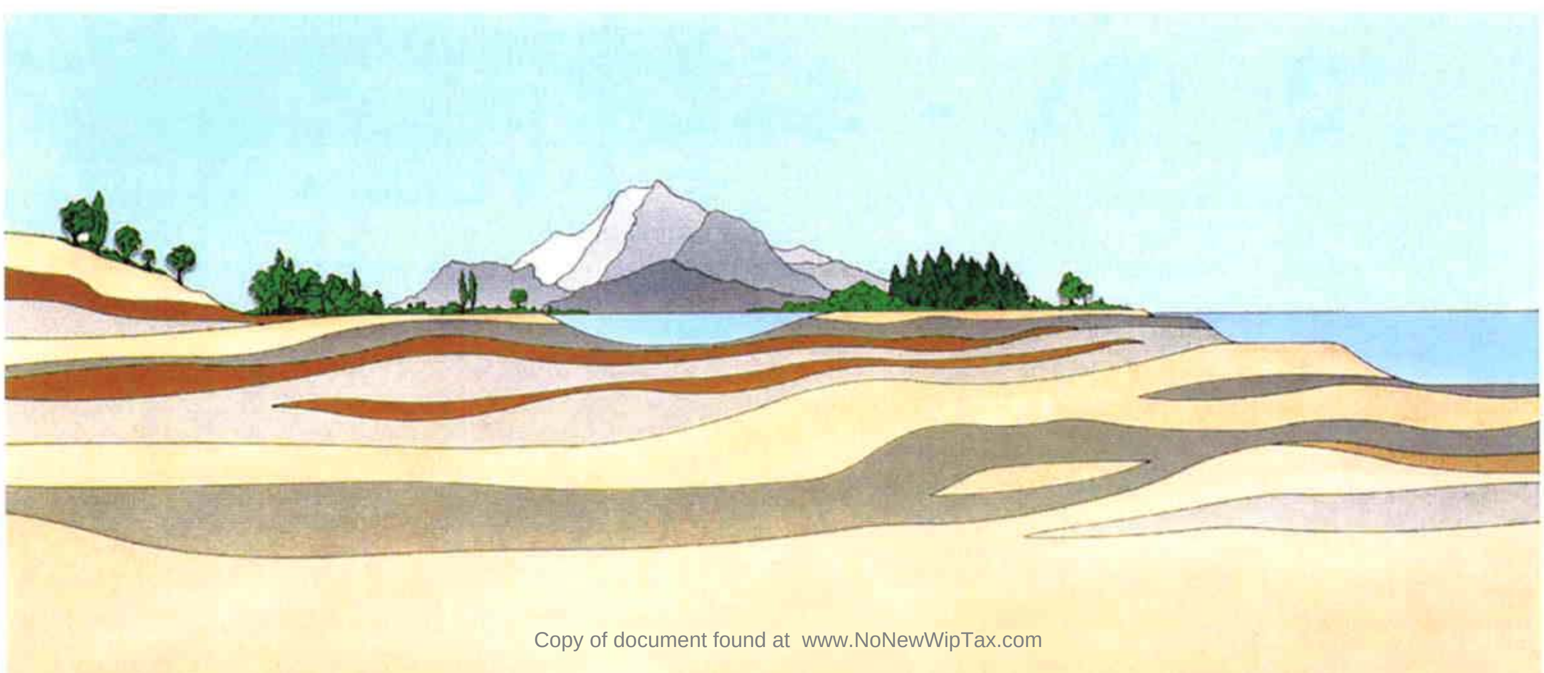
FUGRO WEST, INC.

INTERIM REPORT
PASQUINI PROPERTY HYDROGEOLOGIC INVESTIGATION
NIPOMO, CALIFORNIA

Prepared for:
NIPOMO COMMUNITY SERVICES DISTRICT

Prepared by:
FUGRO WEST, INC.

February 2010



FUGRO WEST, INC.

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February 19, 2010
Project No. 3596.005

Nipomo Community Services District
Post Office Box 326
148 S. Wilson Street
Nipomo, California 93444

Attention: *Mr. Peter Sevcik*
District Engineer

Subject: **Interim Report**
Pasquini Property Hydrogeologic Investigation, Nipomo, California

Dear Mr. Sevcik:

Fugro West Inc. is pleased to submit this Interim Report that summarizes the initial results of a hydrogeologic investigation of the Pasquini property as part of the planned upgrade and expansion of the Nipomo Community Services District's Southland Wastewater Treatment Facility (WWTF). The objective of the study was to assess the feasibility of the site as a supplemental treated wastewater effluent disposal site. This report presents our understanding of the hydrogeology of the site, specifically related to the infiltration capacity and potential for groundwater mounding in the northern portion of the site.

Sincerely,

FUGRO WEST, INC.

Timothy A. Nicely, P.G., C.Hg.
Project Hydrogeologist

Nels C. Ruud, PhD
Project Hydrogeologist

Paul Sorensen, P.G., C.Hg.
Principal Hydrogeologist
Project Manager

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NIPOMO, CALIFORNIA

SITE DESCRIPTION AND BACKGROUND

The Nipomo Community Services District (District) is planning for the expansion of the District's Southland Wastewater Treatment Facilities (WWTF). One site being investigated for expansion of the effluent disposal component of the WWTF is a 35-acre portion of a 192-acre parcel known as the Pasquini property, which is located south of Orchard Road (APN 091-311-001) in Nipomo, California. The Pasquini property extends approximately 3,500 feet southwest of Orchard Road to Riverside Road, the southern edge of which is characterized by a steep bluff that is approximately 80 to 130 feet high. The 35-acre portion of the property extends approximately 1,200 feet southwest of Orchard Road. The location of the site is presented on Plate 1 – Vicinity Map. A map of the area of investigation (project site) on the Pasquini property is presented on Plate 2 – Site Map.

The northerly third of the Pasquini parcel, the subject of this investigation, occupies approximately 35 acres. A generalized cross section of the property, which presents the relative locations of the proposed pond system, the bluff, the alluvium of the Santa Maria River Basin, and the regional water table is presented as Plate 3 – Conceptualization of Subsurface. Generally, the 35-acre site is located about 150 feet higher than the Santa Maria River Basin alluvium. As indicated on Plate 3, the regional water table is located approximately 250 feet below ground surface (bgs) in the vicinity of this investigation.

Following expansion of the WWTF, the District is planning for a facility to dispose of up to approximately 1.8 million gallons per day (MGD) of treated wastewater. Recent modeling has shown that the existing Southland WWTF can dispose of approximately 0.57 MGD on a long-term basis without causing any further increases in groundwater elevations at the existing monitoring wells (that is, the underlying effluent mound will not continue to grow and expand; Fugro 2008a). In order to dispose of the remaining 1.23 MGD of treated effluent, the District needs to identify additional locations for disposal of treated wastewater. The District is considering the Pasquini site as a potential location for the development of a percolation pond disposal facility.

A feasibility level exploration program was previously conducted on the Pasquini property (Fugro 2008b). That preliminary investigation estimated the percolation capacity, the local hydrogeology, and the depth to groundwater. The conclusions presented in that report indicated that relatively lower permeability layers may exist at variable depths in the unsaturated zone, particularly at depths below about 75 feet within the southerly parts of the site. Although the lateral continuity of these low permeability layers is not known, their presence creates a concern relative to the ultimate fate of wastewater discharged in percolation ponds on the parcel. The preliminary conclusions of that report were that discharge of wastewater in the northerly third of the parcel would occur at a sufficient distance from the bluff along the southern portion of the site such that "daylighting" of the applied water on the slope face would not occur.

Since the time of the feasibility-level exploratory work conducted during the Spring and Summer of 2008, the property has been fully planted in strawberries. Development of the agricultural operations has altered the conditions of the site from the time of the initial investigation through the significant irrigation loading of the strawberry plants. Two high-production water wells have been installed along the southwestern edge of the property, as shown on Plate 4 - Site Map and Exploration Locations.

WORK PERFORMED

PURPOSE AND SCOPE

The purpose of this investigation was to conduct an evaluation of the suitability of the property for the development of an effluent disposal facility. Critical to the success of the potential supplemental percolation pond facility is the ability of the wastewater to percolate and flow more or less vertically through the relatively deep unsaturated zone and merge with the water table of the regional water table aquifer at an elevation below the base of the bluff, located approximately 2,000 feet to the southwest. In order to determine the degree to which the surficial materials would accept applied treated effluent, we performed a series of conventional percolation tests. We also dug four exploratory test pits near the center of the site to determine the nature of the shallow geologic materials, within which we built a single prototype percolation pond. Within the pond we performed a percolation test designed to mimic the methods to be used in the proposed ponds. We also collected a water quality sample from one of the onsite water supply wells to determine the chemical characteristics of the deep aquifer (receiving water). Finally, we applied an analytical evaluation and solution to evaluate the fate and transport of wastewater discharged into the proposed percolation ponds, the shape and size of the anticipated effluent mound, and the expected relationship of the effluent mound to the bluff face.

CONVENTIONAL PERCOLATION TESTING

In order to evaluate the percolation capacity of the near-surface sediments underlying the site, we performed a series of seven conventional percolation tests near the anticipated grade (elevation) of the base of the proposed percolation ponds. Because the exact elevation of the base of the percolation ponds was not known, each conventional percolation test was performed at a depth of approximately five feet below the current grade. The conventional percolation tests were performed in accordance with San Luis Obispo County requirements for testing related to private sewage disposal systems. Based on the locations of the conceptual percolation ponds (AECOM, 2009), which included 24-acres of gross area for the percolation ponds, we performed a total of seven conventional percolation tests and one prototype percolation pond test. The locations of the conventional percolation tests and the prototype percolation pond are presented on Plate 2 – Site Map.

Each percolation test was performed by digging an approximately 6-inch diameter hole to a depth of five feet, then emplacing a slotted thin-wall PVC casing within the hole to the bottom. Prior to testing, the property had been heavily irrigated in preparation for planting of strawberries. The resulting soil moisture from field irrigation was considered as pre-saturation of the hole. The bottom of each hole was filled with gravel to a depth of several inches. Each hole was then filled with potable water to a depth approximately one foot below the ground surface. A pressure transducer was installed at the bottom of each percolation hole and programmed to record water levels at 20 second intervals for a period of at least 3 hours. Using the water level data, a hydrograph of each percolation test was created, from which percolation rates were calculated at several water level depths. The hydrographs of the conventional percolation tests are presented as Plate 5 – Conventional Percolation Test, Site 1 through Plate 11 – Conventional Percolation Test, Site 9. A summary of the conventional percolation test results is presented as Table 1 – Summary of Conventional Percolation Test Results.

Table 1. Summary of Conventional Percolation Test Results

Site	Hole Depth, (feet)	General Location	Percolation Rate, 12-inch depth, (gpd/ft^2)	Percolation Rate, 12-inch depth, (feet/day)
Site 1	5	Northern corner	40	5.3
Site 2	11	Central	20	2.7
Site 5	5	Northeastern edge	40	5.3
Site 6	5	Southwestern edge	29	3.9
Site 7	5	Eastern central	20	2.7
Site 8	5	Southern corner	50	6.7
Site 9	5	Southeastern edge	50	6.7

Inspection of the hydrographs and Table 1 indicate that percolation rates range between 20 and 50 gpd/ft^2 (between 2.7 and 6.7 feet/day) for a water depth of approximately 1 foot. In general, percolation rates varied proportionally with water depth, that is, at the highest water levels, the percolation rates were highest and percolation rates were lower at lower water levels. Analysis of the early-time data indicated that percolation rates were significantly higher than those values presented on Table 1. These early-time data were generally believed to be unreasonably high, and therefore were not considered representative of the geologic materials encountered.

TEST PIT EXPLORATION

A series of four exploratory test pits were excavated adjacent to the prototype percolation pond (Plate 2). Each test pit was excavated with a backhoe to a depth of 14 to 15 feet to allow logging of the materials encountered. Fugro staff logged each test pit, photographed the exposed materials, and collected multiple bulk samples of materials from each pit.

The materials within the test pits consisted principally of mixtures of silty sand and sand. Generally, the silty sand was present at the surface and underlain by pale yellowish sand with beds of silty sand below depths of 6 to 10 feet. The lithologic materials were moist to depths of 8 to 15 feet and wet below these depths. Descriptions of the geologic materials are included in Appendix A. Photographs of the test pits are included in Appendix B.

PROTOTYPE PERCOLATION POND TESTING

Based on the conventional percolation testing results, we constructed a prototype percolation pond near the center of the site to allow for larger scale testing of the percolation capacity of the near-surface sediments. Based on anticipated percolation rates in the range of 10 to 50 gpd/ft^2, a 20-foot square (400 ft^2) percolation pond was installed to a depth of approximately two feet. Geologic materials within the excavation for the pond consisted entirely of silty sand. A metered supply of water pumped from the on-site agricultural wells was supplied to fill the pond. The water was delivered through the irrigation system to a 21,000 gallon tank temporarily placed adjacent the percolation pond. Gate valves and one float valve were installed to control water levels and inflow rates. A dedicated pressure transducer was installed in the percolation pond to measure and record water levels at 5-minute intervals throughout the entire test program. A staff gauge was also installed to monitor water level within the pond. Photographs of the constructed pond are provided in Appendix B.

The pond was flooded with water and filled to a stage of approximately 18 inches. A constant head above the base of the pond was controlled with the use of a float valve. Throughout the entire test period, water levels in the test pond were monitored and automatically recorded at 5-minute intervals. A hydrograph of the water level in the test pond is presented as Plate 12 – Prototype Percolation Pond Hydrograph.

At the relatively constant inflow rate of approximately four gallons per minute (gpm) that was maintained throughout testing, the percolation rate of the near-surface sediments underlying the test pond was calculated to be approximately 15 gpd/ft^2 (2 feet/day).

After 10 days of testing, the inflow into the pond was turned off and the test terminated. A falling head test was then conducted by recording the declining water level in the test pond over time until the pond emptied. The partially-full tank was drained into the pond and a second falling head test was conducted by again recording the declining water level in the pond for several hours. Hydrographs of the two falling head tests are presented as Plates 13 and 14.

Inspection of Plate 12 indicates that after approximately three days of initial filling and pre-saturation, the inflow rate varied narrowly between 4.3 gpm (days 3 through 6) and 3.9 gpm (days 6 through 9). This was equal to about 15 gpd/ft^2 at a head of approximately 18 inches. The falling head tests that were started on September 25 (Plate 13) and September 30 (Plate 14) resulted in percolation rates between 7.5 gpd/ft^2 and 12.7 gpd/ft^2.

The range of values indicates that the later tests had slightly lower percolation rates, likely due to minor algal growth within the pond and associated clogging. For the proposed full-scale percolation ponds, algal and turbidity-related clogging will need to be addressed, both of which can decrease percolation rates significantly.

The calculated percolation rates are characteristic of hydraulic conductivity values of materials described as "silt" to "silty sands" (Freeze and Cherry, 1979). According to Driscoll (1986), these percolation values are representative of "silt and loess" to "fine to coarse sand". According to Roscoe Moss (1990), these values are representative of materials somewhere between "silt" and "fine sand". We believe the calculated values of percolation rates reasonably represent the silty sand and sand present in the surficial sediments at the site.

WATER QUALITY ANALYSIS

For the prototype percolation pond test, the supply water was pumped from the two on-site agricultural production wells and delivered to the pond through the irrigation distribution system. The wells are approximately 500 feet apart and are located in the southern portion of the site adjacent to the bluff face (Plate 2). Both wells are perforated between 220 and 380 feet bgs. Well completion details are documented on State of California Well Completion Reports included in Appendix C.

To assess the water quality of the supply water for the percolation test, a water sample was collected from the irrigation distribution system and submitted to an analytical laboratory. The sample was analyzed for general mineral, general physical, and inorganic constituents. The water quality data was reviewed and is presented on Table 2 – Water Quality Data, Receiving Aquifer.

Table 2 - Water Quality Data, Receiving Aquifer
(units in milligrams per liter, unless otherwise noted)

Constituent	On-Site Well September 25, 2009
Total dissolved solids	660
pH (pH units)	7.4
Calcium	79
Magnesium	35
Sodium	63
Potassium	3.3
Alkalinity, Total (as $CaCO_3$)	200
Chloride	83
Sulfate	180
Fluoride	0.36
Nitrate as $N0_3$	4.9
Hardness (as $CaCO_3$)	320
Iron	0.11
Manganese	0.18

A review of the water quality results indicates that the underlying groundwater is calcium sulfate to calcium bicarbonate in chemical character with a total dissolved solids concentration of 660 milligrams per liter (mg/l). The full water quality analytical results are presented in Appendix C.

ANALYTICAL MOUNDING ANALYSIS

The second major objective of this study was to evaluate the groundwater mounding potential above each of three major zones of fine-grained sediments identified in the previous Fugro (2008b) report from CPT, boring, and well drilling logs. For this, a mathematical model developed by Khan et al. (1976) was used to calculate the mound height and lateral spread on each zone due to long-term discharge of treated wastewater effluent in the proposed pond system. In this section, the results of the mounding analysis are presented. This section includes a conceptualization of the site subsurface stratigraphy, a review of the available hydraulic conductivity estimates of the subsurface sediments, and a description of the Khan analytical method and the assumptions invoked in its application.

Conceptualization of Site Subsurface Stratigraphy

A conceptualization of the subsurface underlying the Pasquini property is shown on Plate 4 – Conceptualization of Subsurface. As mentioned previously, the Pasquini property is located on the southern end of the Nipomo Mesa. The western boundary of the property nearly coincides with a westward-facing bluff that separates the Nipomo Mesa from the lower-lying Santa Maria River Basin. The ground surface elevation of the Santa Maria River Basin alluvium varies from about 148 to 164 feet (MSL) near the bluff face whereas the ground surface elevation of the Pasquini property varies from about 295 to 312 feet (MSL). These ground surface elevation differences result in a bluff height of about 150 feet (i.e., the Pasquini property is about 150 feet higher in elevation than the Basin alluvium).

The percolation pond system is planned to occupy up to 80 percent (i.e., 24 acres) of the 35-acre area. In this study, the center of the pond system is assumed to be 2,200 feet east of the nearest point on the bluff face and the distance from the center of the pond to the Santa Maria River Fault (which is believed to run more or less along Orchard Drive) may be as close as 1,200 feet. Based on historical groundwater level measurements in the area, the regional water table is located at a depth of about 250 feet bgs in the site vicinity. The sediments between the ground surface and the water table consist largely of sand, silty sand, sand with silt, clay with gravel, and clay. A geotechnical investigation conducted by Fugro (2008b) indicated thin layers of silt interbedded with sandy sediments at shallow depths (10-12 feet bgs) and a thicker fine-grained layer at a depth of 65 to 70 feet bgs beneath the site. These silty sediments generally have lower hydraulic conductivities in comparison to the coarser-grained sediments and may therefore impede the downward migration of discharged effluent. However, the lateral continuity of the silty layers from the pond site to the bluff face is uncertain.

