Attachment A

Response to USEPA Comment No. 1d from letter dated December 3, 2019

1.0 Introduction

1.1 Purpose of Submittal

As a follow-up to a conference call with United States Environmental Protection Agency (USEPA) Region 9 on December 20, 2019, Panoche Energy Center (PEC) has prepared the following response to Comment No. 1d from the letter provided by USEPA Region 9 dated December 3, 2019. As stated in PEC's e-mail dated December 20, 2019, PEC's planned response to Comment 1d would generally focus on the following four points:

1. **Area of Review (AOR) Evaluation** based on USEPA Region 6 protocol for Class I (hazardous) injection wells, but excluding mud gel strength as a contributing factor to demonstrate protection of the underground source of drinking water (USDW);

2. **Field Plan for Re-Entering and Mud Sampling** at three mud-plugged wells located closest to the PEC plant site (Blue Agave No. 1, England No. 1-31, and Silver Creek No. 18);

3. **Field Plan for Re-Entering and Plugging** at the above three wells with the intent of plugging them with cement plugs to isolate the USDW from the injection zone; and

4. **Groundwater Monitoring** at the above three wells to assess whether any changes in water quality or level in the USDW have been induced by injection well-related activities at PEC.

The purpose of this submittal is to address the four points of focus summarized above within the context of the project work that has been completed thus far, including PEC's current Class I (non-hazardous) injection well permit renewal application (dated March 1, 2019). This is intended to provide greater clarity and serve as a historical record regarding the evolution of the project AOR delineation and corrective action analysis tasks completed to date.

1.2 Summary of Results

Based on a revised AOR evaluation using USEPA Region 6 corrective action protocol (Focus Point No. 1 listed above that is detailed below in Section 2.2), which allows for the addition of mud gel strength as a component, all 17 boreholes/wells located within an expanded 2.6-mile radius AOR around the PEC well sites passed the evaluation and required no corrective action. However, if mud gel strength is removed as a consideration, then only one borehole/well (Souza No. 2, AOR location No. 18) appears to have an insufficient hydrostatic fluid column, based on available well records, to prevent fluid entry from the injection zone when compared to the modeled pressure increase at the well due to PEC's injection. Based on this finding, and for the purpose of evaluating possible corrective actions such as mud sampling and additional plugging (detailed together for efficiency below in Section 3.0), and groundwater monitoring (detailed

below in Section 4.0), the focus of the applicable discussion in the following sections is on Souza No. 2.

It should be noted that the closest wells to the PEC site listed above in Section 1.1 (Blue Agave No. 1, England No. 1-31, and Silver Creek No. 18) are not the focus of the following discussion. This is because these wells passed the USEPA Region 6 AOR corrective action evaluation protocol and do not require any corrective action.

As an alternative to the installation of a groundwater monitoring well near Souza No. 2, an option for groundwater monitoring based on publicly available information is discussed below in Section 4.2. This option looks at the possibility of using existing databases for deep water wells located within the PEC AOR to monitor for possible water quality or water level changes that could indicate potential injection well-related impacts associated with Souza No. 2. This information could be supplemented as needed by sampling and data collection completed by PEC.

2.0 AOR Evaluation

2.1 Prior AOR Evaluation

Since the federal regulations are not clear regarding the exact method to be used when conducting an AOR corrective action evaluation, PEC applied a conservative protocol in their permit renewal application dated March 1, 2019 based on the following two elements:

1. Hydrostatic borehole mud properties (i.e., weight of mud column) from the top of the injection zone to the base of the USDW according to available well logs and official well completion and plugging records; and

2. Freshwater hydrostatic borehole conditions (i.e., weight of mud formation fluid) from the base of the lowermost USDW to surface (given that historical information suggests an original USDW hydraulic head that was likely to have been artesian as discussed in PEC's March 1, 2019 permit renewal application).

This AOR corrective action evaluation protocol was applied to any artificial penetration within the AOR that penetrated the injection zone and where a cement plug was not set between the top of the injection zone and the base of the USDW. This calculated total hydrostatic head pressure at each artificial penetration was then compared to the original calculated head in the injection zone plus the maximum, modeled injection zone reservoir pressure increase (over the life of the project) at each artificial penetration to determine if the combined hydrostatic head of the borehole fluid column was sufficient to prevent fluid movement into a USDW as prescribed in 40 CFR §146.7. As stated above, since the federal regulations are not specific on how the AOR corrective action evaluation protocol should be formulated and applied, the methodology originally adopted by PEC was intended to be extremely conservative since it assumes no drilling mud left in the borehole above the base of the USDW, and assumes freshwater conditions above the base of the USDW even though total dissolved solids (TDS) values approaching 10,000 mg/L (and associated higher specific gravity formation fluids) can be expected at the base of the USDW.

The AOR radius approved historically by USEPA Region 9, which was applied to PEC prior to their current permit renewal application, was set at 25 psi of net injection zone reservoir pressure increase using the more detailed Class I (hazardous) standards provided under 40 CFR §146.62(d)(4). It is PEC's understanding that this pressure limit was adopted as a practical

consideration since the native reservoir pressure found in the injection zone at the time of well completion was positive (i.e., a reservoir fluid level above ground surface), combined with the presence of a deep, freshwater aquifer system, thus indicating excellent injection zone reservoir confinement.

However, based on discussions with USEPA Region 9 in 2018 and 2019 during the preparation of the current permit renewal application for PEC's injection wells (dated March 1, 2019), mud gel strength was adopted as the basis for determining the AOR limit. This decision by USEPA Region 9 was based on the reasoning (as stated above) that since the native reservoir pressure observed in the injection zone at the time of well completion was found to be positive, and if an improperly completed or plugged borehole/well in the AOR was not currently allowing fluids to enter a USDW in the absence of injection by PEC (as evidenced by the presence of a deep, freshwater aquifer system in the area), then the minimum pressure increase associated with PEC's injection that would be needed to create a USDW endangerment concern would be the amount of pressure required to break the gel strength of the mud in a borehole/well and initiate flow into the borehole/well.

Based on the above discussions with USEPA Region 9, a criteria was established that relies on a mud gel strength of 25 pounds per 100 square feet of borehole/well surface area for determining the limits of the project AOR. This specific mud gel strength value was selected since it is within the lower end of the range provided in the public literature, and since given the age of the boreholes/wells in the AOR and the expected effects of time and temperature with depth, the mud gel strength can be expected to be an order of magnitude or more higher now as compared to the time of original mud emplacement.

Based on the AOR delineation agreement outlined above that was reached with USEPA Region 9, the minimum injection zone reservoir pressure increase was calculated at 42 psi (according to the borehole/well conditions at AOR location 5) as shown in Figure A-1 of PEC's permit application dated March 1, 2019. This resulted in an AOR radius of approximately 2.3 miles based on modeled injection zone reservoir conditions in 2018, which encompassed 12 artificial penetrations requiring a corrective action evaluation. Based on the above AOR corrective action evaluation protocol, all of the artificial penetrations except for Silver Creek No. 18 (AOR location No. 14) passed the protocol without the addition of mud gel strength and indicated no need for corrective action. However, with the addition of mud gel strength at an assumed value of 25 pounds per 100 square feet from the top of the injection zone to the next closest overlying cement plug, Silver Creek No. 18 also passed the AOR evaluation protocol.

2.2 Current AOR Evaluation using USEPA Region 6 Protocol

Based on more recent comments from USEPA Region 9 regarding its uncertainty concerning the value of mud plugs in general to serve as a viable form of USDW protection (with or without the inclusion of mud gel strength), PEC proposed to re-evaluate their AOR applying the protocol used by USEPA Region 6 for Class I (hazardous) injection wells. This methodology, while being somewhat less conservative than what PEC applied in their permit renewal application dated March 1, 2019, was proposed by PEC since USEPA Region 6 has regulatory authority over the most Class I injection wells in the United States, and their AOR evaluation protocol is well-established and detailed, based on decades of field experience and regulatory practice.

For those boreholes/wells that do not have a cement plug set between the top of the injection zone and the base of the USDW, the USEPA Region 6 corrective action evaluation protocol considers the following three elements:

1. The hydrostatic borehole/well mud properties (i.e., weight of mud column) from the top of the injection zone to surface based on available well logs and official well completion and plugging records;

2. An assumed 50 feet of mud column fall-back from the surface; and

3. A mud gel strength of 20 pounds per 100 square feet of borehole/well surface area.

While PEC's Class I injection wells are non-hazardous, it should be noted that this protocol used by USEPA Region 6 for Class I (hazardous) injection wells is conservative since it assumes that any cement plugs set above the base of the USDW offer no more resistance to upward fluid displacement than the hydrostatic head of the overall fluid column. Furthermore, this protocol does not consider pressure bleed-off zones between the top of the injection zone and the base of the USDW as is generally contemplated in 40 CFR §146.62(d)(1). Using this methodology and assuming a minimum gel strength of 20 pounds per 100 square feet to define the limits of the AOR, PEC's revised AOR radius extends out farther to 2.6 miles to a minimum reservoir pressure increase contour of 34.8 psi based on modeled injection zone reservoir conditions in 2018 (again, according to the borehole/well conditions at AOR location 5). This increased size of the AOR encompasses a total of 17 artificial penetrations (an increase of five compared to PEC's permit application dated March 1, 2019). This revised AOR is illustrated in Attachment A-1. As summarized in the revised wellbore schematics provided in Attachment A-2, eight of the 17 artificial penetrations within the newly expanded AOR (AOR location Nos. 4, 5, 6, 9, 14, 15, 18, and 20) required further evaluation due to a lack of cement plugs between the top of the injection zone and the base of the USDW, but all of the 17 artificial penetrations pass the USEPA Region 6 evaluation protocol and indicate no need for corrective action. However, if mud gel strength is removed as part of the evaluation protocol, then the hydrostatic head of the fluid column at AOR location 18 (Souza No. 2) is 13 psi less than the calculated borehole entry pressure at this location.

To address the potential borehole/well plugging conditions at Souza No. 2 if mud gel strength is not allowed as part of the AOR corrective action evaluation protocol, an injection pressure limitation at the PEC site could be set by USEPA Region 9 as a permit condition under 40 CFR §144.55(b)(3) and 40 CFR §146.64(d)(3) as an alternative to plugging if the hydrostatic pressure exerted by the fluid column in this well (again, in the absence of gel strength) is determined to be insufficient to protect the USDW. Note that this assessment does not assume the presence of any cement plugs and relies only on a hydrostatic pressure evaluation that compares the fluid column weight in the borehole/well to the modeled maximum pressure in the injection zone. Other alternatives to plugging could include an aquifer exemption for the lowermost USDW pursuant to 40 CFR §146.4. However, the following discussion presents a review of the remaining three points listed above in Section 1.1 that address potential problem AOR locations through means of mud sampling, plugging, and groundwater monitoring.

3.0 Field Plan for Re-Entering, Mud Sampling, and Plugging

As shown in the AOR map provided in Attachment A-1, Souza No. 2 (AOR location No. 18) is located approximately 2.3 miles northwest of the PEC site. This property is not owned by PEC, so negotiations with the landowner for site access rights will be required and may not be successful without intervention by USEPA Region 9.

As shown in the well schematic in Attachment A-2 for Souza No. 2 (Figure No. C-16), this well was a dry hole drilled in 1985 to a depth of 6,587 feet below kelly busing level (KB). Surface casing was set to 700 feet KB and cemented to surface. No longstring casing was set in this well. Cement plugs were set in 1985 from 1,327 to 1,177 feet KB, 1,130 to 1,080 feet KB, 742 to 642 feet KB, and a surface plug from 60 feet KB to ground level. However, as mentioned above, no cement plug was set between the top of the injection zone and the base of the USDW (bottom depth of 2,435 KB), and relatively light drilling mud (9.2 pounds per gallon) was left in the borehole based on the open-hole log information. As discussed above in Section 2.2, if mud gel strength is included as part of the corrective action evaluation protocol, then the hydrostatic head of the fluid column at Souza No. 2 exceeds the calculated borehole entry pressure by at least 34.5 psi and this location passes the USEPA Region 6 protocol. However, if mud gel strength is removed as a consideration, then the mud column hydrostatic head is 13 psi less than the calculated borehole entry pressure at this location.

If corrective action at Souza No. 2 is needed, then we recommend an iterative approach where the mud sampling is attempted followed by plugging. This will address both Focus Points No. 2 and 3 listed above in Section 1.1. The general procedure for mud sampling and plugging would be as follows:

1. Submit final re-entry and plugging plan to USEPA Region 9 and the California Geologic Energy Management Division (CalGEM) for approval.
2. Locate well in the field and weld a casing flange on 9 5/8-inch surface casing to allow for attachment of blowout preventer (BOP).
3. Drill out cement surface plug and three deeper cement plugs using mud of sufficient properties to maintain well control.
4. Once bottom cement plug is cleared, attempt to sample drilling mud left in the borehole using a bailer, discrete interval sampling tool, or other method.
5. Following mud sampling attempt, drill out borehole to total depth of 6,587 feet KB and condition wellbore for open-hole geophysical logging.
6. Run optional logs consisting of (at a minimum): resistivity, spontaneous potential, natural gamma-ray, density, and caliper.
7. Following completion of logging, circulate heavy drilling mud to surface.
8. Spot a balanced cement plug from 6,252 to 5,900 feet KB across the top of the injection zone. Wait on cement.
9. Tag cement top and then spot a second balanced cement plug from 2,600 to 2,300 feet KB across the upper confining zone and lowermost USDW contact interval. Wait on cement.
10. Tag cement and then set remaining cement plugs to surface and cut off surface casing as required by CalGEM regulations and guidance.
11. Submit final reports as required by USEPA Region 9 and CalGEM.

