Appendix L

Evaluation of Site-Wide Hydraulic Data

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Section 1.0 Introduction

The hydraulic monitoring program consisted of pressure measurements within a network of monitoring wells and subtidal piezometers. Four Site-wide hydraulic monitoring (groundwater elevation measurement) events have been conducted at the Site, referred to as Events 1, 2, 3A, and 3B. Figure 3.72 of the main report shows the locations of all Site monitoring wells, and the monitoring well completion details are presented in Table 3.6 of the main report.

This Appendix presents the methodology for the evaluation of the collected Site-wide hydraulic data. This Appendix is organized as follows:

- **Section 1.0 - Introduction:** Presents the objective of the hydraulic investigations.
- **Section 2.0 - Procedure for Computing Average Pressures for 72-Hour Monitoring Events:** Presents the averaging methodology applied in evaluating the hydraulic data.
- **Section 3.0 - Transducer Data Reduction Methodology:** Presents the methodology applied to transform the measured pressures to measurements suitable for evaluating groundwater flow conditions.
- **Section 4.0 - Groundwater Level Recovery Evaluation:** Presents the assessment conducted to determine recovery after temporary shutdown of the extraction/injection system.
- **Section 5.0 - Specific Gravity/Density Versus Specific Conductance Relationship:** Presents the development of the specific gravity/density versus specific conductance relationship applied to estimate the density profile of the water column within monitoring well casings.
- **Section 6.0 – Presentation of Adjusted Event 1 and Event 2 Pressure Transducer Data:** Presents the adjusted mean pressures at each monitoring well or subtidal piezometer location after a quality assurance/quality control (QA/QC) review of the pressure data.
- **Section 7.0 - Calculation Methodology for Fresh Water Equivalent Heads and Environmental Heads:** Presents the methodology applied to convert adjusted pressures at each monitoring location to FEH and ENV, as defined by Lusczynski (1961).
- **Section 8.0 - CSI Event 3 Hydraulic Monitoring Data Analysis:** Presents the interpretation of groundwater flow conditions.

A list of the references cited in this Appendix is presented in Section 9.0.

Section 2.0 Procedure for Computing Average Pressures for 72-Hour Monitoring Events

This section presents the averaging procedure applied to compute a single mean pressure at each monitoring location for each 72-hour event. This single mean pressure is applied to resolve hydraulic gradients and groundwater flow directions at the Site observed during the hydraulic monitoring events.

2.1 Transducer Installation Configurations

As described in Section 3.6.4.1.1 of the main report, monitoring locations for Events 1 and 2 used one of the Type 1, Type 2, or the Type 3 transducer installation configurations. Figure 3.75 of the main report shows a schematic of the three types of transducer installation configurations. For the Type 1 configuration, the pressures measured by the transducer reflect the pressure exerted on the transducer by the weight of the water column above the transducer position. The pressures measured under Type 1 need to be transformed to the pressure within the formation that is exerted on the well screen, and this transformation needs to take into account density variations within the water column above the well screen inside the well casing. For the Type 2 and 3 configurations, the pressure measured by the transducers reflects the formation pressure, since the transducers are directly exposed to the formation through the well screen. Two types of pressure transducers were used for Events 1 and 2: Telog®-brand diaphragm pressure transducers for Types 1 and 2 installation configurations; and Geokon®-brand vibrating wire pressure transducers for Types 1 and 3 installation configurations.

As described in Section 3.6.4.1.2 of the main report text, three types of pressure transducers were used for Events 3A and 3B: Solinst Levelogger® Edge Series Pressure Transducer/Dataloggers installed in standard monitoring wells; Geokon® Model 4500 Vibrating Wire Piezometers installed at CMT monitoring well locations; and Micron Narrow-Diameter Pressure Transducers installed at CMT monitoring well locations where the initially installed Geokon trandsducers malfunctioned. The transducers used for Events 3A and 3B were installed within the monitoring screened intervals.

The procedure for computing an average pressure at each monitoring location over a single hydraulic monitoring event is presented in the following section using example data from an upland monitoring well instrumented with a vented Telog® transducer. For upland monitoring wells and subtidal piezometers instrumented with the non-vented transducers, the correction for barometric pressure fluctuations is applied prior to implementing the averaging procedure described herein.

2.2 Theory – Averaging Procedure

A procedure for averaging groundwater levels for wells affected by tidal fluctuations is presented in Serfes (1991) (with both theory and methodology fully explained). For reference purposes, a copy of Serfes (1991) is provided as Attachment 1 to this Appendix.

Serfes (1991) presents two (2) averaging methods: the first method employs 71 consecutive hourly measurements, and the second method employs only 25 consecutive hourly measurements. The second method provides lower accuracy as compared to the first method. The first method using 71 consecutive hourly measurements was applied to average the pressure measurements recorded by the transducers.

The averaging procedure is demonstrated by applying the Serfes (1991) averaging procedure to raw (i.e., measured) pressure data recorded by the Telog® transducer installed at monitoring well location 9-100. The Telog® transducer is installed in the water column above the well screen, corresponding to the Type 1 configuration illustrated on Figure 3.75 of the main report. The approach to transform the pressure measured at the transducer location for the Type 1 configuration to a pressure that is exerted by the formation at the well screen that accounts for density variations within the water column inside the well casing is described in Section 3.2. The averaging procedure presented herein is applied to develop a single mean of the raw pressure data measured at the monitoring locations for all monitoring events. Then, for monitoring wells with the Type 1 configuration where the transducer is suspended in the water column, the mean of the raw pressure data was transformed to correspond to the formation pressure exerted at the well screen.

2.3 Procedure & Example Calculations – Averaging Procedure Applied to Transducer Pressures

In order to illustrate the Serfes (1991) averaging procedure applied in this analysis, the pressure data collected from well 9-100 are utilized as an example. The measured pressure data obtained at 9-100 during Event 1 are presented on Figure 1. On Figure 1, the blue and orange dots represent the pressure measured and recorded by the pressure transducer at the programmed five-minute interval (the orange dots represent the pressures measured at 1-hour intervals). As expected, the pressure measurements exhibit the cyclical fluctuation in groundwater levels that are typically observed at the Site, rising and falling in concert with the tidal fluctuations in the Blair and Hylebos Waterways adjacent to the Site to the plant east (Hylebos Waterway [Waterway]) and plant west (Blair Waterway).

The Serfes (1991) averaging procedure is applied to obtain a mean pressure at 9-100 that filters out the tidal fluctuations from the recorded pressures. The Serfes (1991) averaging procedure requires only hourly measurements, whereas all the transducers are programmed to obtain and record pressure measurements at five-minute intervals. Therefore, only the hourly measurements of the raw pressure data were used to compute the average pressure.

An example calculation of the averaging procedure applied to the hourly 9-100 pressure measurements for Event 1 is presented in Table 1. Table 1 lists the 71 consecutive hourly measurements of pressure at 9-100 from May 27, 2006 at 09:00 PDT to May 30, 2006 at 07:00 PDT that appear as the orange dots on Figure 1.

The Serfes (1991) moving average method consists of three consecutive averaging steps. First, an arithmetic mean is calculated for each of the 48 24-hour consecutive hourly pressure measurements contained within a 71-hour interval, which is presented as the 'X(i) Mean' in Table 1 (i.e., X(1) is the arithmetic mean of the pressure measurements from 1 to 24 hours, X(2) is the arithmetic mean of the pressure measurements from 2 to 25 hours, etc.). Second, an arithmetic mean is calculated for each of the 25 24-hour consecutive X(i) hourly arithmetic means, which is presented as the 'Y(j) Mean' in Table 1 (i.e., Y(1) is the arithmetic mean of X(1) to X(24), Y(2) is the arithmetic mean of X(2) to X(25), etc.). Finally, the arithmetic mean of Y(1) to Y(25) is computed, which corresponds to the mean pressure at hour 36 within the 71-hour interval and corresponds to May 28, 2006 at 20:00 PDT. On Figure 1, the Serfes (1991) mean pressure at May 28, 2006 at 20:00 PDT of 10.25 pounds per square inch (psi) presented in Table 1 is shown with a large red dot.

Section 3.0 Transducer Data Reduction Methodology

The purpose of this section is to present the details of the various transducer models, transducer installation configurations, the background theory, and example calculations to demonstrate the methodology applied to transform the pressure data measured by the transducers for subsequent use in interpreting the observed hydraulic responses and developing the Site conceptual hydrogeologic model. Where transducers are installed within the monitoring well screens or grouted in place within the formation, the pressures measured by the transducers are directly applicable to the pressure exerted by the formation at the transducer location, and the methodology to determine the formation pressure is presented herein. Where the pressure transducer is suspended in the water column above the well screen, additional steps are required to transform the pressure measured by the transducer to the pressure exerted by the formation at the mid-point of the well screen. The additional steps required for this case are also presented herein. Section 3.2 provides the methodology (with example calculations) applied to compute formation pressures along fixed elevation datums (i.e., horizontal planes) to provide the formation pressures. The methodology applied to convert the formation pressures to FEHs and ENVs is presented in Section 7.0. The FEHs and ENVs are used to interpret horizontal and vertical groundwater flow directions, respectively, that in turn are applied in the development of the conceptual hydrogeologic model for the Site.

3.1 Theory – Required Transformations for Recorded Transducer Data

The theory underlying the pressure data transformations required for each of the Events 1 and 2 three transducer installation configurations, as presented on Figure 3.75 of the main report, is discussed in the following sections.

3.1.1 Type 1 - Upland Monitoring Well with Pressure Transducer Suspended in Water Column above Well Screen

In the Type 1 transducer installation configuration, a transducer is suspended from the well casing in an upland monitoring well location such that the transducer is submerged within the water column above the screened interval of the monitoring well. In this case, the pressure observed and recorded by the transducer does not correspond directly to the actual pressure within the formation (i.e., $P_{FORMATION}$ at Point C shown on Figure 3.75 of the main report). Rather, the transducer measures the pressure at the transducer location exerted by the weight of the water column above the transducer. Using the notation indicated on Figure 3.75 of the main report, the transducer measures the pressure of water at Point B ($P_{OBSERVED}$), which corresponds to the weight of water from Point A (water column surface) to Point B (pressure transducer location). Pressure fluctuations measured and recorded by the transducer at Point B are proportional to fluctuations in the formation pressure. If the water column in the well has a uniform density, the pressure fluctuations observed at Point B would correlate directly to pressure fluctuations in the formation (i.e., $P_{FORMATION}$ at Point C) by the vertical separation distance between Points B and C. Because the density of the water column does vary, the correlation of the pressure fluctuations observed at Point B to that observed at Point C needs to account for the variable density.

In order to determine density variations in the water column, conductivity profiling of the water column is applied to develop a specific gravity profile. The specific gravity profile is used to determine the density profile, that is then used in conjunction with the pressure measured by the suspended transducer to calculate the formation pressure. Further details on applying the conductivity profiling results in this regard are presented in Section 3.2.

The underlying theory to determine the formation pressure is presented following the discussion provided in Domenico and Schwartz (1990) and Freeze and Cherry (1979). The mathematical equations are based on fluid mechanics and can be described by the Bernoulli equation which states that under conditions of steady flow, the total energy of an incompressible fluid is constant at all positions along a flow path in a closed system. The total energy of the fluid is composed of three different types of energy:

Kinetic Energy - the energy required to accelerate the fluid from one velocity, v_o, to another, v

Elastic Energy - the energy required to raise the pressure of fluid from one pressure, P_o, to another, P^*

Potential Energy - the energy required to lift a mass from one elevation, z_o, to another, z

The Bernoulli equation, on a unit volume basis, is expressed mathematically as:

$$\frac{\rho(v-v_o)^2}{2}+(P^*-P_o)+\rho g(z-z_o)=constant \qquad \text{Equation 3.1}$$

Where:

ρ	is the fluid density [ML^{-3}]
v	is the fluid velocity [LT^{-1}]
v_o	is the reference fluid velocity [LT^{-1}]
P^*	is the fluid pressure, where the superscript asterisk denotes absolute pressure [$ML^{-1}T^{-2}$]
P_o	is the reference fluid pressure [$ML^{-1}T^{-2}$]
g	is the acceleration due to gravity [LT^{-2}]
z	is the elevation of the point of measurement [L]
z_o	is the reference elevation [L]

Since the water column in the monitoring well is essentially at rest, the kinetic energy term $\frac{\rho(v-v_o)^2}{2}$ can be neglected. The reference fluid pressure is typically taken as the average atmospheric pressure, and thus, the pressure is typically expressed as $P=P^*-P_o$, where P represents gauge pressure. For situations where density is variable within the water column, the potential energy term must be modified to account for variable density through integrating density over the length of the water column (i.e., $\int_{Z_o}^{Z}\rho(z)gdz$). Therefore, the simplified form of Equation 3.1 becomes:

$$P+\int_{Z_o}^{Z}\rho(z)gdz=constant \qquad \text{Equation 3.2}$$

Applying the simplified Bernoulli equation (Equation 3.2) to a Type 1 installation at both Points A and B and equating the two expressions based on there being a constant total energy at both points [i.e., both points lie along a common flow path in a closed system (e.g., the well casing) under conditions of steady flow], the following equation may be written between Points A and B (refer to Figure 3.75 of the main report):

$$P_B=P_A+g\int_{Z_B}^{Z_A}\rho(z)dz \qquad \text{Equation 3.3}$$

Recognizing that P_A corresponds to atmospheric pressure, and when it is expressed as gauge pressure, then $P_A=0$. Therefore, Equation 3.3 reduces to:

$$P_B = g\int_{Z_B}^{Z_A} \rho(z)dz \qquad \text{Equation 3.4}$$

A similar equation may be developed between Point B and C (refer to Figure 3.75 of the main report):

$$P_C = P_B + g\int_{Z_C}^{Z_B} \rho(z)dz \qquad \text{Equation 3.5}$$

In Equation 3.5, P_B is the pressure measured by the transducer (i.e., $P_{OBSERVED}$) and P_C is actual formation pressure (i.e., $P_{FORMATION}$). Therefore, by application of Equation 3.5, the formation pressure, $P_{FORMATION}$, may be computed based on the recorded transducer pressure, $P_{OBSERVED}$, and the density profile within the water column from Point B to Point C. The density profile of the water column within the well casing is derived from the conductivity profiling, as described in Section 3.2. An example calculation for the application of Equation 3.5 is also presented in Section 3.2.

3.1.2 Type 2 - Upland Monitoring Well with Pressure Transducer Installed Within Well Screen

In a Type 2 installation, a transducer is suspended in an upland monitoring well location such that the transducer is located at the mid-point of the screened interval of the monitoring well. In this case, the pressure observed and recorded by the transducer ($P_{OBSERVED}$) corresponds directly to the actual pressure within the formation ($P_{FORMATION}$). The transducer measures the pressure of the water column inside the well casing above the transducer, which is balanced by the formation pressure.

Revisiting Equation 3.5, relative to Figure 3.75 of the main report, the integration of the density in the water column from Point C to B is zero because points B and C are now identical, and therefore, the equation reduces to:

$$P_C = P_B \qquad \text{Equation 3.6}$$

Therefore, no transformation of the pressure data is required for a Type 2 installation equipped with a vented pressure transducer. However, for wells that contain non-vented transducers, where the water column is in direct communication with the atmosphere, a correction for barometric pressure is required. In order to facilitate these corrections, dedicated transducers were installed for the hydraulic monitoring events to record barometric pressure the same time intervals as the pressure transducers. The barometric pressure was then subtracted from the non-vented total pressure readings to give water column pressure for each monitoring well location. The methodology employed to correct the pressure measurements for barometric pressure fluctuations at non-vented pressure transducers is presented in Section 3.3.

In addition, the Geokon® vibrating wire transducers do not measure a pressure directly. Rather, the Geokon® transducers measure a vibration frequency that is converted to a pressure. This conversion is further described below, and the corresponding methodology is presented in Section 3.4.

3.1.3 Type 3- Subtidal Piezometer with Transducer Buried in Place

Unlike the other pressure transducers used at the Site, the Geokon® transducers do not measure pressure directly. Rather, a vibration frequency is measured, which is directly proportional to the pressure experienced by the transducer, as described in the Geokon® Instruction Manual (Geokon, 2005).

Two uncertainties associated with obtaining absolute pressures from the subtidal piezometers were identified during Events 1 and 2. The first uncertainty was associated with the installation of the subtidal piezometer nests within the Waterway. The installations were performed using a barge-mounted drill rig anchored in the Waterway that increased and decreased in elevation coincident with the changing tide. The continuously changing barge elevation resulted in some uncertainty regarding the transducer elevations measured from the barge. The second uncertainty arose following discussion with vibrating wire transducer manufacturers/distributors. It is generally considered that vibrating wire transducers are more accurate when measuring pressure changes rather than absolute pressures. To minimize the effects of the above uncertainties, two methods (Method 1 and Method 2) were developed to calculate FEH values at the subtidal transducers.

Method 1 is based on determining the absolute pressure experienced by the Geokon vibrating wire transducers. The procedure and example calculations for Method 1 for computing the submergence pressure from the recorded vibration frequency are documented in the Geokon® Instruction Manual (Geokon, 2005). For reference, a copy of the Geokon® Instruction Manual is provided as Attachment 2 to this Appendix. In the Geokon® Instruction Manual, two calculation methods are provided: one based on a linear approximation; and the other based on a polynomial approximation. The Geokon® Instruction Manual suggests that the polynomial expression gives a "*better fit to the data then does a straight line*" (Geokon, 2005; Appendix D, page 26). Examples of the conversion of recorded vibration frequency to submergence pressure using both the linear and polynomial calculation methods are presented in Section 3.3. Pressures and FEH values at piezometer locations that were not continuously overlain by surface water were calculated using Method 1 (i.e., WW-A3, WW-A4, WW-B3, WW-B4, and WW-C3). For these subtidal piezometers, the submergence pressure computed from the recorded vibration frequency is representative of the formation pressure because the transducer is grouted in place within the screened interval. With reference to Figure 3.75 of the main report, in a Type 3 installation, $P_{OBSERVED} = P_{FORMATION}$.

Method 2 was developed to determine FEH values at subtidal piezometers that are continuously overlain by surface water within the Waterway (i.e., WW-A1, WW-A2, WW-B1, WW-B2, WW-C1, WW-C2, WW-C4, and WW-D1). Method 2 is based on the change in pressure experienced by the transducers relative to the pressure exerted on the transducers by the water column inside the open subtidal piezometer casing before the transducers were grouted into place. Method 2 takes advantage of the improved accuracy of the Geokon vibrating wire transducers when measuring changes in pressure, and minimizes any uncertainties in the transducer elevations arising from the barge-mounted drill rig installation of the subtidal piezometers.

As previously stated, since the Geokon® transducer cables are not vented, a correction for barometric pressure fluctuations is applied as presented in Section 3.3.1.

3.2 Pressure Transformation Methodology for Type 1 Installations

As presented in Section 3.1, transforming the pressures recorded by transducers in a Type 1 installation to the pressure exerted by the formation at the well screen mid-point involves integrating the density distribution of the water column within the well casing from the transducer (Point B on Figure 3.75 of the main report) to the mid-point of the screened interval (Point C on Figure 3.75 of the main report) (i.e., Equation 3.5). An overview of the steps involved in this transformation is presented below. The details for each step in the process, including example calculations where appropriate, are presented in the following subsections.

To estimate the density distribution within the water column, conductivity measurements were recorded within the water column during Events 1 and 2 and normalized to a reference temperature of 25°C (77°F). The conductivity measurements are applied as an indirect measurement of water density on the basis that a mathematical relationship between density and specific conductance (derived from conductivity measurements) can be developed. The mathematical relationship is applied to the conductivity measurements, expressed as specific conductance, in order to approximate the water column density. The density distribution is then integrated from the transducer location to the mid-point of the well screen, in accordance with the methodology presented in Section 3.1, to compute the formation pressure that corresponds to the pressure measured by the transducer. The methodology and the mathematical relationship developed between density and specific conductance, along with an example calculation, are presented below.

3.2.1 Methodology/Example Calculation: Correlation to Specific Gravity and Density to Specific Conductance

Field measurements of specific conductance were obtained using a Horiba® meter at the time groundwater samples were collected from the upland monitoring wells and from the subtidal transducer locations during Events 1 and 2. The groundwater samples were submitted for laboratory analysis of specific gravity. Two rounds of sampling from the upland wells were completed: the first prior to initiating Event 1; and the second following the completion of Event 2. The specific conductance and specific gravity data collected during these two sampling events were correlated to determine the coefficients of best-fit for the relationship between specific gravity/density and specific conductance. The laboratory analysis provided specific gravity results that correspond to the density of the groundwater sample divided by the density of water at a standard temperature of 60°F, after the ASTM Standard D1429-86 entitled, "Standard Test Methods for Specific Gravity of Water and Brine". Therefore, the specific gravity laboratory results can be converted to density by multiplying by 999.012 kilograms per cubic meter ($kg/m^{3)}$ [62.4 pounds per cubic foot (lbs/ft^3)], which is the density of pure water at 60°F (CRC Press, 1988).

An example of the specific gravity/density and specific conductance correlation procedure is presented graphically on Figure 2. On Figure 2, for each groundwater sample location, [with the exception of nine (9) locations where the specific conductance reading exceeded the upper limit of the field instrument], the specific gravity laboratory result and corresponding densities in metric and Imperial units are plotted against the field-measured specific conductance. As shown on Figure 2, these data generally follow a linear relationship, with some scatter. A line of best fit, determined through linear regression, is plotted on Figure 2 that represents the idealized relationship between specific gravity/density and specific conductance.

In order to develop this relationship, the specific gravity measurements were adjusted from a reference temperature of 60°F (15.6 C) to 25 C (77°F) to correspond directly to the specific conductance measurements, which are reported by the Horiba® meter relative to a reference temperature of 25°C (77°F). The temperature adjustment for specific gravity is based on the adjustment provided in the ASTM Standard D1429-86, and is expressed mathematically as:

$$SG_{25} = SG_{15} - 0.0002 \times (77°\text{F} - 60°\text{F}) \qquad \text{Equation 3.7}$$

Where:

SG_{25} is the specific gravity adjusted to a reference temperature of 25°C

SG_{15} is the specific gravity reported by the laboratory at the standard reference temperature of 60°F (15.6°C)

The specific conductance measurements and specific gravity laboratory results obtained prior to Event 1 were used in this example calculation, and these data are presented in tabular format in Table 2. In total, there are 117 specific conductance measurements/specific gravity laboratory results obtained prior to Event 1 used in the presentation of the methodology. Note that specific conductance and specific gravity data collected at the subtidal piezometer locations is not included in the example calculations presented in Table 2. These data, however, are incorporated into the dataset used to develop the final specific gravity/density and specific conductance relationship presented in Section 5.4.

In developing the example specific gravity/density and specific conductance relationship presented on Figure 2, some apparent outliers were removed, prior to determining the line of best fit. These outliers are represented on Figure 2 by a green triangle and are listed in Table 2. In total, 14 outliers were identified. In addition, measurements of specific conductance exceeded the upper limit of the field instrument [100 milliSiemens per centimeter (mS/cm)] at thirteen (13) locations (these thirteen locations are listed in Table 2). Therefore, the example specific gravity/density and specific conductance relationship was developed using measurements from a total of 90 locations. The final specific gravity/density and specific conductance relationship is developed using both the Event 1 and Event 2 data, and this is presented in Section 5.4, along with a discussion of points identified as outliers.

The regression tool built into Microsoft Excel® was applied to determine the coefficients for the line of best-fit between specific gravity/density and specific conductance. The regression analyses results generated by Excel® are presented in Table 3. For this example calculation, the resulting specific gravity and specific conductance relationship is expressed mathematically as:

$$SG_{25} = 0.996354669 + 0.000455436 \times SC_{25} \qquad \text{Equation 3.8}$$

Where:

SC_{25} is the specific conductance reported at the standard reference temperature of 25°C (77°F)

Similar relationships may be developed between density and specific conductance by multiplying the specific gravity laboratory results adjusted to 25°C (77°F) by the density of pure water at 25°C (77°F). The regression analyses results generated by Excel® for density in both Imperial and metric units are also presented in Table 3. The resultant relationship for density in Imperial units is:

$$\rho_{I,25} = 62.01464044 + 0.028384604 \times SC_{25} \qquad \text{Equation 3.9}$$

Where:

$\rho_{I,25}$ is the density in Imperial units at a reference temperature of 25°C (77°F) (lbs/ft^3)

The resultant relationship for density in metric units is:

$$\rho_{M,25} = 993.379226 + 0.454677724 \times SC_{25} \qquad \text{Equation 3.10}$$

Where:

$\rho_{M,25}$ is the density in metric units at a reference temperature of 25°C (77°F) (kg/m^3)

The coefficient of correlation (R^2), which is a measure of the 'goodness of fit' of the linear relationship to describe the observed data, is 0.914 for these example relationships presented in Table 3.

The final correlation of specific gravity/density and specific conductance, incorporating all available data points from Events 1 and 2, is determined using the approach described above, and the results are presented in Section 5.4.

3.2.2 Methodology/Example Calculation: Conversion of Conductivity and Temperature Profiling to Specific Conductance Profile

Consistent with the procedures presented in the SAP (CRA, 2005), conductivity profiling was conducted both prior to Event 1 and following Event 2, in order to assess whether the degree of density stratification in the water column changed appreciably due to the temporary shutdown of the extraction/injection system.

The conductivity data collected during both events is summarized graphically to show the specific conductance and temperature profiles measured within the well casing water column. An example of this graphical presentation, corresponding to a Type 1 transducer installation configuration, is presented on Figure 3. Three key elements are presented on Figure 3 are as follows:

i) The well construction details, including the cased and screened intervals, the location of the transducer within the well casing, and the water levels measured at the time of the conductivity profiling
ii) The specific conductance profile within the water column determined from the conductivity measurements normalized to a reference temperature of 25°C (77°F) (i.e., converted to specific conductance)
iii) The temperature profile within the water column

The conductivity and temperature profiling were conducted using Solinst® data loggers/probes. The measured conductivity profile was converted, taking into account the temperature profile, to a specific conductance profile (i.e., corrected to a reference temperature of 25°C). The measured conductivity and temperature profiles were applied to compute the specific conductance using the following relationship, after Franson (1995):

$$SC_{25} = \frac{C}{1 + 0.0191 \times (T_C - 25°\mathrm{C})} \qquad \text{Equation 3.11}$$

Where:

C	is the measured conductivity (mS/cm)
T_C	is the measured temperature (°C)

An example calculation to convert the conductivity and corresponding temperature measured at well 12-160 to specific conductance (i.e., corrected to a reference temperature of 25°C) is presented in Table 4. In this example, only the specific conductance calculations for the conductivity probe depth interval from 54.33 ft to 55.53 ft (i.e., depth below the surface of the water column) within well 12-160 are presented.

3.2.3 Methodology/Example Calculation: Conversion of Specific Conductance Profile to Density Profile and Conversion of Observed Pressure to Formation Pressure

The specific conductance profile presented on Figure 3, along with the example specific gravity/density and specific conductance relationship presented in Equation 3.8, are subsequently applied to develop a density profile for the water column within the well casing. The specific gravity/density and specific conductance relationship used in the example calculation in Table 4 is based on Event 1 data only. The final specific gravity/density and specific conductance relationship based on Events 1 and 2 upland monitoring wells and subtidal piezometer transducer data is presented in Section 5.4. An example calculation of density from specific conductance at well 12-160 using Equation 3.10 is presented in Table 4. In this example, only the specific conductance calculations for the conductivity probe depth interval from 54.33 ft to 55.53 ft (i.e., depth below the surface of the water column) within well 12-160 are presented. Note that the density computed using Equation 3.10 is relative to a reference temperature of 25°C. Therefore, the estimated density is further adjusted to correspond to the actual temperature measured within the water column. This conversion is implemented following the correction provided in ASTM Standard D1429-86, with a corresponding adjustment for density expressed in metric units. This correction is expressed mathematically as:

$$\rho_{M,T} = \rho_{M,25} - 0.2 \times \left(T_F - 77°\text{F}\right) \qquad \text{Equation 3.12}$$

Where:

$\rho_{M,T}$	is the density in metric units at the measured temperature (kg/m^3)
T_F	is the measured temperature in Imperial units (°F)

An example calculation of the conversion of the pressure measured by a Type 1 transducer installation to the formation pressure at the mid-point of the well screen is presented in Table 4 for well 12-160. At well 12-160, the transducer is installed at -47.76 ft NGVD, and the elevation of the mid-point of the well screen is at -144.02 ft NGVD. Therefore, as indicated in Equation 3.5, the density profile is integrated over the interval from -47.76 ft NGVD to -144.02 ft NGVD. Table 4 presents the results of integrating the density profile over this entire interval. For this example calculation, an average observed pressure of 22.63 psi at 12-160 is applied, which represents the mean Event 1 observed pressure determined using the Serfes (1991) averaging procedure, as presented in Section 2.3. Applying Equation 3.5 to compute the formation pressure at the well screen mid-point yields a pressure of 64.37 psi, as presented in Table 4.

3.3 Pressure Transformation Methodology for Type 2 Installations

Transformation of the recorded pressures is not required for a Type 2 installation since the pressure measured by the transducers positioned within the well screens directly measure the formation pressure. For monitoring wells equipped with a Geokon® vibrating wire pressure transducer, a conversion of the vibration frequency measurements is required since these vibrating wire transducers do not measure pressure directly. The methodology and example calculations of this conversion are presented in Section 3.3.1. In addition, the pressures obtained from the wells instrumented with a non-vented Geokon® transducer must be adjusted to account for changes in barometric pressure since the water column within these wells is free-standing and open to the atmosphere such that atmospheric pressures are exerted on the water column. The methodology and an example calculation of the barometric pressure adjustments are also presented in Section 3.3.1.

Barometric pressure was measured during the hydraulic monitoring events via a pressure transducer that was synchronized to obtain barometric pressure measurements at the same time intervals as pressure measurements. The measured barometric pressure data are presented on Figure 4. The range in barometric pressure over Event 1 was 13.99 to 14.26 psi, with a mean barometric pressure of 14.15 psi. The range in barometric pressure over Event 2 was 13.99 to 14.17 psi with a mean barometric pressure of 14.11 psi. For comparison purposes, a variation of barometric pressure of 1.0 psi is equivalent to a water level change of approximately 2.3 ft for a density corresponding to fresh water. For densities greater than fresh water, the corresponding magnitude of the water level change would be lower.

3.3.1 Methodology/Example Calculation: Conversion of Vibrating Wire Transducer Measurements to Pressure Accounting for Fluctuations in Barometric Pressure

The calculations required to convert vibration frequency measurements recorded by the vibrating wire pressure transducers to pressure are provided in the Geokon® Instruction Manual (Geokon®, 2005). A copy of the Geokon® Instruction Manual is provided as Attachment 2 to this Appendix. The Geokon® transducers record two measurements at each reading interval: digits and temperature. The digits measurement recorded by the Geokon® transducer is derived from the wire vibration frequency. The conversion from vibration frequency to a digits measurement is performed internally within the Geokon® transducer (refer to Equation 4-1 of the Geokon® Instruction Manual for further details on the internal conversion). Both the digits and temperature readings are utilized in computing a pressure. Two calculation methodologies are presented: one based on a linear relationship; and the other based on a second-order polynomial relationship. The linear conversion from digits and temperature to pressure is described in Section 4 of the Geokon® Instruction Manual, and the conversion using a second-order polynomial is described in Appendix D of the Geokon® Instruction Manual. An example calculation of each of these conversion methods is presented below.

For both the linear and polynomial conversion methods, a series of calibration factors are required. The calibration factors are provided by Geokon® and are specific to each individual Geokon® transducer. In addition to the calibration factors provided by Geokon®, an initial zero pressure digits reading and site reference temperature and barometric pressure must be obtained in the field. This step was completed for each Geokon® transducer prior to installation. The transducer installation procedures were presented in the CRA document entitled, "Installation Procedures for Downhole Transducers" (CRA, 2006). The calibration factors for well PZ-SHI-3-100 are presented in Table 5 as an example.

Linear Conversion

The conversion of digits and temperature readings to pressure using the linear scaling approach is described in Section 4 of the Geokon® Instruction Manual. The linear conversion procedure consists of a pressure calculation, a temperature correction, and if necessary/warranted, a barometric correction. The linear conversion equation, without the barometric correction, is as follows:

$$P = [(R_0 - R_1) \times G] + [(T_1 - T_0) \times K] \qquad \text{Equation 3.13}$$

Where:

P	is the computed gauge pressure (psi)
R_0	is the Site zero pressure digits reading determined prior to installation (digits)
R_1	is the digits reading recorded by the pressure transducer (digits)
G	is the linear gage factor supplied by Geokon® (psi/digit)
T_1	is the temperature reading recorded by the pressure transducer (°C)
T_0	is the Site temperature reading determined prior to installation (°C)
K	is the thermal factor supplied by Geokon® (psi/°C)

The Geokon Instruction Manual states that the zero pressure digits reading are usually taken in air prior to conducting the field calibration check. The Geokon (2005) manual also describes an alternative method for taking the zero readings under a water column of known height and density. Doing so is considered more accurate in some cases because the zero readings can then correspond to pressures that the transducer will measure while in use.

As previously indicated, a barometric correction to the computed pressure must be applied for Type 2 installations with non-vented transducers because the water column within these wells is free-standing and open to the atmosphere such that atmospheric pressures are exerted on the water column. A dedicated Telog® and a Solinst Barologger® Edge pressure transducer were installed to measure barometric pressure at the Site at 5-minute intervals coincident with the transducer pressure readings. The linear conversion equation incorporating the barometric correction, as presented in the Geokon® Instruction Manual, is as follows:

$$P = [(R_0 - R_1) \times G] + [(T_1 - T_0) \times K] - (S_1 - S_o)$$ Equation 3.14

Where:

S_1 is the barometric pressure reading from the dedicated barometric pressure transducer corresponding to the time of the digits and temperature readings (psi)

S_0 is the initial barometric pressure taken at the time of the zero pressure digits reading prior to installation of the transducer (psi)

The linear conversion procedure incorporating the barometric correction was applied to Event 1 readings obtained from the Geokon® transducer installed at location PZ-SHI-3-100. The calculations are summarized in Table 5 (note that only the hourly Event 1 readings are presented in Table 5).

Polynomial Conversion

The conversion of digits and temperature readings to pressure using the polynomial scaling approach is described in Appendix D of the Geokon® Instruction Manual. The equation, without a barometric correction, is as follows:

$$P = (A \times R_1^2) + (B \times R_1) + C + [(T_1 - T_0) \times K]$$ Equation 3.15

Where:

A, B are polynomial gage factors supplied by Geokon®

C is calculated by inserting the initial zero reading, R_0, into the polynomial equation, with the pressure, P, set to zero

The parameter C in Equation 3.15 is calculated using:

$$C = -(A \times R_0^2 + B \times R_o)$$ Equation 3.16

The polynomial conversion equation incorporating the barometric correction is as follows:

$$P = \left(A \times R_1^2\right) + \left(B \times R_1\right) + C + \left[\left(T_1 - T_0\right) \times K\right] - \left(S_1 - S_0\right) \qquad \text{Equation 3.17}$$

As with the linear conversion, zero pressure digits readings were obtained both in air and while the transducer was submerged in fresh water to verify accurate transducer readings. The pre-installation field calibration data were reviewed to determine whether the linear or polynomial calculation methodologies provided a better fit, and whether the air zero readings or submerged zero readings should be considered. The Geokon® Instruction Manual indicates that the application of the polynomial calculation "*gives a better fit to the data*" than the linear conversion. Therefore, based on the guidance provided in the Geokon® Instruction Manual, all pressures are calculated using the polynomial method.

For the purpose of the example calculations, the polynomial conversion procedure incorporating the barometric correction was applied to Event 1 readings obtained from the Geokon® transducer installed at location PZ-SHI-3-100. The calculations are summarized in Table 5 (note that only Event 1 hourly readings are presented in Table 5). Following the calculation of pressure for each Event 1 hourly reading, the Serfes (1991) mean pressure is computed for Event 1 using the approach presented in Section 2.0. The corresponding Serfes (1991) mean pressure for Event 1 at location PZ-SHI-3-100 is 37.76 psi, as indicated in Table 5. This Serfes (1991) mean pressure is an example intended to demonstrate the calculation methodology.

3.4 Pressure Transformation Methodology for Type 3 Installations

For Type 3 Geokon® vibrating wire transducer installations, two different methods (referred to as Methods 1 and 2) were applied to translate Geokon® readings into pressures depending on whether a Geokon® vibrating wire transducer was continuously overlain by surface water (where Method 2 was applied), or not (where Method 1 was applied). Both Method 1 and Method 2 require the conversion of the measured digits and temperature recorded by the Geokon® vibrating wire transducers to pressure. However, Method 1 calculates an absolute pressure from the Geokon® transducer digits and temperature readings at each transducer that is then converted to a FEH, while Method 2 utilizes the digits and temperature readings to calculate differences in pressure between transducers in a single transducer nest location that are used to calculate FEHs. The Method 1 and Method 2 methodologies used to calculate formation pressures and FEHs with example calculations are presented in Sections 3.4.1 and 3.4.2, respectively.

3.4.1 Method 1 Methodology/Example Calculation: Pressure Calculation for Vibrating Wire Transducers not Continuously Overlain by Surface Water

The methodology for converting the digits and temperature measurements recorded by the Geokon® vibrating wire pressure transducers was presented in Section 3.3. As indicated in Section 3.3, the polynomial conversion method is utilized based on the guidance provided in the Geokon® Instruction Manual. Therefore, the conversion of digits and temperature measurements obtained in a Type 3 installation is given by Equation 3.17. An example calculation of the application of Equation 3.17 for subtidal piezometer WW-A3-75 is presented in Table 6 (note that only the Event 1 hourly readings are presented in Table 6). The corresponding Serfes (1991) mean pressure for Event 1 at location WW-A3-75 is 29.34 psi.

3.4.2 Method 2 Methodology/Example Calculation: Pressure/FEH Calculation for Vibrating Wire Transducers Continuously Overlain by Surface Water

This section presents the Method 2 approach for determining FEHs for the Geokon® vibrating wire transducers installed in the eight subtidal piezometers installed within the Waterway that are continuously overlain by surface water. Method 2 is based on the premise that the mudline transducers should experience a pressure that is equal to the weight of surface water that overlies them. As a result, Method 2 is applicable only to the subtidal piezometers within the Waterway that are continuously overlain by surface water (i.e., WW-A1, WW-A2, WW-B1, WW-B2, WW-C1, WW-C2, WW-C4, and WW-D1).

Before the details of Method 2 are presented, a general summary of the subtidal transducer installation process prior to Events 1 and 2 is provided. All transducers were subjected to a field calibration check before installation to ensure that they were working correctly and to provide an initial zero reading for pressure calculations used to reduce the hydraulic data for Events 1 and 2. The field calibration check consisted of lowering each transducer at 2-foot increments into an 8-foot column of fresh water. Initial zero readings were taken in air prior to lowering them into the fresh water column. The transducer readings under 2 feet, 4 feet, 6 feet, and 8 feet of fresh water column were recorded and reduced to verify that the transducers recorded a pressure equal to that exerted by the column of fresh water. The transducers were then laid out on a warehouse floor, measured, bundled, and taped together such that the transducers were fixed at their designed spacing. For each subtidal piezometer nest, once the piezometer casing was installed, the bundled transducers were then suspended inside the open casing before being grouted into place (referred to as the pre-grout condition). Readings of the digit and temperature output were obtained from each transducer during the pre-grout condition to ensure that the transducers were functioning and measurements of the Site-specific barometric pressure were taken (note that the water level in the casing was not measured at the time of the pre-grout readings).

Following this, each transducer was surrounded by a sand pack within its respective casing screened interval and then grouted in place to provide a seal between each screened interval/transducer.

Method 2 consists of conducting a multiple linear regression analysis to develop an empirical relationship between the Waterway tide elevation, expressed as FEH (referred to as FEH_{TIDE}), and the corresponding mudline transducer digit and temperature outputs along with the Site-specific barometric pressure measurements. The empirical relationship is used to determine the FEH_{TIDE} exerted on the mudline transducer by the water column inside the open subtidal piezometer casing before the transducers were grouted into place. The pre-grout FEH experienced by the transducers located below the mudline transducer was determined from the mudline pre-grout FEH using the separation distance between the transducers and the groundwater density measured at each transducer location. The factory calibrated gage and thermal coefficient provided by Geokon® for the transducers are then used to calculate the change in FEH from the pre-grout condition during Events 1 and 2 for each transducer installed within the subtidal piezometer nests during Events 1 and 2.

The process followed for Method 2 consists of the following five steps:

- Step 1: Using a multiple linear regression analysis, an empirical relationship was developed between the Waterway FEH_{TIDE} and the corresponding mudline transducer digits and temperature output along with the Site-specific barometric pressure measurements. The regression analysis was then used to demonstrate that the pressure experienced by the mudline transducers, in terms of the digits and temperature output from the transducer, when accounting for barometric pressure changes, is strongly correlated to the changing FEH_{TIDE}. Having demonstrated that this strong correlation exists, the empirical relationship developed as an outcome of the regression analysis is used in Step 2.
- Step 2: The empirical relationship for the mudline transducers developed through the regression analysis in Step 1 was used to determine the FEH of the mudline transducer within the subtidal piezometer casing before the transducers were grouted into place. Just prior to grouting the transducers into place within the subtidal piezometer casings (i.e., the pre-grout condition), all of the transducers within each subtidal piezometer nest were suspended in the casing at their installed elevations, with the casing open to the tide elevation within the Waterway. In this pre-grout condition, the digits and temperature readings from each transducer were recorded along with the Site-specific barometric pressure measurement. The empirical relationship developed in Step 1 for the mudline transducers was then applied to the pre-grout digits reading, temperature reading, and barometric pressure measurement to determine the FEH experienced by the mudline transducer under pre-grout conditions (referred to as FEH_{PG}).
- Step 3: For each subtidal piezometer nest, the mudline transducer FEH_{PG} determined in Step 2 was applied to calculate the FEH_{PG} for the underlying transducers using the elevation

differences between the transducers and the measured formation density values at each transducer elevation.

- Step 4: For the transducers within each subtidal piezometer nest, the change in height of fresh water (referred to as ΔH_f) for each of the transducer digit and temperature readings and Site-specific barometric pressure measurements for Events 1 and 2 relative to the pre-grout digits/temperature reading and barometric pressure measurement were calculated using the Geokon linear pressure equation (Geokon, 2005) and the Geokon transducer factory calibrated coefficients.
- Step 5: For the transducers within each subtidal piezometer nest, the FEHs for Events 1 and 2 were calculated by adding ΔH_f calculated in Step 4 to the FEH_{PG} calculated in Step 3.

The FEHs calculated in Step 5 were then used to determine the average FEH for Events 1 and 2 for each subtidal transducer within the Waterway using the Serfes (1991) mean averaging methodology presented in Section 2.0. Each of Steps 1 through 5 are described in further detail below.

Step 1: Develop Empirical Relationship Between FEH_{TIDE} and Mudline Transducer Output

Multiple linear regression analysis was used to develop an empirical relationship between the Waterway tide elevation expressed as FEH, or FEH_{TIDE} , and the corresponding mudline transducer digits and temperature output along with the Site-specific barometric pressure measurements. For Events 1 and 2, Site-specific barometric pressure measurements were obtained using a vented Telog® transducer suspended in air at the Site and programmed to record barometric pressure at 5-minute intervals synchronized with the timing of the readings recorded from all transducers installed for Events 1 and 2. In the regression analysis, the FEH_{TIDE} is the dependent variable, and the digit output, temperature output, and barometric pressure measurements are the independent variables. The regression analysis was conducted using the entire recorded dataset for each mudline transducer, which begins shortly after the transducers were installed and connected to the data loggers (which occurred from mid-April to mid-May 2006 depending upon the mudline transducer) and extends to approximately one day following the completion of Event 2.

The Waterway tide elevation measured at the Site was converted to FEH using the following:

$$FEH_{TIDE} = \left(Z_{TIDE} - Z_{MUDLINE}\right) \times \frac{\rho_{MUDLINE}}{\rho_{Fresh}} + Z_{MUDLINE} \qquad \text{Equation 3.19}$$

Where:

FEH_{TIDE} is the Waterway FEH (ft NGVD)

Z_{TIDE} is the Waterway surface water, or tide, elevation measured at the Site (ft NGVD)

$Z_{MUDLINE}$	is the mudline transducer elevation (ft NGVD)
$\rho_{MUDLINE}$	is the in-situ density measured at the mudline transducer (lbs/ft^3)
ρ_{Fresh}	is the density of fresh water at 62.4 lbs/ft^3

The multiple linear regression was used to determine the line of best fit between the FEH_{TIDE} and the digits output, temperature output, and barometric pressure measurements. The empirical relationship has the form:

$$FEH_{TIDE_t} = AR_t + BT_t + CS_t + D \quad \text{Equation 3.20}$$

Where:

$FEH_{TIDE\,t}$	is the FEH_{TIDE} at time *t* (ft NGVD)
A	is the digits coefficient determined through the regression analysis (ft NGVD/digit)
R_t	is the mudline transducer digits output at time *t* (digit)
B	is the temperature coefficient determined through the regression analysis (ft NGVD/°C)
T_t	is the mudline transducer temperature output at time *t* (°C)
C	is the barometric pressure coefficient determined through the regression analysis (ft NGVD/psi)
S_t	is the Site-specific barometric pressure measurement at time *t* (psi)
D	is the FEH_{TIDE} axis intercept determined through the regression analysis (ft NGVD)

The regression data analysis tool implemented in Microsoft Excel was applied to conduct the multiple regression analysis for each of the mudline transducers. The FEH_{TIDE} transducer digit and temperature output, and barometric pressure measurement data applied in the regression analysis are presented in Tables 3-1 to 3-8 of Attachment 3 in electronic form on the CD accompanying this Appendix for the mudline transducers WW-A1-2, WW-A2-2, WW-B1-2, WW-B2-2, WW-C1-2, WW-C2-2, WW-C4-2, and WW-D1-2. Table 7 summarizes the Excel multiple linear regression analysis results in terms of the coefficients determined and the key regression analysis statistics for above mentioned mudline transducers.

As presented in Table 7, the R^2 statistic of the regression analysis for each mudline transducer approaches 1.0 demonstrating that there is a very strong correlation between FEH_{TIDE} and the transducer digit/temperature output and barometric pressure measurements. The strong correlation resulting from the regression analysis indicates that the mudline transducers are hydraulically linked to the Waterway tide and experience the full pressure of the tide height above them. If the mudline transducers were hydraulically isolated from the Waterway, they would not experience the full pressure of the tide height and the empirical relationship between the FEH_{TIDE} and the transducer digits/temperature output and barometric pressure measurements would have a weak correlation. The empirical relationship developed through the regression analysis is a strong predictor of the FEH_{TIDE} based on the transducer digits/temperature output and barometric pressure measurements. Comparisons of the FEH_{TIDE} predicted by the empirical relationship are presented on Figures 3a through 3h for the mudline transducers WW-A1-2, WW-A2-2, WW-B1-2, WW-B2-2, WW-C1-2, WW-C2-2, WW-C4-2, and WW-D1-2, respectively. Figures 5a through 5h present scatter plots of the measured FEH_{TIDE} versus the FEH_{TIDE} predicted by the empirical relationship. The plotted points on each figure fall very close to the 45-degree straight line that represents an exact match between the measured and predicted values, with little scatter above and below this line, which further illustrates the good correlation determined through the regression analysis.

Since the linear regression analysis established a strong correlation between the Waterway FEH_{TIDE} and the mudline transducer digits/temperature output and barometric pressure measurements, it is reasonable to apply the empirical relationship to determine the FEH_{TIDE} experienced by the mudline transducer within the subtidal piezometer casing before the transducers were grouted into place, referred to as FEH_{PG}. The calculation of the mudline transducer FEH_{PG} is based on the mudline transducer digits/temperature readings and barometric pressure measurement taken during the pre-grout condition, as presented in Step 2 below.

Step 2: Calculate Mudline Transducer FEH_{PG}

Using the empirical relationship developed through the multiple linear regression analysis (i.e., Equation 3.20), the mudline transducer FEH_{PG} was calculated from the digit/temperature outputs and barometric pressure measurement taken during the pre-grout condition. The calculation of FEH_{PG} for each mudline transducer is presented in Table 8.

Step 3: Calculate FEH_{PG} *for the Subtidal Piezometer Nest Transducers Underlying the Mudline Transducer*

Using the FEH_{PG} from the mudline transducer calculated in Step 2, the FEHs for all remaining transducers underlying the mudline transducer within each subtidal piezometer was calculated using the elevation differences between the transducers and the measured formation density values at each transducer elevation, as follows:

$$FEH_{PG2} = \left[(Z_1 - Z_2) \times \frac{(\rho_1 + \rho_2)}{2\rho_{Fresh}} \right] - (Z_1 - Z_2) + FEH_{PG1} \qquad \text{Equation 3.21}$$

Where:

FEH_{PG1} is the pre-grout FEH calculated for the overlying transducer (ft NGVD)

FEH_{PG2} is the pre-grout FEH calculated for the underlying transducer (ft NGVD)

Z_1 is the elevation of the overlying transducer (ft NGVD)

Z_2 is the elevation of the underlying transducer (ft NGVD)

ρ_1 is the in-situ density measured at the elevation of the overlying transducer (lbs/ft^3)

ρ_2 is the in-situ density measured at the elevation of the underlying transducer (lbs/ft^3)

In Equation 3.21, the elevation difference and the average in-situ measured density between two vertically adjacent transducers is used to calculate the change in the pre-grout FEH_{PG}, or ΔFEH_{PG}, from the overlying transducer to the underlying transducer. The ΔFEH_{PG} is then added to the FEH_{PG} of the overlying transducer, and then process is repeated for the subsequent underlying transducer. Equation 3.21 can be simplified to:

$$FEH_{PG2} = \Delta FEH_{PG} + FEH_{PG1} \qquad \text{Equation 3.22}$$

The application of Equations 3.22 and 3.21 to determine the FEH_{PG} for all transducers within the WW-B1 subtidal piezometer nest is illustrated schematically on Figure 6. The calculation of FEH_{PG} for all of the transducers within each subtidal piezometer nest is presented in Table 9.

Step 4: Calculate the Change in Height of Fresh Water Relative to the Pre-Grout Condition

In this step, the change in the height of fresh water (referred to as ΔH_f) for each of the 5-minute transducer digits and temperature readings and Site-specific barometric pressure measurement for Events 1 and 2 relative to the pre-grout digit/temperature reading and pre-grout barometric pressure measurement are calculated using the Geokon® linear pressure equation (Geokon®, 2005). Although Method 1 made use of the polynomial pressure equation, Geokon® (2005; Appendix D; p. 26) states that "*where changes of water levels are being monitored it makes little difference whether the linear coefficient or the polynomial expression is used*". Therefore, Method 2 utilizes the Geokon® linear equation since this approach treats the transducer readings as providing changes in FEH relative to the pre-grout condition. The Geokon® linear pressure equation, in terms of the change in pressure relative to pre-grout conditions, is as follows:

$$\Delta P_t = G(R_{PG} - R_t) + K(T_t - T_{PG}) - (S_t - S_{PG}) \qquad \text{Equation 3.23}$$

Where:

ΔP_t is the change in pressure relative to pre-grout conditions at time *t* (psi)

G	is the Geokon® factory calibrated digit coefficient for the transducer (psi/digit)
R_{PG}	is the pre-grout transducer digits reading for the transducer (digit)
R_t	is the transducer digits reading at time *t* (digit)
K	is the Geokon® factory calibrated thermal coefficient for the transducer (psi/°C)
T_{PG}	is the pre-grout temperature reading for the transducer (°C)
T_t	is the transducer temperature reading at time *t* (°C)
S_{PG}	is the pre-grout Site-specific barometric pressure measurement (psi)
S_t	is the Site-specific barometric pressure measured at time *t* (psi)

In contrast to Method 1, Method 2 calculates ΔP between a specific pressure reading during Events 1 or 2 and the pressure experienced at the transducer during the pre-grout conditions. Since the transducer elevation did not change after the pre-grout readings, Equation 3.23 calculates the ΔP as a result of changes in water level between the time of pre-grouting and a transducer measurement during Events 1 or 2. To obtain an absolute pressure using Method 2, the ΔP calculated using Equation 3.23 can be added to the total or absolute pressure experienced by the transducer at the time of the pre-grout measurement (see Step 5). Note that for Method 2, the Geokon® provided pressure equations and factory calibrated coefficients are still employed. The main difference between Methods 1 and 2 is that the initial transducer readings for Method 2 are taken during the pre-grout condition rather than in the 8-foot water column as applied in the revised Method 1.

Height of fresh water is defined as follows:

$$H_f = C \times \frac{P}{\rho_f \, g} \qquad \text{Equation 3.24a}$$

Where:

H_f	is the height of the fresh water column (ft)
P	is the pressure exerted at the base of the fresh water column (psi)
ρ_f g	is the unit weight of fresh water at 62.4 pounds-force per cubic foot (lbf/ft^3)
C	is a conversion factor of 144 square inches per square foot

Substituting in the values for C and ρ_f g provides:

$$H_f = \frac{144}{62.4} \times P \qquad \text{Equation 3.24b}$$

Equation 3.24b then reduces to:

$$H_f = 2.3077 \times P$$ Equation 3.24c

Switching nomenclature to a change in the height of fresh water, ΔH_f , due to a change in pressure, ΔP , Equation 3.24c becomes:

$$\Delta H_f = 2.3077 \times \Delta P$$ Equation 3.24d

Substituting Equation 3.23 into Equation 3.24d provides:

$$\Delta H_{f_t} = 2.3077 \times \left[G\left(R_{PG} - R_t\right) + K\left(T_t - T_{PG}\right) - \left(S_t - S_{PG}\right)\right]$$ Equation 3.25

Where:

ΔH_{f_t} is the change in the height of the fresh water at time *t* (ft)

Using Equation 3.25, ΔH_{f_t} was calculated for each 5-minute transducer digits/temperature reading and barometric pressure measurement recorded during Events 1 and 2. Table 10 presents example calculations of ΔP_t and ΔH_{f_t} on an hourly basis using Equations 3.23 and 3.25, respectively, for the subtidal transducer WW-B1-100 during Event 1. The calculations are performed in an hourly basis since it is the hourly transducer readings that are applied in the calculation of the Serfes (1991) mean pressure and FEH. In Step 5 below, ΔH_{f_t} is then added to FEH_{PG} to provide the FEH at the subtidal transducer at each time interval during Events 1 and 2. It is important to distinguish that FEH is relative to a 0 ft NGVD datum, whereas ΔH_{f_t} is the change in fresh water height above the transducer elevation that is not relative to a specific datum, but is the height of fresh water relative to the transducer elevation.

Step 5: Calculate Events 1 and 2 FEHs

The FEH at each subtidal transducer in Events 1 and 2 was calculated by adding ΔH_{f_t} to FEH_{PG} , as follows:

$$FEH_t = FEH_{PG} + \Delta H_{f_t}$$ Equation 3.26

Where:

FEH_t is the FEH at time *t* (ft NGVD)

Table 10 presents example calculations of FEH_t on an hourly basis using Equation 3.26 for the subtidal transducer WW-B1-100 during Event 1.

Figures 7a through 7h present measured FEH_{TIDE} (as a line plot) and predicted FEH_{TIDE} (as a plotted points) versus time over the duration of Events 1 and 2. These figures illustrate the good correlation between the measured and predicted FEH_{TIDE}.

The calculated FEH_t values (on an hourly basis) were used to determine the average FEHs for Events 1 and 2 for each subtidal piezometer within the Waterway (i.e., WW-A1, WW-A2, WW-B1, WW-B2, WW-C1, WW-C2, WW-C4, and WW-D1) using the Serfes (1991) mean averaging approach.

Section 4.0 Groundwater Level Recovery Evaluation

4.1 Filtering of Tidal Fluctuation Effects

Tidal fluctuations are observed in the hydraulic pressures measured throughout the Site peninsula. The Hylebos/Blair Waterways and Commencement Bay that surround the Site peninsula experience tidal fluctuations caused by incoming and outgoing tides. The tidal fluctuations produce pressure waves that propagate inland into the adjacent aquifers causing fluctuations in the measured hydraulic pressures. Simultaneous measurements of monitoring well hydraulic pressure and tide elevation were obtained. These simultaneous measurements permit estimation of tidal efficiency and time lag at the monitoring well locations using the method developed by Erskine (1991). The Erskine (1991) method is summarized in Section 4.1.1.

The tidal efficiency and time lag allow tidal fluctuations to be filtered from the monitoring well pressure responses, and also permit estimating the ratio of storativity (*S*) to transmissivity (*T*) for the aquifer (i.e., S/T). In addition, the tidally corrected hydraulic responses at the monitoring wells can be used to estimate the degree of groundwater level recovery occurring between Events 1 and 2 and Events 3A and 3B after shut down of the Site groundwater extraction/injection system. The application of the Erskine (1991) method to estimate tidal efficiency, time lag, S/T, and recovery is presented in Section 4.1.2.

The filtered hydraulic responses also permit evaluating the potential influences of precipitation, pumping rate variations, and barometric pressure changes on the hydraulic responses measured at the Site monitoring wells, as presented in Section 4.1.3.

4.1.1 Erskine (1991) Method Summary

Tidal fluctuations produce pressure waves, or oscillations, that propagate inland from tidally influenced surface water bodies. The tidally induced pressure wave is damped by the aquifer soil matrix as it propagates through the aquifer. The Erskine (1991) method makes use of a set of theoretical equations relating to the propagation of an oscillatory pressure wave through an aquifer based on its storativity and transmissivity.

The Erskine (1991) method assumes a single tidally influenced surface water body adjacent to a theoretically continuous aquifer that continues inland infinitely. The Site is bounded on three sides by tidal fluctuations in the Hylebos/Blair Waterways and Commencement Bay, which introduces some uncertainty in applying the Erskine (1991) method to the Site. Attempts were made to remove dual tidal effects caused by two bounding tidally influenced surface water bodies, after Sun et al. (2008). However, this approach provided filtered monitoring well pressure responses that were only marginally improved over that provided by the Erskine (1991) method, and thus was not pursued further.

For the Erskine (1991) method, a predicted well pressure response ($P_{Predicted}$) is determined based on the tidal efficiency and time lag of the tide data in comparison to the observed well pressure response ($P_{Observed}$). The predicted response is subtracted from the observed response to determine a filtered, or residual, well pressure response ($P_{Residual}$) as follows:

$$P_{Residual} = P_{Observed} - P_{Predicted} \qquad \text{Equation 4.1}$$

The residual pressure response can be used to estimate the degree of recovery occurring following the Site extraction/injection system shut down. An example of approach used to estimate recovery based on the residual pressure response is presented in Section 4.1.2.

The Erskine (1991) method is more specifically described using Equation 4.2, where the second term on the right hand side of Equation 4.2 represents $P_{Predicted}$:

$$h_F(t) = h(t) - \left(TE \times T(t - t_{LAG}) - TE \times \overline{T}\right) \qquad \text{Equation 4.2}$$

Where:

$h_F(t)$ is the filtered monitoring well pressure response at time t (psi), or $P_{Residual}$

$h(t)$ is the measured monitoring well pressure response at time t (psi), or $P_{Observed}$

TE is the tidal efficiency factor between the tide elevation and monitoring well hydraulic response (psi/ft NGVD)

$T(t - t_{LAG})$ is the tide elevation at time t (ft NGVD) offset by the calculated time lag, where the time lag corresponds to the time for the tidally induced pressure wave to travel through the aquifer and reach the monitoring well (minutes)

$TE \times \overline{T}$ is the tidal efficiency multiplied by the average tide, $\overline{T}$. In the application of the Erskine (1991) method here, the term $TE \times \overline{T}$ represents a pressure offset that is estimated visually for each monitoring well to minimize the average difference between the observed and predicted pressure response.

The tidal efficiency and time lag used to calculate $P_{Predicted}$ are determined from the correlation of the observed well pressures to the tide elevations over time. The tidal efficiency is the ratio of the tidal range in the aquifer measured at the well relative to the tidal range observed in the surface water body, calculated as the ratio of the standard deviation of the well pressures to the standard deviation of the tide elevations measured over the same time interval, as follows:

$$TE = \frac{\sigma_{Well\,Pressures}}{\sigma_{Tide\,Elevations}}$$ Equation 4.3

Where:

$\sigma_{Well\,Pressures}$ is the standard deviation of the well pressures over a time interval (psi)

$\sigma_{Tide\,Elevations}$ is the standard deviation of the tide elevations over the same time interval as $\sigma_{Well\,Pressure}$ (ft NGVD)

This approach uses all the measured data rather than just the peak readings (which reduces the potential effect of individual reading errors and is superior to estimating a peak ratio), and is only applicable for identically formed signals symmetrical about their mean where continuous readings are available (Erskine, 1991). As a result, the method was only applied for wells having continuous pressure readings. In most cases, tidal efficiency is dimensionless since observed tide elevations and well hydraulic response readings are usually in the same units. However, since the observed well hydraulic response readings are in terms of pressure (psi) and the observed tide elevations are in terms of elevation (ft NGVD), the units of tidal efficiency calculated here are psi/ft NGVD. An example calculation of the tidal efficiency is presented in Section 4.1.2.

Time lag refers to the amount of time for the tidal signal to travel from one point to another through the aquifer soil matrix. The time lag was determined using the correlation function implemented in Microsoft Excel to correlate the observed well pressure to the tide elevation for incremental time lag durations. The date range for the tide elevation data set was held constant while the date range for the observed well pressures was advanced at 5-minute increments (i.e., an incremental time lag) while holding the total number of data points in each data set constant. A correlation coefficient was determined for the two sets of data for each incremental time lag. The incremental time lag corresponding to the maximum correlation coefficient was selected as the time lag for the observed well hydraulic response. An example calculation the time lag using is presented in Section 4.1.2.

The ratio S/T can be calculated from either the estimated tidal efficiency or the estimated time lag. S/T can be calculated from tidal efficiency using Equation 4.4:

$$(S/T)_{TE} = \frac{2}{\omega}\left(\frac{ln(TE)}{x}\right)^2$$ Equation 4.4

Where:

$(S/T)_{TE}$ is the ratio of storativity to transmissivity calculated from tidal efficiency (day/ft^2)

ω is a constant equal to 12.145 (1/day) determined from $\omega = 2\pi/t_o$ where t_o is the average tide period determined to be 0.51736 days based on the measured tide elevation data

TE is the tidal efficiency (psi/ft NGVD)

x is the distance from the monitoring well location to the shoreline (ft)

S/T can be calculated from time lag using Equation 4.5:

$$(S/T)_{Time\ Lag} = 2\omega\left(\frac{Time\ Lag}{x}\right)^2$$ Equation 4.5

Where:

$(S/T)_{Time\ Lag}$ is the ratio of storativity to transmissivity calculated from time lag (day/ft^2)

An average S/T was calculated from the geometric mean of $(S/T)_{TE}$ and $(S/T)_{Time\ Lag}$.

4.1.2 Erskine (1991) Method Application

The methodology outlined in Section 4.1.1 was used to calculate the tidal efficiency, time lag, and S/T at the upland monitoring wells where a sufficient pressure record was available. The tidally corrected pressure response at each well was then used to estimate the groundwater level recovery that occurred after the shut-down of the Site groundwater extraction/injection system following Event 1 and Event 3A. An example application of the methodology is presented for Event 1 well 11-45. The results for the remaining wells are presented electronically in the Microsoft Excel spreadsheets included on CD in Attachment 4.

Prior to applying the Erskine (1991) method, an evaluation was conducted to select an appropriate data range representative of natural hydraulic responses in the aquifer not impacted by external influences, such as recovery due to the Site groundwater extraction/injection system shut down or variations in the groundwater extraction system pumping rates. Figure 8 presents the daily total pumping rate for the extraction system over the duration of Events 1 and 2. Prior to Event 1, pumping interruptions and variations occurred that were caused by installing flow meters on the extraction wells and maintenance of the treatment system, and then the extraction system was shut down after Event 1 (note that the impacts of the pumping variations on the measured well hydraulic responses during Event 1 are discussed in Section 4.1.3). Thus, the appropriate data range for applying the Erskine (1991) method representative of natural hydraulic responses corresponds to after groundwater levels had fully recovered following the extraction system shut down. An evaluation was conducted using a Theis analysis to estimate when full recovery would be expected, as described below.

The Theis analysis was completed to estimate when theoretical groundwater level recovery would be complete based on a hypothetical pumping well located 500 ft inland from the Waterway pumping at 100 gallons per minute (GPM). The analysis assumes a value of 1×10^{-6} day/ft^2 for S/T. A hydraulic conductivity of 40 ft/day was applied (based on the upper range of hydraulic conductivity values measured in the deltaic deposits at the Site), along with an aquifer thickness of 100 ft to provide a transmissivity of 4,000 ft^2/day and a storativity value of 0.004. Theoretical recovery curves were estimated at various distances from the Waterway in response to the cessation of pumping at the hypothetical well. The resulting recovery curves are presented on Figure 9, and show that approximately 90 percent recovery would be expected 1 day following shut down and full recovery would be expected within approximately 8 days of shut down.

Based on the Theis analysis, the data range for applying the Erskine (1991) method was selected to begin on June 8, 2006 at 00:00 PDT, which is approximately 8.6 days following the extraction system shut down on May 31, 2006 at 13:55 PDT. The data range was extended to June 21, 2006 at 23:55 PDT, which corresponds to maximum time that continuous recorded data were available for all wells. Example calculations of tidal efficiency, time lag, S/T, and recovery for well 11-45 are presented in Table 11 and summarized below. Columns B and C of Table 11 present the observed well pressure and tide elevation data used to perform the calculations for well 11-45. The monitoring well pressures were recorded at 5-minute intervals, while the tide elevations were recorded at 30-minute intervals. Linear interpolation between the 30-minute tide elevation readings was used to determine tide elevations on a 5-minute interval.

Tidal Efficiency Calculation

The tidal efficiency calculation is presented on Line 4 of Table 11, and is based on ratio of the standard deviation of the well pressures to the standard deviation of the tide elevations measured from

June 8, 2006 0:00 PDT to June 21, 2006 23:55 PDT, after Equation 4.3. The standard deviations are calculated using the standard deviation function implemented in Microsoft Excel.

Time Lag Calculation

The calculations to determine time lag are presented on Lines 10 and 11 and in Columns F and G of Table 11. The correlation between the well pressure and tide elevation measurements at 5-minute increments in time lag was calculated from June 8, 2006 0:00 PDT to June 21, 2006 23:55 PDT. The calculated correlation coefficients are shown in Column F for incremental time lags shown in Column G of Table 11. The correlation coefficients were calculated using the correlation function implemented in Microsoft Excel. The maximum correlation coefficient identifies the time at which the strongest relationship exists between the well pressure and the tide elevation, and was selected as the time lag. The correlation coefficients versus incremental time lag for well 11-45 are plotted in Figure 10. The maximum correlation coefficient corresponds to a time lag of 120 minutes.

S/T Calculation

S/T was calculated using both tidal efficiency and time lag. S/T calculated from tidal efficient using Equation 4.4 is presented on Line 6 of Table 11. S/T calculated from time lag on Line 10 of Table 11 using Equation 4.5 is presented on Line 7 of Table 11. The geometric mean of the two S/T values is 1×10^{-6} day/ft^2 presented on Line 8 of Table 11.

Recovery Calculation

The second term of Equation 4.2 represents the predicted pressure $P_{Predicted}$ at the well location based on tidal efficiency and time lag, and is reproduced below as Equation 4.7:

$$P_{Predicted} = TE \times T(t - t_{LAG}) - TE \times \overline{T} \qquad \text{Equation 4.7}$$

As described in the variable definitions for Equation 4.2, the term $TE \times \overline{T}$ is a pressure offset that is estimated visually for each monitoring well to minimize the average difference between the observed and predicted pressure response. The pressure offset for well 11-45 is indicated in Line 5 of Table 11, and minimizes the difference between the observed and predicted pressure responses for 11-45 as presented on Figure 11. An increase or decrease in the pressure offset only shifts the predicted pressure response up or down, respectively. Minimizing the difference between the observed and predicted pressure responses provides an approximate zero residual pressure $P_{Residual}$ just before the Site extraction/injection system shut down, as shown on Figure 12. This aids in estimating the degree of recovery occurring in response to the shut-down, as described below.

The residual pressure $P_{Residual}$ calculated using Equation 4.1 is presented in Column E of Table 11 and is plotted on Figure 12. Figure 12 demonstrates that the Erskine (1991) method does not provide a smooth residual pressure curve that eliminates all oscillations in the observed well pressures, largely due to having tidal fluctuations occur on three sides of the Site peninsula. A 255-point moving average of the residual pressure curve is used to further reduce fluctuations and aid in estimating the degree of recovery occurring in response to the Site extraction/injection system shut down.

The 255-point moving average of the residual pressure is presented on Figure 12. There is a definitive increase in pressure occurring immediately after the Site extraction/injection system shut down. Approximately 2 to 3 days after shut down, the moving average of the residual pressure stabilizes. The degree of recovery is estimated visually based on the moving average of the residual pressure. For well 11-45, the estimated recovery is 0.55 psi, as presented on Figure 12.

Summary of Erskine (1991) Method Application

The detailed results for the estimated tidal efficiency, time lag, S/T, and recovery for the remaining monitoring wells with sufficient continuous pressure readings are presented electronically in the Microsoft Excel spreadsheets included on CD in Attachment 4. Table 12 presents a summary of the tidal efficiency, time lag, S/T, and recovery results from Event 1 to Event 2. The average S/T determined at each well location ranges from 6.8×10^{-8} to 3.3×10^{-4} day/ft^2 with a geometric mean of 3.1×10^{-6} day/ft^2. The estimated recovery ranges from zero, typically occurring at wells that are distant from the extraction system, to a maximum estimated recovery of 1.57 ft at well 11-100 located close to extraction well D-5. Table 13 presents a summary of the tidal efficiency, time lag, S/T, and recovery results from Event 3A to Event 3B. The average S/T determined at each well location ranges from 1.9×10^{-7} to 5.2×10^{-4} day/ft^2 with a geometric mean of 1.6×10^{-6} day/ft^2. The estimated recovery ranges from 0.07 ft, typically occurring at wells that are distant from the extraction system, to a maximum estimated recovery of 1.18 ft at well 40-75 located close to extraction well A-2A.

4.1.3 Evaluation of Tidally Corrected Pressure Responses

Event 1 to Event 2 Recovery

The filtered hydraulic responses were compared to precipitation, pumping rate variations, tide elevation, and barometric pressure changes to evaluate their potential influence on the hydraulic responses measured at the Site monitoring wells. An example of this evaluation is described below for well 11-45.

The filtered hydraulic response, or residual pressure, for well 11-45 is plotted against hourly precipitation and daily pumping rates for the Site extraction system on Figures 13 and 14, respectively. Figure 13 shows that significant rainfall events occurred on May 22 to 26, 2006 and June 1 to 2, 2006.

Both of these precipitation events coincide with increases in the residual pressure on Figure 13, suggesting that the pressure increases may be related to precipitation. However, Figure 14 demonstrates that the pressure increases also correspond to when pumping was reduced on May 23 to 25, 2006 for treatment system maintenance, and when pumping was stopped on May 31, 2006 to conduct Event 2. Pumping was also stopped on May 17 to 18, 2006 to install the extraction well flow meters. Figure 14 shows a distinct increase in the residual pressure occurring from May 17 to 18, 2006, and when pumping resumed on May 19, 2006, the residual pressure decreased abruptly. No precipitation occurred during May 17 to 18, 2006. As a result, the increased residual pressure occurring on May 17 to 18, 2006 is attributable to groundwater level recovery in response to the stoppage in pumping at that time. Based on this, the increased residual pressure occurring on May 22 to 26, 2006 and June 1 to 2, 2006 is also attributable to the pumping rate changes on these dates, and not precipitation.

The residual pressure increases/decreases caused by the pumping rate variations demonstrates that Event 1 was not representative of drawdown under steady-state pumping conditions. Figure 14 demonstrates that the residual pressure continued to decrease over the duration of Event 1 as essentially constant pumping was maintained. As a result, Event 1 was considered suitable as a steady-state pumping condition for calibrating the groundwater model being developed for the Site.

The residual pressure on Figure 14 begins to approach an approximate steady-state condition (i.e., a plateau) just before the Site extraction/injection system was shut down following on May 31, 2006. As a result, the estimated recovery values are assumed representative of steady-state conditions. Some continued decline in the residual pressure could have occurred if pumping was maintained beyond May 31, 2006, and the estimated recovery values may under-estimate actual steady-state recovery conditions. This introduces some uncertainty in applying the estimated recovery values as targets for calibrating the groundwater model being developed for the Site. However, applying the estimated recovery as steady-state targets (when they may under-estimate actual recovery), can lead to an over-prediction of hydraulic conductivity, which is a conservative approach for the model calibration.

The residual pressure for well 11-45 is also plotted against tide elevation and barometric pressure on Figures 15 and 16, respectively. There does not appear to be a consistent correlation between tide elevation or barometric pressure and the changes in residual pressure occurring before, during, and immediately after Event 1. The pumping rate fluctuations shown on Figure 14 have the most significant impact on the residual pressure. Therefore, the increased residual pressure occurring after the May 31, 2006 is representative groundwater level recovery in response to the extraction system shut down.

Event 3A to Event 3B Recovery

Figure 17 presents a summary of the extraction system total pumping, precipitation, and tide elevation over the duration of the Comprehensive Supplemental Investigation (CSI) hydraulic monitoring. The Event 3 CSI hydraulic monitoring formally began on September 9, 2012 and ended on December 15, 2012. However, hydraulic monitoring at several of the Site standard monitoring wells began in late August 2012. The hydraulic monitoring conducted prior the formal beginning of Event 3 aids in evaluating the degree of groundwater elevation recovery occurring following the shut-down of the extraction system, as is described further below. Therefore, Figure 17 extends from late August 2012 to the end of Event 3 on December 15, 2012. Figure 17 shows when shut-downs occurred for the groundwater extraction system. The shut-downs are based on the table inset below that summarizes the extraction system operational status during the CSI hydraulic monitoring.

Two shut-downs of the extraction system occurred during the CSI hydraulic monitoring, as presented on Figure 17. The first shut-down occurred from August 30, 2012 at 18:37PM to September 7, 2012 at 11:55AM. The groundwater treatment system sea water pump was repaired during this time period. The second shut-down occurred from October 24, 2012 at 14:00PM to December 3, 2012 at 09:37AM. There was a temporary start-up of the extraction system pumping on October 24, 2012 at 14:35PM to October 27, 2012 at 04:30AM that was halted due to a failure of the sea water pump. The water pump was repaired for the extraction system start-up occurring on December 3, 2012 at 09:37AM.

The time periods to develop groundwater FEH contours were selected during the Event 3 hydraulic monitoring period from September 9 to December 15, 2012 when the hydraulic pressures were being recorded throughout the complete CSI hydraulic monitoring network. The 72-hour time periods selected to develop groundwater FEH contours are indicated on Figure 17 and correspond to:

- Event 3A – from October 5, 2012 at 12:00PM to October 8, 2012 at 12:00PM and representative of pumping conditions immediately before the second extraction system shut-down
- Event 3B – from October 11, 2012 at 12:00PM to October 14, 2012 at 12:00PM and representative of non-pumping conditions after groundwater elevations had recovered following the second extraction system shut-down

As indicated on Figure 17, rainfall occurred on October 13 to October 15, 2012. The rainfall results in watershed surface water run-off that discharges to the surrounding surface water bodies causing a rise in the tide elevation. On Figure 17, an increased tide elevation is apparent in the Serfes (1991) mean tide elevation following the October 13 to October 15, 2012 rainfall. Increased tide elevations result in increased aquifer pressures, or FEHs, similar to that observed in the continuous hydraulic monitoring results for the 25-ft zone monitoring wells. The Event 3B 72-hour time period was selected to avoid the increasing aquifer pressures caused by the rising tide following the October 13 to October 15, 2012 rainfall. The increased aquifer pressures due to the rising tide would not be representative of the groundwater recovery occurring to the extraction system shut-down (i.e., the recovery occurring due to the cessation of pumping alone would be inflated).

The Erskine (1991) method was used to filter out tidal fluctuations from the measured pressures at selected standard monitoring wells to evaluate the degree of groundwater recovery following the first and second shut-downs, as follows:

- Well 11-75 located near extraction well D-5
- Well 7-100 located near extraction well C-1
- Well 5-75 located in the central portion of the Site

The residual pressures estimated using the Erskine (1991) method during the first extraction system shut-down for wells 5-75, 7-100, and 11-75 are presented on Figures 18, 19, and 20, respectively. The residual pressures estimated during the second extraction system shut-down for wells 5-75, 7-100, and 11-75 are presented on Figures 21, 22, and 23, respectively. The residual pressures are plotted against the extraction system total pumping rate, tide elevation, and precipitation.

The residual pressures during the first shut-down show that recovery occurred at all three wells. The recovery at 5-75 is limited, but there is a distinct increase in the residual pressure at the beginning of the first shut-down that is followed by a distinct decrease in the residual pressure when pumping resumes. No precipitation occurs during the first shut-down, and thus, the observed recovery is due to the cessation of pumping only.

The residual pressures show that full recovery at these wells occurs within approximately 3 days. During the middle of the shut-down, there is a slight decrease in the residual pressure that corresponds to a subtle decline in the tide elevations occurring at this time that is apparent in the average tide presented on Figures 18, 19, and 20.

Similar to the first shut-down, the residual pressures during the second shut-down show that recovery occurred at all three wells within approximately 3 days. Again, the recovery at 5-75 is limited, but there is a distinct increase in the residual pressure at the beginning of the second shut-down, which demonstrates recovery. There is a second increase in the residual pressure that occurs for all three wells following the October 13 to 15, 2012 rainfall, which is caused by the rising tide created by watershed run-off from the rainfall event. This residual pressure increase occurs approximately mid-day on October 14, 2012. Therefore, the end of the 72-hour time period for Event 3B was selected at mid-day on October 14, 2012.

Section 5.0 Specific Gravity/Density Versus Specific Conductance Relationship

This section presents the development of the specific gravity/density versus specific conductance relationship. The relationship is developed using the laboratory analysis of specific gravity in groundwater samples collected from upland monitoring wells, as well as from the transducer locations of the subtidal piezometers, and coincident field measurements of specific conductance obtained at the same time that the groundwater samples were collected. The primary purpose of developing the specific gravity/density versus specific conductance relationship is to allow the conductivity profiles obtained at the upland monitoring wells with a Type 1 transducer configuration to be converted to a density profile that was then used to determine Events 1 and 2 FEHs at these locations. As described in Section 3.6.4.1.1 of the main report, the Type 1 transducer configuration consists of the situation where the transducer is suspended in the well casing above the well screen. The density profile in the Type 1 transducer configuration monitoring wells will allow the pressure recorded by the transducer to be converted to a formation pressure observed at the screen mid-point.

An example specific gravity/density versus specific conductance relationship was developed in Section 3.2 using only the Event 1 specific gravity and specific conductance data. This example relationship is updated in this section using both the data from Event 1, Event 2, and the subtidal piezometers.

A search was conducted for specific gravity versus specific conductance relationships reported in the literature to compare with that developed herein. Section 5.1 presents the results of this literature search. Section 5.2 outlines the methodology applied to develop the specific gravity/density versus specific conductance relationship presented herein. Section 5.3 presents the outlier analysis for the data from Event 1, Event 2, and the subtidal piezometers. Section 5.4 presents the results of the specific gravity versus specific conductivity relationship.

5.1 Literature Search for Specific Gravity vs. Specific Conductance Relationships

A search was conducted to identify specific gravity versus specific conductance relationships identified in relevant literature. The literature search was unable to identify a unique reference that reported a relationship between specific gravity, or density, and specific conductance. Relationships found in scientific literature typically relate Total Dissolved Solids (TDS) to specific gravity/density and relate specific conductance to TDS. Relationships reported between TDS and specific gravity/density and between specific conductance and TDS were combined to determine an approximate range in literature reported relationships between specific gravity/density and specific conductance.

TDS vs. Density

The density of seawater is generally calculated from measurements of temperature, salinity, and pressure using the Equation of State of Seawater (UNESCO, 1981). Since this equation is very complex and computationally expensive to use, in a study conducted by Spirax-Sarco Limited (SSL), a simple relationship was developed between TDS and the density of boiler water (SSL, 2006). The calculation of TDS using a relative density, or specific gravity, is presented in SSL (2006) as:

$$TDS = \left(SG_{15} - 1\right) \times 1.1 \times 10^{6}$$ Equation 5.1

Where:

TDS is the Total Dissolved Solids (ppm)

SG_{15} is the relative density, or specific gravity, of boiler water at 15.6°C (60°F) (mS/cm)

In order to apply this relationship to the specific conductance measurements at the Site, which were obtained using Horiba® and YSI® meters that report specific conductance relative to a reference temperature of 25°C°77°F), the specific gravity in Equation 5.1 requires adjustment from a reference temperature of 60°F°(15.6°C) to 25°C (77°F). The temperature adjustment for specific gravity is based on the adjustment provided in the ASTM Standard D1429-86, and is expressed mathematically as:

$$SG_{25} = SG_{15} - 0.0002(77°\text{F} - 60°\text{F})$$ Equation 5.2

Where:

SG_{25} is the specific gravity adjusted to a reference temperature of 25°C (77°F) (mS/cm)

Substituting Equation 5.2 into Equation 5.1 yields:

$$TDS = \left(SG_{25} - 0.9966\right) \times 1.1 \times 10^{6}$$ Equation 5.3

TDS vs. Specific Conductance

A tolerable empirical approximation between TDS and specific conductance commonly appears in several references (e.g., Walton, 1989; and Driscoll, 1986). By using a measured specific conductance, an empirical relationship can be used to provide a reasonable estimation of TDS. The relationship between TDS and specific conductance can be stated as follows:

$$TDS = SC_{25} \times K$$ Equation 5.4

Where:

TDS	is the Total Dissolved Solids (ppm)
SC_{25}	is the specific conductance reported at the standard reference temperature of 25°C°(77°F) (mS/cm)
K	is an empirical factor relating TDS to specific conductance that ranges from 500 to 750 for different water types (Walton, 1989)

Specific Gravity/Density vs. Specific Conductance

Equations 5.3 and 5.4 can be combined to develop a relationship between specific gravity/density and specific conductance. Substituting Equation 5.3 into Equation 5.4 and rearranging, the resultant relationship between specific gravity/density and specific conductance can be expressed as:

$$SG_{25} = 0.9966 + SC_{25} \times K' \qquad \text{Equation 5.5}$$

Where:

K'	is the empirical factor relating TDS to specific conductance that ranges from 500 to 750 for different water types divided by the constant 1.1×10^6 of Equation 5.3, which provides values for K' that range from 0.0004545 (i.e., $500 \div 1.1 \times 10^6$) to 0.000681818 (i.e., $750 \div 1.1 \times 10^6$)

Equation 5.5 represents a range in the literature-reported relationships between specific gravity/density and specific conductance. This literature range is illustrated as the shaded region on Figure 24a, Figure 24b, Figure 25, Figure 26, and Figure 27.

5.2 Methodology and Results – Specific Gravity/Density versus Specific Conductance Relationship

The general approach to developing the specific gravity/density versus specific conductance relationship involved using linear regression to determine a best-fit line through the specific gravity and specific conductance data obtained from Event 1, Event 2, and the subtidal piezometers. The specific gravity and specific conductance data obtained from Event 1, Event 2, and the subtidal piezometers are presented below. Plotting the specific gravity data versus specific conductance data demonstrates that the data follow a linear relationship, with some apparent outliers that fall outside of the linear trend. The outliers could be the result of several factors, such as formation heterogeneities, meter variance in the specific conductance measurements, variance in the laboratory analytical method for specific gravity, and/or variations in groundwater chemistry. A combined qualitative approach and statistical analysis was applied to identify outliers in each of the three sets of specific gravity and specific conductance data. The identification of outliers in the specific gravity and specific conductance data is presented below. The development of the specific gravity/density versus specific conductance relationship excluding the outlier data points is also presented below.

5.2.1 Specific Gravity and Specific Conductance Data

Field measurements of specific conductance were obtained using a Horiba® meter at the time the Event 1 and subtidal piezometer groundwater samples were collected. The Event 1 groundwater samples were collected from the upland monitoring wells, and the groundwater samples for the subtidal piezometers were collected from the subtidal piezometer transducer locations. In some groundwater samples, the measured specific conductance was greater than the maximum range for the Horiba® meter of 99.9 mS/cm. This limitation in the Horiba® meter was not identified until after the subtidal piezometer and Event 1 groundwater sampling was completed. During Event 2, a YSI® meter was applied in series with the Horiba® meter. The YSI® meter was capable of measuring specific conductance values greater than 99.9 mS/cm. Both the Horiba® and YSI® meters provide measurements of specific conductance relative to a reference temperature of 25°C°(77°F). Specific conductance measurements obtained from the Horiba® meter that were greater than 99.9 mS/cm could not be used to develop the relationship between specific gravity and specific conductance, since the actual specific conductance value is not known.

The groundwater samples were submitted for the laboratory analysis of specific gravity. The groundwater samples for Event 1, Event 2, and the subtidal piezometers were analyzed for specific gravity using ASTM Standard D1429-86, which provides specific gravity results that correspond to the density of the groundwater sample divided by the density of water at a standard temperature of 60°F (15.6°C). Therefore, the specific gravity laboratory results for Event 1, Event 2, and the subtidal piezometers can be converted to density by multiplying by 999.012 kg/m^3 (62.4 lbs/ft^3), which is the density of pure water at 60°F (15.6°C) (CRC Press, 1988). Since the Horiba® and YSI® meters report specific conductance measurements relative to a reference temperature of 25°C (77°F), the specific gravity measurements were adjusted from a reference temperature of 60°F (15.6°C) to 25°C (77°F) to develop the relationship between specific gravity and specific conductance.

The temperature adjustment for the Event 1, Event 2, and subtidal piezometer specific gravity data is based on the adjustment provided in the ASTM Standard D1429-86, which is expressed in Equation 5.2. The Event 1, Event 2, and subtidal piezometer specific conductance data and specific gravity data, adjusted to 25°C (77°F), are presented in Table 14, Table 15, and Table 16, respectively. The specific gravity data are converted to density in both Imperial and Metric units and the transducer configuration type (i.e., Types 1, 2, or 3 as described in Section 2.1) for each data point are indicated in Tables 14, 15, and 16. The data points not used in the analysis (because the specific conductance measurements obtained from the Horiba® meter were greater than 99.9 mS/cm) are indicated in Table 14, Table 15, and Table 16. A limited number of data points that were not used due to not having a measurement of specific gravity or specific conductance are also indicated in Table 14, Table 15, and Table 16.

5.3 Outlier Analysis

For each set of specific gravity and specific conductance data for Event 1, Event 2, and the subtidal piezometers, specific gravity was plotted versus specific conductance. An initial qualitative assessment of outlying data points was conducted by inspecting these plots and removing as outliers the data points that were far removed from the apparent linear relationship that was demonstrated by the data. An initial linear regression analysis then was performed to determine the best-fit linear model through the remaining data points. The regression tool implemented in Microsoft Excel® was applied to carry out the linear regression analysis.

Following the development of the initial linear regression model, a second outlier screening was performed to determine if any further data points did not conform to the overall linear pattern exhibited by the data. This outlier screening was conducted through the calculation of prediction intervals for individual regression model estimates. Specifically, for each measured specific conductance value (x_i), the expected specific gravity based on the initial linear regression model (y_i') was estimated, along with a statistically based Upper Prediction Limit (UPL) and Lower Prediction Limit (LPL) for the specific gravity estimate. The UPL and LPL represent the range within which observed values consistent with the dataset used in the regression analysis are expected to occur, at a 99 percent level of confidence. The UPL and LPL are used to define what is referred to herein as the "99% Prediction Interval". Observations outside of the 99% Prediction Interval are judged to be sufficiently atypical of the underlying dataset to be considered as statistical outliers.

The calculation of a prediction interval for a specific y_i' is obtained through the following equation (Devore and Peck, 1986, p. 470):

$$P.I. = y_i' \pm t_{1-\alpha} \sqrt{s_e^2 + s_{y_i'}^2} \qquad \text{Equation 5.6}$$

Where:

$P.I.$	is the prediction interval about the specific regression model estimate y_i' of specific gravity at the measured specific conductance x_i (i.e., $y_i' = b + m \cdot x_i$, where b and m are the intercept and slope of the linear model determined from the regression analysis)
$t_{1-\alpha}$	is the tabulated value from the Student-*t* distribution (with n - 2 degrees of freedom)
$1-\alpha$	is the selected confidence level where α =0.01 for a 99 percent confidence interval
s_e^2	is the variance of the regression residuals
$s_{y_i'}^2$	is the variance of the regression model estimate of y_i'

The variance of the regression model estimate of y'_i (i.e., $s^2_{y'_i}$) was calculated individually as part of the prediction interval determined using Equation 5.6. This variance is calculated as follows (Devore and Peck, 1986, p. 467):

$$s^2_{y'_i} = s^2_e \left[\frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum (x - \bar{x})^2} \right] \quad \text{Equation 5.7}$$

Where:

n	is the number of observations
$\bar{x}$	is the mean of the measured specific conductance x_i values
$\sum (x - \bar{x})^2$	is the sum of the squared deviations for each measured specific conductance x_i value compared to the mean

The UPL corresponds to $y'_i + t_{1-\alpha}\sqrt{s^2_e + s^2_{y'_i}}$, and the LPL corresponds to $y'_i - t_{1-\alpha}\sqrt{s^2_e + s^2_{y'_i}}$. The UPL and LPL were then added to the plot of specific gravity versus specific conductance data to define the 99% Prediction Interval. Data points not initially considered as outliers that fall outside of the 99% Prediction Interval were identified as additional outlier data points. The additional outlier data points were removed from the dataset and the linear regression analysis was repeated, following a recalculation of the 99% Prediction Interval. The remaining data points were further inspected to ensure that they were inside the 99% Prediction Interval.

The results of the outlier analysis performed on the specific gravity and specific conductance data for Event 1, Event 2, and the subtidal piezometers are summarized below.

Event 1

Figure 24a presents a plot of the specific gravity versus specific conductance data for Event 1 listed in Table 14. Figure 24a demonstrates that the Event 1 specific gravity and specific conductance data generally follow a linear relationship, and largely correspond to the range in the literature-reported relationships between specific gravity/density and specific conductance developed in Section 5.1. A visual inspection of Figure 24a reveals that several data points depart from the apparent linear relationship. These data points were initially identified as outliers, as indicated in Table 14, and an initial linear regression analysis was conducted using Microsoft Excel®. The results of the linear regression analysis are presented in Table 17a for specific gravity versus specific conductance, density in Imperial units (i.e., lbs/ft^3) versus specific conductance, and density in Metric units (i.e., kg/m^3) versus specific conductance. Based on the initial linear regression analysis, the 99% Prediction Interval was developed, as presented on Figure 24a. Points that were outside the 99% Prediction Interval were considered outliers, added to the list of outliers, as presented in Table 14, and a second trial regression analysis was performed. The results of the second trial regression analysis are presented in Table 17b, and the associated 99% Prediction Interval is presented on Figure 24b. As presented in Figure 24b, no further data points fall outside of the 99% Prediction Interval. The remaining 90 data points are considered suitable for developing the specific gravity/density versus specific conductance relationship presented in Section 5.4.

As presented in Table 14, the Event 1 specific gravity/specific conductance dataset consists of a total of 117 data points. Of these, 14 data points were identified as outliers, and 13 data points were not used due to the specific conductance being greater than 99.9 mS/cm or the specific gravity was judged to be outside of the range of values historically obtained at a location. Excluding the outlier and data points not used, the remaining 90 data points used in developing the specific gravity/density versus specific conductance relationship presented in Section 5.4 represent approximately 77 percent of the total specific gravity/specific conductance data points for Event 1. The outliers and not used data points represent approximately 12 percent and 11 percent, respectively, of the total specific gravity/specific conductance data points for Event 1.

Event 2

Figure 25 presents a plot of the specific gravity versus specific conductance data for Event 2 listed in Table 15. Figure 25 demonstrates that the Event 2 specific gravity and specific conductance data generally follow a linear relationship. A large number of data points fall within the range in the literature-reported relationships between specific gravity/density and specific conductance developed in Section 5.1. A visual inspection of Figure 25 reveals that several data points depart from the apparent linear relationship. These data points were initially identified as outliers, as indicated in Table 15, and an initial linear regression analysis was conducted using Microsoft Excel®. The results of the linear regression analysis are presented in Table 18 for specific gravity versus specific conductance, density in Imperial units (i.e., lbs/ft^3) versus specific conductance, and density in Metric units (i.e., kg/m^3) versus specific conductance. Based on the initial linear regression analysis, the 99% Prediction Interval was developed, as presented on Figure 25. No additional data points fall outside of the 99% Prediction Interval. The remaining 96 data points are considered suitable for developing the specific gravity/density versus specific conductance relationship presented in Section 5.4.

As presented in Table 15, the Event 2 specific gravity/specific conductance dataset consists of a total of 117 data points. Of these, 10 data points were identified as outliers, and 11 data points were not used due to the specific conductance being greater than 99.9 mS/cm, specific gravity not being representative of historic well data, or the specific gravity measurement was considerably less than that of fresh water and considered anomalous. Excluding the outlier and data points not used, the remaining 96 data points used in developing the specific gravity/density versus specific conductance relationship presented in Section 5.4 represent approximately 82 percent of the total specific gravity/specific conductance data points for Event 2. The outliers and not used data points each represent 8.5 percent and 9.4 percent, respectively, of the total specific gravity/specific conductance data points for Event 2.

Subtidal Piezometers

Figure 26 presents a plot of the specific gravity versus specific conductance data for the subtidal piezometers listed in Table 16. Figure 26 demonstrates that the subtidal piezometer specific gravity and specific conductance data generally follow a linear relationship, and largely correspond to the range in the literature-reported relationships between specific gravity/density and specific conductance developed in Section 5.1. A visual inspection of Figure 26 reveals that several data points depart from the apparent linear relationship. These data points were initially identified as outliers, as indicated in Table 16, and an initial linear regression analysis was conducted using Microsoft Excel®. The results of the linear regression analysis are presented in Table 19 for specific gravity versus specific conductance, density in Imperial units (i.e., lbs/ft^3) versus specific conductance, and density in Metric units (i.e., kg/m^3) versus specific conductance. Based on the initial linear regression analysis, the 99% Prediction Interval was developed, as presented on Figure 26. No additional data points fall outside of the 99% Prediction Interval. Therefore, the remaining 67 data points are considered suitable for developing the specific gravity/density versus specific conductance relationship presented in Section 5.4.

As presented in Table 16, the subtidal piezometer specific gravity/specific conductance dataset consists of a total of 90 data points. Of these, 15 data points were identified as outliers, and 8 data points were not used either because of the specific conductance being greater than 99.9 mS/cm or specific conductance was not measured (e.g., WW-A1-0, WW-C1-0, WW-C2-0, WW-C3-0, and WW-C4-0). Excluding the outlier and data points not used, the remaining 67 data points used in developing the specific gravity/density versus specific conductance relationship presented in Section 5.4 represent approximately 74 percent of the total specific gravity/specific conductance data points for the subtidal piezometers. The outliers and not used data points represent approximately 17 percent and 9 percent, respectively, of the total specific gravity/specific conductance data points for the subtidal piezometers.

5.4 Specific Gravity/Density versus Specific Conductance Relationship

The Event 1, Event 2, and subtidal piezometer specific gravity and specific conductance data points, not identified as outliers (or not used) in Section 5.3, were combined to develop the specific gravity/density versus specific conductance relationship. Figure 27 presents the plot of the combined Event 1, Event 2, and subtidal transducer data. A linear regression analysis of the data points (excluding the outliers and not used points) was conducted using Microsoft Excel, and the results of the regression analysis are presented in Table 20. The resulting specific gravity versus specific conductance relationship is expressed mathematically as:

$$SG_{25} = 0.99687338 + 0.000432677 \times SC_{25}$$ Equation 5.8

The resulting density (in Imperial units) versus specific conductance relationship is [recall that density can be obtained by multiplying the specific gravity laboratory results adjusted to 25°C (77°F) by the density of pure water at 25°C (77°F), as described in Section 5.1]:

$$\rho_{I,25} = 62.04818778 + 0.02694251 \times SC_{25}$$ Equation 5.9

Where:

$\rho_{I,25}$ is the density in Imperial units at a reference temperature of 25°C (77°F) (lbs/ft^3)

The resulting density (in Metric units) versus specific conductance relationship is:

$$\rho_{M,25} = 993.9167053 + 0.431581436 \times SC_{25}$$ Equation 5.10

Where:

$\rho_{M,25}$ is the density in metric units at a reference temperature of 25°C (77°F) (kg/m^3)

The coefficient of correlation (R^2), which is a measure of the 'goodness of fit' of the linear relationship to describe the observed data, for the specific gravity/density versus specific conductance relationship using the Event 1, Event 2, and subtidal piezometer data is 0.868, as presented in Table 20.

As summarized in the table inset below, the specific gravity versus specific conductance relationship is based on approximately 78 percent of the total specific gravity/specific conductance data points obtained from Event 1, Event 2, and the subtidal piezometers, as summarized below.

Data Group	***Total # of Points***	***# of Outlier Points***	***# of Not Used Points***	***Percentage Used in Developing Relationship***
Event 1	117	14	13	76.9%
Event 2	117	10	11	82.1%
Subtidal Piezometers	90	15	8	74.4%
Combined Data	324	39	32	78.1%

Using approximately 78 percent of the data represents the significant majority of the data collected at the Site and is acceptable for developing the empirical relationship between specific gravity and specific conductance. Figures 28 and 29 present the spatial location of the specific gravity and specific conductance data points (at 77°F), respectively, that were either identified as outliers or were not used. As is evident on Figures 28 and 29, the outlier and data points not used are fairly uniformly distributed throughout the Site. As a whole, the outlier and data points not used are not focused in specific areas of the Site where groundwater chemistry is known to be impacted by elevated volatile organic compounds (VOCs), pH, or density.

As described in Section 5.0, the primary purpose of developing the specific gravity/density versus specific conductance relationship is to allow the conductivity profiles obtained at the upland monitoring wells with a Type 1 transducer configuration to be converted to a density profile. The density profile in the Type 1 transducer configuration monitoring wells allows the pressure recorded by the transducer to be converted to a formation pressure observed at the screen mid-point. As indicated in Table 14 and Table 15, the specific gravity and specific conductance data from several monitoring wells with a Type 1 configuration were identified as outliers, or were not used. These data points were not applied to develop the specific gravity/density versus specific conductance relationship.

If data from the same monitoring well in both Events 1 and 2 were identified as outliers or were not used, then this location is considered to be a true outlier. For the Type 1 true outlier locations, all available data were not applied in developing the specific gravity/specific conductance relationship, and thus, it is possible that the relationship may not hold at these locations. Therefore, applying the specific gravity/specific conductance relationship at these Type 1 locations to determine formation pressures may not be representative. Because the specific gravity and specific conductance data at these locations were beyond the expected range, applying the developed specific gravity/density versus specific conductance relationship at these monitoring well locations might not provide a consistent conversion of the transducer pressure to a formation pressure observed at the well screen mid-point. However, the specific gravity/density versus specific conductance relationship will be applied at the Type 1 true outlier monitoring well locations, and the interpretation of the groundwater flow field in the vicinity of these monitoring wells will be carefully considered in the development of the conceptual hydrogeologic model for the Site. Type 1 true outlier locations are where additional consideration may need to be given to the formation pressures when interpreting groundwater flow directions and developing the conceptual hydrogeologic model.

If data for a Type 1 location from one of Events 1 or 2 is applied in the development of the specific gravity/specific conductance relationship, then the relationship is considered to hold at the location. The reason for the data at the location from one of Events 1 or 2 to be considered an outlier, or not used, most likely is attributable to some systematic error (such as meter error, variance in measuring specific conductance, or variance in the laboratory analysis of specific gravity). These locations are not considered as true outliers.

The outlier and not used data points at monitoring wells/piezometers with Type 2 and Type 3 transducer configurations have no bearing on determining formation pressures. This is because the formation pressure is measured directly at the Type 2 and Type 3 locations (i.e., the transducers are located within the interval being monitored). Therefore, outlier and not used data points at the Type 2 and Type 3 locations require no further consideration.

The Type 1 monitoring wells where the specific gravity and specific conductance data were identified as outliers, or were not used, are summarized in Table 21 for Events 1 and 2 individually. Table 21 then summarizes the Type 1 monitoring wells where the specific gravity/specific conductance was either identified as an outlier or was not used in both Events 1 and 2. As shown in Table 21, there are no monitoring wells identified as an outlier in both Events 1 and 2, and only two monitoring wells are not used in both Events 1 and 2. Therefore, there are only two locations that are considered as true outliers. Figure 30 presents the locations of the two Type 1 true outlier monitoring wells. The two locations are just north of the salt pad where elevated concentrations of VOCs are present in groundwater, and where elevated densities may be present due to historical leaching of sodium and chloride from the salt pad. The formation pressures at these two locations are given additional consideration when interpreting groundwater flow directions in this area.

Section 6.0 Presentation of Adjusted Event 1 and Event 2 Pressure Transducer Data

This section presents the adjusted Serfes (1991) mean Event 1 and Event 2 pressures at each monitoring well or subtidal piezometer location. The pressures presented in this section are subsequently used in interpreting the observed hydraulic responses and developing the conceptual hydrogeologic model for the Site.

6.1 Data Quality Review

As part of the process of calculating the adjusted Serfes (1991) mean Event 1 and Event 2 pressures, the pressure transducer and conductivity data were reviewed to ensure that the collected data are reasonable and suitable for application in the hydraulic investigation. The steps performed as part of this data quality review are described in the following section.

The data quality review consisted of three main components:

i) Review of the conductivity profile data for all Type 1 locations

ii) Review of the pressures measured by each transducer, including comparison to manually-measured water levels

iii) Back-calculation of water density above the transducer

A further data quality review consisted of evaluating the Type 1 FEHs relative to the specific gravity/density vs. specific conductance relationship developed in Section 5.0 to relate the measured conductivity profile within the well casing water column for Type 1 configurations to density and determine the formation pressure, or FEH, at the well screen mid-point of the upland monitoring wells.

A summary of each of the three main review steps is summarized in the following sections. Full documentation of the data quality review is provided in Tables 5-1 to 5-3 of Attachment 5 to this Appendix.

Conductivity Profile Data Review

As presented in Section 2.1, at all Type 1 locations the conductivity profile data are required to adjust the measured transducer pressures vertically downward within the well casing to the well screen in order to compute the corresponding formation pressure. Therefore, for all Type 1 locations, the collected conductivity profile data were plotted and reviewed to ensure that the collected conductivity data were suitable for use in this calculation. As presented in Section 2.1, two rounds of conductivity profile data were collected (one round prior to Event 1; the other following Event 2) in order to assess whether the degree of density stratification in the water column changed appreciably due to the temporary shutdown of the extraction/injection system. The two rounds of conductivity profile data were plotted for each Type 1 well location for visual review. The conductivity profile data review is presented in Table 5-1 of Attachment 5 and associated plots are presented on Figures 6C-1 to 6C-78 of Attachment 6 to this Appendix.

Measured Pressure Transducer Data Review

For each hydraulic monitoring location, the measured transducer pressures for Events 1 and 2 were plotted and visually reviewed to ensure that the data are suitable for application in the presentation of FEHs and ENVs. The visual review of the pressure transducer data included identifying:

- Periods during which some transducer records are missing
- An increasing or decreasing trend in the measured pressures over time
- Pressure data exhibiting abnormal fluctuations relative to tidal fluctuations
- Comparison to manual water level measurements
- For subtidal piezometer locations, pressures at a location vastly different from piezometers installed at the same depth

The pressure transducer review is presented in Table 5-2 of Attachment 5 to this Appendix. Plots of pressure measurements in upland monitoring well locations and subtidal piezometers are presented on Figures 6P-1 to 6P-121 of Attachment 6 to this Appendix.

Back-Calculated Density Review

In order to compare the manual water level measurements to the measured transducer pressures, one of the measured quantities needs to be transformed. That is, the elevation of the piezometric surface determined through manually measuring the depth to water within an upland well must be converted to a corresponding pressure; or, alternatively, the measured transducer pressures must be converted to a corresponding piezometric surface elevation for comparison. The approach adopted as part of the data quality review is to convert the manual water level measurements to a corresponding pressure. This approach is preferable since the number of measured transducer pressures far exceeds the number of manual water level measurements.

The conversion of the manual water level measurements was accomplished by back-calculating an average water column density between the water surface in the well casing and the transducer. This back-calculated density was then compared to available measurements of specific gravity and the estimated density derived from the conductivity profiling results, and significant differences were flagged during this review. Details on the back-calculated density review are presented in Table 5-3 of Attachment 5 to this Appendix.

6.2 Pressure Transformation Results

The adjusted Serfes (1991) mean Event 1 and Event 2 pressures are presented in Table 22, along with the corresponding elevation where the pressure was measured (Type 2 or Type 3 locations), or adjusted to (Type 1 locations). The elevations are applied to adjust the pressures at each monitoring location vertically upwards or downwards to a corresponding zone grouping plane, and subsequently calculate FEH and ENV.

Section 7.0 Calculation Methodology for Fresh Water Equivalent Heads and Environmental Heads

This section presents the details of the calculation methodology applied to convert formation pressures at the well screen mid-point to FEH and ENV, as defined by Lusczynski (1961). The FEH and ENV are applied to interpret horizontal and vertical groundwater flow directions, hydraulic gradients, and groundwater flow velocities. The methodology to calculate groundwater flow velocities based on FEH and ENV is also presented in this section. The interpretation of horizontal and vertical groundwater flow directions, hydraulic gradients, and groundwater flow velocities will be applied in the development of the conceptual hydrogeologic model for the Site.

7.1 Theory and Application of FEH and ENV

The theory underlying the calculation of FEH and ENV is developed by Lusczynski (1961). For reference, a copy of Lusczynski (1961) is provided as Attachment 7 to this Appendix. Generally, the terminology and definitions presented in Lusczynski (1961) are adopted in this section. There are minor differences between Lusczynski (1961) and this section related to the naming of some terms that have been previously applied at the Site. These differences are highlighted in this section where they occur.

The key definitions and conclusions derived by Lusczynski (1961) are presented below to provide an overview of how FEH and ENV will be applied in the context of developing the conceptual hydrogeologic model for the Site. The methodology for calculating FEH and ENV, along with examples, is presented in Section 7.2.

Lusczynski (1961) defines "*point-water head*" at a point in groundwater of variable density as "*the water level, referred to a given datum, in a well filled sufficiently with the water of the type at the point to balance the existing pressure at the point*". The concept of point-water head is presented in Figure 1 of Lusczynski (1961). Generally, the point-water head coincides with the groundwater elevation that one would measure in a monitoring well. That is, the depth to the water surface in a monitoring well is measured from a point of known elevation relative to a reference datum (i.e., the top of the well casing with a surveyed elevation), and the corresponding groundwater elevation is calculated by subtracting the measured depth. The assumption implicit in the Lusczynski (1961) definition for point-water head is that the water column within the well casing has a constant density that corresponds to the density of the groundwater in the formation [refer to Figure 1 of Lusczynski (1961)]. The assumption of a constant density throughout the water column within a well casing is not applicable to the Site, since, for the upland wells, the density of the water column within the well casing is variable, as presented in Section 3.0. Also, rather than the point-water heads applied in Lusczynski (1961), the starting point for the calculations of FEH and ENV in this section is the formation pressure computed at the mid-point of the well screen for upland wells, or at the transducer location for the subtidal piezometers, as presented in Section 3.0. Further details of applying pressure, rather than point-water heads, to calculate FEH and ENV are presented in Section 7.2.

Lusczynski (1961) defines FEH and ENV as follows:

1) FEH – "Fresh-water head at any point *i* in groundwater of variable density is defined as the water level in a well filled with fresh water from point *i* to a level high enough to balance the existing pressure at point *i*"
2) ENV – "Environmental-water head at a given point in groundwater of variable density is defined as a fresh-water head reduced by an amount corresponding to the difference of salt mass in fresh water and that in the environmental water between that point and top of the zone of saturation"

Figure 1 of Lusczynski (1961) presents the definitions of these two quantities in a graphical manner. Note that the Lusczynski (1961) definitions and formulae make repeated use of "point *i*", which is interpreted to represent the mid-point of the well screen for Type 1 installations and the elevation of the transducer within the well screen for Type 2 and Type 3 installations. This is consistent with theory and methodology presented in Sections 2.0 and 3.0 to transform the pressure data measured by the transducers during Events 1 and 2 to pressures at well screen mid-points.

Rather than "*fresh-water head*", as used in Lusczynski (1961), the term 'fresh water equivalent head' has been utilized previously at the Site, and this term is retained herein. In this section, the acronym "FEH" is used to denote fresh water equivalent head. Similarly, the acronym "ENV" is used to denote "*environmental-water head*", as used in Lusczynski (1961).

Due to the variable groundwater density at the Site, calculating FEH and ENV is necessary because:

- "fresh-water heads define hydraulic gradients along a horizontal in groundwater of variable density", and "they are comparable along a horizontal" (Lusczynski, 1961)
- "environmental-water heads define hydraulic gradients along a vertical", and "they are comparable along a vertical" in groundwater of variable density (Lusczynski, 1961)

Calculating FEH and ENV allows both horizontal and vertical hydraulic gradients to be determined in a system of variable density groundwater, which then facilitates the interpretation/characterization of groundwater flow directions and the development of the conceptual hydrogeologic model for the Site.

7.2 Methodology for Calculating FEH and ENV

The methodology to calculate FEH and ENV from formation pressures at the upland well screen mid-point (Type 1) or the transducer elevation (Types 2 and 3) is presented below. To illustrate the calculation methodology, example calculations of FEH and ENV are presented below that apply the Event 1 hydraulic data collected at the subtidal piezometer WW-B4. A summary of the Events 1 and 2 FEHs for the monitoring wells/piezometers included in the hydraulic monitoring network is presented in Table 22.

As indicated by Lusczynski (1961), FEHs must be compared along a common horizontal plane to compute horizontal hydraulic gradients correctly. Therefore, the FEHs are calculated at horizontal planes that approximately correspond to the screened intervals of nested piezometers and monitoring wells. For each horizontal plane, or zone grouping plane, a particular reference elevation was established. The Serfes (1991) mean pressures from the well screen mid-point elevations (Type 1) or transducer (Types 2 and 3) are vertically adjusted to the zone grouping plane, and the pressures are in turn applied to compute the FEHs at the zone grouping plane. The adjustment of the calculated FEHs at a particular well is done as follows:

- Calculate the incremental hydrostatic pressure from the well screen mid-point (Type 1) or the transducer (Types 2 and 3) elevation to the zone grouping reference elevation
- Calculate the total estimated pressure at the zone grouping plane reference elevation
- Convert the total estimated pressure at the zone grouping reference plane elevation to FEH

Once the FEHs are adjusted to a common horizontal plane, the FEHs at horizontally adjacent monitoring intervals within a zone grouping can then be applied to compute horizontal hydraulic gradients. The above procedure to adjust the FEHs to a common horizontal plane is presented in below.

7.2.1 Methodology/Example Calculation of FEH

The calculation of FEH is presented in Equation 2 of Lusczynski (1961) as:

$$\rho_f H_{if} = \rho_i H_{ip} - Z_i(\rho_i - \rho_f) \qquad \text{Equation 7.1}$$

Where:

ρ_f	is the density of fresh water [ML^{-3}] (i.e., 62.4 lbs/ft^3)
H_{if}	is the FEH at point *i* relative to a reference datum [L]
ρ_i	is the density of the formation water at point *i* [ML^{-3}]
H_{ip}	is the point-water head at point *i* [L]
Z_i	is the elevation of point *i* relative to a reference datum [L]

As presented in Section 7.1, direct measurement of the point-water head, denoted as H_{ip} in Equation 7.1, was not conducted as part of the hydraulic monitoring events. Instead, measurements of pressure were obtained via the pressure transducers. The pressure measurements over each of Events 1 and 2 were adjusted and averaged to a single mean formation pressure within the well screen using the approach presented in Sections 2.0 and 3.0. From Lusczynski (1961; page 4248), the pressure at point *i*, denoted by P_i, is given by $\rho_i g(H_{ip} - Z_i)$, where g is the acceleration due to gravity. Solving for H_{ip}, substituting into Equation 7.1, and simplifying yields:

$$H_{if} = \frac{P_i}{\rho_f g} + Z_i \qquad \text{Equation 7.2}$$

As indicated by Lusczynski (1961), the FEHs must be compared along a horizontal (i.e., a uniform horizontal plane) in order to compute horizontal hydraulic gradients. Therefore, the calculated FEHs must be adjusted to a common horizontal reference plane, or reference elevation, to account for the fact that, within the zone groupings, the well screen mid-point elevations in upland wells, and the elevations of the subtidal piezometer monitoring intervals, vary by a small amount throughout the Site. For example, the wells grouped in the 25-ft zone have screen elevations that vary by a few feet over the Site. Thus, for each zone grouping (i.e., 15-ft, 25-ft, 50-ft, 75-ft, 100-ft, 130-ft, and 160-ft zones), a reference elevation is established that approximately corresponds to the average elevation of the screen well mid-points within a particular zone grouping. The seven zone grouping planes include:

- 15 ft BGS (0 ft NGVD), referred to as the 15-ft zone (monitored for Events 3A and 3B only)
- 25 ft BGS (-10 ft NGVD), referred to as the 25-ft zone
- 50 ft BGS (-35 ft NGVD), referred to as the 50-ft zone
- 75 ft BGS (-60 ft NGVD), referred to as the 75-ft zone
- 100 ft BGS (-85 ft NGVD), referred to as the 100-ft zone
- 130 ft BGS (-115 ft NGVD), referred to as the 130-ft zone
- 160 ft BGS (-155 ft NGVD), referred to as the 160-ft zone

Figure 3.74 of the main report provides a graphical presentation of the Events 1 and 2 well/subtidal piezometer screen locations relative to their assigned zone grouping plane. Figure 3.90 of the main report provides a graphical presentation of the Events 3A and 3B well/subtidal piezometer screen locations relative to their assigned zone grouping plane.

The FEHs must be adjusted to correspond to the zone grouping plane reference elevation such that horizontal hydraulic gradients can be calculated correctly. The methodology, with example calculations, applied to adjust the FEH to the zone grouping reference elevation is presented below.

The pressure within the well screen must be adjusted to account for the pressure difference between the well screen mid-point elevation (Type 1) or the transducer elevation (Types 2 and 3) and the zone grouping reference elevation. The incremental pressure can be calculated from the following equation:

$$\Delta P = \rho g \Delta h \qquad \text{Equation 7.3}$$

Where:

ΔP	is the incremental pressure [$ML^{-1}T^{-2}$]
ρ	is the measured density at the well screen mid-point (Type 1) or transducer elevation (Types 2 and 3)

g is the acceleration due to gravity [LT^{-2}]

Δh is the elevation difference of the well screen mid-point (Type 1) or transducer elevation (Types 2 and 3) to the zone grouping reference elevation [L]

Table 23 provides an example calculation of incremental pressures from the well screen mid-point to the zone grouping reference elevation for WW-B4. The pressure at the zone grouping plane is then calculated by the summation of the pressure within the well screen and the newly calculated incremental pressure. The pressure is then converted to FEH using Equation 7.2. The Events 1 and 2 Serfes (1991) mean formation pressures converted to FEHs and adjusted to the zone grouping plane reference elevations are presented in Table 22 for the monitoring wells/piezometers included in the hydraulic monitoring network.

7.2.2 Methodology/Example Calculation of ENV

The calculation of ENV is presented in Equation 3 of Lusczynski (1961) as:

$$\rho_f H_{in} = \rho_f H_{if} - (\rho_f - \rho_a)(Z_i - Z_r) \quad \text{Equation 7.4}$$

Where:

H_{in} is the ENV at point *i* [L]

ρ_a is the average density of water between Z_r and point *i* [ML^{-3}]

Z_r is the elevation of the reference point from which the average density of water to point *i* is determined and above which water is fresh [L]

Rearranging Equation 7.4 to solve for H_{in} provides:

$$H_{in} = H_{if} - \frac{1}{\rho_f}(\rho_f - \rho_a)(Z_i - Z_r) \quad \text{Equation 7.5}$$

An example calculation of ENV at WW-B4 is presented in Table 23.

Lusczynski (1961; page 4249) provides the following guidance on selecting Z_r: "*The reference point must be the top of the zone of saturation if the uppermost water body is not fresh*". For the subtidal piezometer monitoring intervals, the Event 1 Serfes (1991) mean Waterway elevation of 1.09 ft NGVD was applied as Z_r because the Waterway contains saline water. For the upland monitoring wells, Z_r is taken as the estimated groundwater table at each monitoring well location. Table 24 presents the average density interpolated at the various zone grouping planes at the location of WW-B4 based on the 3-D groundwater density distribution presented in Appendix K. The average density per zone grouping plane, taken from the Event 1 Serfes (1991) mean Waterway surface elevation, is used to calculate the corresponding zone grouping plane ENVs.

The average density of the formation from the transducer elevation to the groundwater table, or Waterway surface, is calculated using the following equation from Lusczynski (1961):

$$\rho_a = \frac{1}{(Z_r - Z_i)} \int_{Z_i}^{Z_r} \rho(z) dz \qquad \text{Equation 7.6}$$

This calculation is presented in the last column of Table 24, and is based on the interpolated 3-D groundwater density distribution presented in Appendix K at the location of WW-B4. Finally, Equation 7.5 is applied to compute the ENV. An example calculation of ENV at WW-B4 is presented in Table 23.

Section 8.0 CSI Event 3 Hydraulic Monitoring Data Analysis

The CSI included the Events 3A and 3B hydraulic monitoring events, which was conducted on an expanded network of monitoring wells to provide additional hydraulic data. In addition, continuous monitoring of select shallow groundwater zone monitoring wells was undertaken to measure the responses of shallow groundwater levels to precipitation and further investigate shallow groundwater flow characteristics at the Site.

Pressure transducers were used to record hydraulic pressures over the duration of the CSI hydraulic monitoring. The pressure data recorded by the transducers were reduced to provide a hydraulic pressure exerted by the formation at the screen intervals of the monitoring locations for each zone grouping plane. The formation pressures were then converted to FEH and ENV that account for variable density effects on groundwater flow and were used to interpret the groundwater flow conditions under pumping and non-pumping conditions. The FEHs and ENVs observed throughout the hydraulic monitoring network were applied to interpret horizontal and vertical groundwater flow directions, respectively.

The pressure transducer data validation process for Events 3A and 3B is described in Attachment 8 to this Appendix. The pressure transducer data was converted to FEHs and ENVs using the methodology described in Section 7.0. For Events 3A and 3B, the pressure transducers were placed within the monitoring well screened intervals, and thus measure formation pressure. The Events 3A and 3B were assigned categories based on comparing the pressure transducer data to manual water level measurements. Attachment 8 provides the methodology used for the FEH category assignment, including an analysis of the FEH uncertainty. A summary of the Event 3A and 3B FEHs is provided in Table 25. The Events 3A and 3B FEHs and ENVs are used to evaluate shallow groundwater flow conditions in the 15-ft and 25-ft zones, vertical groundwater flow conditions between the 130-ft and 160-ft zones and at depth below the 160-ft zone, and horizontal groundwater flow conditions along each of the seven zone grouping planes.

8.1 Shallow Groundwater Zone Evaluation

Shallow groundwater flow characteristics at the Site were investigated through conducting continuous hydraulic monitoring from December 2011 to December 2012 at eight shallow groundwater zone monitoring wells located at the southern end of 605 Alexander Avenue and on 709 Alexander Avenue. The continuous monitoring was conducted at five 15-ft zone monitoring wells (49-15, 50-15, 52-15, 709-MW5-15, and 709-MW6-15) and three 25-ft zone monitoring wells (9-25, 18-25, and 709-MW20-25). These wells, along with sixteen nested 15-ft/25-ft zone monitoring wells on 709 and 721 Alexander Avenue were included in the CSI hydraulic monitoring conducted from September to December 2012. The shallow groundwater zone hydraulic monitoring locations are presented on Figure 3.68 of the main report. The findings of the continuous hydraulic monitoring and the CSI hydraulic monitoring of the shallow groundwater zone are summarized below.

Shallow Zone Continuous Hydraulic Monitoring

Monthly hydrographs of the December 2011 to December 2012 continuous hydraulic monitoring results for the five 15-ft zone and three 25-ft zone monitoring wells are presented in Attachment 9 to this Appendix (Attachment 9 Figures 1a-1m to 8a-8m). The hydrographs present FEH, Serfes (1991) mean FEH, tide elevation measured at the Site off of Dock 1, Serfes (1991) mean tide elevation, and precipitation[1] from December 2011 to December 2012.

Serfes (1991) presents a procedure for averaging groundwater elevations for wells affected by tidal fluctuations. The Serfes (1991) averaging procedure reduces 71 consecutive measurements to an average measurement that filters out tidal fluctuations. The Serfes (1991) mean averaging procedure is applied to hourly measurements of FEH based on the pressures recorded by the pressure transducers or hourly measurements of tide elevation. The procedure reduces hourly measurements over a 71-hour time period to a single mean measurement corresponding to the mid-point of the time period (i.e., the 36^{th} hour). The Serfes (1991) averaging procedure can be applied over a single 71-hour measurement period, or applied in a running mean fashion over consecutive 71-hour measurement periods that advance on an hourly basis. The running mean approach was applied to develop the Serfes (1991) mean FEHs and tide elevations shown on the Attachment 9 hydrographs.

[1] Precipitation data was obtained from NOAA National Weather Service office at Tacoma Narrows Airport, Tacoma, WA (accessed from http://www.wunderground.com/history/airport/KTIW/2011/12/1/CustomHistory.html?dayend=6&monthend=1&yearend=2012&req_city=NA&req_state=NA&req_statename=NA).

The FEHs for wells 49-15 (Attachment 9 Figures 1a to 1m) and 709-MW5-15 (Attachment 9 Figures 4a to 4m) located immediately adjacent to the Waterway respond to tidal fluctuations only under peak high tide. The FEHs for the three remaining 15-ft zone wells (i.e., 50-15 on Attachment 9 Figures 2a to 2m, 52-15 on Attachment 9 Figures 3a to 3m, and 709-MW6-15 on Attachment 9 Figures 5a to m) do not respond to tidal fluctuations. The FEHs for the 15-ft zone monitoring wells demonstrate that the 15-ft zone has limited hydraulic connection to the Waterway. In contrast, the FEHs shown on the Attachment 9 hydrographs for the 25-ft zone monitoring wells respond to tidal fluctuations on a continuous basis, as was previously observed during the Events 1 and 2 hydraulic monitoring. This indicates that the 25-ft zone has a strong hydraulic connection to the Waterway. The tidal fluctuations in the 25-ft zone are greatest at well 709-MW20-25 (Attachment 9 Figures 8a to 8m) located immediately adjacent the Waterway and the tidal fluctuations are damped at wells 18-25 (Attachment 9 Figures 7a to 7m) and 9-25 (Attachment 9 Figures 6a to 6m) located at increasing distances inland from the Waterway.

The FEHs for 15-ft zone monitoring wells all show a direct response to increased precipitation. The response is most prominent in the hydrographs during times of increased precipitation occurring in late December 2011 (Attachment 9 Figures 1a, 2a, 3a, 4a, and 5a), late January 2012 (Attachment 9 Figures 1b, 2b, 3b, 4b, and 5b), mid- to late March 2012 (Attachment 9 Figures 1d, 2d, 3d, 4d, and 5d), mid- to late October 2012 (Attachment 9 Figures 1k, 2k, 3k, 4k, and 5k), and mid- to late November 2012 (Attachment 9 Figures 1l, 2l, 3l, 4l, and 5l). The increased precipitation infiltrates into the unsaturated zone and reaches the groundwater table located within the 15-ft zone causing increased 15-ft groundwater elevations, or FEHs.

The 15-ft zone FEHs also show a response to reduced or zero precipitation during dry periods. Limited precipitation occurred during June and July 2012, and essentially no precipitation occurred from August to early October 2012. From June to early October 2012, the 15-ft zone FEHs decrease steadily. The decreasing 15-ft zone FEHs during dry periods is due to a combination of lateral drainage to the Waterway and downward vertical leakage to the 25-ft zone.

A summary of the minimum (month of occurrence), maximum (month of occurrence), and average 15-ft zone Serfes (1991) mean FEHs over the duration of the continuous hydraulic monitoring is provided below.

15-ft Zone Well	Approx. Distance From Hylebos Waterway (ft)	Min. Serfes (1991) Mean FEH (ft NGVD)	Max. Serfes (1991) Mean FEH (ft NGVD)	Avg. Serfes (1991) Mean FEH (ft NGVD)
52-15	680	3.98 (Oct-2012)	6.96 (Apr-2012)	5.46
50-15	220	3.60 (Oct-2012)	6.39 (Dec-2012)	5.01
709-MW6-15	180	3.49 (Oct-2012)	6.19 (Dec-2012)	4.86
49-15	60	3.63 (Oct-2012)	6.37 (Dec-2012)	4.95
709-MW5-15	40	3.08 (Oct-2012)	5.34 (Dec-2012)	4.14

The minimum FEH occurs for the above 15-ft zone wells in mid-October 2012 following the dry period extending from June to mid-October 2012. Except for 52-15, the maximum FEH occurs for the above 15-ft zone wells in December 2012 after the significant rainfall events that took place in November and early December 2012. For 52-15, the maximum FEH occurs in early April 2012 after heavy rainfall events in mid- and late March 2012.

The 15-ft zone wells in the table inset above are ordered from greatest to least distance from the Waterway. The minimum, maximum, and average FEHs show a relatively consistent groundwater flow direction toward the Waterway in the 15-ft zone.

Unlike the 15-ft zone wells, the Attachment 9 hydrographs show that the Serfes (1991) mean FEHs for the 25-ft zone wells do not respond directly to precipitation infiltration. The 25-ft zone Serfes (1991) mean FEHs remain relatively consistent during the continuous hydraulic monitoring. Fluctuations in the 25-ft zone Serfes (1991) mean FEHs correspond directly with fluctuations in the Serfes (1991) mean tide. The only time increases in the 25-ft zone Serfes (1991) mean FEHs appear to coincide with increased rainfall occurs following November 19, 2012, which is when the largest daily rainfall event occurred during the continuous hydraulic monitoring (Attachment 9 Figures 6l, 7l, and 8l). However, the increased 25-ft zone Serfes (1991) mean FEHs also correspond to an increase in the Serfes (1991) mean tide. The increased Serfes (1991) mean tide occurs when the overall tide cycle was declining and should have resulted in a decreasing Serfes (1991) mean tide. Instead, an increase in the Serfes (1991) mean tide occurs, which is caused by increased watershed run-off discharging to the surrounding surface water bodies following the November 19, 2012 rainfall event. Thus, the increases in the 25-ft zone Serfes (1991) mean FEHs following November 19, 2012 are created by increases in the Serfes (1991) mean tide that are in turn caused by increased watershed run-off.

Shallow Zone CSI Hydraulic Monitoring

Monthly hydrographs of the September to December 2012 CSI hydraulic monitoring results for the sixteen nested 15-ft/25-ft zone monitoring wells on 709 and 721 Alexander Avenue are presented in Attachment 10 to this Appendix (Attachment 10 Figures 1a-1d to 16a-16d). The hydrographs present FEH, Serfes (1991) mean FEH, tide elevation measured at the Site off of Dock 1, Serfes (1991) mean tide elevation, and precipitation from September to December 2012.

The Attachment 10 hydrographs show 15-ft and 25-ft zone hydraulic responses similar to what was observed during the continuous hydraulic monitoring. The Serfes (1991) mean FEH for the 15-ft zone monitoring wells increase in response to increased precipitation, and fluctuations in the 25-ft zone Serfes (1991) mean FEHs correspond directly with fluctuations in the Serfes (1991) mean tide.

Increases in the Serfes (1991) mean FEHs at the 15-ft zone monitoring wells in response to increased precipitation are variable between the southern end of 605 Alexander Avenue/709 Alexander Avenue and 721 Alexander Avenue. The variation in this response is due to the presence of permeable and less permeable ground cover on these properties. The ground cover in the southern end of 605 Alexander Avenue/709 Alexander Avenue consists largely of bare soil with some smaller areas of concrete and asphalt. The ground cover on 721 Alexander Avenue consists entirely of asphalt. Similarly, the ground cover on the property immediately south of 721 Alexander Avenue consists of asphalt or building. The largest single daily precipitation event (approximately 2.2 inches) during the CSI hydraulic monitoring occurred on November 19, 2012. Table 26 summarizes the observed increase in the Serfes (1991) mean FEHs for all of the 15-ft monitoring wells following November 19, 2012 rainfall event. The 15-ft zone Serfes (1991) mean FEHs at southern end of 605 Alexander Avenue and the northern end of 709 Alexander Avenue increase by approximately 0.7 to 0.9 ft after November 19, 2012. The 15-ft zone Serfes (1991) mean FEHs on 721 Alexander Avenue increase by a reduced amount of approximately 0.1 to 0.3 ft after November 19, 2012. Thus, the less permeable asphalt ground cover on 721 Alexander Avenue may reduce precipitation infiltration.

The Attachment 10 hydrographs for the nested 15-ft/25-ft zone monitoring wells all show that Serfes (1991) mean FEHs for the 15-ft zone are approximately 2 ft higher on average than for the 25-ft zone. This demonstrates that there is a layer of lower permeability soils separating the two zones, which corresponds to the former tidal mud flats at the base of the Site peninsula.

8.2 Vertical Flow Evaluation

Vertical groundwater flow between the 130-ft and 160-ft zones, and between the 160-ft and underlying zones, was evaluated by comparing hydrographs of the Events 3A and 3B ENVs at well nests that intersect these zones. The hydrographs of ENVs are provided in Attachment 11 to this Appendix.

The hydrographs of 130-ft zone and 160-ft zone ENVs presented in Attachment 11 show that vertical groundwater flow from the 130-ft zone to the 160-ft zone are predominantly downward within, and in close proximity to, the ADP due to the higher density groundwater within the ADP. Predominantly upward vertical hydraulic gradients occur from the 160-ft zone to the 130-ft zone elsewhere within the Site peninsula.

The hydrographes of 160-ft zone and underlying zone ENVs is available at only four monitoring well nests where transducers were installed below the 160-ft zone. The locations of these four deep well pairs (46C, 89C, 93C, and 95C). All four locations are beyond the ADP in the 160-ft zone. Three of the four locations (46C, 93C, and 95C) show downward vertical hydraulic gradients from the 160-ft zone to deeper zones, which is contrary to the upward vertical hydraulic gradients from the 160-ft zone to the 130-ft zone observed at these locations. The hydraulic pressures for the deeper locations come from Geokon transducers that were buried in place and the pressures could not be verified with manual water level measurements. At the location of 89C, an upward vertical hydraulic gradient between the 160-ft zone grouping plane and the deeper transducer was observed, which is consistent with the upward vertical hydraulic gradient from the 160-ft zone to the 130-ft zone at this location. However, the measured ENV in the deeper transducer at 89C is on the order of 14 ft NGVD, which is well above the ENV measured in the other three deeper transducers. The transducer at 89C-185 is installed within a thick clay soil with moderate to high plasticity that could isolate the 89C-185 transducer from the aquifer. Thus, the hydraulic pressure measured at 89C-185 may not be representative of the active groundwater flow throughout the bulk of the deep groundwater flow zone.

Section 9.0 References

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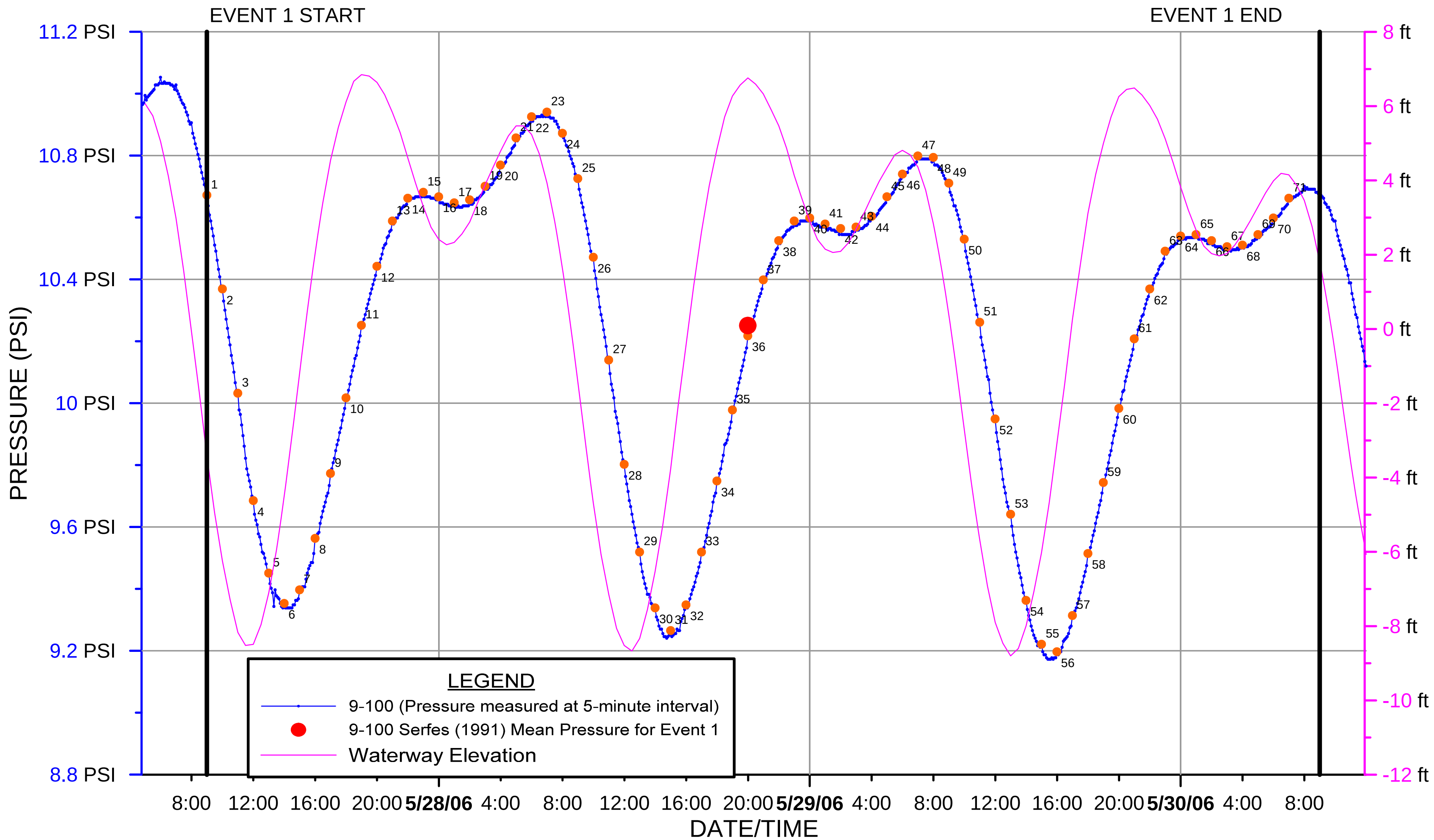


figure 1

EXAMPLE OF SERFES (1991) AVERAGING PROCEDURE FOR EVENT 1 AT WELL 9-100

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 1.grf) AUG 5/2014

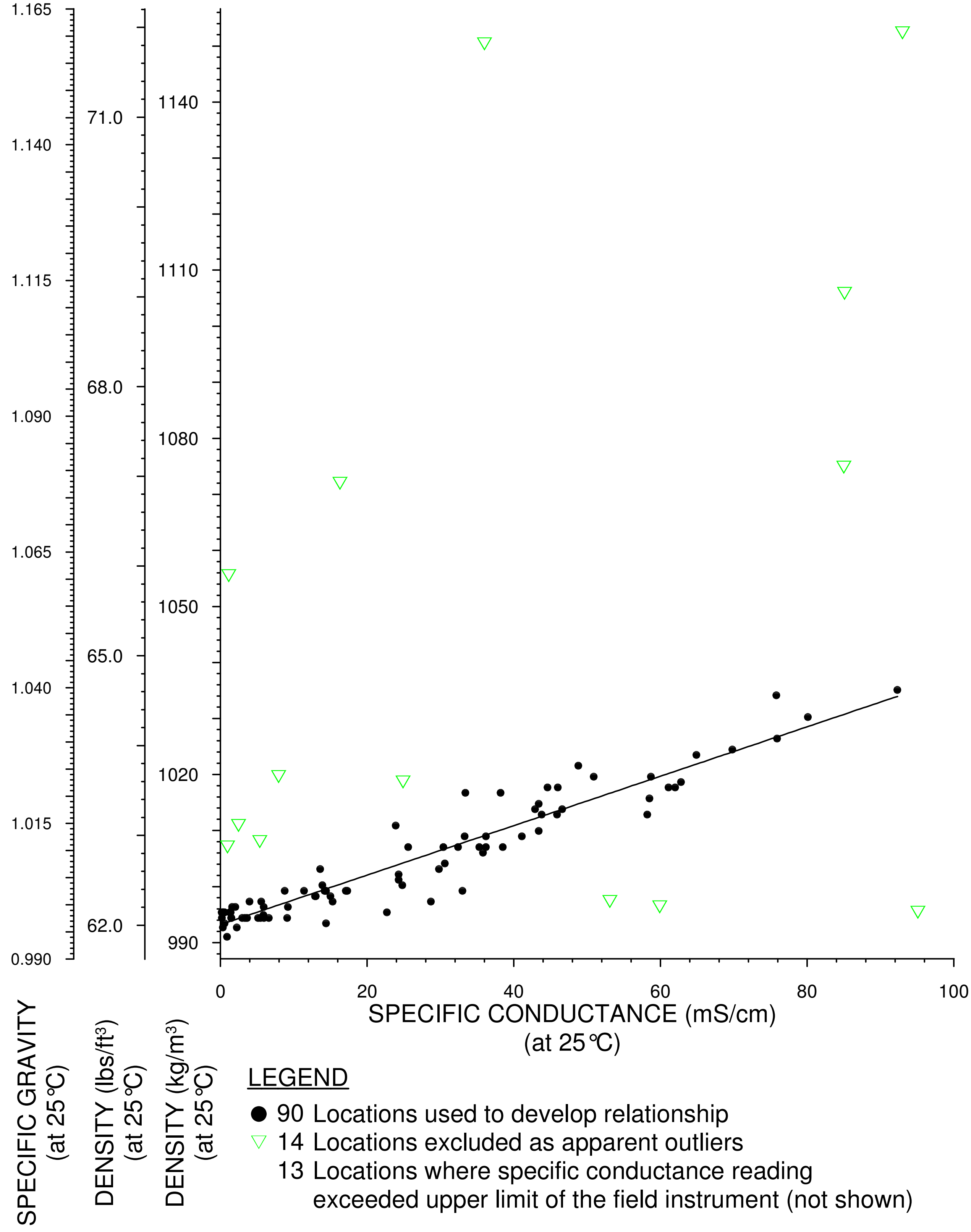


figure 2

EXAMPLE PRESENTATION
DENSITY/SPECIFIC CONDUCTANCE CORRELATION
Occidental Chemical Corporation, Tacoma, Washington

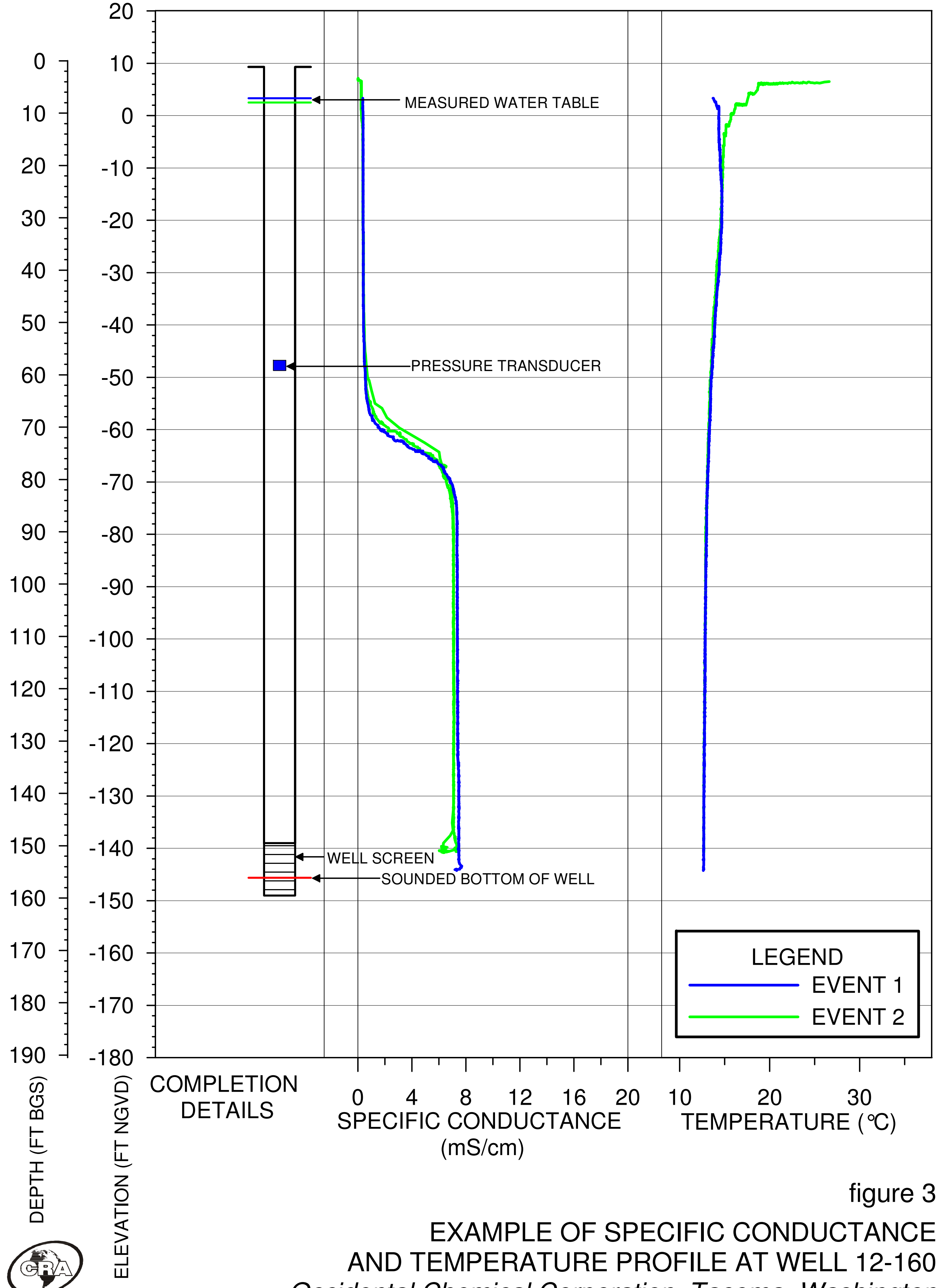


figure 3

EXAMPLE OF SPECIFIC CONDUCTANCE AND TEMPERATURE PROFILE AT WELL 12-160

Occidental Chemical Corporation, Tacoma, Washington

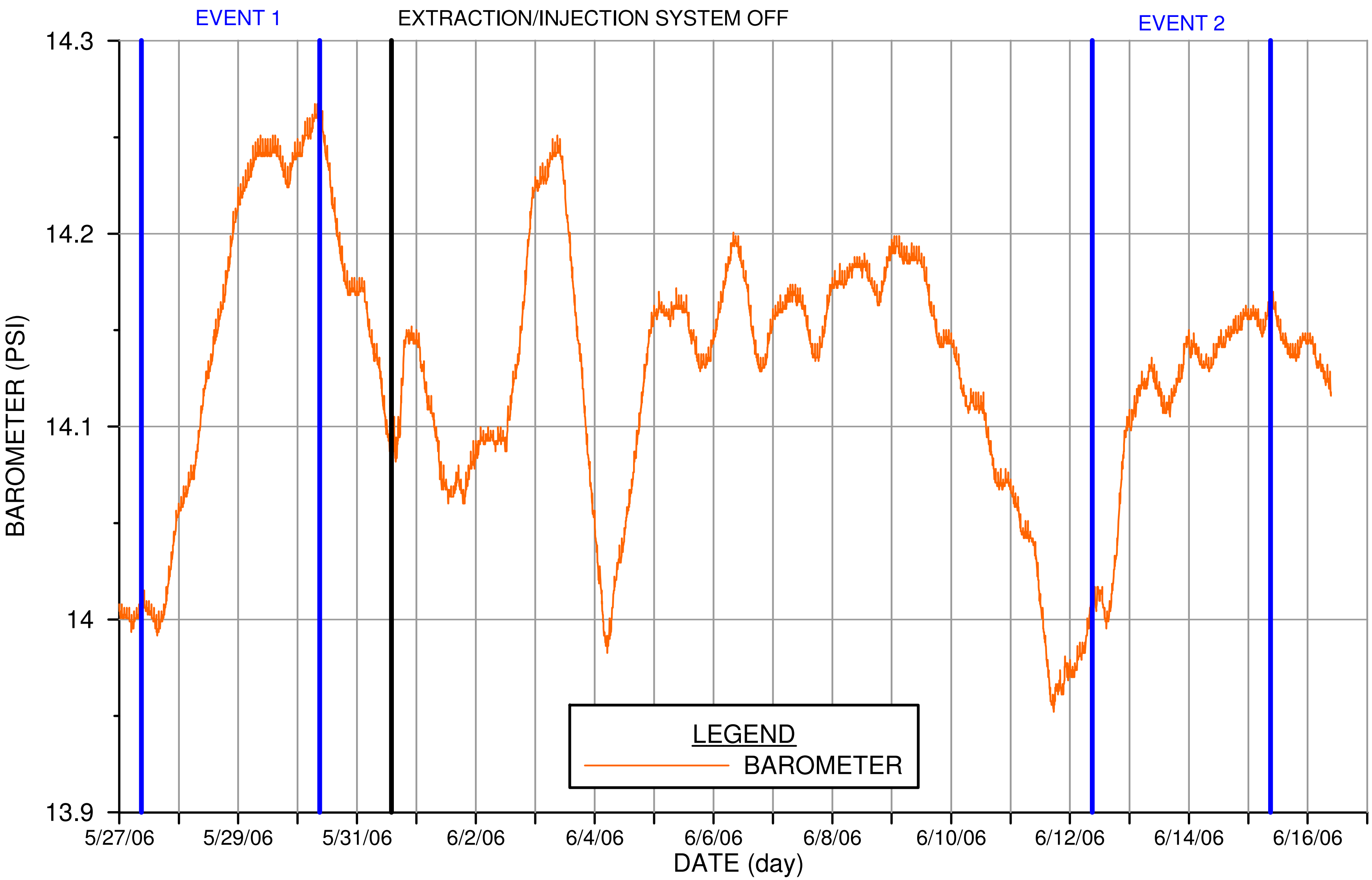
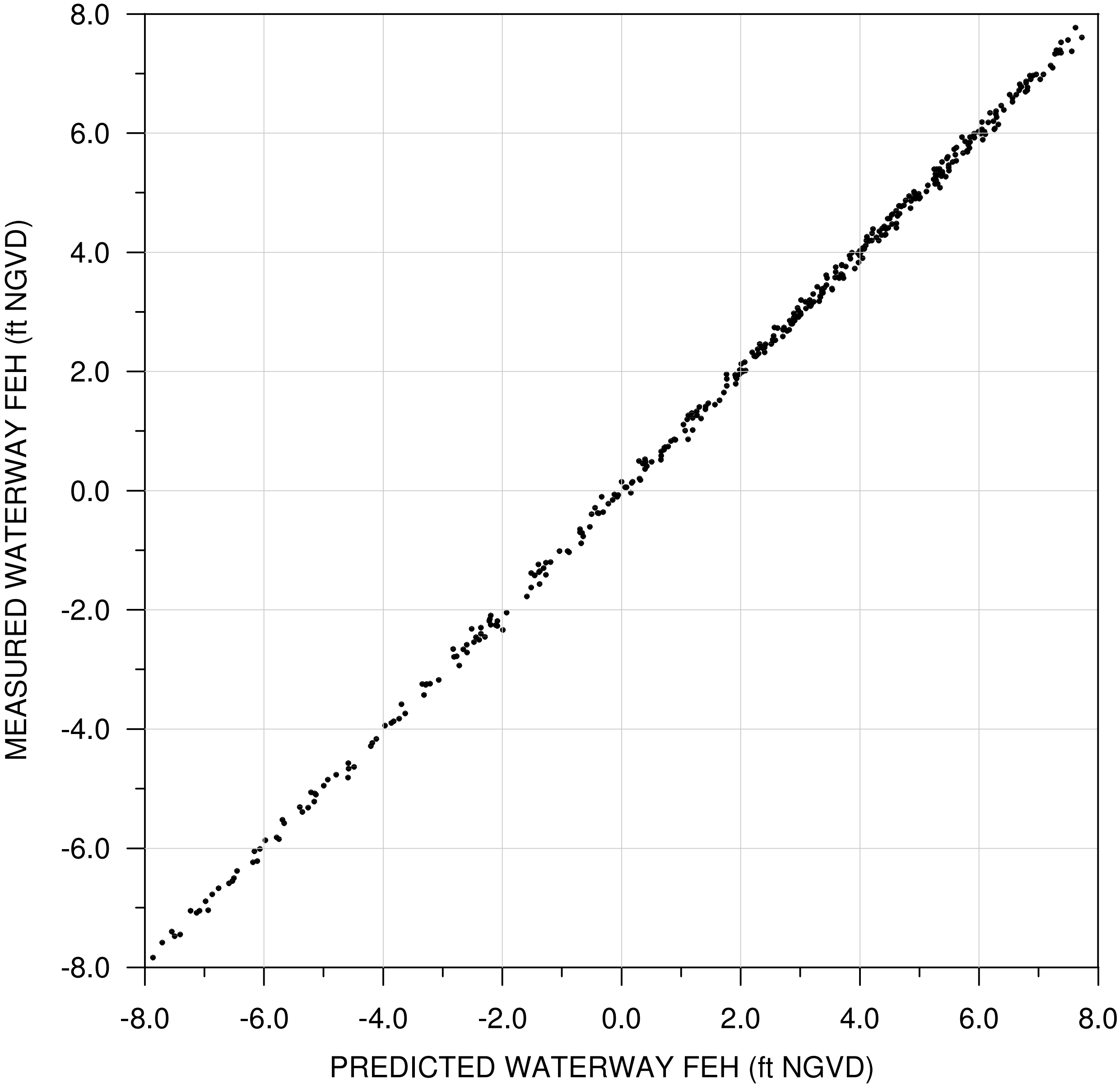


figure 4

BAROMETRIC PRESSURE DURING 72-HOUR HYDRAULIC MONITORING EVENTS

Occidental Chemical Coorporation, Tacoma, Washington

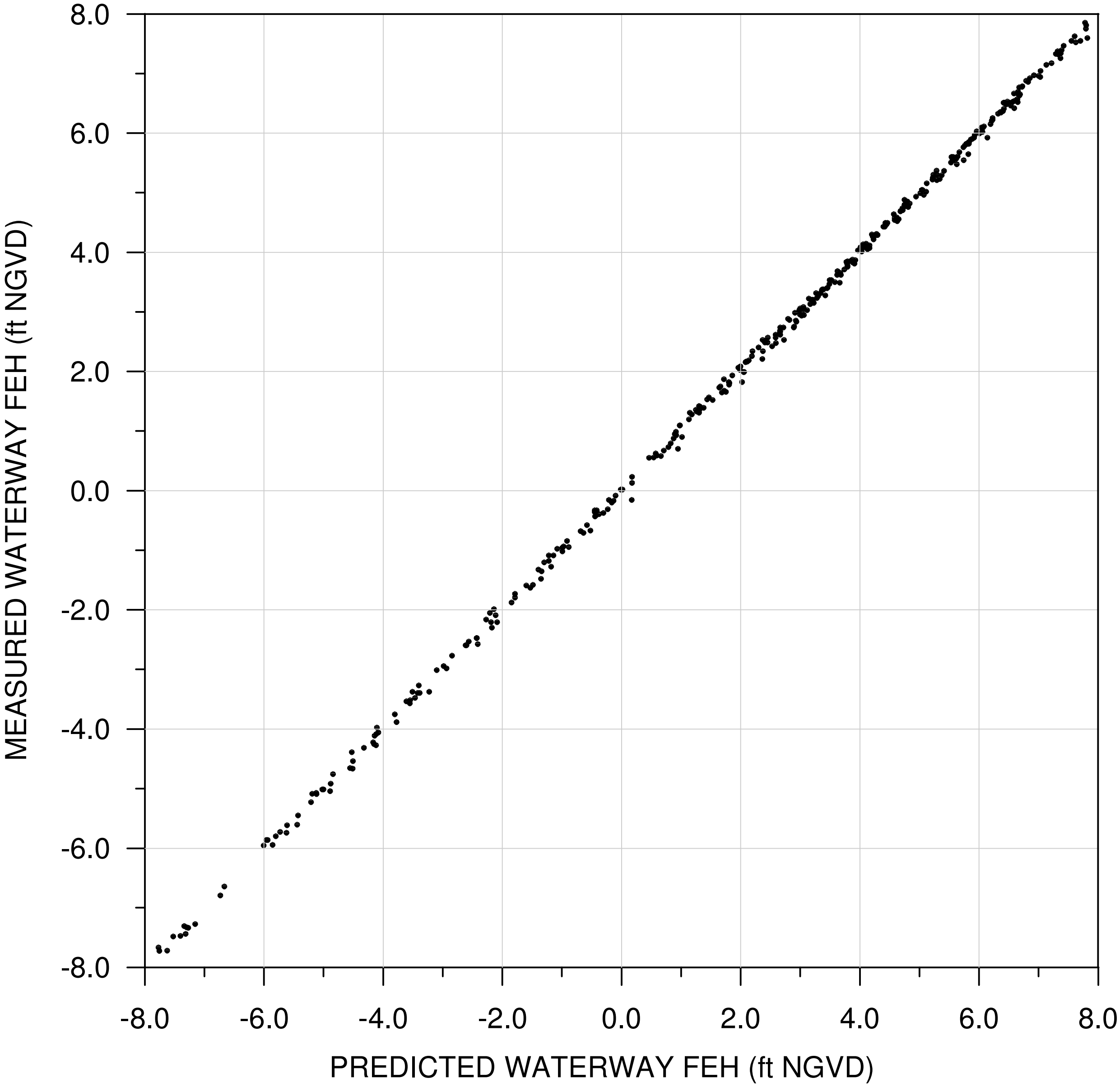


Note: Every eighth data point plotted

figure 5a

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-A1-2

Occidental Chemical Corporation, Tacoma, Washington

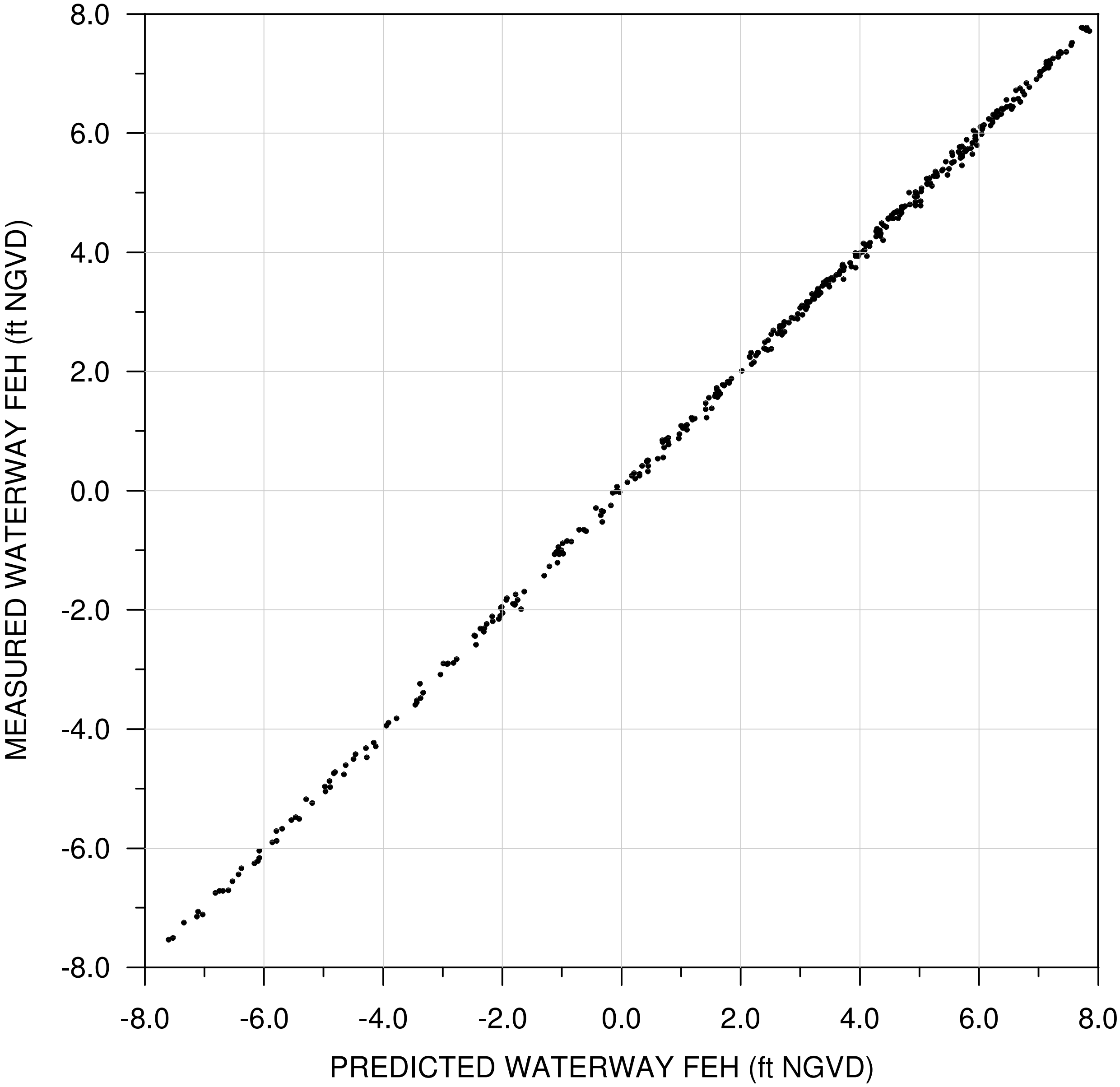


Note: Every eighth data point plotted

figure 5b

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-A2-2
Occidental Chemical Corporation, Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 5b_ WW-A2-2.grf) MAY 6/2014

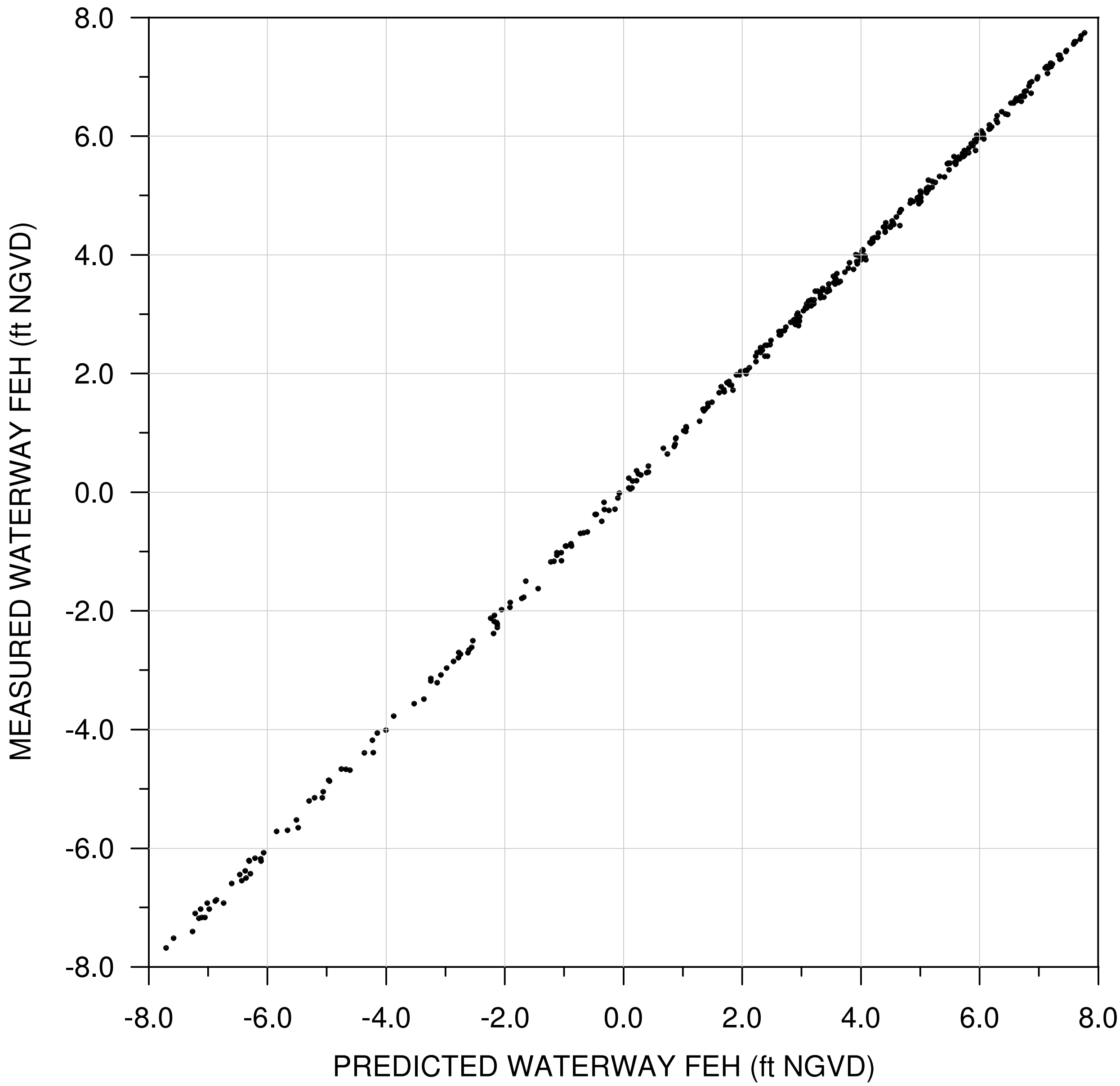


Note: Every eighth data point plotted

figure 5c

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-B1-2

Occidental Chemical Corporation, Tacoma, Washington



Note: Every fifth data point plotted

figure 5d

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-B2-2

Occidental Chemical Corporation, Tacoma, Washington

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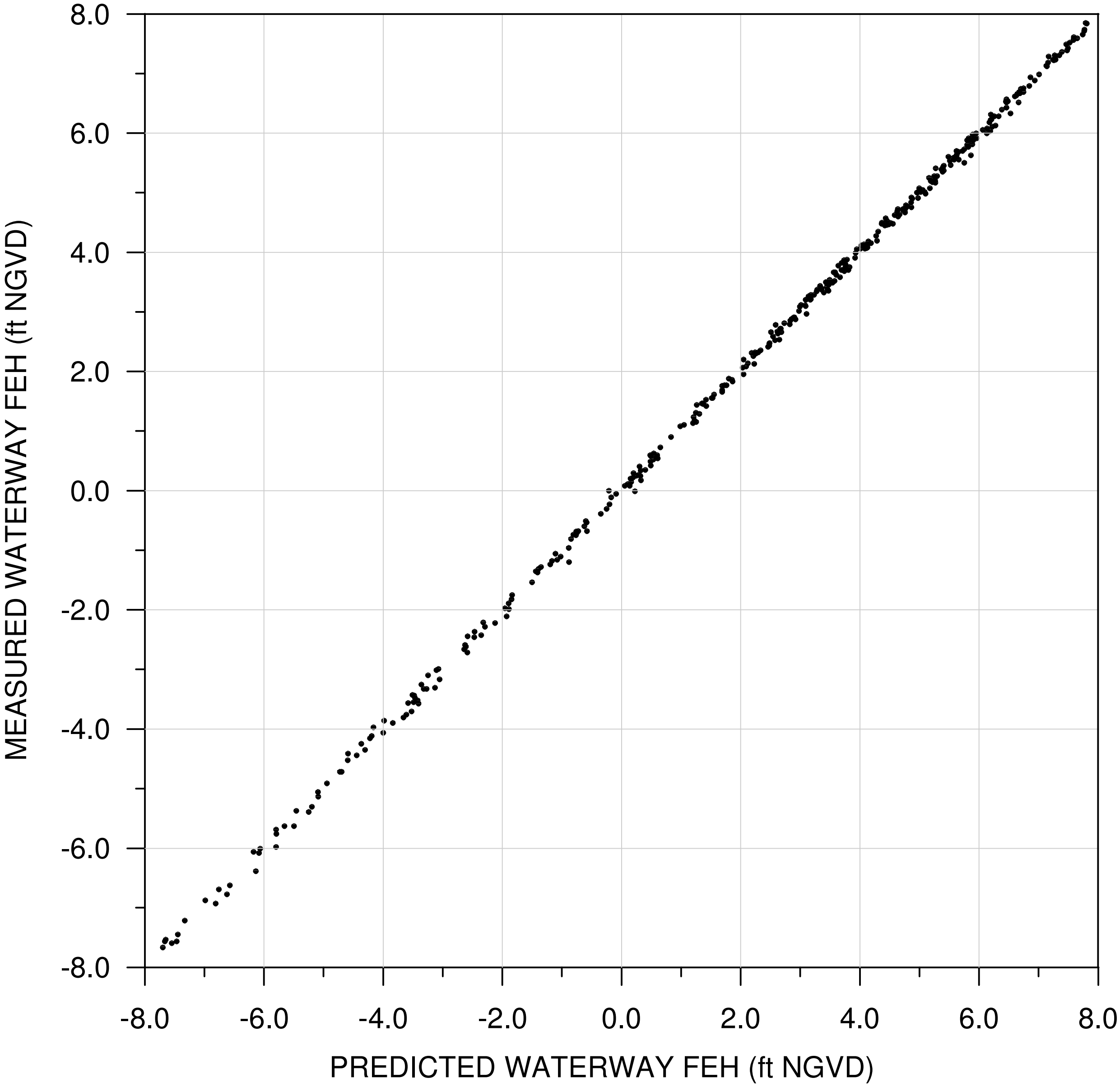
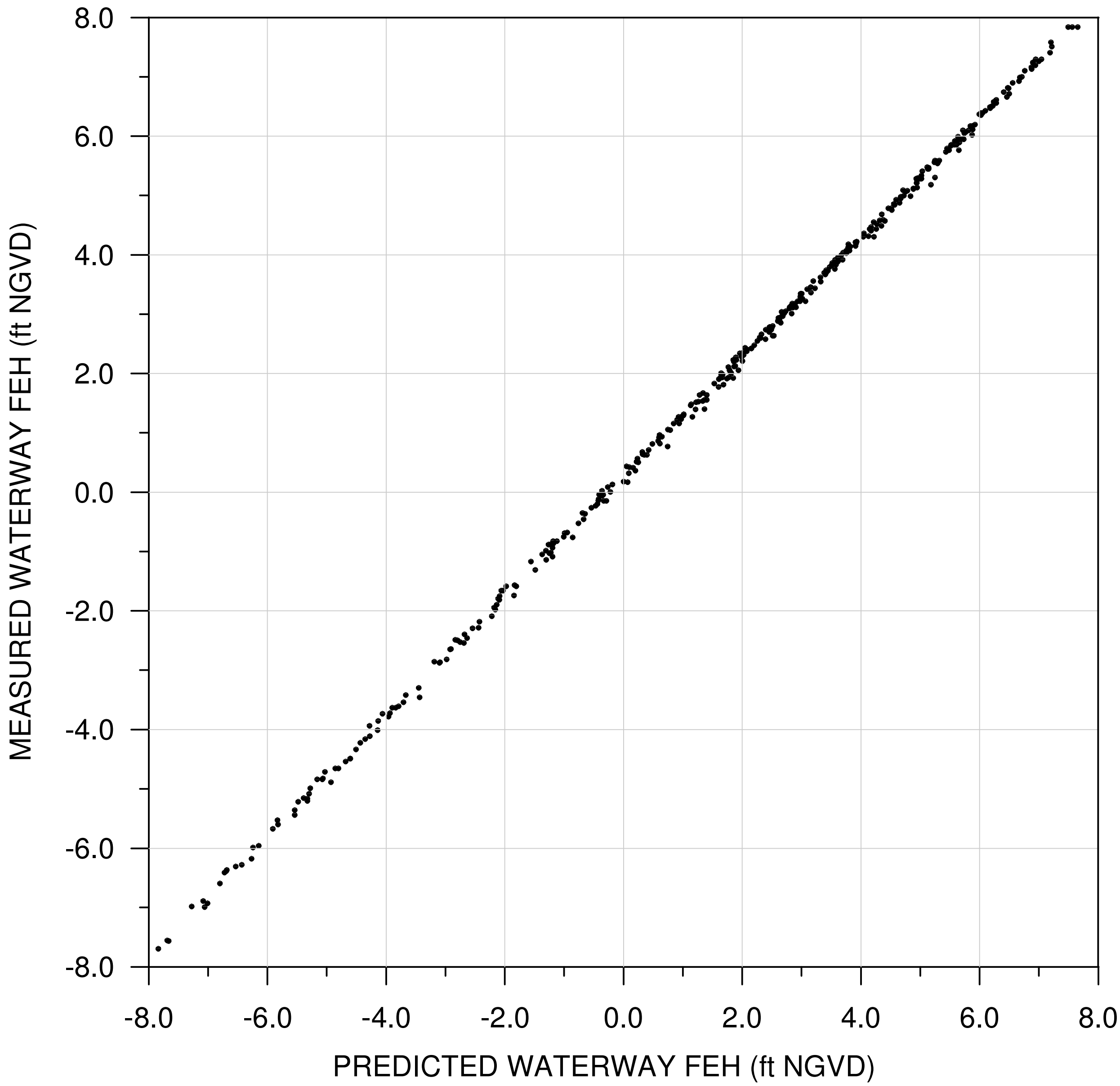


Note: Every eighth data point plotted

figure 5e

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-C1-2

Occidental Chemical Corporation, Tacoma, Washington

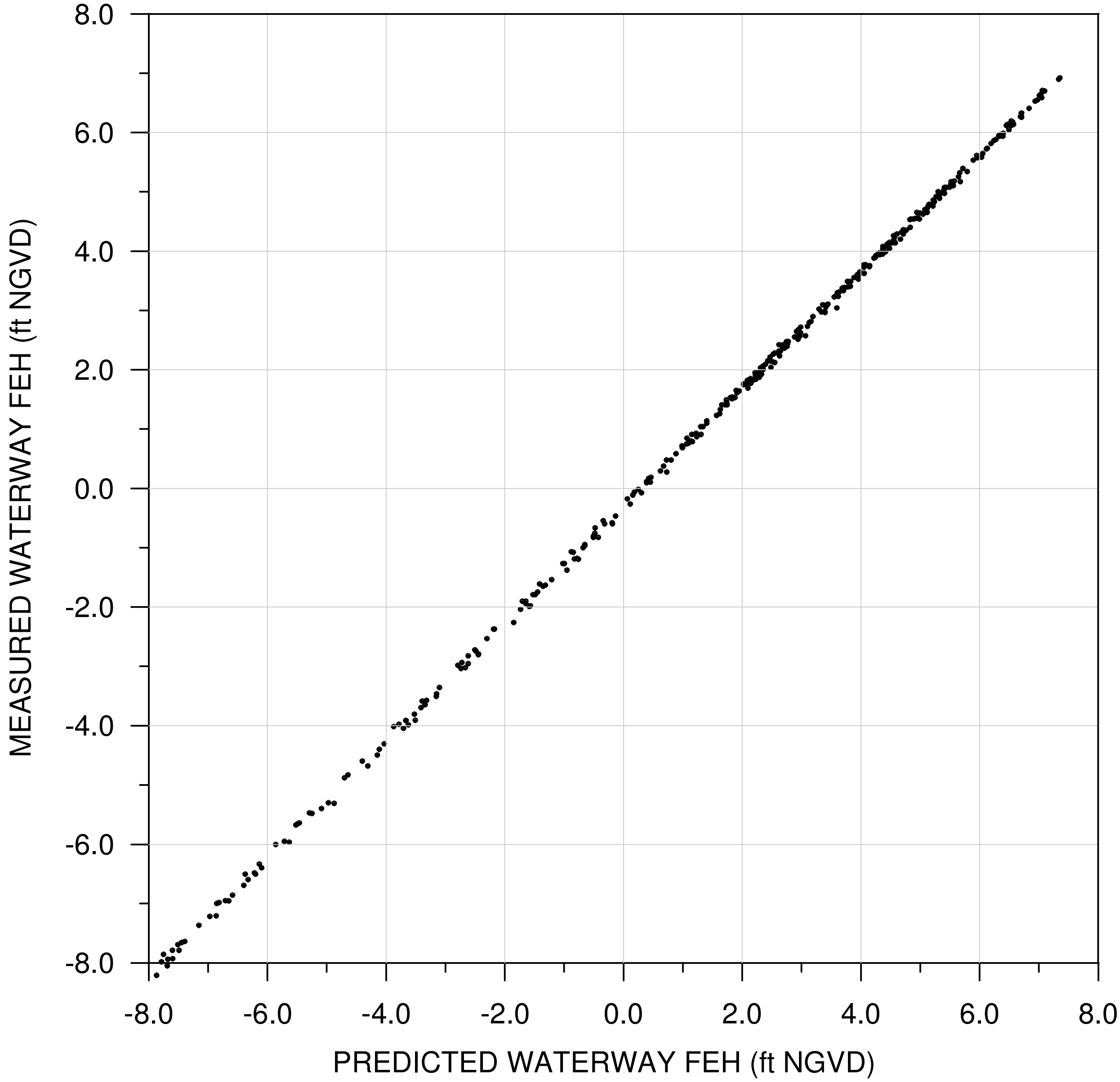


Note: Every sixth data point plotted

figure 5f

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-C2-2

Occidental Chemical Corporation, Tacoma, Washington

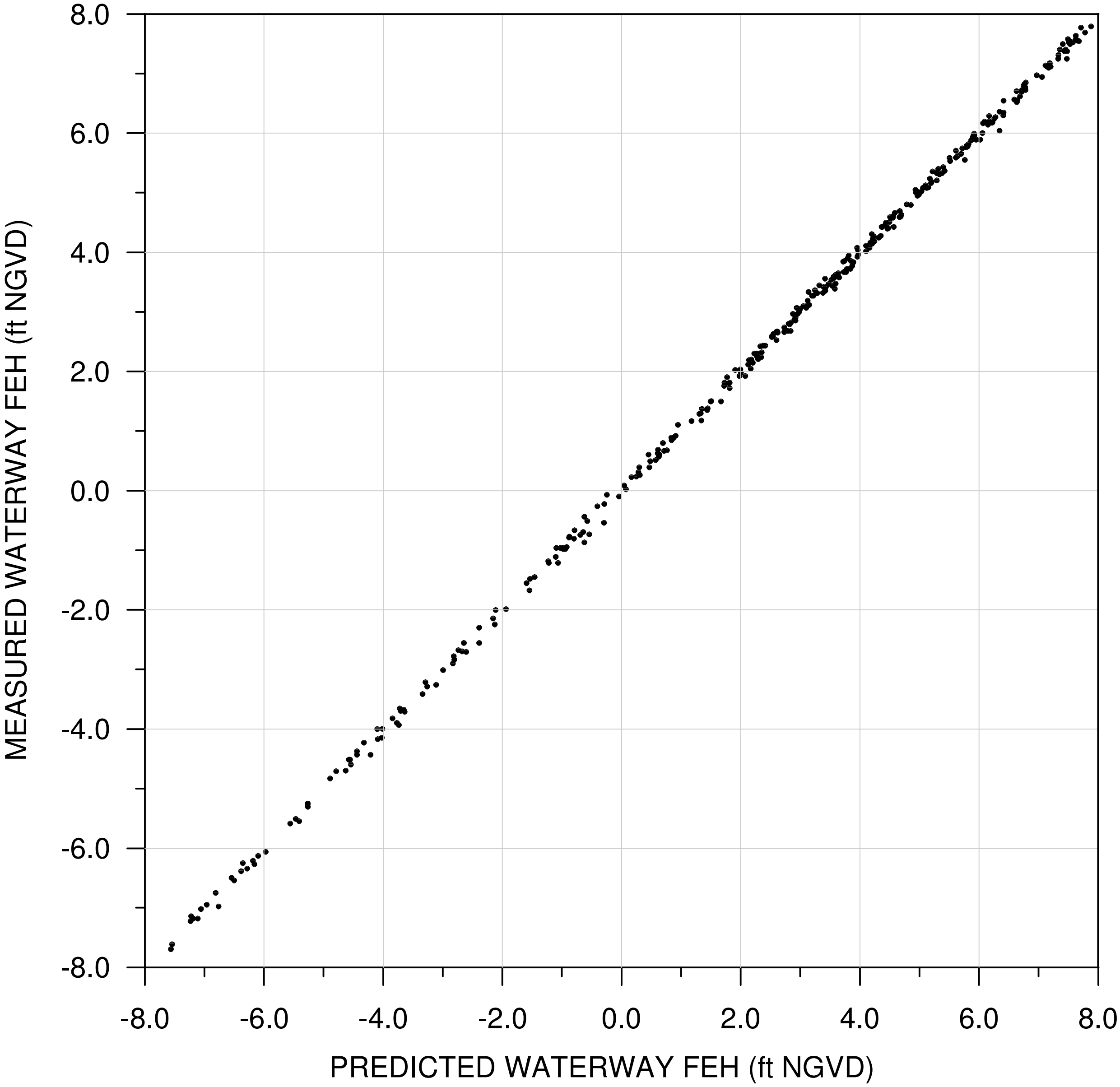


Note: Every fifth data point plotted

figure 5g

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-C4-2

Occidental Chemical Corporation, Tacoma, Washington



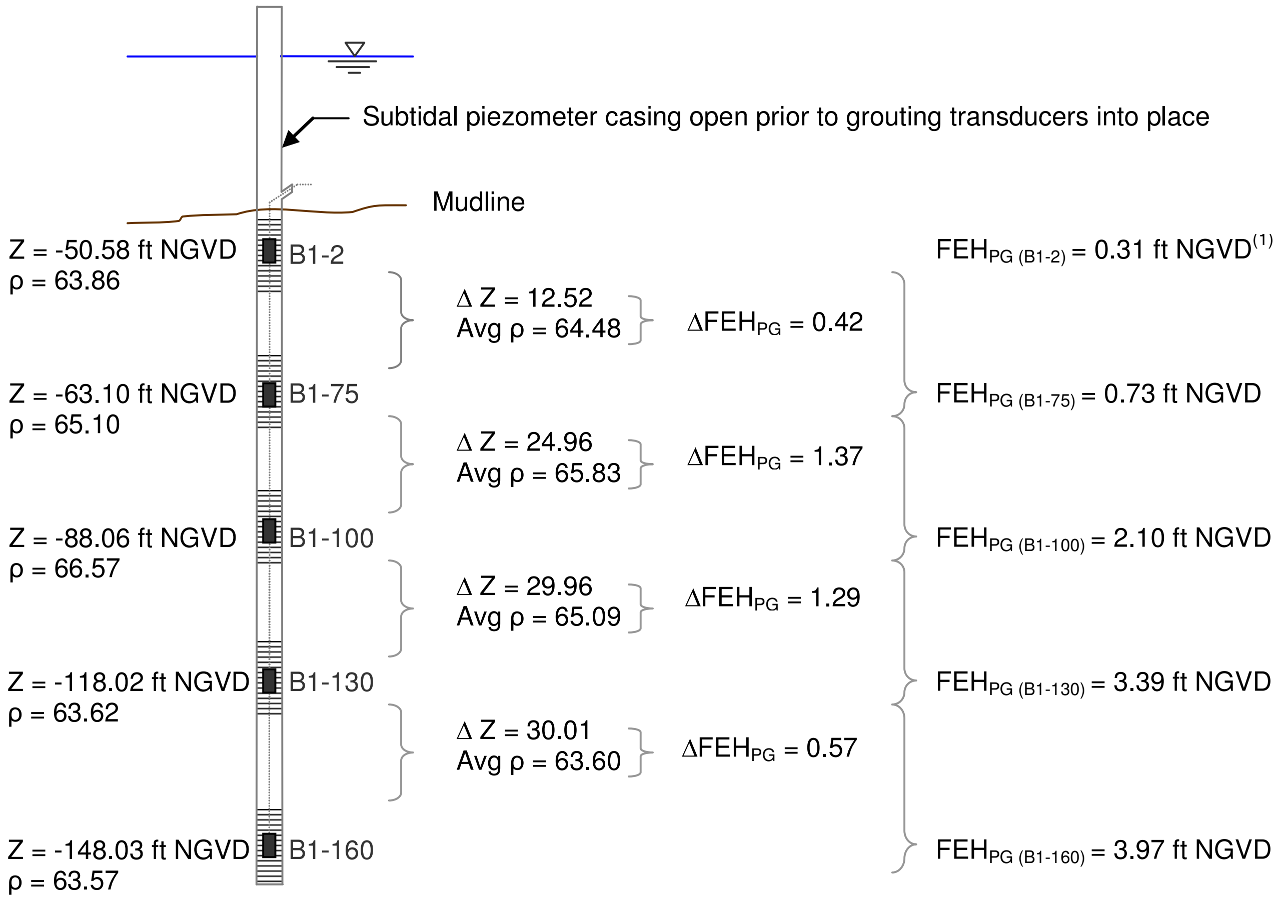
Note: Every fourth data point plotted

figure 5h

SCATTER PLOT OF MEASURED VS. PREDICTED WATERWAY FEH
AT MUDLINE TRANSDUCER LOCATION WW-D1-2

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 5h_ WW-D1-2.grf) MAY 6/2014



Calculation of FEH_{PG} for Underlying Transducer from Overlying Transducer FEH_{PG}:

$$FEH_{PG2} = \left[(Z_1 - Z_2) \times \frac{(\rho_1 + \rho_2)}{2\rho_{Fresh}} \right] - (Z_1 - Z_2) + FEH_{PG1} \qquad \text{Equation 3.21}$$

Equation 3.21 Simplified:

$$FEH_{PG2} = \Delta FEH_{PG} + FEH_{PG1} \qquad \text{Equation 3.22}$$

ΔFEH_{PG} defined as:

$$\Delta FEH_{PG} = \frac{[\Delta Z \times Avg\rho]}{62.4} - \Delta Z$$

Note:

(1) Mudline transducer FEH_{PG} calculated using empirical relationship developed through the multiple linear regression analysis.

figure 6

SCHEMATIC OF PRE-GROUT FEH CALCULATION FOR WW-B1 SUBTIDAL PIEZOMETER NEST

Occidental Chemical Corporation - Tacoma, Washington

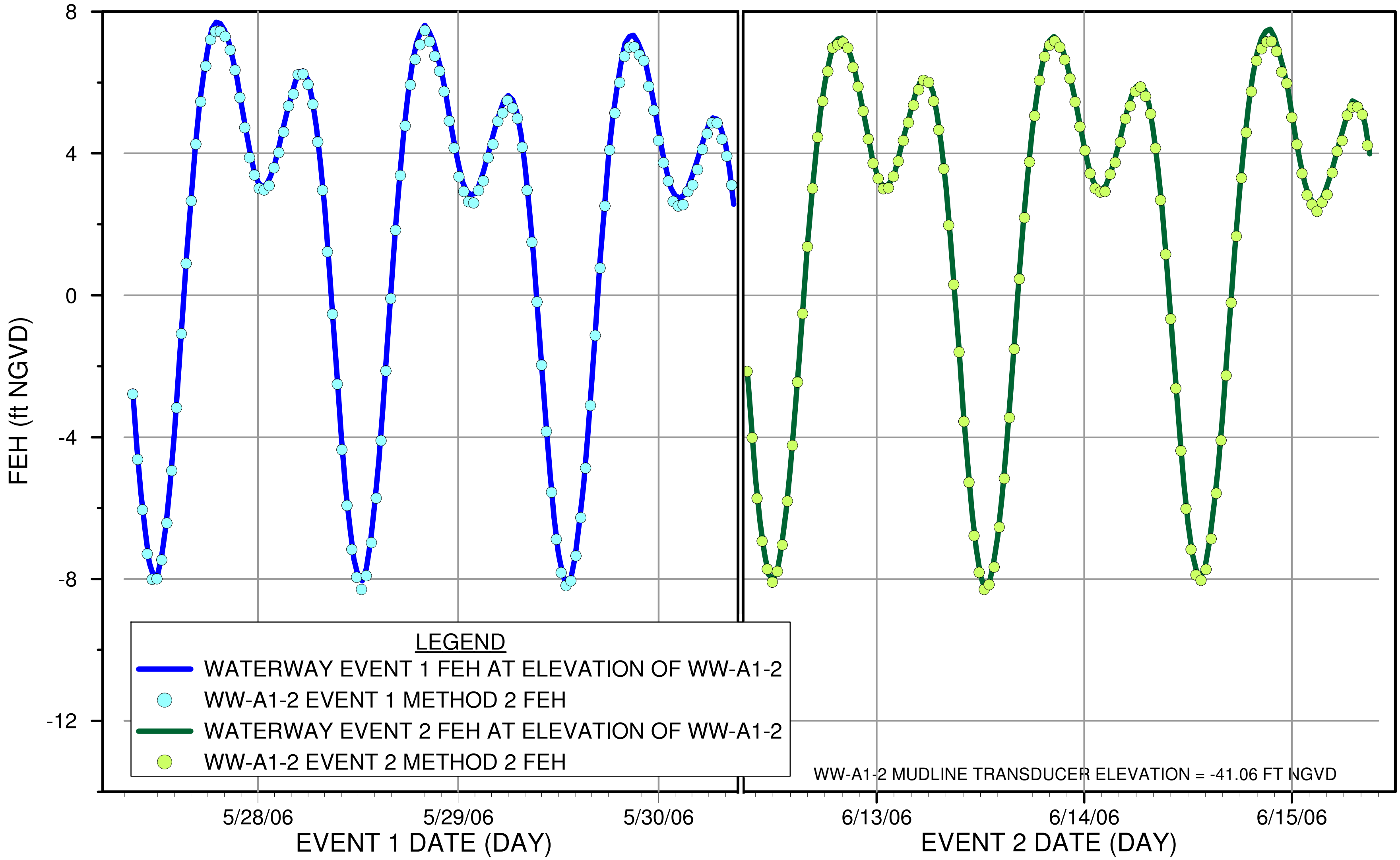


figure 7a

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-A1-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 7a_ WW-A1-2.grf) May 6/2014