Two irrigation wells were drilled during 2008 in the southeastern corner of the property (see Plate 3 for the locations of the wells) and both were completed to depths of 400 feet bgs. The well completion report for well no. 1 indicates a 34-foot thick layer described as 'gray clay' at a depth interval of 180 to 214 feet bgs. The well completion report for well no. 2 indicates a 30-foot thick layer described as 'brown clay with gravel' at a depth interval of 120 to 150 feet bgs and a 5-foot 'clay' layer between 190 to 195 feet bgs. Assuming that the Basin alluvium ground surface elevation is about 150 feet below the ground surface of the pond site, the 'gray clay' layer associated with well no. 1 would be located about 30 feet below the ground surface of the Basin alluvium at the base of the bluff face. Conversely, the top of the 'brown clay with gravel' layer associated with well no. 2 would be about 30 feet above the ground surface of the Basin alluvium at the base of the bluff face (see Plate 3).

Overall, the CPT data, boring logs, and well completion reports indicate three potential relatively thick zones of low permeable sediments beneath the Pasquini property, including 1) a silty sand beginning at 65 feet bgs, 2) a layer of brown clay with gravel at 120 feet bgs, and 3) a layer of gray clay at 180 feet bgs. It is important to note that the lateral continuity of these three layers is not known. This is especially true of the two deeper layers, that is, the layers at 120 feet and 180 feet.

The potential presence of the two deeper layers was unknown to us until after we had been able to receive the State Well Completion Reports for the two new onsite irrigation wells. The wells had not been drilled at the time of our previous investigation (Fugro 2008b), and the standard subsurface investigation methods used during that investigation could not drill to the depths necessary to reach the clay layers represented on the Well Completion Reports. It is also important to note that the lithologic descriptions on Well Completion Reports for water wells are usually not as detailed or as specific as to actual lithology as the descriptions performed for geotechnical investigations. Because a water well drilling contractor is focused on maximizing the water supply capability of the well, he may not necessarily adequately describe a layer other than simply noting that it is a "clay" or "clay with gravel." However, those distinctions are critically important to this investigation.

Thus, the suggestion that these two relatively low permeability layers may exist at depth, and/or may be laterally continuous, is vitally important to evaluate in order to assess the fate of the effluent discharge and the lateral growth of the effluent mound.

As discussed earlier, the existence of significant lateral continuity for any of these layers beneath the pond site and above the water table may cause the layer to behave as a perching layer. Long-term discharge of effluent in the pond would percolate downward through the underlying sediments and form a groundwater mound on the perching layer. The effluent would be expected to continue percolating through the mound and the perching layer, although at a much slower rate than through the overlying sediments, while at the same time spreading out laterally on top of the perching layer. Of particular concern in the planning and long-term operation of the pond system is the potential for breakout of discharged effluent along the bluff face due to lateral spreading of the mound on top of a perching layer. In other words, the width of the mound may increase over time, eventually reaching the bluff face and seeping through it.

Although it is important to conduct additional field work to evaluate the presence and continuity of the two deep clay layers, it was decided to conduct the analysis of the known 65-foot deep layer in order to evaluate the potential impacts of the layer on the growth of the mound. Thus, the analytical method developed by Khan et al. (1976) was used to evaluate the groundwater mounding behavior for the low permeable sediments observed in the logs at the 65-foot level.

Groundwater Levels

The well completion reports for the two wells constructed on the Pasquini property during 2008 indicate depths to groundwater of 250 and 255 feet bgs. The ground surface elevations of these wells likely vary between 279 to 295 feet (MSL). Consequently, the water table elevation associated with these wells is in the neighborhood of 30 to 50 feet (MSL). Contour maps of groundwater elevations during the spring seasons of 1995, 2000, and 2002 show groundwater elevations beneath the property in the range of 50 to 100 feet (MSL). Assuming a water table elevation of 50 feet (MSL) as observed during the construction of the wells, the depth to groundwater beneath the Basin alluvium is between 98 to 114 feet bgs.

CPT and borings were performed during the previous geotechnical investigation at several locations on the Pasquini property (Plate 3). Several CPT and boring logs indicate wet sediments at elevations distinctly above the regional water table. Prior to the 2009 water year, however, the Pasquini property was not known to have ever been irrigated. Therefore, the observed wetness likely represents partially saturated sediments as a result of long-term deep percolation of precipitation through the vadose zone.

Estimated Horizontal and Vertical Hydraulic Conductivities

Four subsurface cross-sections (i.e., A-A' to D-D') were generated using the CPT and boring log descriptions and presented in the geotechnical report (Fugro, 2008b). Of particular note in the immediate vicinity of the proposed pond site are four CPTs (C-103, C-104, C-105, and C-107) and one boring (B-103). Inspection of boring B-103 shows the occurrence of a thin layer of sand with silt (SP-SM) at a depth of 10 to 12 feet bgs. Laboratory permeability tests were performed during the geotechnical investigation on sediment samples at different depths from borings B-102 and B-103 and the results are reproduced in Table 3. The estimated vertical hydraulic conductivity from the permeability test on the 10-foot sample for B-103 is about 1.0 feet/day. The sediments from 0 to 10 feet bgs in boring B-103 are also described as silty sand (SM) with interbeds of sandy silt (ML). A permeability test on the 10-foot sample in boring B-102 yielded a similar vertical hydraulic conductivity of 1.2 feet/day. A permeability test was also performed on the 70-foot sample in B-103 yielding a vertical hydraulic conductivity estimate of 1.5 feet/day for a sediment classification of silty sand (SM). These permeability test results suggest a range of 1.0 to 1.5 feet/day for the vertical hydraulic conductivity of silty sand (SM) sediments beneath the Pasquini property. In general, the vertical hydraulic conductivity of loamy soils is reported to range from 0.3 to 3 feet/day (EPA, 2006). Consequently, the lab permeability test estimates of vertical hydraulic conductivity for the silty sand samples are consistently within the reported range for loamy soils (Table 3).

Table 3. Estimated Vertical Hydraulic Conductivity Values

Boring No.	Depth (feet)	Classification	Vertical Hydraulic Conductivity (feet/day)
B-102	10	Silty sand (SM)	1.2
B-102	50	Sand (SP), poorly graded	28.3
B-102	70	Sand with silt (SP-SM)	26.6
B-103	10	Silty sand (SM)	1.0
B-103	20	Sand (SP), poorly graded	34.0
B-103	70	Silty sand (SM)	1.5

The sediment texture of dune sands is generally characterized as fine- to medium-grained sand. The 50-foot bgs and 70-foot bgs sediment samples in B-102 were classified as sand (SP) and sand with silt (SP-SM), respectively (Table 3). The 20-foot bgs sediment sample in B-103 was also classified as sand (SP). Permeability tests conducted on these sandy samples resulted in a range of vertical hydraulic conductivity estimates of 26.6 to 34 feet/day (Table 3). The vertical hydraulic conductivity of fine sand is reported to vary from 3 to 16 feet/day, whereas the range for medium sand is 16 to 66 feet/day (EPA, 2006). The lab permeability test estimates of vertical hydraulic conductivity for the three sandy samples were therefore consistently within the above reported ranges for fine to medium sand (Table 3).

The anisotropy ratio is equal to the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity. Dune sand deposits are generally well sorted and are characterized by low anisotropy ratios in the range of 2 to 5. Applying this anisotropy ratio range to the estimated vertical hydraulic conductivities for the three sandy samples yields an overall horizontal hydraulic conductivity range of approximately 50 to 170 feet/day for sands and sands with silt. The corresponding horizontal hydraulic conductivities of the sediment samples described as silty sand (see Table 3) are therefore in the range of 2 to 7.5 feet/day. According to the CPT logs, the vertical profile between the ground surface and the top location of the thick zone of silty sand material starting at about 65 feet bgs consists predominantly of sands and sands with silt and thin layers of silty sands. The effective or average horizontal hydraulic conductivity in the upper 65 feet of the subsurface can be estimated as a thickness-weighted average of the horizontal hydraulic conductivities of the sands and sands with silt (50 to 170 feet/day) and silty sands (2 to 7.5 feet/day).

As will be discussed later, the horizontal hydraulic conductivity of the upper stratum of sediments underlying the proposed pond site and above a potential perching layer will control the mound height beneath the pond and above the perching layer. Therefore, a reasonable range of horizontal hydraulic conductivity values for the upper stratum in the mounding analysis conducted in this study was chosen to be 10 to 100 feet/day. The lower end value of 10 feet/day is considered conservative and is likely more representative of the upper stratum between the ground surface and the deep clay layer at 180 feet bgs. The upper end value of

100 feet/day is probably more representative of the upper stratum between the ground surface and the silty sand layer at 65 feet bgs.

Analysis

The potential for breakout along the bluff face was evaluated at the pond site using an analytical solution to a mathematical problem describing the formation of a groundwater mound on a perching layer under steady-state conditions (Khan et al., 1976). A schematic displaying the modeled system is displayed on Plate 4. In this problem, recharge is applied at the ground surface in either a rectangular or circular area at a constant rate. The underlying aquifer is composed of an upper stratum and a lower stratum. The upper stratum is assumed to have a horizontal hydraulic conductivity (K_1) that is significantly greater than the vertical hydraulic conductivity (K_2) of the lower stratum (e.g., K_1/K_2=50, 100, ..., 1000). The actual infiltration rate (q) (i.e., volumetric recharge rate divided by recharge area) is assumed to be less than the saturated vertical hydraulic conductivity of the upper stratum and significantly greater than the vertical hydraulic conductivity of the perching layer. Based on the results of the conventional percolation tests presented in Table 1, an infiltration capacity of 2 feet/day was assumed for the near-surface sediments at the proposed site. Given a constant recharge rate, a groundwater mound with a steady-state shape forms on the lower stratum which acts as the perching layer. The water table in the problem is assumed to be located at a significant distance from the top of the perching layer. As part of the analytical solution to the shape of the steady-state perched groundwater mound, Khan et al. (1976) developed the following relationship:

$$w_{max} = L\frac{K_2}{q} \qquad (1)$$

where w_{max} is the maximum half-width of the recharge area and L is the distance from the center of the pond to the edge of the mound. For design purposes, equation (1) can be used to evaluate the feasibility of a proposed pond system given information describing the vertical hydraulic conductivity of any potential perching layers as well as anticipated effluent discharge rates and pond areas. For the proposed pond system on the Pasquini property, equation (1) will be used to determine whether the assigned hydraulic conductivities of the 65-foot deep low permeable layer beneath the site may potentially generate a groundwater mound that will eventually reach and seep through the bluff face.

Mound height (H) above the perching layer at any horizontal distance (x) from the center of the pond system can be estimated using the following equations derived from Dupuit-Forchheimer seepage theory by Khan et al. (1976):

$$H = w\left[\frac{K_2}{K_1}\left(\frac{q}{K_2}-1\right)\left(\frac{q}{K_2}-\frac{x^2}{w^2}\right)\right]^{1/2} \quad 0 \le x < w \qquad (2)$$

$$H = w\left(\frac{K_2}{K_1}\right)^{1/2}\left[\frac{q}{K_2}-1\right] \qquad x = w \qquad (3)$$

$$H = w\left(\frac{K_2}{K_1}\right)^{1/2}\left[\frac{q}{K_2}-\frac{x}{w}\right] \qquad w < x \le L \qquad (4)$$

Equation (2) estimates mound height for a horizontal distance less than the half-width of the pond system; equation (3) estimates mound height at a horizontal distance equal to the half-width of the pond system; and equation (4) estimates mound height for horizontal distances from the pond center greater than the half-width and less than or equal to the distance of the mound edge.

Results and Analysis

A schematic illustrating the silty sand layer, the clay with gravel layer, and the deep clay layer is presented on Plate 3. The Khan method was used to estimate the mounding height on the 65-foot layer as a function of the distance from the pond system center towards the bluff face. Similar analyses for the two deeper clay layers (the 65-foot layer and the 120-foot layer) are not shown here because of the uncertainty of the presence and lateral continuity of the layers.

A vertical hydraulic conductivity of 0.1 feet/day was initially assigned to the 65-foot deep silty sand layer. This assigned value is within the range of vertical hydraulic conductivity for the textures the layer represents. In particular, K_2=0.1 feet/day is chosen to be just below the low end range value of 0.3 feet/day for loamy soils and is conservative in comparison to the lab permeability test estimates of vertical hydraulic conductivity for silty sands. The mound height was then estimated using equations (2) to (4) by varying the horizontal hydraulic conductivity of the upper stratum (i.e., aquifer region overlying the low permeable perching layer) over the values of 10, 20, 50, and 100 feet/day. The analysis was also conducted assuming a 5-acre size percolation pond and a 1.23 MGD effluent discharge rate.

Plate 15 shows the estimated mound height as a function of horizontal distance from the pond center for the silty sand layer (K_2=0.1 feet/day) and for the four different values of horizontal hydraulic conductivity of the upper stratum (K_1=10, 20, 50, and 100 feet/day). The results for the silty sand layer are also summarized in Table 4. For K_2=0.1 feet/day and for each value of K_1, the maximum mound height beneath the center of the pond was estimated to be below the ground surface (Table 4). Given a constant value of K_2, the lower the value of the horizontal hydraulic conductivity of the upper stratum the greater the mound height. Consequently, K_1=10 feet/day generated the greatest mound height beneath the pond. However, as discussed previously, K_1=10 feet/day represents a conservatively low value of horizontal hydraulic conductivity for the upper stratum, particularly in comparison to lab permeability test estimates of vertical hydraulic conductivity for sands and sands with silt in the range of 26.6 to 34 feet/day (Table 3).

The distance of the mound edge from the pond center is controlled by the vertical hydraulic conductivity of the low permeable perching layer. Therefore, the distance of the mound edge from the center of the pond for a value of K_2=0.1 feet/day was 674 feet. The values of horizontal hydraulic conductivity for the upper stratum and the vertical hydraulic conductivity of the silty sand layer evaluated by the Khan method did not result any breakout of the mound at the bluff face approximately 2,200 feet from the pond center (Table 4).

Table 4. Estimated Mounding on the 65-foot bgs Silty Sand Layer

Silty Sand Shallow Layer Vertical Hydraulic Conductivity (feet/day)	Upper Stratum Horizontal Hydraulic Conductivity (feet/day)	Maximum Mound Height (feet)	Depth to Mound beneath Pond Site (feet, bgs)	Distance from Pond Center Mound Edge (feet)	Mound Height at Bluff Face (feet)	Mound Breakout at Bluff Face?
0.1	10	63	2	674	0	No
0.1	20	44	21	674	0	No
0.1	50	28	37	674	0	No
0.1	100	20	45	674	0	No

CONCLUSIONS

In this study, a hydrogeologic assessment of the Pasquini property was performed to evaluate the property as a potential site for a percolation pond system that will be capable of receiving and infiltrating up to 1.23 MGD of treated wastewater effluent from the WWTF. The assessment consisted of two major tasks: 1) the performance of a series of field tests to quantify the percolation capacity of the near-surface sediments at the site, and 2) application of an analytical method developed by Khan et al. (1976) to evaluate the groundwater mounding potential above a layer of fine-grained sediments identified in logging data.

The results of seven conventional percolation tests performed at different locations on a 24-acre portion of the property indicate that percolation rates range between 20 and 50 gpd/ft^2 (i.e., between 2.7 and 6.7 feet/day) for a water depth of about one foot. Excavation of four exploratory test pits in the site area also revealed that the near-surface sediments to a depth of about 15 feet bgs consisted largely of silty sand and sand.

In order to conduct larger scale testing of the percolation capacity of the near-surface sediments, a 400-square foot prototype percolation pond with a depth of 2 feet was constructed near the center of the proposed site. A constant head test with a steady inflow rate of 4 gpm resulted in a measured percolation rate of 15 gpd/ft^2 (2 feet/day) for a constant head of 18 inches. Two falling head tests performed in the prototype pond resulted in percolation rates of 7.5 and 12.7 gpd/ft^2 (i.e., 1.0 and 1.7 feet/day). It is important to note that the percolation rates estimated in this study were measured in field tests that used essentially clean, debris-free potable water. Percolation rates of discharged wastewater effluent in the pond system, even if highly treated, may be lower. The presence of suspended solids in the discharge and microbial growth on the pond bottom may significantly reduce the actual infiltration rates in a percolation pond system.

Based on previous field work that included CPT data and boring logs, a layer of fine-grained sediments at a depth of approximately 65 feet below ground surface was identified as a zone that could potentially act as a perching layer for the long-term discharge of treated wastewater effluent in the proposed pond system. Given available local hydrogeologic information and the results of the infiltration tests performed by Fugro, the analytical method developed by Khan et al. (1976) was used to evaluate the mounding potential on this low permeable layer for reasonable values of horizontal hydraulic conductivity for the upper stratum and vertical hydraulic conductivity for the perching layer. In particular, the mounding height was calculated to determine the potential for breakout along the bluff face as well as to evaluate the separation of the mound height from the ground surface associated with the pond system site.

For the 65-foot bgs silty sand layer, the Khan method estimated that the resulting mound would neither break out through the bluff face nor intersect the ground surface associated with the pond system site. The horizontal distance of the mound edge from the pond center was estimated to be 674 feet for a vertical hydraulic conductivity of the silty sand layer of K_2=0.1 feet/day. As noted earlier, K_2=0.1 feet/day was chosen to be just below the low end range value of 0.3 feet/day for loamy soils (EPA, 2006) and is conservative in comparison to the lab permeability test estimates of vertical hydraulic conductivity for silty sands.

Inspection of the State Well Completion Reports of the two recently drilled irrigation wells on the property, which were drilled subsequent to our previous work on the site, suggest the possible existence of two more low permeability layers at depths below the reach of conventional geotechnical drilling methods. The well completion report for one of the wells indicates a 34-foot thick layer described as 'gray clay' at a depth interval of 180 to 214 feet bgs. The well completion report for the other well indicates a 30-foot thick layer described as 'brown clay with gravel' at a depth interval of 120 to 150 feet bgs. It is important to note that the only evidence that these layers actually exist is the reference to the zones on the Well Completion Reports. Furthermore, the lateral continuity of these layers is not known. However, the possible significance of these layers is potentially critical to the mounding analysis and evaluation whether the buildup of a mound on these layers could daylight on the bluff.