The total estimated cost to complete this procedure is uncertain due to the following factors: 1) off-site access requirements; 2) ability to locate the well; 3) current casing and borehole conditions; 4) ability to avoid side-tracking out of the original borehole; 5) final requirements approved by USEPA Region 9 and CalGEM; and 6) weather conditions. However, based on similar projects completed elsewhere in the United States, the preliminary cost estimate to complete this procedure is between $250,000 and $1 Million.

4.0 Groundwater Monitoring

4.1 Groundwater Monitoring Well Installation

If corrective action at Souza No. 2 is deemed necessary, and if a field alternative to mud sampling and borehole/well plugging as outlined in Section 3.0 above is determined to be the better solution, then the installation of a monitoring well presents another option for correction action. However, since the property near Souza No. 2 is not owned by PEC (similar to the mud sampling and plugging option discussed in Section 3.0 above), negotiations with the landowner for site access rights will be required and may not be successful without intervention by USEPA Region 9.

USEPA Region 9 in its letter dated December 3, 2019 suggested the installation of a single, dual-completion monitoring well at each AOR location of concern, where the injection zone and base of the USDW are both exposed to the well. However, this completion design would require a complicated system of packers, test ports, and internal systems to enable pressure monitoring and water sampling access from both zones. This creates the likely potential that in the event of a packer, tubing, or casing leak, naturally higher TDS water from the injection zone could discharge upward into the USDW. In addition, this type of well design could prevent the completion of an annulus pressure test (APT) to document that the packer separating the injection zone from the USDW is maintaining a proper seal at all times. Without such a test, it would be uncertain if the USDW water sample collected from this well was truly reflecting conditions in the USDW, and whether a leak between the injection zone and USDW could be taking place. In addition, the cost of such a well could exceed $2 Million per well. Therefore, PEC recommends a simpler approach for groundwater monitoring.

Since the primary question at a potential problem AOR location is whether the USDW is being impacted by injection, and if a monitoring well is determined to be necessary, then PEC recommends the installation of one monitoring well completed at the base of the USDW near Souza No. 2 based on the following general procedure:

1. Submit final well drilling and completion plan to USEPA Region 9 and the Environmental Health Division of Fresno County for approval.
2. Drill to the base of usable quality water at a depth of approximately 1,000 to 1,200 feet KB using freshwater-based mud and log cuttings by a qualified geologist. Currently assume a 14 3/4-inch diameter borehole.
3. Once total depth of surface casing hole is reached, condition wellbore for open-hole geophysical logging.
4. Run logs consisting of (at a minimum): resistivity, spontaneous potential, natural gamma-ray, density, and caliper.
5. Condition wellbore and set carbon steel surface casing (currently assume 10 3/4-inch diameter) to the base of usable quality water at a depth of approximately 1,000 to 1,200 feet with cement to surface. Wait on cement
6. Weld a casing flange on surface casing to allow for attachment of BOP.
7. Drill out of surface casing using mud of sufficient properties to maintain well control (currently assume a 9 1/2-inch diameter borehole).
8. Drill to the estimated base of USDW at approximately 2,435 feet KB (corresponding to top of Kreyenhagen Shale) while logging cuttings by a qualified geologist. Condition wellbore for open-hole geophysical logging.
9. Run logs consisting of (at a minimum): resistivity, spontaneous potential, natural gamma-ray, density, and caliper.

10. Condition borehole for running carbon steel casing (currently assume 7-inch diameter) and set to approximately 2,435 feet KB with cement to surface, or plan for setting screen and gravel-pack or pre-packed screen such that the bottom 100 feet of the USDW is exposed to the well (or less depending on log results).
11. If screen and gravel-pack or pre-packed screen is used, then set 7-inch casing approximately 100 feet above screen depth (depending on log results) and cement to surface. Wait on cement.
12. Drill out 7-inch casing to total depth of 2,435 feet KB (currently assume a 6 1/4-inch borehole, depending on 7-inch casing weight).
13. Condition mud and run up to 125 feet of 5-inch x 3-inch pre-packed, stainless steel screen on hanger such that up to 25 feet of the screen overlaps into the 7-inch casing. If pre-packed screen is not used, then run nominal 4-inch stainless steel screen and gravel-pack material as recommended by screen supplier.
14. If 7-inch casing is cemented to total depth and no screen is installed, then wait on cement and perforate bottom 100 feet of casing (or less depending on log results).
15. Set locking surface completion such that well is secured and weather-proof.
16. Bail, swab, air-lift, or pump well until properly developed and collect samples for standard groundwater parameters, including (at a minimum): TDS, major anions, and major cations.
17. Check water level using an electric line or pressure transducer (depending on depth) after water level has stabilized. Note that the static water level could be above ground surface.
18. Submit final reports as required by USEPA Region 9, the Environmental Health Division of Fresno County, and the California Regional Water Quality Control Board (Region 5).
19. All well installation work will be done under the supervision of a water well driller registered in California.

The total estimated cost to complete this procedure is uncertain due to the following factors: 1) off-site access requirements; 2) final requirements approved by USEPA Region 9, Fresno County, and the California Regional Water Quality Control Board (Region 5); 3) well yield; and 4) weather conditions. However, based on similar projects completed elsewhere in the United States, the preliminary cost estimate to complete this procedure is between $500,000 and $1 Million. This cost does not include future access considerations, well maintenance, sampling, reporting, or plugging requirements.

4.2 Use of Publicly Available Data for Deep Water Wells Located in PEC AOR

As an alternative to the installation of a dedicated groundwater monitoring well to evaluate the conditions in the lowermost USDW near Souza No. 2, PEC suggests the option of researching the available public water level and water quality databases for the water wells located nearest to Souza No. 2 (see well locations shown on Figure B-1 of PEC's permit renewal application dated March 1, 2019). PEC proposes a phased program of further study and monitoring to assess the hydraulic isolation of the PEC injection zone from shallower potential and known sources of drinking water.

As discussed in the PEC permit renewal application (dated March 1, 2019), groundwater in the vicinity of the PEC site is and has been extensively used for agriculture for nearly 100 years. Groundwater near the PEC site is managed by the Westlands Water District. The drinking water aquifer is part of the Central Valley Aquifer system and consists of the shallow, unconfined to semi-confined Upper Tulare Aquifer and the deep, confined Lower Tulare Aquifer (see detailed hydrogeological cross-section provided in Attachment A-3). These aquifers are separated by a regional aquitard (the Corcoran Clay). As shown in Attachment A-3, the Lower Tulare Aquifer

extends from a depth of approximately 800 to 1,600 feet in the vicinity of the PEC site. There are numerous water supply wells completed in the Upper and Lower Tulare Aquifers within PEC's AOR (see Figure B-1 of PEC's permit renewal application dated March 1, 2019). Westlands Water District routinely collects samples for water quality analysis and measures water pressures in the Upper and Lower Tulare Aquifers in compliance with State-mandated groundwater management programs. These data are publicly available. Historical and future water quality and pressure data from these wells will likely provide the most relevant and comprehensive data set regarding the hydraulic isolation of shallow aquifers from the deeper Panoche Formation injection zone, which as stated previously is a naturally over-pressured formation that exists below a depth of approximately 7,200 feet in the PEC site vicinity (see again Attachment A-3). The Panoche Formation has also been the target zone of oil and gas well drilling in the local area since the 1950s and 1960s at the Cheney Ranch Field located in the northern portion of the PEC AOR, including Souza No. 2 (see AOR map provided in Attachment A-1).

PEC proposes to assess the hydraulic isolation of the Panoche Formation injection zone from the shallower drinking water aquifers by evaluating historical, current, and future groundwater quality in the lower portion of the drinking water aquifer (i.e., the Lower Tulare Aquifer). Note that monitoring water quality in the drinking water aquifer adjacent to oil and gas wells that are subjected to hydraulic stimulation procedures is an accepted monitoring practice in California under the requirements of the State Water Resource Control Board's Oil and Gas monitoring program.

The first phase of this proposed evaluation would consist of compiling the well construction details and available operational data of all water wells completed in the Lower Tulare Aquifer within the PEC AOR. Then, historical water quality and water pressure data would be plotted and analyzed. PEC anticipates that there are data available from as far back as the 1960s that can be used to assess whether the drilling of oil and gas wells into the Panoche Formation may have impacted the hydraulic separation between the Panoche Formation and the overlying Tulare Formation aquifers. Particular attention would be focused on possible changes in water quality and water pressures in the Lower Tulare Aquifer within the limits of the PEC AOR that could correspond to the beginning of fluid injection into the Panoche Formation by PEC in 2010. Based on this evaluation, a program of data analysis and annual reporting to USEPA Region 9 could be established covering water quality and water pressure data collected by Westlands Water District from the Lower Tulare Aquifer within the limits of the PEC AOR. This data set could be supplemented as needed by sampling and data collection completed by PEC. Then, if any unusual changes are found in the data that might indicate injection well-related impacts to the USDW near Souza No. 2, the proposed monitoring well option summarized above in Section 4.1 could be a course of action taken to determine if actual injection well-related impacts to the USDW are taking place.

Attachment A-1

Silver Creek 73X
Silver Creek 64
Caine 1
8 Silver Creek 77X
19 Cheney Ranch 81X-30
3 Cheney Ranch 3
9 Silver Creek 72X
15 Silver Creek 22X
Silver Creek 14X
10
1 Cheney Ranch 1
16 Cheney Ranch 15X
Silver Creek 27X
11 Cheney Ranch 2
2
Souza 2
18
Silver Creek 54X
12
13 Silver Creek 32X
Roberts 1
6
20 Blue Agave 1
5 Souza 1-36
4 England 1-31
17 Souza 1
14 Silver Creek 18
Chaney Ranch
Russell Giffen 1
7
2.75-Miles
Gramis Ranch
1-Mile
2-Miles
Sudden 1
Queen 1
C.L.G. 1
34.8 psi (2029)
34.8 psi (2018)

LEGEND

- Injection Well
- Dry Hole (Plugged and Abandoned)
- Plugged former Hydrocarbon Producer Well
- 1 Area of Review Identification Number

N

0 3500 7000

HALEY ALDRICH

Revised Area of Review Based on 34.8 psi Calculated Gel Strength at AOR Penetration No. 5 Using 20 lbs/100 sq. ft. in Gel Strength Calculation

Revised by MGE 1-11-20

Attachment A-2

Figure C-1 Revised

Map ID No.: 1

Operator: Jergins Oil Company

Lease: Cheney Ranch

Well Number: 1 *(1939 spud)*

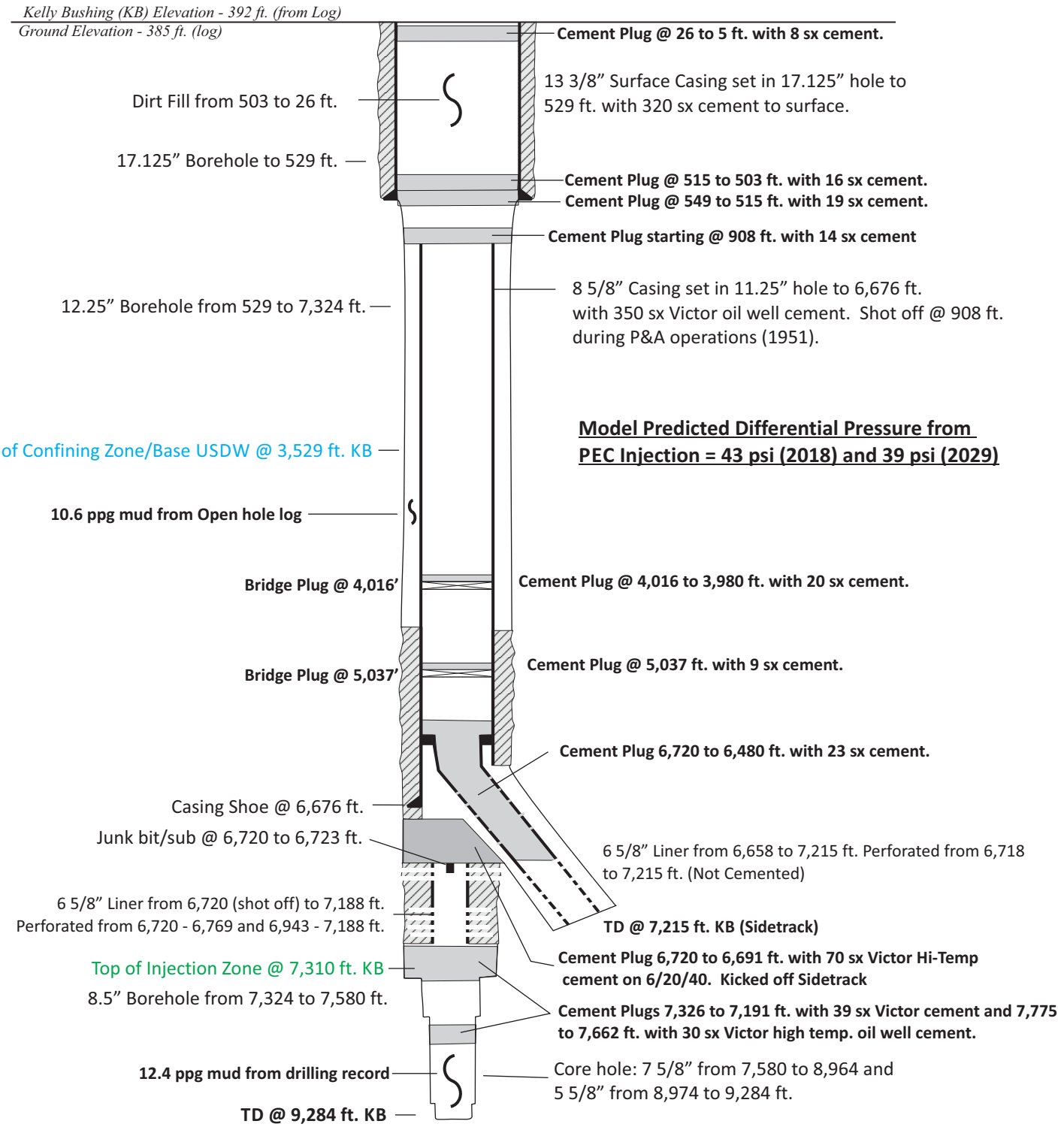
API Number 04-019-00190

Type of Well: Hydrocarbon Producer

Well Status: Plugged and Abandoned (1952)