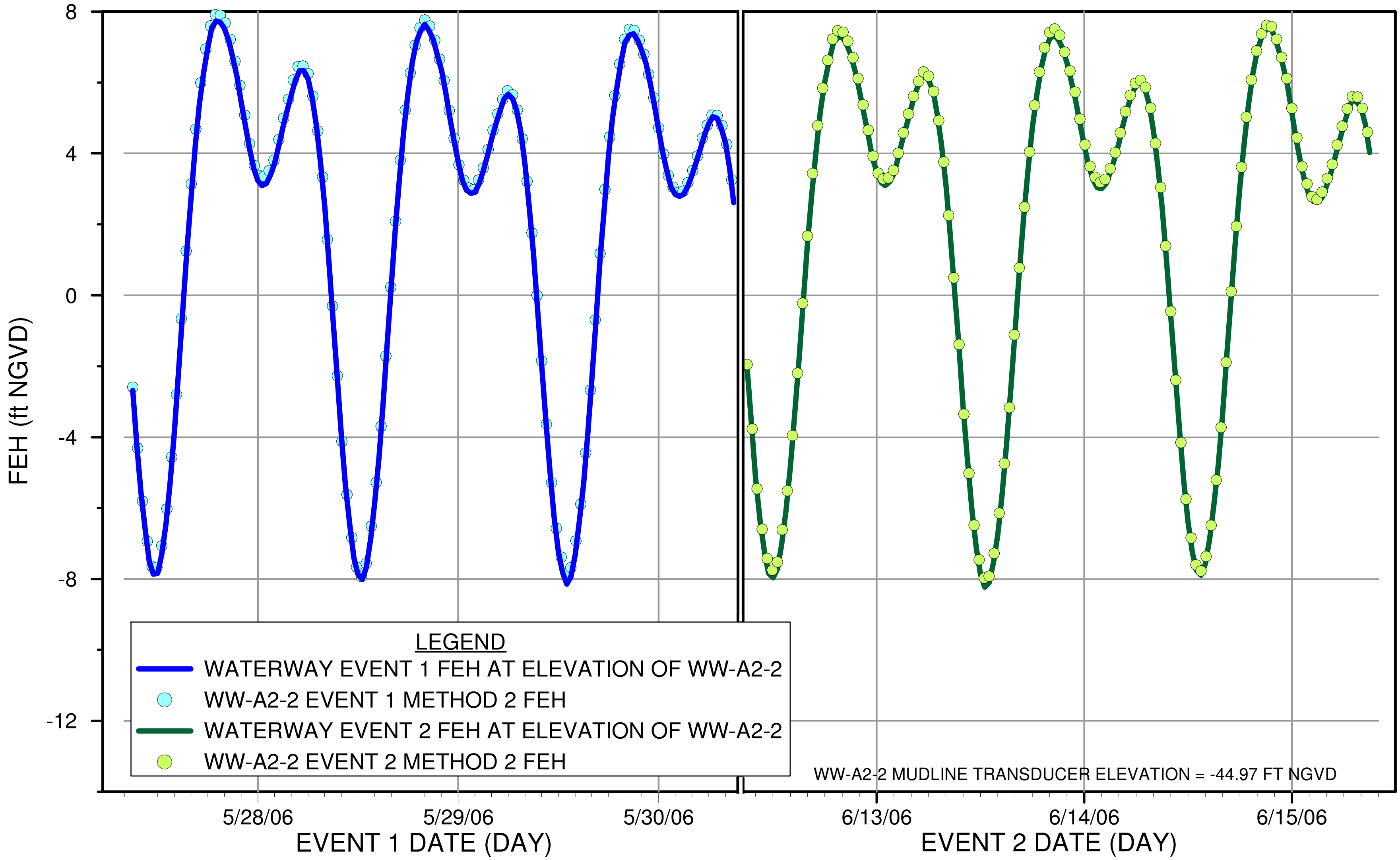


figure 7b

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-A2-2

Occidental Chemical Corporation,Tacoma, Washington

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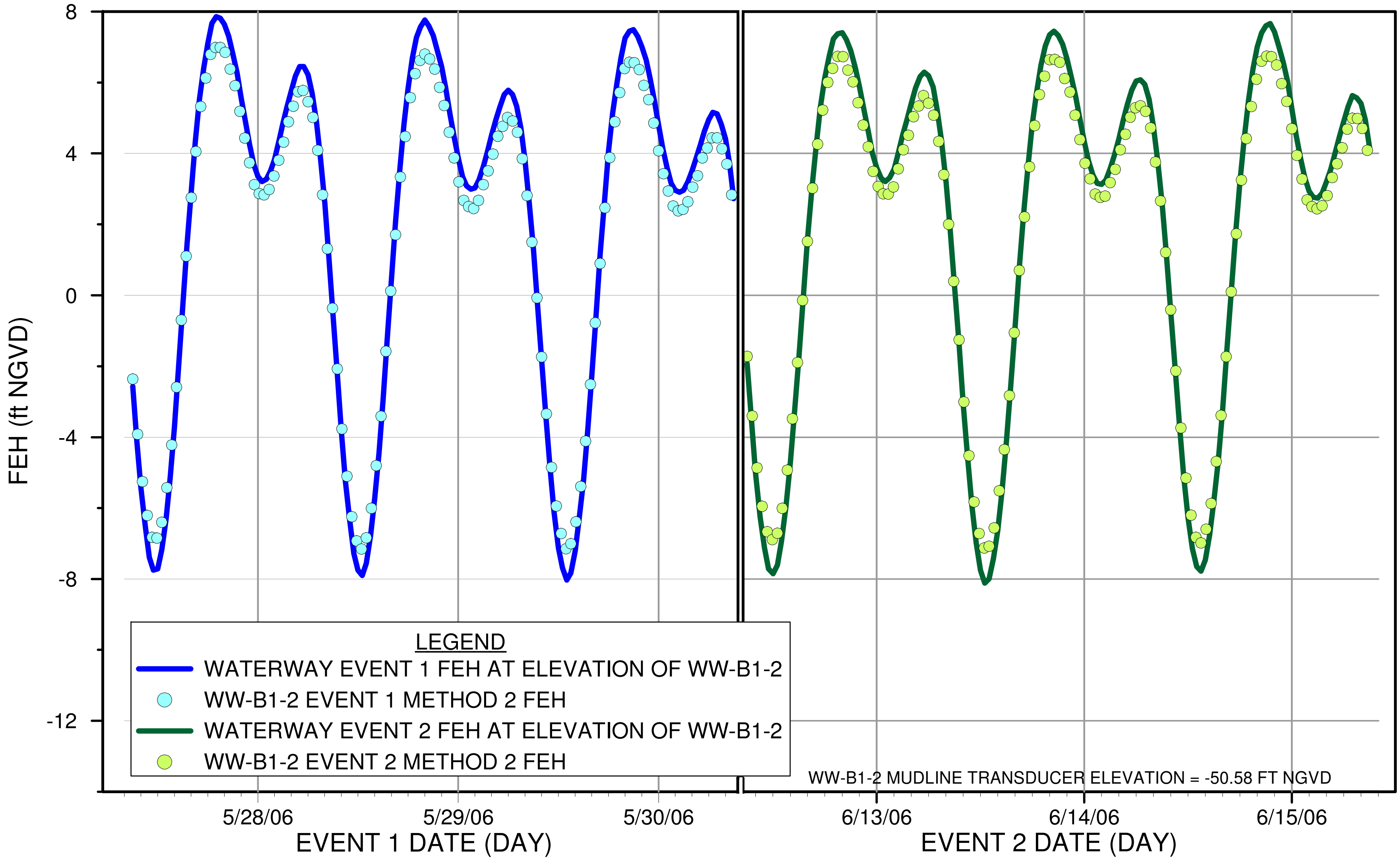

figure 7c

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-B1-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 7c_ WW-B1-2.grf) MAY 6/2014

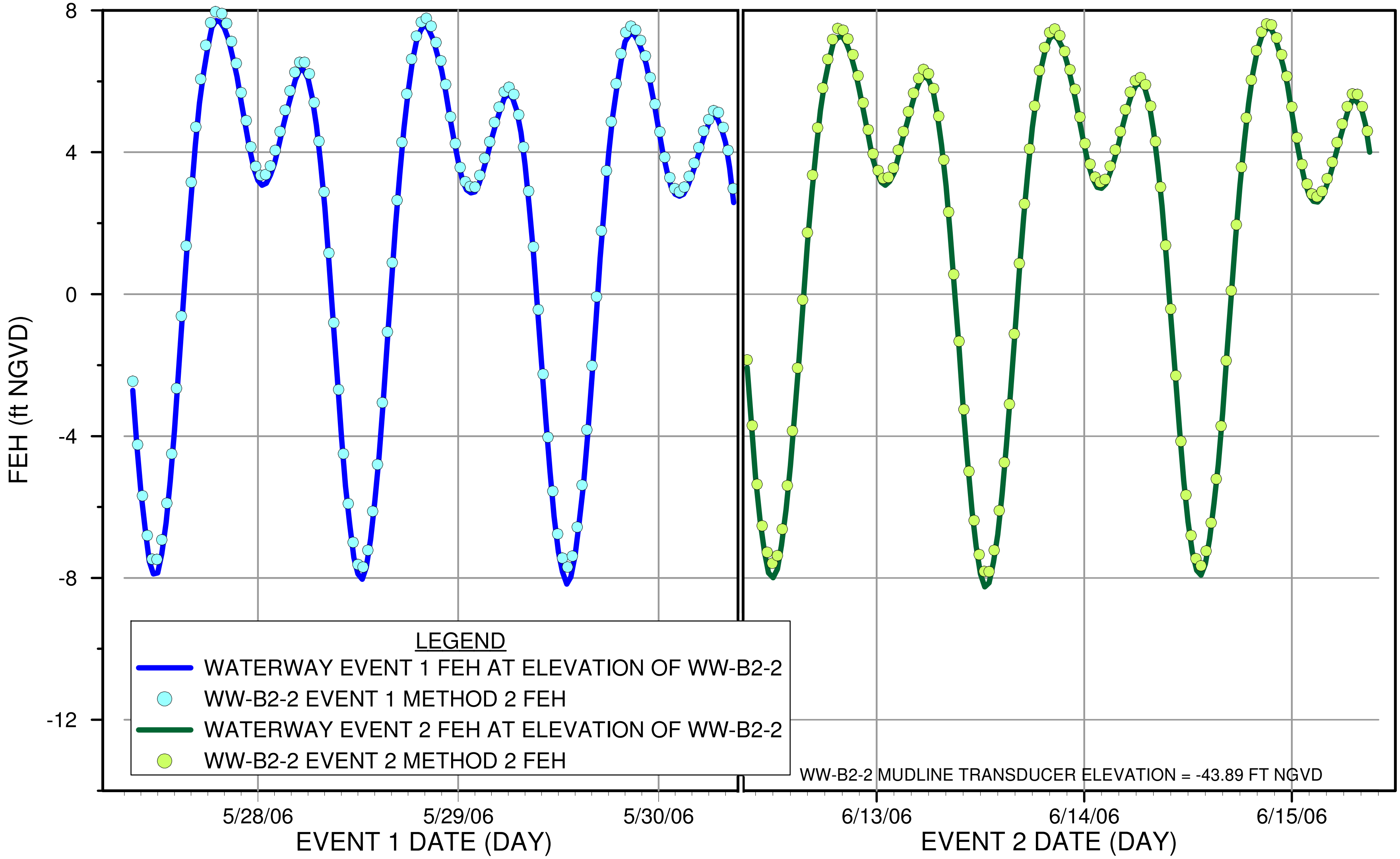

figure 7d

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-B2-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 5d_ WW-B2-2.grf) MAY 6/2014

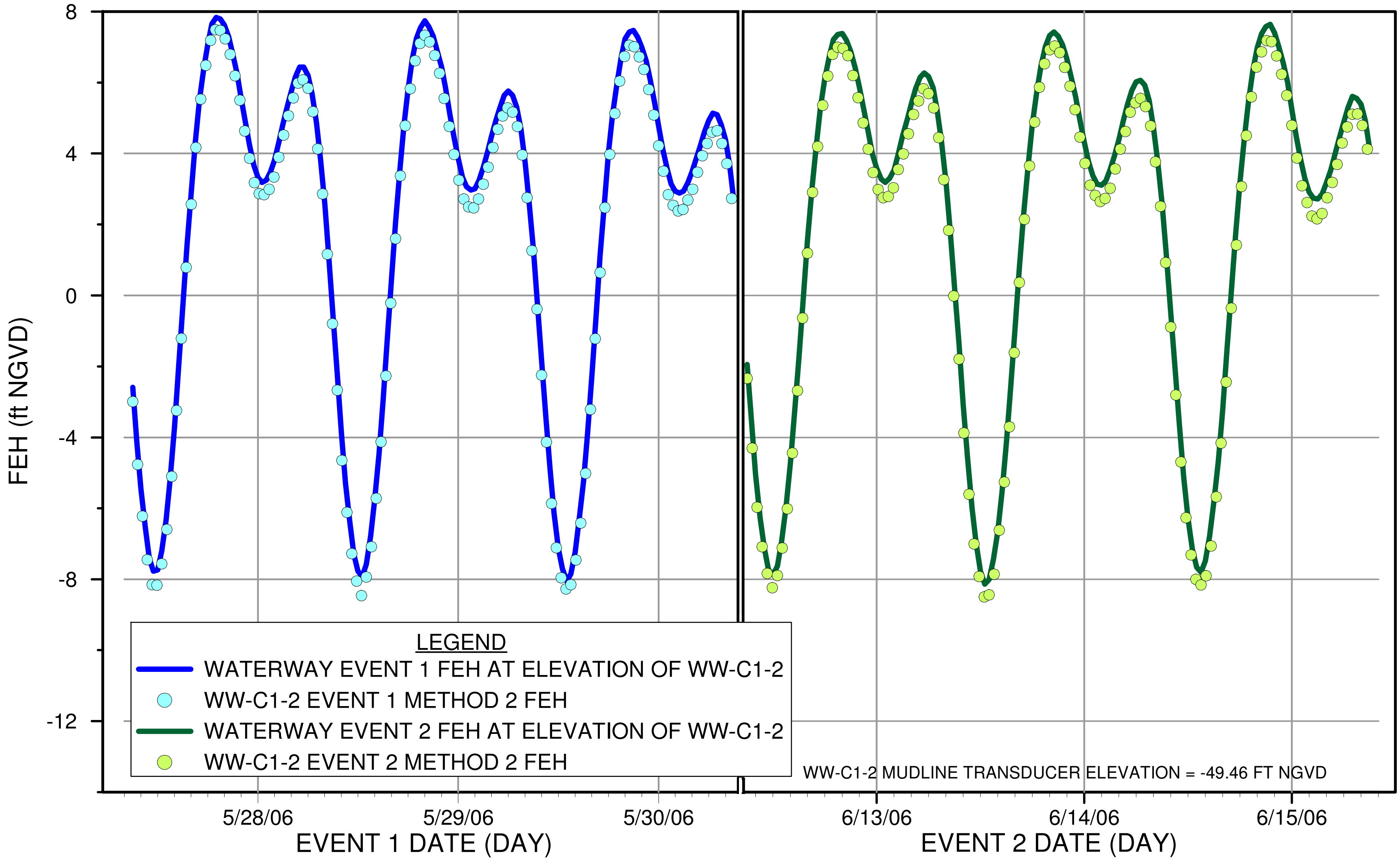

figure 7e

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-C1-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 7e_ WW-C1-2.grf) MAY 6/2014

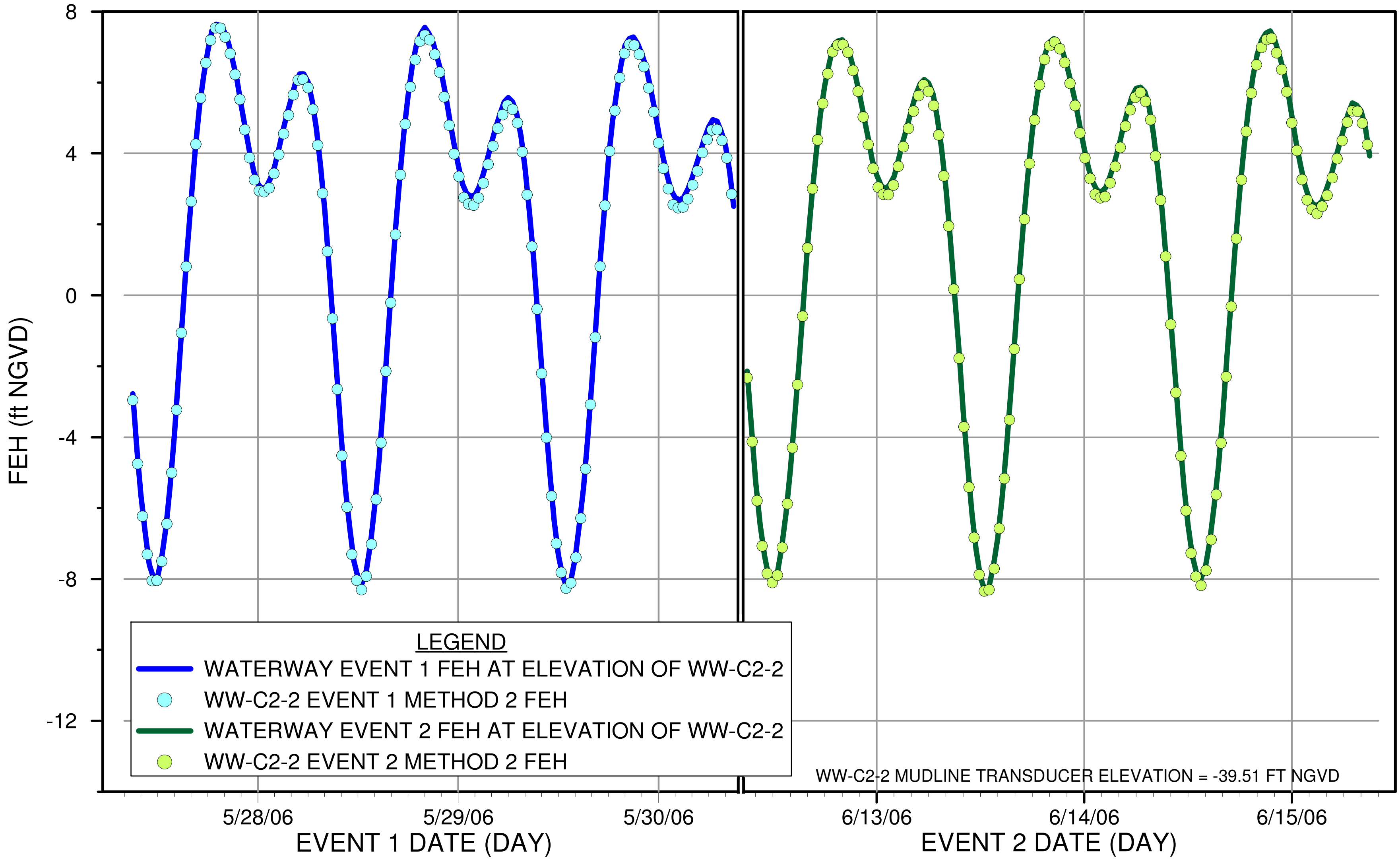

figure 7f

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-C2-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 7f_ WW-C2-2.grf) MAY 6/2014

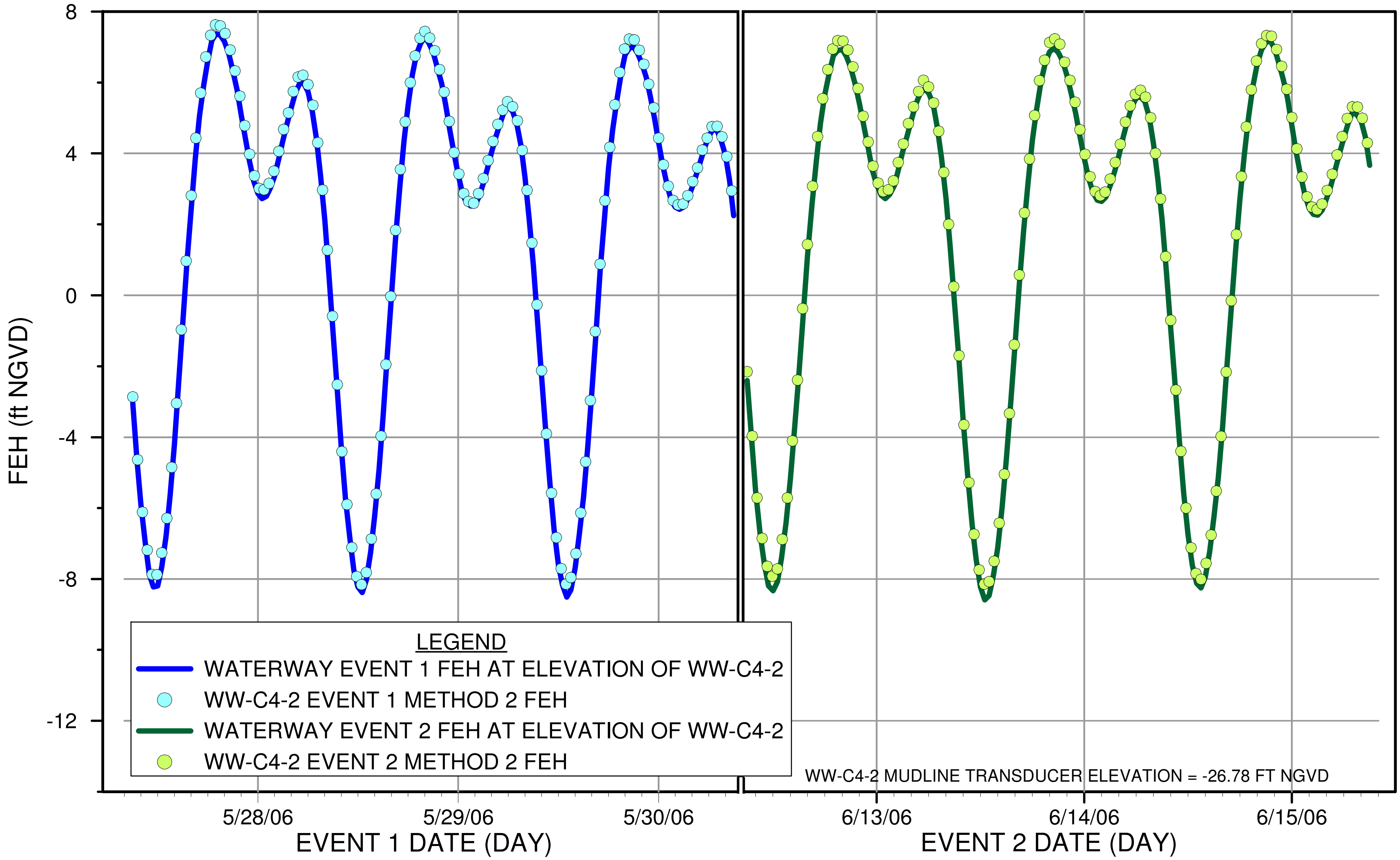

figure 7g

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-C4-2

Occidental Chemical Corporation,Tacoma, Washington

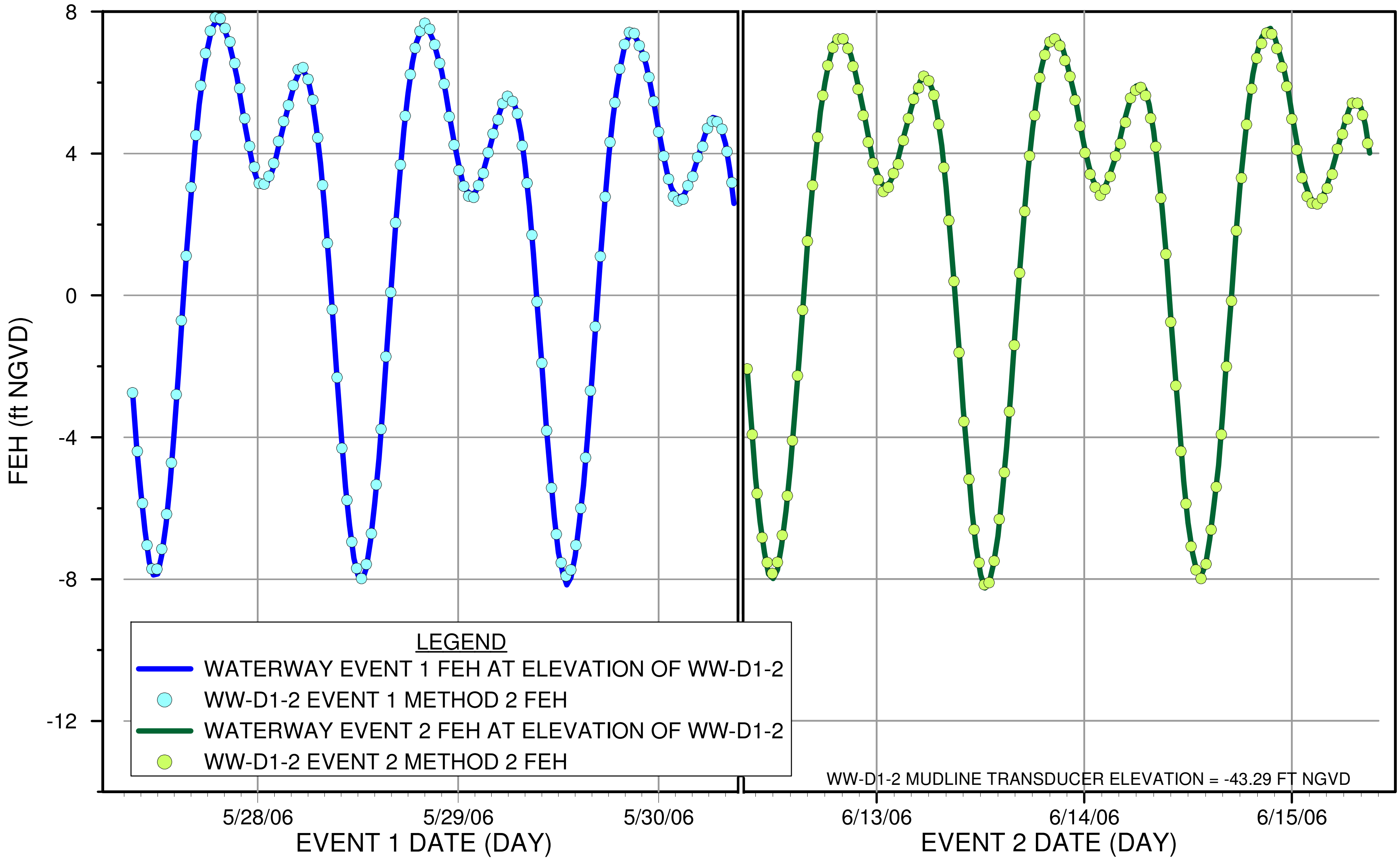

figure 7h

EVENTS 1 AND 2 METHOD 2 MUDLINE TRANSDUCER FEH VS. WATERWAY FEH - WW-D1-2

Occidental Chemical Corporation,Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 7h_ WW-D1-2.grf) MAY 6/2014

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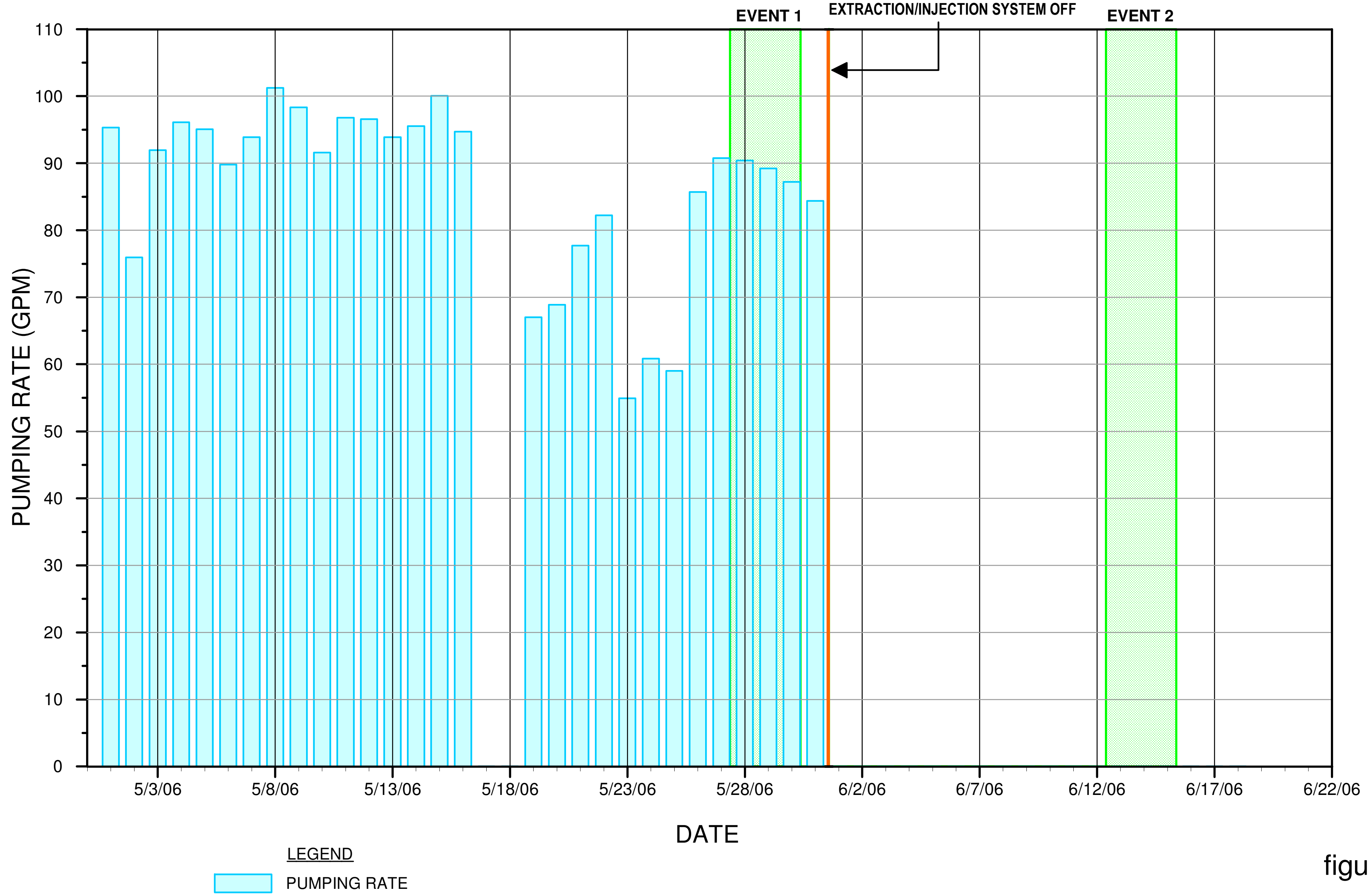
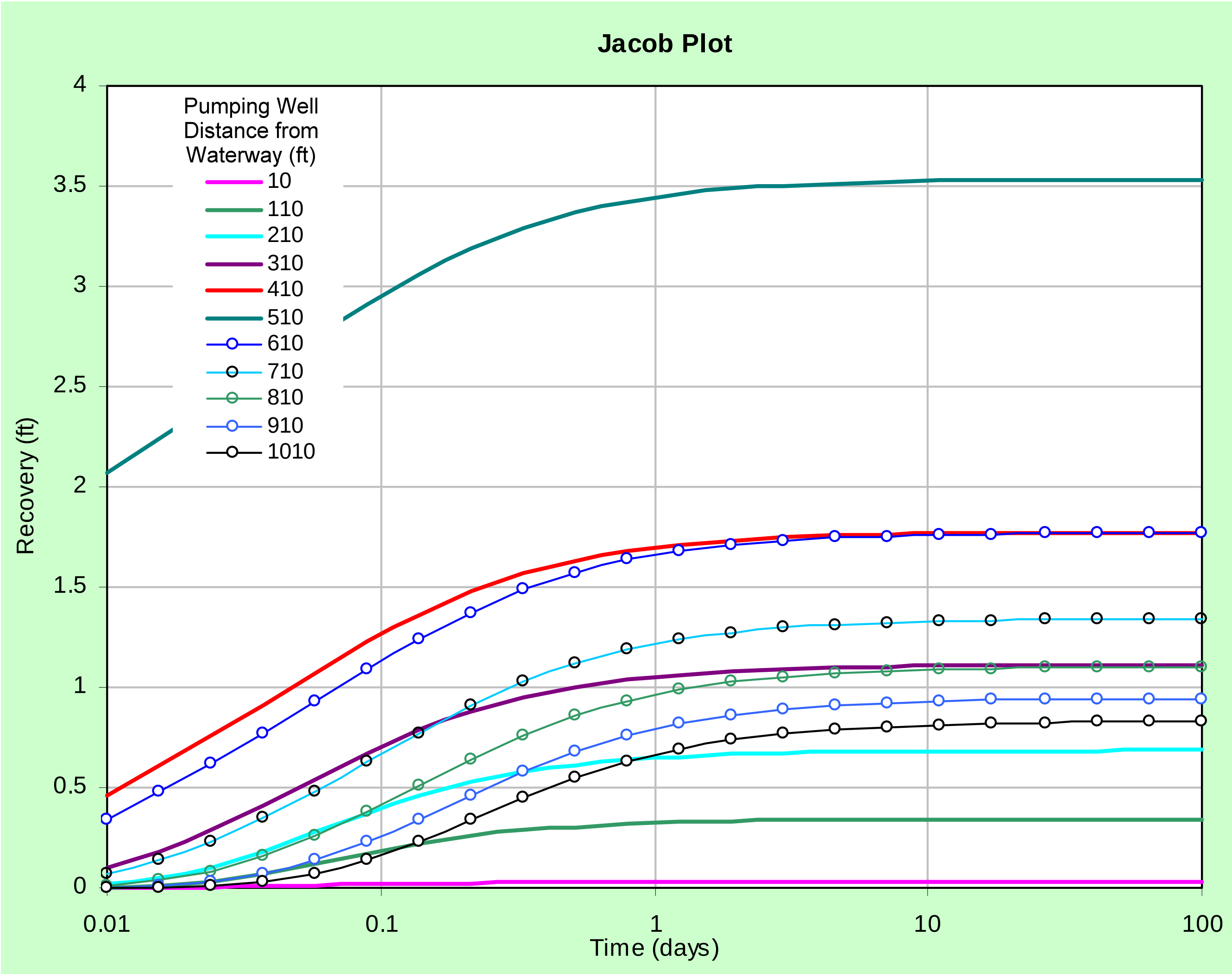


figure 8

AVERAGE DAILY EXTRACTION SYSTEM PUMPING RATE
PRIOR TO AND DURING EVENT 1
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\figure 8.grf) MAY 7/2014



Recovery curves are the predicted water level response at an observation well located 500 ft west of the Hylebos shoreline. A single pumping well is simulated. Each curve reflects the pumping well at a different distance west of the Hylebos Waterway (from 10 to 1,010 ft). When the pumping well is at 510 ft from the Hylebos, or 10 ft from the observation well, the total response is the greatest.

Analysis assumes:
S/T = 1 x 10-6 day/ft^2
T = 4,000 ft^2 /day
S = 0.004 dimensionless

Model uses the Theis equation and an image well to simulate a constant head at the Hylebos Waterway.

Note that the percent recovery is determined by S/T. Increasing S/T slows recovery.

figure 9

PRELIMINARY THEORETICAL RECOVERY FROM EXTRACTION SYSTEM SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

DRAFT

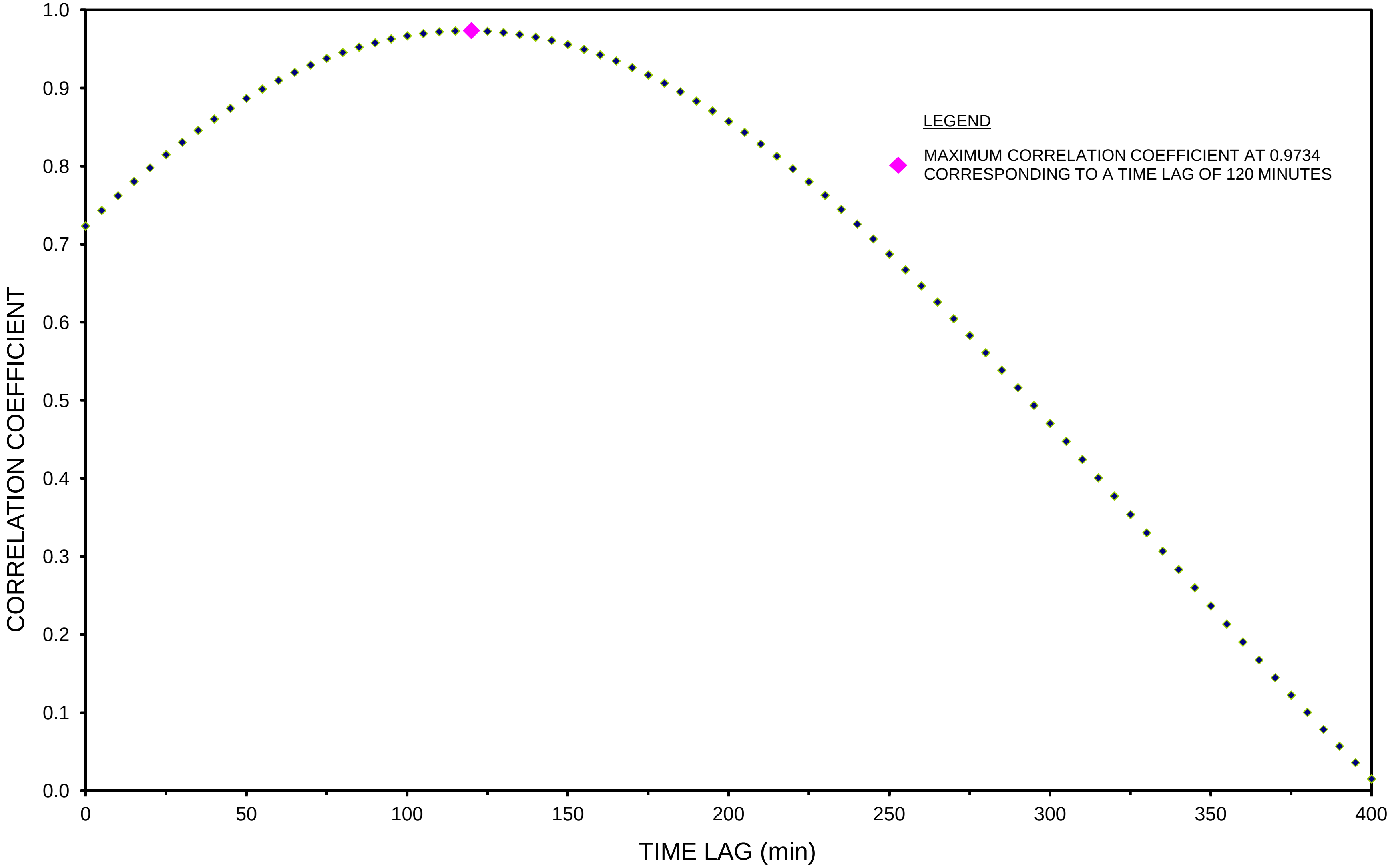


figure 10

WELL 11-45 CORRELATION COEFFICIENT VS. TIME LAG

Occidental Chemical Corporation, Tacoma Washington

007843-A6(128)GN-WA HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\11-45_Example.xls) AUG 5/2014

DRAFT

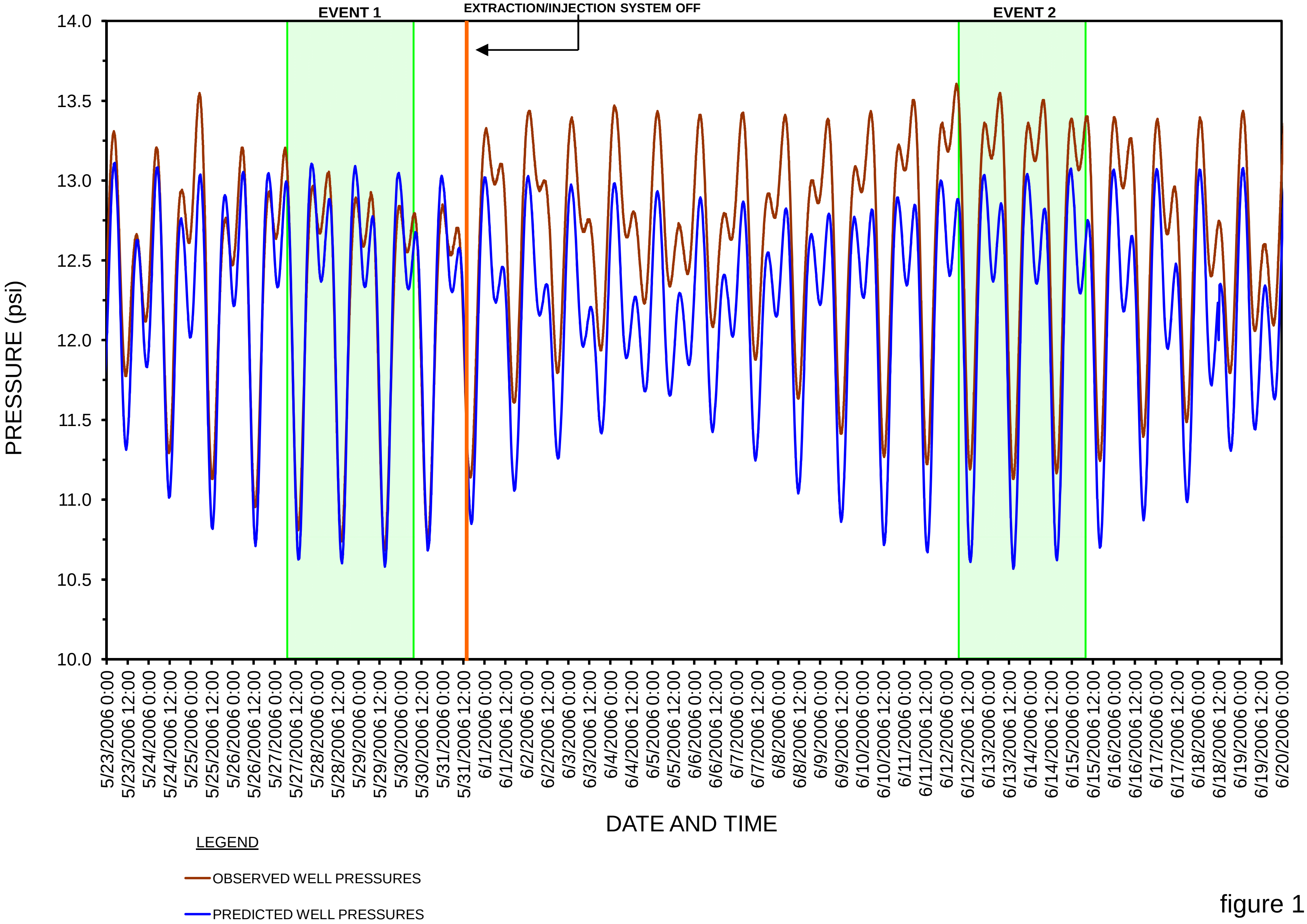
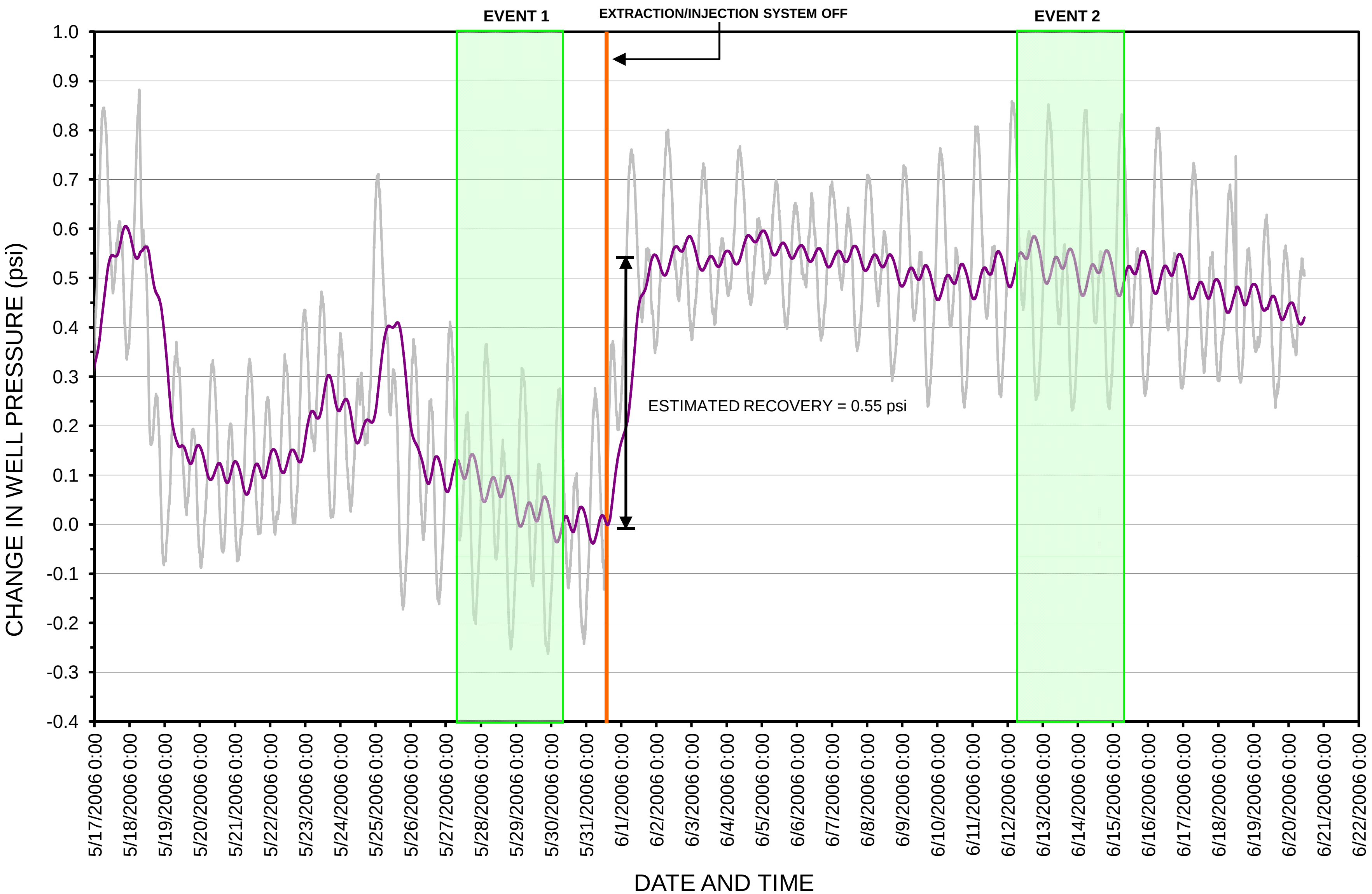


figure 11

WELL 11-45 OBSERVED AND PREDICTED PRESSURES

Occidental Chemical Corporation, Tacoma Washington

007843-A6(128)GN-WA HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\11-45_Example.xls) AUG 5/2014



LEGEND

RESIDUAL PRESSURE

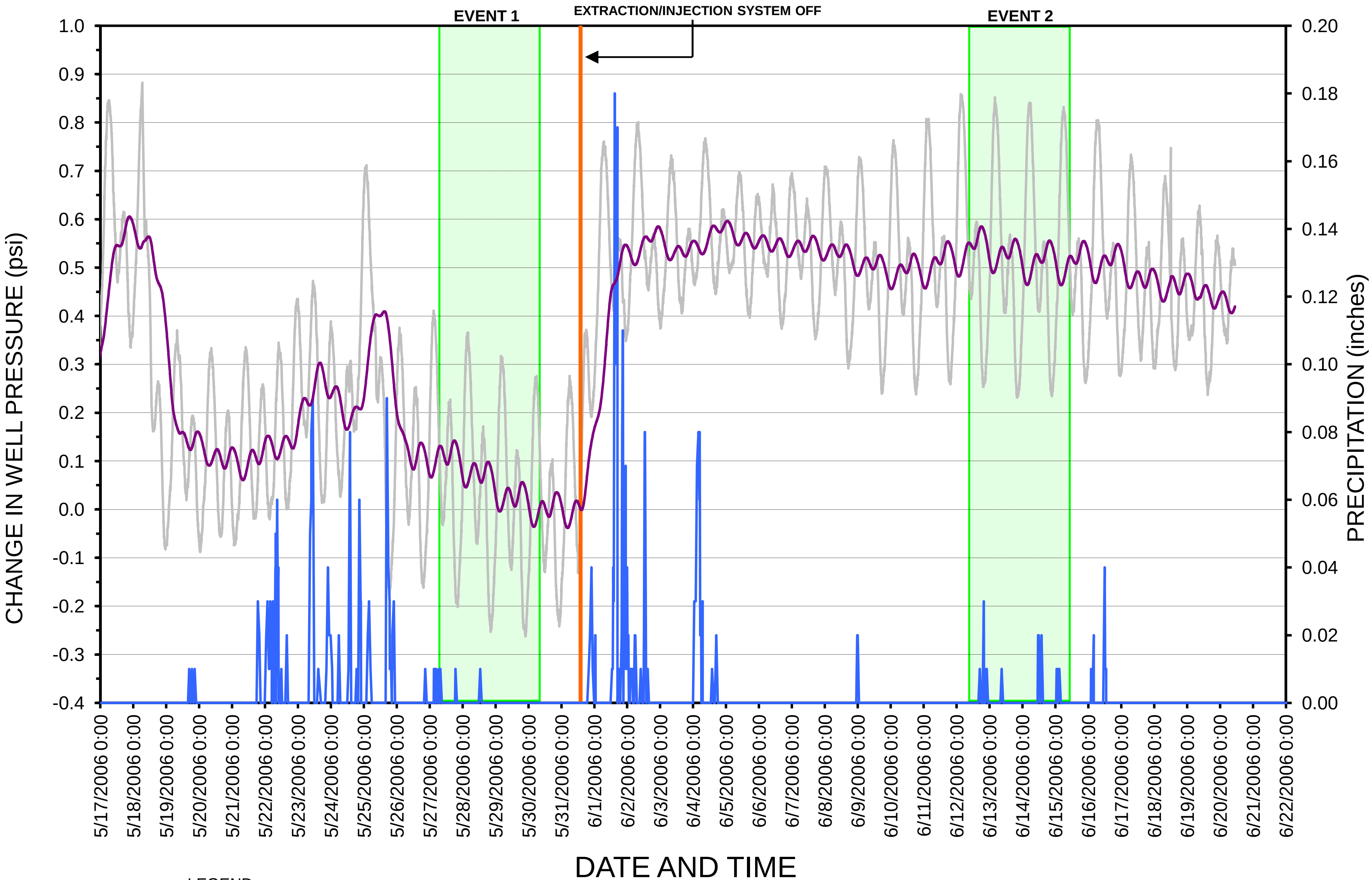
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE

figure 12

WELL 11-45 RESIDUAL PRESSURE

Occidental Chemical Corporation, Tacoma Washington

DRAFT



LEGEND

RESIDUAL PRESSURE

PRECIPITATION

255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE

figure 13

WELL 11-45 RESIDUAL PRESSURE AND PRECIPITATION

Occidental Chemical Corporation, Tacoma Washington

DRAFT

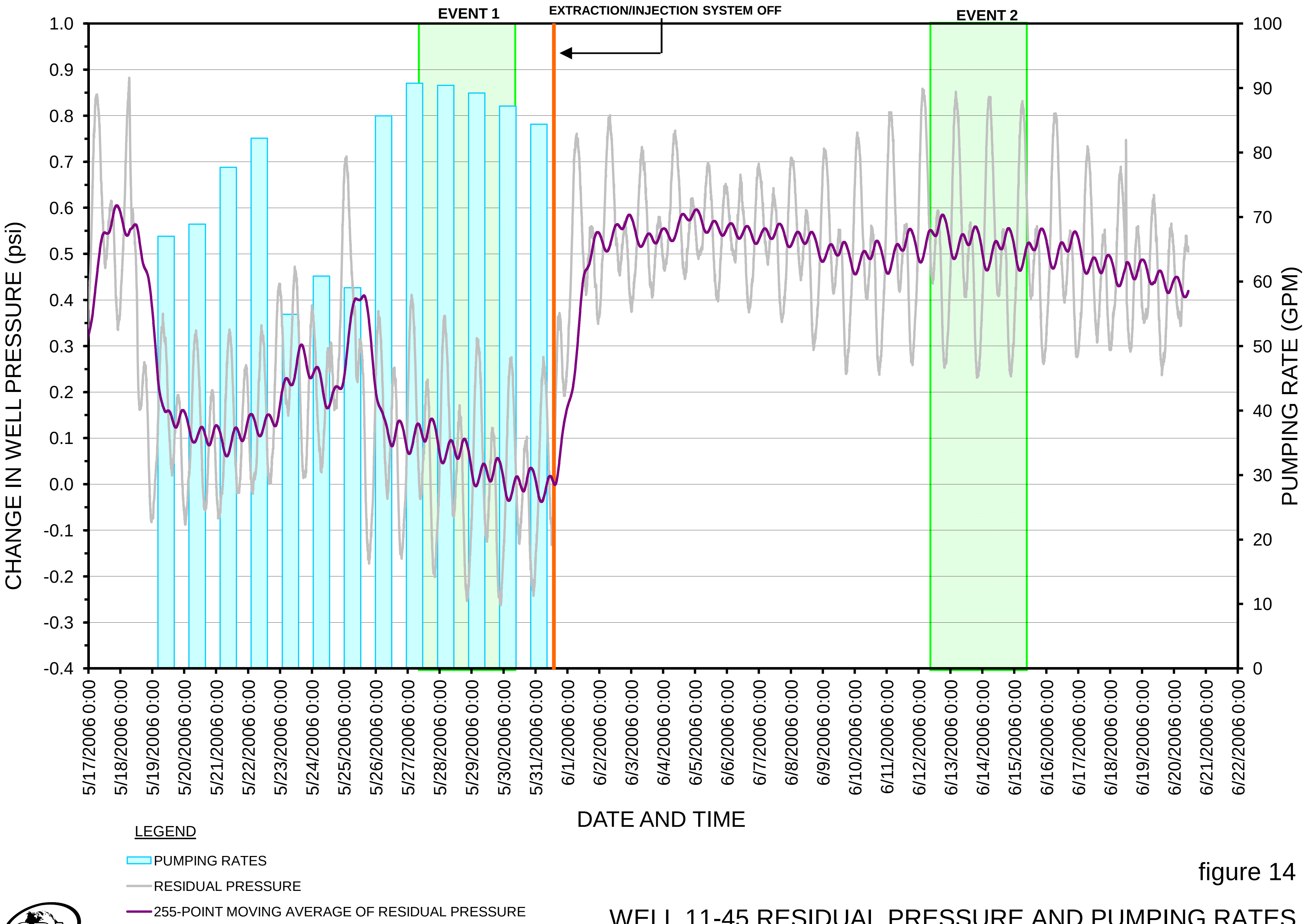


figure 14

WELL 11-45 RESIDUAL PRESSURE AND PUMPING RATES

Occidental Chemical Corporation, Tacoma Washington

007843-A6(128)GN-WA HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\11-45_Example.xls) AUG 5/2014

DRAFT

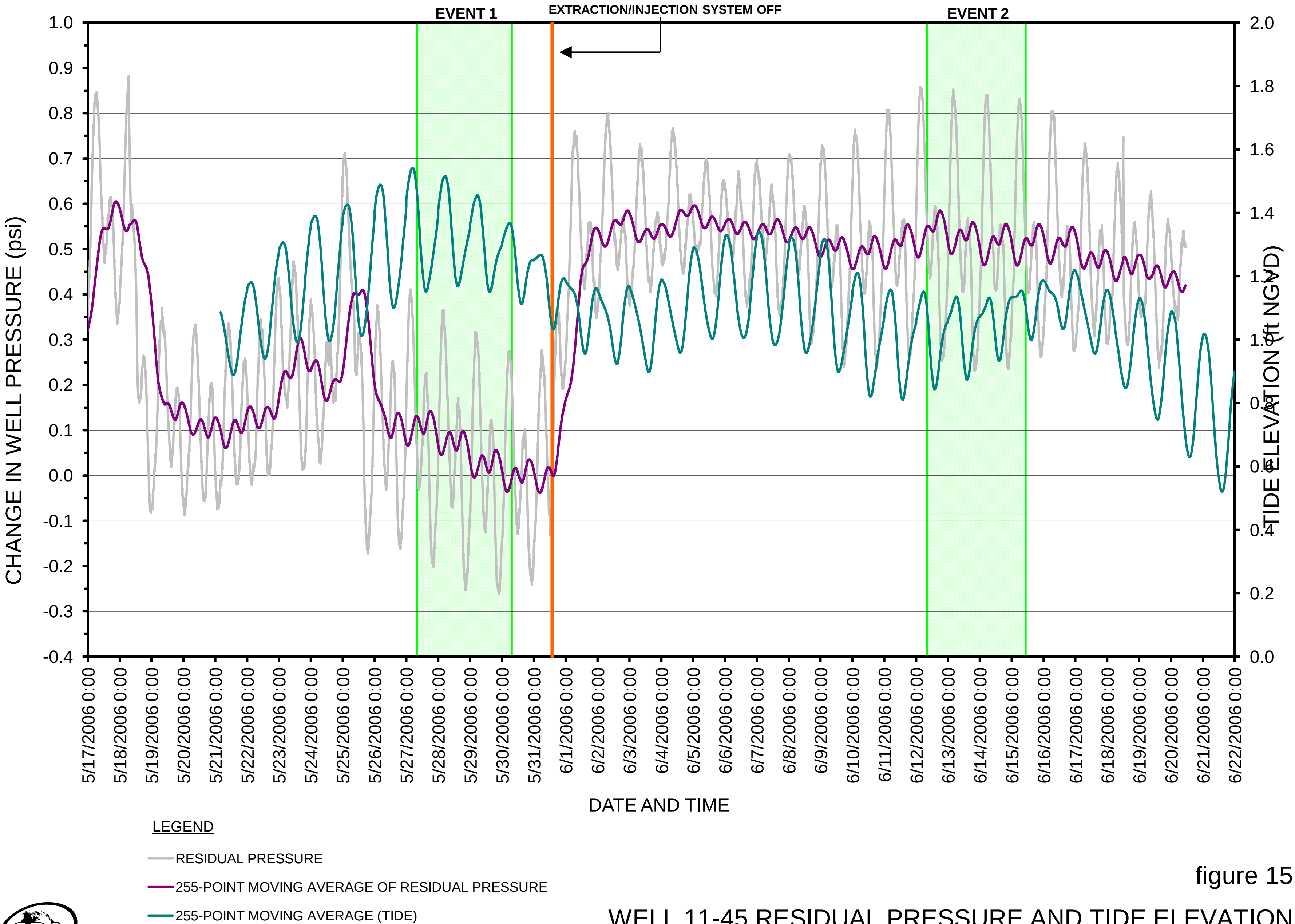


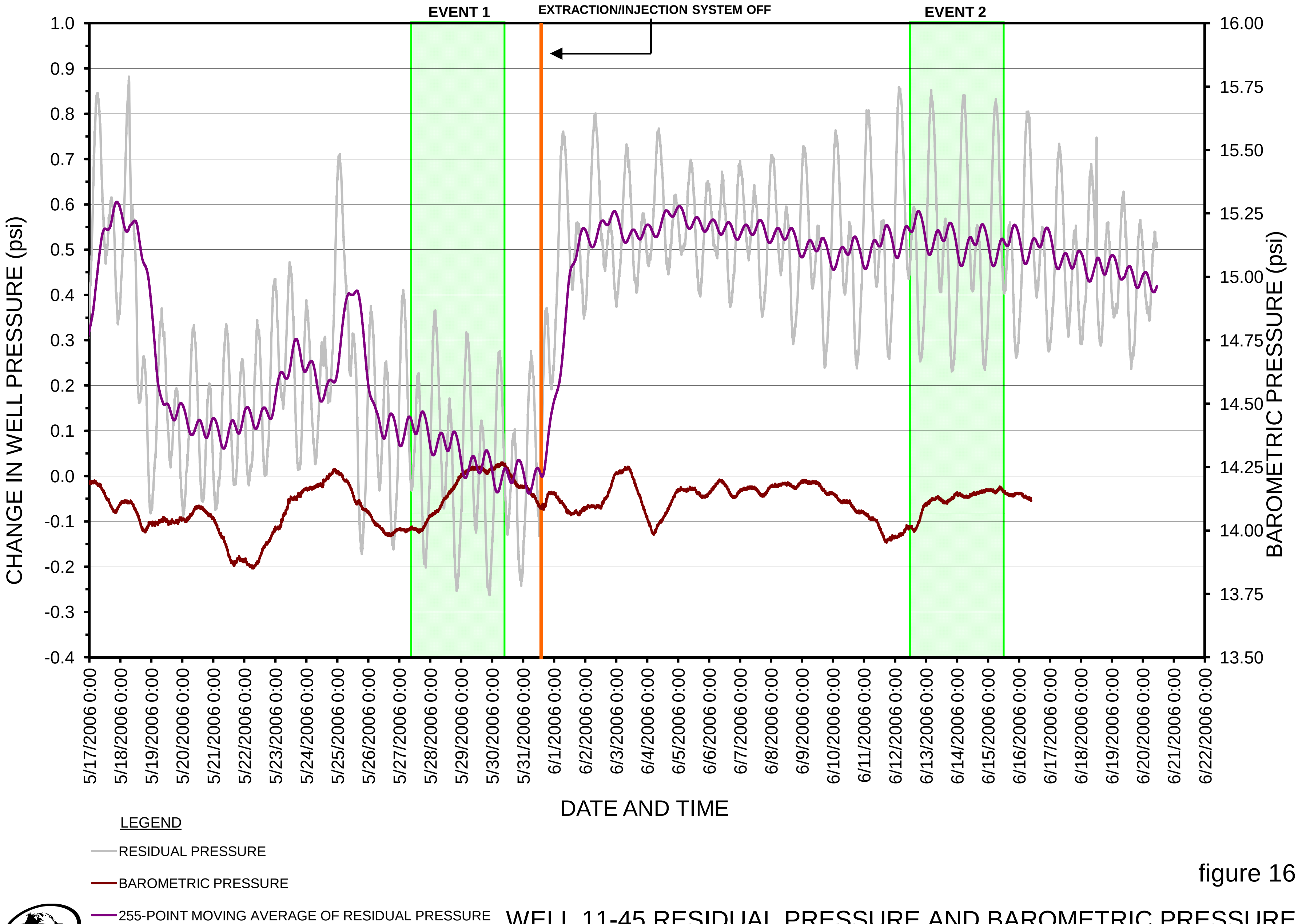
figure 15

WELL 11-45 RESIDUAL PRESSURE AND TIDE ELEVATION

Occidental Chemical Corporation, Tacoma Washington

007843-A6(128)GN-WA HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\11-45_Example.xls) AUG 5/2014

DRAFT



CRA

figure 16

WELL 11-45 RESIDUAL PRESSURE AND BAROMETRIC PRESSURE

Occidental Chemical Corporation, Tacoma Washington

007843-A6(128)GN-WA HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\11-45_Example.xls) AUG 5/2014

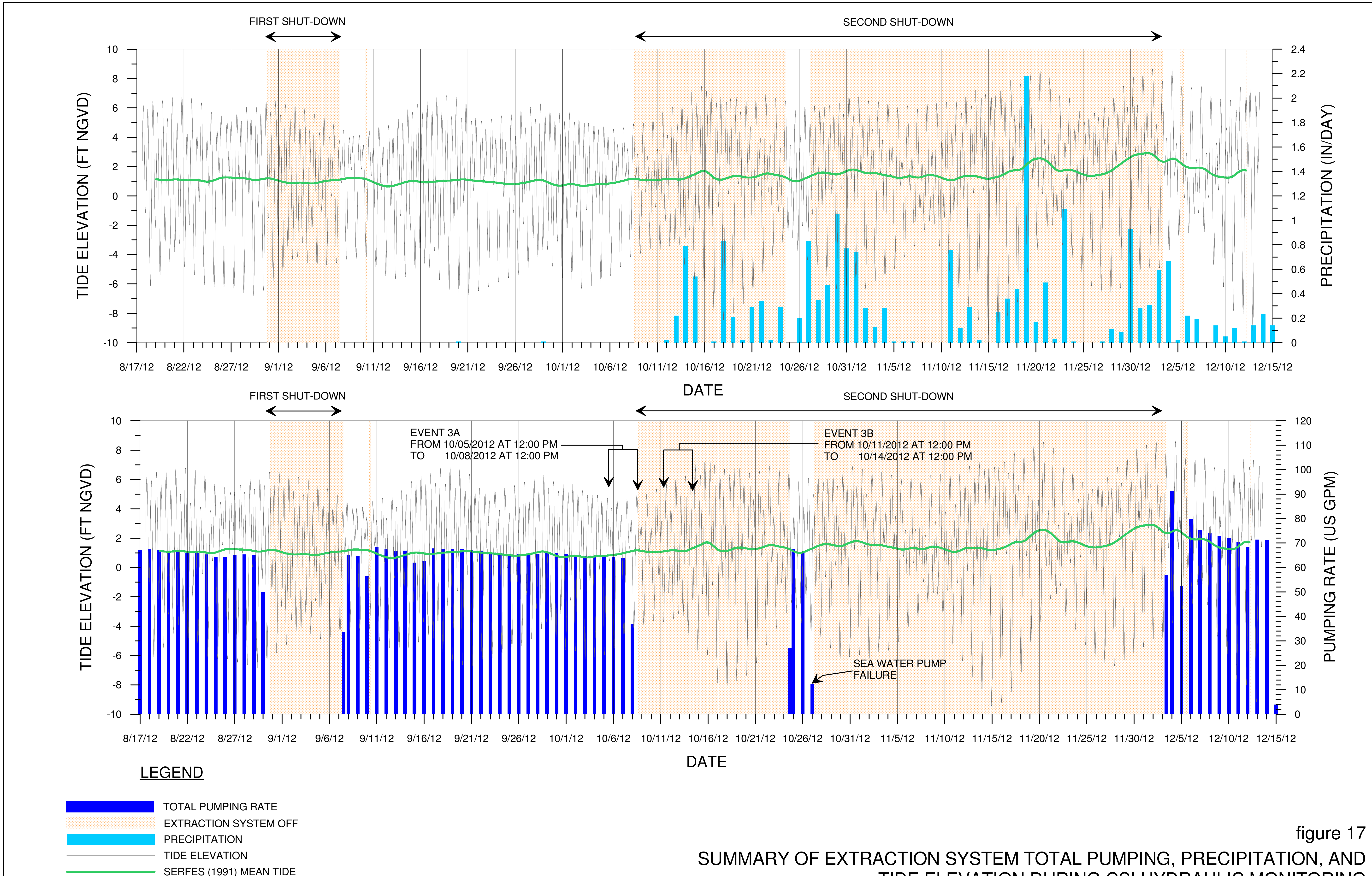
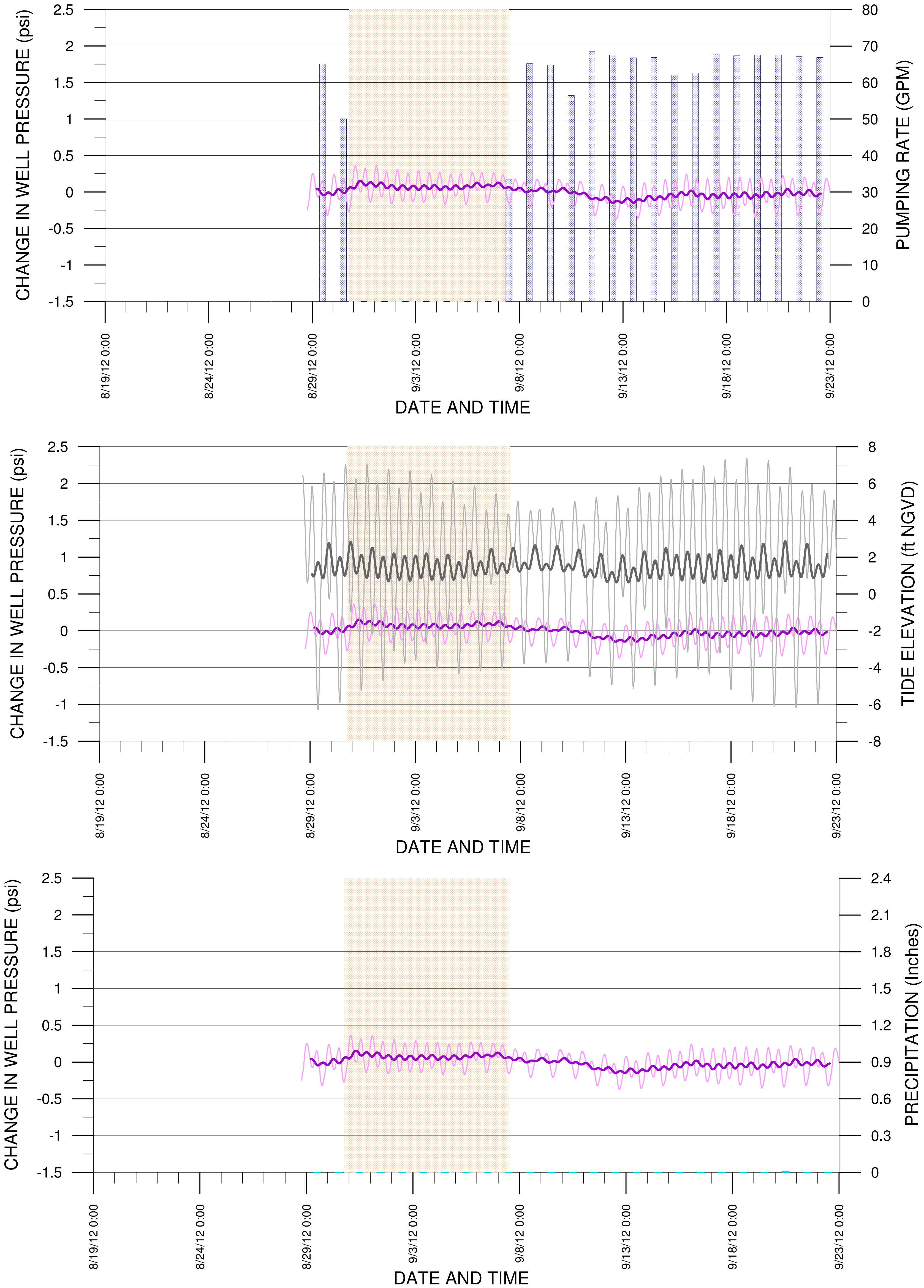


figure 17

SUMMARY OF EXTRACTION SYSTEM TOTAL PUMPING, PRECIPITATION, AND TIDE ELEVATION DURING CSI HYDRAULIC MONITORING

Occidental Chemical Corporation, Tacoma, Washington



LEGEND

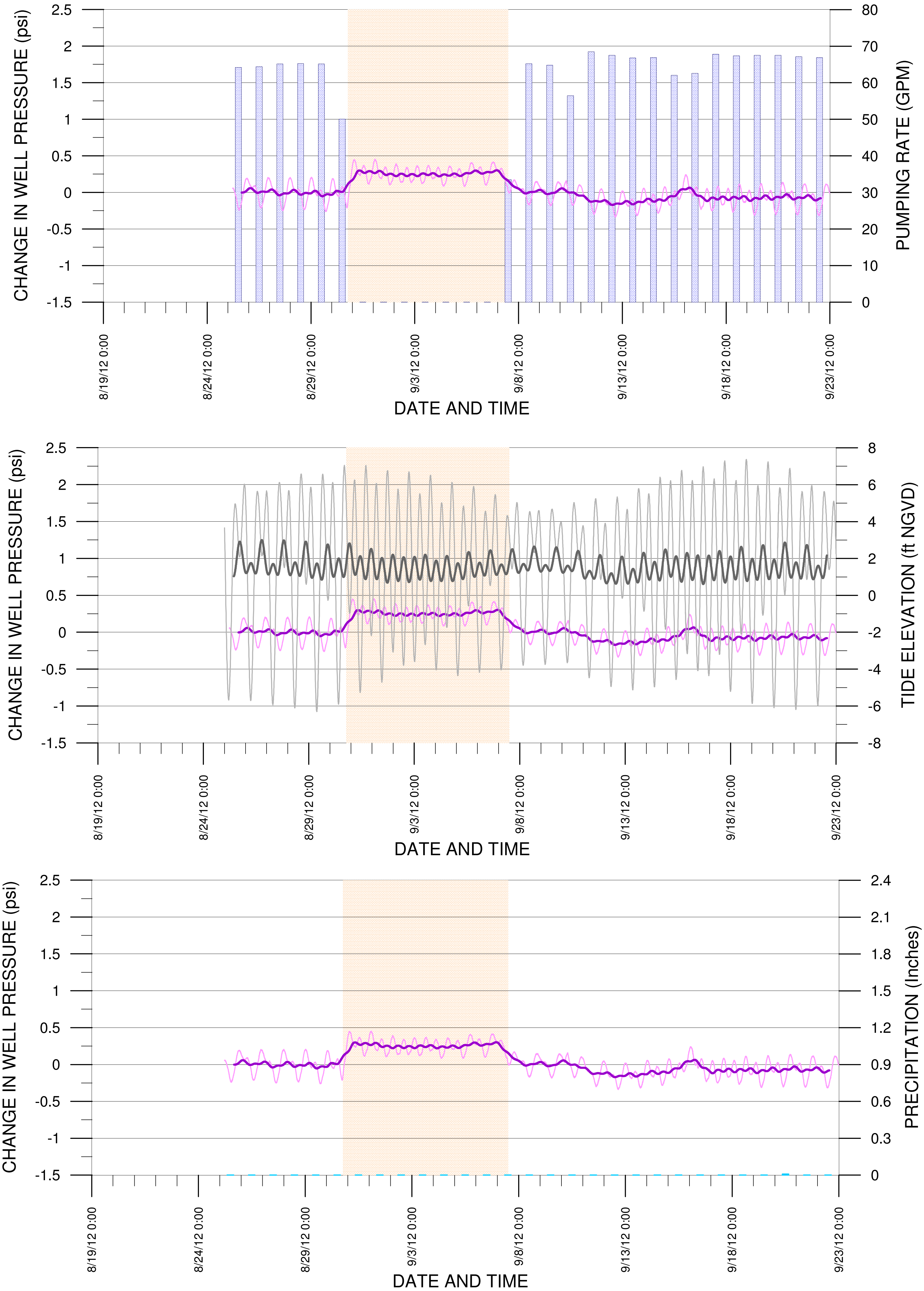
FIRST SHUTDOWN EVENT
PUMPING RATE
RESIDUAL PRESSURE
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE
TIDE ELEVATION
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE
PRECIPITATION

figure 18

WELL 5-75 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - FIRST SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Well 5-75 ResidualPressure1.grf) MAY 8/2014



LEGEND

FIRST SHUTDOWN EVENT
PUMPING RATE
RESIDUAL PRESSURE
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE
TIDE ELEVATION
255-POINT MOVING AVERAGE OF TIDE ELEVATION
PRECIPITATION

figure 19

WELL 7-100 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - FIRST SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

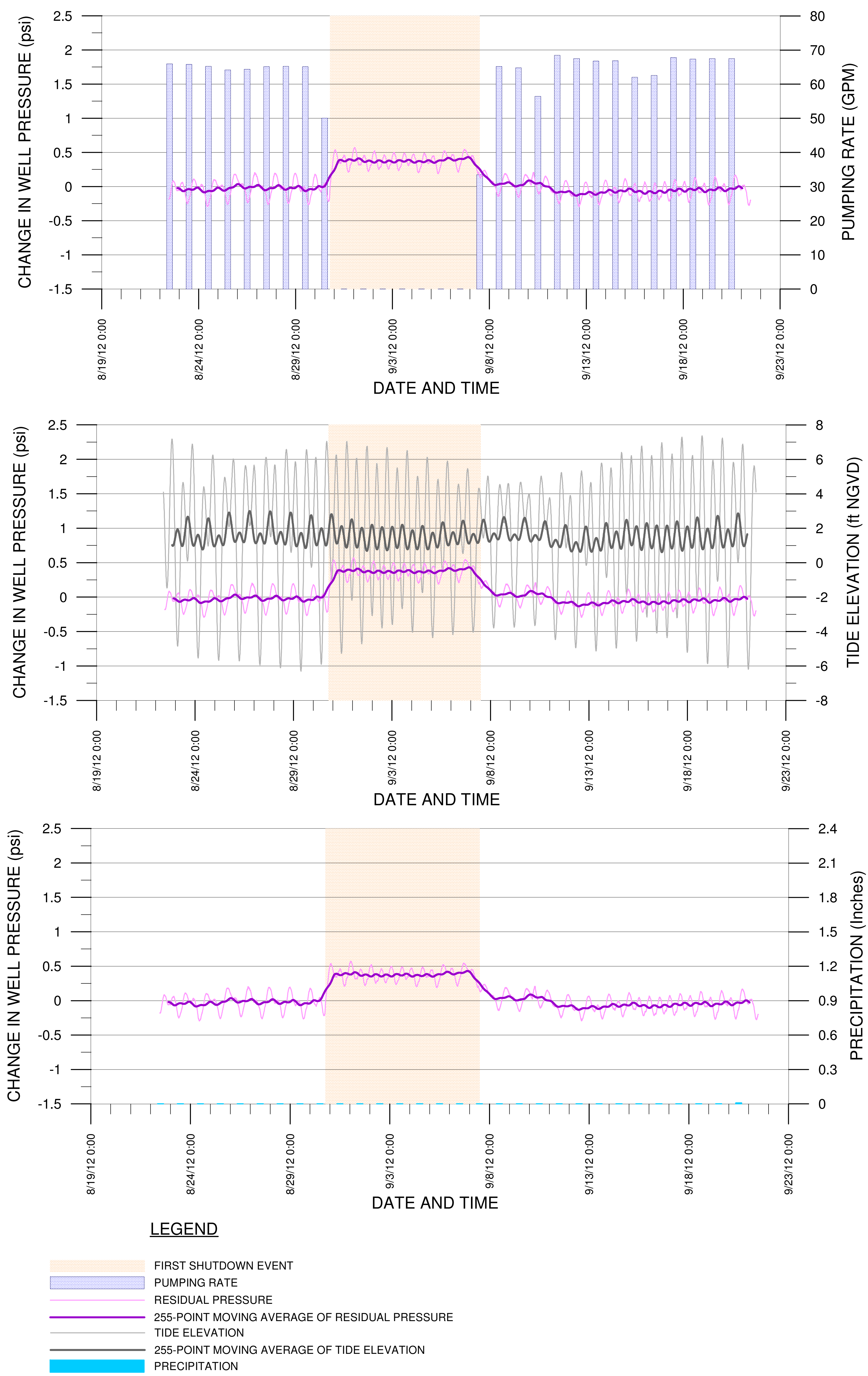


figure 20

WELL 11-75 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - FIRST SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Well 11-75 ResidualPressure1.grf) MAY 8/2014

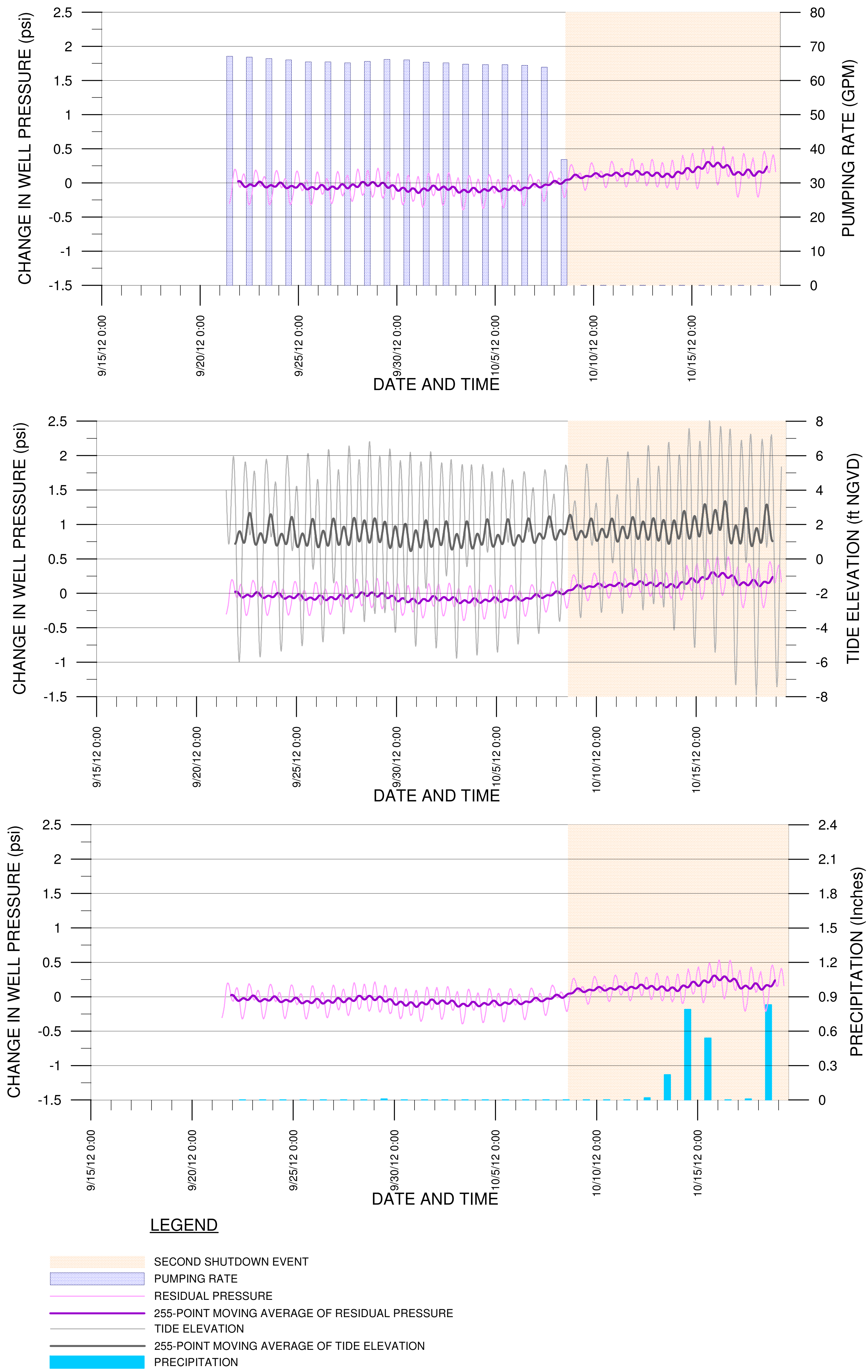


figure 21

WELL 5-75 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - SECOND SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

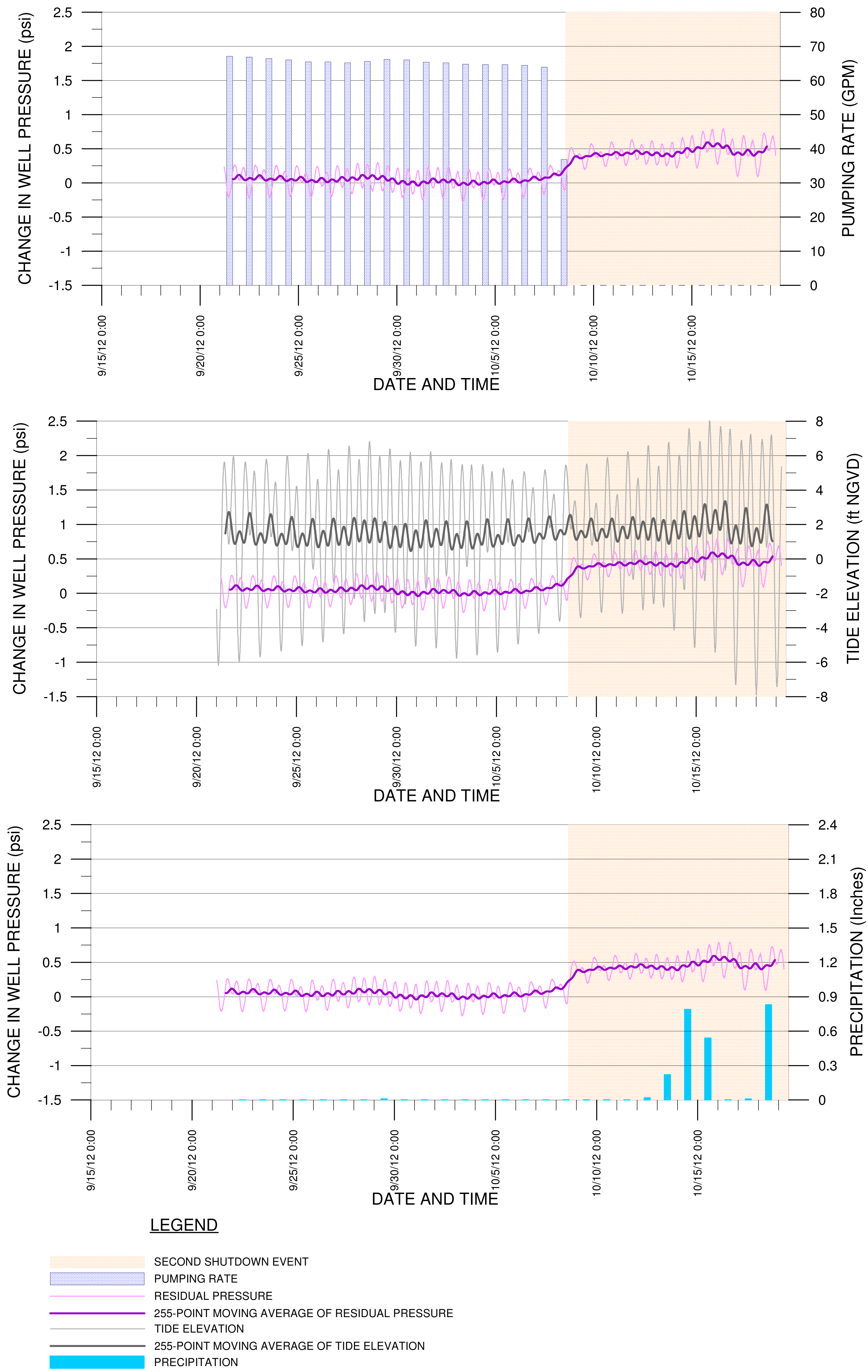
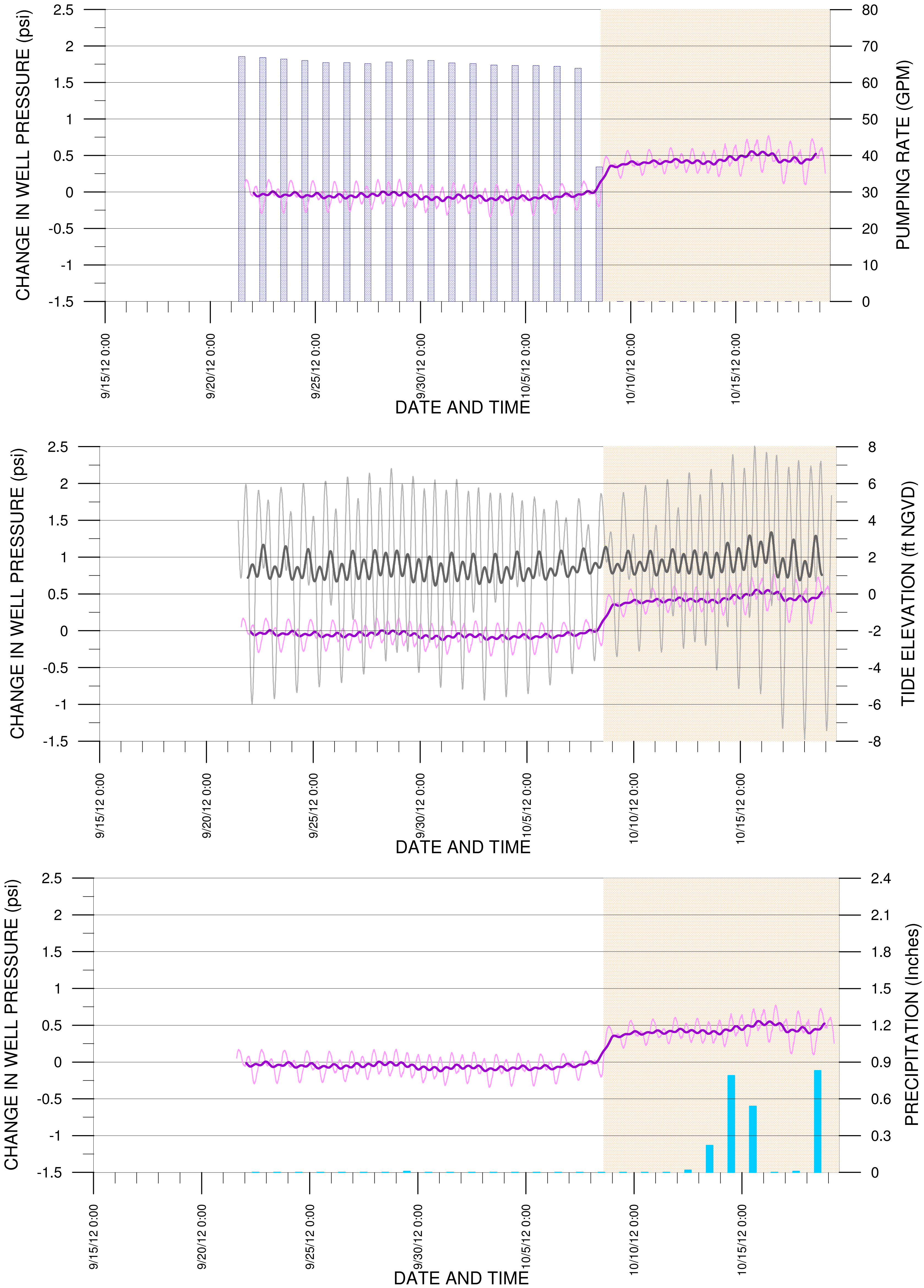


figure 22

WELL 7-100 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - SECOND SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington



LEGEND

SECOND SHUTDOWN EVENT
PUMPING RATE
RESIDUAL PRESSURE
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE
TIDE ELEVATION
255-POINT MOVING AVERAGE OF RESIDUAL PRESSURE
PRECIPITATION

figure 23

WELL 11-75 RESIDUAL PRESSURE VS. PUMPING & PRECIPITATION - SECOND SHUT-DOWN

Occidental Chemical Corporation, Tacoma, Washington

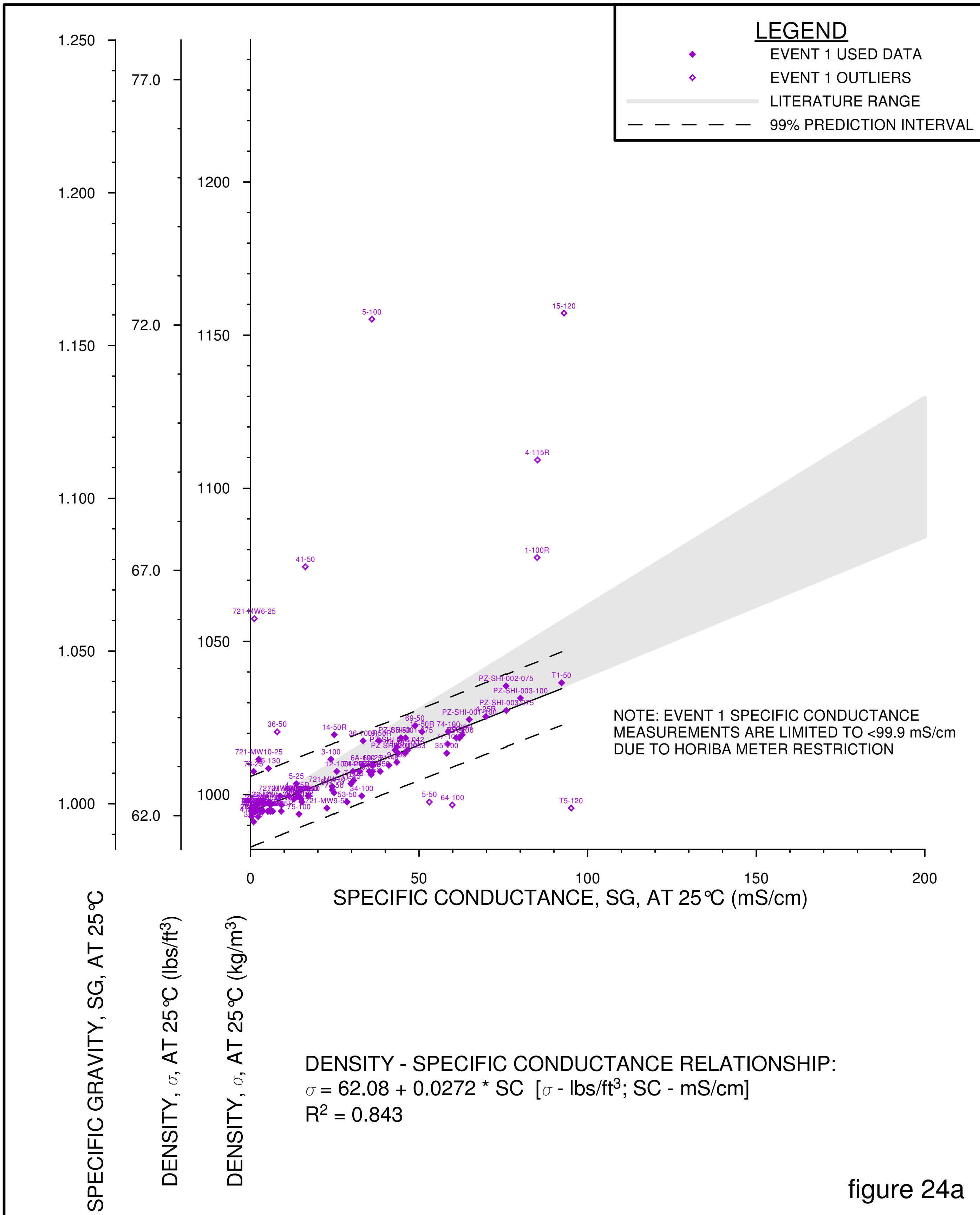
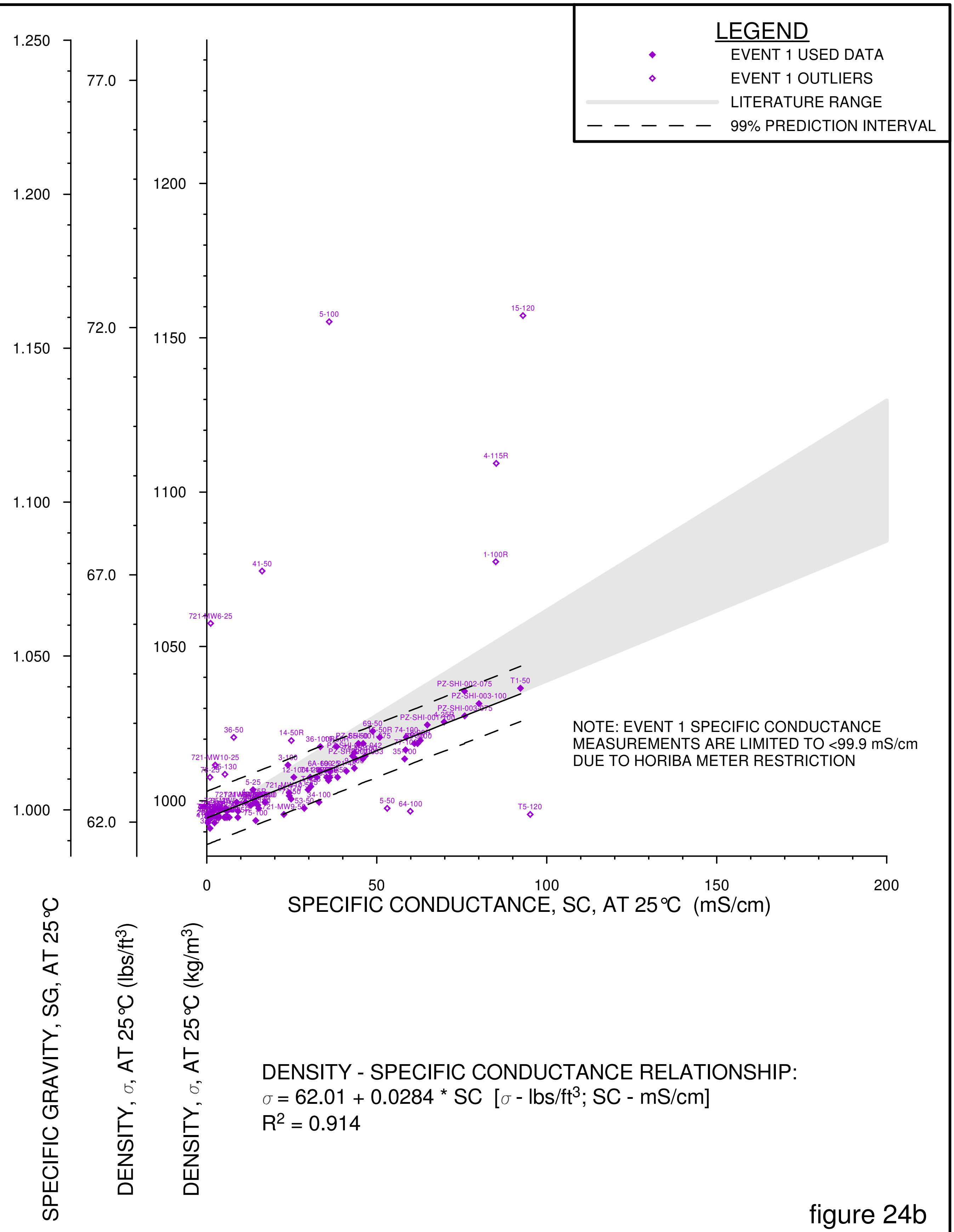


figure 24a

SPECIFIC GRAVITY/ DENSITY VS. SPECIFIC CONDUCTANCE
EVENT 1 DATA ONLY - INITIAL TRIAL
Occidental Chemical Corporation, Tacoma, Washington



DENSITY - SPECIFIC CONDUCTANCE RELATIONSHIP:

$\sigma = 62.01 + 0.0284 * SC$ [σ - lbs/ft^3; SC - mS/cm]

$R^2 = 0.914$

figure 24b

SPECIFIC GRAVITY/ DENSITY VS. SPECIFIC CONDUCTANCE
EVENT 1 DATA ONLY - SECOND TRIAL

Occidental Chemical Corporation, Tacoma, Washington

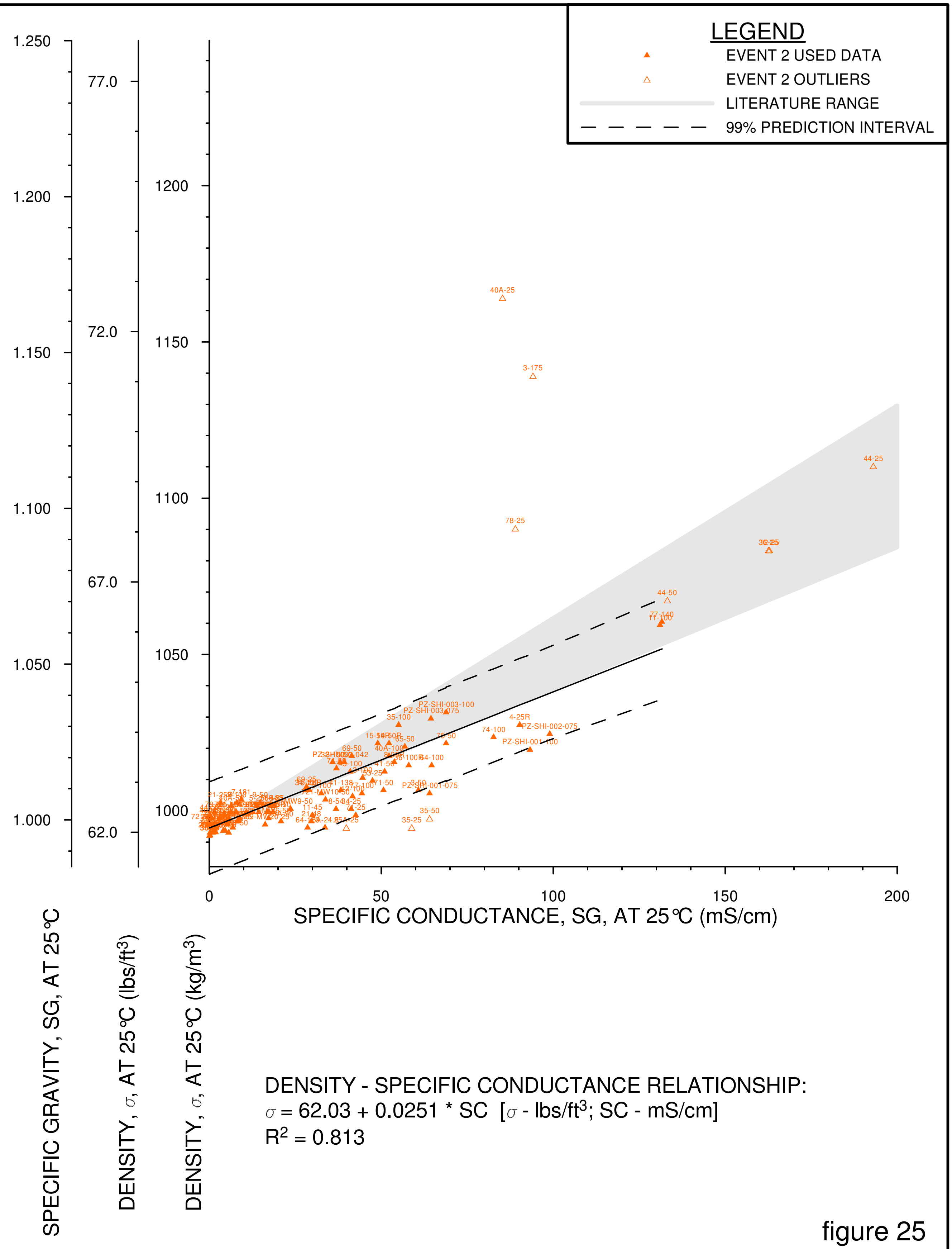


figure 25

SPECIFIC GRAVITY/ DENSITY VS. SPECIFIC CONDUCTANCE
EVENT 2 DATA ONLY

Occidental Chemical Corporation, Tacoma, Washington

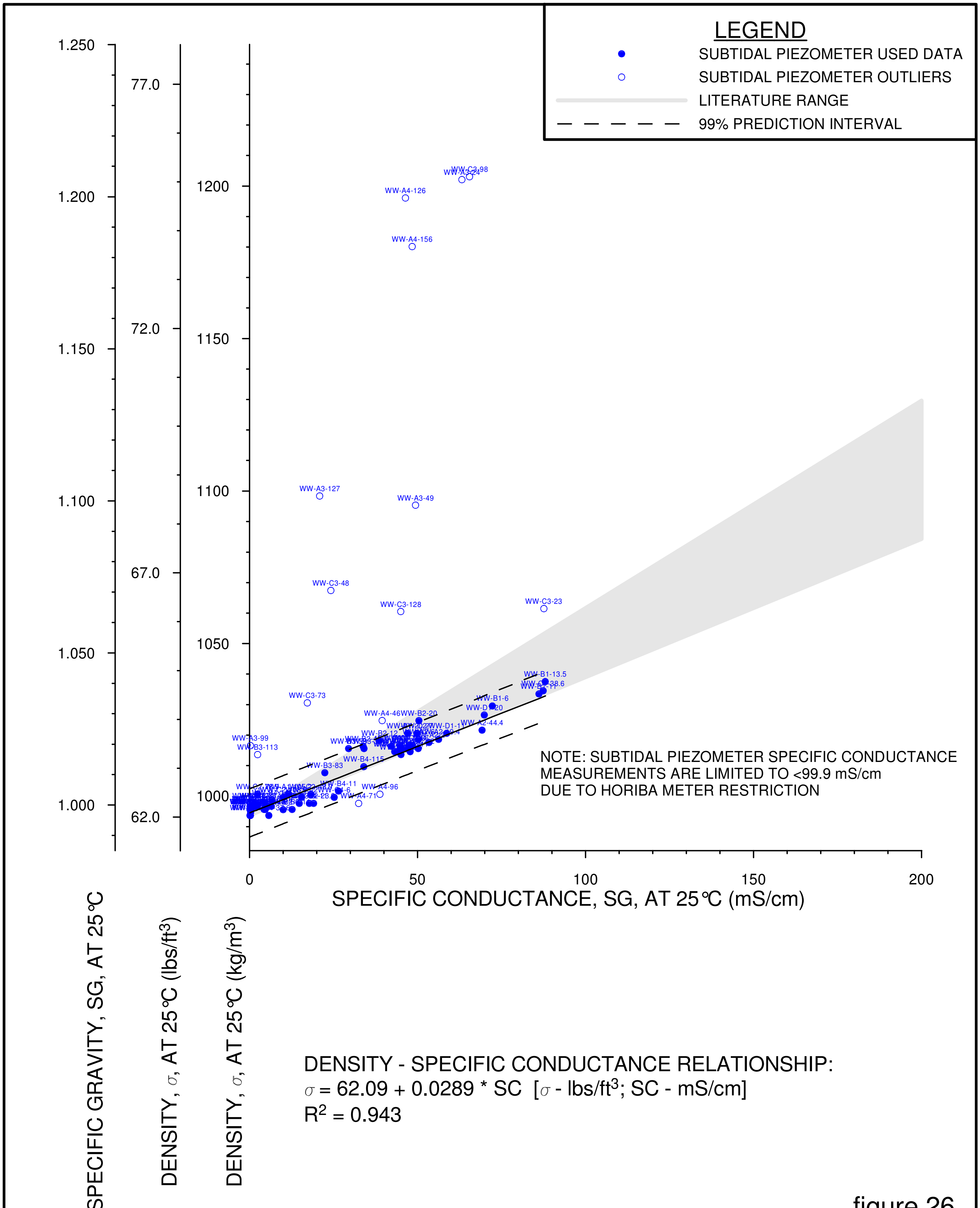
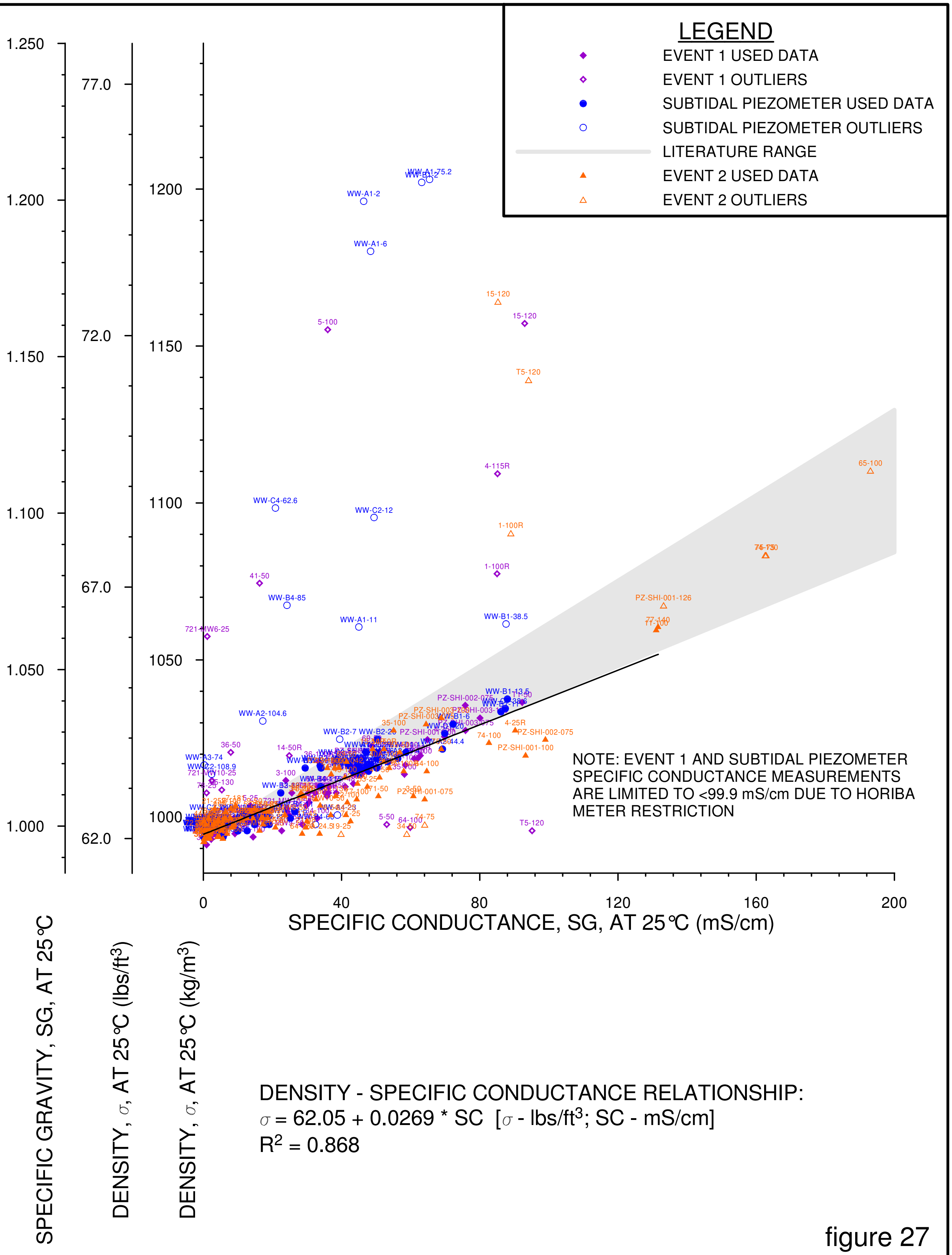


figure 26

SPECIFIC GRAVITY/ DENSITY VS. SPECIFIC CONDUCTANCE
SUBTIDAL PIEZOMETER DATA ONLY

Occidental Chemical Corporation, Tacoma, Washington



DENSITY - SPECIFIC CONDUCTANCE RELATIONSHIP:

$\sigma = 62.05 + 0.0269 * SC$ [σ - lbs/ft^3; SC - mS/cm]

$R^2 = 0.868$

figure 27

SPECIFIC GRAVITY/ DENSITY VS. SPECIFIC CONDUCTANCE
EVENT 1, EVENT 2, AND SUBTIDAL PIEZOMETER DATA
Occidental Chemical Corporation, Tacoma, Washington

07843-A6(128)GN-WA-HYD (N:\HEG\07843\Report 128 Updated SCR\Appendix L\Figures\Figure 9.grf) MAY 8/2014

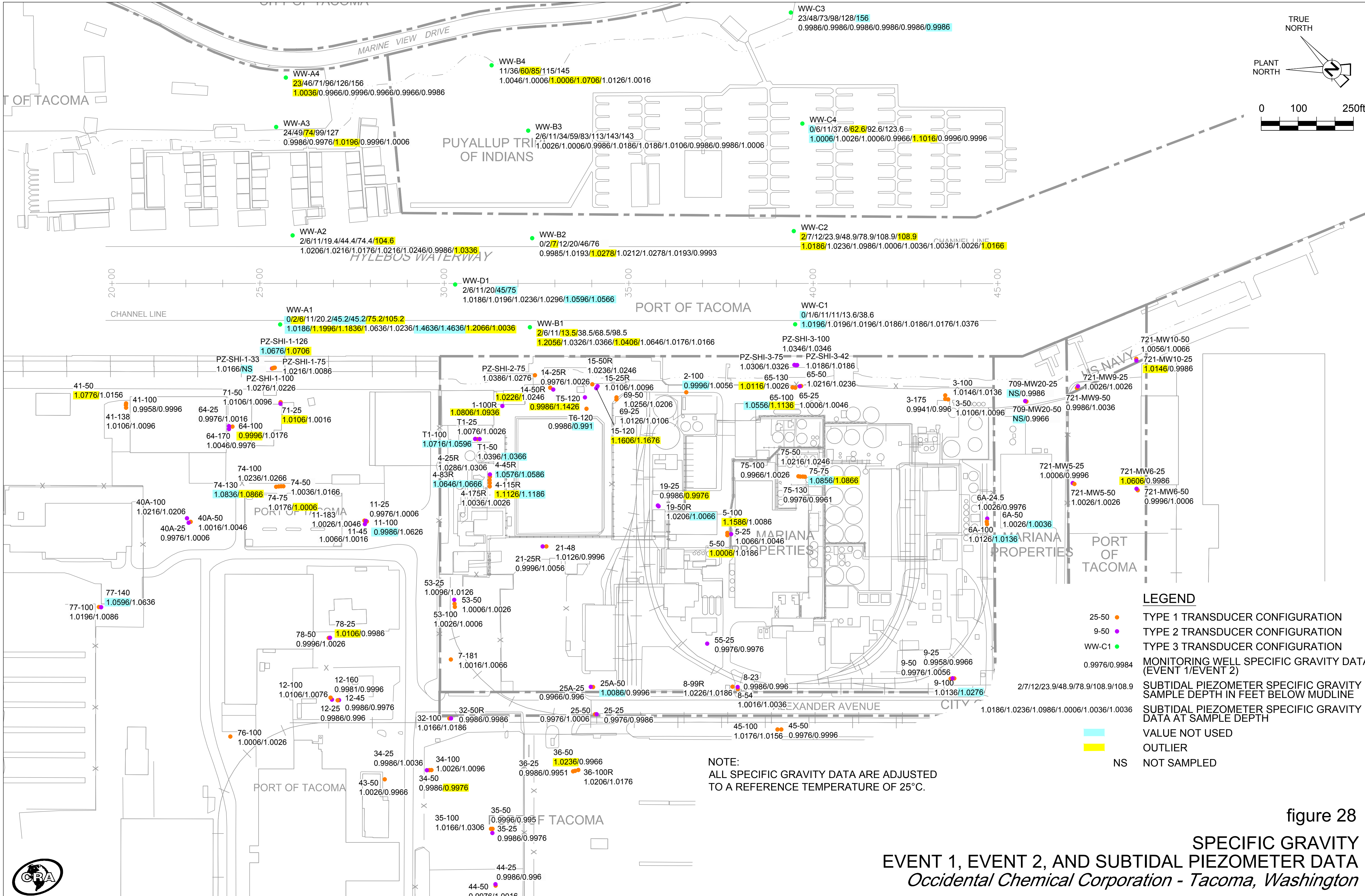


figure 28

SPECIFIC GRAVITY
EVENT 1, EVENT 2, AND SUBTIDAL PIEZOMETER DATA
Occidental Chemical Corporation - Tacoma, Washington

07843-A6(128)GN-WA147 MAY 8/2014

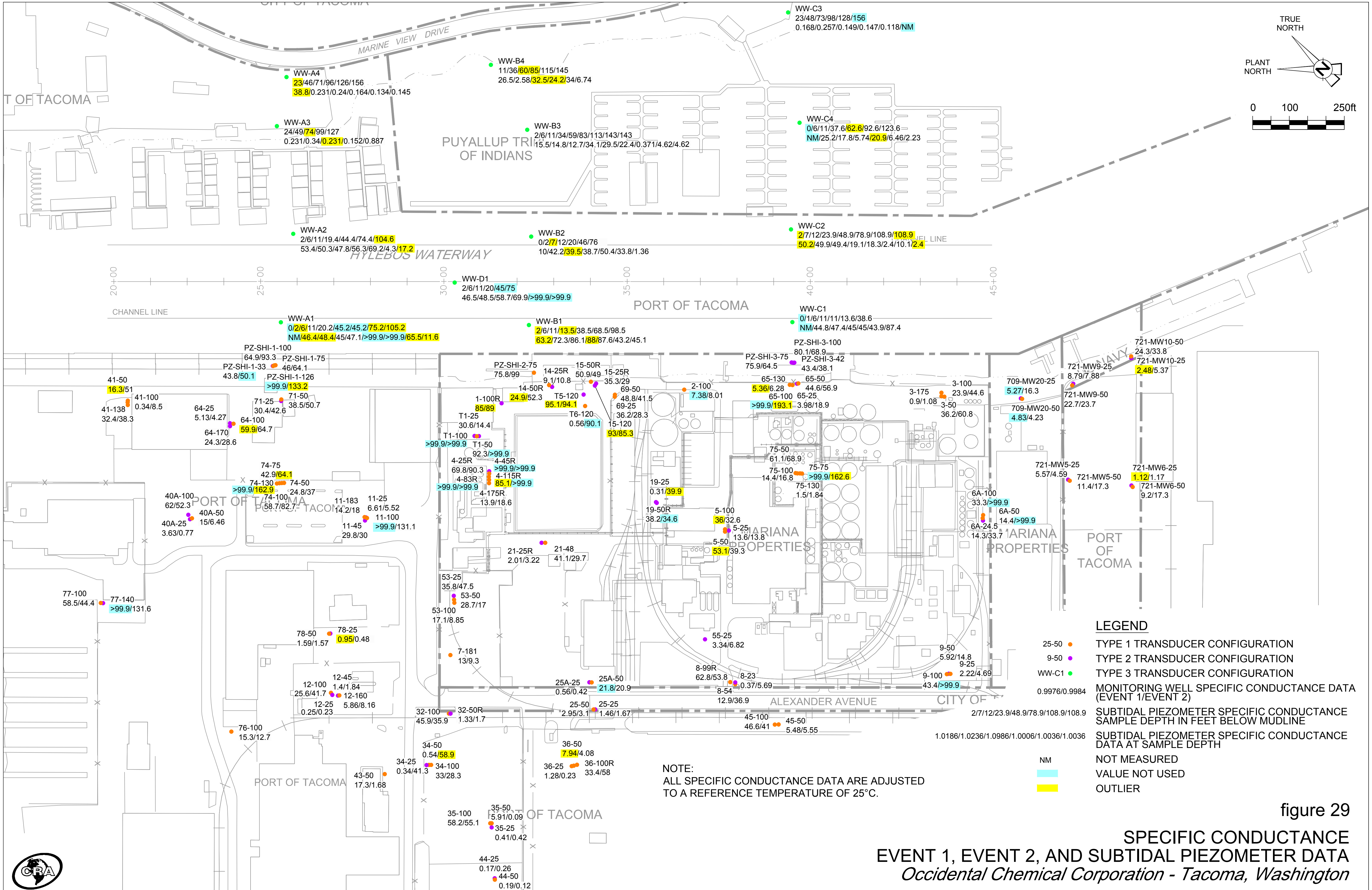


figure 29

SPECIFIC CONDUCTANCE
EVENT 1, EVENT 2, AND SUBTIDAL PIEZOMETER DATA
Occidental Chemical Corporation - Tacoma, Washington

07843-A6(128)GN-WA148 MAY 8/2014

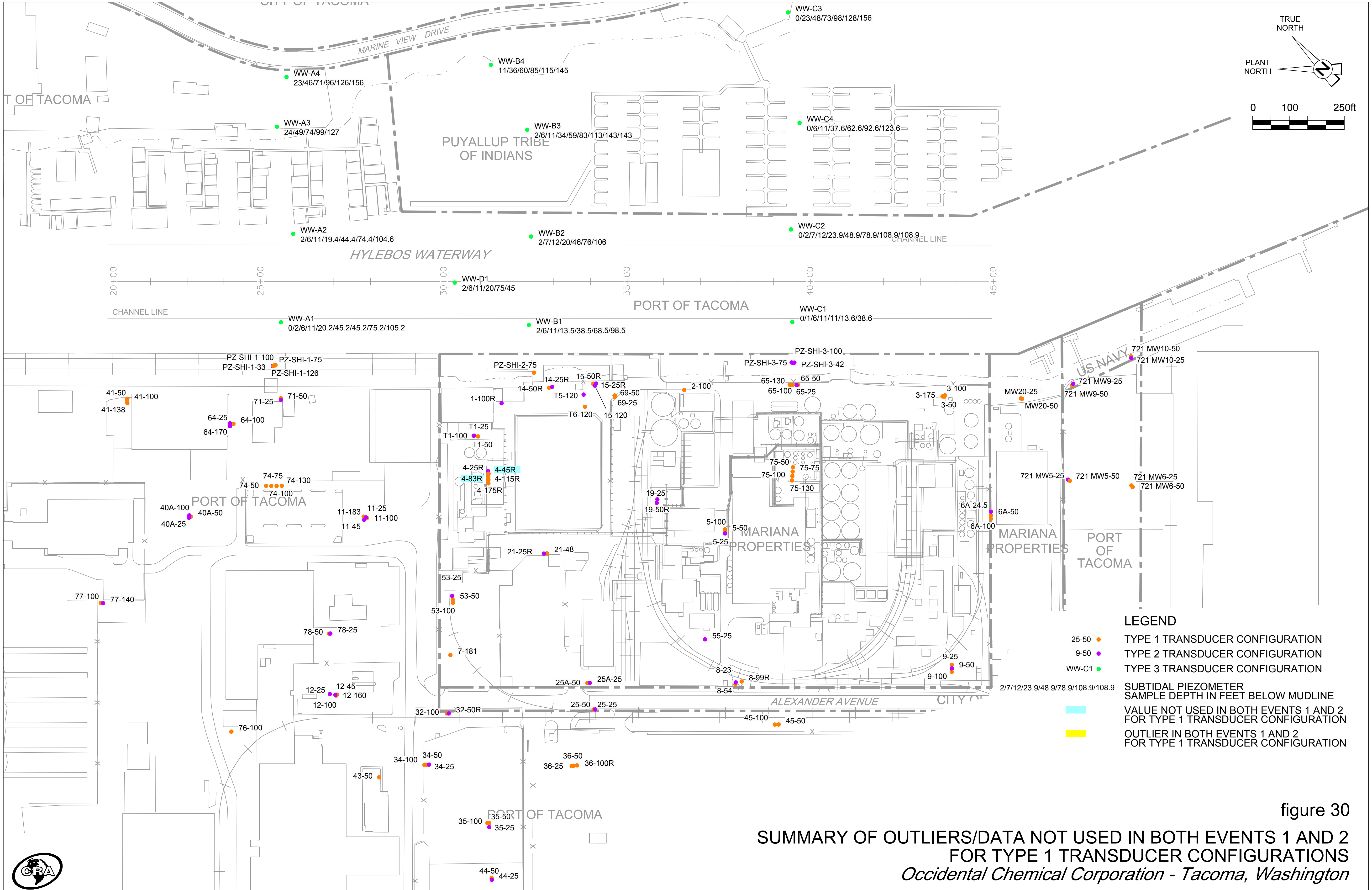


figure 30

SUMMARY OF OUTLIERS/DATA NOT USED IN BOTH EVENTS 1 AND 2
FOR TYPE 1 TRANSDUCER CONFIGURATIONS

Occidental Chemical Corporation - Tacoma, Washington

07843-A6(128)GN-WA149 MAY 8/2014

TABLE 1

EXAMPLE CALCULATION OF SERFES (1991) AVERAGING PROCEDURE AT WELL 9-100
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Hour Number	Actual Time	Measured Pressure [1] (psi)	Pressure (psi) X(i) Mean	Pressure (psi) Y(j) Mean	Pressure (psi) Serfes (1991) Mean
1	5/27/2006 9:00	10.6716			
2	5/27/2006 10:00	10.3687			
3	5/27/2006 11:00	10.0318			
4	5/27/2006 12:00	9.6850			
5	5/27/2006 13:00	9.4506			
6	5/27/2006 14:00	9.3529			
7	5/27/2006 15:00	9.3968			
8	5/27/2006 16:00	9.5629			
9	5/27/2006 17:00	9.7729			
10	5/27/2006 18:00	10.0171			
11	5/27/2006 19:00	10.2515			
12	5/27/2006 20:00	10.4420	X(1) = 10.33		
13	5/27/2006 21:00	10.5885	X(2) = 10.33		
14	5/27/2006 22:00	10.6618	X(3) = 10.34		
15	5/27/2006 23:00	10.6813	X(4) = 10.34		
16	5/28/2006 0:00	10.6667	X(5) = 10.35		
17	5/28/2006 1:00	10.6471	X(6) = 10.35		
18	5/28/2006 2:00	10.6569	X(7) = 10.35		
19	5/28/2006 3:00	10.7009	X(8) = 10.34		
20	5/28/2006 4:00	10.7692	X(9) = 10.34		
21	5/28/2006 5:00	10.8571	X(10) = 10.33		
22	5/28/2006 6:00	10.9255	X(11) = 10.31		
23	5/28/2006 7:00	10.9402	X(12) = 10.30		
24	5/28/2006 8:00	10.8718	X(13) = 10.29	Y(1) = 10.30	
25	5/28/2006 9:00	10.7253	X(14) = 10.29	Y(2) = 10.30	
26	5/28/2006 10:00	10.4713	X(15) = 10.28	Y(3) = 10.29	
27	5/28/2006 11:00	10.1392	X(16) = 10.28	Y(4) = 10.29	
28	5/28/2006 12:00	9.8022	X(17) = 10.27	Y(5) = 10.28	
29	5/28/2006 13:00	9.5189	X(18) = 10.27	Y(6) = 10.28	
30	5/28/2006 14:00	9.3382	X(19) = 10.27	Y(7) = 10.27	
31	5/28/2006 15:00	9.2650	X(20) = 10.26	Y(8) = 10.27	
32	5/28/2006 16:00	9.3480	X(21) = 10.25	Y(9) = 10.26	
33	5/28/2006 17:00	9.5189	X(22) = 10.25	Y(10) = 10.26	
34	5/28/2006 18:00	9.7485	X(23) = 10.24	Y(11) = 10.26	
35	5/28/2006 19:00	9.9780	X(24) = 10.23	Y(12) = 10.25	
36	5/28/2006 20:00	10.2173	X(25) = 10.23	Y(13) = 10.25	10.25
37	5/28/2006 21:00	10.3981	X(26) = 10.23	Y(14) = 10.25	
38	5/28/2006 22:00	10.5250	X(27) = 10.23	Y(15) = 10.24	
39	5/28/2006 23:00	10.5885	X(28) = 10.24	Y(16) = 10.24	
40	5/29/2006 0:00	10.5983	X(29) = 10.24	Y(17) = 10.23	
41	5/29/2006 1:00	10.5788	X(30) = 10.25	Y(18) = 10.23	
42	5/29/2006 2:00	10.5641	X(31) = 10.25	Y(19) = 10.23	
43	5/29/2006 3:00	10.5690	X(32) = 10.25	Y(20) = 10.22	
44	5/29/2006 4:00	10.6032	X(33) = 10.24	Y(21) = 10.22	
45	5/29/2006 5:00	10.6667	X(34) = 10.23	Y(22) = 10.22	
46	5/29/2006 6:00	10.7399	X(35) = 10.22	Y(23) = 10.21	
47	5/29/2006 7:00	10.7985	X(36) = 10.21	Y(24) = 10.21	
48	5/29/2006 8:00	10.7937	X(37) = 10.20	Y(25) = 10.21	
49	5/29/2006 9:00	10.7106	X(38) = 10.19		
50	5/29/2006 10:00	10.5299	X(39) = 10.19		
51	5/29/2006 11:00	10.2613	X(40) = 10.18		
52	5/29/2006 12:00	9.9487	X(41) = 10.18		
53	5/29/2006 13:00	9.6410	X(42) = 10.18		
54	5/29/2006 14:00	9.3626	X(43) = 10.18		
55	5/29/2006 15:00	9.2210	X(44) = 10.18		
56	5/29/2006 16:00	9.1966	X(45) = 10.17		
57	5/29/2006 17:00	9.3138	X(46) = 10.17		
58	5/29/2006 18:00	9.5140	X(47) = 10.16		
59	5/29/2006 19:00	9.7436	X(48) = 10.15		
60	5/29/2006 20:00	9.9829			
61	5/29/2006 21:00	10.2076			
62	5/29/2006 22:00	10.3687			
63	5/29/2006 23:00	10.4908			
64	5/30/2006 0:00	10.5397			
65	5/30/2006 1:00	10.5446			
66	5/30/2006 2:00	10.5250			
67	5/30/2006 3:00	10.5055			
68	5/30/2006 4:00	10.5104			
69	5/30/2006 5:00	10.5446			
70	5/30/2006 6:00	10.5983			
71	5/30/2006 7:00	10.6618			

Note:
(1) Hourly measured pressures at 9-100 presented on Figure 4.
Serfes (1991) mean is applied at hour 36 of the 71-hour interval.

TABLE 2

DATA USED FOR EXAMPLE OF
SPECIFIC GRAVITY/DENSITY AND SPECIFIC CONDUCTANCE CORRELATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	Specific Conductance (at 77°F or 25°C) [1] (mS/cm)	Specific Gravity (at 60°F or 15.6°C) [2] (-)	Specific Gravity (at 77°F or 25°C) [3] (-)	Density (at 77°F or 25°C) (lbs/ft^3) [4]	Density (at 77°F or 25°C) (kg/m^3) [5]
A. Locations applied in regression:					
44-25	0.17	1.002	0.999	62.16	995.65
44-50	0.19	1.001	0.998	62.09	994.65
12-25	0.25	1.002	0.999	62.16	995.65
19-25	0.31	1.002	0.999	62.16	995.65
34-25	0.34	1.002	0.999	62.16	995.65
41-100	0.34	0.999	0.996	61.98	992.86
8-23	0.37	1.002	0.999	62.16	995.65
35-25	0.41	1.002	0.999	62.16	995.65
34-50	0.54	1.002	0.999	62.16	995.65
25A-25	0.56	1.000	0.997	62.03	993.65
T6-120	0.56	1.002	0.999	62.16	995.65
3-175	0.90	0.998	0.994	61.88	991.16
36-25	1.28	1.002	0.999	62.16	995.65
32-50R	1.33	1.002	0.999	62.16	995.65
12-45	1.40	1.002	0.999	62.16	995.65
25-25	1.46	1.001	0.998	62.09	994.65
75-130	1.50	1.001	0.998	62.09	994.65
78-50	1.59	1.003	1.000	62.22	996.65
21-25R	2.01	1.003	1.000	62.22	996.65
9-25	2.22	0.999	0.996	61.98	992.86
25-50	2.95	1.001	0.998	62.09	994.65
55-25	3.34	1.001	0.998	62.09	994.65
40A-25	3.63	1.001	0.998	62.09	994.65
65-25	3.98	1.004	1.001	62.28	997.64
64-25	5.13	1.001	0.998	62.09	994.65
45-50	5.48	1.001	0.998	62.09	994.65
721-MW5-25	5.57	1.004	1.001	62.28	997.64
12-160	5.86	1.002	0.998	62.03	993.65
35-50	5.91	1.003	1.000	62.22	996.65
9-50	5.92	1.001	0.998	62.09	994.65
11-25	6.61	1.001	0.998	62.09	994.65
721-MW9-25	8.79	1.006	1.003	62.41	999.64
14-25R	9.10	1.001	0.998	62.09	994.65
721-MW6-50	9.20	1.003	1.000	62.22	996.65
721-MW5-50	11.4	1.006	1.003	62.41	999.64
8-54	12.9	1.005	1.002	62.34	998.64
7-181	13.0	1.005	1.002	62.34	998.64
5-25	13.6	1.010	1.007	62.65	1003.63
4-175R	13.9	1.007	1.004	62.47	1000.63
11-183	14.2	1.006	1.003	62.41	999.64
6A-24.5	14.3	1.006	1.003	62.41	999.64
6A-50	14.4	1.006	1.003	62.41	999.64
75-100	14.4	1.000	0.997	62.03	993.65
40A-50	15.0	1.005	1.002	62.34	998.64
76-100	15.3	1.004	1.001	62.28	997.64
53-100	17.1	1.006	1.003	62.41	999.64
43-50	17.3	1.006	1.003	62.41	999.64
721-MW9-50	22.7	1.002	0.999	62.16	995.65
3-100	23.9	1.018	1.015	63.15	1011.60
64-170	24.3	1.008	1.005	62.53	1001.63
721-MW10-50	24.3	1.009	1.006	62.59	1002.63
74-50	24.8	1.007	1.004	62.47	1000.63
12-100	25.6	1.014	1.011	62.90	1007.61
53-50	28.7	1.004	1.001	62.28	997.64
11-45	29.8	1.010	1.007	62.65	1003.63
71-25	30.4	1.014	1.011	62.90	1007.61
T1-25	30.6	1.011	1.008	62.72	1004.62
41-138	32.4	1.014	1.011	62.90	1007.61
34-100	33.0	1.006	1.003	62.41	999.64
6A-100	33.3	1.016	1.013	63.03	1009.61
36-100R	33.4	1.024	1.021	63.53	1017.58
15-25R	35.3	1.014	1.011	62.90	1007.61
53-25	35.8	1.013	1.010	62.84	1006.62
3-50	36.2	1.014	1.011	62.90	1007.61
69-25	36.2	1.016	1.013	63.03	1009.61
19-50R	38.2	1.024	1.021	63.53	1017.58
71-50	38.5	1.014	1.011	62.90	1007.61
21-48	41.1	1.016	1.013	63.03	1009.61
74-75	42.9	1.021	1.018	63.34	1014.59
9-100	43.4	1.017	1.014	63.09	1010.60
PZ-SHI-003-042	43.4	1.022	1.019	63.40	1015.59
PZ-SHI-001-033	43.8	1.020	1.017	63.28	1013.60
65-50	44.6	1.025	1.022	63.59	1018.58
32-100	45.9	1.020	1.017	63.28	1013.60
PZ-SHI-001-075	46.0	1.025	1.022	63.59	1018.58
45-100	46.6	1.021	1.018	63.34	1014.59
69-50	48.8	1.029	1.026	63.84	1022.57

TABLE 2

**DATA USED FOR EXAMPLE OF
SPECIFIC GRAVITY/DENSITY AND SPECIFIC CONDUCTANCE CORRELATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON**

Monitoring Well	*Specific Conductance (at 77°F or 25°C) (1) (mS/cm)*	*Specific Gravity (at 60°F or 15.6°C) (2) (-)*	*Specific Gravity (at 77°F or 25°C) (3) (-)*	*Density (at 77°F or 25°C) (lbs/ft³) (4)*	*(kg/m³) (5)*
15-50R	50.9	1.027	1.024	63.71	1020.58
35-100	58.2	1.020	1.017	63.28	1013.60
77-100	58.5	1.023	1.020	63.46	1016.59
74-100	58.7	1.027	1.024	63.71	1020.58
75-50	61.1	1.025	1.022	63.59	1018.58
40A-100	62.0	1.025	1.022	63.59	1018.58
8-99R	62.8	1.026	1.023	63.65	1019.58
PZ-SHI-001-100	64.9	1.031	1.028	63.96	1024.56
4-25R	69.8	1.032	1.029	64.02	1025.56
PZ-SHI-002-075	75.8	1.042	1.039	64.65	1035.53
PZ-SHI-003-075	75.9	1.034	1.031	64.15	1027.55
PZ-SHI-003-100	80.1	1.038	1.035	64.40	1031.54
T1-50	92.3	1.043	1.040	64.71	1036.53
B. Locations identified as outliers:					
14-50R	24.9	1.026	1.023	63.65	1019.58
15-120	93.0	1.164	1.161	72.24	1157.17
36-50	7.94	1.027	1.024	63.71	1020.58
4-115R	85.1	1.116	1.113	69.25	1109.31
41-50	16.3	1.081	1.078	67.07	1074.42
5-100	36.0	1.162	1.159	72.12	1155.18
5-50	53.1	1.004	1.001	62.28	997.64
64-100	59.9	1.003	1.000	62.22	996.65
65-130	5.36	1.015	1.012	62.97	1008.61
721-MW10-25	2.48	1.018	1.015	63.15	1011.60
721-MW6-25	1.12	1.064	1.061	66.02	1057.47
78-25	0.95	1.014	1.011	62.90	1007.61
T5-120	95.1	1.002	0.999	62.16	995.65
1-100R	85.0	1.084	1.081	67.26	1077.41
C. Locations where conductivities exceeded instrument maximum or were not used:					
11-100	>99.9	1.002	0.999	62.16	995.65
4-45R	>99.9	1.061	1.058	65.83	1054.47
4-83R	>99.9	1.068	1.065	66.26	1061.45
65-100	>99.9	1.059	1.056	65.70	1052.48
74-130	>99.9	1.087	1.084	67.45	1080.40
75-75	>99.9	1.089	1.086	67.57	1082.39
77-140	>99.9	1.063	1.060	65.95	1056.47
PZ-SHI-001-126	>99.9	1.071	1.068	66.45	1064.45
T1-100	>99.9	1.075	1.072	66.70	1068.43
709-MW20-25	5.27	NS	-	-	-
709-MW20-50	4.83	NS	-	-	-
2-100	7.38	1.003	1.000	62.22	996.65
25A-50	21.8	1.012	1.009	62.78	1005.62

Notes:
(1) The Horiba meter measures specific conductance relative to a reference temperature of 25°C.
(2) The laboratory reports specific gravity relative to a reference temperature of 60°F.
(3) The specific gravity was adjusted to a reference temperature of 25°C using the method described in ASTM D1429-86.
(4) Density was calculated from the specific gravity using a density of 62.243 lbs/ft³ for fresh water at 25°C.
(5) Density was calculated from the specific gravity using a density of 997.044 kg/m³ for fresh water at 25°C.
NS Not sampled.

TABLE 3

**EXCEL REGRESSION ANALYSES RESULTS FOR EXAMPLE
SPECIFIC GRAVITY/DENSITY AND SPECIFIC CONDUCTANCE CORRELATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON**

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956267676
R Square	0.914447868
Adjusted R Square	0.913475684
Standard Error	0.003250038
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.009935454	0.009935454	940.6125842	9.2383E-49
Residual	88	0.000929522	1.05627E-05		
Total	89	0.010864976			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.996354669	0.000501643	1986.181064	1.8181E-206	0.995357758	0.99735158
X Variable 1	0.000455436	1.48498E-05	30.66940795	9.2383E-49	0.000425925	0.000484947

DENSITY (lbs/ft^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956154797
R Square	0.914231996
Adjusted R Square	0.91325736
Standard Error	0.202834757
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	38.5921116	38.5921116	938.0236493	1.03228E-48
Residual	88	3.620490617	0.041141939		
Total	89	42.21260221			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.01464044	0.031307546	1980.820851	2.3062E-206	61.95242328	62.07685761
X Variable 1	0.028384604	0.000926778	30.62717175	1.03228E-48	0.026542826	0.030226381

DENSITY (kg/m^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956154797
R Square	0.914231996
Adjusted R Square	0.91325736
Standard Error	3.249101066
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9902.394613	9902.394613	938.0236493	1.03228E-48
Residual	88	928.9858807	10.55665773		
Total	89	10831.38049			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	993.379226	0.501498773	1980.820851	2.3062E-206	992.3826026	994.3758494
X Variable 1	0.454677724	0.014845567	30.62717175	1.03228E-48	0.42517528	0.484180168

TABLE 4

EXAMPLE CONVERSION OF OBSERVED PRESSURE TO FORMATION PRESSURE - TYPE 1 TRANSDUCER CONFIGURATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Well Information:

Monitoring Well Location	12-160		
Well Reference Elevation	10.47	ft NGVD	
Transducer Elevation (point B on Figure 3.75 of the main report)	-47.76	ft NGVD	
Midpoint of Wellscreen Elevation (point C on Figure 3.75 of the main report)	-144.02	ft NGVD	
Depth to Water	7.05	ft	
Water Level	3.42	ft NGVD	
Probe Reference Elevation, *PRE*	6.52	ft NGVD	

Pressure Conversion:

Formation Pressure at Midpoint of Well Screen:

$$P_{FORMATION} = P_{OBSERVED} + g\int_{Z_C}^{Z_B} \rho(z)dz$$

Based on Equation 3.5 where $P_{FORMATION} = P_C$ and $P_{OBSERVED} = P_B$

$P_{OBSERVED}$ (psi)	22.63	psi	Serfes (1991) Mean Pressure for Event 1
$P_{OBSERVED}$ (Pa)	156028.35	Pa	1 psi = 6894.757 Pa
Acceleration due to Gravity (g)	9.81	m/s^2	

Column Number on Page 2 and Explanation of Quantity and Source/Basis:

1	Conductivity Probe Depth, *PD*	Observed	ft	The measured conductivity probe depth from 54.33 ft to 55.53 ft is presented in Column 1 of Page 2.
2	To convert Conductivity Probe Depth, *PD* , to Probe Elevation, *PE*	*PE =PRE -PD*	ft NGVD	The conversion of conductivity probe depth to elevation is presented in Column 2 of Page 2.
3	Electrical Conductivity, C	Observed	mS/cm	The measured electrical conductivity is presented in Column 3 of Page 2.
4	Temperature, T_C	Observed	°C	The measured temperature is presented in Column 4 of Page 2.
5	To convert Observed Temperatures in °C into °F, T_F	$T_F=T_C*(9/5)+32$	°F	The conversion of observed temperature in degrees Celsius to degrees Fahrenheit is presented in Column 4 of Page 2.
6	To convert Observed Electrical Conductivity into Specific Conductance, SC_{25}	$SC_{25}=C/[1+0.0191*(T_C-25)]$	mS/cm at 25°C	The conversion of observed electrical conductivity to specific conductance based on Equation 3.11 is presented in Column 6 of Page 2.
7	To convert Specific Conductance into Specific Gravity at 25°C, r_{25}	$SG_{25}=0.000455436*SC_{25}+0.996354669$	at 25°C	The conversion of specific conductance to specific gravity based on Equation 3.8 is presented in Column 7 of Page 2.
8	To convert Specific Gravity to Density at 25°C, $r_{M,T}$	$r_{25}=SG_{25}*997.044$	kg/m^3	The conversion of specific gravity to density using a reference density of fresh water at 25°C of 997.044 kg/m^3 (CRC Press, 1988) is presented in Column 8 of Page 2.
9	To adjust Density at 25°C to Density at the Observed Temperature	$r_T=r_{25}-0.2(T_F-77°F)$	kg/m^3	The conversion of density at 25°C to the observed temperature based on ASTM D1429-86 is presented in Column 9 of Page 2.

The integration of the density within the water column from the transducer (Point B on Figure 3.75 of the main report corresponding to -47.76 ft NGVD) to the midpoint of the wellscreen (Point C on Figure 3.75 of the main report corresponding to -144.02 ft NGVD) is performed using the trapezoid rule. The trapezoid rule integration is given by:

$$g\int_{Z_C}^{Z_B} \rho(z)dz = g\left[\frac{Z_B - Z_c}{2n}\left(\rho_{M,T_0} + 2\sum_{j=1}^{n-1}\rho_{M,T_j} + \rho_{M,T_n}\right)\right]$$

$g\int_{Z_C}^{Z_B} \rho(z)dz =$	287820.56	Pa	Trapezoid Integration from Point B to Point C.
$P_{FORMATION}$ =	**443848.91**	**Pa**	
$P_{FORMATION}$ =	**64.4**	**psi**	

TABLE 4

EXAMPLE CONVERSION OF OBSERVED PRESSURE TO FORMATION PRESSURE - TYPE 1 TRANSDUCER CONFIGURATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Note that this presents an example calculation for only a portion of the well casing from -47.805 ft NGVD to -49.005 ft NGVD. As described on Page 1, the integration of the density profile is from the transducer location to the midpoint of the well screen (i.e, from -47.805 ft NGVD to -144.02 ft NGVD).

Column 1 Measured Probe Depth, PD (ft)	*Column 2* Probe Elevation, PE (ft NGVD)	*Column 3* Observed Electrical Conductivity, C (mS/cm)	*Column 4* Observed Temperature, T_C (°C)	*Column 5* Converted Temperature, T_F (°F)	*Column 6* Specific Conductance, SC_{25} (mS/cm at 25°C)	*Column 7* Specific Gravity at 25°C, SG_{25} (dimensionless)	*Column 8* Estimated Density at 25°C, r_{25} (kg/m^3)	*Column 9* Estimated Density at Observed Temp., $r_{M,T}$ (kg/m^3)
54.33	-47.805	0.38	13.67	56.61	0.48	9.97E-01	993.63	997.71
54.53	-48.005	0.39	13.65	56.57	0.50	9.97E-01	993.64	997.72
54.63	-48.105	0.39	13.67	56.61	0.50	9.97E-01	993.64	997.71
54.73	-48.205	0.41	13.65	56.57	0.52	9.97E-01	993.65	997.73
54.73	-48.205	0.41	13.63	56.53	0.52	9.97E-01	993.65	997.74
54.73	-48.205	0.42	13.63	56.53	0.54	9.97E-01	993.65	997.75
54.63	-48.105	0.42	13.56	56.41	0.54	9.97E-01	993.65	997.77
54.73	-48.205	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.73	-48.205	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.63	-48.105	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.63	-48.105	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.53	-48.005	0.42	13.56	56.41	0.54	9.97E-01	993.65	997.77
54.53	-48.005	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
54.53	-48.005	0.42	13.63	56.53	0.54	9.97E-01	993.65	997.75
54.63	-48.105	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.63	-48.105	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
54.83	-48.305	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.73	-48.205	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
54.73	-48.205	0.42	13.58	56.44	0.54	9.97E-01	993.65	997.76
54.83	-48.305	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
54.73	-48.205	0.42	13.56	56.41	0.54	9.97E-01	993.65	997.77
54.83	-48.305	0.42	13.56	56.41	0.54	9.97E-01	993.65	997.77
54.63	-48.105	0.42	13.61	56.50	0.54	9.97E-01	993.65	997.75
54.83	-48.305	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
54.93	-48.405	0.42	13.63	56.53	0.54	9.97E-01	993.65	997.75
55.13	-48.605	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
55.23	-48.705	0.42	13.6	56.48	0.54	9.97E-01	993.65	997.76
55.23	-48.705	0.42	13.55	56.39	0.54	9.97E-01	993.65	997.78
55.53	-49.005	0.43	13.55	56.39	0.55	9.97E-01	993.66	997.78
55.63	-49.105	0.43	13.6	56.48	0.55	9.97E-01	993.66	997.76
55.53	-49.005	0.43	13.58	56.44	0.55	9.97E-01	993.66	997.77

TABLE 5

EXAMPLE CONVERSION OF GEOKON TRANSDUCER DIGITS TO PRESSURES - TYPE 2 TRANSDUCER CONFIGURATION OCCIDENTAL CHEMICAL CORPORATION TACOMA, WASHINGTON

Well Location: PZ-SHI-3-100

Transducer Calibration Factors:

Regression Zero	R_0	8805.5	(digits)	Initial site "zero" digits reading
Linear Gage Factor	G	0.0174	(psi/digit)	Supplied by Geokon
Polynomial Gage Factors	A	1.36518E-09		Supplied by Geokon
	B	-0.01742		Supplied by Geokon
	C	153.25		As per Equation 3.16
Thermal Factor	K	-0.01846	(psi/°C)	Supplied by Geokon
Initial Temperature	T_0	15	(°C)	Initial site temperature
Initial Barometric Pressure	S_0	14.05	psi	Initial site pressure

Pressure Equations:

Linear	$P = (R_0-R_1)G+(T_1-T_0)K-(S_1-S_0)$	As per Equation 3.14
Polynomial	$P = AxR_1^2+BxR_1+C+(T_1-T_0)K-(S_1-S_0)$	As per Equation 3.17

Example Calculations:

Date/Time	Digit Value, R_1 (digits)	Temperature, T_1 (°C)	Barometric Reading, S_1 (psi)	*Computed Pressure* Linear Calculation, P (psi)	*Computed Pressure* Polynomial Calculation, P (psi)
5/27/2006 9:00	6711.5	18.306	14.0133	36.411	36.373
5/27/2006 10:00	6771.4	18.339	14.0151	35.367	35.328
5/27/2006 11:00	6813.8	18.339	14.0097	34.634	34.596
5/27/2006 12:00	6825.7	18.306	14.0097	34.428	34.389
5/27/2006 13:00	6803.3	18.339	14.0079	34.819	34.780
5/27/2006 14:00	6751.9	18.373	14.0061	35.714	35.676
5/27/2006 15:00	6687.8	18.406	14.0025	36.833	36.794
5/27/2006 16:00	6623.1	18.373	14.0043	37.957	37.919
5/27/2006 17:00	6568.7	18.440	14.0043	38.903	38.864
5/27/2006 18:00	6533.4	18.440	14.0079	39.513	39.475
5/27/2006 19:00	6516.4	18.406	14.0169	39.801	39.763
5/27/2006 20:00	6516.6	18.373	14.0277	39.787	39.749
5/27/2006 21:00	6528.8	18.373	14.0349	39.567	39.529
5/27/2006 22:00	6552.0	18.373	14.0457	39.153	39.115
5/27/2006 23:00	6576.7	18.339	14.0565	38.713	38.675
5/28/2006 0:00	6594.4	18.339	14.0601	38.401	38.363
5/28/2006 1:00	6597.0	18.373	14.0637	38.352	38.314
Date/Time	Digit Value, R_1 (digits)	Temperature, T_1 (°C)	Barometric Reading, S_1 (psi)	*Computed Pressure* Linear Calculation, P (psi)	*Computed Pressure* Polynomial Calculation, P (psi)
5/28/2006 2:00	6586.3	18.339	14.0691	38.533	38.495
5/28/2006 3:00	6566.5	18.373	14.0691	38.877	38.839
5/28/2006 4:00	6546.9	18.373	14.0763	39.211	39.173
5/28/2006 5:00	6532.6	18.339	14.0799	39.457	39.419
5/28/2006 6:00	6535.8	18.306	14.0799	39.402	39.364
5/28/2006 7:00	6561.8	18.339	14.0872	38.942	38.903
5/28/2006 8:00	6606.4	18.339	14.098	38.155	38.116
5/28/2006 9:00	6668.5	18.373	14.1106	37.061	37.023
5/28/2006 10:00	6735.3	18.339	14.1196	35.890	35.852
5/28/2006 11:00	6789.5	18.339	14.1286	34.938	34.900
5/28/2006 12:00	6819.5	18.339	14.134	34.411	34.372
5/28/2006 13:00	6820.1	18.507	14.1376	34.394	34.355
5/28/2006 14:00	6788.4	18.339	14.1466	34.939	34.901
5/28/2006 15:00	6732.9	18.339	14.1556	35.896	35.858
5/28/2006 16:00	6667	18.373	14.161	37.037	36.998
5/28/2006 17:00	6605.2	18.406	14.1646	38.108	38.070
5/28/2006 18:00	6556.3	18.373	14.1736	38.950	38.912
5/28/2006 19:00	6525.6	18.373	14.1808	39.477	39.439
5/28/2006 20:00	6509.8	18.373	14.188	39.745	39.707
5/28/2006 21:00	6514.2	18.373	14.1988	39.658	39.620
5/28/2006 22:00	6529	18.373	14.2114	39.387	39.349
5/28/2006 23:00	6554.2	18.373	14.2132	38.947	38.909
5/29/2006 0:00	6580.7	18.373	14.224	38.475	38.437
5/29/2006 1:00	6594.2	18.373	14.2258	38.239	38.200
5/29/2006 2:00	6595.2	18.373	14.2294	38.218	38.179
5/29/2006 3:00	6585.7	18.339	14.233	38.380	38.342
5/29/2006 4:00	6566.7	18.339	14.2366	38.707	38.669
5/29/2006 5:00	6550	18.339	14.2384	38.996	38.958
5/29/2006 6:00	6541.1	18.339	14.2456	39.143	39.105
5/29/2006 7:00	6547	18.339	14.2474	39.039	39.001
5/29/2006 8:00	6576.3	18.306	14.2492	38.528	38.490
5/29/2006 9:00	6625.9	18.373	14.251	37.662	37.623
5/29/2006 10:00	6688	18.339	14.2492	36.584	36.545
5/29/2006 11:00	6750.1	18.339	14.2492	35.503	35.465
5/29/2006 12:00	6797.1	18.373	14.2492	34.685	34.646

TABLE 5

EXAMPLE CONVERSION OF GEOKON TRANSDUCER DIGITS TO PRESSURES - TYPE 2 TRANSDUCER CONFIGURATION OCCIDENTAL CHEMICAL CORPORATION TACOMA, WASHINGTON

Date/Time	*Digit Value, R_1 (digits)*	*Temperature, T_1 (°C)*	*Barometric Reading, S_1 (psi)*	*Computed Pressure*	
				Linear Calculation, P (psi)	*Polynomial Calculation, P (psi)*
5/29/2006 13:00	6818	18.373	14.2492	34.321	34.282
5/29/2006 14:00	6808.5	18.373	14.251	34.485	34.446
5/29/2006 15:00	6770.7	18.406	14.251	35.142	35.103
5/29/2006 16:00	6712.9	18.44	14.2492	36.149	36.110
5/29/2006 17:00	6648.7	18.44	14.2456	37.269	37.231
5/29/2006 18:00	6589.5	18.44	14.2402	38.305	38.266
5/29/2006 19:00	6549.3	18.406	14.2366	39.008	38.970
5/29/2006 20:00	6523.7	18.406	14.2348	39.456	39.418
5/29/2006 21:00	6512.3	18.406	14.2366	39.652	39.614
5/29/2006 22:00	6520.8	18.406	14.242	39.499	39.461
5/29/2006 23:00	6534.9	18.406	14.2474	39.248	39.210
5/30/2006 0:00	6561.7	18.373	14.2492	38.781	38.742
5/30/2006 1:00	6584.9	18.339	14.2474	38.379	38.341
5/30/2006 2:00	6596.6	18.373	14.251	38.172	38.133
5/30/2006 3:00	6596.9	18.339	14.2582	38.160	38.122
5/30/2006 4:00	6589.5	18.339	14.26	38.287	38.249
5/30/2006 5:00	6570.9	18.339	14.26	38.610	38.572
5/30/2006 6:00	6560	18.306	14.2618	38.799	38.761
5/30/2006 7:00	6552.3	18.306	14.2673	38.927	38.889
		Serfes (1991) Mean Event 1 Pressure (psi)(1)			**37.76**

Note:
(1) Serfes (1991) Mean Event 1 pressure calculated using the pressures determined using the Polynomial Calculation.

TABLE 6

EXAMPLE CONVERSION OF GEOKON TRANSDUCER DIGITS TO PRESSURES - TYPE 3 TRANSDUCER CONFIGURATION OCCIDENTAL CHEMICAL CORPORATION TACOMA, WASHINGTON

Well Location: WW-A3-75

Transducer Calibration Factors:

Regression Zero	R_0	8516.3	(digits)	Initial site "zero" digits reading
Linear Gage Factor	G	0.01349	(psi/digit)	Supplied by Geokon
Polynomial Gage Factors	A	2.14844E-08		Supplied by Geokon
	B	-0.01378		Supplied by Geokon
	C	115.99		As per Equation 3.16
Thermal Factor	K	-0.01587	(psi/°C)	Supplied by Geokon
Initial Temperature	T_0	12.7	(°C)	Initial site temperature
Initial Barometric Pressure	S_0	14.27	psi	Initial site barometric pressure

Pressure Equations:

Polynomial $P = AxR_1^2+BxR_1+C+K(T_1-T_0)-(S_1-S_0)$ As per Equation 3.17

Example Calculations:

Date/Time	*Digit Value, R_1 (digits)*	*Temperature, T_1 (°C)*	*Barometric Reading, S_1 (psi)*	*Computed Pressure, P (psi)*	*Sensitivity Analysis - Computed Pressures: 0% BF [(1)] P (psi)*	*50% BF P (psi)*	*100% BF P (psi)*
5/27/2006 9:00	6436.4	13.2	14.0133	28.435	28.179	28.307	28.435
5/27/2006 10:00	6466.2	13.268	14.0151	28.030	27.775	27.903	28.030
5/27/2006 11:00	6481.1	13.234	14.0097	27.835	27.574	27.705	27.835
5/27/2006 12:00	6478.4	13.234	14.0097	27.871	27.611	27.741	27.871
5/27/2006 13:00	6460.3	13.302	14.0079	28.116	27.854	27.985	28.116
5/27/2006 14:00	6430.5	13.336	14.0061	28.520	28.256	28.388	28.520
5/27/2006 15:00	6388.2	13.404	14.0025	29.094	28.826	28.960	29.094
5/27/2006 16:00	6347.1	13.404	14.0043	29.647	29.381	29.514	29.647
5/27/2006 17:00	6314.1	13.404	14.0043	30.093	29.827	29.960	30.093
5/27/2006 18:00	6294.6	13.37	14.0079	30.353	30.091	30.222	30.353
5/27/2006 19:00	6286.5	13.302	14.0169	30.455	30.202	30.328	30.455
5/27/2006 20:00	6291.5	13.268	14.0277	30.377	30.135	30.256	30.377
5/27/2006 21:00	6304.5	13.234	14.0349	30.195	29.959	30.077	30.195
5/27/2006 22:00	6321.8	13.302	14.0457	29.949	29.725	29.837	29.949
5/27/2006 23:00	6341.2	13.268	14.0565	29.677	29.463	29.570	29.677
5/28/2006 0:00	6351	13.061	14.0601	29.544	29.334	29.439	29.544
5/28/2006 1:00	6350.5	13.268	14.0637	29.544	29.338	29.441	29.544
5/28/2006 2:00	6342.6	13.2	14.0691	29.646	29.445	29.546	29.646
5/28/2006 3:00	6327.7	13.027	14.0691	29.850	29.649	29.750	29.850
5/28/2006 4:00	6313.2	13.234	14.0763	30.036	29.842	29.939	30.036
5/28/2006 5:00	6304.6	13.234	14.0799	30.148	29.958	30.053	30.148
5/28/2006 6:00	6308.7	13.234	14.0799	30.093	29.903	29.998	30.093
5/28/2006 7:00	6329.4	13.234	14.0872	29.806	29.623	29.714	29.806
5/28/2006 8:00	6362.3	13.2	14.098	29.351	29.179	29.265	29.351
5/28/2006 9:00	6406.7	13.2	14.1106	28.739	28.580	28.659	28.739
5/28/2006 10:00	6445.2	13.234	14.1196	28.210	28.059	28.134	28.210
5/28/2006 11:00	6468.5	13.234	14.1286	27.886	27.745	27.815	27.886
5/28/2006 12:00	6476.3	13.129	14.134	27.777	27.641	27.709	27.777
5/28/2006 13:00	6468.8	13.302	14.1376	27.872	27.739	27.806	27.872
5/28/2006 14:00	6447	13.302	14.1466	28.157	28.034	28.095	28.157
5/28/2006 15:00	6413.8	13.37	14.1556	28.595	28.481	28.538	28.595
5/28/2006 16:00	6371.3	13.439	14.161	29.163	29.054	29.108	29.163

TABLE 6

EXAMPLE CONVERSION OF GEOKON TRANSDUCER DIGITS
TO PRESSURES - TYPE 3 TRANSDUCER CONFIGURATION
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

					Sensitivity Analysis - Computed Pressures		
Date/Time	*Digit Value, R_1 (digits)*	*Temperature, T_1 (°C)*	*Barometric Reading, S_1 (psi)*	*Computed Pressure, P (psi)*	*0% BF [(1)] P (psi)*	*50% BF P (psi)*	*100% BF P (psi)*
5/28/2006 17:00	6331.6	13.404	14.1646	29.696	29.591	29.643	29.696
5/28/2006 18:00	6303.4	13.37	14.1736	30.069	29.972	30.020	30.069
5/28/2006 19:00	6285.4	13.336	14.1808	30.305	30.216	30.260	30.305
5/28/2006 20:00	6279.9	13.302	14.188	30.373	30.291	30.332	30.373
5/28/2006 21:00	6287.6	13.302	14.1988	30.258	30.187	30.222	30.258
5/28/2006 22:00	6301.5	13.268	14.2114	30.058	29.999	30.029	30.058
5/28/2006 23:00	6320.8	13.268	14.2132	29.796	29.739	29.767	29.796
5/29/2006 0:00	6338.5	13.2	14.224	29.547	29.501	29.524	29.547
5/29/2006 1:00	6347.5	13.061	14.2258	29.426	29.381	29.403	29.426
5/29/2006 2:00	6346.7	13.234	14.2294	29.430	29.389	29.410	29.430
5/29/2006 3:00	6337	13.2	14.233	29.558	29.521	29.539	29.558
5/29/2006 4:00	6323.3	13.234	14.2366	29.739	29.705	29.722	29.739
5/29/2006 5:00	6312.3	13.027	14.2384	29.889	29.857	29.873	29.889
5/29/2006 6:00	6305.7	13.2	14.2456	29.968	29.944	29.956	29.968
5/29/2006 7:00	6313.4	13.234	14.2474	29.862	29.839	29.851	29.862
5/29/2006 8:00	6337.1	13.234	14.2492	29.540	29.519	29.529	29.540
5/29/2006 9:00	6372.7	13.302	14.251	29.056	29.037	29.047	29.056
5/29/2006 10:00	6414.1	13.268	14.2492	28.499	28.479	28.489	28.499
5/29/2006 11:00	6447.4	13.336	14.2492	28.049	28.028	28.038	28.049
5/29/2006 12:00	6465.6	13.336	14.2492	27.803	27.782	27.792	27.803
5/29/2006 13:00	6468.7	13.439	14.2492	27.759	27.739	27.749	27.759
5/29/2006 14:00	6456.9	13.37	14.251	27.918	27.899	27.909	27.918
5/29/2006 15:00	6434.9	13.439	14.251	28.214	28.195	28.204	28.214
5/29/2006 16:00	6398.9	13.473	14.2492	28.701	28.681	28.691	28.701
5/29/2006 17:00	6357.3	15.45	14.2456	29.235	29.211	29.223	29.235
5/29/2006 18:00	6321.2	13.439	14.2402	29.760	29.731	29.746	29.760
5/29/2006 19:00	6298.3	13.37	14.2366	30.074	30.041	30.058	30.074
5/29/2006 20:00	6282.9	13.37	14.2348	30.284	30.249	30.267	30.284
5/29/2006 21:00	6281.9	13.302	14.2366	30.297	30.264	30.280	30.297
5/29/2006 22:00	6290.6	13.234	14.242	30.175	30.147	30.161	30.175
5/29/2006 23:00	6304.5	13.234	14.2474	29.982	29.959	29.971	29.982
5/30/2006 0:00	6324.5	13.2	14.2492	29.711	29.690	29.700	29.711
5/30/2006 1:00	6340.9	13.2	14.2474	29.491	29.468	29.480	29.491
5/30/2006 2:00	6347	13.167	14.251	29.405	29.386	29.396	29.405
5/30/2006 3:00	6344.9	13.167	14.2582	29.427	29.415	29.421	29.427
5/30/2006 4:00	6338	13.167	14.26	29.518	29.508	29.513	29.518
5/30/2006 5:00	6327.3	13.133	14.26	29.663	29.653	29.658	29.663
5/30/2006 6:00	6317.6	13.099	14.2618	29.793	29.785	29.789	29.793
5/30/2006 7:00	6314.3	13.167	14.2673	29.831	29.828	29.829	29.831
	Serfes (1991) Mean Event 1 Pressure (psi)			**29.34**	**29.25**	**29.29**	**29.34**

Note:
(1) BF - Barometric Factor. Pressure computed as per Equation 3.18

TABLE 7

SUMMARY OF EXCEL MULTIPLE LINEAR REGRESSION ANALYSIS RESULTS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Multiple Linear Regression Analysis Coefficients [(1)]				*Multiple Linear Regression Analysis Statistics* [(1)]		
Subtidal Piezometer	***Digits Coefficent, A (ft NGVD/digit)***	***Temperature Coefficient, B (ft NVGD/°C)***	***Barometric Pressure Coefficient, C (ft NGVD/psi)***	***Intercept, D (ft NGVD)***	R^2	***Standard Error***	***Number of Observations***
WW-A1-2	-4.061E-02	7.519E-05	-1.809E+00	337.4	0.9997	0.0957	3136
WW-A2-2	-3.982E-02	-1.278E-02	-1.867E+00	330.9	0.9998	0.0789	3108
WW-B1-2	-4.238E-02	4.291E-02	-1.844E+00	349.4	0.9998	0.0782	3136
WW-B2-2	-3.810E-02	-1.007E-02	-1.994E+00	320.4	0.9998	0.0720	1764
WW-C1-2	-3.694E-02	1.636E-01	-1.827E+00	293.5	0.9998	0.0800	3135
WW-C2-2	-3.710E-02	-6.335E-03	-1.866E+00	311.8	0.9998	0.0710	2405
WW-C4-2	-4.179E-02	-7.183E-02	-1.945E+00	367.5	0.9999	0.0580	1809
WW-D1-2	-3.440E-02	-1.692E-02	-1.799E+00	284.5	0.9998	0.0800	1430

Note:
(1) The details of the multiple linear regression analysis are presented in Attachment 3 for the mudline transducers WW-A1-2, WW-A2-2, WW-B1-2, WW-B2-2, WW-C1-2, WW-C2-2, WW-C4-2, and WW-D1-2, respectively.

TABLE 8

CALCULATION OF MUDLINE TRANSDUCER PRE-GROUT FEH
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Multiple Linear Regression Analysis Coefficients[1]				*Pre-Grout Readings*			
Subtidal Piezometer	***Digits Coefficent, A (ft NGVD/digit)***	***Temperature Coefficient, B (ft NVGD/°C)***	***Barometric Pressure Coefficient, C (ft NGVD/psi)***	***Intercept, D (ft NGVD)***	***Digit Reading, R (digits)***	***Temperature Reading, T (°C)***	***Barometric Pressure, S (psi)***	***FEH_{PG} [2] (ft NGVD)***
WW-A1-2	-4.061E-02	7.519E-05	-1.809E+00	337.4	7777.9	9.8	14.0781	-3.93
WW-A2-2	-3.982E-02	-1.278E-02	-1.867E+00	330.9	7514.8	8.7	13.9755	5.43
WW-B1-2	-4.238E-02	4.291E-02	-1.844E+00	349.4	7637.6	10.3	14.0025	0.31
WW-B2-2	-3.810E-02	-1.007E-02	-1.994E+00	320.4	7553.4	10.9	14.152	4.26
WW-C1-2	-3.694E-02	1.636E-01	-1.827E+00	293.5	7341.7	11.7	13.8584	-1.16
WW-C2-2	-3.710E-02	-6.335E-03	-1.866E+00	311.8	7826	10.5	13.9539	-4.65
WW-C4-2	-4.179E-02	-7.183E-02	-1.945E+00	367.5	8060.1	10.8	14.2655	2.11
WW-D1-2	-3.440E-02	-1.692E-02	-1.799E+00	284.5	7560.8	10.1	14.16388	-1.30

Notes:
(1) The details of the multiple linear regression analysis are presented in Attachment 3 for the mudline transducers WW-A1-2, WW-A2-2, WW-B1-2, WW-B2-2, WW-C1-2, WW-C2-2, WW-C4-2, and WW-D1-2, respectively.
(2) Mudline transducer FEH under pre-grout conditions determined using Equation 3.20 and the linear regression coefficient

TABLE 9

CALCULATION OF SUBTIDAL PIEZOMETER NEST PRE-GROUT FEH
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Subtidal Pizometer Nest	*Transducer Within Subtidal Piezometer Nest*	*Transducer Elevation (ft NGVD)*	*In-Situ Measured Density at Transducer Elevation (lbs/ft^3)*	*Z_1-Z_2 (ft)*	*ΔFEH_{PG} (1) (ft NGVD)*	*FEH_{PG} (2) (ft NGVD)*
WW-A1	WW-A1-2	-41.06	63.650 (4)	NA	NA	-3.93 (3)
	WW-A1-75	-60.91	64.040	19.85	0.46	-3.47
	WW-A1-100	-86.03	63.910 (6)	25.12	0.63	-2.84
	WW-A1-130	-116.01	64.520 (6)	29.98	0.87	-1.97
	WW-A1-160	-146.02	62.780	30.01	0.60	-1.37
WW-A2	WW-A2-2	-44.97	63.916	NA	NA	5.43 (3)
	WW-A2-75	-63.36	63.922	18.39	0.45	5.87
	WW-A2-100	-88.38	64.108	25.02	0.65	6.52
	WW-A2-130	-118.37	62.485	29.99	0.43	6.95
	WW-A2-160	-147.37	64.667	29	0.55	7.50
WW-B1	WW-B1-2	-50.58	63.860 (4)	NA	NA	0.31 (3)
	WW-B1-75	-63.10	65.103	12.52	0.42	0.73
	WW-B1-100	-88.06	66.566	24.96	1.37	2.10
	WW-B1-130	-118.02	63.619	29.96	1.29	3.39
	WW-B1-160	-148.03	63.572	30.01	0.57	3.97
WW-B2	WW-B2-2	-43.89	63.828	NA	NA	4.26 (3)
	WW-B2-75	-63.40	64.308	19.51	0.52	4.79
	WW-B2-100	-88.39	63.776	24.99	0.66	5.44
	WW-B2-130	-118.37	62.525	NC (7)	NC	NC
	WW-B2-160	-148.39	62.474	60	0.70	6.14
WW-C1	WW-C1-2	-49.46	63.857	NA	NA	3.11 (3)
	WW-C1-75	-62.06	63.664	12.6	0.27	3.39 (3)
	WW-C1-100	-87.06	64.884	25	0.75	4.14
WW-C2	WW-C2-2	-39.51	63.729	NA	NA	-4.65 (3)
	WW-C2-75	-62.41	62.596	22.9	0.28	-4.37
	WW-C2-100	-87.39	62.781	24.98	0.12	-4.25
	WW-C2-130	-117.41	62.779	30.02	0.18	-4.07
	WW-C2-160	-147.41	63.587	30	0.38	-3.70
WW-C4	WW-C4-2	-26.78	62.603	NA	NA	2.11 (3)
	WW-C4-50	-38.40	62.598	11.62	0.04	2.14
	WW-C4-75	-63.39	62.349	24.99	0.03	2.17
	WW-C4-100	-88.40	62.431 (5)	25.01	0.00	2.17
	WW-C4-130	-118.35	62.531	29.95	0.04	2.21
	WW-C4-160	-148.38	62.614	30.03	0.08	2.29
WW-D1	WW-D1-2	-43.29	63.773	NA	NA	-1.30 (3)
	WW-D1-75	-62.28	64.419	18.99	0.52	-0.79
	WW-D1-100	-87.28	66.280	25	1.18	0.39
	WW-D1-130	-117.29	66.088	30.01	1.82	2.21

Notes:

(1) ΔFEH_{PG} from the overlying transducer to the underlying transducer is determined from the first term of Equation 3.21.

(2) FEH_{PG} is determined from Equation 3.22.

(3) Mudline transducer pre-grout FEH_{PG} presented in Table 8 and calculated using the empirical relationship developed between FEH_{TIDE} and the mudline transducer pre-grout digit/temperature reading and barometric pressure measurement

(4) Mudline transducer density was interpolated from the Waterway density at the mudline (estimated using the Waterway density versus elevation relationship presented in Section 6.2) and the measured in-situ density at the 75-ft transducer

(5) Density was interpolated from the measured in-situ density at the 75-ft and 130-ft transducers.

(6) In-situ density measurements taken at HYD-1 at the transducer elevation.

(7) WW-B2-130 was reinstalled at a different date and can not be compared to other WW-B2 transducer pre-grout readings and FEH_{PG}. As a result, a FEH_{PG} was not calculated for WW-B2-130.

TABLE 10

EXAMPLE CALCULATION OF FEH - WW-B1-100
OCCIDENTAL CHEMICAL CORPORTATION
TACOMA, WASHINGTON

Subtidal Piezometer: WW-B1-100

Transducer Calibration Factors and Pre-Grout Readings:

Linear Gage Factor	G	0.01908	(psi/digit)	Geokon factory calibrated gage factor
Thermal Factor	K	-0.00468	(psi/°C)	Geokon factory calibrated thermal factor
Pre-Grout Digit Reading	R_{PG}	6313.6	(digits)	
Pre-Grout Temperature	T_{PG}	12.1	(°C)	
Pre-Grount Barometric Pressure Measurement	S_{PG}	14.0025	(psi)	
Pre-Grout FEH	FEH_{PG}	2.10	(ft NGVD)	Calculated FEH_{PG} from Step 3

Pressure and FEH Equations:

Pressure Change from Pre-Grout Conditions

$$\Delta P_t = G\left(R_{PG} - R_t\right) + K\left(T_t - T_{PG}\right) - \left(S_t - S_{PG}\right)$$ Equation 3.23

Change in Height of Fresh Water from Pre-Grout Conditions

$$\Delta H_{f\,t} = 2.3077 \times G\left(R_{PG} - R_t\right) + K\left(T_t - T_{PG}\right) - \left(S_t - S_{PG}\right)$$ Equation 3.25

Absolute FEH

$$FEH_t = FEH_{PG} + \Delta H_{f\,t}$$ Equation 3.26

Example Calculations:

Time	Tranducer Digit Reading, R_t (digits)	Transducer Temperature Reading, T_t (°C)	Barometric Pressure Measurement, S_t (psi)	Method 2 Calculation of FEH: ΔP_t (psi)	Method 2 Calculation of FEH: $\Delta H_{f\,t}$ (ft)	Method 2 Calculation of FEH: FEH_t (ft NGVD)
5/27/2006 9:00	6386.1	17.268	14.013	-1.418	-3.27	-1.17
5/27/2006 10:00	6454.3	17.268	14.006	-2.712	-6.26	-4.16
5/27/2006 11:00	6501.4	17.300	14.006	-3.611	-8.33	-6.23
5/27/2006 12:00	6514.0	17.300	14.010	-3.855	-8.90	-6.80
5/27/2006 13:00	6489.5	17.465	14.003	-3.381	-7.80	-5.70
5/27/2006 14:00	6437.1	17.300	14.001	-2.379	-5.49	-3.39
5/27/2006 15:00	6364.1	17.363	14.003	-0.988	-2.28	-0.18
5/27/2006 16:00	6290.2	17.331	13.994	0.431	0.99	3.09
5/27/2006 17:00	6229.4	17.395	13.999	1.585	3.66	5.76
5/27/2006 18:00	6187.2	17.331	14.008	2.382	5.50	7.60
5/27/2006 19:00	6166.5	17.331	14.006	2.779	6.41	8.51
5/27/2006 20:00	6165.6	17.363	14.019	2.783	6.42	8.52
5/27/2006 21:00	6178.7	17.331	14.035	2.517	5.81	7.91
5/27/2006 22:00	6205.0	17.331	14.033	2.017	4.65	6.75
5/27/2006 23:00	6232.3	17.465	14.051	1.477	3.41	5.51
5/28/2006 0:00	6252.8	17.300	14.060	1.078	2.49	4.59
5/28/2006 1:00	6256.3	17.300	14.057	1.015	2.34	4.44
5/28/2006 2:00	6244.5	17.268	14.064	1.233	2.85	4.94
5/28/2006 3:00	6222.8	17.465	14.069	1.641	3.79	5.89
5/28/2006 4:00	6200.8	17.268	14.066	2.065	4.77	6.86
5/28/2006 5:00	6184.8	17.268	14.073	2.363	5.45	7.55
5/28/2006 6:00	6187.3	17.268	14.080	2.308	5.33	7.43
5/28/2006 7:00	6215.3	17.268	14.078	1.776	4.10	6.20
5/28/2006 8:00	6265.6	17.300	14.093	0.801	1.85	3.95
5/28/2006 9:00	6335.8	17.237	14.111	-0.556	-1.28	0.82
5/28/2006 10:00	6412.5	17.268	14.109	-2.017	-4.66	-2.56
5/28/2006 11:00	6471.8	17.268	14.121	-3.162	-7.30	-5.20
5/28/2006 12:00	6506.2	17.268	14.134	-3.830	-8.84	-6.74
5/28/2006 13:00	6506.6	17.268	14.129	-3.833	-8.84	-6.75
5/28/2006 14:00	6475.6	17.268	14.141	-3.254	-7.51	-5.41
5/28/2006 15:00	6415.9	17.268	14.156	-2.129	-4.91	-2.81
5/28/2006 16:00	6341.2	17.363	14.148	-0.697	-1.61	0.49
5/28/2006 17:00	6270.4	17.496	14.157	0.644	1.49	3.59
5/28/2006 18:00	6215.2	17.363	14.174	1.682	3.88	5.98
5/28/2006 19:00	6176.3	17.363	14.165	2.433	5.61	7.71
5/28/2006 20:00	6159.1	17.465	14.181	2.744	6.33	8.43
5/28/2006 21:00	6163.8	17.331	14.199	2.637	6.09	8.19
5/28/2006 22:00	6179.1	17.496	14.195	2.348	5.42	7.52
5/28/2006 23:00	6206.5	17.300	14.206	1.816	4.19	6.29
5/29/2006 0:00	6235.3	17.268	14.224	1.248	2.88	4.98
5/29/2006 1:00	6253.9	17.268	14.219	0.899	2.07	4.17
5/29/2006 2:00	6256.4	17.331	14.220	0.849	1.96	4.06
5/29/2006 3:00	6242.1	17.268	14.233	1.110	2.56	4.66

TABLE 10

EXAMPLE CALCULATION OF FEH - WW-B1-100
OCCIDENTAL CHEMICAL CORPORTATION
TACOMA, WASHINGTON

	Tranducer Digit Reading, R_t	Transducer Temperature Reading, T_t	Barometric Pressure Measurement, S_t	Method 2 Calculation of FEH		
				ΔP_t	$\Delta H_{f\ t}$	FEH_t
Time	*(digits)*	*(°C)*	*(psi)*	*(psi)*	*(ft)*	*(ft NGVD)*
5/29/2006 4:00	6223.1	17.268	14.226	1.479	3.41	5.51
5/29/2006 5:00	6204.7	17.237	14.233	1.823	4.21	6.31
5/29/2006 6:00	6192.4	17.300	14.246	2.045	4.72	6.82
5/29/2006 7:00	6200.0	17.401	14.237	1.909	4.40	6.50
5/29/2006 8:00	6233.7	17.268	14.242	1.261	2.91	5.01
5/29/2006 9:00	6287.6	17.300	14.251	0.223	0.52	2.61
5/29/2006 10:00	6358.2	17.300	14.240	-1.113	-2.57	-0.47
5/29/2006 11:00	6428.2	17.300	14.242	-2.450	-5.65	-3.56
5/29/2006 12:00	6481.3	17.300	14.249	-3.471	-8.01	-5.91
5/29/2006 13:00	6504.6	17.331	14.242	-3.908	-9.02	-6.92
5/29/2006 14:00	6495.3	17.331	14.246	-3.734	-8.62	-6.52
5/29/2006 15:00	6456.0	17.363	14.251	-2.990	-6.90	-4.80
5/29/2006 16:00	6394.4	17.363	14.242	-1.806	-4.17	-2.07
5/29/2006 17:00	6321.1	17.363	14.238	-0.404	-0.93	1.17
5/29/2006 18:00	6252.8	17.395	14.240	0.898	2.07	4.17
5/29/2006 19:00	6205.2	17.395	14.233	1.813	4.18	6.28
5/29/2006 20:00	6172.7	17.363	14.224	2.442	5.64	7.73
5/29/2006 21:00	6160.9	17.395	14.237	2.655	6.13	8.22
5/29/2006 22:00	6167.3	17.496	14.233	2.536	5.85	7.95
5/29/2006 23:00	6184.7	17.331	14.240	2.197	5.07	7.17
5/30/2006 0:00	6212.9	17.268	14.249	1.650	3.81	5.91
5/30/2006 1:00	6239.6	17.300	14.242	1.148	2.65	4.75
5/30/2006 2:00	6255.9	17.300	14.242	0.837	1.93	4.03
5/30/2006 3:00	6256.1	17.268	14.258	0.817	1.89	3.98
5/30/2006 4:00	6245.6	17.237	14.251	1.025	2.37	4.46
5/30/2006 5:00	6229.4	17.237	14.253	1.332	3.07	5.17
5/30/2006 6:00	6213.0	17.237	14.262	1.636	3.78	5.87
5/30/2006 7:00	6206.2	17.237	14.258	1.769	4.08	6.18

TABLE 11

EXAMPLE CALCULATIONS FOR TIDAL FLUCTUATION FILTERING
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Well Location: 11-45

	Constant Input Parameters			
Line 1	t_o (tide period)	0.51736	days	Average tide period
Line 2	x dist from waterway	410	ft	Distance from monitoring well to the closest shoreline location (i.e., Hylebos/Blair Waterways or Commencement Bay)
Line 3	ω	12.145	1/day	Calculated as $\omega=2\pi/t_o$
	Calculated Parameters			
Line 4	TE (Ratio of Standard Deviation):	0.161320449	psi/ft	Calculated using Equation 4.3
Line 5	b = TE x Avg. $T_{Waterway}$	12	psi	Pressure offset estimated visually to minimize the average difference between the observed and predicted pressure response
Line 6	S/T from TE	9.6E-07	day/ft^2	Calculated using Equation 4.4
Line 7	S/T from lag	1.0E-06	day/ft^2	Calculated using Equation 4.5
Line 8	Average S/T	9.8E-07	day/ft^2	Geometric mean of S/T for TE and S/T from time lag
Line 9	Ratio S/T methods	1.0		
Line 10	Time Lag	120	min	Time lag in Column G corresponding to the maximum correlation between Event 2 well pressure and tide elevation from Column I
Line 11	Maximum Correlation Coefficient	0.973408654		Maximum correlation coefficient between the Event 2 well pressure, offset by lag time and the tide elevation, as calculated by Excel in Column F

Column Explanations
Columns A through C: Observed data
Column D: Calculated using Equation 4.6
Column E: Residual Pressure = Column B - Column D
Column F: Correlation coefficient between the observed well pressure and tidal data for the specified time lag in Column G
Column G: 5-minute incremental time lag approximation corresponding to the correlation coefficient in Column F

Observed Data:			***Recovery Approximation:***		***Event 2 Lag Time Correlation:***		
Column A	*Column B*	*Column C*	*Column D*	*Column E*	*Column F*	*Column G*	
Date and Time	**Measured Well Pressure (psi)**	**Tide Elevation (ft NGVD)**	**$P_{Predicted}$ (psi)**	**$P_{Residual}$ (psi)**	**Correlation Coefficient**	**Incremental Time Lag (min)**	
5/16/2006 0:00	12.7131	3.49			0.723475607	0	
5/16/2006 0:05	12.6984	3.39			0.743064678	5	
5/16/2006 0:10	12.6984	3.30			0.761990281	10	
5/16/2006 0:15	12.6887	3.20			0.780223622	15	
5/16/2006 0:20	12.6789	3.10			0.797745018	20	
5/16/2006 0:25	12.6691	3.01			0.814530256	25	
5/16/2006 0:30	12.6642	2.91			0.830562193	30	
5/16/2006 0:35	12.6545	2.85			0.845818878	35	
5/16/2006 0:40	12.6545	2.78			0.860281498	40	
5/16/2006 0:45	12.6447	2.72			0.873935837	45	
5/16/2006 0:50	12.6349	2.66			0.886764267	50	
5/16/2006 0:55	12.63	2.59			0.898753638	55	
5/16/2006 1:00	12.63	2.53			0.909885164	60	
5/16/2006 1:05	12.6105	2.49			0.920148449	65	
5/16/2006 1:10	12.6007	2.45			0.929533921	70	
5/16/2006 1:15	12.6007	2.41			0.938030297	75	
5/16/2006 1:20	12.5959	2.38			0.945629045	80	
5/16/2006 1:25	12.5861	2.34			0.952320775	85	
5/16/2006 1:30	12.5763	2.3			0.958101441	90	
5/16/2006 1:35	12.5763	2.29			0.962962273	95	
5/16/2006 1:40	12.5666	2.28			0.966901229	100	
5/16/2006 1:45	12.5617	2.27			0.969915894	105	
5/16/2006 1:50	12.5519	2.26			0.972004254	110	
5/16/2006 1:55	12.5421	2.25			0.973169827	115	
5/16/2006 2:00	12.5519	2.24	12.56300837	-0.011108366	0.973408654	120	Max. Correlation Coefficient
5/16/2006 2:05	12.5324	2.24	12.54741406	-0.015014056	0.972727658	125	
5/16/2006 2:10	12.5324	2.25	12.53181975	0.000580254	0.971126718	130	
5/16/2006 2:15	12.5275	2.26	12.51622544	0.011274564	0.968612095	135	
5/16/2006 2:20	12.5177	2.26	12.50063113	0.017068874	0.965189795	140	
5/16/2006 2:25	12.5275	2.27	12.48503682	0.042463184	0.960868908	145	
5/16/2006 2:30	12.5177	2.27	12.46944251	0.048257494	0.95565529	150	
5/16/2006 2:35	12.5177	2.30	12.45922554	0.058474456	0.949557629	155	
5/16/2006 2:40	12.5079	2.34	12.44900858	0.058891418	0.942592527	160	
5/16/2006 2:45	12.5079	2.37	12.43879162	0.069108379	0.93476955	165	
5/16/2006 2:50	12.4982	2.40	12.42857466	0.069625341	0.92610096	170	
5/16/2006 2:55	12.5079	2.44	12.4183577	0.089542303	0.916602697	175	
5/16/2006 3:00	12.5177	2.47	12.40814074	0.109559265	0.906288725	180	
5/16/2006 3:05	12.5079	2.54	12.40195678	0.105943215	0.895177026	185	
5/16/2006 3:10	12.4982	2.61	12.39577283	0.102427166	0.883284414	190	
5/16/2006 3:15	12.4982	2.67	12.38958888	0.108611116	0.870629908	195	
5/16/2006 3:20	12.5079	2.74	12.38340493	0.124495067	0.857230847	200	
5/16/2006 3:25	12.5079	2.81	12.37722098	0.130679017	0.843109527	205	
5/16/2006 3:30	12.5177	2.88	12.37103703	0.146662968	0.828288056	210	
5/16/2006 3:35	12.5079	2.95	12.36942383	0.138476172	0.81278747	215	
5/16/2006 3:40	12.5177	3.02	12.36781062	0.149889377	0.796631919	220	
5/16/2006 3:45	12.5177	3.09	12.36619742	0.151502581	0.779846077	225	
5/16/2006 3:50	12.5275	3.16	12.36458421	0.162915786	0.762453791	230	
5/16/2006 3:55	12.5275	3.23	12.36297101	0.16452899	0.744479349	235	
5/16/2006 4:00	12.5421	3.3	12.36135781	0.180742195	0.725949822	240	
5/16/2006 4:05	12.5324	3.36	12.36216441	0.170235593	0.706893846	245	
5/16/2006 4:10	12.5421	3.41	12.36297101	0.17912899	0.687335345	250	
5/16/2006 4:15	12.5519	3.47	12.36377761	0.188122388	0.667304359	255	
5/16/2006 4:20	12.5617	3.53	12.36458421	0.197115786	0.646828995	260	
5/16/2006 4:25	12.5617	3.58	12.36539082	0.196309184	0.625938675	265	
5/16/2006 4:30	12.5666	3.64	12.36619742	0.200402581	0.604662528	270	
5/16/2006 4:35	12.5763	3.71	12.37157477	0.204725233	0.583028736	275	
5/16/2006 4:40	12.5861	3.78	12.37695212	0.209147885	0.561069552	280	
5/16/2006 4:45	12.5861	3.85	12.38232946	0.203770536	0.538813508	285	
5/16/2006 4:50	12.5959	3.92	12.38770681	0.208193188	0.516293037	290	
5/16/2006 4:55	12.6007	3.99	12.39308416	0.20761584	0.493538222	295	
5/16/2006 5:00	12.6203	4.06	12.39846151	0.221838492	0.470579295	300	
5/16/2006 5:05	12.6203	4.12	12.40948507	0.210814928	0.447448199	305	
5/16/2006 5:10	12.63	4.18	12.42050864	0.209491364	0.424175163	310	
5/16/2006 5:15	12.6349	4.24	12.4315322	0.2033678	0.400791503	315	
5/16/2006 5:20	12.6349	4.30	12.44255576	0.192344236	0.377328375	320	
5/16/2006 5:25	12.6545	4.36	12.45357933	0.200920672	0.353815438	325	
5/16/2006 5:30	12.6642	4.42	12.46460289	0.199597108	0.330284801	330	
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.	.	.	.	.	.	.	
.	.	.	.	.	.	.	