Thus, it is our opinion that additional field investigation is necessary to evaluate whether the layers of low permeability exist at depths of 120 feet and 180 feet, and if they exist, whether they are laterally continuous. If the layers exist, then samples can be taken of the materials and laboratory permeability tests conducted to determine the permeability of the sediments. Finally, a similar mounding analysis can then be performed to evaluate the significance of the layers with respect to buildup of the effluent mound and possible daylighting of the mound in the bluff face.

RECOMMENDATIONS

- The results of this analysis indicate the need to perform additional site characterization to evaluate the vertical and lateral extent, and permeabilities of deep clay layers beneath the pond site.

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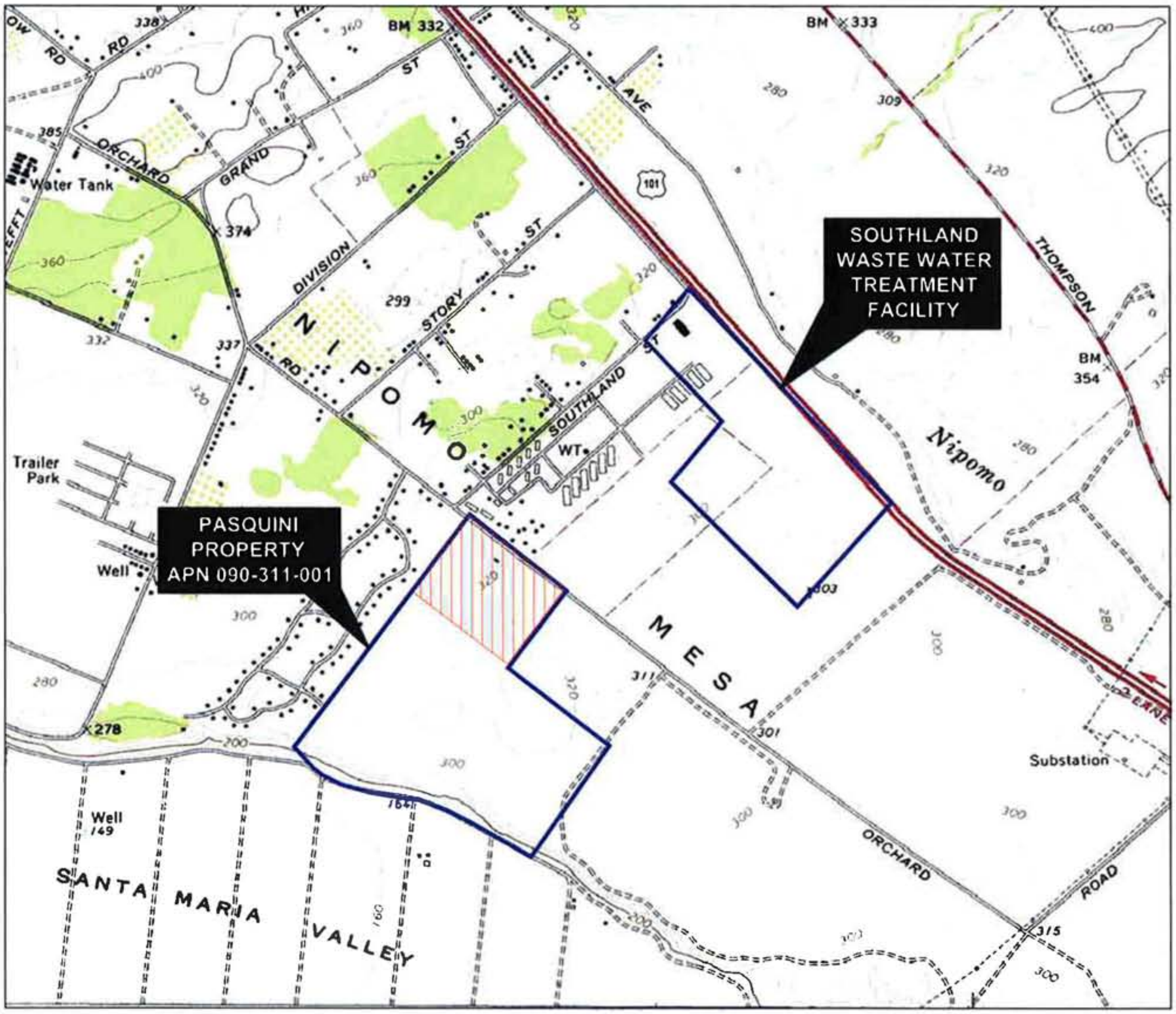
PLATES

Nipomo Community Services District
Project No. 3596.005



BASE MAP SOURCE: USGS NIPOMO QUADRANGLE TOPOGRAPHIC MAP

NORTH
0 2000
FEET

LEGEND

Area of Investigation (Plate 2)

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VICINITY MAP
Pasquini Property Investigation
Nipomo, California

PLATE 1

BASE MAP SOURCE: Aerial photograph from Google Earth Pro (July 2007).

LEGEND

- 9 ● Conventional Percolation Test Location
- Prototype Percolation Pond (dimensions of approximately 20 feet by 20 feet).
- PIT 1 Exploration Pit Location
- Access Roads
- Area of Investigation

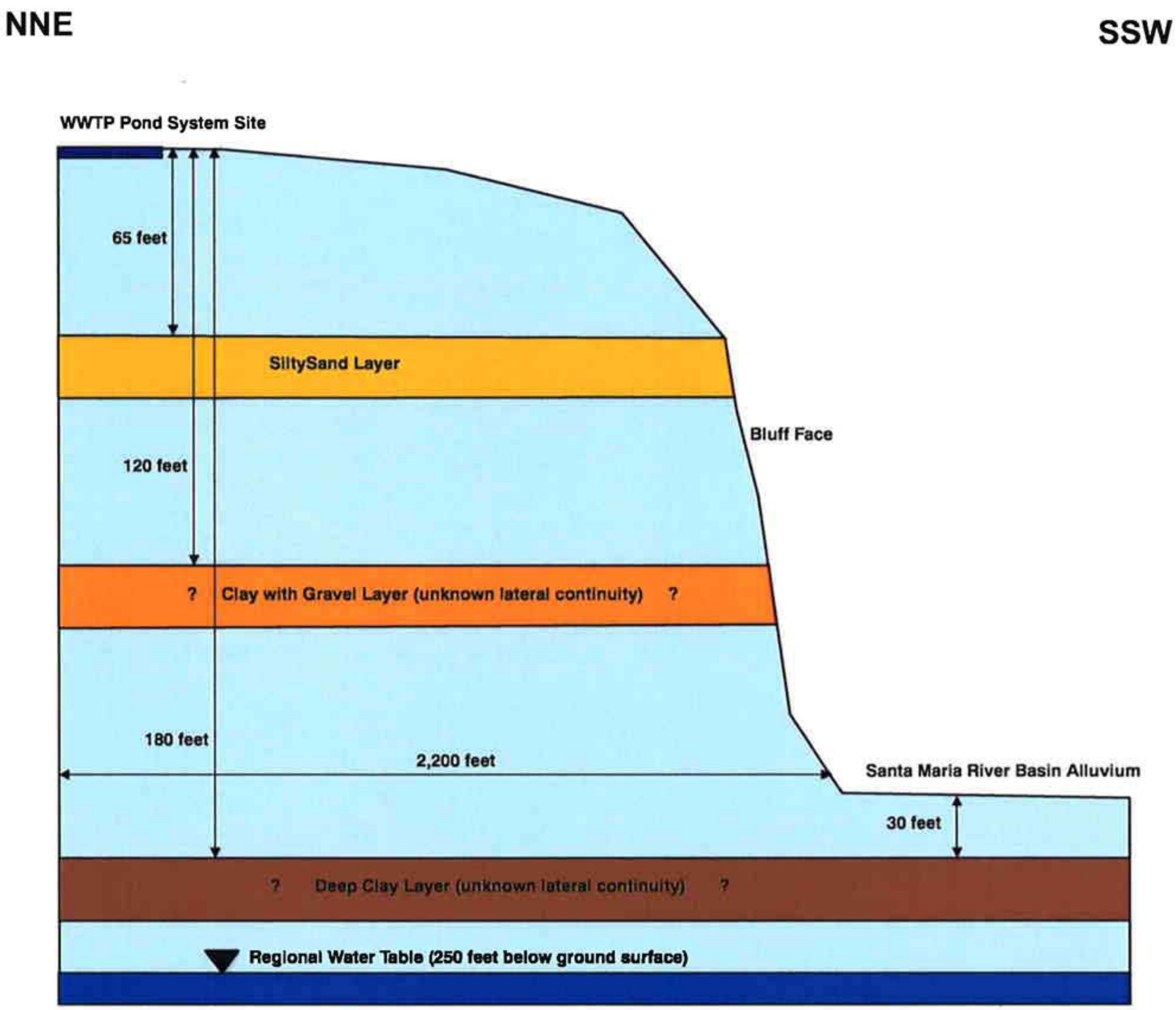
NORTH

0 300

FEET

SITE MAP
Pasquini Property Investigation
Nipomo, California

PLATE 2



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CONCEPTUALIZATION OF SUBSURFACE
Pasquini Property Investigation
Nipomo, California

PLATE 3

Nipomo Community Services District
Project No. 3596.005

BASE MAP SOURCE: GOOGLE EARTH PRO

LEGEND

C-113	Approximate Location of CPT Soundings
B-103	Approximate Location of Borings
CB-4595	Approximate Location of CPT Soundings from previous Investigation
DH-301	Approximate Location of Boring from previous Investigation
(red dot)	Approximate Location of Water Well

NORTH

0 — 1000 FEET

SITE MAP AND EXPLORATION LOCATIONS

Pasquini Property Investigation
Nipomo, California

PLATE 4

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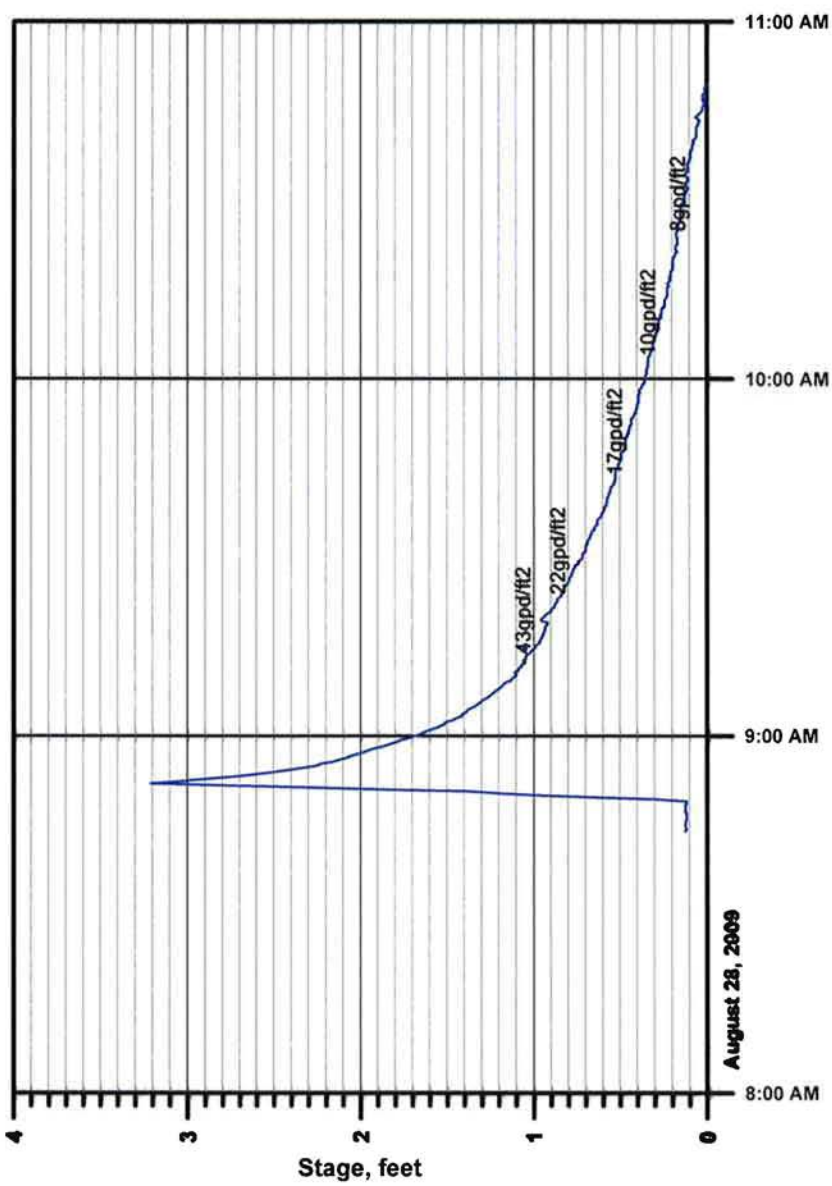
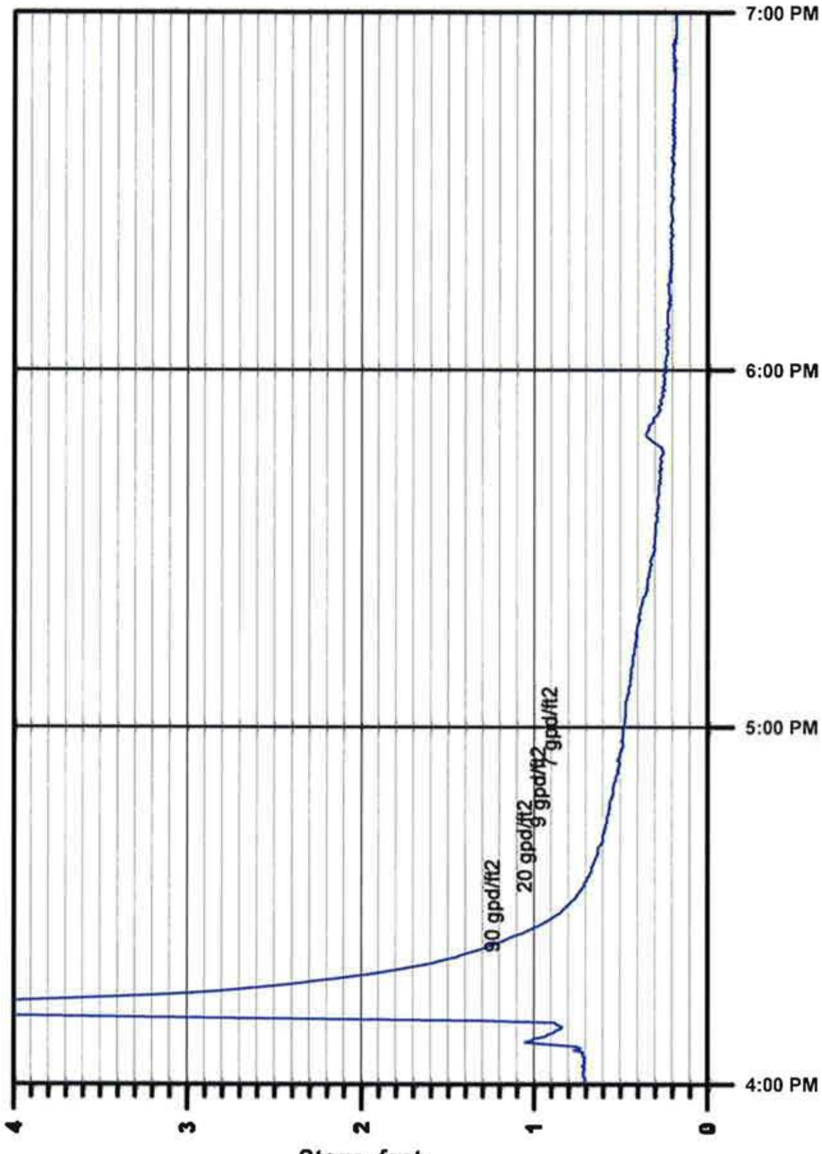