Records: DOGGR Forms: OG100, OG101, OG103, OG105, OG108, OG109B, OG109D, OG111, OG123, OG,136, OG159

Distance from nearest injection well: 11,750 ft. NNE



SYNOPSIS: The model predicted pressure differential at this location is 43 psi at the end of 2018. This is a sidetracked well with surface casing, longstring casing and a sidetrack liner. There are several plugs (cement and mechanical bridge plugs) between the top of the injection zone and the base of the USDW. Additionally, based on well records, none of the perforated intervals in the original hole or sidetrack liner section reached the depth of the top of the injection zone. This well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-2 Revised

Map ID No.: 2

Operator: Jergins Oil Company

Lease: Cheney Ranch

Well Number: 2 (1940 spud)

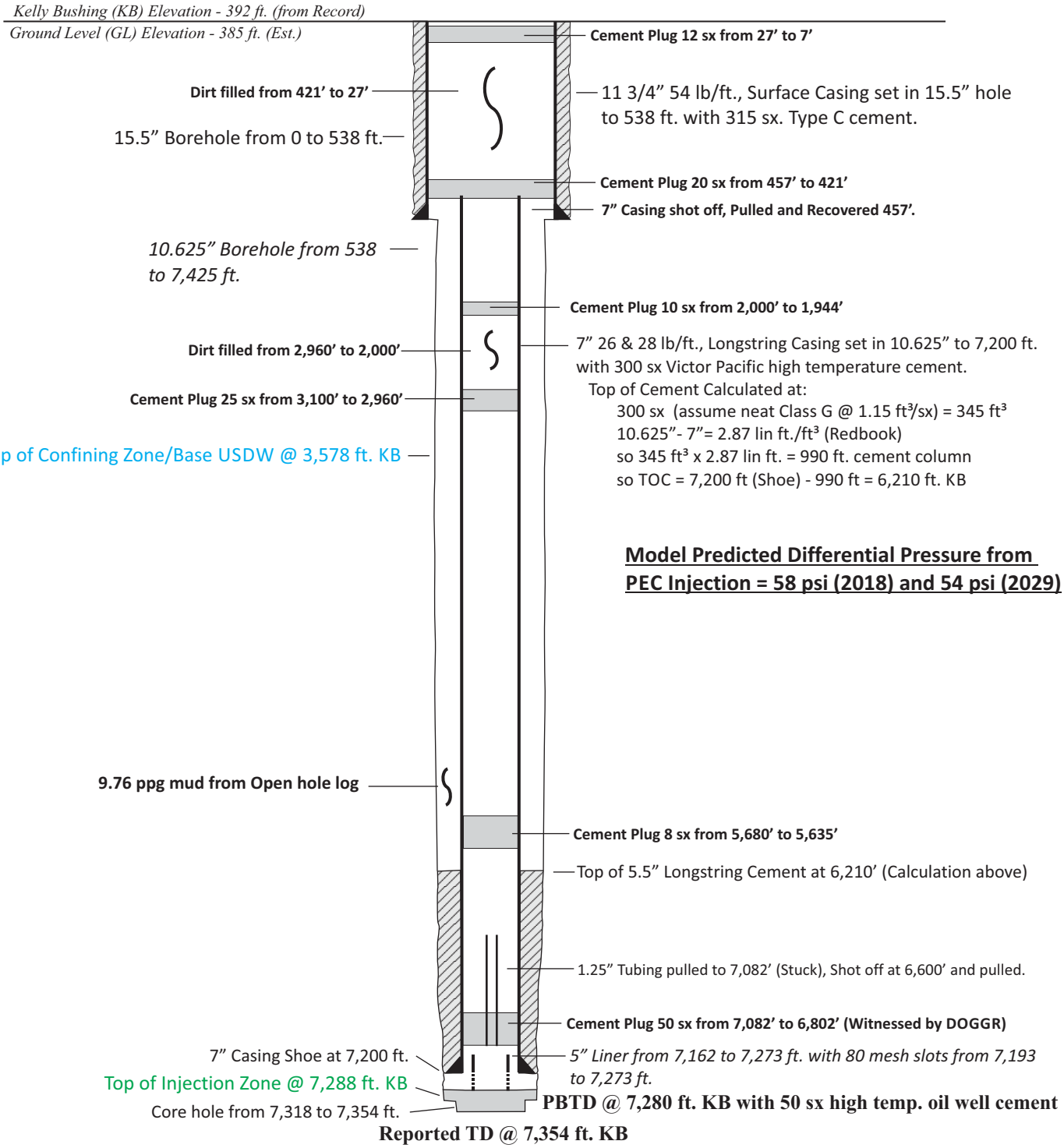
API Number 04-019-00191

Type of Well: Hydrocarbon Producer

Well Status: Plugged and Abandoned (1964)

Records: Doggr Forms: 100, 101,103, 108, 109B&D, 111, 136A, 156, 159

Distance from nearest injection well: 9,550 ft. NNE



SYNOPSIS: The model predicted pressure differential at this location is 58 psi at the end of 2018. This well was plugged back with cement to a level above the PEC injection zone. This well has a 7-inch steel casing and based on the volume of cement pumped, has a cement sheath that extends up to approximately 6,210 ft KB based on calculation, which is well above the top of the injection zone. Additionally, the longstring casing conains two cement plugs between the top of the injection zone and the base of the lowermost USDW. This well is adequately completed and plugged to be protective of the USDW and no corrective action is necessary.

Figure C-3 Revised

Map ID No.: 4

Operator: L. M. Lockhart

Lease: England

Well Number: 1-31 *(1950 spud)*

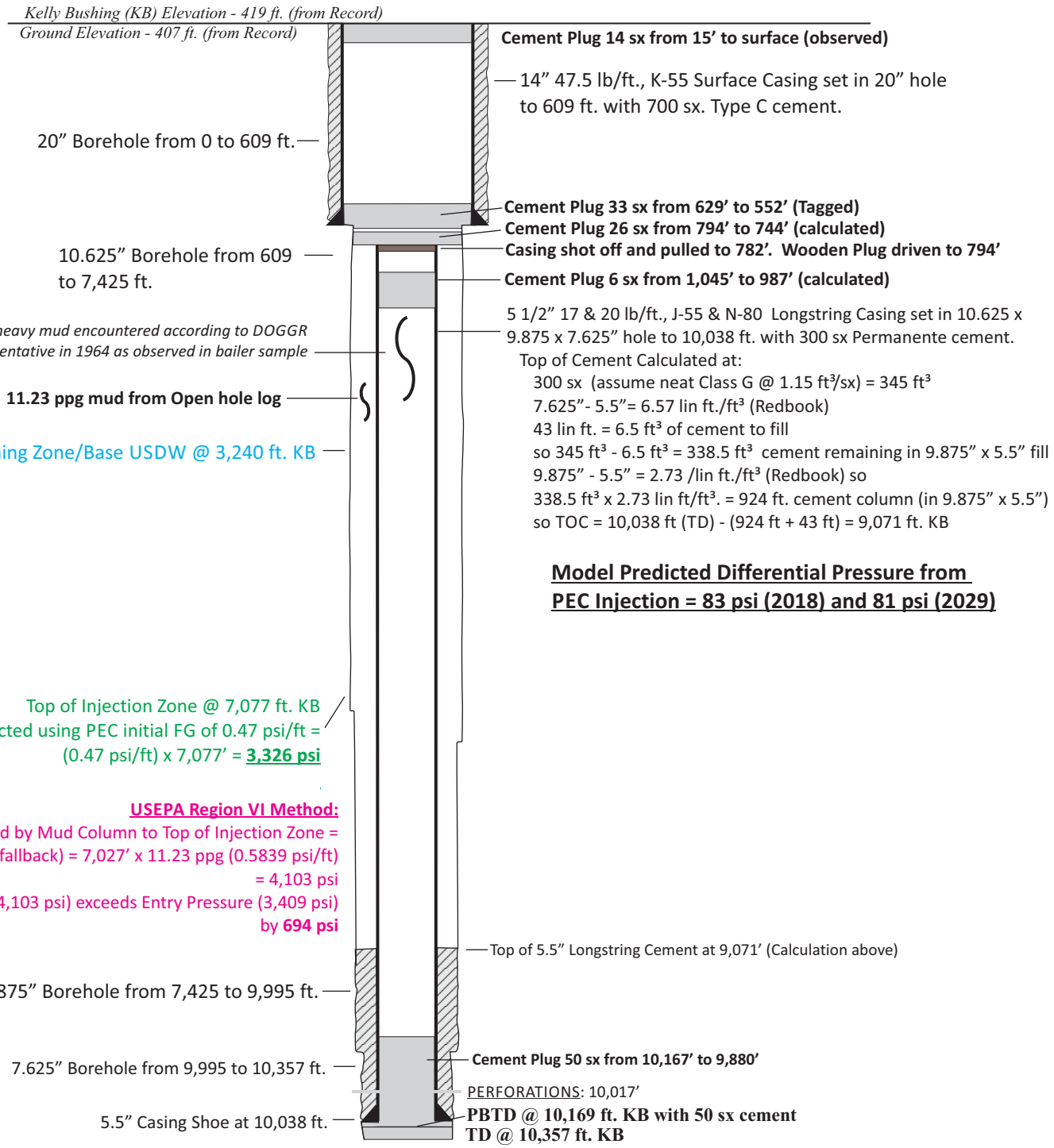
API Number 04-019-00193

Type of Well: Hydrocarbon Producer

Well Status: Plugged and Abandoned *(1964)*

Records: Doggr Forms: 100, 103, 105, 109, 111, 123, 159, 165

Distance from nearest injection well: 6,350 ft. NNW



SYNOPSIS: The model predicted pressure differential at this location is 83 psi at the end of 2018. This wellbore has 5.5-inch steel casing from 10,038 to 782 ft. Based on the volume of cement pumped, the cement sheath extends up to approximately 9,071 ft KB based on calculation. There are no plugs between the injection interval and the base of the USDW in the annular space . The perforations at 10,017 are plugged with cement. The potential exist for pressure to enter the annulus behind the casing. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (4,103 psi) exceeds the entry pressure (3,326 psi + 83 psi) by 694 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-4 Revised

Map ID No.: 5

Operator: L. M. Lockhart

Lease: Souza

Well Number: 1-36 *(1951 spud)*

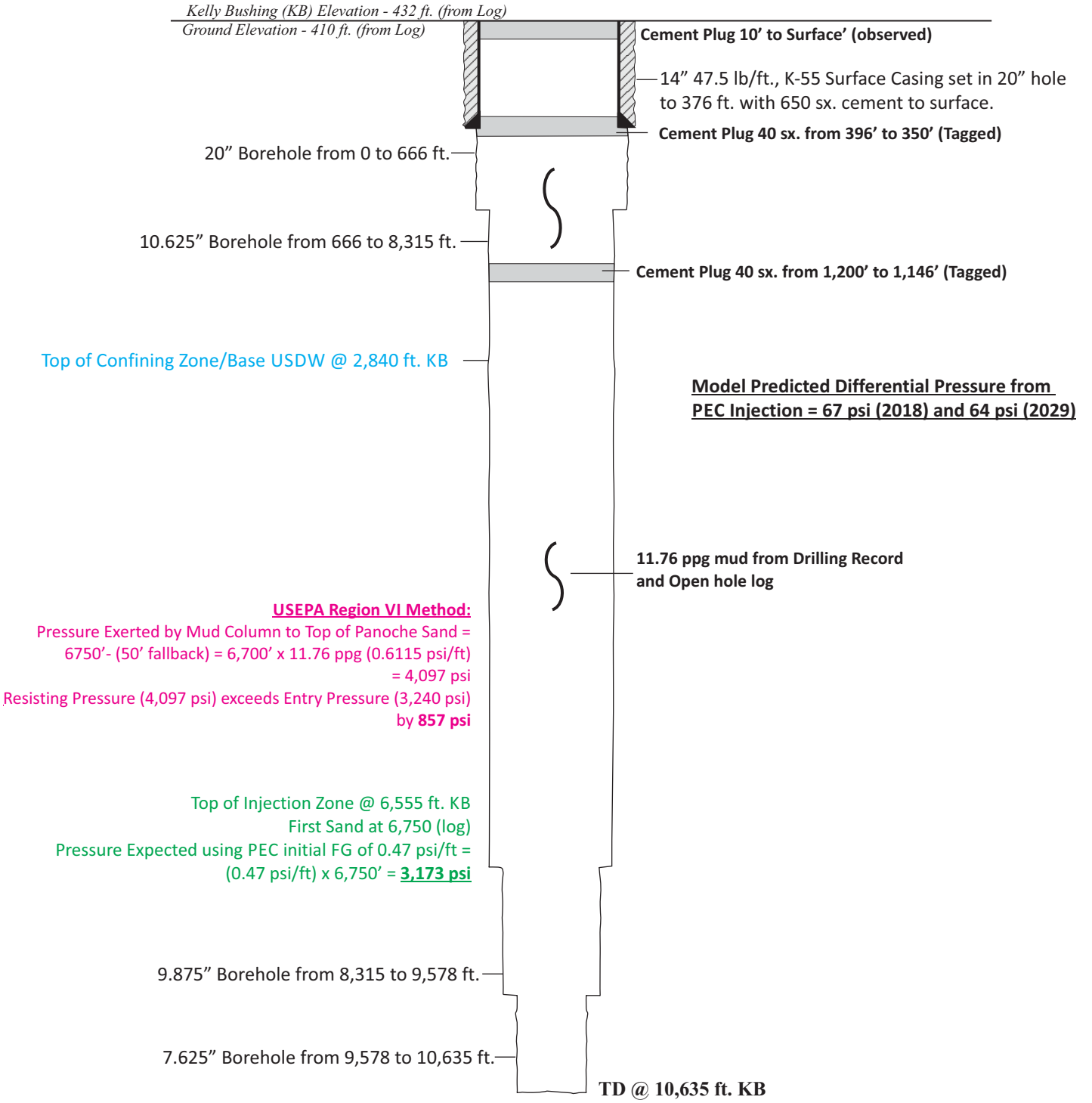
API Number 04-019-06032

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1951)

Records: DOGGR Forms: 100, 101, 103, 105, 108, 111, 159

Distance from nearest injection well: 8,400 ft. NW



SYNOPSIS: The model predicted pressure differential at this location is 67 psi at the end of 2018. This penetration is a dry hole and has only surface casing set. There are no plugs between the top of the injection zone first sand in the Panoche Fm. at 6,750 ft. KB (log) and the base of the lowermost USDW at 2,840 ft. KB. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (4,097 psi) exceeds the entry pressure (3,173 psi + 67 psi) by 857 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-5 Revised

Map ID No.: 6

Operator: Atlantic Richfield Co.