The remaining data has been truncated for presentation purposes. The complete table and data are provided in the Excel spreadsheets for each monitoring well nest included in Attachment 4.

TABLE 12

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 1 TO EVENT 2
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	*Approximate Distance from Waterway (1) (ft)*	*Calculated Parameters Using Event 2 Pressure Response Data* Tidal Efficiency, TE (2) (psi/ft)	*Time Lag (3) (min)*	*S/T from TE (4) (day/ft²)*	*S/T from Time Lag (5) (day/ft²)*	*Average S/T (day/ft²)*	*Ratio of S/T from TE to S/T from Time Lag*	*Estimated Recovery* Recovery (psi)	*Recovery (ft)*	*Comments on Recovery Estimate*
1-100R	60	0.2850	40	8.1E-06	5.2E-06	6.5E-06	1.5E+00	- -	- -	No clear recovery
1-175	60	0.2061	85	2.5E-05	2.4E-05	2.4E-05	1.1E+00	0	0.00	
2-100	50	0.1867	150	4.7E-05	1.1E-04	7.0E-05	4.4E-01	0	0.00	
3-50	60	0.1568	190	4.7E-05	1.2E-04	7.5E-05	4.0E-01	0	0.00	
3-100	60	0.1189	70	7.7E-05	1.6E-05	3.5E-05	4.8E+00	0	0.00	
4-25R	260	0.1174	80	4.2E-06	1.1E-06	2.1E-06	3.7E+00	- -	- -	No clear recovery
4-45R	260	0.0116	- -	3.2E-05	- -	- -	- -	- -	- -	Lag time could not be calculated due to lack of correlation
4-83R	260	0.2092	110	1.3E-06	2.1E-06	1.6E-06	6.2E-01	0.14	0.32	
4-115R	260	0.1248	130	3.8E-06	2.9E-06	3.3E-06	1.3E+00	0.16	0.37	
4-175R	260	0.1609	20	2.4E-06	6.9E-08	4.1E-07	3.5E+01	- -	- -	No clear recovery
5-25	420	0.0437	535	4.9E-06	1.9E-05	9.7E-06	2.6E-01	0.17	0.39	
5-50	420	0.0977	130	2.1E-06	1.1E-06	1.5E-06	1.8E+00	0.15	0.35	
5-100	420	0.0945	195	2.2E-06	2.5E-06	2.3E-06	8.6E-01	0.15	0.35	
6A-24.5	360	0.0740	240	4.0E-06	5.2E-06	4.5E-06	7.6E-01	0	0.00	
6A-50	360	0.1125	135	2.3E-06	1.6E-06	2.0E-06	1.4E+00	0.06	0.14	
6A-100	360	0.1100	150	2.4E-06	2.0E-06	2.2E-06	1.2E+00	0	0.00	
7-181	744	0.1511	45	3.3E-07	4.3E-08	1.2E-07	7.7E+00	- -	- -	No clear recovery
8-23	816	0.0477	275	1.2E-06	1.3E-06	1.3E-06	9.0E-01	- -	- -	No clear recovery
8-54	816	0.1367	130	3.3E-07	3.0E-07	3.1E-07	1.1E+00	0.18	0.42	
8-99R	816	0.1250	140	3.8E-07	3.4E-07	3.6E-07	1.1E+00	0.12	0.28	
9-25	780	0.0624	240	1.0E-06	1.1E-06	1.1E-06	9.2E-01	- -	- -	No clear recovery
9-50	780	0.1342	115	3.7E-07	2.5E-07	3.1E-07	1.5E+00	0.05	0.12	
9-100	780	0.1088	160	5.2E-07	4.9E-07	5.0E-07	1.0E+00	- -	- -	No clear recovery
11-25	410	0.0789	110	2.8E-06	8.4E-07	1.5E-06	3.4E+00	0.25	0.58	
11-45	410	0.1613	120	9.6E-07	1.0E-06	9.8E-07	9.5E-01	0.55	1.27	
11-100	410	0.1598	115	9.8E-07	9.2E-07	9.5E-07	1.1E+00	0.68	1.57	
11-183	410	0.1432	60	1.2E-06	2.5E-07	5.5E-07	4.8E+00	- -	- -	No clear recovery
12-25	780	0.0493	240	1.3E-06	1.1E-06	1.2E-06	1.2E+00	0.43	0.99	
12-45	780	0.0548	290	1.2E-06	1.6E-06	1.4E-06	7.1E-01	0.48	1.11	
12-100	780	0.0513	275	1.2E-06	1.5E-06	1.3E-06	8.5E-01	0.51	1.18	
12-160	780	0.1626	30	2.6E-07	1.7E-08	6.7E-08	1.5E+01	- -	- -	No clear recovery
14-25R	36	0.1717	50	1.1E-04	2.3E-05	5.0E-05	4.8E+00	0.04	0.09	
14-50R	36	0.3661	40	3.6E-06	1.4E-05	7.2E-06	2.5E-01	- -	- -	No clear recovery
15-25R	36	0.1738	60	1.1E-04	3.3E-05	5.9E-05	3.3E+00	0	0.00	
15-50R	36	0.2866	50	2.2E-05	2.3E-05	2.2E-05	9.6E-01	0	0.00	
15-120	36	0.2236	90	5.6E-05	7.3E-05	6.4E-05	7.6E-01	0	0.00	
19-25	336	0.0484	190	7.0E-06	3.7E-06	5.1E-06	1.9E+00	0.15	0.35	
19-50R	336	0.1003	150	3.1E-06	2.3E-06	2.7E-06	1.3E+00	- -	- -	No clear recovery
21-25R	456	0.0768	180	2.4E-06	1.8E-06	2.1E-06	1.3E+00	0.28	0.65	
21-48	456	0.0880	185	2.0E-06	1.9E-06	2.0E-06	1.0E+00	0.28	0.65	
25-25	816	0.0547	280	1.1E-06	1.4E-06	1.2E-06	7.7E-01	0.28	0.65	
25-50	816	0.1487	125	2.8E-07	2.7E-07	2.8E-07	1.0E+00	0.26	0.60	
25A-50	816	0.0568	280	1.0E-06	1.4E-06	1.2E-06	7.4E-01	0.3	0.69	
32-50R	744	0.0453	325	1.5E-06	2.2E-06	1.8E-06	6.8E-01	0.5	1.15	
32-100	744	0.1248	160	4.6E-07	5.4E-07	5.0E-07	8.5E-01	- -	- -	Not enough data during Event 2 to determine recovery
34-25	612	0.0476	280	2.1E-06	2.5E-06	2.3E-06	8.7E-01	0.39	0.90	
34-100	612	0.0506	305	2.0E-06	2.9E-06	2.4E-06	7.0E-01	0.48	1.11	
35-25	432	0.0493	225	4.2E-06	3.2E-06	3.6E-06	1.3E+00	0.32	0.74	
35-50	432	0.0684	200	3.0E-06	2.5E-06	2.7E-06	1.2E+00	0.32	0.74	
35-100	432	0.1717	95	7.6E-07	5.7E-07	6.5E-07	1.3E+00	- -	- -	No clear recovery
36-25	588	0.0589	250	1.9E-06	2.1E-06	2.0E-06	9.0E-01	0.3	0.69	
36-50	588	0.1548	105	5.0E-07	3.7E-07	4.3E-07	1.4E+00	0.29	0.67	
36-100R	588	0.1306	120	6.9E-07	4.9E-07	5.8E-07	1.4E+00	0.29	0.67	

TABLE 12

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 1 TO EVENT 2
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

		Calculated Parameters Using Event 2 Pressure Response Data						*Estimated Recovery*		
Location	*Approximate Distance from Waterway [1] (ft)*	*Tidal Efficiency, TE [2] (psi/ft)*	*Time Lag [3] (min)*	*S/T from TE [4] (day/ft^2)*	*S/T from Time Lag [5] (day/ft^2)*	*Average S/T (day/ft^2)*	*Ratio of S/T from TE to S/T from Time Lag*	*Recovery (psi)*	*Recovery (ft)*	*Comments on Recovery Estimate*
40A-25	396	0.0315	115	7.2E-06	9.9E-07	2.7E-06	7.3E+00	- -	- -	No clear recovery
40A-50	396	0.1062	210	2.1E-06	3.3E-06	2.6E-06	6.3E-01	0.38	0.88	
40A-100	396	0.1733	110	8.8E-07	9.0E-07	8.9E-07	9.8E-01	0.5	1.15	
41-50	72	0.2572	55	8.7E-06	6.8E-06	7.7E-06	1.3E+00	- -	- -	No clear recovery
41-100	72	0.2832	55	5.8E-06	6.8E-06	6.3E-06	8.4E-01	- -	- -	No clear recovery
41-138	72	0.1385	65	4.1E-05	9.5E-06	2.0E-05	4.3E+00	- -	- -	No clear recovery
43-50	564	0.0357	390	3.2E-06	5.6E-06	4.3E-06	5.8E-01	0.51	1.18	
44-25	288	0.0266	310	1.5E-05	1.4E-05	1.4E-05	1.1E+00	- -	- -	No clear recovery
44-50	288	0.1101	175	3.7E-06	4.3E-06	4.0E-06	8.6E-01	- -	- -	No clear recovery
45-50	696	0.1396	120	4.4E-07	3.5E-07	3.9E-07	1.3E+00	0.16	0.37	
45-100	696	0.1316	120	4.8E-07	3.5E-07	4.1E-07	1.4E+00	0.16	0.37	
53-25	600	0.0688	190	1.6E-06	1.2E-06	1.3E-06	1.3E+00	0.48	1.11	
53-50	600	0.1012	175	9.7E-07	1.0E-06	9.8E-07	9.7E-01	0.62	1.43	
53-100	280	0.0094	280	3.1E-05	1.2E-05	1.9E-05	2.6E+00	0.1	0.23	
55-25	720	0.0507	295	1.5E-06	2.0E-06	1.7E-06	7.4E-01	0.15	0.35	
64-25	144	0.1109	115	1.5E-05	7.5E-06	1.0E-05	2.0E+00	0.07	0.16	
64-50	144	0.2155	75	3.9E-06	3.2E-06	3.5E-06	1.2E+00	0.3	0.69	
64-100	144	0.2565	50	2.2E-06	1.4E-06	1.8E-06	1.5E+00	0.25	0.58	
64-170	144	0.1770	15	6.4E-06	1.3E-07	9.0E-07	5.0E+01	- -	- -	No clear recovery
65-25	24	0.1018	70	6.0E-04	1.0E-04	2.4E-04	6.0E+00	0	0.00	
65-50	24	0.1749	150	2.4E-04	4.6E-04	3.3E-04	5.1E-01	0	0.00	
65-100	24	0.3092	30	3.3E-05	1.8E-05	2.4E-05	1.8E+00	0	0.00	
65-130	24	0.1729	0.1	2.4E-04	2.0E-10	2.2E-07	1.2E+06	- -	- -	No clear recovery
69-25	60	0.1546	70	4.9E-05	1.6E-05	2.8E-05	3.1E+00	0.05	0.12	
69-50	60	0.2358	75	1.7E-05	1.8E-05	1.8E-05	9.3E-01	0.1	0.23	
71-25	84	0.1071	55	4.6E-05	5.0E-06	1.5E-05	9.1E+00	0.05	0.12	
71-50	84	0.2694	45	5.3E-06	3.4E-06	4.2E-06	1.6E+00	- -	- -	No clear recovery
74-50	300	0.1763	105	1.5E-06	1.4E-06	1.5E-06	1.0E+00	0.48	1.11	
74-75	300	0.1980	90	1.1E-06	1.1E-06	1.1E-06	1.1E+00	0.48	1.11	
74-100	300	0.2424	60	6.2E-07	4.7E-07	5.4E-07	1.3E+00	0.33	0.76	
74-130	300	0.2017	90	1.1E-06	1.1E-06	1.1E-06	1.0E+00	- -	- -	No clear recovery
75-50	264	0.1573	90	2.4E-06	1.4E-06	1.8E-06	1.8E+00	- -	- -	Insufficient Event 1 data to calculate recovery.
75-75	264	0.1500	165	2.7E-06	4.6E-06	3.5E-06	5.8E-01	- -	- -	No clear recovery
75-100	264	0.0987	145	5.2E-06	3.5E-06	4.3E-06	1.5E+00	0.1	0.23	
75-130	264	- -	- -	- -	- -	- -	- -	- -	- -	Lag time could not be calculated due to lack of correlation.
76-100	600	0.0538	245	2.0E-06	2.0E-06	2.0E-06	1.0E+00	0.4	0.92	
77-100	288	0.0325	185	1.3E-05	4.8E-06	8.0E-06	2.8E+00	0.2	0.46	
77-140	288	0.1115	135	3.7E-06	2.6E-06	3.1E-06	1.4E+00	- -	- -	No clear recovery
78-25	708	0.0570	205	1.4E-06	9.8E-07	1.2E-06	1.4E+00	0.41	0.95	
78-50	708	0.0654	195	1.2E-06	8.9E-07	1.0E-06	1.3E+00	0.54	1.25	
709-MW20-25	60	0.2286	70	1.9E-05	1.6E-05	1.7E-05	1.2E+00	- -	- -	
709-MW20-50	60	0.2251	90	2.0E-05	2.6E-05	2.3E-05	7.5E-01	0	0.00	
721-MW5-25	276	0.1097	180	4.1E-06	5.0E-06	4.5E-06	8.2E-01	0	0.00	
721-MW5-50	276	0.1357	120	2.9E-06	2.2E-06	2.5E-06	1.3E+00	0	0.00	
721-MW6-25	360	0.1171	160	2.2E-06	2.3E-06	2.2E-06	9.4E-01	0	0.00	
721-MW6-50	360	0.1277	110	1.9E-06	1.1E-06	1.4E-06	1.7E+00	- -	- -	No clear recovery
721-MW9-25	36	0.3029	40	1.6E-05	1.4E-05	1.5E-05	1.1E+00	0	0.00	
721-MW9-50	36	0.1589	70	1.3E-04	4.4E-05	7.5E-05	2.9E+00	- -	- -	No clear recovery
721-MW10-25	36	0.3456	25	6.5E-06	5.6E-06	6.1E-06	1.2E+00	0	0.00	
PZ-SHI-001-33	- -	0.3268	20	- -	- -	- -	- -	0.2	0.46	
PZ-SHI-001-75	- -	0.3533	15	- -	- -	- -	- -	0.22	0.51	
PZ-SHI-001-100	- -	0.3465	35	- -	- -	- -	- -	0.09	0.21	
PZ-SHI-001-126	- -	0.1876	135	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway

TABLE 12

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 1 TO EVENT 2
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

		Calculated Parameters Using Event 2 Pressure Response Data						*Estimated Recovery*		
Location	***Approximate Distance from Waterway [(1)] (ft)***	***Tidal Efficiency, TE [(2)] (psi/ft)***	***Time Lag [(3)] (min)***	***S/T from TE [(4)] (day/ft^2)***	***S/T from Time Lag [(5)] (day/ft^2)***	***Average S/T (day/ft^2)***	***Ratio of S/T from TE to S/T from Time Lag***	***Recovery (psi)***	***Recovery (ft)***	***Comments on Recovery Estimate***
PZ-SHI-002-25	- -	0.4334	5	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
PZ-SHI-002-75	- -	0.3677	15	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
PZ-SHI-002-100	- -	0.3447	25	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
PZ-SHI-003-42	- -	0.1333	195	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
PZ-SHI-003-75	- -	0.2607	50	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
PZ-SHI-003-100	- -	0.3557	10	- -	- -	- -	- -	- -	- -	Transducer at or under Hylebos Waterway
T1-25	144	0.1752	35	6.5E-06	6.9E-07	2.1E-06	9.4E+00	0.05	0.12	
T1-50	144	0.2575	65	2.2E-06	2.4E-06	2.3E-06	9.0E-01	0.15	0.35	
T1-100	144	0.2890	90	1.3E-06	4.6E-06	2.4E-06	2.9E-01	- -	- -	No clear recovery
T5-120	72	0.2131	95	1.6E-05	2.0E-05	1.8E-05	7.9E-01	- -	- -	No clear recovery
T6-120	120	0.0629	310	4.3E-05	7.8E-05	5.8E-05	5.4E-01	- -	- -	No clear recovery
					Minimum Average S/T =	**6.7E-08**				
					Maximum Average S/T =	**3.3E-04**				
					Geometic Mean Average S/T =	**3.1E-06**				
					Median Average S/T =	**2.3E-06**				

Notes:

(1) Taken as the distance to the surface water body closet to the well location.
(2) Tidal efficiency is calculated using Equation 4.3.
(3) Time lag corresponds to the maximum correlation between the observed well pressure and the tide elevation over Event 2.
(4) S/T calculated using tidal efficiency and Equation 4.4.
(5) S/T calculated using time lag and Equation 4.5.

Calculation Constants:		
	Tidal Period (day):	0.51736
	psi to ft correction (ft/psi):	2.3067
	w (1/day):	12.145

TABLE 13

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 3A TO EVENT 3B
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

			Calculated Parameters Using Using Second Shut-Down Pressure Response Data (6)						Estimated Recovery		
Location	Transduer Type	Approximate Distance from Waterway (1) (ft)	Tidal Efficiency, TE (2) (psi/ft)	Time Lag (3) (min)	S/T from TE (4) (day/ft²)	S/T from Time Lag (5) (day/ft²)	Average S/T (day/ft²)	Ratio of S/T from TE to S/T from Time Lag	Recovery (psi)	Recovery (ft)	Comments on Estimated Recovery
5-25	Standard Well	420	0.0451	260	4.78E-06	4.5E-06	4.6E-06	1.1E+00	0.08	0.18	
5-50	Standard Well	420	0.0451	260	4.8E-06	4.5E-06	4.6E-06	1.1E+00	0.08	0.18	
5-75	Standard Well	420	0.0451	260	4.8E-06	4.5E-06	4.6E-06	1.1E+00	0.12	0.28	
5-100	Standard Well	420	0.0834	170	2.5E-06	1.9E-06	2.2E-06	1.3E+00	0.10	0.23	
7-25	Standard Well	744	0.0687	205	1.0E-06	8.9E-07	9.5E-07	1.1E+00	0.27	0.62	
7-100	Standard Well	744	0.1143	140	5.3E-07	4.1E-07	4.7E-07	1.3E+00	0.32	0.74	
8-23	Standard Well	816	0.0251	340	2.0E-06	2.0E-06	2.0E-06	9.9E-01	0.05	0.12	
9-25	Standard Well	780	0.0519	220	1.2E-06	9.3E-07	1.1E-06	1.3E+00	0.04	0.09	
9-50	Standard Well	780	0.1182	110	4.6E-07	2.3E-07	3.3E-07	2.0E+00	0.05	0.12	
9-100	Standard Well	780	0.0953	140	6.2E-07	3.8E-07	4.8E-07	1.6E+00	0.08	0.18	
11-25	Standard Well	410	0.0854	90	2.6E-06	5.6E-07	1.2E-06	4.6E+00	0.15	0.35	
11-45	Standard Well	410	0.1644	110	9.2E-07	8.4E-07	8.8E-07	1.1E+00	0.45	1.04	
11-75	Standard Well	410	0.1907	105	6.6E-07	7.7E-07	7.1E-07	8.6E-01	0.41	0.95	
11-100	Standard Well	410	0.1700	100	8.6E-07	7.0E-07	7.7E-07	1.2E+00	0.43	0.99	
12-25	Standard Well	780	0.0654	200	9.7E-07	7.7E-07	8.6E-07	1.3E+00	0.24	0.55	
12A-25	Standard Well	780	0.0660	210	9.6E-07	8.5E-07	9.0E-07	1.1E+00	0.25	0.58	
12A-50	Standard Well	780	0.0867	265	7.0E-07	1.4E-06	9.7E-07	5.2E-01	0.40	0.92	
12-75	Standard Well	780	0.0817	310	7.5E-07	1.9E-06	1.2E-06	4.1E-01	0.38	0.88	
12-100	Standard Well	780	0.0802	230	7.7E-07	1.0E-06	8.9E-07	7.6E-01	0.38	0.88	
14-25R	Standard Well	36	0.1735	45	1.1E-04	1.8E-05	4.4E-05	5.8E+00	0.05	0.12	
17C-25	Geokon	40	0.0451	260	5.4E-04	4.9E-04	5.2E-04	1.1E+00	- -	- -	No clear recovery
17C-50	Geokon	40	0.2662	45	2.7E-05	1.5E-05	2.0E-05	1.8E+00	- -	- -	No clear recovery
17C-75	Geokon	40	0.2926	25	1.8E-05	4.6E-06	9.0E-06	3.9E+00	- -	- -	No clear recovery
18-25	Standard Well	400	0.0468	265	5.1E-06	5.1E-06	5.1E-06	9.9E-01	0.05	0.12	
18-50R	Standard Well	340	0.0794	185	4.1E-06	3.5E-06	3.8E-06	1.2E+00	0.03	0.07	
21C-25	Geokon	500	0.0098	165	9.6E-06	1.3E-06	3.5E-06	7.5E+00	- -	- -	No clear recovery
21C-50	Geokon	500	0.0808	170	1.9E-06	1.4E-06	1.6E-06	1.4E+00	0.19	0.44	
21C-75	Geokon	500	0.0792	185	2.0E-06	1.6E-06	1.8E-06	1.2E+00	0.13	0.30	
21C-100	Geokon	500	0.0794	165	1.9E-06	1.3E-06	1.6E-06	1.5E+00	0.13	0.30	
21C-130	Geokon	500	0.0855	180	1.8E-06	1.5E-06	1.6E-06	1.2E+00	0.13	0.30	
22-50	Standard Well	390	0.0787	195	3.1E-06	2.9E-06	3.0E-06	1.1E+00	0.12	0.28	
23-25R	Standard Well	625	0.0443	260	2.2E-06	2.0E-06	2.1E-06	1.1E+00	0.05	0.12	
32-50R	Standard Well	744	0.0742	270	9.3E-07	1.5E-06	1.2E-06	6.0E-01	0.35	0.81	
34-25R	Standard Well	612	0.0646	240	1.6E-06	1.8E-06	1.7E-06	8.8E-01	0.26	0.60	
34-50R	Standard Well	612	0.0734	250	1.4E-06	2.0E-06	1.6E-06	7.1E-01	0.32	0.74	
34-75	Standard Well	612	0.0775	275	1.3E-06	2.4E-06	1.8E-06	5.5E-01	0.38	0.88	
34C-100	Geokon	610	0.0555	0	1.9E-06	- -	- -	- -	0.22	0.51	
34C-130	Geokon	610	0.1190	0	7.7E-07	- -	- -	- -	0.23	0.53	
34C-160	Geokon	610	0.0419	445	2.5E-06	6.2E-06	3.9E-06	3.9E-01	- -	- -	No clear recovery
35-25	Standard Well	432	0.0527	195	3.9E-06	2.4E-06	3.1E-06	1.6E+00	0.18	0.42	
35-100R	Standard Well	432	0.1581	75	9.0E-07	3.5E-07	5.6E-07	2.5E+00	0.20	0.46	
36-25	Standard Well	588	0.0634	220	1.8E-06	1.6E-06	1.7E-06	1.1E+00	0.20	0.46	
36-50	Standard Well	588	0.1407	90	6.0E-07	2.7E-07	4.1E-07	2.2E+00	0.24	0.55	
36-100R	Standard Well	588	0.1256	110	7.3E-07	4.1E-07	5.5E-07	1.8E+00	0.20	0.46	
40-25	Standard Well	396	0.0853	100	2.8E-06	7.5E-07	1.4E-06	3.7E+00	0.10	0.23	

TABLE 13

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 3A TO EVENT 3B
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

			Calculated Parameters Using Using Second Shut-Down Pressure Response Data [6]						*Estimated Recovery*		
Location	*Transduer Type*	*Approximate Distance from Waterway [1] (ft)*	*Tidal Efficiency, TE [2] (psi/ft)*	*Time Lag [3] (min)*	*S/T from TE [4] (day/ft²)*	*S/T from Time Lag [5] (day/ft²)*	*Average S/T (day/ft²)*	*Ratio of S/T from TE to S/T from Time Lag*	*Recovery (psi)*	*Recovery (ft)*	*Comments on Estimated Recovery*
40-50	Standard Well	396	0.1358	175	1.4E-06	2.3E-06	1.8E-06	6.2E-01	0.50	1.15	
40-75	Standard Well	396	0.1505	125	1.2E-06	1.2E-06	1.2E-06	1.0E+00	0.51	1.18	
40-100R	Standard Well	396	0.1703	90	9.2E-07	6.1E-07	7.4E-07	1.5E+00	0.45	1.04	
41C-75	Geokon	85	0.2609	55	6.4E-06	4.9E-06	5.6E-06	1.3E+00	0.14	0.32	
41C-100	Geokon	85	0.2371	50	8.9E-06	4.1E-06	6.0E-06	2.2E+00	0.18	0.42	
41C-130	Geokon	85	- -	- -	- -	- -	- -	- -	- -	- -	No clear recovery
42-25	Standard Well	400	0.0239	270	8.6E-06	5.3E-06	6.8E-06	1.6E+00	0.10	0.23	
42-50	Standard Well	396	0.0668	210	3.7E-06	3.3E-06	3.5E-06	1.1E+00	0.28	0.65	
43-50	Standard Well	564	0.0721	320	1.7E-06	3.8E-06	2.5E-06	4.4E-01	0.35	0.81	
44-25	Standard Well	288	0.0290	225	1.5E-05	7.1E-06	1.0E-05	2.0E+00	0.08	0.18	
44-50	Standard Well	288	0.1455	75	2.4E-06	7.9E-07	1.4E-06	3.0E+00	0.16	0.37	
45-50	Standard Well	696	0.1264	100	5.2E-07	2.4E-07	3.5E-07	2.1E+00	0.13	0.30	
45-100	Standard Well	696	0.1220	110	5.5E-07	2.9E-07	4.0E-07	1.9E+00	0.12	0.28	
46C-25	Geokon	730	0.0451	260	1.6E-06	1.5E-06	1.5E-06	1.1E+00	0.09	0.21	
46C-50	Geokon	730	0.1031	95	6.6E-07	2.0E-07	3.6E-07	3.3E+00	0.15	0.35	
46C-75	Geokon	730	0.1030	95	6.6E-07	2.0E-07	3.6E-07	3.3E+00	0.13	0.30	
46C-100	Geokon	730	0.0992	100	6.9E-07	2.2E-07	3.9E-07	3.2E+00	0.13	0.30	
46C-130	Geokon	730	0.0702	135	1.0E-06	4.0E-07	6.5E-07	2.6E+00	0.10	0.23	
46C-160	Geokon	730	0.0527	170	1.4E-06	6.4E-07	9.4E-07	2.2E+00	0.07	0.16	
53C-25	Geokon	490	0.0229	140	6.0E-06	9.6E-07	2.4E-06	6.3E+00	0.07	0.16	
53C-50	Geokon	490	0.1310	140	1.0E-06	9.6E-07	9.9E-07	1.1E+00	0.38	0.88	
53C-75	Geokon	490	0.1173	155	1.2E-06	1.2E-06	1.2E-06	1.0E+00	0.38	0.88	
53C-100	Geokon	490	0.0973	195	1.6E-06	1.9E-06	1.7E-06	8.5E-01	0.26	0.60	
53C-130	Geokon	490	0.0974	155	1.6E-06	1.2E-06	1.4E-06	1.3E+00	0.13	0.30	
55-25	Standard Well	720	0.0491	260	1.5E-06	1.5E-06	1.5E-06	9.9E-01	0.10	0.23	
55-50	Standard Well	720	0.1141	125	5.7E-07	3.5E-07	4.5E-07	1.6E+00	0.17	0.39	
61C-25	Geokon	630	0.0079	135	6.7E-06	5.4E-07	1.9E-06	1.3E+01	- -	- -	No clear recovery
61C-50	Geokon	630	0.0646	145	1.5E-06	6.2E-07	9.8E-07	2.5E+00	0.14	0.32	
61C-75	Geokon	630	0.0764	250	1.3E-06	1.8E-06	1.5E-06	7.0E-01	0.31	0.72	
61C-100	Geokon	630	0.1237	145	6.8E-07	6.2E-07	6.5E-07	1.1E+00	0.47	1.08	
61C-130	Geokon	630	0.1187	130	7.2E-07	5.0E-07	6.0E-07	1.4E+00	0.40	0.92	
61C-160	Geokon	630	0.1249	80	6.7E-07	1.9E-07	3.5E-07	3.5E+00	- -	- -	No clear recovery
64-100	Standard Well	144	0.2456	45	2.6E-06	1.1E-06	1.7E-06	2.2E+00	0.22	0.51	
69-25	Standard Well	60	0.1552	55	4.8E-05	9.8E-06	2.2E-05	4.9E+00	0.05	0.12	
70-25	Standard Well	40	0.3392	35	6.2E-06	9.0E-06	7.4E-06	6.9E-01	0.11	0.25	
71-25	Standard Well	84	0.1097	40	4.4E-05	2.7E-06	1.1E-05	1.7E+01	0.03	0.07	
71-50	Standard Well	84	0.2382	45	8.4E-06	3.4E-06	5.3E-06	2.5E+00	0.25	0.58	
74-50	Standard Well	300	0.1766	95	1.5E-06	1.2E-06	1.3E-06	1.3E+00	0.45	1.04	
74-75	Standard Well	300	0.1872	85	1.3E-06	9.4E-07	1.1E-06	1.4E+00	0.36	0.83	
74-100	Standard Well	300	0.2256	75	7.8E-07	7.3E-07	7.6E-07	1.1E+00	0.26	0.60	
75-130	Standard Well	264	0.0660	200	8.4E-06	6.7E-06	7.5E-06	1.2E+00	0.08	0.18	
77C-25	Geokon	320	0.0167	95	1.7E-05	1.0E-06	4.2E-06	1.7E+01	- -	- -	No clear recovery
77C-50	Geokon	320	0.0475	145	8.0E-06	2.4E-06	4.4E-06	3.3E+00	0.12	0.28	
77C-75	Geokon	320	0.0502	115	7.6E-06	1.5E-06	3.4E-06	5.0E+00	0.14	0.32	
77C-100	Geokon	320	0.0549	180	7.0E-06	3.7E-06	5.1E-06	1.9E+00	0.21	0.48	

TABLE 13

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 3A TO EVENT 3B
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

			Calculated Parameters Using Using Second Shut-Down Pressure Response Data [(6)]						*Estimated Recovery*		
Location	*Transduer Type*	*Approximate Distance from Waterway [(1)] (ft)*	*Tidal Efficiency, TE [(2)] (psi/ft)*	*Time Lag [(3)] (min)*	*S/T from TE [(4)] (day/ft ^{2})*	*S/T from Time Lag [(5)] (day/ft ^{2})*	*Average S/T (day/ft ^{2})*	*Ratio of S/T from TE to S/T from Time Lag*	*Recovery (psi)*	*Recovery (ft)*	*Comments on Estimated Recovery*
77C-130	Geokon	320	0.1157	125	2.9E-06	1.8E-06	2.3E-06	1.6E+00	0.29	0.67	
77C-160	Geokon	320	0.0864	125	4.3E-06	1.8E-06	2.8E-06	2.4E+00	0.30	0.69	
78C-25	Geokon	710	0.0635	180	1.2E-06	7.5E-07	9.6E-07	1.6E+00	0.22	0.51	
78C-50	Geokon	710	0.1086	180	6.5E-07	7.5E-07	7.0E-07	8.6E-01	0.46	1.06	
78C-75	Geokon	710	0.1103	180	6.3E-07	7.5E-07	6.9E-07	8.4E-01	0.44	1.02	
78C-100	Geokon	710	0.1120	170	6.2E-07	6.7E-07	6.4E-07	9.2E-01	0.42	0.97	
81-50	Standard Well	240	0.1094	95	5.4E-06	1.8E-06	3.2E-06	3.0E+00	0.06	0.14	
83C-50	Geokon	60	0.3043	35	6.5E-06	4.0E-06	5.1E-06	1.6E+00	0.10	0.23	
83C-100	Geokon	60	0.3201	30	4.9E-06	2.9E-06	3.8E-06	1.7E+00	- -	- -	No clear recovery
84C-25	Geokon	250	0.1291	75	4.0E-06	1.1E-06	2.1E-06	3.8E+00	- -	- -	No clear recovery
84C-50	Geokon	250	0.0703	95	8.9E-06	1.7E-06	3.9E-06	5.3E+00	- -	- -	No clear recovery
84C-75	Geokon	250	0.0624	45	1.0E-05	3.8E-07	2.0E-06	2.7E+01	- -	- -	No clear recovery
84C-100	Geokon	250	0.0644	40	9.8E-06	3.0E-07	1.7E-06	3.3E+01	- -	- -	No clear recovery
84C-130	Geokon	250	0.0635	35	9.9E-06	2.3E-07	1.5E-06	4.3E+01	- -	- -	No clear recovery
84C-160	Geokon	250	0.1918	10	1.9E-06	1.9E-08	1.9E-07	9.9E+01	- -	- -	No clear recovery
85C-50	Geokon	310	0.0671	180	6.1E-06	3.9E-06	4.9E-06	1.5E+00	0.22	0.51	
85C-75	Geokon	310	0.1838	45	1.3E-06	2.5E-07	5.7E-07	5.4E+00	0.12	0.28	
85C-100	Geokon	310	0.1770	50	1.4E-06	3.0E-07	6.6E-07	4.7E+00	0.15	0.35	
85C-130	Geokon	310	0.1631	55	1.7E-06	3.7E-07	8.0E-07	4.6E+00	0.14	0.32	
85C-160	Geokon	310	0.1597	55	1.8E-06	3.7E-07	8.1E-07	4.8E+00	0.10	0.23	
86C-25	Geokon	370	0.0719	155	4.0E-06	2.1E-06	2.9E-06	1.9E+00	0.05	0.12	
86C-50	Geokon	370	0.1658	65	1.2E-06	3.6E-07	6.5E-07	3.2E+00	0.12	0.28	
86C-75	Geokon	370	0.1625	65	1.2E-06	3.6E-07	6.6E-07	3.4E+00	0.11	0.25	
86C-100	Geokon	370	0.1806	65	9.7E-07	3.6E-07	5.9E-07	2.7E+00	- -	- -	No clear recovery
86C-130	Geokon	370	0.1435	75	1.5E-06	4.8E-07	8.6E-07	3.2E+00	0.11	0.25	
86C-160	Geokon	775	0.0982	100	6.2E-07	2.0E-07	3.5E-07	3.2E+00	0.10	0.23	
87C-25	Geokon	510	0.0501	180	3.0E-06	1.5E-06	2.1E-06	2.1E+00	0.05	0.12	
87C-50	Geokon	510	0.1449	80	7.9E-07	2.9E-07	4.8E-07	2.7E+00	0.13	0.30	
87C-75	Geokon	510	0.1680	85	6.0E-07	3.3E-07	4.4E-07	1.8E+00	- -	- -	No clear recovery
87C-100	Geokon	510	0.1528	95	7.2E-07	4.1E-07	5.4E-07	1.8E+00	- -	- -	No clear recovery
87C-130	Geokon	510	0.1240	105	1.0E-06	5.0E-07	7.1E-07	2.1E+00	0.13	0.30	
87C-160	Geokon	510	0.0835	130	1.8E-06	7.6E-07	1.2E-06	2.3E+00	0.10	0.23	
88C-50	Geokon	420	0.1640	75	9.2E-07	3.7E-07	5.9E-07	2.5E+00	0.08	0.18	
88C-75	Geokon	420	0.1451	75	1.2E-06	3.7E-07	6.6E-07	3.1E+00	0.08	0.18	
88C-100	Geokon	420	0.1286	85	1.4E-06	4.8E-07	8.3E-07	3.0E+00	0.08	0.18	
88C-130	Geokon	420	0.1044	115	2.0E-06	8.8E-07	1.3E-06	2.2E+00	0.05	0.12	
88C-160	Geokon	420	0.0687	135	3.2E-06	1.2E-06	2.0E-06	2.7E+00	0.05	0.12	
89C-25	Geokon	775	- -	- -	- -	- -	- -	- -	- -	- -	No clear recovery
89C-50	Geokon	775	0.1190	135	4.7E-07	3.6E-07	4.1E-07	1.3E+00	- -	- -	No clear recovery
89C-75	Geokon	775	0.1040	150	5.8E-07	4.4E-07	5.0E-07	1.3E+00	- -	- -	No clear recovery
89C-100	Geokon	775	0.1190	135	4.7E-07	3.6E-07	4.1E-07	1.3E+00	0.26	0.60	
89C-130	Geokon	775	0.1040	- -	5.8E-07	- -	- -	- -	0.18	0.42	
90C-25	Geokon	190	0.1208	60	7.7E-06	1.2E-06	3.0E-06	6.6E+00	0.08	0.18	
90C-50	Geokon	190	0.2431	70	1.6E-06	1.6E-06	1.6E-06	1.0E+00	- -	- -	No clear recovery
90C-75	Geokon	190	0.2643	70	1.2E-06	1.6E-06	1.4E-06	7.7E-01	- -	- -	No clear recovery

TABLE 13

SUMMARY OF S/T CALCULATIONS AND ESTIMATED RECOVERY - EVENT 3A TO EVENT 3B
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

			Calculated Parameters Using Using Second Shut-Down Pressure Response Data [(6)]						*Estimated Recovery*		
Location	***Transduer Type***	***Approximate Distance from Waterway [(1)] (ft)***	***Tidal Efficiency, TE [(2)] (psi/ft)***	***Time Lag [(3)] (min)***	***S/T from TE [(4)] (day/ft^2)***	***S/T from Time Lag [(5)] (day/ft^2)***	***Average S/T (day/ft^2)***	***Ratio of S/T from TE to S/T from Time Lag***	***Recovery (psi)***	***Recovery (ft)***	***Comments on Estimated Recovery***
90C-100	Geokon	190	0.2303	65	2.0E-06	1.4E-06	1.6E-06	1.4E+00	0.04	0.09	
91C-25	Geokon	520	0.0292	200	4.5E-06	1.7E-06	2.8E-06	2.6E+00	0.09	0.21	
91C-50	Geokon	520	0.0539	180	2.7E-06	1.4E-06	1.9E-06	1.9E+00	0.15	0.35	
91C-75	Geokon	520	0.0534	165	2.7E-06	1.2E-06	1.8E-06	2.3E+00	0.17	0.39	
91C-100	Geokon	520	0.0592	215	2.5E-06	2.0E-06	2.2E-06	1.2E+00	0.25	0.58	
91C-130	Geokon	520	0.1367	85	8.4E-07	3.1E-07	5.1E-07	2.7E+00	0.15	0.35	
92C-75	Geokon	275	0.1905	55	1.6E-06	4.7E-07	8.5E-07	3.3E+00	0.08	0.18	
92C-100	Geokon	275	0.1605	65	2.2E-06	6.5E-07	1.2E-06	3.4E+00	0.06	0.14	
92C-130	Geokon	275	0.1448	70	2.7E-06	7.6E-07	1.4E-06	3.6E+00	0.06	0.14	
92C-160	Geokon	275	0.0756	105	6.8E-06	1.7E-06	3.4E-06	4.0E+00	0.06	0.14	
94C-25	Geokon	95	0.1253	30	2.9E-05	1.2E-06	5.8E-06	2.5E+01	0.08	0.18	
94C-50	Geokon	95	0.2448	45	6.4E-06	2.6E-06	4.1E-06	2.4E+00	0.23	0.53	
94C-75	Geokon	95	0.2679	40	4.6E-06	2.1E-06	3.1E-06	2.2E+00	- -	- -	No clear recovery
94C-100	Geokon	95	0.2865	40	3.5E-06	2.1E-06	2.7E-06	1.7E+00	0.16	0.37	
94C-130	Geokon	95	0.2814	50	3.8E-06	3.2E-06	3.5E-06	1.2E+00	0.07	0.16	
T3-50	Standard Well	155	0.2320	60	2.7E-06	1.8E-06	2.2E-06	1.5E+00	0.18	0.42	

Minimum Average S/T =	**1.9E-07**
Maximum Average S/T =	**5.2E-04**
Geometic Mean Average S/T =	**1.6E-06**
Median Average S/T =	**1.5E-06**

Notes:

(1) Taken as the distance to the surface water body closet to the well location.

(2) Tidal efficiency is calculated using Equation 4.3.

(3) Time lag corresponds to the maximum correlation between the observed well pressure and the tide elevation over second shut-down.

(4) S/T calculated using tidal efficiency using Equation 4.4.

(5) S/T calculated using time lag using Equation 4.5.

(6) Parameters calculations make use of the following constants:

Tidal Period (day):	0.517
psi to ft correction (ft/psi):	2.3077
ϖ (1/day):	12.145

TABLE 14

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - EVENT 1
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Transducer Configuration	*Specific Conductance (at 77°F or 25°C)*[1]	*Specific Gravity (at 60°F or 15.6°C)*[2]	*Specific Gravity (at 77°F or 25°C)*[3]	*Density (at 77°F or 25°C)*		*Initially Considered Outlier?*	*Considered Outlier for Second Trial?*
Monitoring Well	***Type***	***(mS/cm)***	***(-)***	***(-)***	***(lbs/ft^3)***[4]	***(kg/m^3)***[5]		
1-100R	2	85.00	1.0840	1.0806	67.26	1077.41	YES	YES
11-100	1	>99.9	1.0020	0.9986	62.16	995.65	NOT USED[6]	NOT USED[6]
11-183	1	14.20	1.0060	1.0026	62.41	999.64	NO	NO
11-25	2	6.61	1.0010	0.9976	62.09	994.65	NO	NO
11-45	2	29.80	1.0100	1.0066	62.65	1003.63	NO	NO
12-100	1	25.60	1.0140	1.0106	62.90	1007.61	NO	NO
12-160	1	5.86	1.0015	0.9981	62.03	993.65	NO	NO
12-25	2	0.25	1.0020	0.9986	62.16	995.65	NO	NO
12-45	2	1.40	1.0020	0.9986	62.16	995.65	NO	NO
14-25R	2	9.10	1.0010	0.9976	62.09	994.65	NO	NO
14-50R	1	24.90	1.0260	1.0226	63.65	1019.58	NO	YES
15-120	2	93.00	1.1640	1.1606	72.24	1157.17	YES	YES
15-25R	2	35.30	1.0140	1.0106	62.90	1007.61	NO	NO
15-50R	1	50.90	1.0270	1.0236	63.71	1020.58	NO	NO
19-25	2	0.31	1.0020	0.9986	62.16	995.65	NO	NO
19-50R	2	38.20	1.0240	1.0206	63.53	1017.58	NO	NO
2-100	1	7.38	1.0030	0.9996	62.22	996.65	NOT USED[7]	NOT USED[7]
21-25R	2	2.01	1.0030	0.9996	62.22	996.65	NO	NO
21-48	1	41.10	1.0160	1.0126	63.03	1009.61	NO	NO
25-25	2	1.46	1.0010	0.9976	62.09	994.65	NO	NO
25-50	1	2.95	1.0010	0.9976	62.09	994.65	NO	NO
25A-25	2	0.56	1.0000	0.9966	62.03	993.65	NO	NO
25A-50	1	21.80	1.0120	1.0086	62.78	1005.62	NOT USED[7]	NOT USED[7]
3-100	1	23.90	1.0180	1.0146	63.15	1011.60	NO	NO
3-175	1	0.90	0.9975	0.9941	61.88	991.16	NO	NO
32-100	1	45.90	1.0200	1.0166	63.28	1013.60	NO	NO
32-50R	1	1.33	1.0020	0.9986	62.16	995.65	NO	NO
34-100	1	33.00	1.0060	1.0026	62.41	999.64	NO	NO
34-25	2	0.34	1.0020	0.9986	62.16	995.65	NO	NO
34-50	1	0.54	1.0020	0.9986	62.16	995.65	NO	NO
3-50	1	36.20	1.0140	1.0106	62.90	1007.61	NO	NO
35-100	2	58.20	1.0200	1.0166	63.28	1013.60	NO	NO
35-25	2	0.41	1.0020	0.9986	62.16	995.65	NO	NO
35-50	1	5.91	1.0030	0.9996	62.22	996.65	NO	NO
36-100R	1	33.40	1.0240	1.0206	63.53	1017.58	NO	NO
36-25	2	1.28	1.0020	0.9986	62.16	995.65	NO	NO
36-50	1	7.94	1.0270	1.0236	63.71	1020.58	YES	YES
40A-100	2	62.00	1.0250	1.0216	63.59	1018.58	NO	NO
40A-25	2	3.63	1.0010	0.9976	62.09	994.65	NO	NO
40A-50	1	15.00	1.0050	1.0016	62.34	998.64	NO	NO
41-100	1	0.34	0.9992	0.9958	61.98	992.86	NO	NO
41-138	1	32.40	1.0140	1.0106	62.90	1007.61	NO	NO
4-115R	1	85.10	1.1160	1.1126	69.25	1109.31	YES	YES
41-50	1	16.30	1.0810	1.0776	67.07	1074.42	YES	YES
4-175R	1	13.90	1.0070	1.0036	62.47	1000.63	NO	NO
4-25R	2	69.80	1.0320	1.0286	64.02	1025.56	NO	NO
43-50	1	17.30	1.0060	1.0026	62.41	999.64	NO	NO
44-25	2	0.17	1.0020	0.9986	62.16	995.65	NO	NO
44-50	1	0.19	1.0010	0.9976	62.09	994.65	NO	NO
4-45R	1	>99.9	1.0610	1.0576	65.83	1054.47	NOT USED[6]	NOT USED[6]
45-100	1	46.60	1.0210	1.0176	63.34	1014.59	NO	NO
45-50	1	5.48	1.0010	0.9976	62.09	994.65	NO	NO
4-83R	1	>99.9	1.0680	1.0646	66.26	1061.45	NOT USED[6]	NOT USED[6]
5-100	1	36.00	1.1620	1.1586	72.12	1155.18	YES	YES
5-25	2	13.60	1.0100	1.0066	62.65	1003.63	NO	NO
53-100	1	17.10	1.0060	1.0026	62.41	999.64	NO	NO
53-25	2	35.80	1.0130	1.0096	62.84	1006.62	NO	NO
53-50	1	28.70	1.0040	1.0006	62.28	997.64	NO	NO
5-50	1	53.10	1.0040	1.0006	62.28	997.64	YES	YES
55-25	2	3.34	1.0010	0.9976	62.09	994.65	NO	NO
64-100	1	59.90	1.0030	0.9996	62.22	996.65	YES	YES
64-170	2	24.30	1.0080	1.0046	62.53	1001.63	NO	NO
64-25	2	5.13	1.0010	0.9976	62.09	994.65	NO	NO
65-100	1	>99.9	1.0590	1.0556	65.70	1052.48	NOT USED[6]	NOT USED[6]
65-130	1	5.36	1.0150	1.0116	62.97	1008.61	NO	YES
65-25	2	3.98	1.0040	1.0006	62.28	997.64	NO	NO
65-50	1	44.60	1.0250	1.0216	63.59	1018.58	NO	NO
69-25	1	36.20	1.0160	1.0126	63.03	1009.61	NO	NO
69-50	1	48.80	1.0290	1.0256	63.84	1022.57	NO	NO
6A-100	1	33.30	1.0160	1.0126	63.03	1009.61	NO	NO
6A-24.5	2	14.30	1.0060	1.0026	62.41	999.64	NO	NO
6A-50	1	14.40	1.0060	1.0026	62.41	999.64	NO	NO
709-MW20-25	2	5.27	NS	-	-	-	NOT USED	NOT USED
709-MW20-50	1	4.83	NS	-	-	-	NOT USED	NOT USED

TABLE 14

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - EVENT 1
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Transducer Configuration Type*	*Specific Conductance (at 77°F or 25°C) (1) (mS/cm)*	*Specific Gravity (at 60°F or 15.6°C) (2) (-)*	*Specific Gravity (at 77°F or 25°C) (3) (-)*	*Density (at 77°F or 25°C) (lbs/ft³) (4)*	*Density (at 77°F or 25°C) (kg/m³) (5)*	*Initially Considered Outlier?*	*Considered Outlier for Second Trial?*
71-25	2	30.40	1.0140	1.0106	62.90	1007.61	NO	NO
71-50	1	38.50	1.0140	1.0106	62.90	1007.61	NO	NO
7-181	1	13.00	1.0050	1.0016	62.34	998.64	NO	NO
721-MW10-25	2	2.48	1.0180	1.0146	63.15	1011.60	NO	YES
721-MW10-50	1	24.30	1.0090	1.0056	62.59	1002.63	NO	NO
721-MW5-25	1	5.57	1.0040	1.0006	62.28	997.64	NO	NO
721-MW5-50	1	11.40	1.0060	1.0026	62.41	999.64	NO	NO
721-MW6-25	2	1.12	1.0640	1.0606	66.02	1057.47	YES	YES
721-MW6-50	1	9.20	1.0030	0.9996	62.22	996.65	NO	NO
721-MW9-25	2	8.79	1.0060	1.0026	62.41	999.64	NO	NO
721-MW9-50	1	22.70	1.0020	0.9986	62.16	995.65	NO	NO
74-100	1	58.70	1.0270	1.0236	63.71	1020.58	NO	NO
74-130	2	>99.9	1.0870	1.0836	67.45	1080.40	NOT USED(6)	NOT USED(6)
74-50	1	24.80	1.0070	1.0036	62.47	1000.63	NO	NO
74-75	1	42.90	1.0210	1.0176	63.34	1014.59	NO	NO
75-100	1	14.40	1.0000	0.9966	62.03	993.65	NO	NO
75-130	1	1.50	1.0010	0.9976	62.09	994.65	NO	NO
75-50	1	61.10	1.0250	1.0216	63.59	1018.58	NO	NO
75-75	1	>99.9	1.0890	1.0856	67.57	1082.39	NOT USED(6)	NOT USED(6)
76-100	1	15.30	1.0040	1.0006	62.28	997.64	NO	NO
77-100	1	58.50	1.0230	1.0196	63.46	1016.59	NO	NO
77-140	2	>99.9	1.0630	1.0596	65.95	1056.47	NOT USED(6)	NOT USED(6)
78-25	2	0.95	1.0140	1.0106	62.90	1007.61	NO	YES
78-50	1	1.59	1.0030	0.9996	62.22	996.65	NO	NO
8-23	2	0.37	1.0020	0.9986	62.16	995.65	NO	NO
8-54	1	12.90	1.0050	1.0016	62.34	998.64	NO	NO
8-99R	1	62.80	1.0260	1.0226	63.65	1019.58	NO	NO
9-100	1	43.40	1.0170	1.0136	63.09	1010.60	NO	NO
9-25	1	2.22	0.9992	0.9958	61.98	992.86	NO	NO
9-50	2	5.92	1.0010	0.9976	62.09	994.65	NO	NO
PZ-SHI-1-33	2	43.80	1.0200	1.0166	63.28	1013.60	NO	NO
PZ-SHI-1-75	1	46.00	1.0250	1.0216	63.59	1018.58	NO	NO
PZ-SHI-1-100	1	64.90	1.0310	1.0276	63.96	1024.56	NO	NO
PZ-SHI-1-126	1	>99.9	1.0710	1.0676	66.45	1064.45	NOT USED(6)	NOT USED(6)
PZ-SHI-2-75	1	75.80	1.0420	1.0386	64.65	1035.53	NO	NO
PZ-SHI-3-42	2	43.40	1.0220	1.0186	63.40	1015.59	NO	NO
PZ-SHI-3-75	2	75.90	1.0340	1.0306	64.15	1027.55	NO	NO
PZ-SHI-3-100	2	80.10	1.0380	1.0346	64.40	1031.54	NO	NO
T1-100	2	>99.9	1.0750	1.0716	66.70	1068.43	NOT USED(6)	NOT USED(6)
T1-25	2	30.60	1.0110	1.0076	62.72	1004.62	NO	NO
T1-50	1	92.30	1.0430	1.0396	64.71	1036.53	NO	NO
T5-120	2	95.10	1.0020	0.9986	62.16	995.65	YES	YES
T6-120	1	0.56	1.0020	0.9986	62.16	995.65	NO	NO

Total Number of Data Points	*Total Number of Outliers*	*Total Number of Not Used*	*Total Points Used*	*Percentages: Points Used*	*Percentages: Outliers*	*Percentages: Not Used*
117	14	13	90	76.9%	12.0%	11.1%

Notes:
(1) Field measured specific conductance reported by meter relative to a reference temperature of 25°C
(2) Laboratory reported specific gravity at 60°F consistent with ASTM Standard D1429-86
(3) Specific gravity corrected to 25°C using the method described in Section 23 of ASTM Standard D1429-86
(4) Density was calculated using a density of 62.24 lbs/ft³ fresh water at 25°C.
(5) Density was calculated using a density of 997.044 kg/m³ fresh water at 25°C.
(6) Specific conductance was beyond the upper limit for the Horiba meter of 99.9 mS/cm
(7) Specific gravity was not representative of the well's historic data.
YES Additional outlier identified following initial trial
NS Not sampled.

TABLE 15

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - EVENT 2
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Transducer Configuration Type*	*Specific Conductance (at 77°F or 25°C)[(1)] (mS/cm)*	*Specific Gravity (at 60°F or 15.6°C)[(2)] (-)*	*Specific Gravity (at 77°F or 25°C)[(3)] (-)*	*Density (at 77°F or 25°C) (lbs/ft³)[(4)]*	*Density (at 77°F or 25°C) (kg/m³)[(5)]*	*Initially Considered Outlier?*
35-50	1	0.09	0.9984	0.9950	61.93	992.06	NO
44-50	1	0.12	1.0050	1.0016	62.34	998.64	NO
36-25	2	0.23	0.9985	0.9951	61.94	992.16	NO
12-25	2	0.23	0.9994	0.9960	61.99	993.06	NO
44-25	2	0.26	0.9994	0.9960	61.99	993.06	NO
25A-25	2	0.42	0.9994	0.9960	61.99	993.06	NO
35-25	2	0.42	1.0010	0.9976	62.09	994.65	NO
78-25	2	0.48	1.0020	0.9986	62.16	995.65	NO
40A-25	2	0.77	1.0040	1.0006	62.28	997.64	NO
3-175	1	1.08	0.9994	0.9960	61.99	993.06	NO
721-MW6-25	2	1.17	1.0020	0.9986	62.16	995.65	NO
78-50	1	1.57	1.0060	1.0026	62.41	999.64	NO
25-25	2	1.67	1.0020	0.9986	62.16	995.65	NO
43-50	1	1.68	1.0000	0.9966	62.03	993.65	NO
32-50R	1	1.70	1.0020	0.9986	62.16	995.65	NO
12-45	2	1.84	1.0010	0.9976	62.09	994.65	NO
75-130	1	1.84	0.9995	0.9961	62.00	993.16	NO
25-50	1	3.10	1.0040	1.0006	62.28	997.64	NO
21-25R	2	3.22	1.0090	1.0056	62.59	1002.63	NO
36-50	1	4.08	1.0000	0.9966	62.03	993.65	NO
709-MW20-50	1	4.23	1.0000	0.9966	62.03	993.65	NO
64-25	2	4.27	1.0050	1.0016	62.34	998.64	NO
721-MW5-25	1	4.59	1.0030	0.9996	62.22	996.65	NO
9-25	1	4.69	1.0000	0.9966	62.03	993.65	NO
721-MW10-25	2	5.37	1.0020	0.9986	62.16	995.65	NO
11-25	2	5.52	1.0040	1.0006	62.28	997.64	NO
45-50	1	5.55	1.0030	0.9996	62.22	996.65	NO
8-23	2	5.69	0.9994	0.9960	61.99	993.06	NO
65-130	1	6.28	1.0060	1.0026	62.41	999.64	NO
40A-50	1	6.46	1.0080	1.0046	62.53	1001.63	NO
55-25	2	6.82	1.0010	0.9976	62.09	994.65	NO
721-MW9-25	2	7.88	1.0060	1.0026	62.41	999.64	NO
2-100	1	8.01	1.0090	1.0056	62.59	1002.63	NO
12-160	1	8.16	1.0030	0.9996	62.22	996.65	NO
41-100	1	8.50	1.0030	0.9996	62.22	996.65	NO
53-100	1	8.85	1.0040	1.0006	62.28	997.64	NO
7-181	1	9.30	1.0100	1.0066	62.65	1003.63	NO
14-25R	2	10.80	1.0060	1.0026	62.41	999.64	NO
76-100	1	12.70	1.0060	1.0026	62.41	999.64	NO
5-25	2	13.80	1.0080	1.0046	62.53	1001.63	NO
T1-25	2	14.40	1.0060	1.0026	62.41	999.64	NO
9-50	2	14.80	1.0090	1.0056	62.59	1002.63	NO
709-MW20-25	2	16.30	1.0020	0.9986	62.16	995.65	NO
75-100	1	16.80	1.0060	1.0026	62.41	999.64	NO
53-50	1	17.00	1.0060	1.0026	62.41	999.64	NO
721-MW5-50	1	17.30	1.0060	1.0026	62.41	999.64	NO
721-MW6-50	1	17.30	1.0040	1.0006	62.28	997.64	NO
11-183	1	18.00	1.0080	1.0046	62.53	1001.63	NO
4-175R	1	18.60	1.0060	1.0026	62.41	999.64	NO
65-25	2	18.90	1.0080	1.0046	62.53	1001.63	NO
25A-50	1	20.90	1.0030	0.9996	62.22	996.65	NO
721-MW9-50	1	23.70	1.0070	1.0036	62.47	1000.63	NO
34-100	1	28.30	1.0130	1.0096	62.84	1006.62	NO
69-25	1	28.30	1.0140	1.0106	62.90	1007.61	NO
64-170	2	28.60	1.0010	0.9976[(3)]	62.09	994.65	NO
15-25R	2	29.00	1.0130	1.0096	62.84	1006.62	NO
21-48	1	29.70	1.0030	0.9996	62.22	996.65	NO
11-45	2	30.00	1.0050	1.0016	62.34	998.64	NO
5-100	1	32.60	1.0120	1.0086	62.78	1005.62	NO
6A-24.5	2	33.70	1.0010	0.9976	62.09	994.65	NO
721-MW10-50	1	33.80	1.0100	1.0066	62.65	1003.63	NO
19-50R	2	34.60	1.0100	1.0066	62.65	1003.63	NOT USED[(7)]
32-100	1	35.90	1.0220	1.0186	63.40	1015.59	NO
8-54	1	36.90	1.0070	1.0036	62.47	1000.63	NO
74-50	1	37.00	1.0200	1.0166	63.28	1013.60	NO
PZ-SHI-3-42	2	38.10	1.0220	1.0186	63.40	1015.59	NO
41-138	1	38.30	1.0130	1.0096	62.84	1006.62	NO

TABLE 15

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - EVENT 2
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	Transducer Configuration Type	Specific Conductance (at 77°F or 25°C)[(1)] (mS/cm)	Specific Gravity (at 60°F or 15.6°C)[(2)] (-)	Specific Gravity (at 77°F or 25°C)[(3)] (-)	Density (at 77°F or 25°C) (lbs/ft^3)[(4)]	Density (at 77°F or 25°C) (kg/m^3)[(5)]	Initially Considered Outlier?
5-50	1	39.30	1.0220	1.0186	63.40	1015.58	NO
45-100	1	41.00	1.0190	1.0156	63.21	1012.60	NO
69-50	1	41.50	1.0240	1.0206	63.53	1017.58	NO
12-100	1	41.70	1.0110	1.0076	62.72	1004.62	NO
71-25	2	42.60	1.0050	1.0016	62.34	998.64	NO
77-100	1	44.40	1.0120	1.0086	62.78	1005.62	NO
3-100	1	44.60	1.0170	1.0136	63.09	1010.60	NO
53-25	2	47.50	1.0160	1.0126	63.03	1009.61	NO
15-50R	1	49.00	1.0280	1.0246	63.77	1021.57	NO
PZ-SHI-1-33	2	50.10	NS	NS	NS	NS	NOT USED
71-50	1	50.70	1.0130	1.0096	62.84	1006.62	NO
41-50	1	51.00	1.0190	1.0156	63.21	1012.60	NO
14-50R	1	52.30	1.0280	1.0246	63.77	1021.57	NO
40A-100	2	52.30	1.0240	1.0206	63.53	1017.58	NO
8-99R	1	53.80	1.0220	1.0186	63.40	1015.59	NO
35-100	2	55.10	1.0340	1.0306	64.15	1027.55	NO
65-50	1	56.90	1.0270	1.0236	63.71	1020.58	NO
36-100R	1	58.00	1.0210	1.0176	63.34	1014.59	NO
3-50	1	60.80	1.0130	1.0096	62.84	1006.62	NO
74-75	1	64.10	1.0040	1.0006	62.28	997.64	YES
PZ-SHI-1-75	1	64.10	1.0120	1.0086	62.78	1005.62	NO
PZ-SHI-3-75	2	64.50	1.0360	1.0326	64.27	1029.55	NO
64-100	1	64.70	1.0210	1.0176	63.34	1014.59	NO
75-50	1	68.90	1.0280	1.0246	63.77	1021.57	NO
PZ-SHI-3-100	2	68.90	1.0380	1.0346	64.40	1031.54	NO
74-100	1	82.70	1.0300	1.0266	63.90	1023.57	NO
4-25R	2	90.30	1.0340	1.0306	64.15	1027.55	NO
PZ-SHI-1-100	1	93.30	1.0260	1.0226	63.65	1019.58	NO
PZ-SHI-2-75	1	99.00	1.0310	1.0276	63.96	1024.56	NO
11-100	1	131.10	1.0660	1.0626	66.14	1059.46	NO
77-140	2	131.60	1.0670	1.0636	66.20	1060.46	NO
PZ-SHI-1-126	1	133.20	1.0740	1.0706	66.64	1067.44	YES
75-75	1	162.60	1.0900	1.0866	67.63	1083.39	YES
74-130	2	162.90	1.0900	1.0866	67.63	1083.39	YES
65-100	1	193.10	1.1170	1.1136	69.31	1110.31	YES
19-25	2	39.90	1.0010	0.9976	62.09	994.65	YES
34-25	2	41.30	1.0070	1.0036	62.47	1000.63	NO
34-50	1	58.90	1.0010	0.9976	62.09	994.65	YES
1-100R	2	89.00	1.0970	1.0936	68.07	1090.37	YES
15-120	2	85.30	1.1710	1.1676	72.68	1164.15	YES
4-115R	1	>99.9	1.1220	1.1186	69.63	1115.29	NOT USED[(6)]
4-45R	1	>99.9	1.0620	1.0586	65.89	1055.47	NOT USED[(6)]
4-83R	1	>99.9	1.0700	1.0666	66.39	1063.45	NOT USED[(6)]
6A-100	1	>99.9	1.0170	1.0136	63.09	1010.60	NOT USED[(6)]
6A-50	1	>99.9	1.0070	1.0036	62.47	1000.63	NOT USED[(6)]
9-100	1	>99.9	1.0310	1.0276	63.96	1024.56	NOT USED[(6)]
T1-100	2	>99.9	1.0630	1.0596	65.95	1056.47	NOT USED[(6)]
T1-50	1	>99.9	1.0400	1.0366	64.52	1033.54	NOT USED[(6)]
T5-120	2	94.10	1.1460	1.1426	71.12	1139.22	YES
T6-120	1	90.10	0.9944	0.9910	61.68	988.07	NOT USED[(8)]

	Total Number of Data Points	Total Number of Outliers	Total Number of Not Used	Total Points Used	Percentages: Points Used	Percentages: Outliers	Percentages: Not Used
	117	10	11	96	82.1%	8.5%	9.4%

Notes:
(1) Field measured specific conductance reported by meter relative to a reference temperature of 25°C
(2) Laboratory reported specific gravity at 60°F consistent with ASTM Standard D1429-86
(3) Specific gravity corrected to 25°C using the method described in Section 23 of ASTM Standard D1429-86
(4) Density was calculated using a density of 62.24 lbs/ft^3 fresh water at 25°C.
(5) Density was calculated using a density of 997.044 kg/m^3 fresh water at 25°C.
(6) Specific conductance was either beyond the upper limit of the meter used or was not collected at this depth.
(7) Specific gravity was not representative of the well's historic data.
(8) Specific gravity value is considerably less than that of fresh water and is anomalous.
NS Not Sampled.

TABLE 16

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - SUBTIDAL PIEZOMETERS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Transducer Configuration Type*	*Specific Conductance (at 77°F or 25°C)* (1) *(mS/cm)*	*Specific Gravity (at 60°F or 15.6°C)* (2) *(-)*	*Specific Gravity (at 77°F or 25°C)* (3) *(-)*	*Density (at 77°F or 25°C)* *(lbs/ft³)* (4)	*(kg/m³)* (5)	*Initially Considered Outlier?*
WW-A1-105.2	3	11.60	1.0070	1.0036	62.47	1000.63	NO
WW-A1-11	3	45.00	1.0670	1.0636	66.20	1060.46	YES
WW-A1-20.2	3	47.10	1.0270	1.0236	63.71	1020.58	NO
WW-A1-2	3	46.40	1.2030	1.1996	74.67	1196.06	YES
WW-A1-6	3	48.40	1.1870	1.1836	73.67	1180.10	YES
WW-A1-75.2	3	65.50	1.2100	1.2066	75.10	1203.03	YES
WW-A1-45.2	3	>99.9	1.4670	1.4636	91.10	1459.27	NOT USED(6)
WW-A1-45.2	3	>99.9	1.4670	1.4636	91.10	1459.27	NOT USED(6)
WW-A1-0	3	NM	1.0220	1.0186	63.40	1015.59	NOT USED(7)
WW-A2-74.4	3	4.30	1.0020	0.9986	62.16	995.65	NO
WW-A2-11	3	47.80	1.0210	1.0176	63.34	1014.59	NO
WW-A2-6	3	50.30	1.0250	1.0216	63.59	1018.58	NO
WW-A2-2	3	53.40	1.0240	1.0206	63.53	1017.58	NO
WW-A2-19.4	3	56.30	1.0250	1.0216	63.59	1018.58	NO
WW-A2-44.4	3	69.20	1.0280	1.0246	63.77	1021.57	NO
WW-A2-104.6	3	17.20	1.0370	1.0336	64.33	1030.55	YES
WW-A3-99	3	0.15	1.0030	0.9996	62.22	996.65	NO
WW-A3-24	3	0.23	1.0020	0.9986	62.16	995.65	NO
WW-A3-74	3	0.23	1.0230	1.0196	63.46	1016.59	YES
WW-A3-49	3	0.34	1.0010	0.9976	62.09	994.65	NO
WW-A3-127	3	0.89	1.0040	1.0006	62.28	997.64	NO
WW-A4-126	3	0.13	1.0000	0.9966	62.03	993.65	NO
WW-A4-156	3	0.15	1.0020	0.9986	62.16	995.65	NO
WW-A4-96	3	0.16	1.0000	0.9966	62.03	993.65	NO
WW-A4-46	3	0.23	1.0000	0.9966	62.03	993.65	NO
WW-A4-71	3	0.24	1.0030	0.9996	62.22	996.65	NO
WW-A4-23	3	38.80	1.0070	1.0036	62.47	1000.63	YES
WW-B1-68.5	3	43.20	1.0210	1.0176	63.34	1014.59	NO
WW-B1-98.5	3	45.10	1.0200	1.0166	63.28	1013.60	NO
WW-B1-6	3	72.30	1.0360	1.0326	64.27	1029.55	NO
WW-B1-11	3	86.10	1.0400	1.0366	64.52	1033.54	NO
WW-B1-38.5	3	87.60	1.0680	1.0646	66.26	1061.45	YES
WW-B1-13.5	3	88.00	1.0440	1.0406	64.77	1037.52	NO
WW-B1-2	3	63.20	1.2090	1.2056	75.04	1202.04	YES
WW-B2-76	3	1.36	1.0027	0.9993	62.20	996.35	NO
WW-B2-0	3	10.00	1.0019	0.9985	62.15	995.55	NO
WW-B2-46	3	33.80	1.0227	1.0193	63.44	1016.29	NO
WW-B2-12	3	38.70	1.0246	1.0212	63.56	1018.18	NO
WW-B2-7	3	39.50	1.0312	1.0278	63.97	1024.76	YES
WW-B2-2	3	42.20	1.0227	1.0193	63.44	1016.29	NO
WW-B2-20	3	50.40	1.0312	1.0278	63.97	1024.76	NO
WW-B3-113	3	0.37	1.0020	0.9986	62.16	995.65	NO
WW-B3-143	3	4.62	1.0020	0.9986	62.16	995.65	NO
WW-B3-143	3	4.62	1.0040	1.0006	62.28	997.64	NO
WW-B3-11	3	12.70	1.0020	0.9986	62.16	995.65	NO
WW-B3-6	3	14.80	1.0040	1.0006	62.28	997.64	NO
WW-B3-2	3	15.50	1.0060	1.0026	62.41	999.64	NO
WW-B3-83	3	22.40	1.0140	1.0106	62.90	1007.61	NO
WW-B3-59	3	29.50	1.0220	1.0186	63.40	1015.59	NO
WW-B3-34	3	34.10	1.0220	1.0186	63.40	1015.59	NO
WW-B4-36	3	2.58	1.0040	1.0006	62.28	997.64	NO
WW-B4-145	3	6.74	1.0050	1.0016	62.34	998.64	NO
WW-B4-11	3	26.50	1.0080	1.0046	62.53	1001.63	NO
WW-B4-60	3	32.50	1.0040	1.0006	62.28	997.64	YES
WW-B4-115	3	34.00	1.0160	1.0126	63.03	1009.61	NO
WW-B4-85	3	24.20	1.0740	1.0706	66.64	1067.44	YES
WW-C1-13.6	3	43.90	1.0210	1.0176	63.34	1014.59	NO
WW-C1-1	3	44.80	1.0230	1.0196	63.46	1016.59	NO
WW-C1-11	3	45.00	1.0220	1.0186	63.40	1015.59	NO
WW-C1-11	3	45.00	1.0220	1.0186	63.40	1015.59	NO

TABLE 16

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE DATA - SUBTIDAL PIEZOMETERS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Transducer Configuration Type*	*Specific Conductance (at 77°F or 25°C) (1) (mS/cm)*	*Specific Gravity (at 60°F or 15.6°C) (2) (-)*	*Specific Gravity (at 77°F or 25°C) (3) (-)*	*Density (at 77°F or 25°C) (lbs/ft³) (4)*	*Density (at 77°F or 25°C) (kg/m³) (5)*	*Initially Considered Outlier?*
WW-C1-6	3	47.40	1.0230	1.0196	63.46	1016.59	NO
WW-C1-38.6	3	87.40	1.0410	1.0376	64.58	1034.53	NO
WW-C1-0	3	NM	1.0230	1.0196	63.46	1016.59	NOT USED(7)
WW-C2-78.9	3	2.40	1.0070	1.0036	62.47	1000.63	NO
WW-C2-108.9	3	10.10	1.0060	1.0026	62.41	999.64	NO
WW-C2-48.9	3	18.30	1.0070	1.0036	62.47	1000.63	NO
WW-C2-23.9	3	19.10	1.0040	1.0006	62.28	997.64	NO
WW-C2-7	3	49.90	1.0270	1.0236	63.71	1020.58	NO
WW-C2-2	3	50.20	1.0220	1.0186	63.40	1015.59	NO
WW-C2-12	3	49.40	1.1020	1.0986	68.38	1095.35	YES
WW-C2-108.9	3	2.40	1.0200	1.0166	63.28	1013.60	YES
WW-C3-128	3	0.12	1.0020	0.9986	62.16	995.65	NO
WW-C3-98	3	0.15	1.0020	0.9986	62.16	995.65	NO
WW-C3-73	3	0.15	1.0020	0.9986	62.16	995.65	NO
WW-C3-23	3	0.17	1.0020	0.9986	62.16	995.65	NO
WW-C3-48	3	0.26	1.0020	0.9986	62.16	995.65	NO
WW-C3-156	3	NM	1.0020	0.9986	62.16	995.65	NOT USED(7)
WW-C4-123.6	3	2.23	1.0030	0.9996	62.22	996.65	NO
WW-C4-37.6	3	5.74	1.0000	0.9966	62.03	993.65	NO
WW-C4-92.6	3	6.46	1.0030	0.9996	62.22	996.65	NO
WW-C4-11	3	17.80	1.0040	1.0006	62.28	997.64	NO
WW-C4-6	3	25.20	1.0060	1.0026	62.41	999.64	NO
WW-C4-62.6	3	20.90	1.1050	1.1016	68.57	1098.34	YES
WW-C4-0	3	NM	1.0040	1.0006	62.28	997.64	NOT USED(7)
WW-D1-2	3	46.50	1.0220	1.0186	63.40	1015.59	NO
WW-D1-6	3	48.50	1.0230	1.0196	63.46	1016.59	NO
WW-D1-11	3	58.70	1.0270	1.0236	63.71	1020.58	NO
WW-D1-20	3	69.90	1.0330	1.0296	64.09	1026.56	NO
WW-D1-75	3	>99.9	1.0600	1.0566	65.77	1053.48	NOT USED(6)
WW-D1-45	3	>99.9	1.0630	1.0596	65.95	1056.47	NOT USED(6)

	Total Number of Data Points	*Total Number of Outliers*	*Total Number of Not Used*	*Total Points Used*	*Percentages: Points Used*	*Percentages: Outliers*	*Percentages: Not Used*
	90	15	8	67	74.4%	16.7%	8.9%

Notes:
(1) Field measured specific conductance reported by meter relative to a reference temperature of 25°C.
(2) Laboratory reported specific gravity at 60°F consistent with ASTM Standard D1429-86.
(3) Specific gravity corrected to 25°C using the method described in Section 23 of ASTM Standard D1429-86.
(4) Density was calculated using a density of 62.24 lbs/ft³ fresh water at 25°C.
(5) Density was calculated using a density of 997.044 kg/m³ fresh water at 25°C.
(6) Specific conductance was beyond the upper limit for the Horiba meter of 99.9 mS/cm.
(7) Specific conductance was not measured at this location.

TABLE 17a

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE REGRESSION ANALYSIS
EVENT 1 DATA ONLY - INITIAL TRIAL
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.918416442
R Square	0.84348876
Adjusted R Square	0.841787551
Standard Error	0.004356336
Observations	94

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.009409454	0.009409454	495.8172089	8.02E-39
Residual	92	0.001745945	1.90E-05		
Total	93	0.0111554			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.997421917	0.000650702	1532.840189	1.54E-204	0.996129567	0.998714267
X Variable 1	0.000436949	1.96E-05	22.26695329	8.02E-39	0.000397975	0.000475922

DENSITY (lbs/ft^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.918165084
R Square	0.843027121
Adjusted R Square	0.841320894
Standard Error	0.272073284
Observations	94

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	36.57434421	36.57434421	494.0885054	9.18E-39
Residual	92	6.810196212	0.074023872		
Total	93	43.38454043			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.08128546	0.040639327	1527.615973	2.10E-204	62.00057225	62.16199867
X Variable 1	0.027241834	0.001225558	22.2281017	9.18E-39	0.02480777	0.029675898

DENSITY (kg/m^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.918278202
R Square	0.843234857
Adjusted R Square	0.841530888
Standard Error	4.353138915
Observations	94

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9377.604843	9377.604843	494.8651559	8.64E-39
Residual	92	1743.383294	18.94981841		
Total	93	11120.98814			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	994.4450945	0.650224213	1529.387978	1.89E-204	993.1536931	995.7364959
X Variable 1	0.436208408	0.019608781	22.24556486	8.64E-39	0.397263677	0.475153139

TABLE 17b

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE REGRESSION ANALYSIS
EVENT 1 DATA ONLY - SECOND TRIAL
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956267676
R Square	0.914447868
Adjusted R Square	0.913475684
Standard Error	0.003250038
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.009935454	0.009935454	940.6125842	9.24E-49
Residual	88	0.000929522	1.06E-05		
Total	89	0.010864976			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.996354669	0.000501643	1986.181064	1.82E-206	0.995357758	0.99735158
X Variable 1	0.000455436	1.48E-05	30.66940795	9.24E-49	0.000425925	0.000484947

DENSITY (lbs/ft^3):

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956154797
R Square	0.914231996
Adjusted R Square	0.91325736
Standard Error	0.202834757
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	38.5921116	38.5921116	938.0236493	1.03E-48
Residual	88	3.620490617	0.041141939		
Total	89	42.21260221			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.01464044	0.031307546	1980.820851	2.31E-206	61.95242328	62.07685761
X Variable 1	0.028384604	0.000926778	30.62717175	1.03E-48	0.026542826	0.030226381

DENSITY (kg/m^3):

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.956154797
R Square	0.914231996
Adjusted R Square	0.91325736
Standard Error	3.249101066
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9902.394613	9902.394613	938.0236493	1.03E-48
Residual	88	928.9858807	10.55665773		
Total	89	10831.38049			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	993.379226	0.501498773	1980.820851	2.31E-206	992.3826026	994.3758494
X Variable 1	0.454677724	0.014845567	30.62717175	1.03E-48	0.42517528	0.484180168

TABLE 18

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE REGRESSION ANALYSIS
EVENT 2 DATA ONLY
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.90168442
R Square	0.813034794
Adjusted R Square	0.811045803
Standard Error	0.005588138
Observations	96

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.012764694	0.012764694	408.767344	5.38E-36
Residual	94	0.002935365	3.12E-05		
Total	95	0.015700058			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.996549798	0.000804481	1238.748247	8.12E-200	0.994952482	0.998147115
X Variable 1	0.000403297	1.99E-05	20.21799555	5.38E-36	0.000363691	0.000442903

DENSITY (lbs/ft^3):

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.901701322
R Square	0.813065273
Adjusted R Square	0.811076606
Standard Error	0.347783478
Observations	96

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	49.45169371	49.45169371	408.8493193	5.34E-36
Residual	94	11.36961465	0.120953347		
Total	95	60.82130836			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.02870546	0.050067718	1238.896201	8.03E-200	61.92929483	62.12811608
X Variable 1	0.025102127	0.001241449	20.22002273	5.34E-36	0.022637201	0.027567053

DENSITY (kg/m^3):

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.901685913
R Square	0.813037486
Adjusted R Square	0.811048523
Standard Error	5.57156534
Observations	96

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	12689.31969	12689.31969	408.7745819	5.38E-36
Residual	94	2917.979992	31.04234034		
Total	95	15607.29968			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	993.6048617	0.802095497	1238.761301	8.11E-200	992.0122823	995.1974411
X Variable 1	0.402104659	0.019888277	20.21817454	5.38E-36	0.36261602	0.441593299

TABLE 19

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE REGRESSION ANALYSIS
SUBTIDAL PIEZOMETER DATA ONLY
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.971193042
R Square	0.943215925
Adjusted R Square	0.942342324
Standard Error	0.00294176
Observations	67

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.009343561	0.009343561	1079.687138	3.30E-42
Residual	65	0.000562507	8.65E-06		
Total	66	0.009906067			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.997611377	0.000524175	1903.202053	5.58E-156	0.996564527	0.998658227
X Variable 1	0.000464755	1.41E-05	32.85859306	3.30E-42	0.000436508	0.000493003

DENSITY (lbs/ft^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.971193042
R Square	0.943215925
Adjusted R Square	0.942342324
Standard Error	0.183105383
Observations	67

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	36.19929827	36.19929827	1079.687138	3.30E-42
Residual	65	2.179292784	0.033527581		
Total	66	38.37859105			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.09480478	0.032626491	1903.202053	5.58E-156	62.02964518	62.15996438
X Variable 1	0.028927987	0.000880378	32.85859306	3.30E-42	0.027169751	0.030686224

DENSITY (kg/m^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.971193042
R Square	0.943215925
Adjusted R Square	0.942342324
Standard Error	2.93306681
Observations	67

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9288.419869	9288.419869	1079.687138	3.30E-42
Residual	65	559.1872594	8.602880914		
Total	66	9847.607129			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	994.6633355	0.522626241	1903.202053	5.58E-156	993.6195788	995.7070921
X Variable 1	0.463381893	0.014102305	32.85859306	3.30E-42	0.435217646	0.49154614

TABLE 20

SPECIFIC GRAVITY / DENSITY AND SPECIFIC CONDUCTANCE REGRESSION ANALYSIS
EVENT 1, EVENT 2, AND SUBTIDAL PIEZOMETER DATA
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

REGRESSION ANALYSES (performed using Regression tool within Excel)

SPECIFIC GRAVITY:
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.931444408
R Square	0.867588685
Adjusted R Square	0.867061149
Standard Error	0.004402951
Observations	253

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.031882335	0.031882335	1644.608386	3.42E-112
Residual	251	0.004865879	1.94E-05		
Total	252	0.036748214			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.99687338	0.000397324	2508.968467	0	0.996090866	0.997655894
X Variable 1	0.000432677	1.07E-05	40.55377154	3.42E-112	0.000411665	0.00045369

DENSITY (lbs/ft^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.931424286
R Square	0.867551201
Adjusted R Square	0.867023516
Standard Error	0.274213378
Observations	253

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	123.6226615	123.6226615	1644.071916	3.54E-112
Residual	251	18.87343718	0.075192977		
Total	252	142.4960987			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.04818778	0.024745124	2507.491537	0	61.99945325	62.09692232
X Variable 1	0.02694251	0.000664473	40.5471567	3.54E-112	0.025633856	0.028251165

DENSITY (kg/m^3):
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.931419202
R Square	0.867541731
Adjusted R Square	0.867014008
Standard Error	4.392696831
Observations	253

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	31721.04465	31721.04465	1643.93643	3.57E-112
Residual	251	4843.242148	19.29578545		
Total	252	36564.2868			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	993.9167053	0.396398696	2507.366231	0	993.1360139	994.6973968
X Variable 1	0.431581436	0.010644377	40.54548594	3.57E-112	0.41061776	0.452545113

TABLE 21

**SUMMARY OF OUTLIERS/DATA NOT USED
FOR TYPE 1 TRANSDUCER CONFIGURATIONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON**

Event 1

Outliers		***Monitoring Wells Not Used***	
Monitoring Well	***Transducer Configuration***	***Monitoring Well***	***Transducer Configuration***
14-50R	1	11-100	1
36-50	1	2-100	1
4-115R	1	25A-50	1
41-50	1	4-45R	1
5-100	1	4-83R	1
5-50	1	65-100	1
64-100	1	75-75	1
65-130	1	PZ-SHI-1-126	1
		709-MW20-50	1

Event 2

Outliers		***Monitoring Wells Not Used***	
Monitoring Well	***Transducer Configuration***	***Monitoring Well***	***Transducer Configuration***
PZ-SHI-001-126	1	4-115R	1
74-75	1	4-45R	1
75-75	1	4-83R	1
65-100	1	6A-100	1
34-50	1	6A-50	1
		9-100	1
		T1-50	1
		T6-120	1

Both Event 1 and Event 2

Outliers		***Monitoring Wells Not Used***	
Monitoring Well	***Transducer Configuration***	***Monitoring Well***	***Transducer Configuration***
None		4-45R	1
		4-83R	1

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well/ Subtidal Piezometer		*Zone Grouping Plane Elevation (ft NGVD)*	*dZ [(a)] (ft)*	*Average of Events 1 and 2 Density (lbs/ft³)*	*dP [(b)] (psi)*	*Screen Top Elevation (ft NGVD)*	*Screen Bottom Elevation (ft NGVD)*	*Transducer Elevation (ft NGVD)*	*Mid-Point of Screen Elevation (ft NGVD)*	*Serfes (1991) Mean Pressure for Event 1 [(c)] (psi)*	*Serfes (1991) Mean Pressure for Event 2 [(c)] (psi)*	*FEHs [(d)] Event 1 (ft NGVD)*	*FEHs [(d)] Event 2 (ft NGVD)*	*Zone Grouping Plane FEH [(e)] Event 1 (ft NGVD)*	*Zone Grouping Plane FEH [(e)] Event 2 (ft NGVD)*
4-25R	2	-10	0.12	64.409 [(9)]	0.05	-8.10	-13.10	-10.12	-10.60	5.28	5.26	2.07	2.01	2.07	2.01
5-25	2	-10	0.59	62.918	0.26	-8.30	-13.30	-10.59	-10.80	5.77	5.90	2.71	3.02	2.71	3.02
6A-24.5	2	-10	0.05	62.513	0.02	-7.90	-12.90	-10.05	-10.40	5.29	5.31	2.16	2.21	2.16	2.21
8-23	2	-10	0.35	62.457 [(9)]	0.15	-6.00	-11.00	-10.35	-8.50	5.53	NC [(5)]	2.41	NC [(5)]	2.41	NC [(5)]
9-25	1	-10	0.90	62.356	0.39	-8.40	-13.40	-6.20	-10.90	5.88	5.91	2.67	2.74	2.67	2.74
11-25	2	-10	-2.06	62.491	-0.89	-7.68	-12.68	-7.94	-10.18	4.21	4.42	1.78	2.27	1.79	2.27
12-25	2	-10	0.76	62.386	0.33	-8.10	-13.10	-10.76	-10.60	5.09	5.19	0.99	1.23	0.99	1.23
14-25R	3 [(2)]	-10	1.02	62.593 [(9)]	0.44	-8.20	-13.20	-11.02	-10.70	5.34	5.38	1.30 [(21)]	1.40 [(21)]	1.30 [(21)]	1.40 [(21)]
15-25R	2	-10	2.08	63.239	0.91	-9.20	-14.20	-12.08	-11.70	6.08	6.14	1.95	2.10	1.92	2.07
19-25	2	-10	0.72	62.502	0.31	-8.60	-13.60	-10.72	-11.10	5.81	5.94	2.69	2.98	2.69	2.98
21-25R	2	-10	1.50	62.726	0.65	-7.00	-12.00	-11.50	-9.50	5.80	5.97	1.88	2.27	1.87	2.26
25-25	2	-10	1.22	62.460	0.53	-8.70	-13.70	-11.22	-11.20	5.55	5.78	1.59	2.11	1.59	2.11
25A-25	2	-10	0.32	62.338	0.14	-5.60	-10.60	-10.32	-8.10	NC [(3)]	5.66	NC [(3)]	2.74	NC [(3)]	2.74
34-25	2	-10	1.22	62.675	0.53	-9.20	-14.20	-11.22	-11.70	5.54	5.89	1.56	2.37	1.56	2.37
35-25	2	-10	-1.35	62.477	-0.59	-8.10	-13.10	-8.65	-10.60	4.59	4.85	1.95	2.56	1.95	2.56
36-25	1	-10	2.40	62.323	1.04	-9.90	-14.90	-9.54	-12.40	6.11	6.39	1.70	2.35	1.70	2.35
40A-25	2	-10	-2.23	62.513	-0.97	-5.40	-10.40	-7.77	-7.90	4.33	4.17	2.21	1.85	2.22	1.85
44-25	2	-10	0.99	62.378	0.43	-6.70	-11.70	-10.99	-9.20	6.46	5.99	3.92	2.83	3.92	2.83
53-25	2	-10	-1.03	63.253	-0.45	-7.60	-12.60	-8.97	-10.10	4.94	5.30	2.44	3.26	2.45	3.27
55-25	2	-10	0.00	62.406	0.00	-6.29	-11.19	-10.00	-8.74	5.27	5.40	2.15	2.47	2.15	2.47
64-25	2	-10	2.49	62.556	1.08	-8.84	-13.84	-12.49	-11.34	6.37	NC [(4)]	2.20	NC [(4)]	2.20	NC [(4)]
65-25	2	-10	-1.13	62.724	-0.49	-8.55	-13.55	-8.87	-11.05	4.98	5.00	2.63	2.67	2.64	2.67
69-25	1	-10	2.41	63.284	1.06	-9.91	-14.91	-9.28	-12.41	6.72	6.78	3.10	3.24	3.06	3.20
71-25	2	-10	-0.29	62.989	-0.13	-9.18	-14.18	-9.71	-11.68	5.14	5.18	2.15	2.25	2.16	2.25
78-25	2	-10	4.65	62.452	2.02	-9.71	-14.71	-14.65	-12.21	6.49	6.96	0.33	1.40	0.33	1.40
709-MW20-25	2	-10	-1.22	62.383	-0.53	-6.47	-11.47	-8.78	-8.97	4.28	4.52	1.10	1.65	1.10	1.65
721-MW5-25	2	-10	-0.82	62.544	-0.36	-8.53	-13.53	-9.18	-11.03	4.77	4.77	1.83	1.82	1.84	1.83
721-MW6-25	2	-10	-0.38	62.432	-0.16	-8.73	-13.73	-9.62	-11.23	4.96	4.86	1.83	1.58	1.83	1.58
721-MW9-25	2	-10	-0.49	62.637	-0.21	-8.60	-13.60	-9.51	-11.10	4.68	4.70	1.29	1.35	1.29	1.35
721-MW10-25	2	-10	-0.47	63.001 [(9)]	-0.21	-9.30	-14.30	-9.53	-11.80	4.41	4.41	0.65	0.65	0.65	0.65
PZ-SHI-001-033	2	-10	11.39	63.722	5.04	-20.39	-21.39	-21.39	-20.89	9.63	9.74	0.82	1.08	0.58	0.84
PZ-SHI-002-025	1	-10	2.82	63.176 [(9)]	1.24	-12.32	-13.32	-9.19	-12.82	6.03	6.10	1.10	1.26	1.06	1.22
T1-25	2	-10	0.19	62.898	0.08	-7.78	-12.78	-10.19	-10.28	5.30	5.37	2.05	2.20	2.05	2.19
WW-A3-25	3	-10	2.54	62.528	1.10	-12.32	-14.32	-12.54	-13.32	6.02	6.01	1.36 [(21)]	1.33 [(21)]	1.36 [(21)]	1.33 [(21)]
WW-A4-25	3	-10	2.51	62.797	1.09	-11.72	-13.72	-12.51	-12.72	7.69	7.67	5.22 [(21)]	5.20 [(21)]	5.21 [(21)]	5.18 [(21)]
WW-B3-2	3	-10	-4.36	62.715	-1.90	-5.52	-7.52	-5.64	-6.52	4.01	3.96	3.62 [(21)]	3.49 [(21)]	3.64 [(21)]	3.51 [(21)]
WW-B3-25	3	-10	2.51	62.481	1.09	-12.32	-14.32	-12.51	-13.32	5.95	5.93	1.23 [(21)]	1.17 [(21)]	1.22 [(21)]	1.17 [(21)]
WW-B4-25	3	-10	2.51	62.860	1.10	-12.32	-14.32	-12.51	-13.32	5.65	5.64	0.52 [(21)]	0.50 [(21)]	0.50 [(21)]	0.48 [(21)]
WW-C3-25	3	-10	2.50	62.485	1.08	-12.32	-14.32	-12.50	-13.32	6.59	6.58	2.71 [(21)]	2.69 [(21)]	2.71 [(21)]	2.69 [(21)]
WW-C4-2	3	-10	16.78	62.603	7.29	-25.62	-27.62	-26.78	-26.62	NC [(20)]	NC [(20)]	1.72 [(20)]	1.70 [(20)]	1.66 [(20)]	1.65 [(20)]

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well/ Subtidal Piezometer		*Zone Grouping Plane Elevation (ft NGVD)*	*dZ [a] (ft)*	*Average of Events 1 and 2 Density (lbs/ft^3)*	*dP [b] (psi)*	*Screen Top Elevation (ft NGVD)*	*Screen Bottom Elevation (ft NGVD)*	*Transducer Elevation (ft NGVD)*	*Mid-Point of Screen Elevation (ft NGVD)*	*Serfes (1991) Mean Pressure for Event 1 [c] (psi)*	*Serfes (1991) Mean Pressure for Event 2 [c] (psi)*	*FEHs [d] Event 1 (ft NGVD)*	*FEHs [d] Event 2 (ft NGVD)*	*Zone Grouping Plane FEH [e] Event 1 (ft NGVD)*	*Zone Grouping Plane FEH [e] Event 2 (ft NGVD)*
50-ft Zone															
3-50	1	-35	-0.10	63.151	-0.04	-32.40	-37.40	-5.36	-34.90	16.39	16.26	2.92	2.62	2.92	2.62
4-45R	1	-35	-4.40	66.123 [9]	-2.02	-28.10	-33.10	-8.79	-30.60	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]
5-50	1	-35	0.80	63.679	0.35	-33.30	-38.30	-23.58	-35.80	16.20	16.31	1.58	1.84	1.57	1.82
6A-50	1	-35	0.60	62.706	0.26	-33.10	-38.10	-22.13	-35.60	16.26	16.30	1.92	2.02	1.92	2.01
8-54	1	-35	4.50	62.734 [9]	1.96	-37.00	-42.00	1.59	-39.50	20.89	21.05	8.71 [16]	9.08 [16]	8.68 [16]	9.05 [16]
9-50	2	-35	0.80	62.663	0.35	-33.20	-38.20	-35.80	-35.70	16.47	16.52	2.22	2.33	2.21	2.32
11-45	2	-35	-6.95	62.744	-3.03	-22.62	-32.62	-28.05	-27.62	12.23	12.69	0.16	1.24	0.20	1.28
12-45	2	-35	-5.20	62.433	-2.25	-23.92	-33.92	-29.80	-28.92	12.77	13.02	-0.33	0.26	-0.33	0.26
14-50R	1	-35	2.60	64.038	1.16	-35.10	-40.10	-21.44	-37.60	NC [14]	17.11	NC [14]	1.88	NC [14]	1.82
15-50R	1	-35	1.60	64.041	0.71	-34.10	-39.10	-19.87	-36.60	16.34	16.36	1.11	1.15	1.07	1.11
19-50R	2	-35	1.56	63.866	0.69	-33.80	-38.80	-36.56	-36.30	16.46	16.84	1.42	2.31	1.38	2.27
21-48	1	-35	-2.90	62.918	-1.27	-29.60	-34.60	-20.58	-32.10	14.70	14.92	1.82	2.33	1.85	2.35
25-50	1	-35	1.30	62.512	0.56	-33.80	-38.80	-18.81	-36.30	16.13	NC [5]	0.92	NC [5]	0.92	NC [5]
25A-50	1	-35	-1.80	62.478	-0.78	-30.70	-35.70	-7.55	-33.20	15.34	15.61	2.20	2.82	2.20	2.83
32-50R	2	-35	0.28	62.500	0.12	-32.80	-37.80	-35.28	-35.30	15.77	16.23	1.11	2.18	1.11	2.18
34-50	1	-35	0.70	62.481 [9]	0.30	-33.20	-38.20	-24.05	-35.70	NC [6]	22.01	NC [6]	15.09 [16]	NC [6]	15.09 [16]
35-50	1	-35	-4.60	62.377	-1.99	-27.90	-32.90	-18.62	-30.40	13.80	14.07	1.45	2.07	1.44	2.07
36-50	1	-35	1.80	62.237	0.78	-34.30	-39.30	-24.87	-36.80	16.88	17.11	2.15	2.68	2.16	2.69
40A-50	1	-35	-2.20	62.748	-0.96	-30.30	-35.30	-7.49	-32.80	14.93	NC [7]	1.65	NC [7]	1.67	NC [7]
41-50	1	-35	0.00	63.465 [9]	0.00	-32.50	-37.50	-28.43	-35.00	NC [8]	NC [8]	NC [8]	NC [8]	NC [8]	NC [8]
43-50	1	-35	-1.20	62.536	-0.52	-31.30	-36.30	-10.55	-33.80	15.05	15.52	0.93	2.02	0.93	2.02
44-50	1	-35	-0.80	62.538	-0.35	-31.70	-36.70	-24.47	-34.20	15.35	15.40	1.22	1.34	1.22	1.34
45-50	1	-35	0.20	62.513	0.09	-32.70	-37.70	-19.35	-35.20	16.09	16.22	1.93	2.23	1.93	2.23
53-50	1	-35	0.10	62.666 [9]	0.04	-32.60	-37.60	-8.76	-35.10	15.85	16.41	1.48	2.77	1.48	2.77
64-50	1	-35	-0.40	63.528	-0.18	-32.10	-37.10	-24.54	-34.60	15.58	15.83	1.35	1.93	1.36	1.94
65-50	1	-35	1.04	63.984	0.46	-33.54	-38.54	-9.17	-36.04	16.23	16.20	1.41	1.34	1.39	1.32
69-50	1	-35	2.60	63.938	1.15	-35.10	-40.10	-25.19	-37.60	17.15	17.33	1.98	2.39	1.91	2.33
71-50	1	-35	2.30	63.242 [9]	1.01	-34.80	-39.80	-19.98	-37.30	NC [12]	17.51	NC [12]	3.11	NC [12]	3.08
74-50	1	-35	0.76	63.194	0.33	-33.26	-38.26	-23.57	-35.76	15.77	16.24	0.63	1.72	0.62	1.71
75-50	1	-35	0.36	63.951	0.16	-32.86	-37.86	-8.13	-35.36	NC [3]	16.24	NC [3]	2.12	NC [3]	2.11
78-50	1	-35	2.21	62.628	0.96	-34.71	-39.71	-13.15	-37.21	15.66	16.17	-1.07	0.11	-1.08	0.10
709-MW20-50	1	-35	-0.71	62.284	-0.31	-31.79	-36.79	-22.08	-34.29	15.60	15.60	1.71	1.71	1.71	1.71
721-MW5-50	1	-35	0.11	62.694	0.05	-32.61	-37.61	-23.98	-35.11	16.02	16.15	1.86	2.16	1.86	2.16
721-MW6-50	1	-35	1.32	62.556	0.57	-33.82	-38.82	-24.41	-36.32	16.31	16.45	1.32	1.64	1.32	1.64
721-MW9-50	1	-35	1.40	62.619	0.61	-33.90	-38.90	-24.06	-36.40	16.30	16.27	1.22	1.15	1.21	1.14
721-MW10-50	1	-35	1.84	62.954	0.80	-34.34	-39.34	-9.94	-36.84	NC [10]	NC [10]	NC [10]	NC [10]	NC [10]	NC [10]
PZ-SHI-003-042	3 [2]	-35	-7.98	63.575 [9]	-3.52	-28.28	-29.28	-27.02	-28.78	NC [11]	NC [11]	NC [11]	NC [11]	NC [11]	NC [11]
T1-50	1	-35	0.35	64.930	0.16	-32.85	-37.85	-24.49	-35.35	16.11	16.29	1.83	2.24	1.81	2.23
WW-A1-2	3	-35	6.06	63.610 [15]	2.68	-46.22	-48.22	-41.06	-47.22	NC [20]	NC [20]	1.67 [20]	1.70 [20]	1.55 [20]	1.58 [20]
WW-A2-2	3	-35	9.97	63.916	4.43	-43.62	-45.62	-44.97	-44.62	NC [20]	NC [20]	2.01 [20]	1.98 [20]	1.77 [20]	1.74 [20]
WW-A3-50	3	-35	2.51	62.470	1.09	-37.32	-39.32	-37.51	-38.32	18.58	18.55	5.36 [21]	5.30 [21]	5.36 [21]	5.29 [21]
WW-A4-50	3	-35	2.68	62.403	1.16	-36.72	-38.72	-37.68	-37.72	18.78	18.75	5.65 [21]	5.59 [21]	5.65 [21]	5.59 [21]
WW-B2-2	3	-35	8.89	63.828	3.94	-45.12	-47.12	-43.89	-46.12	NC [20]	NC [20]	2.08 [20]	2.01 [20]	1.88 [20]	1.81 [20]

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well/ Subtidal Piezometer		Zone Grouping Plane Elevation (ft NGVD)	dZ [(a)] (ft)	Average of Events 1 and 2 Density (lbs/ft^3)	dP [(b)] (psi)	Screen Top Elevation (ft NGVD)	Screen Bottom Elevation (ft NGVD)	Transducer Elevation (ft NGVD)	Mid-Point of Screen Elevation (ft NGVD)	Serfes (1991) Mean Pressure for Event 1 [(c)] (psi)	Serfes (1991) Mean Pressure for Event 2 [(c)] (psi)	FEHs [(d)] Event 1 (ft NGVD)	FEHs [(d)] Event 2 (ft NGVD)	Zone Grouping Plane FEH [(e)] Event 1 (ft NGVD)	Zone Grouping Plane FEH [(e)] Event 2 (ft NGVD)
50-ft Zone (Cont'd)															
WW-B3-50	3	-35	2.51	63.730	1.11	-37.32	-39.32	-37.51	-38.32	16.88	17.15	1.45 [(21)]	2.07 [(21)]	1.40 [(21)]	2.01 [(21)]
WW-B4-50	3	-35	2.51	62.642	1.09	-37.32	-39.32	-37.51	-38.32	17.27	17.25	2.35 [(21)]	2.30 [(21)]	2.34 [(21)]	2.29 [(21)]
WW-C2-2	3	-35	4.51	63.729	2.00	-40.92	-42.92	-39.51	-41.92	NC [(20)]	NC [(20)]	1.60 [(20)]	1.60 [(20)]	1.51 [(20)]	1.50 [(20)]
WW-C3-50	3	-35	2.48	62.485	1.08	-37.32	-39.32	-37.48	-38.32	18.57	18.56	5.37 [(21)]	5.34 [(21)]	5.37 [(21)]	5.34 [(21)]
WW-C4-50	3	-35	3.40	62.598	1.48	-36.22	-38.22	-38.40	-37.22	NC [(20)]	NC [(20)]	1.59 [(20)]	1.58 [(20)]	1.58 [(20)]	1.57 [(20)]
WW-D1-2	3	-35	8.29	63.773	3.67	-44.42	-46.42	-43.29	-45.42	NC [(20)]	NC [(20)]	1.90 [(20)]	1.78 [(20)]	1.72 [(20)]	1.60 [(20)]
75-ft Zone															
4-83R	1	-60	7.30	66.620 [(9)]	3.38	-64.80	-69.80	-18.72	-67.30	25.29	25.40	-8.93 [(16)]	-8.67 [(16)]	-9.42 [(16)]	-9.17 [(16)]
74-75	1	-60	0.76	63.722	0.34	-58.26	-63.26	-43.51	-60.76	26.84	27.30	1.18	2.24	1.16	2.22
75-75	1	-60	0.27	67.916 [(9)]	0.13	-57.77	-62.77	-23.11	-60.27	26.63	26.23	1.18	0.26	1.16	0.24
PZ-SHI-001-075	1	-60	1.62	63.556	0.72	-59.12	-64.12	-19.66	-61.62	27.80	27.90	2.54	2.77	2.51	2.74
PZ-SHI-002-075	1	-60	1.18	64.601	0.53	-58.68	-63.68	-49.19	-61.18	27.37	27.38	1.98	2.00	1.94	1.96
PZ-SHI-003-075	3 [(2)]	-60	0.03	64.546	0.01	-57.78	-62.78	-60.03	-60.28	26.62	26.57	1.40 [(21)]	1.29 [(21)]	1.40 [(21)]	1.29 [(21)]
WW-A1-75	3	-60	0.91	64.041	0.40	-65.22	-67.22	-60.91	-66.22	NC [(20)]	NC [(20)]	1.28 [(20)]	1.35 [(20)]	1.25 [(20)]	1.33 [(20)]
WW-A2-75	3	-60	3.36	63.922	1.49	-61.12	-63.12	-63.36	-62.12	NC [(20)]	NC [(20)]	2.56 [(20)]	2.54 [(20)]	2.47 [(20)]	2.46 [(20)]
WW-A3-75	3	-60	2.51	62.820 [(15)]	1.09	-62.32	-64.32	-62.51	-63.32	29.34	29.31	5.20 [(21)]	5.13 [(21)]	5.18 [(21)]	5.12 [(21)]
WW-A4-75	3	-60	2.62	62.604	1.14	-61.72	-63.72	-62.62	-62.72	29.53	29.51	5.53 [(21)]	5.48 [(21)]	5.52 [(21)]	5.48 [(21)]
WW-B1-2	3	-60	-9.42	63.720 [(15)]	-4.17	-50.82	-52.82	-50.58	-51.82	NC [(20)]	NC [(20)]	1.74 [(20)]	1.74 [(20)]	1.94 [(20)]	1.94 [(20)]
WW-B1-75	3	-60	3.10	65.103	1.40	-62.32	-64.32	-63.10	-63.32	NC [(20)]	NC [(20)]	2.36 [(20)]	2.31 [(20)]	2.22 [(20)]	2.17 [(20)]
WW-B2-75	3	-60	3.40	64.308	1.52	-64.12	-66.12	-63.40	-65.12	NC [(20)]	NC [(20)]	2.70 [(20)]	2.67 [(20)]	2.60 [(20)]	2.56 [(20)]
WW-B3-75	3	-60	2.51	63.736	1.11	-62.32	-64.32	-62.51	-63.32	28.18	28.21	2.53 [(21)]	2.59 [(21)]	2.48 [(21)]	2.53 [(21)]
WW-B4-75	3	-60	2.51	62.653	1.09	-60.82	-65.82	-62.51	-63.32	28.97	28.94	4.34 [(21)]	4.27 [(21)]	4.33 [(21)]	4.26 [(21)]
WW-C1-2	3	-60	-10.54	63.857	-4.67	-49.12	-51.12	-49.46	-50.12	NC [(20)]	NC [(20)]	1.55 [(20)]	1.49 [(20)]	1.79 [(20)]	1.74 [(20)]
WW-C1-75	3	-60	2.06	63.664	0.91	-60.62	-62.62	-62.06	-61.62	NC [(20)]	NC [(20)]	1.69 [(20)]	1.65 [(20)]	1.65 [(20)]	1.61 [(20)]
WW-C2-75	3	-60	2.41	62.596	1.05	-62.92	-64.92	-62.41	-63.92	NC [(20)]	NC [(20)]	2.19 [(20)]	2.18 [(20)]	2.18 [(20)]	2.18 [(20)]
WW-C3-75	3	-60	2.46	62.485	1.07	-62.32	-64.32	-62.46	-63.32	29.53	29.52	5.69 [(21)]	5.66 [(21)]	5.69 [(21)]	5.65 [(21)]
WW-C4-75	3	-60	3.39	62.349	1.47	-61.22	-63.22	-63.39	-62.22	NC [(20)]	NC [(20)]	2.39 [(20)]	2.34 [(20)]	2.39 [(20)]	2.34 [(20)]
WW-D1-75	3	-60	2.28	64.419	1.02	-61.02	-63.02	-62.28	-62.02	NC [(20)]	NC [(20)]	2.15 [(20)]	2.07 [(20)]	2.07 [(20)]	2.00 [(20)]
100-ft Zone															
1-100R	3 [(2)]	-85	1.34	67.995	0.63	-87.90	-92.90	-86.34	-90.40	38.66	38.62	2.87 [(21)]	2.79 [(21)]	2.75 [(21)]	2.67 [(21)]
2-100	1	-85	-0.50	62.673	-0.22	-82.00	-87.00	-24.44	-84.50	37.90	38.17	2.96	3.58	2.96	3.59
3-100	1	-85	0.00	63.444	0.00	-82.50	-87.50	-20.64	-85.00	37.87	37.88	2.39	2.42	2.39	2.42
4-115R	1	-85	16.10	69.701 [(9)]	7.79	-98.60	-103.60	-43.58	-101.10	43.97	44.17	0.37	0.83	-1.51	-1.05
5-100	1	-85	0.80	63.042	0.35	-83.30	-88.30	-23.55	-85.80	38.28	38.32	2.54	2.63	2.53	2.62
6A-100	1	-85	0.30	63.306	0.13	-82.80	-87.80	-21.62	-85.30	38.20	38.07	2.85	2.55	2.85	2.55
8-99R	1	-85	-2.00	63.833	-0.89	-80.50	-85.50	-8.64	-83.00	37.14	37.02	2.71	2.43	2.75	2.48
9-100	1	-85	0.80	63.848	0.35	-83.30	-88.30	-21.19	-85.80	38.66	38.72	3.42	3.55	3.40	3.54
11-100	1	-85	-1.50	66.407 [(9)]	-0.69	-81.00	-86.00	-23.23	-83.50	36.71	37.36	1.22	2.72	1.31	2.81
12-100	1	-85	3.28	63.110	1.44	-85.78	-90.78	-26.26	-88.28	38.36	38.86	0.24	1.40	0.21	1.36
32-100	1	-85	0.20	63.607	0.09	-82.70	-87.70	-23.67	-85.20	NC [(3)]	38.07	NC [(3)]	2.65	NC [(3)]	2.65

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well/ Subtidal Piezometer		*Zone Grouping Plane Elevation (ft NGVD)*	*dZ [a] (ft)*	*Average of Events 1 and 2 Density (lbs/ft³)*	*dP [b] (psi)*	*Screen Top Elevation (ft NGVD)*	*Screen Bottom Elevation (ft NGVD)*	*Transducer Elevation (ft NGVD)*	*Mid-Point of Screen Elevation (ft NGVD)*	*Serfes (1991) Mean Pressure for Event 1 [c] (psi)*	*Serfes (1991) Mean Pressure for Event 2 [c] (psi)*	*FEHs [d] Event 1 (ft NGVD)*	*FEHs [d] Event 2 (ft NGVD)*	*Zone Grouping Plane FEH [e] Event 1 (ft NGVD)*	*Zone Grouping Plane FEH [e] Event 2 (ft NGVD)*
100-ft Zone (Cont'd)															
34-100	1	-85	0.50	62.946	0.22	-83.00	-88.00	-23.70	-85.50	37.42	37.88	0.85	1.92	0.85	1.91
35-100	1	-85	-1.50	64.020 [9]	-0.67	-81.00	-86.00	-78.68	-83.50	NC [22]	35.72	NC [22]	-1.07 [16]	NC [22]	-1.03
36-100R	1	-85	1.80	63.705	0.80	-84.30	-89.30	-44.55	-86.80	38.66	38.69	2.42	2.48	2.38	2.45
40A-100	2	-85	-0.29	63.856	-0.13	-83.90	-88.90	-84.71	-86.40	37.56	37.64	1.96	2.16	1.96	2.17
41-100	1	-85	0.80	62.471	0.35	-83.30	-88.30	-81.52	-85.80	37.67	38.43	1.13	2.88	1.13	2.88
45-100	1	-85	0.90	63.642	0.40	-83.40	-88.40	-9.08	-85.90	38.42	38.56	2.76	3.08	2.74	3.07
53-100	1	-85	-0.40	62.651	-0.17	-82.10	-87.10	-23.57	-84.60	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]
64-100	1	-85	0.23	63.667	0.10	-82.73	-87.73	-19.46	-85.23	37.70	37.90	1.77	2.23	1.77	2.23
65-100	1	-85	0.94	67.836	0.44	-83.44	-88.44	-19.10	-85.94	38.55	38.54	3.02	3.00	2.94	2.92
74-100	1	-85	0.76	64.082	0.34	-83.26	-88.26	-8.66	-85.76	38.01	38.30	1.96	2.62	1.93	2.60
75-100	1	-85	0.29	62.465	0.13	-82.79	-87.79	-8.10	-85.29	38.26	38.33	3.00	3.16	3.00	3.16
76-100	1	-85	1.31	62.629	0.57	-83.81	-88.81	-8.99	-86.31	38.35	38.72	2.19	3.04	2.19	3.04
77-100	1	-85	3.99	63.409	1.76	-86.49	-91.49	-7.82	-88.99	39.62	39.81	2.44	2.88	2.38	2.81
PZ-SHI-001-100	1	-85	1.61	64.182	0.72	-84.11	-89.11	-7.70	-86.61	38.56	38.58	2.37	2.42	2.33	2.37
PZ-SHI-002-100	2	-85	2.97	68.835	1.42	-83.64	-88.64	-87.97	-86.14	39.04	38.64	2.11	1.20	1.81	0.89
PZ-SHI-003-100	3 [2]	-85	0.25	64.745	0.11	-83.32	-88.32	-85.25	-85.82	37.76	37.71	1.89 [21]	1.76 [21]	1.88 [21]	1.75 [21]
T1-100	2	-85	-1.41	66.614 [9]	-0.65	-82.93	-87.93	-83.59	-85.43	37.25	37.77	2.38	3.57	2.47	3.67
WW-A1-100	3	-85	1.03	64.420 [15]	0.46	-90.22	-92.22	-86.03	-91.22	NC [20]	NC [20]	1.44 [20]	1.55 [20]	1.40 [20]	1.52 [20]
WW-A2-100	3	-85	3.38	64.108	1.50	-86.12	-88.12	-88.38	-87.12	NC [20]	NC [20]	3.41 [20]	3.42 [20]	3.32 [20]	3.32 [20]
WW-A3-100	3	-85	2.51	62.594	1.09	-87.32	-89.32	-87.51	-88.32	40.29	40.25	5.46 [21]	5.37 [21]	5.46 [21]	5.37 [21]
WW-A4-100	3	-85	2.49	62.423	1.08	-86.72	-88.72	-87.49	-87.72	40.21	40.19	5.31 [21]	5.26 [21]	5.31 [21]	5.26 [21]
WW-B1-100	3	-85	3.06	66.566	1.41	-87.32	-89.32	-88.06	-88.32	NC [20]	NC [20]	2.88 [20]	2.81 [20]	2.67 [20]	2.60 [20]
WW-B2-100	3	-85	3.39	63.776	1.50	-89.52	-91.52	-88.39	-90.52	NC [20]	NC [20]	3.93 [20]	3.90 [20]	3.86 [20]	3.82 [20]
WW-B3-100	3	-85	2.51	63.262	1.10	-87.32	-89.32	-87.51	-88.32	40.26	40.23	5.40 [21]	5.33 [21]	5.36 [21]	5.30 [21]
WW-B4-100	3	-85	2.51	62.980 [15]	1.10	-85.82	-90.82	-87.51	-88.32	40.18	40.14	5.22 [21]	5.13 [21]	5.19 [21]	5.11 [21]
WW-C1-100	3	-85	2.06	64.884	0.93	-85.62	-87.62	-87.06	-86.62	NC [20]	NC [20]	2.49 [20]	2.42 [20]	2.40 [20]	2.34 [20]
WW-C2-100	3	-85	2.39	62.781	1.04	-87.92	-89.92	-87.39	-88.92	NC [20]	NC [20]	2.06 [20]	2.02 [20]	2.04 [20]	2.01 [20]
WW-C3-100	3	-85	2.45	62.487	1.06	-87.32	-89.32	-87.45	-88.32	51.70	51.66	31.85 [16] [21]	31.76 [16] [21]	31.84 [16] [21]	31.75 [16] [21]
WW-C4-100	3	-85	3.40	62.400 [15]	1.47	-86.22	-88.22	-88.40	-87.22	NC [20]	NC [20]	2.84 [20]	2.84 [20]	2.84 [20]	2.84 [20]
WW-D1-100	3	-85	2.28	66.280	1.05	-87.72	-89.72	-87.28	-88.72	NC [20]	NC [20]	3.36 [20]	3.31 [20]	3.22 [20]	3.17 [20]
130-ft Zone															
15-120	3 [2]	-115	-11.75	72.735 [9]	-5.93	-103.00	-108.00	-103.25	-105.50	49.36	49.29	10.66 [16] [21]	10.50 [16] [21]	12.61 [16] [21]	12.45 [16] [21]
41-138	1	-115	8.00	63.230	3.51	-120.50	-125.50	-99.77	-123.00	NC [8]	NC [8]	NC [8]	NC [8]	NC [8]	NC [8]
65-130	1	-115	0.73	63.031	0.32	-113.23	-118.23	-23.20	-115.73	52.82	52.81	6.16	6.14	6.15	6.13
74-130	1	-115	0.72	67.900 [9]	0.34	-113.22	-118.22	-110.49	-115.72	55.00	55.11	11.20 [16]	11.46 [16]	11.14 [16]	11.39 [16]
75-130	1	-115	0.20	62.323	0.09	-112.70	-117.70	-86.12	-115.20	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]	NC [13]
77-140	2	-115	12.55	66.408	5.79	-126.22	-131.22	-127.55	-128.72	NC [1]	NC [1]	NC [1]	NC [1]	NC [1]	NC [1]
PZ-SHI-001-126	1	-115	-0.36	66.849	-0.17	-112.14	-117.14	-24.33	-114.64	51.87	52.09	5.06	5.57	5.09	5.59
T5-120	2	-115	-10.33	71.396	-5.12	-101.80	-106.80	-104.67	-104.30	47.18	46.97	4.21	3.73	5.70	5.22
T6-120	1	-115	-10.00	62.507	-4.34	-102.50	-107.50	-101.10	-105.00	48.15	NC [17]	6.12	NC [17]	6.13	NC [17]
WW-A1-130	3	-115	1.01	65.330 [15]	0.46	-120.22	-122.22	-116.01	-121.22	NC [20]	NC [20]	3.34 [20]	3.34 [20]	3.29 [20]	3.30 [20]
WW-A2-130	3	-115	3.37	62.485	1.46	-116.12	-118.12	-118.37	-117.12	NC [20]	NC [20]	5.01 [20]	4.94 [20]	5.00 [20]	4.94 [20]

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well/ Subtidal Piezometer		*Zone Grouping Plane Elevation (ft NGVD)*	*dZ [a] (ft)*	*Average of Events 1 and 2 Density (lbs/ft³)*	*dP [b] (psi)*	*Screen Top Elevation (ft NGVD)*	*Screen Bottom Elevation (ft NGVD)*	*Transducer Elevation (ft NGVD)*	*Mid-Point of Screen Elevation (ft NGVD)*	*Serfes (1991) Mean Pressure for Event 1 [c] (psi)*	*Serfes (1991) Mean Pressure for Event 2 [c] (psi)*	*FEHs [d]*		*Zone Grouping Plane FEH [e]*	
												Event 1 (ft NGVD)	*Event 2 (ft NGVD)*	*Event 1 (ft NGVD)*	*Event 2 (ft NGVD)*
130-ft Zone (Cont'd)															
WW-A3-130	3	-115	2.51	62.635	1.09	-117.32	-119.32	-117.51	-118.32	52.95	52.92	4.68 [21]	4.60 [21]	4.67 [21]	4.59 [21]
WW-A4-130	3	-115	2.50	62.418	1.08	-116.72	-118.72	-117.50	-117.72	53.13	53.09	5.10 [21]	5.02 [21]	5.10 [21]	5.01 [21]
WW-B1-130	3	-115	3.02	63.619	1.33	-117.32	-119.32	-118.02	-118.32	NC [20]	NC [20]	4.77 [20]	4.70 [20]	4.71 [20]	4.64 [20]
WW-B2-130	3	-115	3.37	62.525	1.46	-119.52	-121.52	-118.37	-120.52	NC [20]	NC [20]	NC [18]	NC [18]	NC [18]	NC [18]
WW-B3-130	3	-115	2.51	62.522	1.09	-117.32	-119.32	-117.51	-118.32	53.22	53.17	5.30 [21]	5.19 [21]	5.30 [21]	5.18 [21]
WW-B4-130	3	-115	0.51	63.398	0.22	-115.82	-120.82	-115.51	-118.32	53.02	52.99	6.84 [21]	6.77 [21]	6.84 [21]	6.76 [21]
WW-C2-130	3	-115	2.41	62.779	1.05	-117.92	-119.92	-117.41	-118.92	NC [20]	NC [20]	2.02 [20]	1.97 [20]	2.01 [20]	1.96 [20]
WW-C3-130	3	-115	2.45	62.486	1.06	-117.32	-119.32	-117.45	-118.32	53.07	53.05	5.01 [21]	4.97 [21]	5.01 [21]	4.96 [21]
WW-C4-130	3	-115	3.35	62.531	1.45	-116.22	-118.22	-118.35	-117.22	NC [20]	NC [20]	5.40 [20]	5.33 [20]	5.39 [20]	5.32 [20]
WW-D1-130	3	-115	2.29	66.088	1.05	-118.12	-120.12	-117.29	-119.12	NC [20]	NC [20]	5.15 [20]	5.06 [20]	5.01 [20]	4.93 [20]
160-ft Zone															
1-175	1	-155	3.60	- [20]	-	-153.60	-163.60	-24.21	-158.60	- [19]	- [19]	NC [19]	NC [19]	NC [19]	NC [19]
3-175	1	-155	4.70	62.244 [9]	2.03	-157.20	-162.20	-83.56	-159.70	NC [1]	NC [1]	NC [1]	NC [1]	NC [1]	NC [1]
4-175R	1	-155	4.10	62.721	1.79	-156.60	-161.60	-149.76	-159.10	71.20	71.15	5.21	5.09	5.19	5.07
7-181	1	-155	10.50	62.806	4.58	-163.00	-168.00	-145.06	-165.50	73.70	74.10	4.58	5.50	4.51	5.43
11-183	1	-155	10.62	62.653	4.62	-160.62	-170.62	-17.98	-165.62	74.41	74.40	6.10	6.07	6.05	6.03
12-160	1	-155	-10.98	62.491	-4.76	-139.02	-149.02	-47.76	-144.02	64.39	63.89	4.57	3.42	4.59	3.43
64-170	2	-155	10.03	62.615	4.36	-158.97	-163.97	-165.03	-161.47	72.98	72.59	3.38	2.49	3.35	2.46
WW-A1-160	3	-155	-8.98	62.780	-3.92	-147.82	-149.82	-146.02	-148.82	NC [20]	NC [20]	2.05 [20]	2.00 [20]	2.10 [20]	2.06 [20]
WW-A2-160	3	-155	-7.63	62.580 [15]	-3.32 [15]	-146.12	-148.12	-147.37	-147.12	NC [20]	NC [20]	5.14 [20]	5.07 [20]	5.17 [20]	5.09 [20]
WW-A4-160	3	-155	-7.49	62.542	-3.25	-146.72	-148.72	-147.51	-147.72	66.20	66.17	5.26 [21]	5.19 [21]	5.28 [21]	5.21 [21]
WW-B1-160	3	-155	-6.97	63.572	-3.08	-147.32	-149.32	-148.03	-148.32	NC [20]	NC [20]	5.27 [20]	5.20 [20]	5.40 [20]	5.33 [20]
WW-B2-160	3	-155	-6.61		0.00	-149.52	-151.52	-148.39	-150.52	NC [20]	NC [20]	5.38 [20]	5.34 [20]	5.39 [20]	5.35 [20]
WW-B3-160	3	-155	-7.49	62.593	-3.26	-147.32	-149.32	-147.51	-148.32	66.13	66.08	5.10 [21]	4.98 [21]	5.12 [21]	5.00 [21]
WW-B4-160	3	-155	-7.49	62.771	-3.26	-145.82	-150.82	-147.51	-148.32	66.63	66.59	6.24 [21]	6.15 [21]	6.28 [21]	6.20 [21]
WW-C2-160	3	-155	-7.59	63.587	-3.35	-147.32	-149.92	-147.41	-148.62	NC [20]	NC [20]	5.66 [20]	5.60 [20]	5.81 [20]	5.75 [20]
WW-C3-160	3	-155	-7.53	62.484	-3.27	-147.32	-149.32	-147.47	-148.32	66.02	65.99	4.89 [21]	4.82 [21]	4.90 [21]	4.83 [21]
WW-C4-160	3	-155	-6.62	62.614	-2.88	-146.22	-148.22	-148.38	-147.22	NC [20]	NC [20]	4.79 [20]	4.72 [20]	4.81 [20]	4.74 [20]

TABLE 22

EVENTS 1 AND 2 SERFES (1991) MEAN PRESSURES AND FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Notes:

psi	Pounds per square inch.
ft NGVD	Feet National Geodetic Vertical Datum.
NC	FEH value not calculated.
(a)	Elevation difference, dZ, between zone grouping plane elevation and elevation of the screen mid-point for the Type 1 transducer configuration, or elevation of transducer for the Types 2 and 3 transducer configurations, calculated as the zone grouping plane elevation minus the screen mid-point/transducer elevation.
(b)	The pressure difference between the well screen mid point elevation (Type 1) or the transducer elevation (Types 2 and 3) and the zone grouping reference elevation based on the average Events 1 and 2 density at the well screen mid point (Type 1) or transducer elevation (Types 2 and 3) calculated using Equation 7.3.
(c)	For the Type 1 transducer configurations, the Serfes (1991) mean pressure is adjusted from the transducer elevation to the monitoring well screen mid-point using the specific gravity/density versus specific conductance relationship presented in Section 5.4.
(d)	FEHs are at the screen mid-point elevation for Type 1 transducer configuration, and at the transducer elevation for Type 2 and 3 transducer configurations. The FEHs are calculated using Equation 7.2, except where Method 2 is applied for the Geokon transducers installed in the subtidal piezometers within the Waterway that are continuously overlain by surface water, as described in Section 3.4.2.
(e)	The zone grouping plane FEH is calculated as the Serfes (1991) mean pressure minus the pressure difference, dP, to the zone grouping plane elevation, and then converted to an FEH from the zone grouping plane elevation using Equation 8.2. The zone grouping plane FEH is used to develop the FEH contours for the zone grouping planes.
(1)	Pressure data shows a decreasing trend over the entire data record, as presented in Table 5-2 of Attachment 5.
(2)	Geokon transducer installed within well screen as a Type 2 installation. The transducers installed in PZ-SHI-003-042 and 1-100R are 1.26 ft and 1.56 ft, respectively, above the top of the screen, and thus, the pressure measurements for these locations are considered representative of the formation at the transducer elevation.
(3)	Event 1 pressure data not measured, as presented in Table 5-2 of Attachment 5.
(4)	Event 2 pressure data not measured, as presented in Table 5-2 of Attachment 5.
(5)	Event 2 pressure data shows a decreasing trend, as presented in Table 5-2 of Attachment 5.
(6)	Event 1 pressure data does not match manual measurements, as presented in Table 5-2 of Attachment 5.
(7)	Event 2 pressure data is not measured, as presented in Table 5-2 of Attachment 5.
(8)	The well was obstructed preventing measurement of the conductivity profile in the well casing, as presented in Table 5-1 of Attachment 5.
(9)	Back calculated density shows greater than five percent difference between observed and estimated density, as presented in Table 5-3 of Attachment 5.
(10)	Transducer appears to have shifted during monitoring events, as presented in Table 5-2 of Attachment 5.
(11)	Transducer malfunctioned prior to Event 1, as presented in Table 5-2 of Attachment 5.
(12)	Event 1 pressure shows an increasing trend, as presented in Table 5-2 of Attachment 5.
(13)	No tidal fluctuations occur in the pressure data and the well screen is likely isolated from the formation, as presented in Table 5-2 of Attachment 5.
(14)	Event 1 pressure data is low and does not match manual measurements for Event 1, as presented in Table 5-2 of Attachment 5.
(15)	The measured density value is considered anomolous, or indicative of indicative of anthropogenic density impacts to groundwater while the specific gravity at other locations within the subtidal piezometer nest, and nearby subtidal piezometers, are not indicative of anthropogenic density impacts. The density value indicated is based on the interpolated 3-D groundwater density distribution and is applied to calculate the zone grouping plane FEH.
(16)	FEH value is significantly out of range of the FEH values for surrounding monitoring locations.
(17)	Event 2 pressure data shows an increasing trend, as presented in Table 5-2 of Attachment 5.
(18)	Not calculated because WW-B2-130 was reinstalled at a different date and can not be compared to other WW-B2 transducer pre-grout readings and the Method 2 FEH calculation approach is not applicable.
(19)	A suspected breach in the well casing occurs above the well screen. As a result, the measured density and pressure are not considered representative of the formation at the well screen, and FEHs are not calculated.
(20)	Method 2 is used to calculate FEHs for Geokon transducers installed in the subtidal piezometers located within the Waterway that are continuously overlain by surface water. The Serfes (1991) mean pressure is not directly applied.
(21)	Geokon transducer where Method 1 is used to calculate FEHs.
(22)	Event 1 pressure data shows a decreasing trend, as presented in Table 5-2 of Attachment 5.

TABLE 23

EXAMPLE CALCULATIONS OF FEH AND ENV - WW-B4
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

A. Calculation Methodology for FEH:

Well ID	*Transducer Elevation (ft NGVD)* z_i	*Measured Density at Transducer Elevation (lbs/ft³)* r	*Event 1 Serfes (1991) Mean Transducer Pressure at Transducer Elevation (psi)* P_i	*Zone Grouping Plane*	*Zone Grouping Plane Elevation (ft NGVD)* z_{zg}	*Incremental Pressure from Transducer to Zone Grouping Plane (psi)*	*Pressure At Zone Grouping Plane Elevation (psi)* $P_{zg} = P_i + \Delta P$	*FEH at Zone Grouping Plane Elevation (ft NGVD)* $FEH_{ZG} = P_{zg}/\rho_f g + z_{zg}$	*ENV at Zone Grouping Plane Elevation*
WW-B4-25	-12.51	62.860	5.65	25-foot Zone	-10	-1.10	4.55	0.50	Calculated from hand drawn contours.
WW-B4-50	-37.51	62.642	17.27	50-foot Zone	-35	-1.09	16.18	2.34	
WW-B4-75	-62.51	62.653	28.97	75-foot Zone	-60	-1.09	27.88	4.33	
WW-B4-100	-87.51	62.980	40.18	100-foot Zone	-85	-1.10	39.08	5.19	
WW-B4-130	-115.51	63.398	53.02	130-foot Zone	-115	-0.22	52.80	6.84	
WW-B4-160	-147.51	62.771	66.63	160-foot Zone	-155	3.26	69.89	6.28	

B. Calculation Methodology for ENV (Presented for demonstrational purposes only):

Well ID	*Transducer Elevation (ft NGVD)* z_i	*Measured Density at Transducer Elevation (lbs/ft³)*	*Event 1 Serfes (1991) Mean Transducer Pressure at Transducer Elevation (psi)* P_i	*Zone Grouping Plane*	*Zone Grouping Plane Elevation (ft NGVD)* z_{zg}	*Serfes (1991) Mean Waterway Elevation from Event 1 (ft NGVD)* z_r	*FEH at Zone Grouping Plane Elevation (ft NGVD)*	*Average Density from Waterway to Zone Grouping Plane Elevation (1) (kg/m³)*	*ENV at Zone Grouping Plane Elevation (2) (ft NGVD)*
WW-B4-25	-12.51	62.860	5.65	25-foot Zone	-10	1.09	0.50	1011.08	0.37
WW-B4-50	-37.51	62.642	17.27	50-foot Zone	-35	1.09	2.34	1007.99	2.03
WW-B4-75	-62.51	62.653	28.97	75-foot Zone	-60	1.09	4.33	1005.34	3.98
WW-B4-100	-87.51	62.980	40.18	100-foot Zone	-85	1.09	5.19	1003.84	4.82
WW-B4-130	-115.51	63.398	53.02	130-foot Zone	-115	1.09	6.84	1002.97	6.44
WW-B4-160	-147.51	62.771	66.63	160-foot Zone	-155	1.09	6.28	1002.54	5.82

Notes:
(1) Obtained from interpolated 3-D groundwater density distribution as presented in Appendix K.
(2) ENV calculated using Equation 7.5.

TABLE 24

EXAMPLE CALCULATIONS OF INCREMENTAL PRESSURES AND AVERAGE DENSITY - WW-B4
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Elevation (ft NGVD)	***Notes on Elevation***	***Interpolated Density (1) (kg/m^3)***	***Average Density from Waterway Surface to Zone Grouping Plane Elevation (kg/m^3)***
1.09	*Event 1 Serfes (1991) Mean Waterway Surface Elevation*		1014.40
0		1012.56	1014.45
-5		1010.73	1011.69
-10	**25-ft Zone Grouping Plane**	1009.96	**1011.08**
-15		1008.91	1010.57
-20		1007.56	1010.02
-25		1005.86	1009.39
-30		1004.16	1008.68
-35	**50-ft Zone Grouping Plane**	1003.23	**1007.99**
-40		1002.24	1007.35
-45		1001.50	1006.76
-50		1001.13	1006.22
-55		1000.80	1005.76
-60	**75-ft Zone Grouping Plane**	1000.53	**1005.34**
-65		1000.25	1004.96
-70		1000.11	1004.63
-75		1000.11	1004.33
-80		1000.09	1004.07
-85	**100-ft Zone Grouping Plane**	1000.09	**1003.84**
-90		1000.20	1003.64
-95		1000.20	1003.46
-100		1000.46	1003.30
-105		1000.46	1003.17
-110		1000.96	1003.06
-115	**130-ft Zone Grouping Plane**	1000.96	**1002.97**
-120		1001.18	1002.89
-125		1001.18	1002.82
-130		1001.35	1002.76
-135		1001.35	1002.71
-140		1001.41	1002.66
-145		1001.41	1002.62
-150		1001.33	1002.58
-155	**160-ft Zone Grouping Plane**	1001.33	**1002.54**
-160		1001.09	1002.50

Note:
(1) Obtained from the interploated 3-D groundwater density distribution.

TABLE 25

EVENT 3A AND 3B ZONE GROUPING PLANE FEH
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Zone Grouping Plane FEH			*Zone Grouping Plane FEH*			*Zone Grouping Plane FEH*	
Location	*Event 3A (ft NGVD)*	*Event 3B (ft NGVD)*	*Location*	*Event 3A (ft NGVD)*	*Event 3B (ft NGVD)*	*Location*	*Event 3A (ft NGVD)*	*Event 3B (ft NGVD)*
Standard Wells			***CMT Wells (Geokon)***			***CMT Wells (Micron)***		
5-25	1.89	2.16	17C-25	1.94	2.02	17C-50	2.98	2.30
5-50	1.57	1.86	17C-130	2.40	2.59	17C-75	0.15	0.70
5-75	1.92	2.39	17C-160	5.52	5.64	17C-100	3.89	4.84
5-100	2.35	2.78	21C-25	3.20	3.15	34C-100	2.82	3.14
6A-50	1.97	2.27	21C-50	1.80	2.33	53C-100	3.26	3.92
6A-100	2.16	2.46	21C-75	3.10	3.55	83C-100	7.73	8.04
7-25	1.20	1.89	21C-100	3.55	3.97	86C-100	4.23	5.06
7-100	1.84	2.75	21C-130	3.10	3.71	87C-75	2.58	3.52
7-181	6.17	6.32	21C-160	6.94	7.07	87C-100	4.26	5.16
8-23	3.14	3.30	34C-130	3.22	3.89	90C-50	2.40	3.51
9-25	2.19	2.36	34C-160	3.29	3.80	90C-75	8.68	9.41
9-50	1.84	2.19	41C-25	2.09	2.15	94C-75	1.14	2.09
9-100	2.79	3.13	41C-50	2.06	2.38			
11-25	1.50	1.97	41C-75	2.70	3.16			
11-45	0.56	1.77	41C-100	3.33	3.89			
11-75	0.88	2.03	41C-160	6.78	6.90			
11-100	1.80	2.98	46C-25	1.76	2.02			
11-183	5.88	6.03	46C-50	1.73	2.22			
12-25	1.27	1.93	46C-75	2.42	2.92			
12-75	1.10	2.17	46C-100	3.30	3.77			
12-100	0.29	1.30	46C-130	4.05	4.41			
12-160	7.03	7.18	46C-160	4.64	4.95			
12A-25	1.87	2.56	53C-25	2.57	2.72			
12A-50	1.47	2.60	53C-50	0.97	1.99			
14-25R	1.47	1.73	53C-75	1.55	2.55			
15-50R	1.54	1.74	53C-130	5.25	5.66			
18-25	1.59	1.75	53C-160	5.63	5.77			
18-50R	1.98	2.19	61C-25	2.45	2.43			
22-50	1.97	2.53	61C-50	1.58	1.97			
23-25R	1.66	1.88	61C-75	1.24	2.08			
32-50R	0.91	1.84	61C-100	3.36	4.56			
34-75	1.09	2.11	61C-130	3.75	4.82			
34-25R	1.24	1.95	61C-160	7.52	7.55			
34-50R	1.05	1.96	77C-25	2.67	2.68			
35-25	2.38	2.86	77C-50	1.57	1.92			
35-100R	2.15	2.81	77C-75	2.47	2.86			
36-25	2.13	2.68	77C-100	2.88	3.46			
36-50	1.42	2.12	77C-130	3.72	4.73			
36-100R	2.28	2.94	77C-160	5.98	6.85			
40-25	2.44	2.75	78C-25	0.48	1.11			
40-50	1.35	2.75	78C-50	0.82	2.09			
40-75	0.91	2.31	78C-75	0.41	1.67			
40-100R	2.19	3.42	78C-100	1.15	2.30			
42-25	2.30	2.54	78C-130	6.88	7.02			
42-50	1.38	2.14	78C-160	6.31	6.45			
43-50	1.19	2.14	83C-25	2.26	2.40			
44-25	2.16	2.38	83C-50	1.64	2.04			
44-50	1.41	1.93	83C-75	3.18	3.44			
45-50	1.71	2.20	83C-130	5.25	5.43			
45-100	2.40	2.89	83C-160	5.04	5.16			
49-15	3.67	3.71	84C-25	1.62	No Data			
50-15	3.69	3.60	84C-50	1.90	No Data			
52-15	4.08	4.02	84C-75	2.17	No Data			
55-25	1.85	2.17	84C-100	2.81	No Data			
55-50	1.43	2.01	84C-130	3.14	No Data			
64-100	2.12	2.81	84C-160	6.62	No Data			
64-170	5.71	5.82	85C-25	2.92	2.95			
65-25	1.84	1.93	85C-50	1.51	2.13			
65-50	1.39	1.55	85C-75	2.45	2.90			
65-100	2.91	3.09	85C-100	1.50	1.97			
65-130	5.20	5.34	85C-130	3.57	4.06			
67-25	1.88	1.97	85C-160	4.41	4.91			
67-50	1.35	1.54	86C-25	1.90	2.08			
69-25	2.41	2.65	86C-50	1.61	2.03			
70-25	1.23	1.68	86C-75	2.62	3.04			
71-25	1.54	1.74	86C-130	4.81	5.22			
71-50	1.00	1.73	86C-160	6.37	6.73			
74-50	0.66	1.91	87C-25	2.04	2.24			
74-75	1.24	2.31	87C-50	1.58	2.05			

TABLE 25

EVENT 3A AND 3B ZONE GROUPING PLANE FEH
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Zone Grouping Plane FEH			*Zone Grouping Plane FEH*			*Zone Grouping Plane FEH*	
	Event 3A	*Event 3B*		*Event 3A*	*Event 3B*		*Event 3A*	*Event 3B*
Location	*(ft NGVD)*	*(ft NGVD)*	***Location***	*(ft NGVD)*	*(ft NGVD)*	***Location***	*(ft NGVD)*	*(ft NGVD)*
74-100	2.18	2.96	87C-130	4.61	5.09			
75-50	1.90	2.10	87C-160	5.96	6.31			
75-75	2.70	2.93	88C-25	1.88	2.05			
75-100	3.00	3.33	88C-50	1.82	2.15			
75-130	3.12	3.43	88C-75	2.76	3.10			
80-25	1.78	1.89	88C-100	3.62	3.96			
81-50	1.16	1.38	88C-130	3.66	3.96			
82-100	3.38	3.60	88C-160	4.41	4.69			
95-15	2.93	2.95	89C-100	2.92	3.72			
709-MW5-15	3.11	3.30	89C-130	4.21	4.83			
709-MW6-15	3.55	3.50	89C-160	5.46	5.83			
709-MW6-25	1.48	1.64	90C-25	1.65	1.99			
709-MW6-50	1.78	2.07	90C-100	5.94	6.20			
709-MW9-15	3.60	3.53	90C-130	5.71	5.93			
709-MW9-25	1.73	1.87	90C-160	6.94	7.05			
709-MW11-15	3.44	3.36	91C-25	2.14	2.36			
709-MW11-25	1.86	2.01	91C-50	1.80	2.22			
709-MW15A-50	1.65	1.96	91C-75	1.93	2.40			
709-MW16-15	3.61	3.54	91C-100	2.17	2.91			
709-MW16-25	1.82	1.97	91C-130	3.55	4.03			
709-MW16-50	1.65	1.96	91C-160	6.76	6.91			
709-MW16-75	1.87	2.13	92C-25	1.74	1.90			
709-MW18-15	3.37	3.32	92C-50	1.83	2.09			
709-MW18-25	1.80	1.95	92C-75	1.30	1.61			
709-MW18-50	1.69	2.00	92C-100	2.64	2.95			
709-MW20-25	1.11	1.28	92C-130	3.17	3.47			
709-MW20-50	1.39	1.57	92C-160	4.07	4.34			
709-MW20-75	1.96	2.22	93C-25	2.33	2.42			
709-MW21-15	3.51	3.45	93C-50	2.28	2.53			
709-MW21-25	1.87	2.01	93C-75	2.74	2.99			
709-MW21-50	1.69	1.99	93C-100	2.92	3.16			
721-MW5-15	3.58	3.50	93C-130	3.33	3.53			
721-MW5-25	1.45	1.58	93C-160	4.25	4.43			
721-MW5-50	1.55	1.82	94C-25	1.77	2.01			
721-MW5-75	1.91	2.19	94C-50	1.42	2.09			
721-MW6-15	3.56	3.48	94C-100	3.54	4.05			
721-MW6-25	1.45	1.59	94C-130	4.13	4.43			
721-MW6-50	1.58	1.84	94C-160	4.57	4.69			
721-MW9-15	2.97	3.09	95C-25	1.15	1.31			
721-MW9-25	1.08	1.24	95C-50	1.42	1.66			
721-MW9-50	1.48	1.74	95C-75	1.73	1.93			
721-MW10-15	2.97	2.99	95C-100	2.90	3.08			
721-MW10-25	1.04	1.20	95C-130	3.60	3.79			
721-MW10-50	1.84	2.07	95C-160	4.63	4.82			
721-MW10-75	1.91	2.15						
721-MW11-15	3.47	3.40						
721-MW11-25	1.28	1.42						
721-MW11-50	1.62	1.87						
721-MW11-75	1.84	2.10						
721-MW12-15	3.71	3.64						
721-MW12-25	1.89	2.02						
721-MW12-50	1.66	1.93						
721-MW13-15	3.70	3.64						
721-MW13-25	1.80	1.92						
721-MW13-50	1.67	1.94						
721-MW14-15	3.49	3.43						
721-MW14-25	1.85	1.99						
721-MW14-50	1.77	2.05						
721-MW15-15	3.50	3.45						
721-MW15-25	1.82	1.95						
721-MW15-50	1.63	1.90						
PZ-SHI-2-75	2.11	2.30						
PZ-SHI-2-100	2.96	3.18						
PZ-SHI-3-75	1.85	2.03						
T3-50	2.24	2.78						
T5-120	7.19	7.42						
41-130	3.12	3.72						
89-25	1.35	1.95						
89-50	1.20	1.91						
89-75	1.39	2.32						

TABLE 26

SERFES (1991) MEAN FEH INCREASES FOR 15-FT ZONE MONITORING WELLS FOLLOWING NOVEMBER 19, 2012 PRECIPITATION EVENT
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WA

15-ft Zone Monitoring Well	*Ground Cover*	*Figure Showing Serfes (1991) Mean FEH for November 2012*	*Approximate Increase in Serfes (1991) Mean FEH Following November 19, 2013 Rainfall Event (ft)*
Southern End of 605 Alexander Avenue and Northern End of 709 Alexander Avenue			
49-15	Soil	Figure D.1l	0.7
50-15	Soil	Figure D.2l	0.9
52-15	Soil	Figure D.3l	0.7
709-MW6-15	Soil	Figure D.5l	0.8
709-MW11-15	Soil	Figure E.3c	0.5
709-MW16-15	Soil	Figure E.4c	0.6
709-MW18-15	Soil	Figure E.5c	0.5
709-MW20-15	Soil	Figure E.6c	0.5
		Average Increase (ft) =	**0.65**
Southern End of 709 Alexander Avenue and 721 Alexander Avenue			
709-MW5-15	Asphalt	Figure D.4l	0.4
709-MW9-15	Asphalt	Figure E.2c	0.3
721-MW5-15	Asphalt	Figure D.4l	0.3
721-MW6-15	Asphalt	Figure E.9c	0.1
721-MW9-15	Asphalt	Figure E.10c	0.2
721-MW10-15	Asphalt	Figure E.11c	0.3
721-MW11-15	Asphalt	Figure E.12c	0.1
721-MW12-15	Asphalt	Figure E.13c	0.2
721-MW13-15	Asphalt	Figure E.14c	0.1
721-MW14-15	Asphalt	Figure E.15c	0.2
721-MW15-15	Asphalt	Figure E.16c	0.1
		Average Increase (ft) =	**0.21**

Attachment 1

Copy of Serfes (1991)

Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations

by Michael E. Serfes[a]

Abstract

Tidal fluctuations in surface-water bodies produce progressive pressure waves in adjacent aquifers. As these pressure waves propagate inland, ground-water levels and hydraulic gradients continuously fluctuate, creating a situation where a single set of water-level measurements cannot be used to accurately characterize ground-water flow. For example, a time series of water levels measured in a confined aquifer in Atlantic City, New Jersey, showed that the hydraulic gradient ranged from .01 to .001 with a 22-degree change in direction during a tidal day of approximately 25 hours. At any point where ground water tidally fluctuates, the magnitude and direction of the hydraulic gradient fluctuates about the mean or regional hydraulic gradient. The net effect of these fluctuations on ground-water flow can be determined using the mean hydraulic gradient, which can be calculated by comparing mean ground- and surface-water elevations. Filtering methods traditionally used to determine daily mean sea level can be similarly applied to ground water to determine mean levels. Method (1) uses 71 consecutive hourly water-level observations to accurately determine the mean level. Method (2) approximates the mean level using only 25 consecutive hourly observations; however, there is a small error associated with this method. The exact magnitude of this error is usually unknown, and therefore the accuracy of the mean level is also unknown. Method (1) should be used if a higher degree of accuracy is required.

Introduction

In coastal areas the periodic rise and fall of tide-water stage in the ocean and hydraulically connected streams and tidal marshes produce sinusoidal ground-water-level fluctuations in adjacent aquifers. Such fluctuations occur when propagating pressure waves, produced by fluctuating hydraulic head at submarine outcrops of confined or unconfined aquifers or from loading and unloading on confined layers, travel inland from the surface-water body. In unconfined aquifers the pressure wave is mostly generated from changes in storage due to dewatering and resaturation of pores whereas in confined aquifers it is mostly due to changes in fluid pressure. The velocity, amplitude, wavelength and attenuation of these pressure waves are largely a function of the tidal period and amplitude in the surface-water body, the aquifer's transmissivity and storage coefficient, and the distance inland to the measuring point (Ferris, 1951). If loading is involved, the tidal efficiency of the aquifer is a factor (Jacob, 1940).

As these pressure waves travel inland, they cause ground-water levels and hydraulic gradients to fluctuate continuously. In these areas synoptic ground-water level measurements cannot be used to accurately characterize flow because they only define a point in time, not the net or mean effect of these fluctuations. For example, the Atlantic City Site (ACS) in New Jersey illustrates this problem clearly (Figures 1a, 1b). This site abuts the tidal Beach Thorofare which is hydraulically connected to the Atlantic Ocean. Well clusters 1, 2, and 3 are screened in the shallow unconfined (U) and confined (C) aquifers. The unconfined aquifer is 5 to 8 ft thick and comprised of miscellaneous permeable fill, whereas the confined aquifer is approximately 15 ft thick and comprised of fine sand. These aquifers are separated by a 3- to 5-ft thick, organic-rich, sandy-silty clay layer. The lower confining boundary of the confined aquifer is a sandy-clay layer. Most of the data presented here were obtained by Camp Dresser & McKee Inc. (1987).

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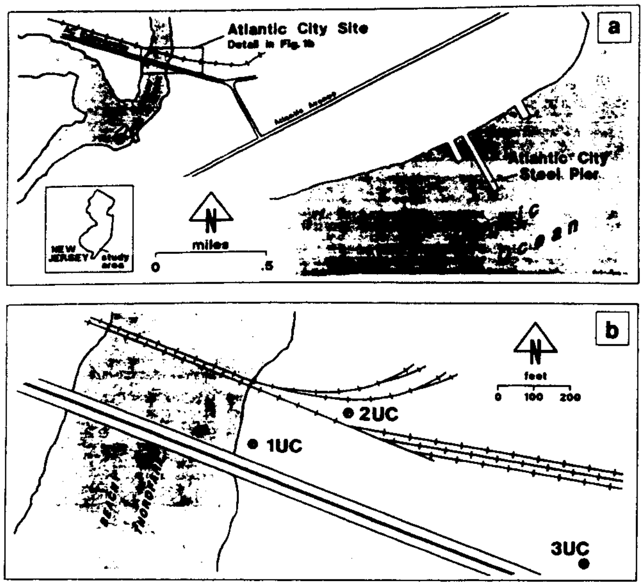

Fig. 1. a: Map of the Atlantic City Area showing the Beach Thorofare, Atlantic City Site (ACS), and the Steel Pier (ACSP). b: Plan view of the Atlantic City Site showing the three well clusters.

Ground-water hydrographs based on data collected over an approximately 25-hour period are shown in Figure 2. Note that there is a downward vertical gradient at the more inland clusters two and three. However, because of the large tidal fluctuation in the confined aquifer at well cluster one, the vertical gradient actually reverses for several hours during the measurement period. It is obvious that neglecting tidal fluctuations could produce a false interpretation of vertical ground-water flow. The magnitude of the hydraulic gradient in the confined aquifer ranges from a minimum of .001 to a maximum of .01 over a tidal day. There is also a 22-degree difference in ground-water flow direction between the minimum and maximum gradients. In order to accurately characterize ground-water flow, a method that filters tidal changes and yields the net effect of the changing flow conditions must be applied.

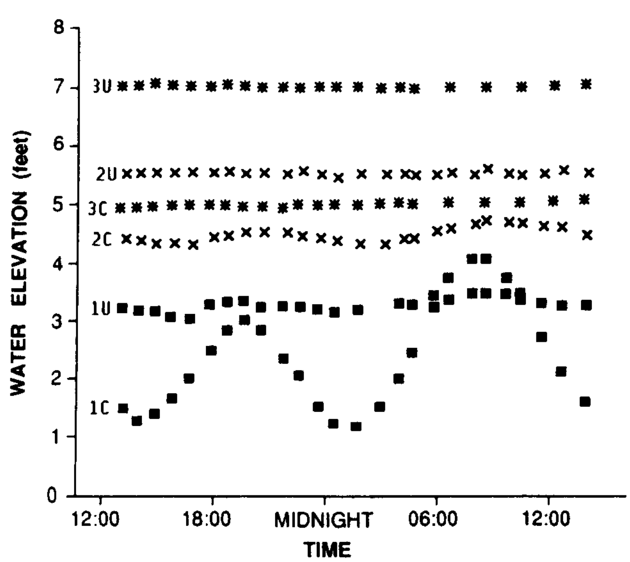

Fig. 2. Hydrographs of ground-water levels in the three well clusters at the Atlantic City Site during a 26-hour period, December 29-30, 1986. U = unconfined and C = confined.

Earlier work on tidally fluctuating ground-water levels emphasized the use of observed water-level fluctuations to calculate aquifer parameters. For example, Ferris (1951) used cyclic ground-water-level fluctuations to determine aquifer transmissivity, and Gregg (1966) used the ratio of the surface-water tidal range to that in confined aquifers to determine aquifer tidal efficiency. Some recent articles, for example, Vacher (1978) and Serfes (1987), are concerned with filtering the tidal response in ground water to examine long-period barometric fluctuations and to determine ground-water-flow directions, respectively. This paper shows how tidal filtering methods traditionally applied to surface-water measurements to determine mean levels can be applied to tidally fluctuating ground water to determine the mean hydraulic gradient.

Theory

A mathematical relationship used to model heat transfer in a solid subjected to periodic temperature variations was applied by analogy to the tidally influenced ground-water case (Jacob, 1950; Ferris, 1951; and Werner and Noren, 1951). This equation is:

$$h(x, t) = h_o \exp(-x\sqrt{\pi S/t_p T}) \cdot \sin\left(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_p T}\right) \quad (1)$$

The variables in equation (1) are: h (x, t), the net rise or fall of the water level with respect to the mean level; h_o, tidal amplitude; x, distance from the outcrop or tidally varying boundary; t_p, tidal period; S, storage coefficient; t, time; and T, transmissivity. The assumed boundary conditions are $h_x = h_o \sin(\omega t)$ at $x = 0$ and $h = 0$ at $x = \infty$ (angular velocity $\omega = 2\pi/t_p$). According to Todd (1980) this equation approximates water-table conditions if the amplitude of the fluctuations is small in comparison to the saturated thickness of the aquifer. A related equation used to calculate wavelength (λ) is:

$$\lambda = \sqrt{(4\pi t_p T)/S} \quad (2)$$

The first derivative of equation (1) can be used to show that only the mean or regional hydraulic gradient is needed to understand ground-water flow in aquifers affected by tidally induced water-level fluctuations. To accomplish this, the change in hydraulic gradient as a function of time at a distance x for an ideal unconfined and confined aquifer is investigated. The derivative of h (x, t) with respect to x in equation (1) is:

$$\partial h/\partial x|_{x,t} = -\sqrt{\pi S/t_p T}\, h_o \exp(-x\sqrt{\pi S/t_p T}) \cdot \left[\sin\left(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_p T}\right) + \cos\left(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_p T}\right)\right] \quad \ldots (3)$$

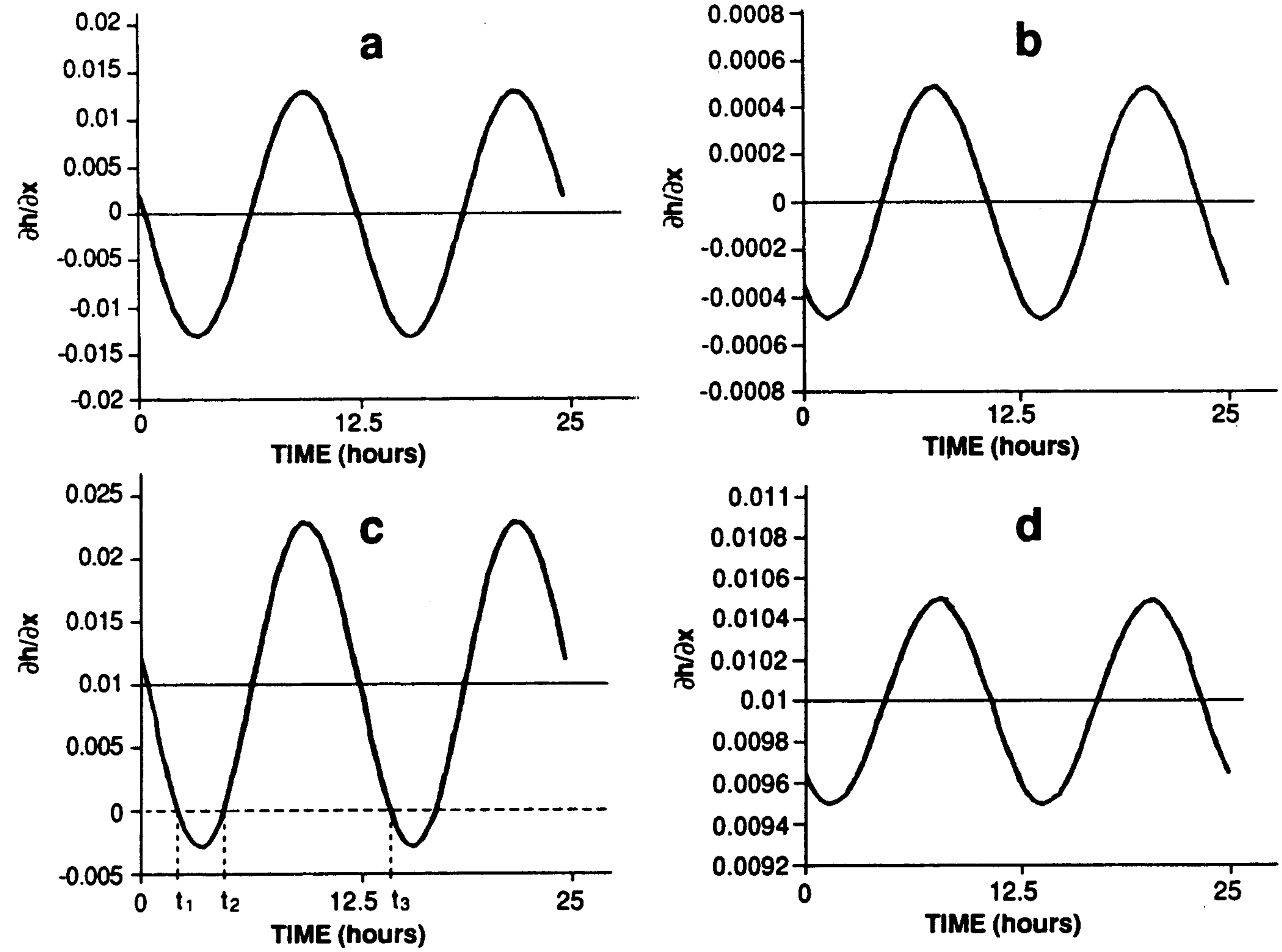

Fig. 3. Changes in ∂h/∂x during a tidal cycle for the hypothetical unconfined and confined aquifer described in the text. a: Unconfined aquifer with a mean ∂h/∂x equal to zero. b: Confined aquifer with a mean ∂h/∂x equal to zero. c: Unconfined aquifer with a mean ∂h/∂x equal to .01. d: Confined aquifer with a mean ∂h/∂x equal to .01 (note that the scale of a and c are greater than b and d).

Equation (3) can be used to calculate values of $\partial h/\partial x$ for a given value of x at any time t.

For this example, the aquifers are assumed to consist of coarse sand 20 ft thick, subjected to a 2-ft tidal range at their submarine outcrops during a tidal period of 12.5 hours. Therefore, a tidal sine wave with an amplitude of one ft and a period of 12.5 hours is assumed. A transmissivity of 2,953 ft squared/day, storage coefficients of .27 for the unconfined and .00006 for the confined aquifer, and a porosity of .39, all obtained in Todd (1980) as representative values for a coarse sand, are assumed. A distance x of 40 ft from the shoreline is selected.

The graphs of $\partial h/\partial x$ versus time during one tidal cycle are shown in Figures 3a and 3b. The major distinction between the two graphs is that the amplitude of $\partial h/\partial x$ for the unconfined aquifer is 26 times greater than it is for the confined one. This difference is explained by comparing the wavelengths of the propagating pressure wave produced in each example. From equation (2), wavelengths for the confined and unconfined aquifers are 267.5 and 17,947.5 ft, respectively. In the unconfined aquifer, two wells 133.75 ft apart are half a wavelength out of phase whereas in the confined aquifer they are 8,973.25 ft apart for a similar phase difference. This indicates that in an unconfined aquifer, ground-water fluctuations in wells only tens of ft from each other are out of phase and rise and fall with different amplitudes. However, in a confined aquifer, ground-water fluctuations in wells only a short distance from each other are nearly in phase and rise and fall with about the same amplitude.

The graphs of $\partial h/\partial x$ versus time in Figures 3a and 3b are for a mean gradient of zero. During the first half of the cycle, ground water flows a unit distance in one direction, and during the second half of the cycle, it flows an equal distance in the opposite direction, to its starting point. Therefore, the mean gradient induced by tides is zero. In the real world, however, the mean gradient is seldom zero. To simulate this condition, an arbitrarily selected mean or regional gradient of .01 is added to equation (3).

The mean hydraulic gradient of the waveforms plotted in Figures 3c and 3d is .01. As plotted in Figure 3c, ground water flows in the negative ($\partial h/\partial x < 0$) direction for a small part of the cycle and in the positive ($\partial h/\partial x > 0$) direction for most of the cycle. As shown below, the net distance that ground water flows during one complete tidal cycle is determined using the mean or regional hydraulic gradient of .01.

The relationship

$$x = \frac{KIt_*}{\phi} \tag{4}$$

derived from Darcy's law and the relationship distance equals velocity multiplied by time (t_*), is used to calculate the mean distances that ground water flows; where K is the hydraulic conductivity of 147 ft/day or 6.15 ft/hour, I is the mean hydraulic gradient, t_* is the length of time that the tidal cycle or subcycles operate, and ϕ is the porosity.

The areas under the positive and negative subcycles in Figure 3c are equal to each subcycle's mean hydraulic gradient times, the time during which it operates or (It_*) in the equation above. These areas are calculated by integration below:

$$It_*(+) = \int_{t_2}^{t_3} \frac{\partial h}{\partial x}\, dt = \int_{t_2}^{t_3} \Big\{.01 - \sqrt{\pi S/t_pT} \cdot h_o \exp(-x\sqrt{\pi S/t_pT}) \Big[\sin\Big(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_pT}\Big) + \cos\Big(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_pT}\Big)\Big]\Big\}\, dt$$

$$It_*(-) = \int_{t_1}^{t_2} \frac{\partial h}{\partial x}\, dt = \int_{t_1}^{t_2} \Big\{.01 - \sqrt{\pi S/t_pT} \cdot h_o \exp(-x\sqrt{\pi S/t_pT}) \Big[\sin\Big(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_pT}\Big) + \cos\Big(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_pT}\Big)\Big]\Big\}\, dt \tag{5}$$

The areas calculated above are multiplied by the hydraulic conductivity and divided by the porosity to determine the distance and direction that ground water travels per subcycle. These calculations indicate that during the positive subcycle, ground water flows 2.05 ft toward the submarine outcrop, and during the negative subcycle it flows .08 ft away from the outcrop. Subtracting one from the other and rounding yields a net flow distance of 1.97 ft toward the outcrop per tidal cycle. This value is identical with the value of 1.97 ft calculated using equation (4) and a mean hydraulic gradient of .01. Therefore, since the mean hydraulic gradient induced by the tidal fluctuation is 0.0, only the regional gradient, here .01, is needed to accurately interpret ground-water flow. Several methods of determining mean water levels to calculate mean gradients are explained in the next section.

In Figure 3d, the range of $\partial h/\partial x$ in the confined aquifer is .001. The mean hydraulic gradient is .01 so there is no reversal in ground-water flow direction, only a change in the ground-water flow velocity. The flow velocity ranges from 3.28 to 4.31 ft/day in this example.

The discussion above shows that the mean hydraulic gradient can be used to accurately interpret ground-water flow. The mean hydraulic gradient can be determined by comparing mean ground-water levels. For example, if x/100 for the regional gradient is added to equation (1), and the average h (x, t) over the range $t = 0$ to $t = t_p$ is found by integration:

$$\text{Average } h(x,t) = \frac{\int_0^{t_p} h\, dt}{\int_0^{t_p} dt} = \frac{\int_0^{t_p} \Big[\frac{x}{100} + h_o \exp(-x\sqrt{\pi S/t_pT}) \sin\Big(\frac{2\pi t}{t_p} - x\sqrt{\pi S/t_pT}\Big)\Big]\, dt}{\int_0^{t_p} dt} \quad \ldots (6)$$

an average or mean h (x, t) of x/100, the regional gradient, is obtained over the tidal period. Therefore, the mean h (x, t) due to tidal rise and fall is 0.0. It follows that the regional or mean hydraulic gradient can be obtained by comparing mean ground-water levels.

Filtering Methods

Numerous tractive gravitational forces, mainly from the moon and sun, produce the tides observed on earth. The resultant tidal waveform is comprised of many lunar and solar gravitational frequencies and is therefore much more complex than the single sine wave model discussed in the Theory section. The lunar tidal effects are about 50% greater than the solar influence, and it is the interaction between the speed of the earth's rotation and the moon's revolution around the earth that sets the tidal day at approximately 24 hours and 50 minutes. The filtering methods discussed here cancel out the major lunar and solar frequencies. For a more thorough discussion of tidal harmonics, see Schureman (1941).

For the analysis and discussions that follow, a tidal prediction program produced and used by the National Ocean Service to predict tides in various ports is used. Harmonic data from the Steel Pier in Atlantic City (ACSP), New Jersey, which includes annual, semiannual, monthly, semimonthly, daily, and semidaily constants, a total of 22, are entered into the program to generate predicted hourly water-level values at the pier. For this analysis, Sa, the solar annual, Ssa, the solar semiannual, both resulting mainly from climatic factors, and Mm, the lunar monthly, and Mf, the semilunar monthly tidal components are omitted so that a constant baseline or theoretical mean water level of zero is maintained for comparison purposes. Since the period of these constants is long, producing very long wavelengths in ground water, and their amplitudes small, the maximum slopes of the ground-water pressure waves they produce are insignificant for gradient determination in confined aquifers; however, they may be significant in unconfined aquifers. For example, Mf has an amplitude of .095 ft, a period of approximately 14 days and produces the greatest slope of the omitted constants. Given these values, a maximum slope of approximately .0004 is calculated using equation (3) at x = 40 ft for the unconfined aquifer described in the Theory section. This equates to a maximum .04 ft water-level difference over 100 ft, which may be significant in some cases. This discussion concerns filtering only the daily and semidaily frequencies because they are typically the most significant. The effects of the omitted frequencies are essentially retained in the data using the filtering methods described here.

The filtering methods discussed here are applied to surface-water harmonic data for illustrative purposes. However, their direct applicability to tidally fluctuating ground water is valid because the frequencies present in the tidally affected surface water, to which these methods were originally applied, are also transmitted into the adjacent aquifers. From equation (1) it can be inferred that as the tidal ground-water pressure wave propagates inland, the shorter period frequencies are attenuated more rapidly than longer period frequencies. Therefore, some of the original tidal harmonic constants present when the pressure wave was generated may be missing farther inland. The lack of those frequencies assists in the determination of mean ground-water levels since they no longer need to be filtered.

It is important to note that conclusions concerning ground-water flow using mean ground-water levels are derived in the same manner and are subject to the same limitations as those in nontidally influenced aquifers. Ground-water-level data should always be corrected for barometric pressure effects, if applicable, and data should always be reviewed to determine if other influences, such as those related to changes in surface-water level, have affected adjacent ground-water levels. For example, ground-water levels rise near stream channels due to bank storage during flood periods, and Vacher (1978) noted that the rise and fall of sea level due to changing barometric pressure affects adjacent ground-water levels. Other factors such as changes in recharge, winds, pumping influences, and earth tides also can directly or indirectly affect ground-water levels. Definitive methods to correct for the above factors are beyond the scope of this paper; however, it is suggested that ground-water and surface-water levels be measured for a period long enough to enable the investigator to determine if water levels are being affected by factors other than tidal and barometric. If so, then the investigator must decide, based on consideration of the individual situation, if subsequent resampling is required.

Method (1)

This section discusses one of two similar filters described in Godin (1966) which is used to effectively remove all diurnal and semidiurnal lunar and solar harmonics from 71 or 72 consecutive, hourly, water-level measurements. The filter requires 71 consecutive hourly observations. Using moving averages it yields a filtered mean level for the median time of the 71 hours. First, a sequence of means is computed for 24 observations, starting with observation one for the first mean and observation 48 for the last, yielding a total of 48 means. Second, a similar series of means is computed for 24 of those means yielding 25 means. Last, the mean of those 25 means is computed yielding the mean level at hour 36.

Hourly water levels at the Atlantic City Steel Pier (ACSP) (Figure 1a), calculated using the NOS program, for the dates of December 23, 24, and 25, 1986 are selected for this example. A graph of the hourly water levels, the first and second mean series, and the final mean of −.001 ft are shown in Figure 4. This graph illustrates the filtering process. Considering that the accuracy of most ground-water-level measurements is .01 ft and the computed mean water level is −.001 ft, then for practical purposes the mean water level is zero. Therefore, this is a very accurate method for determining the mean water level in ground and surface waters.

Filtering method (1) can be expressed mathematically as:

Let the consecutive hourly water-level values be O (1), O (2), O (3) . . . , O (71):

the first sequence of means (X_i) is

$$X_i = \sum_{K=0}^{23} \frac{O(K+i)}{24} \quad \text{where } i = 1, 2, 3, \ldots, 48;$$

the second sequence of means (Y_j) is

$$Y_j = \sum_{i=0}^{23} \frac{X_i + j}{24} \quad \text{where } j = 1, 2, 3, \ldots, 25;$$

then the mean level (M) at hour 36 is

$$M = \sum_{j=1}^{25} \frac{Y_j}{25} \qquad (7)$$

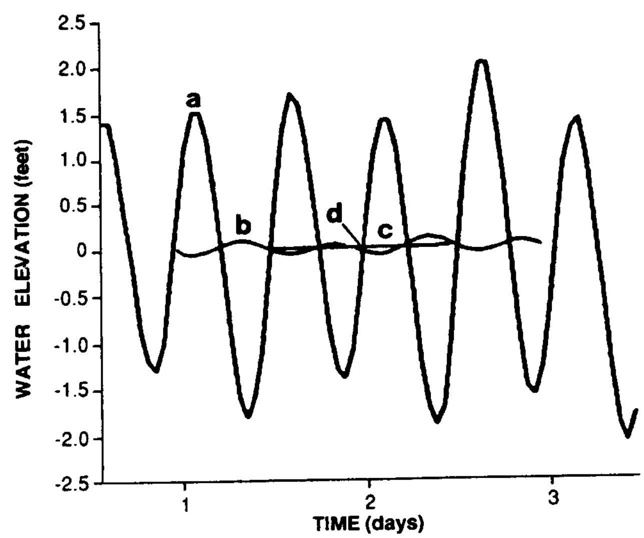

Fig. 4. Hydrographs showing the 71-hour filtering process using predicted data for the Atlantic City Steel Pier from 12/24/86 to 12/26/86. a: 71 consecutive hourly water elevations; b: 48 means from moving average of 24 hourly elevations over the 71 hours; c: 25 means from moving average of 24 means over the 48; and d is the mean elevation of −.001 ft at hour 36.

Method (2): The 25-Hour Mean

Two methods requiring fewer data than method (1) can be used to approximate the mean water level. The first is the mean of 25 consecutive, hourly, water levels that filters out most of the lunar frequencies, but lets through some of the solar, resulting in a slight error to the mean. The second is the mean of 24 consecutive, hourly water levels which effectively filters out solar frequencies that are multiples of one-twelfth cycle/day, but lets through certain percentages of the other frequencies, mostly lunar, resulting in a similar error to the mean (Godin, 1966 and 1972). This error is called an aliasing error and results either from an inadequate number of samples or from a sampling period inadequate to filter a particular frequency. In this situation the latter is the problem. For a more thorough discussion of this error, see Godin (1966). The magnitude of this error is site-specific because of the selective amplification of lunar versus solar frequencies as a function of basin shape, and it varies as a function of time. For example, Figure 5 shows how the magnitudes of this error varied between 12/24/86 and 12/26/86 at the Atlantic City Steel Pier using the 24- and 25-hour means. The range of the 24-hour error is greater than the 25-hour one, indicating that the errors associated with the lunar frequencies are greater than those of the solar. Since the magnitude of the lunar frequencies are known to dominate the solar, it is suggested, unless site-specific information suggests otherwise, that the 25-hour mean be used. The mean calculated using this method represents the mean level at hour 13.

This method, although less accurate than method (1), is less time-consuming, easier to calculate, and in many cases is accurate enough to draw at least preliminary conclusions concerning ground-water flow.

Case Study: The Atlantic City Site

Ground-water hydrographs representing 25 consecutive hourly levels from the three well clusters at the ACS (Figure 1) are shown in Figure 6. The hourly levels were calculated using a linear interpolation of the raw data collected during a 25-hour period on December 29 and 30, 1986 (Figure 2). For this analysis it is assumed that nontidal changes in the surface-water level do not significantly affect ground-water levels. Therefore, corrections are needed only for barometric pressure influences and tidal effects.

A comparison of the change in barometric pressure with the change in water level in well 3C, which is beyond the zone of tidal influence, was conducted and the barometric efficiency, as described in Todd (1980), calculated. All applicable ground-water levels were corrected for barometric pressure effects to a mean sea-level pressure of 30.03 inches of mercury. This is the annual mean sea-level pressure at Philadelphia, Pennsylvania as determined by the U.S. Department of Commerce (1968) and should be similar to that at Atlantic City, New Jersey.

The corrected mean ground-water levels are listed in Table 1. These mean levels can be used to make valid predictions concerning ground-water flow. In this particular case the error associated with these mean ground-water levels can be estimated because nearby harmonic data are available. The error associated with the daily, mean sea-level calculation at the ACSP for this 25-hour period is 0.02 ft. There is a one-for-one linear relationship between the tidal range and the associated error of the mean. Therefore, the error associated with the ground-water-level fluctuations is .01 ft for well 1C and .002 ft for well 2C.

In this study the aliasing errors associated with tidally fluctuating ground water were not significantly large compared to the differences in the mean levels between wells. However, if they had been significant, for example, if the

Table 1. Corrected Mean Ground-Water Levels

Wells:	1U	1C	2U	2C	3U	3C
Mean elevations (ft):	3.30	2.43	5.53	4.50	7.03	5.02

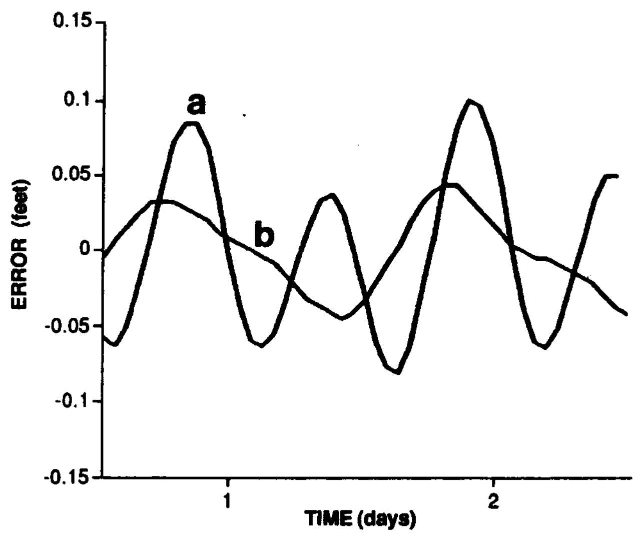

Fig. 5. Shows errors associated with (a) the 24-hour, and (b) the 25-hour mean surface-water elevation at the Atlantic City Steel Pier from 12/24/86 to 12/26/86.

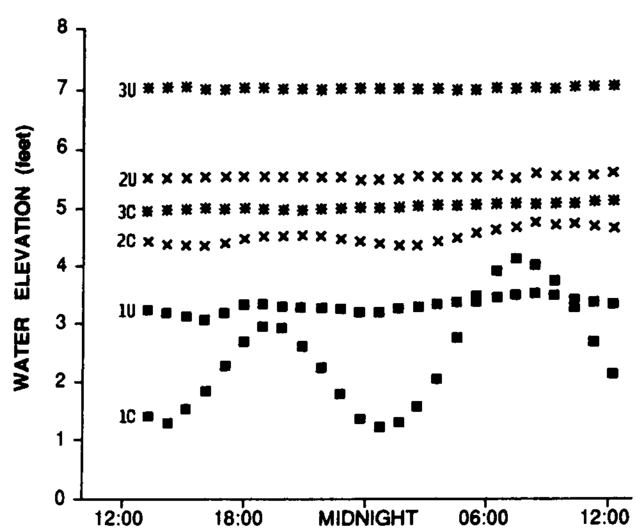

Fig. 6. Hydrographs of hourly ground-water elevations derived from the raw data in Figure 2 using the method described in the text.

error had been larger or the gradient had been very small, these errors could have resulted in a misinterpretation of ground-water flow. This method should only be used when there are large differences in mean water levels between wells because the aliasing errors are then less significant. If differences in mean water levels between wells are small, and/or accurate gradient determinations are required, then method (1), the more efficient frequency filter, should be used.

Conclusions

The determination of ground-water flow based on a single set of water-level measurements in aquifers affected by tidal fluctuations may not be accurate and may result in a significant misinterpretation. Accurate determinations of ground-water flow can only be obtained if the mean hydraulic gradient or regional gradient is ascertained. Mean horizontal and vertical hydraulic gradients can be determined by comparing mean ground- and surface-water levels. The filtering methods presented here can be used to determine daily mean, filtered, water levels. A limitation of these methods is that they do not effectively filter longer period frequencies, for example, Mf the semilunar monthly component, which can result in an inaccurate assessment of flow in unconfined aquifers. Method (1) uses 71 consecutive, hourly, water-level observations to accurately determine the mean level. Method (2) approximates the mean level using only 25 consecutive hourly observations; however, there is a small error associated with this method. The exact magnitude of this error is usually unknown, and therefore the accuracy of the mean level is also usually unknown. Method (1) should be used if a higher degree of accuracy is required.

Acknowledgments

This study was supported by the New Jersey Geological Survey. I thank coworkers I. G. (Butch) Grossman for carefully reading and editing this text, James Boyle for helping me with the finer points of Lotus, Mark Fiorentino for drafting the figures, and the three anonymous reviewers, particularly reviewers 1 and 2, for their helpful comments that upgraded the quality of this text.

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Attachment 2

Geokon Instruction Manual

GEOKON
The World Leader in Vibrating Wire Technology

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Fax: 603•448•3216
E-mail: geokon@geokon.com
http://www.geokon.com

Instruction Manual

Model 4500

Vibrating Wire Piezometer

(Doc Rev R, 1/06)

Warranty Statement

Geokon, Inc. warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by Geokon, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of Geokon's control. Components which wear or which are damaged by misuse are not warranted. This includes fuses and batteries.

Geokon manufactures scientific instruments whose misuse is potentially dangerous. The instruments are intended to be installed and used only by qualified personnel. There are no warranties except as stated herein. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and of fitness for a particular purpose. Geokon, Inc. is not responsible for any damages or losses caused to other equipment, whether direct, indirect, incidental, special or consequential which the purchaser may experience as a result of the installation or use of the product. The buyer's sole remedy for any breach of this agreement by Geokon, Inc. or any breach of any warranty by Geokon, Inc. shall not exceed the purchase price paid by the purchaser to Geokon, Inc. for the unit or units, or equipment directly affected by such breach. Under no circumstances will Geokon reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

Every precaution for accuracy has been taken in the preparation of manuals and/or software, however, Geokon, Inc. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages or losses that result from the use of the products in accordance with the information contained in the manual or software.

TABLE of CONTENTS

LIST of FIGURES, TABLES and EQUATIONS

1. THEORY OF OPERATION

Geokon Model 4500 Vibrating Wire Piezometers are intended primarily for long-term measurements of fluid and/or pore pressures in standpipes, boreholes, embankments, pipelines and pressure vessels. Several models of the 4500 series are available (see Appendix A). Contact Geokon sales engineers for specific application information.

The instrument utilizes a sensitive stainless steel diaphragm to which a vibrating wire element is connected. See Figure 1-1. In use, changing pressures on the diaphragm cause it to deflect, and this deflection is measured as a change in tension and frequency of vibration of the vibrating wire element. The square of the vibration frequency is directly proportional to the pressure applied to the diaphragm. Two coils, one with a magnet, another with a pole piece, are located close to the wire. In use, a pulse of varying frequency (swept frequency) is applied to the coils and this causes the wire to vibrate primarily at its resonant frequency. When excitation ends the wire continues to vibrate and a sinusoidal AC electrical signal, at the resonant frequency, is induced in the coils and transmitted to the readout box where it is conditioned and displayed.

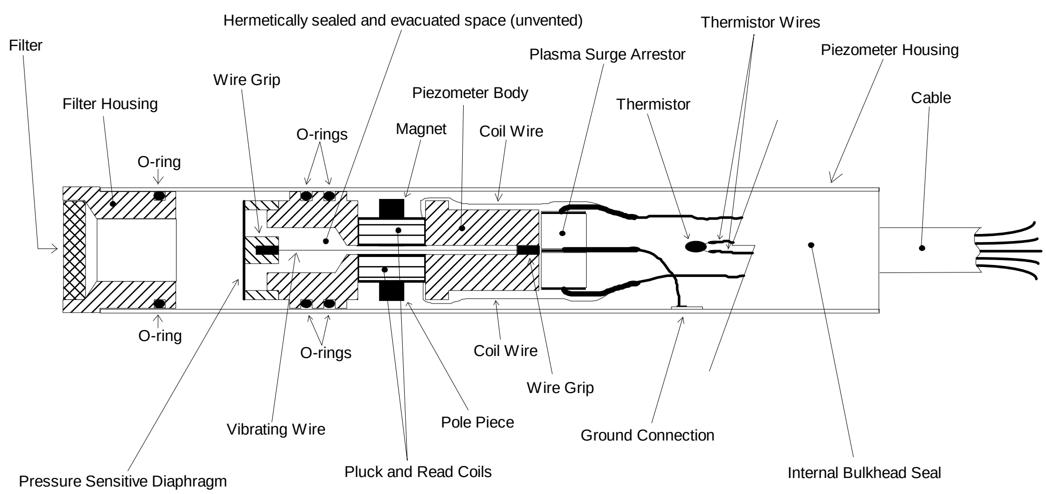

Figure 1-1 Vibrating Wire Piezometer

To prevent damage to the sensitive diaphragm a filter is used to keep out solid particles. Figure 1-1 illustrates. Standard filters are 50 micron stainless steel; high air entry value tips are available on request.

All exposed components are made of corrosion resistant stainless steel and, if proper installation techniques are used, the device should have an unlimited life. In salt water it may be necessary to use special materials for the diaphragm and housing.

Portable readout units are available to provide the excitation, signal conditioning and readout of the instrument. Datalogging systems are also available for remote unattended data collection of multiple sensors. Contact Geokon for additional information.

Calibration data are supplied with each piezometer for conversion of gage readings to engineering units such as pressure or level. See Section 4.

2. INSTALLATION

(For Quick Installation Instructions see AppendixE)

2.1 Preliminary Tests

Upon receipt of the piezometer the zero reading should be checked and noted (see Sections 3.1 to 3.3 for readout instructions). A thermistor is included inside the body of the piezometer (Figure 1-1) for the measurement of temperature (see Section 3.4 for instructions).

Calibration data are supplied with each gage and a zero reading, at a specific temperature and barometric pressure, is included. Zero readings at the site should coincide with the factory readings within 20 digits after barometric and temperature corrections are made. The factory elevation is +580 ft. Before March 21, 1995 factory barometric pressure readings were corrected to sea level; readings after this date represent absolute pressure. (Barometric pressure changes with elevation at a rate of ≈½ psi per 1,000 ft.) See Figure 2-1 for a sample calibration sheet.