CONVENTIONAL PERCOLATION TEST, SITE 1

Pasquini Property Investigation

Nipomo, California

PLATE 5

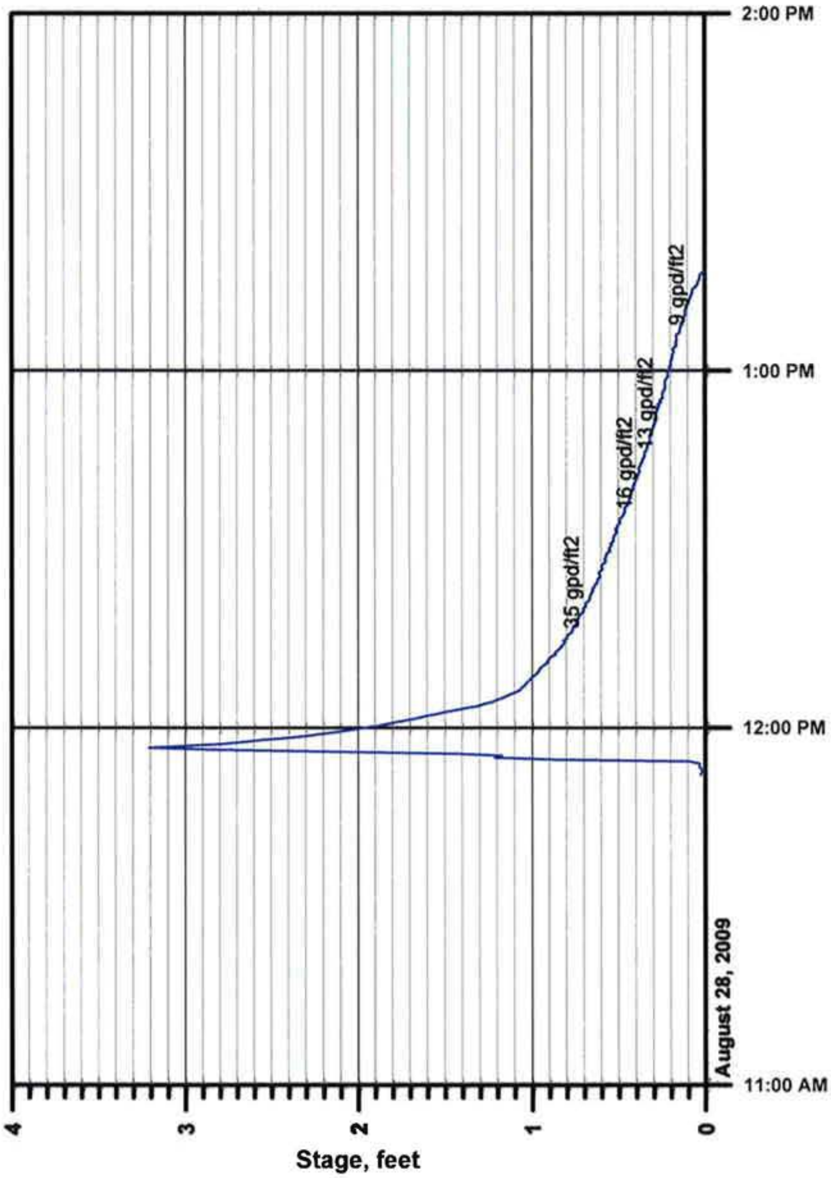


CONVENTIONAL PERCOLATION TEST, SITE 2

Pasquini Property Investigation

Nipomo, California

PLATE 6

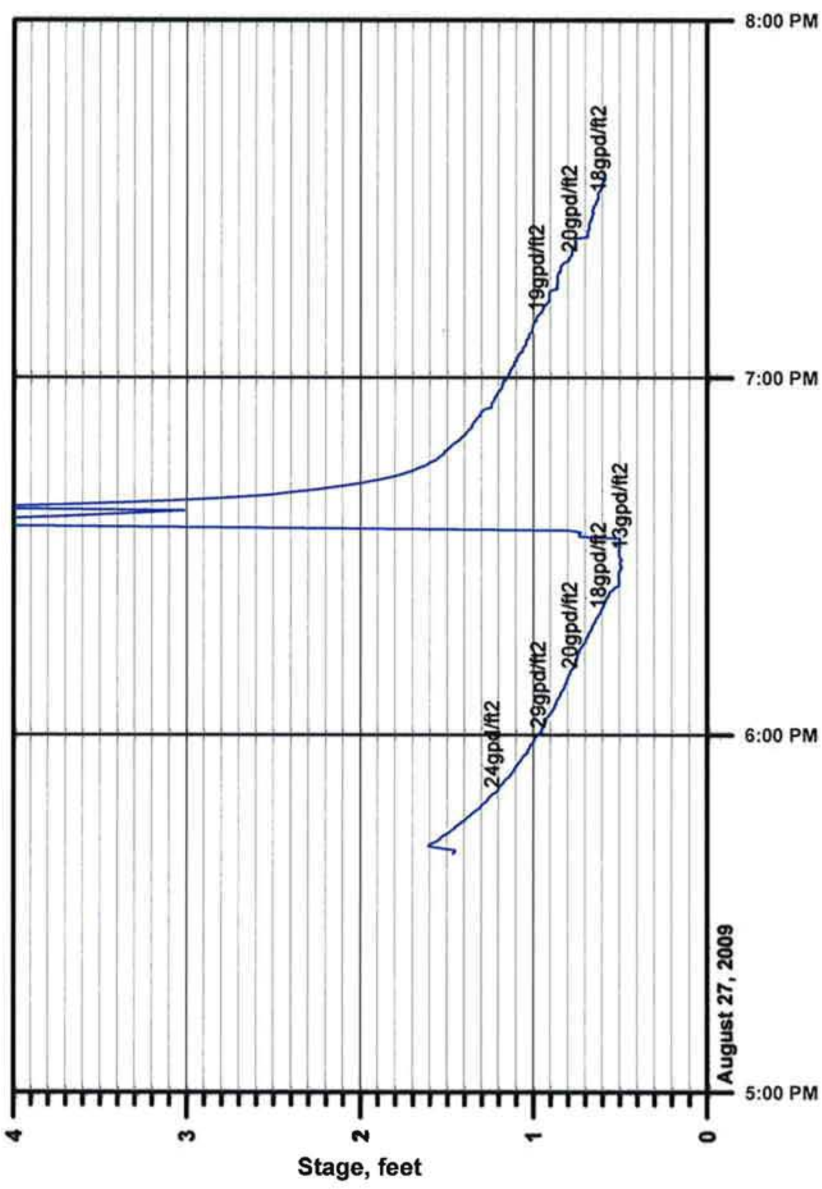


CONVENTIONAL PERCOLATION TEST, SITE 5

Pasquini Property Investigation

Nipomo, California

PLATE 7

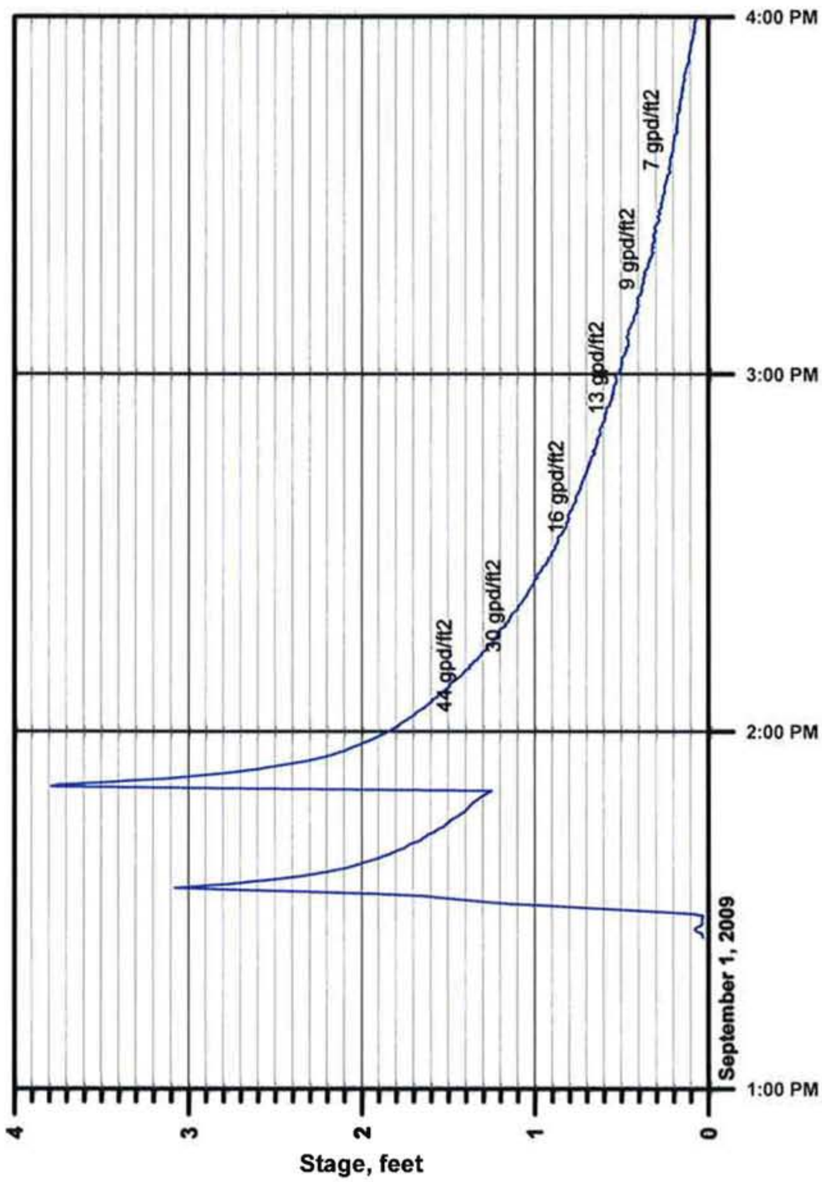


CONVENTIONAL PERCOLATION TEST, SITE 6

Pasquini Property Investigation

Nipomo, California

PLATE 8

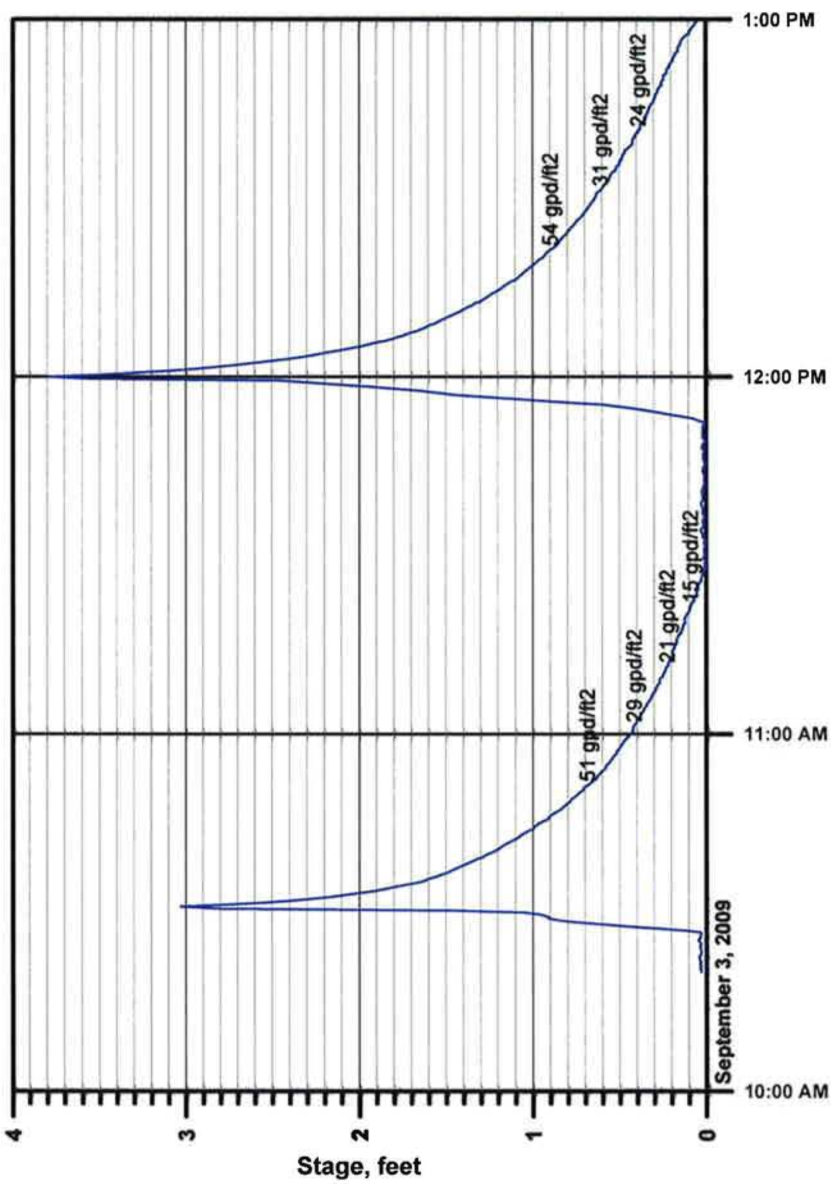


CONVENTIONAL PERCOLATION TEST, SITE 7

Pasquini Property Investigation

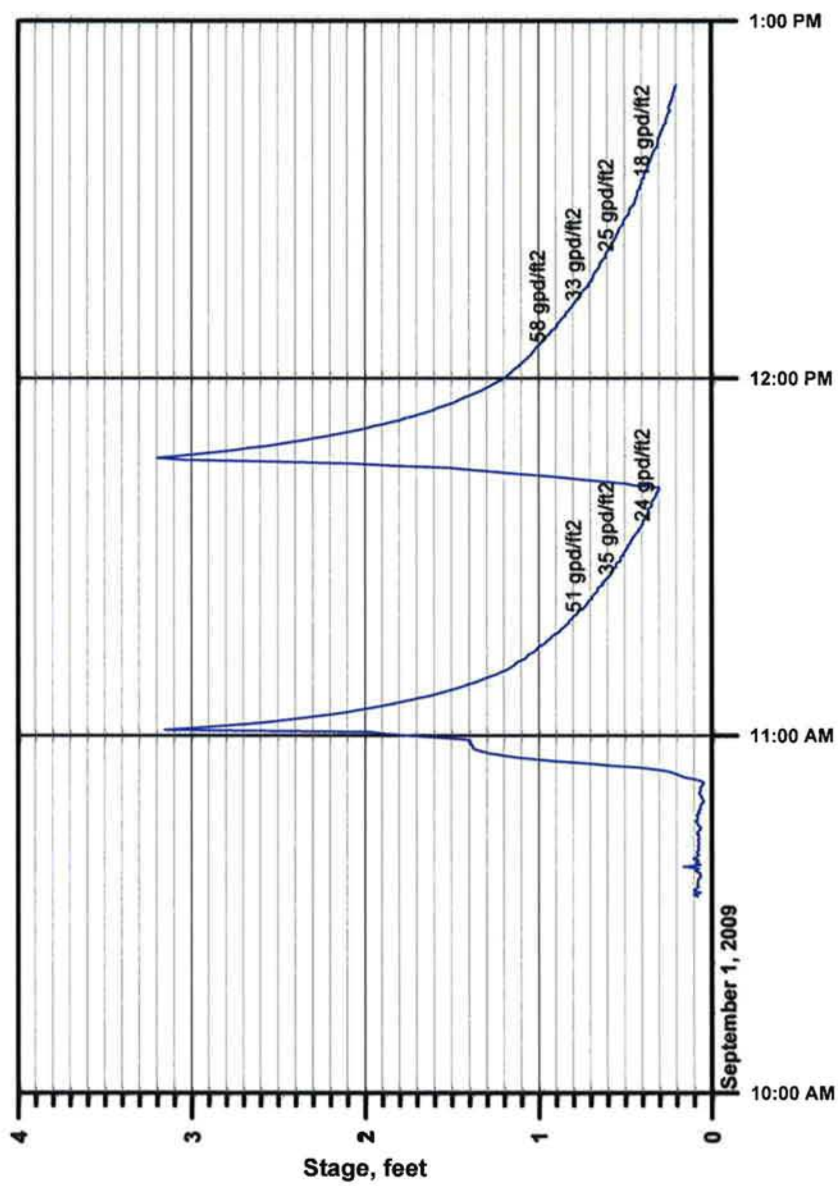
Nipomo, California

PLATE 9



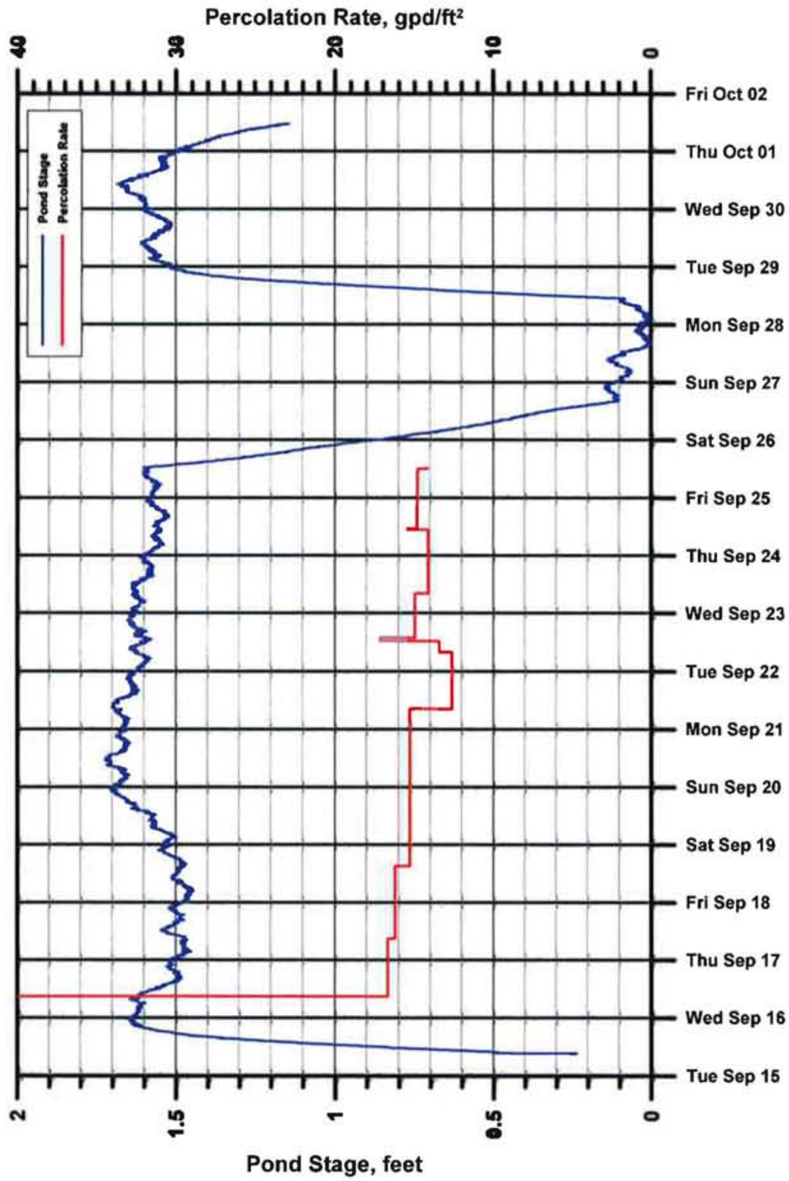
CONVENTIONAL PERCOLATION TEST, SITE 8
Pasquini Property Investigation
Nipomo, California

PLATE 10



CONVENTIONAL PERCOLATION TEST, SITE 9
Pasquini Property Investigation
Nipomo, California