Lease: Roberts

Well Number: 1 *(12/22/63 spud)*

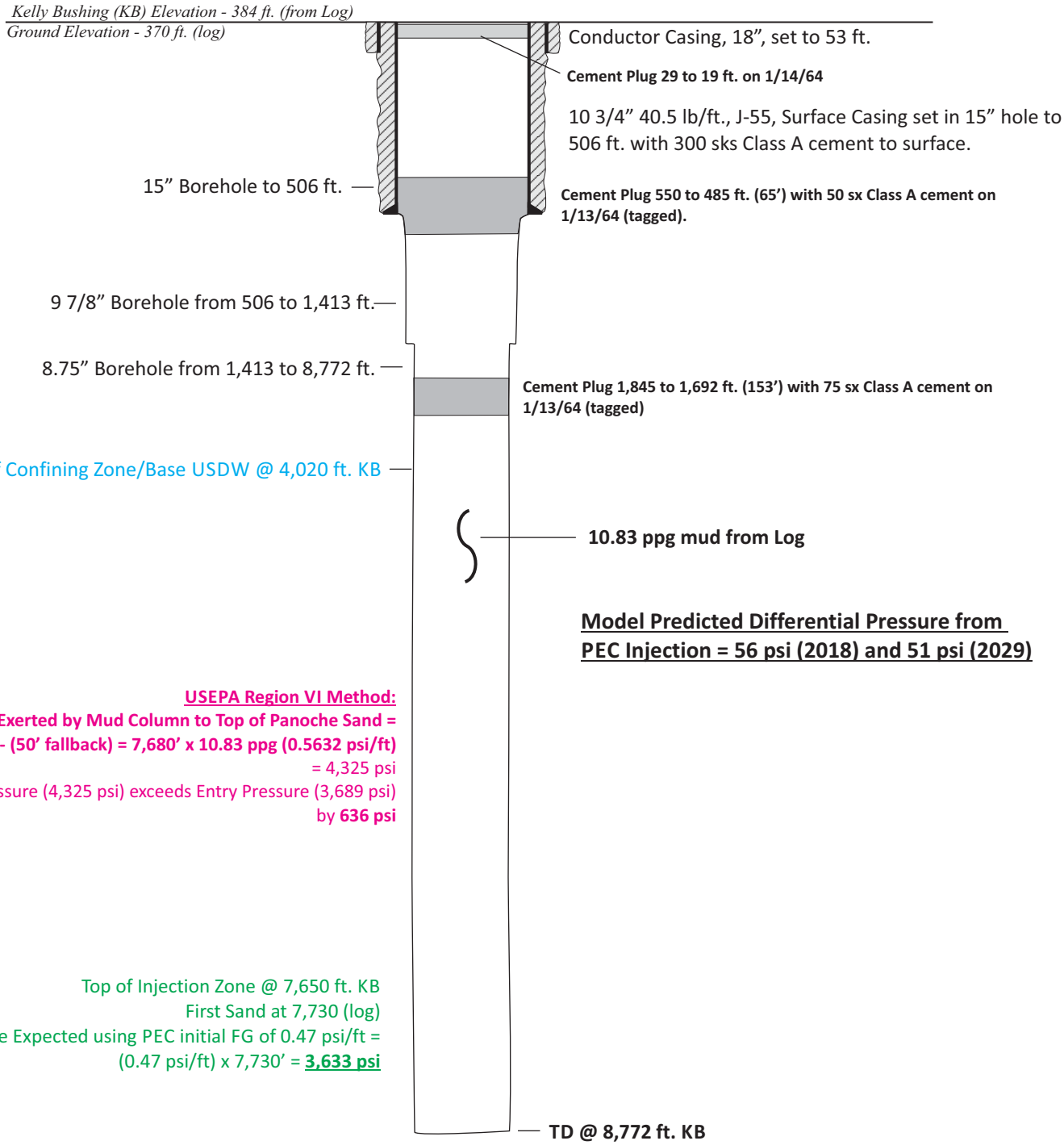
API Number 04-019-06039

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1964)

Records: DOGGR Forms: 105, 108, 109, 111, 136A, 159

Distance from nearest injection well: 9,450 ft. NE



SYNOPSIS: The model predicted pressure differential at this location is 56 psi at the end of 2018. This is a dry hole and no casing was set beyond the surface casing. There are no plugs between the base of the USDW and the first sand in the correlative injection zone where pressure could enter the well. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (4,325 psi) exceeds the entry pressure (3,633 psi + 56 psi) by 636 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure of the mud column , this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-17 (New)

Map ID No.: 7

Operator: The Ohio Oil Co.

Lease: Russell Giffen

Well Number: 1 *(1955 spud)*

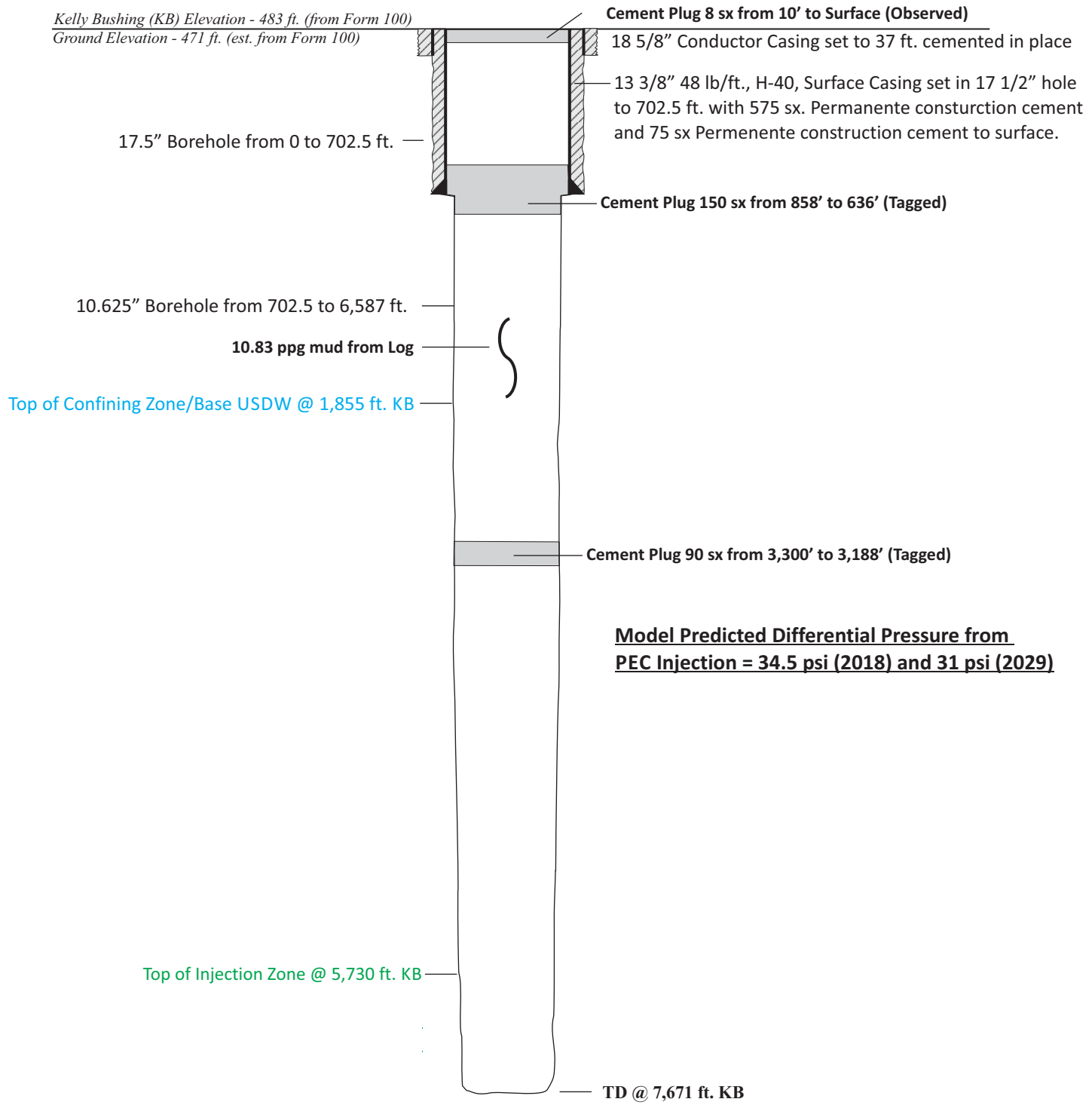
API Number 04-019-06071

Type of Well: Dry Hole

Well Status: Plugged and Abandoned *(1955)*

Records: Doggr Forms: 100, 105, 108, 111, 484, 2509, 165, 123, 159

Distance from nearest injection well: 13,350 West



SYNOPSIS: The model predicted pressure differential at this location is 34.5 psi at the end of 2018. This is a dry hole and no casing was set beyond the surface casing. A cement plug is located from 3,300 to 3,188 ft. as confirmed by tag. This well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-14 (New)

Map ID No.: 9

Operator: E. A. Bender

Lease: Silver Creek

Well Number: 72X *(1972 spud)*

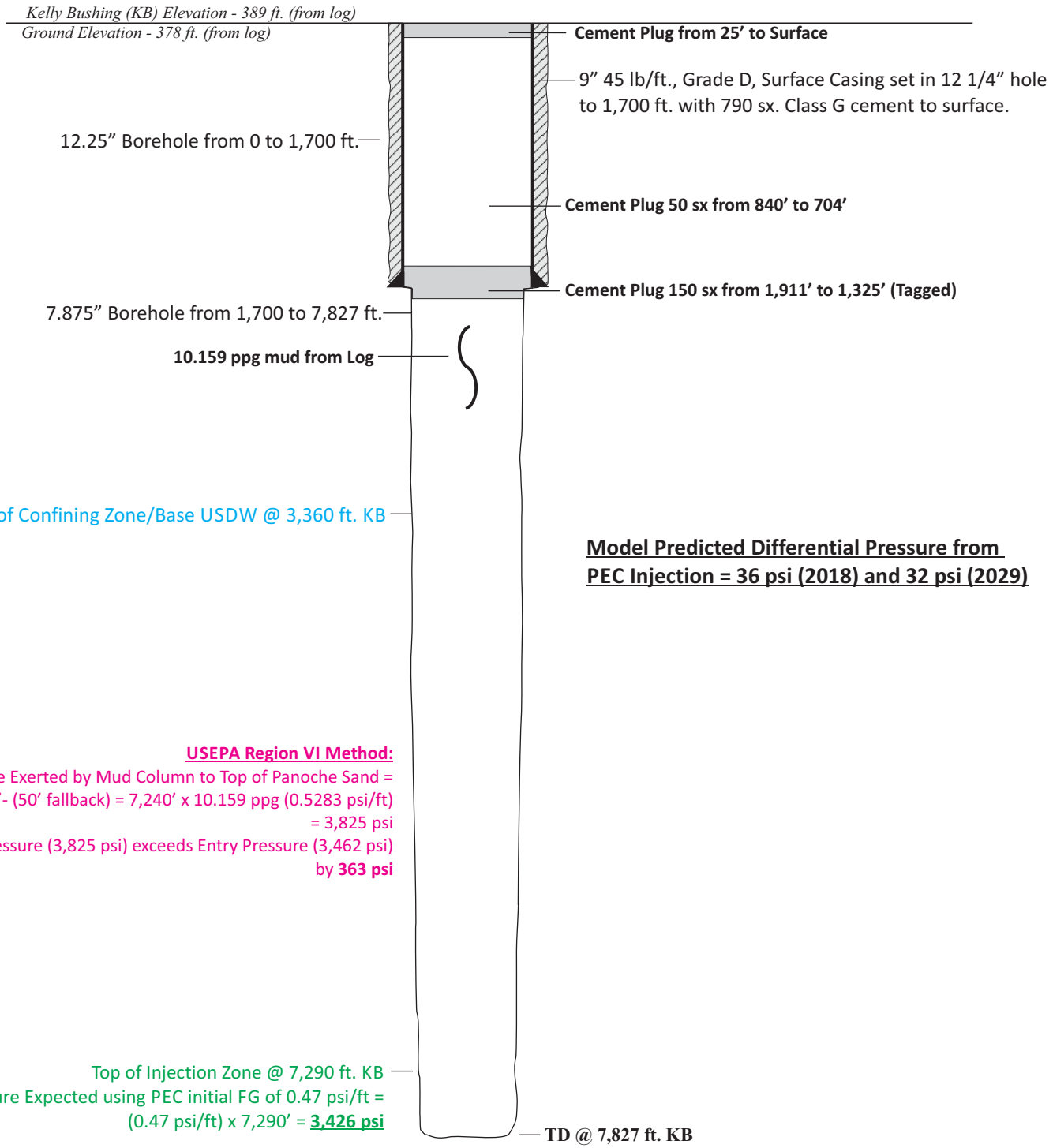
API Number 04-019-20710

Type of Well: Dry Hole

Well Status: Plugged and Abandoned *(1972 & 1973)*

Records: Doggr Forms: 100, 103, 105, 108, 109, 111, 159, 36, 38

Distance from nearest injection well: 13,550 North



Model Predicted Differential Pressure from PEC Injection = 36 psi (2018) and 32 psi (2029)