GEOKON

Vibrating Wire Pressure Transducer Calibration

Model Number: 4500S-100 Pressure Range: 100 psi

Serial Number: 48056 Mfg. Number: 8-3275

Customer: Temperature: 21.1 °C

Cust. I.D. #: n/a Barometric Pressure: 998.1 mbar

Job Number: 13053 Date: Nov. 7, 1998

Cal. Std. Control #(s): 183, 468 Technician:

Pressure (psi)	Reading 1st Cycle	Pressure (psi)	Reading 2nd Cycle	Average Pressure	Average Reading	Change	Linearity (%FS)	Polynomial Fit (%FS)
0	9136	0	9141	0	9139		0.18	-0.04
20	8453	20	8456	20	8455	684	0.03	0.08
40	7772	40	7774	40	7773	682	-0.19	-0.01
60	7085	60	7083	60	7084	689	-0.19	-0.01
80	6392	80	6390	80	6391	693	-0.08	-0.03
100	5694	100	5687	100	5691	701	0.25	0.03

Linear Gage Factor (G): 0.029021 (psi/digit) Regression Zero: 9145

Polynomial Gage Factors: A: -1.40E-07 B: -0.026943 C:* 257.8826

Thermal Factor (K): -0.004326 (psi/°C)

Calculated Pressures: **Linear,** $P = G(R_0 - R_1) + K(T_1 - T_0) - (S_1 - S_0)$**

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$**

***Barometric compensation is not required with vented transducers.*

Factory Zero Reading:

GK-401 Pos. B or F(R_0): 9128 Temp(T_0): 21.8 °C Baro(S_0): 1001.4mbar Date: Jan. 27, 1997

**The user is advised to establish zero conditions in the field by recording the reading at a known temperature and barometric pressure.*

Wiring Code: Red and Black: Gage White and Green: Thermistor Bare: Shield

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

Figure 2-1 Sample Calibration Sheet

2.1.1 Establishing an Initial Zero Reading

Vibrating Wire Piezometers differ from other types of pressure sensors in that they indicate a reading at zero pressure. Therefore it is imperative that an accurate initial zero pressure reading be obtained for each piezometer as this reading will be used in all subsequent data reduction.

There are different ways of doing this but the essential element in all methods is that the piezometer be allowed to thermally stabilize in a constant temperature environment while the pressure on the piezometer is barometric only. Because of the way the piezometer is constructed it takes about 5 to 15 minutes for the temperature of all the different elements to equalize.

It will be necessary to measure the barometric pressure only if the piezometer is un-vented and if it will be installed in a location that is subject to barometric pressure changes that require correction, such as in an open well. *A piezometer sealed in place at depth could be recording pressures in groundwater that is not hydraulically connected to the atmosphere, and, for which, barometric pressure compensation would be inappropriate.*

The recommended way to achieve temperature stability is to hang the piezometer in the borehole at a point just above the water and wait until the piezometer reading has stopped changing. Now take the zero reading and read the temperature, indicated by the thermistor inside the piezometer.

Another way is to place the piezometer under water in a bucket and allow 5 to 15 minutes for the temperature to stabilize, then lift the piezometer out of the water and immediately take a reading. When doing this, lift the piezometer by the cable only, do not handle the piezometer housing as body heat from the hand could cause temperature transients. Use the thermistor inside the piezometer to measure the water temperature.

Another way is to simply read the piezometer while in the air while making sure that the temperature has had time to stabilized. If this method is chosen be sure that the piezometer is protected from sunlight or sudden changes of temperature: Wrapping it in some insulating material is recommended.

Yet another way is to lower the piezometer to a known depth as marked out on the piezometer cable, (The diaphragm inside the piezometer is located approximately ¾ inch (15mm), from the tip. Then use a dip meter to accurately measure the depth to the water surface. Now, after temperature stabilization, read the piezometer pressure and, using the factory calibration constants and a knowledge of the pressure (height x density) of the water column above the piezometer, calculate either the equivalent zero pressure reading, if the linear regression is used, or the factor, C, if the second order polynomial is used.

A question may arise as to what to do with the filter stone while taking zero readings. If a standard stainless steel filter is being used, it will not matter if the filter stone is saturated or not. But if ceramic high air entry filter stone is in use then it must be saturated while taking the zero readings and must not be allowed to dry out to the extent that surface tension effects can affect the zero reading.

2.1.2 Checking the Calibration

The following procedure is recommended to verify the calibration factor as supplied on the calibration sheet (Figure 2-1). It should be borne in mind that the piezometer measures water pressure and that the conversion to a water level requires an accurate knowledge of the density of the water.

1. The best method is to remove the filter housing and filter stone from off the tip of the piezometer: Pulling on the knurled ring will accomplish this. Alternatively, saturate the filter stone and fill the space between it and the diaphragm with water (Section 2.6).

2. Lower the piezometer to a point near the bottom of a water-filled borehole, or below the surface of a body of water. The use of a dip meter to measure the actual depth of the water in the borehole will be very desirable.

3. Allow 15-20 minutes for the piezometer to come to thermal equilibrium. Using a readout box record the reading at that level.

4. Raise the piezometer by known depth increments. Record the pressure reading at each depth increment. Calculate the in-situ calibration factor and compare to the calibration factor on the calibration sheet. The two values should agree within ± 0.5%. Repeat test if necessary.

There are a couple of things that can affect the in-situ calibration:

- The density of the in-situ water may not be 1gm/cc if it is saline or turbid. If this is the case then the factory calibration factor, should be adjusted to take into account the actual water density.
- **The water level inside the borehole may vary during the test due to the displacement of the water level as the cable is raised and lowered in the borehole**. This effect will be greater where the borehole diameter is smaller. For example, a Model 4500S-50 piezometer lowered 50 feet below the water column in a 1 inch (.875 inch ID) standpipe will displace the water level by more than 4 feet! If a dip-meter is available it should be used to confirm the water levels at each depth increment.

2.2 Installation in Standpipes or Wells

- A zero reading is first established (follow the procedures outlined in Section 2.1.1). The filter stone is saturated (follow the procedures in Section 2.6). Make a mark on the cable which will lie opposite the top of the standpipe, (well), when the piezometer has reached the desired depth. (The piezo diaphragm lies ¾ inch above the tip of the piezo).

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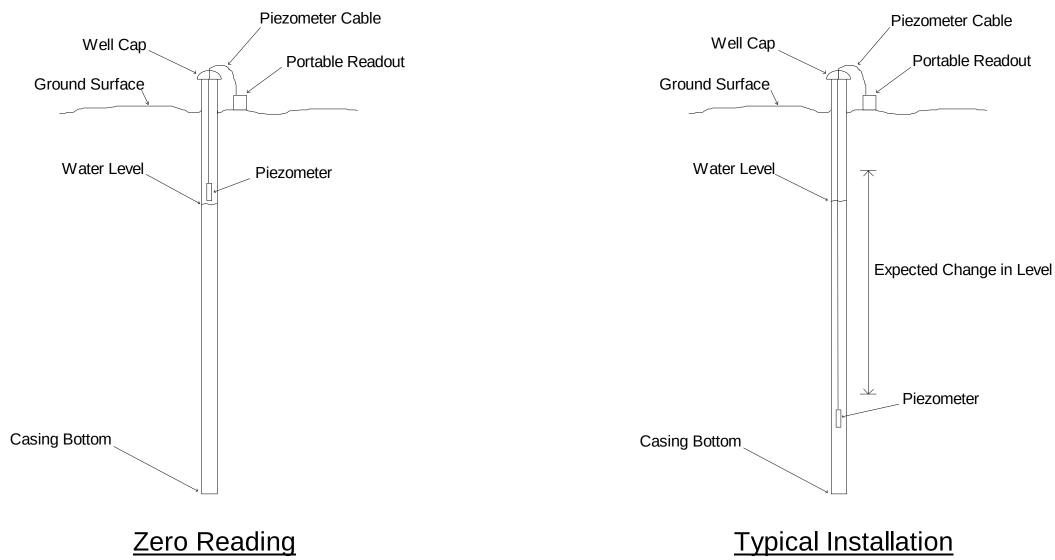


Figure 2-2 Typical Level Monitoring Installations

Be sure the cable is securely fastened at the top of the well or readings could be in error due to slippage of the piezometer into the well.

It is not recommended that piezometers be installed in wells or standpipes where an electrical pump and/or cable is present or nearby. Electrical interference from these sources can cause unstable readings. If unavoidable, it is recommended that the piezometer be placed inside a piece of steel pipe.

In situations where packers are used in standpipes the same sequence as above should be noted and special care should be taken to avoid cutting the cable jacket with the packer since this could introduce a possible pressure leakage path.

2.3 Installation in Boreholes

Geokon piezometers can be installed in boreholes in either single or multiple installations per hole, in cased or uncased holes. See Figure 2-3. Careful attention must be paid to borehole sealing techniques if pore pressures in a particular zone are to be monitored.

Boreholes should be drilled either without drilling mud or with a material that degrades rapidly with time, such as Revert™. The hole should extend from 6 inches to 12 inches below the proposed piezometer location and should be washed clean of drill cuttings. The bottom of the borehole should then be backfilled with clean fine sand to a point 6 inches below the piezometer tip. The piezometer can then be lowered, as delivered, into position. Preferably, the piezometer may be encapsulated in a canvas-cloth bag containing clean, saturated sand and then lowered into position. While holding the instrument in position (a mark on the cable is helpful) clean sand should be placed around the piezometer and to a point 6 inches above it. Figure 2-3 details two methods of isolating the zone to be monitored.

Installation A

Immediately above the "collection zone" the borehole should be sealed with either alternating layers of bentonite and sand backfill tamped in place for approximately 1 foot followed by common backfill or by an impermeable bentonite-cement grout mix. If multiple piezometers are to be used in a single hole the bentonite-sand plugs should be tamped in place below and above the upper piezometers and also at intervals between the piezometer zones. When designing and using tamping tools special care should be taken to ensure that the piezometer cable jackets are not cut during installation.

Installation B

Immediately above the "collection zone" the borehole should be filled with an impermeable bentonite grout.

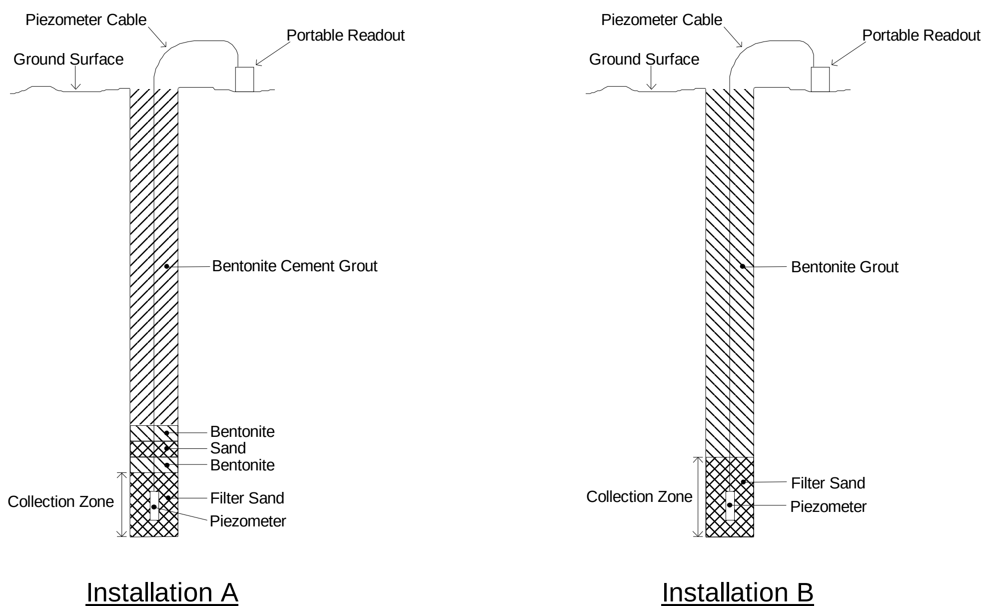


Figure 2-3 Typical Borehole Installations

Installation C

It should be noted that since the vibrating wire piezometer is basically a no-flow instrument, collection zones of appreciable size are not required and the piezometer can, in fact, be placed directly in contact with most materials provided that the fines are not able to migrate through the filter. The latest thinking, (*Mikkelson and Green, Piezometers in Fully Grouted Boreholes.Proceedings of FMGM 2003, Field Measurements in Geomechanics, Oslo, Norway, Sept. 2003. Contact Geokon for a copy o f this paper)*

is that it is not necessary to provide sand zones and that the piezometer can be grouted directly into the borehole using a bentonite cement grout only.
The general rule for installing piezometers in this way is to use a bentonite grout that mimics the strength of the surrounding soil. The emphasis should be on controlling the water-cement ratio. This is accomplished **by mixing the cement with the water first.** The most effective way of mixing is in a 50 to 200 gallon barrel or tub using the drill-rig pump to circulate the mix. Any kind of bentonite powder used to make drilling mud, combined with Type 1 or 2 Portland cement can be used. The exact amount of bentonite added will vary somewhat. The table below shows 2 possible mixes for strengths of 50 psi and 4 psi.
Add the measured amount of clean water to the barrel then gradually add the cement in the correct weight ratio. Next add the bentonite powder, slowly, so clumps do not form. Keep adding bentonite until the watery mix turns to an oily/slimy consistency. Let the grout thicken for another five to ten minutes. Add more bentonite as required until it is a smooth thick cream like pancake batter. It is now as heavy as it is feasible to pump. When pumping grout, unless the tremie-pipe is to be left in place, withdraw the tremie-pipe after each batch, by an amount corresponding to the grout level in the borehole.

Application	**Grout for Medium to Hard Soils**		**Grout for Soft Soils**	
Materials	Weight	Ratio by Weight	Weight	Ratio by Weight
Water	30 gallons	2.5	75 gallons	6.6
Portland Cement	94 lbs (1 sack)	1	94 lbs (1 sack)	1
Bentonite	25 lbs (as required)	0.3	39 lbs (as required)	0.4
Notes	The 28 day compressive strength of this mix is about 50 psi, similar to very stiff to hard clay. The modulus is about 10,000 psi		The 28 day strength of this mix is about 4psi, similar to very soft clay.	

Table 1 showing Cement/bentonite/water ratios for two grout mixes.

(For more details on this method of installation ask for a copy of the FMGM paper)

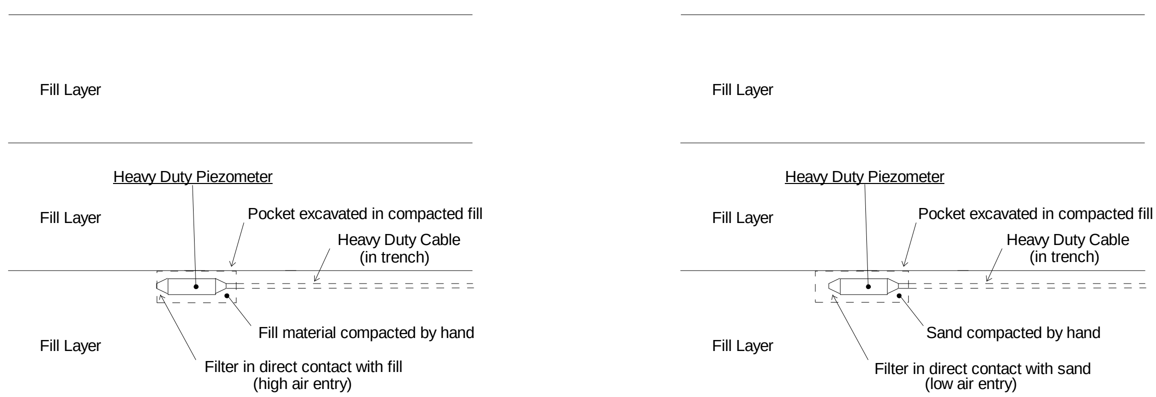
2.4 Installation in Fills and Embankments

Geokon piezometers are normally supplied with direct burial cable suitable for placement in fills such as highway embankments and dams, both in the core and in the surrounding materials.

In installations in non-cohesive fill materials the piezometer may be placed directly in the fill or, if large aggregate sizes are present, in a saturated sand pocket in the fill. If installed in large aggregate, additional measures may be necessary to protect the cable from damage.

In fills such as impervious dam cores where sub-atmospheric pore water pressure may need to be measured (as opposed to the pore air pressure) a ceramic tip with a high air entry value is often used which should be carefully placed in direct contact with the compacted fill material (see Installation A of Figure 2-4). In partially saturated fills if only the pore air pressure is to be measured, the standard tip is satisfactory. It should be noted that the coarse tip measures the air pressure when there is a difference between the pore air pressure and the pore water pressure, and that the difference between the two pressures is due to the capillary suction in the soil. The general consensus is that the difference is normally of no consequence to embankment stability. As a general rule the coarse (low air entry) tip is suitable for most routine measurements and, in fine cohesive soils, sand pockets should not be used around the piezometer tip (see Installation B of Figure 2-4). In high traffic areas and in material which exhibit pronounced "weaving", a heavy-duty armored cable should be used.

Cables are normally installed inside shallow trenches with the fill material consisting of smaller size aggregate. This fill is carefully hand compacted around the cable. Bentonite plugs are placed at regular intervals to prevent migration of water along the cable path.



Installation A   Installation B

Figure 2-4 Typical Dam Installations

2.5 Installation by Pushing or Driving into Soft Soils

The Model 4500DP piezometer is designed for pushing into soft soils. See Figure 2-5. The unit is connected directly to the drill rod (AW, EW or other) and pressed into the ground either by hand or by means of the hydraulics on the rig. The units can also be driven but the possibility of a zero shift due to the driving forces exists.

The piezometer should be connected to the readout box and monitored during the driving process. If measurement pressures reach or exceed the calibrated range, the driving should be stopped and the pressures allowed to dissipate before continuing.

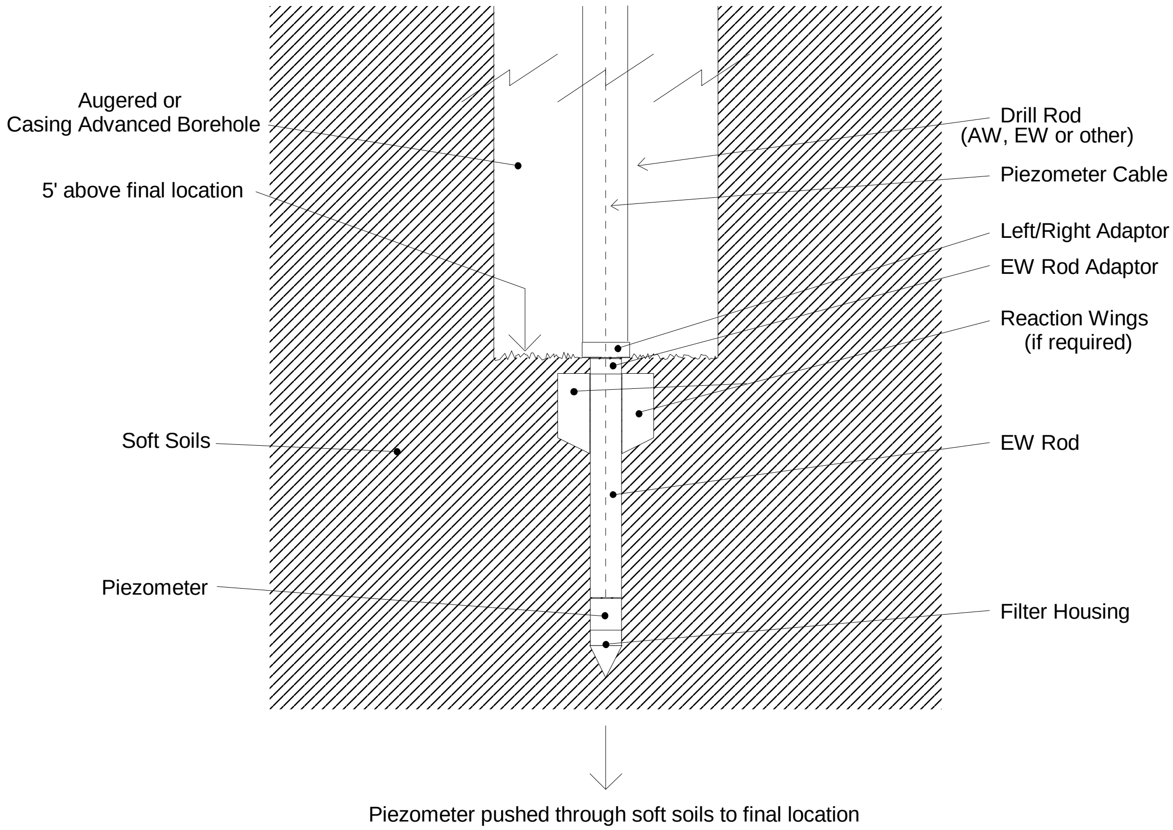


Figure 2-5 Typical Soft Soils Installation

The drill rod can be left in place or it can be removed. If it is to be removed then a special 5 foot section of EW (or AW) rod with wings and a left hand thread are attached directly to the piezometer tip. This section is detached from the rest of the drill string by rotating the string clockwise. The left hand thread will then loosen. The wings prevent the special EW rod from turning. A special LH/RH adapter is available from Geokon. The adapter is retrieved along with the drill string.

2.6 De-airing Filter Tips

Most Geokon filter tips can be removed for saturating and re-assembly. The procedures are as follows:

2.6.1 Low Air Entry Filter, Model 4500S and 4500PN

For accurate results, total saturation of the filter is necessary. For the low air entry filter normally supplied, this saturation occurs as the tip is lowered into the water. Water is forced into the filter, compressing the air in the space between the filter stone and the pressure sensitive diaphragm. After a period of time, this air will dissolve into the water until the space and the filter is entirely filled with water. To speed up the saturation process, remove the filter assembly and fill the space above the diaphragm with water, then slowly replace the filter housing allowing the water to squeeze through the filter stone. With low pressure range piezometers (<10 psi) take readings with a readout box while pushing the filter housing on so as not to over-range the sensor.

To maintain saturation, the unit should be kept under water until installation.

If the 4500S piezometer is to be used in standpipes and raised and lowered many times the filter may loosen. A permanent filter assembly may be required. The removable filter may be fixed permanently by prick punching the piezometer tube approximately 1/16" to 1/8" behind the filter assembly joint.

Screens are also available for standpipe installations. Screens are less likely than standard filters to become clogged where salts in the water can be deposited if the filter is allowed to dry out completely.

2.6.2 Removable Ceramic Filter, Model 4500S

The ceramic filter on the 4500S piezometer is also removable for de-airing. Because of the high air entry characteristics, de-airing is particularly important for this filter assembly. Filters with different air entry values require different procedures.

1 Bar Filters

1. Remove the filter from the piezometer by carefully twisting and pulling on the filter housing assembly.

2. Boil the filter assembly in de-aired water.

3. Re-assemble the filter housing and piezometer under the surface of a container of de-aired water. Be sure that no air is trapped in the transducer cavity. While pushing the filter on use a readout box to monitor the diaphragm pressure. Allow over-range pressure to dissipate before pushing further.

4. To maintain saturation, the unit should remain immersed until installation.

2 Bar and Higher

The proper procedure for de-airing and saturating these filters is somewhat complex and should be done either at the factory by Geokon or by carefully following the instructions below:

1. Place the assembled piezometer, filter down, in a vacuum chamber with an inlet port at the bottom for de-aired water.

2. Close off the water inlet and evacuate the chamber. The transducer should be monitored while the chamber is being evacuated.

3. When the maximum vacuum has been achieved, allow de-aired water to enter the chamber and reach an elevation a few inches above the piezometer filter.

4. Close off the inlet port. Release the vacuum.

5. Observe the transducer output. It will take as long as 24 hours for the filter to completely saturate (5 bar) and the pressure to rise to zero.

6. After saturation the transducer should be kept in a container of de-aired water until installation. If de-aired at the factory a special cap is applied to the piezometer to maintain saturation.

2.6.3 Model 4500DP

The 4500 Drive Point is de-aired in the same way as the above models by first unscrewing the point of the piezometer assembly and then following the instruction for the 4500S.

2.7 Model 4500H Transducer

When connecting the Model 4500H transducer to external fittings, the fitting should be tightened into the ¼"-NPT thread with a wrench on the flats provided on the transducer housing. Also, avoid tightening onto a closed system since the process of tightening the fittings could over-range and permanently damage the transducer. If in doubt, attach the gage leads to the readout box and take readings while tightening. Teflon tape on the threads makes for easier and more positive connection to the transducer.

2.8 Splicing and Junction Boxes

Because the vibrating wire output signal is a frequency rather than current or voltage, variations in cable resistance have little effect on gage readings and, therefore, splicing of cables has no effect either and, in some cases, may be beneficial. For example, if multiple piezometers are installed in a borehole, and the distance from the borehole to the terminal box or datalogger is great, a splice (or junction box, see Figure 2-6) could be made to connect the individual cables to a single multi-conductor cable. This multi-conductor cable would then be run to the readout station. For such installations it is recommended that the piezometer be supplied with enough cable to reach the installation depth plus extra cable to pass through drilling equipment (rods, casing, etc.).
The cable used for making splices should be a high quality twisted pair type with 100% shielding (with integral shield drain wire). When splicing, it is very important that the shield drain wires be spliced together! Splice kits recommended by Geokon incorporate casts placed around the splice then filled with epoxy to waterproof the connections. When properly made, this type of splice is equal or superior to the cable itself in strength and electrical properties. Contact Geokon for splicing materials and additional cable splicing instructions

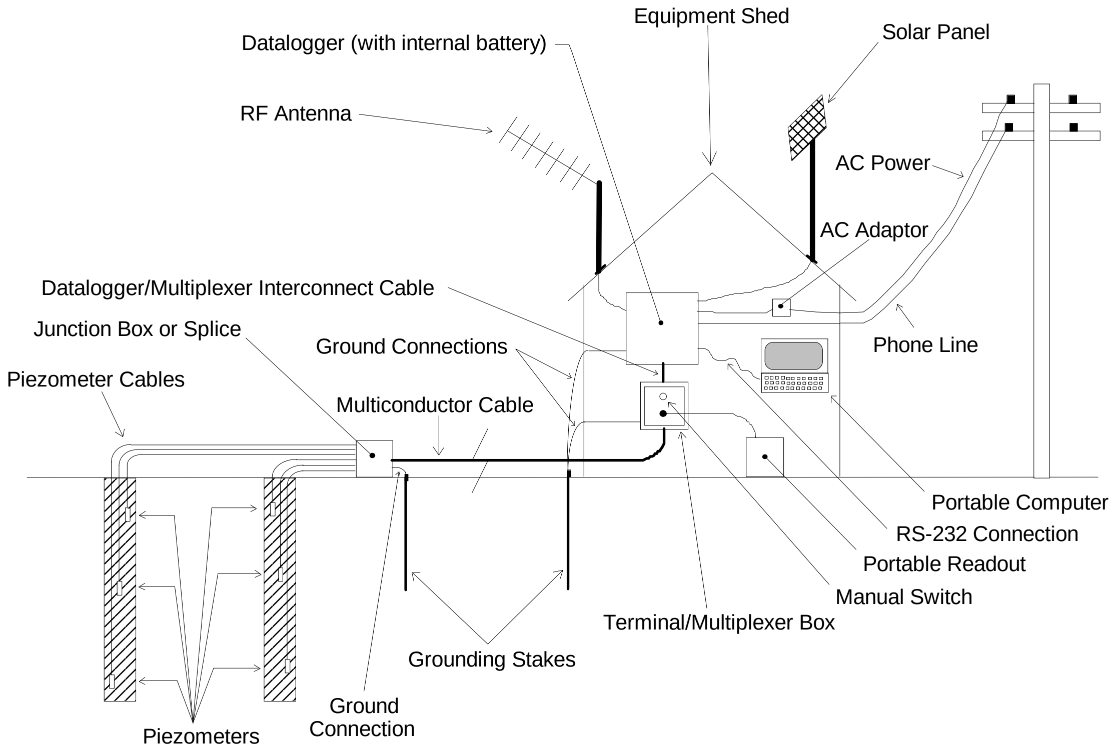


Figure 2-6 Typical Multi-Piezometer Installation

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Junction boxes and terminal boxes are available from Geokon for all types of applications. In addition, portable readout equipment and datalogging hardware are available. See Figure 2-6. Contact Geokon for specific application information.

2.9 Lightning Protection

In exposed locations it is vital that the piezometer be protected against lightning strikes.

A tripolar plasma surge arrestor (Figure 1-1) is built into the body of the piezometer and protects against voltage spikes across the input leads. Following are additional lightning protection measures available;

1. If the instruments will be read manually with a portable readout (no terminal box) a simple way to help protect against lightning damage is to connect the cable leads to a good earth ground when not in use. This will help shunt transients induced in the cable to ground thereby protecting the instrument.

2. Terminal boxes available from Geokon can be ordered with lightning protection built in. There are two levels of protection;

    - The terminal board used to make the gage connections has provision for installation of plasma surge arrestors (similar to the device inside the piezometer).

- Lightning Arrestor Boards (LAB-3) can be incorporated into the terminal box. These units utilize surge arrestors and transzorbs to further protect the piezometer.

In the above cases the terminal box would be connected to an earth ground.

3. Improved protection using the LAB-3 can be had by placing the board in line with the cable as close as possible to the installed piezometer (see Figure 2-7). This is the recommended method of lightning protection.

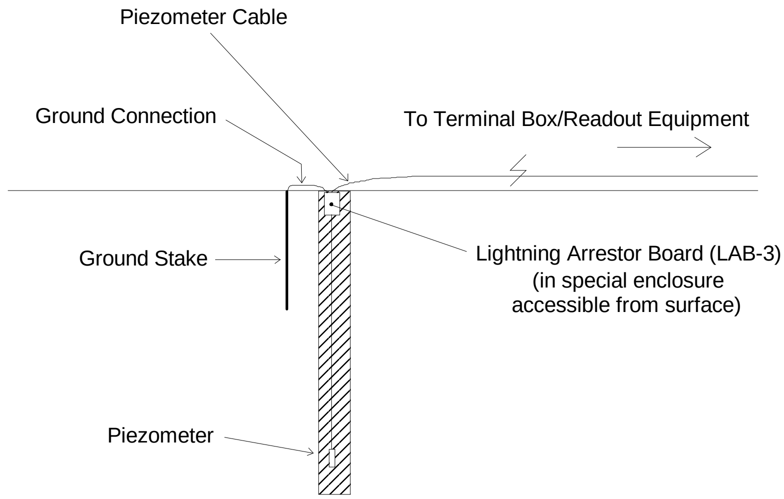


Figure 2-7 Recommended Lightning Protection Scheme

3. TAKING READINGS

3.1 Operation of the GK-401 Readout Box

The GK-401 is a basic readout for all vibrating wire gages.

Connect the Readout using the flying leads or in the case of a terminal station, with a connector. The red and black clips are for the vibrating wire gage, the green lead for the shield drain wire. The GK-401 cannot read the thermistor (see Section 3.4).

1. Turn the display selector to position "B" (or "F"). Readout is in digits (Equation 4-1).

2. Turn the unit on and a reading will appear in the front display window. The last digit may change one or two digits while reading. Record the value displayed. If zeros are displayed or the reading is unstable see section 5 for troubleshooting suggestions.

3. The unit will automatically turn itself off after approximately 4 minutes to conserve power.

3.2 Operation of the GK-403 Readout Box

The GK-403 can store gage readings and also apply calibration factors to convert readings to engineering units. Consult the GK-403 Instruction Manual for additional information on Mode "G" of the Readout. The following instructions will explain taking gage measurements using Modes "B" and "F" (similar to the GK-401 switch positions "B" and "F").

Connect the Readout using the flying leads or in the case of a terminal station, with a connector. The red and black clips are for the vibrating wire gage, the white and green leads are for the thermistor and the blue for the shield drain wire.

1. Turn the display selector to position "B" (or "F"). Readout is in digits (Equation 4-1).

2. Turn the unit on and a reading will appear in the front display window. The last digit may change one or two digits while reading. Press the "Store" button to record the value displayed. If the no reading displays or the reading is unstable see section 5 for troubleshooting suggestions. The thermistor will be read and output directly in degrees centigrade.

3. The unit will automatically turn itself off after approximately 2 minutes to conserve power.

3.3 Operation of the GK404 Readout Box

The GK404 is a palm sized readout box which displays the Vibrating wire value and the temperature in degrees centigrade.
The GK-404 Vibrating Wire Readout arrives with a patch cord for connecting to the vibrating wire gages. One end will consist of a 5-pin plug for connecting to the respective socket on the bottom of the GK-404 enclosure. The other end will consist of 5 leads terminated with alligator clips. Note the colors of the alligator clips are red, black, green, white and blue. The colors represent the positive vibrating wire gage lead (red), negative vibrating wire gage lead (black), positive thermistor lead (green), negative thermistor lead (white) and transducer cable drain wire (blue). The clips should be connected to their respectively colored leads from the vibrating wire gage cable.

Use the **POS** (Position) button to select position **B** and the MODE button to select **Dg** (digits).
Other functions can be selected as described in the GK404 Manual.

The GK-404 will continue to take measurements and display the readings until the OFF button is pushed, or if enabled, when the automatic Power-Off timer shuts the GK-404 off.
The GK-404 continuously monitors the status of the (2) 1.5V AA cells, and when their combined voltage drops to 2V, the message **Batteries Low** is displayed on the screen. A fresh set of 1.5V AA batteries should be installed at this point

3.4 Measuring Temperatures

Each vibrating wire piezometer is equipped with a thermistor for reading temperature. The thermistor gives a varying resistance output as the temperature changes. Usually the white and green leads are connected to the internal thermistor. High temperature versions use a different thermistor than the standard versions.
The GK-403 and GK 404 readout boxes when used with the **standard** temperature thermistor will display the temperature in °C automatically. They will **not** do this with high temperature thermistors. The GK 401 readout box will not read temperatures directly, instead an ohmmeter must be used.

1. Connect the ohmmeter to the two thermistor leads coming from the piezometer. (Since the resistance changes with temperature are so large, the effect of cable resistance is usually insignificant. For long cables a cirrection can be applied – equal to 16 ohms per thousand feet.)

2. For standard temperature models, look up the temperature for the measured resistance in Table B-1.Page 21 Alternately the temperature could be calculated using Equation B-1. For high temperature models use Table B2 or the equation B2 given on page 22.

4. DATA REDUCTION

4.1 Pressure Calculation

The digits displayed by the Geokon Models GK-401 or GK-403 Readout Boxes on channel B are based on the equation

$$\text{Digits} = \left(\frac{1}{\text{Period}}\right)^2 \times 10^{-3} \quad \text{or} \quad \text{Digits} = \frac{\text{Hz}^2}{1000}$$

Equation 4-1 Digits Calculation

For example, a piezometer reading 8000 digits corresponds to a period of 354μs and a frequency of 2828 Hz. Note that in the above equation, the period is in seconds: the readout boxes display microseconds.
Since digits are directly proportional to the applied pressure,

Pressure = (Initial Reading - Current Reading) × Calibration Factor

or

$$\mathbf{P = (R_0 - R_1) \times G}$$

Equation 4-2 Convert Digits to Pressure

Since the linearity of most sensors is within □ 0.2% FS the errors associated with non-linearity are of minor consequence. However, for those situations requiring the highest accuracy it may be desirable to use a second order polynomial to get a better fit of the data points. The use of a second order polynomial is explained in Appendix D.

The calibration sheet, a typical example of which is shown in figure 2.1 on page 4, shows the data from which the linear gage factor and the second order polynomial coefficients are derived. Columns on the right show the size of the error incurred by assuming a linear coefficient and the improvement which can be expected by going to a second order polynomial . In many cases the difference is minor. The calibration sheets gives the pressure in certain engineering units. These can be converted to other engineering units using the multiplication factors shown in Table 4-1 below.

From → To ↓	psi	"H_2O	'H_2O	mm H_20	m H_20	"HG	mm HG	atm	mbar	bar	kPa	MPa
psi	1	.036127	.43275	.0014223	1.4223	.49116	.019337	14.696	.014503	14.5039	.14503	145.03
"H_2O	27.730	1	12	.039372	39.372	13.596	.53525	406.78	.40147	401.47	4.0147	4016.1
'H_2O	2.3108	.08333	1	.003281	3.281	1.133	.044604	33.8983	.033456	33.4558	.3346	334.6
mm H_20	704.32	25.399	304.788	1	1000	345.32	13.595	10332	10.197	10197	101.97	101970
m H_20	.70432	.025399	.304788	.001	1	.34532	.013595	10.332	.010197	10.197	.10197	101.97
"HG	2.036	.073552	.882624	.0028959	2.8959	1	.03937	29.920	.029529	29.529	.2953	295.3
mm HG	51.706	1.8683	22.4196	.073558	73.558	25.4	1	760	.75008	750.08	7.5008	7500.8
atm	.06805	.0024583	.0294996	.0000968	.0968	.03342	.0013158	1	.0009869	.98692	.009869	9.869
mbar	68.947	2.4908	29.8896	.098068	98.068	33.863	1.3332	1013.2	1	1000	10	10000
bar	.068947	.0024908	.0298896	.0000981	.098068	.033863	.001333	1.0132	.001	1	.01	10
kPa	6.8947	.24908	2.98896	.0098068	9.8068	3.3863	.13332	101.320	.1	100	1	1000
MPa	.006895	.000249	.002988	.00000981	.009807	.003386	.000133	.101320	.0001	.1	.001	1

Table 4-1 Engineering Units Multiplication Factors

Note: Due to changes in specific gravity with temperature the factors for mercury and water in the above table are approximations!

4.2 Temperature Correction

Careful selection of materials is made in constructing the vibrating wire piezometer to minimize thermal effects, however, most units still have a slight temperature coefficient. Consult the supplied calibration sheet to obtain the coefficient for a given piezometer.

Since piezometers are normally installed in a tranquil and constant temperature environment, corrections are not normally required. If however, that is not the case for a selected installation, corrections can be made using the internal thermistor (Figure 1-1) for temperature measurement. See Section 3.4 for instructions regarding obtaining the piezometer temperature.

Temperature correction equation is as follows;

Temperature Correction = (Current Temperature - Initial Temperature) × Thermal Factor

or

$$P_T = (T_1 - T_0) \times K$$

Equation 4-3 Temperature Correction

The calculated correction would then be **added** to the Pressure calculated using Equation 4-2. If the engineering units were converted remember to apply the same conversion to the calculated temperature correction!

For example, assume the initial temperature was 22° C, the current temperature is 15° C, and the thermal coefficient is −.01879 PSI per °C rise (Figure 2-1). The temperature correction is .13 PSI. Adding this to the calculated pressure in the example of Section 4.1 results in a temperature corrected pressure of 19.98 PSI.

4.3 Barometric Correction (required only on un-vented transducers)
Since the standard piezometer is hermetically sealed and un-vented, it responds to changes in atmospheric pressure. That being the case, corrections may be necessary, particularly for the sensitive, low pressure models. For example, a barometric pressure change from 29 to 31 inches of mercury would result in ≈1 PSI of error (or ≈2.3 feet if monitoring water level in a well!). Thus it is advisable to read and record the barometric pressure every time the piezometer is read. A separate pressure transducer (piezometer), kept out of the water, may be used for this purpose.
Barometric correction equation is as follows;

$$\textbf{Barometric Correction} = (\textbf{Current Barometer} - \textbf{Initial Barometer}) \times \textbf{Conversion Factor}$$

or

$$P_B = (S_1 - S_0) \times F$$

Equation 4-4 Barometric Correction

Since barometric pressure is usually recorded in inches of mercury a Conversion Factor is necessary to convert to PSI. The Conversion Factor for inches of mercury to PSI is .491. Table 4-1 lists other common Conversion Factors.

The calculated correction is usually **subtracted** from the Pressure calculated using Equation 4-2. If the engineering units were converted remember to apply the same conversion to the calculated barometric correction!

The user should be cautioned that this correction scheme assumes ideal conditions. In reality, conditions are not always ideal. For example, if the well is sealed, barometric effects at the piezometer level may be minimal or attenuated from the actual changes at the surface. Thus errors may result when applying a correction which is not required. We recommend, in these cases, to independently record barometric pressure changes and correlate these with observed pressure changes to arrive at a correction factor.

> An alternative to making barometric correction is to use piezometers that are vented to the atmosphere as noted section 4.3.1. However, vented piezos only make sense if the piezo is in an open well or standpipe and the user is only interested in the water level. Otherwise, if the piezo is buried it is not certain that the full effect of the barometric change will be felt immediately at the piezo and is more likely to be attenuated and delayed, in which case a vented piezo would automatically apply a correction that is too large and too soon. Having an on-site barometer with un-vented piezos also has the advantage that you can see the barometric change and judge to what extent it may have affected the piezo reading.

Equation 4-5 describes the pressure calculation with temperature and barometric correction applied.

$$P_{corrected} = ((R_0 - R_1) \times G) + ((T_1 - T_0) \times K) - ((S_1 - S_0) \times F)$$

Equation 4-5 Corrected Pressure Calculation

4.3.1 Vented Piezometers

Vented piezometers are designed to eliminate barometric effects. The space inside the transducer is not hermetically sealed and evacuated (see Figure 1-1), but is connected via a tube (integral with the cable) to the atmosphere. A chamber containing desiccant capsules is attached to the end of the tube to prevent moisture from entered the transducer cavity. Vented piezometers require more maintenance then non-vented types, and there is always a danger that water can find its way into the inside of the transducer and ruin it.
As supplied, the outer end of the desiccant chamber is closed by means of a seal screw to keep the desiccant fresh during storage and transportation. **THE SEAL SCREW MUST BE REMOVED BEFORE THE PIEZOMETER IS PUT INTO SERVICE!** The desiccant capsules are blue when fresh, they will gradually turn pink as they absorb moisture. When they have turned light pink in color they should be replaced. Contact Geokon for replacement capsules.

4.4 Environmental Factors

Since the purpose of the piezometer installation is to monitor site conditions, factors which may affect these conditions should always be observed and recorded. Seemingly minor effects may have a real influence on the behavior of the structure being monitored and may give an early indication of potential problems. Some of the factors include, but are not limited to; blasting, rainfall, tidal levels, excavation and fill levels and sequences, traffic, temperature and barometric changes (and other weather conditions), changes in personnel, nearby construction activities, seasonal changes, etc.

5. TROUBLESHOOTING

Maintenance and troubleshooting of vibrating wire piezometers is confined to periodic checks of cable connections and maintenance of terminals. The transducers themselves are sealed and not user serviceable. Following are typical problems and suggested remedial action.

- **Piezometer fails to give a reading**

1. Check the resistance of the coils by connecting an ohmmeter across the gage terminals. Nominal resistance is 180Ω (±5%), plus cable resistance at approximately 16Ω per 1000' of 22 AWG wire. If the resistance is very high or infinite the cable is probably broken or cut. If the resistance is very low the gage conductors may be shorted. If a cut or a short is located in the cable, splice according to instructions in Section 2.8.
2. Check the readout with another gage.
3. The Piezometer may have been over-ranged or shocked. Inspect the diaphragm and housing for damage. Contact the factory.

- **Piezometer reading unstable**

1. Connect the shield drain wire to the readout using the green (GK-401) or the blue (GK-403) clip.
2. Isolate the readout from the ground by placing it on a piece of wood or similar non-conductive material.

3. Check for sources of nearby noise such as motors, generators, antennas or electrical cables. Move the piezometer cables if possible. Contact the factory for filtering and shielding equipment available.
4. The Piezometer may have been damaged by over-ranging or shock.
5. The body of the Piezometer may be shorted to the shield. Check the resistance between the shield drain wire and the Piezometer housing.

- **Thermistor resistance is too high**

1. Likely there is an open circuit. Check all connections, terminals and plugs. If a cut is located in the cable, splice according to instructions in Section 2.8.

- **Thermistor resistance is too low**

1. Likely there is a short. Check all connections, terminals and plugs. If a short is located in the cable, splice according to instructions in Section 2.8.
2. Water may have penetrated the interior of the piezometer. There is no remedial action.

APPENDIX A - SPECIFICATIONS

Model	4500S	4500AL[1]	4500B	4500C	4500DP	4580[2]
Available Ranges (psi)	0-50 0-100 0-150 0-250 0-500 0-750 0-1000 0-1500 0-3000 0-5000 0-10000 0-15000	0-5 0-10 0-25	0-50 0-100 0-250	0-50 0-100 0-250	0-10 0-25 0-50 0-150 0-250 0-500 0-750 0-1000 0-1500 0-3000 0-5000 0-10000	0-1 0-5
Resolution	0.025% FS	0.025% FS	0.025% FS	0.05% FS	0.025% FS	0.01% FS
Linearity	< 0.5% FS[3]	< 0.5% FS[3]	< 0.5% FS[3]	< 0.5% FS[3]	< 0.5% FS[3]	< 0.5% FS[3]
Accuracy	0.1% FS[4]	0.1% FS[4]	0.1% FS[4]	0.1% FS[4]	0.1% FS[4]	0.1% FS
Over-Range	2 × FS	2 × FS	2 × FS	2 × FS	2 × FS	2 × FS
Thermal Coefficient	<0.025% FS/ °C	<0.05% FS/ °C	<0.025% FS/ °C	<0.05% FS/ °C	<0.025% FS/ °C	<0.025% FS/ °C
Temperature Range	-20°C to +80°C	-20°C to +80°C	-20°C to +80°C	-20°C to +80°C	-20°C to +80°C	-20°C to +80°C
OD	.75" 19.05 mm	1" 25.40 mm	.687" 17.45 mm	.437" 11.10 mm	1.3” 33.3mm	1.5" 38.10 mm
Length	5.25" 133.35 mm	5.25" 133.35 mm	5.25" 133.35 mm	6.5" 165.10 mm	7.36” 187 mm	6.5" 165.10 mm

Table A-1 Vibrating Wire Piezometer Specifications

Accuracy of Geokon test apparatus: 0.1%

Contact Geokon for specific application information.

Notes:

[1] Accuracy of test apparatus: 0.05%

[2] Other ranges available upon request.

[3] 0.1% FS linearity available upon request.

[4] Derived using 2nd order polynomial.

APPENDIX B – **STANDARD TEMPERATURE** THERMISTOR TEMPERATURE DERIVATION

Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3

Resistance to Temperature Equation B1:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3} - 273.2$$

Where; T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance
A = 1.4051×10^{-3} (coefficients calculated over the -50 to $+150°$ C. span)
B = 2.369×10^{-4}
C = 1.019×10^{-7}

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	**3000**	**25**	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Table B-1 **STANDARD TEMPERATURE** Thermistor Resistance versus Temperature

High Temperature Thermistor Linearization using SteinHart-Hart Log Equation

Thermistor Type: Thermometrics BR55KA822J

Basic Equation B2:

$$\mathbf{T = \frac{1}{A + B(LnR) + C(LnR)^3} - 273.2}$$

Where: T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance
$A = 1.02569 \times 10^{-3}$
$B = 2.478265 \times 10^{-4}$
$C = 1.289498 \times 10^{-7}$

Note: Coefficients calculated over -30° to +260° C. span.

Table B2

Temp	R (ohms)	LnR	LnR^3	Calculated Temp	Diff	FS Error	Temp	R (ohms)	LnR	LnR^3	Calculated Temp	Diff	FS Error
-30	113898	11.643	1578.342	-30.17	0.17	0.06	120	407.62	6.010	217.118	120.00	0.00	0.00
-25	86182	11.364	1467.637	-25.14	0.14	0.05	125	360.8	5.888	204.162	125.00	0.00	0.00
-20	65805	11.094	1365.581	-20.12	0.12	0.04	130	320.21	5.769	191.998	130.00	0.00	0.00
-15	50684.2	10.833	1271.425	-15.10	0.10	0.03	135	284.95	5.652	180.584	135.00	0.00	0.00
-10	39360	10.581	1184.457	-10.08	0.08	0.03	140	254.2	5.538	169.859	140.01	-0.01	0.00
-5	30807.4	10.336	1104.068	-5.07	0.07	0.02	145	227.3	5.426	159.773	145.02	-0.02	-0.01
0	24288.4	10.098	1029.614	-0.05	0.05	0.02	150	203.77	5.317	150.314	150.03	-0.03	-0.01
5	19294.6	9.868	960.798	4.96	0.04	0.01	155	183.11	5.210	141.428	155.04	-0.04	-0.01
10	15424.2	9.644	896.871	9.98	0.02	0.01	160	164.9	5.105	133.068	160.06	-0.06	-0.02
15	12423	9.427	837.843	14.98	0.02	0.01	165	148.83	5.003	125.210	165.08	-0.08	-0.03
20	10061.4	9.216	782.875	19.99	0.01	0.00	170	134.64	4.903	117.837	170.09	-0.09	-0.03
25	8200	9.012	731.893	25.00	0.00	0.00	175	122.1	4.805	110.927	175.08	-0.08	-0.03
30	6721.54	8.813	684.514	30.01	-0.01	0.00	180	110.95	4.709	104.426	180.07	-0.07	-0.02
35	5540.74	8.620	640.478	35.01	-0.01	0.00	185	100.94	4.615	98.261	185.10	-0.10	-0.04
40	4592	8.432	599.519	40.02	-0.02	-0.01	190	92.086	4.523	92.512	190.09	-0.09	-0.03
45	3825.3	8.249	561.392	45.02	-0.02	-0.01	195	84.214	4.433	87.136	195.05	-0.05	-0.02
50	3202.92	8.072	525.913	50.01	-0.01	-0.01	200	77.088	4.345	82.026	200.05	-0.05	-0.02
55	2693.7	7.899	492.790	55.02	-0.02	-0.01	205	70.717	4.259	77.237	205.02	-0.02	-0.01
60	2276.32	7.730	461.946	60.02	-0.02	-0.01	210	64.985	4.174	72.729	210.00	0.00	0.00
65	1931.92	7.566	433.157	65.02	-0.02	-0.01	215	59.819	4.091	68.484	214.97	0.03	0.01
70	1646.56	7.406	406.283	70.02	-0.02	-0.01	220	55.161	4.010	64.494	219.93	0.07	0.02
75	1409.58	7.251	381.243	75.01	-0.01	0.00	225	50.955	3.931	60.742	224.88	0.12	0.04
80	1211.14	7.099	357.808	80.00	0.00	0.00	230	47.142	3.853	57.207	229.82	0.18	0.06
85	1044.68	6.951	335.915	85.00	0.00	0.00	235	43.673	3.777	53.870	234.77	0.23	0.08
90	903.64	6.806	315.325	90.02	-0.02	-0.01	240	40.533	3.702	50.740	239.69	0.31	0.11
95	785.15	6.666	296.191	95.01	-0.01	0.00	245	37.671	3.629	47.788	244.62	0.38	0.13
100	684.37	6.528	278.253	100.00	0.00	0.00	250	35.055	3.557	45.001	249.54	0.46	0.16
105	598.44	6.394	261.447	105.00	0.00	0.00	255	32.677	3.487	42.387	254.44	0.56	0.19
110	524.96	6.263	245.705	110.00	0.00	0.00	260	30.496	3.418	39.917	259.34	0.66	0.23
115	461.91	6.135	230.952	115.00	0.00	0.00							

Table B2 High Temperature. Temperature v Thermistor Resistance

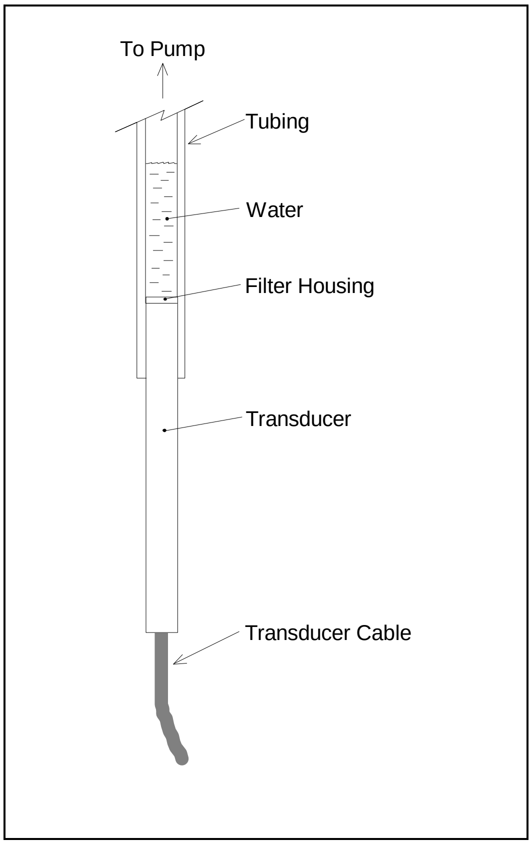
APPENDIX C - NOTES REGARDING THE MODEL 4500C

Installation

The construction of this very slender vibrating wire transducer, requires a miniaturization of the internal parts and consequently they are somewhat delicate. Despite every precaution it is possible for the zero to shift during shipment due to rough handling. However, tests have shown that the zero may shift but the calibration factors do not change. Therefore it is doubly important that the initial no load zero reading be taken prior to installation. **And it is also important to handle the transducer gently during the installation procedure.**

If the pressures to be measured are less than 5 psi the filter stone in the filter housing must be saturated. ***However, the filter stone and housing are not removable in the 4500C. Any attempt to remove the filter stone or the housing will destroy the transducer!***

To saturate the filter a hand vacuum pump and short length of tubing (½" surgical tubing) is required. Attach the tube to the transducer as shown in the figure. Fill the tubing with approximately 2" (5 cm) of water. Hold the transducer so that the water rests on the filter. Attach the other end of the tube to the hand vacuum pump. While holding the transducer so that the water rests on the filter (and doesn't enter the pump!), squeeze the hand pump to initiate vacuum in the tubing. This will draw the air out of the filter and the space behind it. The water will replace it. A vacuum of 20-25" Hg. (50-65 cm Hg.) is sufficient for proper evacuation.



A hand pump that has been used successfully is the mityvacII® by Neward Enterprises, Inc. of Cucamonga, CA, USA. Hand pumps and tubing are available from the factory.

Data Reduction
Data reduction follows the same procedures as outlined in Section 4 of this manual.. Use Table 4-1 to convert psi to other engineering units.

APPENDIX D

NON LINEARITY AND THE USE OF A SECOND ORDER POLYNOMIAL TO IMPROVE THE ACCURACY OF THE CALCULATED PRESSURE

Most vibrating wire pressure transducers are sufficiently linear (± 0.2 % FS) that use of the linear calibration factor satisfies normal requirements. However, it should be noted that the accuracy of the calibration data, which is dictated by the accuracy of the calibration apparatus, is always ± 0.1 % FS.

This level of accuracy can be recaptured, even where the transducer is non-linear, by the use of a second order polynomial expression which gives a better fit to the data then does a straight line.

The polynomial expression has the form:

$$\text{pressure} = AR^2 + BR + C$$

where R is the reading (digits channel B) and A,B,C, are coefficients. The figure on page 24 shows a calibration sheet of a transducer which has a comparatively high non-linearity. The figure under the "Linearity (%FS)" column is

$$\frac{\text{Calculated pressure- True pressure}}{\text{Full-scale Pressure}} \times 100\% = \frac{G(R_0 - R_1) - P}{F.S} \times 100\%$$

Note The linearity is calculated using the regression zero for R_0

For example when P= 40 psi, G (R_0 - R_1) = 0.029021(9145-7773), gives a calculated pressure of 39.817 psi. The error is 0.183 psi equal to 5 inches of water.

Whereas the polynomial expression gives a calculated pressure of A $(7773)^2$ + B (7773) + C = 39.996 psi and the actual error is only 0.004 psi or 0.1 inch of water.

Note. If the polynomial equation is used it is important that the value of C, in the polynomial equation, be taken in the field, following the procedures described in section 2.1.1. The field value of C is calculated by inserting the initial zero reading into the polynomial equation with the pressure, P, set to zero.

It should be noted that where changes of water levels are being monitored it makes little difference whether the linear coefficient or the polynomial expression is used.

GEOKON

Vibrating Wire Pressure Transducer Calibration

Model Number: 4500S-100 Pressure Range: 100 psi

Serial Number: 48056 Mfg. Number: 8-3275

Customer: Temperature: 21.1 °C

Cust. I.D. #: n/a Barometric Pressure: 998.1 mbar

Job Number: 13053 Date: Nov. 7, 1998

Cal. Std. Control #(s): 183, 468 Technician:

Pressure (psi)	Reading 1st Cycle	Pressure (psi)	Reading 2nd Cycle	Average Pressure	Average Reading	Change	Linearity (%FS)	Polynomial Fit (%FS)
0	9136	0	9141	0	9139		0.18	-0.04
20	8453	20	8456	20	8455	684	0.03	0.08
40	7772	40	7774	40	7773	682	-0.19	-0.01
60	7085	60	7083	60	7084	689	-0.19	-0.01
80	6392	80	6390	80	6391	693	-0.08	-0.03
100	5694	100	5687	100	5691	701	0.25	0.03

Linear Gage Factor (G): 0.029021 (psi/digit) Regression Zero: 9145

Polynomial Gage Factors: A: -1.40E-07 B: -0.026943 C:* 257.8826

Thermal Factor (K): -0.004326 (psi/°C)

Calculated Pressures: **Linear,** $P = G(R_0 - R_1) + K(T_1 - T_0) - (S_1 - S_0)$**

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$**

***Barometric compensation is <u>not</u> required with vented transducers.*

Factory Zero Reading:

GK-401 Pos. B or F(R_0): 9128 Temp(T_0): 21.8 °C Baro(S_0): 1001.4 mbar Date: Jan. 27, 1997

**The user is advised to establish zero conditions in the field by recording the reading at a known temperature and barometric pressure.*

Wiring Code: Red and Black: Gage White and Green: Thermistor Bare: Shield

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

Vibrating Wire Pressure Transducer Calibration Sheet

APPENDIX E

QUICK INSTRUCTIONS FOR INSTALLING A VIBRATING WIRE PIEZOMETER.

- Take a zero reading at zero, (atmospheric), pressure. Make sure that the temperature has not changed for 15 minutes previously. (Or until the piezo reading has stabilized). Check that this zero reading is compatible with the zero on the calibration sheet

- Record the barometric pressure and the temperature at the time the zero reading is taken.

- Carefully measure the length of the cable and make a mark on the cable which will lie opposite the top of the borehole, well, or standpipe when the piezometer has reached the desired depth. (The piezo diaphragm lies ¾ inch above the tip of the piezo).

- Saturate the piezometer filter. (Section 2.6)

- Follow the instruction of Section 2.2 for installation in standpipes or wells or Section 2.3 for boreholes.

Attachment 3

Multiple Linear Regression Analysis Results for Mudline Transducers

Attachment 4

Groundwater Level Recovery Evaluation

Attachment 5

Events 1 and 2 Data Quality Review for Pressure Transducers

Attachment 6

Events 1 and 2 Conductivity Profiles and Pressure Plots

List of Figures

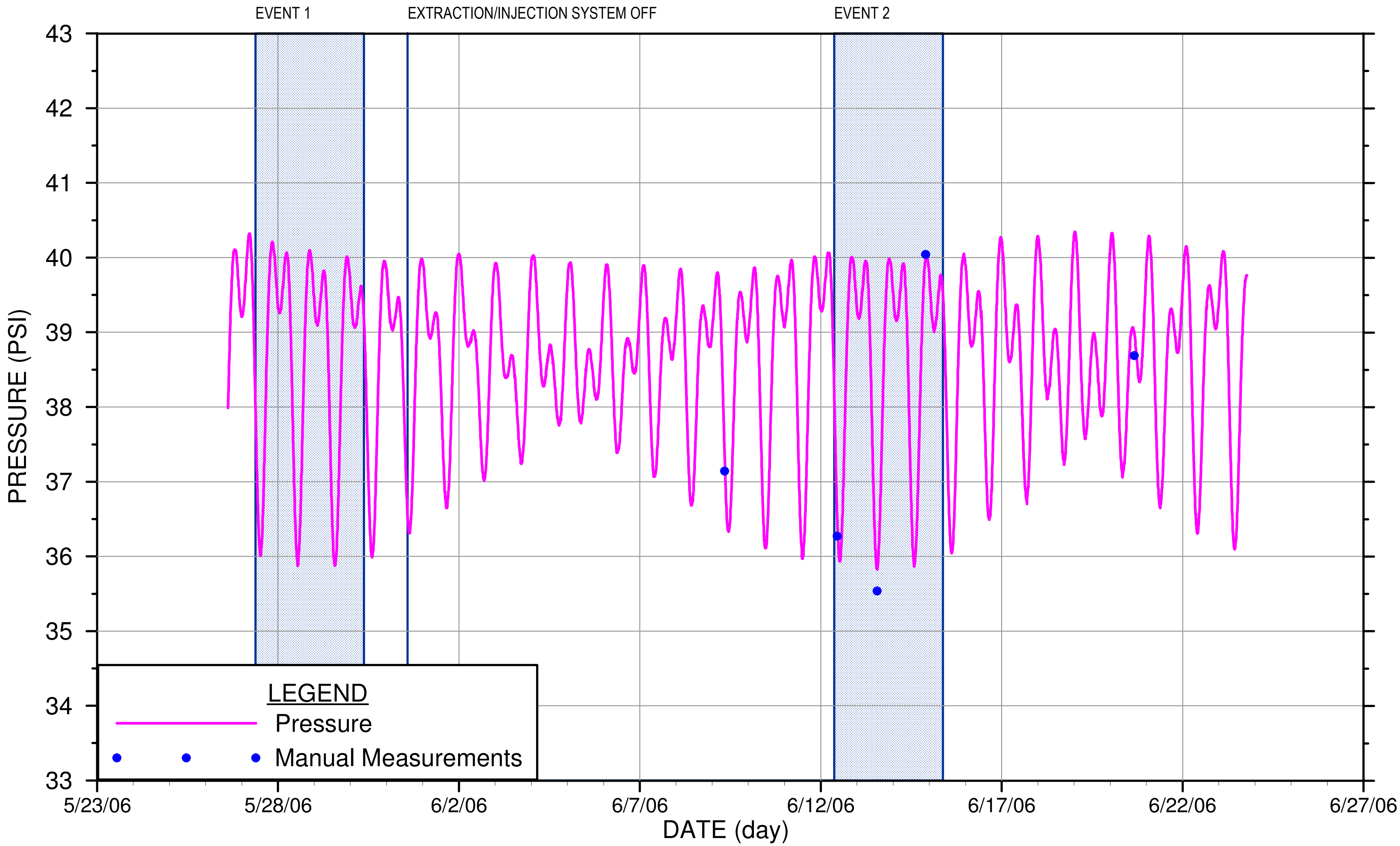


figure 6P-1

1-100R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

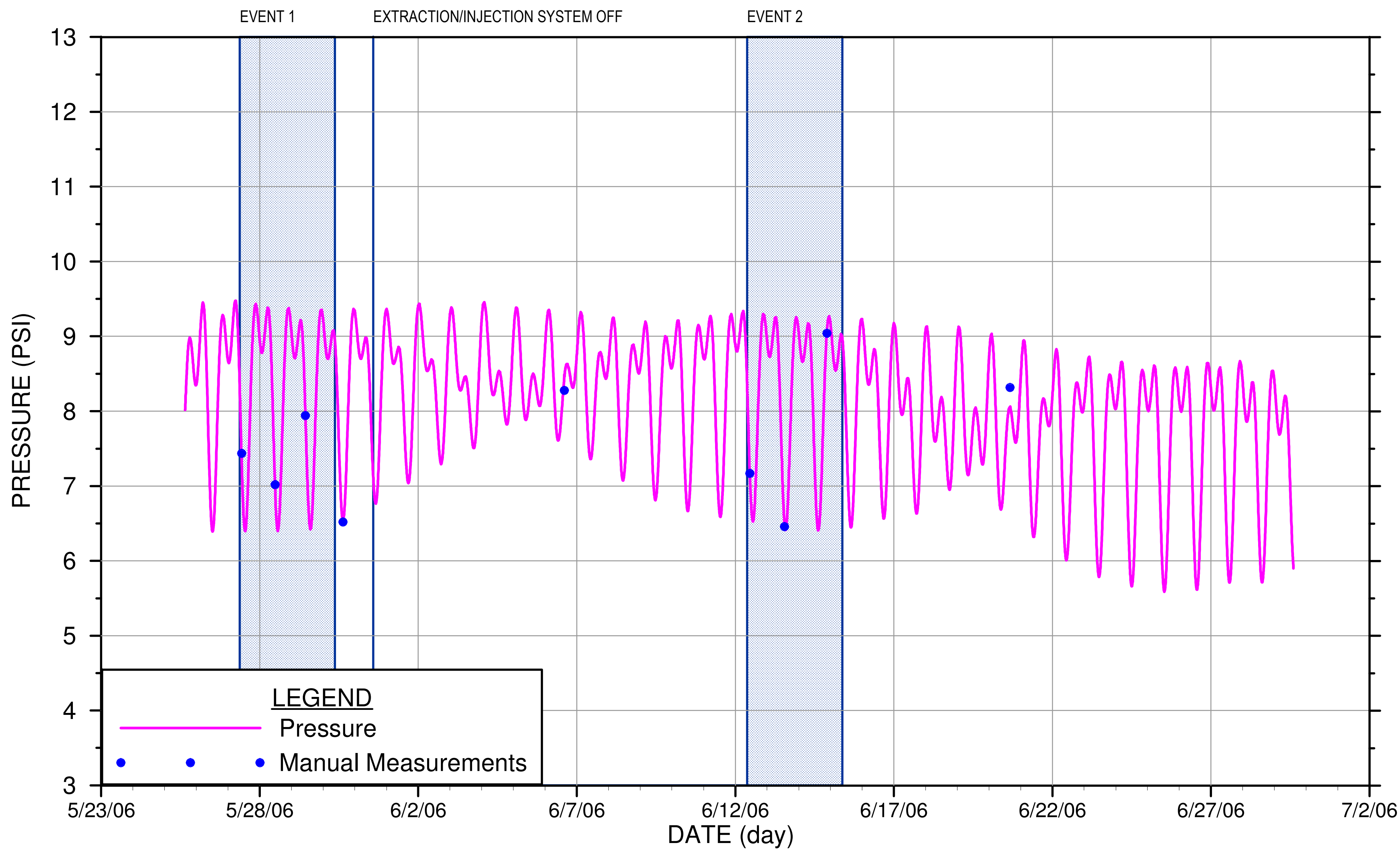


figure 6P-2

1-175 PRESSURE VERSUS TIMES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-2.grf) JAN 3/2011

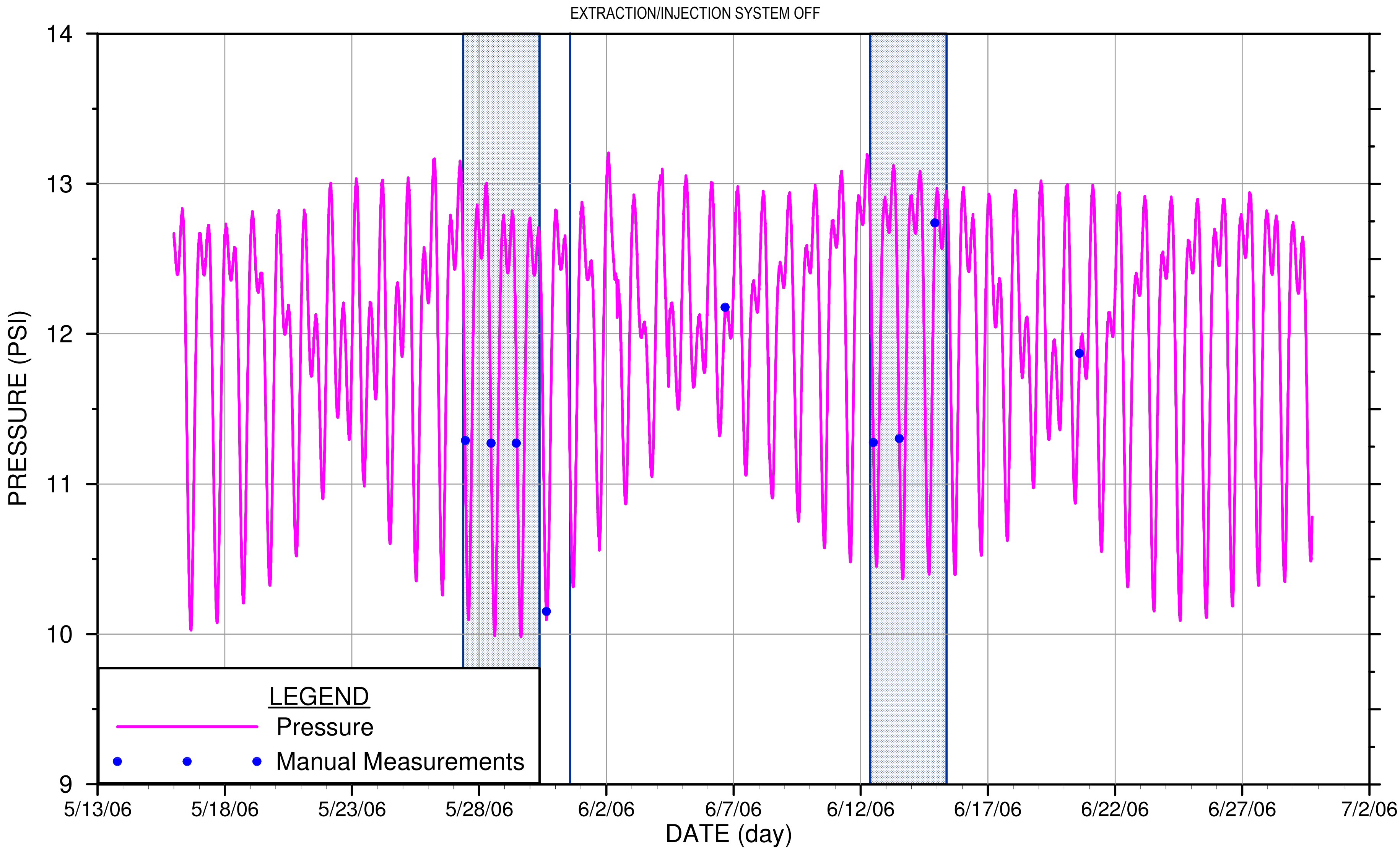


figure 6P-3

2-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

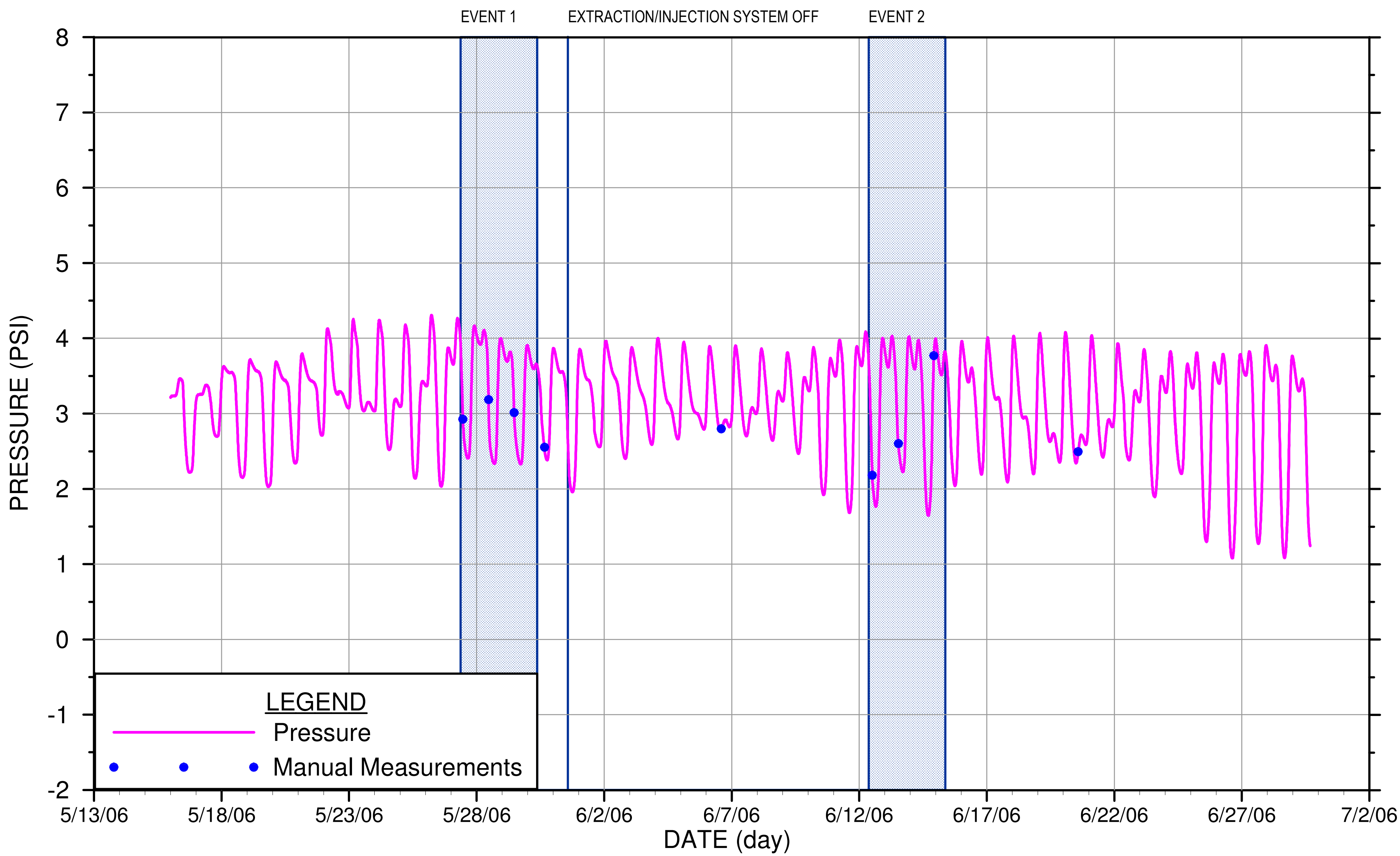


figure 6P-4

3-50 PRESSURE VERSUS TIMES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-4.grf) JAN 3/2011