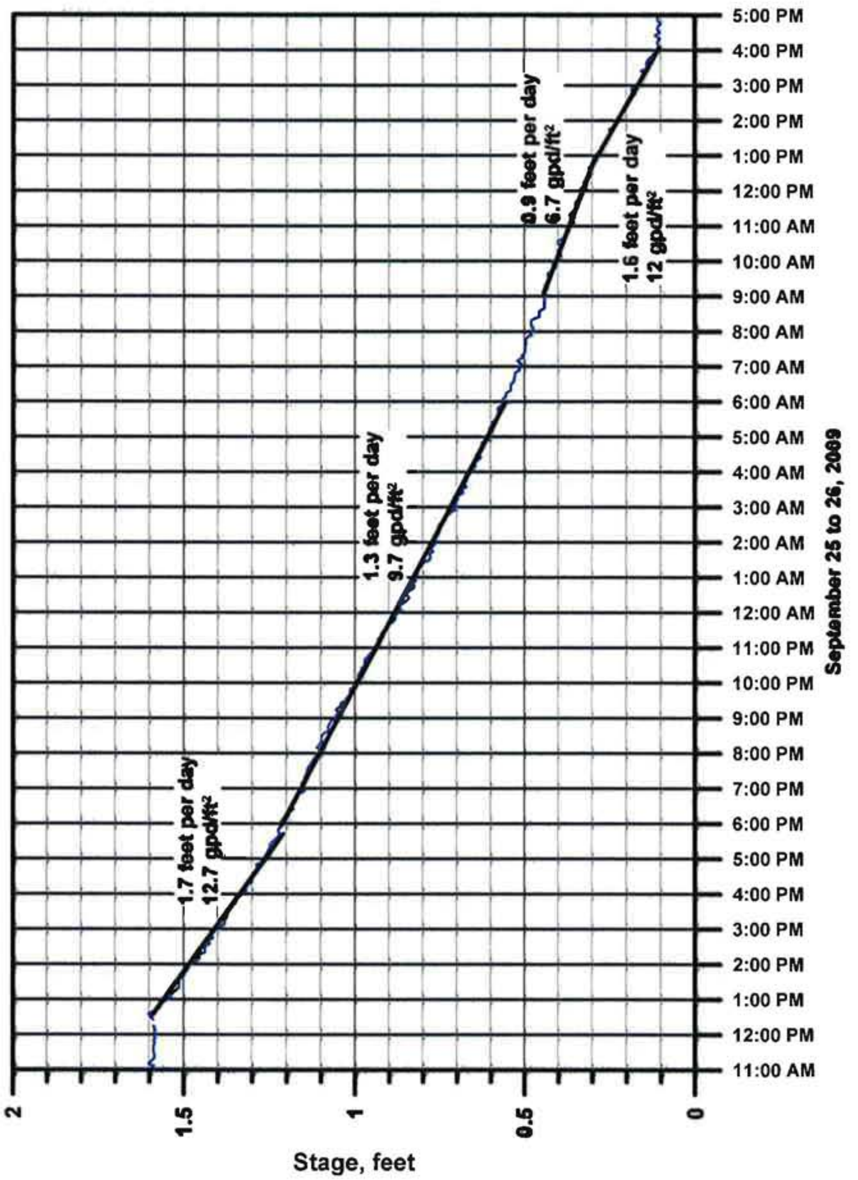
PLATE 11



PROTOTYPE PERCOLATION POND HYDROGRAPH

Pasquini Property Investigation
Nipomo, California

PLATE 12



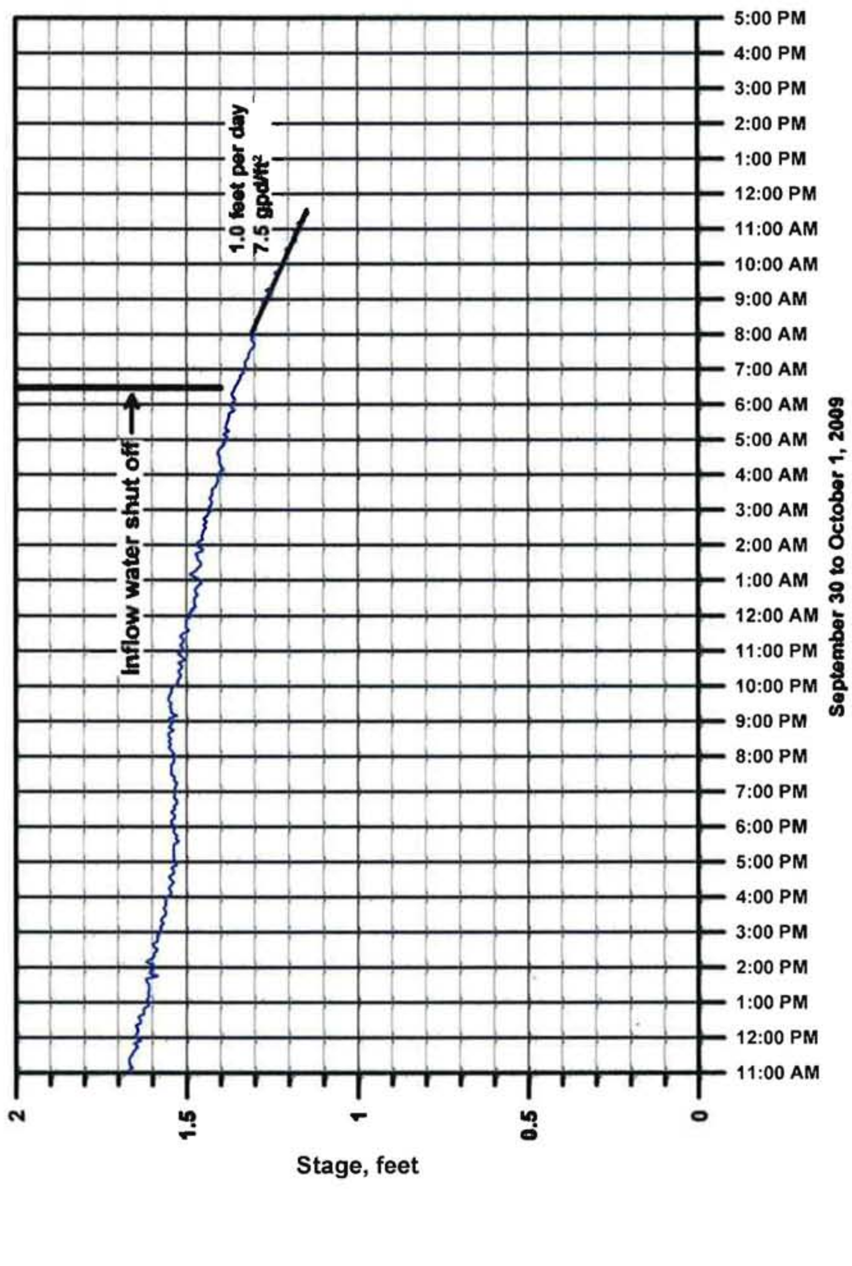
PROTOTYPE PERCOLATION POND FALLING HEAD TEST

September 25 to 26, 2009

Pasquini Property Investigation

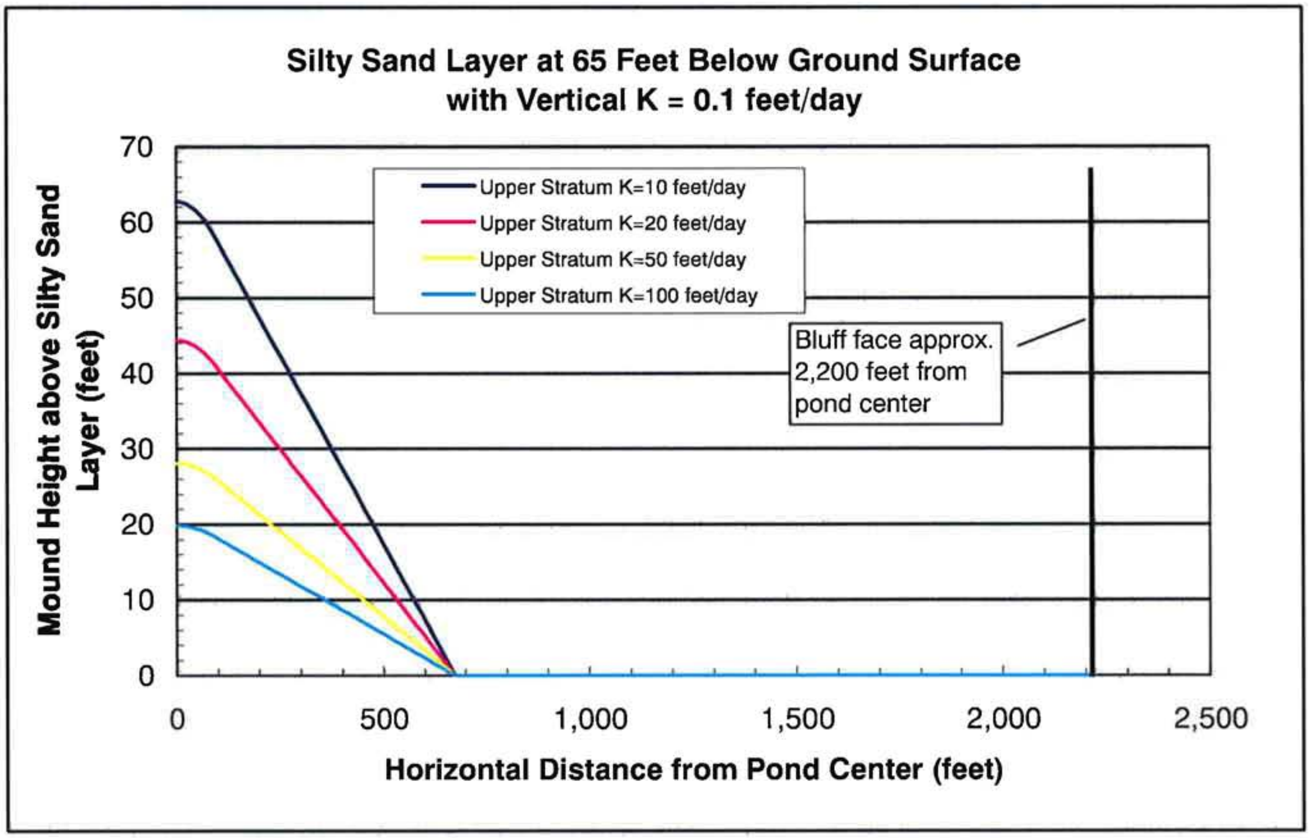
Nipomo, California

PLATE 13



PROTOTYPE PERCOLATION POND FALLING HEAD TEST
September 30 to October 1, 2009
Pasquini Property Investigation
Nipomo, California

PLATE 14



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GROUNDWATER MOUND HEIGHTS ABOVE SILTY SAND LAYER
VARYING UPPER STRATUM HORIZONTAL HYDRAULIC CONDUCTIVITY VALUES
Pasquini Property Investigation
Nipomo, California

APPENDIX A

Nicely, Tim [FWI]

August 27, 2009 Pasquini

Comparison of percolation test methods:
SLO County: Presoak until water level stabilizes (?). No pre-saturation is required if 6 inches drop in 25 minutes twice, then test run for 1 hour. Final 10 minutes is used for percolation rate.
Otherwise, pre-soak overnight,
Ventura County: no soaking needed if, after filling twice to 12 inches, water seeps away in less than 10 minutes. Then, if final 6 inches dprops in 30 minutes, run for 1 hour.

3:40 pm
Perc hole 6 (5 feet deep, all silty sand)
4:30 pm filled with 12 inches of water (24 inches from top.
Drop 19.5 to 13.5 inches (0.5 feet):
To 18.5: 1.25 minutes, (75 seconds)
To 17.5: 3.0 minutes, (105 seconds)
To 16.5: 4.75 minutes, (105)
15.5: 7 minutes, (135 seconds)
14.5: 9 mins, 35 seconds (155 seconds)
13.5: 13 mins, 35 seconds (240 seconds)

4:50
Drop 1 inch to marker at top of pipe: 3 minutes, 56 seconds (236 seconds).

5:05
Drop 1 inch: 4 minutes, 32 seconds (272 seconds). +15 percent.

5:12
Drop 1 inch: 5 minutes, 7 seconds (307 seconds). +13 percent.

Filled to within 1 foot of surface.
Installed transducer at 5:20, recording water levels at 20 second intervals to record drop of final foot.

Dug hole at 5 and 2.
Site 5: Silty sand to 5 feet, moist below 3 feet.

6:35 or so, filled site 6 to near ground surface. 6:45 pm. Filled uncased hole at site 5.
7 pm. Left site.

Nicely, Tim [FWI]

August 28, 2009 Pasquini
7:30 am Removed equipment from site 6.

Site 2 not accesible by vehicle and at topographic high, a location less preferred for testing because it is likely to be removed.

Moved to Site 1, dug to 5 feet (silty sand to depth). Installed 6-inch casing to 5 feet bgs. Installed transducer at 20 second interval.

8:50 am. Filled to about 3 feet depth with water.
Removed transducer at 10:50 am. About 3.25 inches (of inital 36) left in hole.
Stopped test and moved to site 5.

Site 5
Filled hole and performed test to 5 feet.

Site 2, 11 feet deep. Performed test by filling with water at ~4 pm.

Nicely, Tim [FWI]

September 1, 2009 Pasquini
Nipomo CSD, Pasqini Phase 2 Investigation
9:00 am
Ended test at deeper percolation hole, dug and tested site 9 and site 7, met with Bryan Gresser and Peter Sevcik, refilled site 7. Entire site is recently irrigated. Left site at 2 pm.

Nicely, Tim [FWI]

September 2, 2009 Pasquini

Nipomo CSD, Pasquini Site
Backhoe operator, Pat with R. Baker, on site to dig 20 by 20 foot hole for test basin to 2 feet. Pat is going to seperate top 1 to 1.5 feet of soil from bottom-most soil, to ultimately replace it whereis. The 60 by 60 foot work area is located at northwest corner of central intersection. The 20 by 20 foot pit will be located approximately 3 feet from the northwest corner of the work area. A tank, if needed will be located in the southwest corner of the work area.

Sprinklers on eastern side of site are on.

10:00 Pat started digging. Area has been irrigated on Monday and sprinklers removed.
Top 12 to 16 inches is moist moderate yellowish brown fine silty sand.

11:00 Completed hole to 12 to 16 inches.
12:15 Completed digging with backhoe.
Leveling.
Base of test pond is moist and quite compactable, therefore walking within pond is to be avoided. Pat will scarify / scrape bottom. Construction can be performed from without.
Walls are 2 to 3 feet high and base is level. Length of a wall is 20 feet, 2 inches, so Pat is going to widen length and width slightly.

Dug step at high side of hole.

Dug Pit 1, located ~200 feet southwest of southwest corner of pond.

Dark yellowish brown silty sand to 4 feet,
Reddish brown silty sand to 8 to 9 feet,
Pale yellowish brown sand with silt to 10 feet,
Pale yellow sand to 14 feet.
All moist.

Pit 2 ~200 ft NW of NW corner of pond.
Dark yellowish brown silty sand to 4
To reddish brn to 8 or 9 feet wet at 8
Pale yellowish sand 9 to 15 feet, beds of silty sand, dyb. Wet.

Pit 4 is 200 ft S of SE corner.
Dyb silty sand to 4 ft
Pale sand w silt to 6 ft wet
Pale yellow sand w minor color changes to 12 ft, moist to wet
11 to interbedded with silty sand, moist

Pit 3 is 250 NNE of NE corner of pond
Dyb silty sand to 5 feet

Pale yellow silty sand to 9 moist wet at 10 ft
Pale yellow sand w minor silt 11 to 13.
Off site at 4:45 pm.

Nicely, Tim [FWI]

September 3, 2009 Pasquini
Purchased equipment for and constructed the shoring for the test basin.

10:30 or so: performed Perc test at Site 7, at southeast corner of site.

4:30 pm or so: built 4-inch solid pipe percolation test pushed 3 inches into the base of the test pond; filled with water.

Nicely, Tim [FWI]

September 4, 2009 Pasquini

7:00 On site to meet delivery of 21,000 gallon tank for test pond
7:30 Valve is 4x3 gheen, which the ranch manager offered to supply.
8:00 Tank is installed along and parallel to the north-south road.
Water source is 4-inch male pvc, which needs to rise about 10.5 feet, then flow 30 feet across tank to inlet.
Outflow is either 2-inch male or 4-inch female. 45 degree, 20 feet, 45 degree, 15 feet to NE corner of test pond.

Bought plumbing supplies except 4-inch pipe. 1 inch meter accurate between 0.75 (3%) to 50 gpm (1.5%). 3/4 inch meter accurate 0.5 (3%) to 30 gpm (1.5%).

Nicely, Tim [FWI]

September 10, 2009 Pasquini

Nipomo CSD Pasquini
Discussed irrigation schedules and fittings with Bryan Gresser. We are going to plumb and fill the tank and start the test Monday. Will rent 3-inch VEO valve in AG.

Nicely, Tim [FWI]

September 14, 2009 Pasquini
Nipomo Pasquini Site. Completed plumbing for tank. Left site. Returned at 4 pm to start test.

Pasquini site
5:30 pm. Although the water was supposed to be ready to fill the 21,000 gallon tank, alas, the operator Steve is not ready because of problems with the well pump and valves. They will be ready tomorrow at 8 am.
Left site.

Nicely, Tim [FWI]

September 15, 2009 Pasquini

8 am on site. Steve will be ready for me to open my 4-inch valve to fill tank at 8:50 am.

8:45 am to 10:15 filled tank to overflowing. Gauge on side of tank doesn't work.

524,230 gallons
Opened at 9:46 am
10:00 am 524,404 gallons, 13 gpm
10:15 am 524,609 gallons, 13.7 gpm 15 minute average
At 12 gpm, tank would
10:30 left site.

2:30 on site
3:00 pm 528,301 gallons, 1-minute rate of 11.5 gpm, pond filled to over one foot and up to float.

Topped off tank, slowly (1 turn) 3 pm to 3:20 pm.

3:05 water depth 1.16 feet deep.

Nicely, Tim [FWI]

September 18, 2009 Pasquini

2:30 at Pasquini to fill tank
2:37 pm 550,761 gallons (4.5 gpm)
Tank water level down 3 feet 5 inches from top, which is approximately 14,640 gallons left, according to label on side of tank.

Alas, Steve's irrigators are not available, so Steve assures me that he will fill it tomorrow morning and again Monday morning.

3:03 pm 550,872 gallons: 4.3 gpm

Nicely, Tim [FWI]

September 25, 2009 Pasquini

9:50 left office

11:45 On-site at Southland WTP
Meter at 12:00 pm: 591,560 gallons. 1 minute rate: 4.2 gpm. 1.55 feet stage. (0.45 ft below top of wall).

12:10 Tank down 2 ft, 7 inches (2.6 ft or 31 inches). Volume based on side label: 15,494 gallons.

12:20 Downloaded diver. All data looks fine.

12:30 Stopped inflow into pond. Flow: 3.8 gpm (1 minute). Meter: 591,678 gallons. Test is hereby ended. Average rate between 9/19 and end of test: 4.2 gpm.
1 pm left site.

Nicely, Tim [FWI]

October 1, 2009 Pasquini

6:30 to 7:15 am remove piping and drain tank. Tank is empty and water is not flowing in to the test pond. About 15 inches of water is in the pond.
Meter: 605,794 gallons.