USEPA Region VI Method:
Pressure Exerted by Mud Column to Top of Panoche Sand = 7,290'- (50' fallback) = 7,240' x 10.159 ppg (0.5283 psi/ft) = 3,825 psi
Resisting Pressure (3,825 psi) exceeds Entry Pressure (3,462 psi) by **363 psi**

SYNOPSIS: The model predicted pressure differential at this location is 36 psi at the end of 2018. This penetration is a dry hole and no casing was set beyond the surface casing. There are no plugs between the base of the USDW and the first sand in the correlative injection zone . Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (3,825 psi) exceeds the entry pressure (3,426 psi + 36 psi) by 363 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-13 (New)

Map ID No.: 10

Operator: Cencal Drilling, Inc.

Lease: Silver Creek

Well Number: 14X *(1972 spud)*

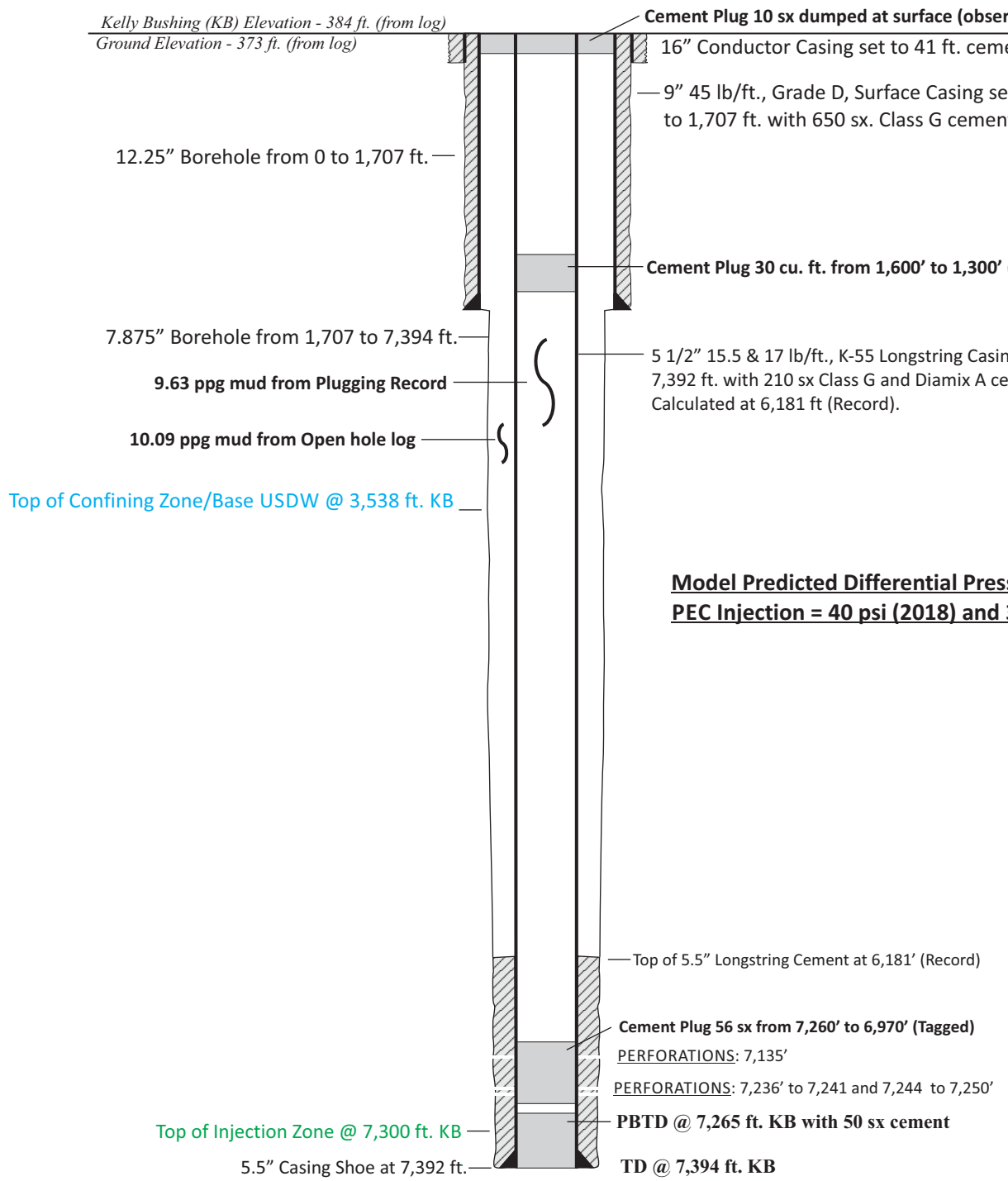
API Number 04-019-20712

Type of Well: Hydrocarbon Producer

Well Status: Plugged and Abandoned *(1994)*

Records: Doggr Forms: 100, 103, 105, 107, 109, 111, 123, 159, 165, OGD10, OG108, OG111

Distance from nearest injection well: 12,700 North



Model Predicted Differential Pressure from PEC Injection = 40 psi (2018) and 36 psi (2029)

SYNOPSIS: The model predicted pressure differential at this location is 40 psi at the end of 2018. This wellbore has 5.5-inch steel longstring casing set to a depth of 7,394 ft. that is cemented to 6,181 ft. Additionally, the well was plugged back with cement to 7,265 ft. Based on geological mapping, the top of the Panoche Fm. occurs at a depth of 7,300 ft. KB. As such, the cement sheath and plug back plug extend above the top of the injection zone. Additionally, the casing is plugged with a cement plug that extends well above the top of the injection zone. This well is completed and plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-6 Revised

Map ID No.: 11

Operator: E.A. Bender

Lease: Silver Creek

Well Number: 27X *(12/7/72 spud)*

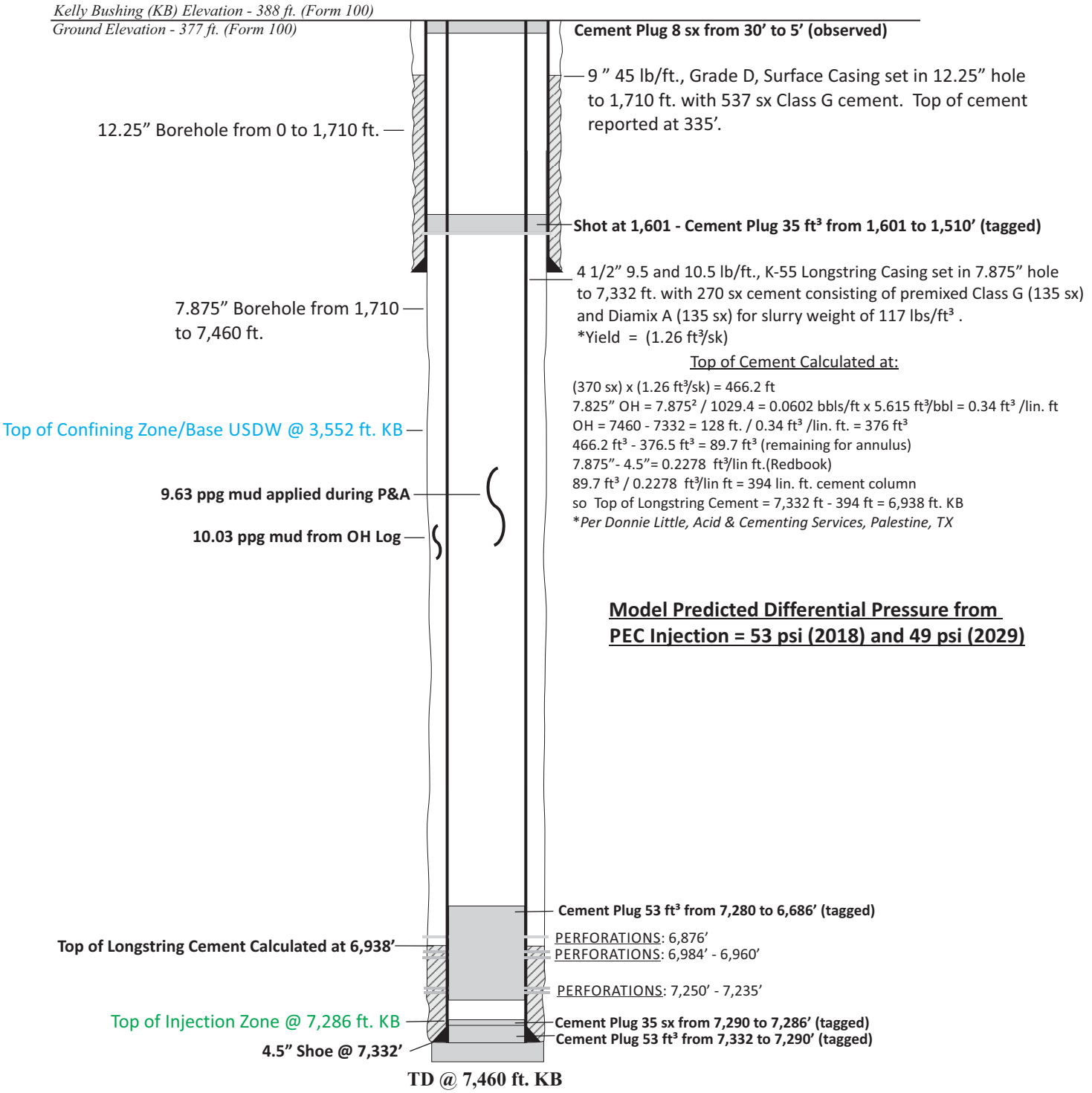
API Number 04-019-21924

Type of Well: Hydrocarbon Producer

Well Status: Plugged and Abandoned (1994)

Records: Doggr Forms: OGD10, OG100, OG103, OG105, OG107 OG108, OG109, OG111, OG159

Distance from nearest injection well: 10,000 ft. NNE



SYNOPSIS: The model predicted pressure differential at this location is 53 psi at the end of 2018. This well was plugged back to the top of the injection zone. The well has a 4.5-inch steel casing and based on the volume of cement pumped, has a cement sheath that extends up above the top of the injection zone. A cement plug is located in the casing extending above the top of the injection zone and covering all perforations in the well. This well is completed and plugged in a manner to be protective of the USDW and no corrective action is necessary.