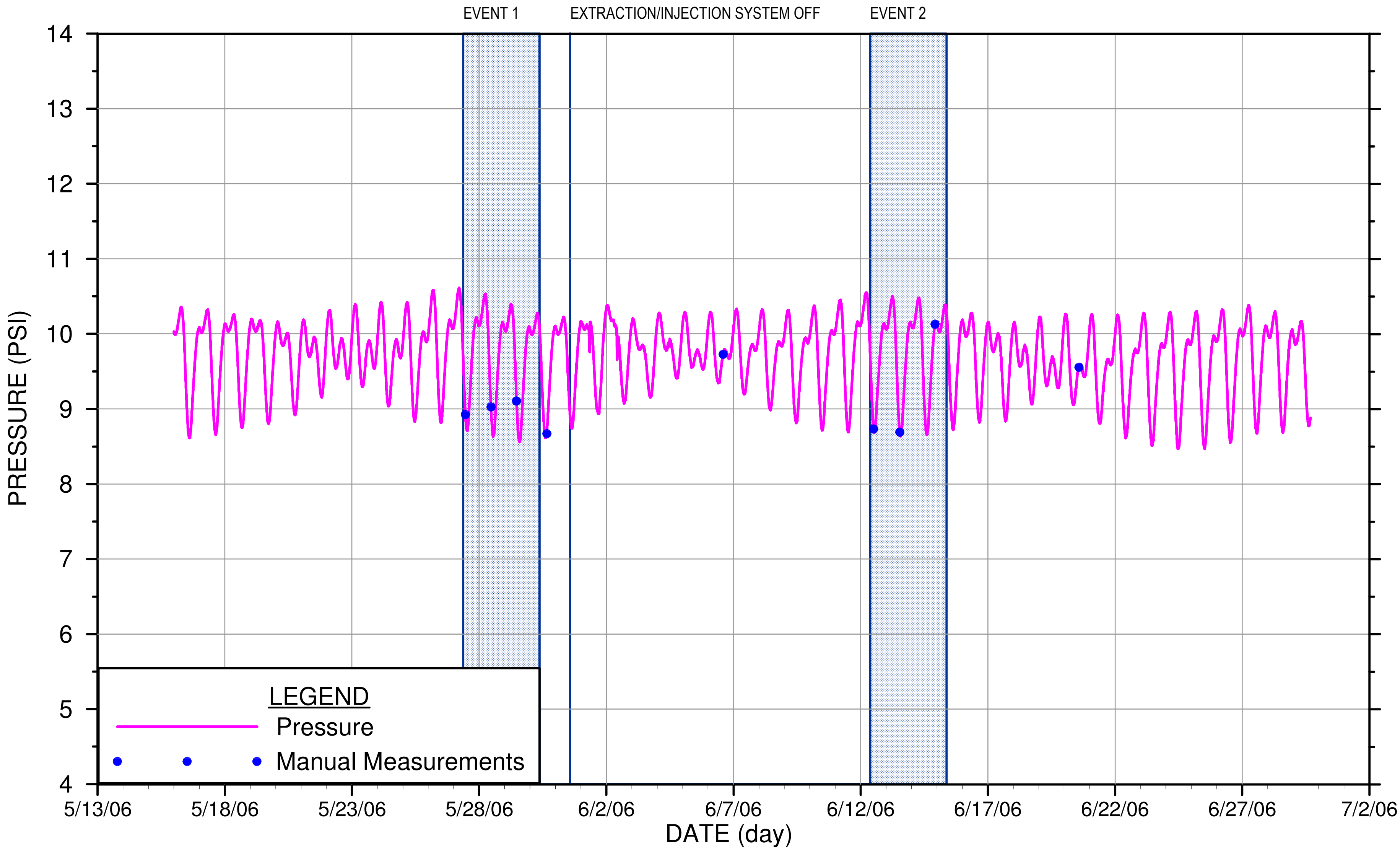


figure 6P-5

3-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-5.grf) JAN 3/2011

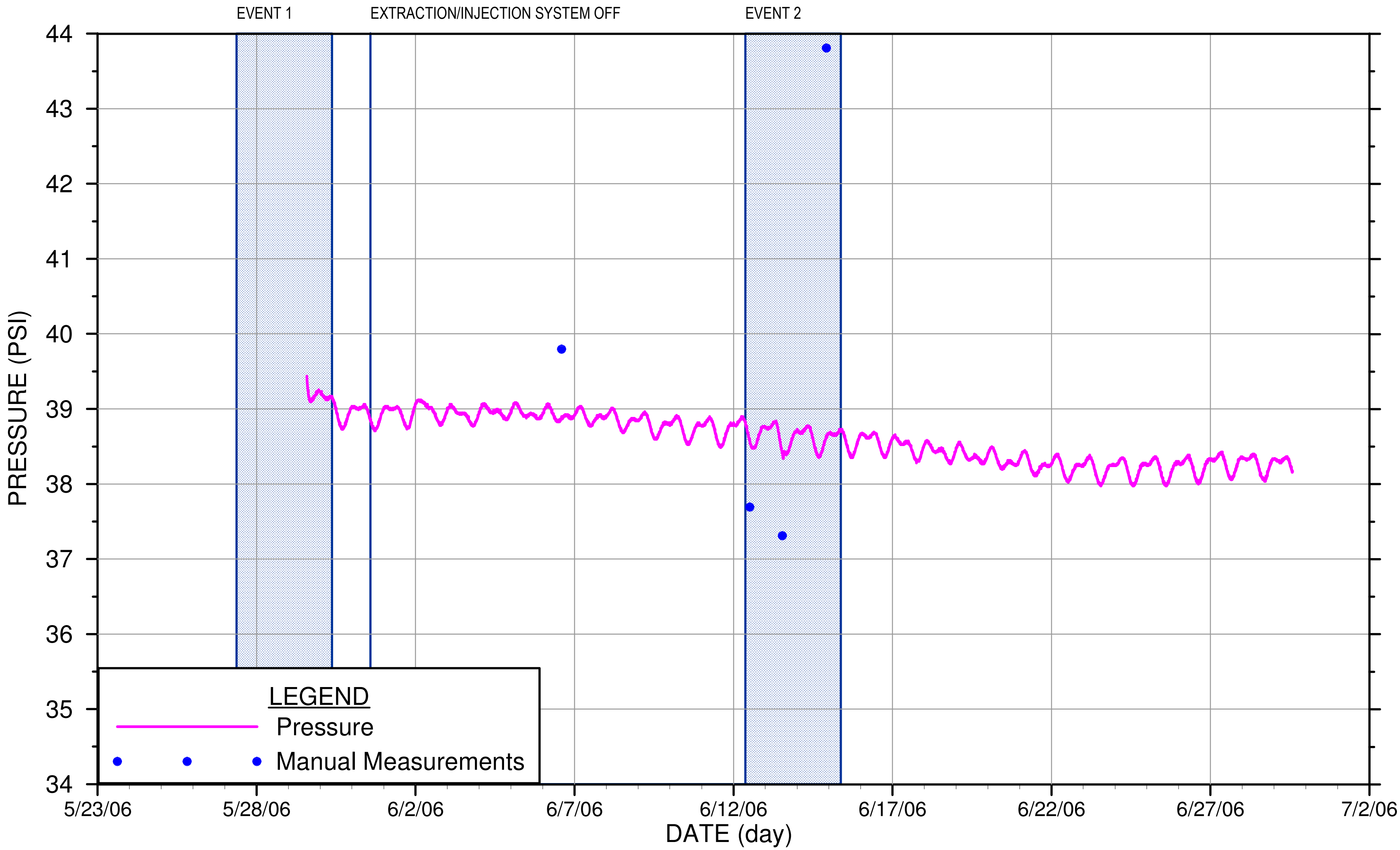


figure 6P-6

3-175 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

CRA

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-6.grf) JAN 3/2011

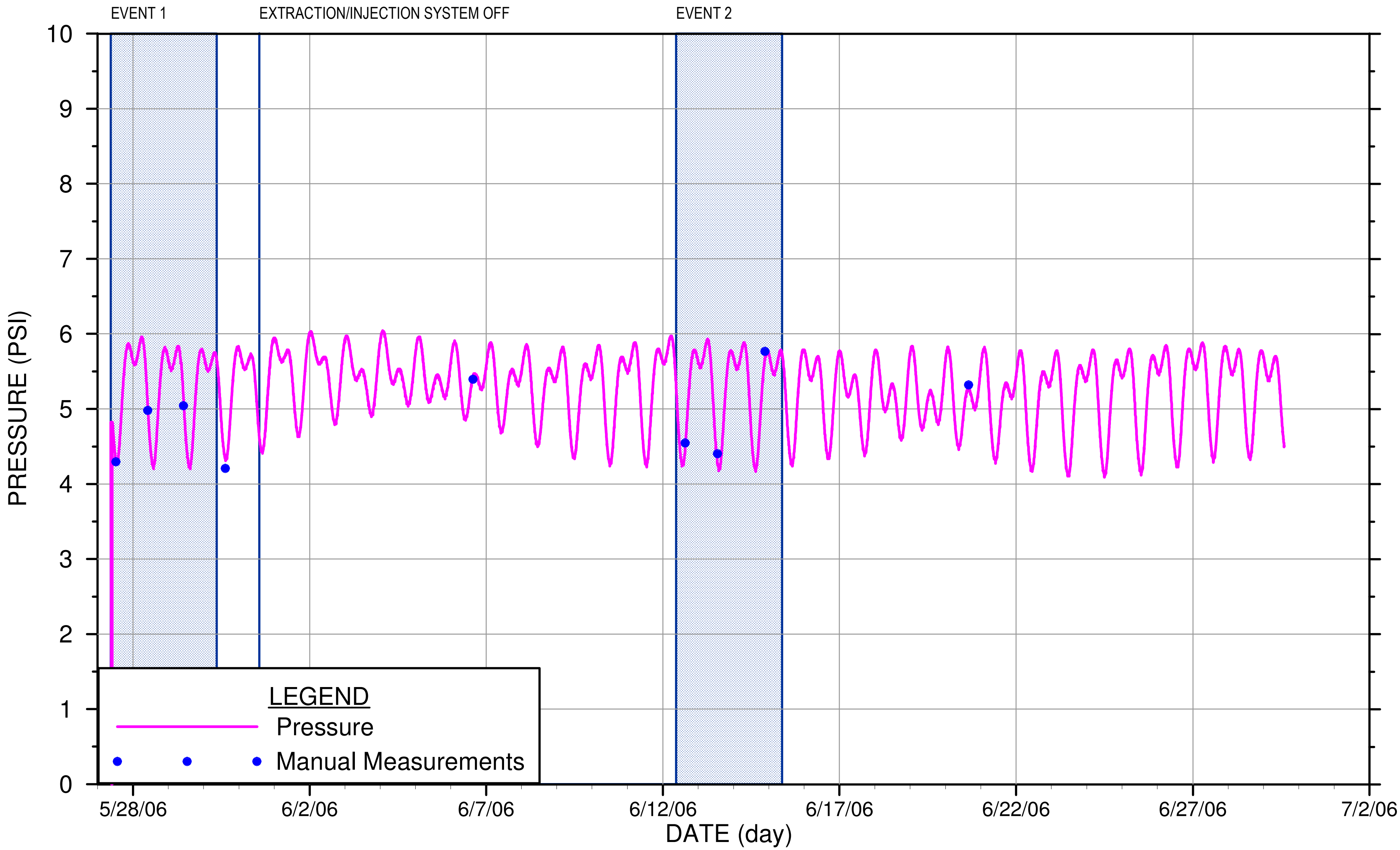


figure 6P-7

4-25R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-7.grf) JAN 3/2011

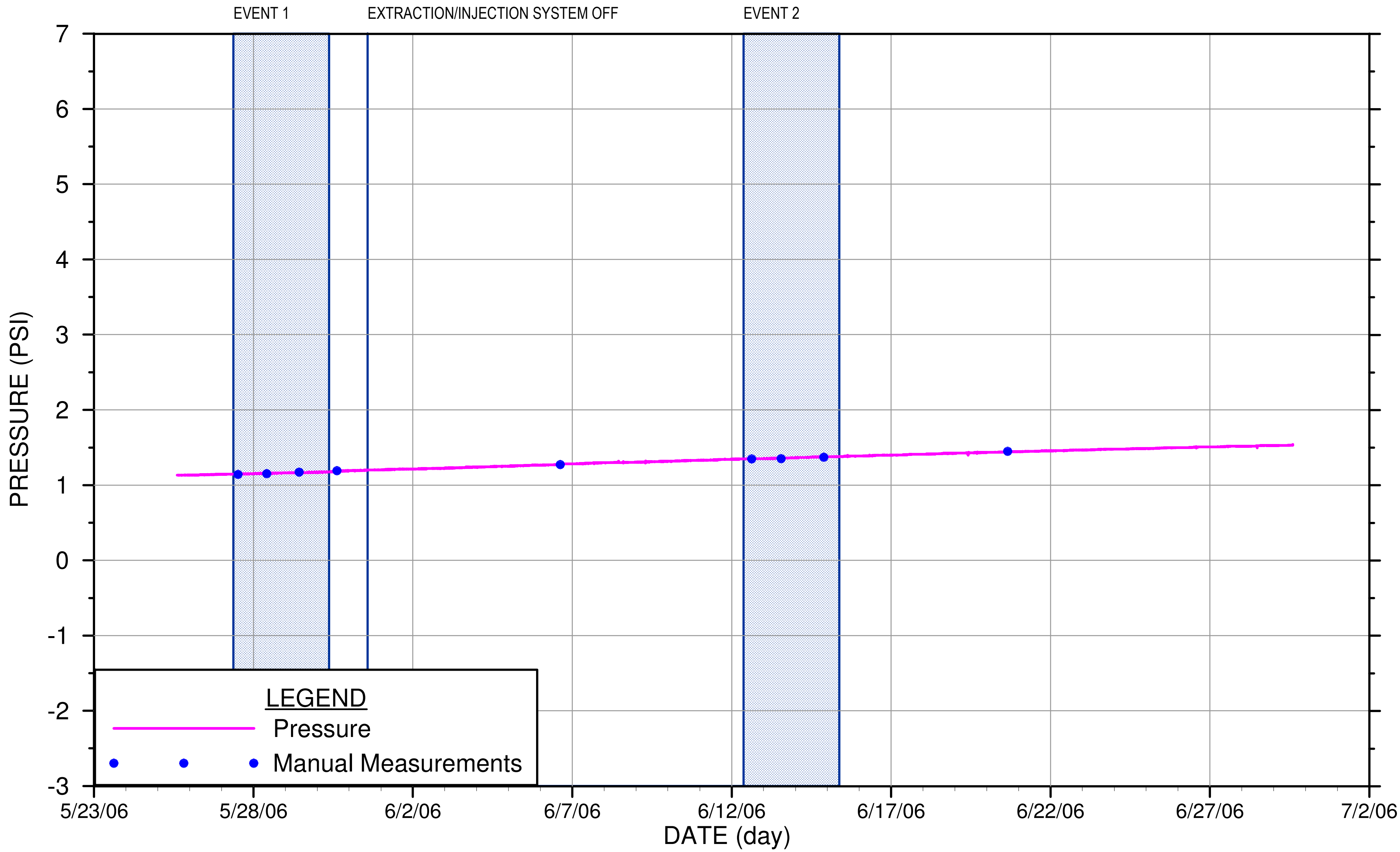


figure 6P-8

4-45R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-8.grf) JAN 3/2011

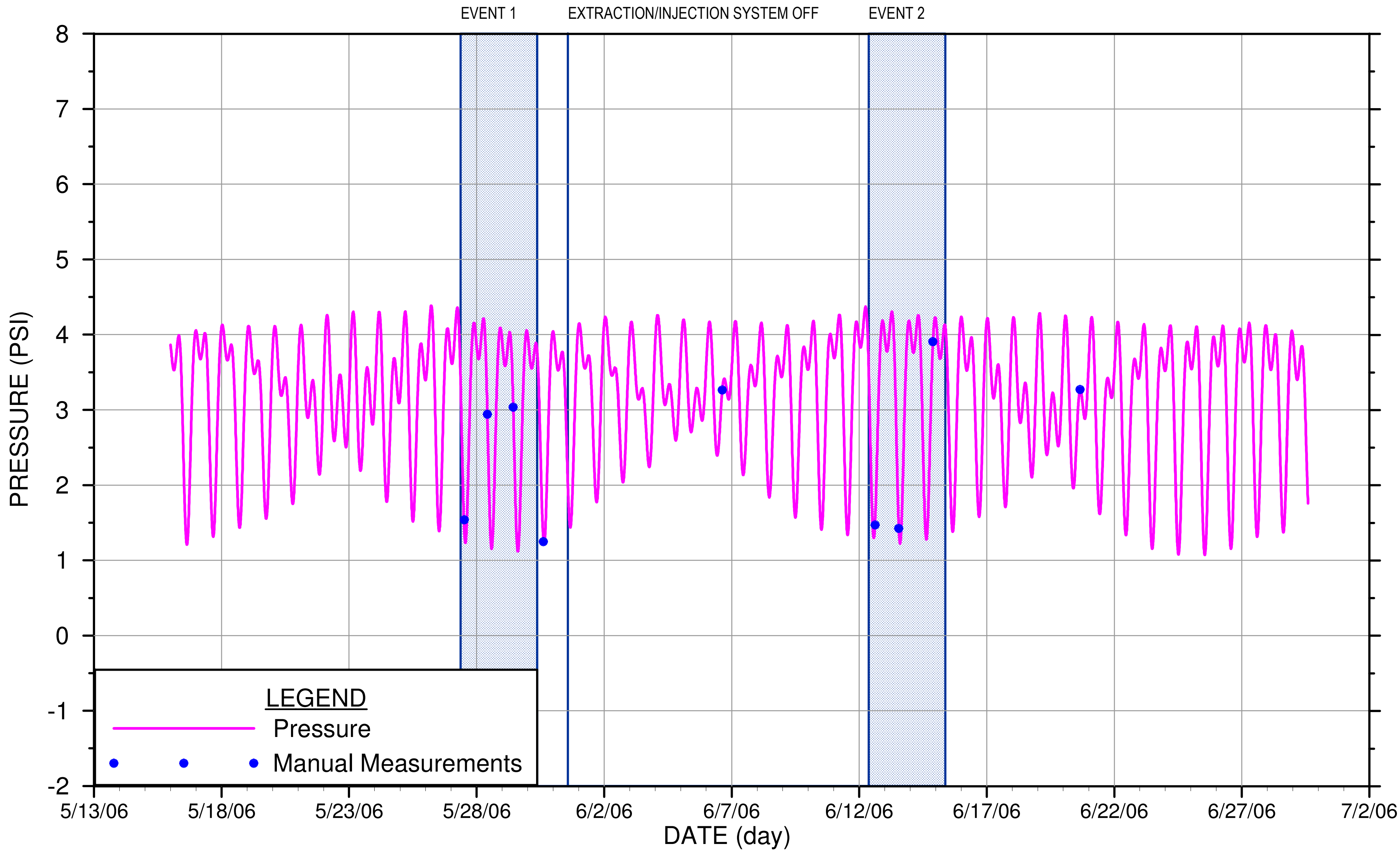


figure 6P-9

4-83R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-9.grf) JAN 3/2011

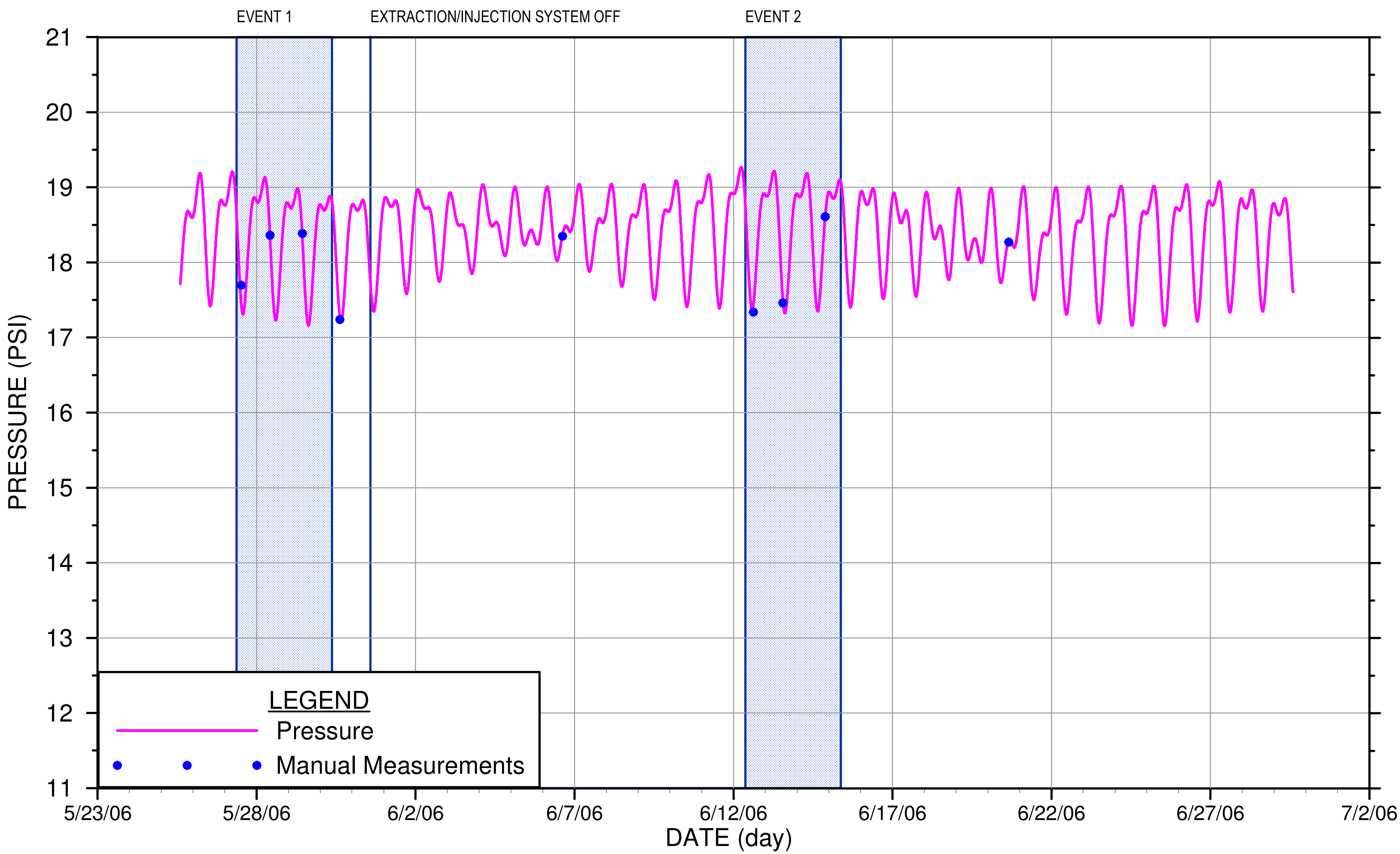


figure 6P-10

4-115R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-10.grf) JAN 3/2011

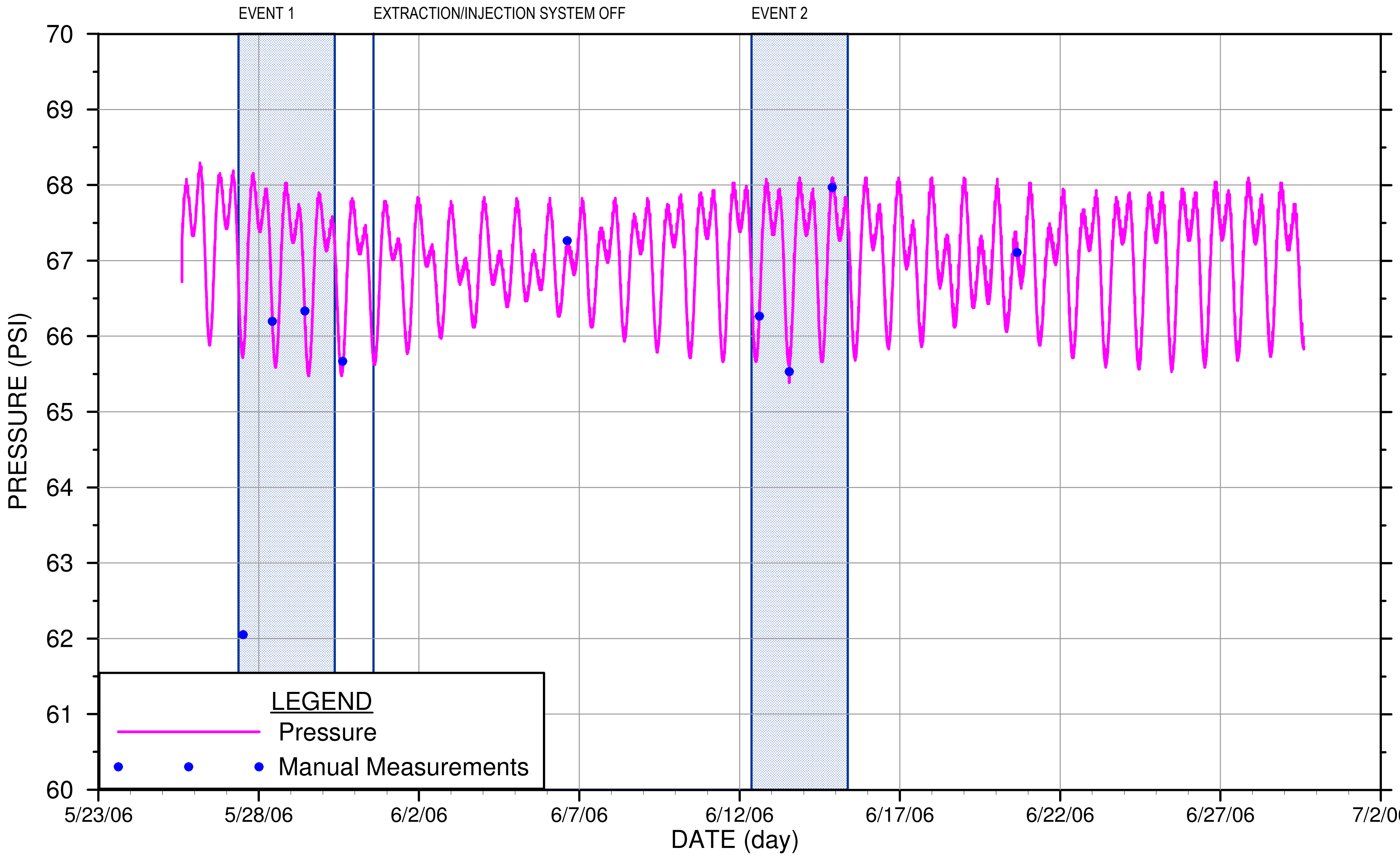


figure 6P-11

4-175R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-11.grf) JAN 3/2011

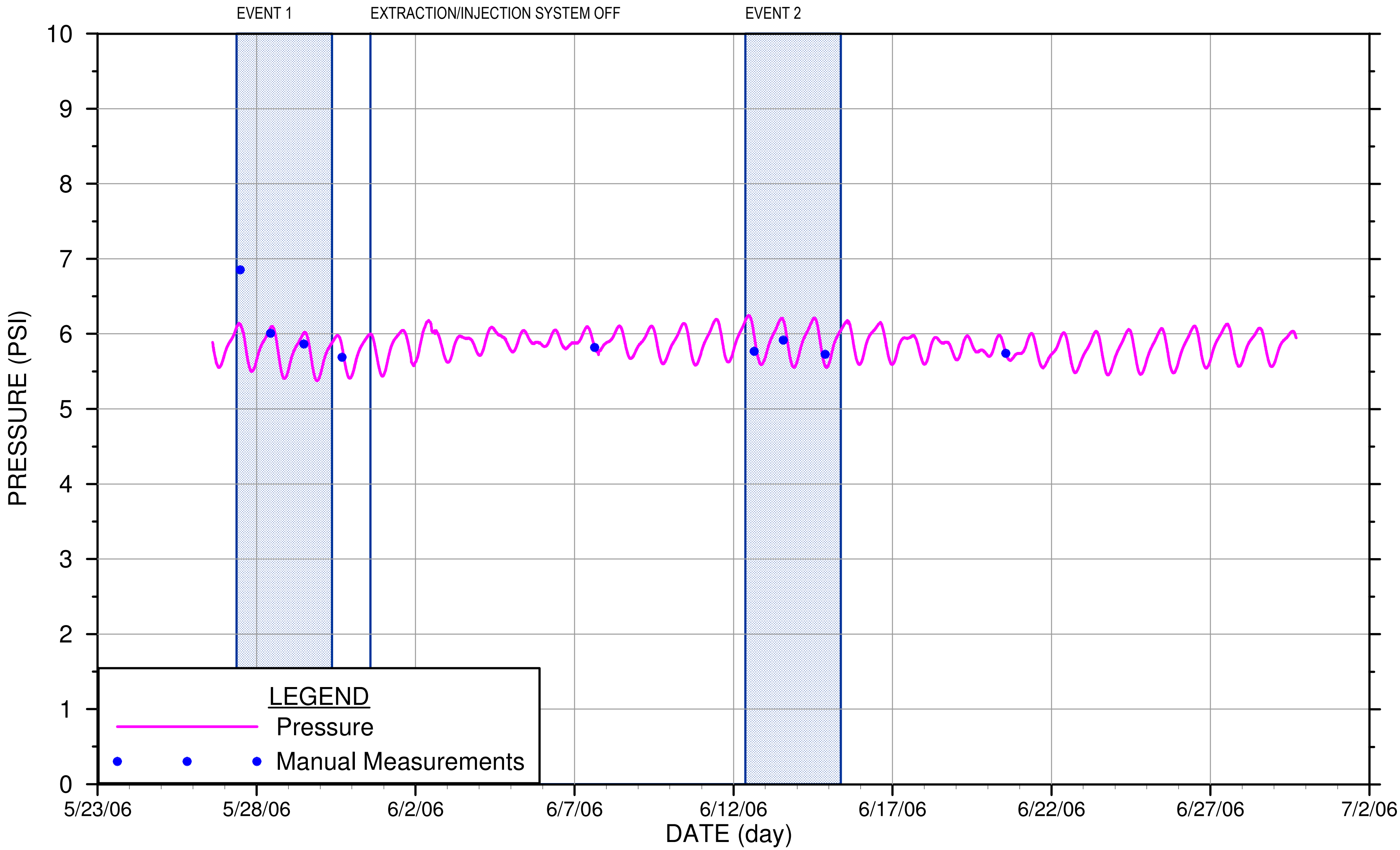


figure 6P-12

5-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

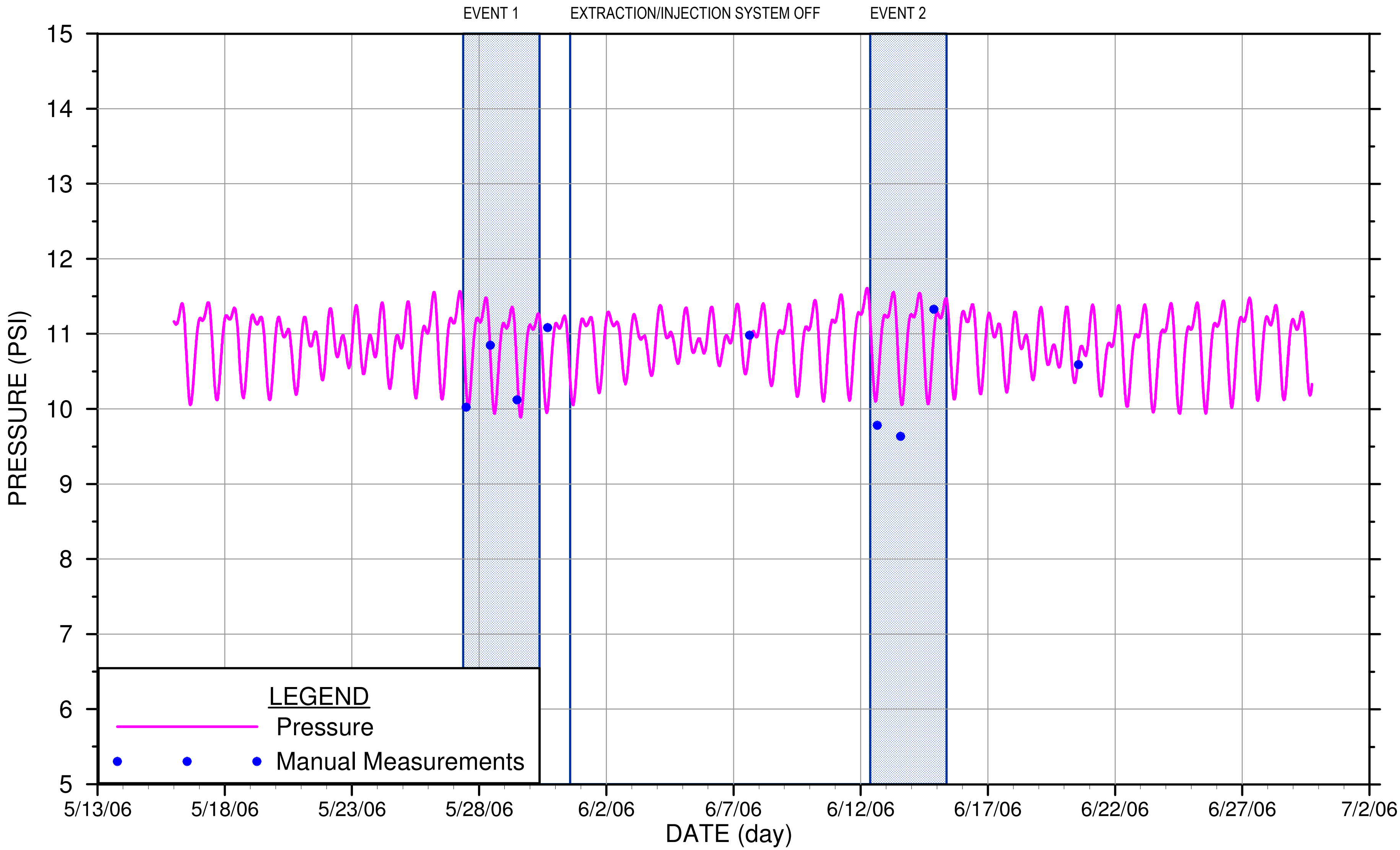


figure 6P-13

5-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-13.grf) JAN 3/2011

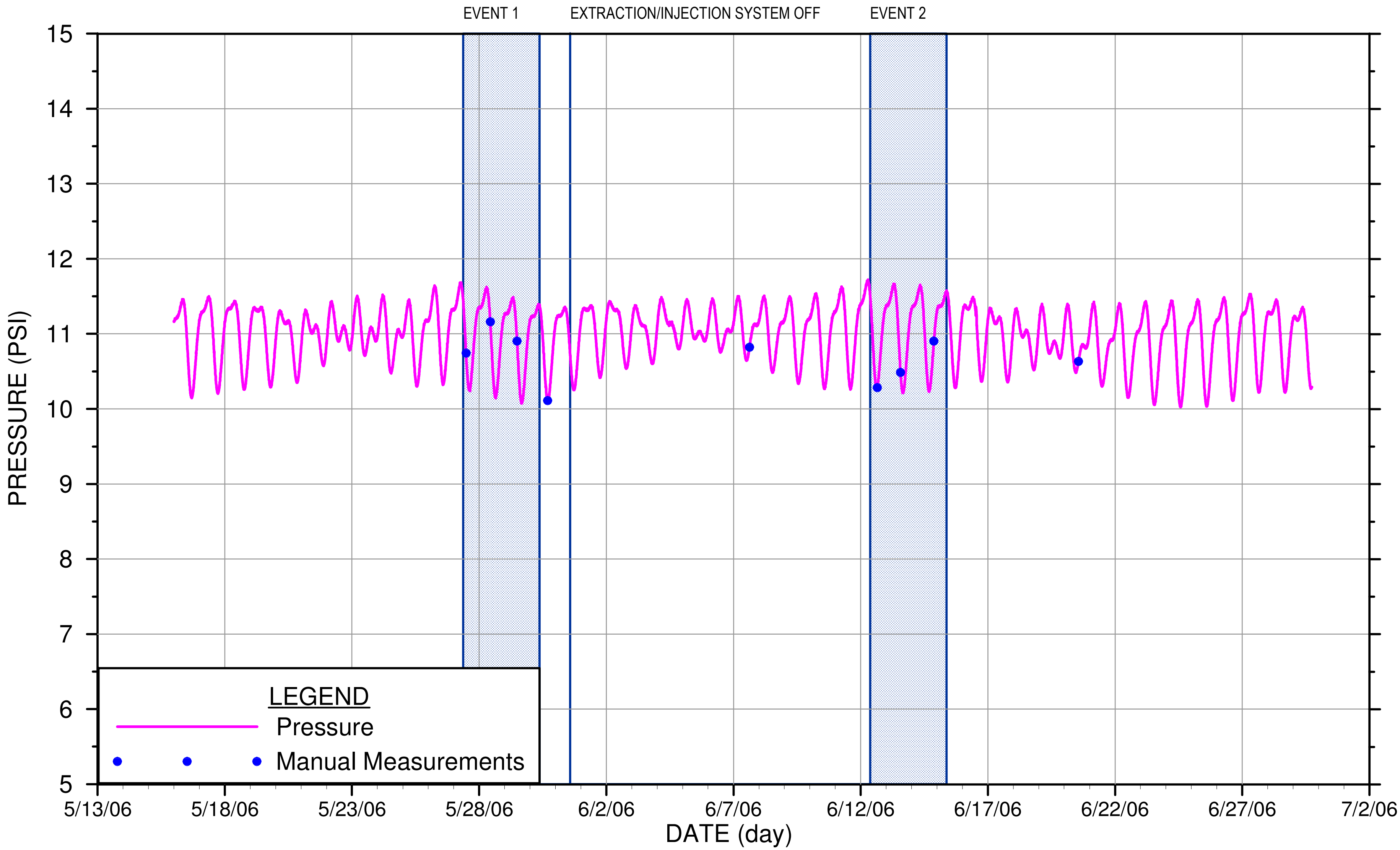


figure 6P-14

5-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-14.grf) JAN 3/2011

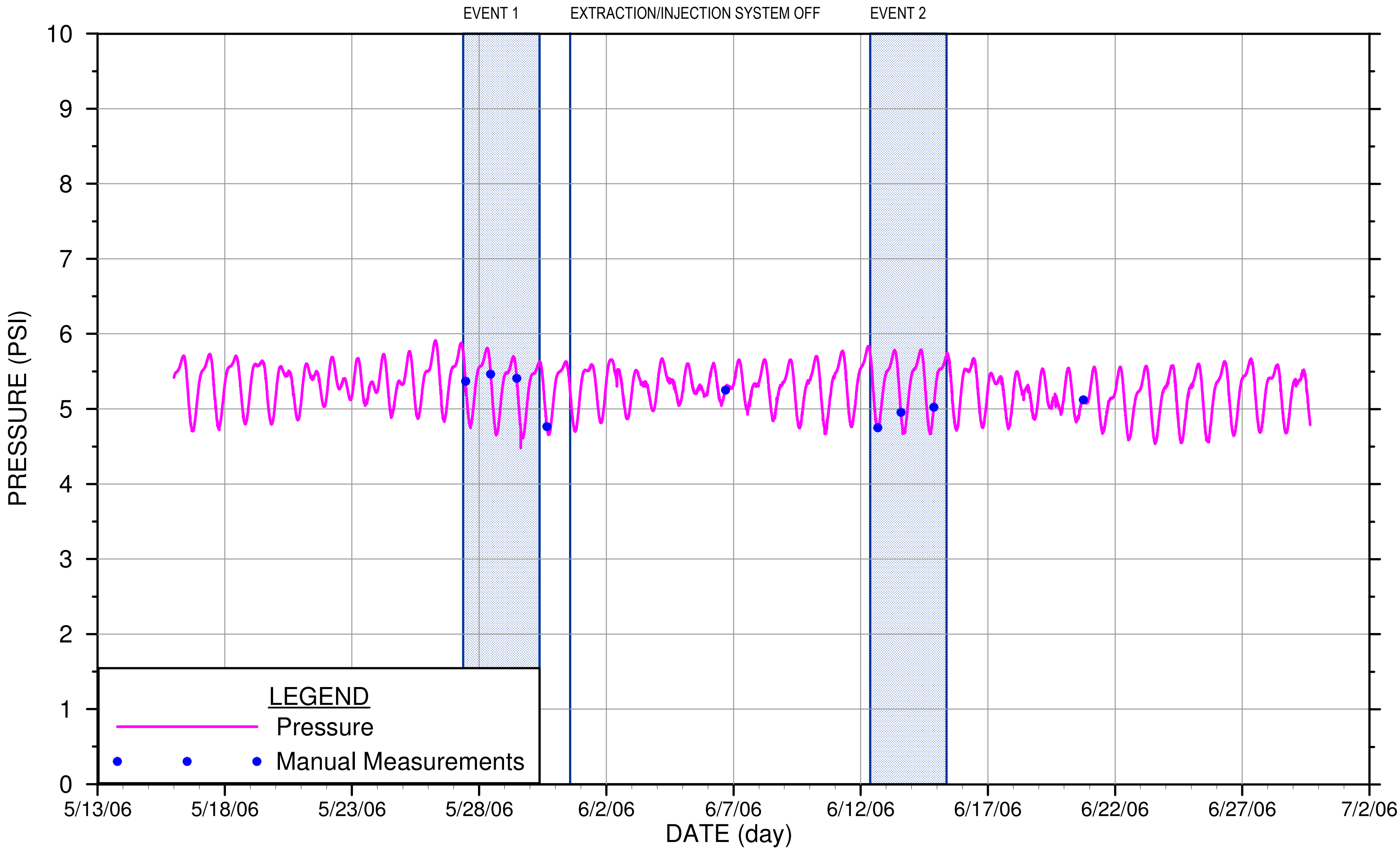


figure 6P-15

6A-24.5 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-15.grf) JAN 3/2011

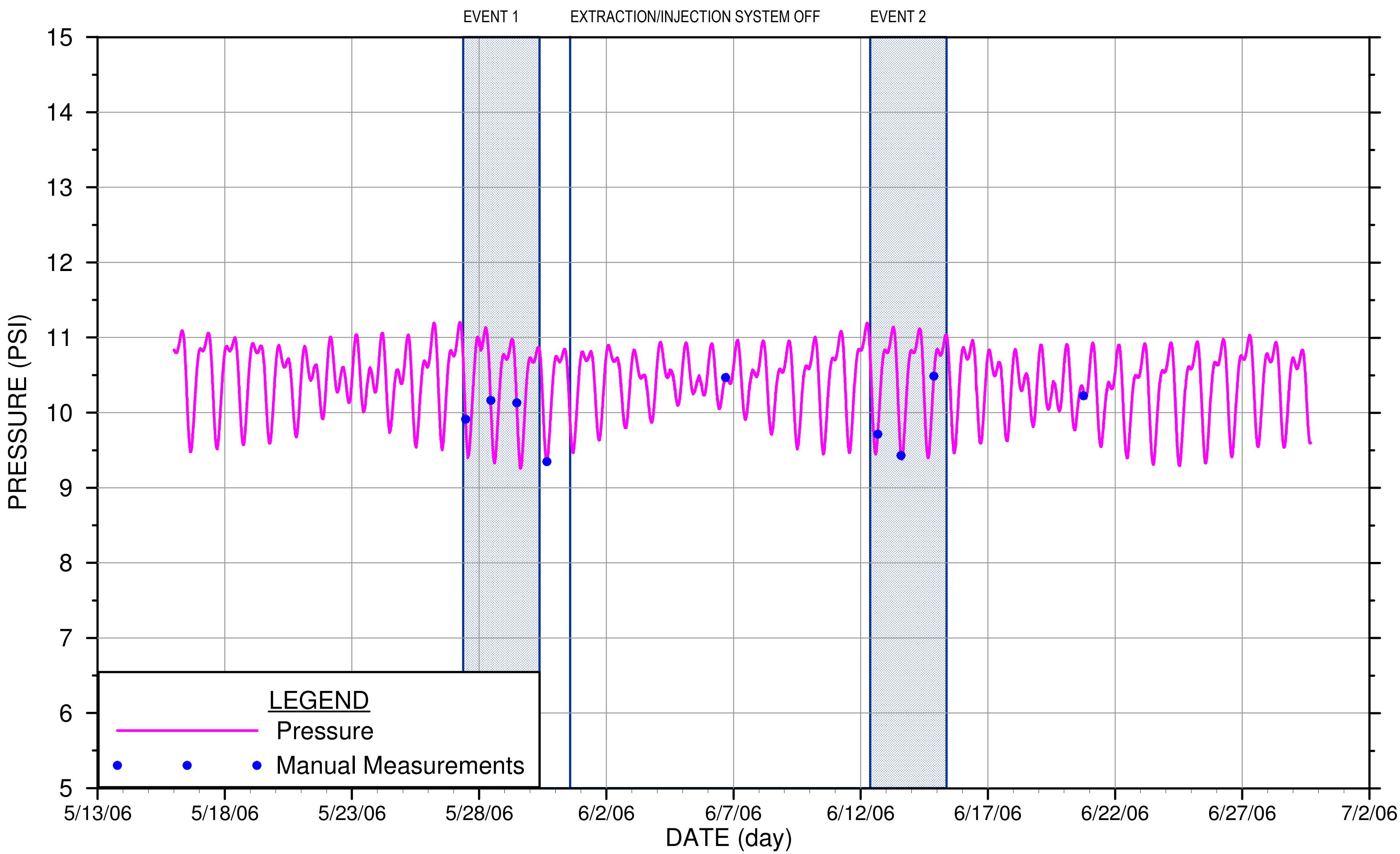


figure 6P-16

6A-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-16.grf) JAN 3/2011

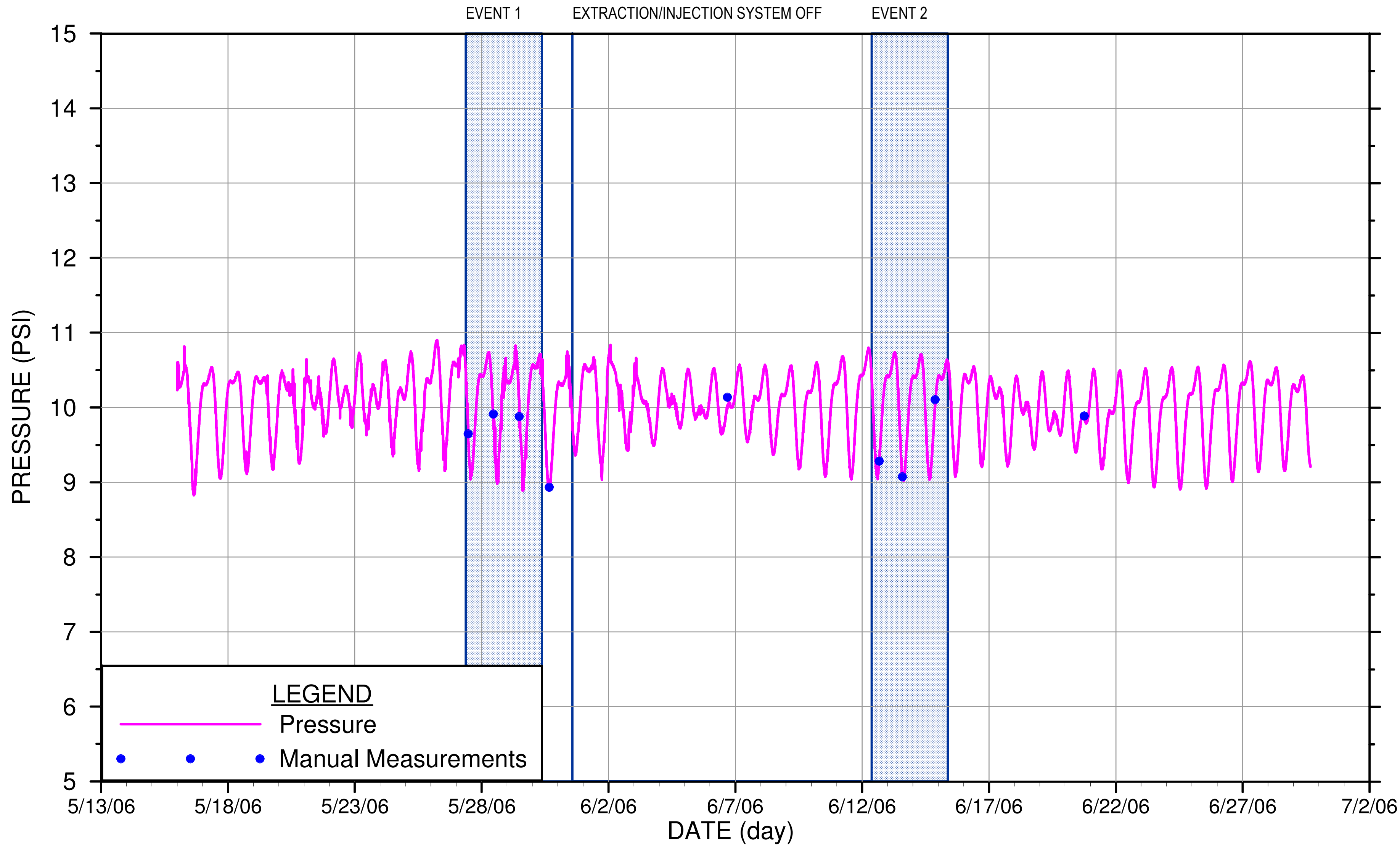


figure 6P-17

6A-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

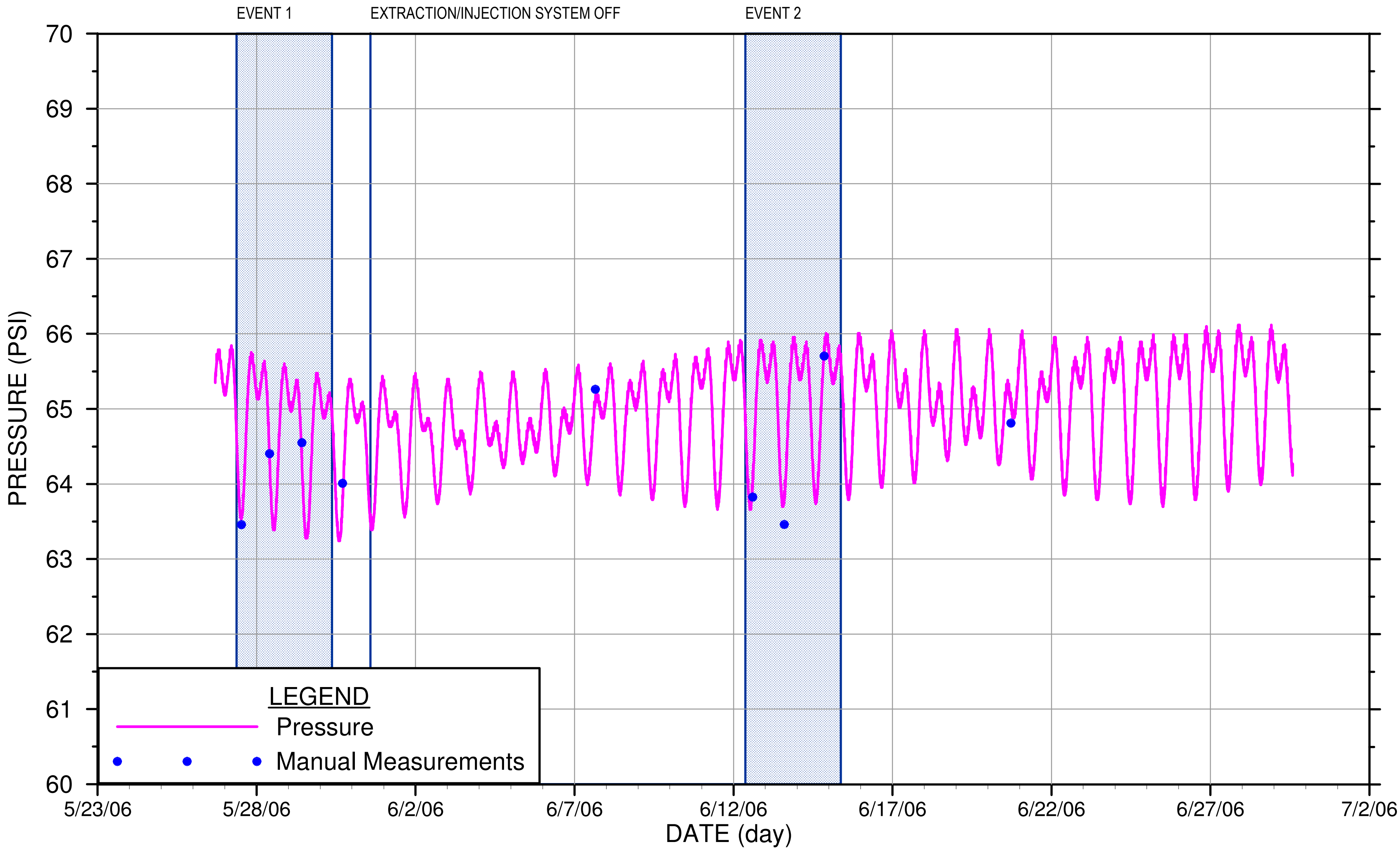


figure 6P-18

7-181 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-18.grf) JAN 3/2011

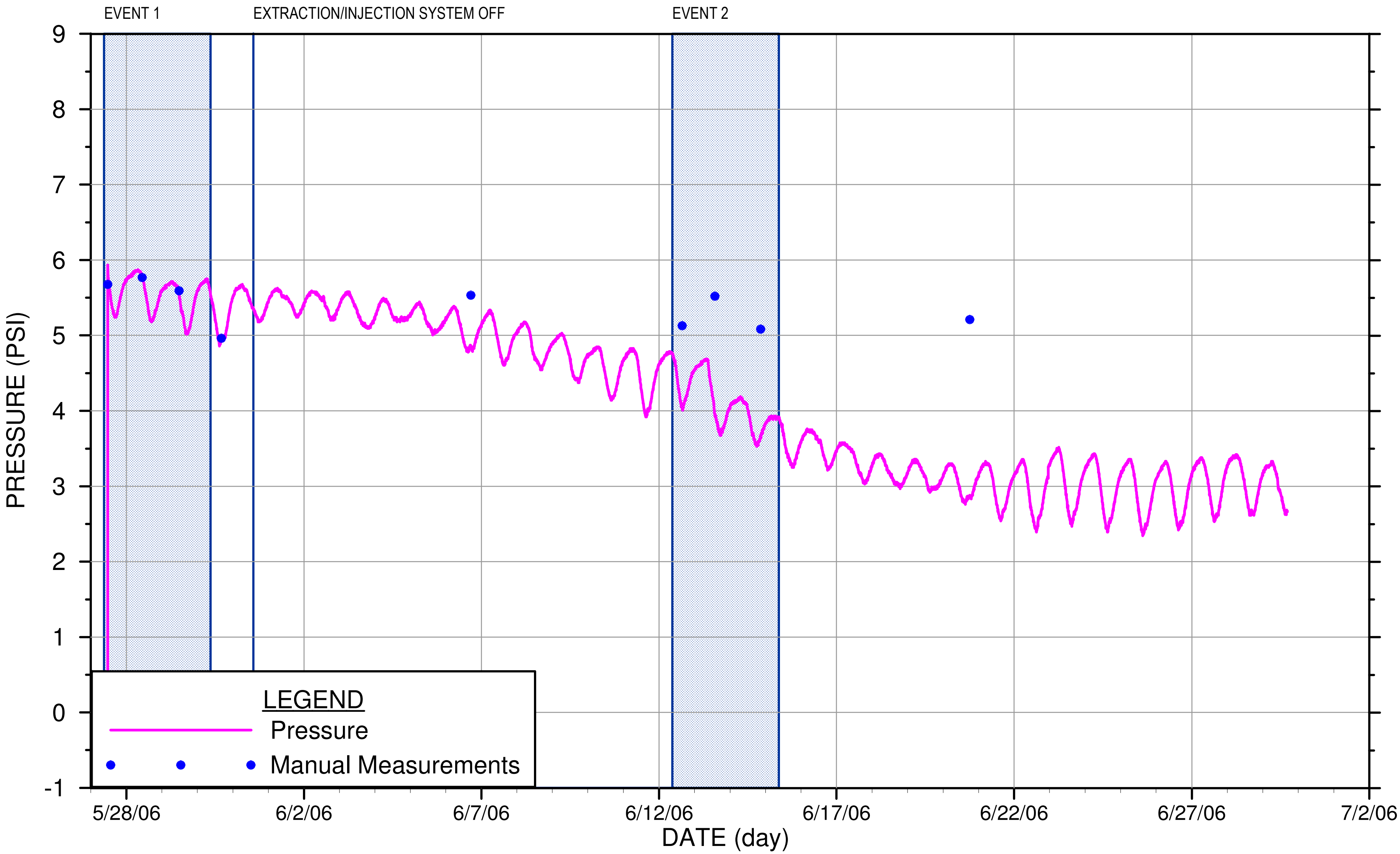


figure 6P-19

8-23 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

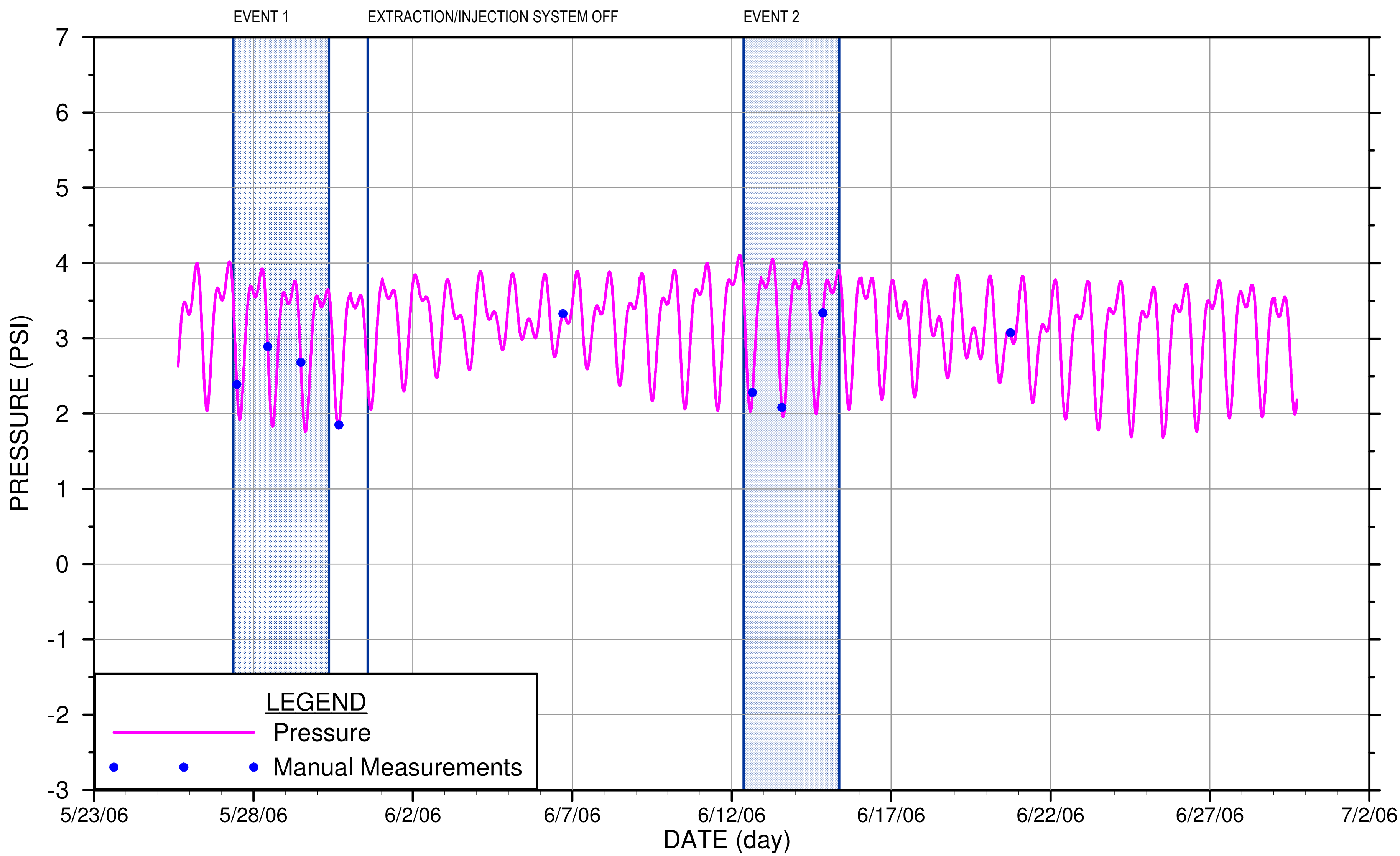


figure 6P-20

8-54 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-20.grf) JAN 3/2011

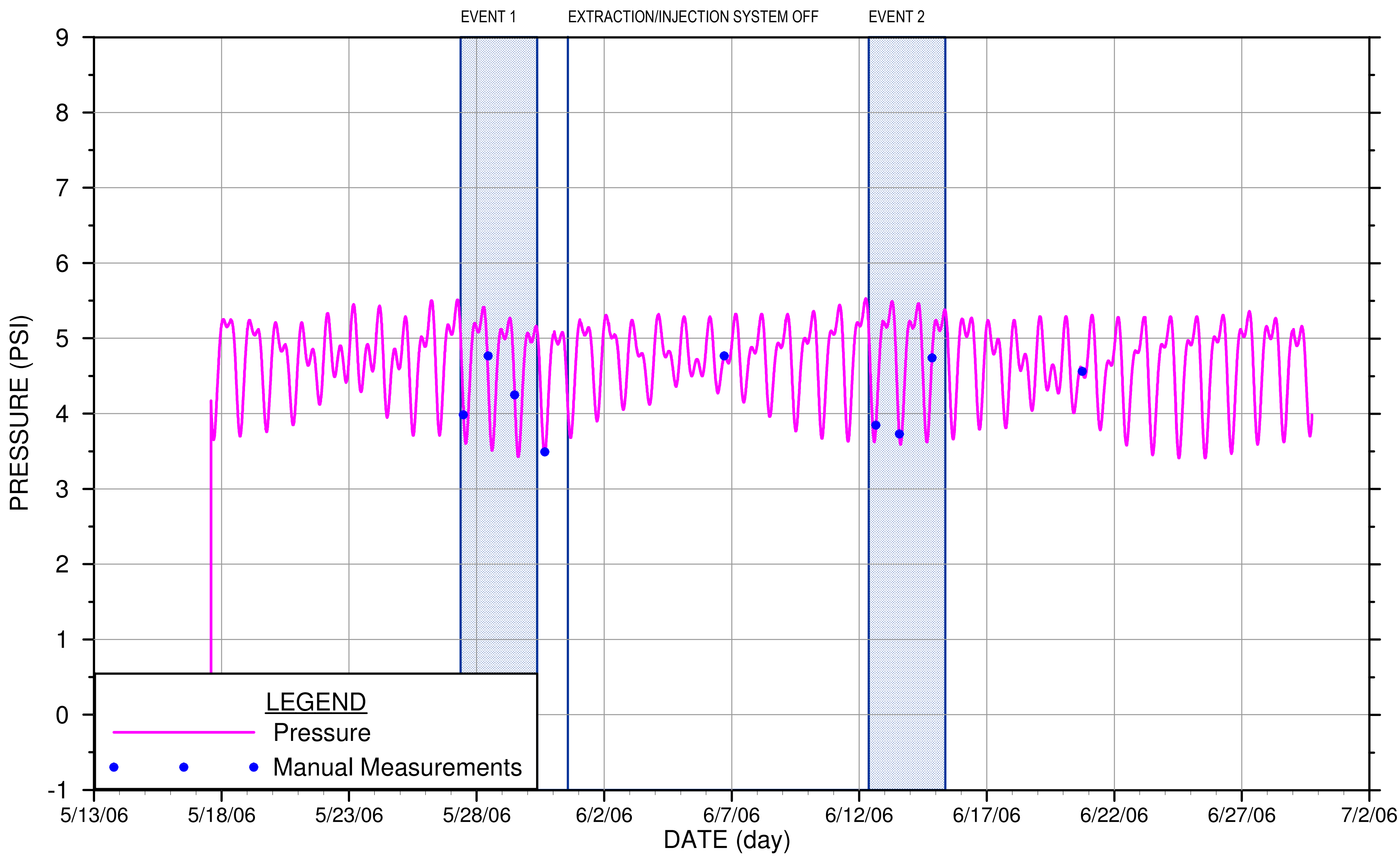


figure 6P-21

8-99R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-21.grf) JAN 3/2011

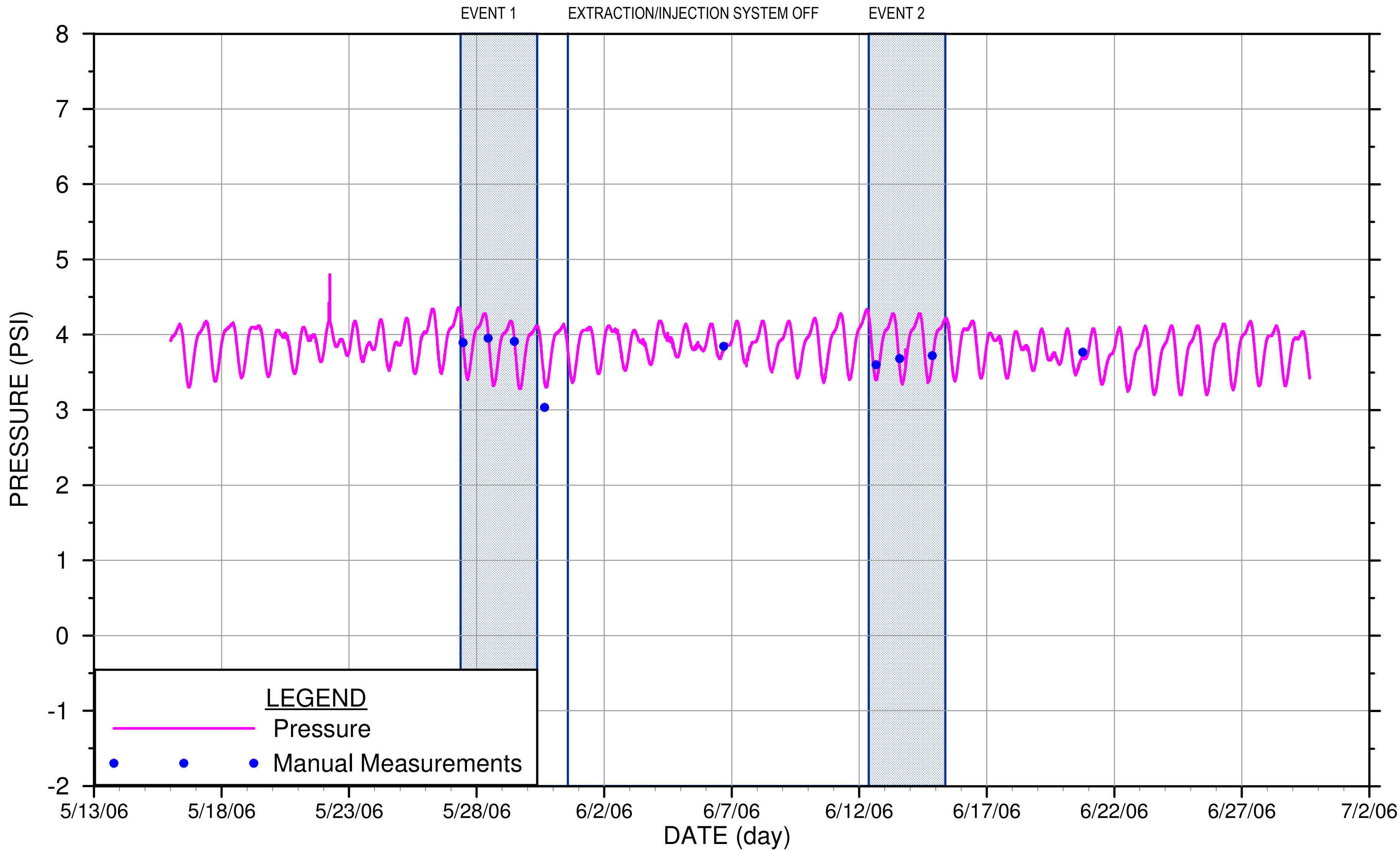


figure 6P-22

9-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-22.grf) JAN 3/2011

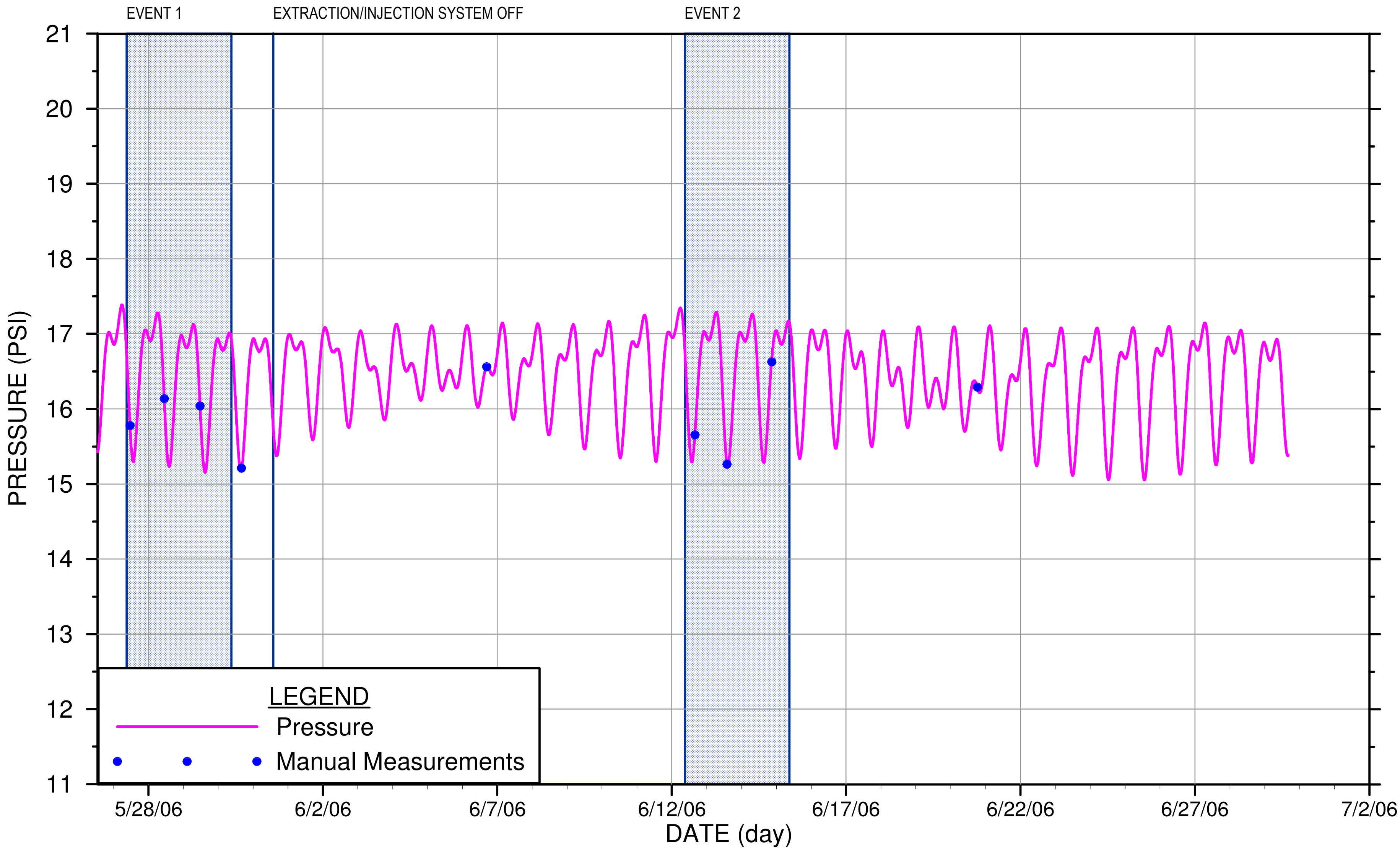


figure 6P-23

9-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-23.grf) JAN 3/2011

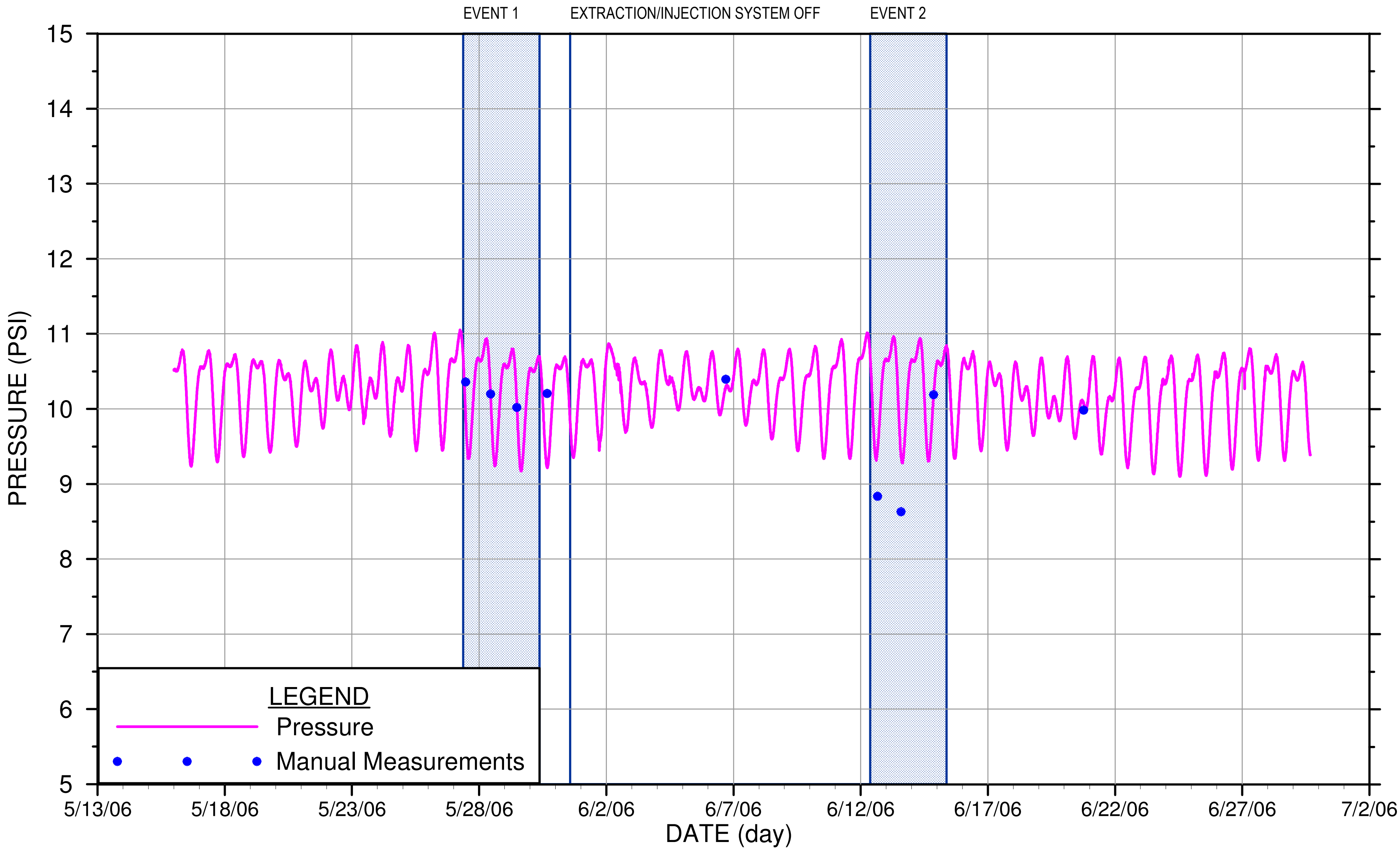


figure 6P-24

9-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

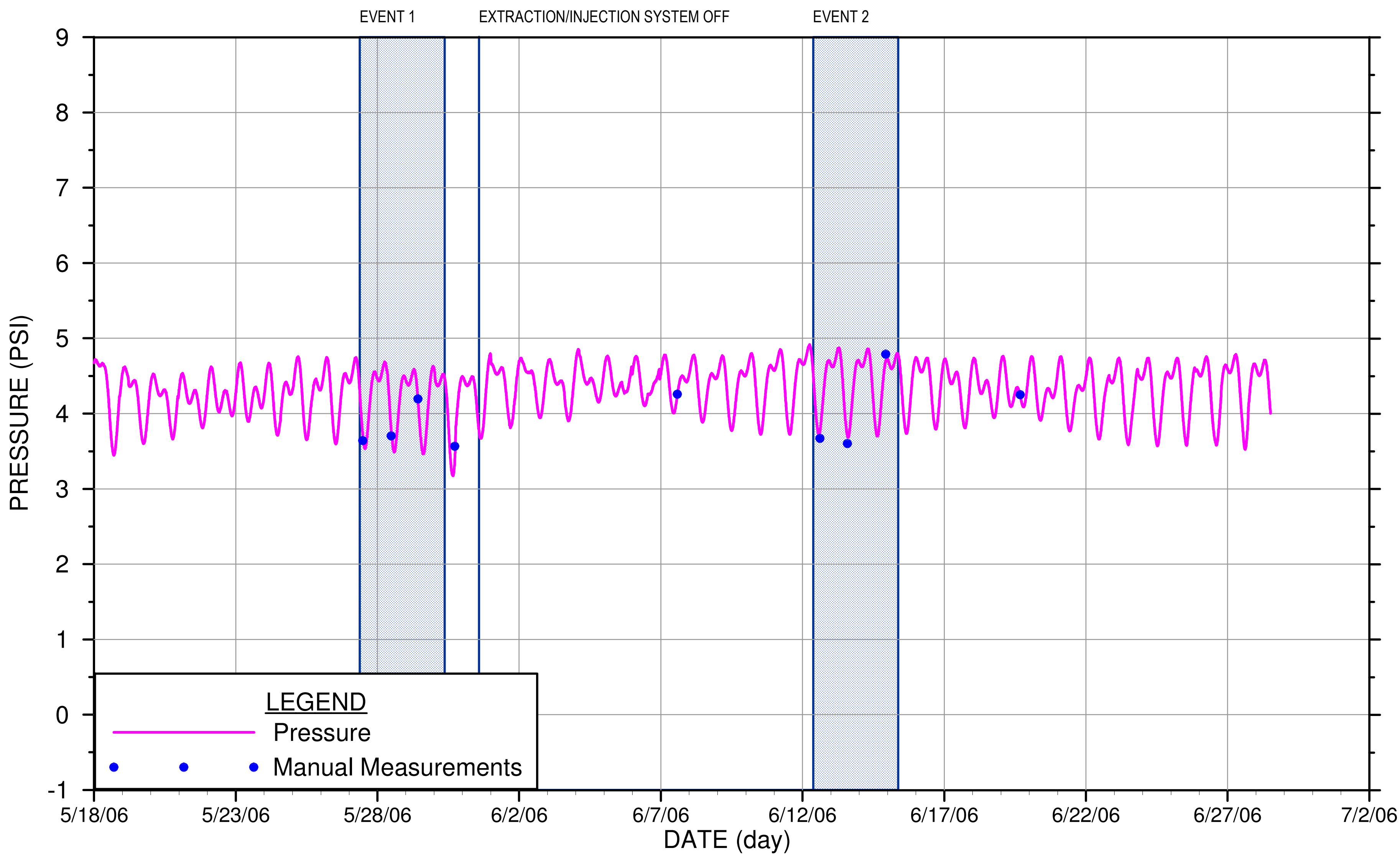


figure 6P-25

11-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-25.grf) JAN 3/2011

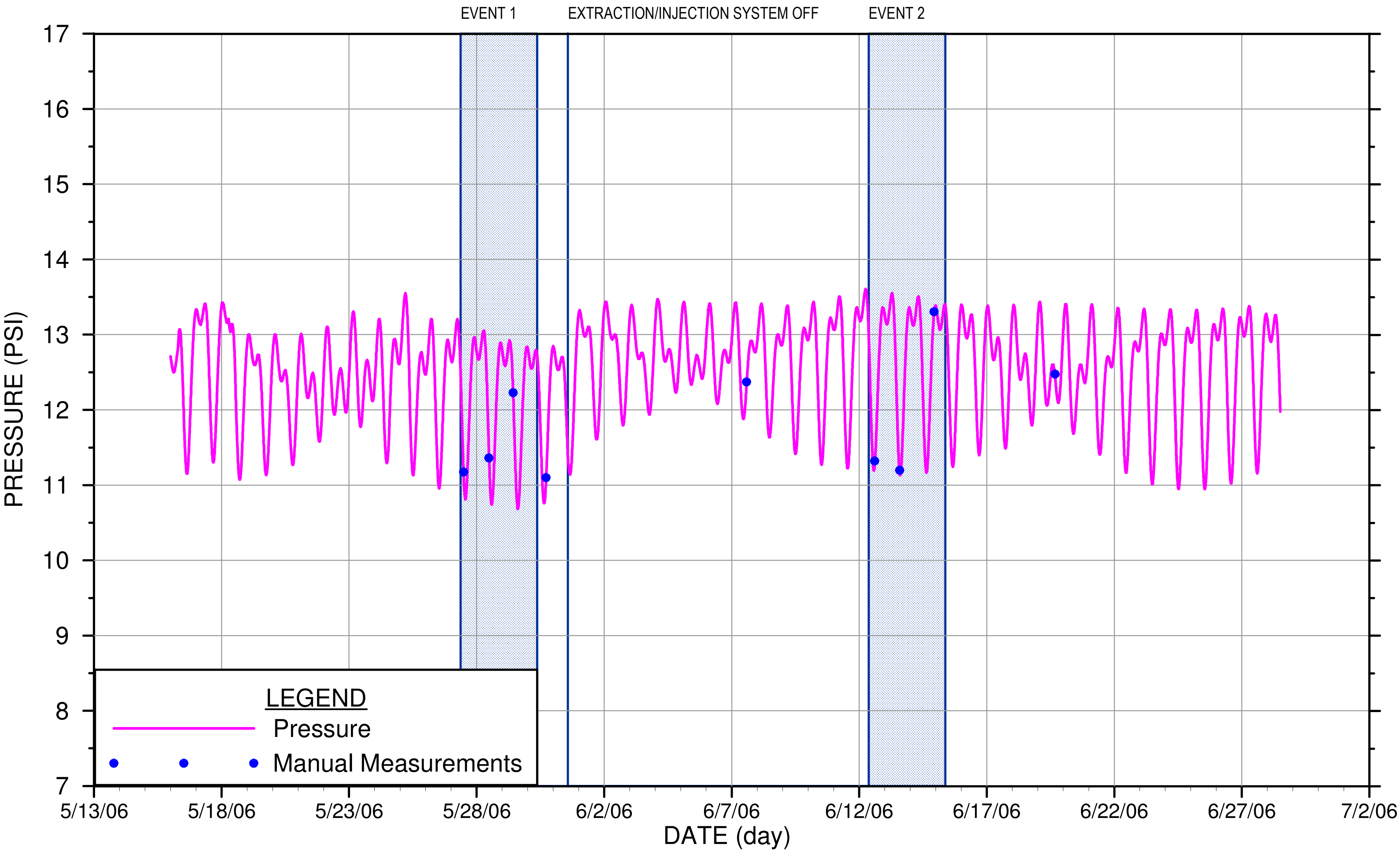


figure 6P-26

11-45 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-26.grf) JAN 3/2011

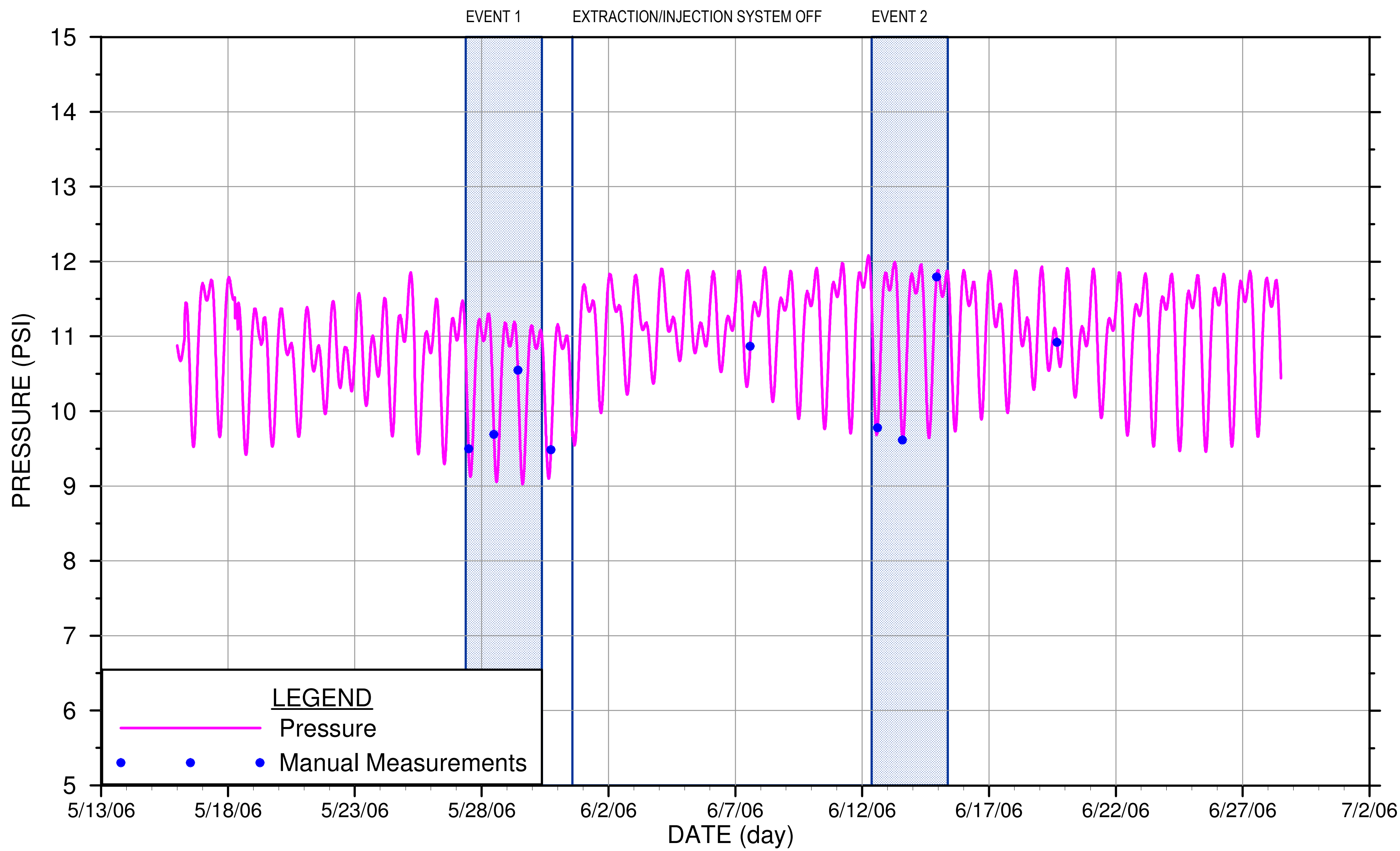


figure 6P-27

11-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-27.grf) JAN 3/2011

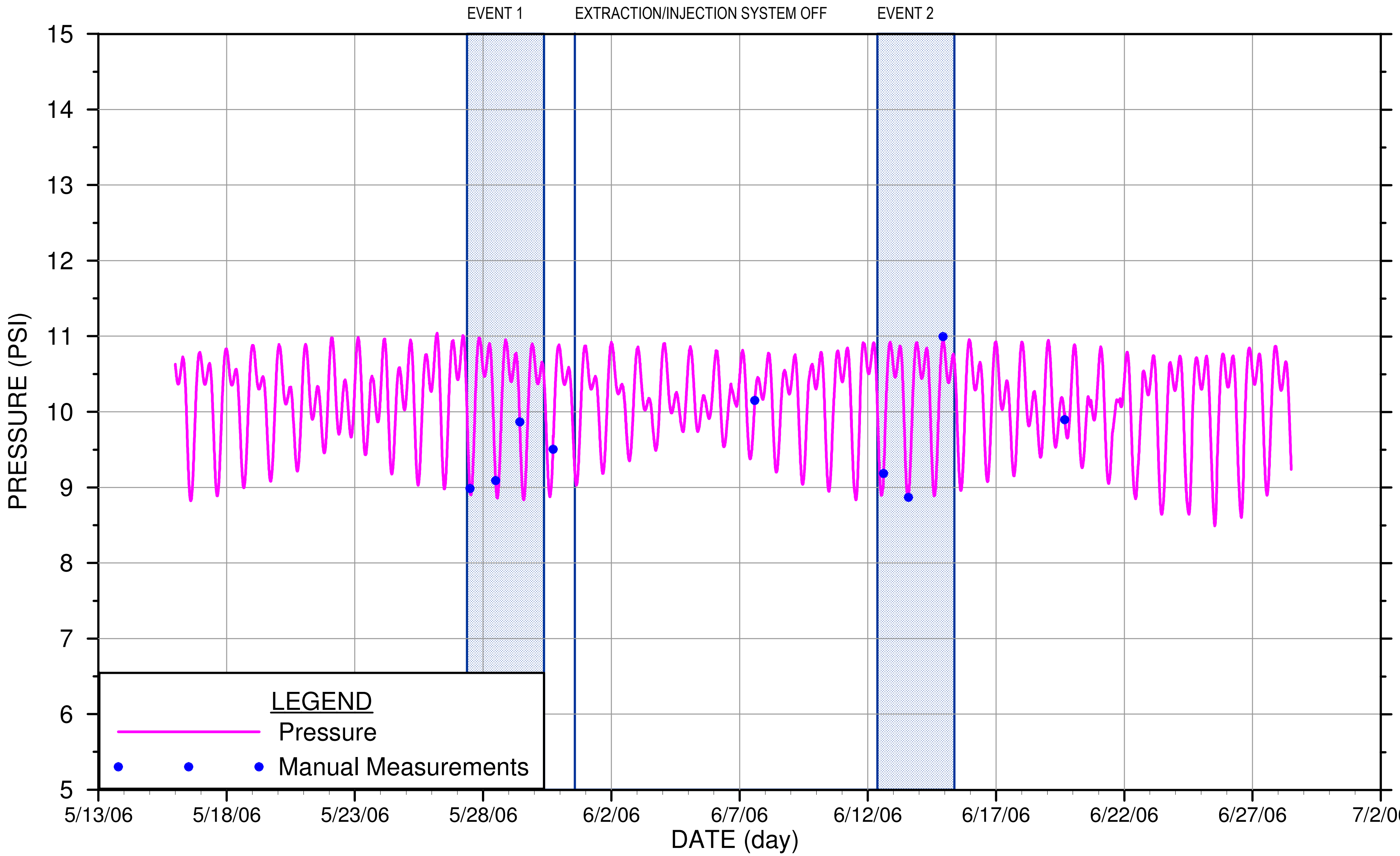


figure 6P-28

11-183 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-28.grf) JAN 3/2011

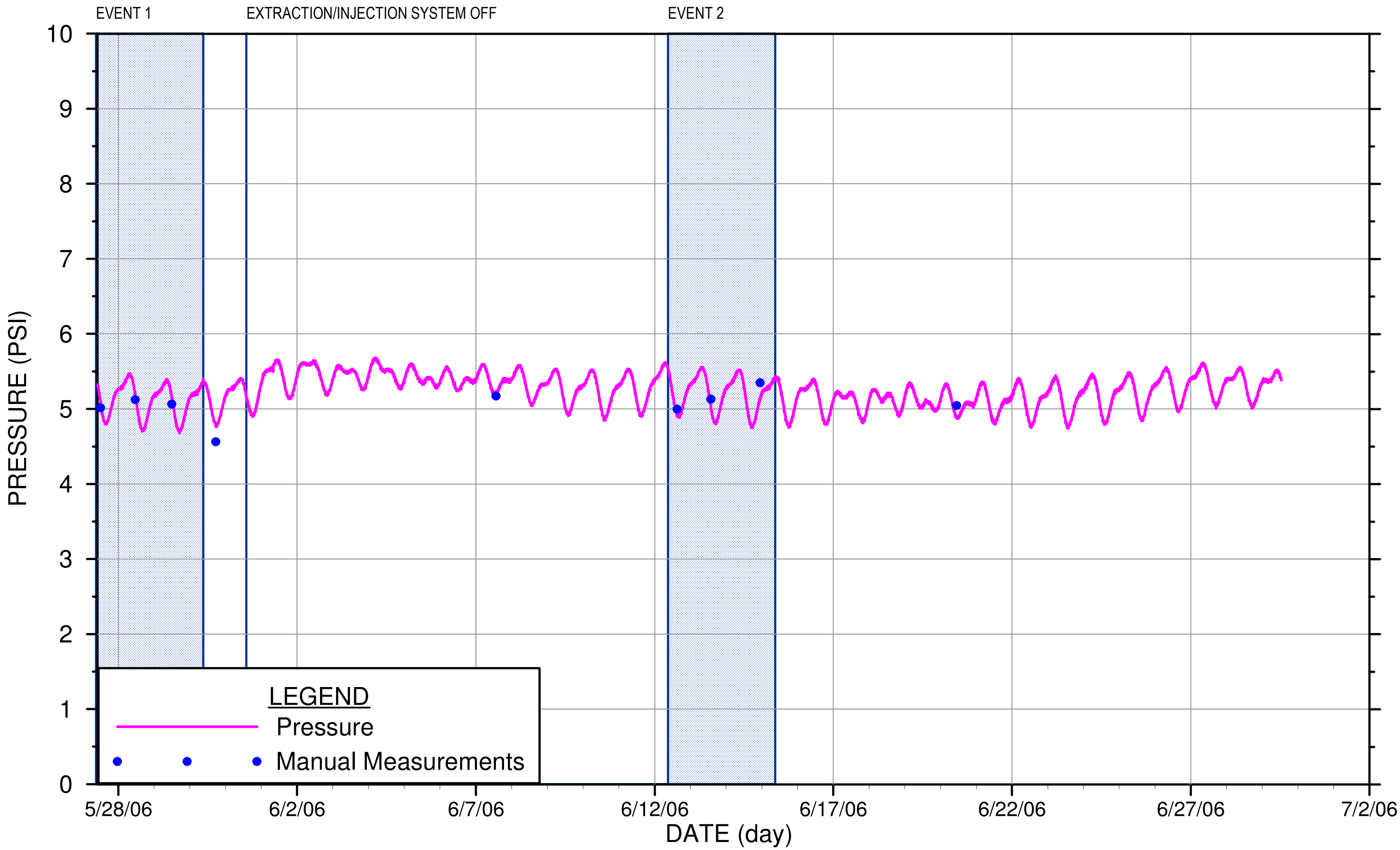


figure 6P-29

12-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-29.grf) JAN 3/2011

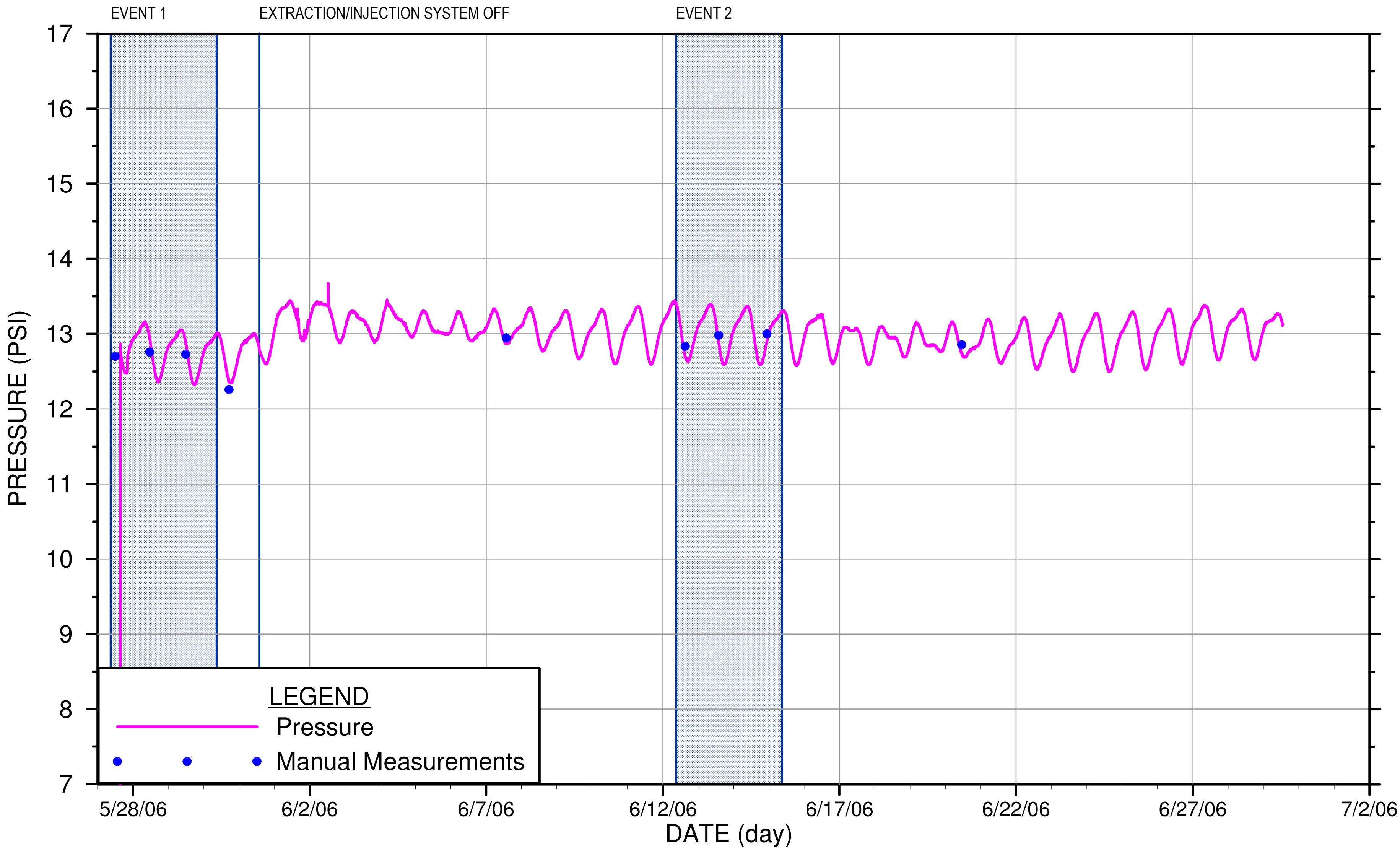


figure 6P-30

12-45 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-30.grf) JAN 3/2011

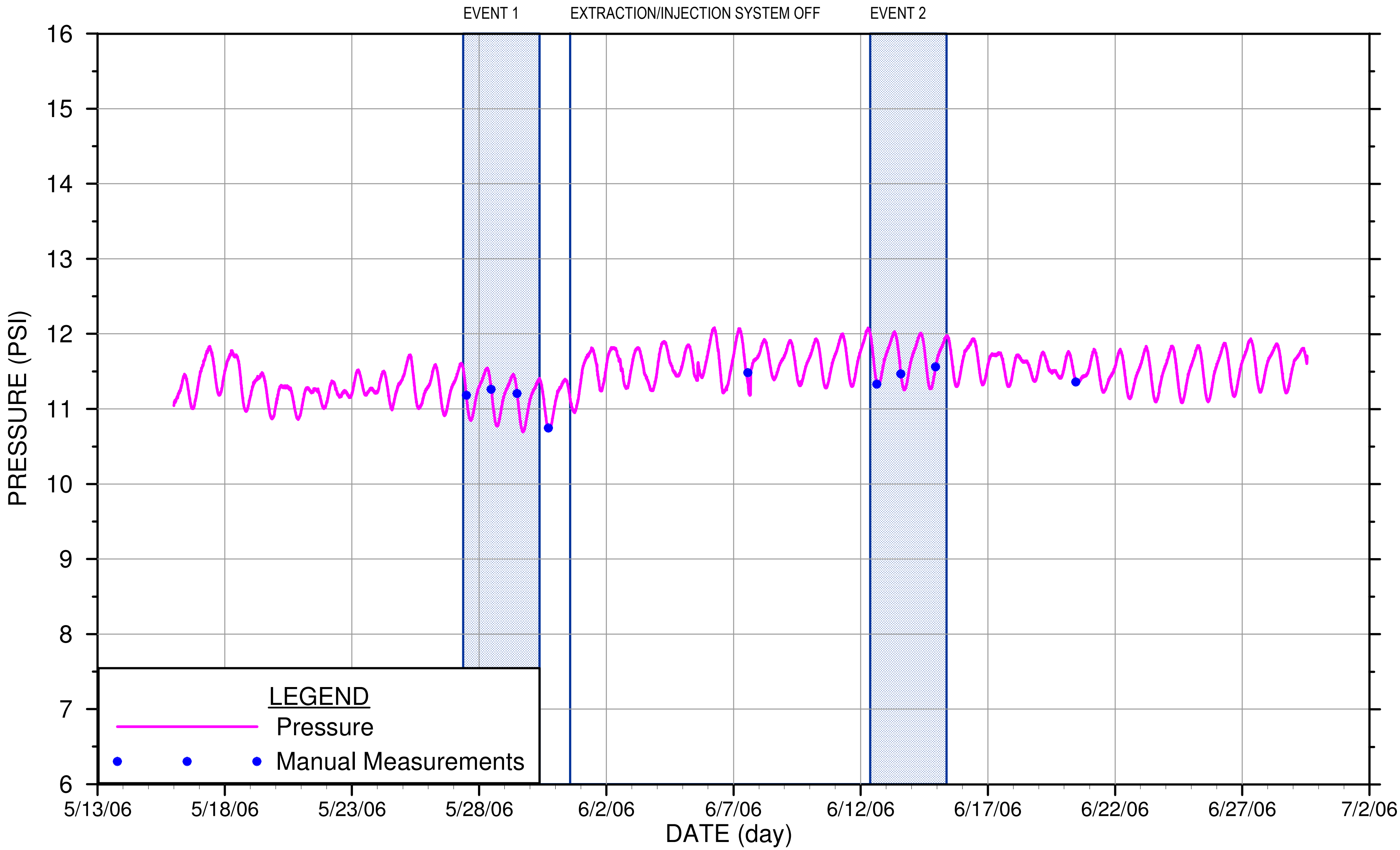


figure 6P-31

12-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-31.grf) JAN 3/2011

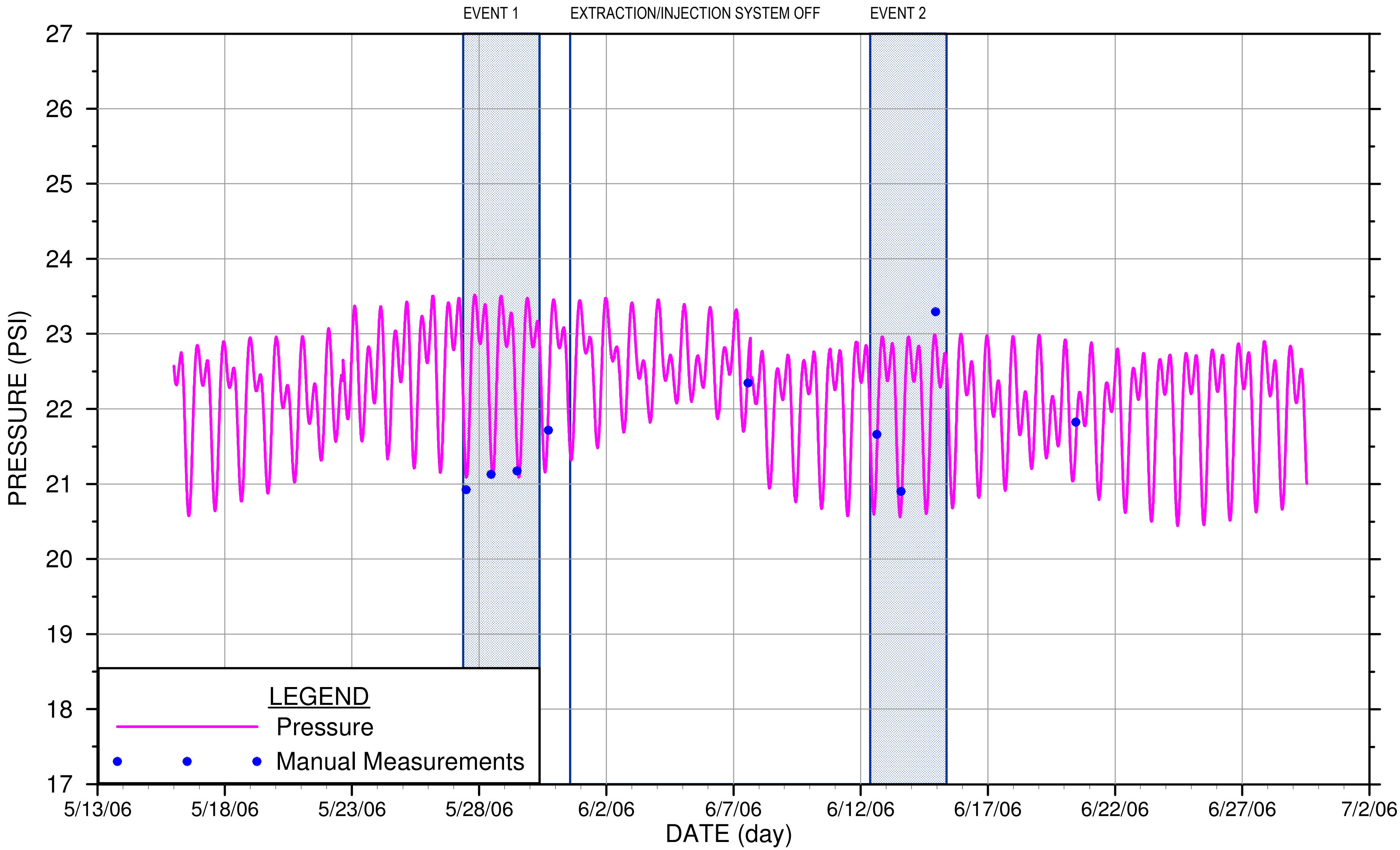


figure 6P-32

12-160 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-32.grf) JAN 3/2011

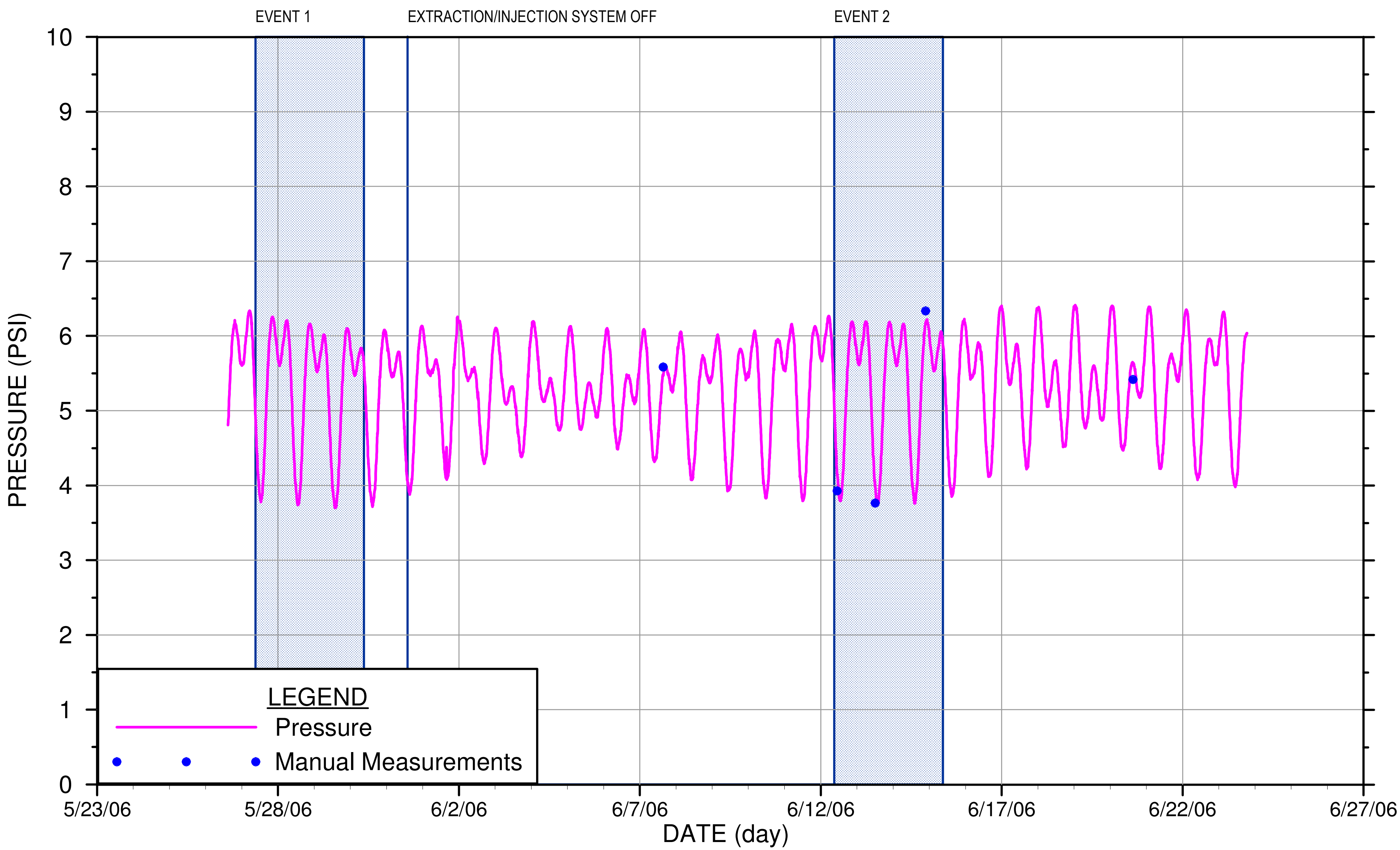


figure 6P-33

14-25R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-33.grf) JAN 3/2011

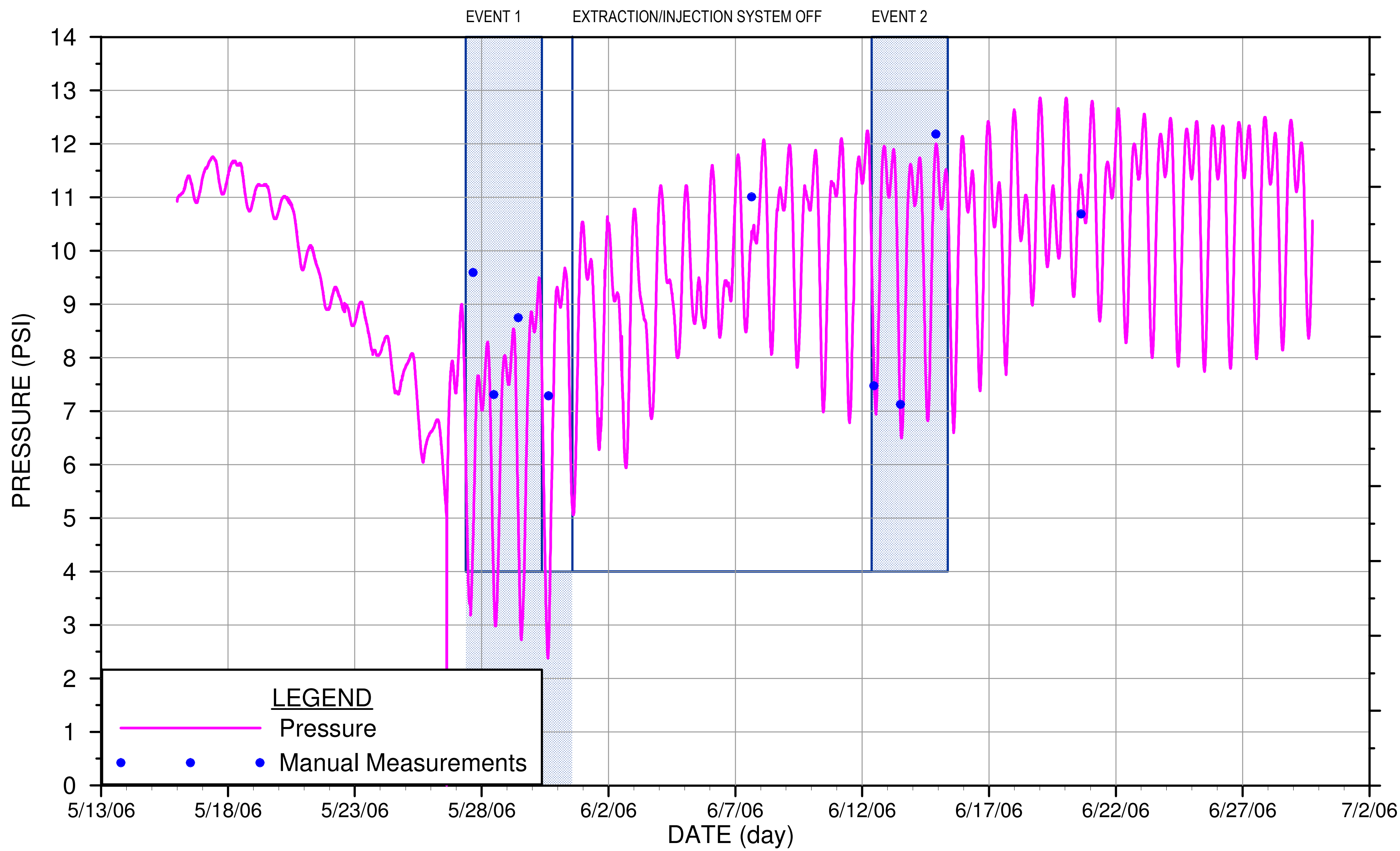


figure 6P-34

14-50R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-34.grf) JAN 3/2011

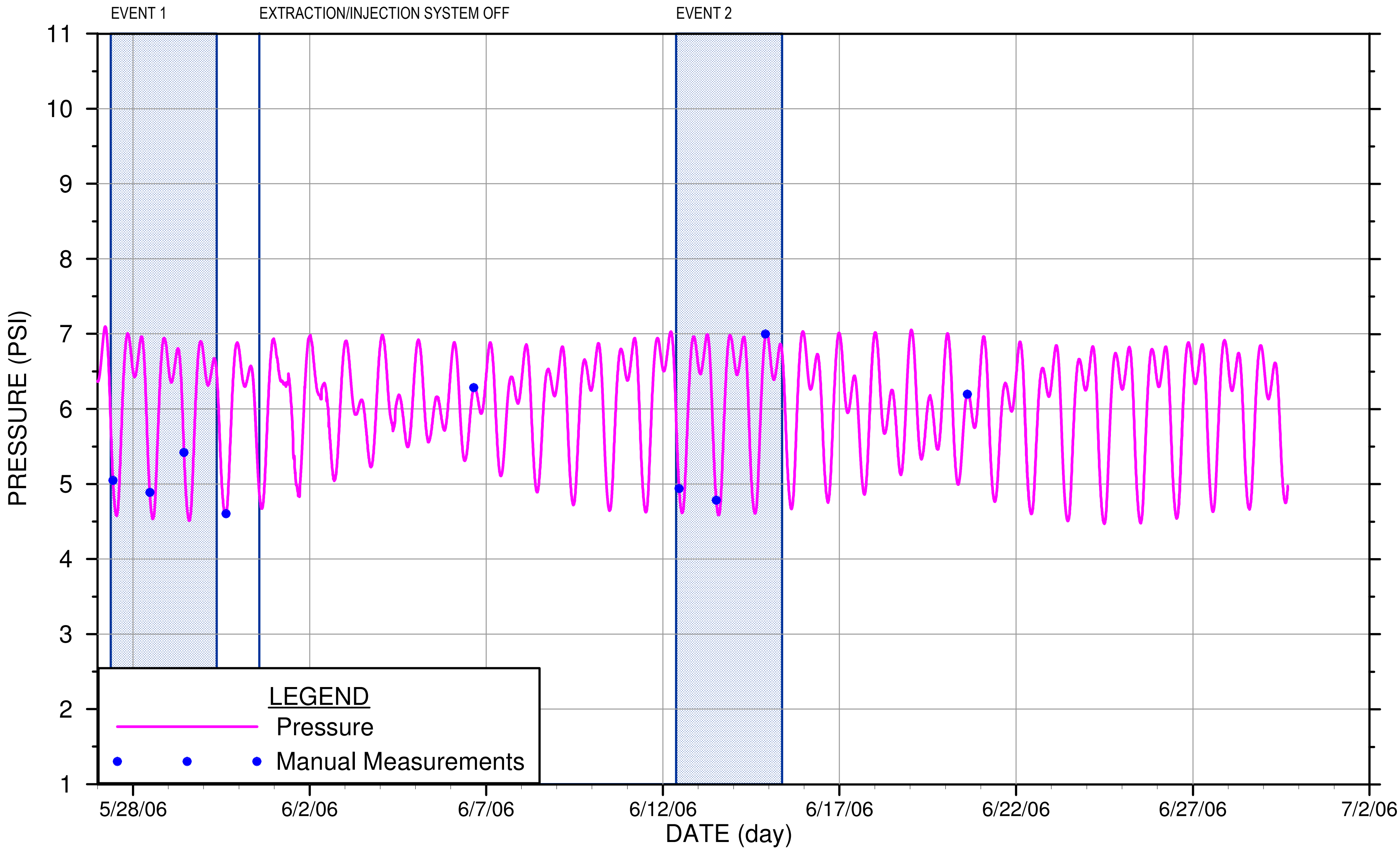


figure 6P-35

15-25R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-35.grf) JAN 3/2011

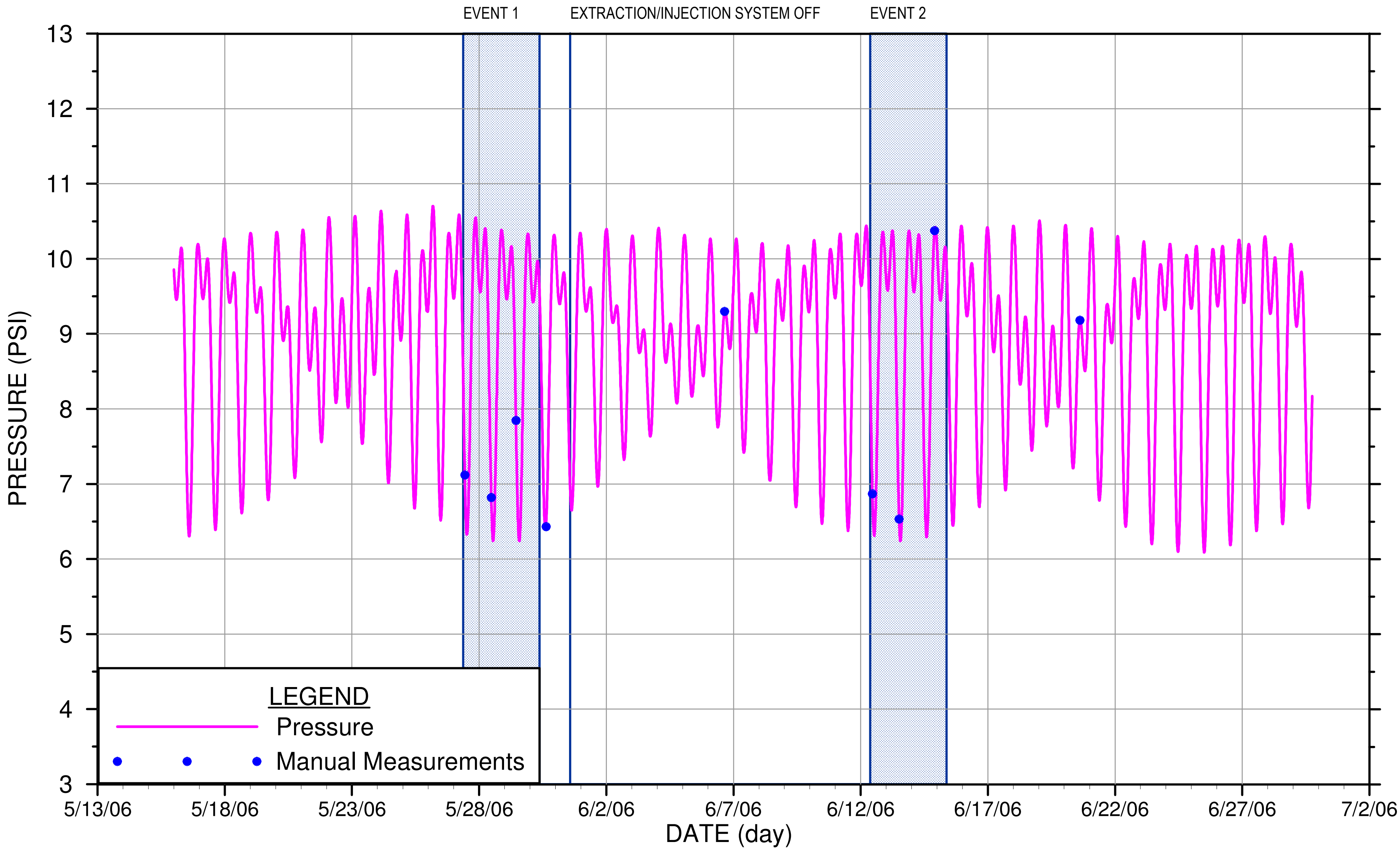


figure 6P-36

15-50R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-36.grf) JAN 3/2011

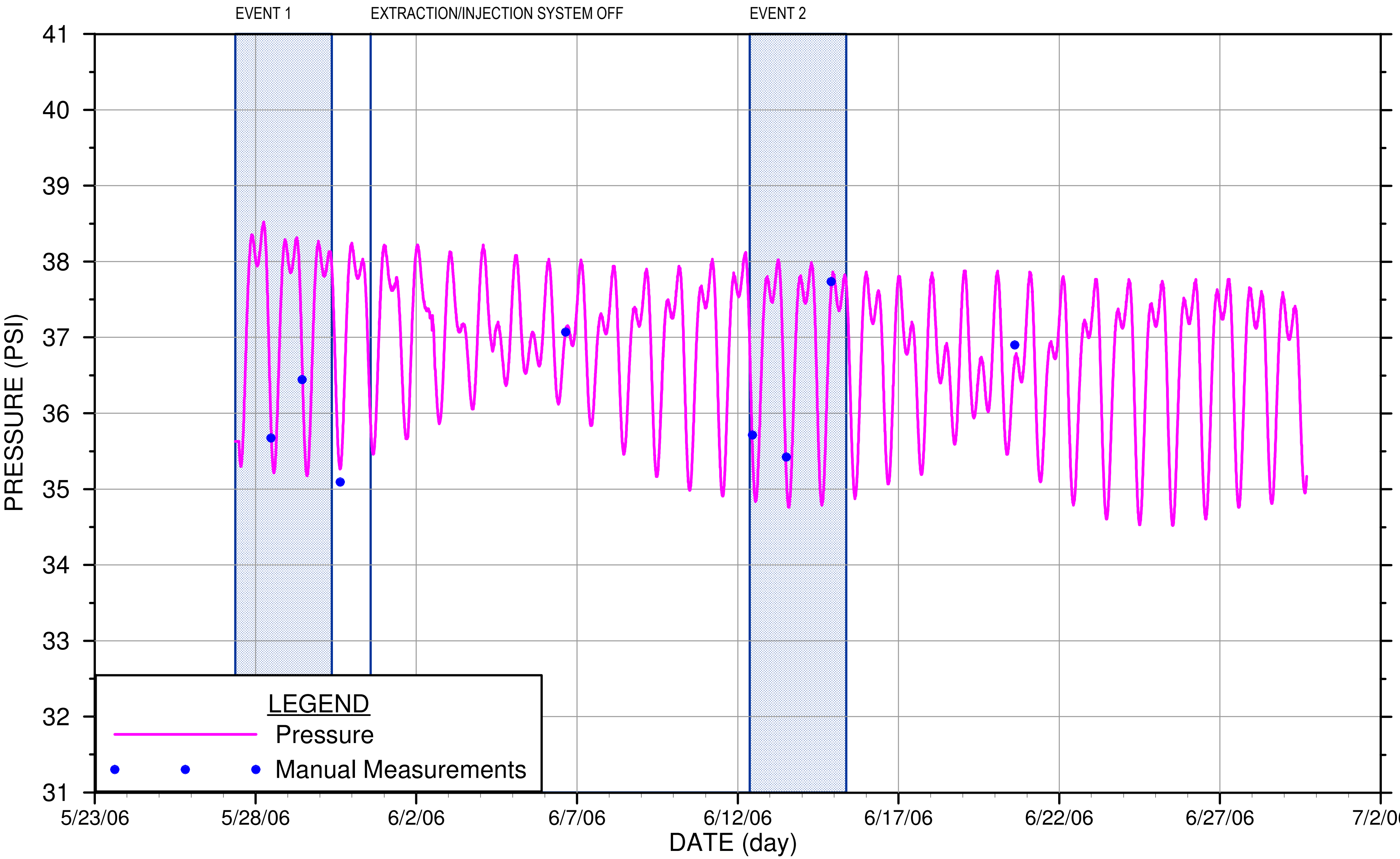


figure 6P-37

15-120 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-37.grf) JAN 3/2011

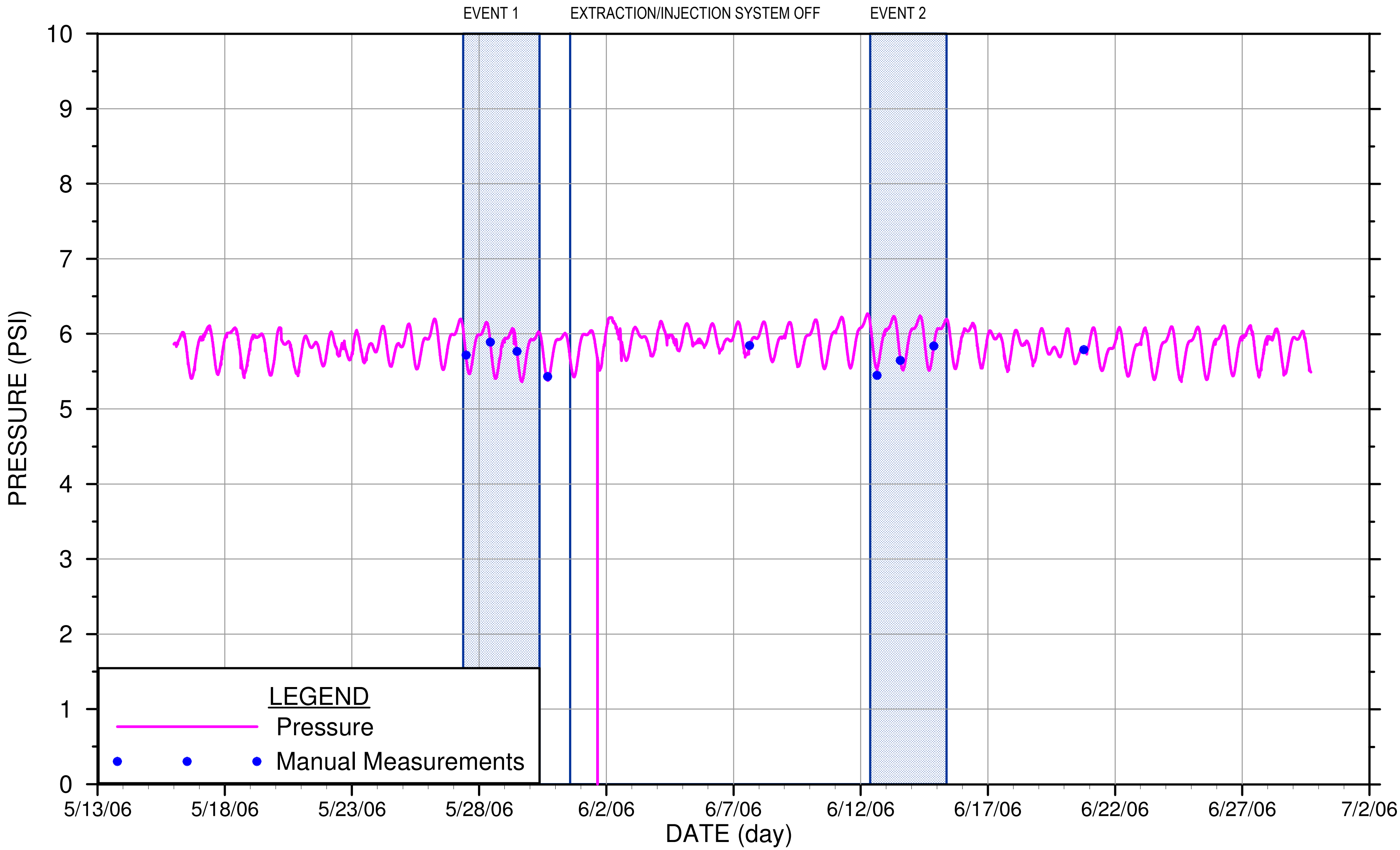


figure 6P-38

19-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-38.grf) JAN 3/2011

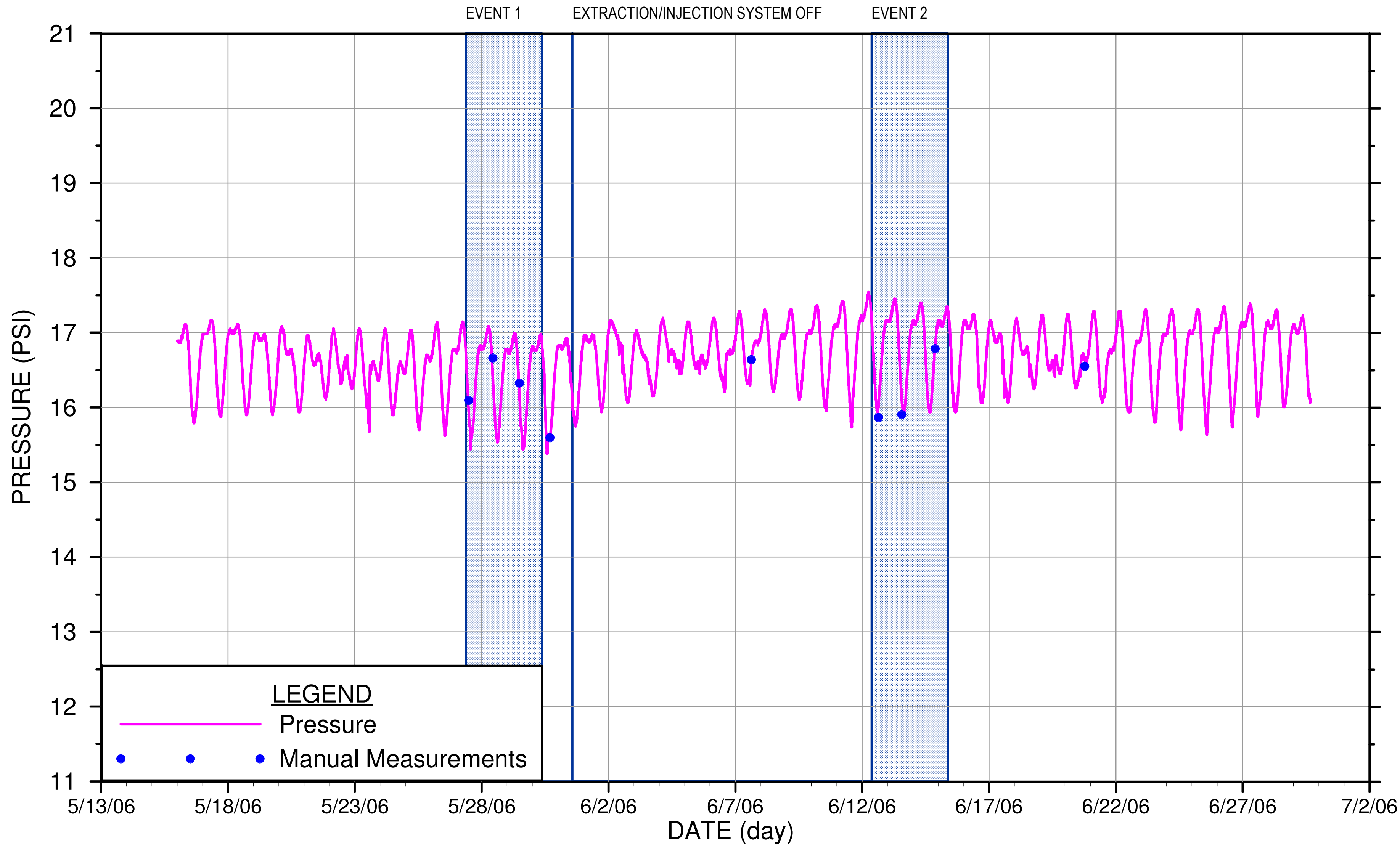


figure 6P-39

19-50R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-39.grf) JAN 3/2011

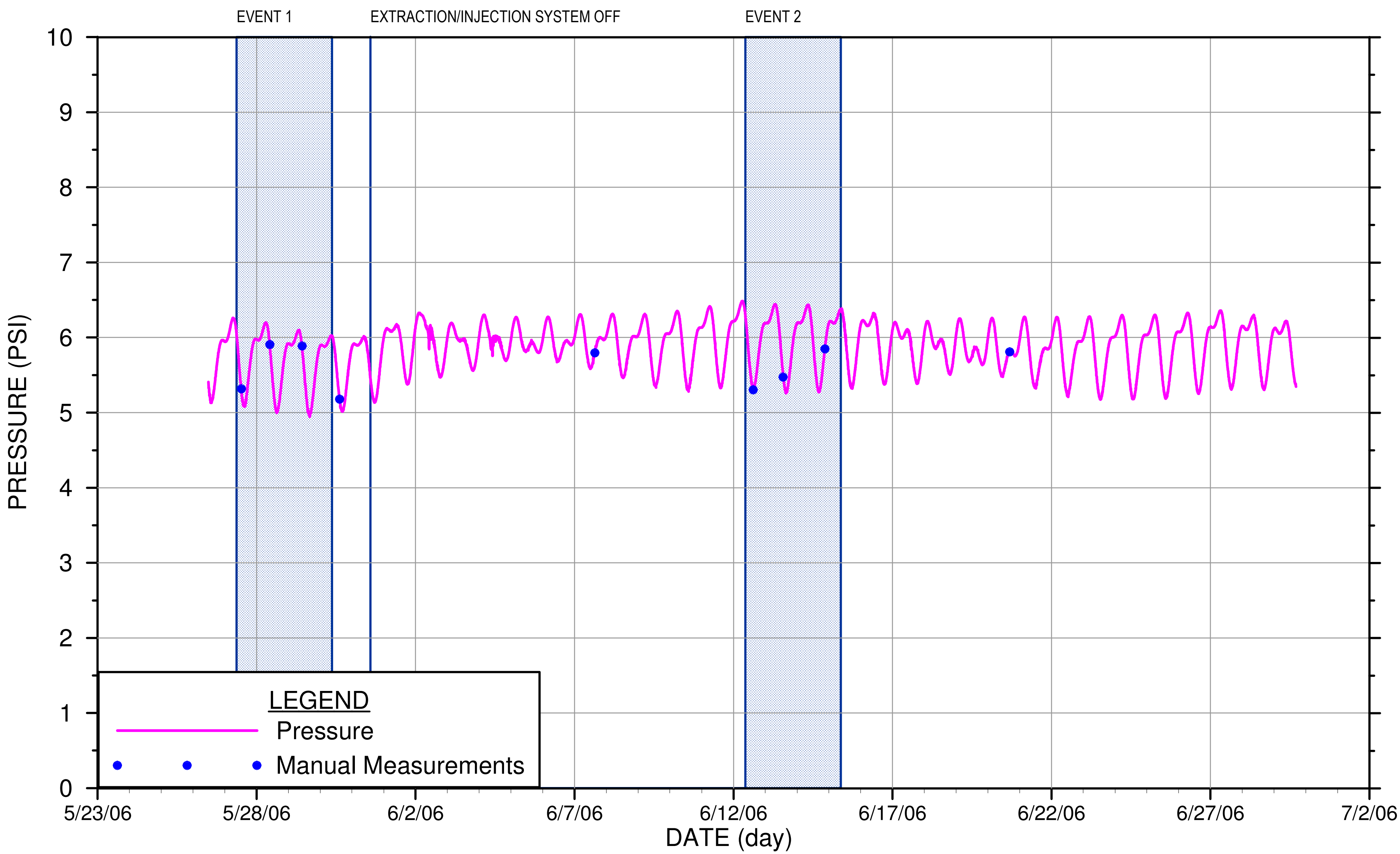


figure 6P-40

21-25R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

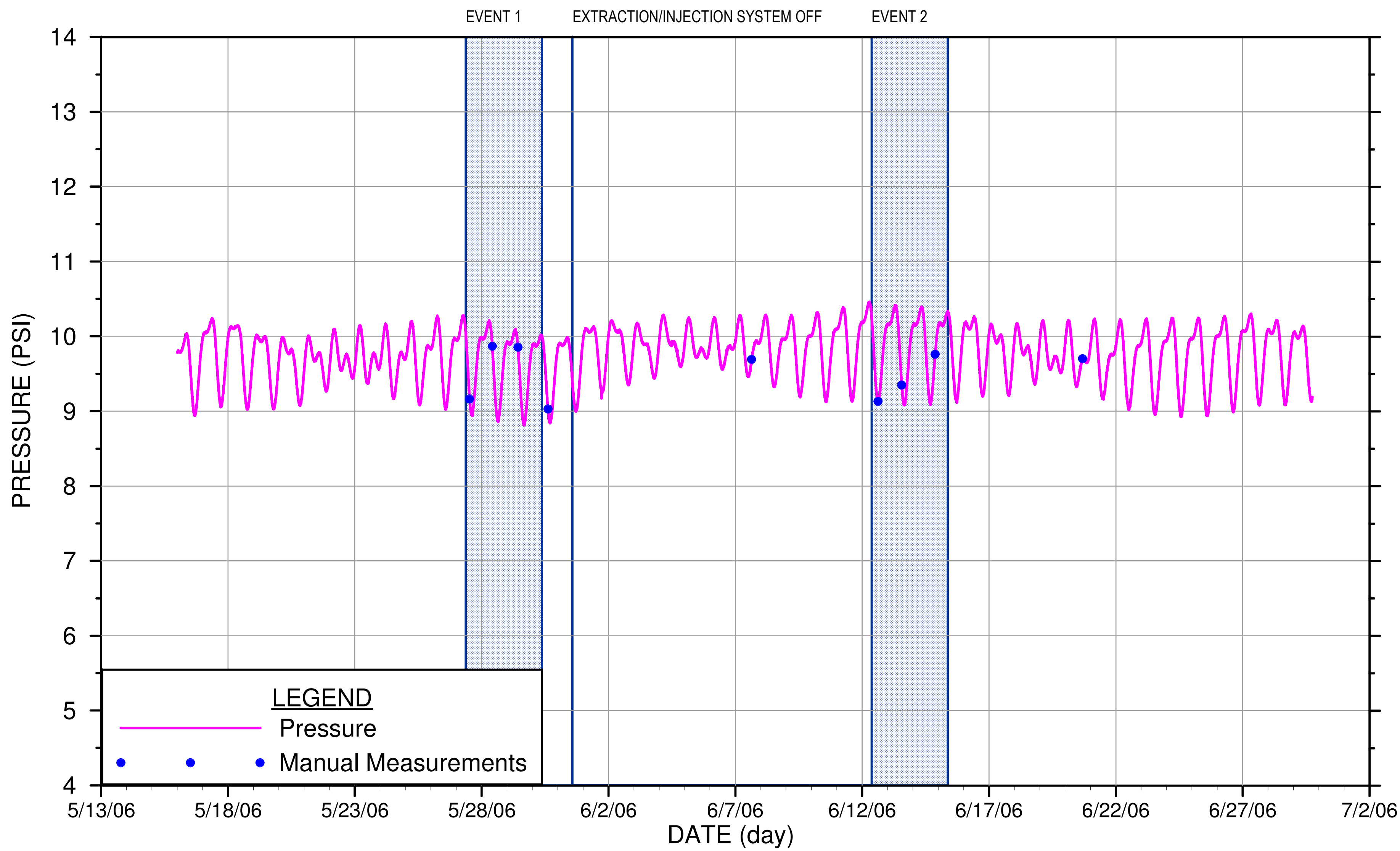


figure 6P-41

21-48 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

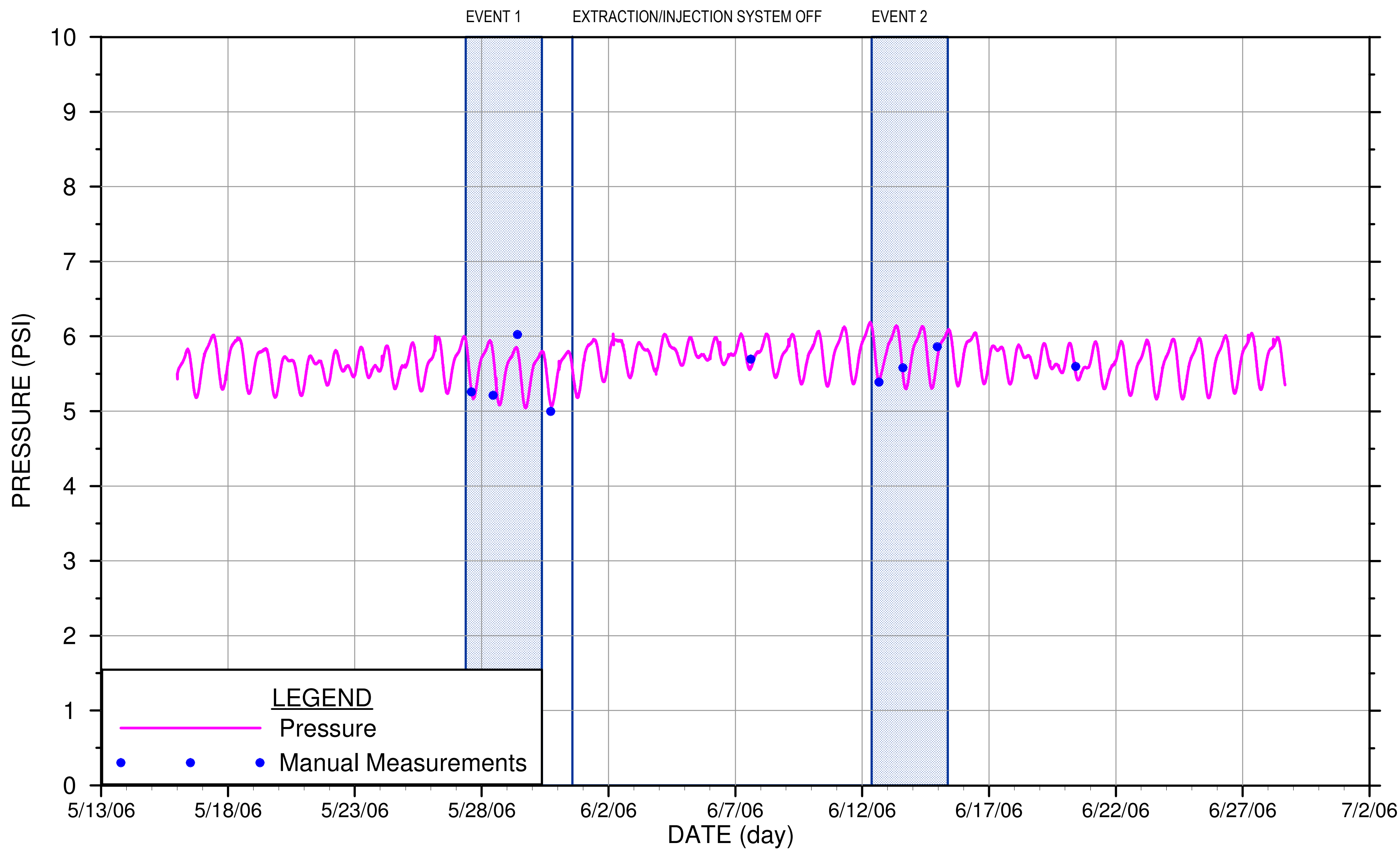


figure 6P-42

25-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-42.grf) JAN 3/2011

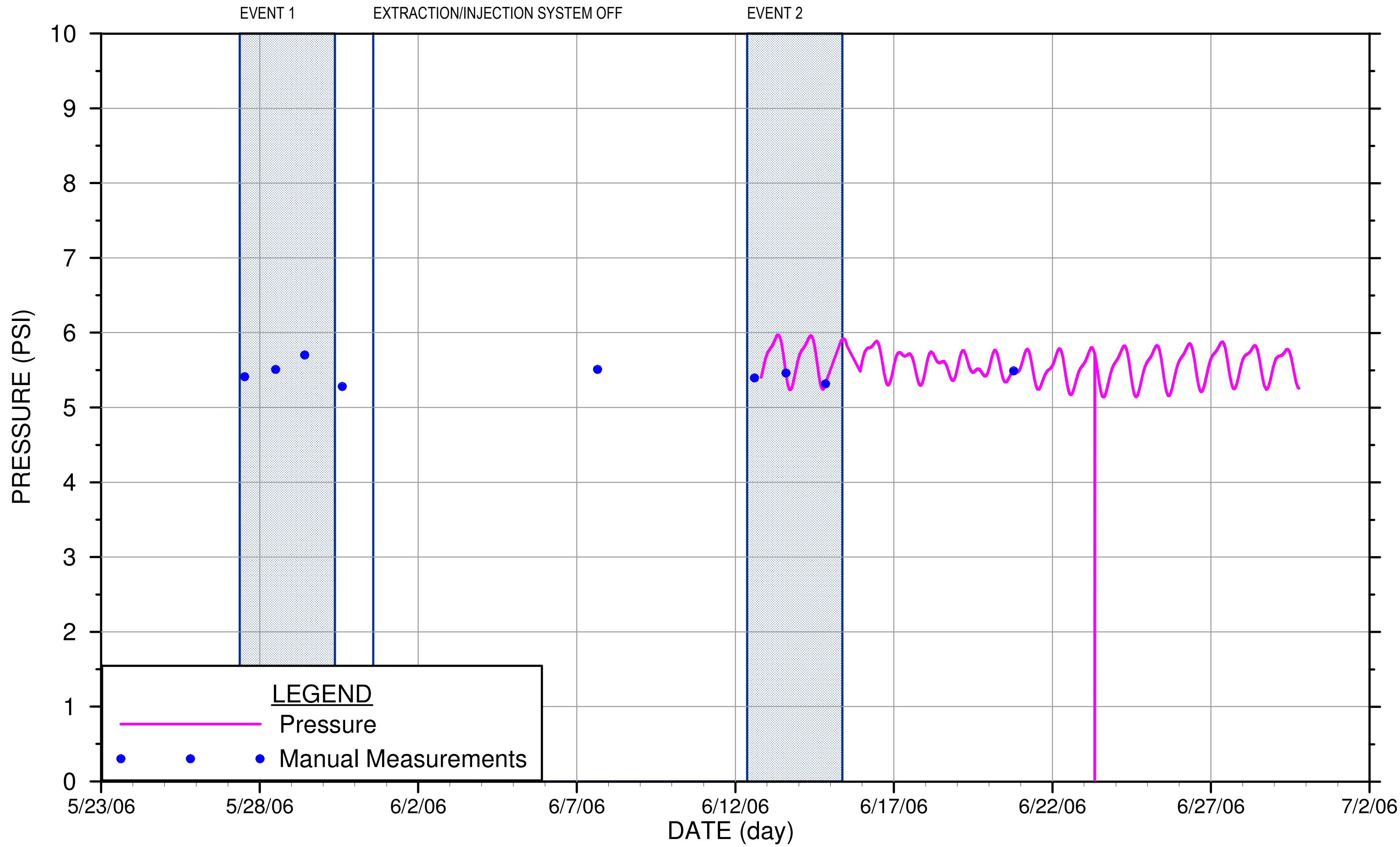


figure 6P-43

25A-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

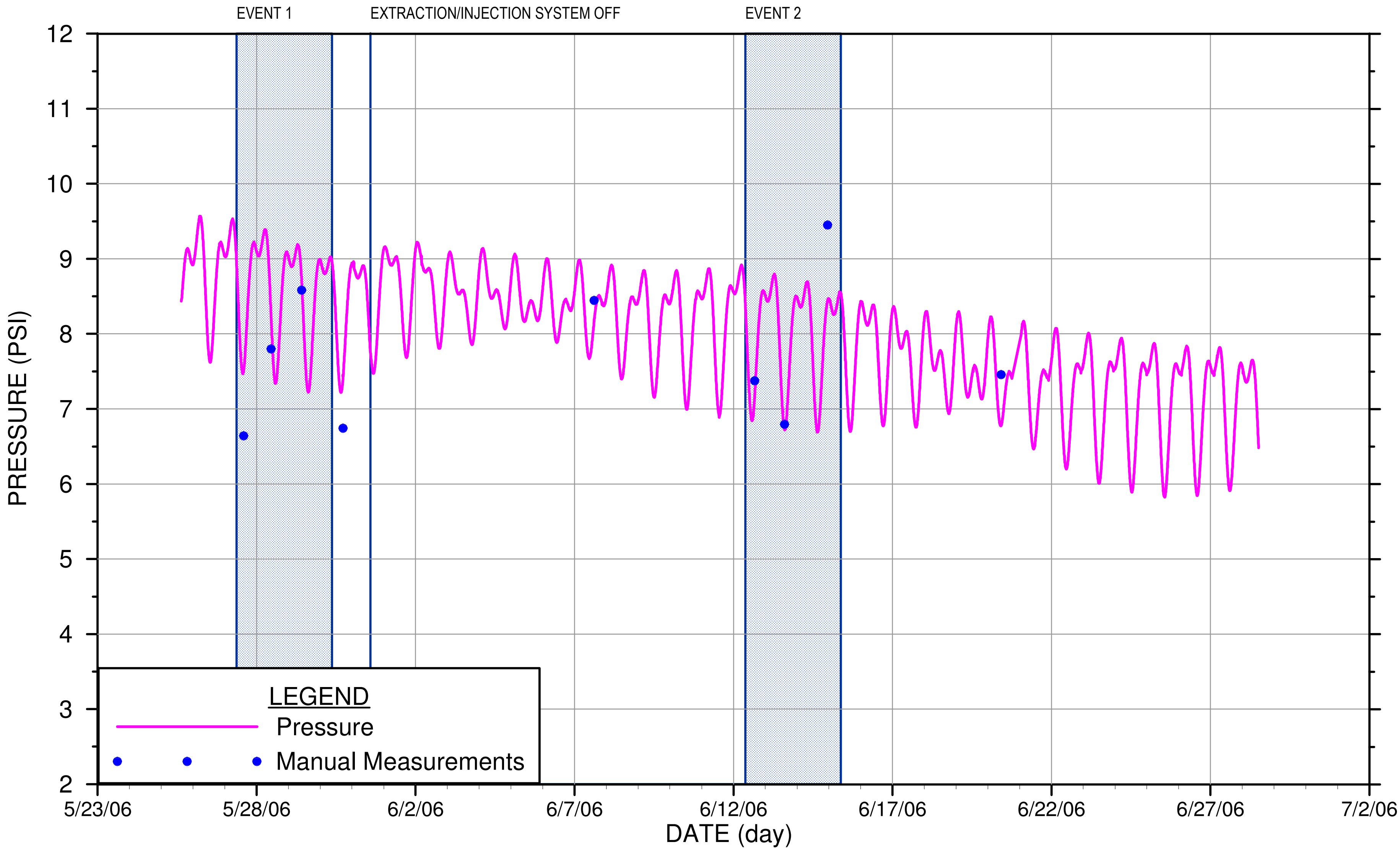


figure 6P-44

25-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-44.grf) JAN 3/2011

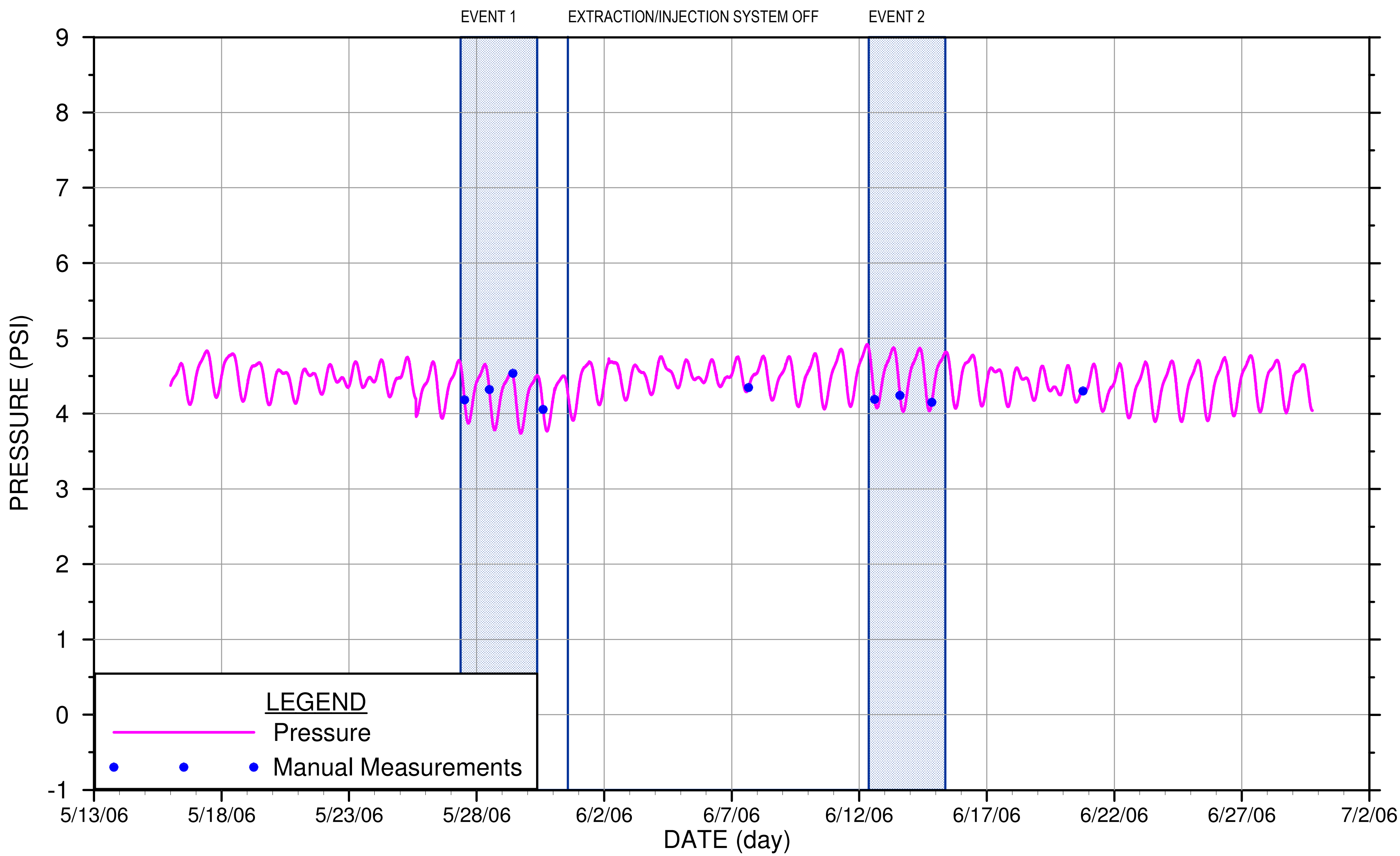


figure 6P-45

25A-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-45.grf) JAN 3/2011

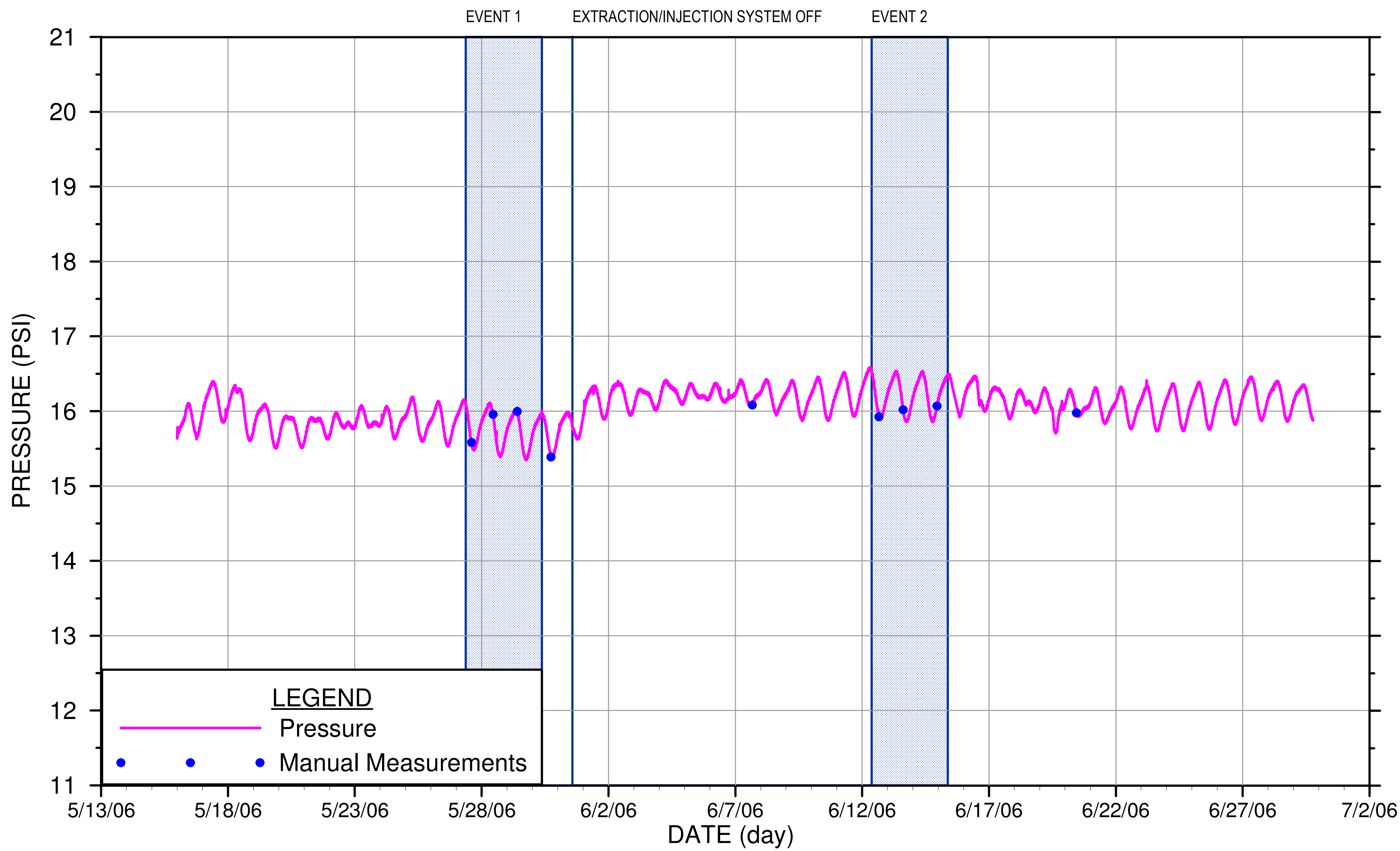


figure 6P-46

32-50R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-46.grf) JAN 3/2011

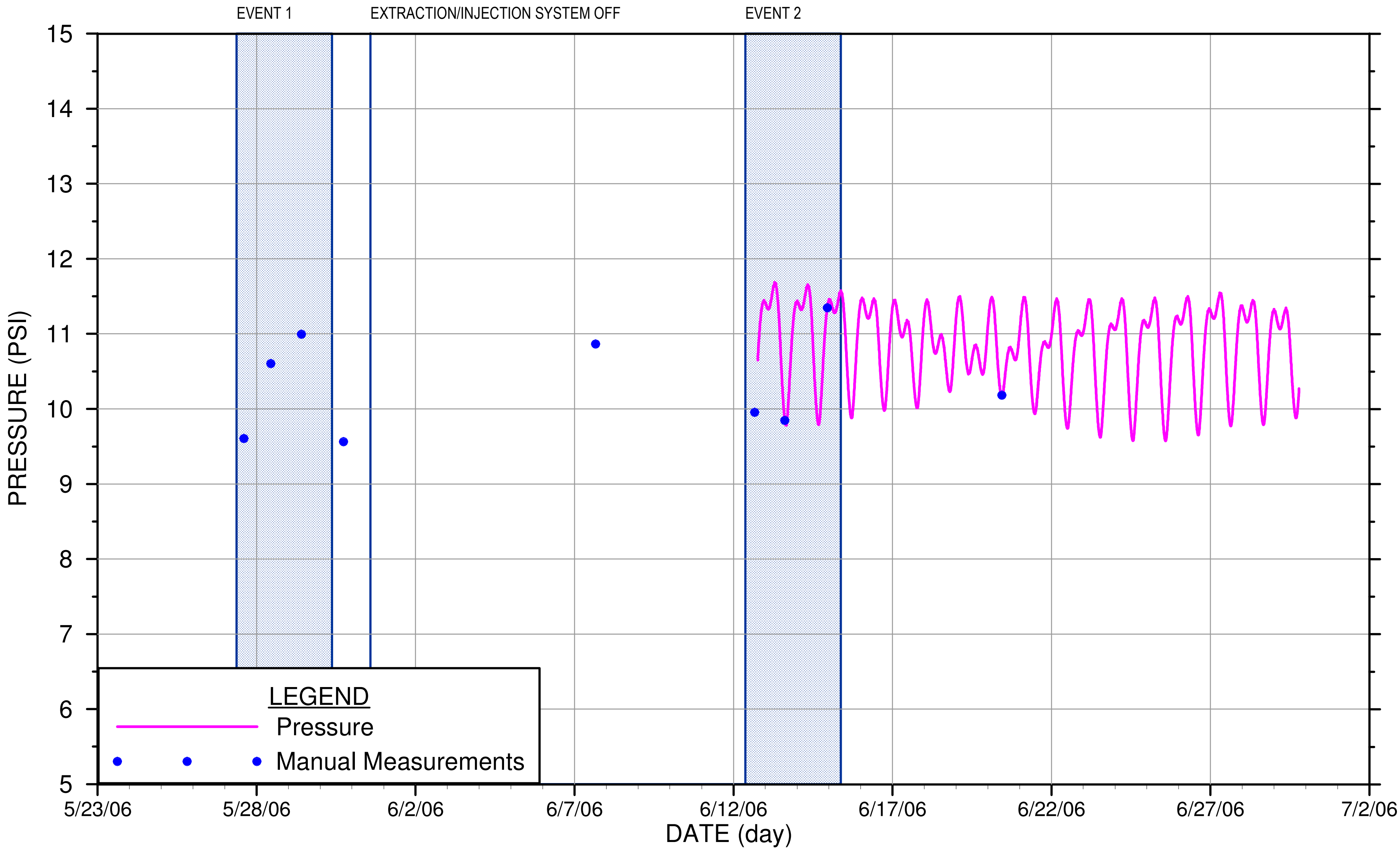


figure 6P-47

32-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

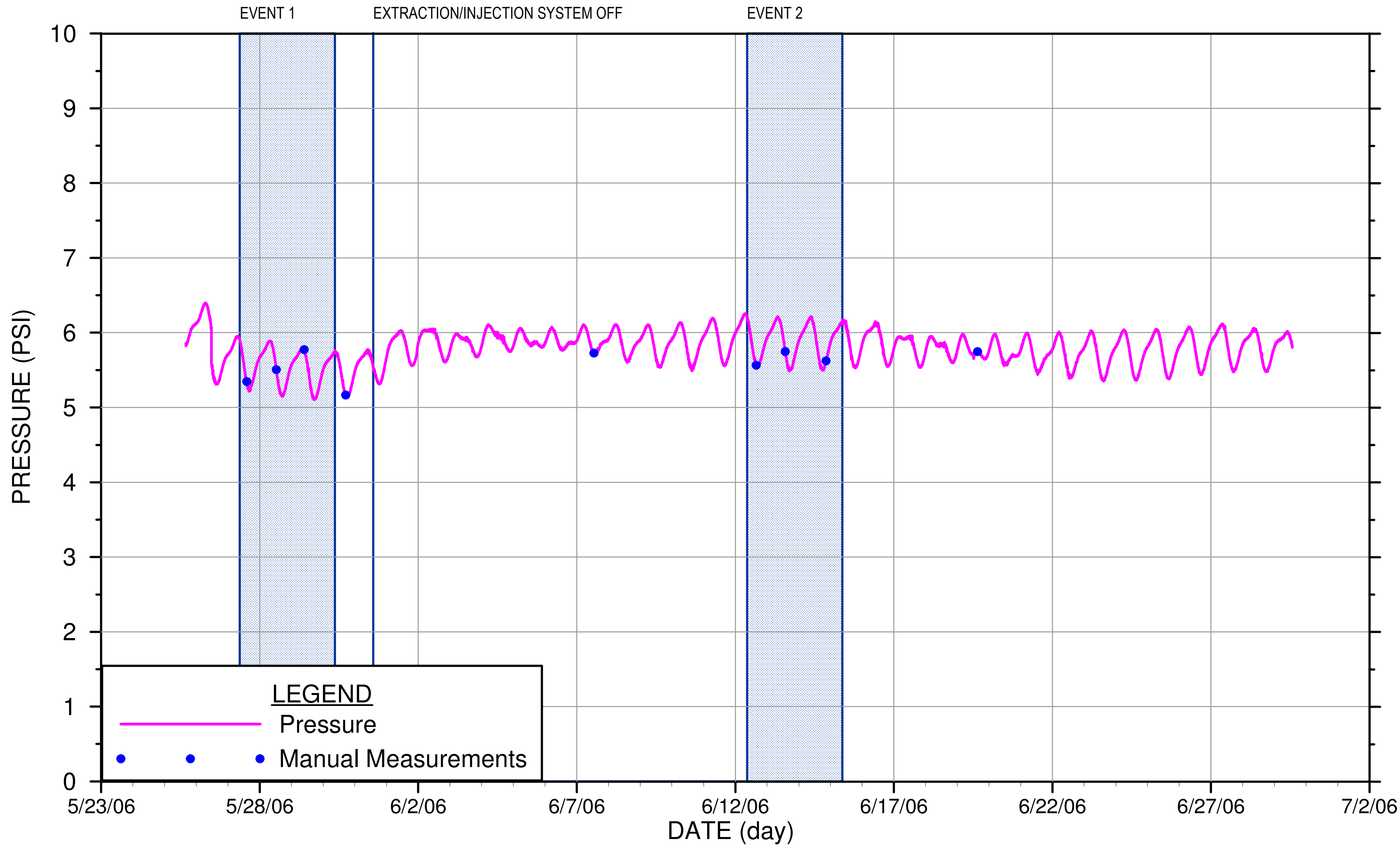


figure 6P-48

34-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-48.grf) JAN 3/2011

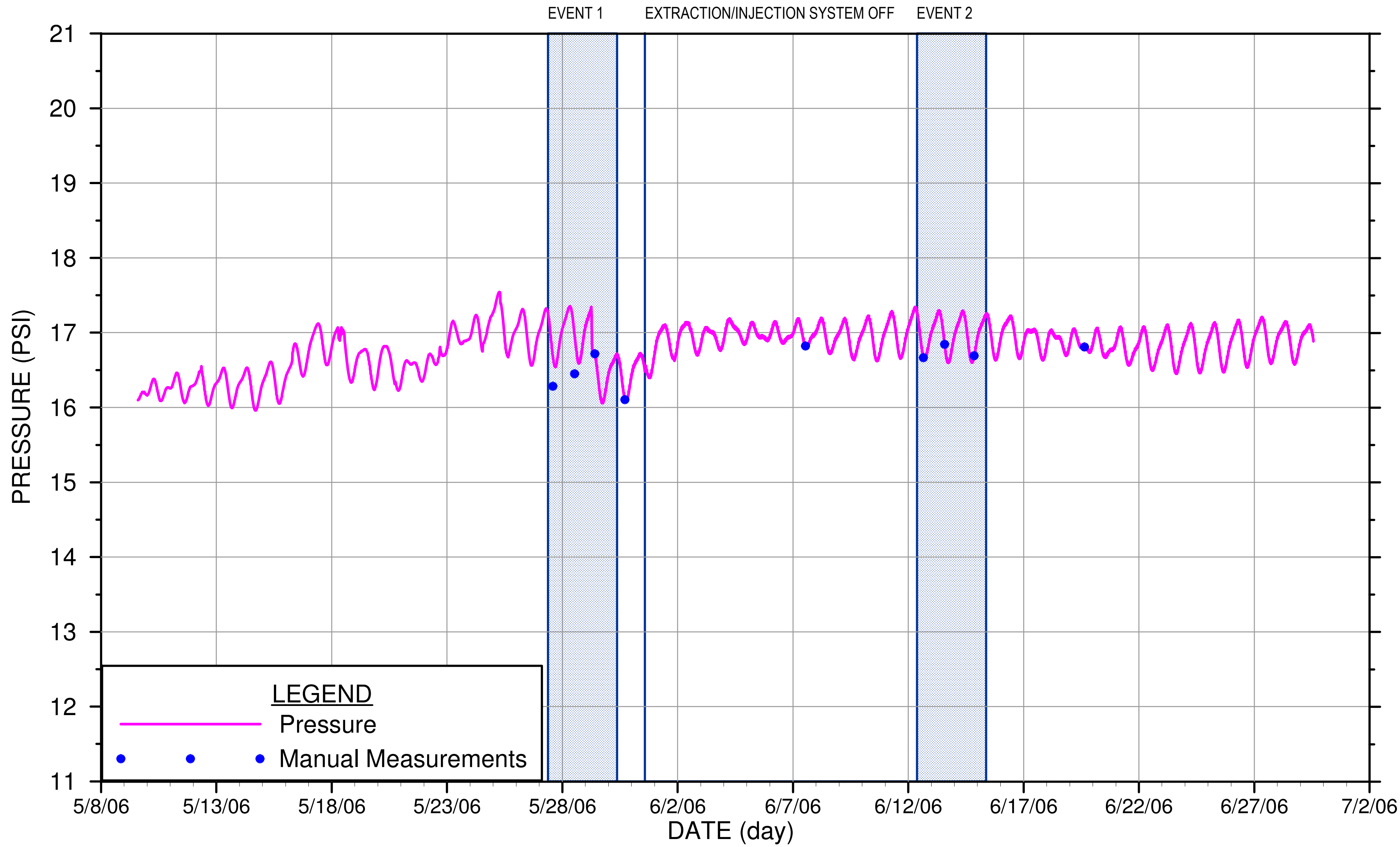


figure 6P-49

34-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-49.grf) JAN 3/2011

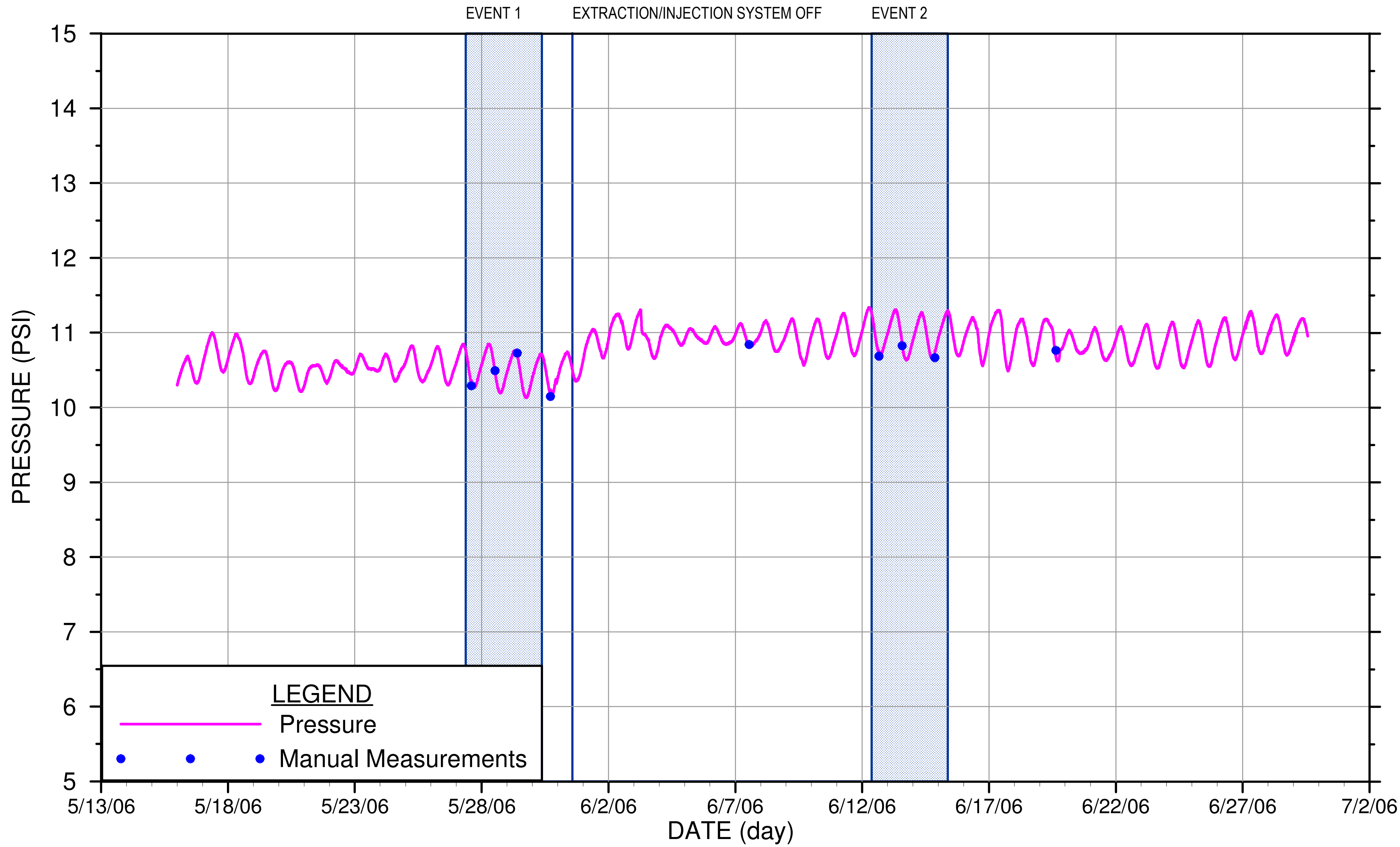


figure 6P-50

34-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-50.grf) JAN 3/2011

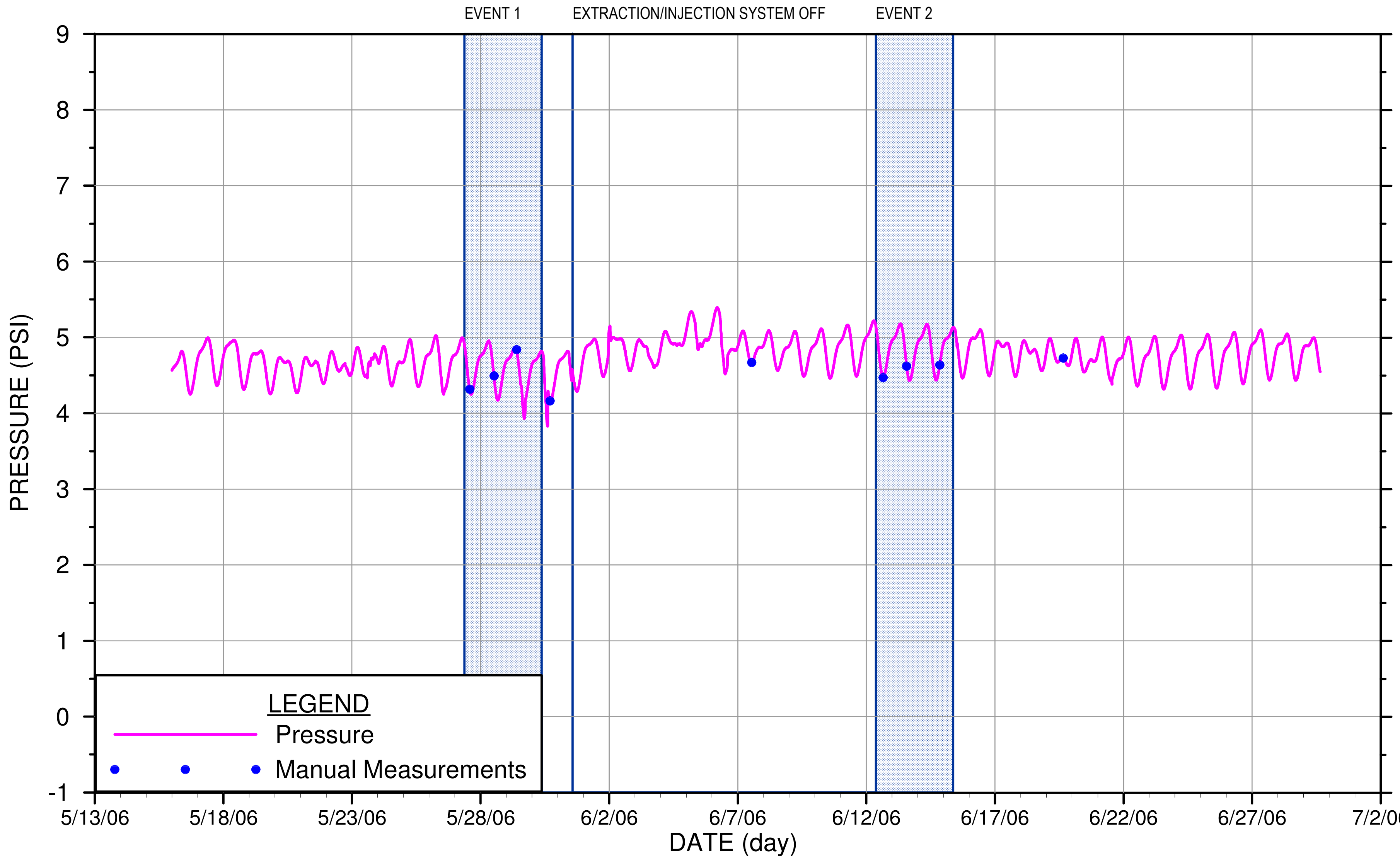


figure 6P-51

35-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

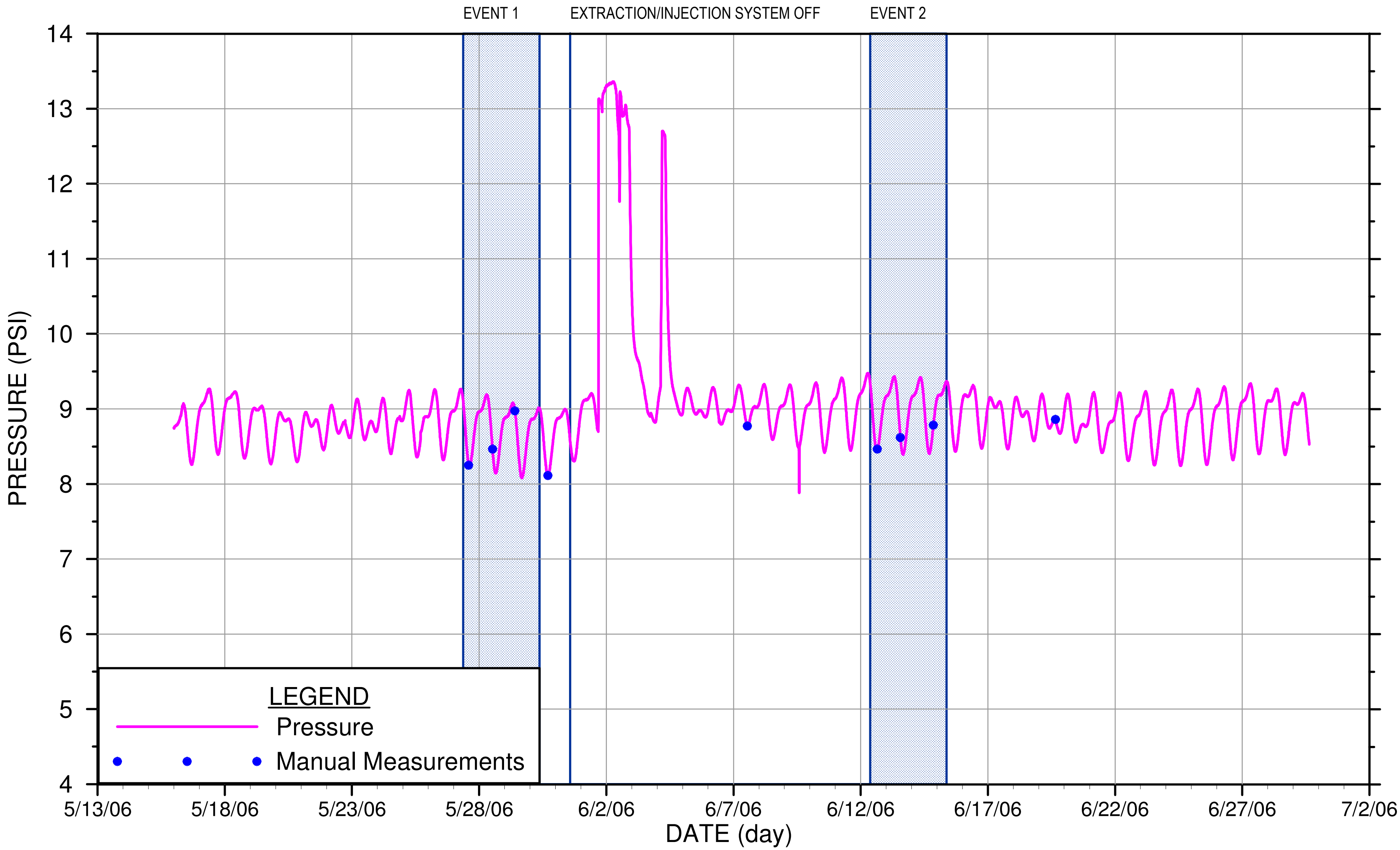


figure 6P-52

35-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-52.grf) JAN 3/2011

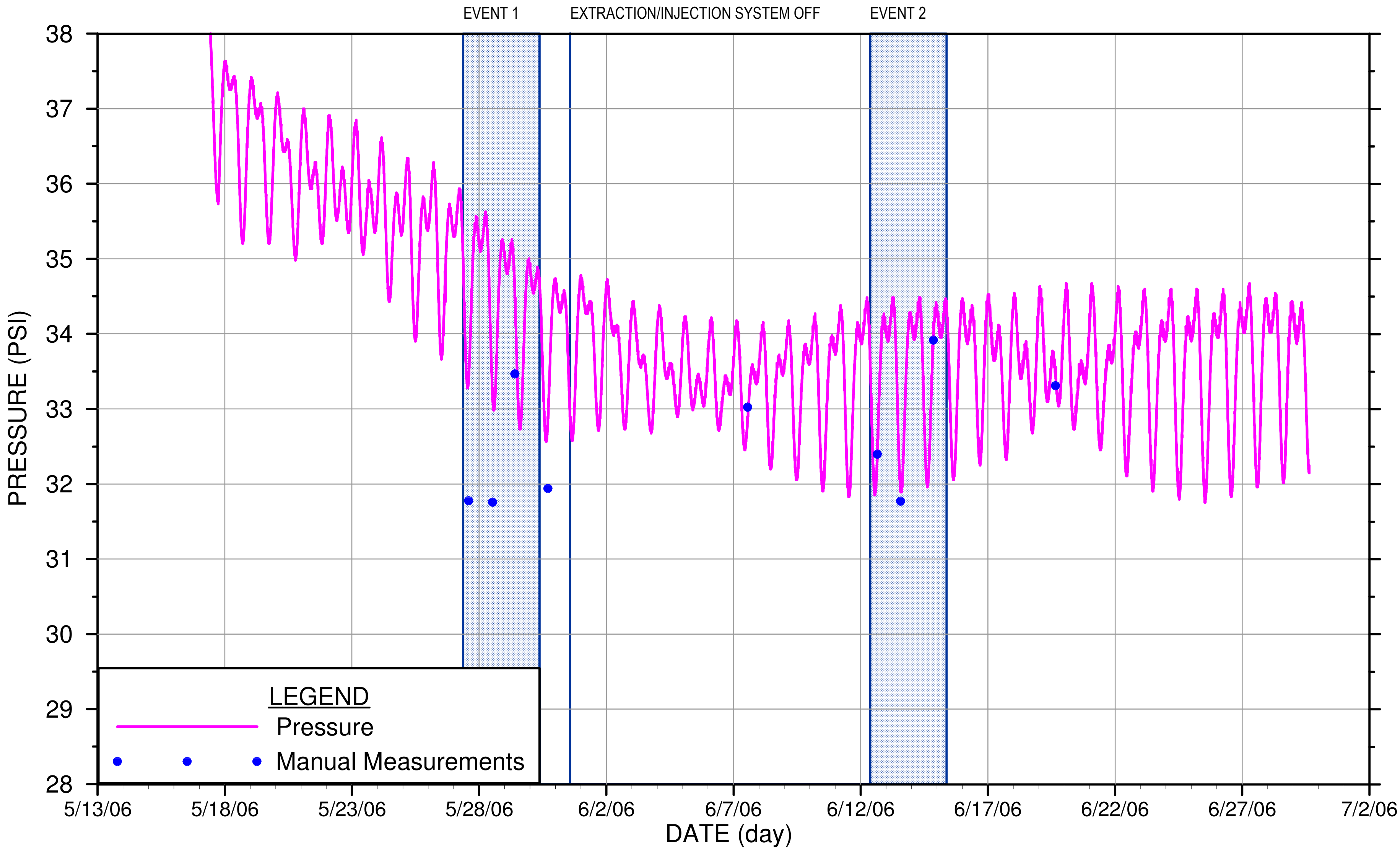


figure 6P-53

35-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-53.grf) JAN 3/2011

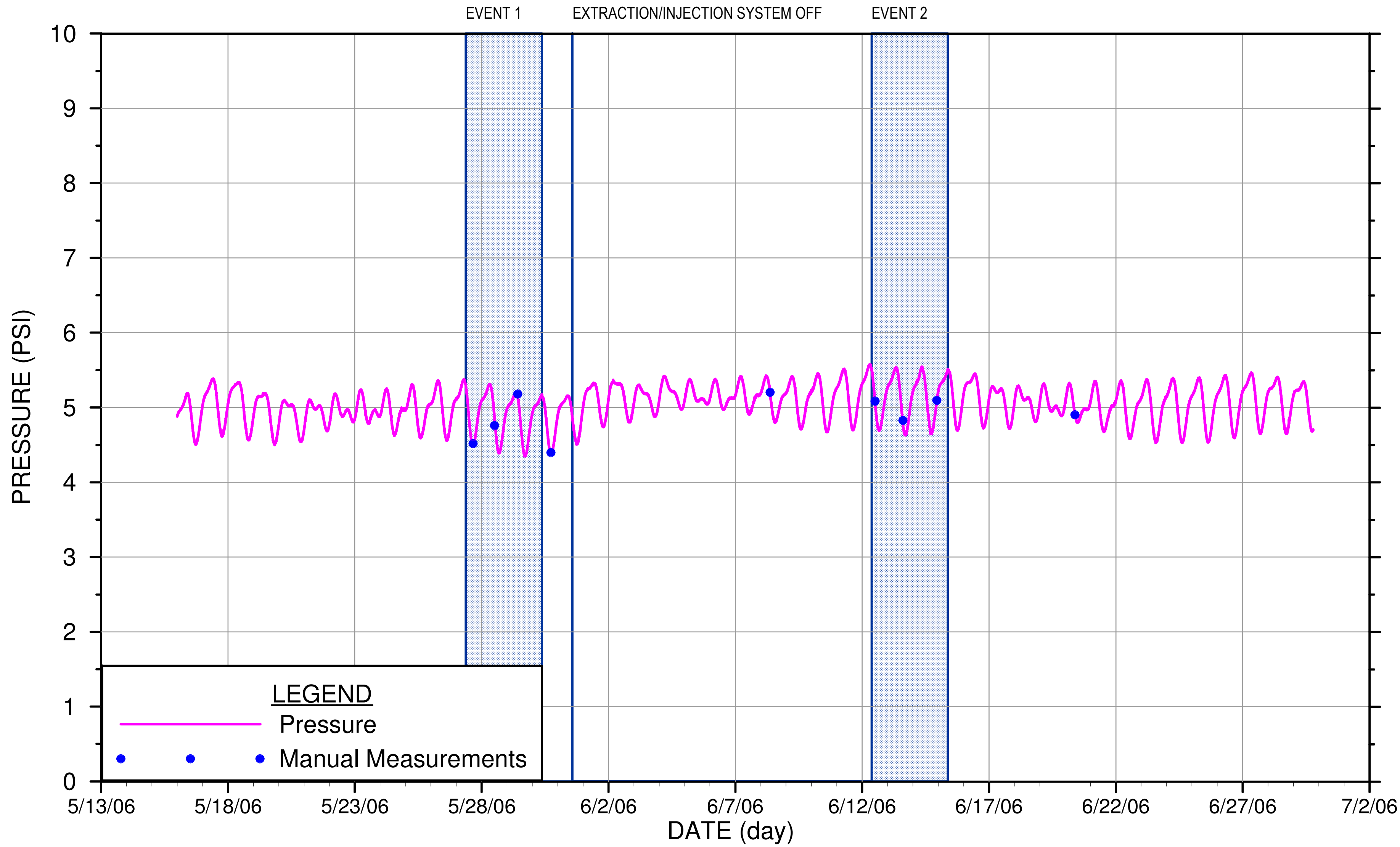


figure 6P-54

36-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-54.grf)JAN 3/2011

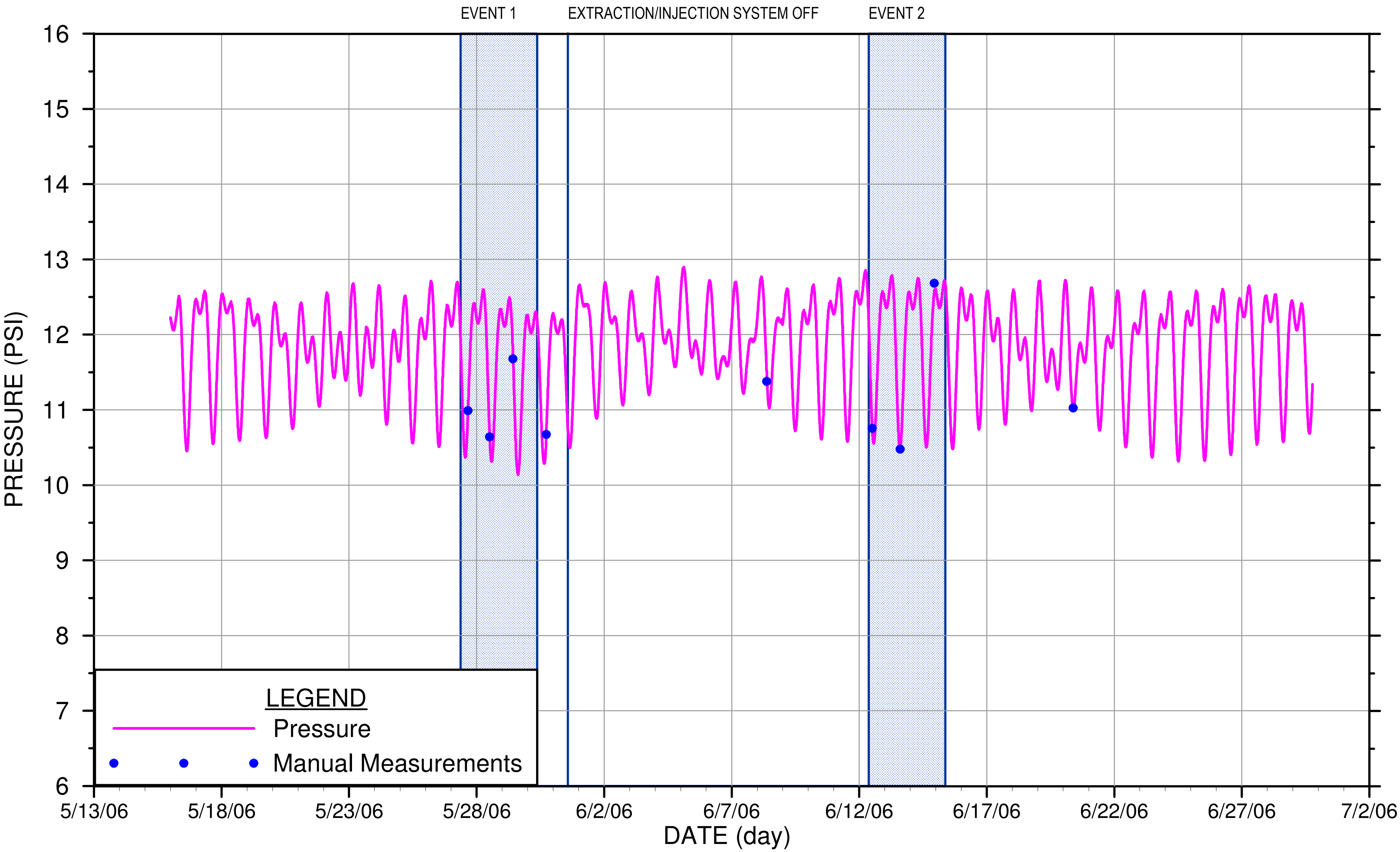


figure 6P-55

36-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-55.grf) JAN 3/2011

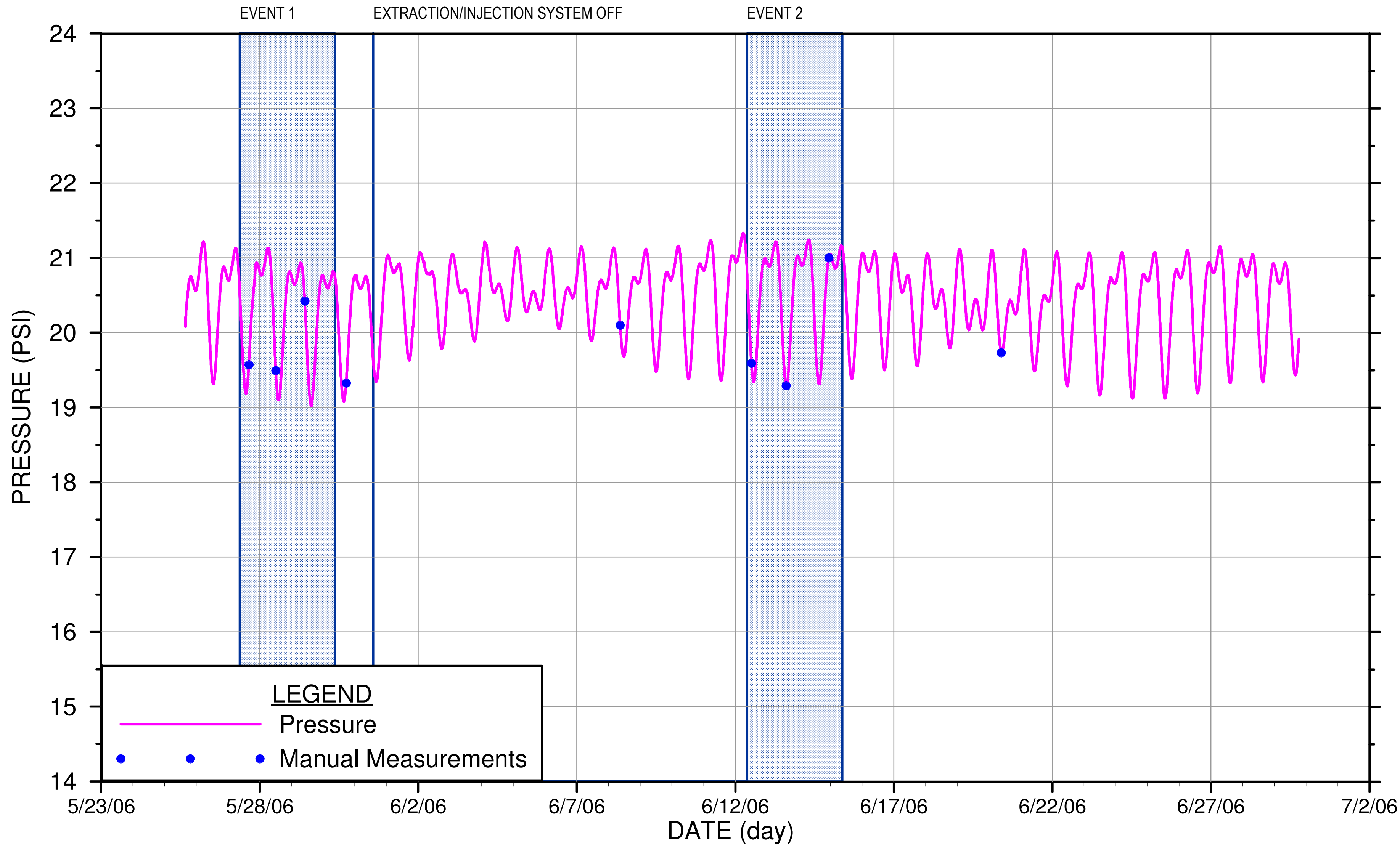


figure 6P-56

36-100R PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-56.grf) JAN 3/2011

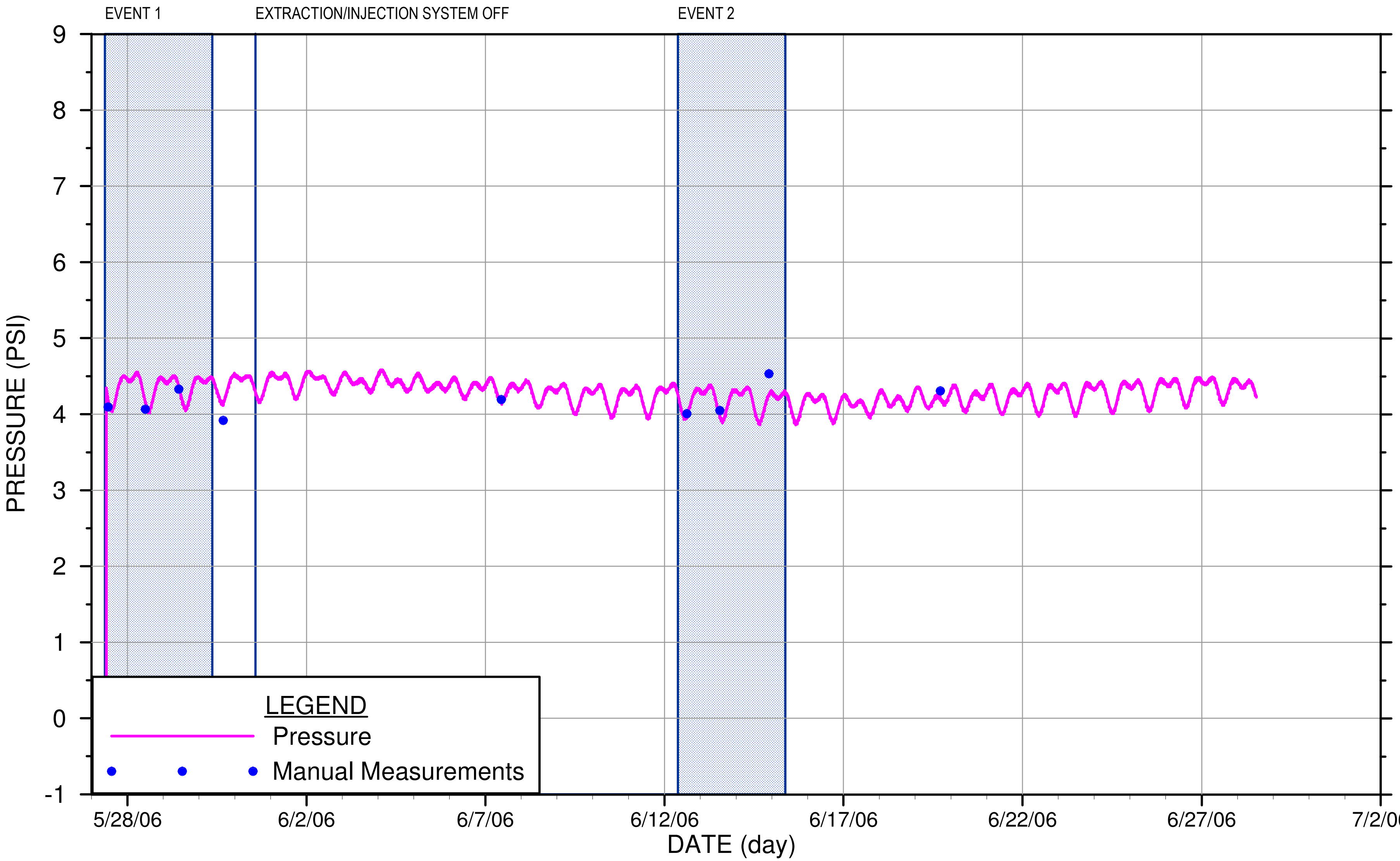


figure 6P-57

40A-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-57.grf) JAN 3/2011

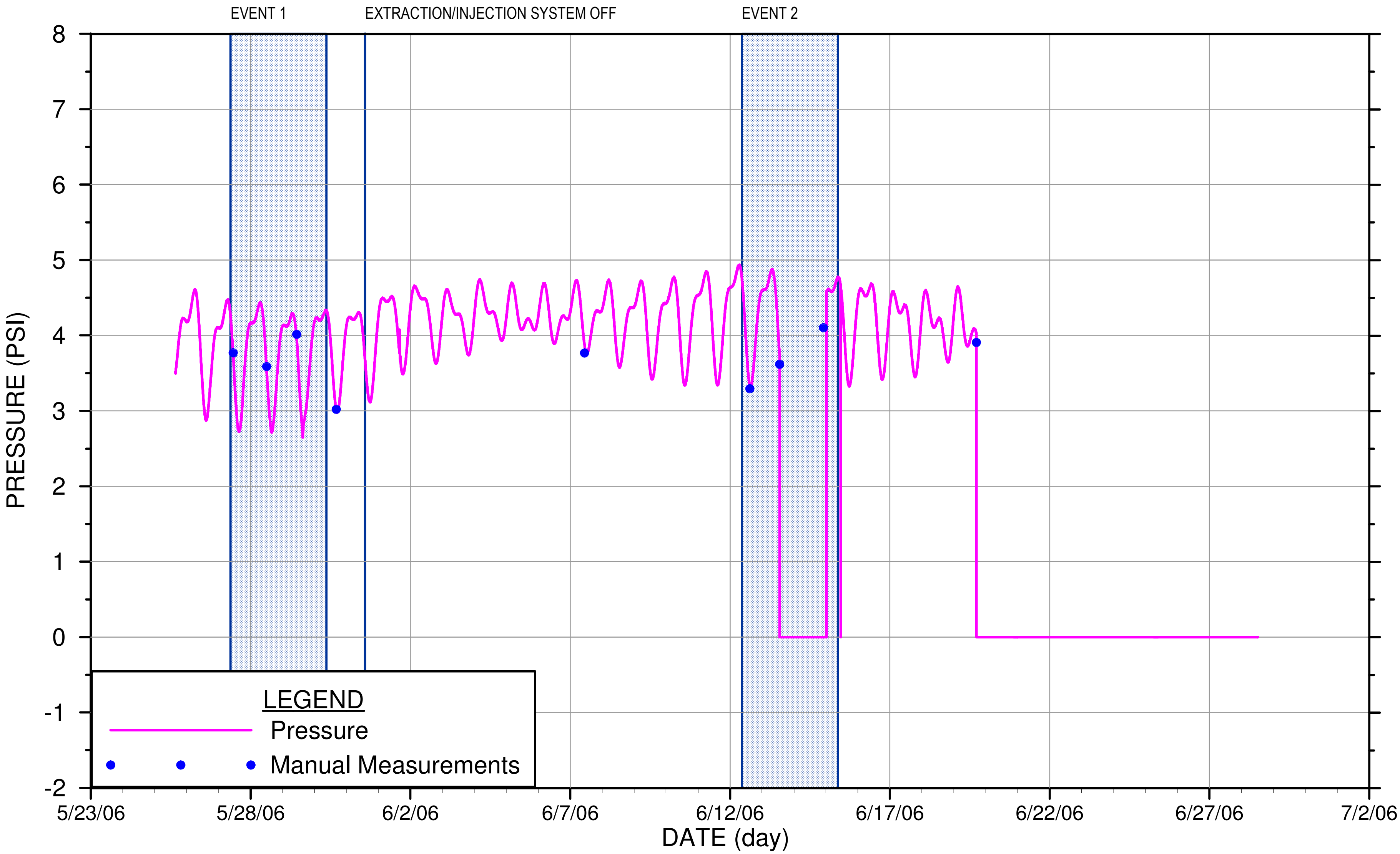


figure 6P-58

40A-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-58.grf) JAN 3/2011

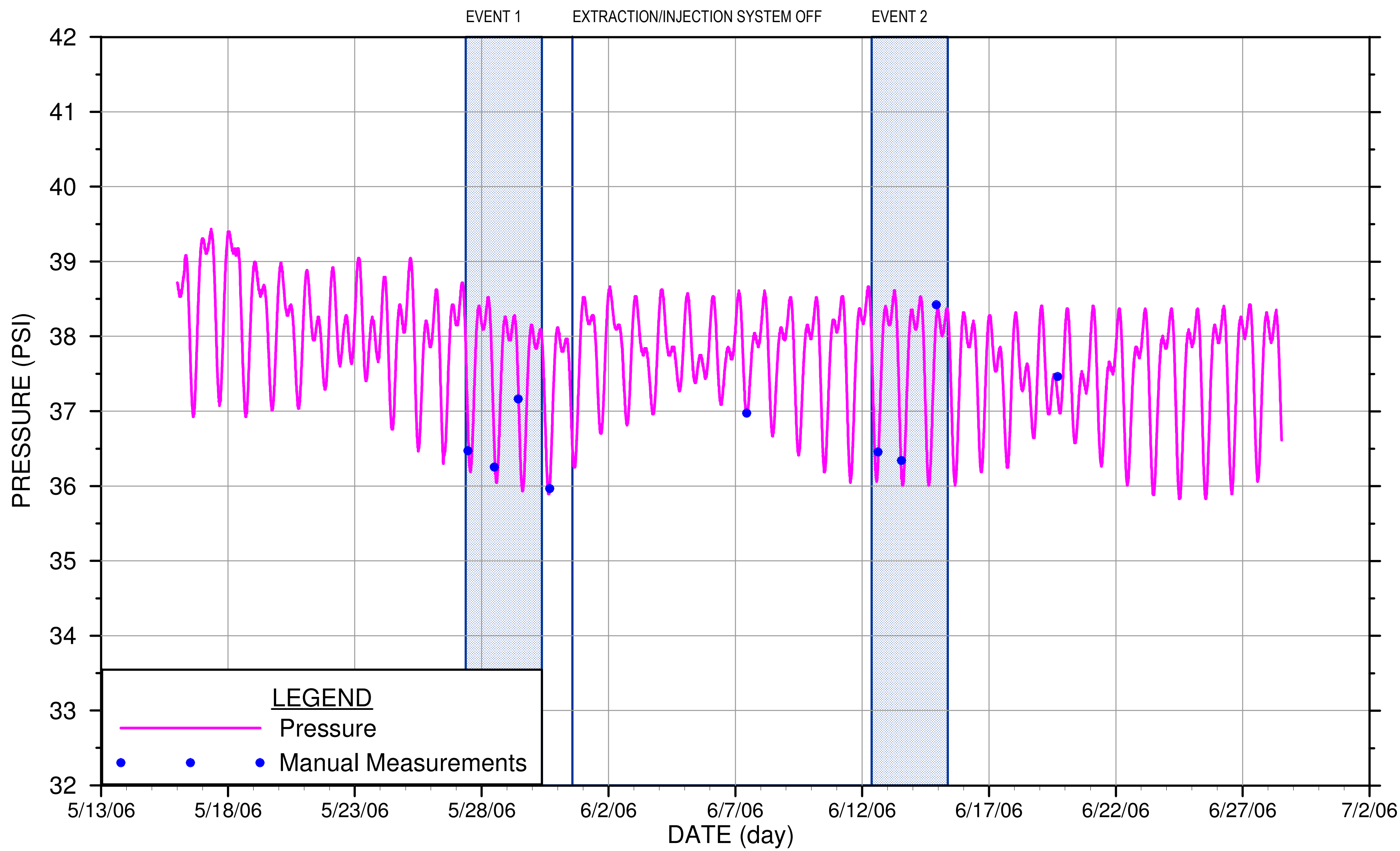


figure 6P-59

40A-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-59.grf) JAN 3/2011

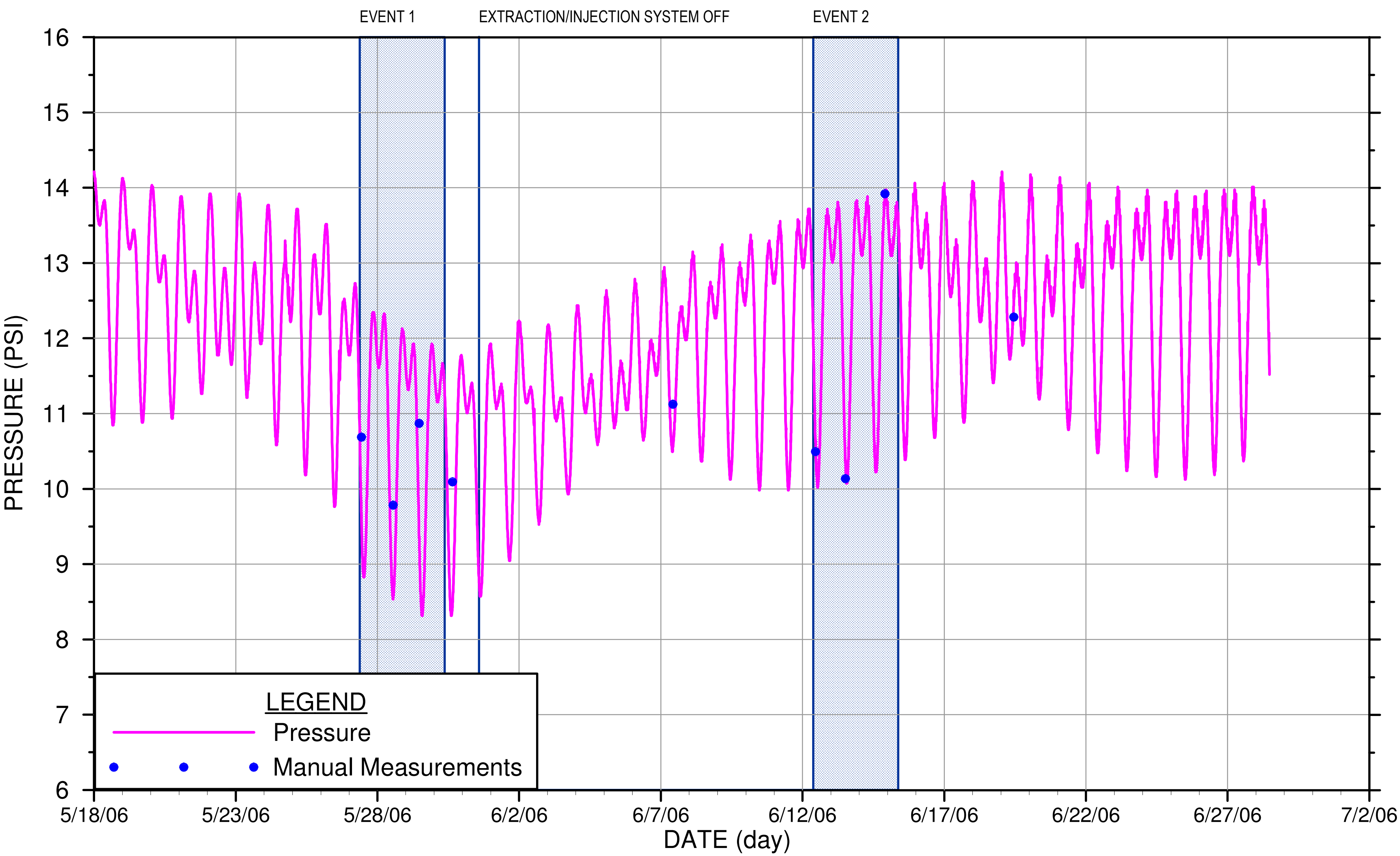


figure 6P-60

41-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-60.grf) JAN 3/2011

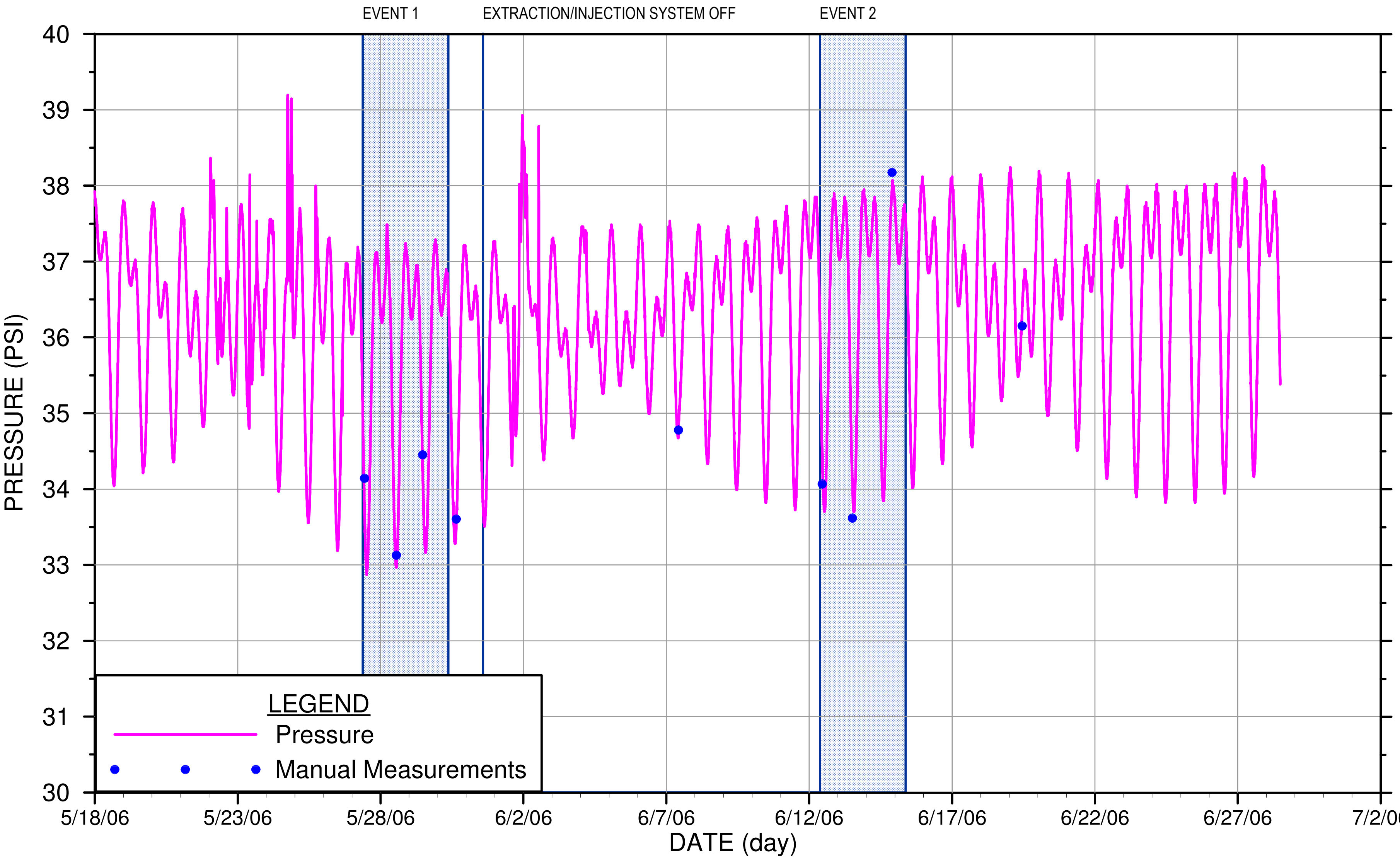


figure 6P-61

41-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-61.grf) JAN 3/2011

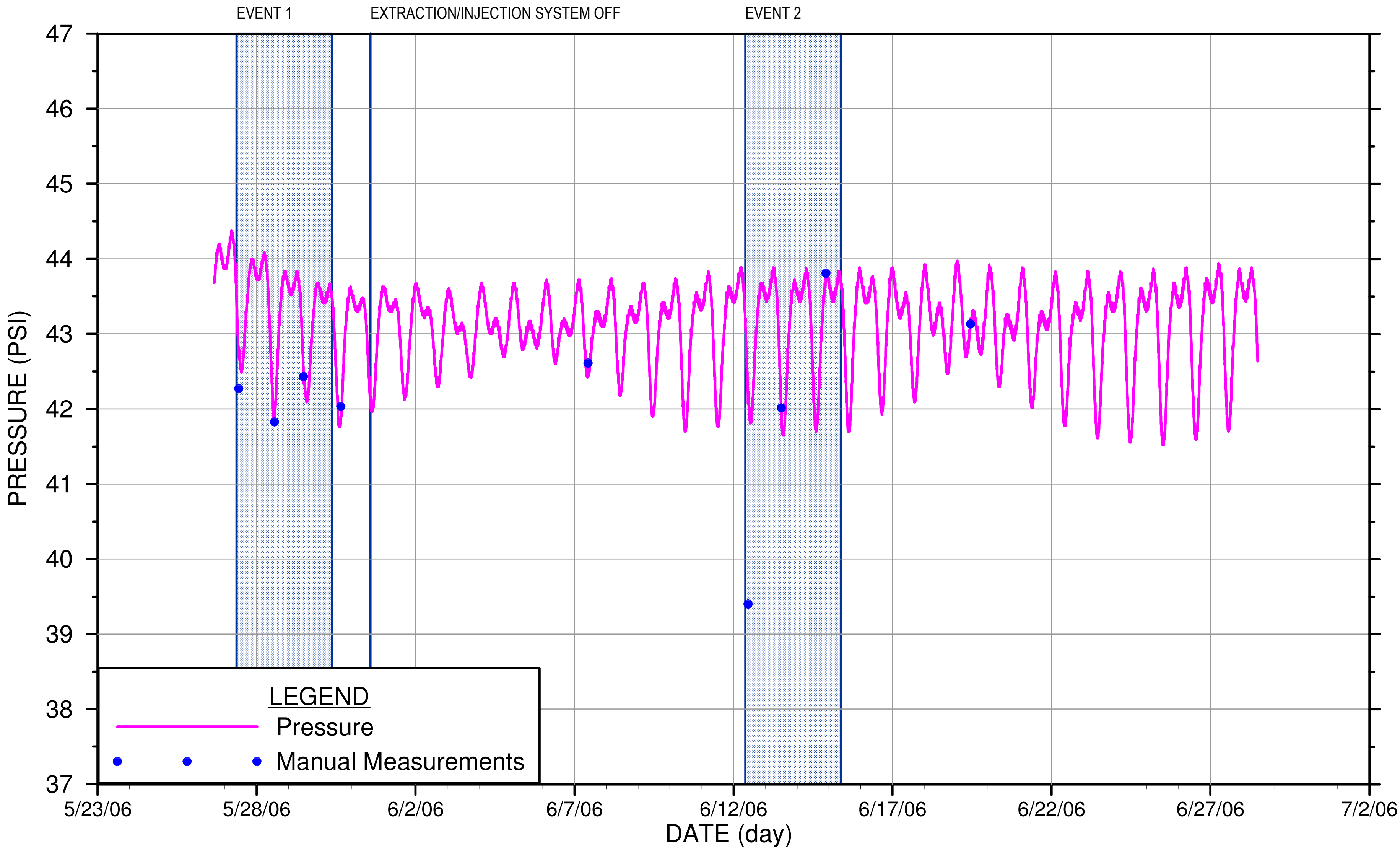


figure 6P-62

41-138 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-62.grf) JAN 3/2011

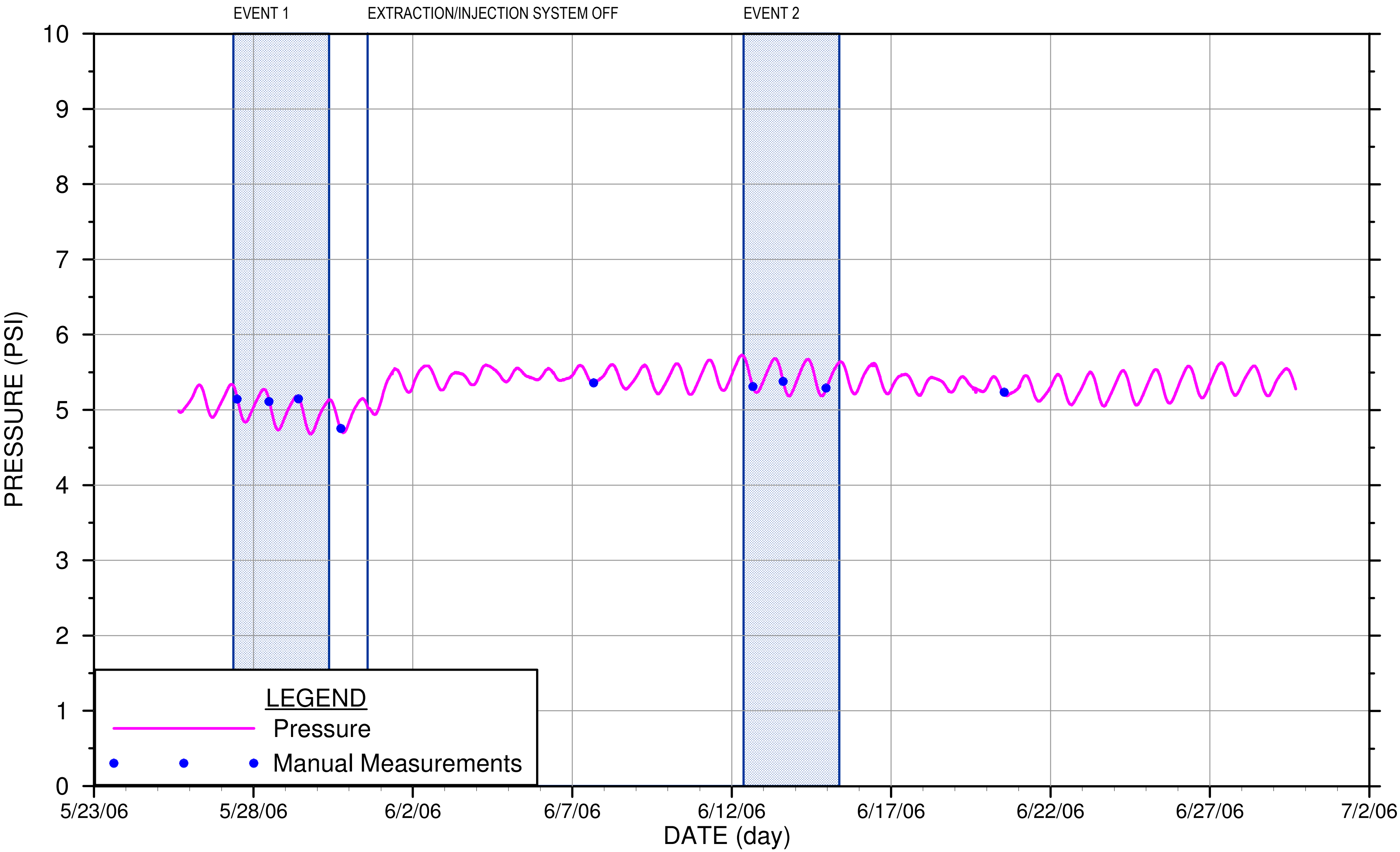


figure 6P-63

43-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-63.grf) JAN 3/2011

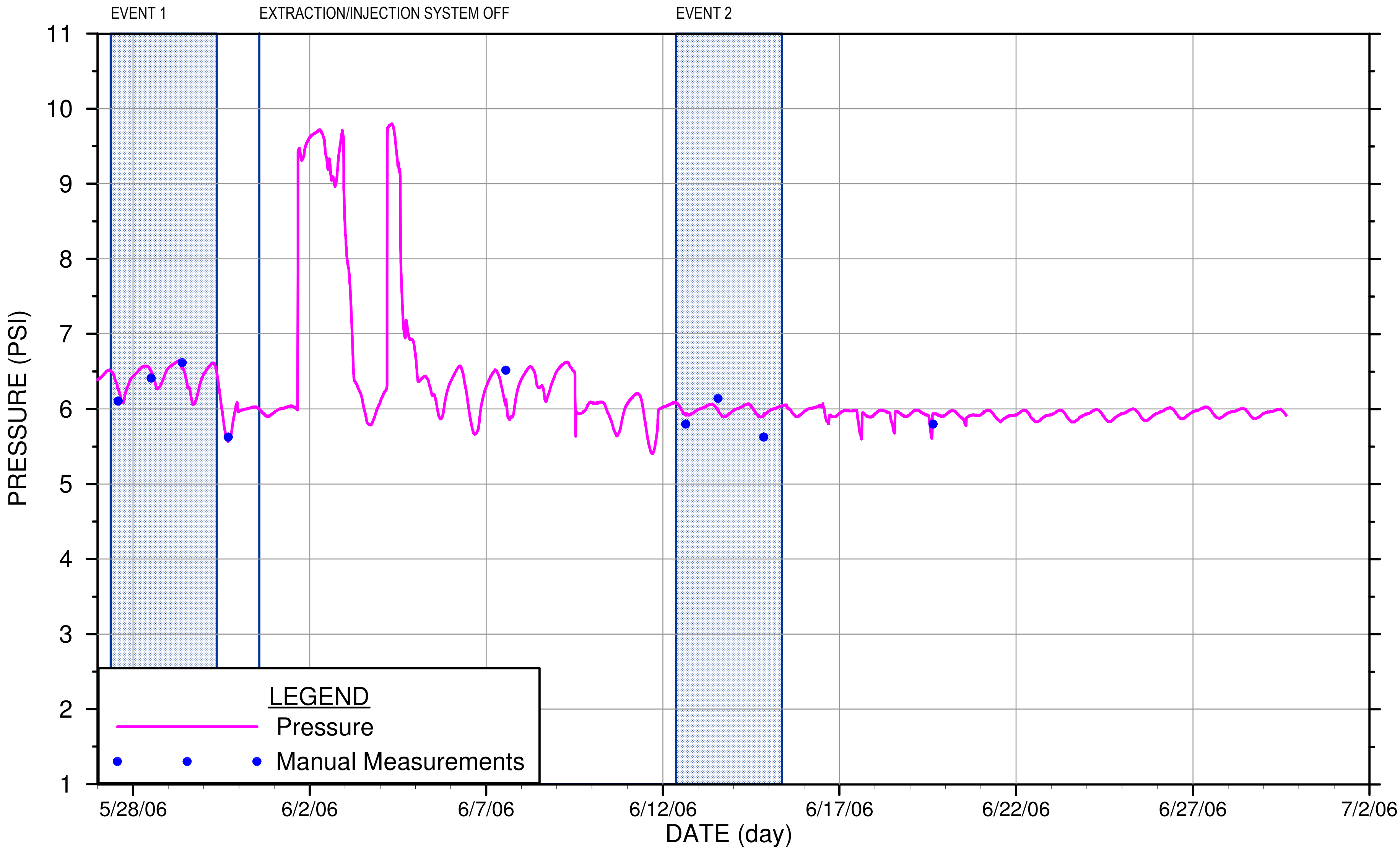


figure 6P-64

44-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-64.grf) JAN 3/2011

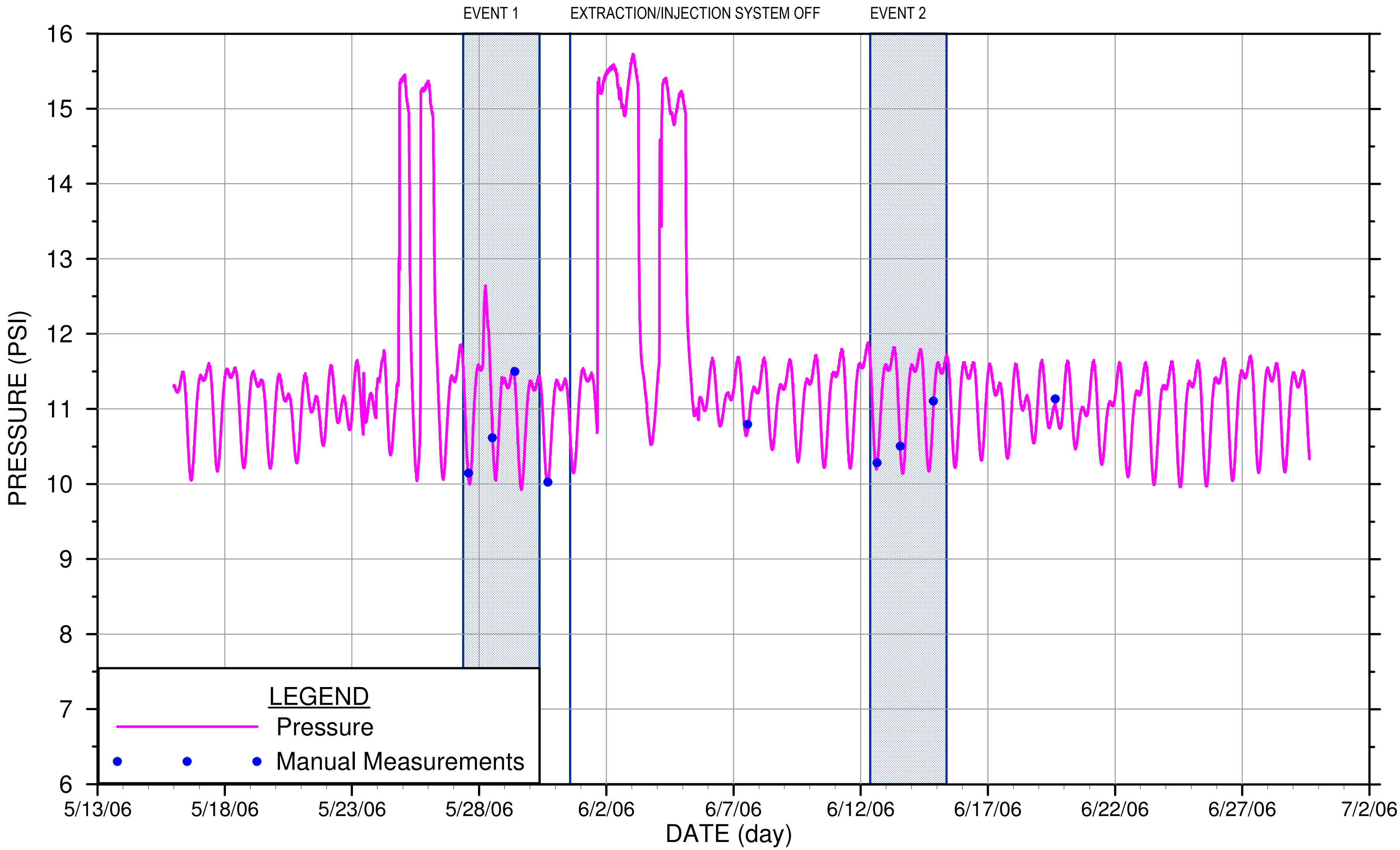


figure 6P-65

44-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-65.grf) JAN 3/2011

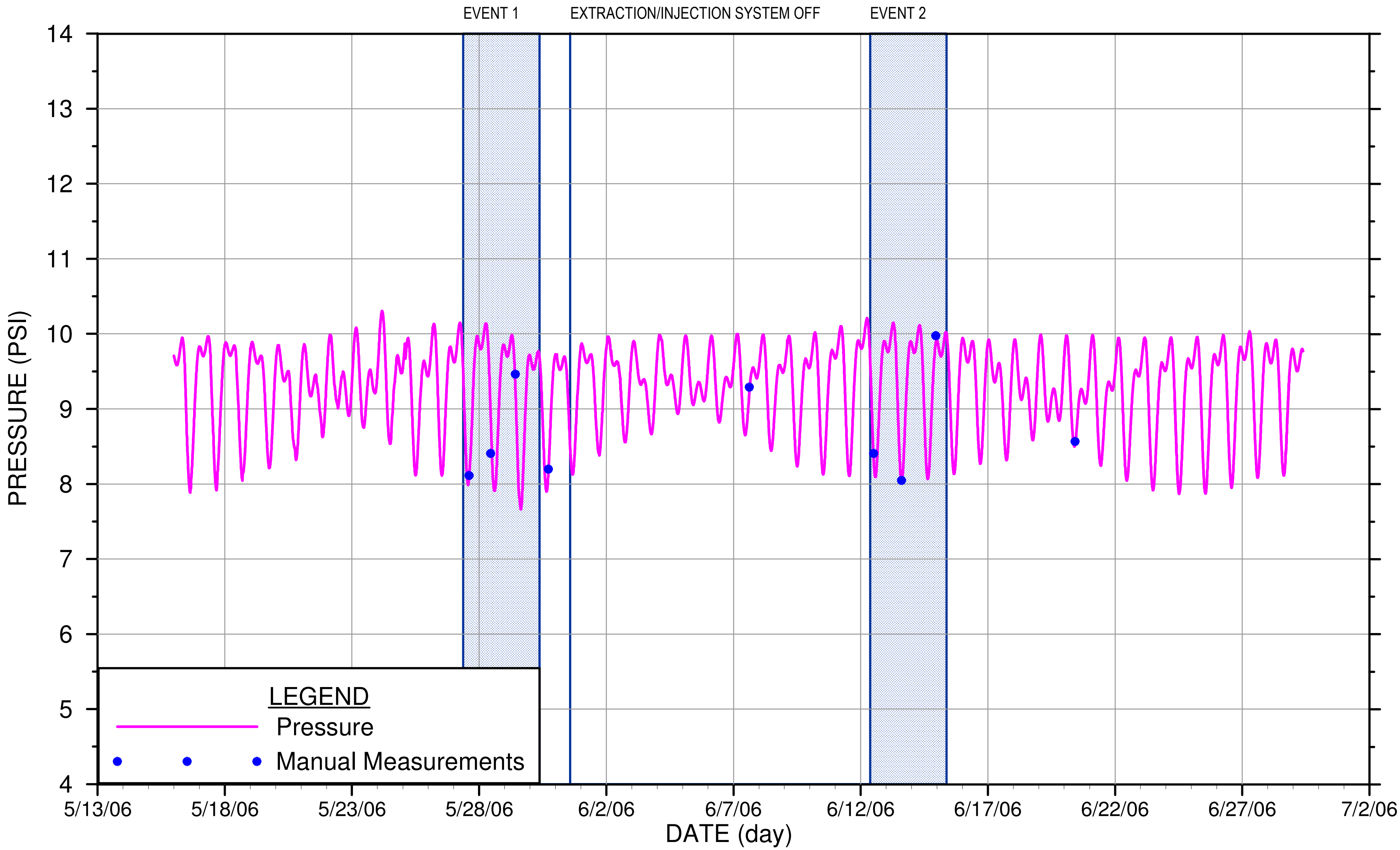


figure 6P-66

45-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-66.grf) JAN 3/2011

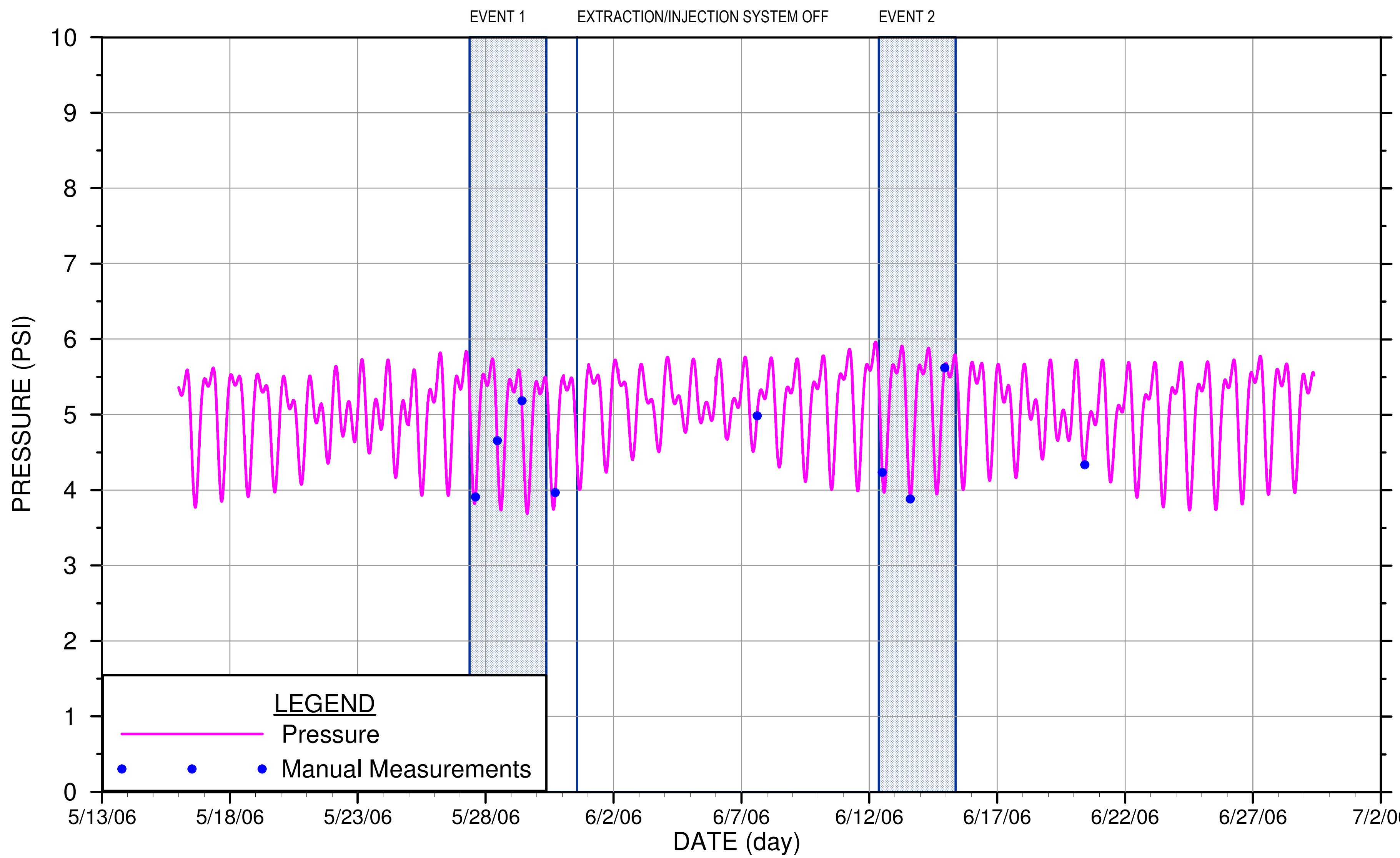


figure 6P-67

45-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\AppI\Att6\pressure\6P-67.grf) JAN 3/2011

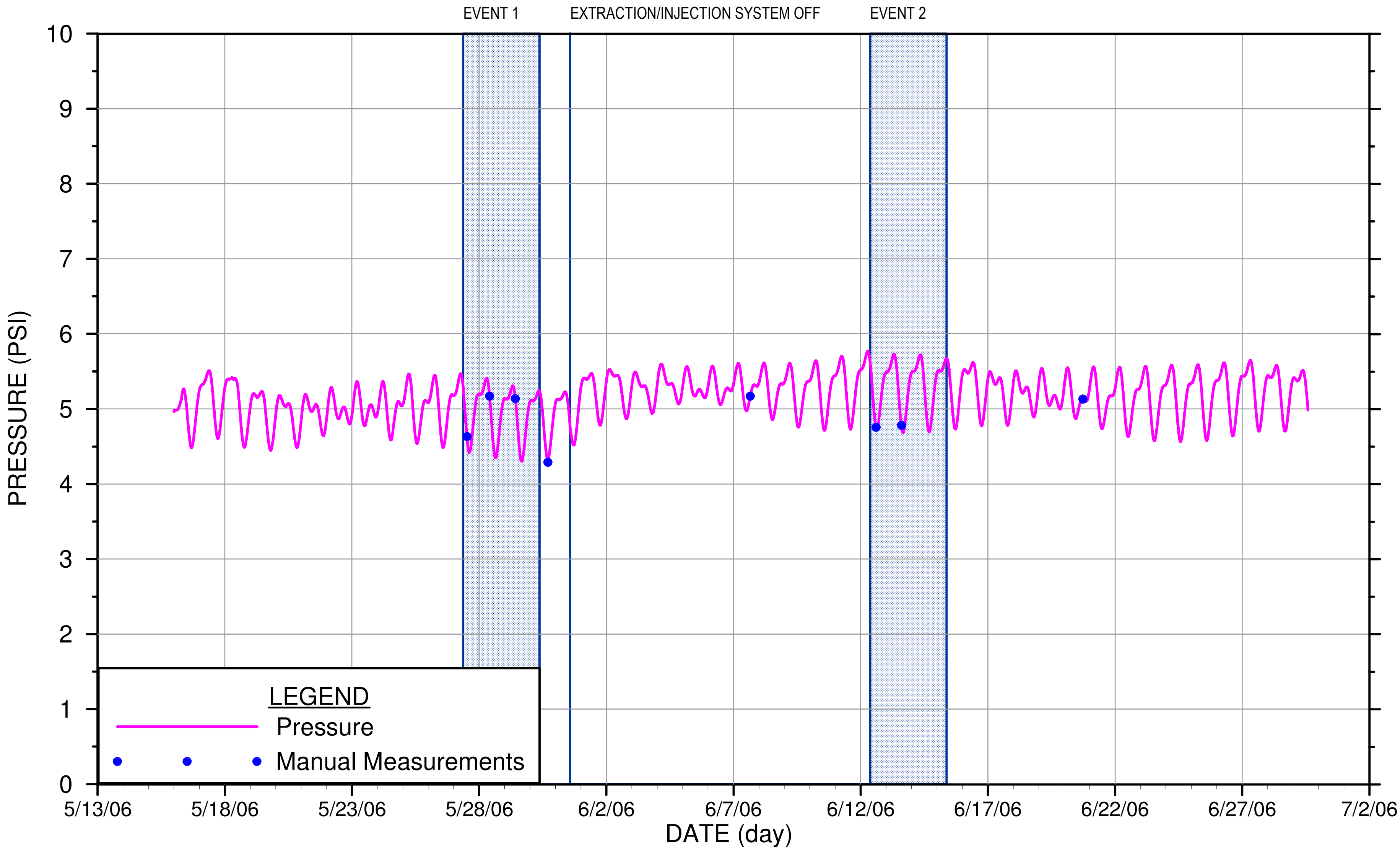


figure 6P-68

53-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-68.grf) JAN 3/2011

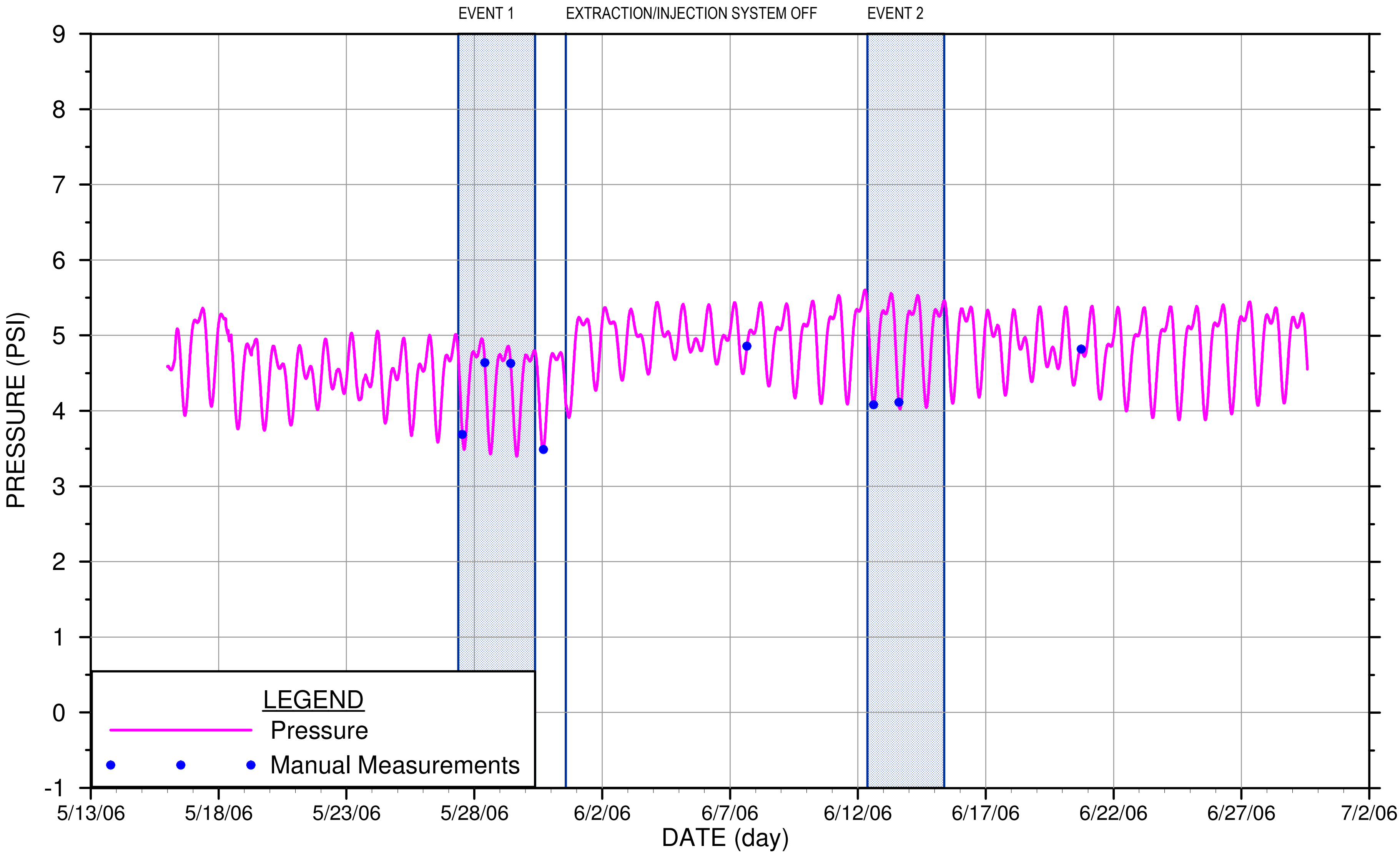


figure 6P-69

53-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-69.grf) JAN 3/2011

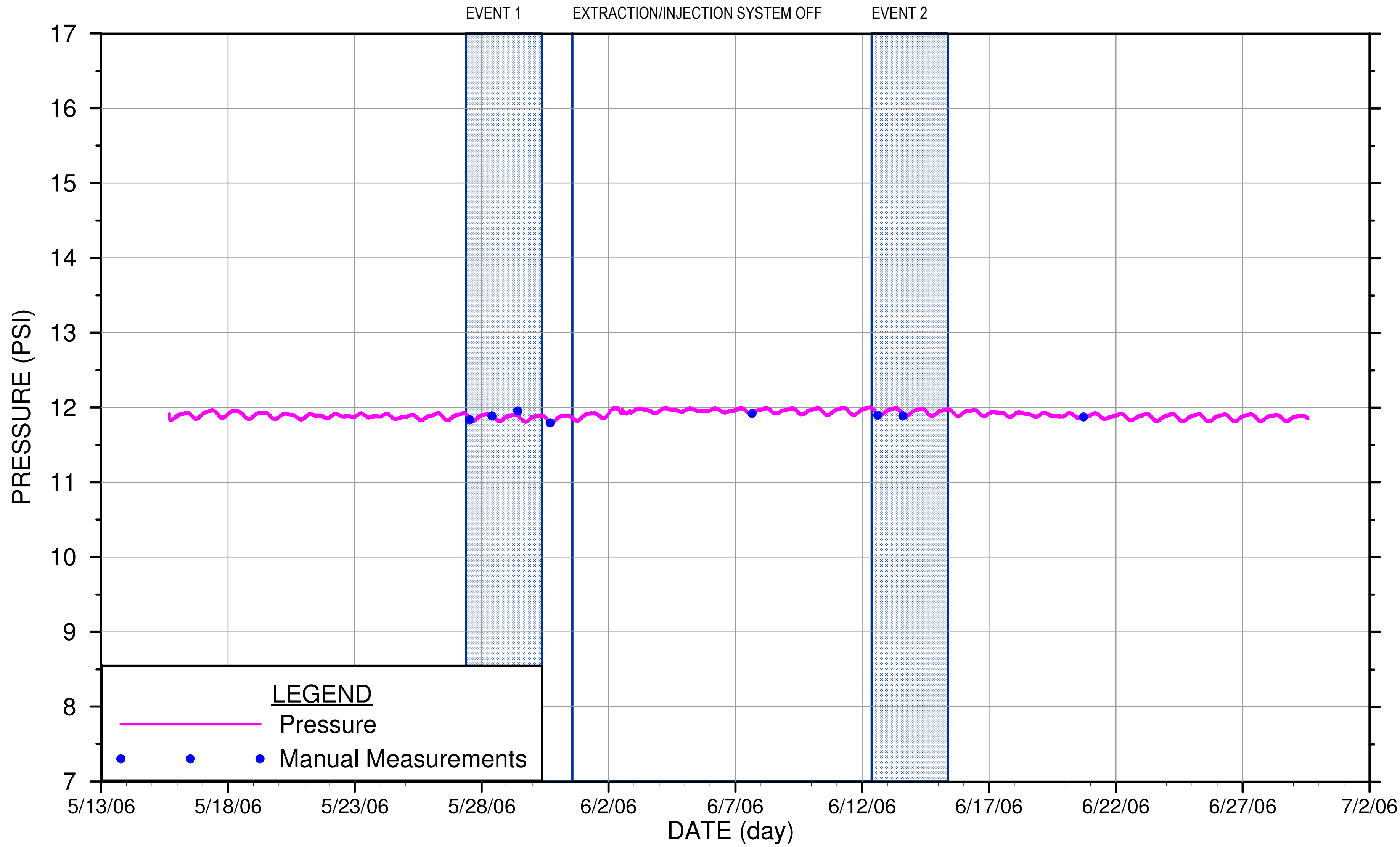


figure 6P-70

53-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-70.grf) JAN 3/2011

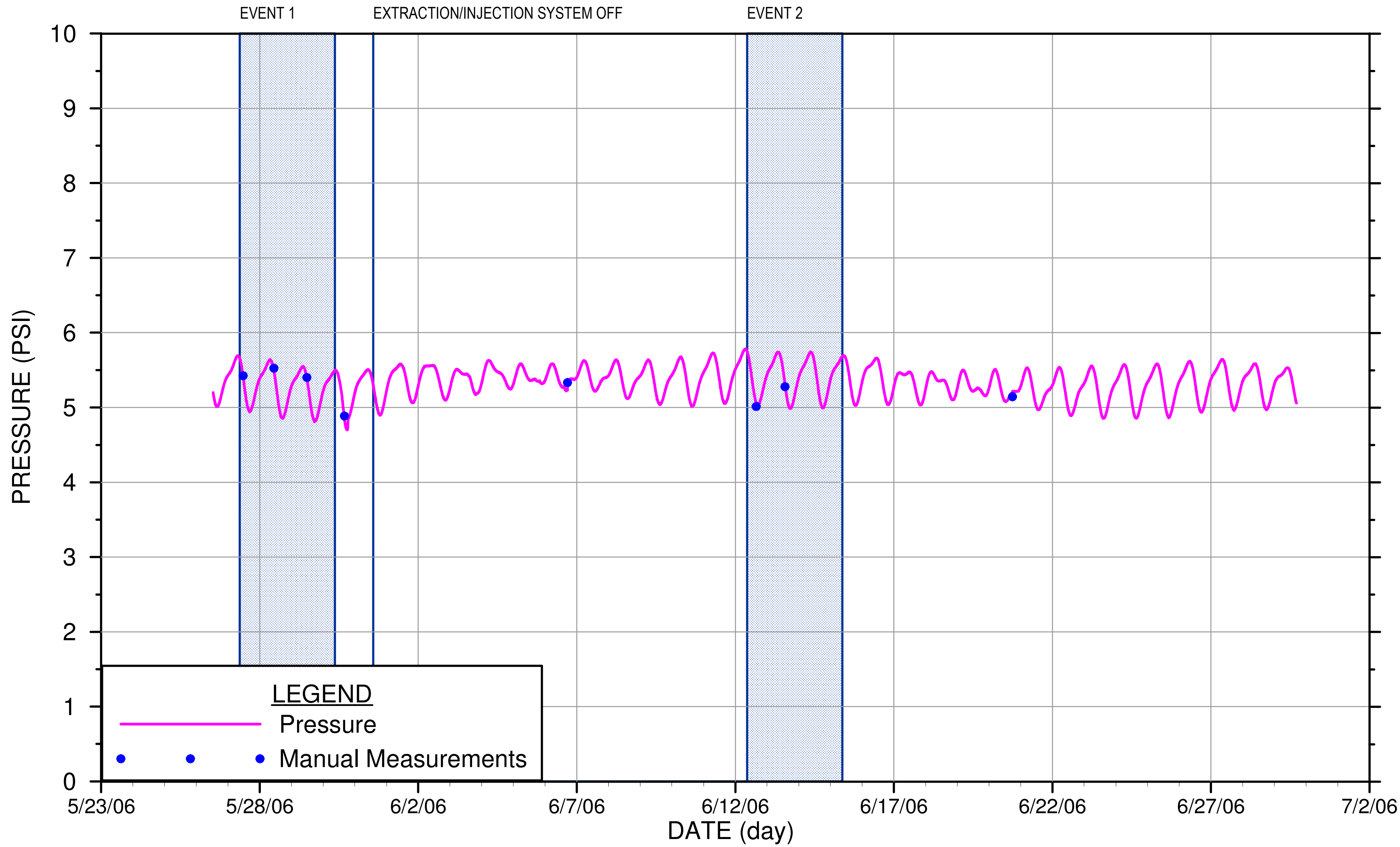


figure 6P-71

55-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-71.grf) JAN 3/2011

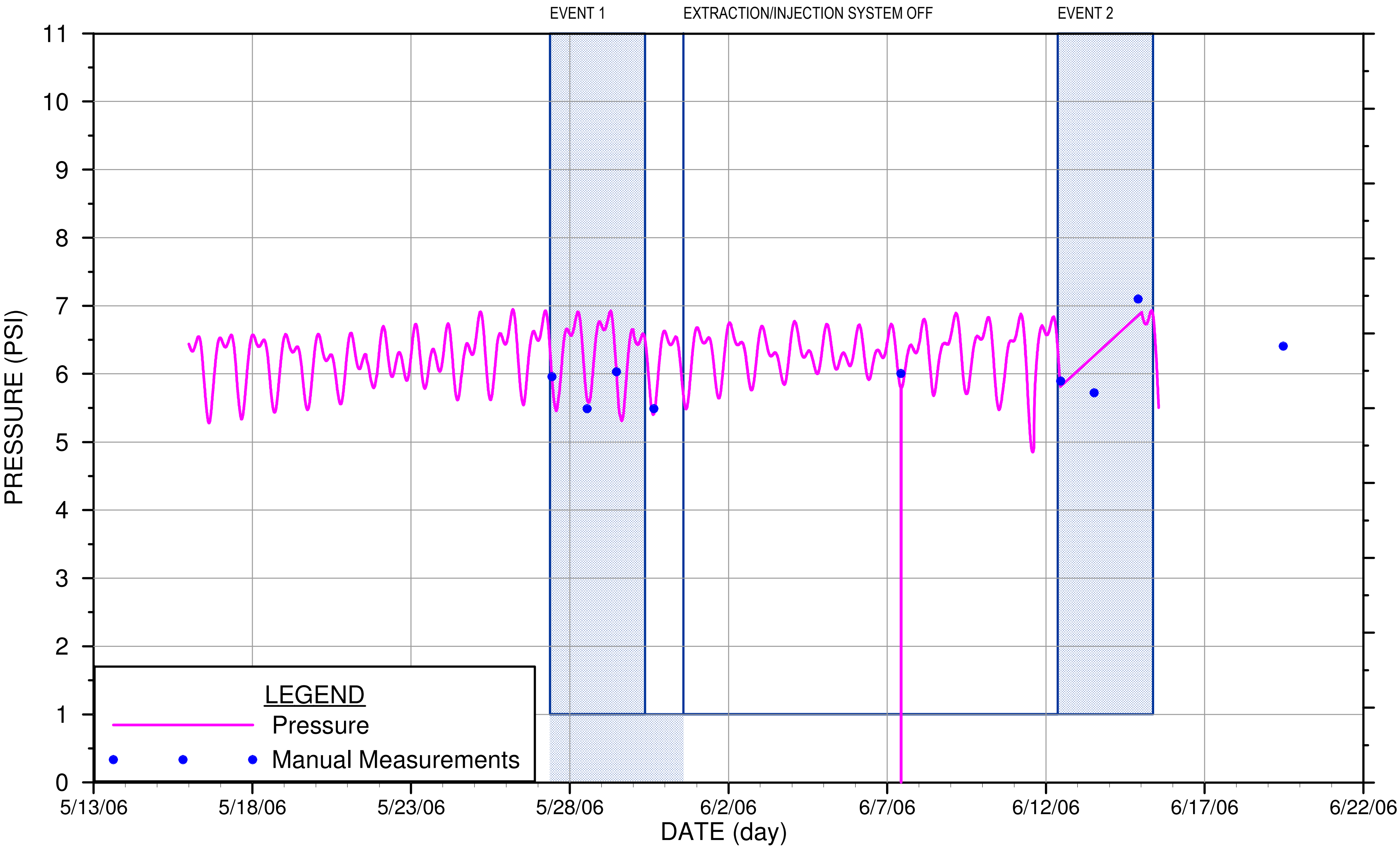


figure 6P-72

64-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

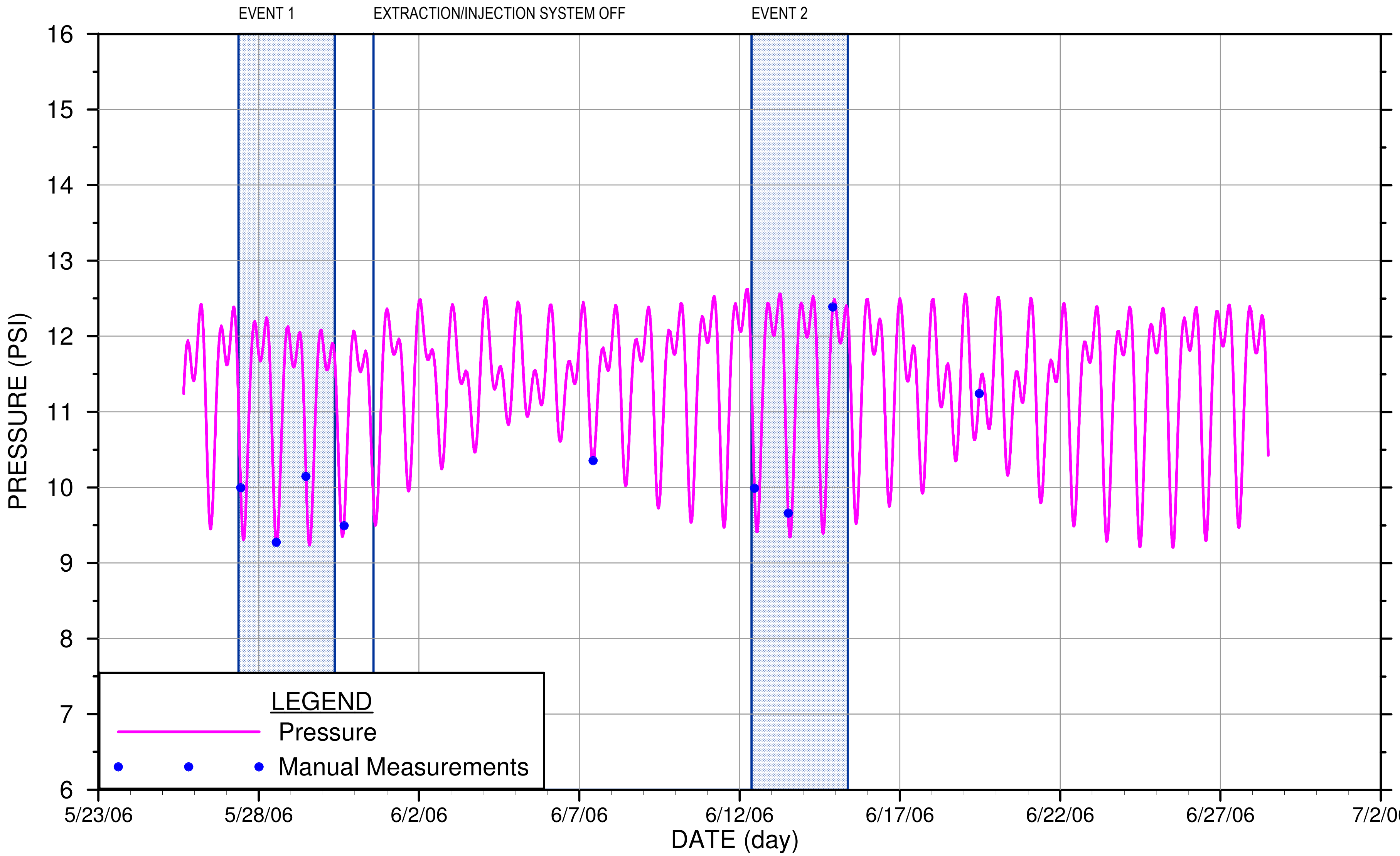


figure 6P-73

64-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-73.grf) JAN 3/2011

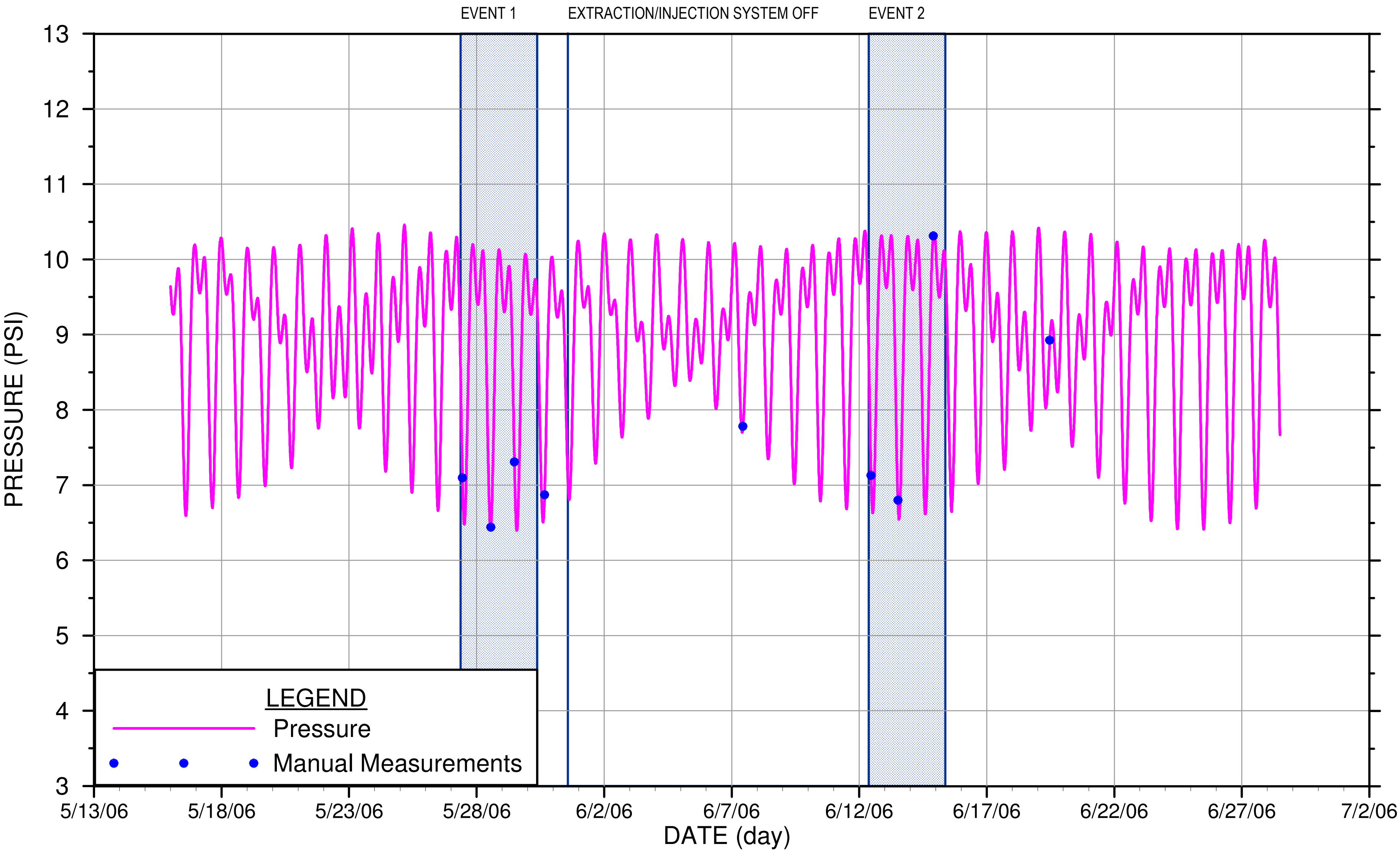


figure 6P-74

64-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-74.grf) JAN 3/2011

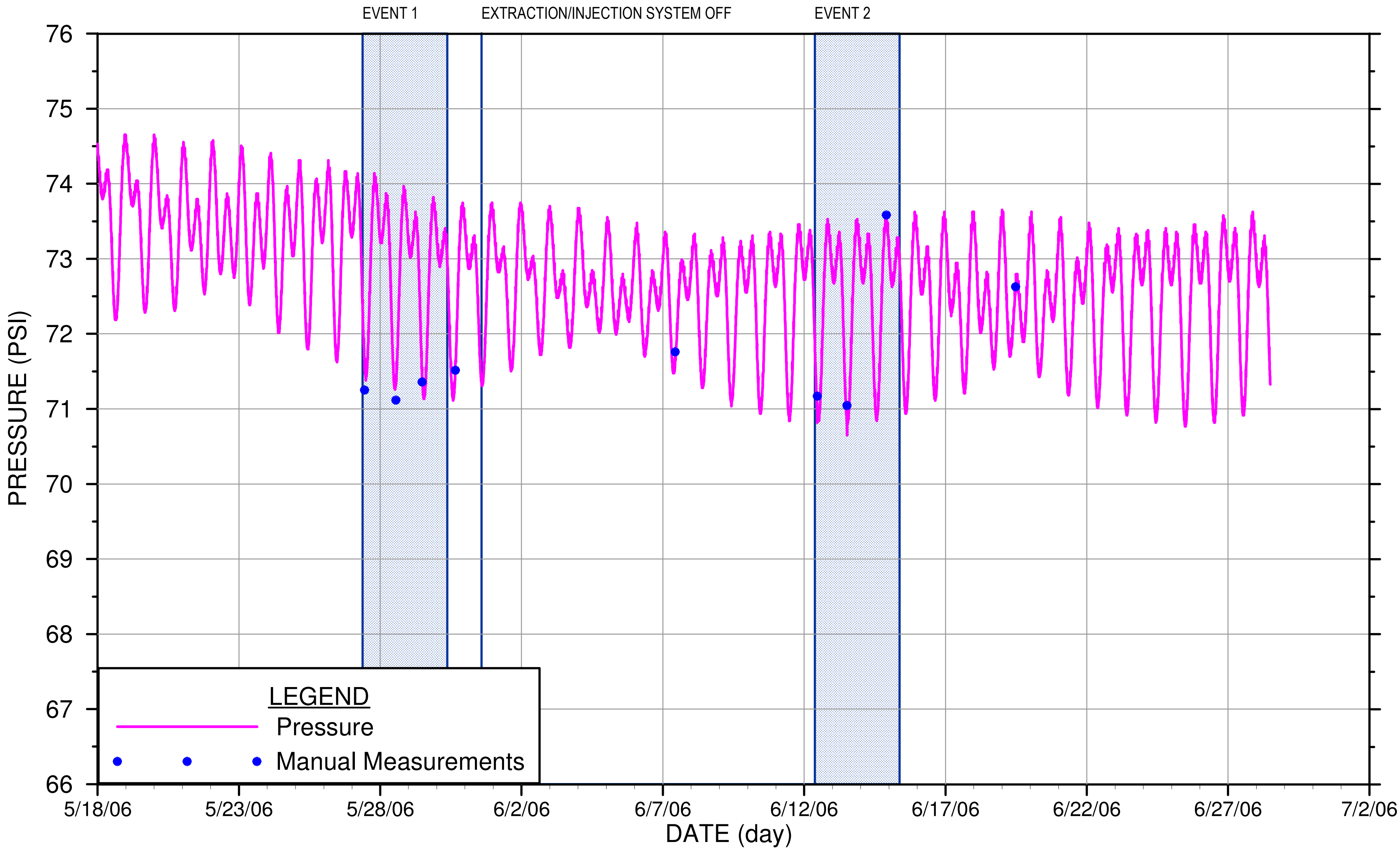


figure 6P-75

64-170 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

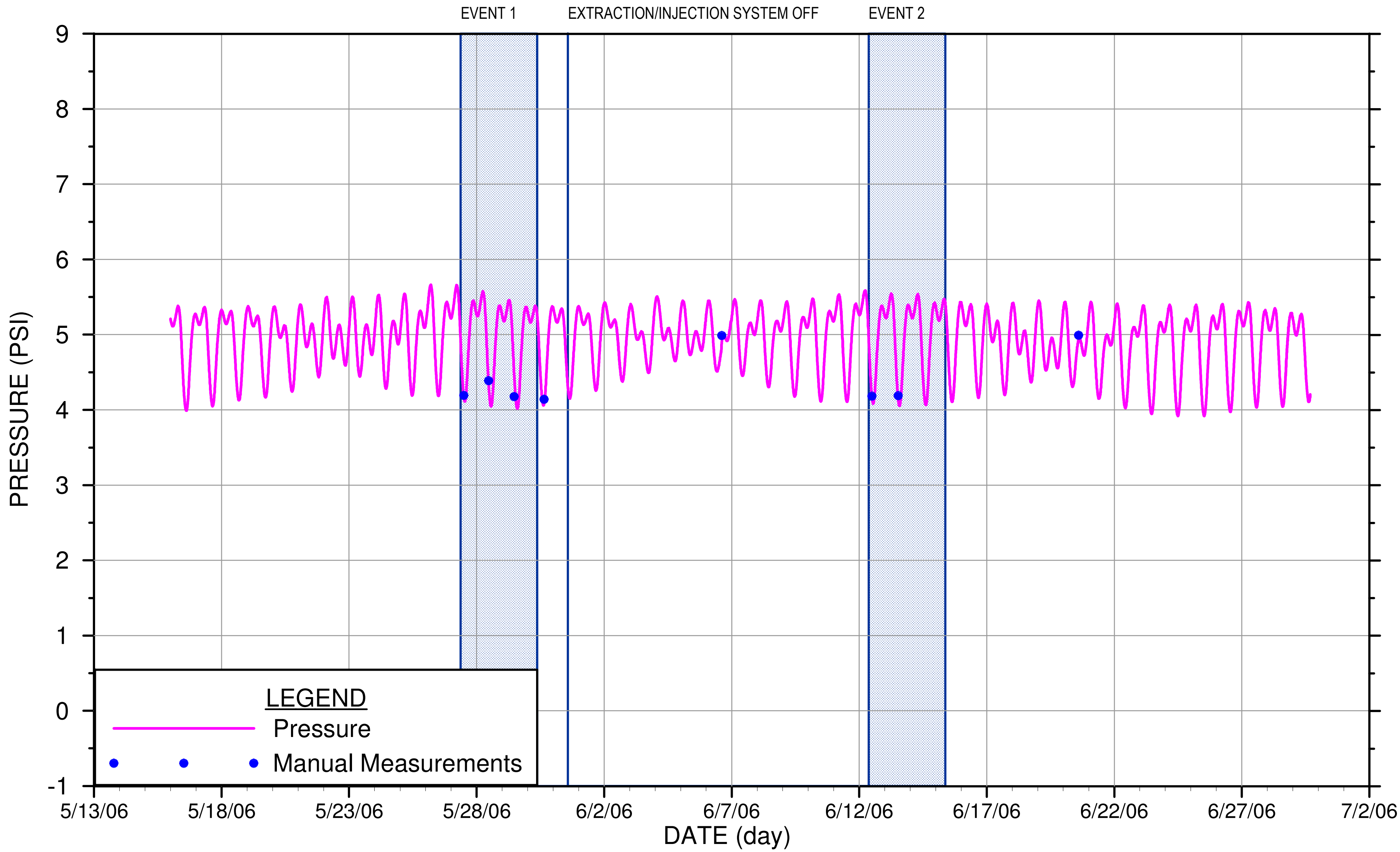


figure 6P-76

65-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-76.grf) JAN 3/2011

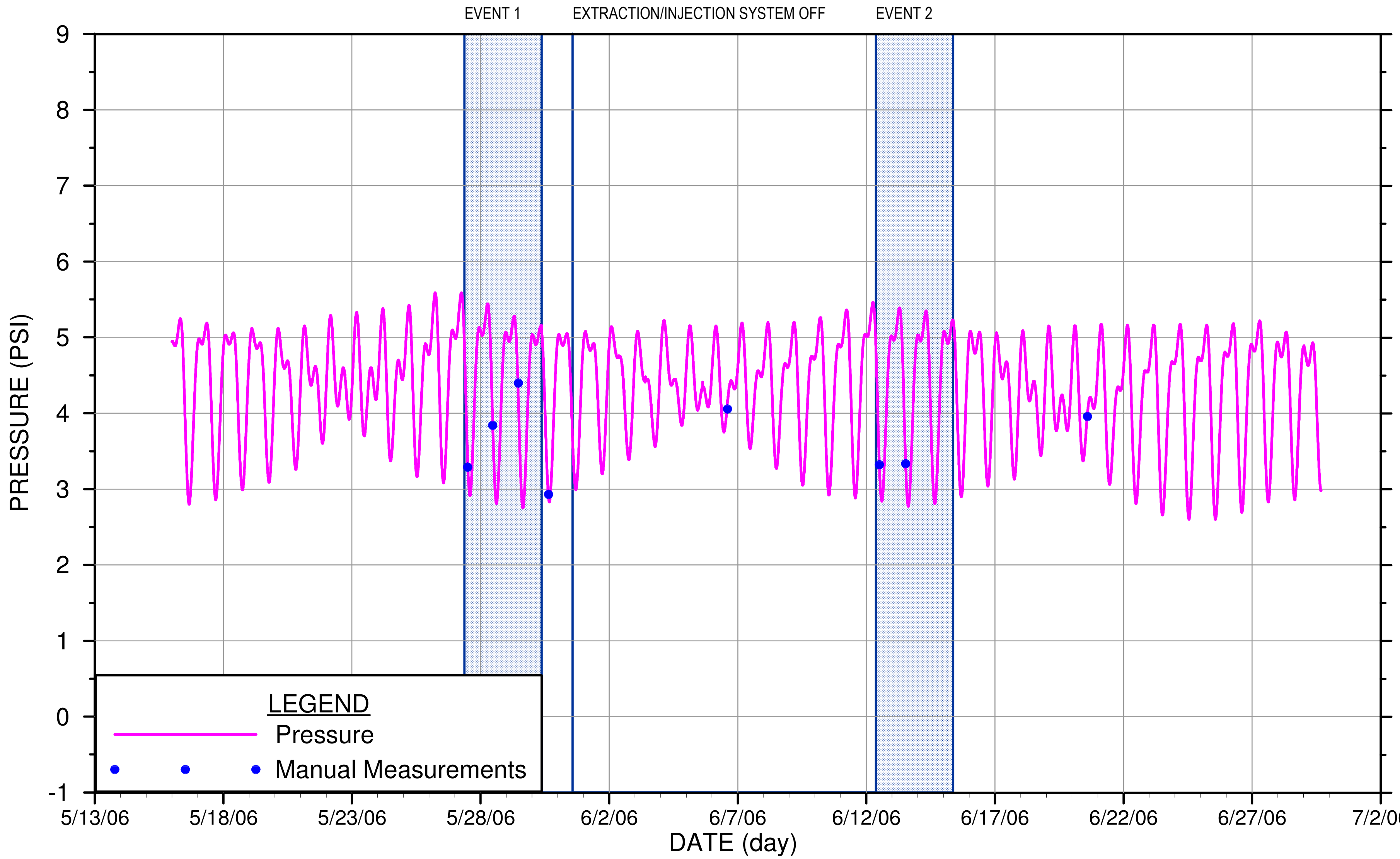


figure 6P-77

65-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-77.grf) JAN 3/2011

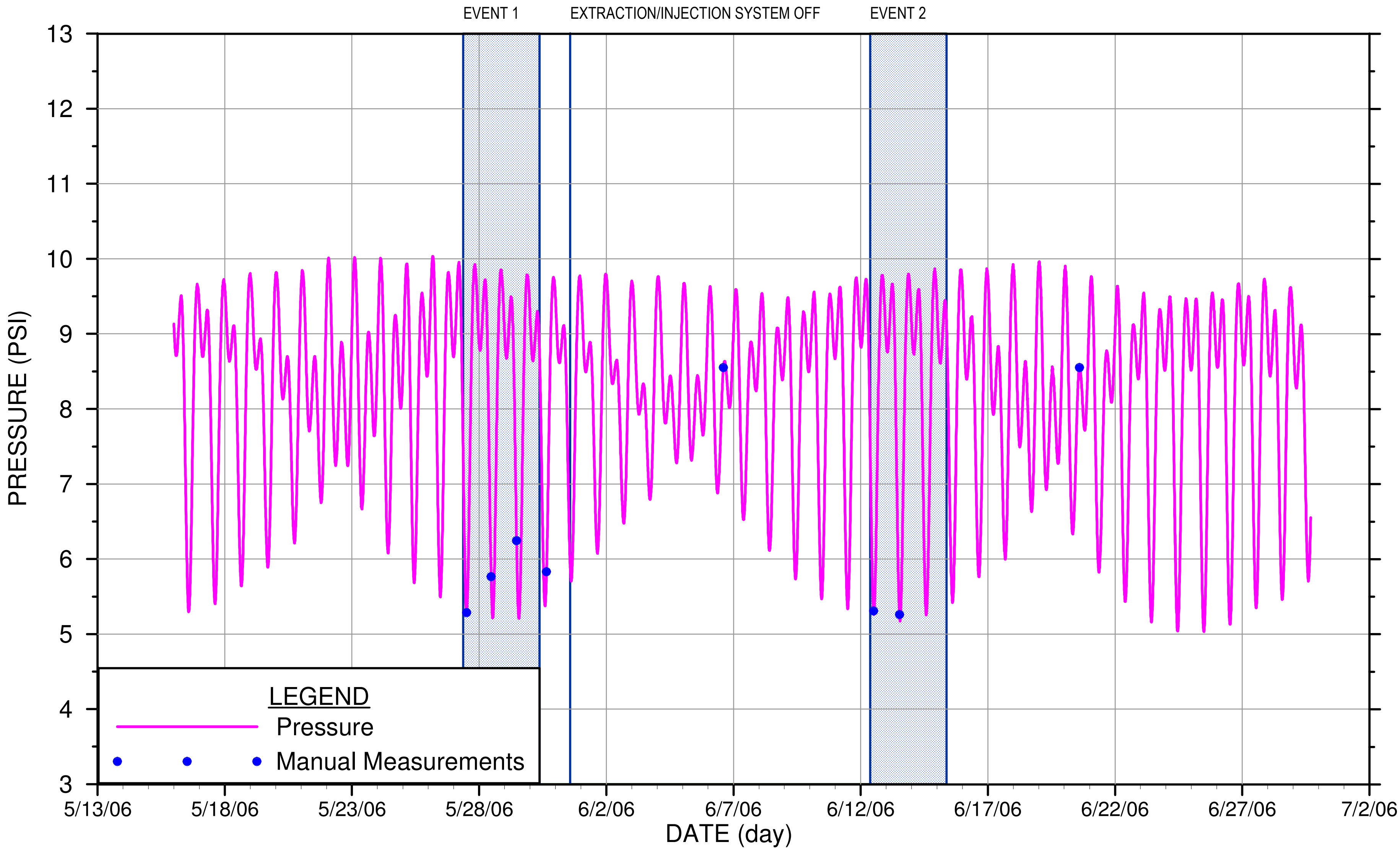


figure 6P-78

65-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-78.grf) JAN 3/2011

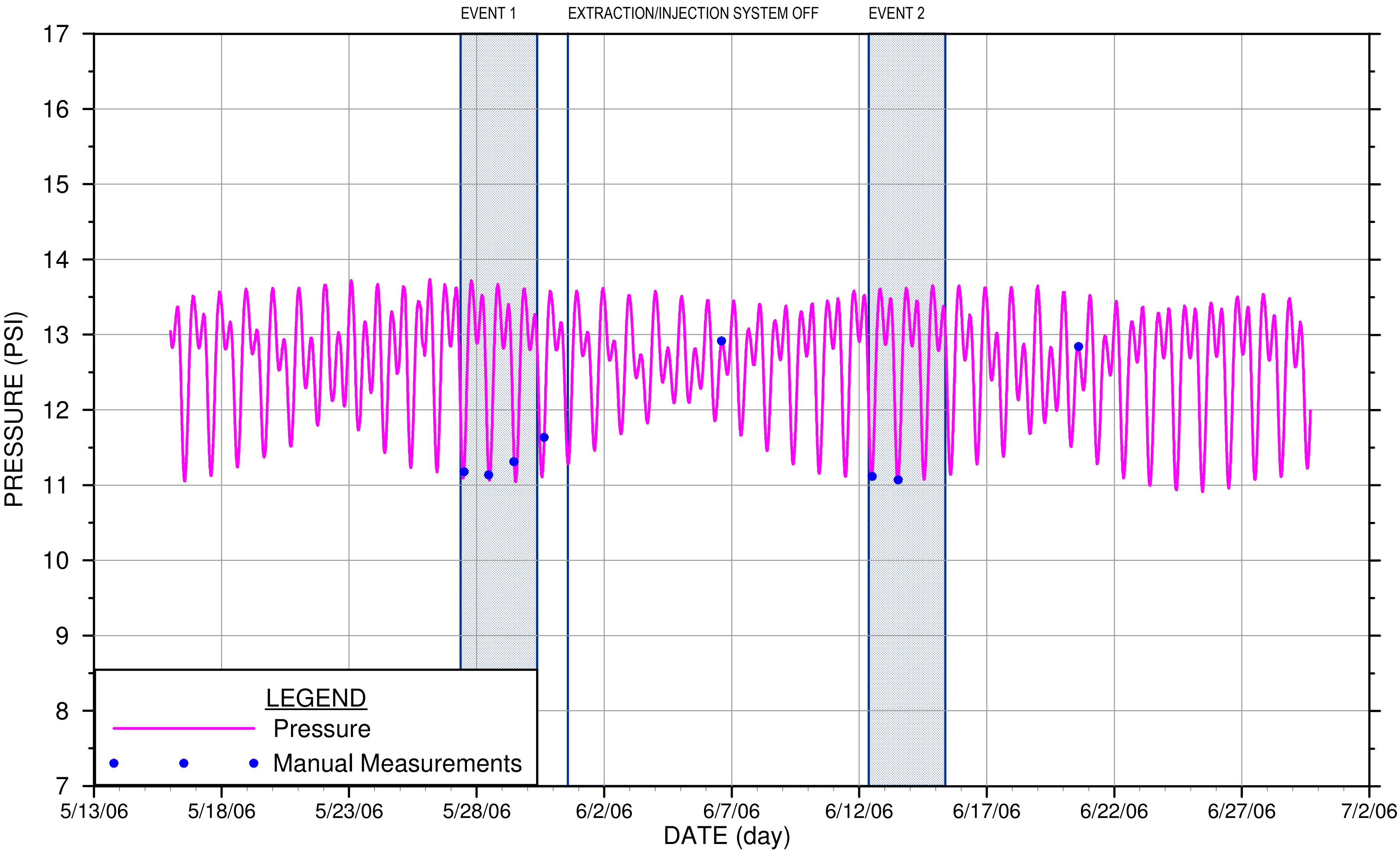


figure 6P-79

65-130 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-79.grf) JAN 3/2011

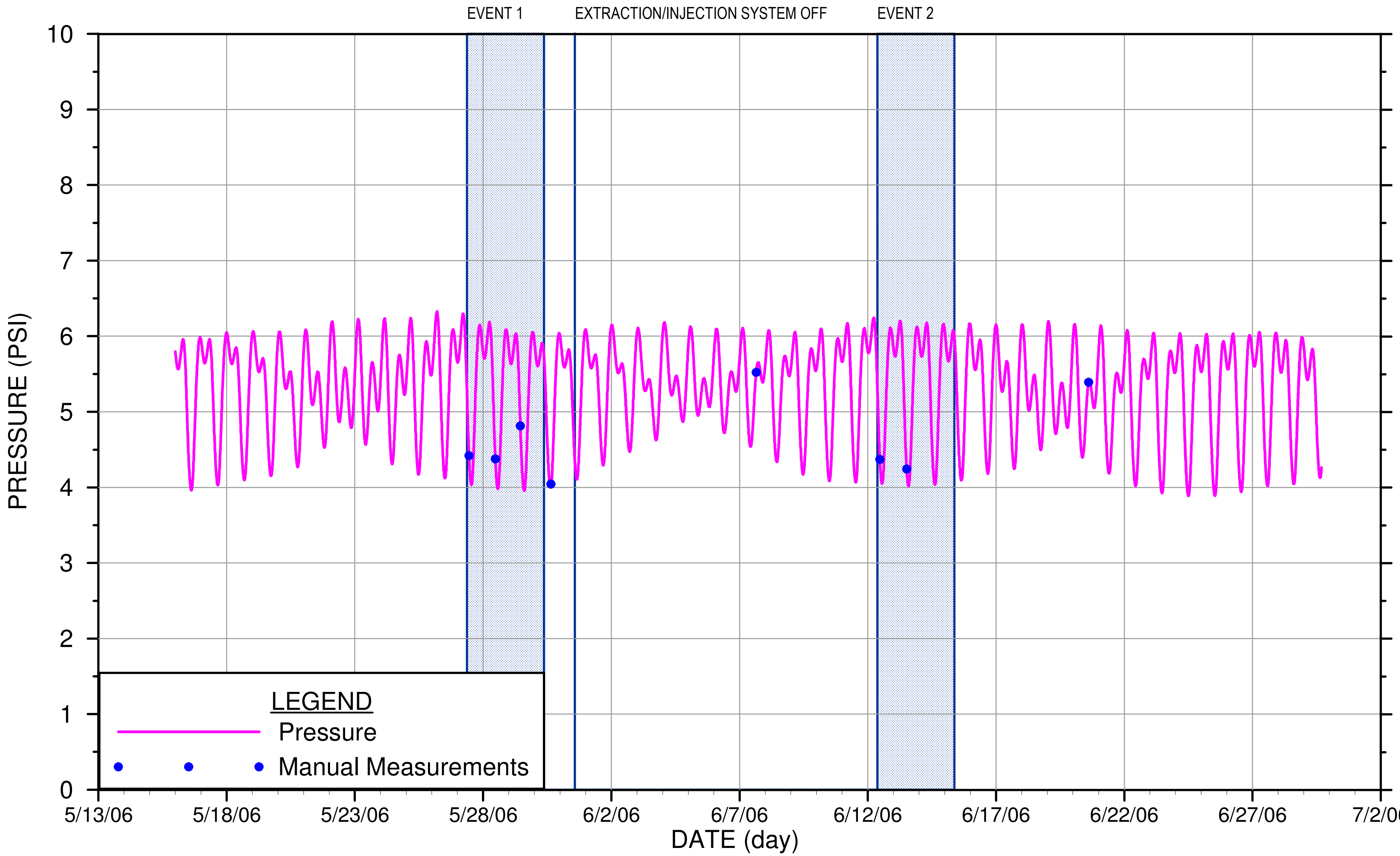


figure 6P-80

69-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-80.grf) JAN 3/2011

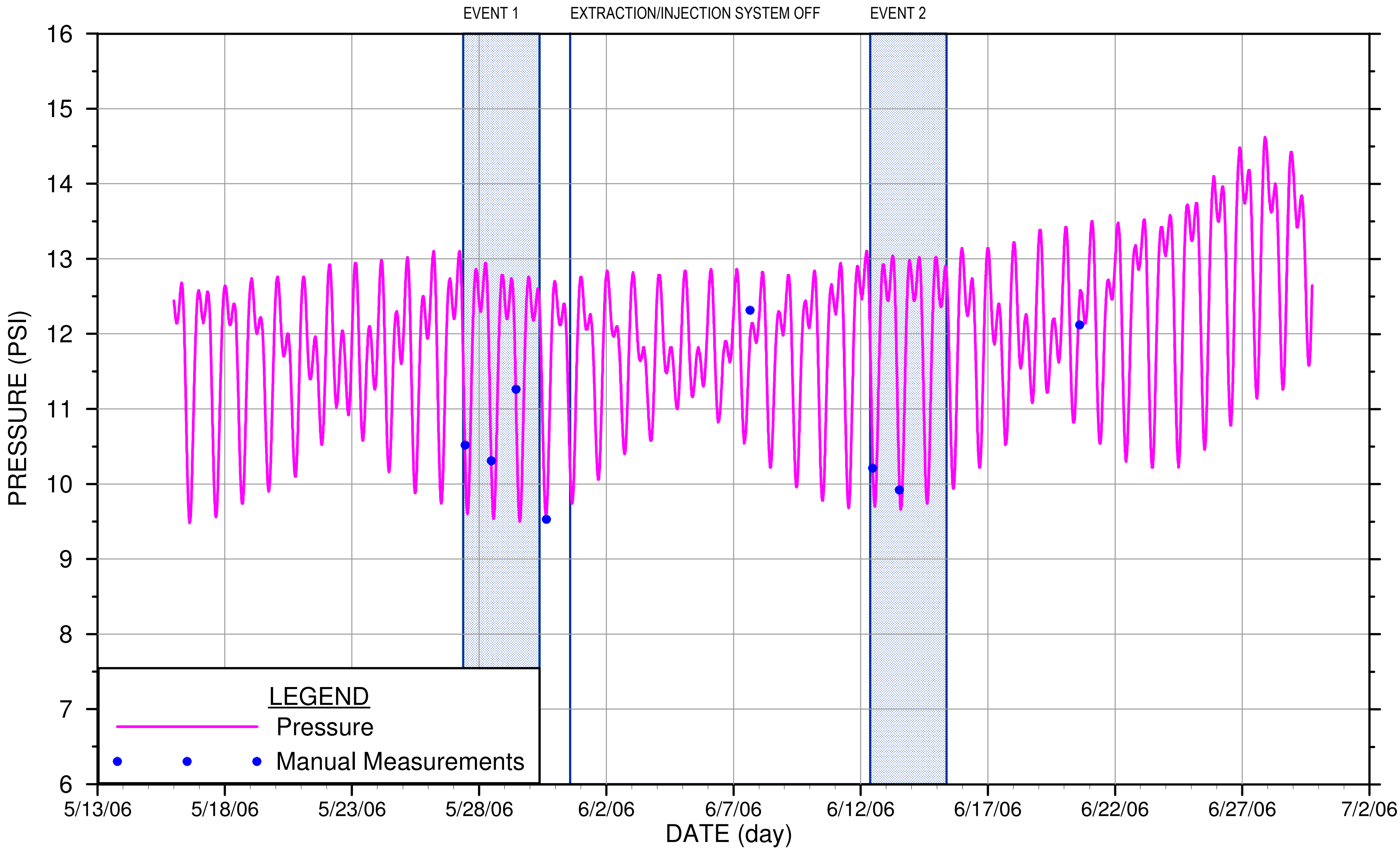


figure 6P-81

69-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-81.grf) JAN 3/2011

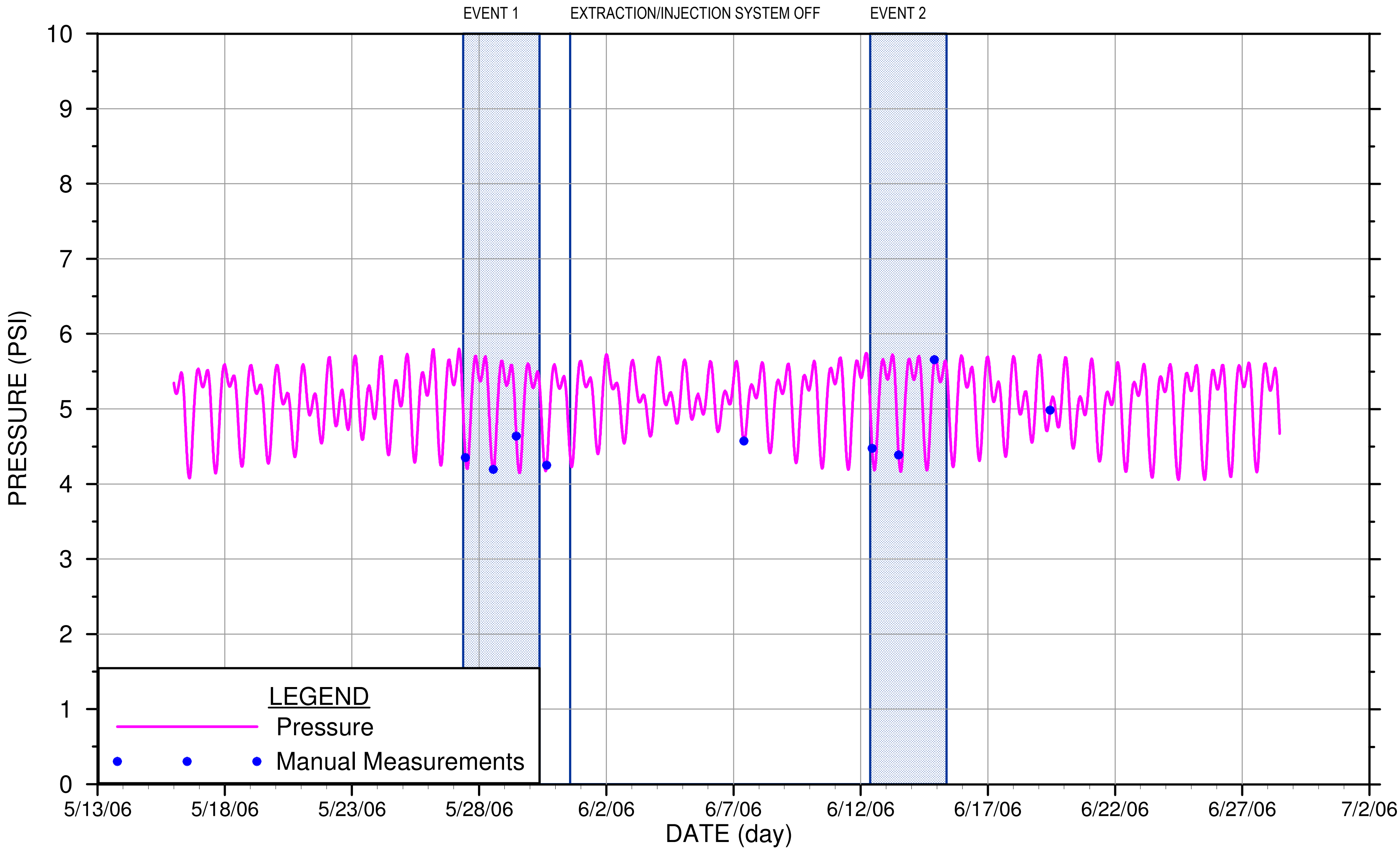


figure 6P-82

71-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

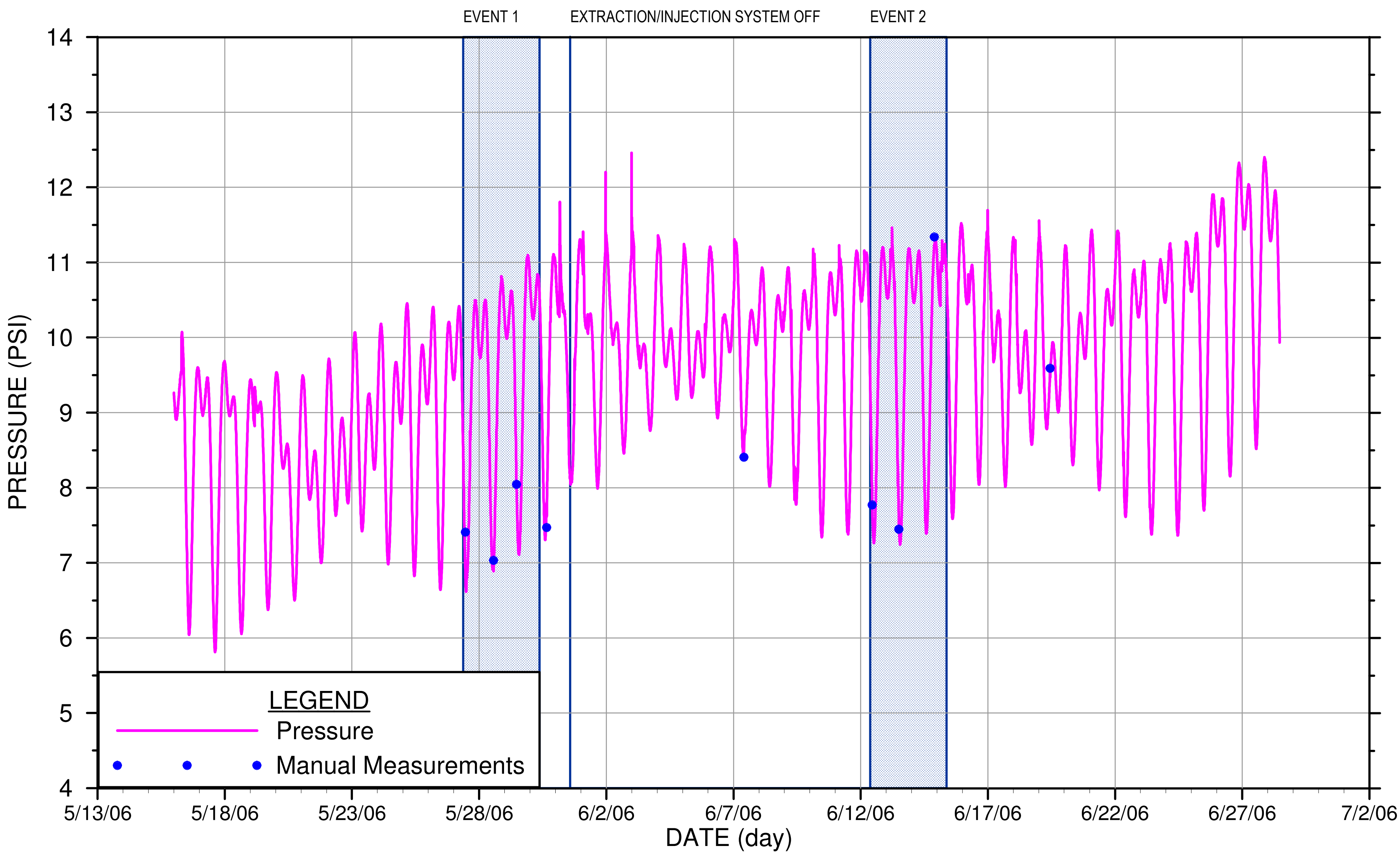


figure 6P-83

71-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-83.grf) JAN 3/2011

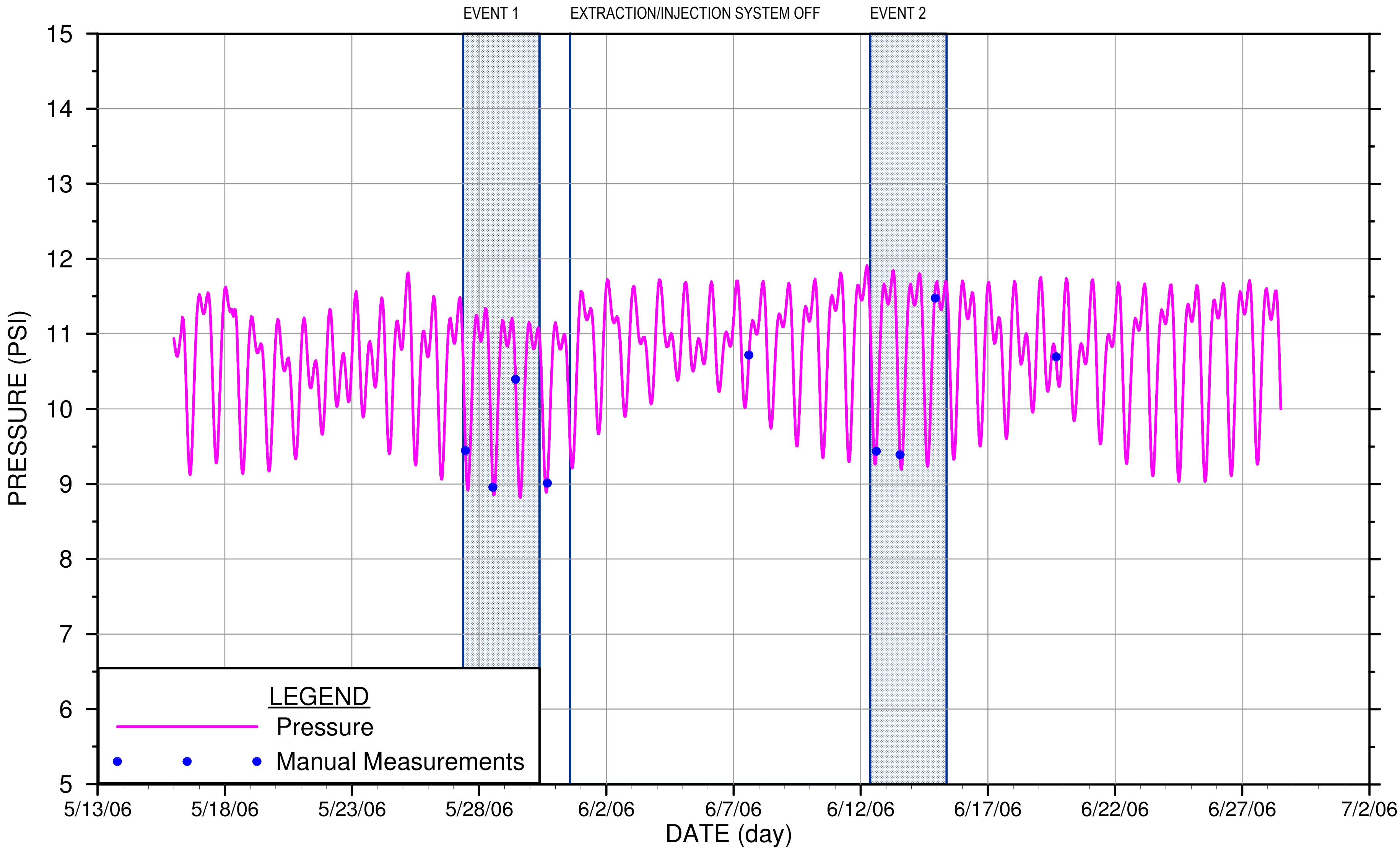


figure 6P-84

74-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-84.grf) JAN 3/2011

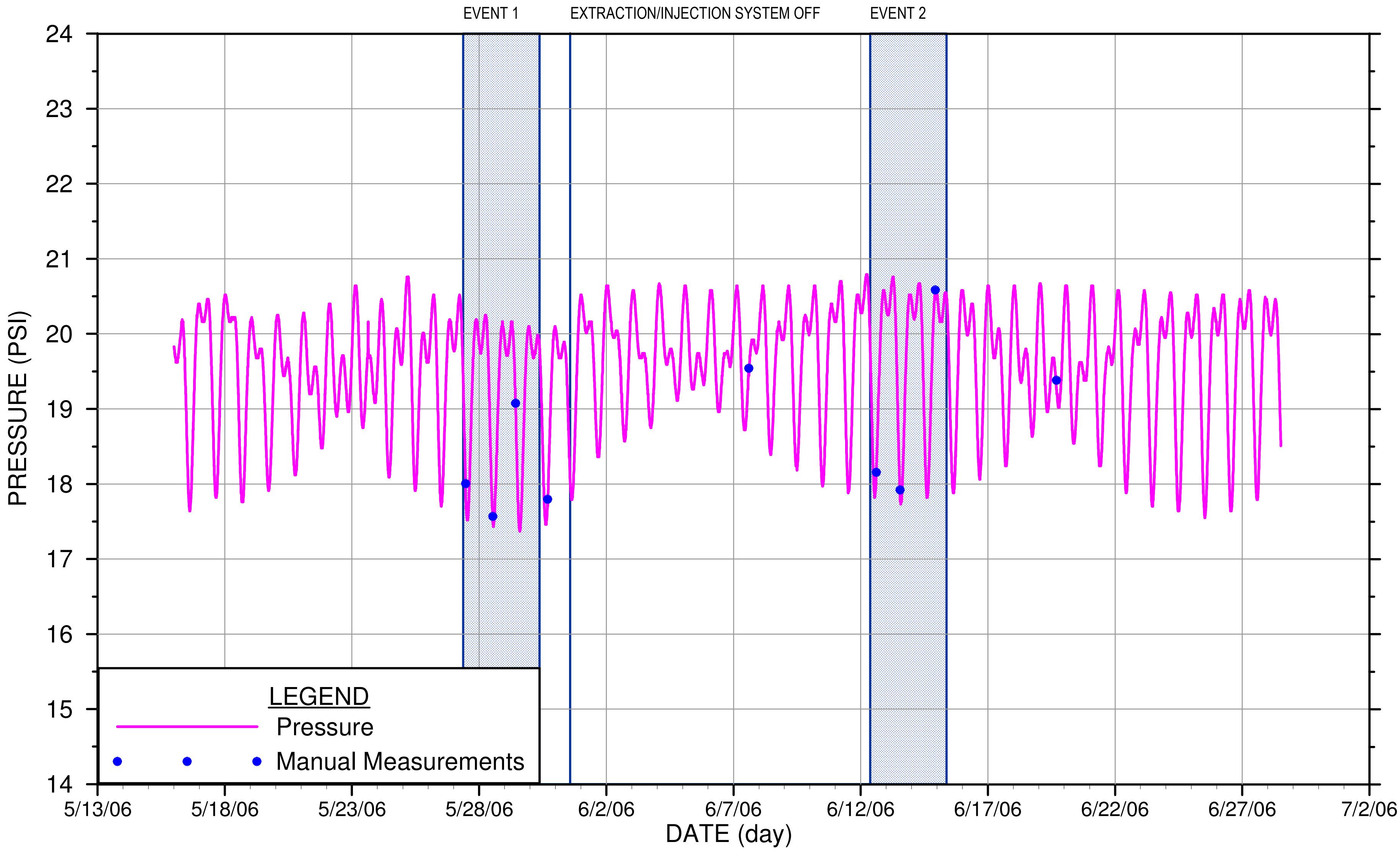


figure 6P-85

74-75 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-85.grf) JAN 3/2011

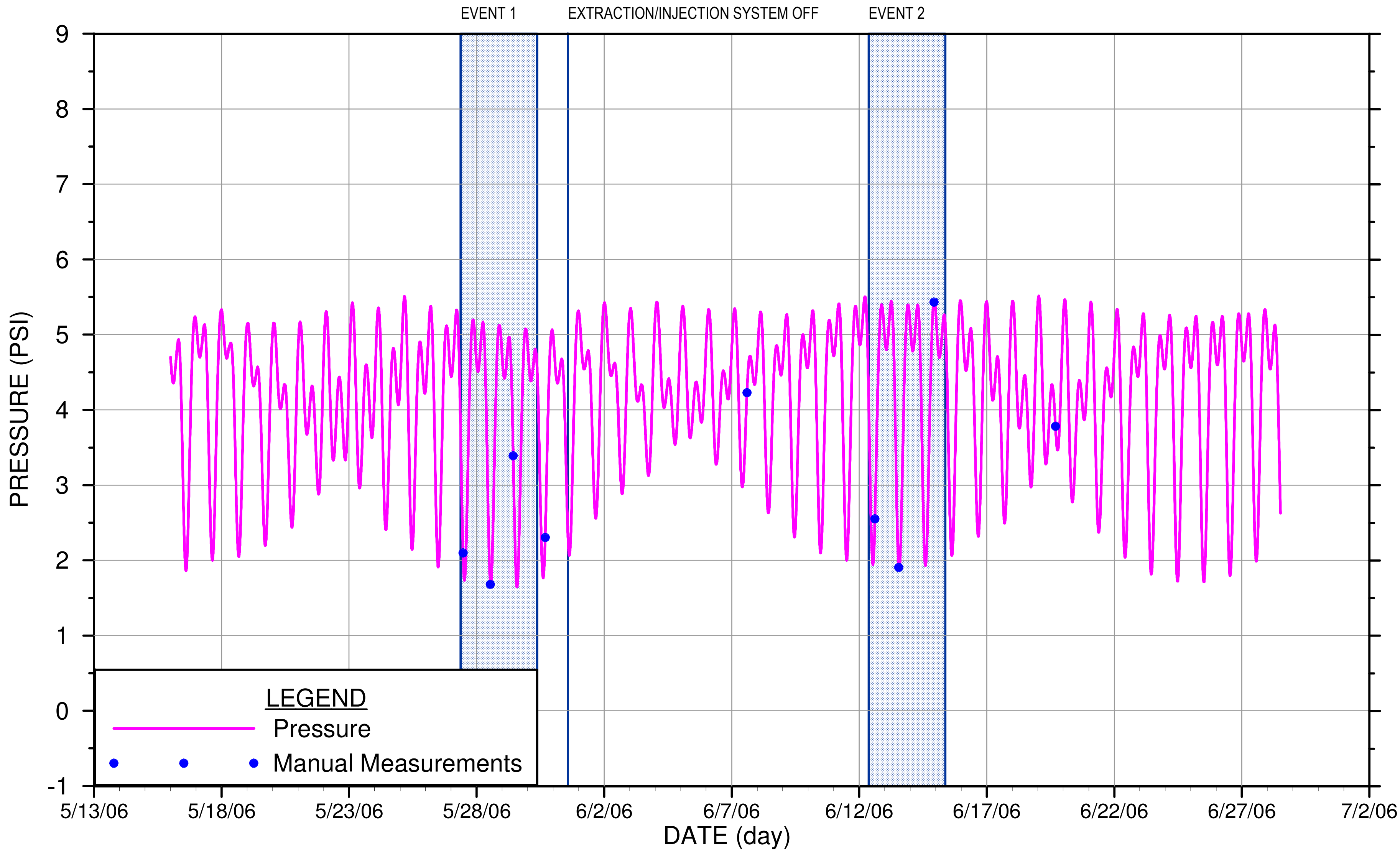


figure 6P-86

74-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-86.grf) JAN 3/2011

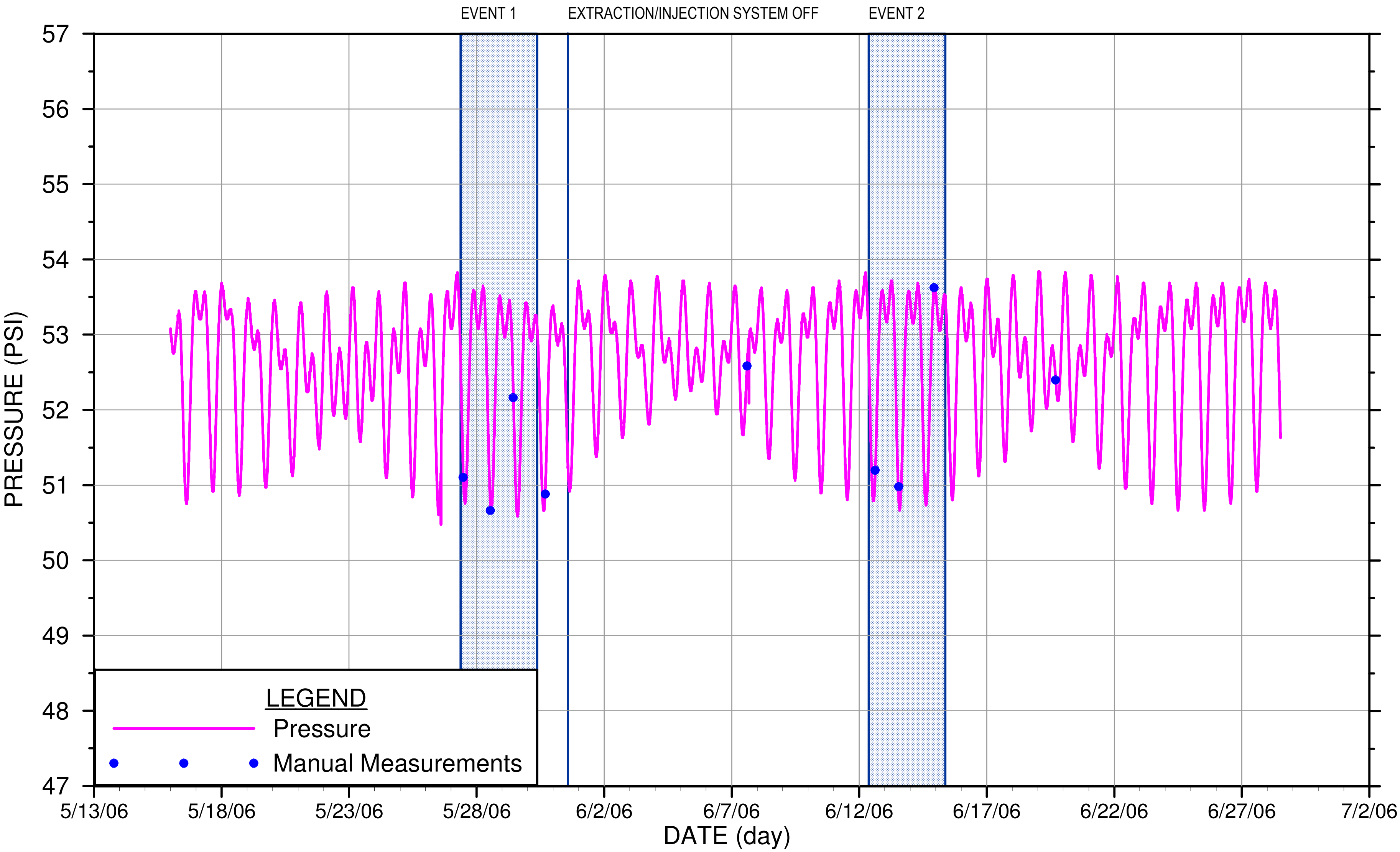


figure 6P-87

74-130 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-87.grf) JAN 3/2011

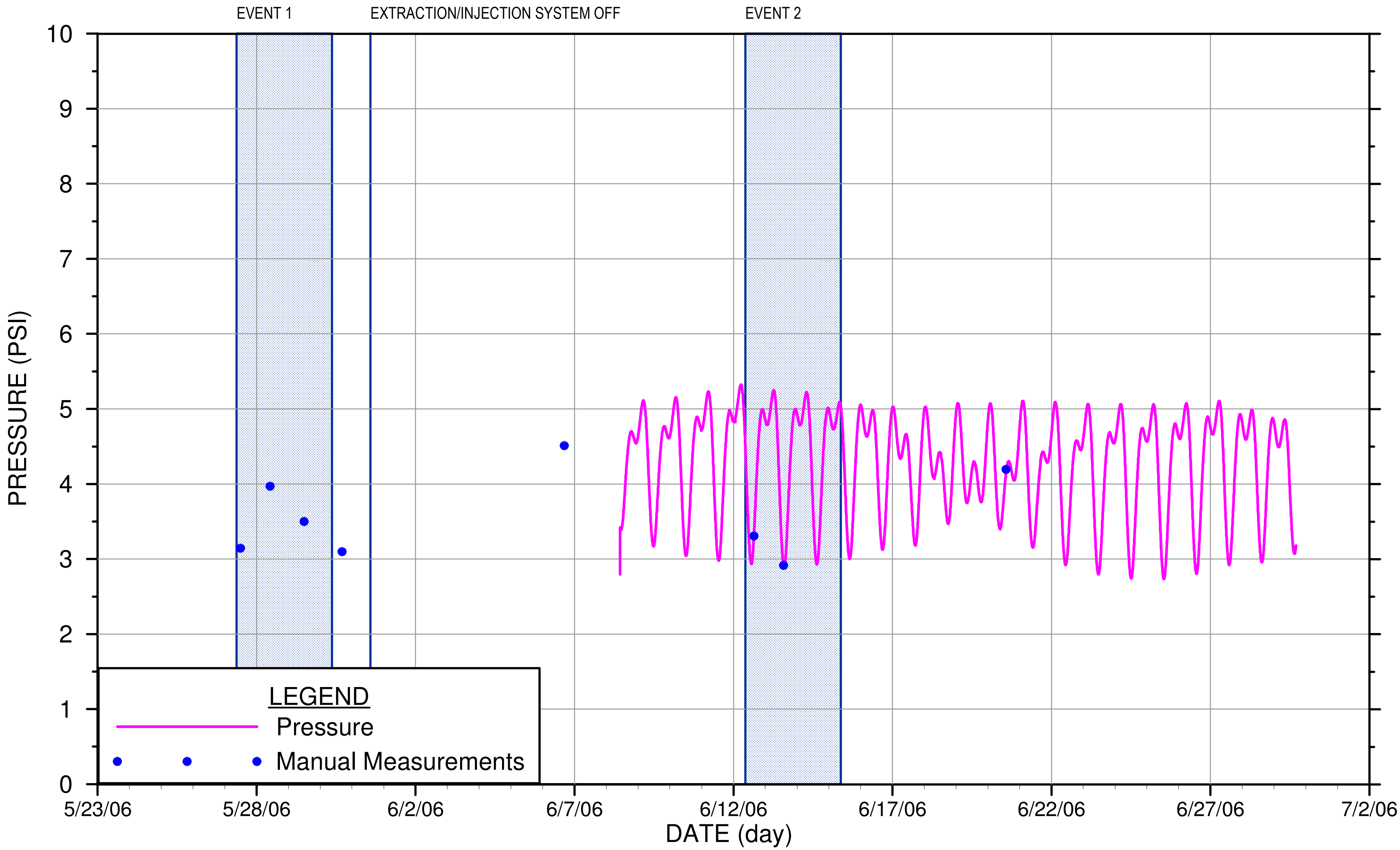


figure 6P-88

75-50 PRESSURE VERSUS TIMES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-88.grf) JAN 3/2011