Nipomo Community Services District
Pasquini Property Test Percolation Pond, September 15 to 25, 2009

Date and Time	Elapsed time (minutes)	Meter (Gallons)	Total Meter (Gallons)	Flow Rate (av. gpm)	Flow Rate (gpm)	K (gpd/ft2)	K (ft/d)	Notes	Tank Status
9/15/09 9:46 AM	0.1	524,230						Started filling Test Pond	Filling from empty
9/15/09 3:00 PM	314	528,301	4,071.0	13.0	12	47	6.2	3:05 1.16 ft depth	Down ~2 feet, topping off
9/16/09 8:56 AM	1,390	535,778	11,548.0	6.9	5.2	25	3.3	About 2 ft pond depth	1/2 to 2/3 full
9/17/09 8:55 AM	2,829	542,440	18,210.0	4.6	4.2	17	2.2	Tank quite low	Filled tank to full by 10:30 am
9/17/09 9:52 AM	2,886				6.5			Manual Reading	
9/18/09 2:37 PM	4,611	550,761	26,531.0	4.7	4.5	16	2.2	Steve can't fill today, will tomorrow morning	3 feet 5 inches: 14,600 gallons
9/18/09 3:03 PM	4,637	550,872	26,642.0	4.3	4.5	16	2.2		
9/19/09 9:00 AM	5,714							Steve filled in our absence	
9/20/09 9:00 AM	7,154							Steve filled in our absence	
9/21/09 8:24 AM	8,558	567,510	43,280.0	4.2		15	2.0		
9/22/09 8:03 AM	9,977	573,126	48,896.0	4.0	3.5	13	1.7	Filled tank	Tank 1/3 full
9/22/09 12:41 PM	10,255	574,160	49,930.0	3.7		13	1.8		
9/22/09 2:07 PM	10,341	574,570	50,340.0	4.8	6.1	17	2.3	Tank full	Full
9/23/09 8:07 AM	11,421	579,060	54,830.0	4.2	4.0	15	2.0		
9/24/09 10:38 AM	13,012	585,300	61,070.0	3.9	3.7	14	1.9		1/4 to 1/3 full
9/24/09 11:20 AM	13,054	585,480	61,250.0	4.3	5.5	15	2.1	Tank full	Full
9/25/09 12:00 PM	14,534	591,560	67,330.0	4.1	4.2	15	2.0		31 Inches: 15,494 gallons
9/25/09 12:30 PM	14,564	591,678	67,448.0	3.9	3.8	14	1.9	Ended Test	
				4.2					
9/29/09 8:30 AM					2.3				71 inches: 7000

DRAFT

AECOM

AECOM
1194 Pacific St, Su 204, San Luis Obispo, CA 93401
T 805.542.9840 F 805.542.9990 www.aecom.com

Mr. Bruce Buel
Nipomo Community Services District
PO Box 326
Nipomo, CA and 93444

June 5, 2009

Dear Mr. Buel,

Subject: DRAFT Conceptual Percolation Pond Layout, Pasquini Property (APN 090-311-001)

At the request of the District, AECOM has prepared a conceptual layout for percolation ponds on the Pasquini Property, APN 090-311-001. The property is one of several in the area being investigated for feasibility for percolation of treated effluent from Southland Wastewater Treatment Facility.

The Pasquini property is a 192-acre parcel southwest of Orchard Road, extending approximately 3,500 feet to Riverside Road. The southern edge of the property is formed by the Santa Maria River Valley floodplain, creating a naturally steep bluff face, 80 to 130 feet high.

In May 2008, Fugro West performed a hydrogeologic and geotechnical assessment of the property and submitted their findings and analysis in a report dated July 30, 2008 (Hydrogeologic and Geotechnical Assessment of APN 090-31-001, Nipomo, California). The purpose was to assess the appropriateness of the property for percolation (i.e., estimate percolation capacity of the soils, and investigate the potential for the presence of aquitards), and evaluate the potential for percolated water to daylight on the bluff.

The Fugro report contained several conclusions and recommendations, briefly summarized as follows:

- Discharge of treated wastewater within the northerly third of the Pasquini property (adjacent to and immediately south of Orchard Road within an approximate 35-acre area) would be at a sufficient distance from the bluff of the floodplain, and would not daylight on the slope face. This conclusion should be confirmed with supplemental field work.
- Soils could be expected to percolate at a rate of 10 gallons per day per square foot (gpd/ft^2) of clean water. This conclusion should be confirmed with supplemental field work.
- Percolation ponds within the northern 35 acres area considered are unlikely to adversely impact the existing bluff face, provided that groundwater elevations remain below the base of the bluff.
- Stability of the bluff face is predominately influenced by erosion that has resulted from groundwater daylighting on the slope during high groundwater periods and storm events. Surface drainage should be controlled such that surface water does not run towards or over the bluff slope.
- To assess the percolation capacity of the surficial soils, Fugro recommends a series of conventional percolation tests be performed (approximately 1 test per every 2 acres of proposed percolation basin area).
- A small, on-site pilot test is recommended by Fugro. A 10- to 20- foot square percolation basin, constructed onsite would allow additional tests to more closely estimate the percolation capacity of the soils.
- Construction of four monitoring wells will provide water level data and background water quality information. Water level data is needed to estimate fate and transport of percolation water. Water quality data can ultimately be used to satisfy Regional Water Quality Control Board requirements

DRAFT

should the site be used for the proposed project in the future.

- A groundwater flow model could be constructed from the data gathered to better predict the fate and transport of treated wastewater discharged into the percolation basins.

To assist with the site testing, a conceptual layout was prepared for potential future percolation basins at the Pasquini property (Figure 1, attached). The following assumptions were used to prepare the layout:

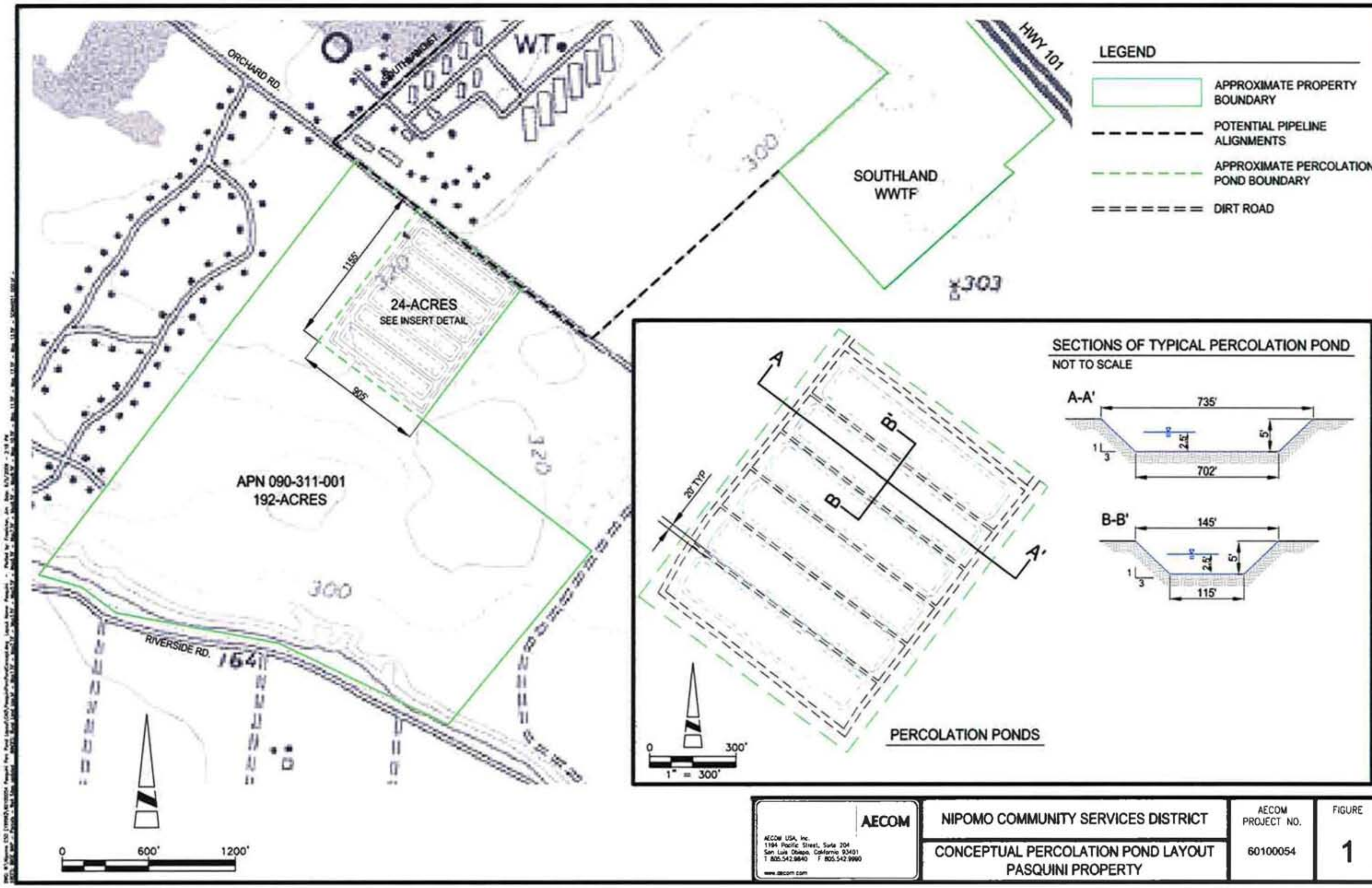
- Site soils have a percolation rate of 10 gpd/ft^2 for clean water. Assuming a de-rating of 50% for treated wastewater, the conceptual percolation rate is assumed to be 5 gpd/ft^2 for treated wastewater
    - Percolation Rate = 5 gpd/ft^2
- Future (2030) WWTF influent flow rates = 1.8 MGD, based on the maximum monthly flow (MMF) from the January 2009 NCSD Southland WWTF Master Plan (AECOM).
    - Hydraulic Loading = 1.8 MGD (future MMF)
- Dividing the hydraulic loading by the percolation rate, a net percolation area of 8.3 acres is needed.

The attached conceptual layout shows 6 percolation basins contained in a gross area of 24 acres. Basin floors are approximately 115 feet by 702 feet, providing just over 11 acres of percolation area. The total pond depth is 5 feet with a minimum freeboard of 2.5 feet. During max month flows, three ponds could handle the percolation without creating standing water. Periodically operations will cycle to the other three ponds, allowing the first three to dry completely. Once dried, the ponds should be scarified with a rake or light disc to maintain percolation rates. An operations and maintenance schedule should be developed based on results of the site-specific percolation tests.

Yours sincerely,

Eileen Shields, EIT

CC: Peter Sevcik (NCSD), Josh Reynolds (AECOM), Mike Nunley (AECOM), Paul Sorensen (Fugro)


LEGEND
APPROXIMATE PROPERTY BOUNDARY
POTENTIAL PIPELINE ALIGNMENTS
APPROXIMATE PERCOLATION POND BOUNDARY
DIRT ROAD
ORCHARD RD.
HWY 101
W.T.
SOUTHLAND WWTF
300
320
303
24-ACRES
SEE INSERT DETAIL
1155'
905'
APN 090-311-001
192-ACRES
RIVERSIDE RD.
164
0
600'
1200'
SECTIONS OF TYPICAL PERCOLATION POND
NOT TO SCALE
A-A'
735'
5'
2.5'
702'
B-B'
145'
115'
20' TYP
PERCOLATION PONDS
300'
1" = 300'
AECOM
AECOM USA, Inc.
1194 Pacific Street, Suite 204
San Luis Obispo, California 93401
T 805.542.9840 F 805.542.9990
www.aecom.com
NIPOMO COMMUNITY SERVICES DISTRICT
CONCEPTUAL PERCOLATION POND LAYOUT
PASQUINI PROPERTY
AECOM PROJECT NO.
60100054
FIGURE
1

FUGRO

APPENDIX B

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9/1/2009 12:37:23 PM

9/2/2009 8:57:47 AM

9/2/2009 9:07:16 AM

9/2/2009 9:08:00 AM

9/2/2009 9:28:44 AM

9/2/2009 10:58:41 AM

9/2/2009 10:59:18 AM

9/3/2009 10:03:51 AM

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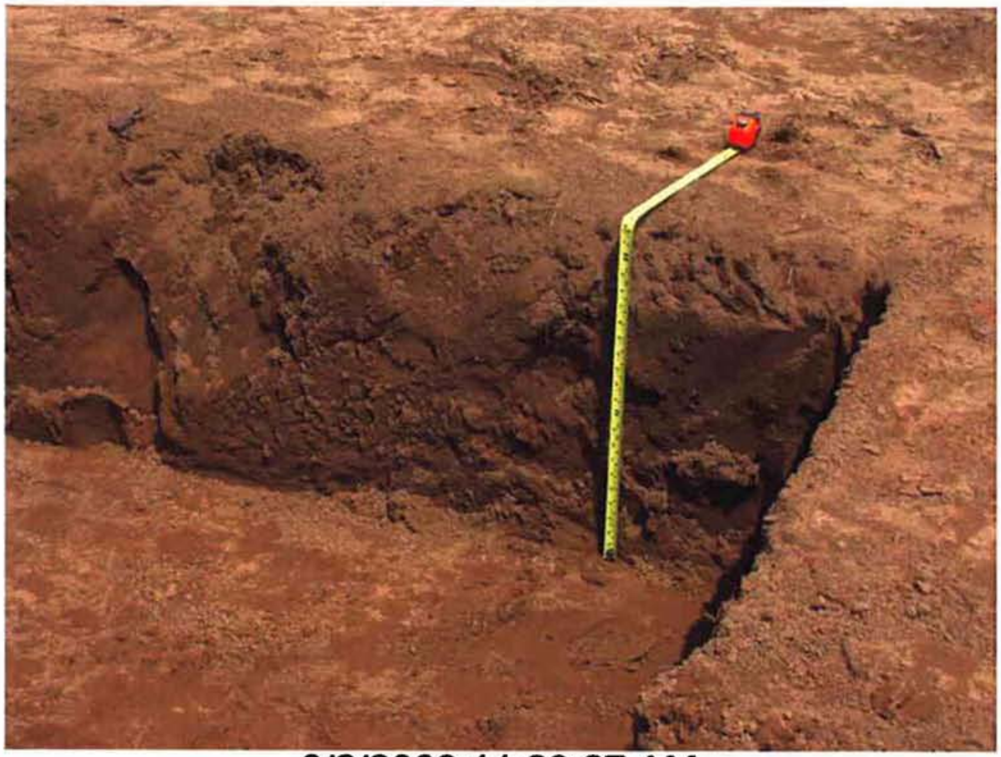

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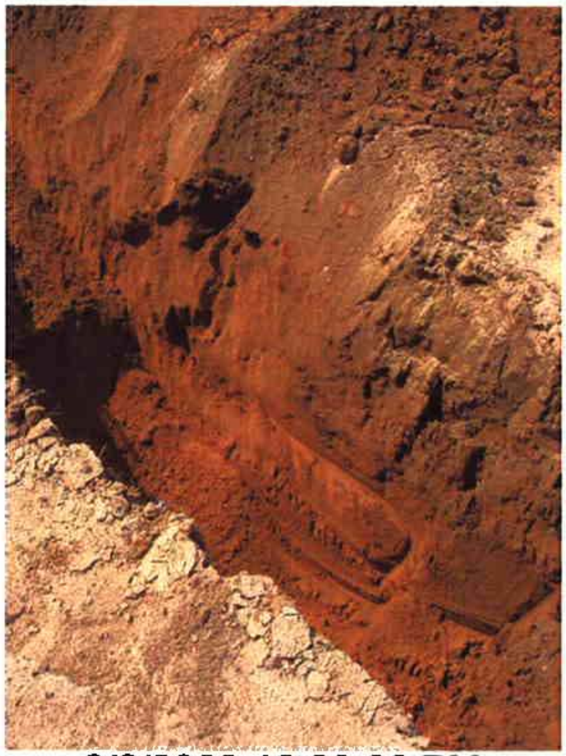

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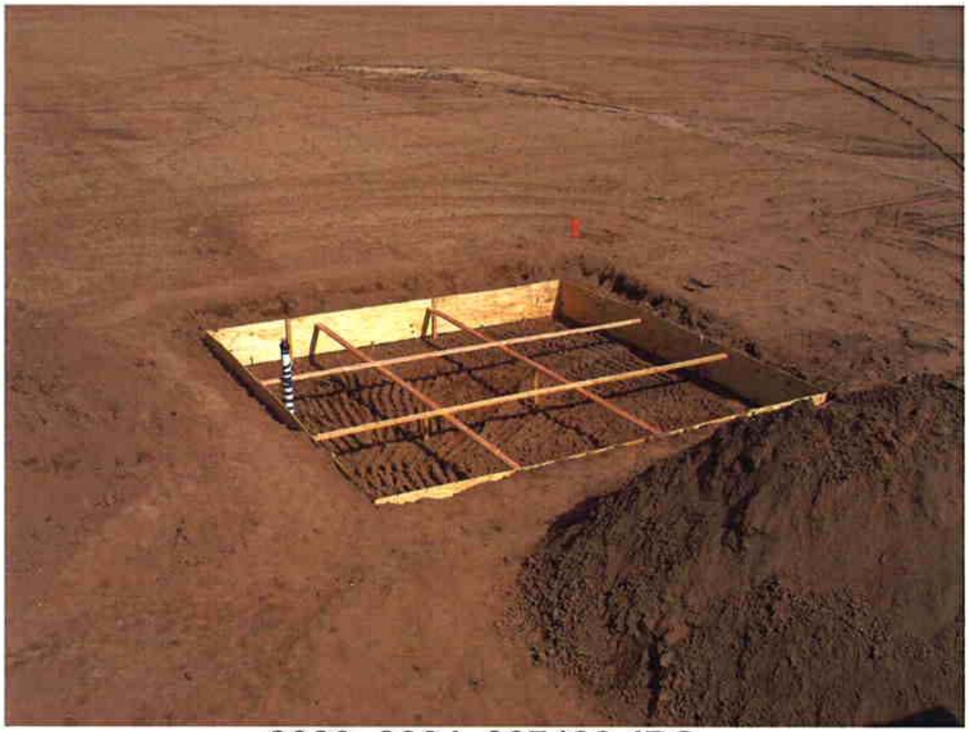