Figure C-7 Revised

Map ID No.: 12

Operator: E. A. Bender

Lease: Silver Creek

Well Number: 54X *(1973 spud)*

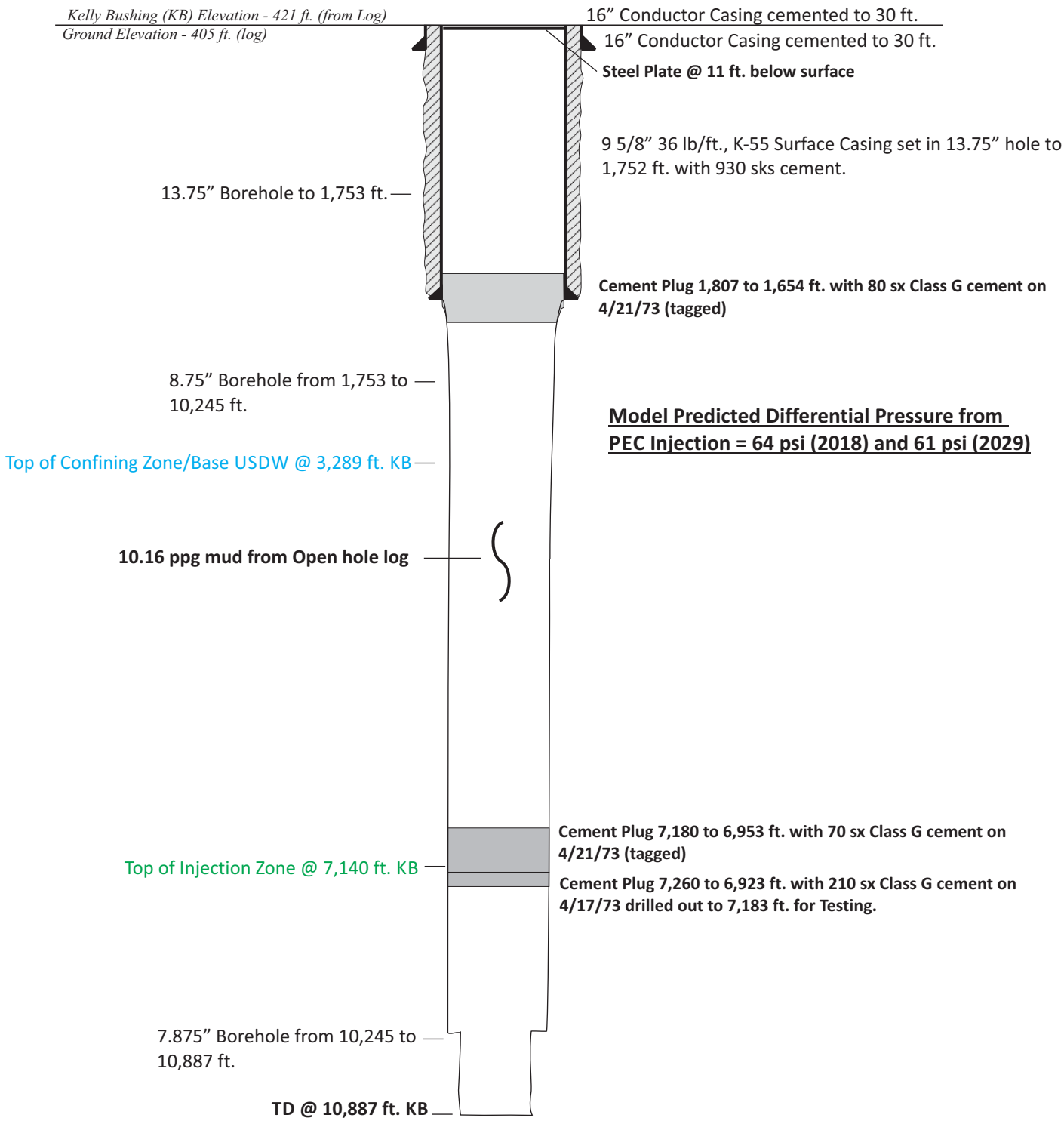
API Number 04-019-20758

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1973)

Records: DOGGR Forms: 100, 103, 105, 107, 108, 109, 111, 157, 159

Distance from nearest injection well: 8,050 ft. NNW



SYNOPSIS: The model predicted pressure differential at this location is 64 psi at the end of 2018. The wellbore contains no casing from the surface casing shoe to total depth. However, a cement plug is present between the top of the injection zone and the base of the USDW from 7,260 to 6,953 ft. isolating the the Panoche Fm. from the USDW. This well is plugged in a manner to be protective of the USDW and no corrective action is necessary.

Figure C-8 Revised

Map ID No.: 13

Operator: E. A. Bender

Lease: Silver Creek

Well Number: 32X *(1973 spud)*

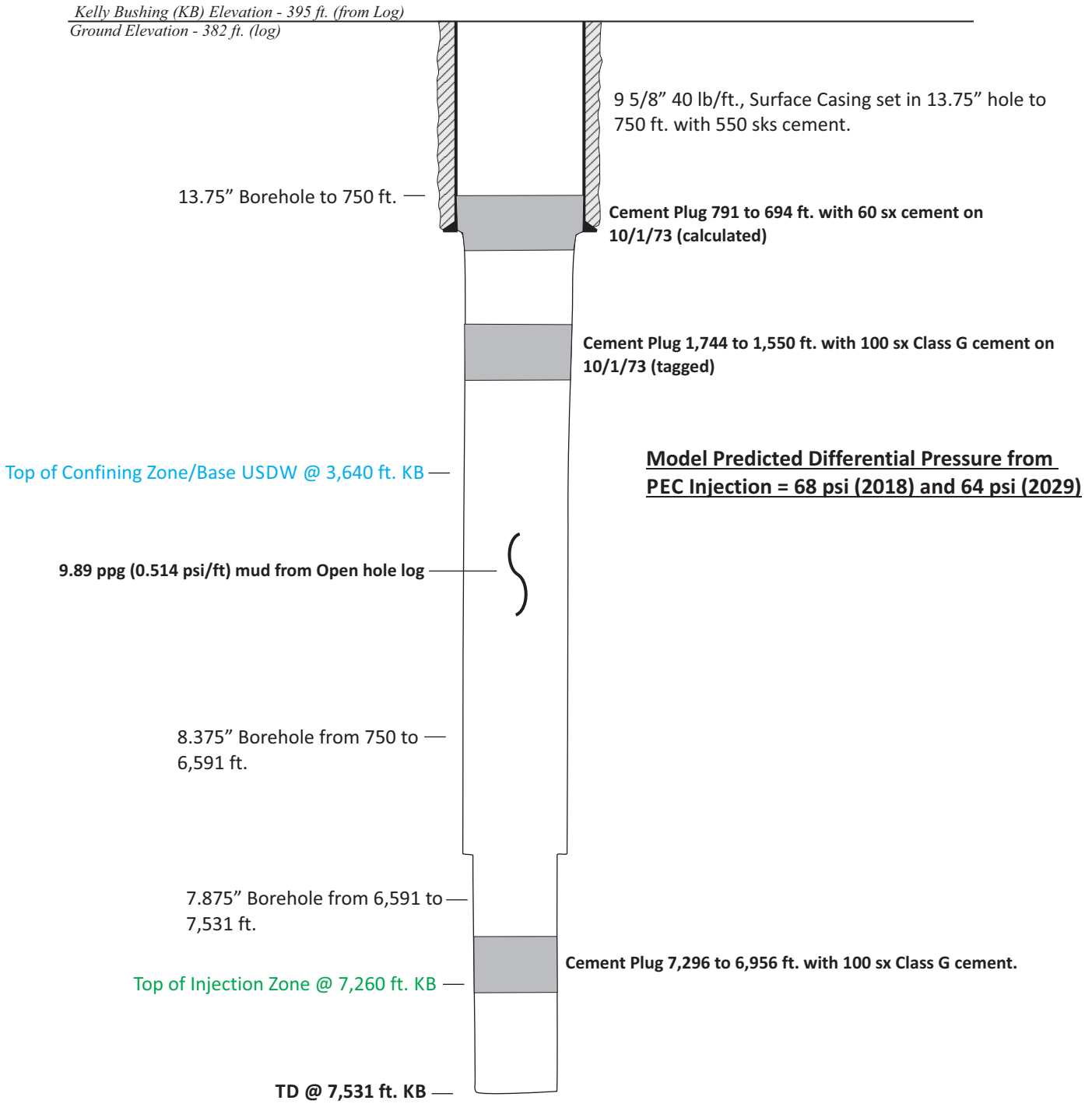
API Number 04-019-20776

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1973)

Records: DOGGR Forms: 100, 103, 105, 108, 109, 111

Distance from nearest injection well: 8,000 ft. NNE



SYNOPSIS: The model predicted pressure differential at this location is 68 psi at the end of 2018. The wellbore contains no casing from the surface casing shoe to total depth. However, a cement plug is present between the top of the injection zone and the base of the USDW from 7,296 to 6,956 ft. isolating the Panoche Fm. from the USDW. This well is adequately plugged to be protective of the USDW and no corrective action is necessary.

Figure C-9 (Revised)

Map ID No.: 14

Operator: E. A. Bender

Lease: Silver Creek

Well Number: 18 *(1974 spud)*

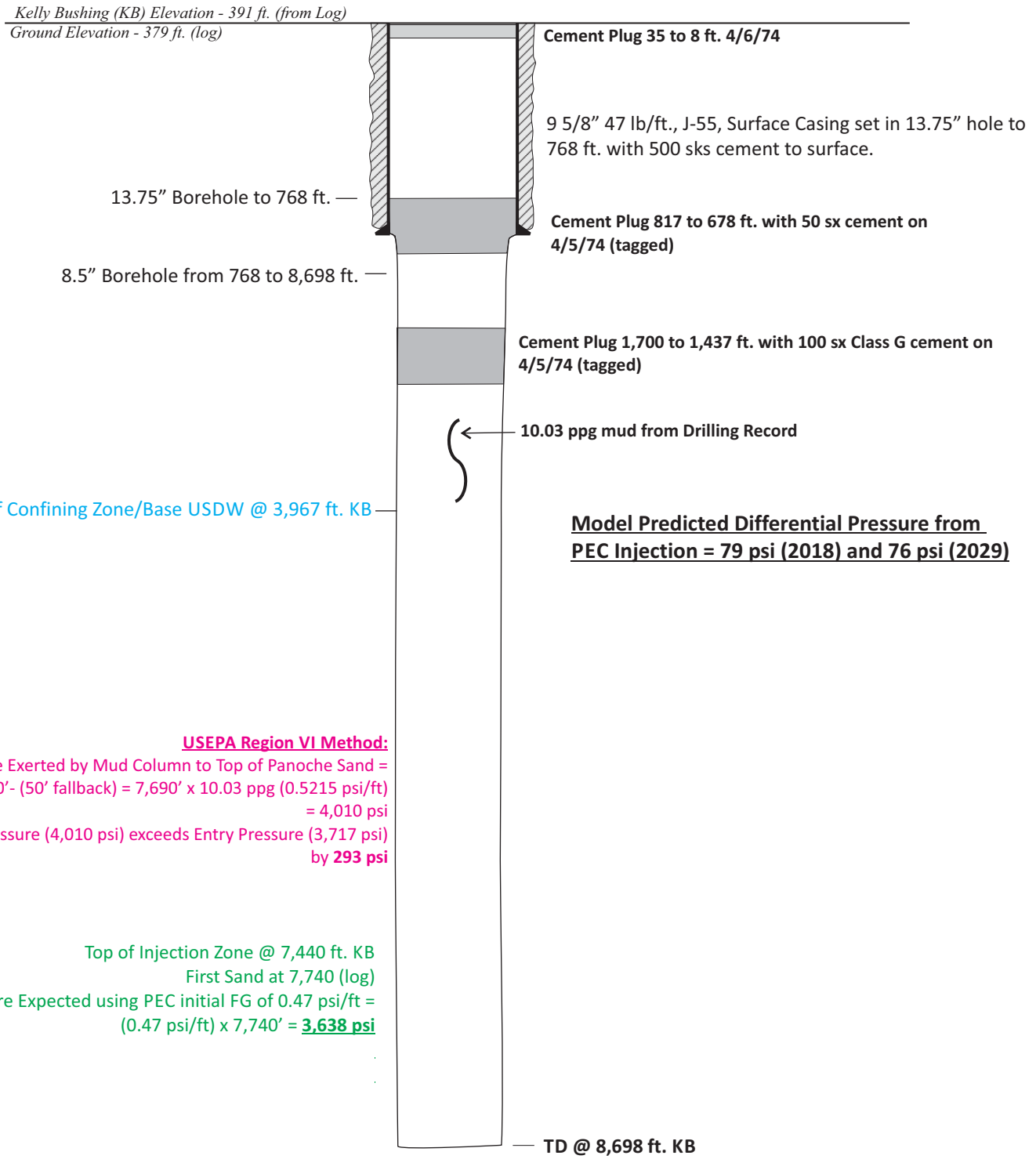
API Number 04-019-20804

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1974)

Records: DOGGR Forms: 100, 103, 105, 108, 109, 111, 136A, 159

Distance from nearest injection well: 6,350 ft. NE



SYNOPSIS: The model predicted pressure differential at this location is 79 psi at the end of 2018. This penetration is a dry hole and has only surface casing set. There are no plugs between the top of the injection zone first sand in the Panoche Fm. at 7,7400 ft. KB (log) and the base of the lowermost USDW at 3,967 ft. KB. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (4,010 psi) exceeds the entry pressure (3,638 psi + 79 psi) by 293 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-15 (New)