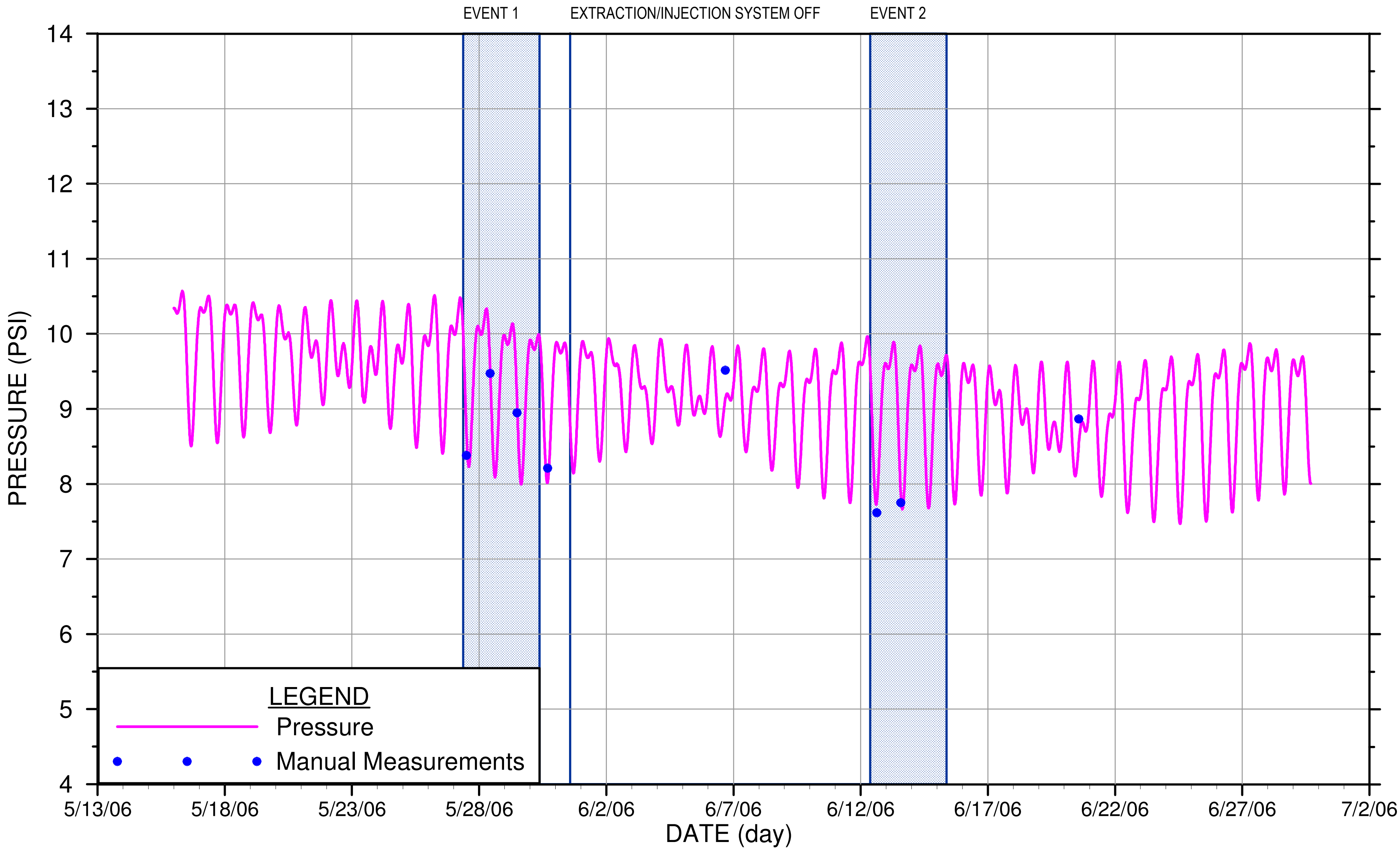


figure 6P-89

75-75 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-89.grf) JAN 3/2011

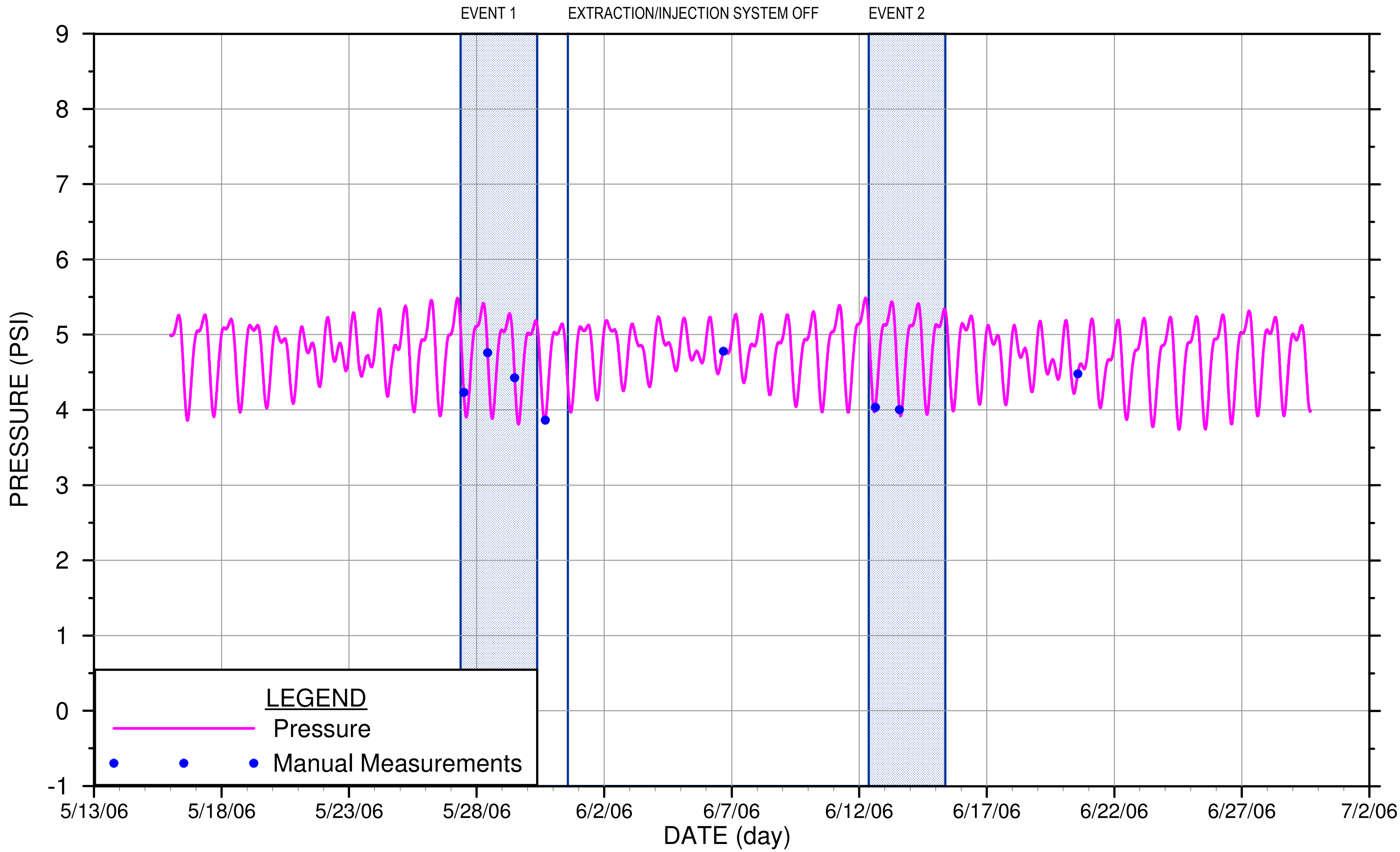


figure 6P-90

75-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-90.grf) JAN 3/2011

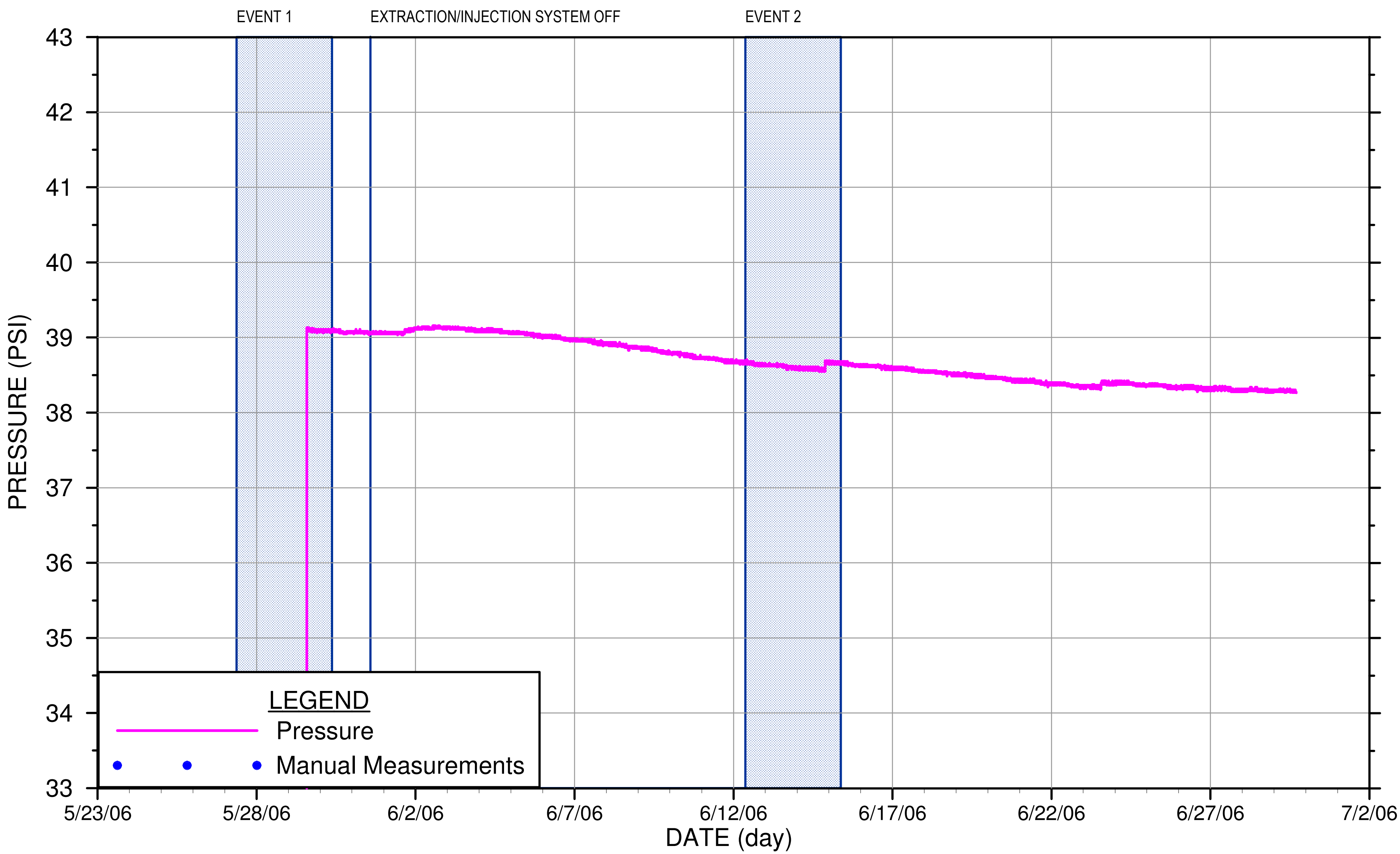


figure 6P-91

75-130 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-91.grf) JAN 3/2011

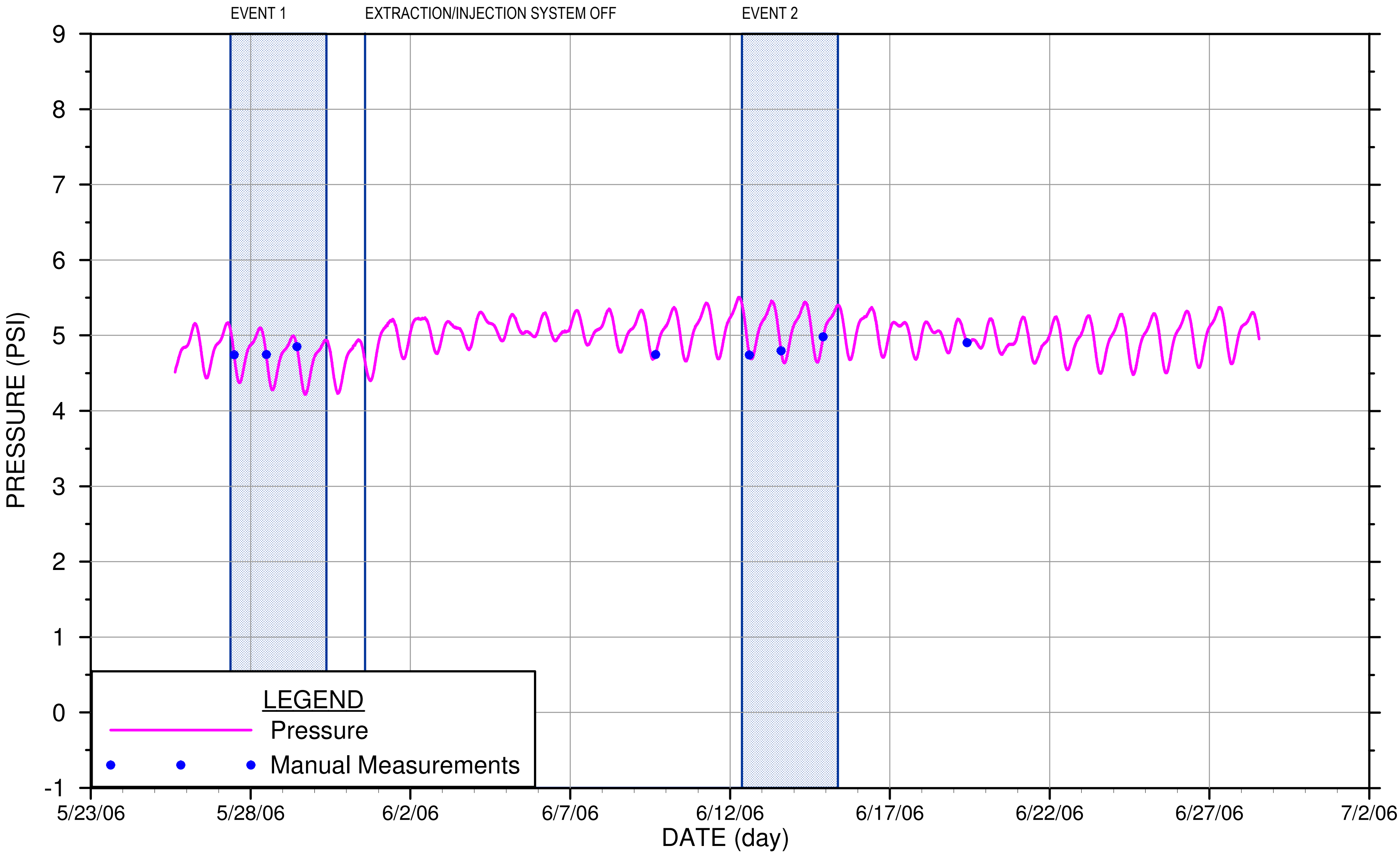


figure 6P-92

76-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

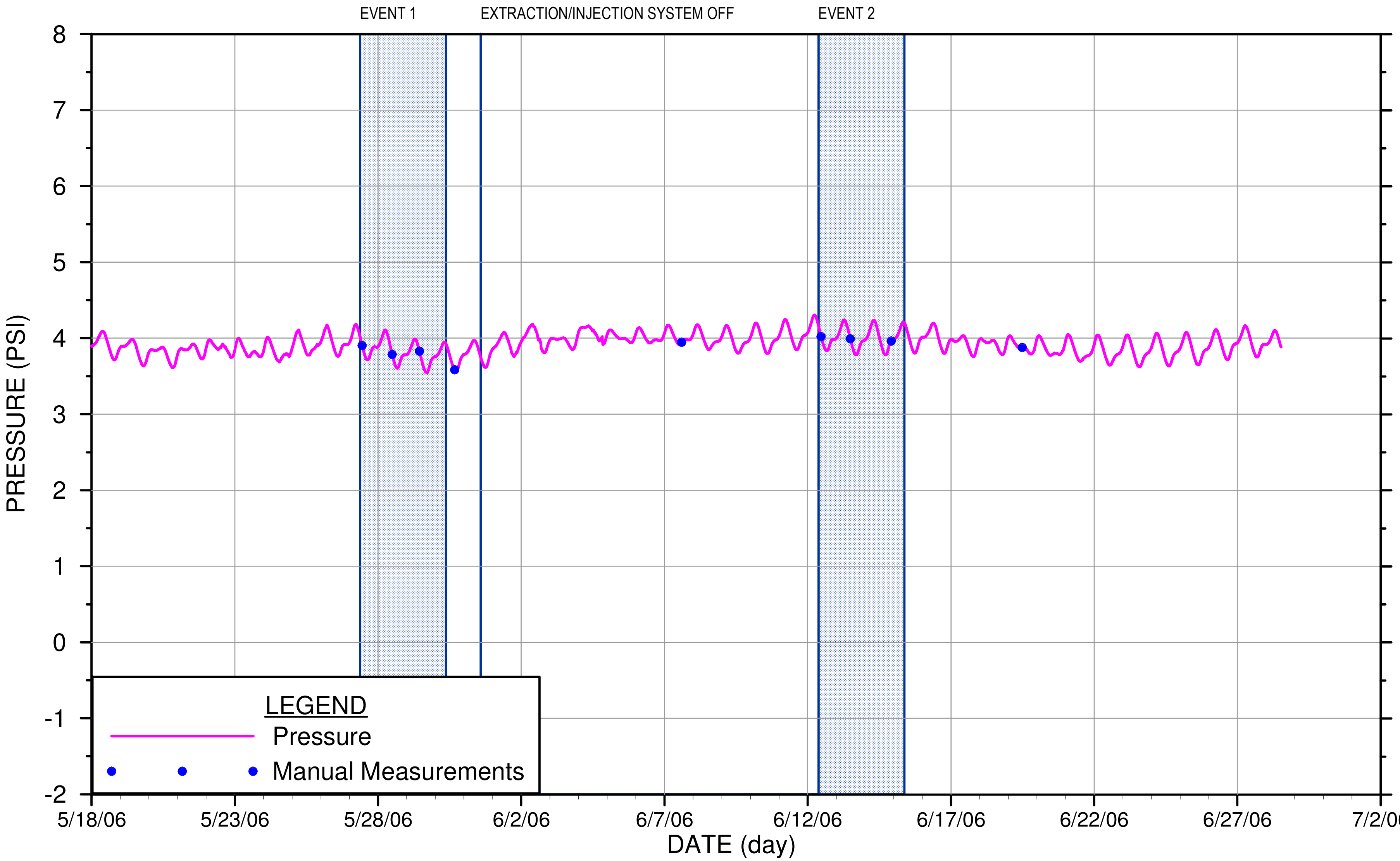


figure 6P-93

77-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-93.grf) JAN 3/2011

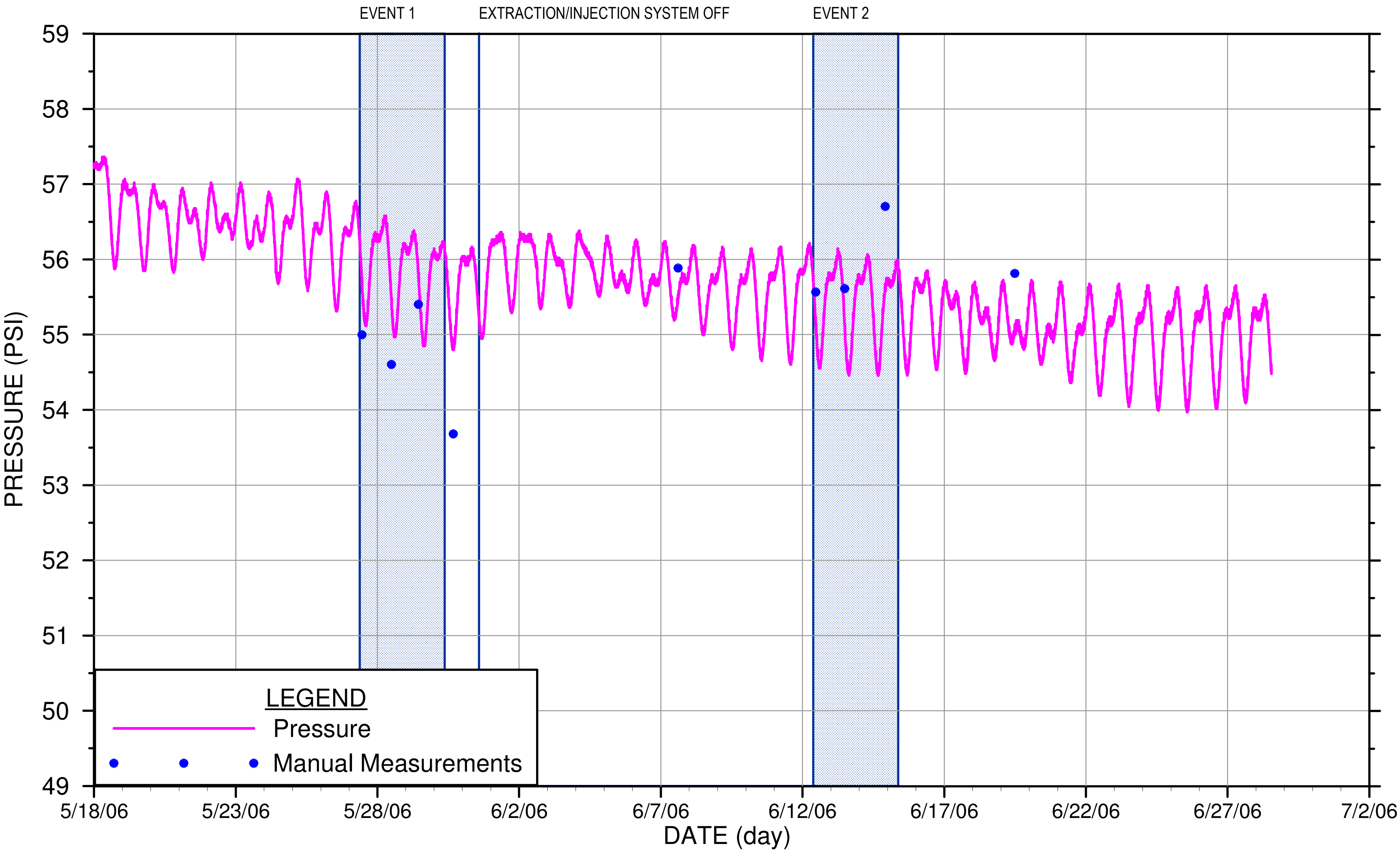


figure 6P-94

77-140 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-94.grf) JAN 3/2011

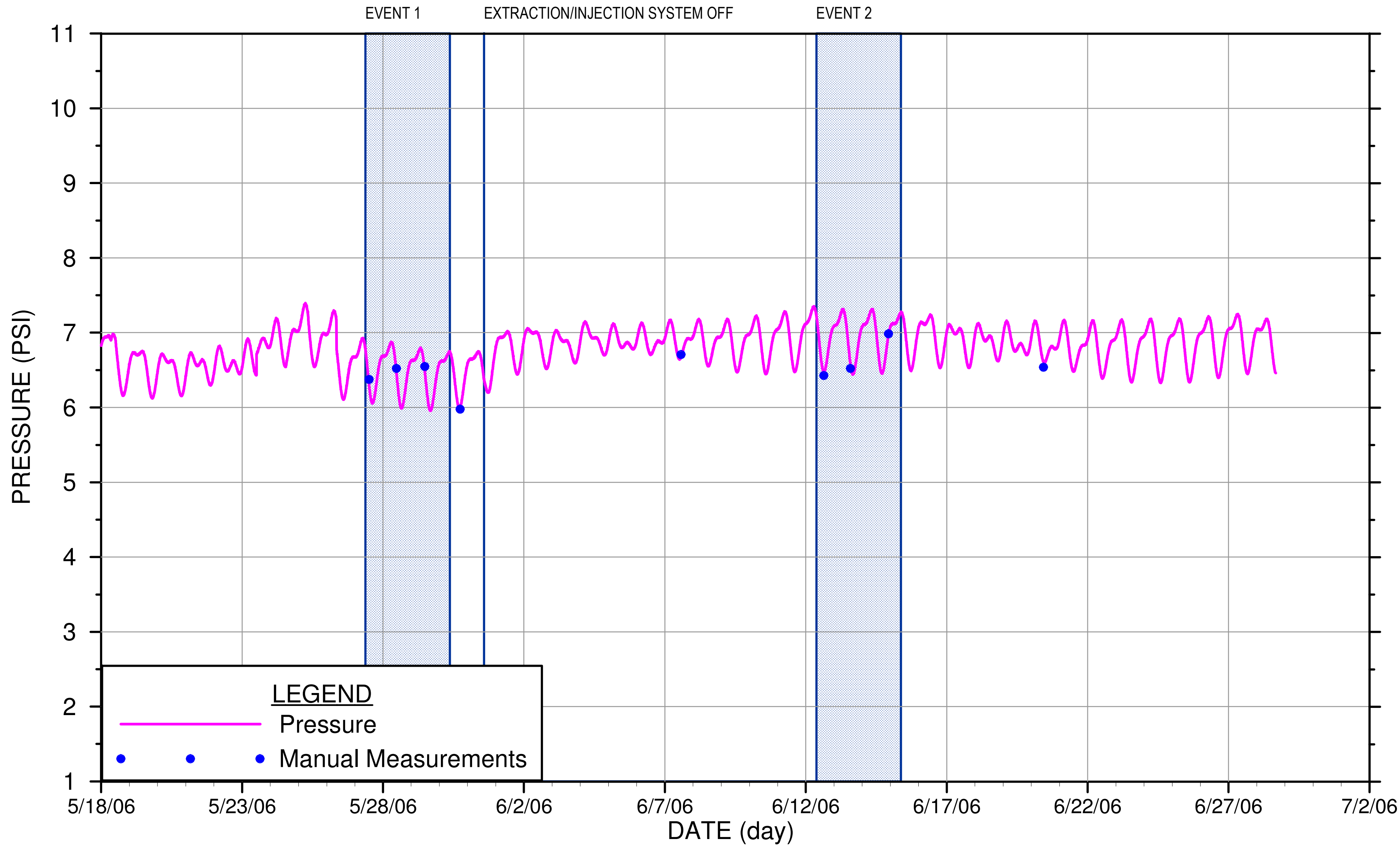


figure 6P-95

78-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-95.grf) JAN 3/2011

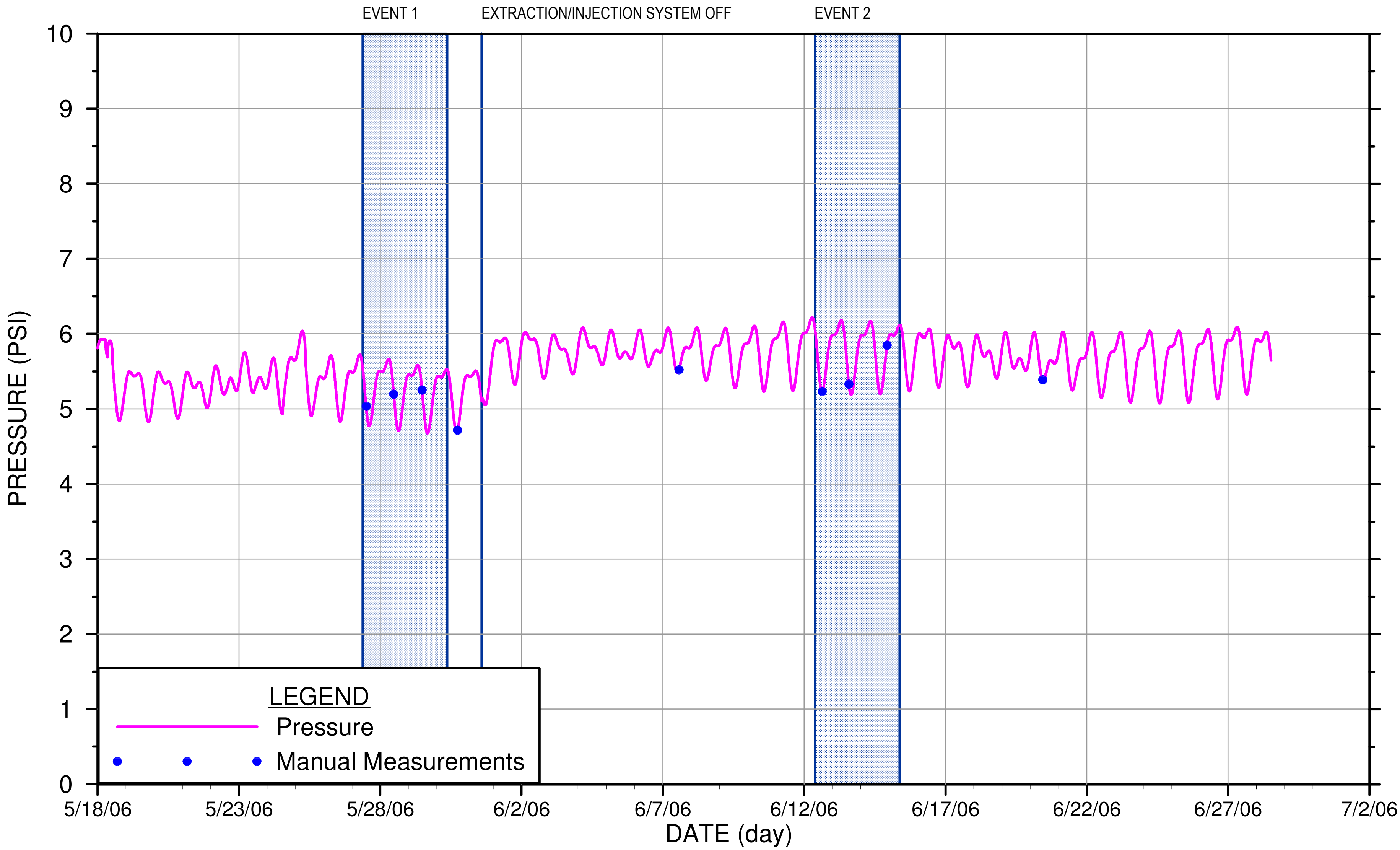


figure 6P-96

78-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-96.grf) JAN 3/2011

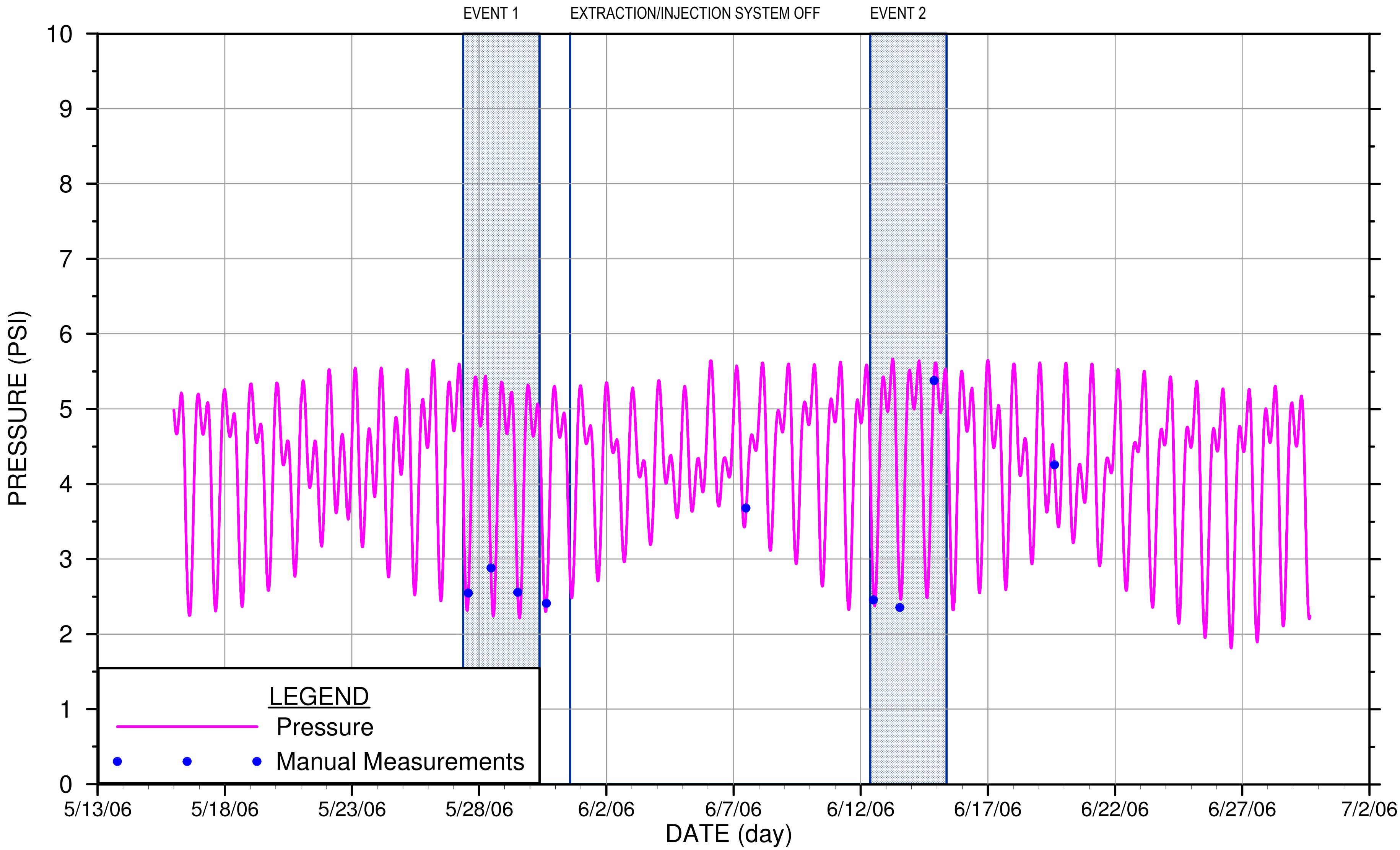


figure 6P-97

709-MW20-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

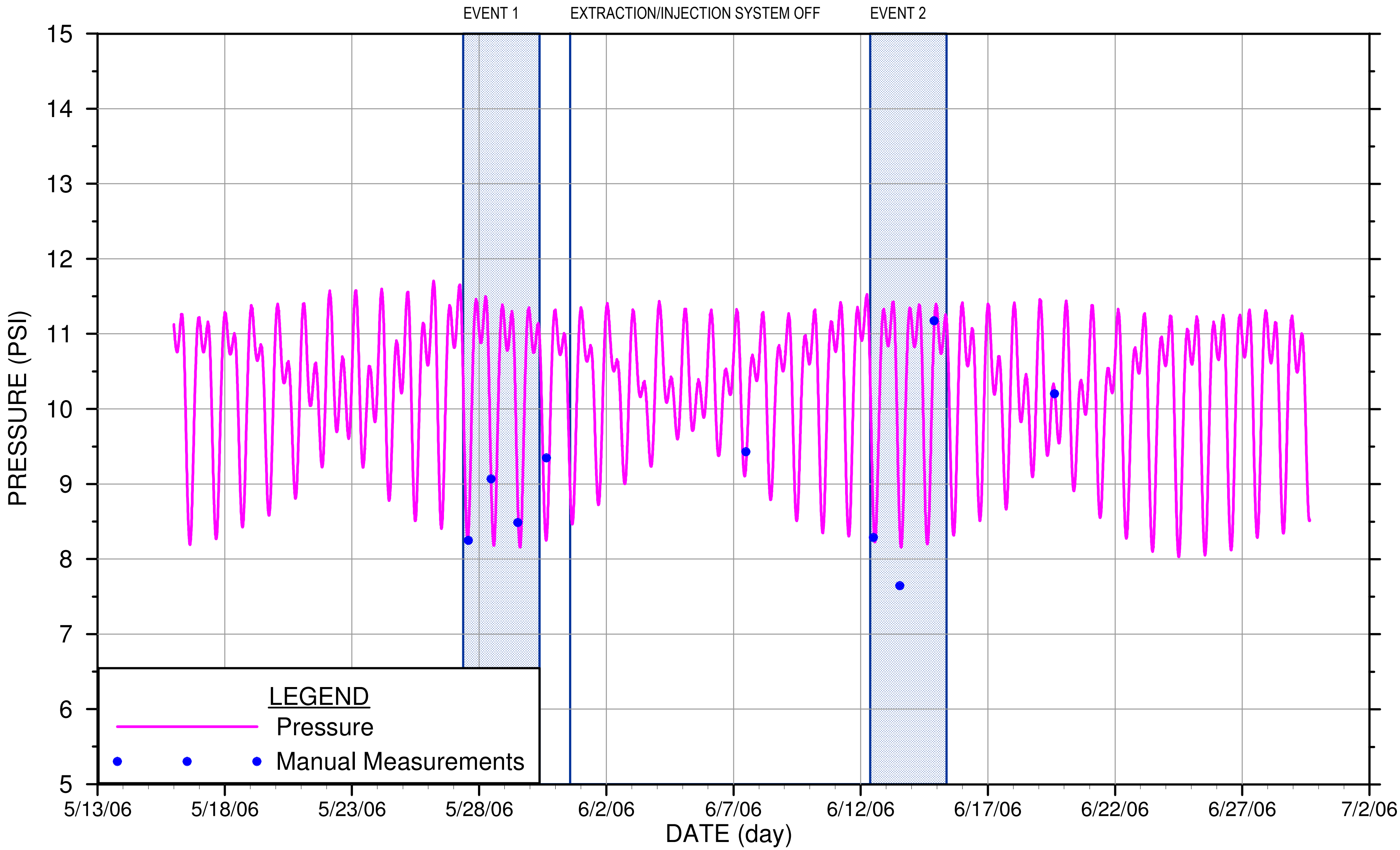


figure 6P-98

709-MW20-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-98.grf) JAN 3/2011

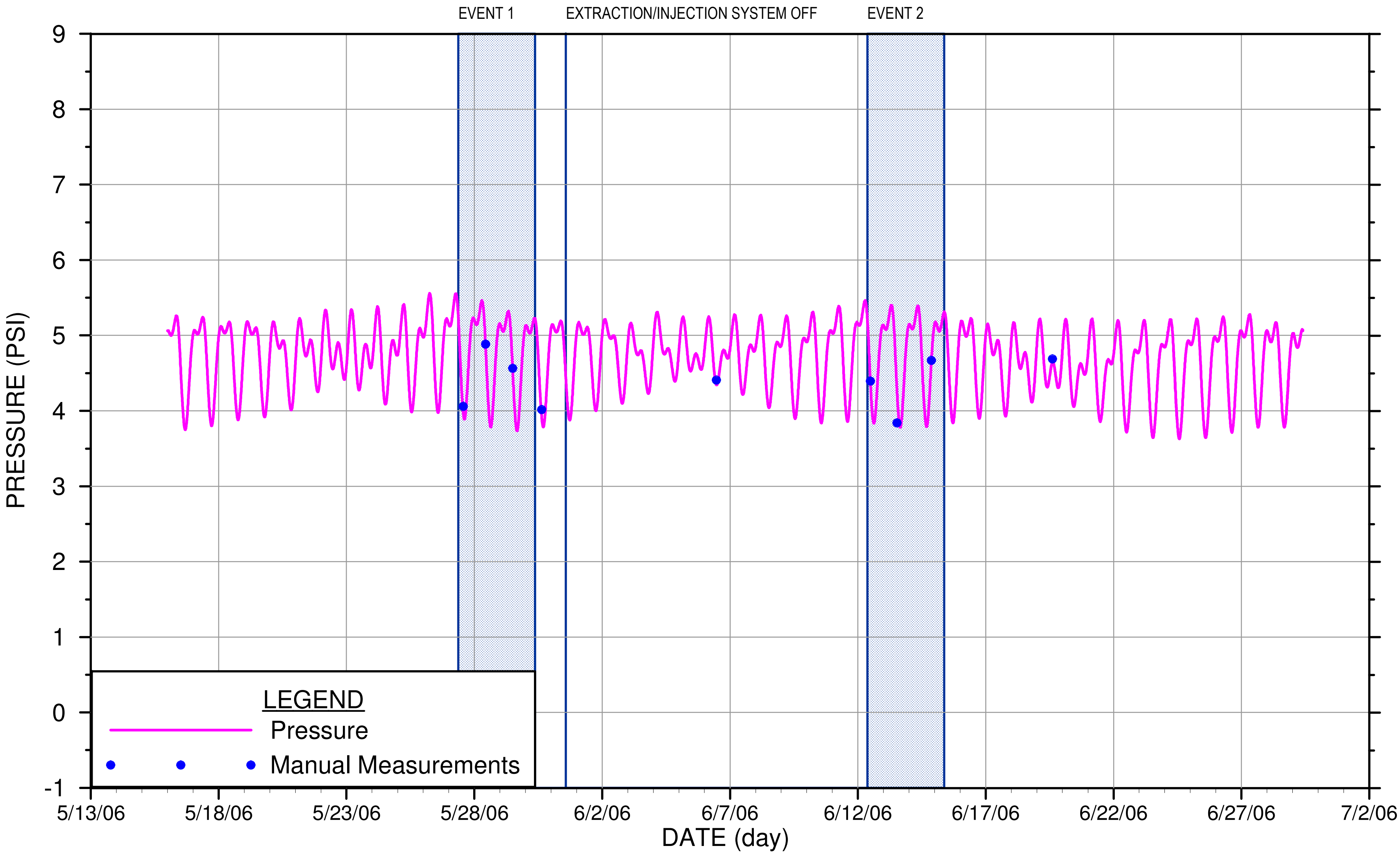


figure 6P-99

721-MW5-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-99.grf) JAN 3/2011

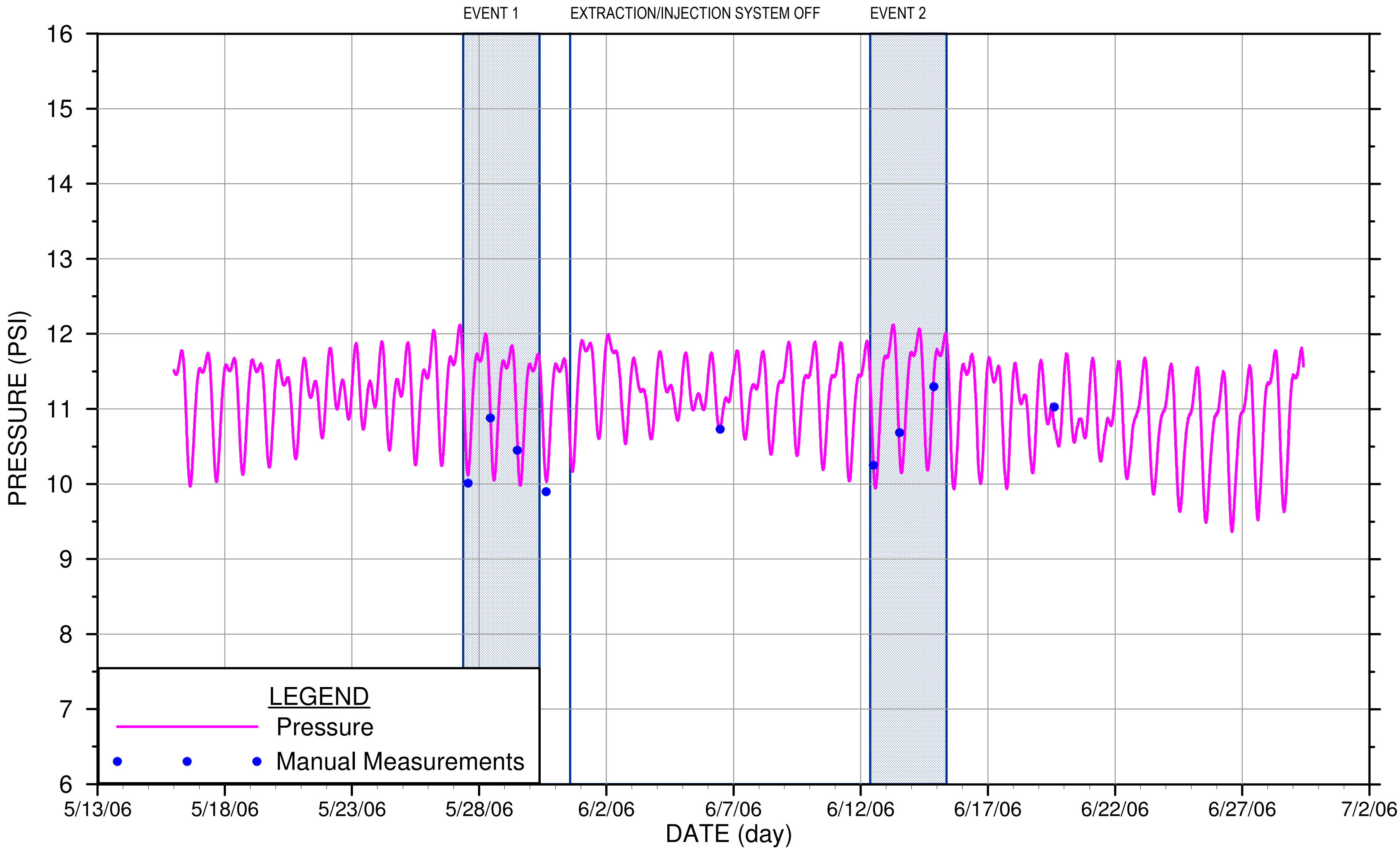


figure 6P-100

721-MW5-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

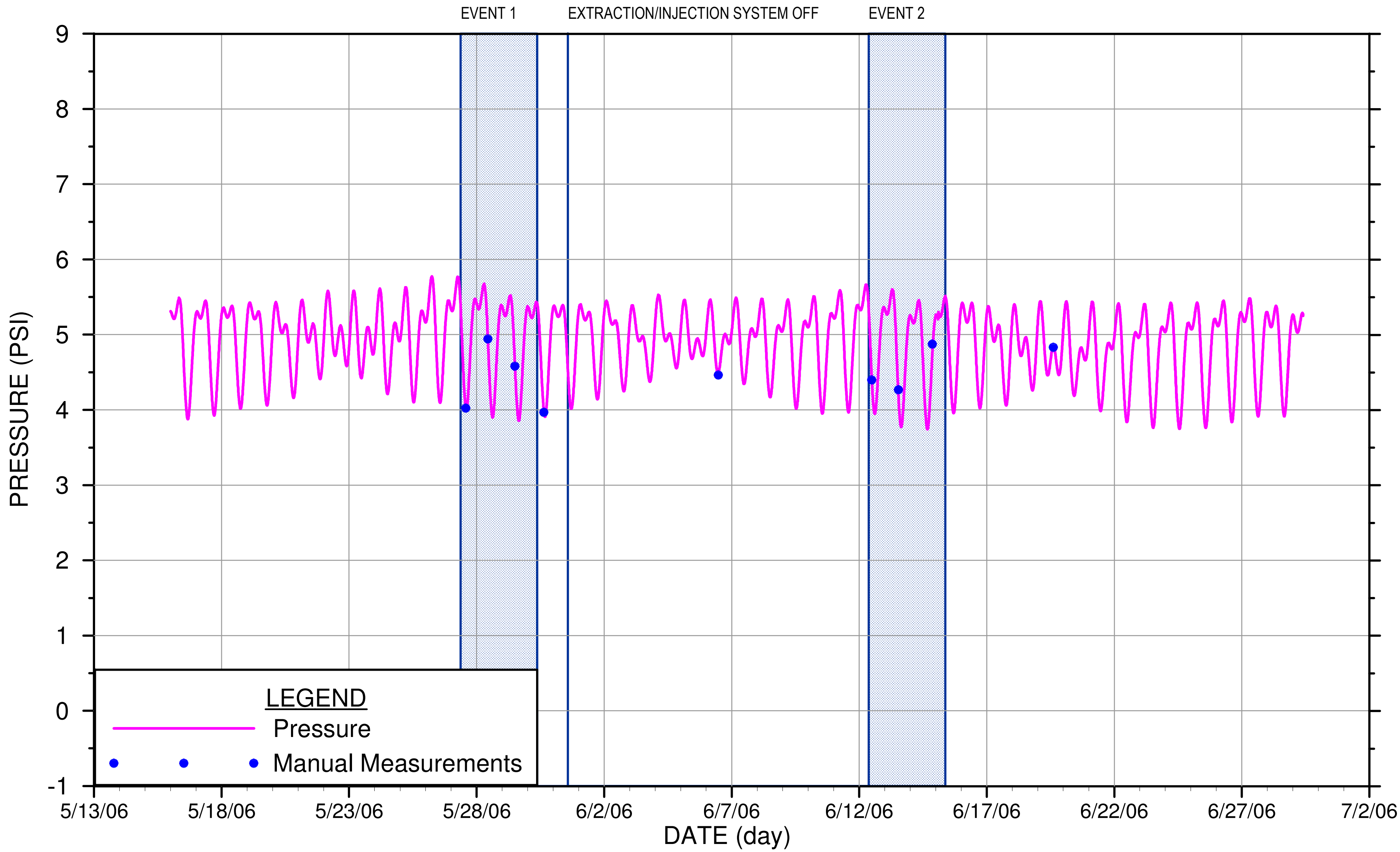


figure 6P-101

721-MW6-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-101.grf) JAN 3/2011

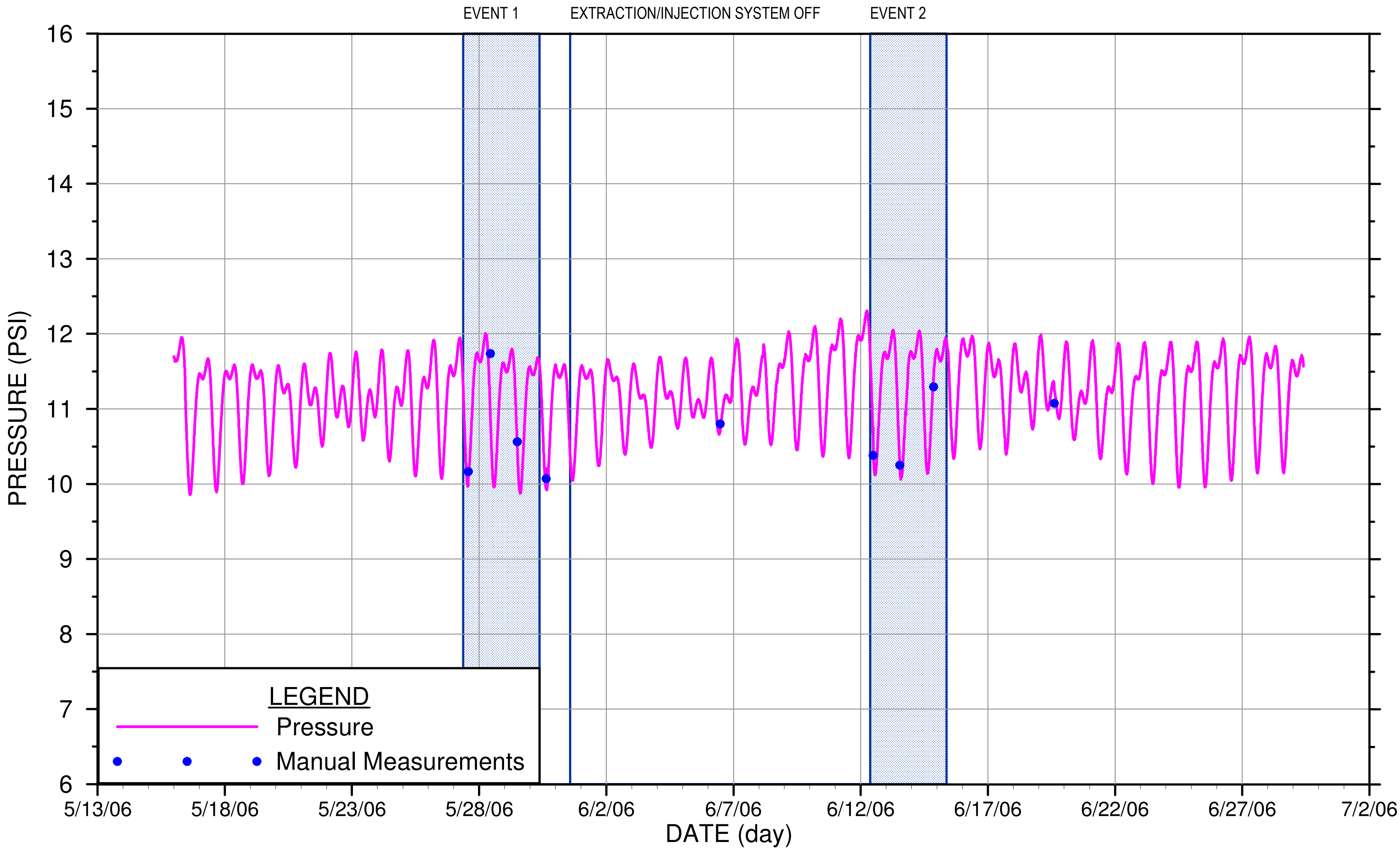


figure 6P-102

721-MW6-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-102.grf) JAN 3/2011

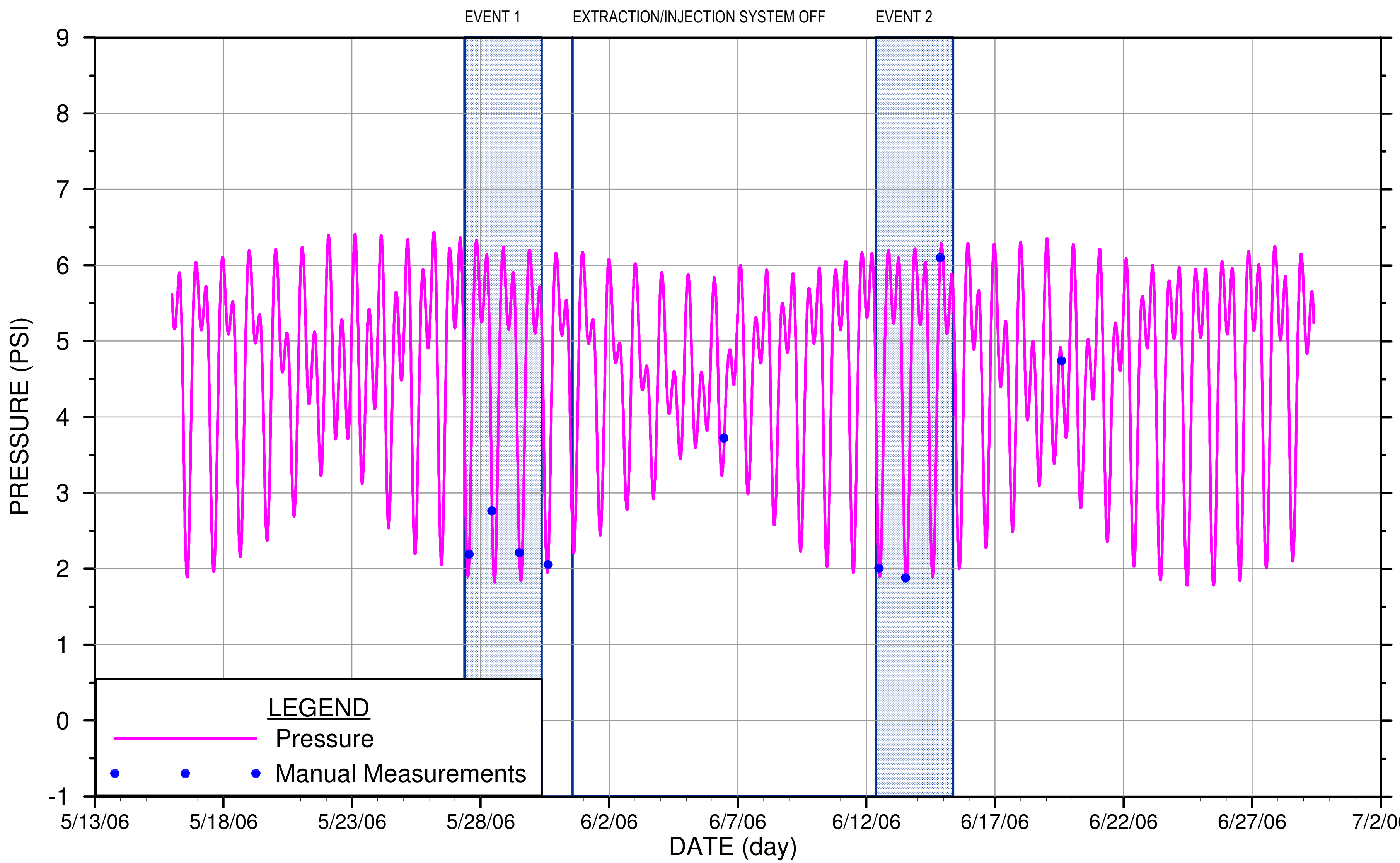


figure 6P-103

721-MW9-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-103.grf) JAN 3/2011

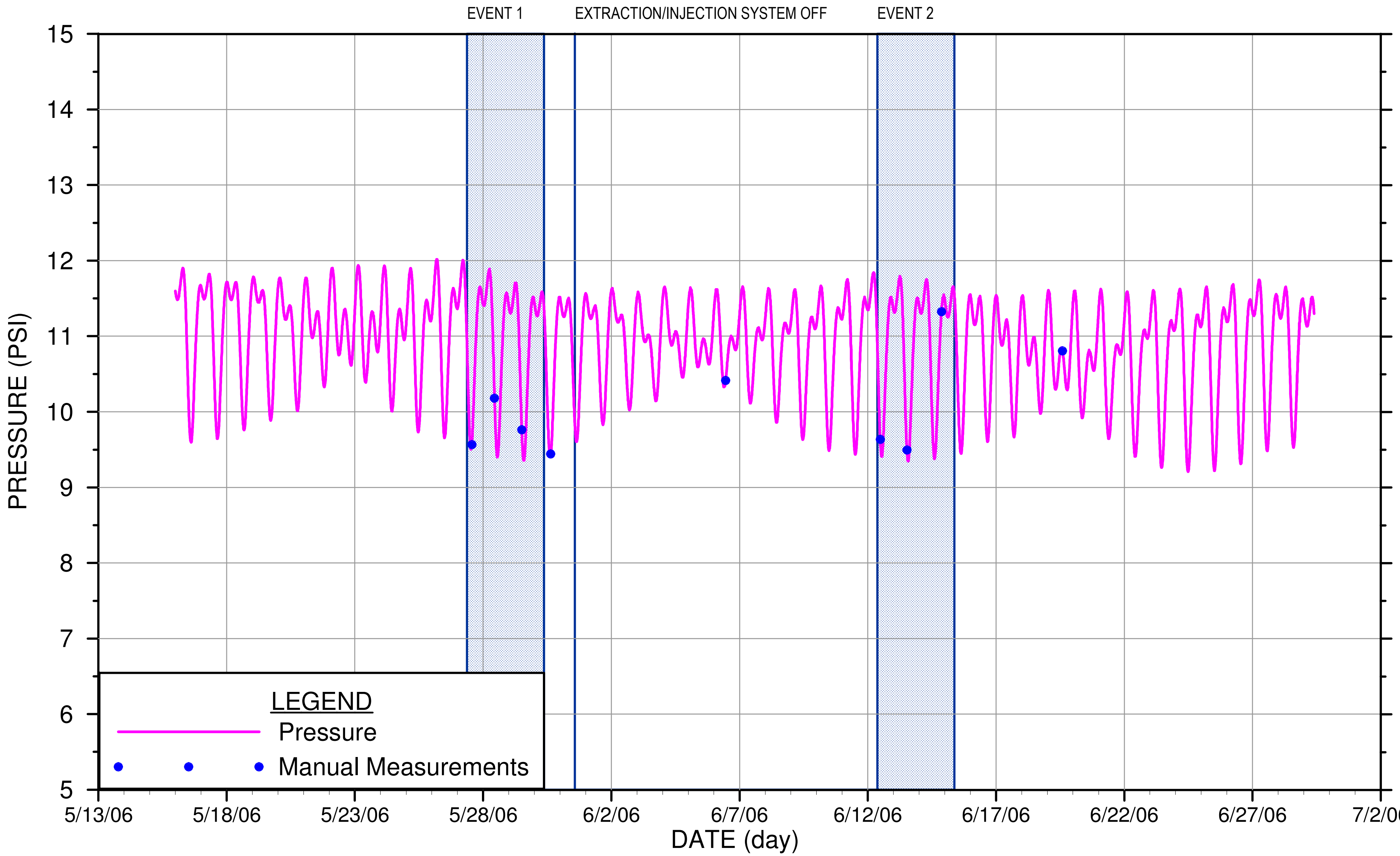


figure 6P-104

721-MW9-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-104.grf) JAN 3/2011

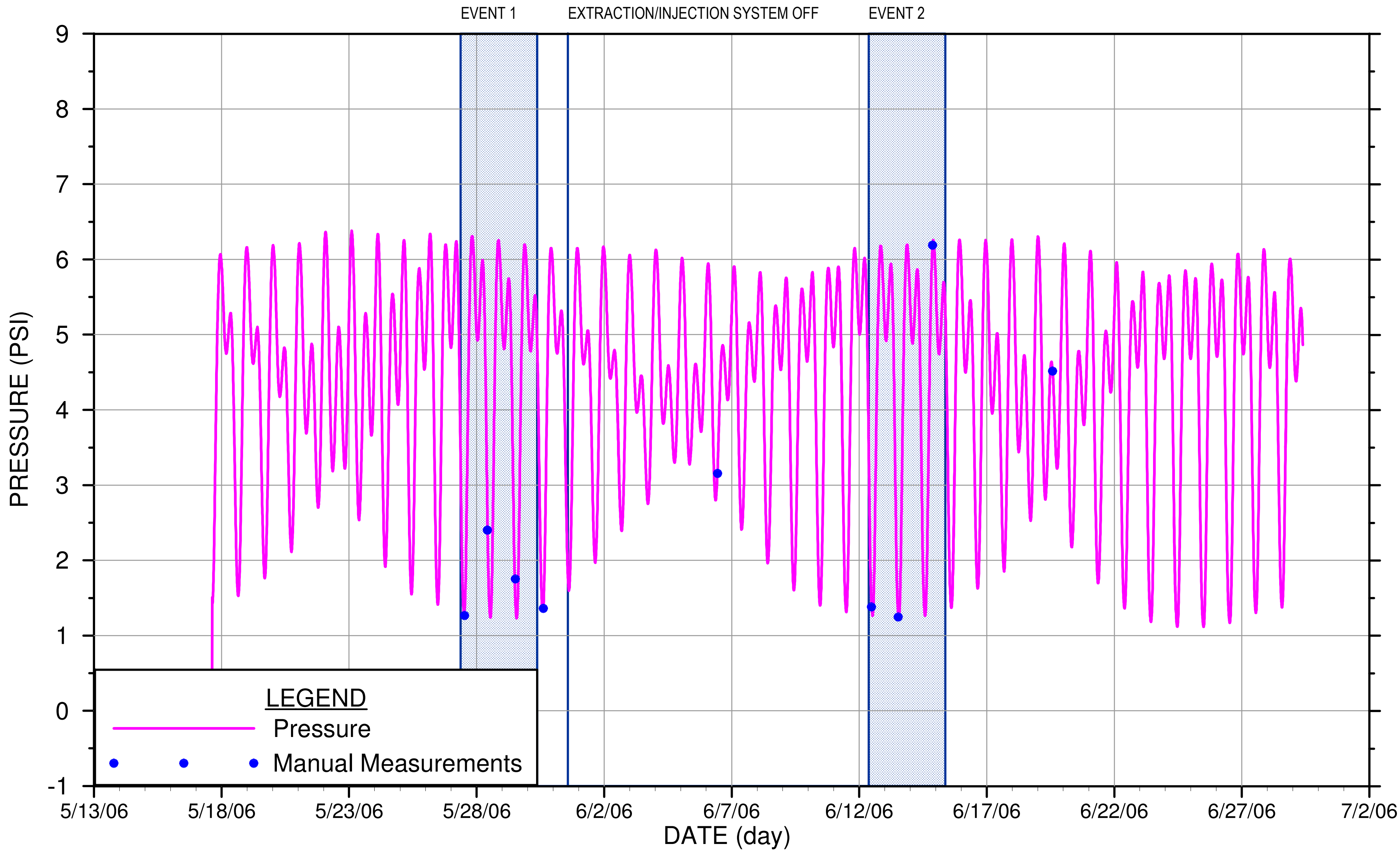


figure 6P-105

721-MW10-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

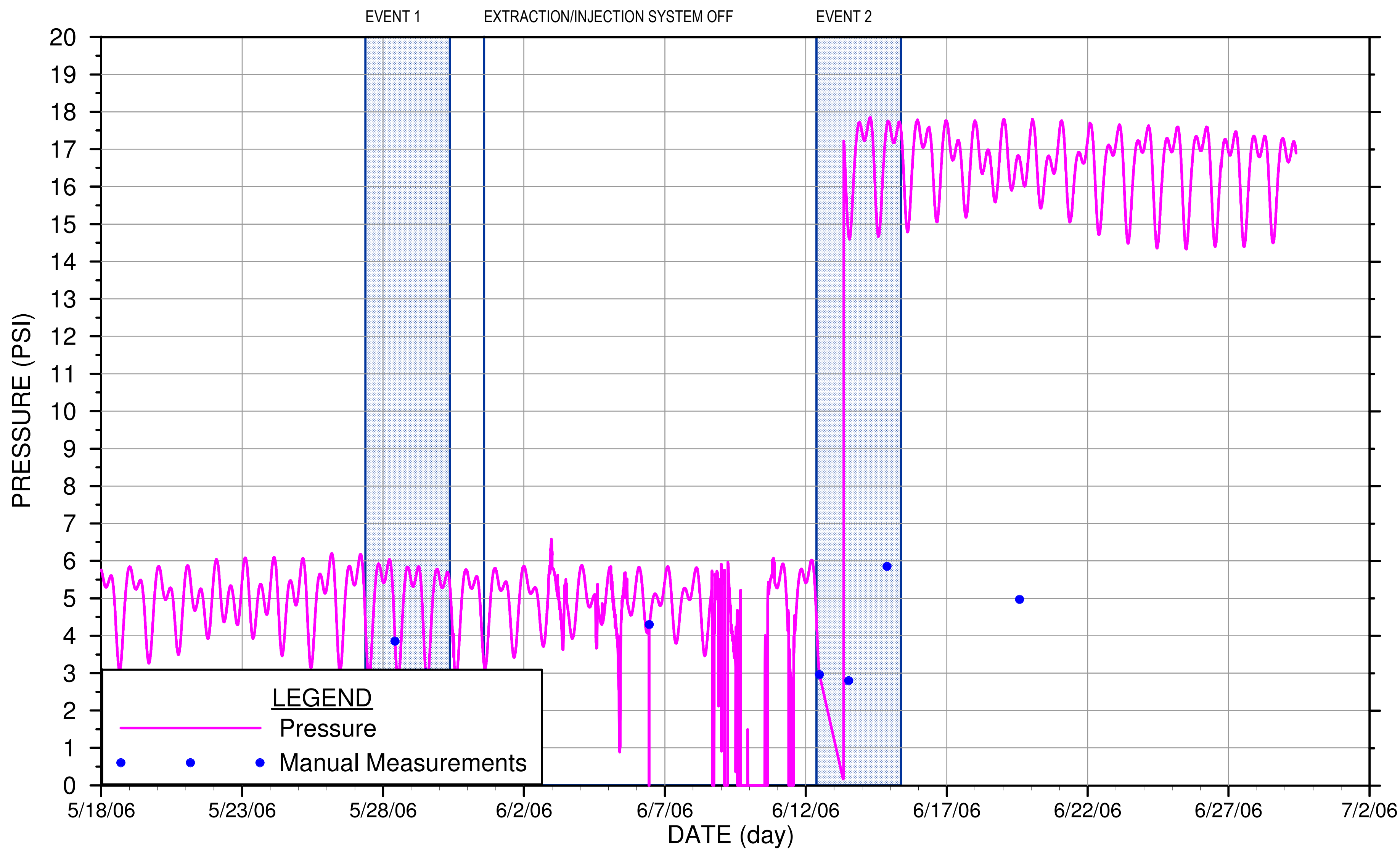


figure 6P-106

721-MW10-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-106.grf) JAN 3/2011

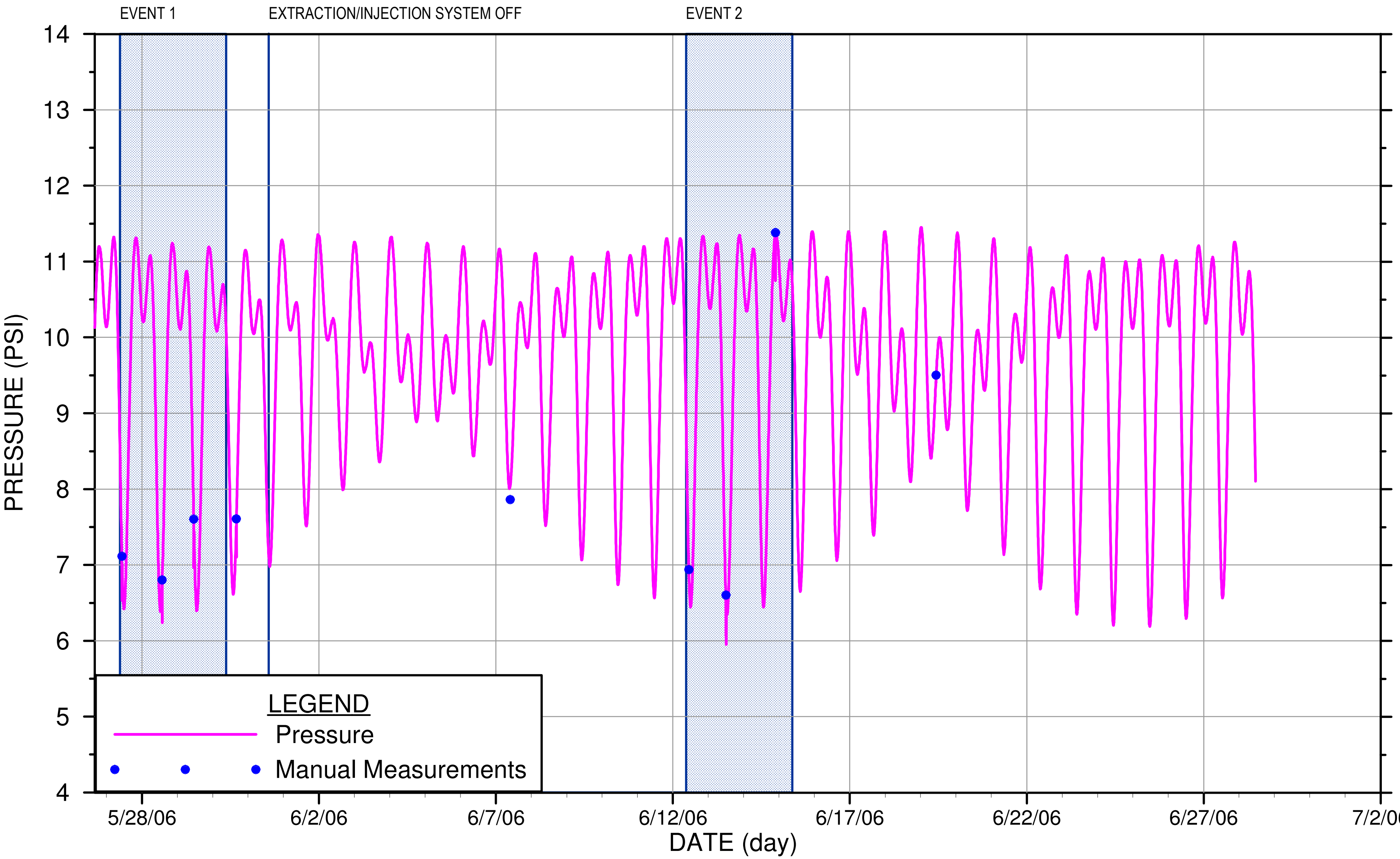


figure 6P-107

PZ-SHI-001-033 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-107.grf) JAN 3/2011

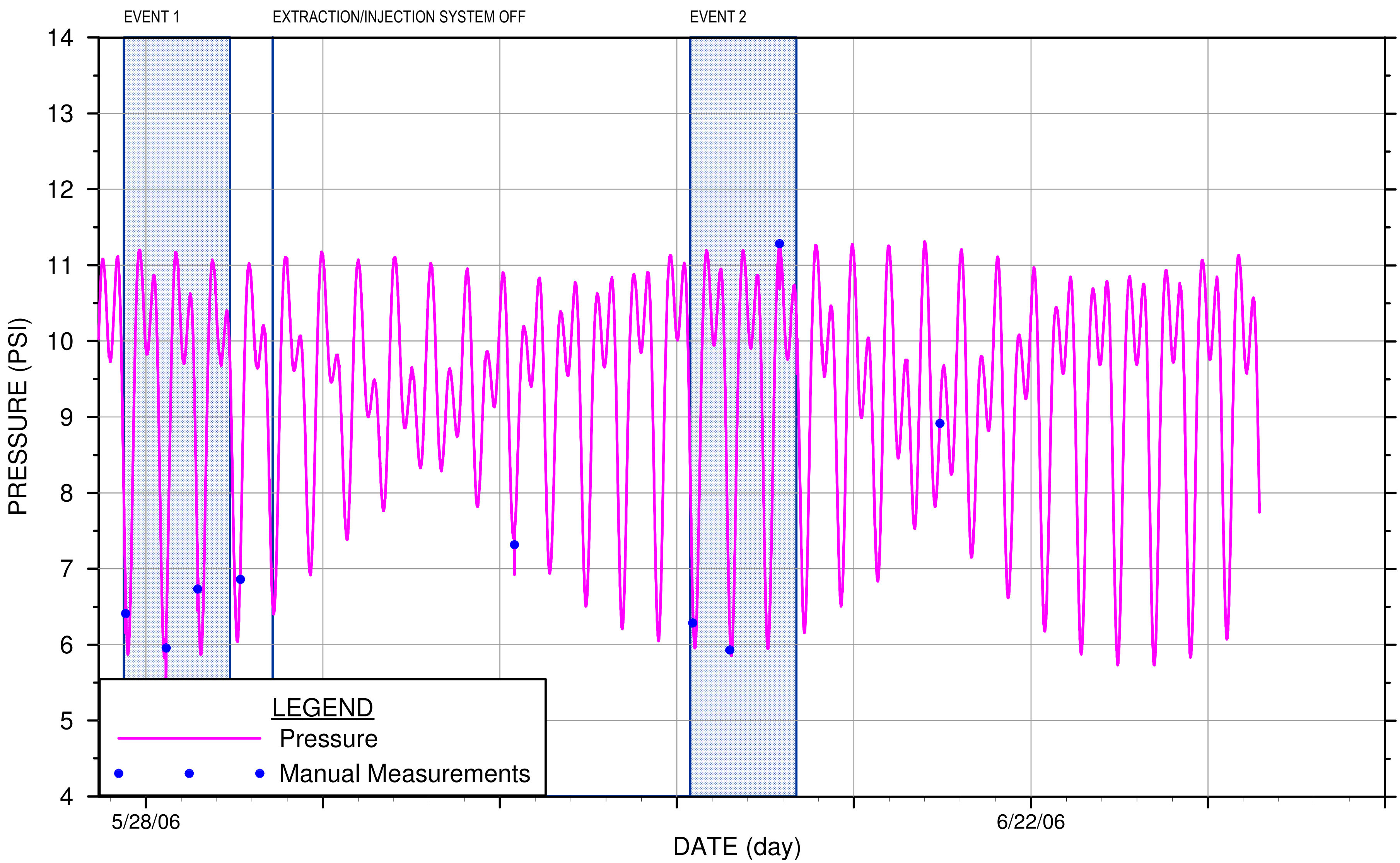


figure 6P-108

PZ-SHI-001-075 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-108.grf) JAN 3/2011

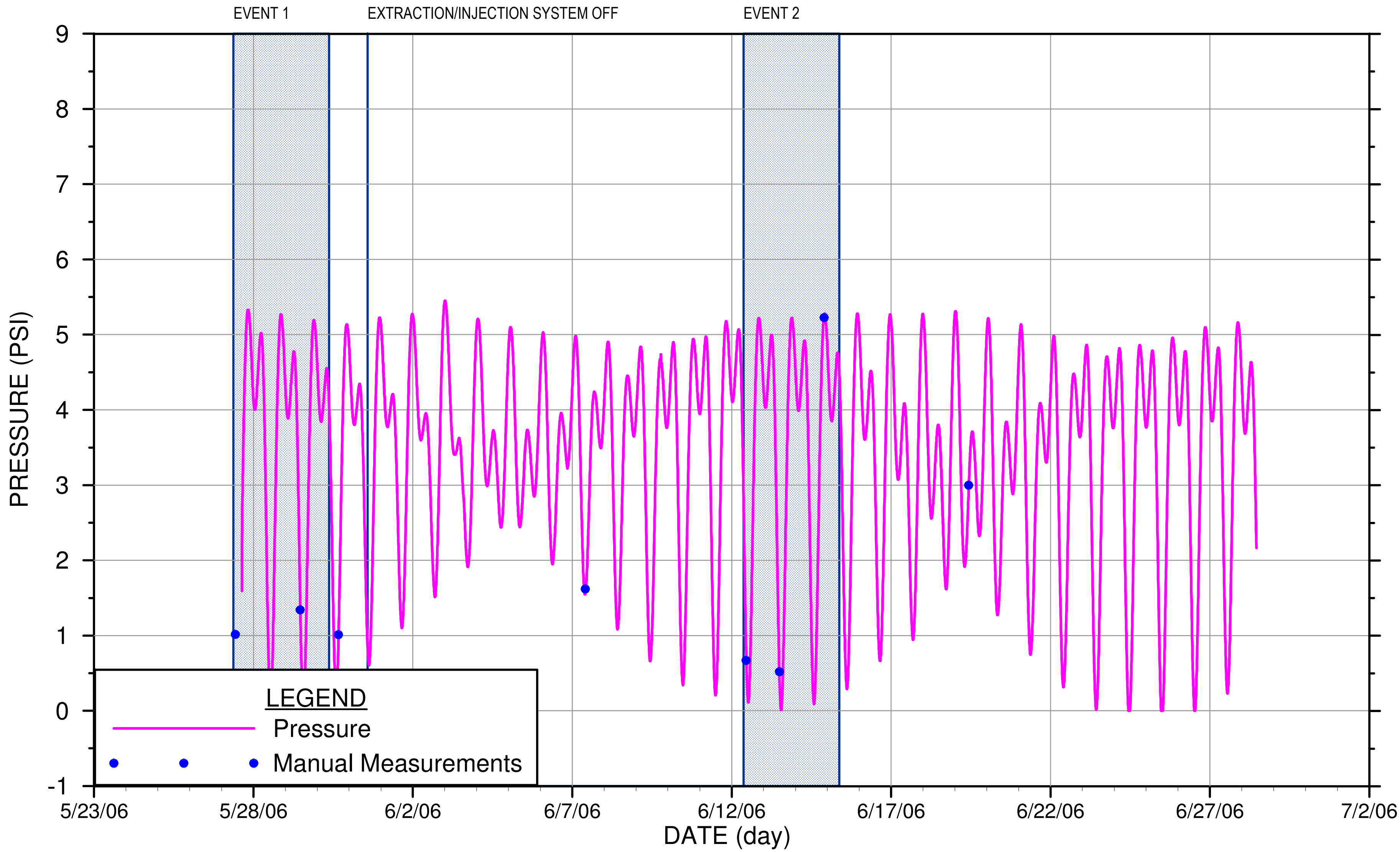


figure 6P-109

PZ-SHI-001-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-109.grf) JAN 3/2011

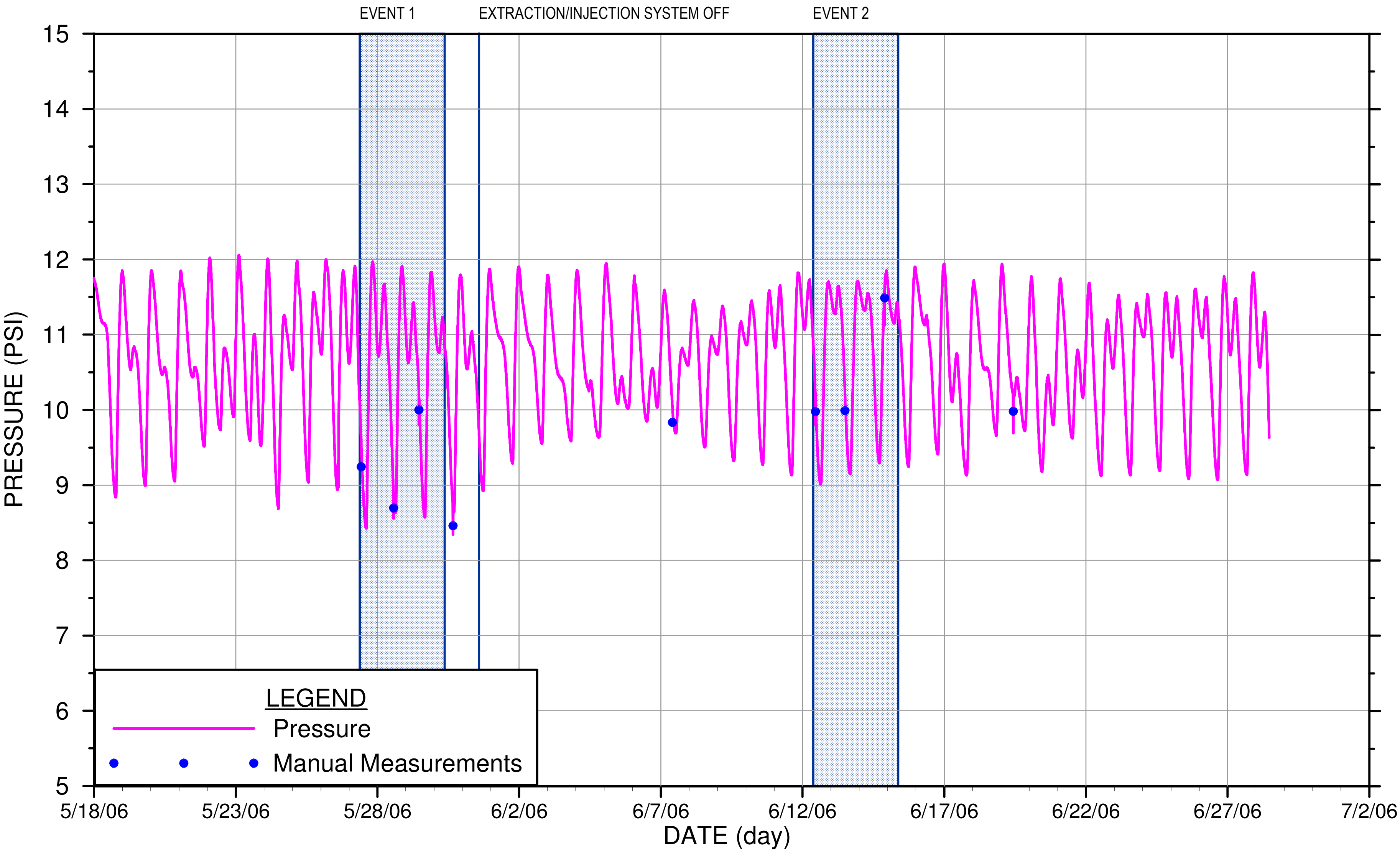


figure 6P-110

PZ-SHI-001-126 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-110.grf) JAN 3/2011

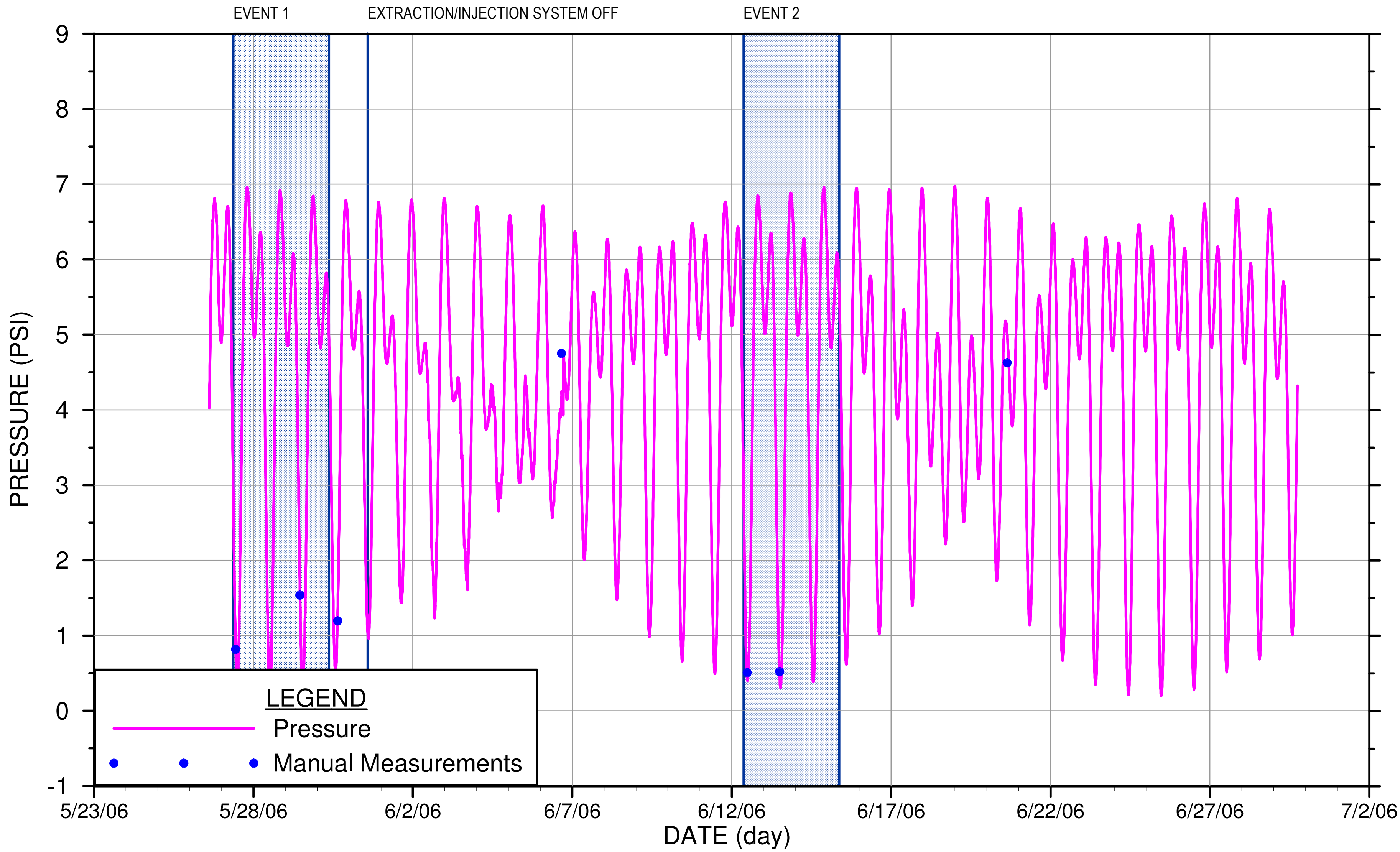


figure 6P-111

PZ-SHI-002-025 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

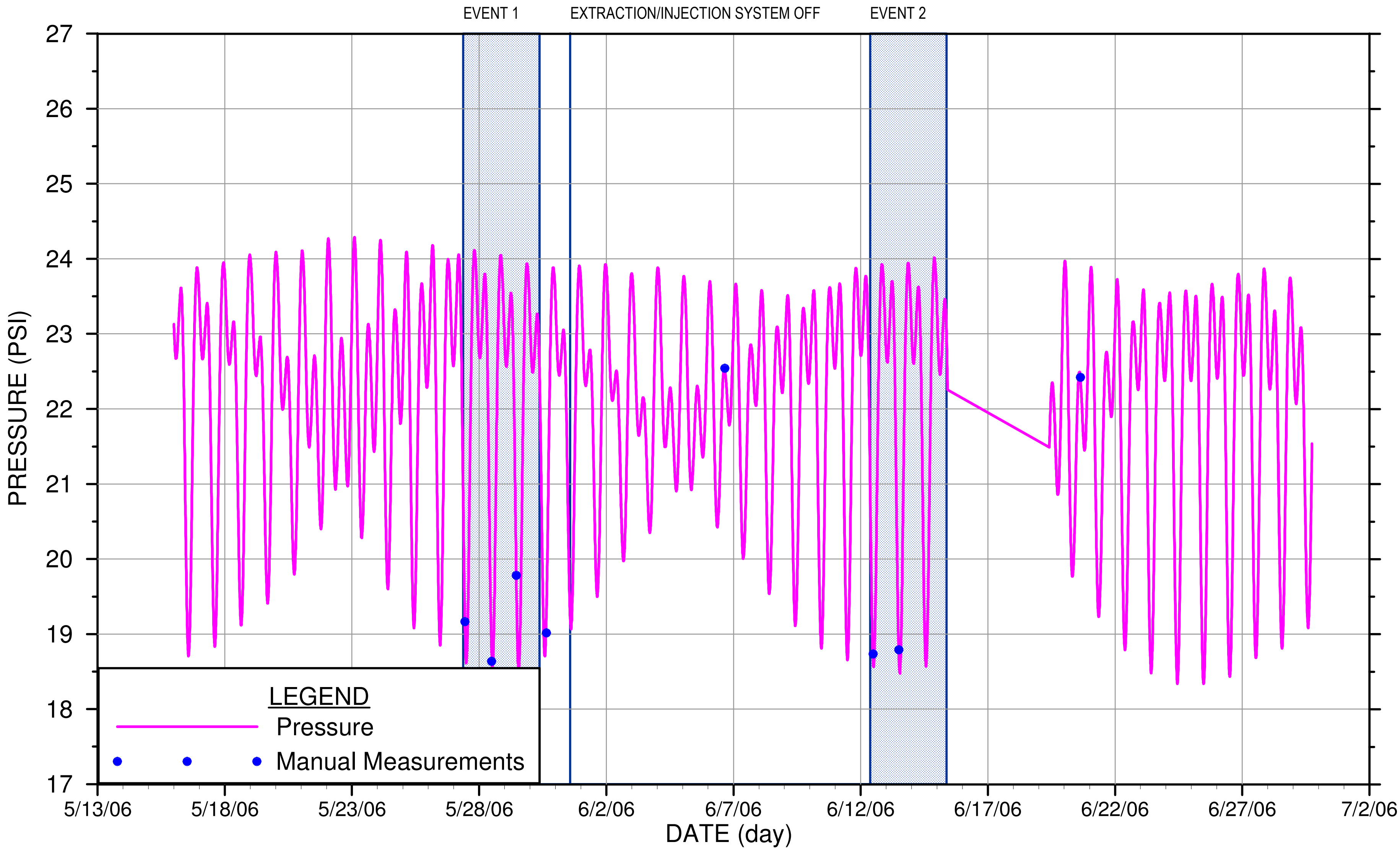


figure 6P-112

PZ-SHI-002-075 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-112.grf) JAN 3/2011

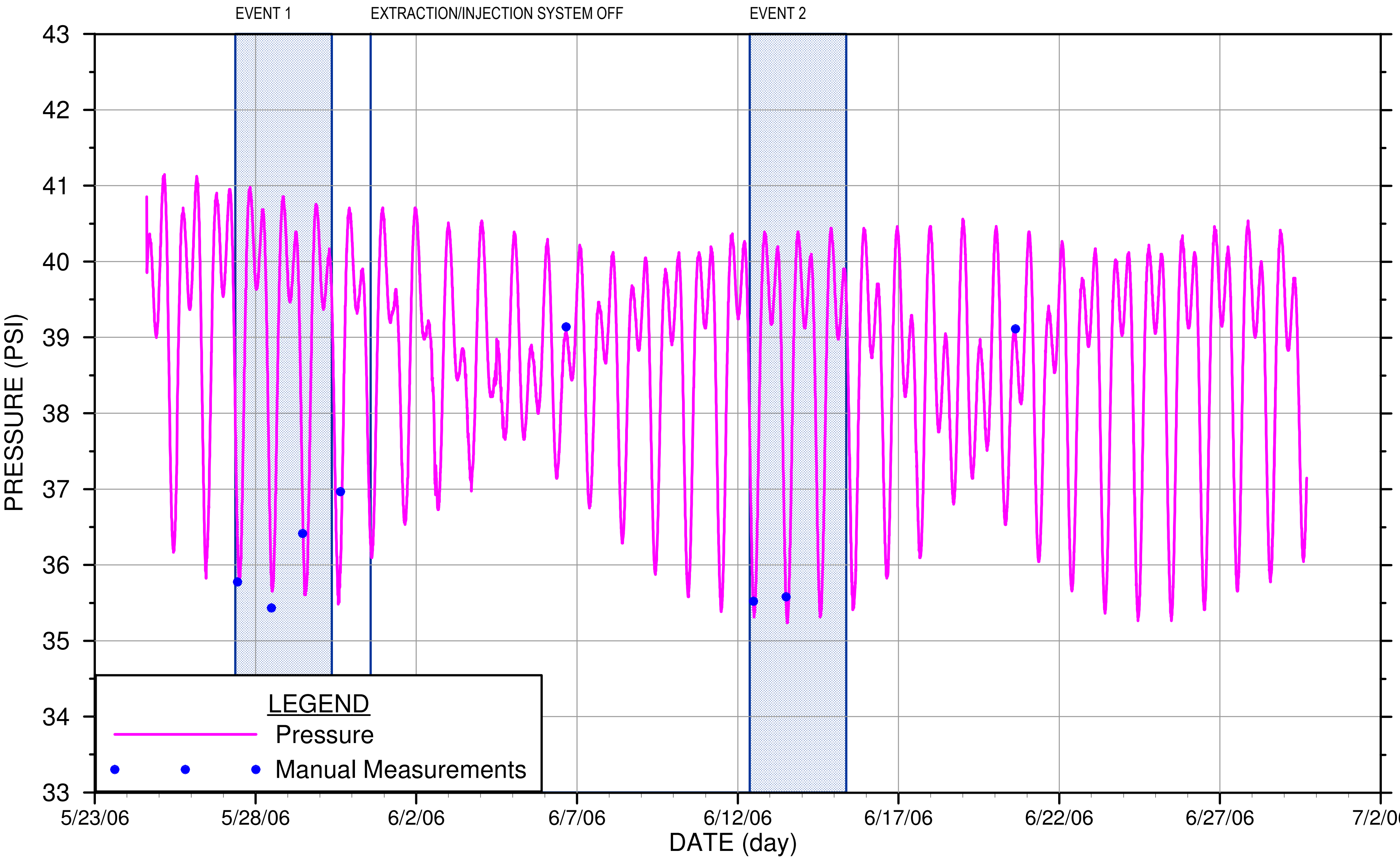


figure 6P-113

PZ-SHI-002-100 PRESSURE VERSUS TIME
SITE CHARACTERIZTION
Occidental Chemical Corporation, Tacoma, Washington

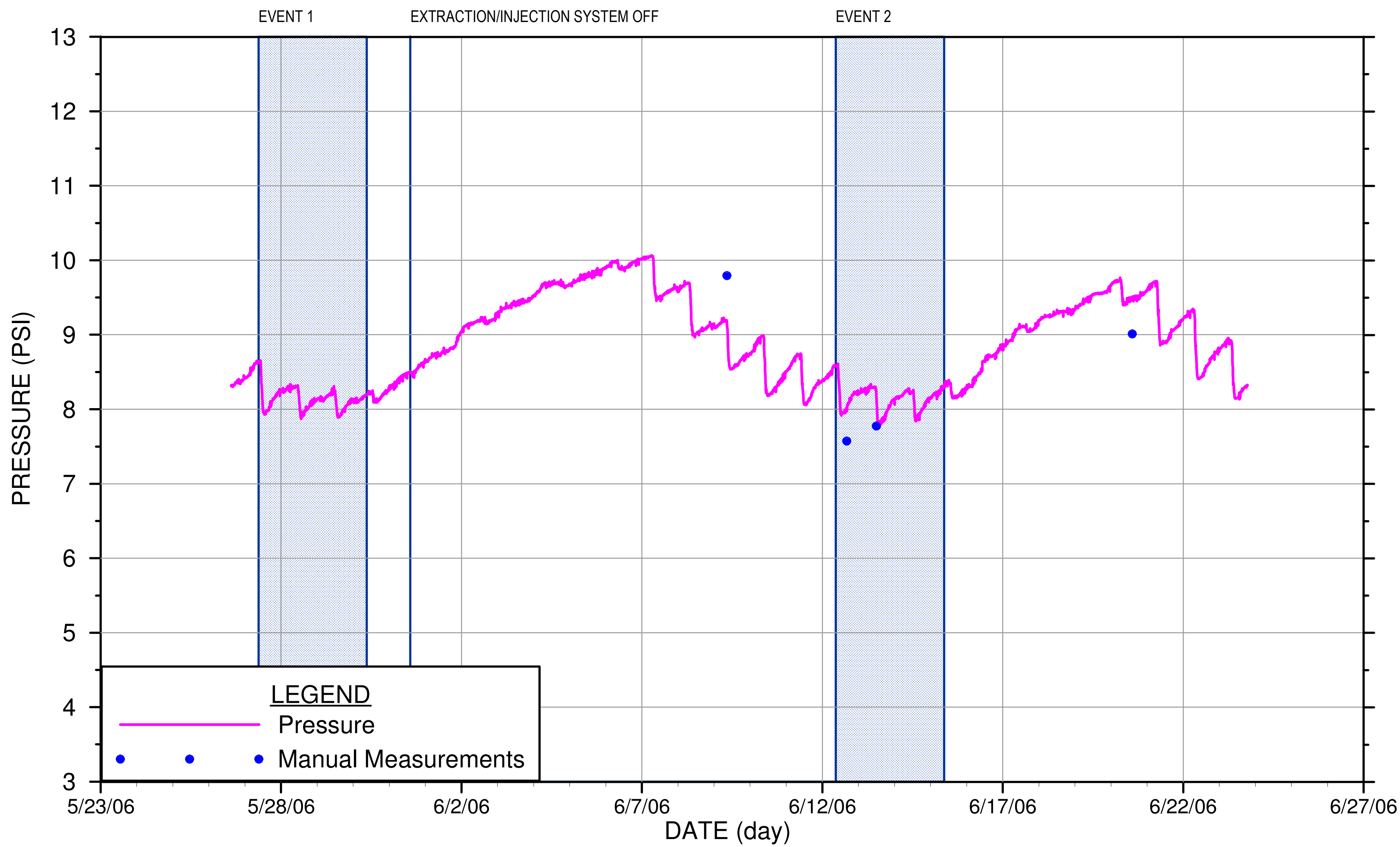


figure 6P-114

PZ-SHI-003-042 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

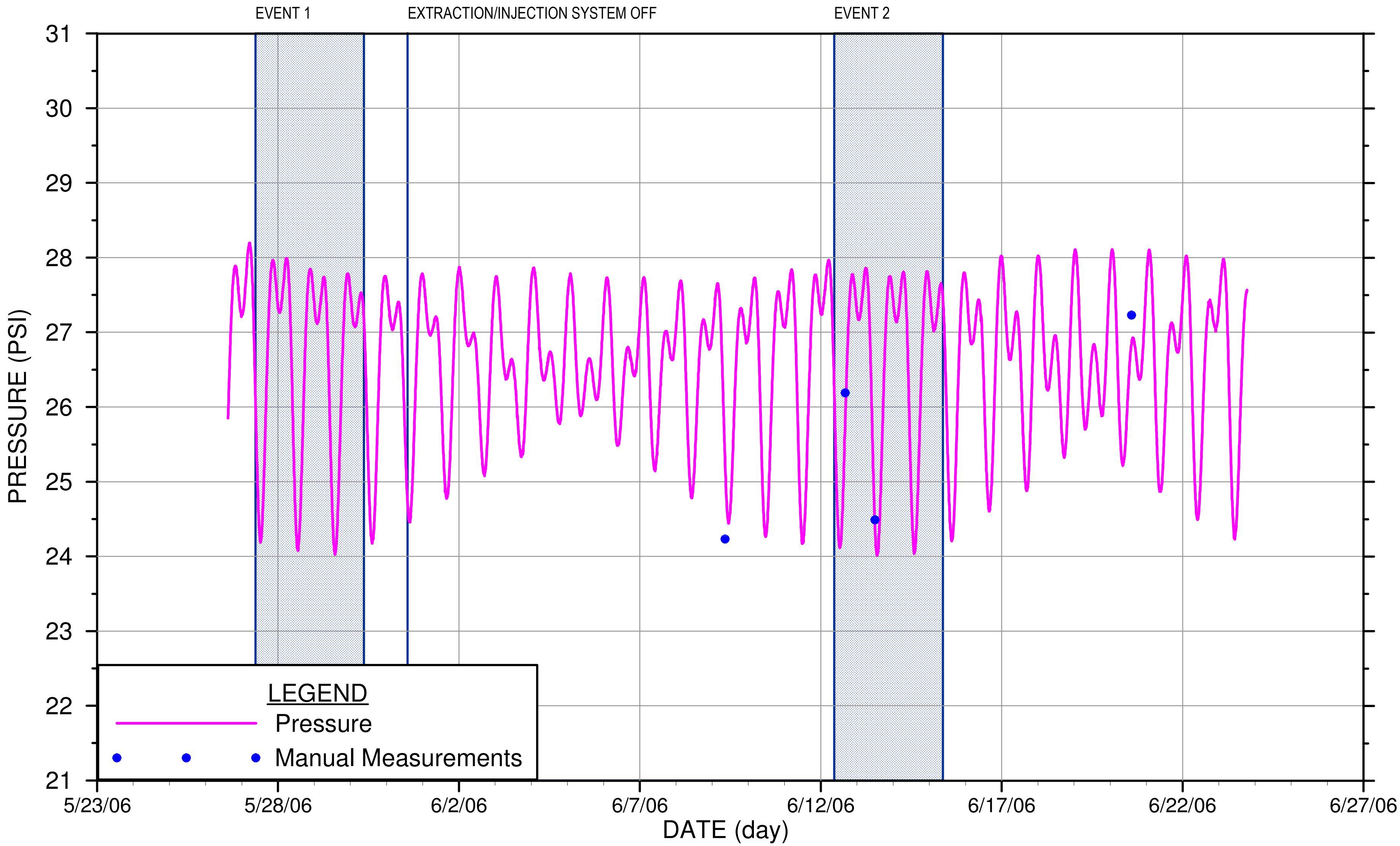


figure 6P-115

PZ-SHI-003-075 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-115.grf) JAN 3/2011

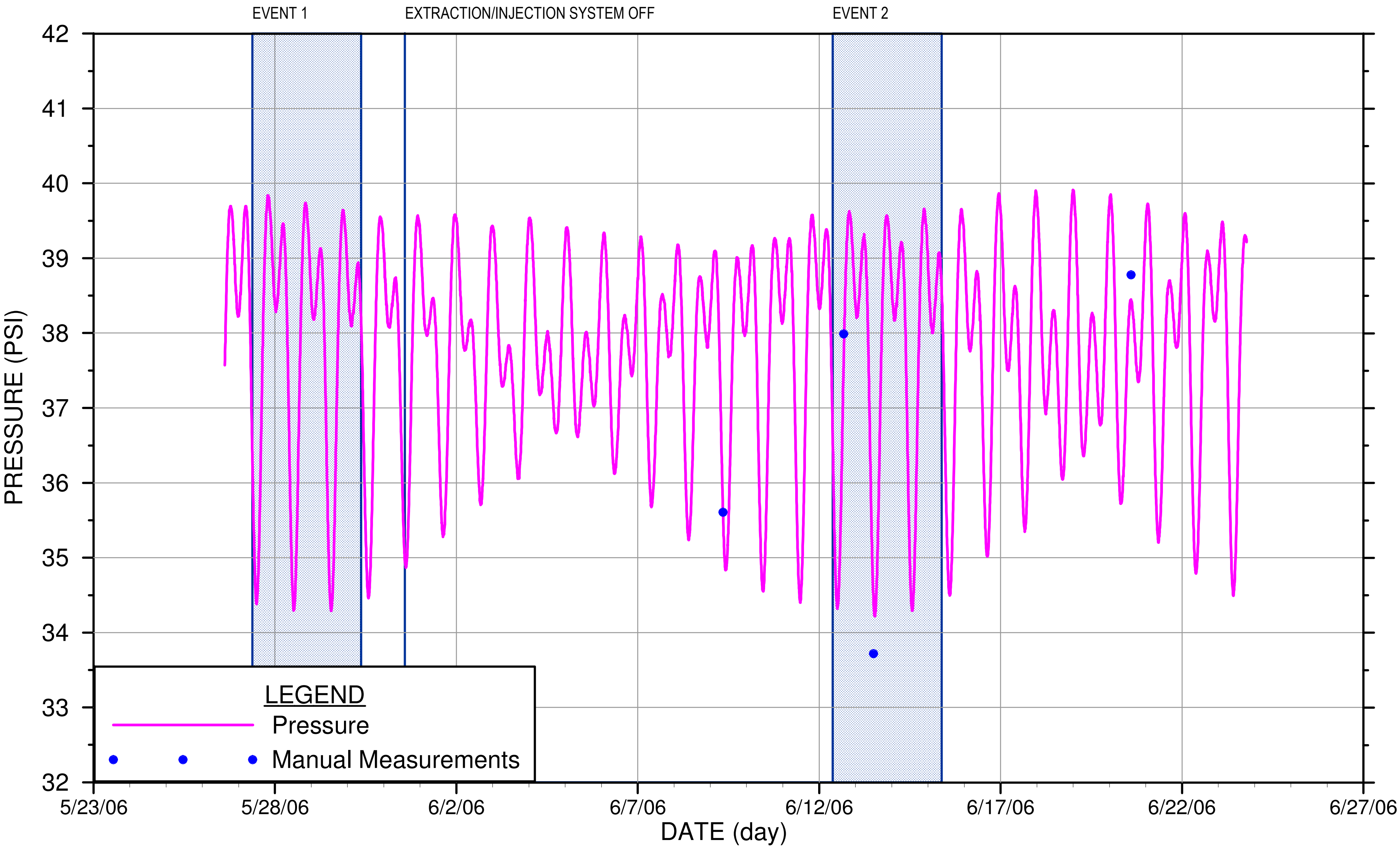


figure 6P-116

PZ-SHI-003-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\heg\07843\SCR\Appl\Att6\pressure\6P-116.grf) JAN 3/2011

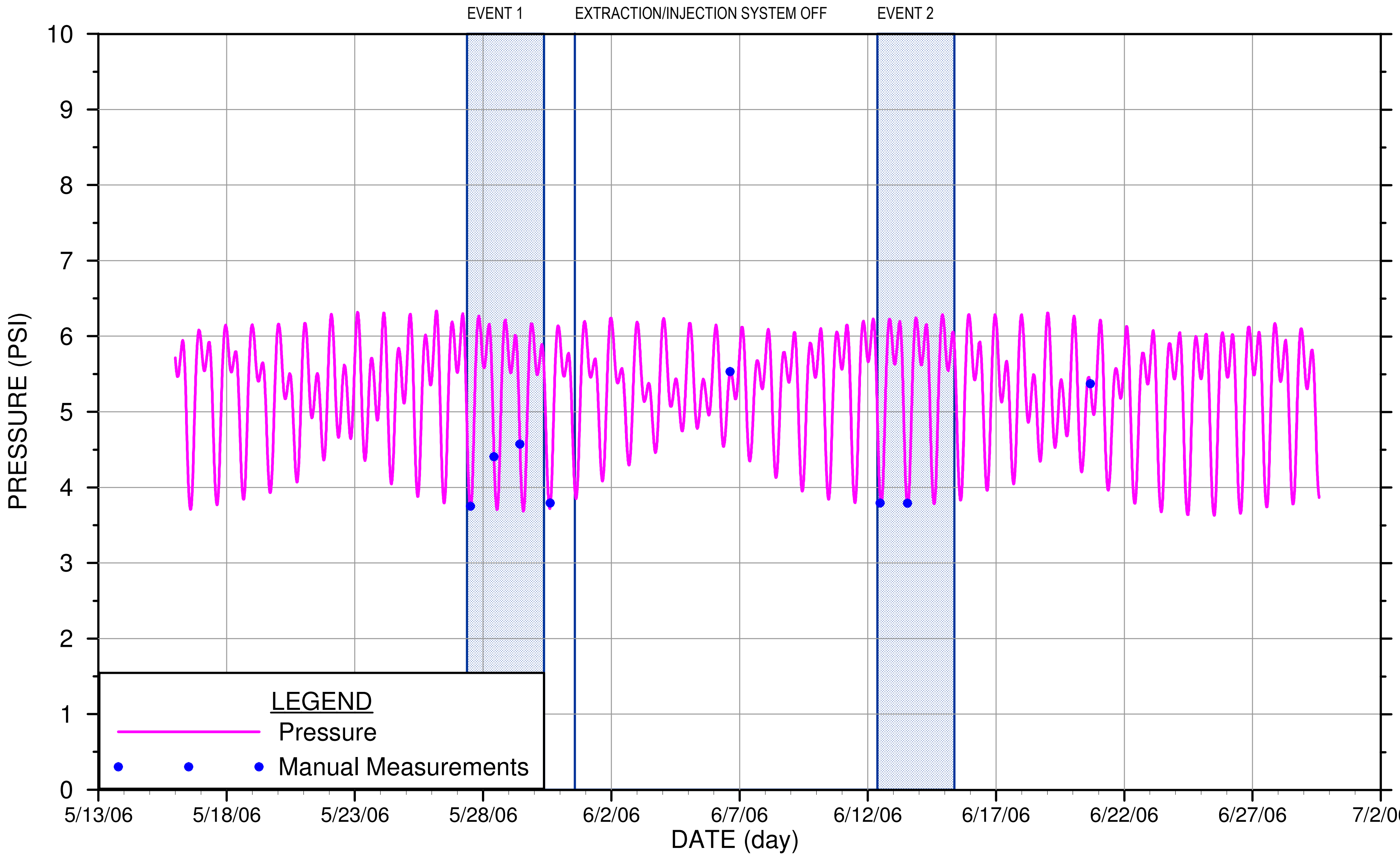


figure 6P-117

T1-25 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-117.grf) JAN 3/2011

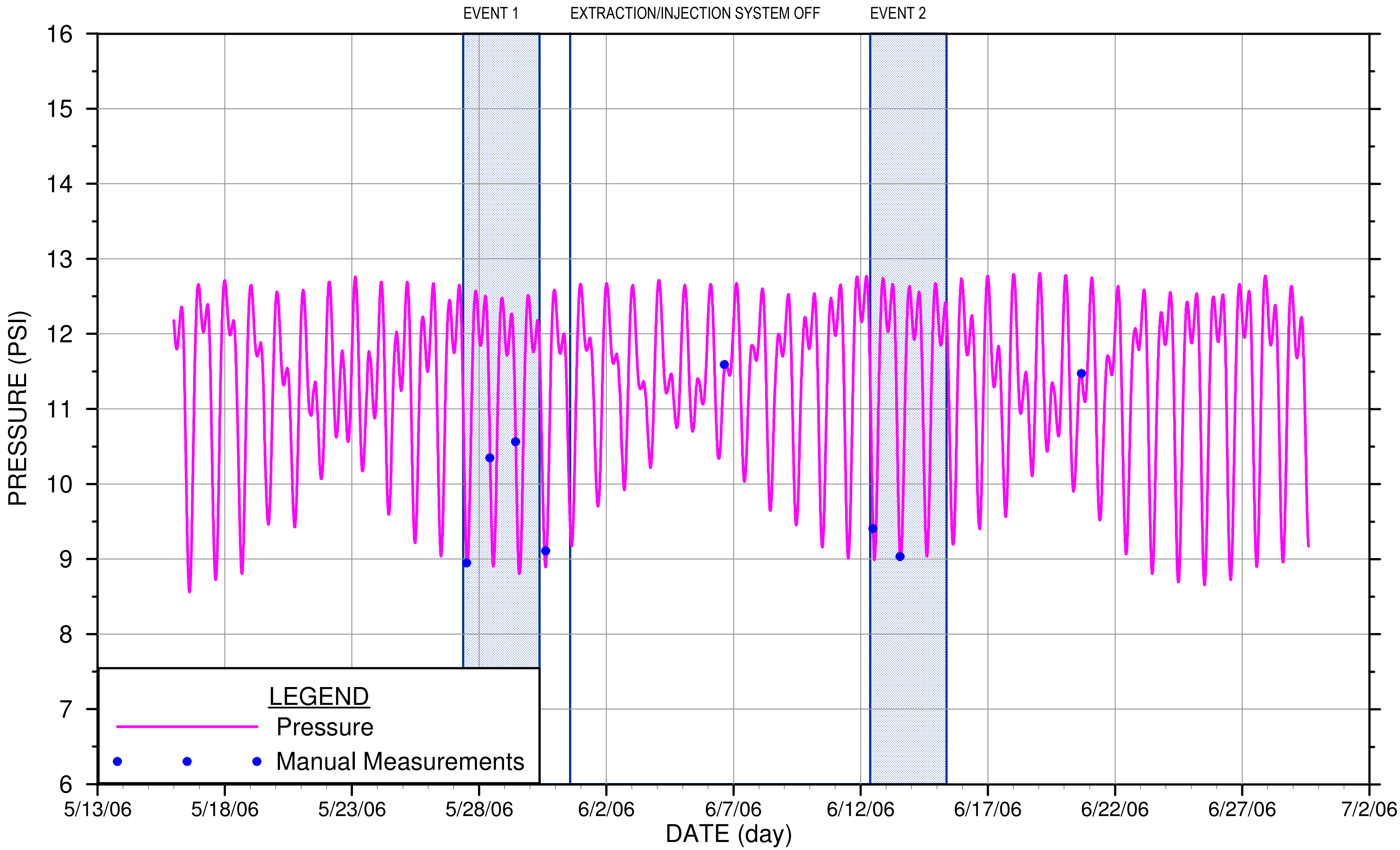


figure 6P-118

T1-50 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

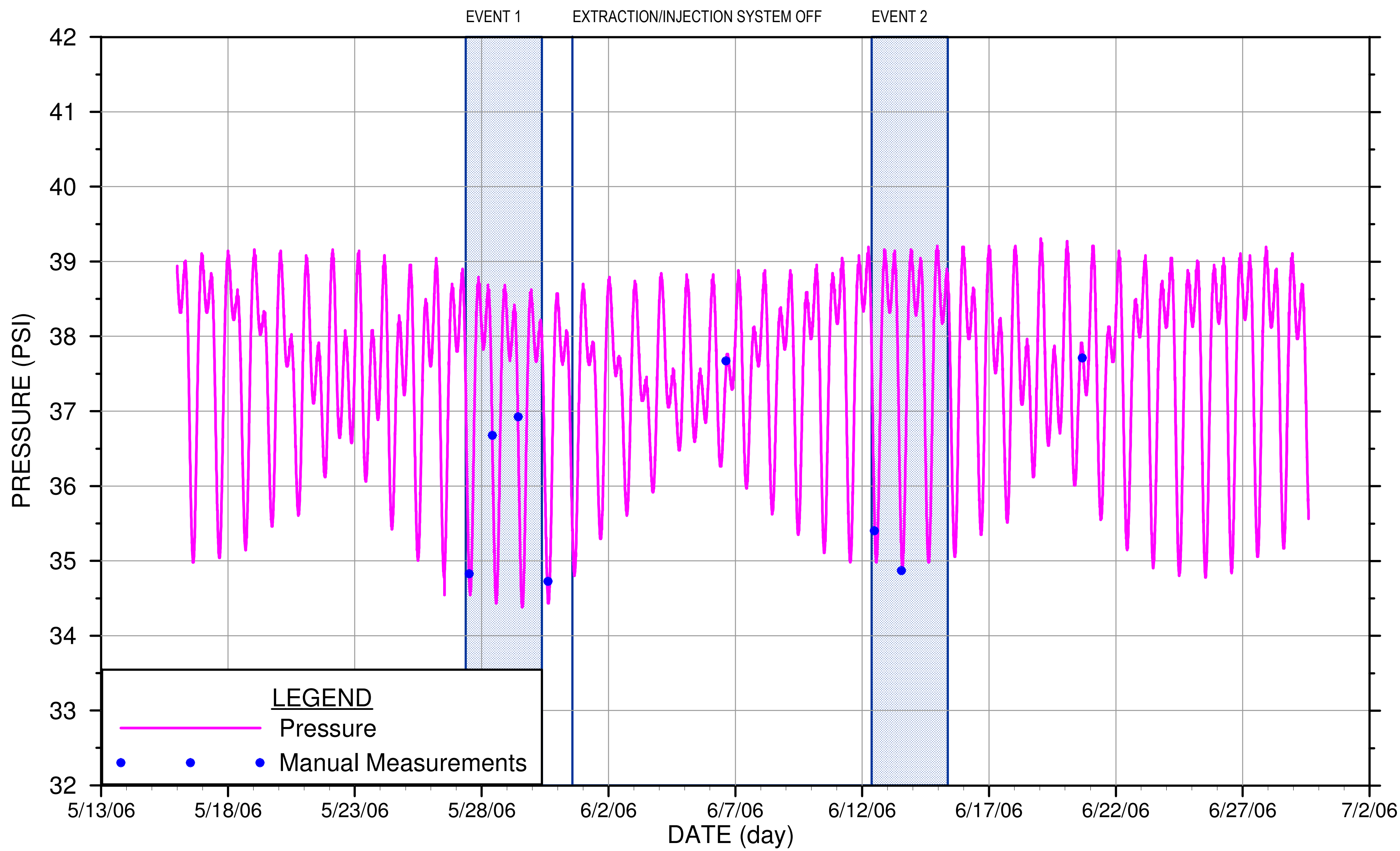


figure 6P-119

T1-100 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-119.grf) JAN 3/2011

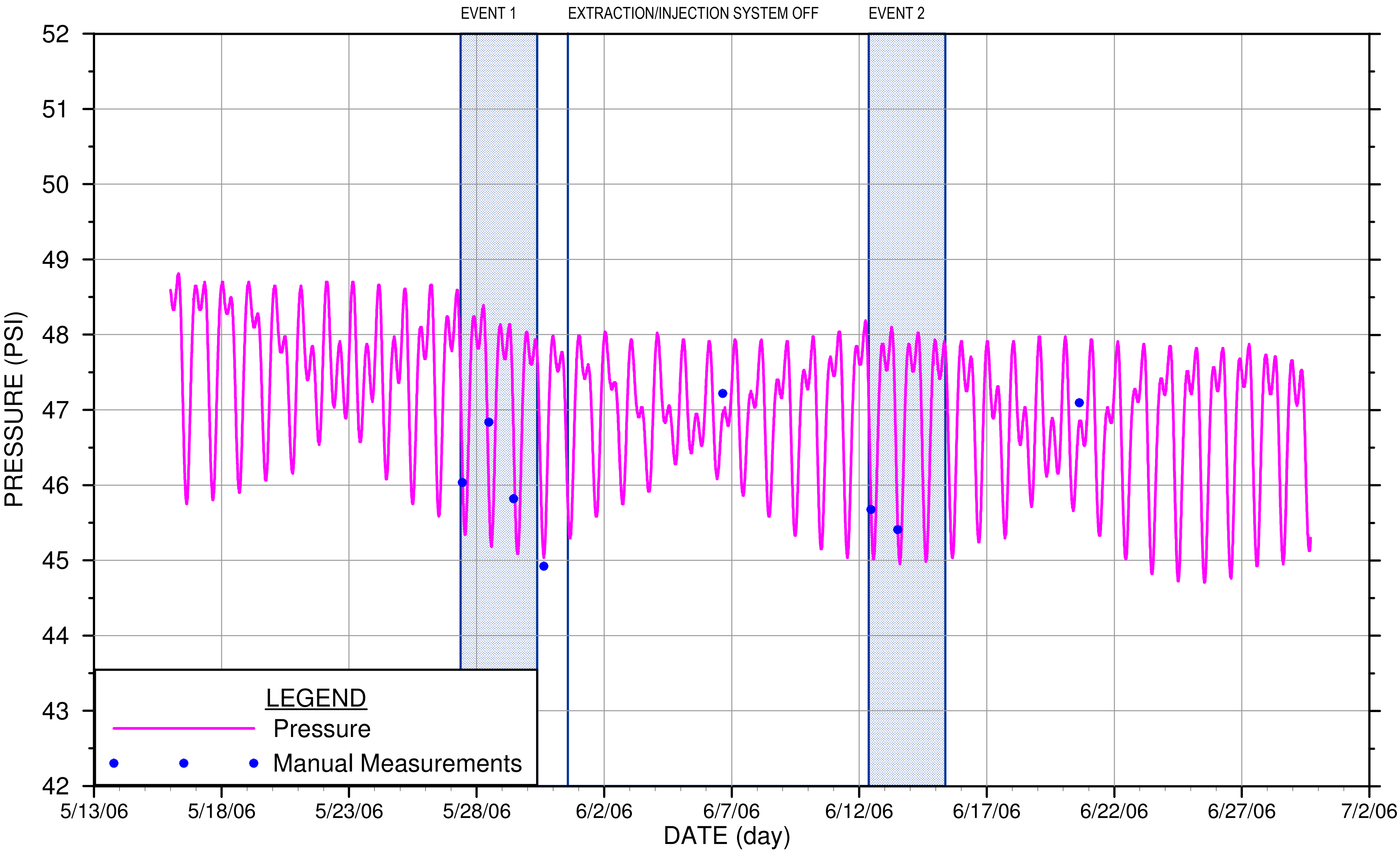


figure 6P-120

T5-120 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-120.grf) JAN 3/2011

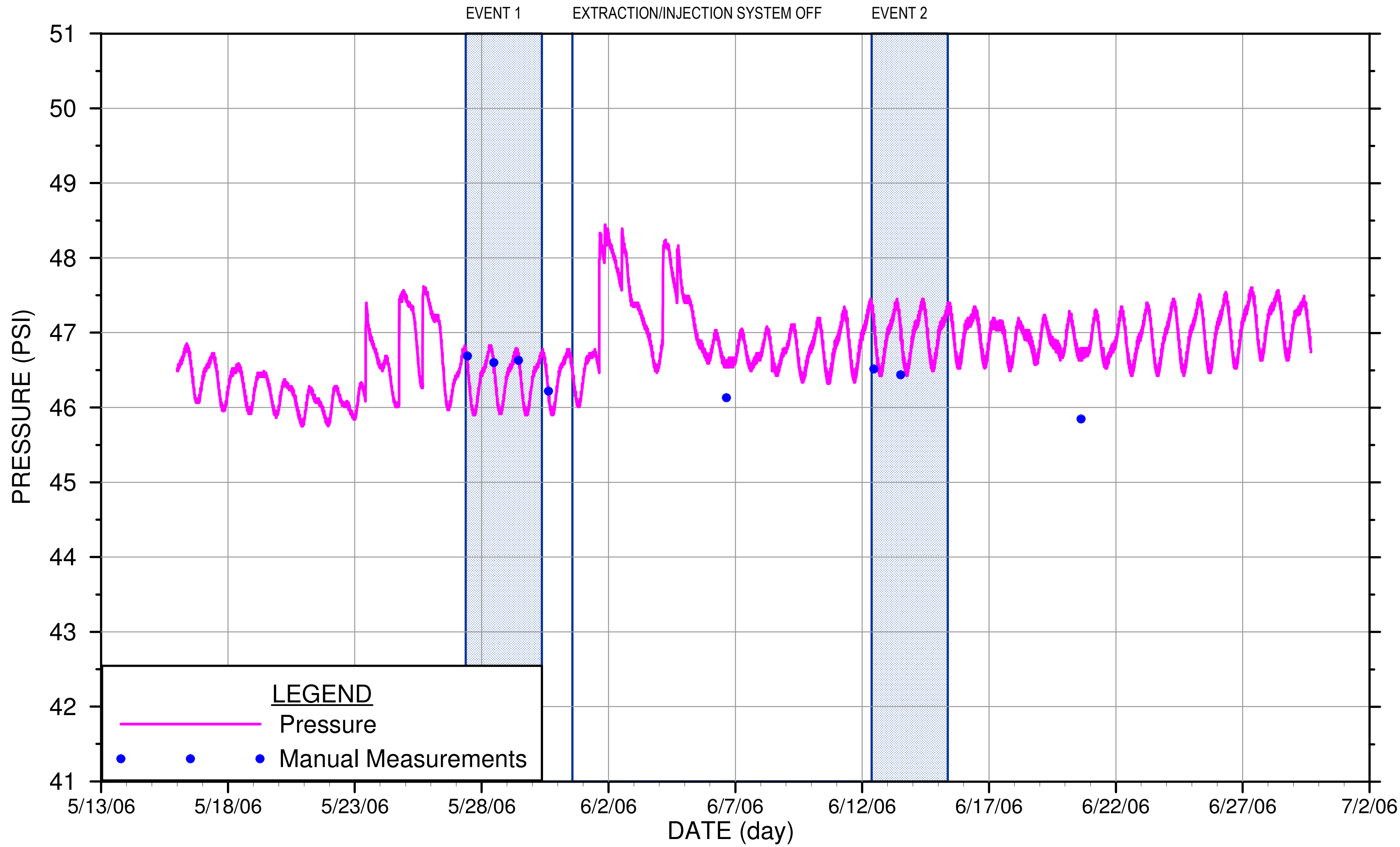


figure 6P-121

T6-120 PRESSURE VERSUS TIME
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\pressure\6P-121.grf) JAN 3/2011

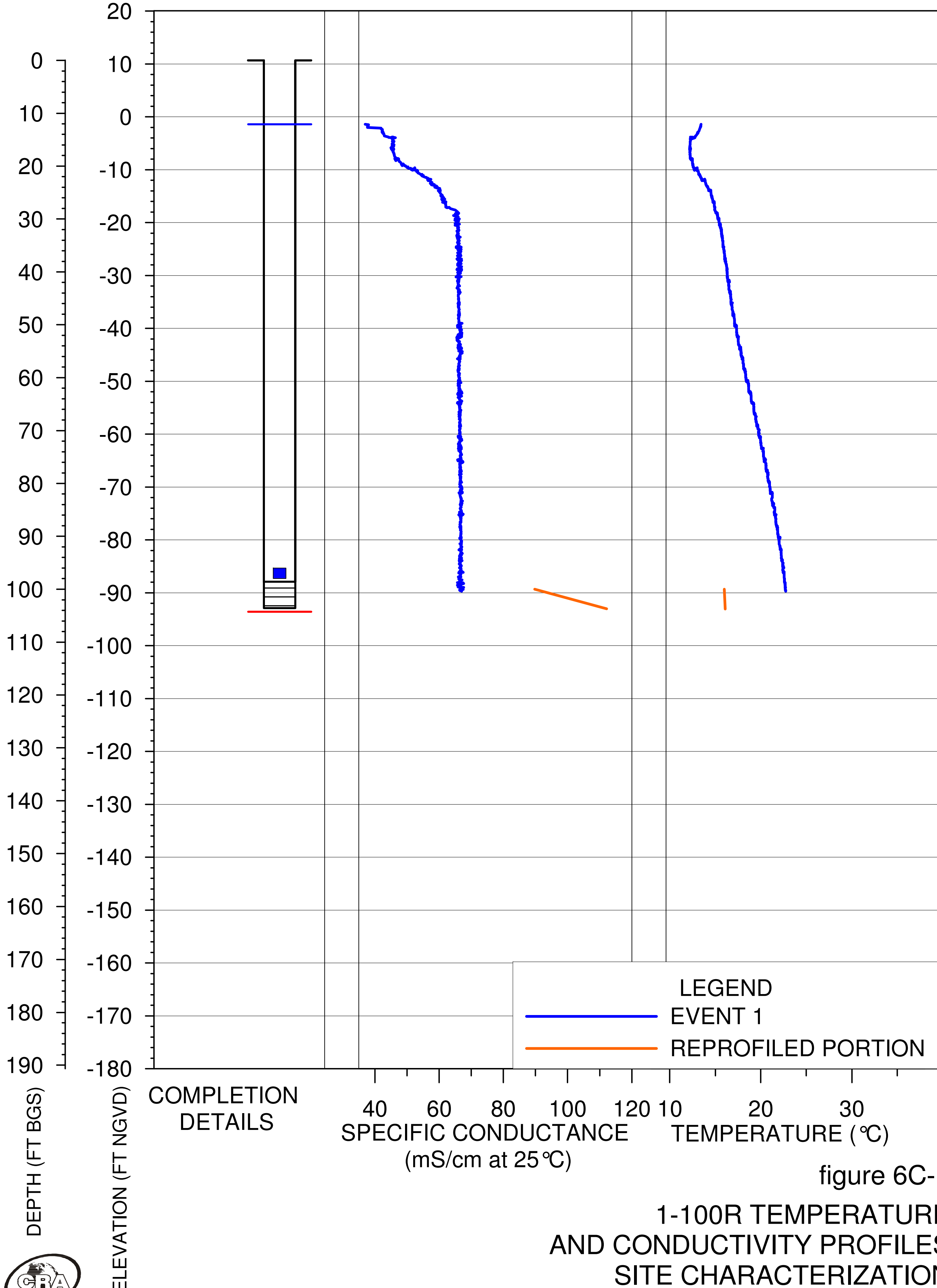


figure 6C-1

1-100R TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-1.grf) JAN 3/2011

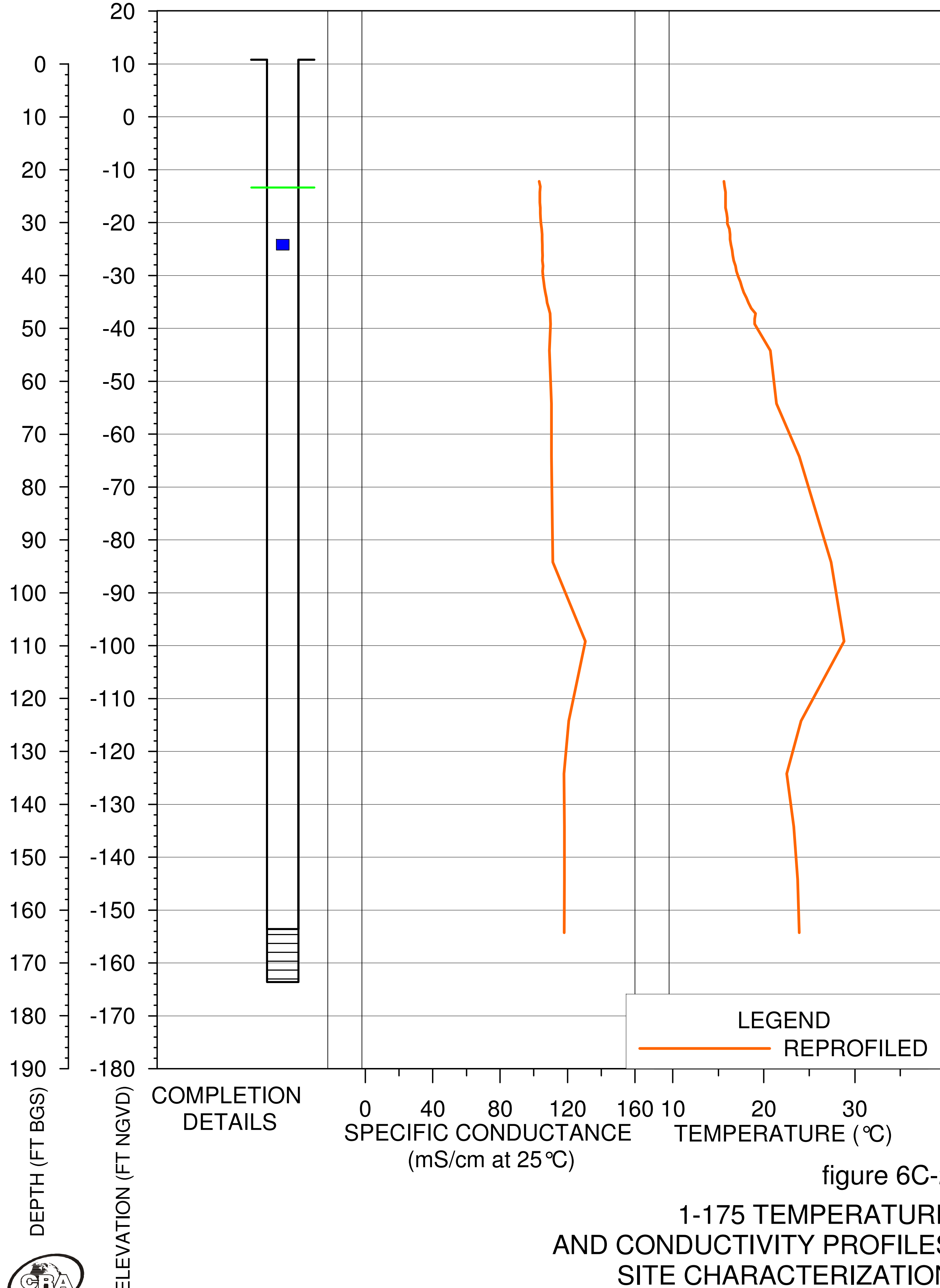


figure 6C-2

1-175 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-2.grf) JAN 3/2011

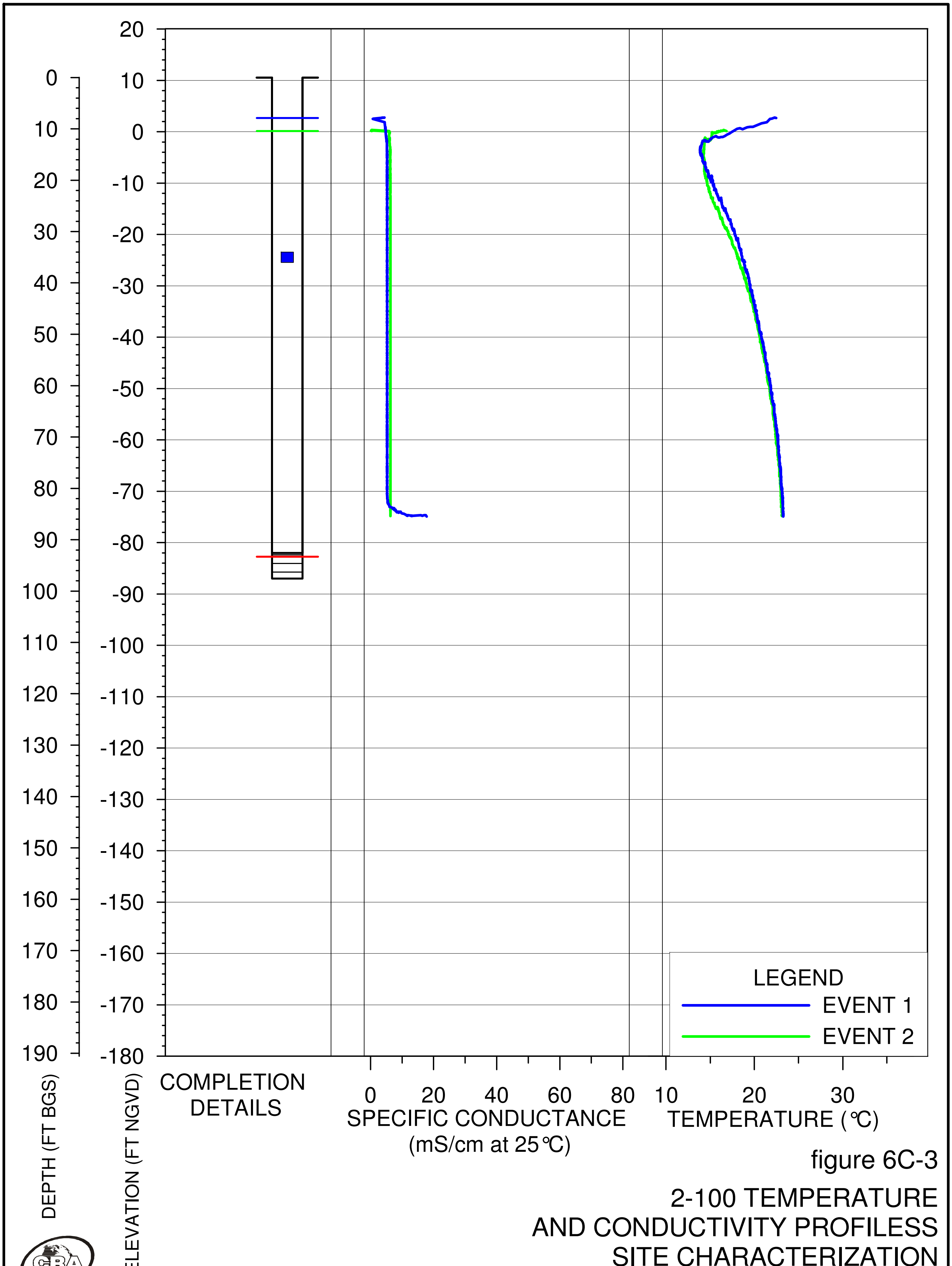


figure 6C-3

2-100 TEMPERATURE
AND CONDUCTIVITY PROFILESS
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-3.grf) JAN 3/2011