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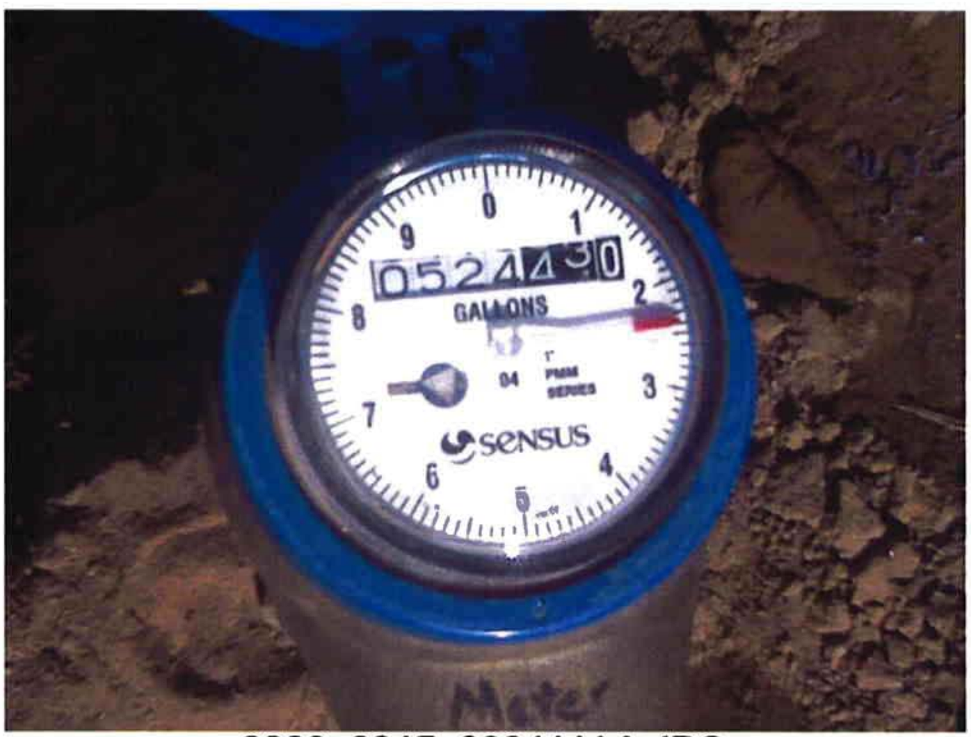

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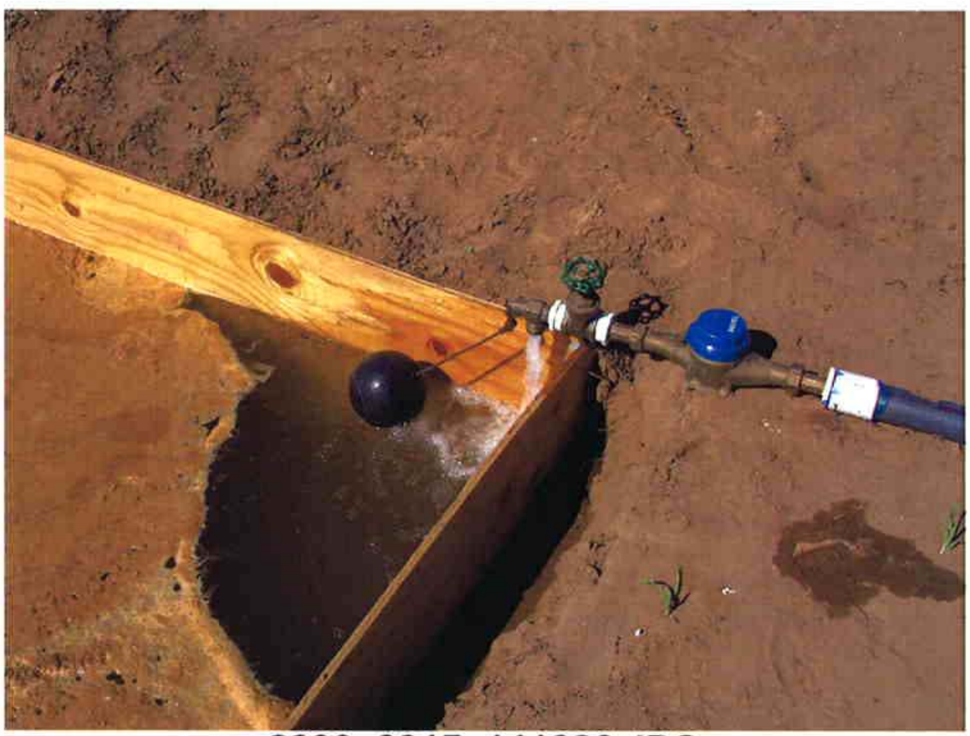

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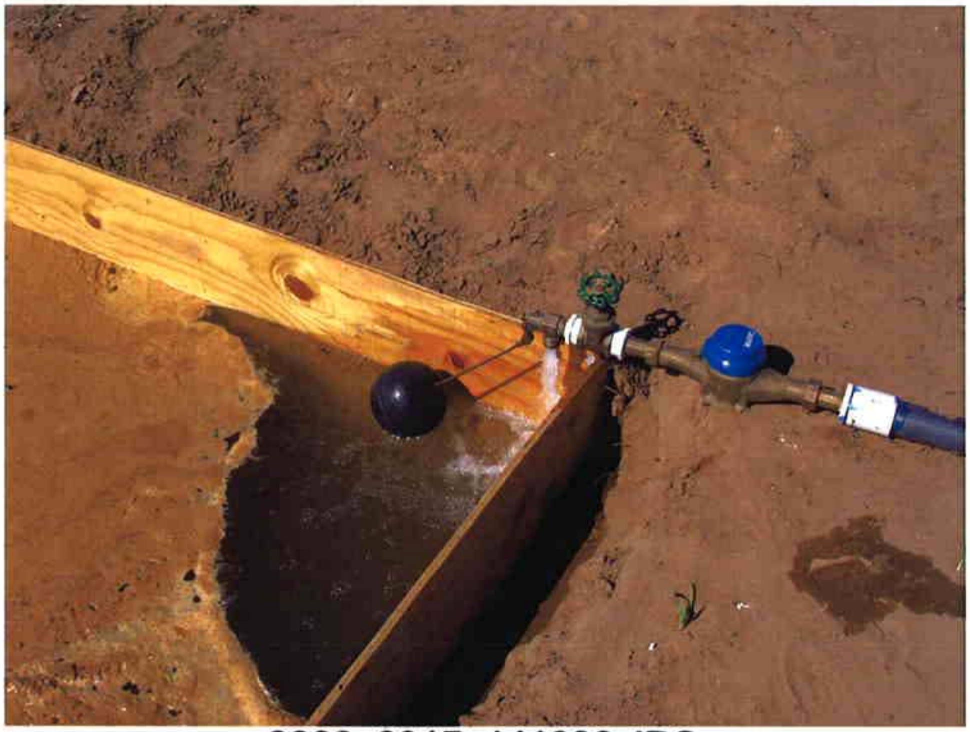

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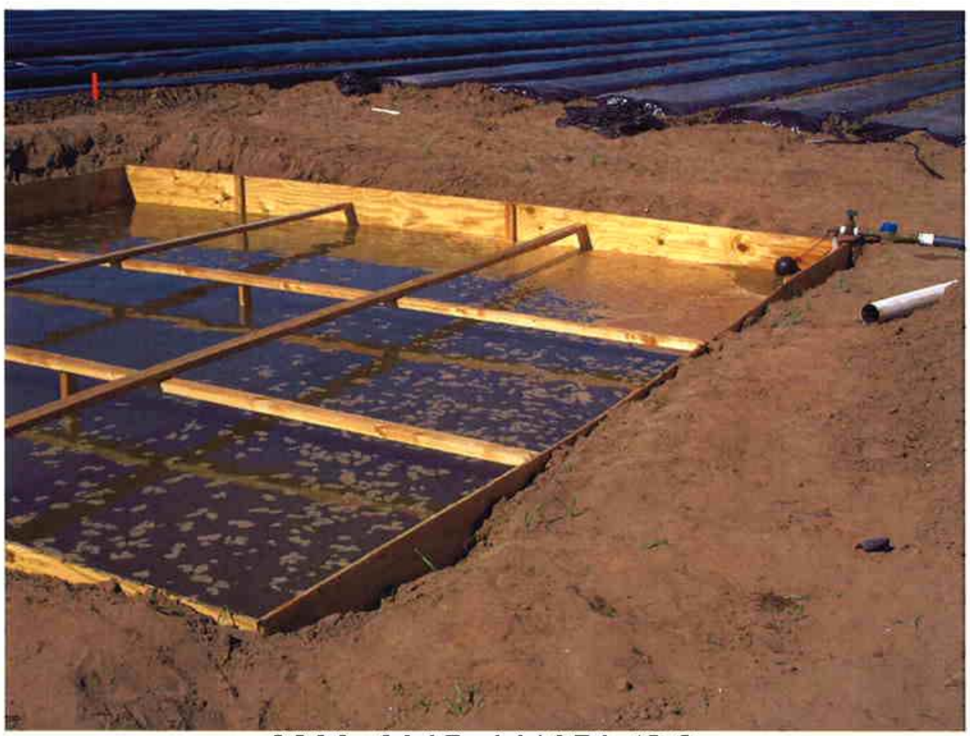

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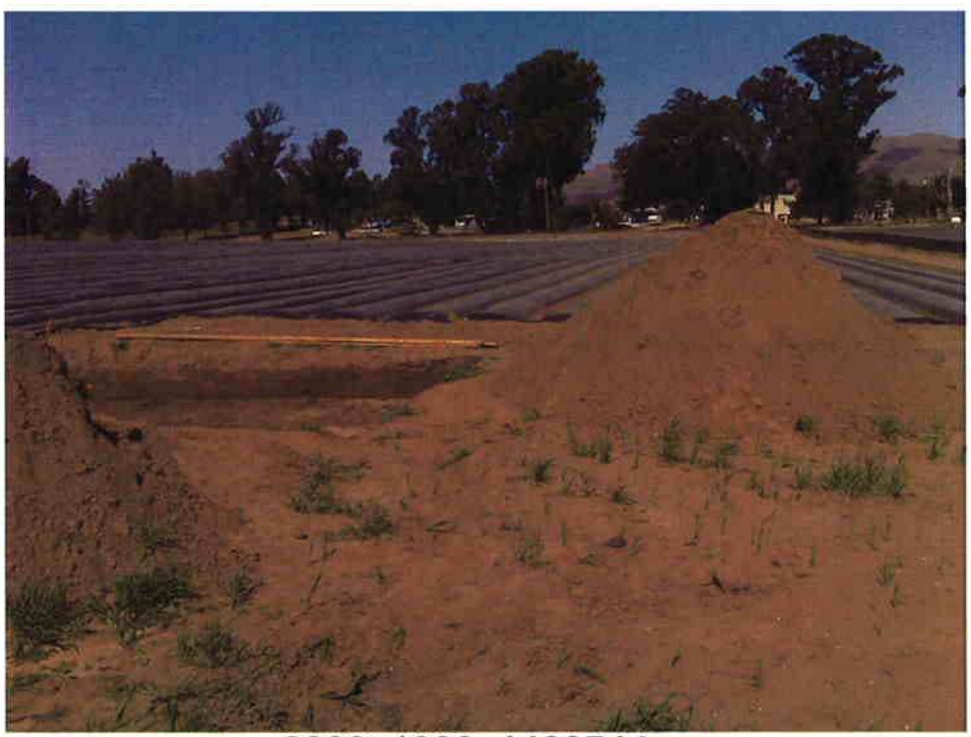

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FUGRO

APPENDIX C

CAPCO Analytical Services, Inc.
Environmental and Analytical Services-Since 1994

Client: Fugro West, Inc.
Sample ID: Pesquini Irrigation Water
CAS LAB NO: 09240001
Analyst: ABE/AN/GM/AJ

Date Sampled: 09/25/09
Date Received: 09/25/09
Sample Matrix: Water

GENERAL MINERAL ANALYSIS SUMMARY

COMPOUND	RESULT	UNITS	DF	PQL	METHOD	ANALYZED
Alkalinity ($CaCO_3$)	200	mg/L	1	10	2320 B	09/28/09
Bicarbonate ($CaCO_3$)	200	mg/L	1	10	2320 B	09/28/09
Carbonate ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
Hydroxide ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
pH	7.4	S.U.	1	--	$4500-^{H+}B$	09/25/09
Total Hardness	320	mg/L	1	10	130.2	09/25/09
Chloride	83	mg/L	1	0.2	300.0	09/25/09
Fluoride	0.36	mg/L	1	0.1	300.0	09/25/09
Nitrate (as N)	4.9	mg/L	1	0.1	300.0	09/25/09
Sulfate	180	mg/L	1	0.5	300.0	09/25/09
Spec. Conductivity	1010	umhos/cm	1	1	120.1	09/28/09
T.D.S.	660	mg/L	1	10	2540 C	09/28/09
MBAS Surfactants	BQL	mg/L	1	0.1	5540 C	09/25/09
Boron	0.36	mg/L	1	0.1	200.7	09/29/09
Calcium	79	mg/L	1	0.1	200.7	09/29/09
Copper	0.064	mg/L	1	0.02	200.7	09/29/09
Iron	0.11	mg/L	1	0.1	200.7	09/29/09
Magnesium	35	mg/L	1	0.1	200.7	09/29/09
Manganese	0.18	mg/L	1	0.005	200.7	09/29/09
Potassium	3.3	mg/L	1	0.2	200.7	09/29/09
Sodium	63	mg/L	1	0.5	200.7	09/29/09
Zinc	BQL	mg/L	1	0.05	200.7	09/29/09

T.D.S.: Total Dissolved Solids
PQL: Practical Quantitation Limit
BQL: Below Practical Quantitation Limit

AM Jac
Principal Analyst

1536 Eastman Ave. Suite B, Ventura, California 93003 Ph: (805)644-1095 FAX: (805)644-9947
www.capcoenv.com

CAPCO Analytical Services, Inc.
Environmental and Analytical Services-Since 1994

Client: Fugro West, Inc.
Sample ID: Method Blank
CAS LAB NO: 092400-MB

Sample Matrix: Water
Analyst: ABE/AN/AJ/GM

GENERAL MINERAL ANALYSIS SUMMARY

COMPOUND	RESULT	UNITS	DF	PQL	METHOD	DATE ANALYZED
Alkalinity ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
Bicarbonate ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
Carbonate ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
Hydroxide ($CaCO_3$)	BQL	mg/L	1	10	2320 B	09/28/09
Total Hardness	BQL	mg/L	1	10	130.2	09/25/09
Chloride	BQL	mg/L	1	0.2	300.0	09/25/09
Fluoride	BQL	mg/L	1	0.1	300.0	09/25/09
Nitrate (as N)	BQL	mg/L	1	0.1	300.0	09/25/09
Sulfate	BQL	mg/L	1	0.5	300.0	09/25/09
T.D.S.	BQL	mg/L	1	10	2540 C	09/28/09
MBAS Surfactants	BQL	mg/L	1	0.1	5540 C	09/18/09
Boron	BQL	mg/L	1	0.1	200.7	09/29/09
Calcium	BQL	mg/L	1	0.1	200.7	09/29/09
Copper	BQL	mg/L	1	0.02	200.7	09/29/09
Iron	BQL	mg/L	1	0.1	200.7	09/29/09
Magnesium	BQL	mg/L	1	0.1	200.7	09/29/09
Manganese	BQL	mg/L	1	0.005	200.7	09/29/09
Potassium	BQL	mg/L	1	0.2	200.7	09/29/09
Sodium	BQL	mg/L	1	0.5	200.7	09/29/09
Zinc	BQL	mg/L	1	0.05	200.7	09/29/09

T.D.S.: Total Dissolved Solids
PQL: Practical Quantitation Limit
BQL: Below Practical Quantitation Limit

AMJac
Principal Analyst

Fax from : 8185434604

ORIGINAL File with DWR 11N 34W 24

Page ___ of ___

Owner's Well No. 1

Date Work Began 8-12-08, Ended 11-29-08

Local Permit Agency San Luis Obispo

Permit No 2008-197 Permit Date 7-24-08

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1082553

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	180	Brown Sand
180	214	Gray Clay
214	220	Brown Clay With Gravel
220	250	Gravel
250	267	Brown Clay
267	280	Gravel & Brown Sand
280	295	Gray Clay
295	345	Gray Gravel & Sand & Strips Of Clay
345	400	Gray Clay & Sand Streaks
400	420	Gray Clay With Sea Shells

TOTAL DEPTH OF BORING 420 (Feet)

TOTAL DEPTH OF COMPLETED WELL 400 (Feet)

WELL OWNER

Name Charile PasQuini

Mailing Address 238 Brant St

Arroyo Grande Calif 93420

CITY STATE ZIP

WELL LOCATION

Address 590 Orchard Rd Nipomo Ca

City Nipomo Calif

County San Luis Obispo

APN Book ___ Page ___ Parcel 090-311-001

Township ___ Range ___ Section ___

Lat ___ DEG. MIN SEC. N Long ___ DEG. MIN. SEC. W

LOCATION SKETCH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 255 (Ft.) & DATE MEASURED 9-10-08

ESTIMATED YIELD * 600 (GPM) & TEST TYPE Pump

TEST LENGTH 24 (Hrs.) TOTAL DRAWDOWN 95 (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE: BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	220	22	X				Pvc	12	Sdr-21	
220	380	22		X			Pvc	12	Sdr-21	032
380	400	22	X				Pvc	12	Sdr-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	52	X			
					Montery

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling (PERSON, FIRM OR CORPORATION) (TYPED OR PRINTED)

2801 Mahoney Rd Santa Maria Calif 93455

ADDRESS CITY STATE ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR

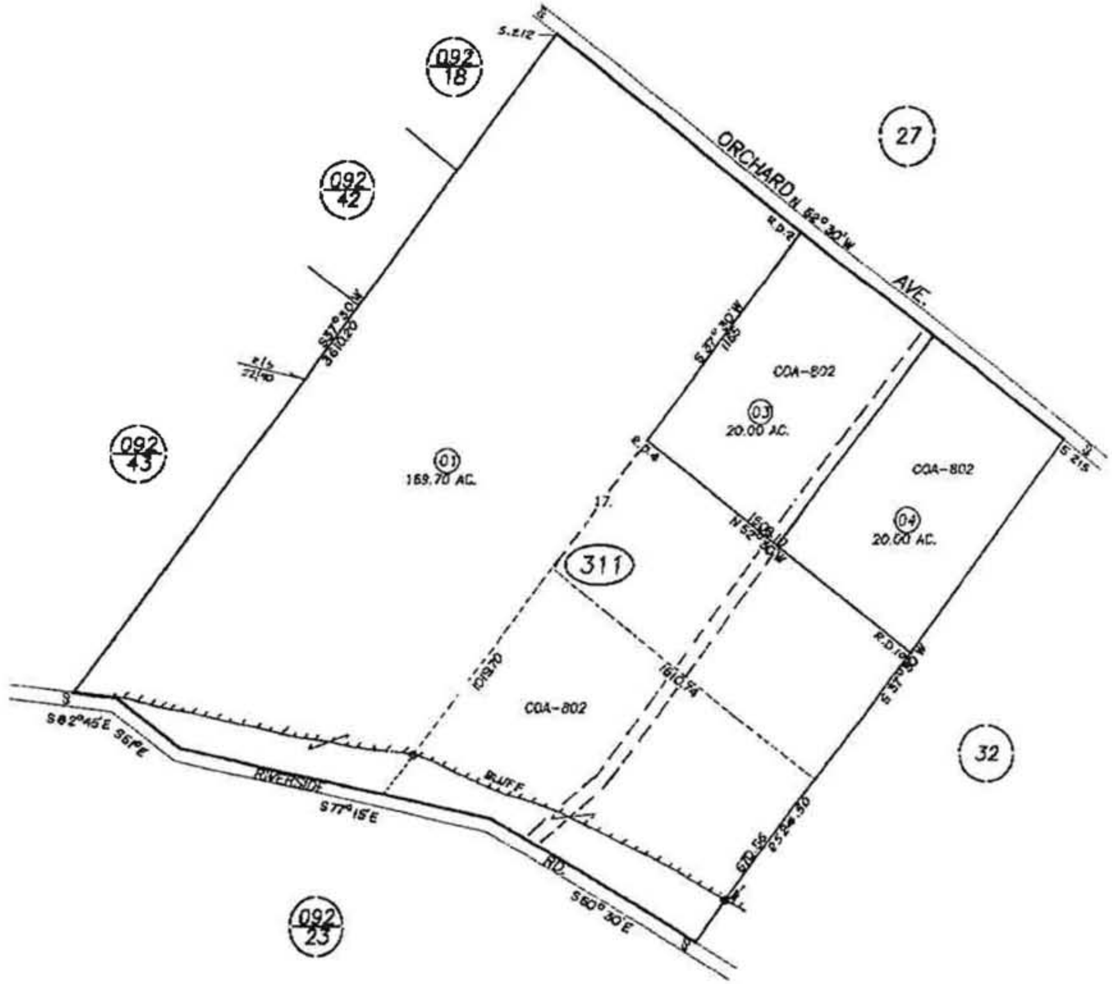
10-30-08 DATE SIGNED

523-858 C-57 LICENSE NUMBER

DWR 188 REV. 05-03 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM OSP 03 781

090-31

1" = 500'



REVISIONS	
TECH	DATE
JAW	03-25-03

250' 0 500' 1000'

JAV 03-25-03	THIS MAP IS PREPARED FOR ASSESSMENT PURPOSES ONLY.