Map ID No.: 15

Operator: E. A. Bender

Lease: Silver Creek

Well Number: 22X *(1974 spud)*

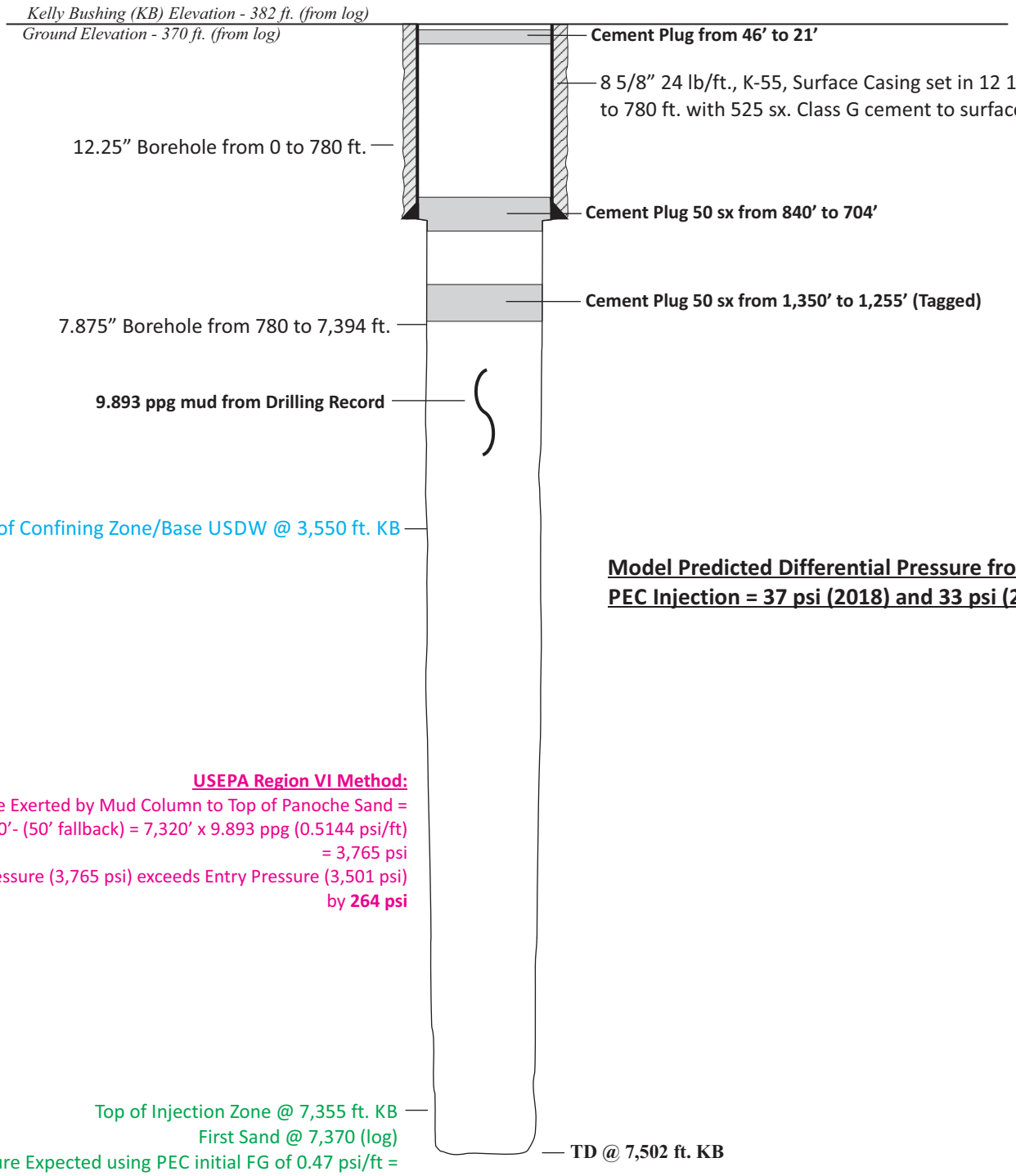
API Number 04-019-20830

Type of Well: Dry Hole

Well Status: Plugged and Abandoned *(1974)*

Records: Doggr Forms: 100, 103, 105, 109, 111, 111x, 159, 165, OG108, OG111, 38

Distance from nearest injection well: 13,200 North



SYNOPSIS: The model predicted pressure differential at this location is 37 psi at the end of 2018. This is a dry hole and no casing was set beyond the surface casing. There are no plugs between the base of the USDW and the first sand in the correlative injection zone. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (3,765 psi) exceeds the entry pressure (3,464 psi + 37 psi) by 264 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-10 Revised

Map ID No.: 16

Type of Well: Hydrocarbon Producer

Operator: Cencal Oil Company

Well Status: Plugged and Abandoned (1994)

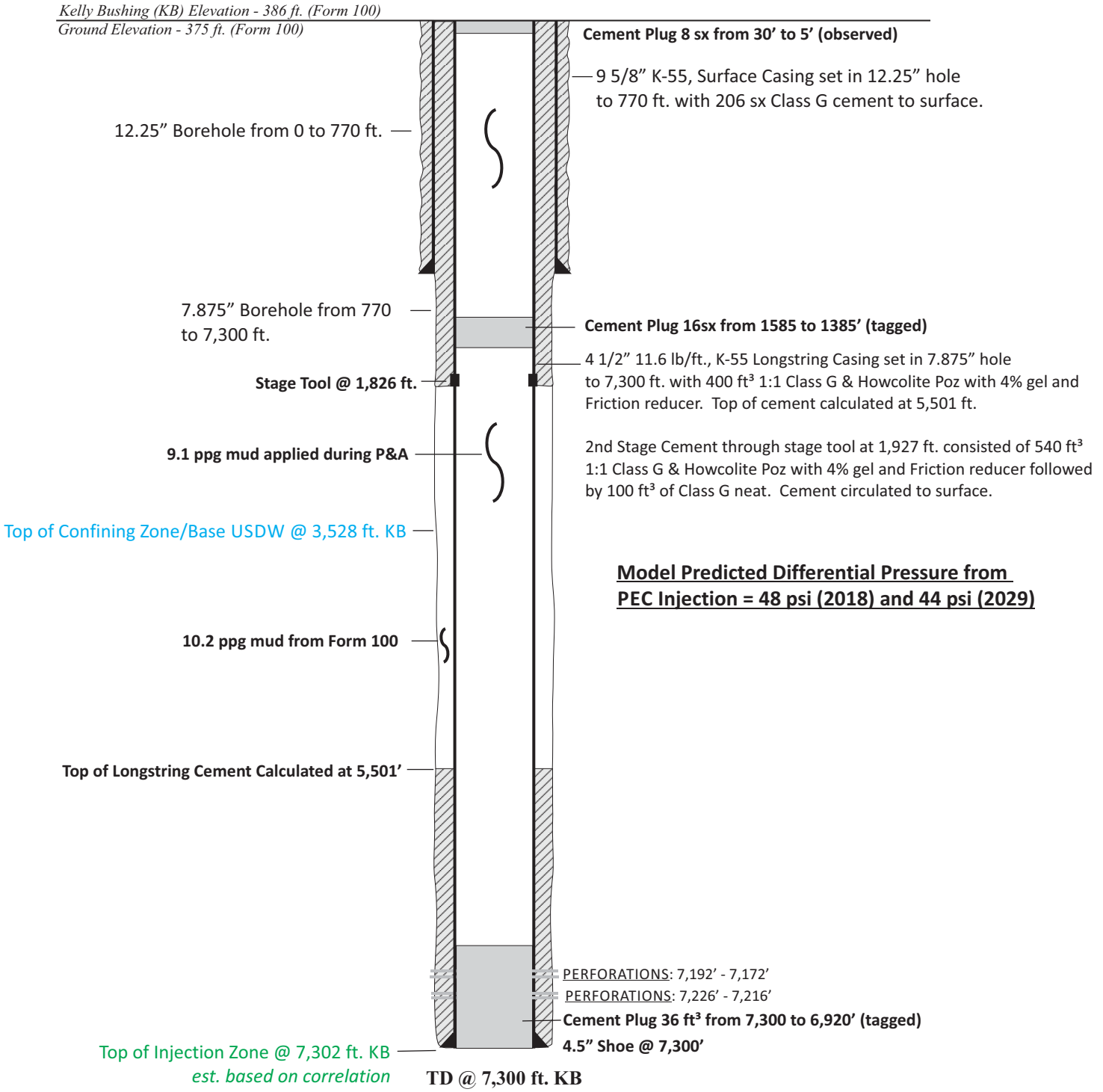
Lease: Cheney Ranch

Records: Doggr Forms: OGD10, OG100, OG105, OG108, OG109, OG111, OG123, OG136, OG159, OG170

Well Number: 15X *(7/12/81 spud)*

Distance from nearest injection well: 10,950 ft. NNE

API Number 04-019-21446



SYNOPSIS: The model predicted pressure differential at this location is 48 psi at the end of 2018. This wellbore has steel casing and based on the volume of cement pumped, has a cement sheath that extends up above the top of the injection zone. A cement plug is emplaced in the casing extending above the top of the injection zone and covering all perforations in the well. This well is completed and plugged in a manner to be protective of the USDW and no corrective action is necessary.

Figure C-11 Revised

Map ID No.: 17

Operator: American Hunter Exploration Ltd.

Lease: Souza

Well Number: 1 *(1983 spud)*

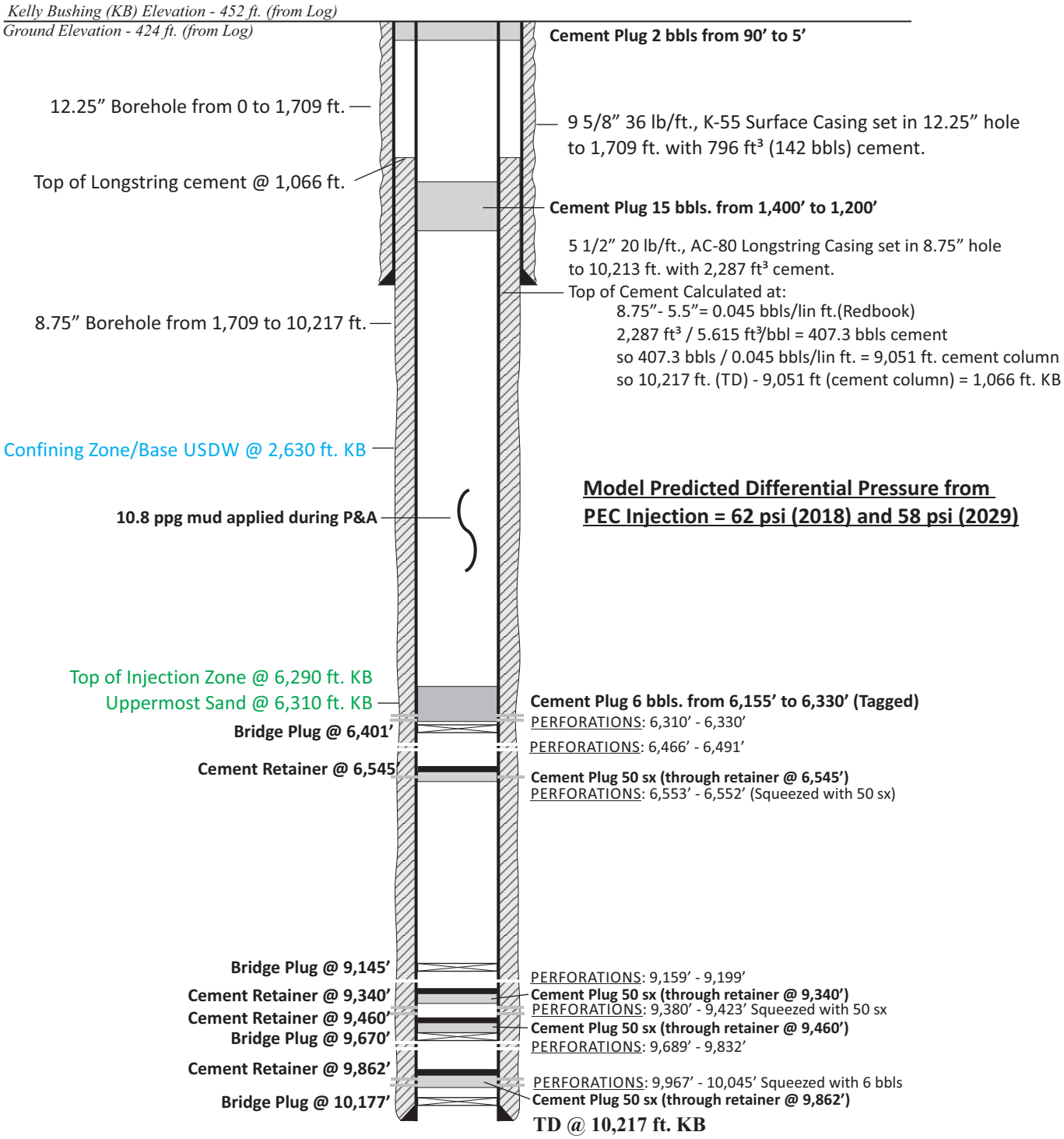
API Number 04-019-21924

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (1984)

Records: Doggr Forms: OGD10, OG100, OG105, OG109, OG111, OG136, OG159

Distance from nearest injection well: 8,800 ft. NW



SYNOPSIS: The model predicted pressure differential at this location is 62 psi at the end of 2018. This wellbore has steel casing and based on the volume of cement pumped, has a cement sheath that extends up into the surface casing. The well has four mechanical bridge plugs and four cement plugs isolating the lower wellbore. The cement plug above the uppermost perforations in the Panoche Formation isolates the PEC injection zone from the base of the lowermost USDW. Additionally, based on available records, 10.8 ppg mud was emplaced in the casing during plugging and abandonment on 6/20/84. This well is completed and plugged in a manner to be protective of the USDW and no corrective action is necessary.

Figure C-16 (New)

Map ID No.: 18

Operator: American Hunter Exploration, LTD.