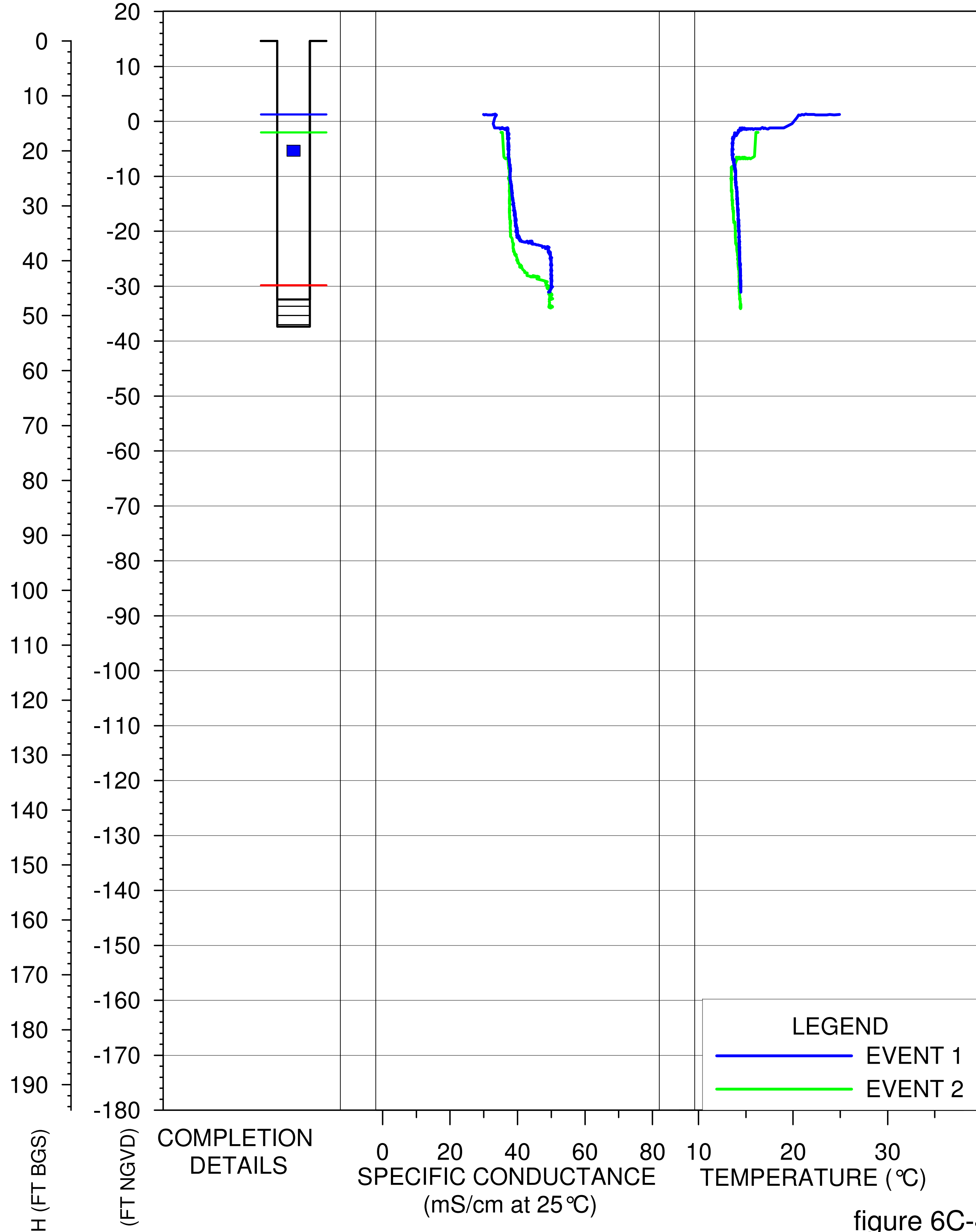


figure 6C-4

3-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-4.grf) JAN 3/2011

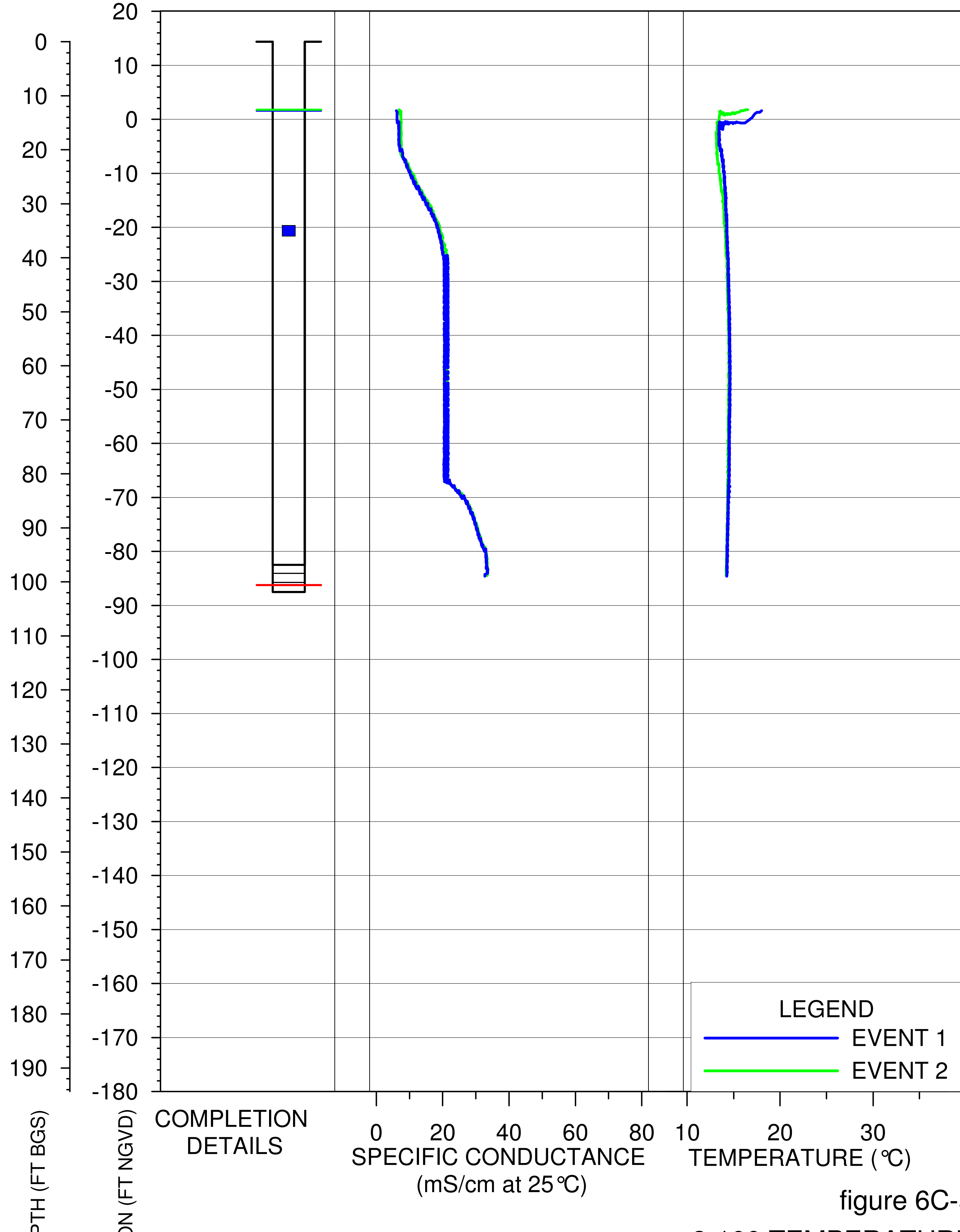


figure 6C-5

3-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

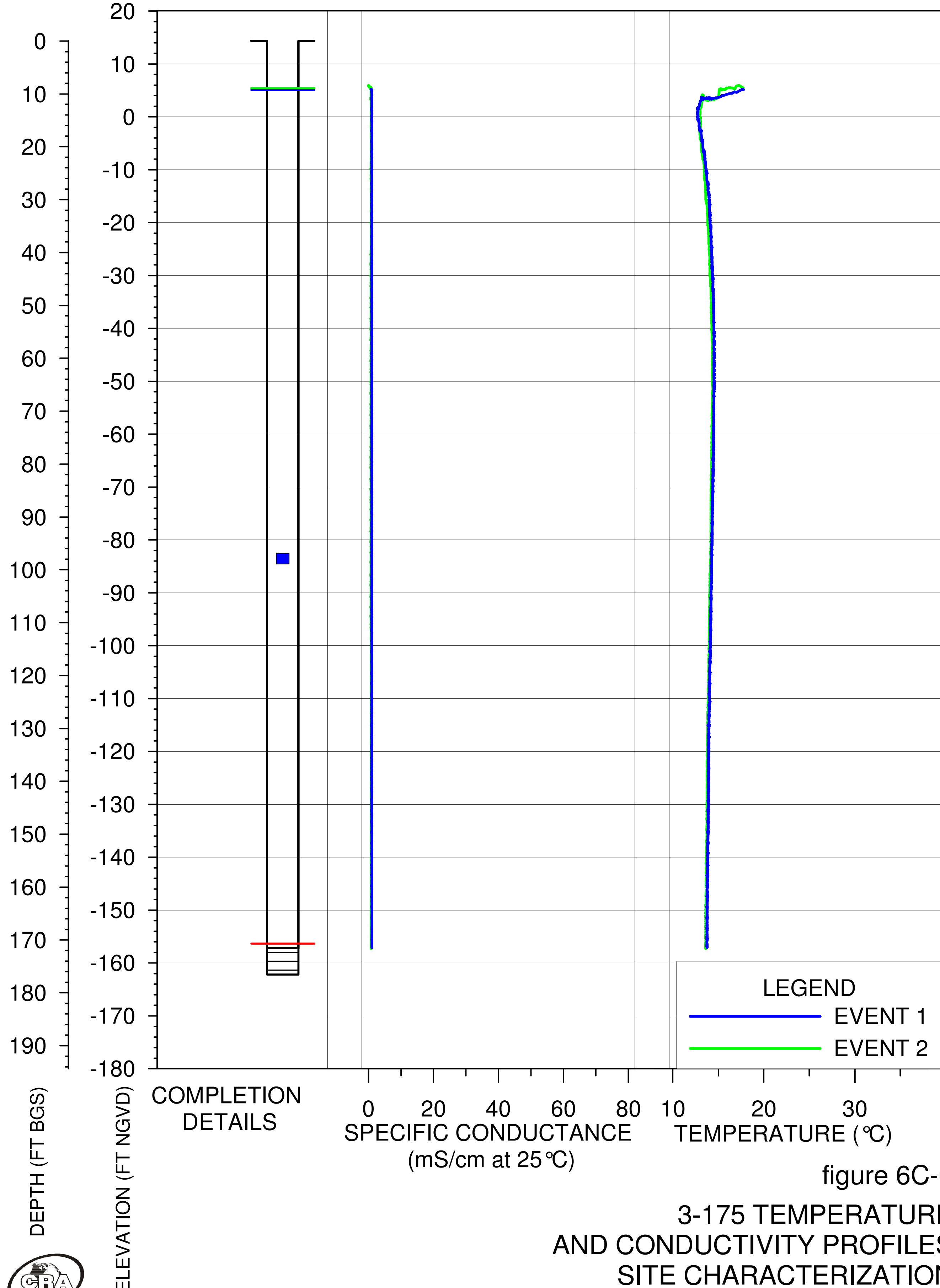


figure 6C-6

3-175 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-6.grf) JAN 3/2011

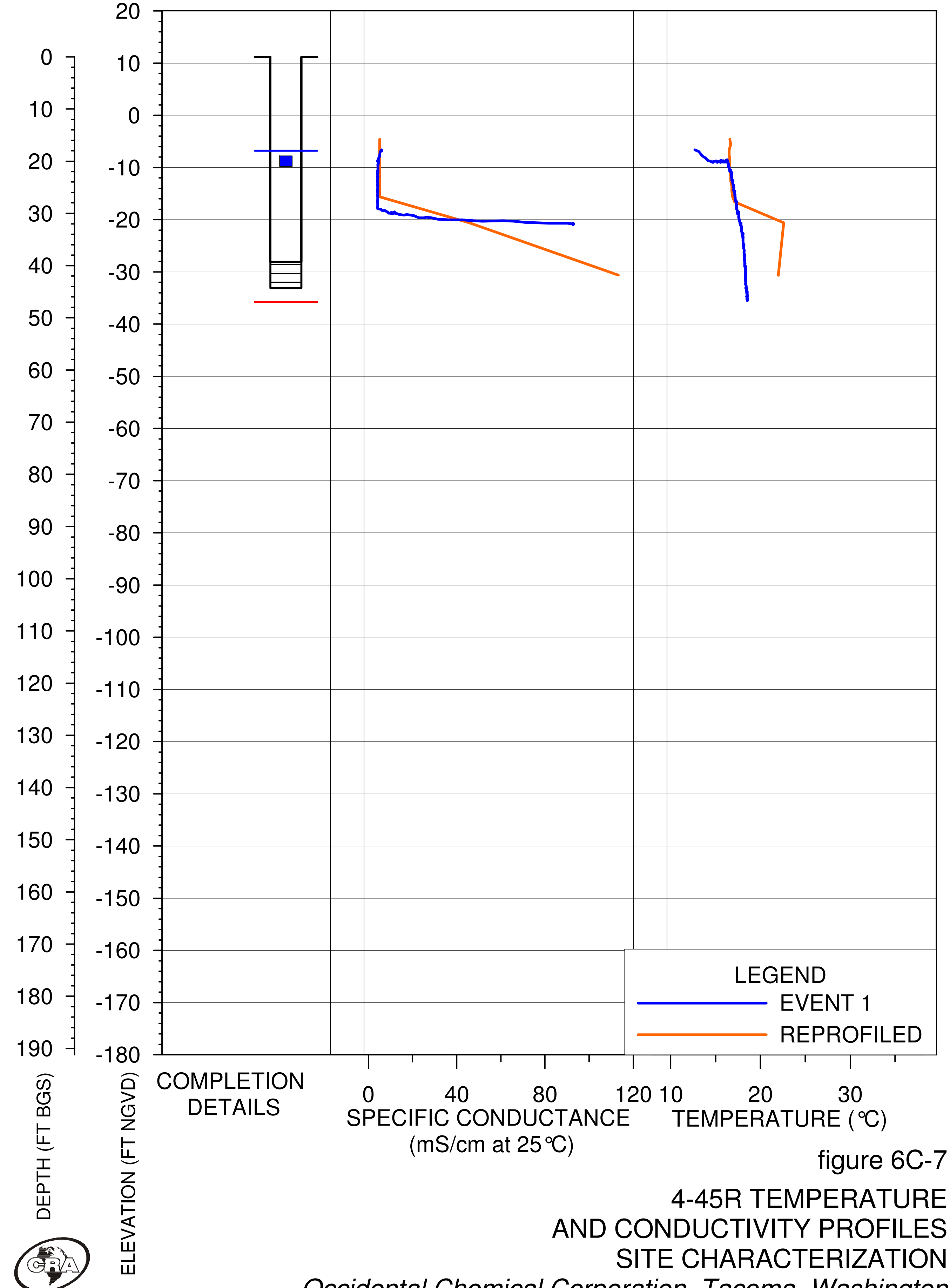


figure 6C-7

4-45R TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

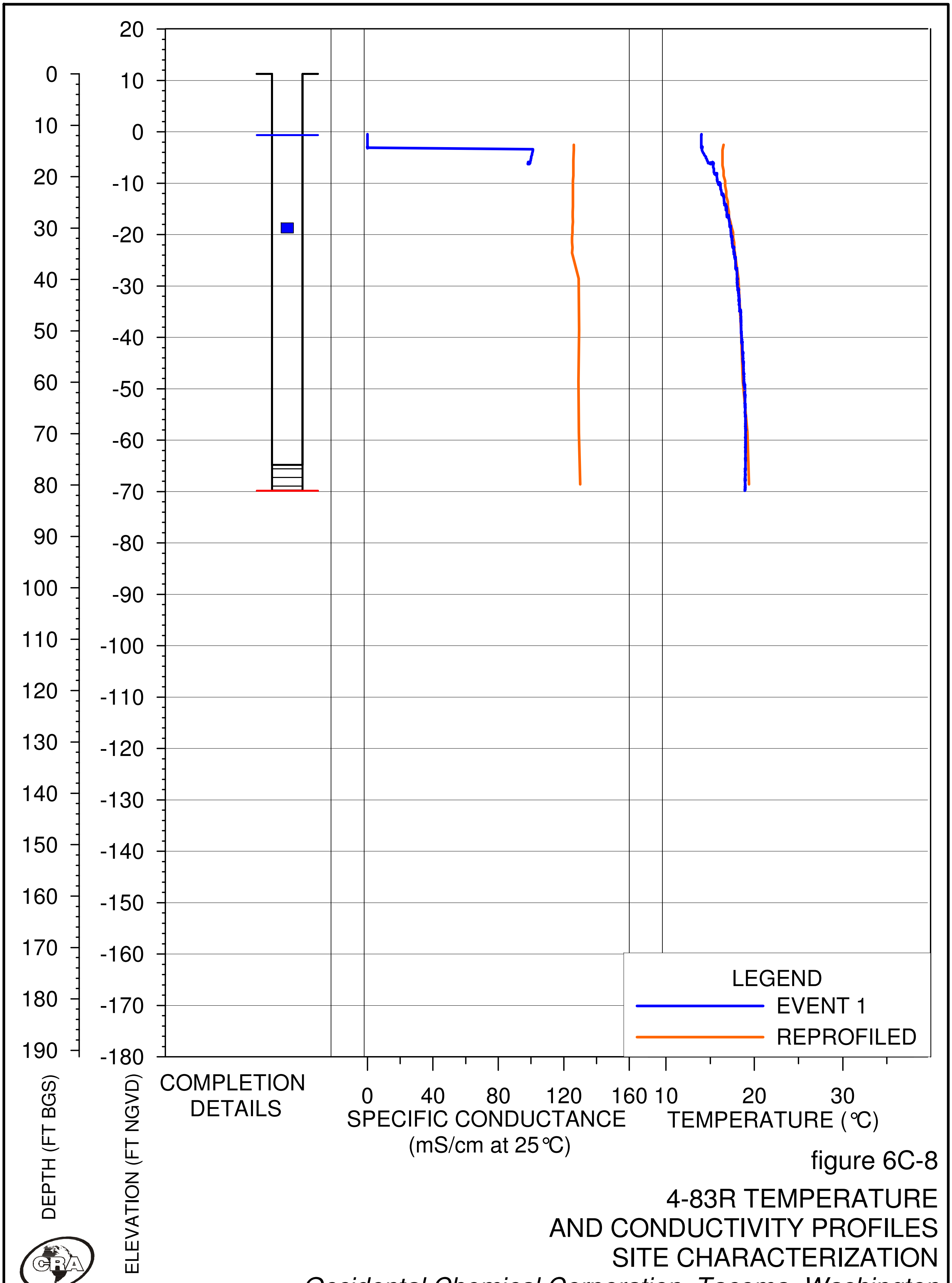


figure 6C-8

4-83R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-8.grf) JAN 3/2011

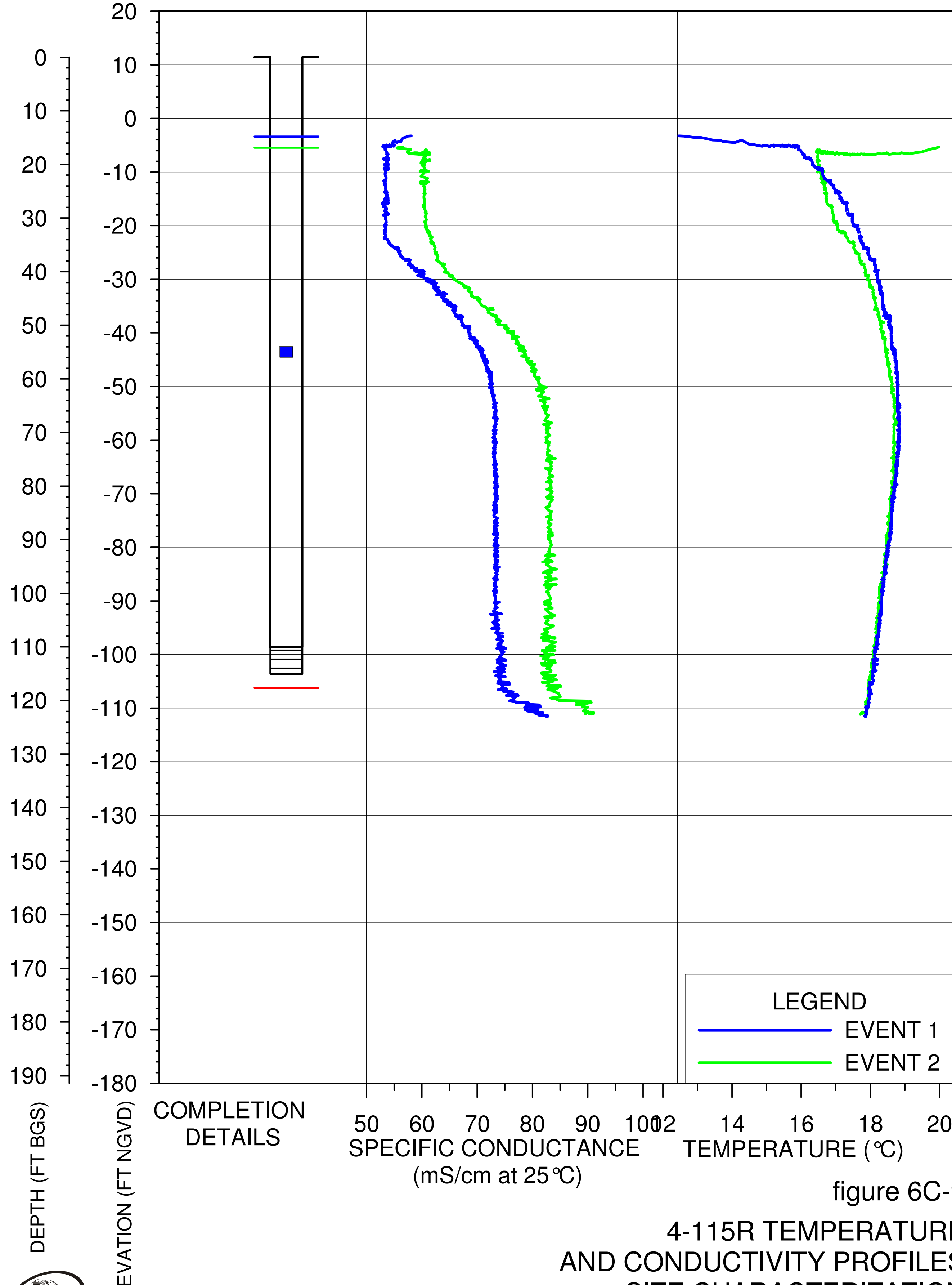


figure 6C-9

4-115R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-9.grf) JAN 3/2011

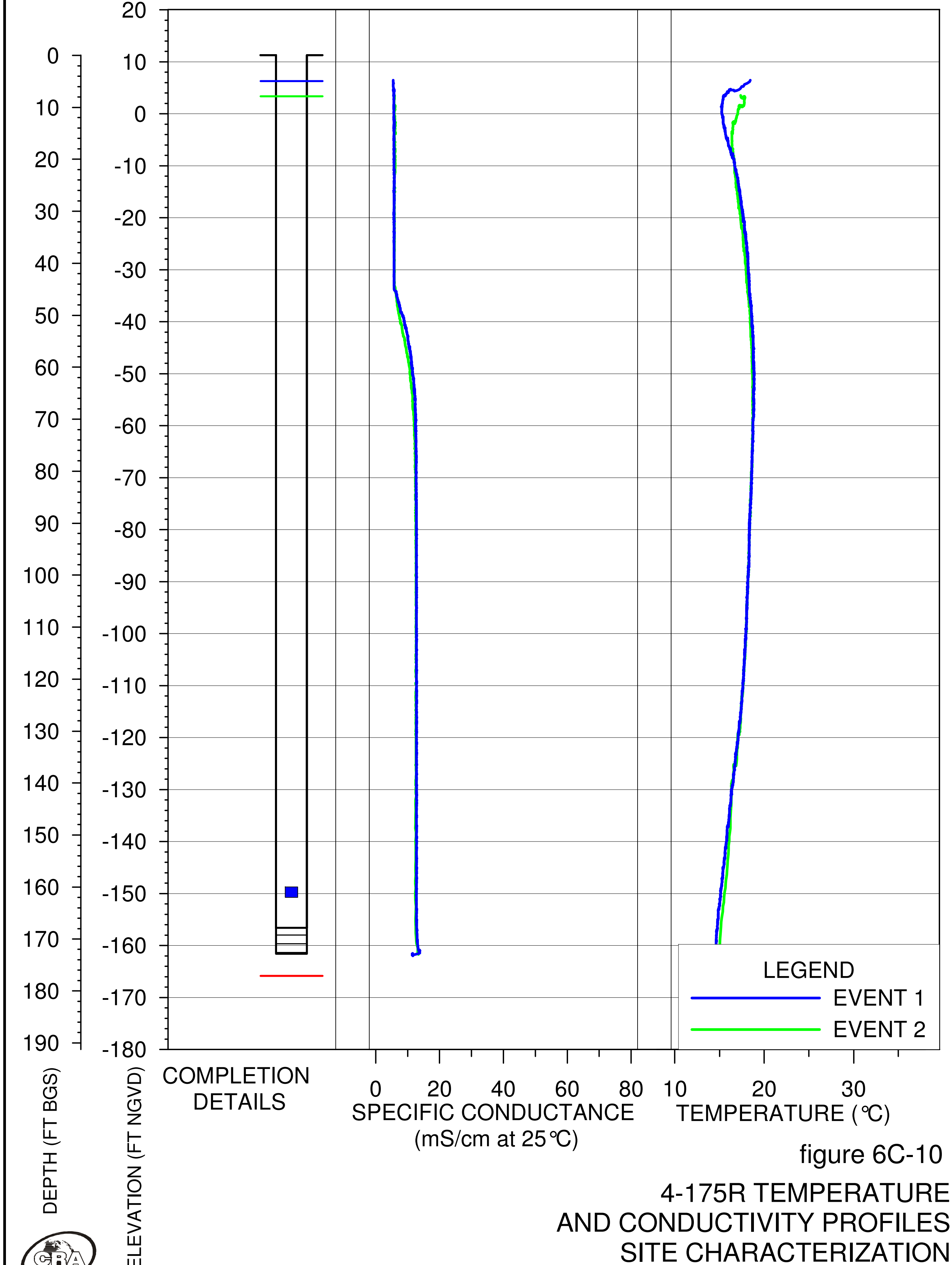


figure 6C-10

4-175R TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

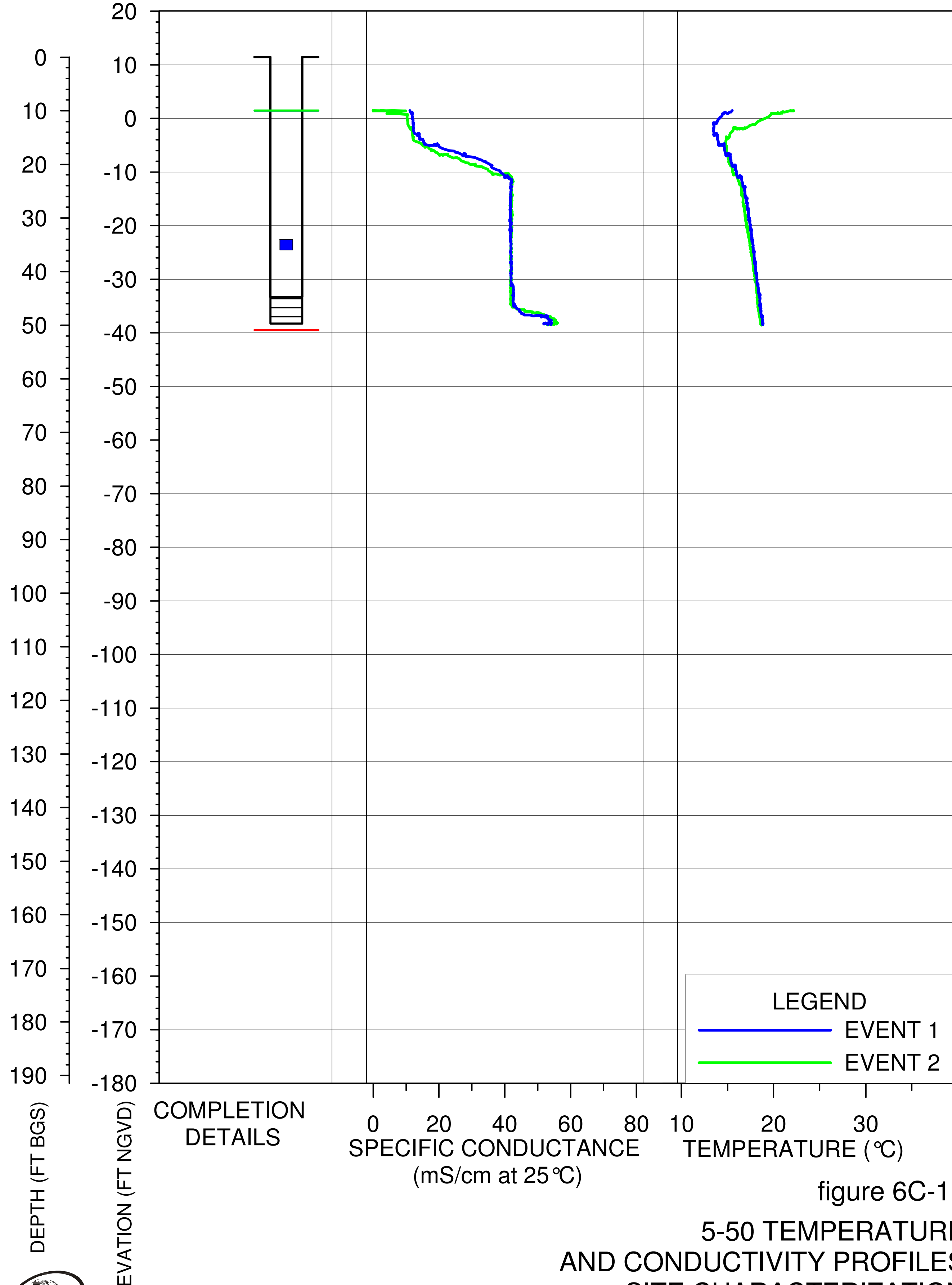


figure 6C-11

5-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

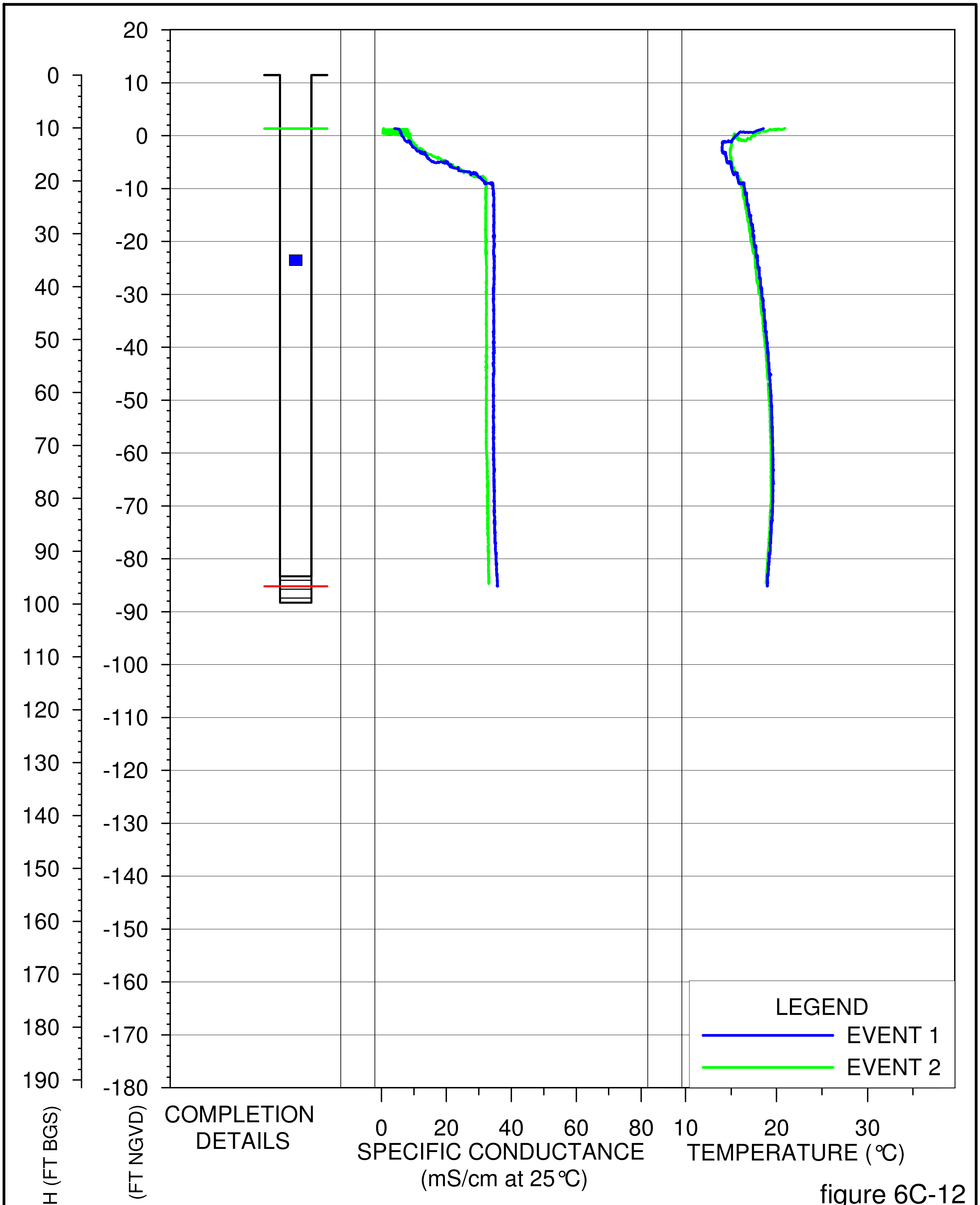


figure 6C-12

5-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

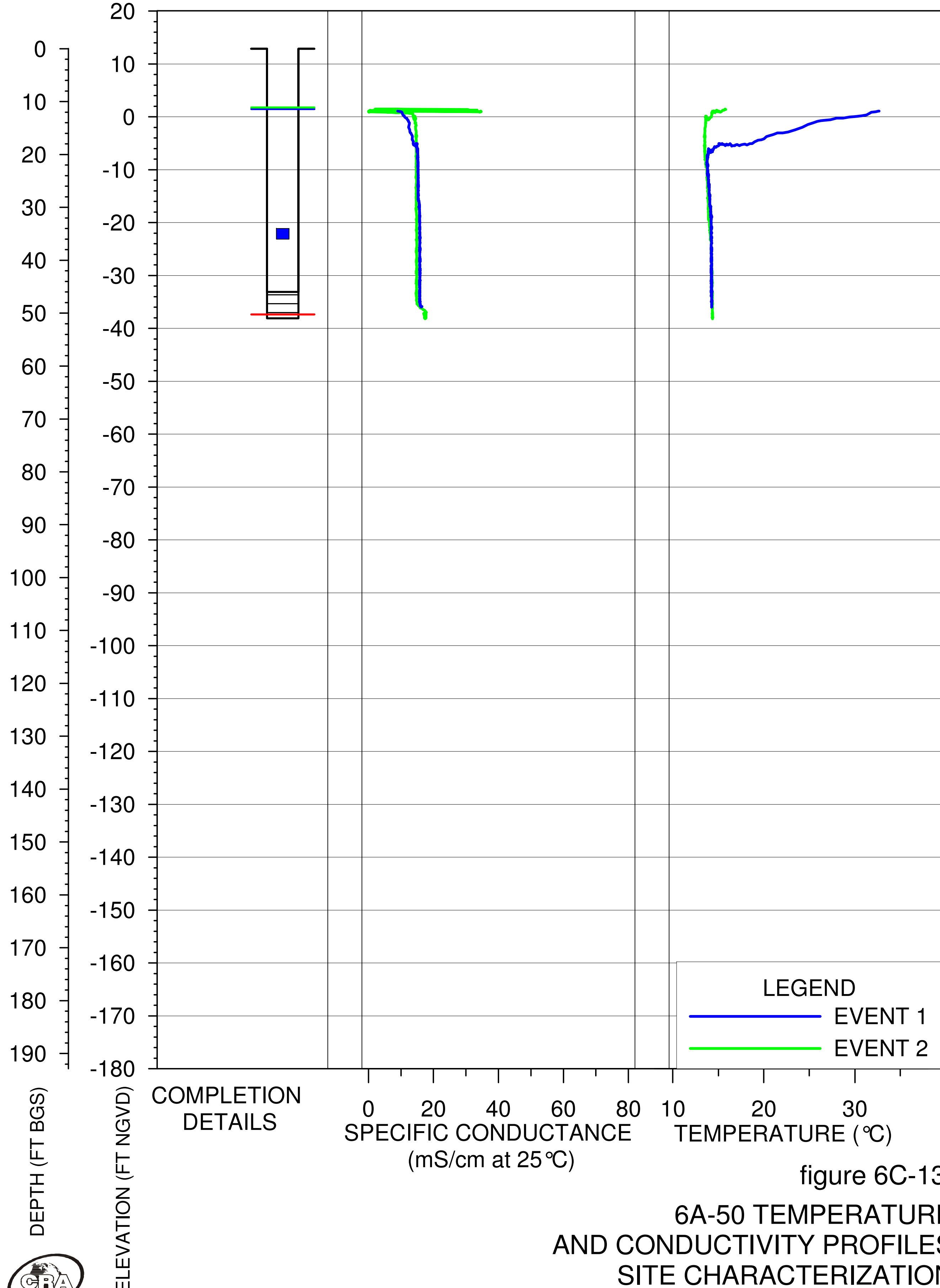


figure 6C-13

6A-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-13.grf) JAN 3/2011

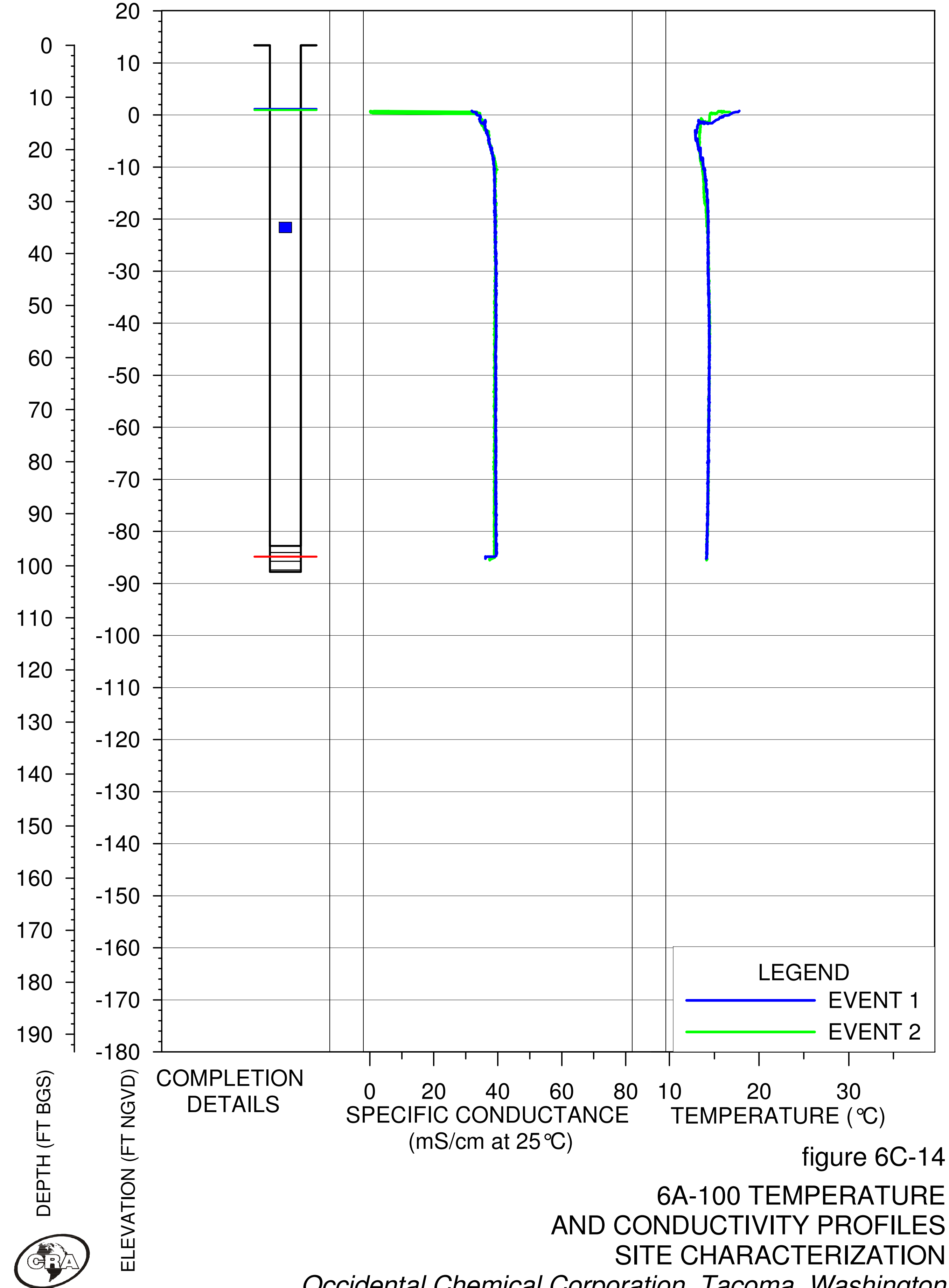


figure 6C-14

6A-100 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

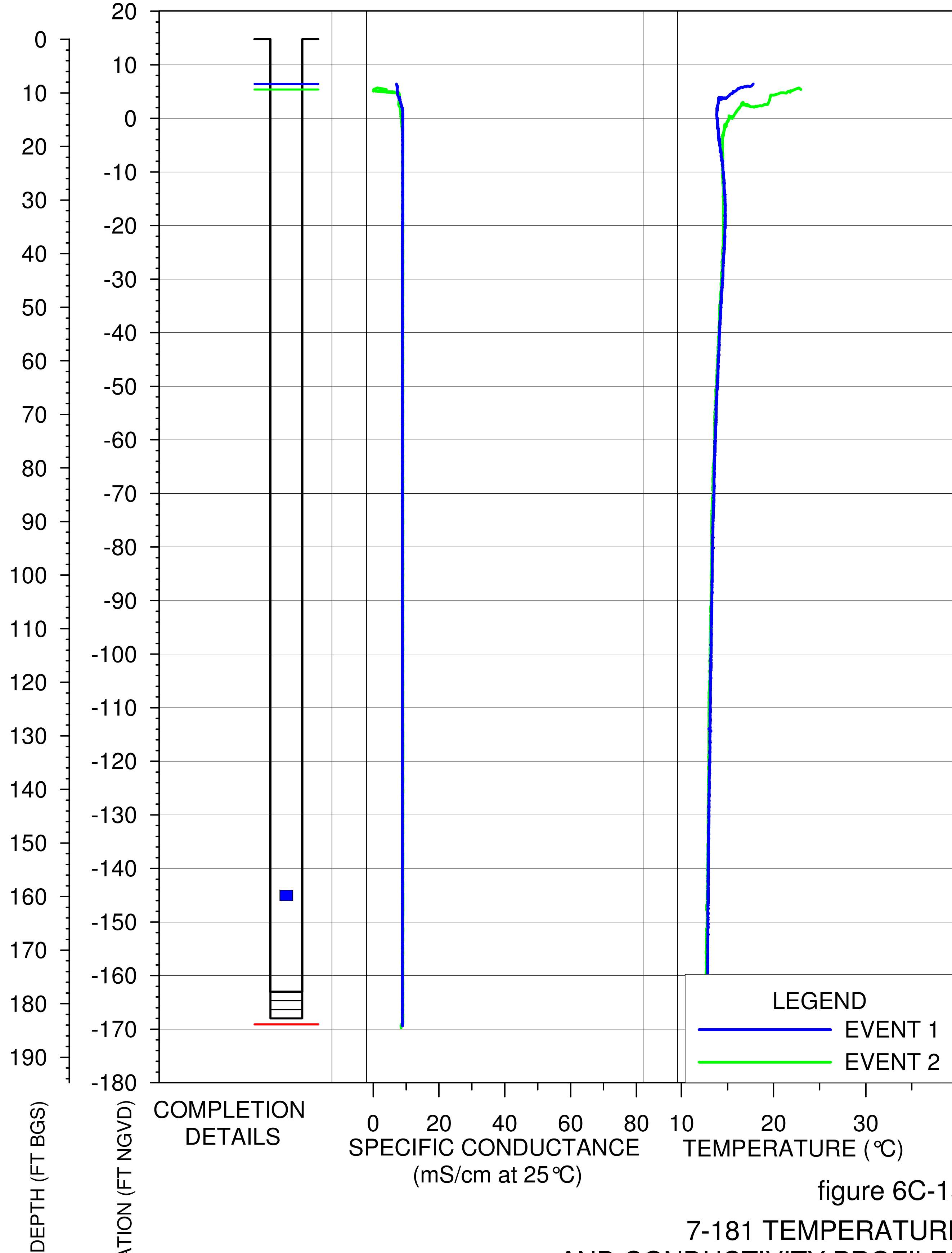


figure 6C-15

7-181 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

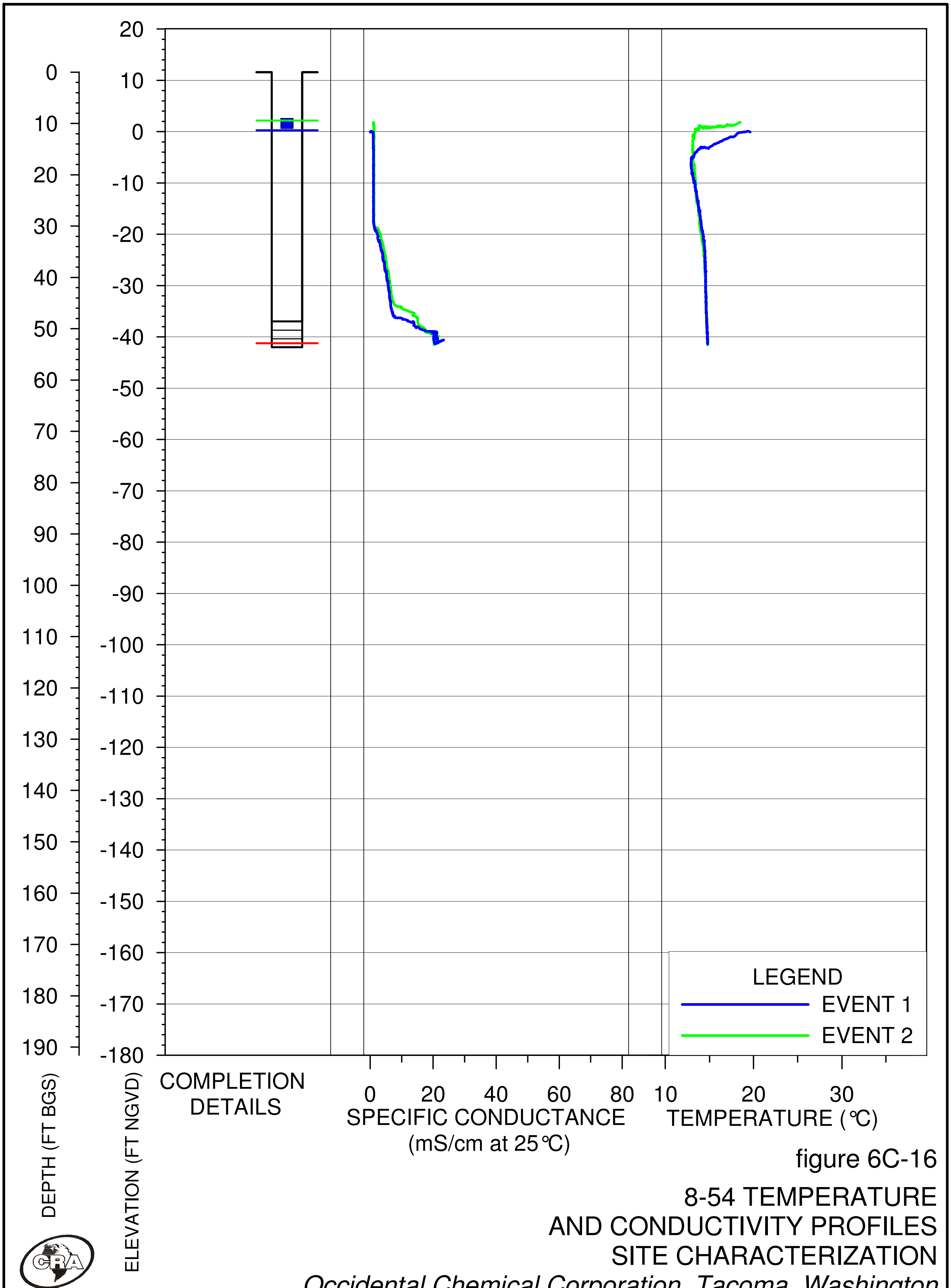


figure 6C-16

8-54 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

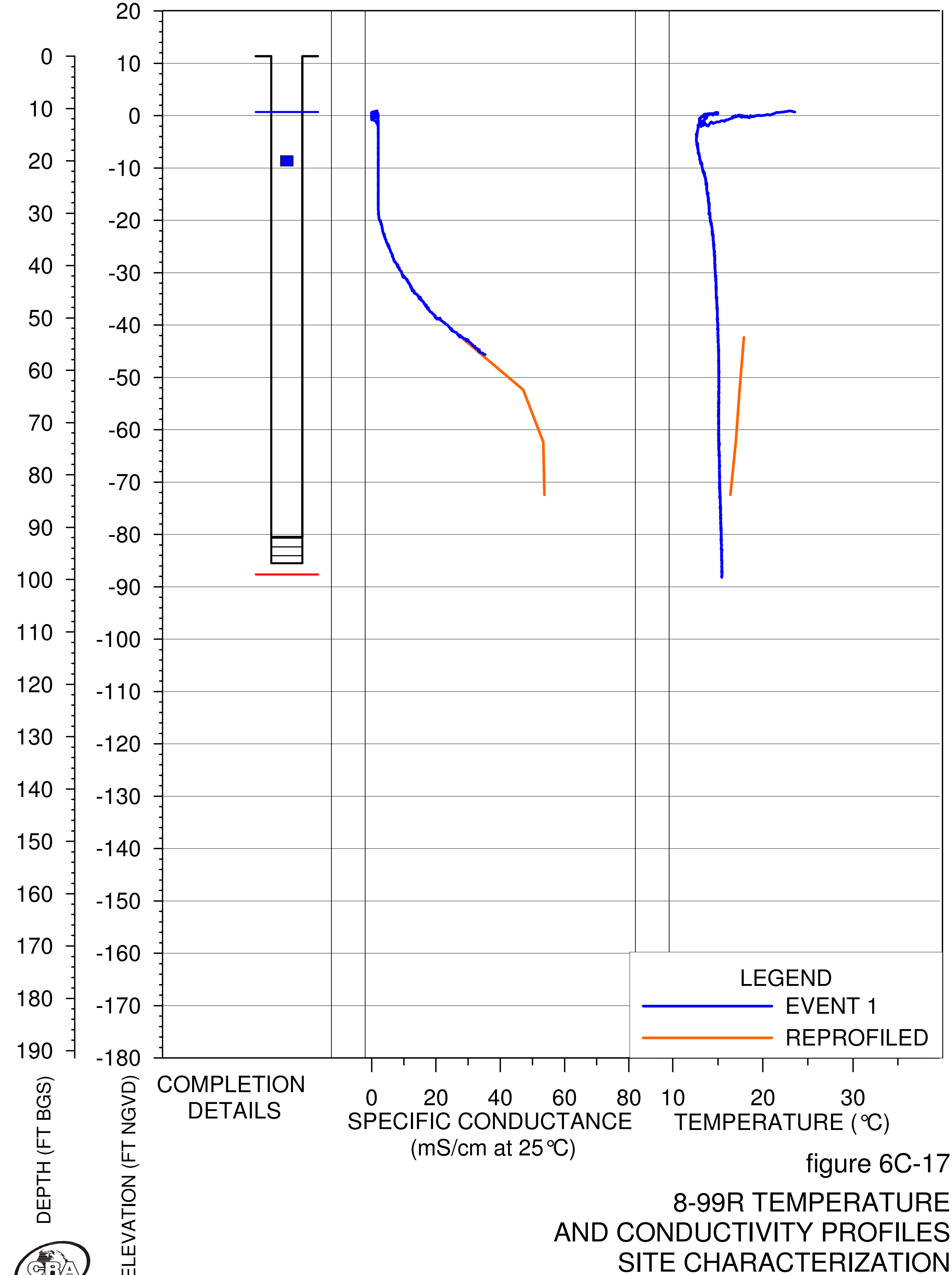


figure 6C-17

8-99R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

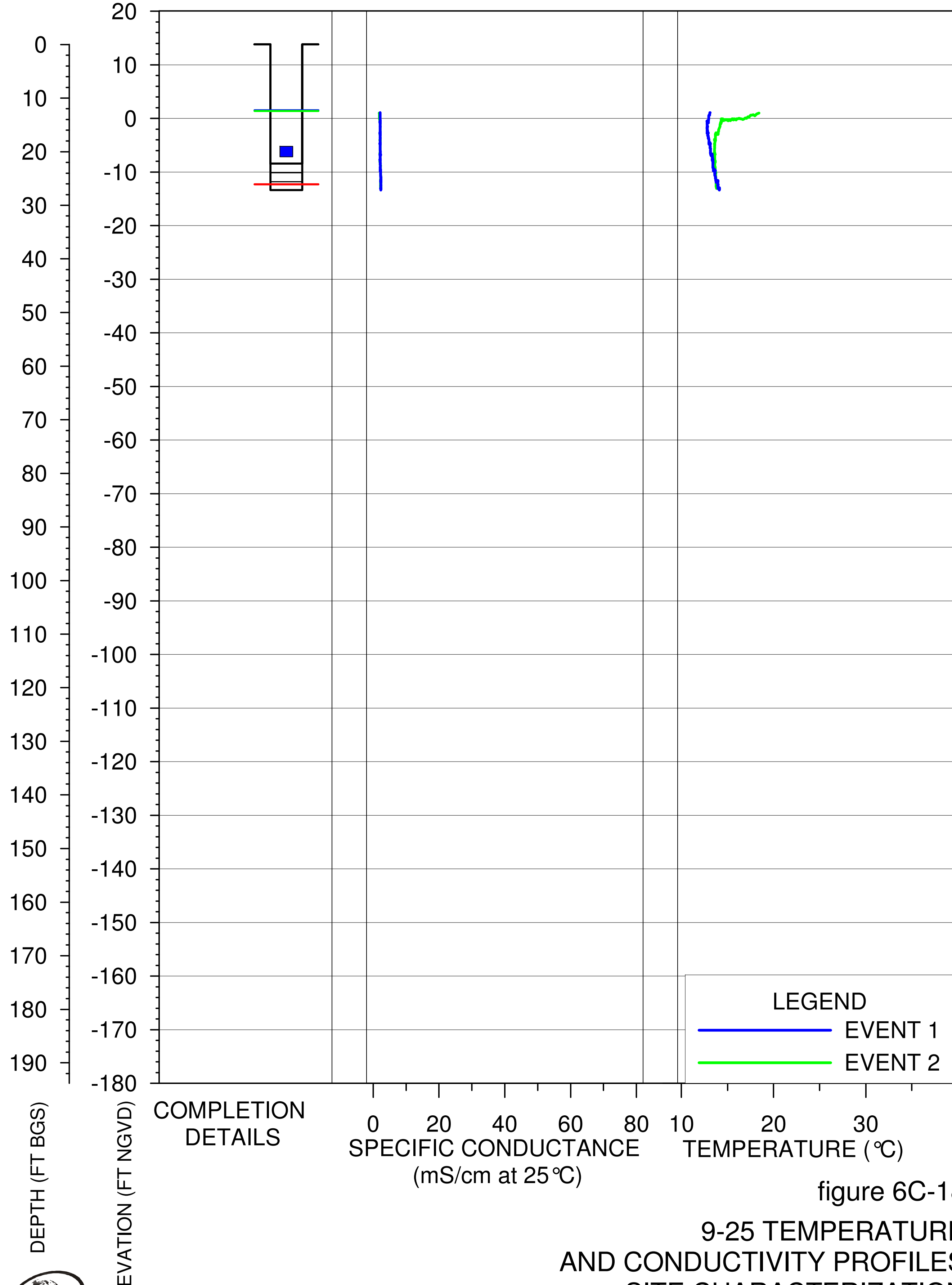


figure 6C-18

9-25 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-18.grf) JAN 3/2011

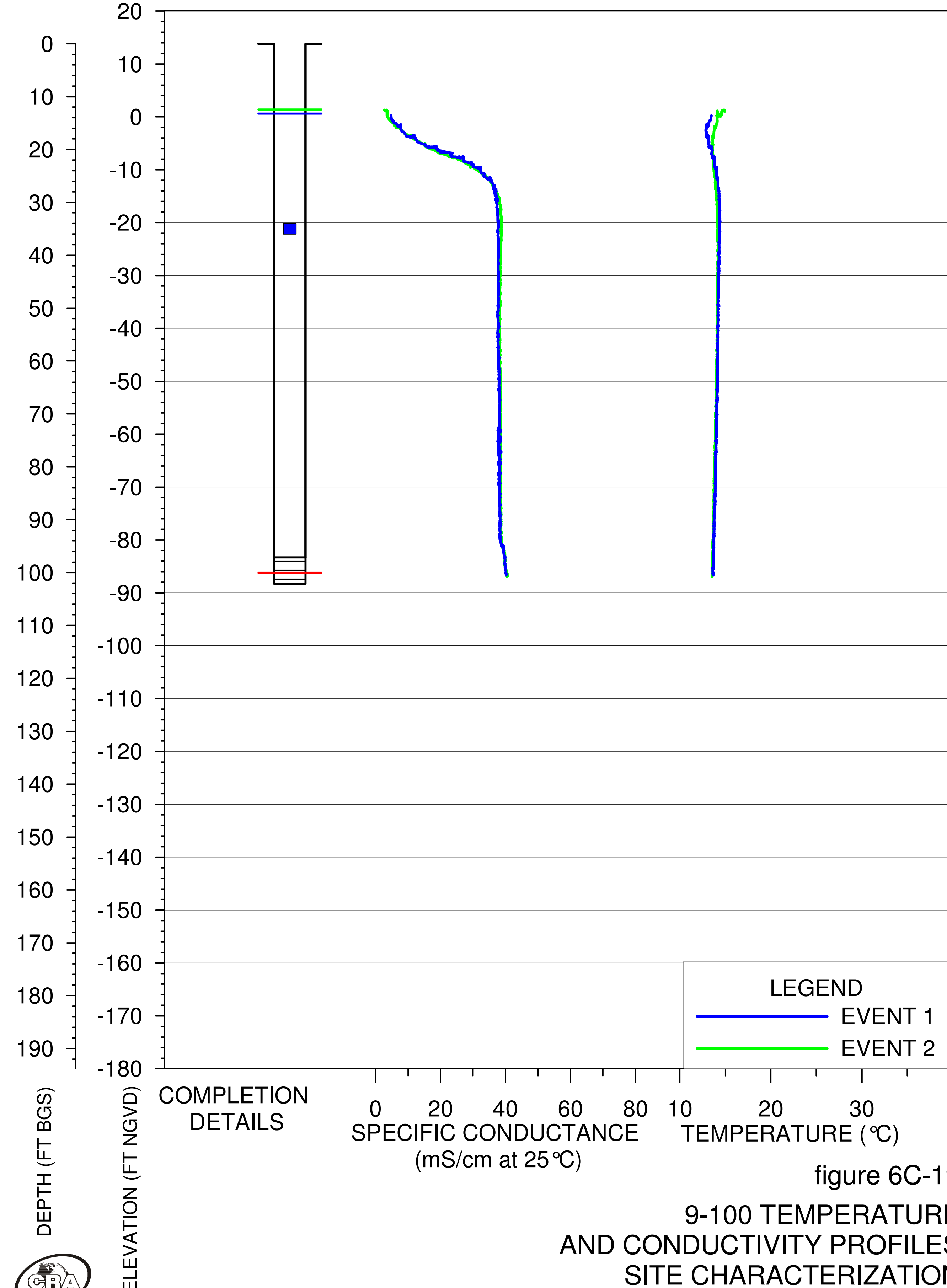


figure 6C-19

9-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-19.grf) JAN 3/2011

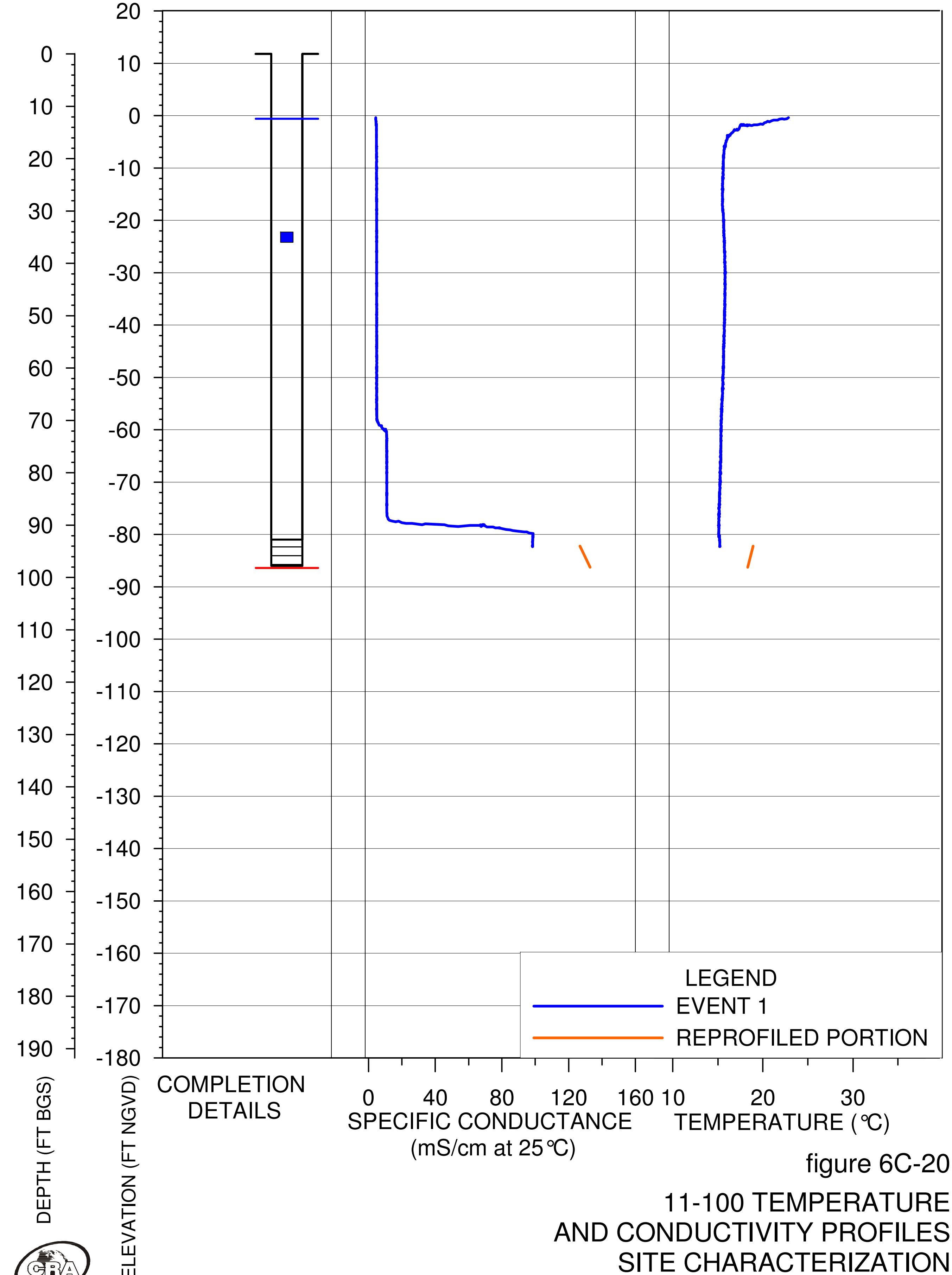


figure 6C-20

11-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

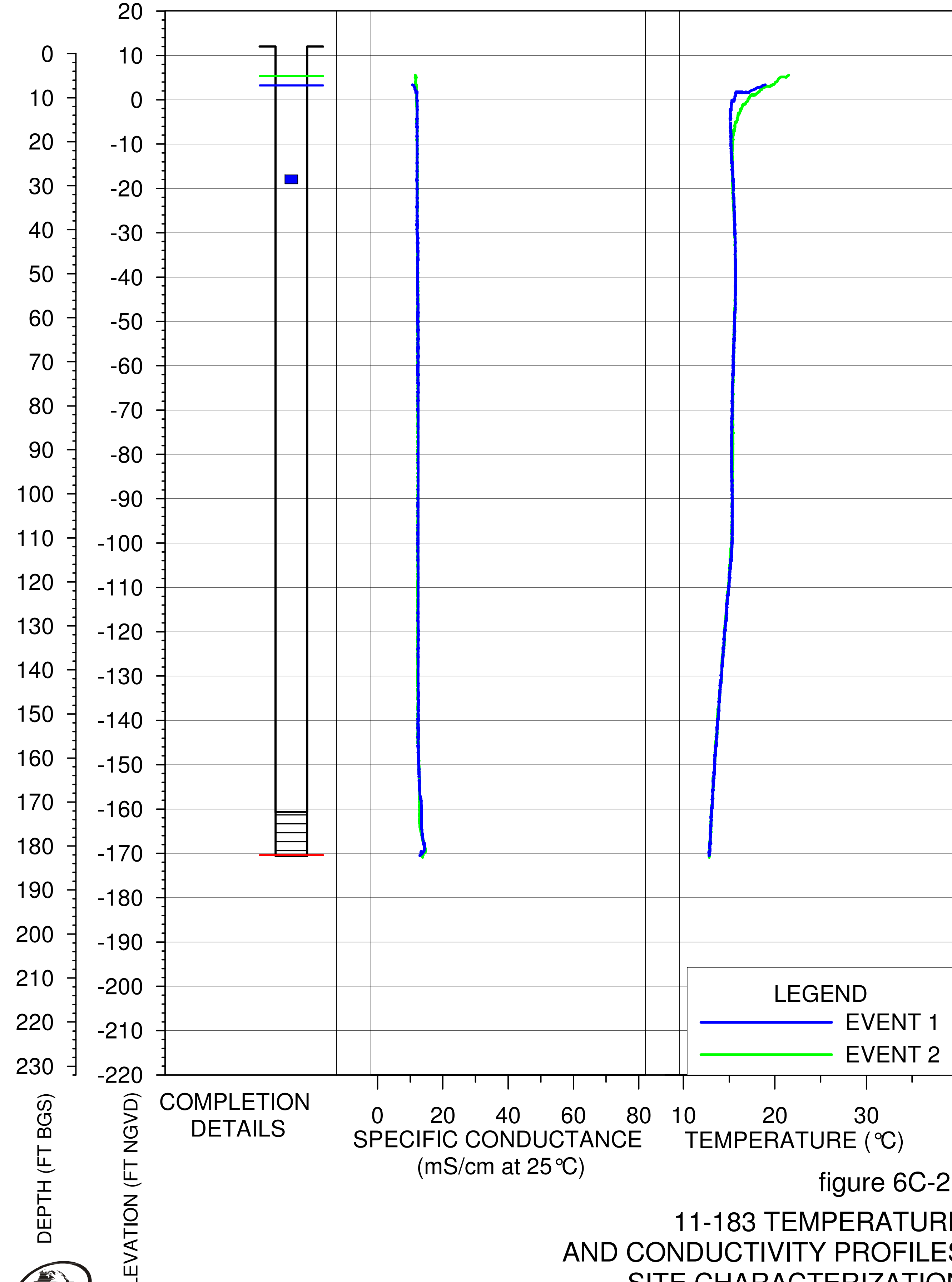


figure 6C-21

11-183 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-21.grf) JAN 3/2011

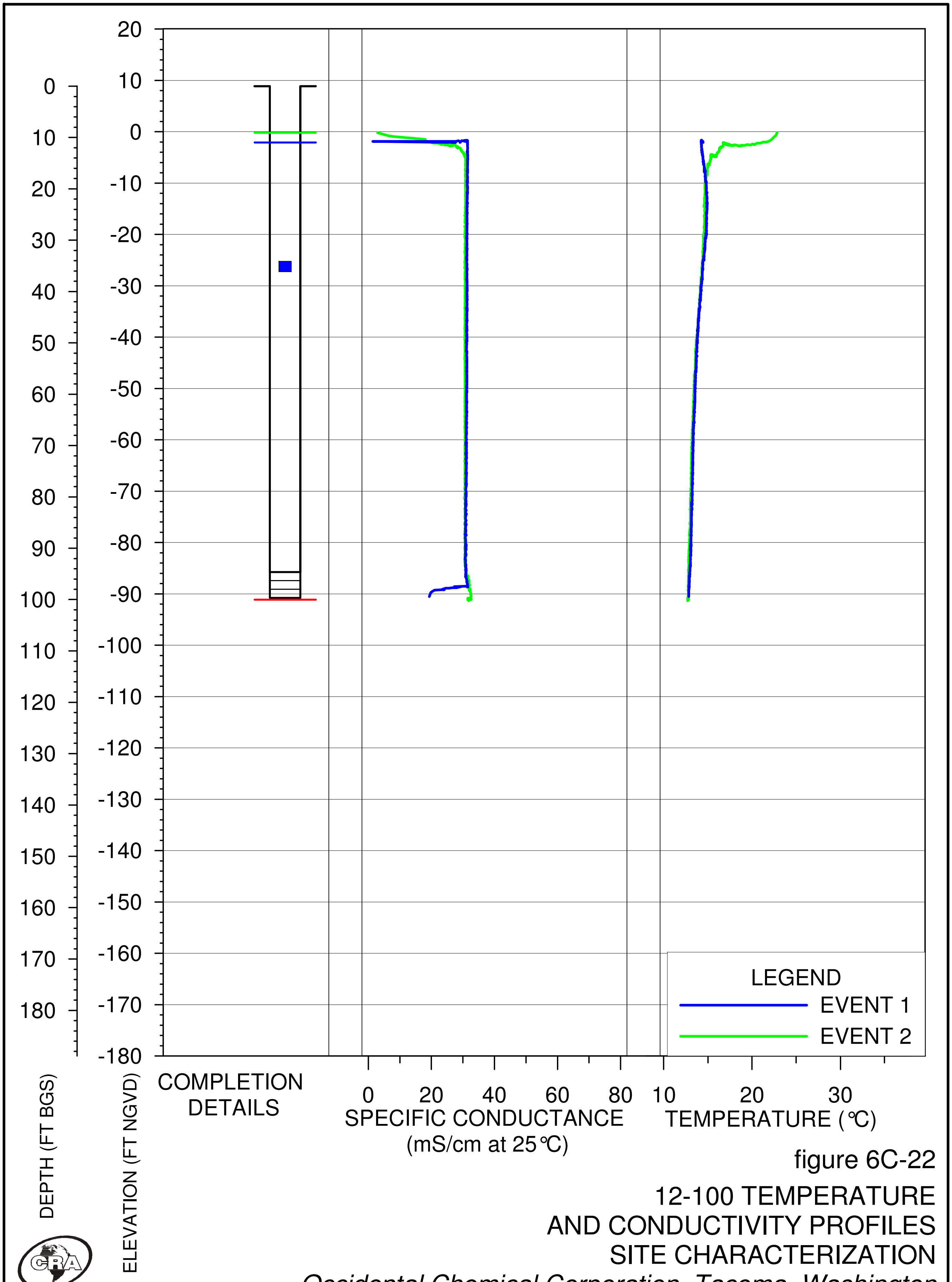


figure 6C-22

12-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-22.grf) JAN 3/2011

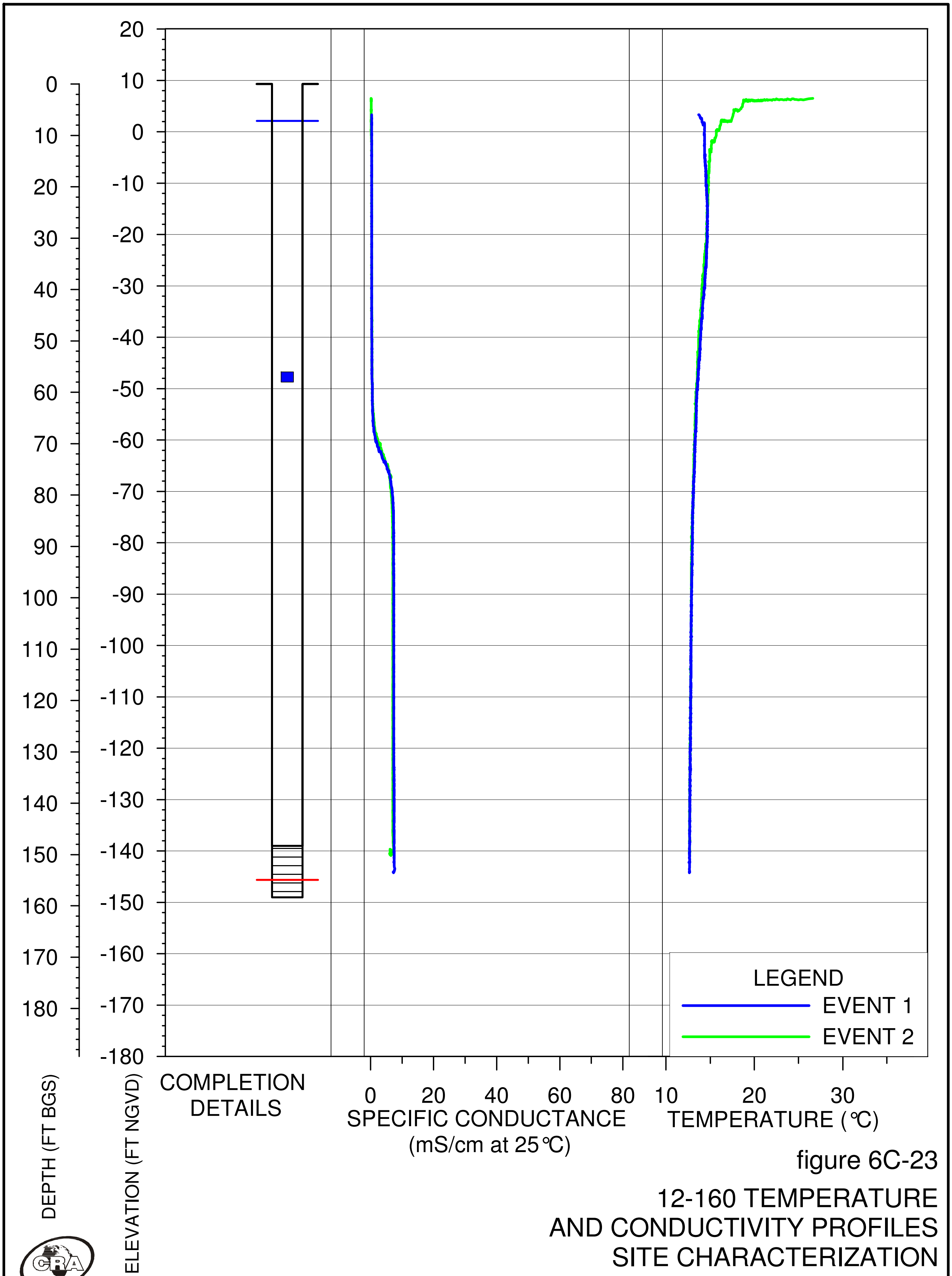


figure 6C-23

12-160 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-23.grf) JAN 3/2011

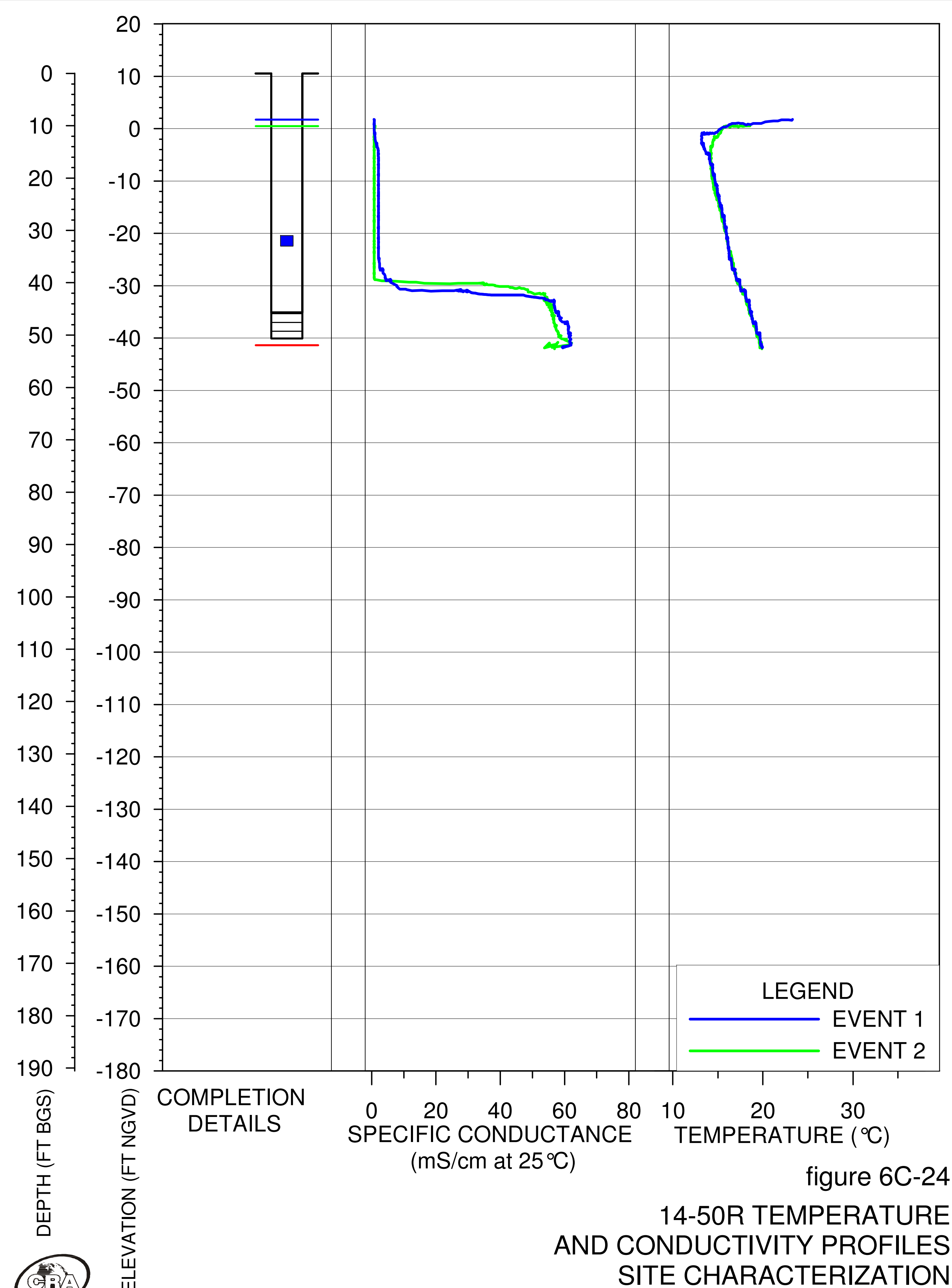


figure 6C-24

14-50R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

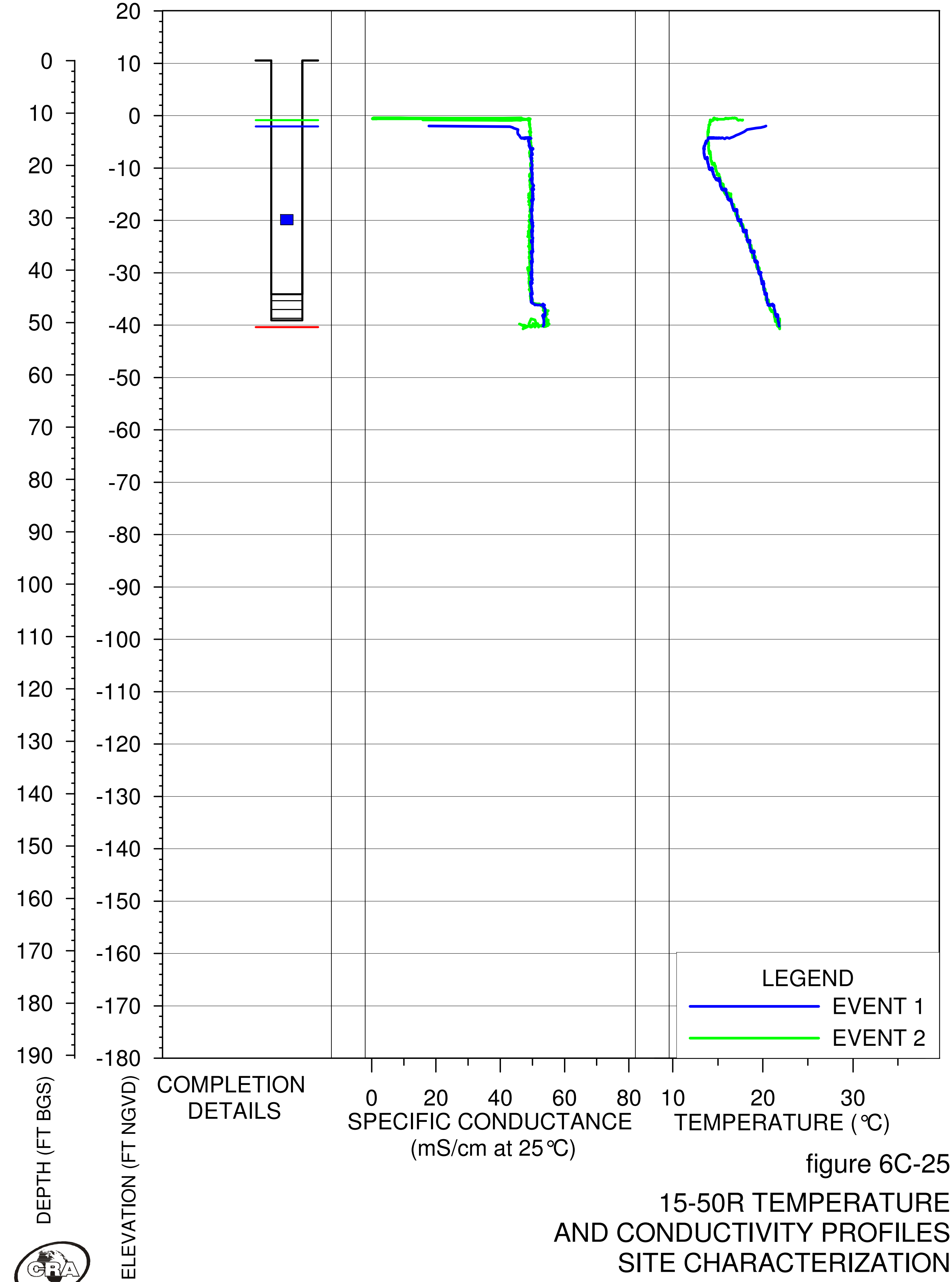


figure 6C-25

15-50R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-25.grf) JAN 3/2011

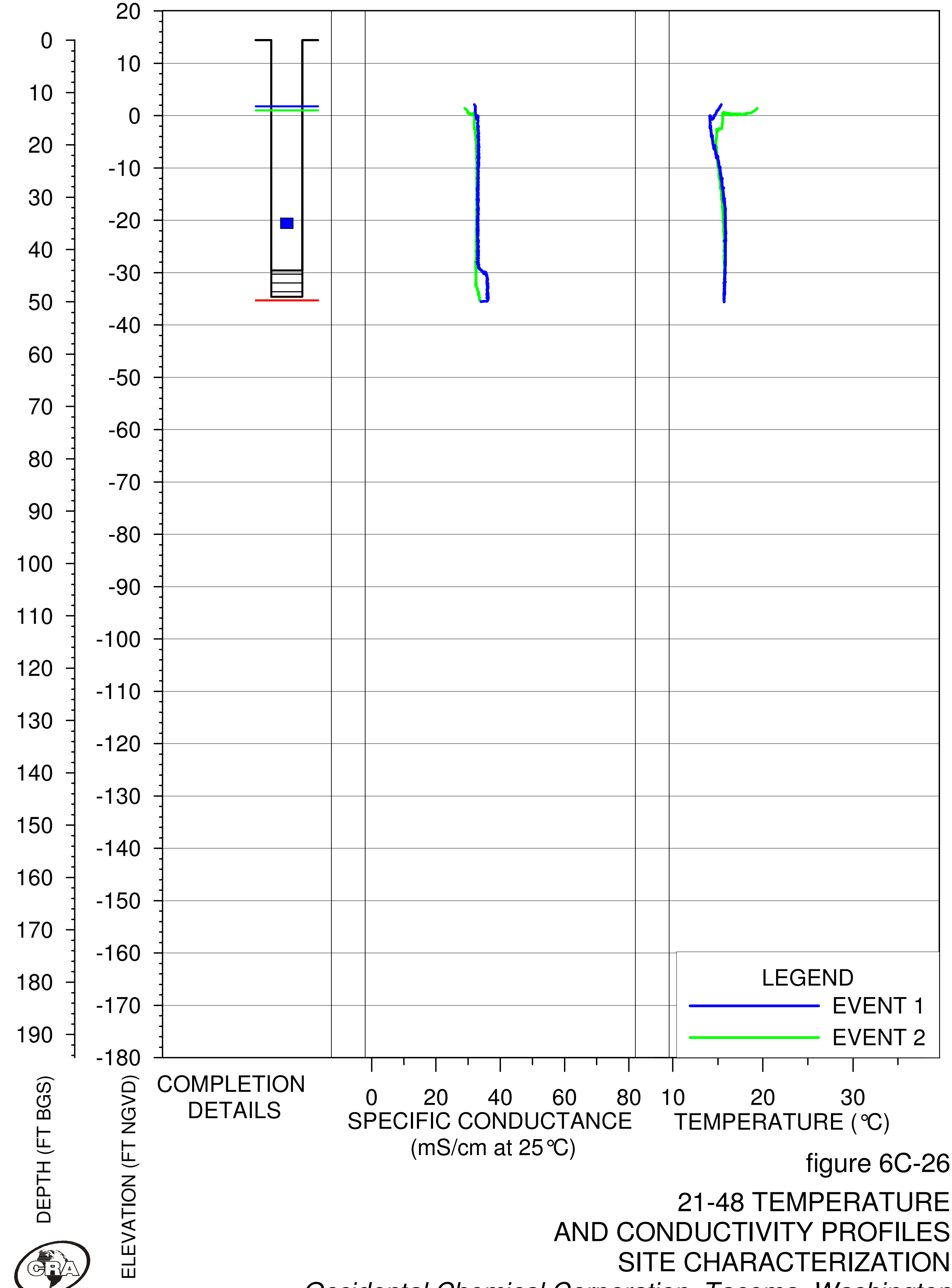


figure 6C-26

21-48 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

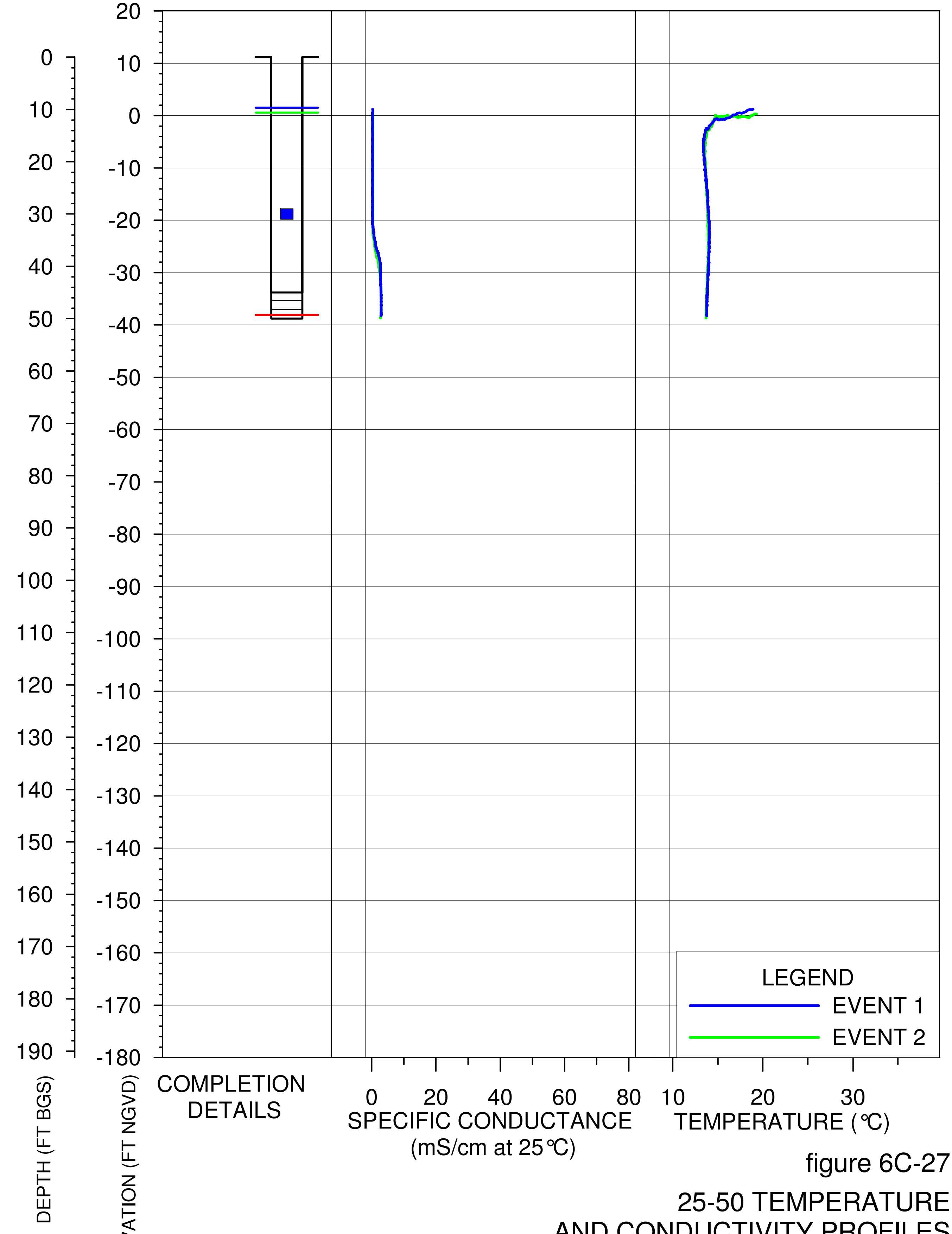


figure 6C-27

25-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

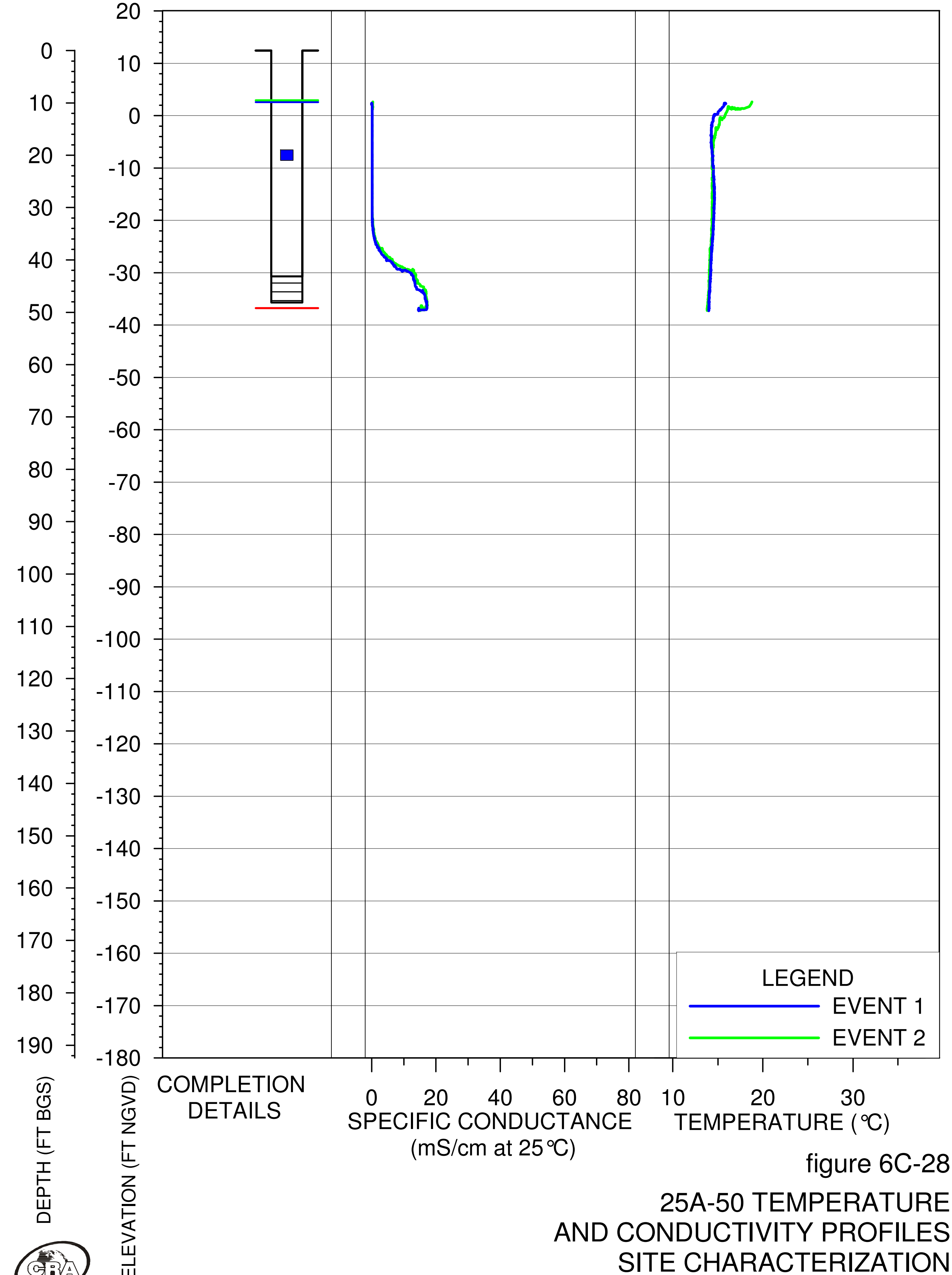


figure 6C-28

25A-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

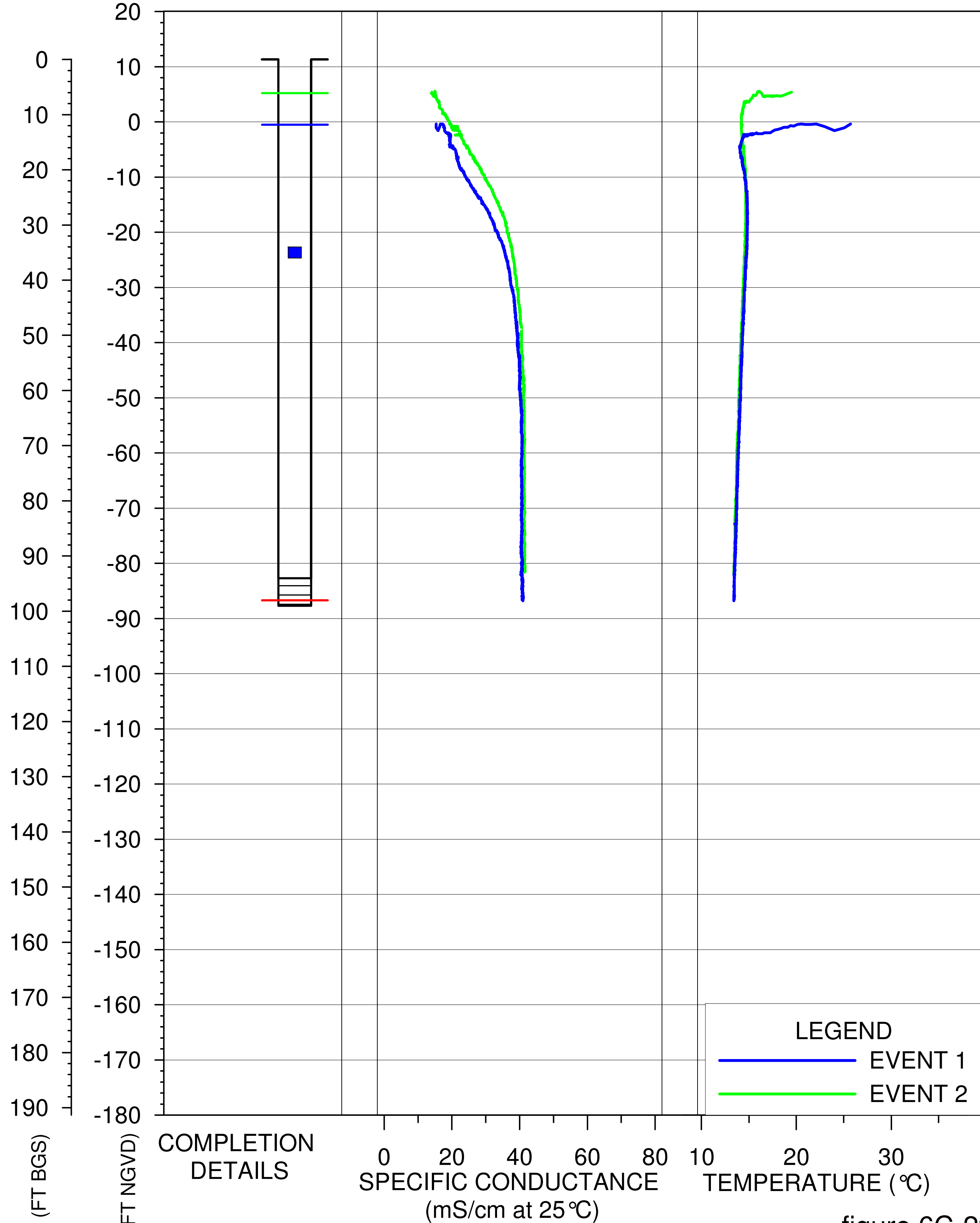


figure 6C-29

32-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-29.grf) JAN 3/2011

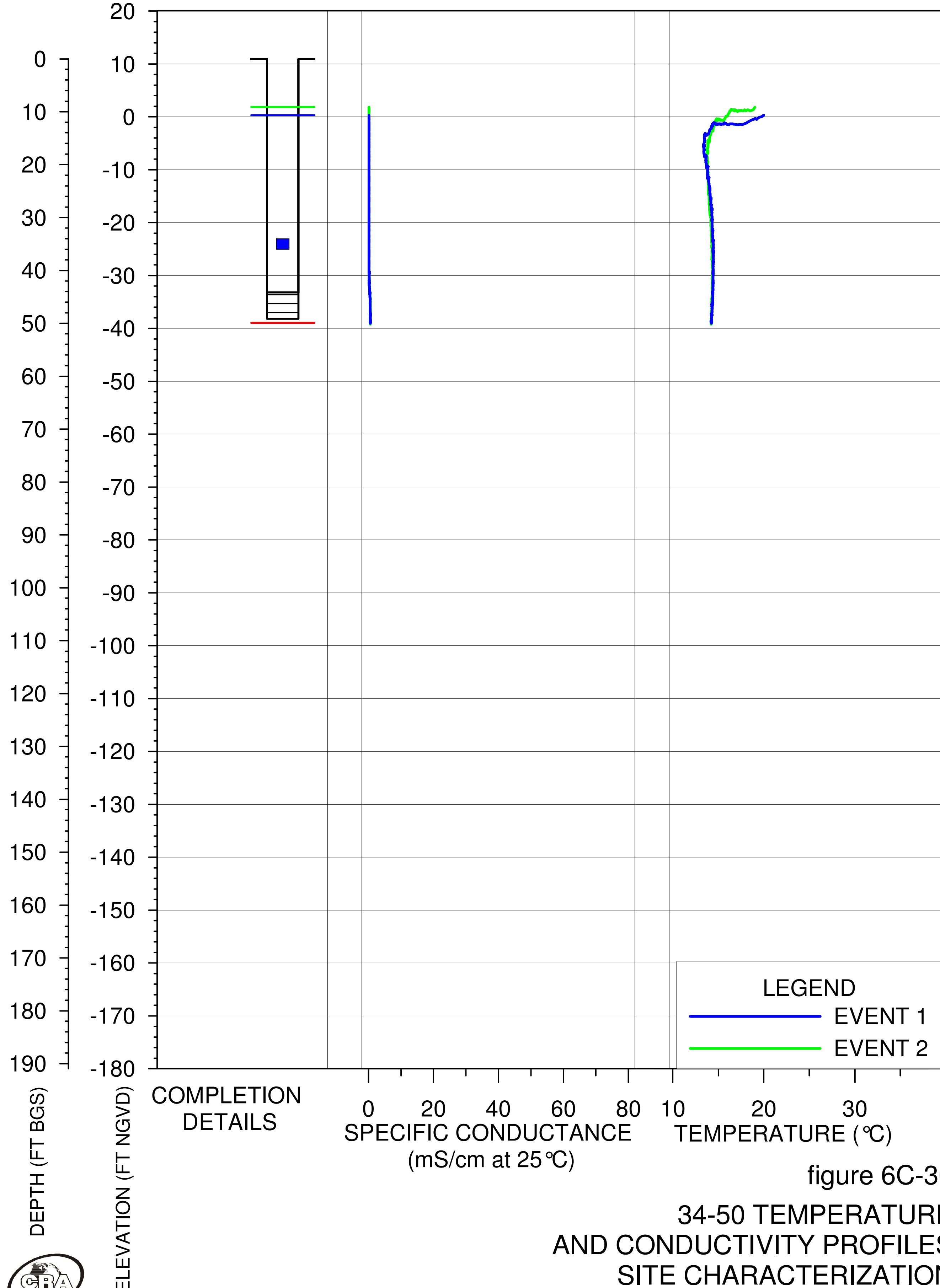


figure 6C-30

34-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

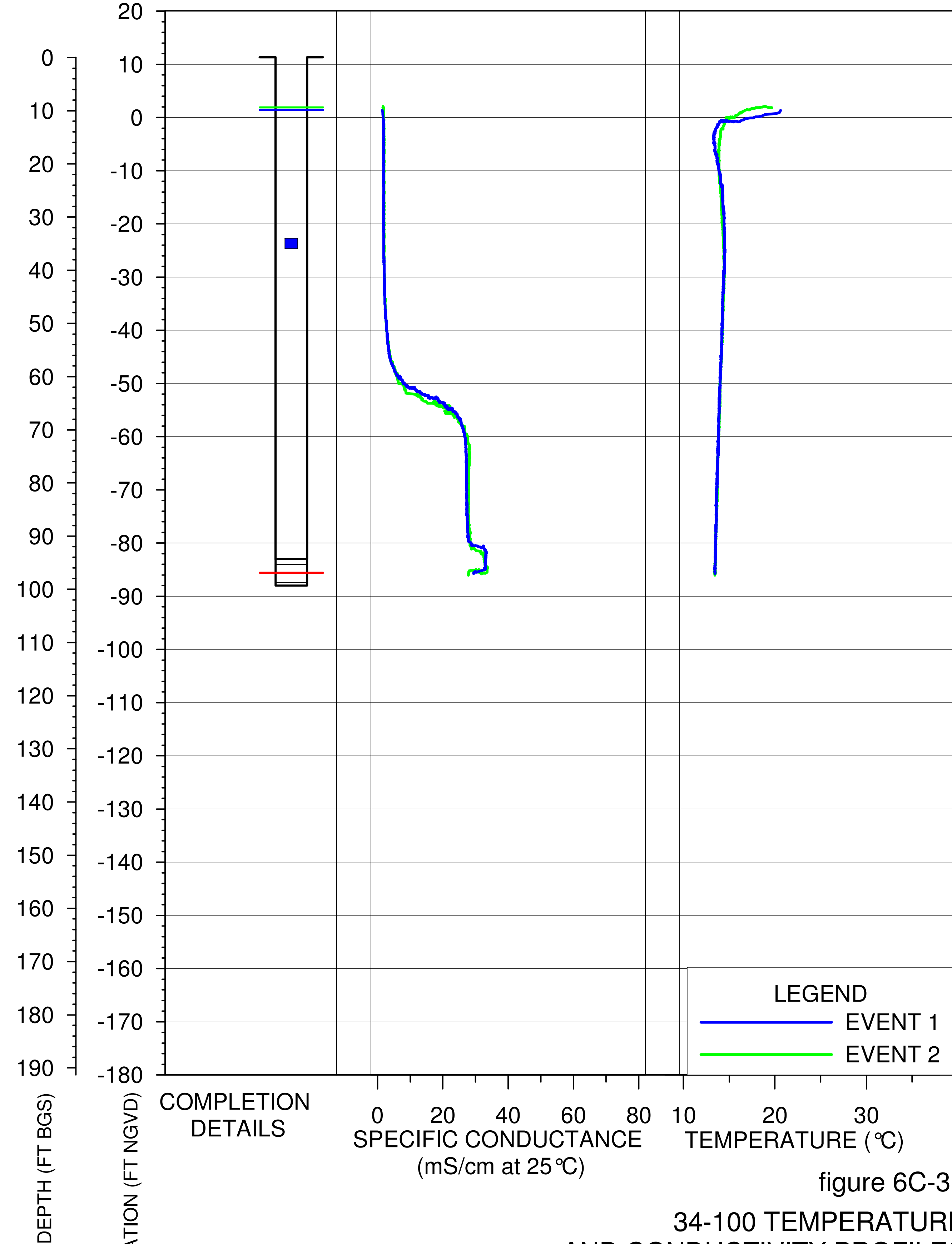


figure 6C-31

34-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-31.grf) JAN 3/2011

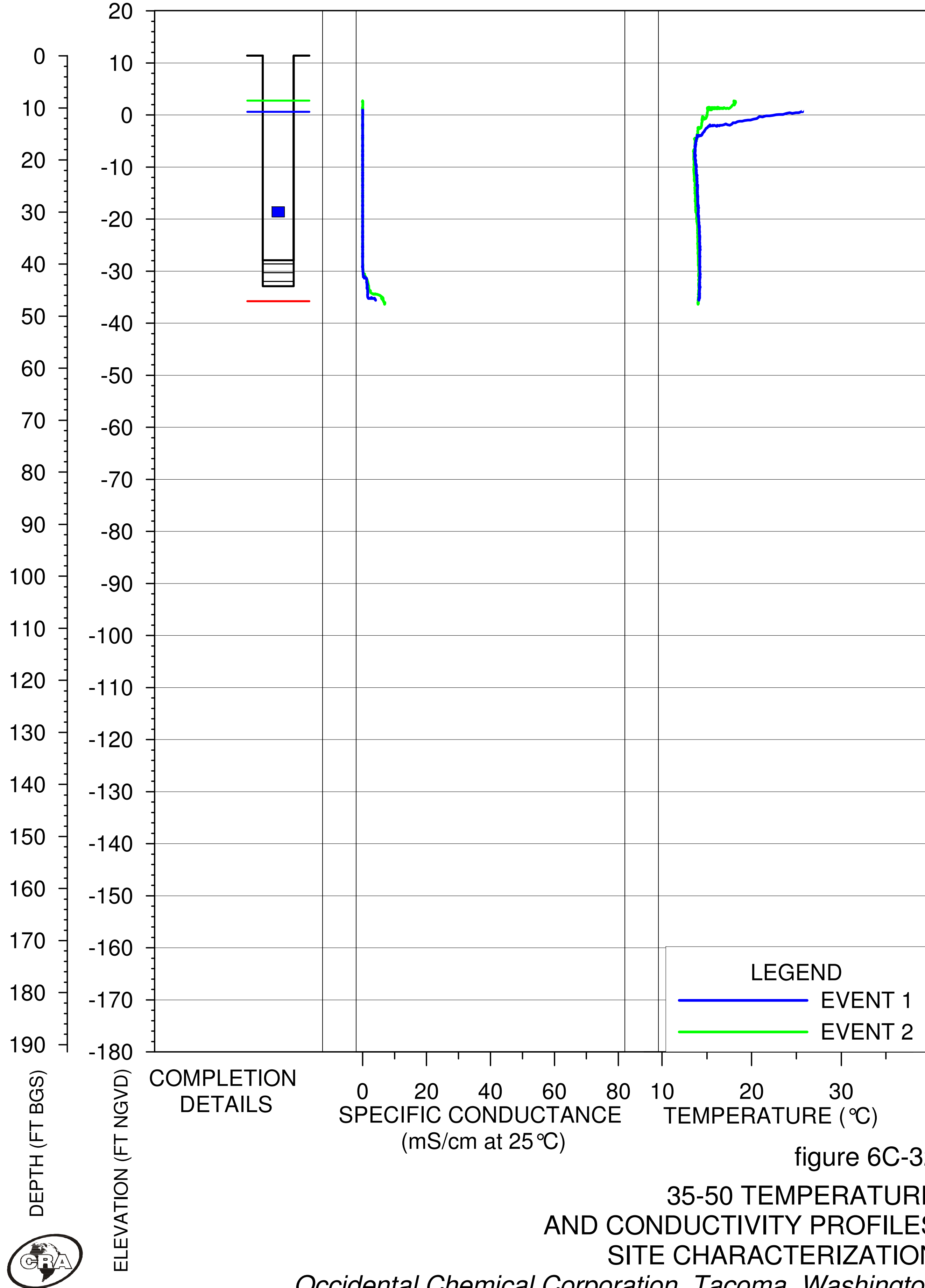


figure 6C-32

35-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

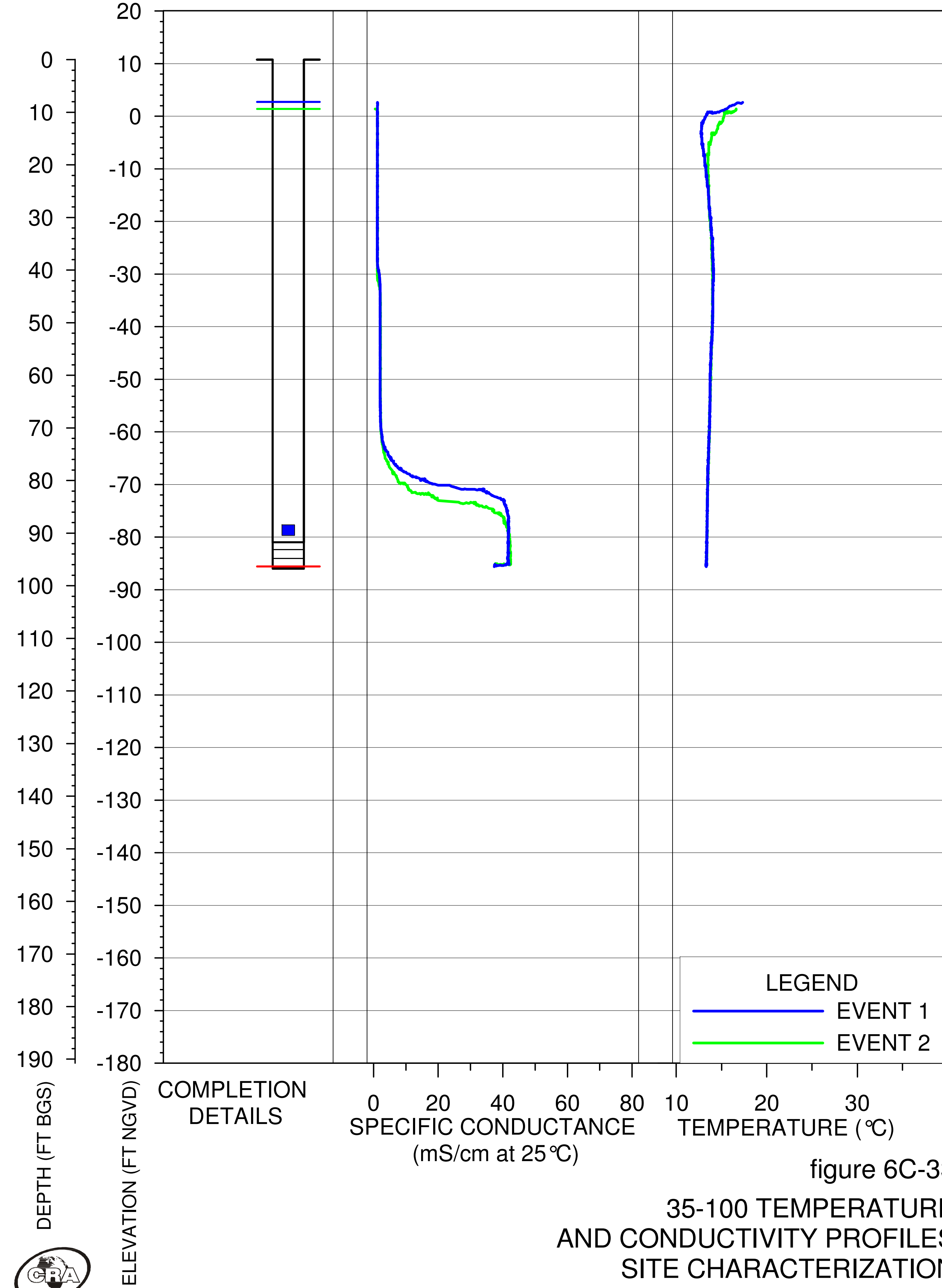


figure 6C-33

35-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-33.grf) JAN 3/2011

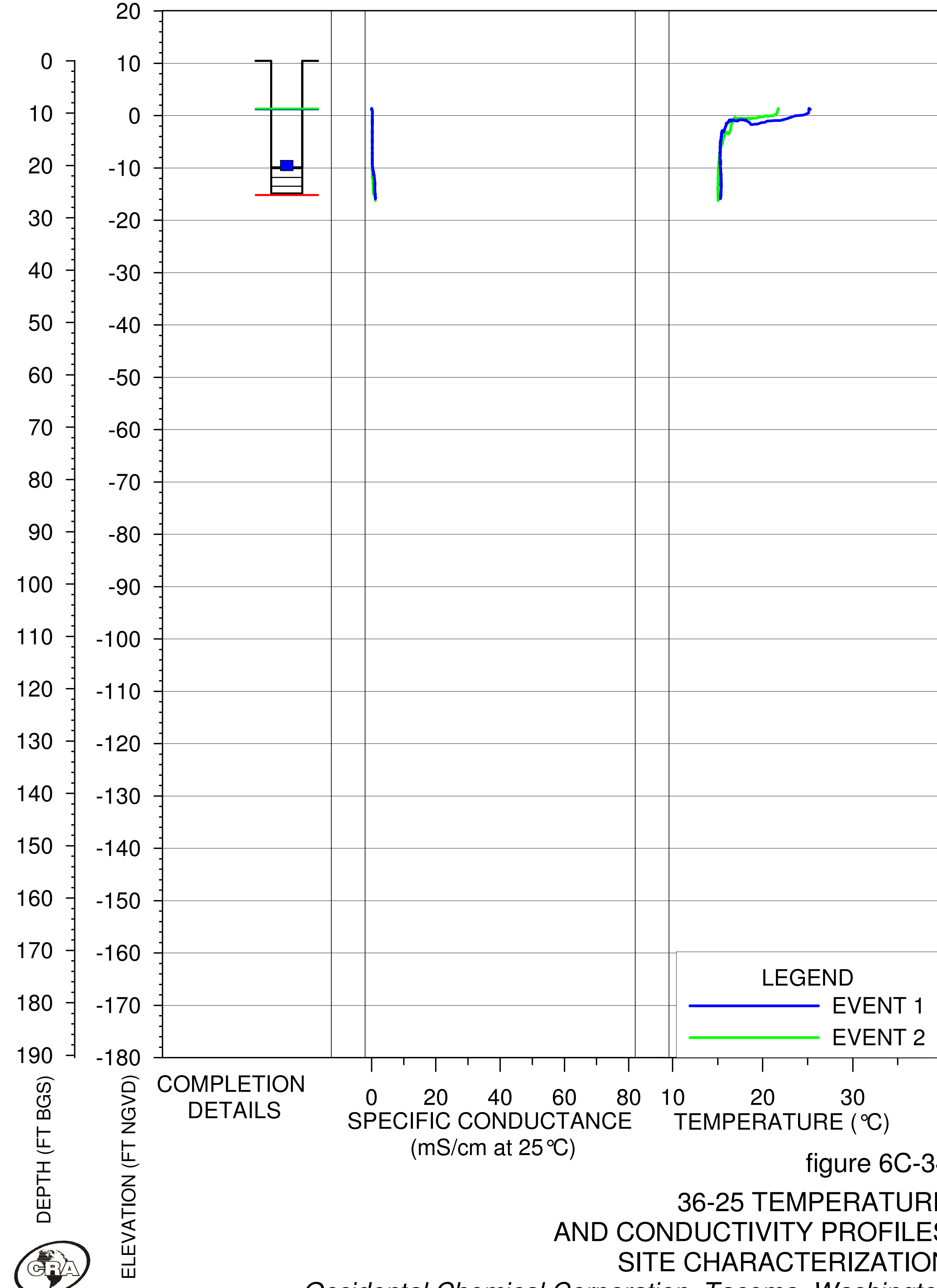


figure 6C-34

36-25 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

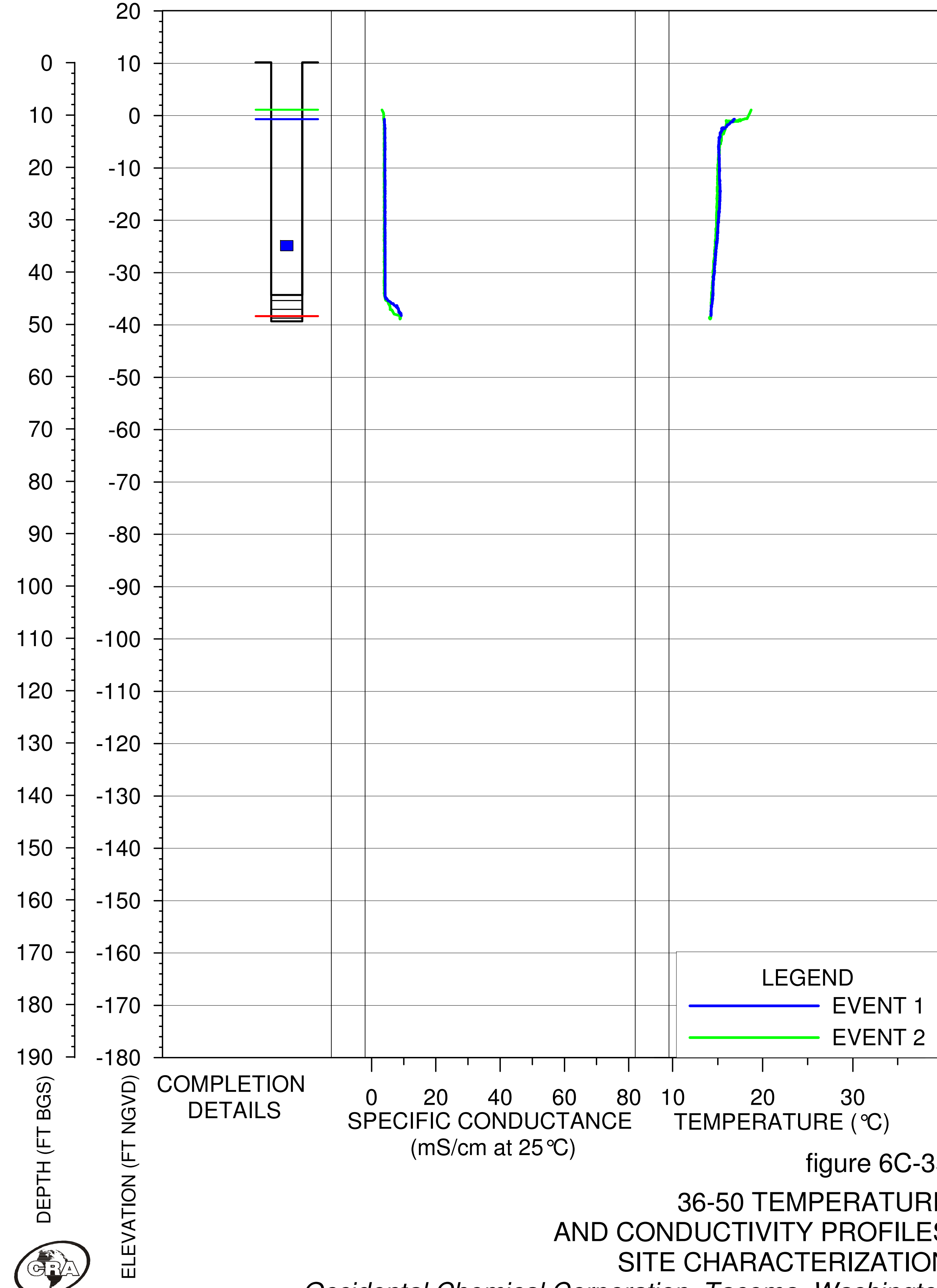


figure 6C-35

36-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-35.grf) JAN 3/2011

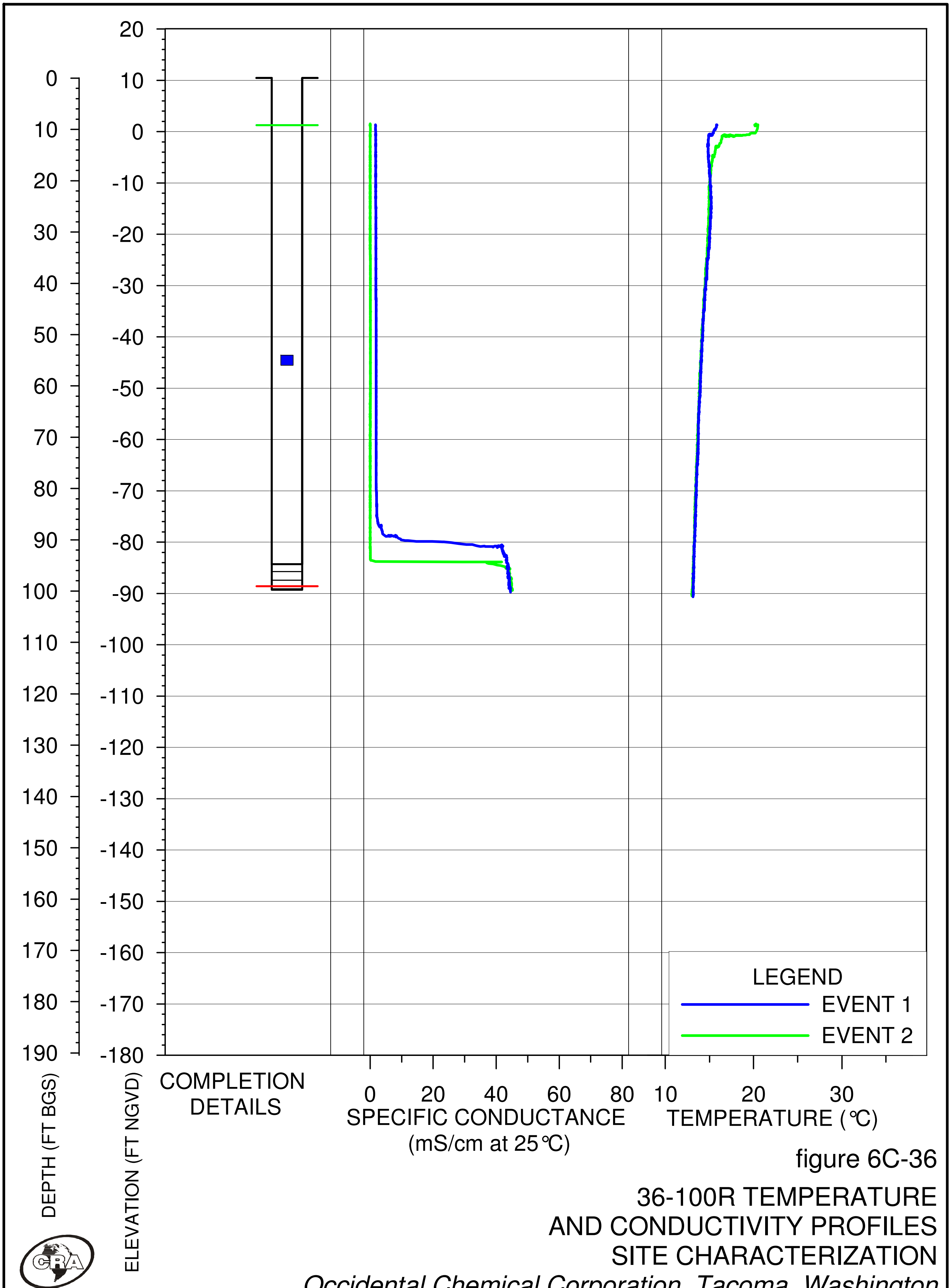


figure 6C-36

36-100R TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

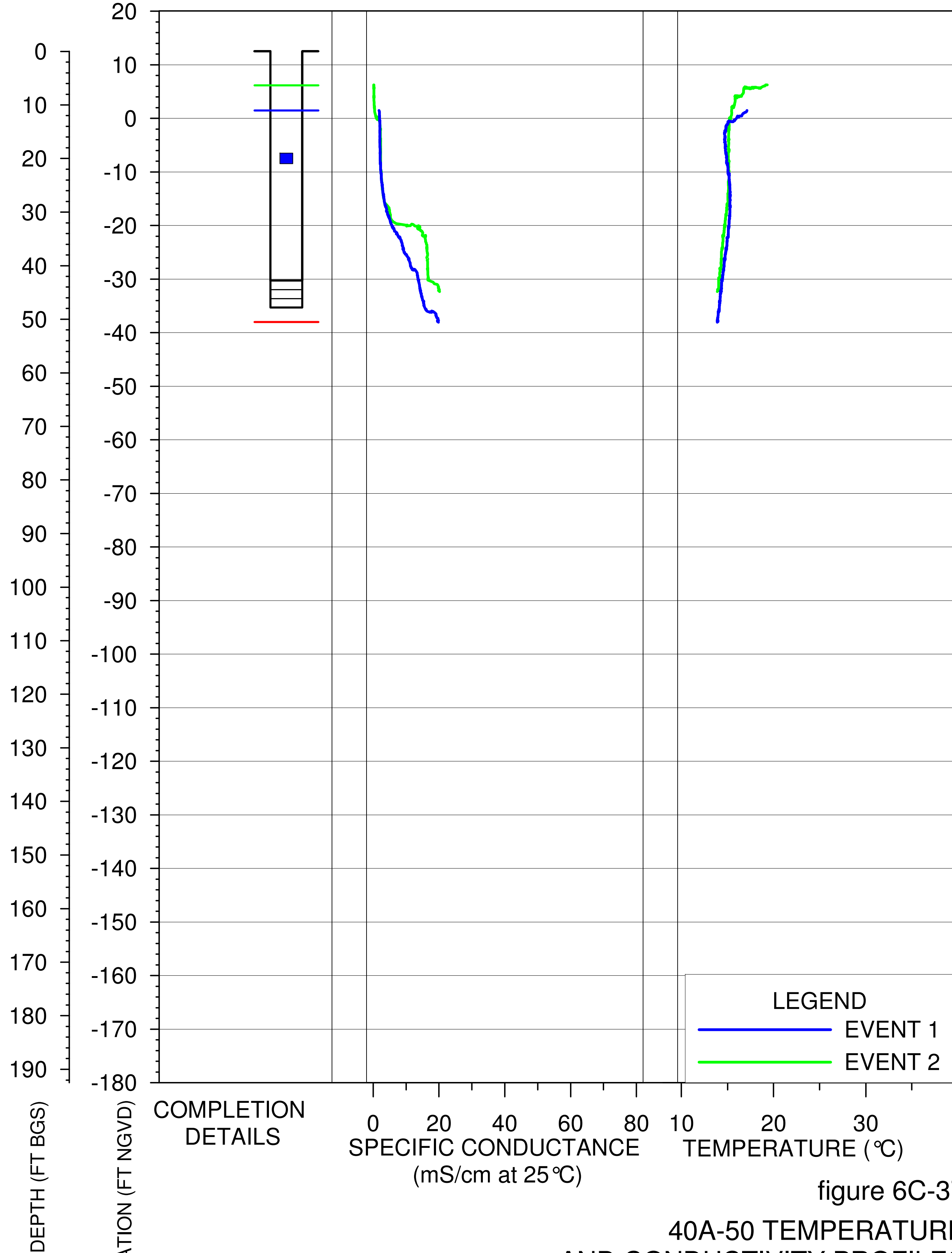


figure 6C-37

40A-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

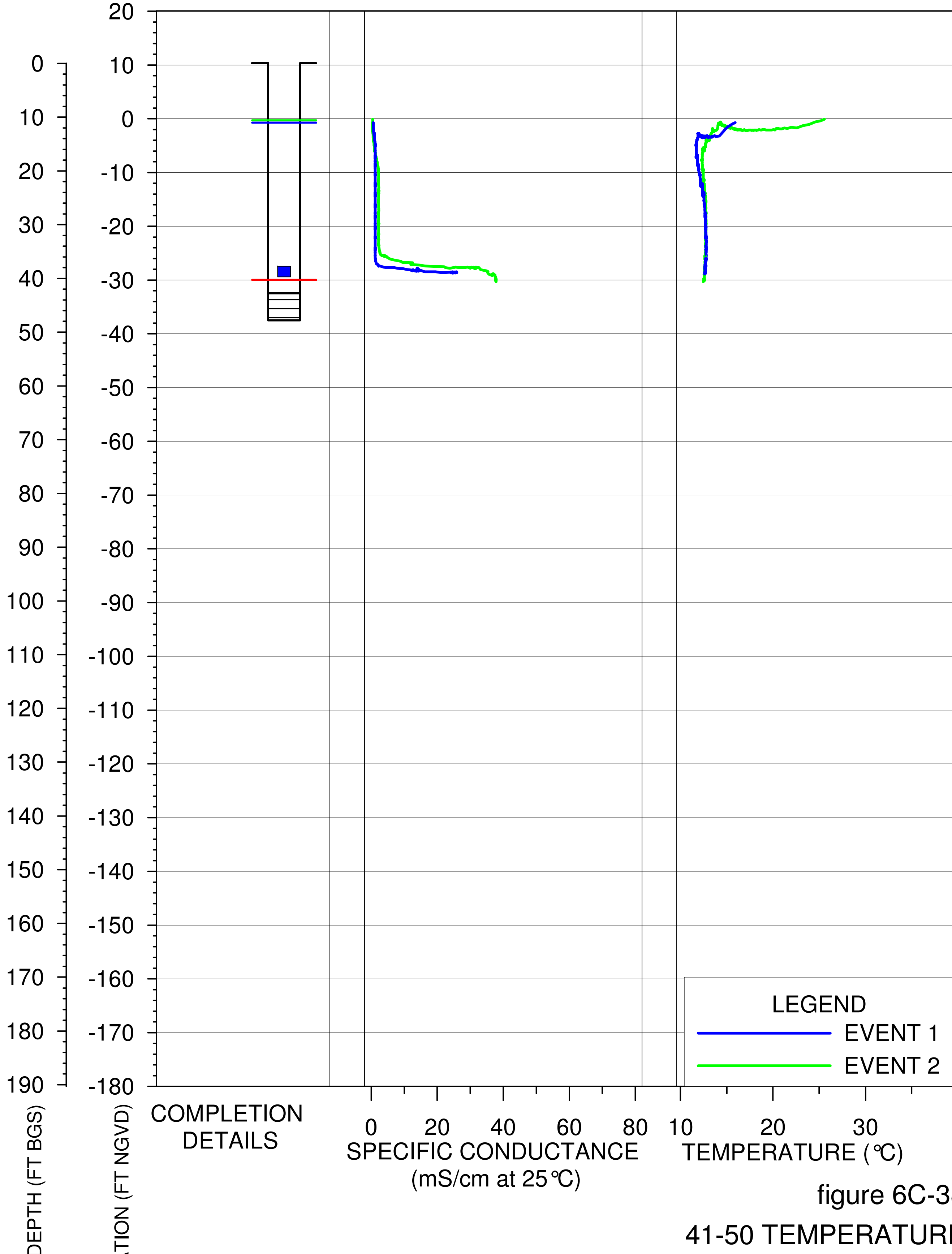


figure 6C-38

41-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-38.grf) JAN 3/2011

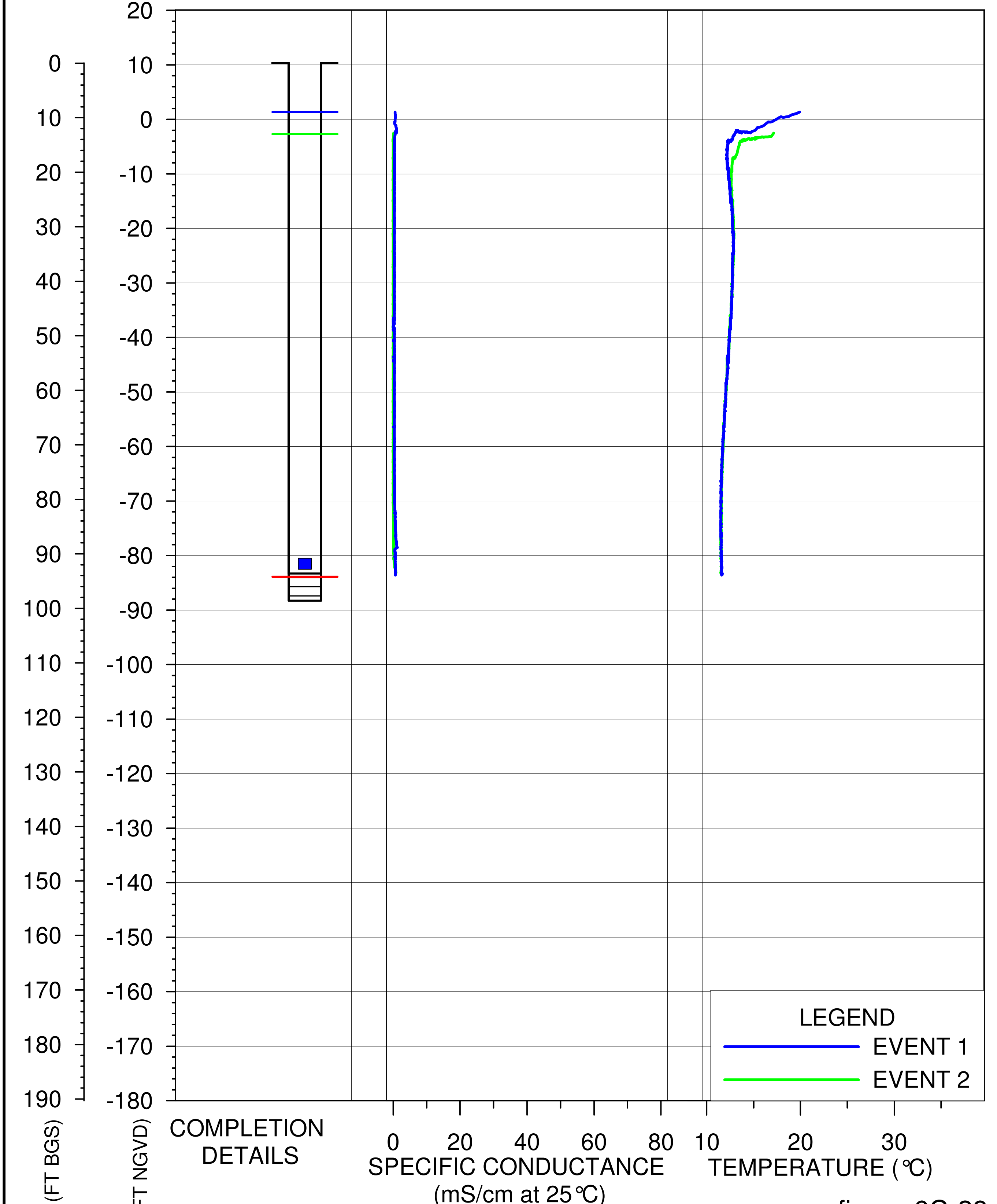


figure 6C-39

41-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

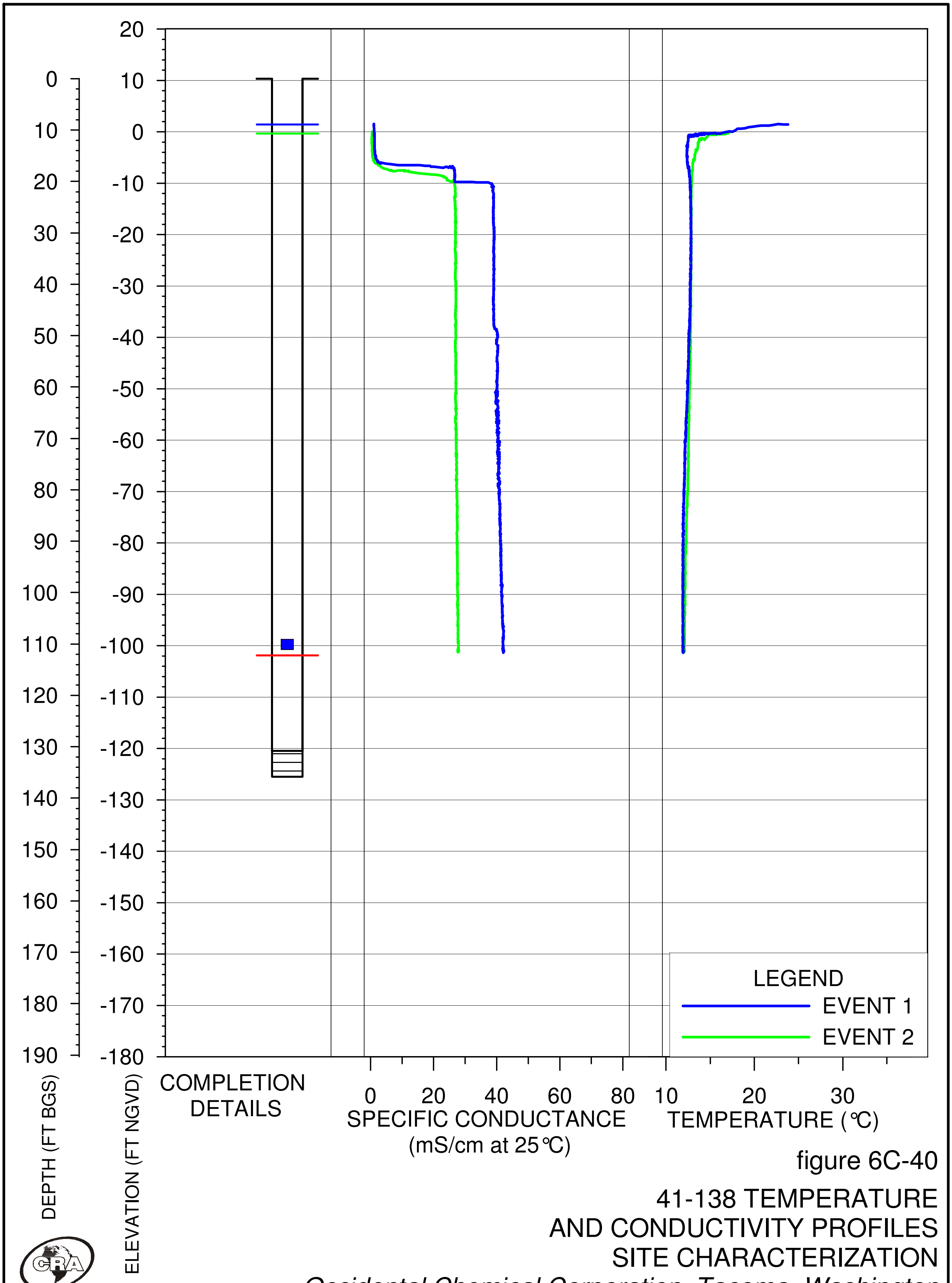


figure 6C-40

41-138 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

figure 6C-41

43-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-41.grf) JAN 3/2011

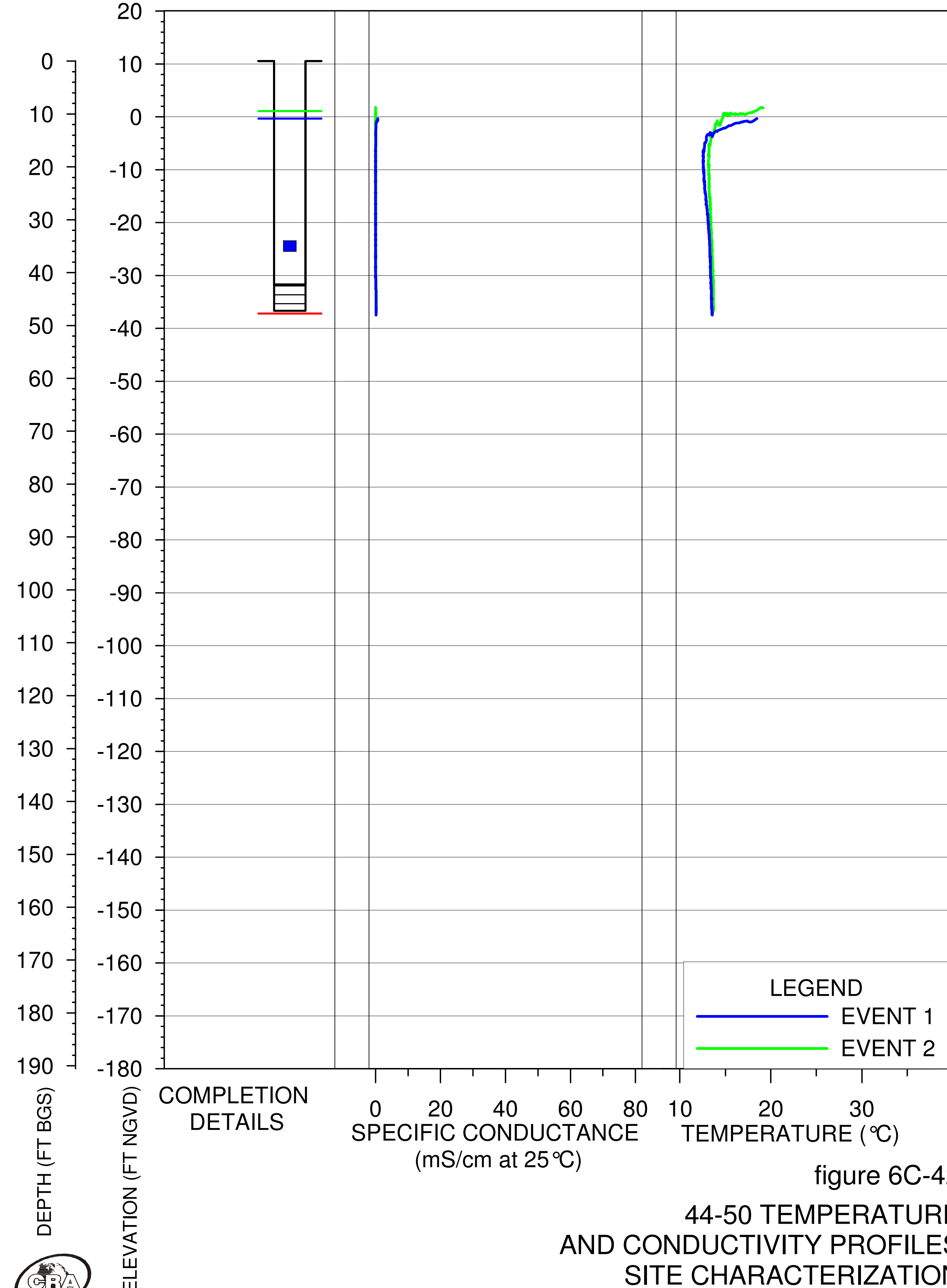


figure 6C-42

44-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

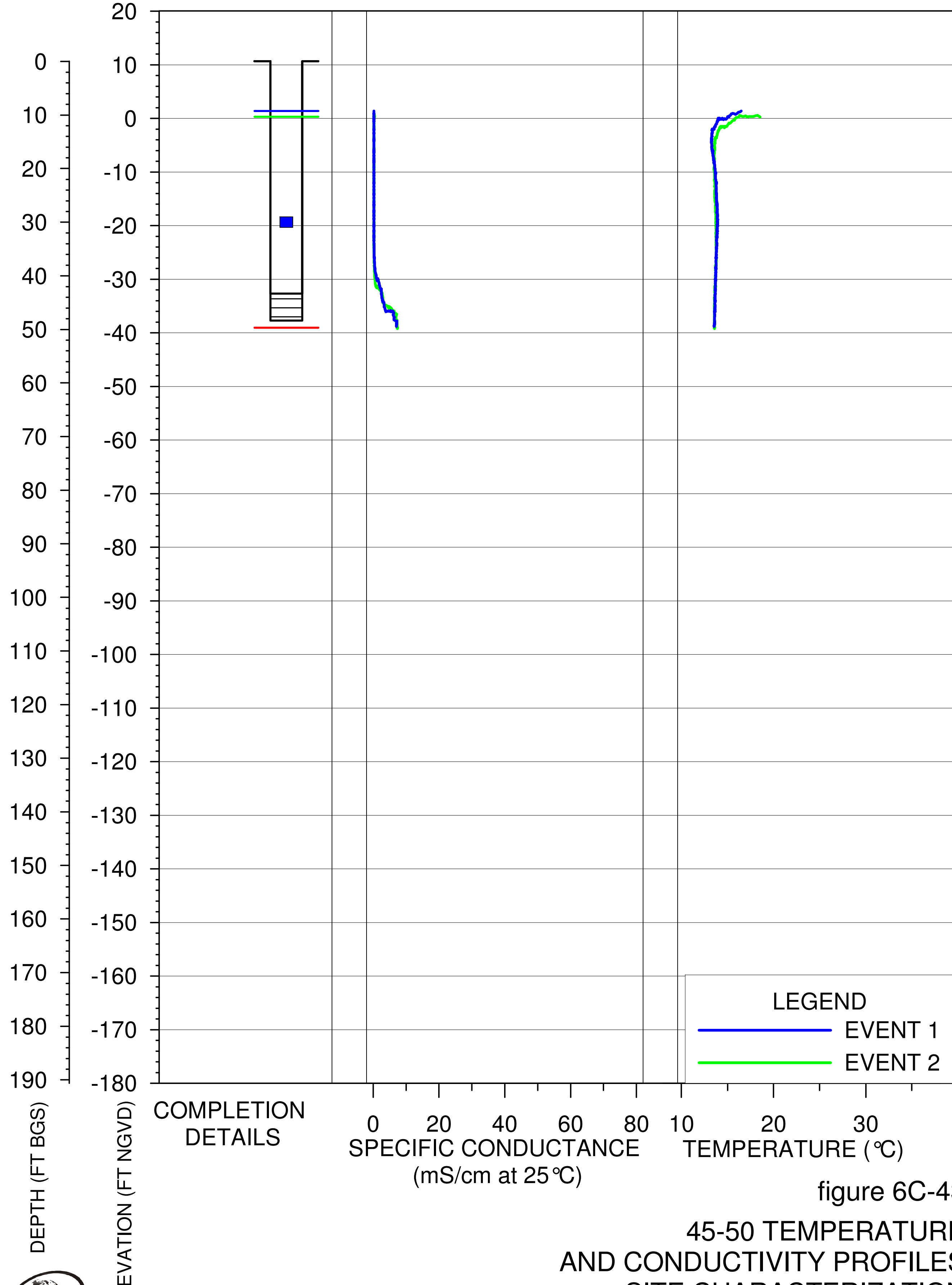


figure 6C-43

45-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-43.grf) JAN 3/2011

figure 6C-44

45-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-44.grf) JAN 3/2011

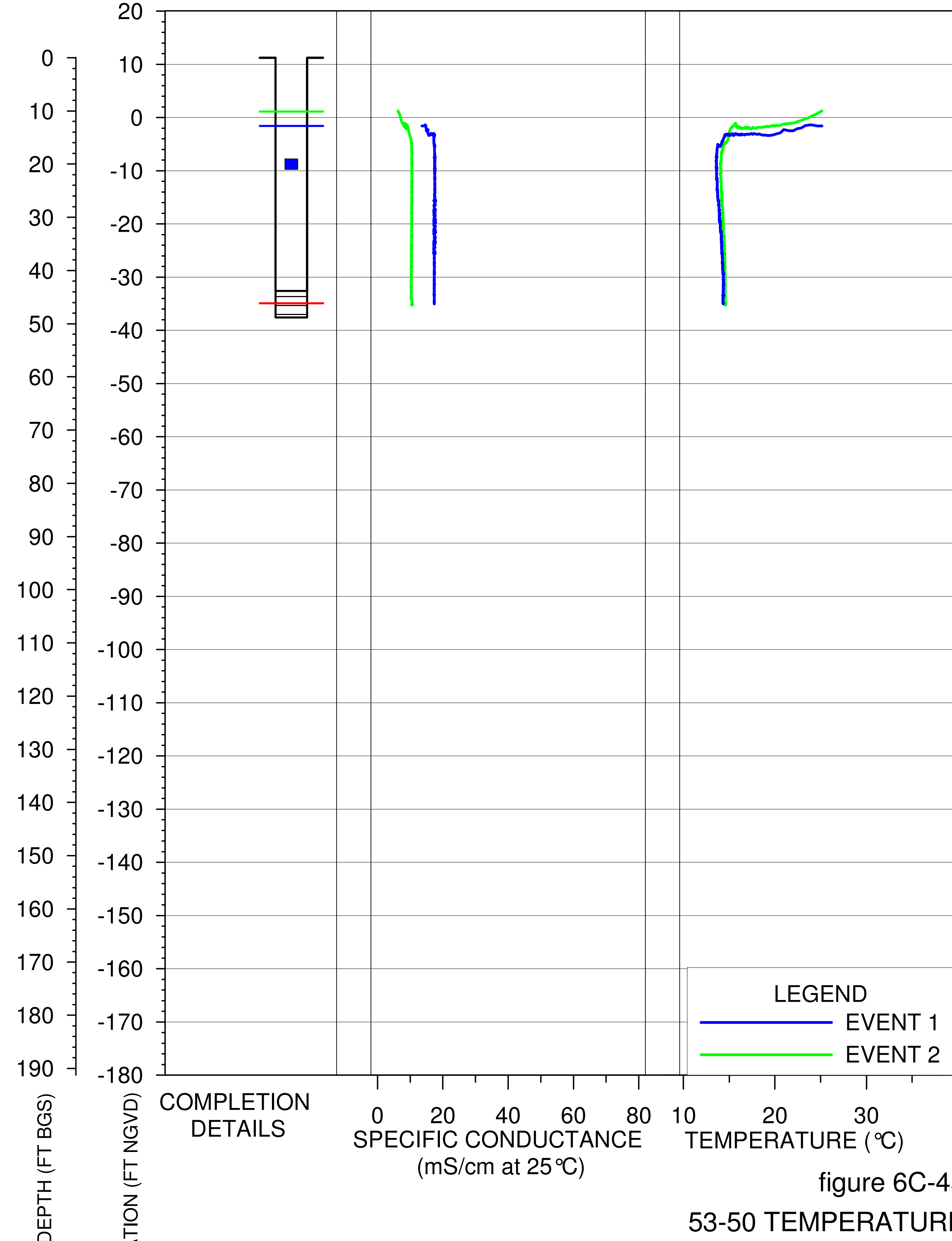


figure 6C-45

53-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

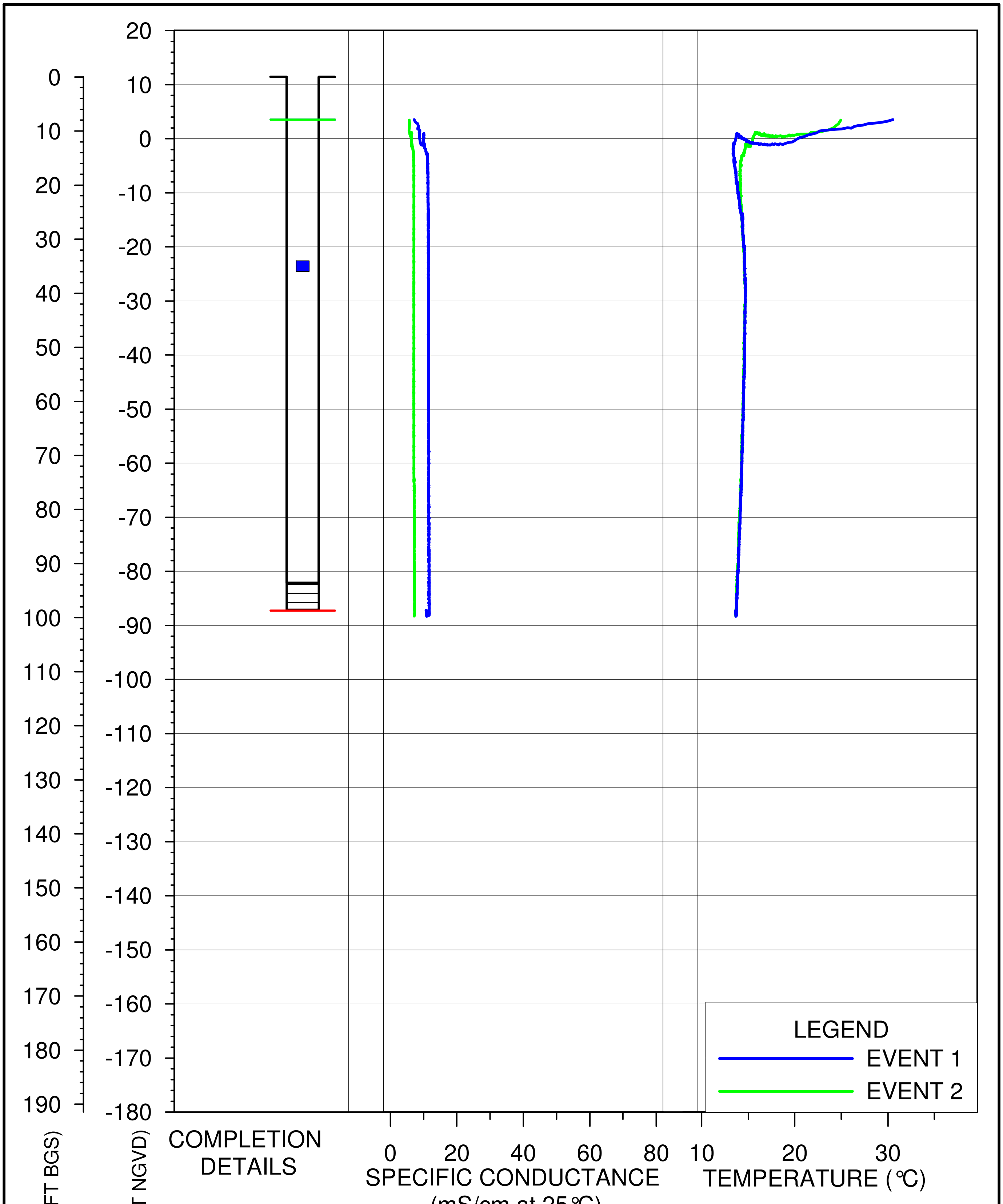


figure 6C-46

53-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

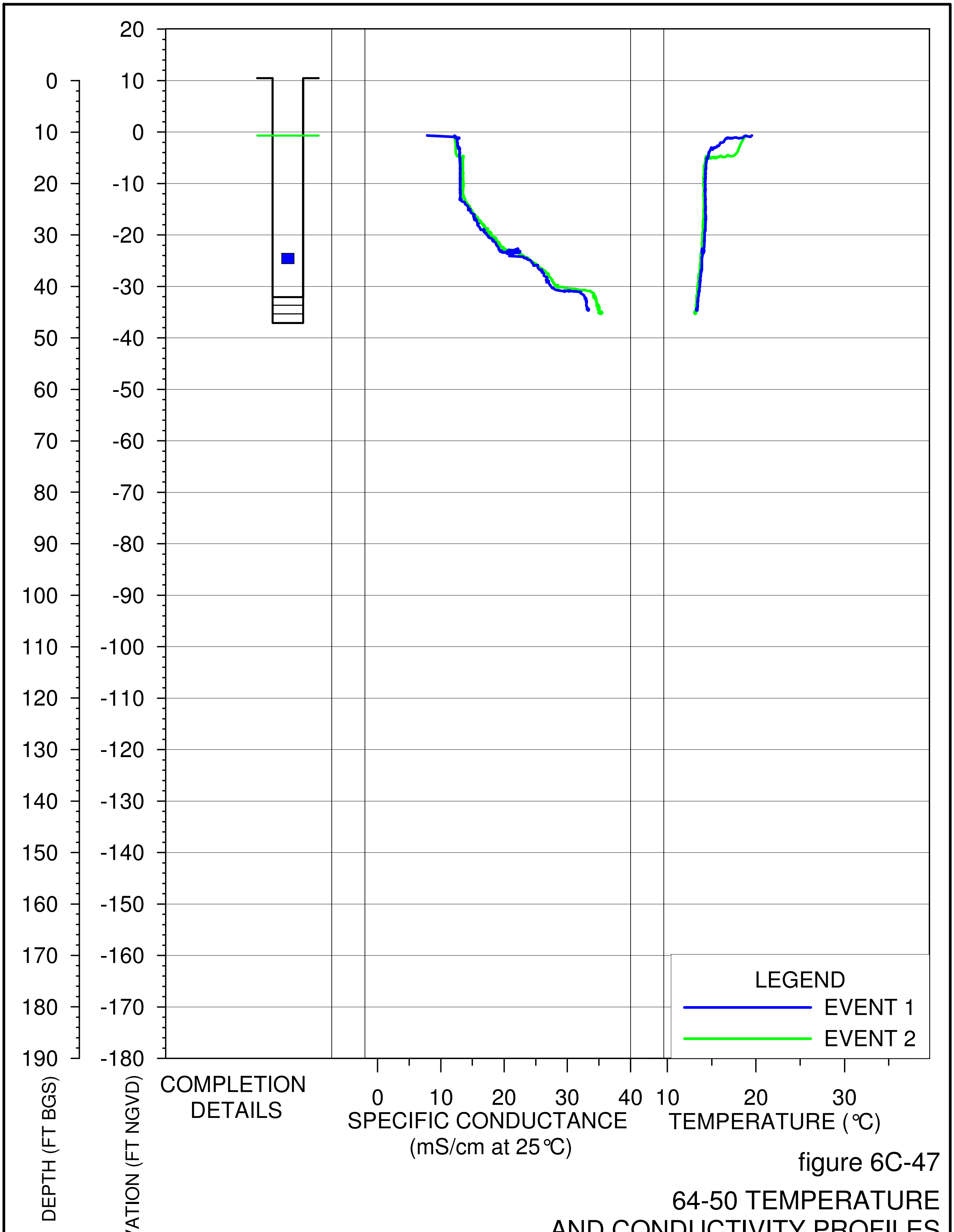


figure 6C-47

64-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

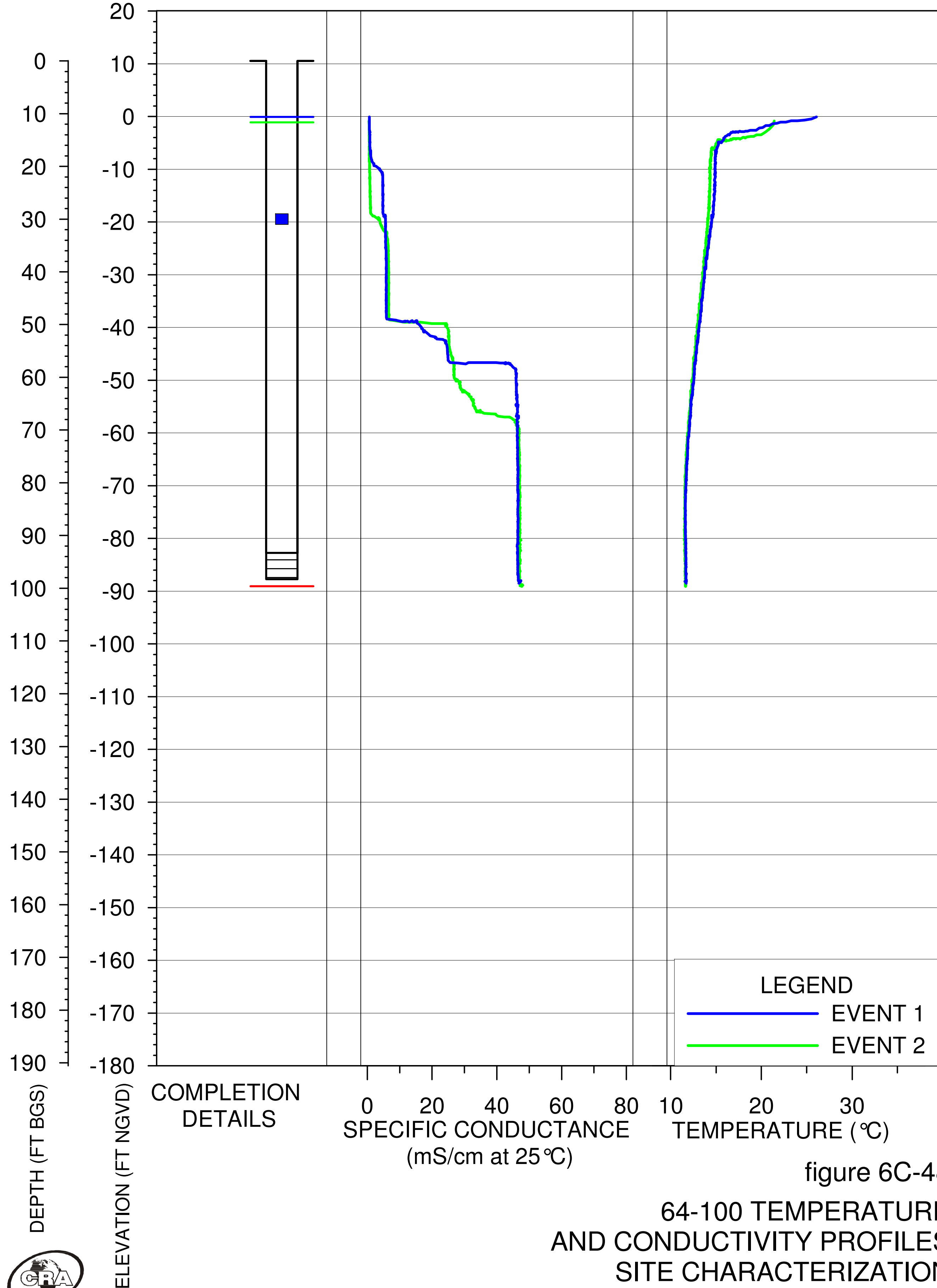


figure 6C-48

64-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

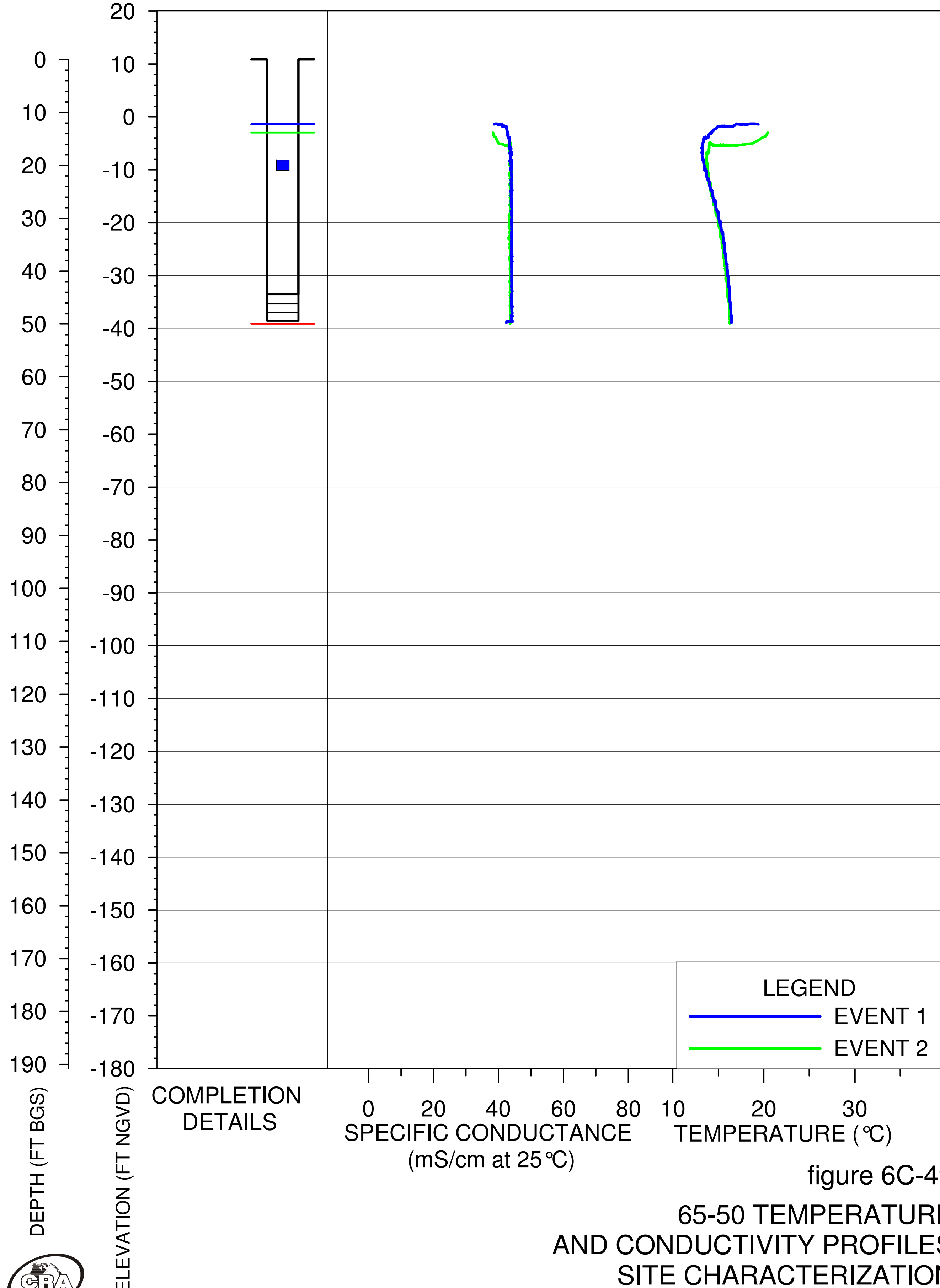


figure 6C-49

65-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

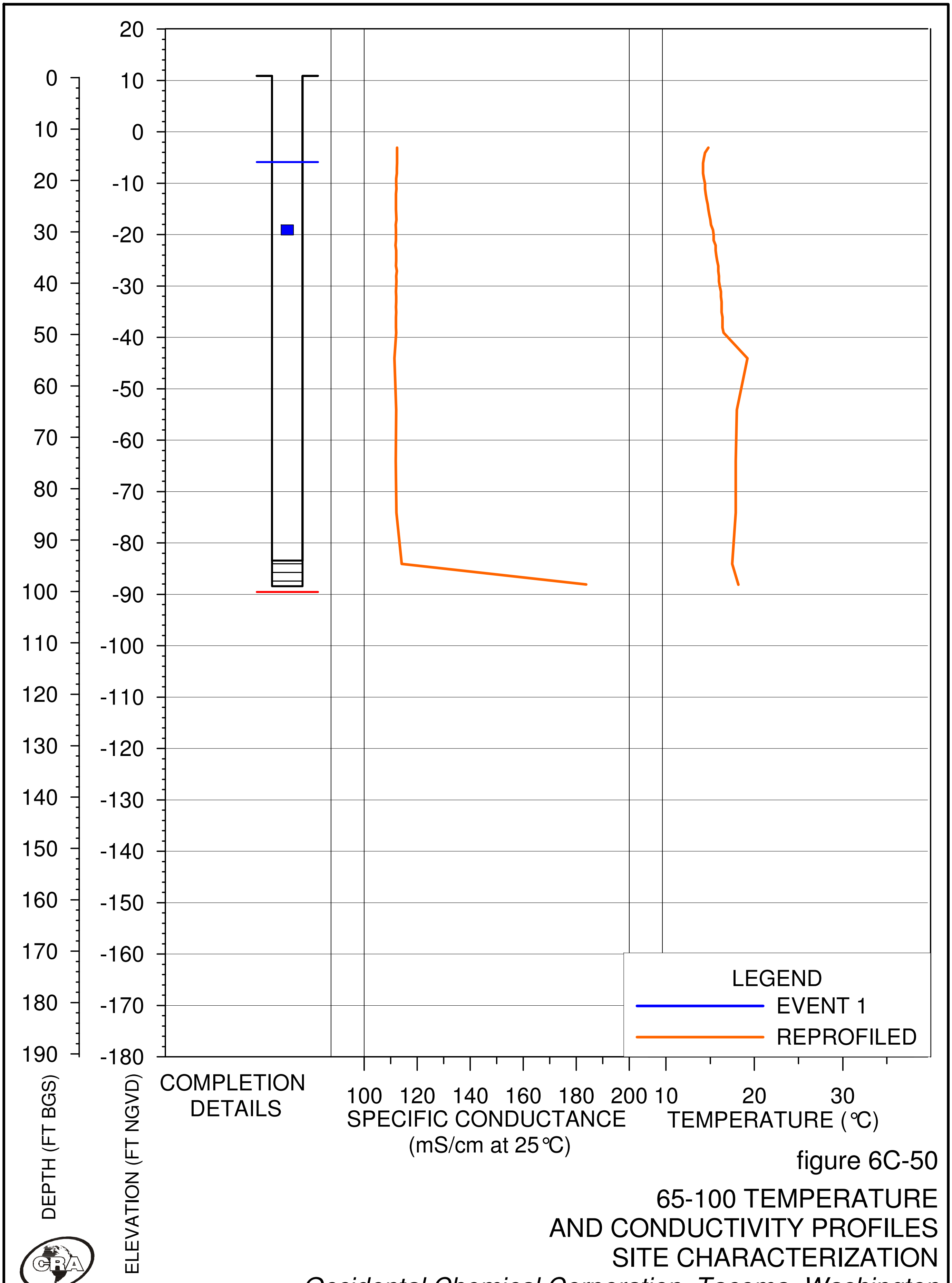


figure 6C-50

65-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

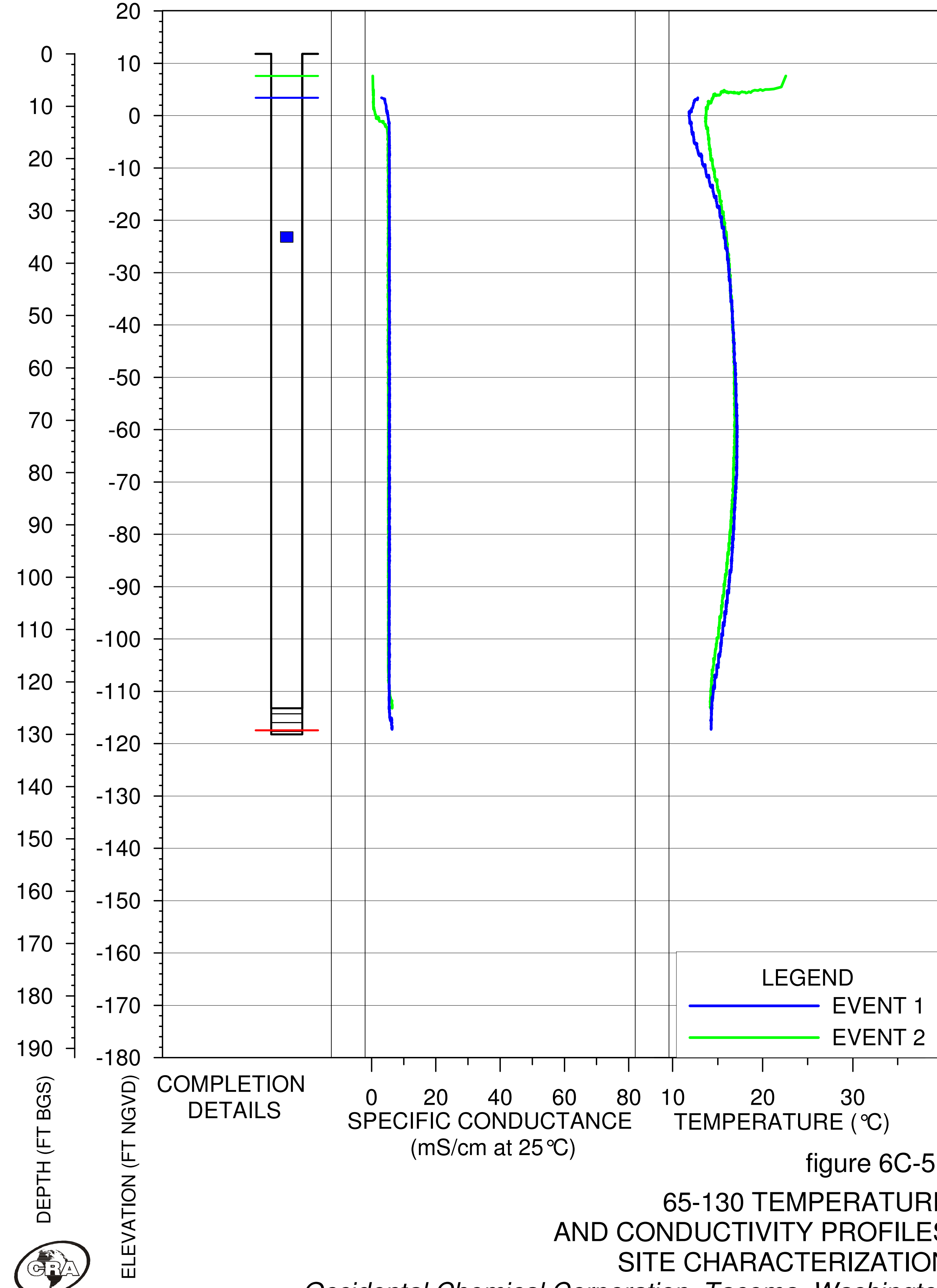


figure 6C-51

65-130 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-51.grf) JAN 3/2011

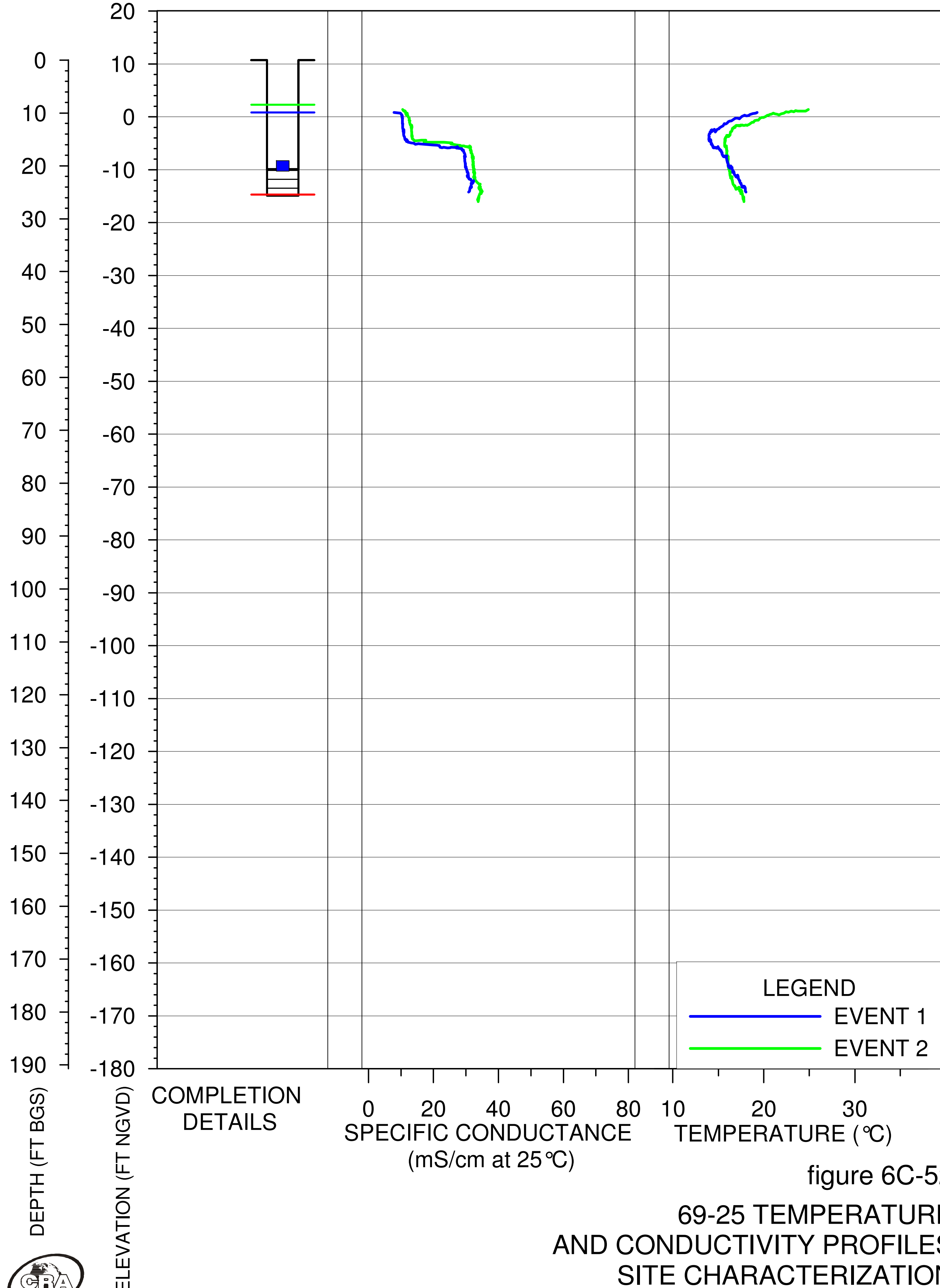


figure 6C-52

69-25 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

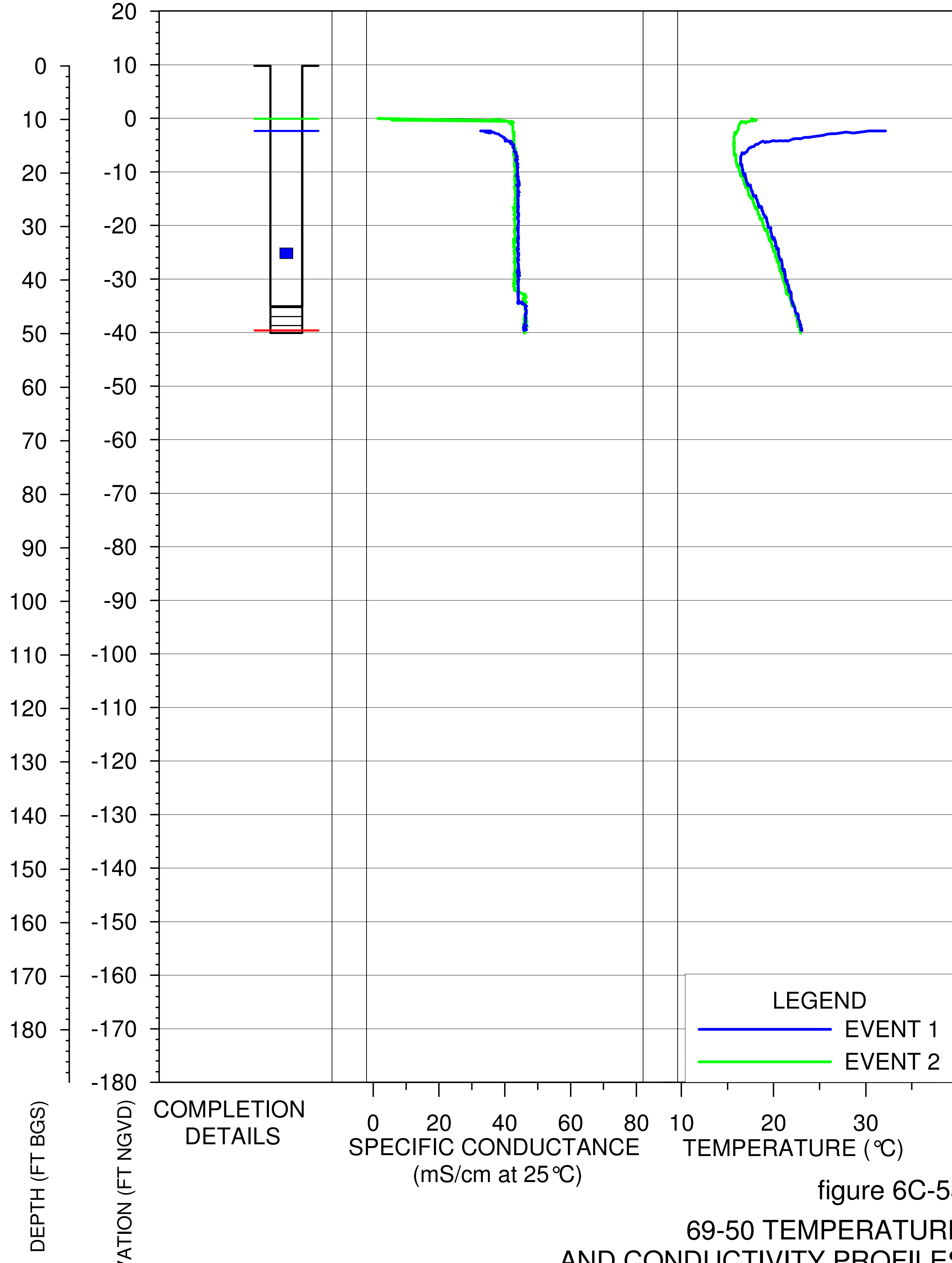


figure 6C-53

69-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

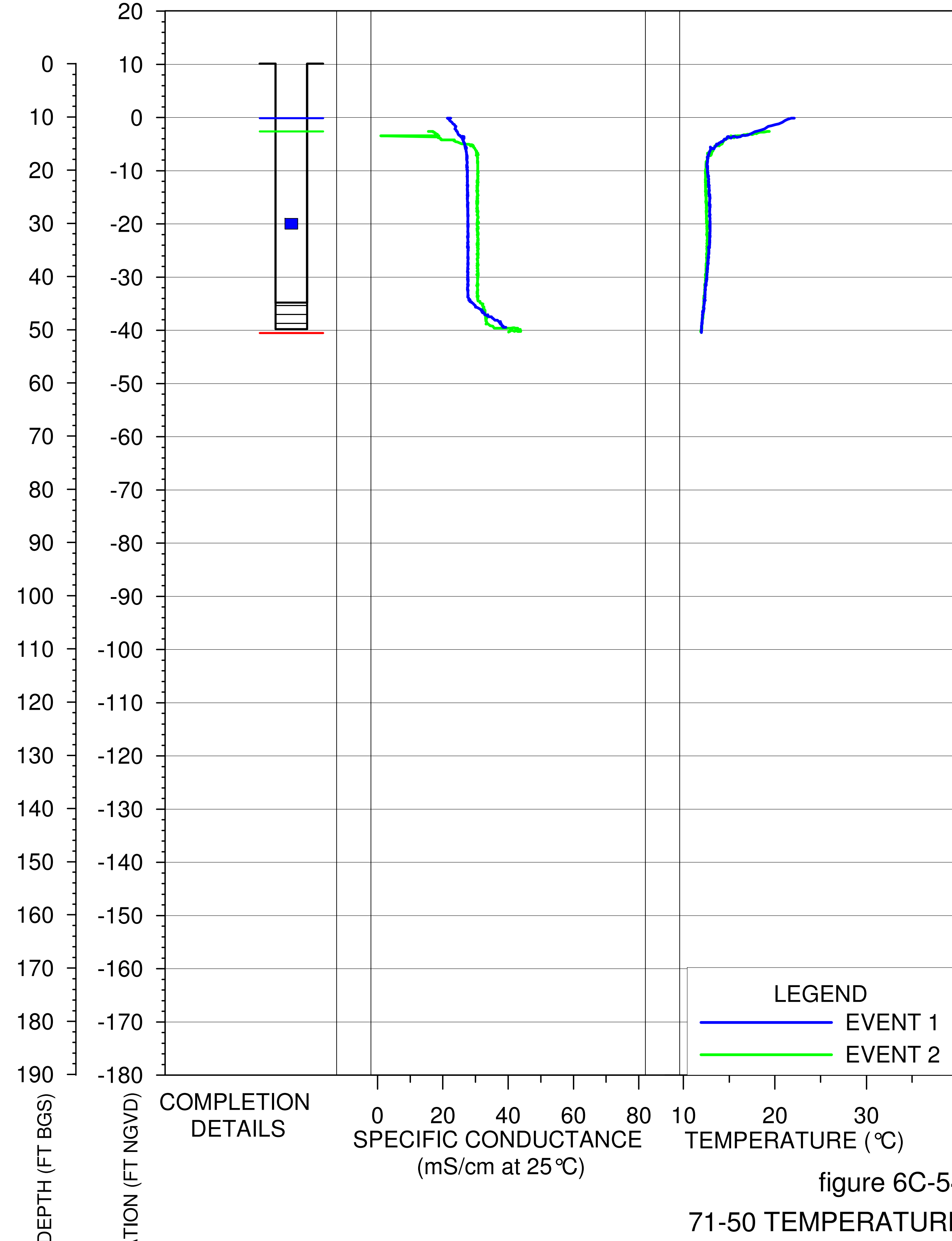


figure 6C-54

71-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

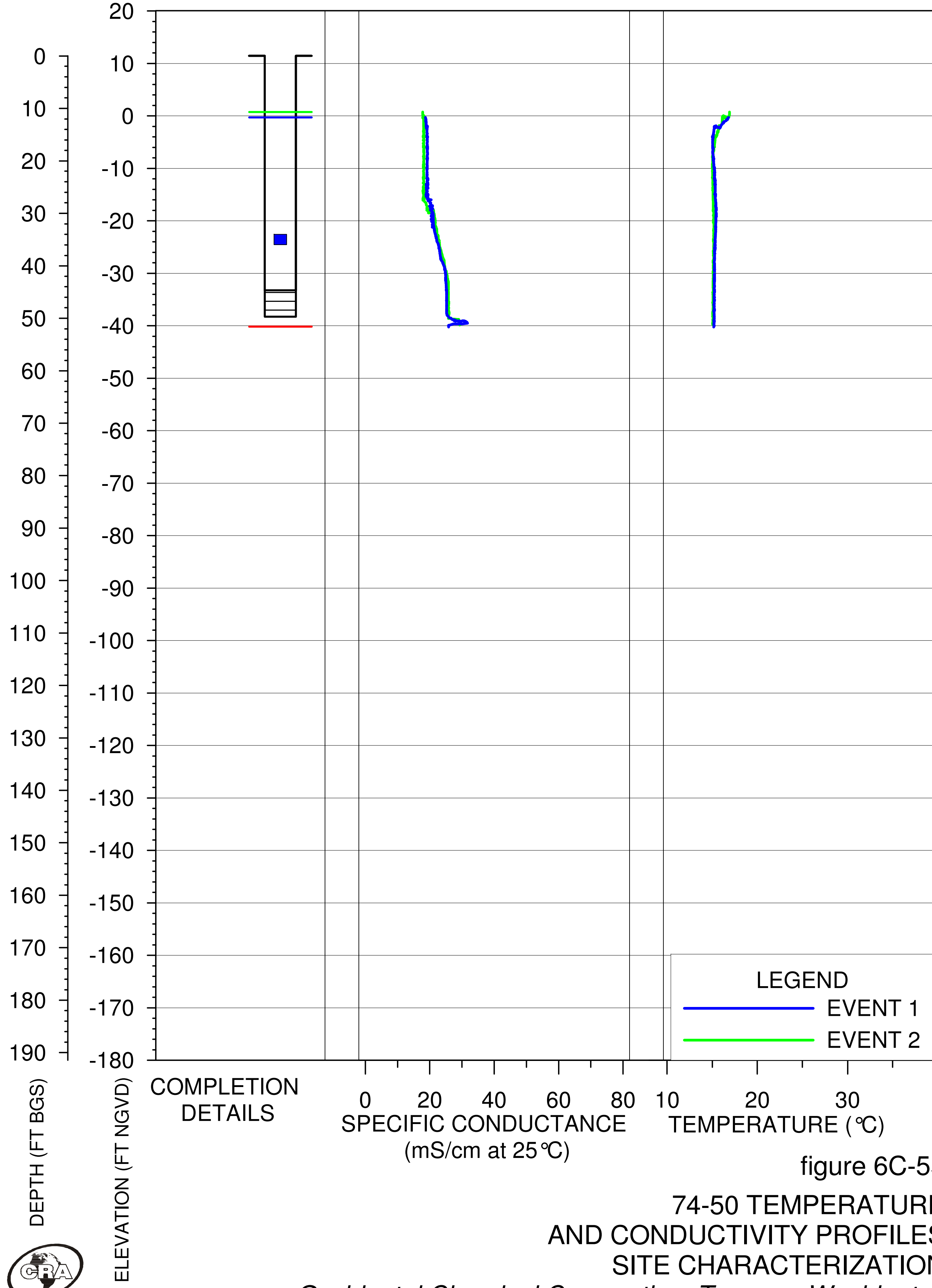


figure 6C-55

74-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-55.grf) JAN 3/2011

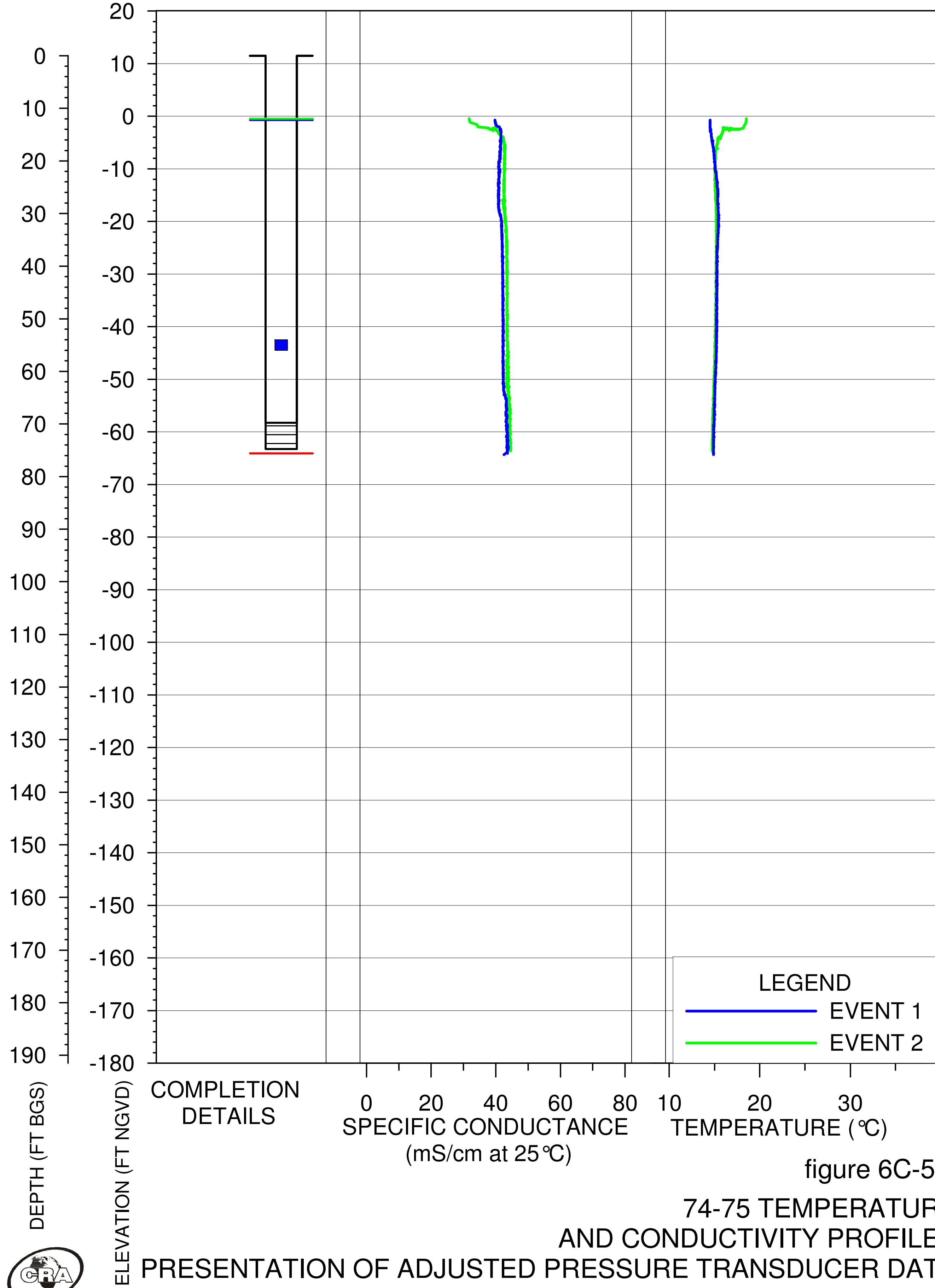


figure 6C-56

74-75 TEMPERATURE
AND CONDUCTIVITY PROFILES
PRESENTATION OF ADJUSTED PRESSURE TRANSDUCER DATA
Occidental Chemical Corporation, Tacoma, Washington

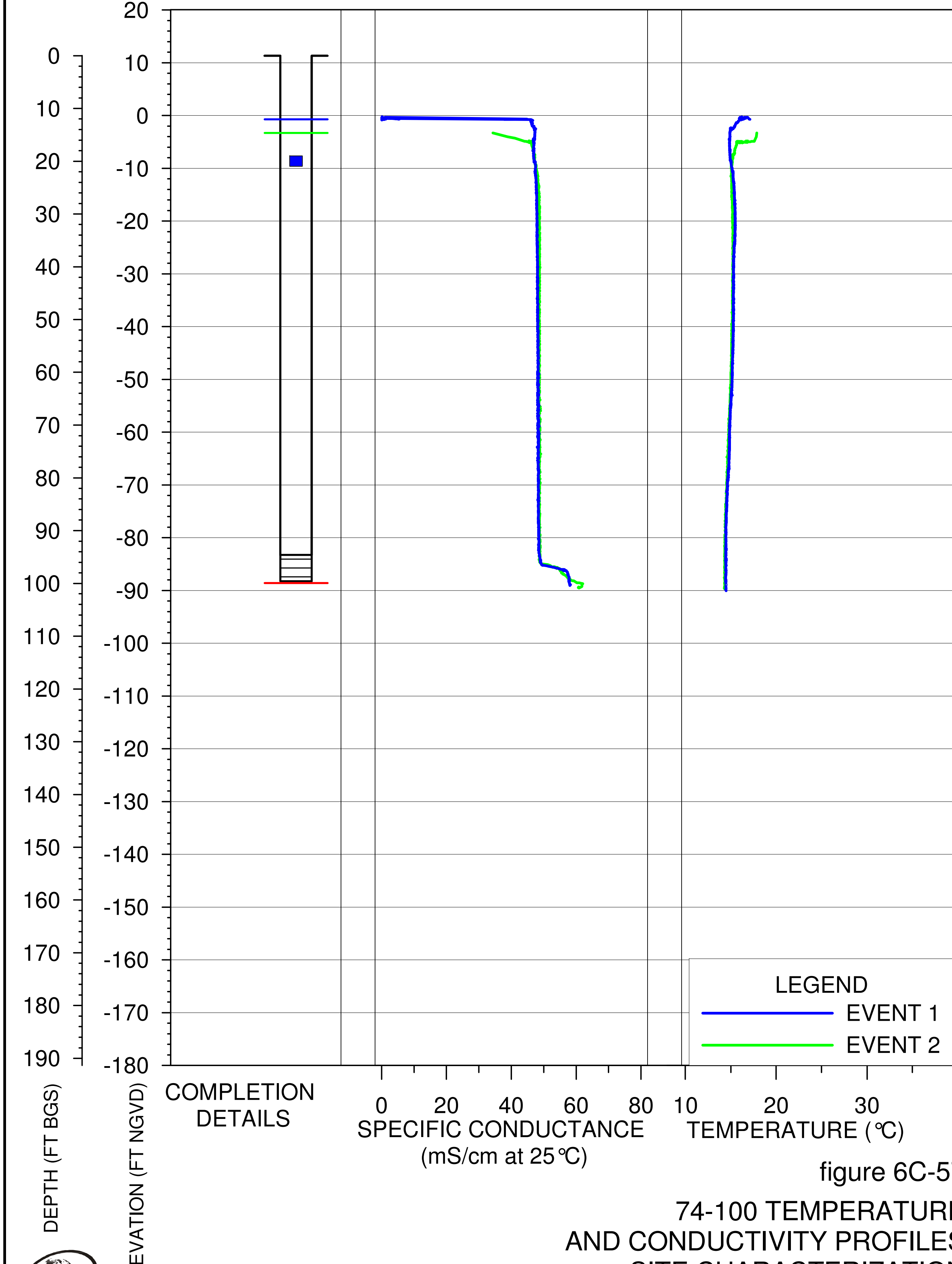


figure 6C-57

74-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-57.grf) JAN 3/2011

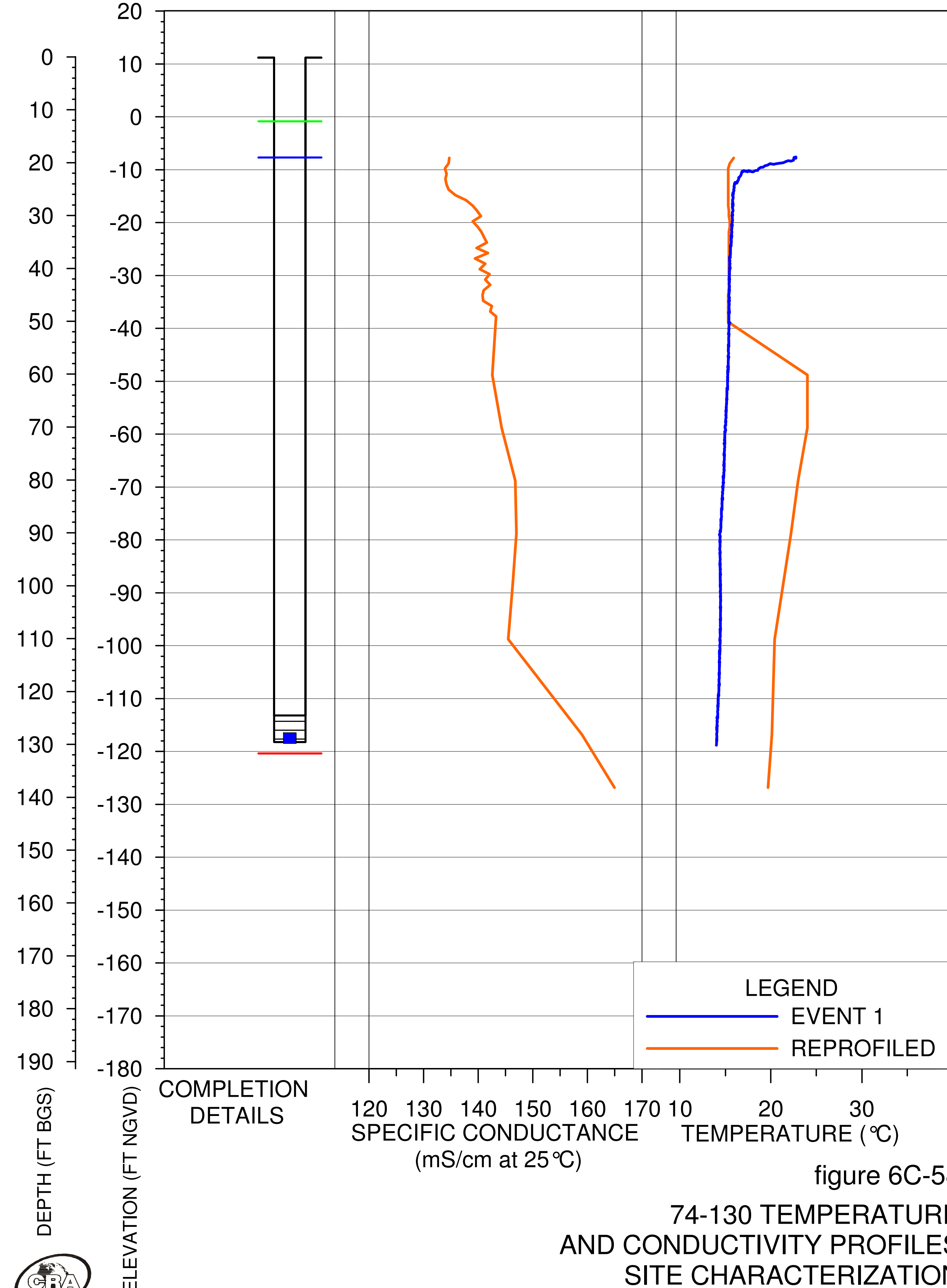


figure 6C-58

74-130 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

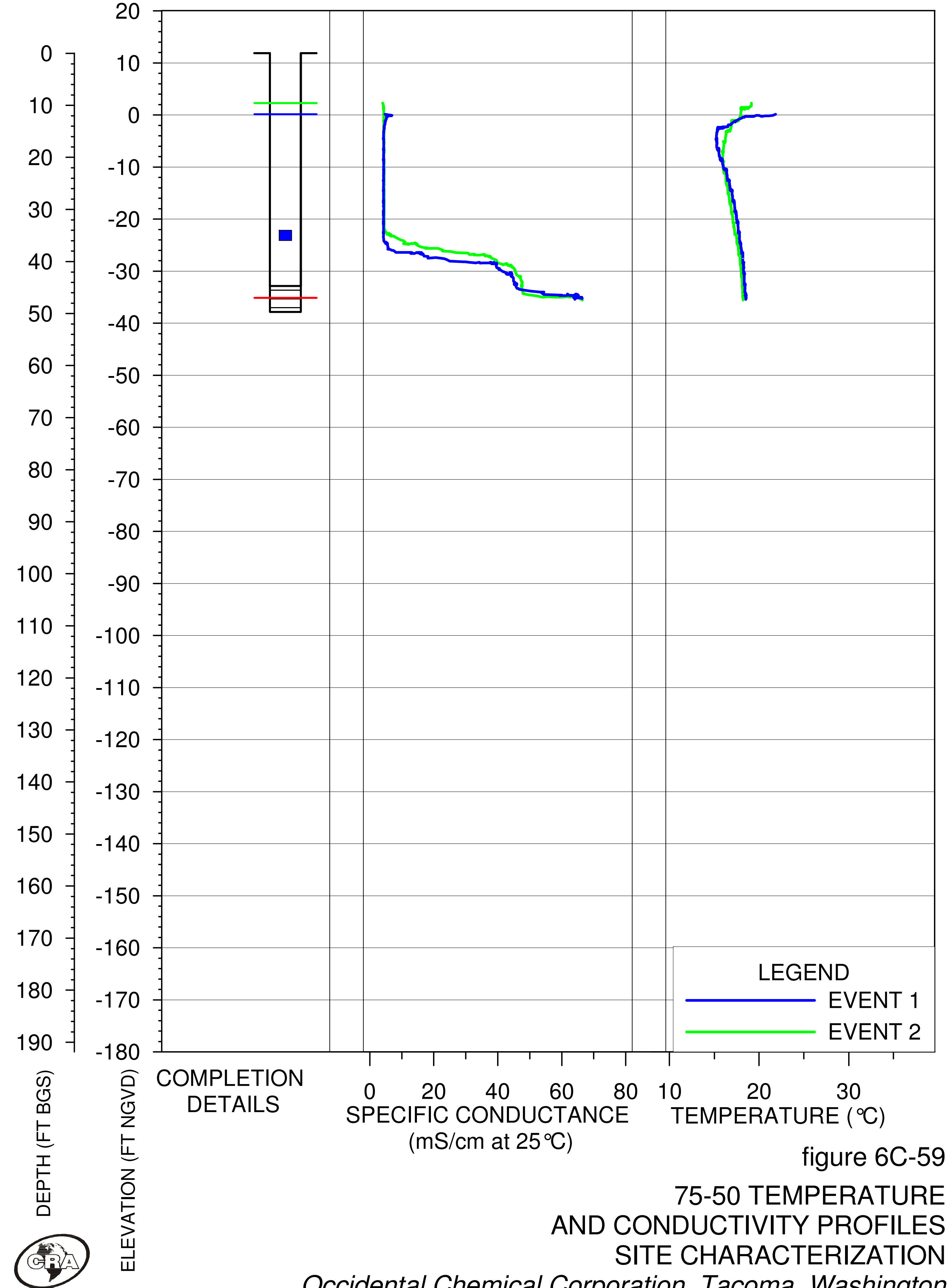


figure 6C-59

75-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-59.grf) JAN 3/2011

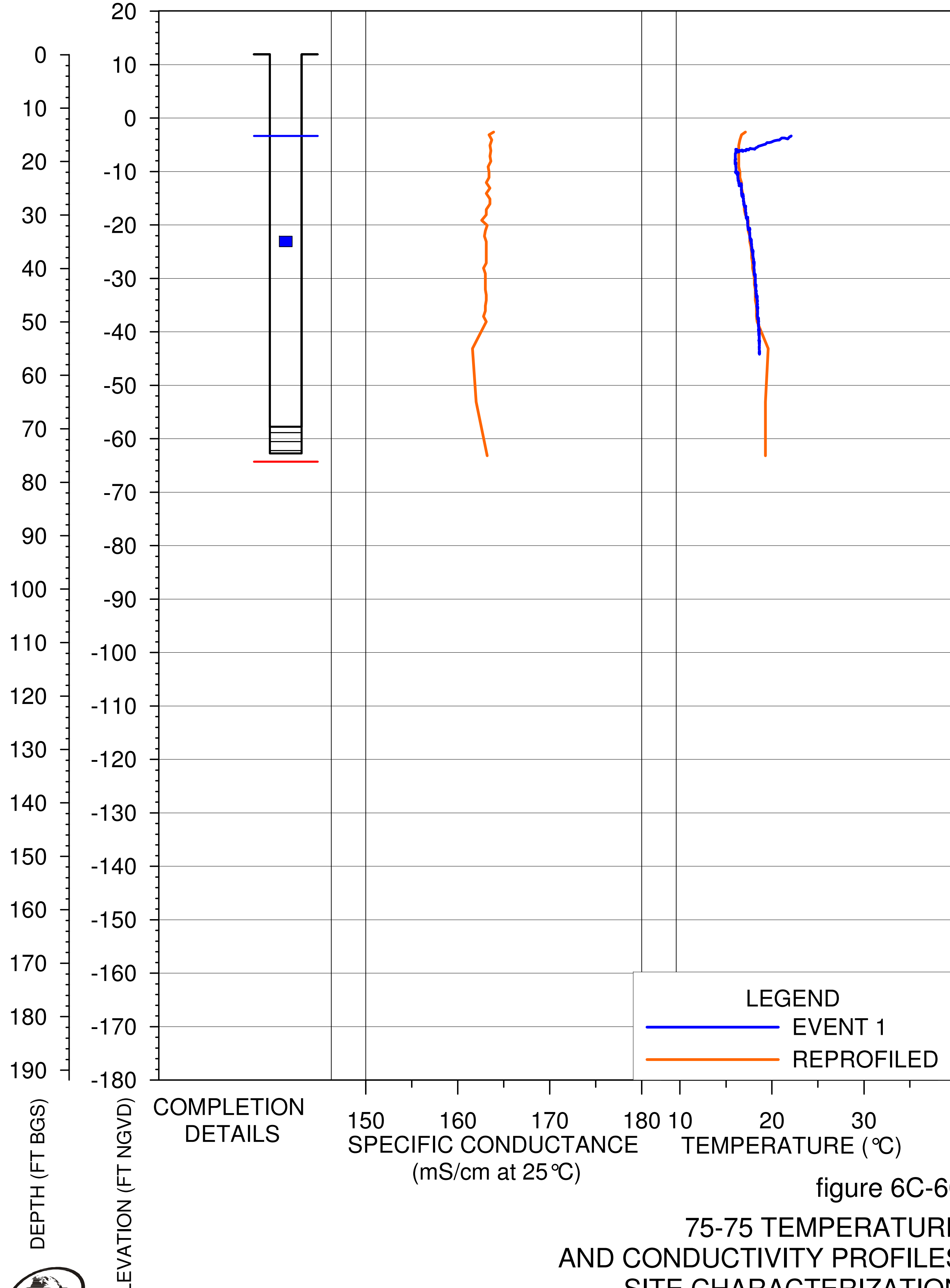


figure 6C-60

75-75 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-60.grf) JAN 3/2011

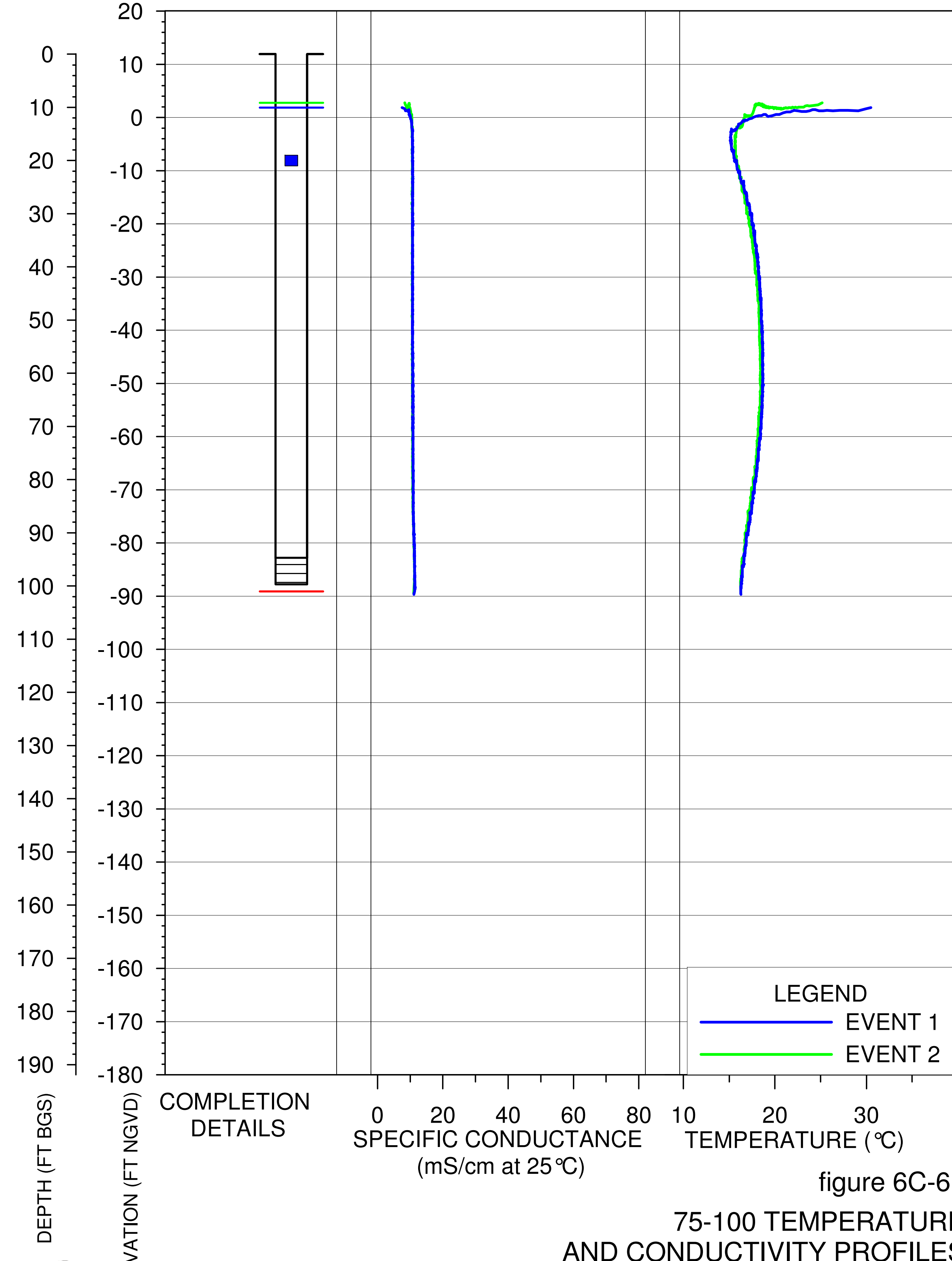


figure 6C-61

75-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

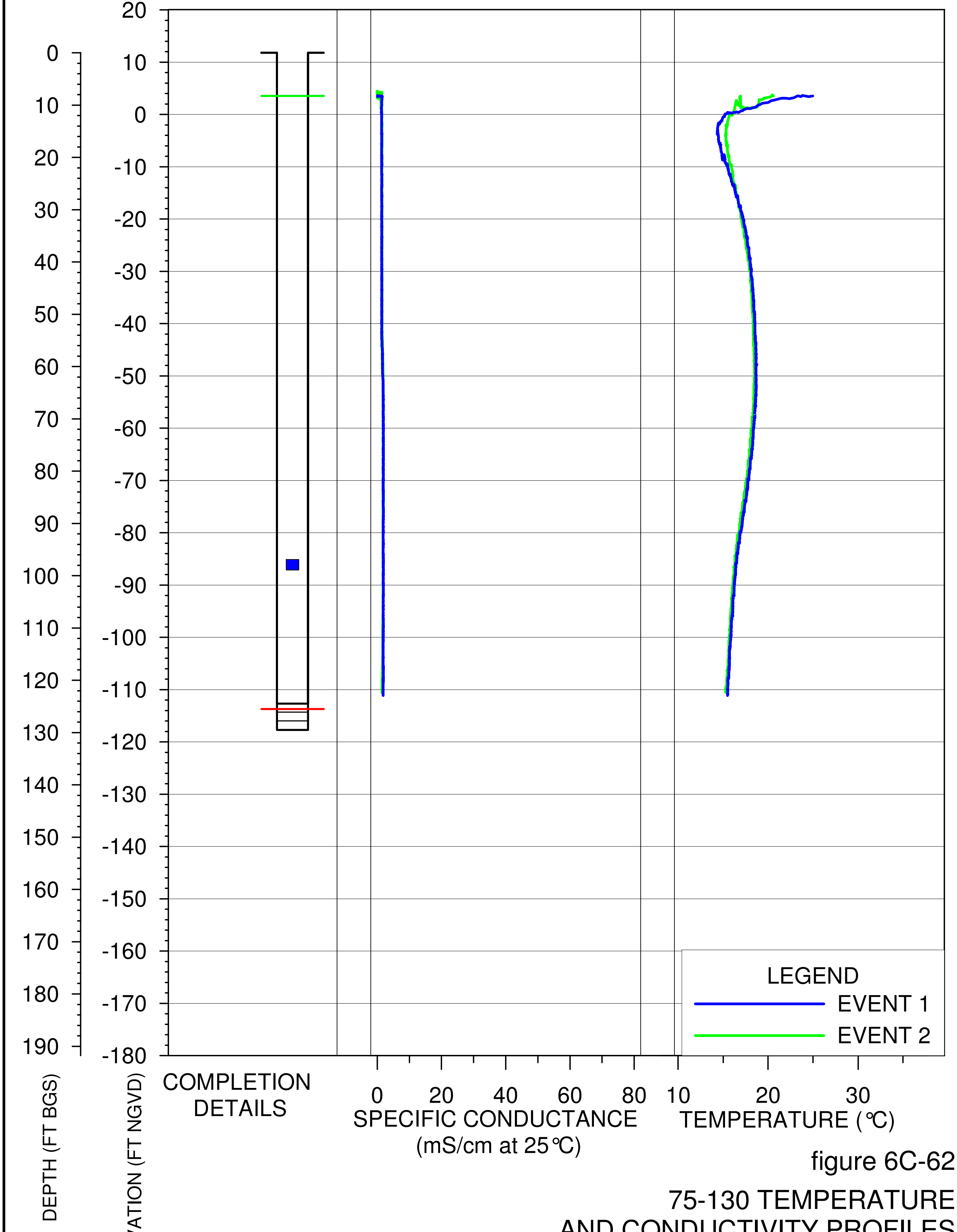


figure 6C-62

75-130 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-62.grf) JAN 3/2011

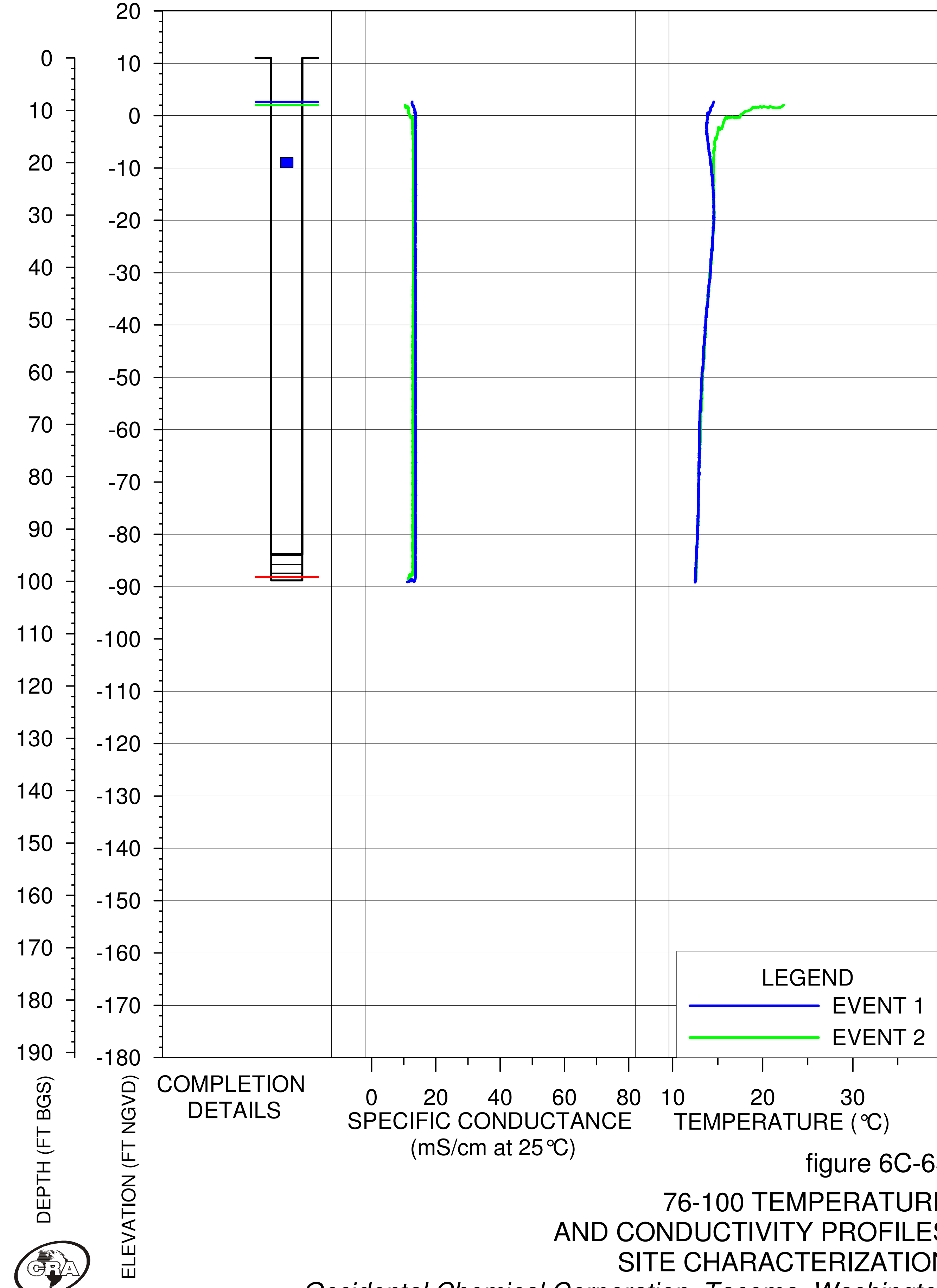


figure 6C-63

76-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

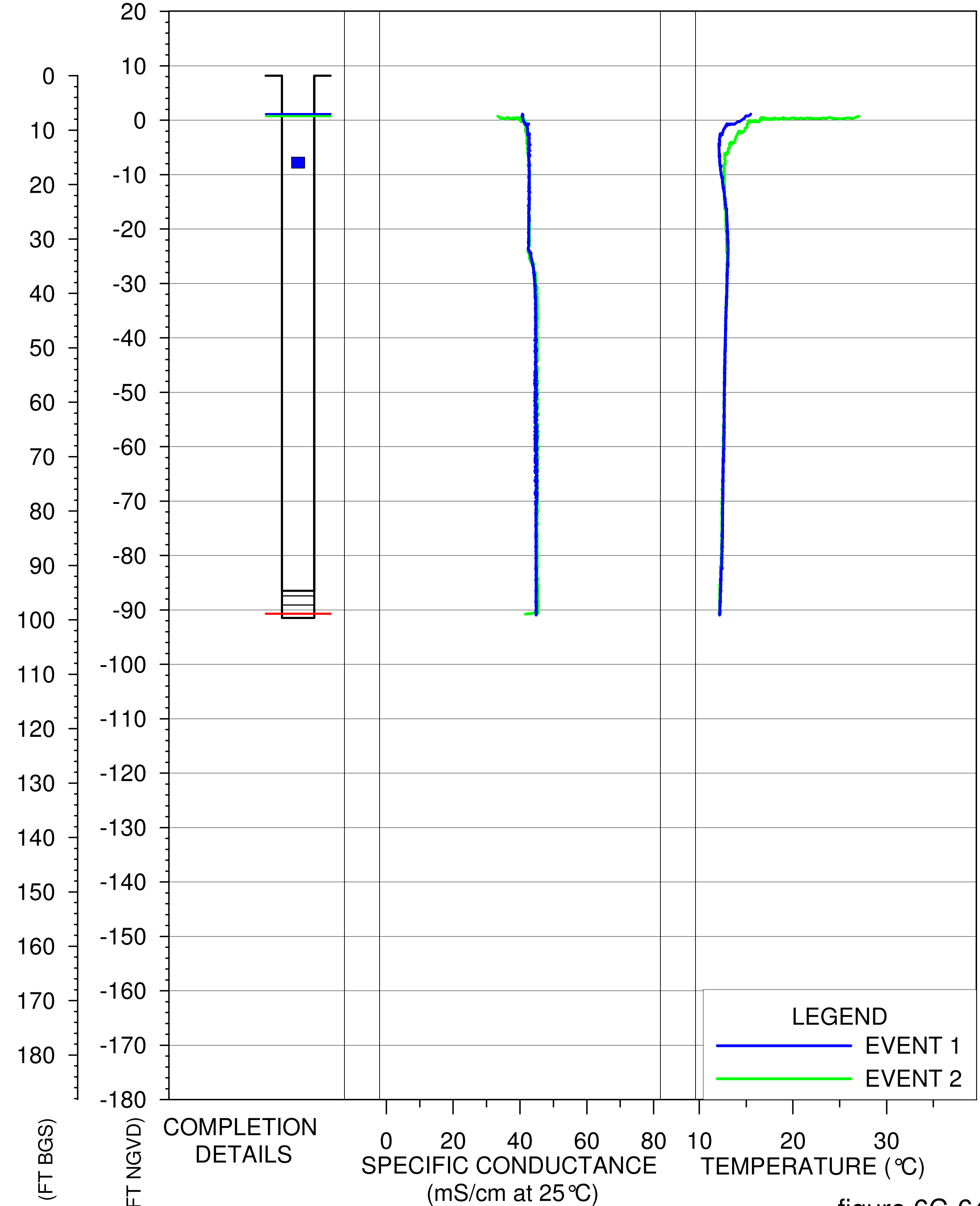


figure 6C-64

77-100 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-64.grf) JAN 3/2011

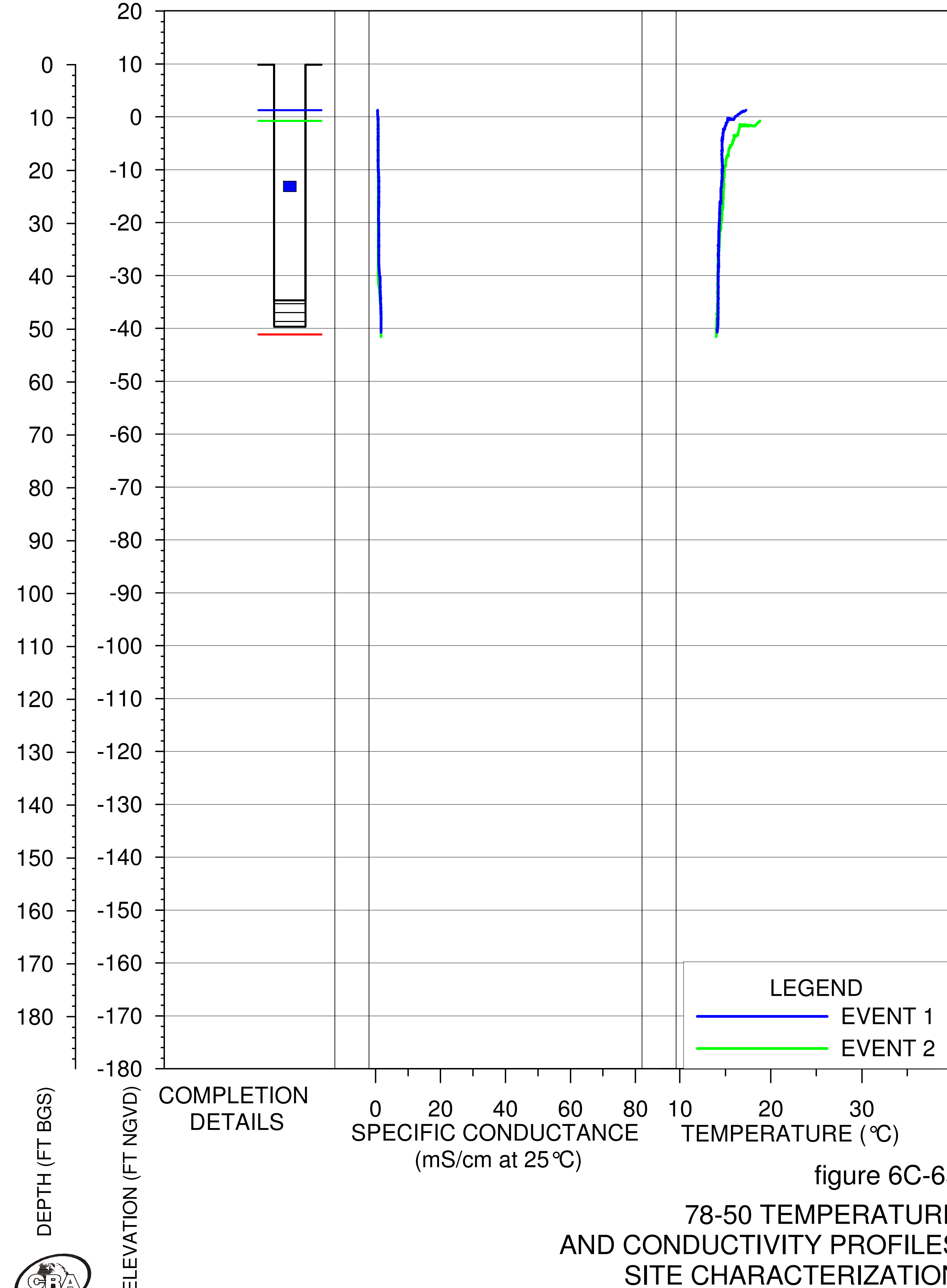


figure 6C-65

78-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

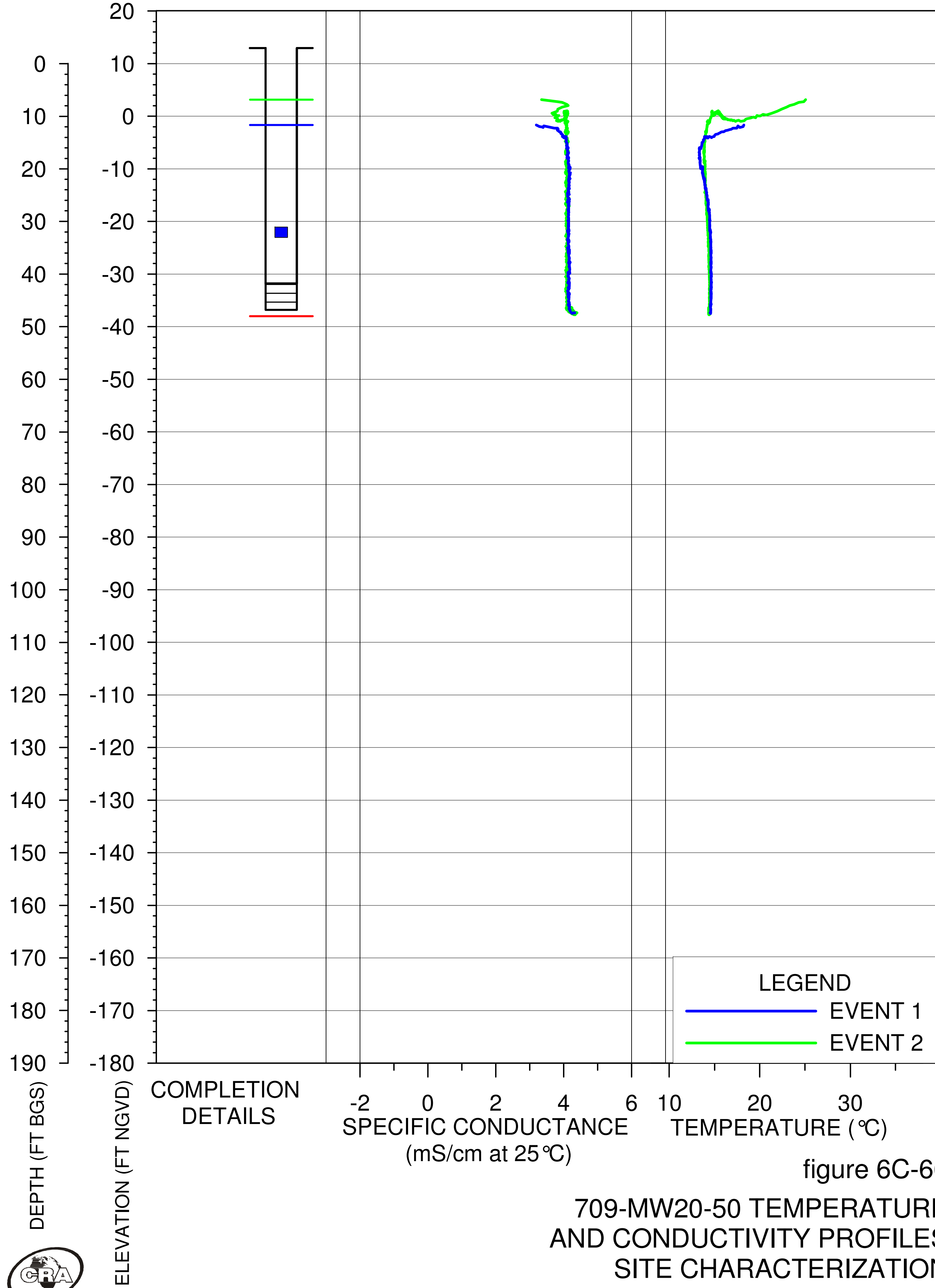


figure 6C-66

709-MW20-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-66.grf) JAN 3/2011