SUBDIVISIONS OF THE RANCHO NIPOMO, R.M. Bk. A , Pg. 13.

NIPOMO
ASSESSOR'S MAP, COUNTY OF SAN LUIS OBISPO, CA.
BOOK 090 PAGE 31

Fax from : 8105434884

ORIGINAL 11N 34W 21
File with DWR

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 1082554

Page ___ of ___
Owner's Well No. 2
Date Work Began 9-4-08, Ended 11-08-08
Local Permit Agency San Luis Obispo
Permit No. 2008-248 Permit Date 9-2-08

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.		DESCRIPTION Describe material, grain size, color, etc.
0	60	Sand & Gravel
60	70	Sand
70	100	Gravel
100	120	Sand
120	150	Brown Clay With Gravel
150	190	Gravel
190	195	Clay
195	220	Small Gravel
220	237	Clay
237	268	Small Gravel
268	300	Sand
300	330	Clay
330	360	Sand & Gravel Blue
360	410	Sand & Clay Stringers With Sea Shells

TOTAL DEPTH OF BORING 410 (Feet)
TOTAL DEPTH OF COMPLETED WELL 400 (Feet)

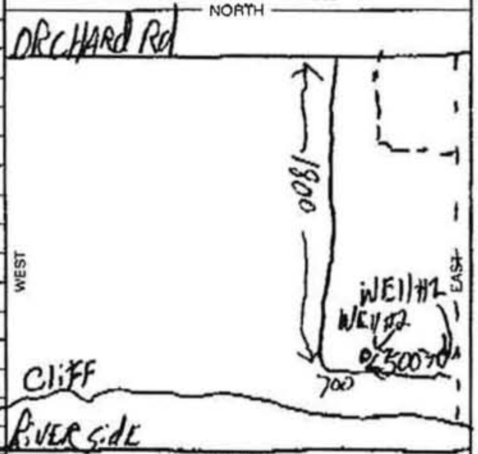
WELL OWNER

Name Charile Pasquini
Mailing Address 2381 Brant st
Arroyo Grande Calif 93420
CITY STATE ZIP

WELL LOCATION

Address 590 Orchard Rd
City Nipomo Calif
County San Luis Obispo
APN Book ___ Page ___ Parcel 090-311-001
Township ___ Range ___ Section ___
Lat ___ N (DEG. MIN. SEC.) Long ___ W (DEG. MIN. SEC.)

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

USES (✓)
WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 250 (Ft.) & DATE MEASURED 11-02-08
ESTIMATED YIELD * 650 (GPM) & TEST TYPE Pump
TEST LENGTH 24 (Hrs.) TOTAL DRAWDOWN 87 (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE: BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	220	26	X				Pvc	12	Sdr-21	
220	380	26		X			Pvc	12	Sdr-21	032
380	400	26	X				Pvc	12	Sdr-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	X			
					Montery

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

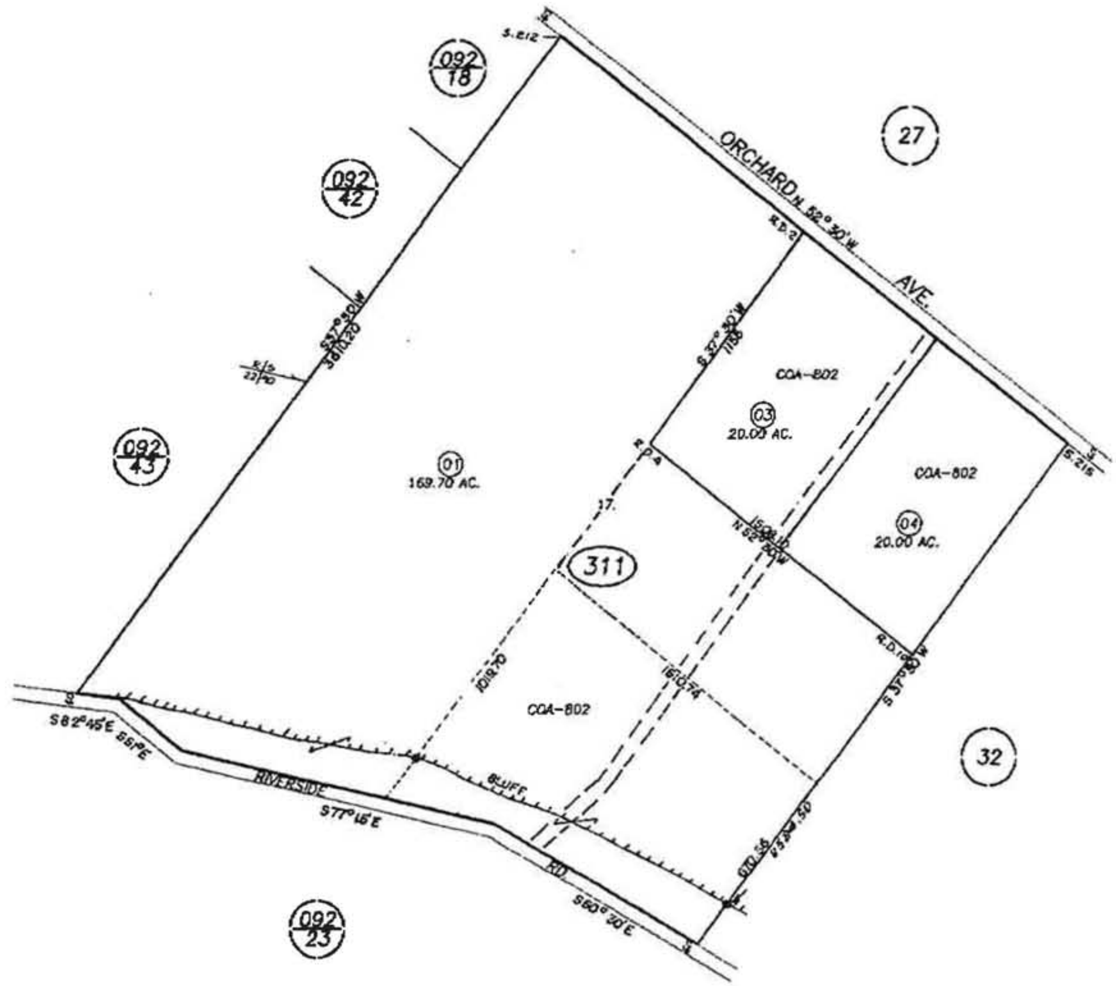
2801 Mahoney Santa Maria Calif 93455
ADDRESS CITY STATE ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR
11-30-08 DATE SIGNED
523-858 C-57 LICENSE NUMBER

DWR 188 REV 05-03 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM OSP 03 78881

090-31

1" = 500'



REVISIONS	
TECH	DATE
JAV	03-25-03

250' 0 500' 1000'

JAV 03-25-03 THIS MAP IS PREPARED FOR ASSESSMENT PURPOSES ONLY.

SUBDIVISIONS OF THE RANCHO NIPOMO, R.M. Bk. A, Pg. 13.

NIPOMO
ASSESSOR'S MAP, COUNTY OF SAN LUIS OBISPO, CA.
BOOK 090 PAGE 31

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

FACSIMILE TRANSMITTAL SHEET

TO: Tim Nicely	FROM: Michal Van Raalte
COMPANY: Fugro West	DATE: 12/2/09
FAX NUMBER: 805 650-7010	FAX NUMBER: 818.543.4604
PHONE NUMBER: 289-3836	PHONE NUMBER: 818.500.1645 EXT.
RE: WCR's	TOTAL NO. OF PAGES INCLUDING COVER: 5

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY

NOTES/COMMENTS:

STATE OF CALIFORNIA

Michael Van Raalte
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February 19, 2010
Project No. 3596.005

PROJECT MEMORANDUM

To: **Peter Sevcik**

From: **Timothy Nicely and Paul Sorensen**

Subject: **Work Plan for Additional Field Work Related to the Hydrogeologic Investigation of the Pasquini Property**

This work plan summarizes the additional field work to be performed at the Pasquini Property relative to the ongoing hydrogeologic investigation to evaluate the feasibility of developing a treated wastewater effluent discharge facility using a percolation pond system. The additional work is designed to investigate the presence and possible lateral continuity of two deep clay layers that were identified in the recently drilled on-site irrigation wells. The potential presence of the clay layers, at 120 feet below ground surface and 180 feet below ground surface, could potentially have significant implications on the vertical percolation of the effluent and the eventual buildup of the effluent mound beneath the percolation pond facility. Of critical concern is the potential for the mound to spread laterally and daylight in the adjacent bluff face.

Based on our discussions with District staff, we have developed a plan to drill three deep boreholes to investigate the presence and lateral continuity of the clay layers. We propose to utilize a sonic drilling rig to drill the boreholes, which has the capability to drill to the required depths as well as the ability to sample the encountered materials to allow for laboratory testing and evaluation. Although the sonic drilling method is slightly more expensive than normal drilling methods such as hollow-stem auger drilling or mud-rotary drilling, it will accomplish the required objectives. Hollow-stem auger drilling does not have the capability to drill to the required depths, and mud-rotary drilling does not have the ability to collect "undisturbed" samples suitable for laboratory testing.

Once the drilling is completed and the samples are collected, we will perform laboratory tests to determine hydraulic conductivity of the materials, specifically grain-size analyses and lab permeability tests.

Upon completion of the laboratory testing phase, we will incorporate the results into the analytical modeling and mounding analysis that we performed and described in the draft summary report (February 2010). We will then finalize the summary report of the entire investigation and submit a final report to the District.

The field work will be performed in a single task over a period of approximately two weeks. Laboratory testing, analytical modeling and mound analysis, and final report preparation will require an additional four weeks.

DRILLING AND SAMPLING

This task will involve the drilling of three borings on the site to evaluate the presence, lateral continuity, and properties of two possible clay layers that were identified in the drillers logs of the on-site water wells. The task involves 1) clearance of underground utilities in accordance with Dig Alert standards, 2) drilling of three test holes, and 3) sampling of the clay layers.

Utility Clearance

Based on prior investigation at the site, no utilities are expected to exist beneath the site with the notable exception of irrigation pipelines. The locations of the irrigation pipelines are presumed to be known by the owner and lessee of the site. In addition to working with the property lessee to identify the locations of the buried irrigation lines, Dig Alert will be called to obtain site clearance.

Exploration Drilling

The approximate locations of the proposed drilling explorations are shown on the attached map (Plate 1.) The locations are located (1) along the southern road on the top of the bluff, (2) in the central staging area of the site, and (3) along the central access road near the prototype percolation pond area. These locations are approximate and could be moved in the event of conflicts.

Drilling Method: The drilling operation will be conducted by Prosonic (Boart Longyear) using the sonic drilling method. A description of the drilling method is included on the appended literature.

Each borehole is anticipated to require one to two days for drilling and sampling. A total of six working days is planned to complete the field work.

Site Layout: At each of the three test drilling sites, an area of approximately 75 feet by 20 feet must be accessible for the drilling equipment (see photo at right for typical drill rig layout). The drill rig and support rig can set up along existing roadways, although farm traffic may need to be routed around the drilling.

Access Routes: Access to each of the drill sites will be via the existing access roadways. The drilling operation will require a site of approximately 75 feet long by 15 to 20 feet wide. Because the area for drilling is limited by the strawberry fields, the drilling will be performed to avoid encroaching on the strawberry fields by staging the drilling on access roads or similar areas.

Equipment: The drilling contractor will be using a drill rig and pipe trailer (total length of 75 feet) along with a single support truck during the drilling. A Fugro pickup truck will be on-site at all times.

Water Requirements: The drilling operations may require up to 400 gallons of water per day. If the water is not easily accessible at the site, the drilling contractor may fill up their tank at the Southland operations yard.

Following the completion of drilling, the cuttings will be backfilled into the hole. Remaining cuttings will be spread out at the site in a neat manner acceptable to the owner and lessee. No structures will be installed as part of this investigation.

LABORATORY TESTING

The advantage of the using the sonic drilling method is that relatively undisturbed samples can be obtained from the required depths. These undisturbed subsurface samples will be obtained and laboratory analyses run in order to obtain grain-size analyses (a direct indication of permeability), and obtain estimates of sustained infiltration rates based on laboratory-determined permeability values.

MOUNDING ANALYSIS

Based on the data obtained from the field work and laboratory testing, the sediment characteristics and aquifer parameters will be incorporated into the existing analytical model and mounding analysis that we have already performed at the site. The analysis will predict the fate and transport of wastewater discharged into percolation basins, the shape and size of the anticipated effluent mound, and the expected relationship of the mound with the bluff face.

REPORT PREPARATION

The results of the work effort will be incorporated into the existing interim report, which will document all of the work performed at the site, present findings and conclusions, and provide appropriate recommendations.

FEES

Our anticipated fee for these efforts is shown on the attached Fee Estimate (Plate 2). As shown on Plate 2, the estimated fee is $73,200, including all subcontractor and laboratory charges. It is important to note that, as of February 18, approximately $43,000 of the authorized $128,800 remains on the existing Fugro agreement with the District. Thus, the additional field work will constitute an increase of $30,200 over the original authorized investigation fees.

BASE MAP SOURCE: Aerial photograph from Google Earth Pro 2007.

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Site 3 **LEGEND**
Proposed Drilling Locations

NORTH
0 1000
FEET

EXPLORATION LOCATION MAP
NCSD - Pasquini Phase 2
Nipomo, California

PLATE 1

Task	Office Assistant	GIS Operator	Illustrator	Staff I	Staff II	Project I - Nicely	Project I - Ruud	Associate - Leffler	Principal - Sorensen	Total Hours		Total Cost
Rate/Hour (2008sc):	$55	$90	$85	$110	$115	$135	$145	$200	$200			
Geotechnical Services:												
Project Prep, Site Work and Permitting						8			4		$	1,880
Test Hole Drilling						60				60	$	8,100
Laboratory Tests					Unit rates as listed below						$	4,400
Analytical Mounding Analysis							40	2	2		$	6,600
Report Preparation	4		4			8	8	4	8	36	$	5,200
Project Management and Meetings									16	16	$	3,200
Subtotal:	4	0	4	0	0	76	48	6	30	112	$	29,380

Laboratory Costs (see fee schedule for additional tests)	Rate	No.	Other Direct Costs	Units	Rate	Billing Factor		ODC Costs
Moisture Content-Classification	$ 25	8	Prosonic Rig Mob/Demob		$ 215	1.15	$	-
Atterberg Limits	$ 150	0	Prosonic Rig Rate (per day)	6	$ 6,000	1.15	$	41,400
Sieve Analysis	$ 100	8	Chase Truck (per day)	4	$ -	1.15	$	-
Sand Equivalent	$ 95	0	Crew Mob-demob	4	$ -	1.15	$	-
Compaction Curve, ASTM D1557, 4" Mold	$ 225	0		0	$ -	1.15	$	-
Direct Shear, CU 3 points, ASTM 3080	$ 420	0		0	$ -	1.15	$	-
Direct Shear, CU 3 points, residual ASTM 3080	$ 570	0		0	$ -	1.00	$	-
Percent Passing #200	$ 65	8		0	$ -	1.15	$	-
UU Triaxial	$ 120	0	CPT Mobilization/Demobilization	0	$ 2,000	1.00	$	-
Unconfined Compression	$ 100	0	CPT Soundings (per day)	0	$ 3,000	1.00	$	-
Constant Head Permeability	$ 325	0	CPT Rig per diem (2 person)	0	$ 300	1.00	$	-
Flex-wall Permeability ASTM D5084	$ 360	8	CPT Standby/Dissipation	0	$ -	1.15	$	-
Incremental Consolidation with UL-RL	$ 375	0		0	$ -	1.15	$	-
Sieve and Hydrometer	$ 170	0		0	$ -	1.15	$	-
Expansion Index	$ 225	0		0	$ -	1.15	$	-
R-value, Soil	$ 300	0		0	$ -	1.15	$	-
	$ -	0	Per diem	5	$ 200	1.15	$	1,150
	$ -	0	Pickup Truck (per day)	5	$ 115	1.00	$	575
Soil Chemistry (pH, CL, SO4, R)	$ 240	0	Field Supplies	1	$ 500	1.15	$	575
Sample Remold Charge	$ 80	0	Shipping, Overnight, Copies, etc.	1	$ 50	1.15	$	58
					Subtotal ODC:		**$**	**43,758**

Revised: January 16, 2009

Estimated Total for Hydrogeologic Services: $ 73,200

FEE ESTIMATE FOR HYDROGEOLOGIC SERVICES
Pasquini Property Investigation
Nipomo, California