Lease: Souza

Well Number: 2 *(1985 spud)*

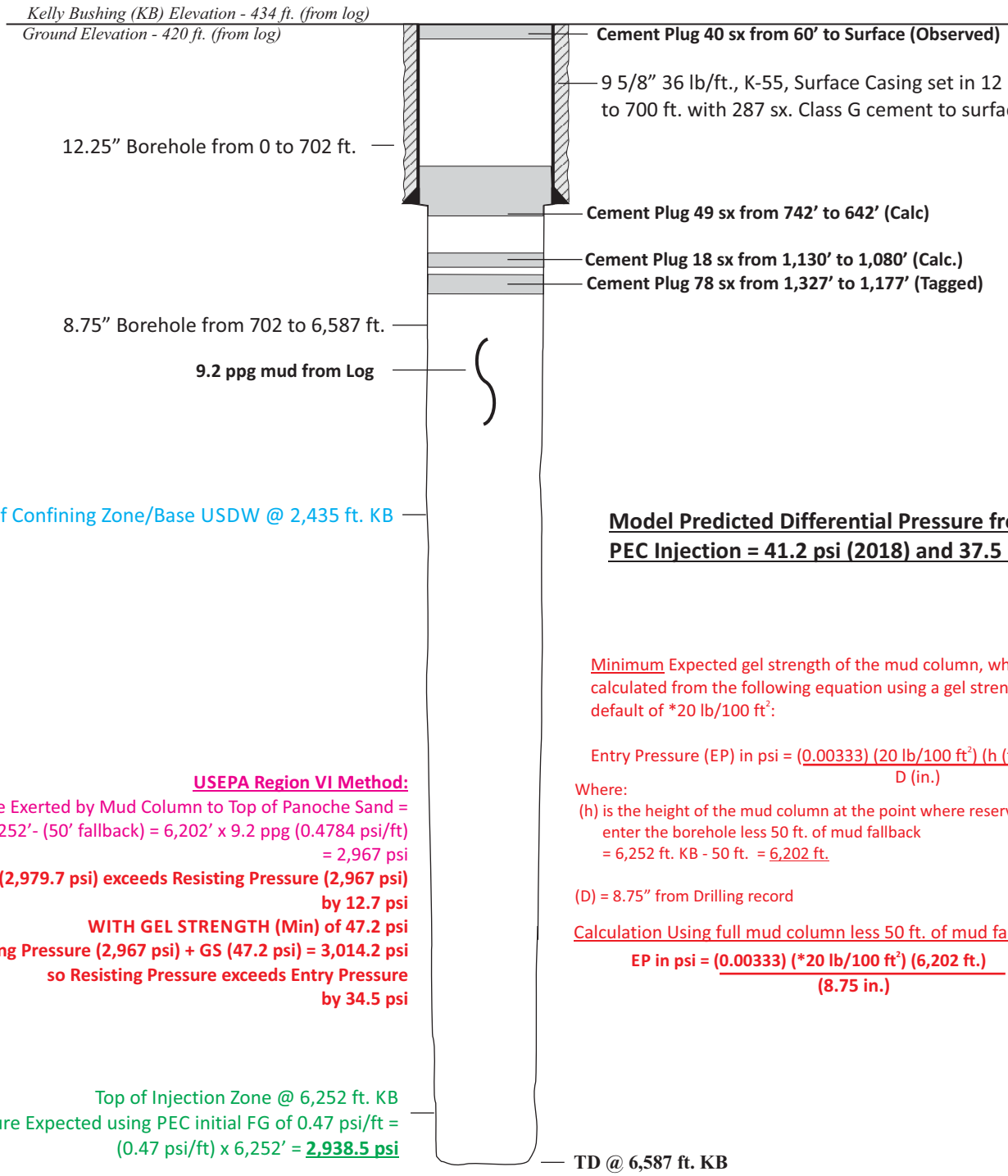
API Number 04-019-22412

Type of Well: Dry Hole

Well Status: Plugged and Abandoned *(1985)*

Records: Doggr Forms: 100, 103, 105, 108, 109, 111, 159, OGD10

Distance from nearest injection well: 12,450 Northwest



Model Predicted Differential Pressure from PEC Injection = 41.2 psi (2018) and 37.5 psi (2029)

USEPA Region VI Method:

Pressure Exerted by Mud Column to Top of Panoche Sand = 6,252'- (50' fallback) = 6,202' x 9.2 ppg (0.4784 psi/ft) = 2,967 psi

Entry Pressure (2,979.7 psi) exceeds Resisting Pressure (2,967 psi) by 12.7 psi

WITH GEL STRENGTH (Min) of 47.2 psi

Resisting Pressure (2,967 psi) + GS (47.2 psi) = 3,014.2 psi so Resisting Pressure exceeds Entry Pressure by 34.5 psi

Minimum Expected gel strength of the mud column, which can be calculated from the following equation using a gel strength default of *20 lb/100 ft^2:

$$\text{Entry Pressure (EP) in psi} = \frac{(0.00333)\ (20\ \text{lb}/100\ \text{ft}^2)\ (\text{h (ft.)})}{\text{D (in.)}}$$

Where:

(h) is the height of the mud column at the point where reservoir fluid could enter the borehole less 50 ft. of mud fallback = 6,252 ft. KB - 50 ft. = 6,202 ft.

(D) = 8.75" from Drilling record

Calculation Using full mud column less 50 ft. of mud fallback

$$\text{EP in psi} = \frac{(0.00333)\ (*20\ \text{lb}/100\ \text{ft}^2)\ (6{,}202\ \text{ft.})}{(8.75\ \text{in.})} = 47.2\ \text{psi}$$

SYNOPSIS: The model predicted pressure differential at this location is 41.2 psi at the end of 2018. This is a dry hole and no casing was set below the surface casing. There are no cement plugs between the base of the USDW and the top of the injection zone. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (2967 psi) is 13 psi less than the entry pressure (2,938.5 psi + 41.2 psi = 2,979.7 psi). However, the minimum drilling mud gel strength (using 20 lbs/100 ft^2) provides an additional safety factor of 47.2 psi. Using the EPA Region VI method and the minimum calculated gel strength for the mud column from the surface (and assuming 50 ft. of mud fallback) to the top of the injection zone, the resisting pressure exceed the entry pressure by 34.5 psi. As such, using the EPA Region VI method and taking into account mud gel strength, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Figure C-12 Revised

Map ID No.: 20

Operator: R&R Resources, LLC

Lease: Blue Agave

Well Number: 1 *(2002 spud)*

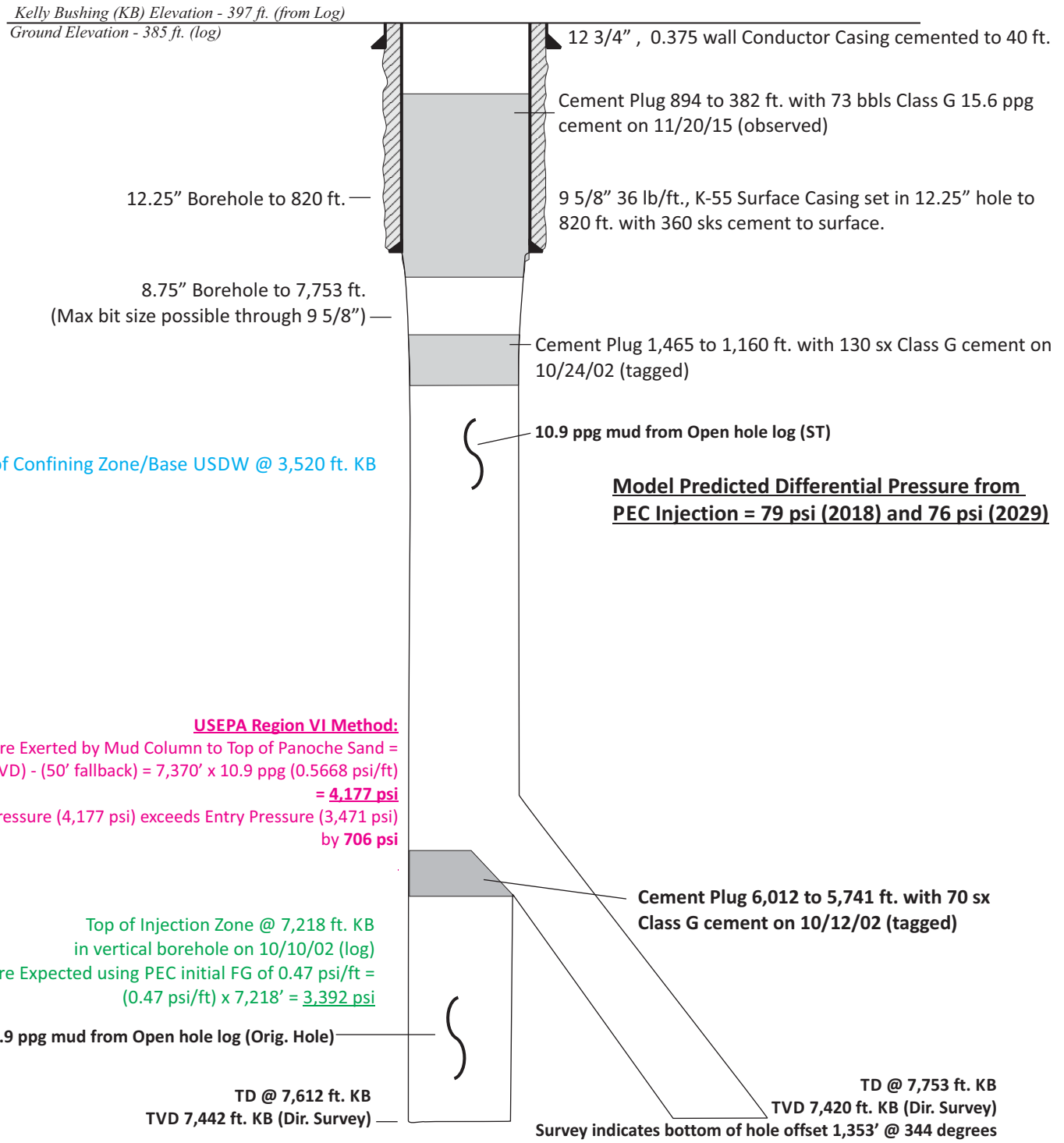
API Number 04-019-24225

Type of Well: Dry Hole

Well Status: Plugged and Abandoned (2002 and 2015)

Records: DOGGR Forms: OGD10, OG103, OG108, OG109, OG111, OG157, OG159

Distance from nearest injection well: 6,650 ft. North



SYNOPSIS: The model predicted pressure differential at this location is 79 psi at the end of 2018. This penetration is a sidetracked dry hole and no casing was placed below the surface casing. There are no plugs between the top of the top of the injection zone at 7,218 ft. KB (log) and the base of the USDW at 3,520 ft. KB in the sidetrack. Using the EPA Region VI method, the hydrostatic pressure provided by the mud column (4,177 psi) exceeds the entry pressure (3,392 psi + 79 psi)by 706 psi. The minimum drilling mud gel strength provides an additional safety factor of 44 psi. Based on the calculated resisting pressure provided by the hydrostatic pressure exerted by the mud column, this well is plugged in a manner that is protective of the USDW and no corrective action is necessary.

Attachment A-3

DOGGR CHANEY FIELD
CORRELATION DIAGRAM

SERIES	FORMATION	MEMBER AND ZONE	TYPICAL ELECTRIC LOG
MIOCENE TO HOLOCENE	UNDIFF NONMARINE STRATA		1000
			2000
			3000
OLIGOCENE	TUMEY		
EOCENE	KREYENHAGEN		
	DOMENGINE	ARROYO HONDO	
	LODO	CANTUA	5000
		CERROS	
PALEOCENE		UPPER DOS PALOS	
	MORENO	CIMA SAND	
		LOWER DOS PALOS	6000
		MARCA SHALE	
		TIERRA LOMA SHALE	7000
UPPER CRETACEOUS		JERGINS SAND	
	PANOCHE	D_1 ZONE *	
		D_2 ZONE *	8000
		E ZONE *	
		F ZONE *	9000

* GOUDKOFF ASSEMBLAGE ZONE

November 1997

Modified from California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR), 1998, California Oil and Gas Fields, Volume 1 – Central California (CD-1), Contour Maps, Cross Sections and Data Sheets for California's Oil and Gas Fields: Publication TR-31.

A

PEC INJECTION WELL IW2
TD = 8,901 FT BKB
KB=402 FT MSL

GAMMA RAY
10 60 110 160 210
SP
-100 -50 0 50
RESISTIVITY
0 2.5 5 7.5 10

API #1924225
BLUEAGAVE 1
TD = 7,612 FT BKB
KB=385 FT MSL

API #1900191
CHENEY RANCH 2
TD = 7,354 FT BKB
KB=404 FT MSL

API #1920726
SILVER CREEK 27X
TD = 7,460 FT BKB
KB=377 FT MSL

API #1921446
CHENEY RANCH 15X
TD = 7,290 FT BKB
KB=375 FT MSL

API #1900190
CHENEY RANCH 1
TD = 9,284 FT BKB
KB=392 FT MSL

API #1920712
CHENEY RANCH 14X
TD = 7,394 FT BKB
KB=373 FT MSL

API #1923117
CHENEY RANCH 81X-30
TD = 7,400 BKB
KB=386 FT MSL

API #1920687
SILVER CREEK 77X
TD = 7,250 BKB
KB=377 FT MSL

API #1920711
SILVER CREEK 73X
TD = 7,496 BKB
KB=373 FT MSL

A'

FORMATION

PEC water supply wells

UPPER UNCONFINED/ SEMI-CONFINED AQUIFER
UPPER TULARE
CORCORAN CLAY
LOWER CONFINED AQUIFER
LOWER TULARE

Base of Lower Tulare Fm (drinking water aquifer)

ORO LOMA AND OTHER UNCONSOLIDATED NON-MARINE UNITS

BASE OF USDW (2019)

Base of USDW

TUMEY

SECOND CONFINING ZONE

KREYENHAGEN

DOMENGINE

LODO

MORENO

FIRST UPPER CONFINING ZONE

COALINGA MEMBER OF THE MORENO FORMATION

SAND 1
Slotted liner
SAND 2
Slotted liner
SAND 3

INJECTION ZONE
(UPPER THREE SANDSTONE UNITS OF THE PANOCHE FORMATION)

PANOCHE

Injection Zone (Panoche Fm)

0 feet
-1,000 feet
-2,000 feet
-3,000 feet
-4,000 feet
-5,000 feet
-6,000 feet
-7,000 feet
-8,000 feet
-9,000 feet

NOTES:
LINE OF CROSS-SECTION SHOWN ON FIGURE F-4
WELL DATA PROVIDED IN TABLE F-1
USDW = UNDERGROUND SOURCE OF DRINKING WATER

500
250
0
500 1000
Scale in Feet
Vertical Exaggeration = 2

HALEY ALDRICH

PANOCHE ENERGY CENTER
43833 WEST PANOCHE ROAD
FIREBAUGH, CALIFORNIA

STRIKE-ORIENTED LOCAL STRUCTURAL CROSS-SECTION A-A'

FEBRUARY 2019

FIGURE F-5