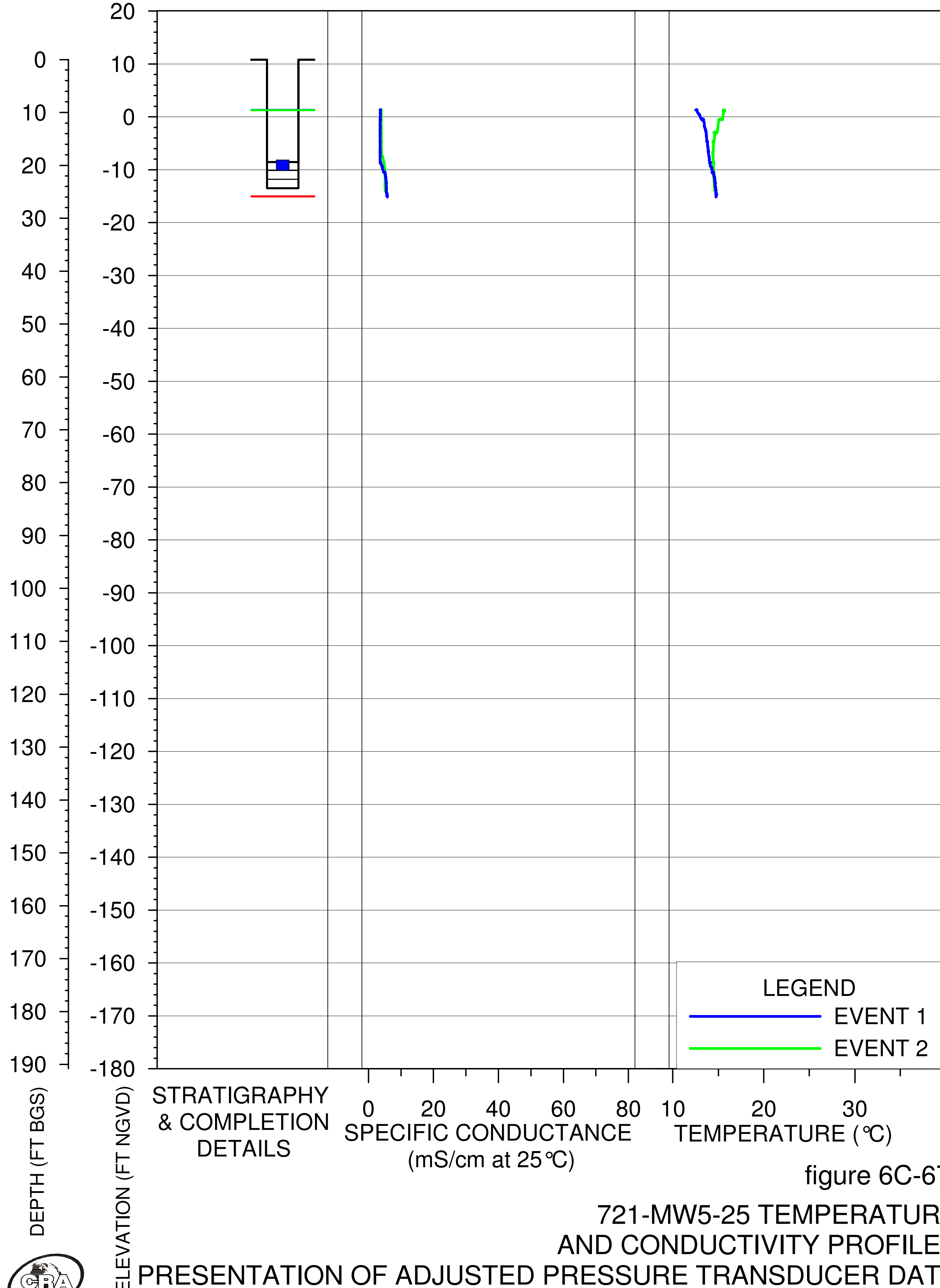


figure 6C-67

721-MW5-25 TEMPERATURE AND CONDUCTIVITY PROFILES

PRESENTATION OF ADJUSTED PRESSURE TRANSDUCER DATA

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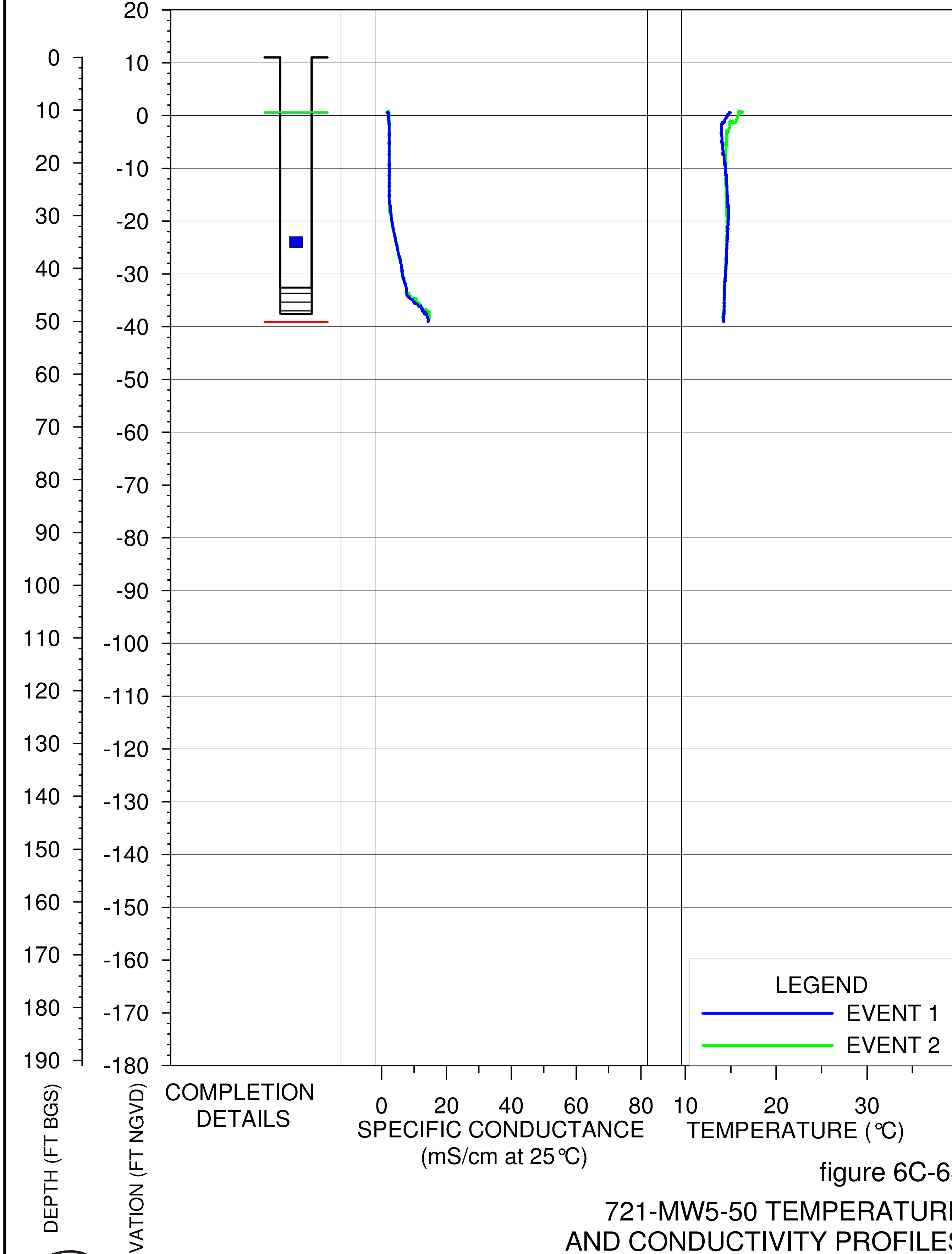

figure 6C-68

721-MW5-50 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

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07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-68.grf) JAN 3/2011

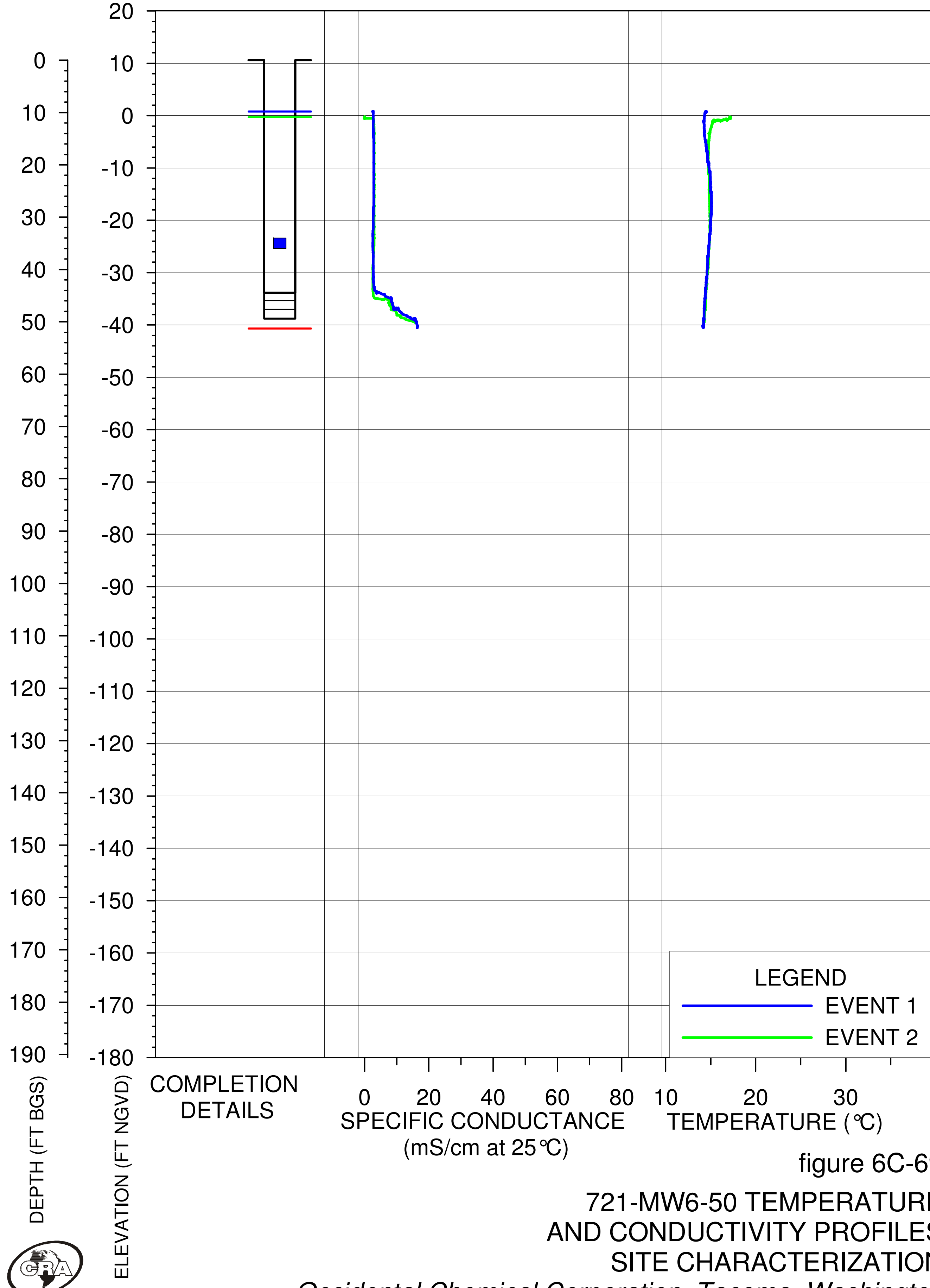

figure 6C-69

721-MW6-50 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-69.grf) JAN 3/2011

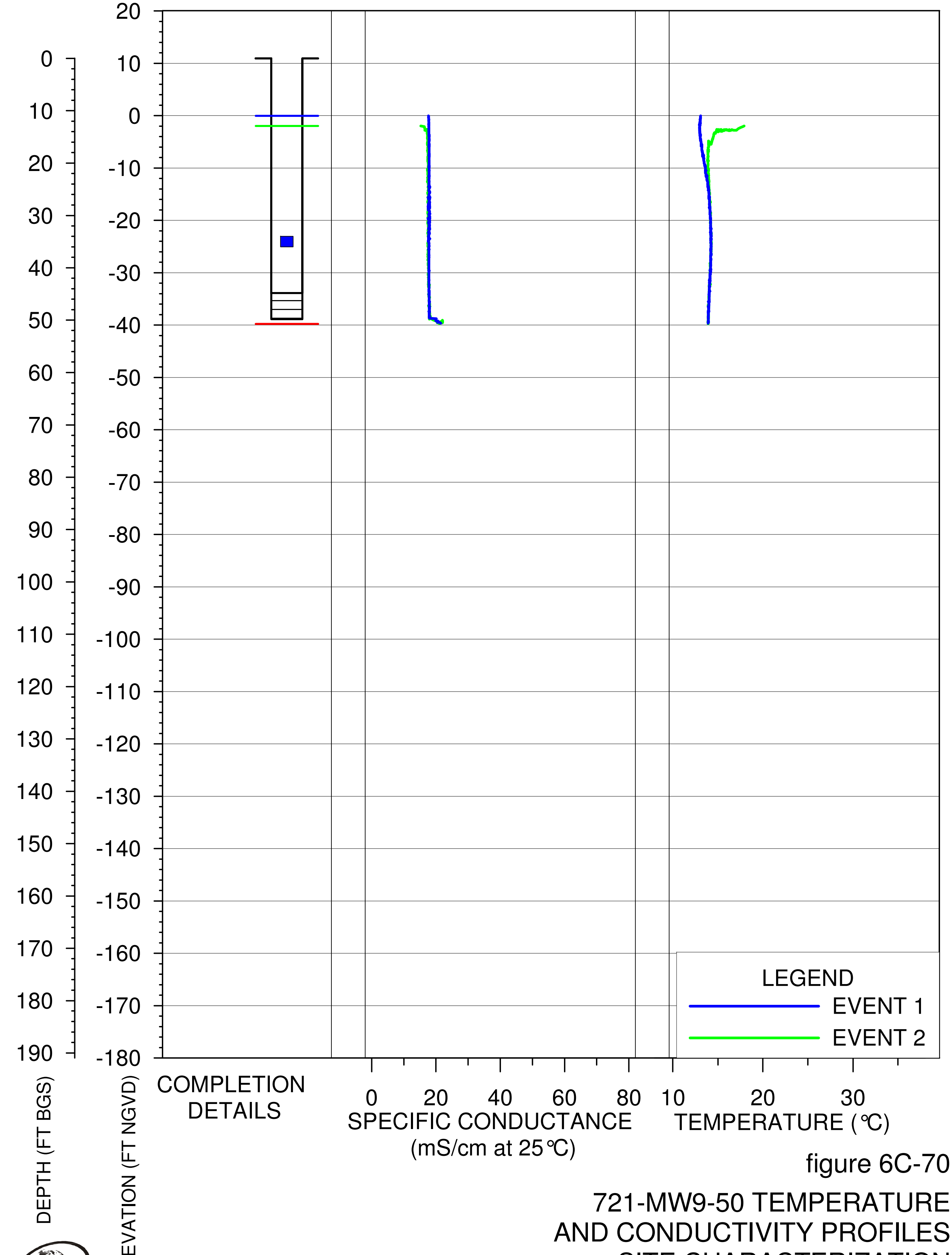

figure 6C-70

721-MW9-50 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

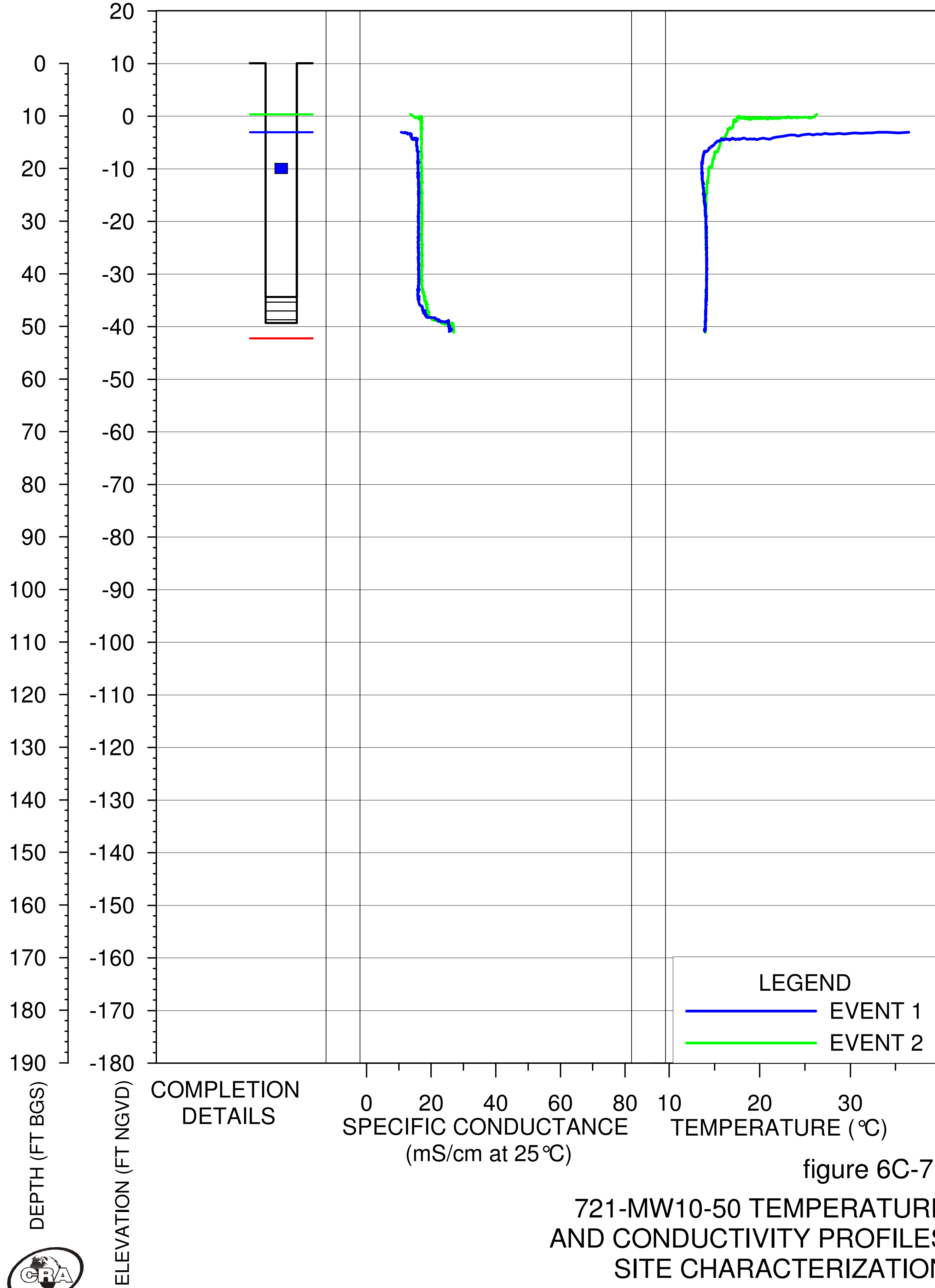

figure 6C-71

721-MW10-50 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

07843-00(083)GN-WA-HYD (N:\HEG\07843\SCR\Appl\Att6\conductivity\6C-71.grf) JAN 3/2011

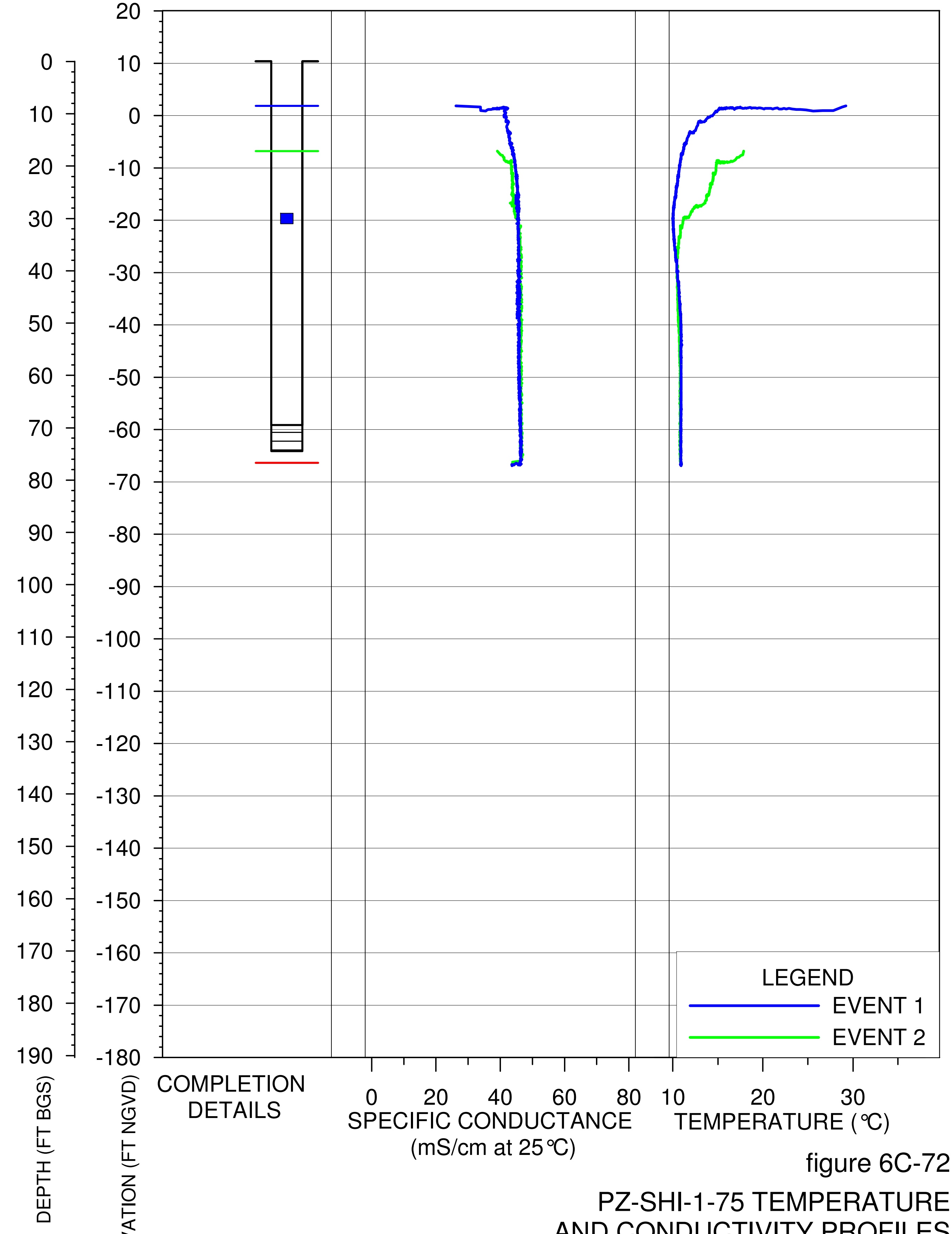

figure 6C-72

PZ-SHI-1-75 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

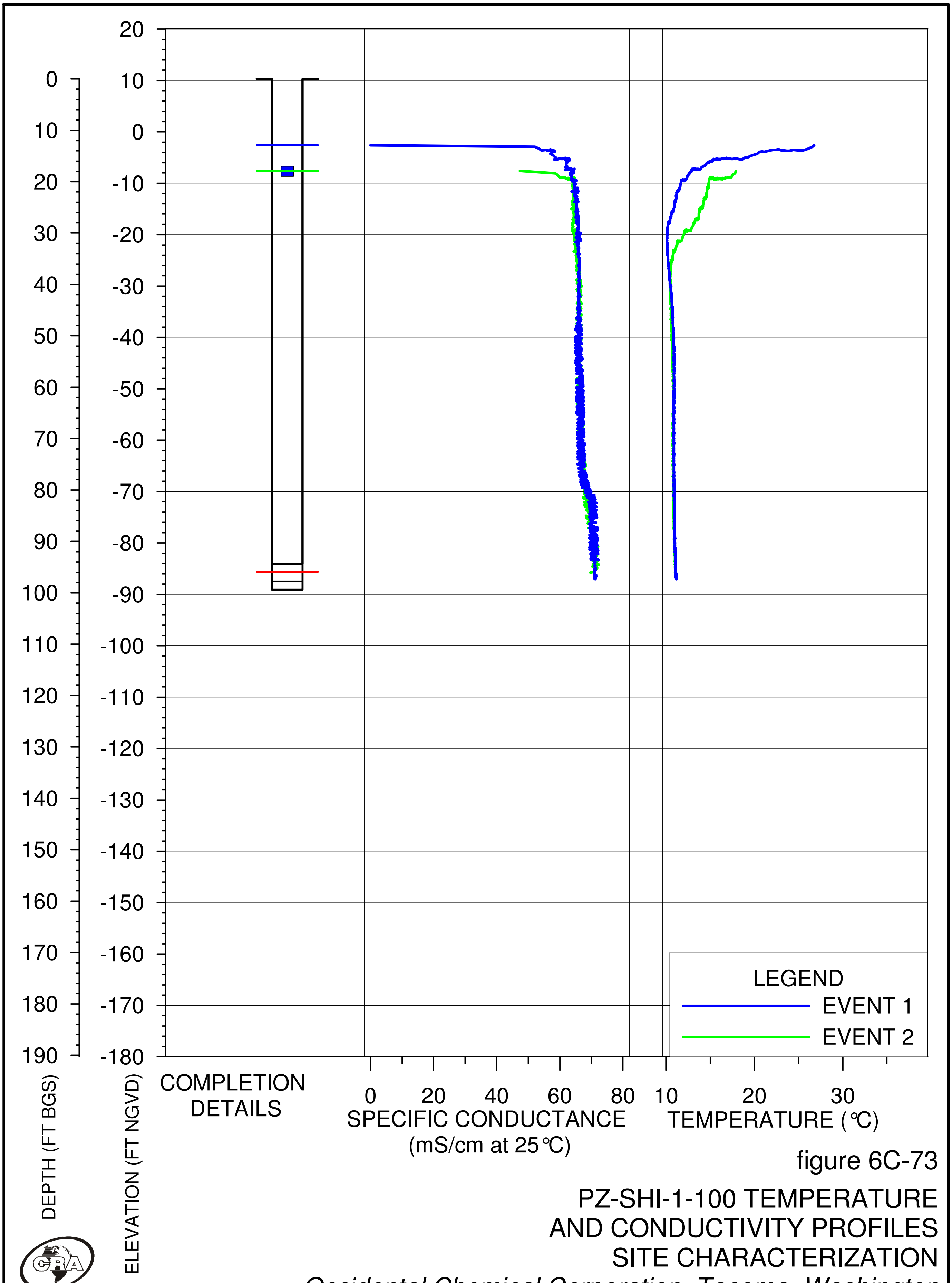

figure 6C-73

PZ-SHI-1-100 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

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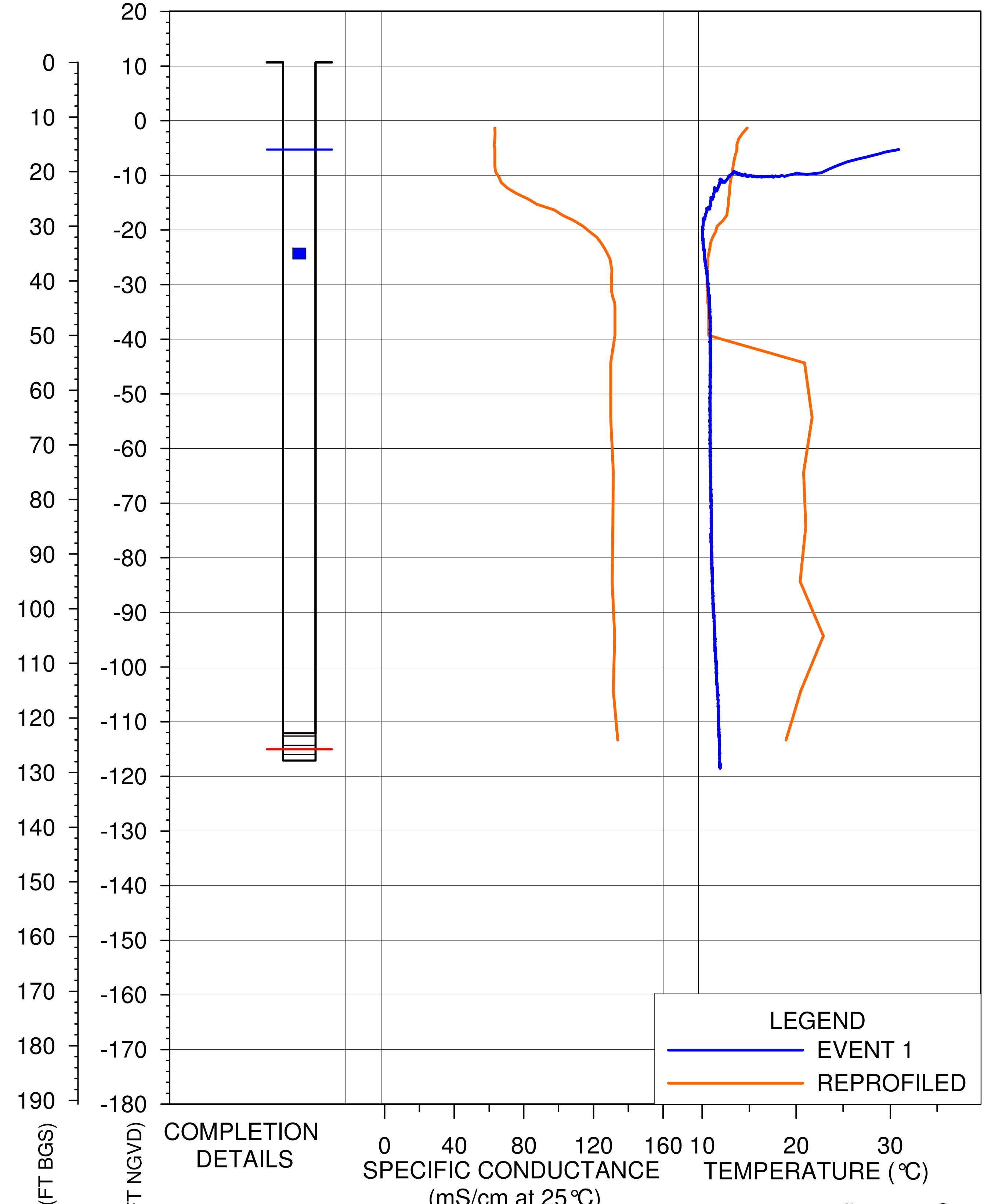

figure 6C-74

PZ-SHI-1-126 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

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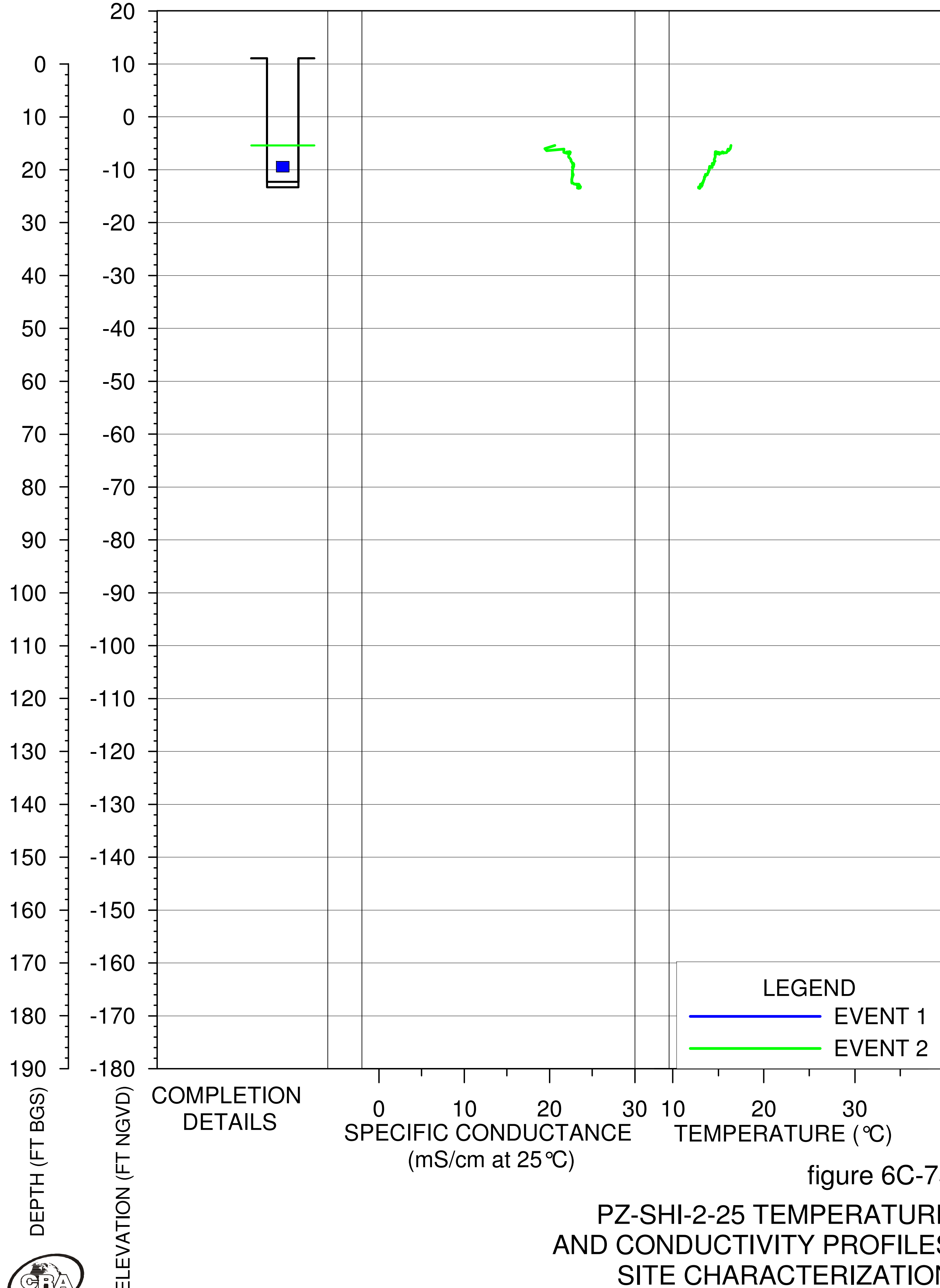

figure 6C-75

PZ-SHI-2-25 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

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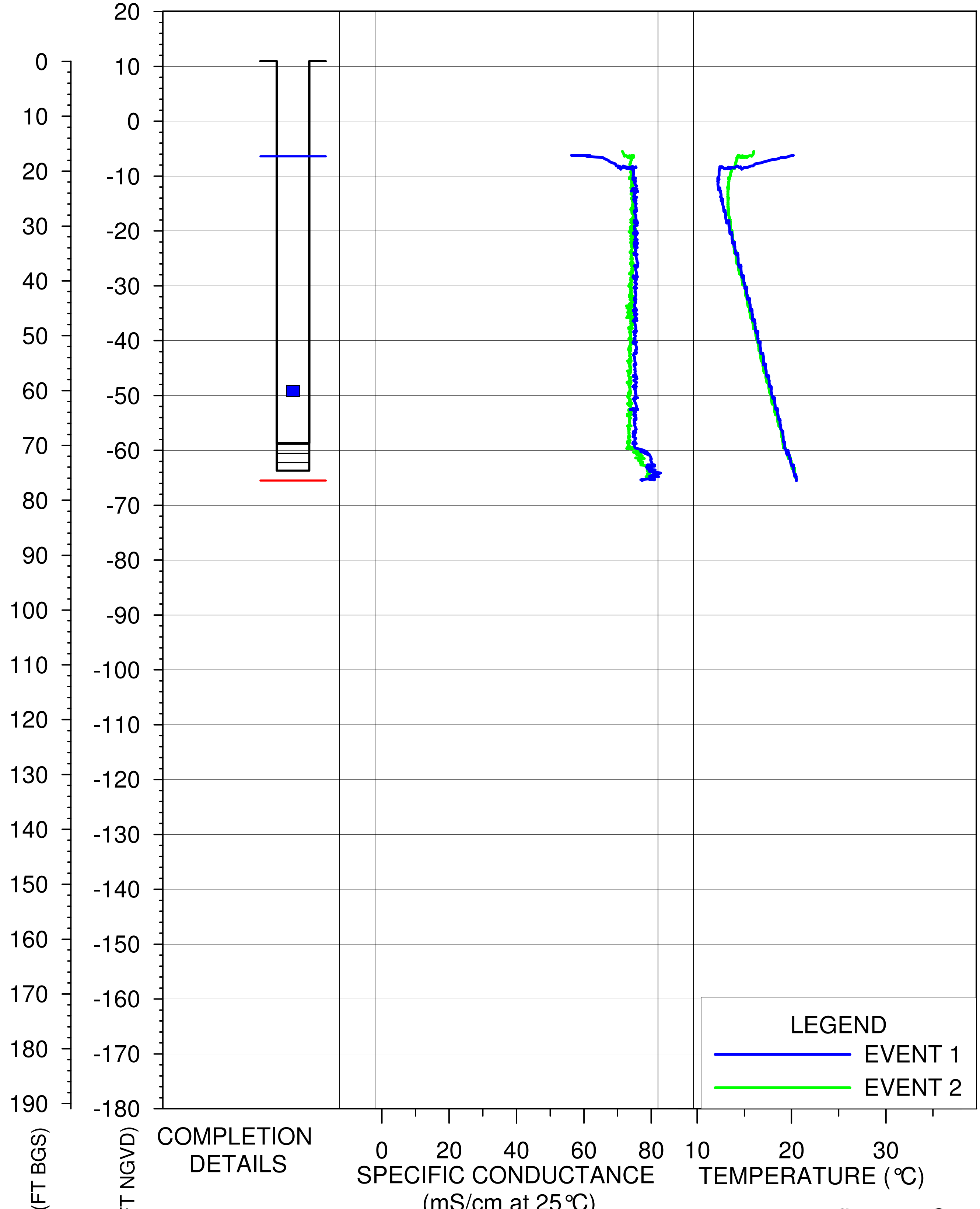

figure 6C-76

PZ-SHI-2-75 TEMPERATURE AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

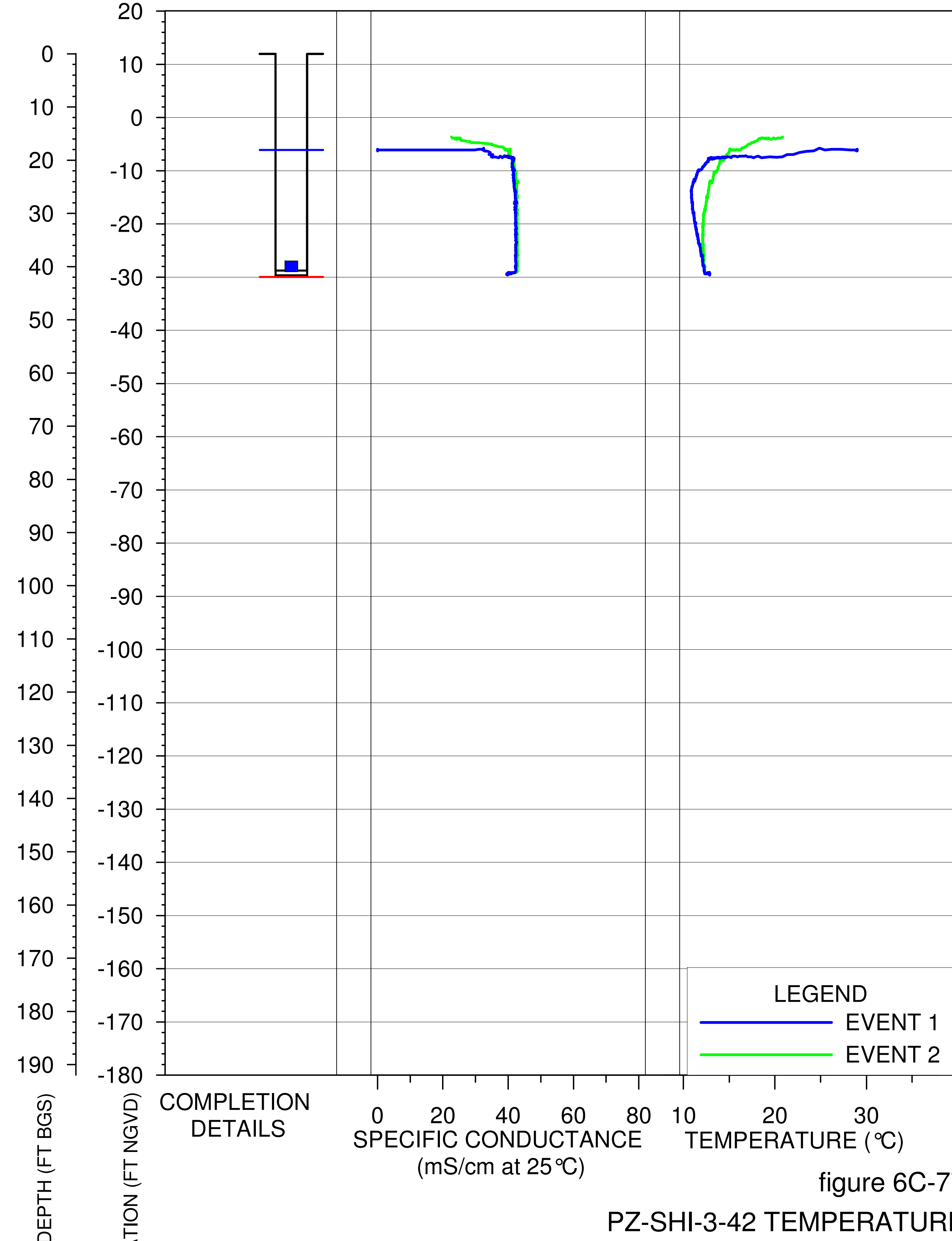

figure 6C-77

PZ-SHI-3-42 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

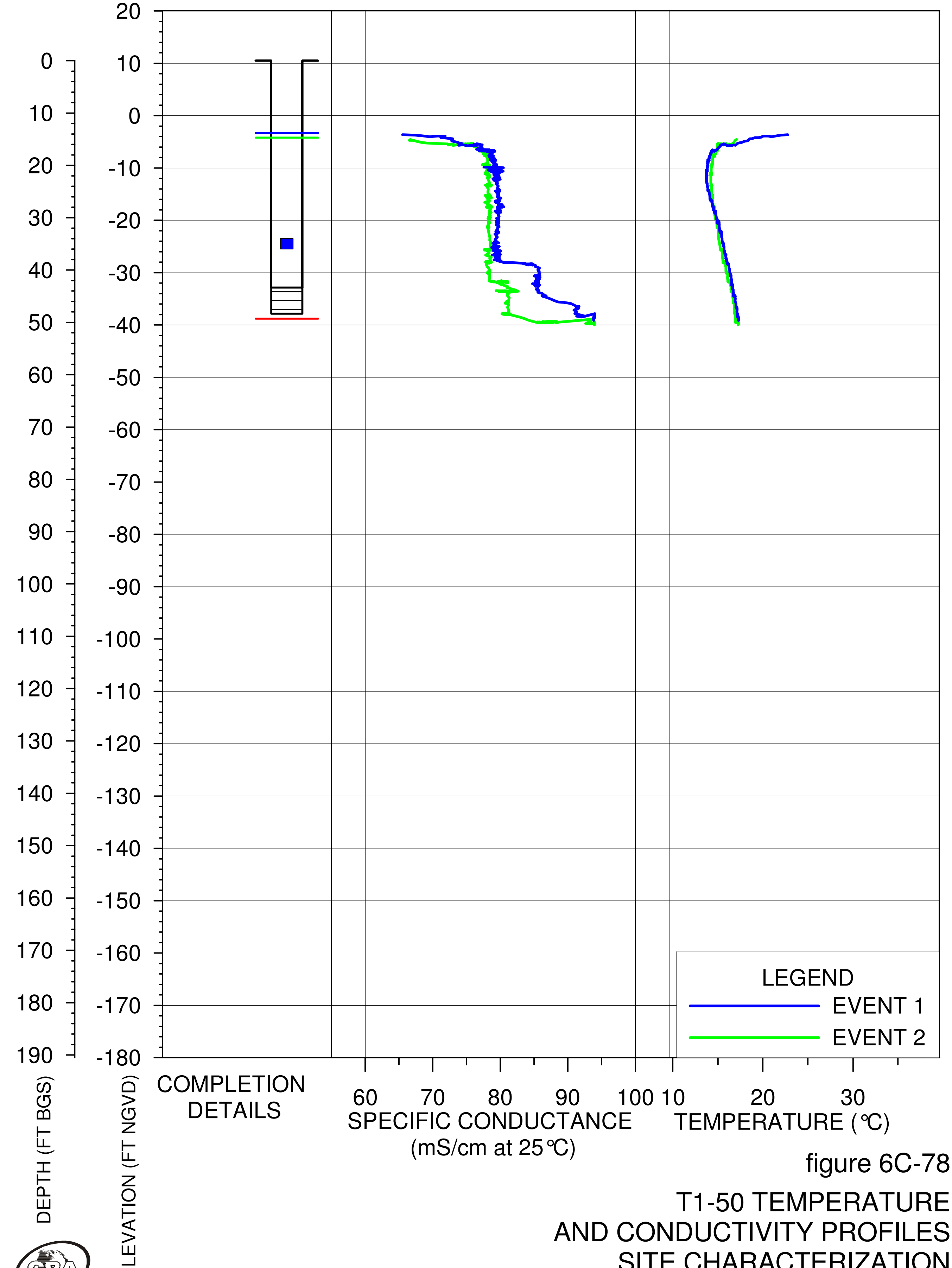

figure 6C-78

T1-50 TEMPERATURE AND CONDUCTIVITY PROFILES SITE CHARACTERIZATION

Occidental Chemical Corporation, Tacoma, Washington

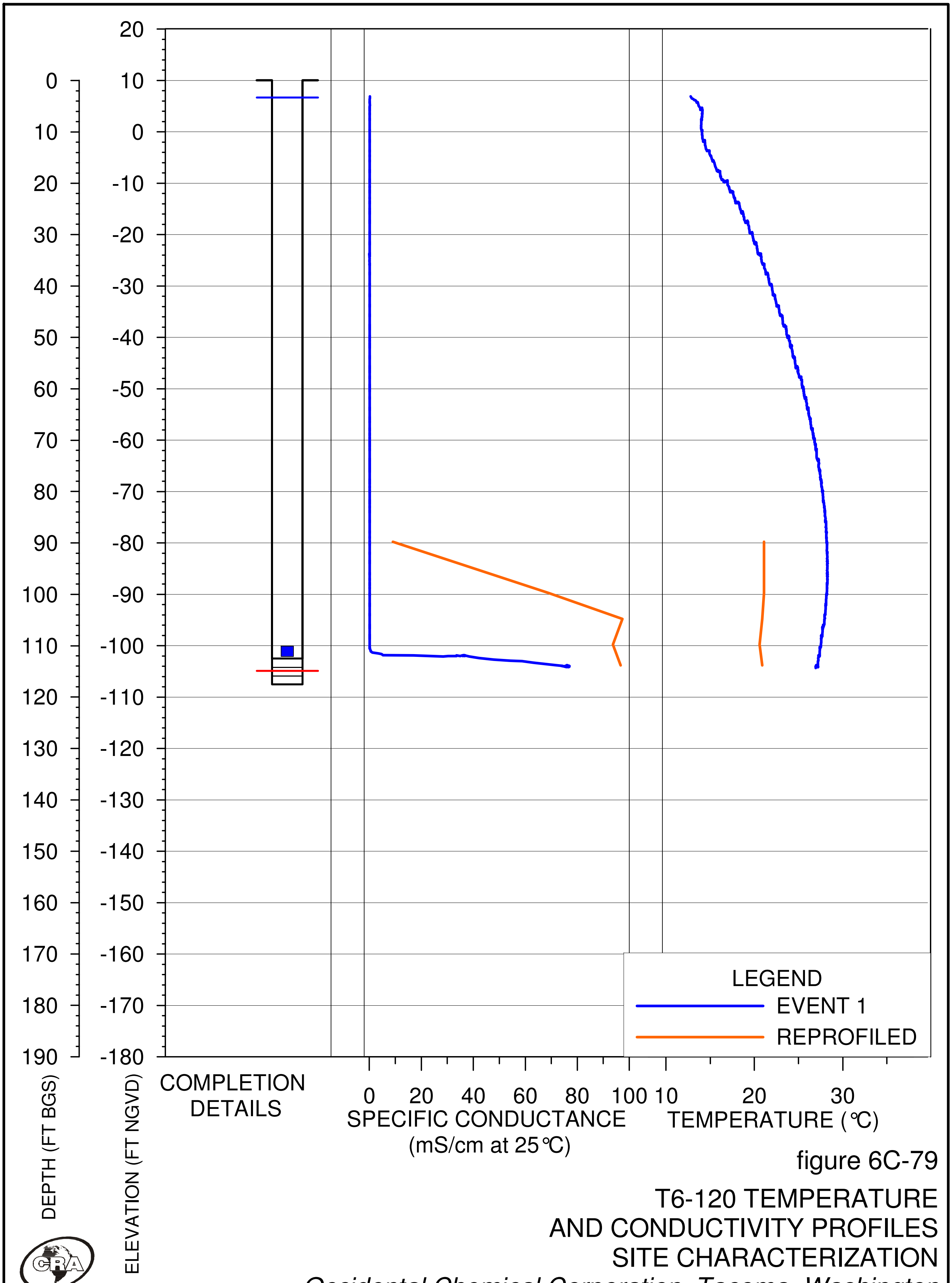

figure 6C-79

T6-120 TEMPERATURE
AND CONDUCTIVITY PROFILES
SITE CHARACTERIZATION
Occidental Chemical Corporation, Tacoma, Washington

Attachment 7

Copy of Lusczynski (1961)

JOURNAL OF GEOPHYSICAL RESEARCH VOLUME 66, NO. 12 DECEMBER 1961

Head and Flow of Ground Water of Variable Density

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Abstract. Fresh-water and environmental-water heads are shown to be useful in studying movement of ground water of variable density, such as in a system of fresh, diffused, and salt water. Fresh-water head at a given point in ground water of variable density is defined as the water level in a well filled with fresh water from that point to a level high enough to balance the existing pressure at the point. Fresh-water heads define hydraulic gradients along a horizontal. An environmental-water head at a given point in ground water of variable density is defined as a fresh-water head reduced by an amount corresponding to the difference of salt mass in fresh water and that in the environmental water between that point and the top of the zone of saturation. Environmental-water heads define hydraulic gradients along a vertical. Vertical and horizontal components of velocity in an anisotropic system with ground water of variable density are computed from hydraulic gradients defined by environmental-water and fresh-water heads, respectively, and from appropriate components of the permeability tensor. Equations for the component velocities are based on a particular generalized form of the Darcy equation. An equation showing a relation between the head observed in fresh water overlying diffused water and the elevation of the contact between fresh water and diffused water is given. The equation is based on the concept of environmental head. It is found to be a suitable basis for defining the specific limitations of the Ghyben-Herzberg and the Hubbert equations when they are used for fresh-diffused-salt water environments.

INTRODUCTION

The purpose of this paper is (1) to introduce the concept of environmental-water head and to define its relation to point-water and fresh-water heads; (2) to state and illustrate equations for determining hydraulic gradients and also rates and directions of flow from environmental-water heads along the vertical and from the fresh-water heads along the horizontal in ground water of variable density; and (3) to illustrate an equation based on environmental-water heads by means of which the specific limitations of the Ghyben-Herzberg and the Hubbert equations can be defined.

The symbols are explained as they appear in the presentation. A list of all symbols used in this paper is in Appendix 1.

1. POINT-WATER, FRESH-WATER, AND ENVIRONMENTAL-WATER HEADS

In this section, point-water, fresh-water, and environmental-water heads are defined, and equations for determining hydraulic gradients and vector velocities by use of fresh-water and environmental-water heads are stated and illustrated.

Water at a point in ground water of variable density is called point water. Point water may be fresh, diffused, or salt. The head at any point varies with the datum and the kind of water used in the well for measuring the head.

Point-water head at a point in ground water of variable density is defined as the water level, referred to a given datum,[1] in a well filled sufficiently with the water of the type at the point to balance the existing pressure at the point. From this definition (Fig. 1*a*),

$$\rho_i H_{ip} = Z_i \rho_i + p_i/g \qquad (1)$$

where

i = any point in ground water of variable density.
ρ_i = density of water at i.
H_{ip} = point-water head at i.
Z_i = elevation of i, measured positively upward.
p_i = pressure at i.
g = gravitational acceleration.

The first subscript in H_{ip} refers to the point in

[1] All heads and elevations in this paper are referred to mean-sea-level datum.

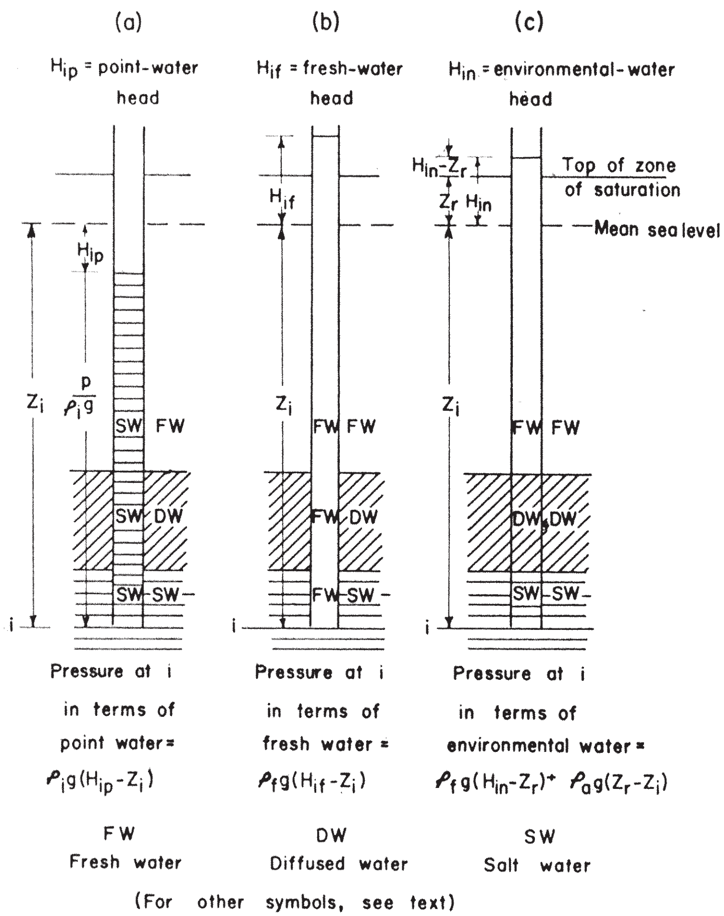

Fig. 1. Heads in ground water of variable density.

question and the second subscript signifies that the water in the well is that at the point.

Fresh-water head at any point i in ground water of variable density is defined as the water level in a well filled with fresh water from i to a level high enough to balance the existing pressure at i. The pressure at i is given by $\rho_i g(H_{ip} - Z_i)$ when point water at i is used in the well. It is given by $\rho_f g(H_{if} - Z_i)$ when fresh water is used (Fig. 1b). From this equality, the fresh-water head may be expressed in terms of the point-water head as

$$\rho_f H_{if} = \rho_i H_{ip} - Z_i(\rho_i - \rho_f) \qquad (2)$$

where

ρ_f = density of fresh water.
H_{if} = fresh-water head at i.

Environmental water between a given point in a ground-water system and the top of the zone of saturation is herein defined to be the water of constant or variable density occurring in the environment along a vertical between that point and the top of the zone of saturation. Environmental-water head at a given point in ground water of variable density is defined as a fresh-water head reduced by an amount corresponding to the difference of salt mass in fresh water and that in the environmental water between that point and the top of the zone of saturation. The reduction is occasioned, in effect, by the replacement of the fresh water in the well shown in Figure 1b by the diffused water and salt water as shown in Figure 1c at depths where diffused water and salt water occur in the environment.

Environmental-water head, as determined from the equality of pressures expressed in terms of environmental water and fresh water, is

$$\rho_f H_{in} = \rho_f H_{if} - (\rho_f - \rho_a)(Z_i - Z_r) \qquad (3)$$

where

ρ_a = average density of water between Z_r and i, as defined by

$$\frac{1}{Z_r - Z_i}\int_{Z_i}^{Z_r} \rho \, dz.$$

H_{in} = environmental-water head at i.
Z_r = elevation of reference point from which the average density of water to i is determined and above which water is fresh; elevation measured positively upward.

It can also be determined from the equality of pressures expressed in terms of environmental water (Fig. 1c) and point water (Fig. 1a) as

$$\rho_f H_{in} = \rho_i H_{ip} - Z_i(\rho_i - \rho_a) - Z_r(\rho_a - \rho_f) \qquad (4)$$

In (3) the relation between environmental-water head and fresh-water head is expressed. The relation between environmental-water head and point-water head is expressed in (4).

As stated, ρ_a is the average density of water between a selected reference point and the point in question. The reference point must be the top of the zone of saturation if the uppermost water body is not fresh. If the uppermost body is fresh, any reference point may be selected between the top of the zone of saturation and the first contact of fresh water with diffused water. When the reference point can be and is made coincident with the datum (mean sea level), $Z_r = 0$, and (3) and (4) reduce to

$$\rho_f H_{in} = \rho_f H_{if} - Z_i(\rho_f - \rho_a) \qquad (3a)$$

and

$$\rho_f H_{in} = \rho_i H_{ip} - Z_i(\rho_i - \rho_a) \qquad (4a)$$

In these equations, ρ_a is then the average density of water between mean sea level and point i.

The use of the contact of fresh water with the underlying diffused water as a reference point sets up (3) and (4) in a convenient form when this contact is of specific interest to the problem (see equation 9).

Hydraulic gradients. The gradient of (1) for any point i in ground water of variable density is

$$\nabla p_i/g + \rho_i \mathbf{k} = \nabla(\rho_i H_{ip}) - Z_i \nabla \rho_i \qquad (5a)$$

where

∇ = gradient operator.
$\mathbf{k}$ = unit vector directed upward along a vertical.

Similarly, from (1) and (2) with H_{ip} eliminated, we obtain

$$\nabla p_i/g + \rho_i \mathbf{k} = \rho_f \nabla H_{if} + (\rho_i - \rho_f)\mathbf{k} \qquad (5b)$$

Also from (3), keeping in mind that $(Z_i - Z_r)\,\partial(\rho_a)/\partial z = (\rho_i - \rho_a)$, we obtain

$$\rho_f \nabla H_{in} - (Z_i - Z_r)\left[\frac{\partial(\rho_a)}{\partial x}\mathbf{i} + \frac{\partial(\rho_a)}{\partial y}\mathbf{j}\right] = \rho_f \nabla H_{if} + (\rho_i - \rho_f)\mathbf{k} \qquad (5c)$$

where $\mathbf{i}$, $\mathbf{j}$ = unit vectors normal to one another in a horizontal plane. Equations 5a to 5c represent gradients determined from point-water densities and pressures, from point-water densities and point-water heads, from fresh-water density and fresh-water heads, or from fresh-water density and environmental-water heads.

Equation 5c is of special value to this paper because of the following. Along a vertical, the left-hand side of (5c) reduces conveniently to $\rho_f(\partial H_{in}/\partial z)$, which is simply a product of fresh-water density and a gradient defined by environmental-water heads. Along any horizontal, the right-hand side of (5c) reduces to $\rho_f(\partial H_{if}/\partial x)$, which is simply a product of a fresh-water density and a gradient defined by fresh-water heads.

Because environmental-water heads define hydraulic gradients along a vertical, they are comparable along a vertical. This is evidently not the case for point-water or fresh-water heads. Also, because fresh-water heads define hydraulic gradients along a horizontal in ground water of variable density, they are comparable along a horizontal. This is not the case for point-water or environmental-water heads.

Velocity components. A vector velocity is the rate and direction of flow. A variation of the

Darcy equation expressing vector velocity for steady flow at a point in a ground-water system is

$$\mathbf{q}_i = -\frac{k_i}{\mu_i} g \left[\frac{\nabla p_i}{g} + \rho_i \mathbf{k} \right] \qquad (6)$$

where

$\mathbf{q}$ = vector velocity at i.
k_i = permeability of the medium at i.
μ_i = dynamic viscosity at i.

The proper value of permeability depends on the medium. In an isotropic medium the permeability is constant in all directions. In an anisotropic medium the permeability varies with direction and is a tensor. The permeability tensor has three principal directional permeabilities according to the tensor theory of permeability substantiated by *Scheidegger* [1957, pp. 47–66]. He summarized the results of studies on directional permeabilities in anisotropic media made by him and other investigators. He referred to Ferrandon and Litwiniszyn, who developed more-or-less identical theories on the permeability tensor and on flow through anisotropic media. The theories state in effect that the vector velocity may be computed from (6) using a symmetric permeability tensor with components K_{rs}.

For the bracketed term in (6), any one of its equivalents in (5*a-c*) may be used with components K_{rs} of the permeability tensor to define velocity components in ground water of variable density. The use of (5*c*) in (6) is suited for the definition of specific component velocities from environmental-water and fresh-water heads as indicated in the two following paragraphs.

For the case of random orientation of coordinates in relation to the axes of principal directional permeabilities, components of velocity in (6) may be expressed in terms of the components K_{rs} of the permeability tensor and in terms of gradients of environmental-water and fresh-water heads from (5*c*), as follows:

$$v_x = -K_{11} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial x} \right] - K_{12} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial y} \right] - K_{13} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{in}}{\partial z} \right] \qquad (7a)$$

$$v_y = -K_{21} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial x} \right] - K_{22} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial y} \right] - K_{23} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{in}}{\partial z} \right] \qquad (7b)$$

$$v_z = -K_{31} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial x} \right] - K_{32} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial y} \right] - K_{33} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{in}}{\partial z} \right] \qquad (7c)$$

where v_x, v_y, and v_z are velocity components along the x, y, and z coordinates, respectively, and where the K_{rs} components are as indicated in Appendix 2.

When the x and y coordinates are horizontal, the z coordinate is vertical, and when the coordinates coincide with the axes of the principal directional permeabilities,

$$v_x = -K_{11} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial x} \right] \qquad (8a)$$

$$v_y = -K_{22} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{if}}{\partial y} \right] \qquad (8b)$$

and

$$v_z = -K_{33} \frac{g}{\mu_i} \left[\rho_f \frac{\partial H_{in}}{\partial z} \right] \qquad (8c)$$

where K_{11}, K_{22}, K_{33} are, in this case, the principal directional permeabilities in the x, y, z directions.

Thus, in an anisotropic medium with horizontal beds, the components of velocity in the two horizontal directions corresponding to the axes of the two principal directional permeabilities may be computed from (8*a*) and (8*b*) by using in each case the appropriate directional permeability, gravity, viscosity of water, density of fresh water, and the hydraulic gradient defined by fresh-water heads. The vertical component of velocity may be computed from (8*c*) by using the principal directional permeability along the vertical, gravity, viscosity of water, density of fresh water, and the hydraulic gradient defined by environmental-water heads.

Because the permeability in an anisotropic medium is a tensor, the direction of flow is usually not parallel to the hydraulic gradient. The direction of flow is defined by the resultant of velocity components defined by (7*a-c*) or (8*a-c*).

Example. The use of environmental-water heads and fresh-water heads for defining hydraulic gradients and velocities at points in an aquifer having fresh, diffused, and salt water is to be illustrated by data furnished through the courtesy of the Government Institute of Water Supply in the Netherlands. The Institute supplied information on water levels and chloride concentrations for July 1957 at suites of wells, each screened at a different depth at each of seven observation and sampling stations in the dune area near The Hague (Fig. 2). The stations are in the general vicinity of infiltration canals and ponds by means of which imported river water is recharged to the ground-water system. Also, ground water is pumped from several nearby areas. The geologic environment consists of dune sand above sea level, a clay layer at about sea level, fine to coarse sand zones to depths of about 50 m below sea level, and then fine and silty sand interspersed with layers and lenses of clay below sea level to depths of about 100 m below sea level. These deposits are anisotropic and essentially horizontal.

The data are used in this paper only to illustrate the use of environmental-water and fresh-water heads for determining hydraulic gradients and velocities in water of variable density. Actually, the computed heads, gradients, directions, and velocities may not be precise because (*a*) the point-water heads and chlorides were not observed on the same day in July 1957, (*b*) heads are reportedly accurate only to the nearest 0.02 m, and (*c*) densities were computed on the basis of 1.025 g/ml for a water with 18,000 ppm chlorides. Two-dimensional steady-state flow was also assumed.

Point-water, fresh-water, and environmental-water heads are given in Figure 2. Fresh-water heads were determined by (2) and environmental-water heads by (3) or (3*a*).

Point-water heads in fresh water are also envirionmental-water heads and as such compare directly with environmental-water heads in the diffused water along the verticals. The environmental-water heads at the seven stations indicate components of flow upward at some points and downward at other points in the fresh water as well as in the diffused water.

Point-water heads in fresh water are also fresh-water heads, and as such compare with fresh-water heads in the diffused water along the horizontals. Fresh-water heads at the seven stations indicate components of flow in a landward direction at most of the points in the fresh water as well as in the diffused water.

Consider the point at the −54-m elevation at station MN. A hydraulic gradient of about 0.001 in favor of a downward component of flow is computed from the tangent at the point in question to the environmental-water head vs. depth curve. Also a gradient of about 0.0015 in favor of a landward component of flow is computed from the tangent at the point in question to the fresh-water head vs. distance curve. (A fresh-water head of 1.12 m at the −54-m elevation at station N was used for this purpose. It was determined by (4*a*) from an environmental-water head interpolated between that of 1.03 m at the −47-m elevation and 1.04 m at the −56-m elevation.)

If we compare the direction of flow with that of the resultant hydraulic gradient at the −54-m elevation at station MN and assume that the horizontal and vertical permeabilities at the point are the same as the principal directional permeabilities, then the direction flow may be determined from the horizontal and vertical velocity components computed by (8*a*) and (8*c*), respectively, by using the horizontal and vertical permeabilities and the gradients defined by fresh-water and environmental-water heads. For an assumed ratio of horizontal to vertical permeability of 5, the direction of flow at the −54-m elevation at station MN would be landward and downward at an angle of 8° from the horizontal. For an assumed ratio of 10, the direction would be 4° from the horizontal. If these ratios were of the right order of magnitude, the direction of flow at the point would be landward and essentially horizontal. In comparison, the resultant hydraulic gradient was landward and downward at an angle of about 34° from the horizontal.

The horizontal permeability at the −54-m elevation is about 25 millidarcys (1 millidarcy = 0.001 cm/sec). This is estimated from the range of values furnished by the Institute. On the basis of this permeability, a horizontal gradient

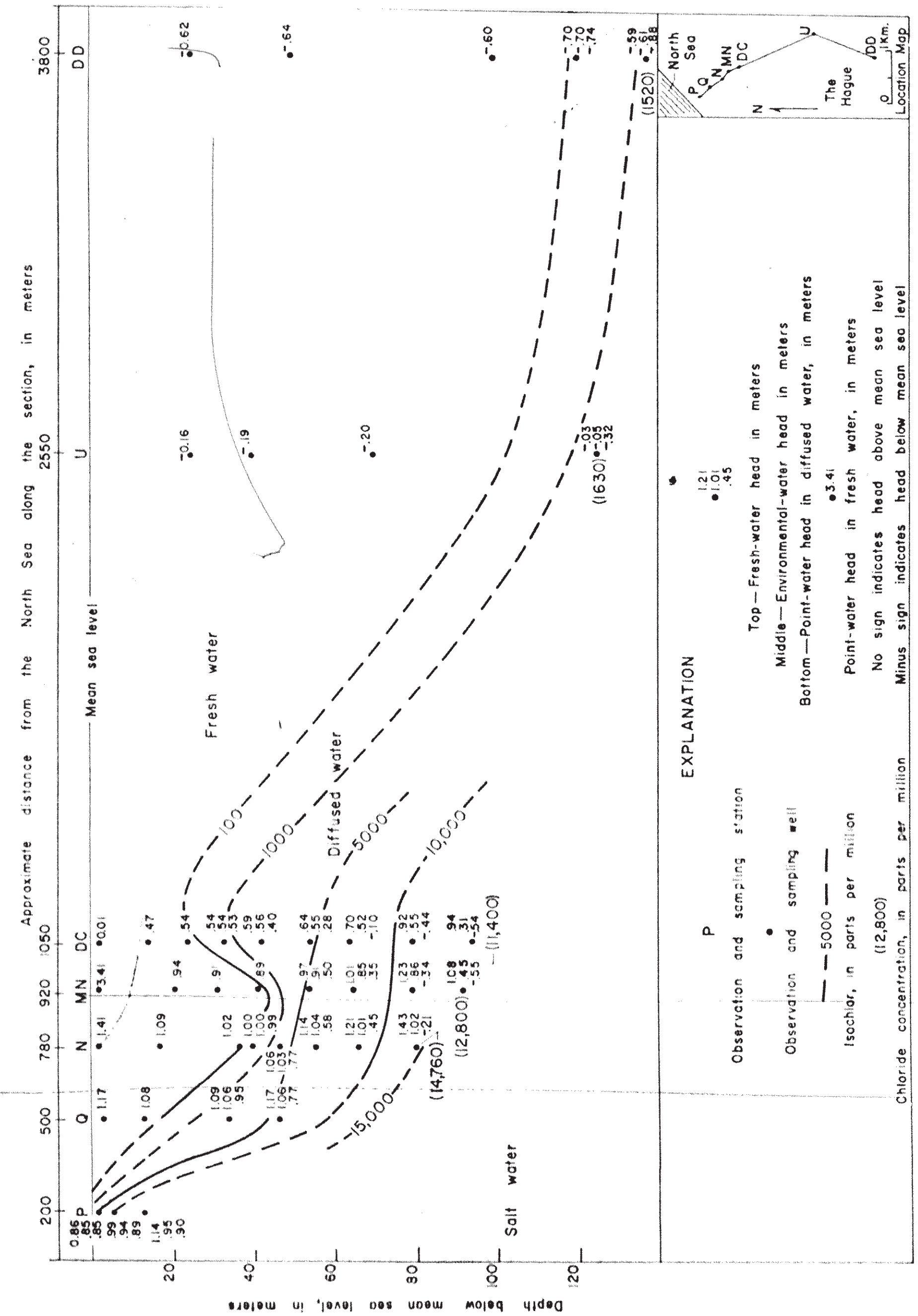

Fig. 2. Heads in coastal ground-water system near The Hague, Netherlands, along section P-DD.

of 0.0015, and a porosity of 1/3, the component of actual velocity[2] along the horizontal would be landward at about 9.7 cm/day (about 0.3 ft/day) at the −54-m elevation in station MN. On the basis of a horizontal to vertical ratio of 5 to 10, a vertical gradient of 0.001, and a porosity of 1/3, the component of actual velocity[3] along the vertical would be downward at about 1.3 to 0.6+ cm/day (about 0.04 to 0.02 ft/day).

2. Equation 9 vs. Ghyben-Herzberg and Hubbert Equations

In this section an equation based on the concept of environmental-water head is used for defining the specific limitations of the Ghyben-Herzberg and Hubbert equations when they are used for fresh-diffused-salt water environments.

Let h denote the difference between the environmental-water head at any point 1 in fresh water and that at any point 2 in salt water along a vertical in a ground-water system having fresh water, diffused water, and salt water (top to bottom). Actually h represents the head loss due to vertical velocities between points 1 and 2. From (4), written for points 1 and 2, we get

$$\rho_1 H_{1p} = \rho_1 h + \rho_2 H_{2p} - Z_2(\rho_2 - \rho_a) - Z_d(\rho_a - \rho_1) \qquad (9)$$

where $h = H_{1n} - H_{2n} = H_{1p} - H_{2n}$ and where Z_d is the elevation of the contact of fresh water with diffused water and also of the reference point from which ρ_a is computed. A derivation of (9) from the Darcy equation is given in Appendix 3.

Equation 9 may be interpreted as a relation between H_{ip}, a point-water or fresh-water head in fresh water, and Z_d, the elevation of the contact of fresh water with diffused water. The relation includes a term which accounts for the difference in environmental-water head between points 1 and 2, a term which accounts for the point-water head in salt water, and two terms which account for the variable density in the zone of diffusion.

Using the symbols of this paper, the Ghyben-Herzberg equation [*Ghyben*, 1889; *Herzberg*, 1901] is

$$\rho_1 H_{1p} = -Z_d'(\rho_2 - \rho_1) \qquad (10)$$

[2] v_x from (8*a*) divided by the porosity.
[3] v_z from (8*c*) divided by the porosity.

where H_{ip} is the water table and Z_d' is an approximate depth to diffused water. Thus (10) is evidently a special case of (9) in which $h = 0$ and $\rho_a = \rho_2$. Then $Z_d = Z_d'$. Therefore the depth to diffused water computed by the Ghyben-Herzberg equation is correct or approximately correct when (*a*) the difference in environmental-water head between points 1 and 2 is zero or relatively small, (*b*) the point-water head in salt water is zero or relatively small, and (*c*) the zone of diffusion is of zero or relatively small thickness. If only the (*a*) and (*b*) conditions are met, Z_d' is a depth to an indefinite point in the zone of diffusion.

In symbols of this paper, *Hubbert*'s [1940] equation 189 is

$$\rho_1 H_{1p} = \rho_2 H_{2p} - Z_d''(\rho_2 - \rho_1) \qquad (11)$$

This equation expresses the correct relation between Z_d'', the contact or interface between two immiscible liquids ρ_1 and ρ_2 (for $\rho_2 > \rho_1$), and H_{1p} and H_{2p} on the ρ_1-side and ρ_2-side, respectively, of a given point on the interface of the two liquids. Equation 11 would define the contact between fresh water and salt water with a sharp interface. It was used by *Perlmutter, Geraghty, and Upson* [1959] for determining an elevation of such a theoretical contact of fresh water with salt water. The computed elevation was shown to be within the diffused water in an actual fresh-diffused-salt water environment. For the computations, the heads observed at points some distance apart in a vertical were used; one point was in fresh water and the other in salt water. Equation 11 is valid when the head loss due to vertical velocities between the points of observation is negligible. Then at least an approximate elevation of the theoretical contact of fresh water with salt water is determined.

The head loss between any two points in a vertical is actually the difference in environmental heads between the two points. It is defined by the $\rho_1 h$ term in (9). When not negligible, this term should be included with (11) as in the following:

$$\rho_1 H_{1p} = \rho_1 h + \rho_2 H_{2p} - Z_d'''(\rho_2 - \rho_1) \qquad (12)$$

Equation 12 is then a special case of (9) in which $\rho_a = \rho_2$ and $Z_d = Z_d'''$. It may be interpreted as a relation between H_{1p}, a point-water head in fresh water, and Z_d''', the actual elevaion of the theoretical contact between fresh water and salt water.

Examples. Compare the Z_d elevations computed by (10–12) using the following data for two selected points at station N (Fig. 2) near The Hague in the Netherlands:

$$\rho_1 = 1.000 \text{ g/ml}$$

$$\rho_2 = 1.0205 \text{ g/ml}$$

$$H_{1p} = 1.09 \text{ m}$$

$$H_{2p} = -.21 \text{ m}$$

$$Z_1 = -17 \text{ m}$$

$$Z_2 = -80 \text{ m}$$

Sufficient information was obtained at six additional points in the vertical (Fig. 2) to define the contact between fresh water and diffused water at −37 m and to compute $h = +0.07$ m between points 1 and 2.

$Z_d' = -53$ m was computed by the Ghyben-Herzberg equation (10), $Z_d'' = -64$ m by the Hubbert equation (11), and $Z_d''' = -60$ m by (12). The difference of −11 m between Z_d' and Z_d'' is attributed to the term $\rho_2 H_{2p}$; the difference of +4 m between Z_d'' and Z_d''' is due to the 0.07-m difference in environmental heads at points 1 and 2. Because the corrections in this case are small, the Ghyben-Herzberg and Hubbert equations give elevations within the zone of diffusion. Also these elevations are not appreciably different from the actual elevation of the theoretical contact, Z_d''', between fresh water and salt water. The theoretical contact is 23 m below the contact of fresh water with diffused water.

The H_{1p} at the −17-m elevation was selected arbitrarily for the above. If, instead, the $H_{1p} = -1.41$ m at the −2-m elevation (Fig. 2) is selected, then $Z_d' = -69$ m from (1), $Z_d'' = -79$ m from (11), and $Z_d''' = -60$ m from (12). In this case Z_d''' is the same as computed previously. (In the computation, $h = +0.39$ m was used.) However, the Z_d' by the Ghyben-Herzberg equation is 9 m lower than Z_d''', and the Z_d'' by the Hubbert equation is practically at point 2 in salt water.

Compare also the depths Z_d, computed from (10–12) using the following data obtained in October 1958 at two wells screened at two different depths in the same vertical at a site in Cedarhurst, L. I., N. Y.:

$$\rho_1 = 0.999 + \text{ g/ml}$$

$$\rho_2 = 1.020 + \text{ g/ml}$$

$$H_{1p} = 3.57 \text{ ft}$$

$$H_{2p} = -4.72 \text{ ft}$$

$$Z_1 = -167 \text{ ft}$$

$$Z_2 = -520 \text{ ft}$$

The average density at Cedarhurst in the zone of diffusion between the −320-ft and −490-ft elevations is computed to be about 1.010 g/ml. On this basis, h = −0.47 ft is determined from (9).

$Z_d' = -170$ ft is obtained by the Ghyben-Herzberg equation, $Z_d'' = -399$ ft by the Hubbert equation, and $Z_d''' = -421$ ft by (12). The difference of −229 ft between Z_d' and Z_d'' is the result of the $\rho_2 H_{2p}$ term. In this case, the Ghyben-Herzberg equation gives an elevation which is not even in the zone of diffusion and is as much as 150 ft above it. The Hubbert equation gives a depth 22 ft shallower than the actual elevation of the theoretical contact between fresh water and salt water. The 22 ft difference indicates that every 0.1-ft difference in environmental-water head between points 1 and 2 makes a difference of nearly 5 ft between the depth computed by the Hubbert equation and that computed by (12).

The theoretical contact of fresh water with salt water at Cedarhurst is about 101 ft below the contact of fresh water with diffused water, defined by electrical log to be at −320 ft.

Elevations computed by equations 9 to 12. Z_d in (9) is the elevation of the contact of fresh water with diffused water. The relation in (9) between point-water head in fresh water and the depth to this contact is not simple and direct; it depends on several variables. However, the elevation of the contact can be computed if there is a suitable basis for estimating h, H_{2p}, and ρ_a for a given Z_2 and ρ_2.

Z_d''' in (12) is the elevation to the theoretical contact between fresh water and salt water. It can be computed from a point-water head in fresh water if there is a suitable basis for estimating h and H_{2p} for a given Z_2 and ρ_2.

As shown, the Z_d' computed by the Ghyben-Herzberg equation may not necessarily be an elevation of a point in the zone of diffusion. Also as shown, the Z_d'' computed by the Hubbert equation may not necessarily be an elevation of a point in the zone of diffusion. However, the Ghyben-Herzberg and Hubbert equations can yield elevations of points in the zone of diffusion for conditions approximating those stated for (10) and (11).

Appendix 1. Symbols Used in This Paper

g = gravitational acceleration.
$\mathbf{g}$ = gravitational acceleration vector.
H_{ip}, H_{if}, H_{in} = point-water head, fresh-water head, and environmental-water head at i, respectively.
h = difference in environmental-water heads at point 1 in fresh water and point 2 in diffused or salt water.
i = point in variable density ground water; i = 1, point in fresh water; i = 2, point in diffused or salt water.
$\mathbf{i}$ = unit vector directed along a horizontal.
k_i = permeability of the medium at i.
$\mathbf{k}$ = unit vector directed upward along a vertical.
P_i = pressure at i.
$\mathbf{q}_i$ = vector velocity at i.
v_x, v_y, v_z = component of velocity along axis x, y, z, respectively.
Z_d, Z_d', Z_d'', Z_d''' = elevation to diffused water in (9–12), respectively.
Z_i = elevation of i, measured positively upward.
Z_r = elevation of reference point, measured positively upward.
ρ_i = density of water at i.
ρ_a = average density of water between depths Z_r and i.
ρ_f = density of fresh water.
μ_i = viscosity of water at i.
$\partial h_{if}/\partial x$ = hydraulic gradient at i in x direction (defined by fresh water heads).
$\partial h_{if}/\partial y$ = hydraulic gradient at i in y direction (defined by fresh-water heads).
$\partial h_{in}/\partial z$ = hydraulic gradient at i and z direction (defined by environmental-water heads).
∇ = gradient operator.

Appendix 2. K_{rs} Components of Permeability Tensor

$$\begin{bmatrix} K_{11} = \begin{Bmatrix} K_1 l_1 l_1 \\ +K_2 l_2 l_2 \\ +K_3 l_3 l_3 \end{Bmatrix} & K_{12} = \begin{Bmatrix} K_1 l_1 m_1 \\ +K_2 l_2 m_2 \\ +K_3 l_3 m_3 \end{Bmatrix} & K_{13} = \begin{Bmatrix} K_1 l_1 n_1 \\ +K_2 l_2 n_2 \\ +k_3 l_3 n_3 \end{Bmatrix} \\ K_{21} = \begin{Bmatrix} K_1 l_1 m_1 \\ +K_2 l_2 m_2 \\ +K_3 l_3 m_3 \end{Bmatrix} & K_{22} = \begin{Bmatrix} K_1 m_1 m_1 \\ +K_2 m_2 m_2 \\ +K_3 m_3 m_3 \end{Bmatrix} & K_{23} = \begin{Bmatrix} K_1 m_1 n_1 \\ +K_2 m_2 n_2 \\ +K_3 m_3 n_3 \end{Bmatrix} \\ K_{31} = \begin{Bmatrix} K_1 l_1 n_1 \\ +K_2 l_2 n_2 \\ +K_3 l_3 n_3 \end{Bmatrix} & K_{32} = \begin{Bmatrix} K_1 m_1 n_1 \\ +K_2 m_2 n_2 \\ +K_3 m_3 n_3 \end{Bmatrix} & K_{33} = \begin{Bmatrix} K_1 n_1 n_1 \\ +K_2 n_2 n_2 \\ +K_3 n_3 n_3 \end{Bmatrix} \end{bmatrix}$$

where

K_1, K_2, K_3 = principal directional permeabilities.
l_1, m_1, n_1 = directional cosines between K_1 and x, y, z coordinates.
l_2, m_2, n_2 = directional cosines between K_2 and x, y, z coordinates.
l_3, m_3, n_3 = directional cosines between K_3 and x, y, z coordinates.

Appendix 3

The introduction and use of the 'environmental-water head' is a valid interpretation of the Darcy equation. This was indicated by Professor R. Skalak, who reviewed the early draft of the paper. The following is an excerpt from his written communication:

The generalized Darcy equation in vector form is

$$\mathbf{q} = -\frac{k}{\mu}(\nabla p - \rho_i \mathbf{g}) \qquad \text{(A)}$$

The z component of this equation may be written as

$$v \frac{\mu}{k\rho_1 g} = -\frac{1}{\rho_1 g}\left(\frac{\partial p}{\partial z} + \rho_i g\right) \qquad \text{(B)}$$

where

v = vertical component of velocity.
μ = viscosity.
k = permeability.
$\mathbf{g}$ = gravitational acceleration vector.
ρ_1 = density of fresh water.
p = pressure.
z = vertical coordinate, plus upwards.
ρ_i = density of fluid at any point.

It appears that the right-hand side of (B) is the same as the 'gradient of environmental head' that you have defined. The left-hand side is the head loss gradient in terms of velocity and is essentially the gradient of h in your equation 9. To show the equivalence of the above to your (9), integrate (B) from point 2 to point 1.

$$\int_{z_2}^{z_1} v \frac{\mu}{k\rho_1 g}\, dz = -\int_{z_2}^{z_1} \frac{1}{\rho_1 g}\left(\frac{\partial p}{\partial z} + \rho_i g\right) \partial z \qquad \text{(C)}$$

or

$$\int_{z_2}^{z_1} \frac{v\mu}{kg}\, dz = -\frac{1}{g}[p_1 - p_2] - \int_{z_2}^{z_r} \rho_i\, dz - \int_{z_r}^{z_1} \rho_i\, dz \qquad \text{(D)}$$

Now define h to be the head loss due to vertical velocities, i.e., such that $-\rho_1 h$ is equal to the left-hand side of (D). Further define ρ_a such that

$$\int_{z_2}^{z_r} \rho_i\, dz = \rho_a(z_r - z_2) \qquad \text{(E)}$$

This is the same as your ρ_a. Further note that

$$p_1 = \rho_1 g(H_{1p} - z_1)$$

and

$$p_2 = \rho_2 g(H_{2p} - z_2) \qquad \text{(F)}$$

Substituting in (D):

$$-\rho_1 h = -\rho_1(H_{1p} - z_1) + \rho_2(H_{2p} - z_2) - \rho_a(z_r - z_2) - \rho_1(z - z_r) \qquad \text{(G)}$$

The right-hand side of (G) is $(-\rho_1 H_{1n} + \rho_1 H_{2n})$ where H_{1n} and H_{2n} are the environmental heads defined as you have suggested. Equation (G) may be written as

$$\rho_1 H_{1p} = \rho_1 h + \rho_2 H_{2p} - z_2(\rho_2 - \rho_a) - z_r(\rho_a - \rho_1) \qquad \text{(H)}$$

which is exactly your (9), when $Z_r = Z_d$.

Acknowledgments. This paper is one of the products of an investigation of salt-water encroachment in Long Island, New York. The investigation now in progress is being conducted by the U. S. Geological Survey in cooperation with the Nassau County Department of Public Works and the New York State Water Resources Commission.

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Attachment 8

Events 3A and 3B Freshwater Equivalent Head (FEH) Category Assignment

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1.0 Introduction

This Appendix discusses the following topics related to the Event 3A and 3B Freshwater Equivalent Heads (FEHs) and Environmental Heads (ENVs) at the Site:

- The category assignment of Event 3 FEHs for the Site
- An evaluation of the Summer 2103 "in situ" calibration results for the Geokon transducers installed at the CMT well locations
- An analysis of uncertainty associated with the derived FEH values
- Field testing to evaluate changes in the Geokon transducer calibration factors A, B, and C
- A summary of the additional in situ calibration performed at the 61C monitoring well nest
- A summary of the Micron versus Geokon transducer comparison at 61C-130/160
- A summary of the hydraulic monitoring data at monitoring well nests MW-F and MW-G collected in preparation for the pumping test at extraction well EXT-9

The results related to these topics are presented as follows:

- A summary of the FEH category assignment is presented in Section 2.0.
- The methodology used for the FEH category assignment is presented in Section 3.0.
- Section 4.0 contains an analysis of the in situ calculation of the Summer 2013 C values for the sixteen wells that were field-checked in June to August 2013. The procedure used to determine the Summer 2013 C values (involving well casing water column purging to remove potential density stratification) is presented in Attachment A.
- The results of field testing to evaluate changes in the Geokon transducer calibration factors A, B, and C is presented in Section 5.0.
- The main observations from the Micron versus Geokon transducer comparison at 61C-130/160 and hydraulic monitoring data at monitoring well nests MW-F and MW-G performed in preparation for the EXT-9 pumping test are summarized in Section 6.0.
- Section 8.0 presents conclusions and recommendations based on the FEH category assignment, changes in the Geokon transducer calibration factors A, B, and C, and EXT-9 pre-pumping test hydraulic monitoring.

Key findings presented in this Appendix include:

- Clamping the Geokon transducers to the CMT well casing can cause a change in the calibration factors A and B, and these changes can be compensated for by the in situ calibration of the Geokon transducer C value. For the field testing presented in this Report, and the change in C values that this testing created, C values were determined through in situ calibration such that the clamped transducers matched measured depth to water settings to within the transducer accuracy.

- The recent hydraulic monitoring data collected in preparation for the extraction well EXT-9 pumping test show upward vertical hydraulic gradients at depth, which supports the Conceptual Site Model (CSM) developed for the Site.

2.0 FEH Category Assignment - Summary

The categories as discussed during the November 8, 2013 and December 12, 2013 technical team meetings are described as follows:

Category	***Description***
1	For the standard and CMT[1] wells, there is a good match between the transducer FEH and manual FEH (where the manual FEH is calculated from the measured density and the manual water levels). Use the FEH.
2	For the standard and CMT[1] wells, the density determined from the linear regression of the manual versus transducer FEHs is reasonable in comparison to the measured density. Use the FEH.
3	For some CMT wells, a shift has occurred in the C value of the Geokon transducer polynomial pressure conversion equation. Use the procedure presented in Attachment A to calculate an in situ C value. Use the FEH provided by the in situ C value.
4	None of the above apply. Asterisk these FEHs. For CMT wells in this category, an in situ C value may be determined later using the procedure presented in Attachment A as necessary.

Table 1 presents the FEHs assigned to each category for the standard wells with Levelogger transducers installed. Table 2 presents the FEHs assigned to each category for the CMT wells with Geokon transducers installed where the original C values are used to determine the FEHs. The original C values were determined from the blank field casing filled with deionized water (DI well) used to confirm the factory calibration of the Geokon transducers prior to installation.

[1] Evaluated using the original C value determined from the DI well used to confirm the factory calibration of the Geokon transducers prior to installation, and using the best-fit C values determined from the manual water levels taken during Event 3 to provide a linear regression density that was similar to the density determined from the laboratory measured specific gravity.

The procedure used to determine the original C values is presented in Attachment A. Table 3 presents the FEHs assigned to each category for the CMT wells with Geokon transducers installed where the best-fit C values are used to determine the FEHs. The best-fit C values were determined from the linear regression of Event 3 manual water levels versus Event 3 transducers pressures to obtain a slope of the linear regression line, equal to the well casing water column density, that was similar to the laboratory measured density for the monitoring well. The procedure used to determine the best-fit C values is presented in Attachment A. As noted in Table 3, the original C value was retained for some CMT wells because the original C value provided a reasonable match to the manual water levels and was selected as the best-fit C value. Table 4 presents the FEHs assigned to each category for the CMT wells with Micron transducers installed. For the sixteen wells that were field-checked in June to August 2013, the FEHs presented in both Tables 2 and 3 were determined based on the Summer 2013 C values.

The methodology used to assign FEHs to the four categories is described in Section 3.0. The FEHs per category for each well type and transducer are summarized below.

Well Type	***No. of Wells***	***Category 1***	***Category 2***	***Category 3***	***Category 4***
Standard - Table 1	139	91	28	-(1)	20
CMT (w/ Geokon & Original C Value) - Table 2	113	18	67	15	13
CMT (w/ Geokon & Best-Fit C Value) - Table 3	113	84	9	15	5
CMT (w/ Micron) - Table 4	12	8	0	-(1)	4

Note:

(1) Category 3 does not pertain to standard wells or CMT wells with Micron transducers installed.

Prior to installation, the Geokon transducers were fastened to the CMT well casing using hose clamps that were hand-tightened using either a 4-inch ratchet wrench or 10-inch screw driver to firmly hold the transducers in place. As presented in Section 5.0, additional testing was conducted where Geokon transducers were clamped with increasing torque and lowered to specific water depth settings in the DI well. The testing shows that clamping the Geokon transducers can cause a change in the calibration slope factors A and B. The changes to A and B result in potential transducer water level errors ranging from 0.063 ft H_2O and 0.078 ft H_2O over the typical maximum 10 ft change in groundwater levels at the Site monitoring wells due to tidal fluctuations. For the field testing presented in this Report, C values are determined through in situ calibration such that the clamped transducers match measured water depth settings to within the transducer accuracy. Thus, the in situ C value calibration compensates for the error introduced by changes in A and B. A maximum change in C value of 0.8 pounds per square inch (psi) [1.85 feet of water (ft H_2O)] occurred for the highest torque applied to the clamps during the testing. A C value change of 0.8 psi or less occurred for 75 of 101 of the Geokon transducers where there was a change in the original C value.

As described in Section 4.0, the in situ calibration procedure has been used on three occasions to calculate in situ C values at 61C-130/160. The three C values obtained for 61C-130 vary by a maximum of 0.03 psi, which is within the transducer accuracy. The three C values obtained for 61C-160 vary from 0.11 psi to 0.33 psi, which is greater than the transducer accuracy. The range in manual water level measurements for the in situ calibration of Summer 2013 is greater than it is for either November 14, 2013 or December 20, 2013. Thus, greater confidence can be placed in the Summer 2013 in situ C values since they are determined over a greater range of pressures.

The in situ calibration was conducted on November 14, 2013 for the Geokon transducers installed at 61C-25, 61C-50, 61C-75, and 61C-100, and the C values obtained range within 0.1 psi to 0.28 psi of the 2012 best-fit C values. The range in manual water level measurements for the 2012 best-fit C values is greater than it is for November 14, 2013. Thus, greater confidence can be placed in the 2012 best-fit C values since they are determined over a greater range of pressures.

In addition, in situ calibration for 78C-130 and 90C-160 provides C values that range within 0.02 psi to 0.05 psi of the 2012 best-fit C values, which is within the transducer accuracy. Since 78C-130 and 90C-160 are screened in fresh to near-fresh water, well purging for the in situ calibration procedure is not needed to avoid potential density stratification in the well casing water column. As a result, the in situ and 2012 best-fit C values are similar at 78C-130 and 90C-160. It is recommended that the FEHs determined using the best-fit C values, rather than using the original C values, be retained as model calibration targets, subject to the FEH categories described above.

Using the best-fit C values, the FEHs at five CMT well locations with Geokon transducers are assigned to Category 4 based on the assessment presented here. Combining these with the Category 4 FEHs for standard wells and CMT wells with Micron transducers installed, 29 out of 264 FEHs are assigned to Category 4, which is approximately 11 percent of the total number of FEHs. The FEHs assigned to each of Categories 1, 2, 3, and 4 for each of the seven aquifer zone grouping planes (i.e., 15-ft, 25-ft, 50-ft, 75-ft, 100-ft, 130-ft, and 160-ft zones) for Event 3A are presented on Figures 3.91 to 3.97 of the main report.

3.0 FEH Category Assignment - Methodology

The methodology used to assign the FEHs to Categories 1 thru 4 is described in following sub-sections.

Category 1

For Category 1, the accuracy of the transducer pressure readings was evaluated based on the average difference (offset) between the manual and transducer FEHs. The transducer and manual FEHs are defined as follows:

- The transducer FEH equals the pressure reading from the transducer in psi, converted to a pressure in feet of fresh water (ft H_2O), and then added to the transducer elevation in ft NGVD. The transducer FEH has two inputs: pressure from the transducer; and transducer elevation. It is assumed that the transducers are properly calibrated, the elevation of the transducer is known precisely, and the transducer is located within the well screen. The accuracy is therefore only associated with the full scale range of the transducers. The factory reported transducer accuracy ranges from ±0.05 percent to ±0.5 percent of the transducer full scale range. Because the transducer reads pressure directly, there is no influence of water column density on the transducer FEH (i.e., it experiences the formation pressure exerted on the well screen).
- The manual FEH equals the measured height of water above the transducer (based on the manual water levels and transducer elevation) multiplied by the water column density (assumed uniform throughout the well casing water column), converted to a pressure in ft H_2O, and then added to the transducer elevation in ft NGVD. The manual FEH is dependent on a manual water level measurement, the measurement of water column density, the assumption that the measured density is uniform throughout the entire water column, and the elevation of a point of reference (i.e., top of casing) and the transducer.

The match between manual water levels and the transducer pressure readings is considered acceptable for Category 1 where the average offset is within the expected accuracy of both the transducer and manual FEHs. FEHs with an average offset greater than the expected accuracy were passed to Category 2 for further evaluation. FEHs based on the in situ Summer 2013 C value calculation were passed directly to Category 3.

The expected accuracy of the transducer and manual FEHs is related to:

1) Accuracy of the transducers
2) Accuracy reasonably expected for obtaining manual water level measurements at the Site

3) Uncertainty in the manual FEHs due to water column density variations in the well casing above the transducer

The expected accuracy is equal to the sum of the accuracies associated with Items 1) to 3), referred to as the 'total accuracy'. The level of accuracy for the above Items 1) to 3) is described below.

1) Transducer Accuracy

The transducer accuracy is based on the manufacturer specifications for each transducer, which depending on the transducer model, ranges from ±0.05 percent to ±0.5 percent of the full scale of the transducer pressure rating. The transducer accuracy at each well location is shown in Tables 1 to 4.

2) Manual Water Level Accuracy

The manual water level measurement accuracy is estimated to be ±0.025 ft based on the subjective interpretations made by variable field staff using the depth to water meters. The accuracy is complicated by tidal fluctuations and sometimes adverse field conditions (inclement weather, poor lighting, etc.). The manual water level measurement accuracy of ±0.025 ft is consistent with Holmes et al. (2001) that report the accuracy of electric water level tapes is considered to be ±0.02 ft, but may be as great as 0.1 ft. In practice, our experience suggests that the combined influence of different personnel and weather conditions result in an accuracy of ±0.1 ft (excluding any errors associated with recording/transcribing data).

3) Uncertainty in Manual FEHs Related to Water Column Density

Uncertainty in the manual FEHs, or water column FEH in the well casing above the transducer, occurs due to density variations in the water column. The water column density variations occur due to density stratification within the water column, and also due variations in laboratory measured specific gravity that is observed between recent (i.e., 2012-2013) successive sampling events. Density variations in the well casing water column directly translate to uncertainty in the water column FEH because FEH equals the water column density multiplied by the water column height. Uncertainty in the water column FEH translates to uncertainty in the aquifer depth zone FEHs as follows:

- CMT wells using best-fit or Summer 2013 C values - the water column FEH is used directly to determine the C values

- Standard wells and CMT wells using original C values - the water column FEH is used directly to determine the offset between manual and transducer FEHs, which is then used to determine whether a FEH is acceptable for Category 1

The uncertainty in water column FEH due to variations in laboratory measured specific gravity (i.e., density) was evaluated using the 2012-2013 specific gravity data for the Site. The change between the 2012 and 2013 laboratory reported specific gravity values were assumed to reflect measurement uncertainty. The uncertainty may be related in part to temporal changes in groundwater density; however, the anthropogenic density plume (ADP) appears to be relatively stable. The changes occurring between 2012 and 2013 are more likely related to the accuracy of the laboratory measurement and the representativeness of the water sample to the water column density. The variability in water density measurement was evaluated for wells screened in fresh groundwater and the transition zone between fresh groundwater and salt water (referred to as fresh/transition groundwater), salt water, and the ADP. The classification of fresh/transition groundwater, salt water, and ADP was based on density within the ranges for these zones defined in Tables 1 to 4, and not bromide or total chlorinated volatile organic compounds (TCVOCs) since the objective was to evaluate only density measurement variability within these classifications. The classification of each well location as fresh/transition groundwater, salt water, and ADP in Tables 1 to 4 did consider bromide and TCVOCs, as well as density.

The change in water column FEH due to a change in specific gravity over the water column height above the transducer can be calculated using:

$$\Delta\, FEH = \frac{\left(\Delta SG\ \times \dfrac{62.4\ lbs}{ft^3}\right) \times H}{144\,\dfrac{in^2}{ft^2}} \times 2.3077\ \frac{ft\ H_2O}{psi} \qquad \text{Equation 3.1}$$

Where:

$\Delta\, FEH$ change in water column FEH due to the variation in specific gravity over the water column height above the transducer (ft H_2O)

$\Delta\, SG$ change in specific gravity of the water column

H water column height above the transducer (ft)

Table 5 presents the calculated change in laboratory specific gravity values between successive samples collected in 2012-2013 for the three water types. The standard deviation of the change in specific gravity for each water type was used in Equation 3.1 to estimate the uncertainty in water column FEH. Using one standard deviation as a measurement uncertainty represents 68% of the data; 32% of the data could have an uncertainty larger than one standard deviation. Because the FEH is also dependent on the water column height, an uncertainty was calculated for each depth zone grouping plane using the average water columns heights presented in Table 5. The table below summarizes the results.

	Water Column Height (ft)	***Fresh Water***	***Salt Water***	***ADP***
Standard Deviation of Specific Gravity	-	± 0.0020	± 0.0057	± 0.0114
25-ft Zone (ft H_2O)	11.40	± 0.02	± 0.06	± 0.13
50-ft Zone (ft H_2O)	49.21	± 0.10	± 0.28	± 0.56
75-ft Zone (ft H_2O)	59.63	± 0.12	± 0.34	± 0.68
100-ft Zone (ft H_2O)	87.45	± 0.18	± 0.50	± 0.99
130-ft Zone (ft H_2O)	109.93	± 0.22	± 0.62	± 1.25
160-ft Zone (ft H_2O)	125.16	± 0.25	± 0.71	± 1.42

The total accuracy used to evaluate FEHs to include in Category 1 is the sum of the transducer accuracy, the manual water level measurement accuracy, and the uncertainty in manual, or water column, FEHs. The total accuracy for each monitoring well is shown in Tables 1 to 4.

Category 2

For Category 2, the 2012 (i.e., Event 3) formation density (determined from the laboratory measured specific gravity in the groundwater sample collected from the well) was compared to the density of the water column in the well casing determined from the linear regression of the manual versus transducer FEHs. The formation density was also compared to the density value estimated from total dissolved solids (TDS) using the TDS versus specific gravity relationship developed by the Agencies and presented on Figure 2 of the Agencies' December 28, 2012 email. The FEH was considered suitable for Category 2 where the linear regression density value is reasonable based on:

- Comparison to the laboratory measured formation density
- Comparison to the formation density based on the Agency TDS versus specific gravity relationship

For the comparison to the laboratory density, the difference was determined between the linear regression density and laboratory density, and the standard deviation for the differences across all wells was calculated. The linear regression density was considered reasonable where the difference between the linear regression density and the laboratory density at a well was within one standard deviation of the differences across all wells. For the comparison to the TDS density, the difference was determined between the linear regression density and TDS density, and the standard deviation for the differences across all wells was calculated. The linear regression density was considered reasonable where the difference between the linear regression density and the TDS density at a well was within one standard deviation if the differences across all wells. The FEHs at a well were considered suitable for Category 2 where the linear regression was considered reasonable based on comparing to either the laboratory density or the TDS density.

Category 3

For Category 3, an in situ C value was calculated based on the manual water level measurements obtained after well purging to ensure the well casing water column consisted of a uniform density, as presented in Attachment A.

Category 4

The FEHs not assigned to Categories 1, 2, or 3, were passed to Category 4. FEHs were passed to Category 4 because:

- The offset between the manual and transducer FEHs is greater than the total accuracy for the monitoring well location
- The well casing water column density determined from the linear regression of the manual versus transducer FEHs is not reasonable based on the laboratory measured formation density, the well location relative to fresh/transition groundwater, salt water, ADP, and the formation density based on the Agency TDS versus specific gravity relationship

The FEHs presented in Tables 1, 3, and 4 will be used to calibrate the groundwater flow for the Site.

4.0 Analysis of In Situ C Values

Table 6 compares the original, 2012 best-fit, and Summer 2013 in situ C values for the sixteen CMT wells where the in situ C value calculation was performed and presented in Attachment A. The density data associated with the 2012 best-fit C values and Summer 2013 in situ C values are shown in Table 6. The 2012 best-fit C values were determined from the manual water levels taken during Event 3 to provide a linear regression density that was similar to the laboratory measured density, which is essentially the same approach used to determine the Summer 2013 in situ C values except that well purging was not performed to provide a uniform density in the well casing water column.

As presented in Table 6, eleven of the sixteen CMT wells are installed in salt water or the ADP. For the wells installed in salt water or the ADP, the 2012 best-fit and Summer 2013 in situ C values are different by more than 0.369 psi (0.85 ft H_2O), which could be attributable to density stratification in the well casing water column. Evidence of well casing water column density stratification was observed in the conductivity profiling performed as part of Events 1 and 2.

Five of the sixteen CMT wells (34C-160, 78C-130, 84C-160, 88C-130, and 90C-160) are screened in the transition zone between fresh groundwater and salt water. Two of these (78C-130 and 90C-160) have a near-fresh groundwater density (SG = 1.006 for both 78C-130 and 90C-160). The 2012 best-fit and Summer 2013 in situ C values differ by 0.053 psi (0.122 ft H_2O) and 0.017 psi (0.039 ft H_2O), for 78C-130 and 90C-160, which is within the transducer accuracy for these wells. For wells screened in fresh to near-fresh water, density stratification is not expected to occur to a significant degree in the well casing water column, and the water column density is essentially uniform without well purging. Thus, manual water levels for wells screened in fresh to near-fresh water provide C values within a range similar to that obtained for 78C-130 and 90C-160, either with or without well purging. The wells installed in fresh to near-fresh water are listed in Tables 1 to 4 and identified on Figures 3.91 to 3.97 of the main report.

For 34C-160, the 2012 best-fit C value equals the original C value because the original C value provided a reasonable match to the 2012 manual water level measurements and was selected as the 2012 best-fit C value. The change between the 2012 best-fit C value and the Summer 2013 in situ C value for 34C-160 is related to the Summer 2013 manual water levels only varying over a range of approximately 0.03 ft. The 2012 manual water levels used to determine the 2012 best-fit C value for 34C-160 varied over a range of approximately 1.9 ft. Thus, the 2012 best-fit C value is considered more reliable than the Summer 2013 in situ C value. As a result, the FEHs determined using the 2012 best-fit C value are retained for 34C-160, but are included in Category 4, as noted in Tables 2 and 3.

For 84C-160 and 88C-130, higher groundwater densities of 62.94 lbs/ft^3 (SG = 1.009) and 63.57 lbs/ft^3 (SG = 1.019) occur, respectively. These higher densities could have caused density stratification in the well casing leading to the change between the 2012 best-fit and Summer 2013 C values.

For 21C-130, a near-fresh groundwater density occurs although this well is classified as being with the ADP (21C-130 is located near the edge of the ADP). As for 78C-130, 84C-160, and 90C-160, the near-fresh groundwater density suggests that density stratification within well casing should not be significant. However, there is a change between the 2012 best-fit C value and the Summer 2013 in situ C value for 21C-130 of -0.393 psi. This change is attributed to achieving a better match to the 2013 laboratory measured density using the Summer 2013 manual water levels than is achieved to the 2012 laboratory measured density using the 2012 manual water levels.

The in situ C value calculation procedure described in Attachment A has been used on three occasions to calculate in situ C values at 61C-130/160: Summer 2013; November 14, 2013; and December 20, 2013. The results for the in situ C values are summarized in Table 7, and plots of manual height of water versus transducer pressure for each in situ calibration are presented on Figures 1 to 6. For 61C-130, the Summer 2013 and November 14, 2013 in situ C values differ by 0.027 psi (0.06 ft H_2O), and the Summer 2013 and December 20, 2013 in situ C values differ by 0.004 psi (0.01 ft H_2O). Both of these differences are within the transducer accuracy of ±0.234 ft H_2O for this location. The change from the 2012 best-fit C value to the Summer 2013 C value shown in Table 6 is due to removing density stratification in the well casing water column through the purging conducted to determine the Summer 2013 C value.

For 61C-160, the Summer 2013 and November 14, 2013 in situ C values differ by 0.113 psi (0.26 ft H_2O), and the Summer 2013 and December 20, 2013 in situ C values differ by 0.328 psi (0.76 ft H_2O). Both of these differences are greater than the transducer accuracy of ±0.234 ft H_2O for this location. As shown in Table 7, the range in manual water level measurements for the in situ calibration of Summer 2013 is greater than it is for either November 14, 2013 or December 20, 2013. Thus, greater confidence can be placed in the Summer 2013 in situ C values since they are determined over a greater range of pressures. The change from the 2012 best-fit C value to Summer 2013 C value shown in Table 6 is due to achieving a better match to the 2013 laboratory measured density using the Summer 2013 manual water levels than is achieved to the 2012 laboratory measured density using the 2012 manual water levels. Furthermore, the Summer 2013 C value is greater than the 2012 best-fit C value, and this is due to the lower density that was measured for the Summer 2013 in situ calibration [62.98 lbs/ft^3 (SG = 1.009)] versus what was measure in 2012 [63.7 lbs/ft^3 (SG = 1.021)].

The in situ C value calculation procedure also was used on November 14, 2013 to calculate in situ C values at 61C-25/50/75/100. The results for these in situ C values are summarized in Table 8, and plots of manual height of water versus transducer pressure for each in situ calibration are presented on Figures 7 to 14. The 2012 best-fit and in situ C values differ by 0.104 psi (0.24 ft H_2O) to 0.277 psi (0.64 ft H_2O). As shown in Table 8, the range in manual water level measurements for the 2012 best-fit C values is greater than for the November 14, 2013 in situ calibration, as follows:

- For 61C-25, the range in manual water level measurements for the 2012 best-fit C values is 1.16 ft versus 0.02 ft for November 14, 2013
- For 61C-50, the range in manual water level measurements for the 2012 best-fit C values is 2.86 ft versus 0.26 ft for November 14, 2013
- For 61C-75, the range in manual water level measurements for the 2012 best-fit C values is 2.82 ft versus 0.08 ft for November 14, 2013
- For 61C-100, the range in manual water level measurements for the 2012 best-fit C values is 4.42 ft versus 0.37 ft for November 14, 2013

Thus, greater confidence can be placed in the 2012 best-fit C values since they are determined over a larger range of pressures.

5.0 Evaluation of Cause for Shift in C Values

Prior to installation, the Geokon transducers were fastened to the CMT well casing using hose clamps that were hand-tightened using either a 4-inch ratchet wrench or 10-inch screw driver or a to firmly hold the transducers in place. A simple field test was performed to investigate whether a tightened hose clamp on the housing of a Geokon transducer could shift its zero pressure reading in air. A hose clamp was tightened around the center of a spare Geokon transducer available at the Site and connected to a transducer data readout unit. The results of this test are summarized on Figure 15. Figure 15 shows photographs of the transducer digits reading in air with and without the tighten hose clamp. The hose clamp was hand-tightened using a 4-inch ratchet wrench as was done when the transducers were fastened to the CMT well casing prior to installing the CMT wells. Figure 15 also shows a photograph illustrating the effect on the digits reading by gripping the transducer tightly by hand (a gloved hand was used so that body temperature would not directly alter the digits reading). As shown on Figure 15, the zero digits reading changes 13.6 digits due to gripping the transducer tightly by hand, and changes 19.5 digits due to the tightened hose clamp. Based on these changes in the zero digits reading, and assuming that the transducer calibration factors A and B did not change, the magnitude of the shift in the C value for the transducer caused by the tightened hose clamp is approximately 0.27 psi (0.6 ft H_2O), and gripping the transducer tightly by hand shifts the C value by approximately 0.18 psi (0.4 ft H_2O). The results of this test show that applying pressure to the housing of the Geokon transducer can cause a change to the C value (the intercept for the Geokon polynomial calibration equation). A potential corresponding change to the A and B calibration factors (the slope factors for the Geokon polynomial calibration equation) was evaluated through the additional testing.

As discussed previously with the Agencies, the calibration of the Geokon transducers appears to have changed between the time they were calibrated on Site in the "DI well" and the final in-situ installation. The potential causes for this change have been that:

- The calibration change is the result of stresses imposed on the transducers when they were clamped to the CMT well casings and buried
- The calibration adjustment could be limited to adjusting the C calibration factor and the A and B calibration factors could be held equal to the factory reported A and B values

A work plan describing a field test to evaluate the effect of clamping the transducers to a well casing was submitted to the Agencies on March 27, 2014 and approved during a conference call held on that same day.

The primary objectives of the additional testing were to:

1. Determine whether or not a significant change in the transducer calibration factors (A, B, and C) resulted from stressing the transducers in a fashion similar to the stress created when they were clamped to the CMT well casing
2. If the transducer calibration did change, were the previous observations that only the C value needed to be changed, and the calibration factors A and B could be held constant, reasonable based on a test that reproduced in situ conditions

Bench testing was performed to evaluate changes to the transducer zero digits reading caused by different clamp positions on the transducer, and by applying alternative stresses on the transducer. The zero digits reading is used directly to calculate the transducer calibration intercept C. A change in the C value could also indicate a change in the transducer calibration slope factors A and B. DI well testing was conducted where Geokon transducers were clamped with increasing torque and lowered to specific water depth settings within the DI well to evaluate whether changes occur to the slope factors A and B due to the clamping. The bench testing and DI well testing procedures are described in Attachment B, and the results are summarized below.

Bench Testing

Three bench tests were performed:

- Clamp Position Test: the transducer was clamped with a single hose clamp in different locations along the transducer body
- Pipe Bending Test: the test consisted of clamping a transducer to a section of CMT casing, bending the casing, and recording changes in the transducer zero digits reading (transducer digits reading with the transducer in air)
- Weight Test: the transducer was supported on the ends and a bending stress was applied by suspending a weight from the transducer.

For the clamp position test, the greatest change in the zero digits reading (18 digits) occurs when the clamp is tightened over the pressure sensitive diaphragm. The results of this test show that clamping the transducer over the diaphragm, 0.75 inches from the bottom of the transducer, has the greatest potential to change the transducer calibration factors. Subsequent tests were conducted by positioning clamps, or applying stresses, at the diaphragm.

For the bulk of the CMT well installations, two clamps were used to secure the Geokon transducers to the CMT casing. It was determined early during the CMT well installation process that a single clamp would not prevent the transducers from shifting from their measured positions as the CMT well assembly was coiled so it could be carried to the drill rig for installation. The two clamps were positioned approximately 1 inch from the transducer top and bottom, and the bottom clamp would have been close to, or over, the diaphragm.

For the pipe bending test and the DI well test, two clamps were used and were positioned approximately 1 inch from the top and bottom of the transducer. For the weight test, the weight suspended from the transducer was position at the diaphragm.

For the pipe bending test, a transducer was attached to a section of CMT well casing using two clamps. The casing was bent by hand about the clamped transducer with the transducer on the inside of the bend. The pipe bending test was intended to represent the CMT well assembly bending that occurred as it was coiled so it could be carried to the drill rig for installation. The pipe bending caused a change in the zero digits reading up to 2.5 digits. Thus, coiling the CMT well assembly could have applied further stress on the transducer, in addition to clamping, and resulted in additional potential changes to the transducer calibration factors.

For the weight test, a change of up to 6 digits in the zero digits reading was observed. Thus, a bending moment stress placed on the transducer during the CMT well installation process could have resulted in potential changes to the transducer calibration factors.

Potential additional stresses could have been applied to the transducers during the CMT well installation due to placing the sand pack around the transducer and placing grout above the sand pack. However, testing to replicate the level stress applied to the transducers by these conditions is not possible.

DI Well Testing

For the DI well testing, two Geokon transducers (one Model 4500s 350 kPa and one Model 4500s 700 kPa) were clamped to a PVC rod approximately 3 ft long. The clamps were successively tightened to three increased levels of torque (Torque 1, Torque 2, and Torque 3). The torque level used to tighten the clamps was measured using a torque wrench. For each torque level, the transducer assembly was lowered to specific water depth settings within the DI well to evaluate whether changes occur to the transducer calibration factors.

Prior to clamping the transducers to the PVC rod, they were lowered individually into the DI well to confirm the calibration of the unclamped transducers. For each transducer, zero readings in air were recorded, and then the transducers were lowered into the DI well to depth settings of 50 ft, 75 ft, and 100 ft, followed by raising the transducers to depth settings of 75 ft and 50 ft. The depth settings were measured using a steel measuring tape.

The transducers were clamped to the PVC rod using two clamps positioned approximately 1 inch from the transducer top and bottom. The 700 kPa transducer was the bottom transducer, and the 350 kPa transducer was the top transducer. The pressure sensitive diaphragms for the transducers were set 2 ft apart. For the 350 kPa transducer, Torque 1 was set between 25 and 30 inch-pounds (in-lbs), Torque 2 was set at 35 in-lbs, and Torque 3 was set at 45 in-lbs. For the 700 kPa transducer, Torque 1 was set between 25 and 30 in-lbs, Torque 2 was set at 40 in-lbs, and Torque 3 was set at 50 in-lbs. After tightening the clamps to Torque 3, it appeared that a higher torque level might cause to clamps to fail by stripping the clamp screw and/or clamp treads. Thus, a higher torque level was not tested.

The three torque levels were tested in sequence. The clamps were tightened to Torque 1, zero readings were obtained, and the transducer assembly was lowered into the DI well to the depth settings. For the 700 kPa transducer, the depth settings were the same as that applied to confirm the unclamped transducer calibration (i.e., 50 ft, 75, 100 ft, 75 ft, and 50 ft). For the 350 kPa transducer, the depth settings were 2 ft less than that applied to confirm the unclamped transducer calibration (i.e., 48 ft, 73 ft, 98 ft, 73 ft, and 48 ft). After completing the test at Torque 1, the clamps were tightened to Torque 2, new zero readings were obtained, and the transducer assembly was lowered again into the DI well to the depth settings. After completing the test at Torque 2, the clamps were tightened to Torque 3, new zero readings were obtained, and the transducer assembly was lowered a final time into the DI well to the depth settings.

Table 9 summarizes the changes in the zero digits readings for the two transducers for each torque level. The greatest change occurs for Torque 3 where the zero digits readings changed by 28.5 digits and 28.6 digits for the 350 kPa and 700 kPa transducers, respectively, from the unclamped calibration check. The change in the zero digits readings caused by clamping the transducers is evaluated below in terms of changes to the C values, and changes to the calibration slope factors A and B.

Table 10 summarizes the results of the calibration check for the unclamped transducers. For each transducer, the original C value was calculated from the initial zero readings, and the transducer pressure at each depth setting in the DI well (converted to water column depth) was calculated based on the transducer readings and factory calibration slope factors A and B. As presented in Table 10, the difference between the measured depth setting and the transducer water column depth ranges from -0.03 to -0.05 ft H_2O for the 350 kPa transducer, and from -0.08 to 0.06 ft H_2O for the 700 kPa transducer. These differences are within the accuracy of ±0.117 ft H_2O and ±0.234 ft H_2O, respectively, for the 350 kPa and 700 kPa transducers.

The original C values (i.e., C values calculated based on the zero reading for the unclamped transducers) and factory calibration slope factors A and B were used in Table 10 to calculate the transducer water column depth for the clamped transducers. For the 350 kPa transducer, the average difference between the transducer and measured water column depth ranges from -0.88 to -1.27 ft H_2O for the three torque levels. For the 700 kPa transducer, the average difference between the transducer and measured water column depth ranges from -1.17 to -1.85 ft H_2O for the three torque levels. The amount of this error contributed by using the original C value versus using the factory calibration slope factors A and B was evaluated below.

Error Due To Original C Value

For the error between the clamped transducers and measured water column depth shown in Table 10, in situ C value calibration was performed to examine the amount of this error caused by using the original C values. Table 11 presents the results of the in situ C value calibration to the DI well depth settings for each torque level. The in situ calibration was performed by holding the factory calibration slope factors A and B constant, and adjusting the C value to provide a zero average difference (over all five depth settings) between the transducer water column depth and DI well depth setting.

For the 350 kPa transducer, the transducer water column depth matches the measured depth setting to within the transducer accuracy for all depth settings at Torque 1 and Torque 2, and for three of five depth settings at Torque 3. For the 700 kPa transducer, the transducer water column depth matches the measured depth setting to within the transducer accuracy for all depth settings for all three torque levels.

For the 350 kPa transducer at Torque 3, differences of -0.13 ft H_2O and 0.15 ft H_2O (greater than the transducer accuracy of 0.117 ft H_2O) occur for the depth setting of 98 ft H_2O and the second depth setting of 48 ft H_2O. Although the difference is greater than the transducer accuracy for these two depth settings, the typical maximum change in groundwater levels at the Site monitoring wells due to tidal fluctuations is approximately 10 ft, whereas the change in the DI well depth settings is 25 ft. The in situ calibration for the 350 kPa transducer at Torque 3 was repeated in Table 12 over the DI well depth settings of 73 to 98 ft H_2O to evaluate whether the transducer accuracy could be met over a smaller range in depth settings. As presented in Table 12, the repeated in situ C value calibration matches the measured depth setting to within the transducer accuracy for the 73 to 98 ft H_2O depth settings.

As presented in Tables 11 and 12, the maximum change in the in situ C value (from the original C value determined for the unclamped transducer) is 0.569 psi for the 350 kPa transducer, and 0.802 psi for the 700 kPa transducer. For this amount of change in the original C values, Tables 11 and 12 show that the in situ C value calibration is capable of matching measured water levels to within the transducer accuracy over the typical maximum range in groundwater level fluctuations occurring at the Site.

The in situ C value calibration results indicate that using the original C values accounts for the bulk of the error between the transducer and measured water column depths occurring in Table 10 for the clamped transducers when using the original C values. The error was removed by performing the in situ C value calibration.

Error Due To Factory Calibration Slope Factors A and B

For the error between the clamped transducers and measured water column depth shown in Table 10, Table 13 examines the amount of this error caused by using the factory calibration slope factors A and B. In Table 13, the average change in the digits reading between each 25-ft depth setting was determined for the unclamped and clamped transducers. This was then converted to an average digits change per 1 ft change in depth setting, or water level. For the 350 kPa transducer, the unclamped average digits change is 24.899 digits/ft, while the Torque 3 average digits change is 24.739 digits/ft. For the 700 kPa transducer, the unclamped average digits change is 16.37 digits/ft, while the Torque 3 average digits change is 16.235 digits/ft. The difference in the average digits change between the unclamped transducer and the transducer clamped at Torque 3 indicates that the factory calibration slope factors A and B were altered by the clamping.

The amount of error introduced by holding A and B constant for the clamped transducers can be determined by applying A and B to the maximum difference in the average digits change between the unclamped and Torque 3 transducers. As shown in Table 13, the maximum difference in the average digits change between the unclamped and Torque 3 transducers is 0.16 digits/ft and 0.135 digits/ft for the 350 kPa and 700 kPa transducers, respectively. Applying A and B as in the polynomial equation to the maximum difference in digits change provides the maximum error in the water column depth provided by the transducer. This maximum error per foot of water level change corresponds to 0.0063 ft H_2O and 0.0078 ft H_2O for the 350 kPa and 700 kPa transducers, respectively. The typical maximum change in groundwater levels at the Site monitoring wells due to tidal fluctuations is approximately 10 ft. The maximum error corresponding to a 10 ft change in water level corresponds to 0.063 ft H_2O and 0.078 ft H_2O for the 350 kPa and 700 kPa transducers, respectively, as shown in Table 13. For the 350 kPa transducer, the error introduced by holding A and B constant for the transducer clamped at Torque 3 is a factor of approximately 20 less than the error introduced by using the original C values (i.e., the 1.27 ft H_2O average difference for Torque 3 in Table 10 divided by 0.063 ft H_2O). For the 700 kPa transducer, the error introduced by holding A and B constant for the transducer clamped at Torque 3 is a factor of approximately 24 less than the error introduced by using the original C values (i.e., the 1.85 ft H_2O average difference for Torque 3 in Table 10 divided by 0.078 ft H_2O). Although changes occur to the slope factors A and B, the error that this introduces is compensated for by the in situ calibration of the C values, as shown in Table 11.

The DI well testing results show that applying stress to the Geokon transducers can change both the intercept C value and factory calibration slope factors A and B. The changes to the C value introduced the greatest amount of error between the transducer and measured water depth settings. In situ calibration of the C values provided transducer water column depths that match the measured depth settings to within the transducer accuracy. The in situ C value calibration also compensates for the error introduced by the change to the slope factors A and B.

Table 14 presents a comparison of the change between the original and 2012 best-fit or Summer 2013 C values. Of the 113 CMT wells with Geokon transducers installed, 101 of the original C values changed. Of these, the shift in the C value was less than 0.8 psi for 75 transducers, and was greater than 0.8 psi for the remaining 27 transducers. For the DI well testing, where a maximum C value shift of 0.8 psi occurred, in situ C value calibration provided a match to measured water levels to within the transducer accuracy. For the 75 transducers with a C value shift of up to 0.8 psi, the DI well testing results support using the 2012 best-fit or Summer 2013 C values to determine FEHs at these locations. For the 27 transducers with an original C value shift greater than 0.8 psi, the four largest shifts are 19.4 psi for 53C-75, 11.7 psi of 90C-160, 5.8 psi for 84C-130, and -3.6 psi for 61C-160, as indicated in Table 14. The shifts for the remaining 23 transducers are between 0.8 and 1.4 psi[2]. Additional stresses applied to the transducer through a bending moment during installation, or due to placing the sand pack around the transducer, followed by placing grout above the sand pack, could explain the original C values changes that were greater than 0.8 psi. Given that stresses applied by hand in the initial test (i.e., Figure 15) caused a change in the original C value, bending moments imposed on the transducers during installation, and burying the transducers at the depths of the 25-ft to 160-ft zones, can be expected to result in additional stresses beyond that occurring due to clamps alone for some transducers. Thus, additional stresses occurring during installation could explain the C value changes greater than the maximum 0.8 psi change occurring for the DI well testing.

A change in original C value of greater than 0.8 introduces uncertainty related to whether in situ C value calibration can fully compensate for potential changes in the transducer calibration factors.

6.0 Summary of EXT-9 Pre-Pumping Test Hydraulic Monitoring

Hydraulic monitoring was conducted at selected monitoring wells during December 2013 in preparation for the EXT-9 pumping test. The main objective of the monitoring was to ensure that the transducers installed in the monitoring wells were functioning accurately before initiating the EXT-9 pumping test. A summary is presented in this section of the key observations for:

- The comparison of the Micron versus Geokon transducer pressures at 61C-130/160
- The hydraulic monitoring conducted at monitoring wells MW-F-Shallow/Intermediate/Deep and MW-G-Shallow/Intermediate/Deep

61C-130/160 Micron vs. Geokon Comparison

From December 31, 2013 to January 6, 2014, Micron transducers were deployed in 61C-130/160 for comparison to the pressures provided by the Geokon transducers installed at the CMT wells. The Micron transducers were lowered into the 61C-130/160 CMT channels and positioned at the installed elevation of the Geokon transducers. Periodic manual water levels at 61C-130/160 were measured during the monitoring period. A comparison between the

2 As noted in Tables 3 and 4, adjustments to some 2012 best-fit and Summer 2013 C values have occurred due to corrections in reference point elevations and transducer calibration factors and/or zero readings. This occurred for some locations where previously there was a larger change in original C value (e.g., 88C well nest). The adjusted C values are reflected in the FEHs presented in Tables 3 and 4.

Geokon, Micron, and manual FEHs for 61C-130 and 61C-160 is presented on Figures 16 and 17, respectively. Figure 18 shows the difference between the Micron and Geokon FEHs during the monitoring period (i.e., Micron FEH minus Geokon FEH). Table 15 compares the manual and Geokon FEHs for the manual water level measurements, and shows the average FEH offset along with the linear regression density from the manual height of water versus Geokon transducer pressure.

Figures 16 and 17 demonstrate that the manual FEHs correspond best to the Geokon FEHs. The manual and Geokon FEHs at 61C-130 differ by an average offset of 0.04 ft, as shown in Table 15, which is within the transducer accuracy. At 61C-160, the manual and Geokon FEHs differ by an average offset of -0.88 ft (see Table 15), and the manual FEHs are closer to the Geokon FEHs than to the Micron FEHs. The average offset of -0.88 ft between the manual and Geokon FEHs is greater than the transducer accuracy, but this could be related to variability in the laboratory measured specific gravity for 61C-160, which is described later in this section.

At 61C-130, the Micron FEHs differ from the manual and Geokon FEHs by approximately 2 ft on average over the monitoring period, as shown on Figure 18. Figure 18 also shows that the Micron FEHs drift during the monitoring period, where the difference between the Micron and Geokon FEHs (i.e., Micron FEH minus Geokon FEH) increases in magnitude from the beginning to the end of the monitoring period.

At 61C-160, the Micron FEHs differs from the manual and Geokon FEHs early in the monitoring period by more than 2 ft, as shown on Figure 18. Figure 18 also shows that the Micron FEHs drift from the Geokon FEHs early in the monitoring period, shift abruptly mid-way through the monitoring period, and then become similar to the Geokon FEHs at the end of the monitoring period. The shift in the Micron pressure signal corresponds to an increase in FEH of approximately 1.3 ft. The transducer cable was securely clamped at ground surface and the transducer was not re-programmed at the time the shift occurred. Manual water levels were measured just prior to the shift, which suggests that the water level tape might have disturbed the transducer in some way, but manual measurements were obtained four other times prior to the shift without altering the transducer position or its signal. It could be speculated that possibly the Micron transducer was caught in some way just above the Geokon transducer elevation, and removing the water level tape just prior to the shift jostled the Micron transducer so that it dropped down to the elevation of the Geokon transducer. In this case, the correlation between the Micron and Geokon FEHs would be improved at the end of the monitoring period. However, the Micron FEHs continue to drift as shown on Figure 18, which demonstrates that inaccuracies with the Micron transducer continued after the shift.

The Micron transducers were tested in the DI well prior to deploying them in 61C-130/160. This testing identified drift and inaccuracies in the Micron transducer pressure readings, and this was discussed with the Agencies prior to the monitoring period. The Micron FEH results as deployed in 61C-130/160 are consistent with the findings of the Micron testing in the DI well.

For 61C-130, as shown in Table 15, the difference between the linear regression density of 66.80 lbs/ft^3 (SG = 1.0705) and the density based on the laboratory measured specific gravity of 66.82 lbs/ft^3 (SG = 1.0709) is 0.02 lbs/ft^3 (SG = 0.0004). For 61C-160, the difference between the linear regression density of 63.37 lbs/ft^3 (SG = 1.0156) and the laboratory measured specific gravity of 63.03 lbs/ft^3 (SG = 1.0101) is 0.34 lbs/ft^3 (SG = 0.0055). This difference is within the specific gravity variation of 0.0117 observed at 61C-160 between the four most recent laboratory measured specific gravity values at 61C-160 of 1.0196 (Event 3), 1.0079 (Summer 2013), 1.0095 (November 14, 2013), and 1.0088 (December 20, 2013). In Table 15, the December 20, 2013 specific gravity of 1.0088, temperature corrected to 1.0101, was used to calculate the manual FEHs at 61C-160, and the average FEH offset using the December 20, 2013 specific gravity is -0.88 ft indicating there is uncertainty in the FEHs at 61C-160. At the bottom of Table 15, the linear regression density of 63.37 lbs/ft^3 (SG = 1.0156) was used to re-calculate the manual FEHs. The manual FEHs increase due to the greater water column density, and the average FEH offset becomes 0 ft. The difference between the linear regression density and the laboratory measured specific gravity is within the observed variability for the most recent laboratory measured specific gravity values at 61C-160, as described above. This analysis demonstrates that the average offset between the manual and transducer FEHs of -0.88 ft is not related to transducer error and can be explained by variability in the manual FEHs caused by variability in the laboratory measured specific gravity values at 61C-160.

Environmental heads (ENVs) were calculated from the Geokon FEHs at 61C-130/160 and are presented on Figure 19. The Serfes mean ENVs for 61C-130/160 are presented on Figure 20. The 61C-160 ENVs are greater than the 61C-130 ENVs, which indicates upward vertical hydraulic gradients from the 160-ft zone to the 130-ft zone at this location. The upward vertical hydraulic gradients are consistent with the CSM.

ENVs are calculated directly from FEHs and the average formation density at the well nest. Thus, uncertainty in FEHs results in uncertainty in ENVs. The uncertainty in ENVs at 61C-160, and the upward vertical hydraulic gradients at this location, due to the uncertainty in the 61C-160 FEHs was evaluated. The 61C-160 ENVs were recalculated assuming the FEHs at 61C-160 were reduced by 0.88 ft (i.e., lowered by the average FEH offset of -0.88 ft). The resulting Serfes mean ENVs for 61C-160 were plotted on Figure 21 against the Serfes mean ENVs for 61C-130. A reduction in the 61C-160 ENVs is apparent in comparison to Figure 20, but the upward vertical hydraulic gradient from 61C-160 to 61C-130 remains.

MW-F and MW-G Hydraulic Monitoring

For the hydraulic monitoring at the MW-F and MW-G well nests, each well was purged to obtain a uniform density within the well casing water column. After purging, groundwater samples were collected for laboratory analysis of specific gravity. Manual water levels were measured and converted to manual FEHs based on the laboratory measured specific gravity. The difference between the manual and Levelogger transducer FEHs was determined and compared to the combined range of the transducer accuracy and manual water level measurement accuracy. The average FEH offset for each well is summarized in Table 16, and is greater than the combined transducer and manual water level measurement accuracy. The difference between the manual and transducer FEHs could be related to variability laboratory measured specific gravity, as described above for 61C-160. To check this, all of the transducers were tested in the DI well. The DI well checks are also summarized in Table 16. For the DI well checks, the difference between the transducer pressure and its depth setting in the DI well, averaged over the four depth settings, was compared to the transducer accuracy. As shown in Table 16, the DI well transducer pressures were within the transducer accuracy, except MW-F-Shallow and MW-G-Intermediate. The MW-F-Shallow transducer pressures were greater than the transducer accuracy for all four depth settings. As a result, this transducer was replaced, and the replacement transducer pressures were within the transducer accuracy, as shown in Table 16 for the January 2014 DI Well Checks. The MW-G-Intermediate transducer pressures were within the transducer accuracy for three of the four depth settings, and this transducer was not replaced. After the DI well checking, the transducers were re-installed in the monitoring wells in December 2013. The replacement transducer for MW-F-Shallow was installed in mid-January 2014.

ENVs were calculated from the transducer FEHs measured at MW-F-Intermediate/Deep and MW-G-Shallow/Intermediate/Deep from December 20 2013 to January 3, 2013. The ENVs and Serfes mean ENVs are presented on Figures 21 and 22, respectively, for MW-F-Intermediate/Deep. The ENVs and Serfes mean ENVs are presented on Figures 23 and 24, respectively, for MW-G-Shallow/Intermediate/Deep. The Serfes mean ENVs demonstrate that there is an upward hydraulic gradient from the deep to intermediate wells at both MW-F and MW-G. The upward vertical hydraulic gradients are consistent with the draft CSM.

7.0 FEH Uncertainty Bounds and FEH Contours

FEH Uncertainty Bounds and FEH Contours

The total accuracy described in Section 3.0 under Category 1 provides an estimate of the uncertainty in the FEHs, and provides quantitative bounds for the FEH at each monitoring well.

Environmental heads (ENVs), used to evaluate vertical hydraulic gradients at a monitoring well nest, are calculated directly from the FEHs at the well nest. As a result, the total accuracy also provides uncertainty bounds for the ENVs.

The average total accuracy for the monitoring wells in each aquifer depth zone can be used to determine appropriate intervals for the FEH contours. A summary of the average total accuracy for the monitoring wells in each aquifer depth zone is provided below.

Aquifer Depth Zone	***Average Total Accuracy per Zone (ft H_2O)***
15-ft zone	±0.04
25-ft zone	±0.12
50-ft zone	±0.33
75-ft zone	±0.52
100-ft zone	±0.82
130-ft zone	±0.92
160-ft zone	±0.83

The average total accuracy for the 100-ft, 130-ft, and 160-ft zones is essentially ±1 ft, which suggests applying a FEH contour interval of more than 1 ft for these zones. However, the variation in FEH across the Site in the 100-ft, 130-ft, and 160-ft zones is approximately 2 to 3 ft. Using an interval of more than 1 ft would result in too few contour lines for the FEH contours to be meaningful. As a result, a contour interval of 1 ft is considered appropriate for the 100-ft, 130-ft, and 160-ft zones. To be consistent with this, a 1 ft FEH contour interval is also applied in the 25-ft to 75-ft zones. A 0.5 ft contour interval is used for 15-ft zone since the variation in FEH for this zone is approximately 1 ft. FEH contours for Event 3A for the 15-ft to 130-ft zones are presented in Figures 3.91 to 3.96 of the main report.

The FEH contours are drawn by hand taking into consideration key features of the CSM for the Site, including:

- Regional groundwater inflow from south along the Puyallup River Valley
- Regional groundwater inflow from beneath the Bluffs east of the Site
- Shallow groundwater discharge to Commencement Bay and the Hylebos and Blair Waterways
- Shallow groundwater mounding over the Site peninsula due to precipitation infiltration

- Operation of the existing Site groundwater extraction system

8.0 Conclusions and Recommendations

Prior to installation, the Geokon transducers were fastened to the CMT well casing using hose clamps that were hand-tightened using either a 4-inch ratchet wrench or 10-inch screw driver or to firmly hold the transducers in place. Additional testing was conducted where Geokon transducers were clamped with increasing torque and lowered to specific water depth settings in the DI well. The testing shows that clamping the Geokon transducers can cause a change in the calibration slope factors A and B. The changes to A and B result in potential transducer water level errors ranging from 0.063 ft H_2O and 0.078 ft H_2O over the typical maximum 10 ft change in groundwater levels at the Site monitoring wells due to tidal fluctuations. For the field testing presented in this Report, C values are determined through in situ C value calibration that compensate for the slope factor changes. By applying the in situ C value calibration, the clamped transducers are shown to match measured water depth settings to within the transducer accuracy. A maximum change in C value of 0.8 psi (1.85 ft H_2O) occurred for the highest torque applied to the clamps during the testing. A C value change of up to 0.8 psi occurred for 75 of 101 of the Geokon transducers where there was a change in the original C value.

The FEHs presented in Tables 1, 3, and 4 will be used to calibrate the groundwater flow for the Site. The results of the DI well testing described in Section 5.0 show that using the original C values introduces more error to the FEHs than occurs using the in situ calibrated C values. As a result, it is recommended that the FEHs determined using the best-fit, or in situ, C values, rather than using the original C values, be retained as model calibration targets. The DI well testing shows that in situ C value calibration can account for changes in transducer calibration factors caused by stressing the transducer housing for a change in original C value of up to 0.8 psi, as described in Section 5.0, where the 0.8 psi threshold corresponds to the maximum change in original C value that occurred for the DI well testing.

The average offset between the manual and transducer FEHs was compared to a total accuracy based on the sum of the accuracy of the transducers, the accuracy reasonably expected for obtaining manual water level measurements at the Site, and the uncertainty in the manual FEHs due to water column density variations in the well casing above the transducer. The total accuracy provides an estimate of the uncertainty in the FEHs, and provides quantitative bounds for the FEH at each monitoring well. ENVs, used to evaluate vertical hydraulic gradients at a monitoring well nest, are calculated directly from the FEHs at the well nest. As a result, the total accuracy also provides uncertainty bounds for the ENVs.

A comparison between FEHs based on Geokon transducer pressures, Micron transducer pressures, and manual water levels was conducted at 61C-130/160. The manual FEHs correspond best to the Geokon FEHs. The Micron FEHs differ considerably from the manual and Geokon FEHs, and the Micron FEHs drifted during the monitoring period. The average offset between manual and transducer FEHs is 0.04 ft for 61C-130, which is within the transducer accuracy. The average offset between manual and transducer FEHs is -0.88 ft for 61C-160, which is greater than the transducer accuracy. However, example calculations demonstrate that the average FEH offset of -0.88 ft is not related to transducer error and can be explained by variability in the manual FEHs caused by variability in the laboratory measured specific gravity values at 61C-160. The example calculations show that an increase in the specific gravity at 61C-160 of 0.0055 increases the manual FEHs, and provides an average FEH offset of zero. The increase in specific gravity of 0.0055 is within the variability of the four most recent laboratory specific gravity values at 61C-160 measured from 2012 to 2013 that vary from 1.0079 to 1.0196 (a range of 0.0117). Thus, the average offset between the manual and transducer FEHs at 61C-160 of -0.88 ft is within the variability of the laboratory measured specific gravity values at this location, and is not indicative of a transducer error.

ENVs were calculated from the Geokon FEHs at 61C-130/160 and demonstrated that vertical hydraulic gradients from the 160-ft zone to the 130-ft zone are upward at this location. The upward vertical hydraulic gradients are consistent with the CSM.

Prior to the EXT-9 pumping test, hydraulic monitoring was conducted at the MW-F and MW-G well nests. ENVs were calculated from the transducer FEHs for each of the MW-F and MW-G wells. The Serfes mean ENVs show there is an upward vertical hydraulic gradient from the deep to intermediate wells at both MW-F and MW-G. The upward vertical hydraulic gradients are consistent with the CSM.

9.0 References

Holmes, R.R., Jr., Terrio, P.J., Harris, M.A., and Mills, P.C., 2001. Introduction to Field Methods for Hydrologic and Environmental Studies, U.S. Geological Survey Open-File Report 01-50 (http://il.water.usgs.gov/pubsearch/reports.cgi/view?series=OFR&number=01-50).

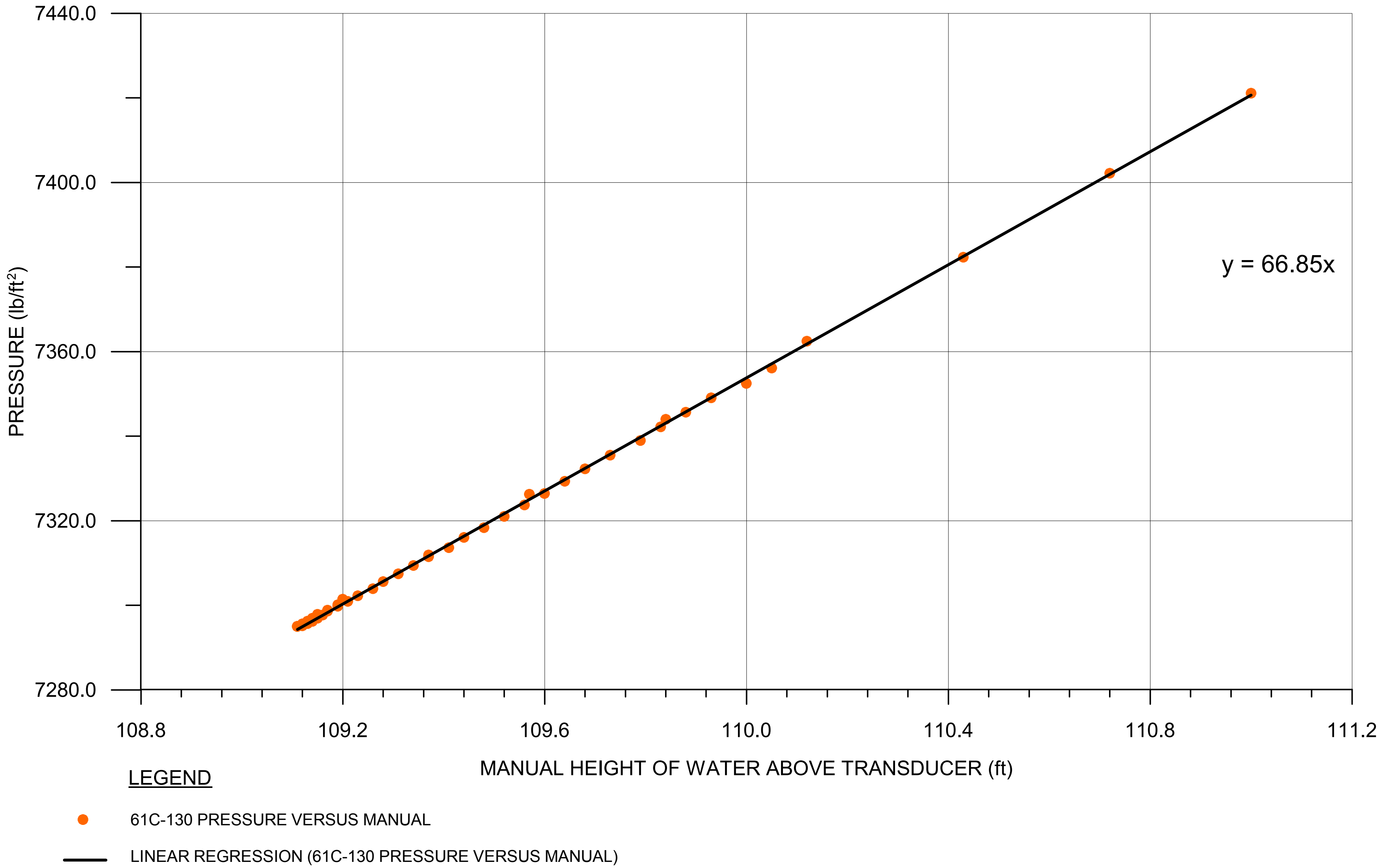


figure 1

SUMMER 2013 61C-130 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- Summer 2013 61C-130 Pressure Versus Manual Height of Water.grf) JAN 30/2014

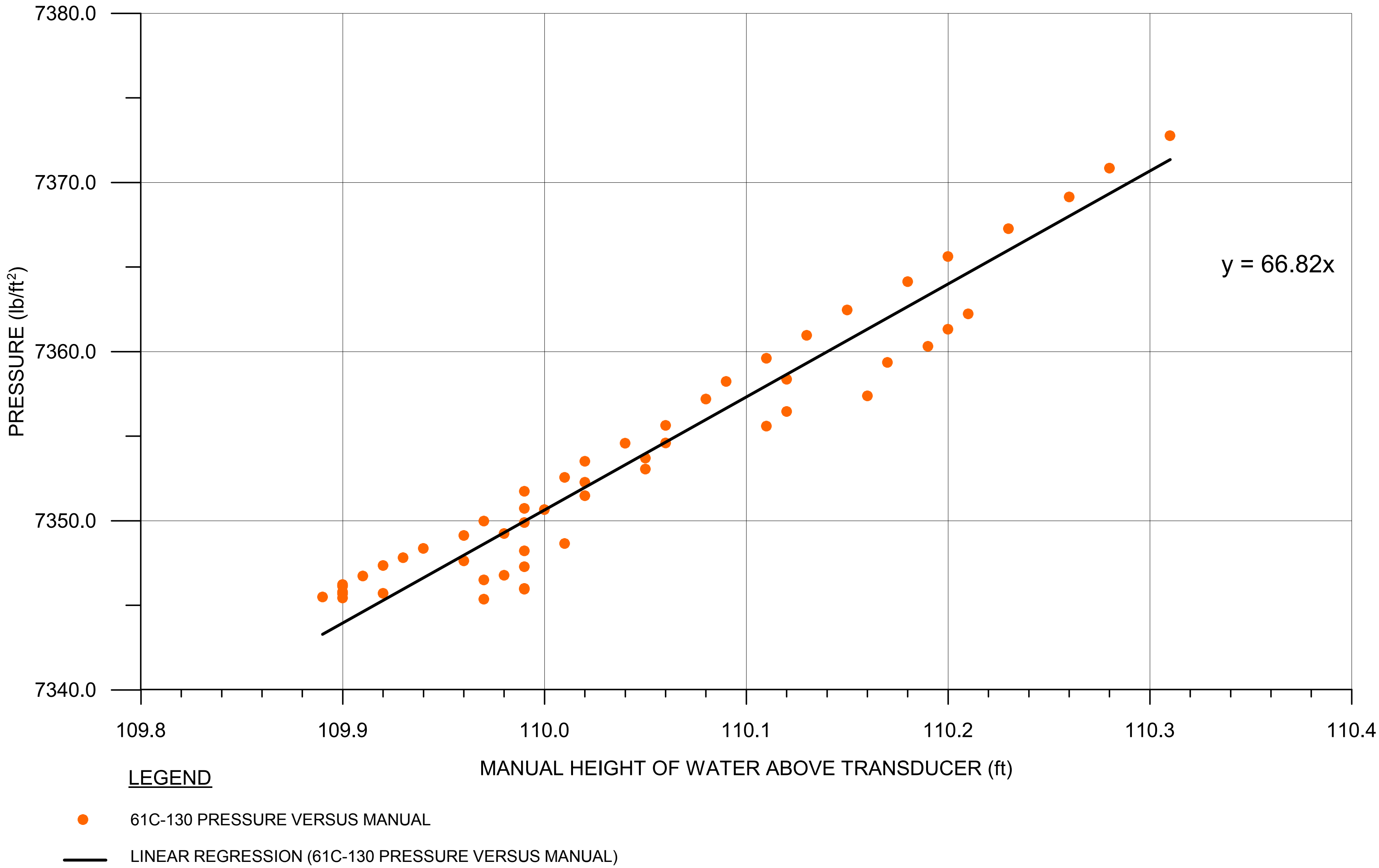
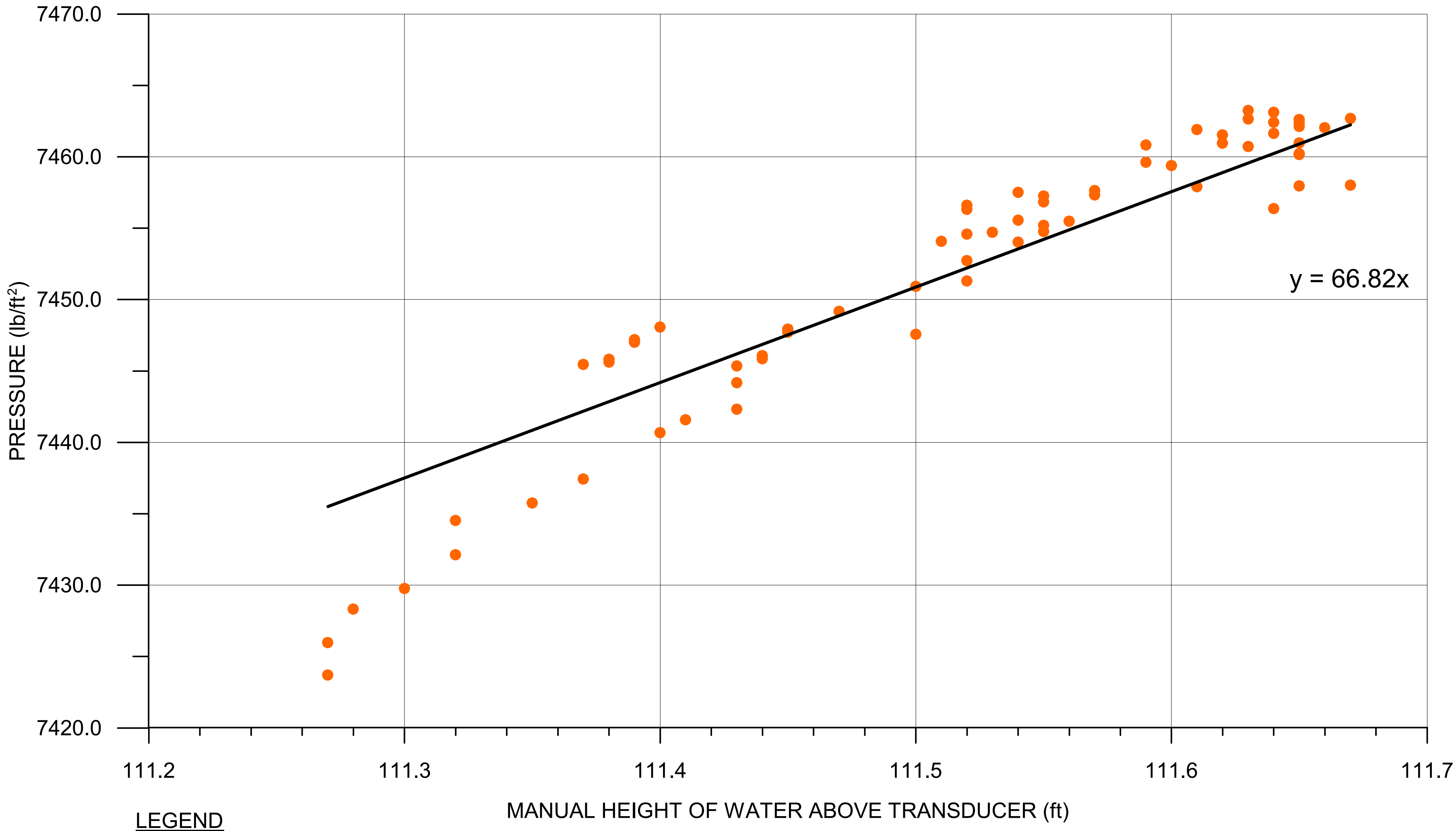


figure 2

NOVEMBER 14, 2013 61C-130 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- November 14, 2013 61C-130 Pressure Versus Manual Height of Water.grf) JAN 30/2014



LEGEND

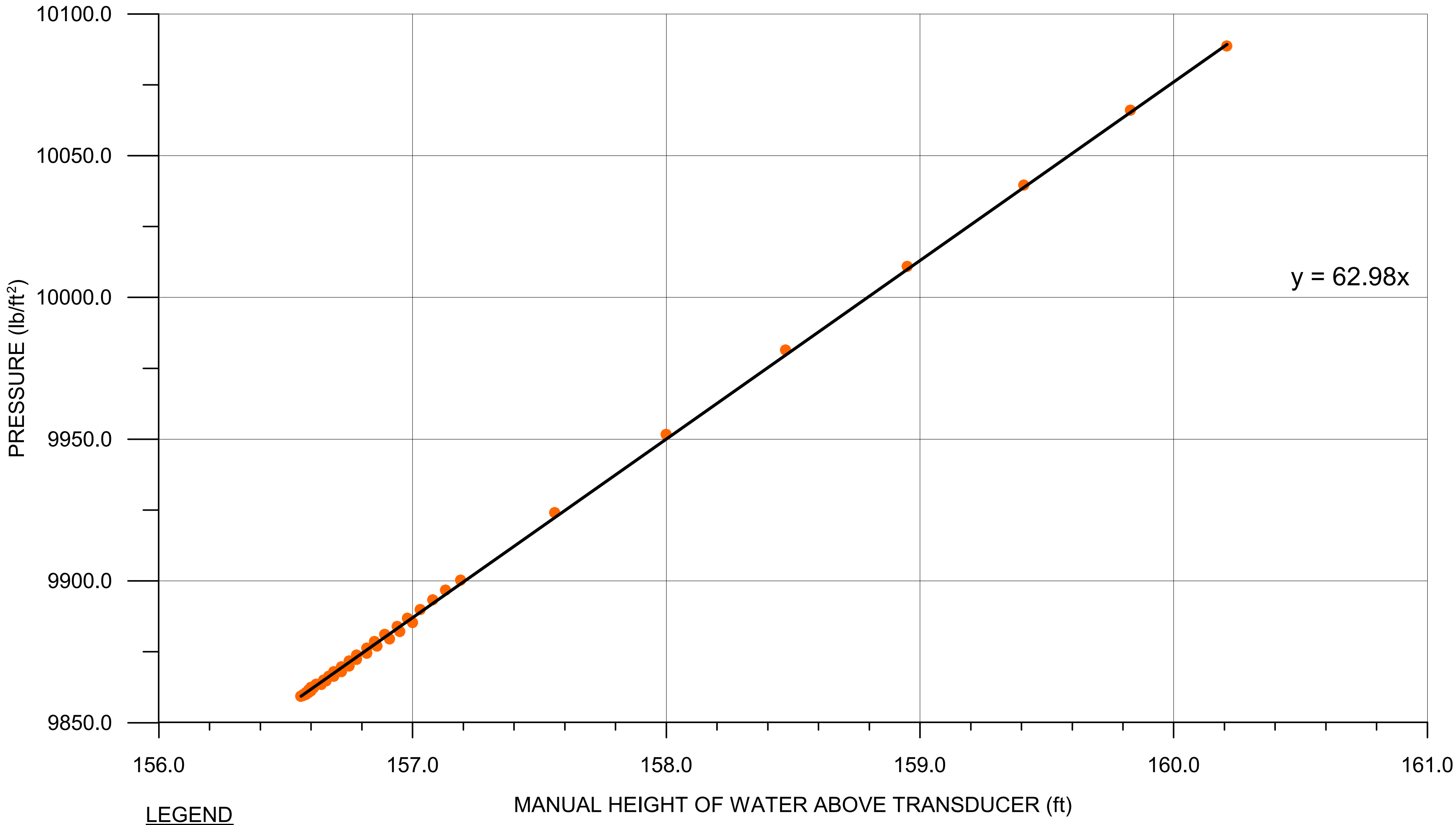
61C-130 PRESSURE VERSUS MANUAL

LINEAR REGRESSION (61C-130 PRESSURE VERSUS MANUAL)

figure 3

DECEMBER 20, 2013 61C-130 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington



LEGEND

- 61C-160 PRESSURE VERSUS MANUAL
- LINEAR REGRESSION (61C-160 PRESSURE VERSUS MANUAL)

figure 4

SUMMER 2013 61C-160 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

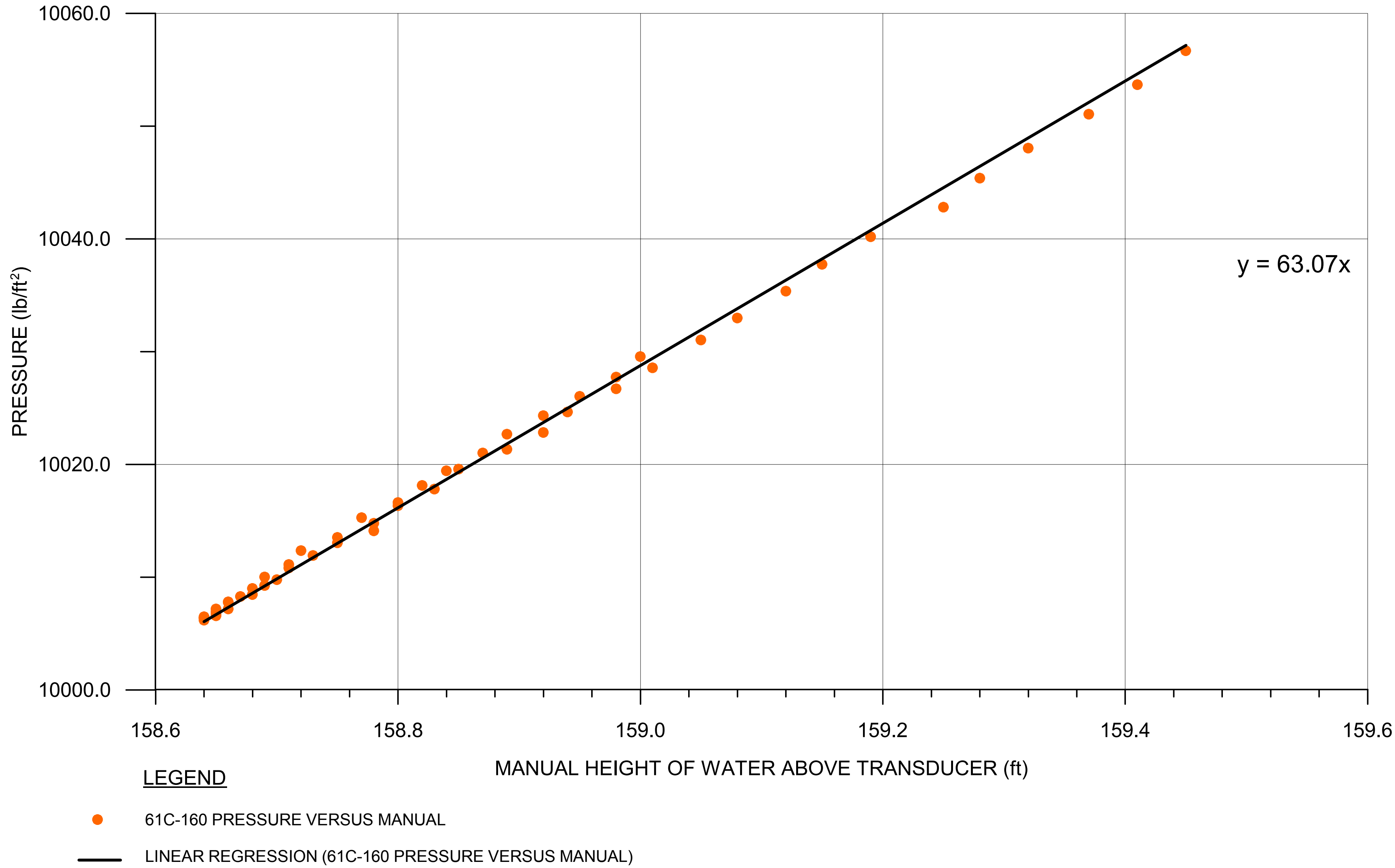


figure 5

NOVEMBER 14, 2013 61C-160 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

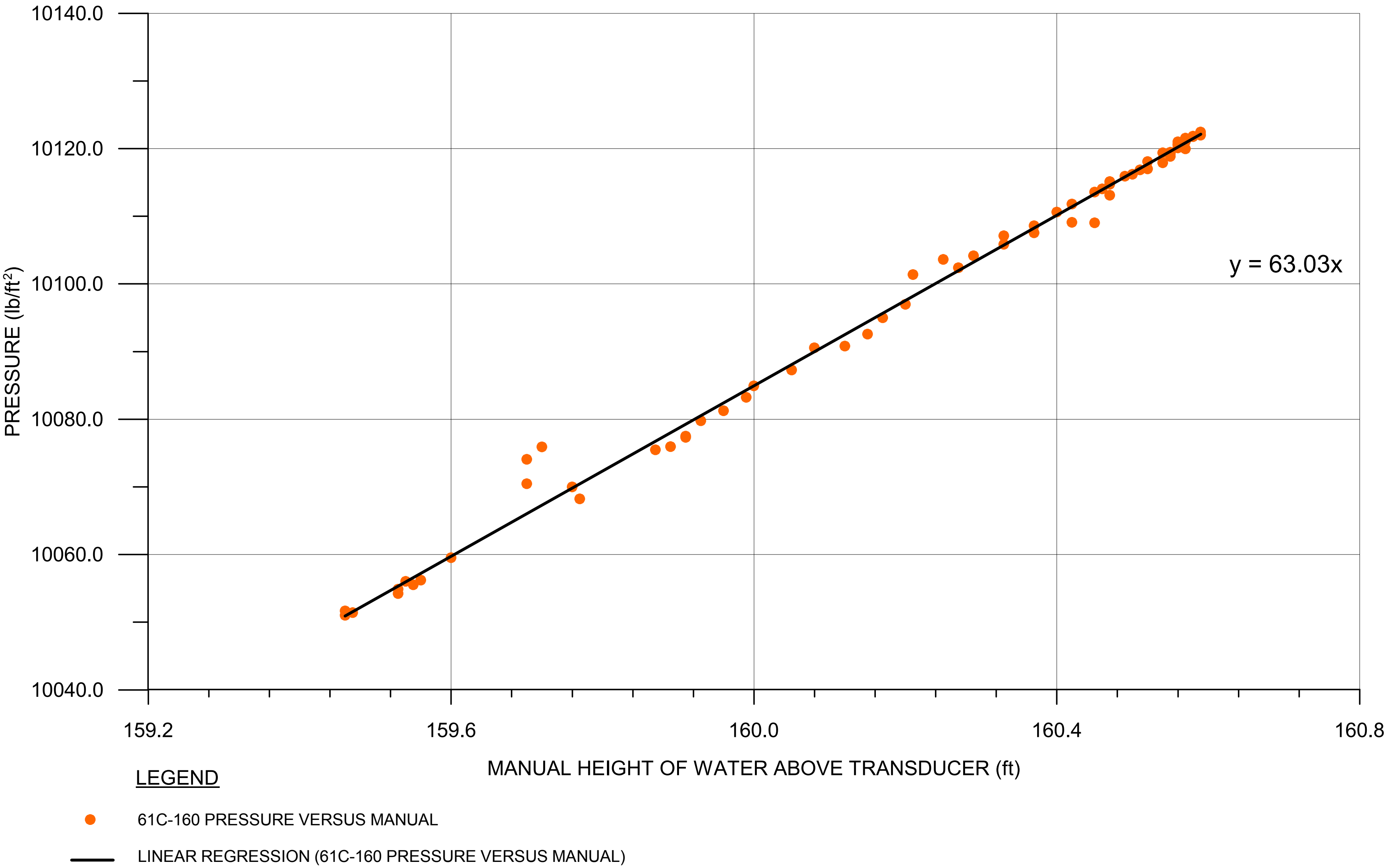
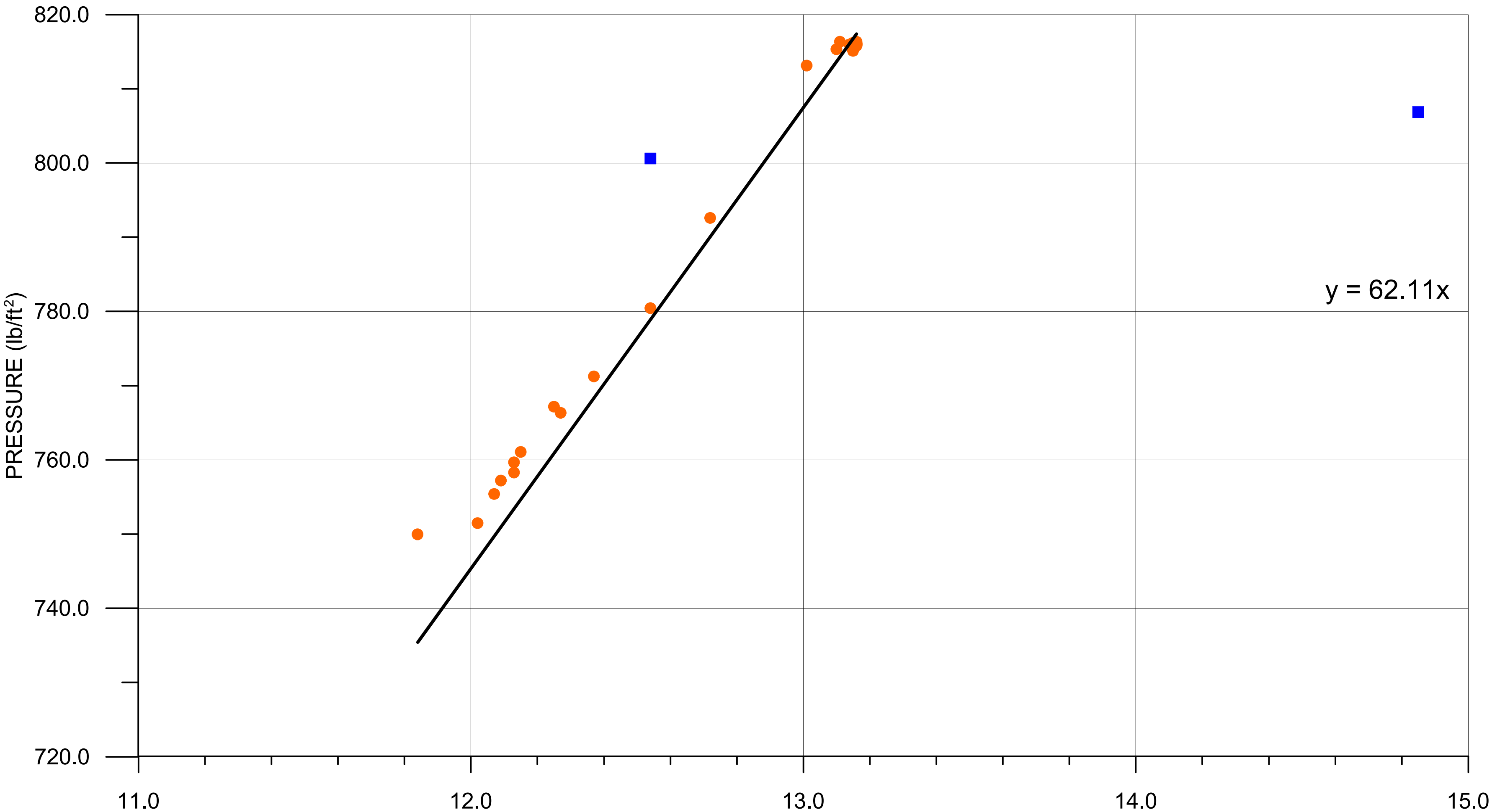


figure 6

DECEMBER 20, 2013 61C-160 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- December 20, 2013 61C-160 Pressure Versus Manual Height of Water.grf) JAN 30/2014



<u>LEGEND</u>

- 61C-25 PRESSURE VERSUS MANUAL
- EXCLUDED DATA
- LINEAR REGRESSION (61C-25 PRESSURE VERSUS MANUAL)

figure 7

2012 61C-25 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

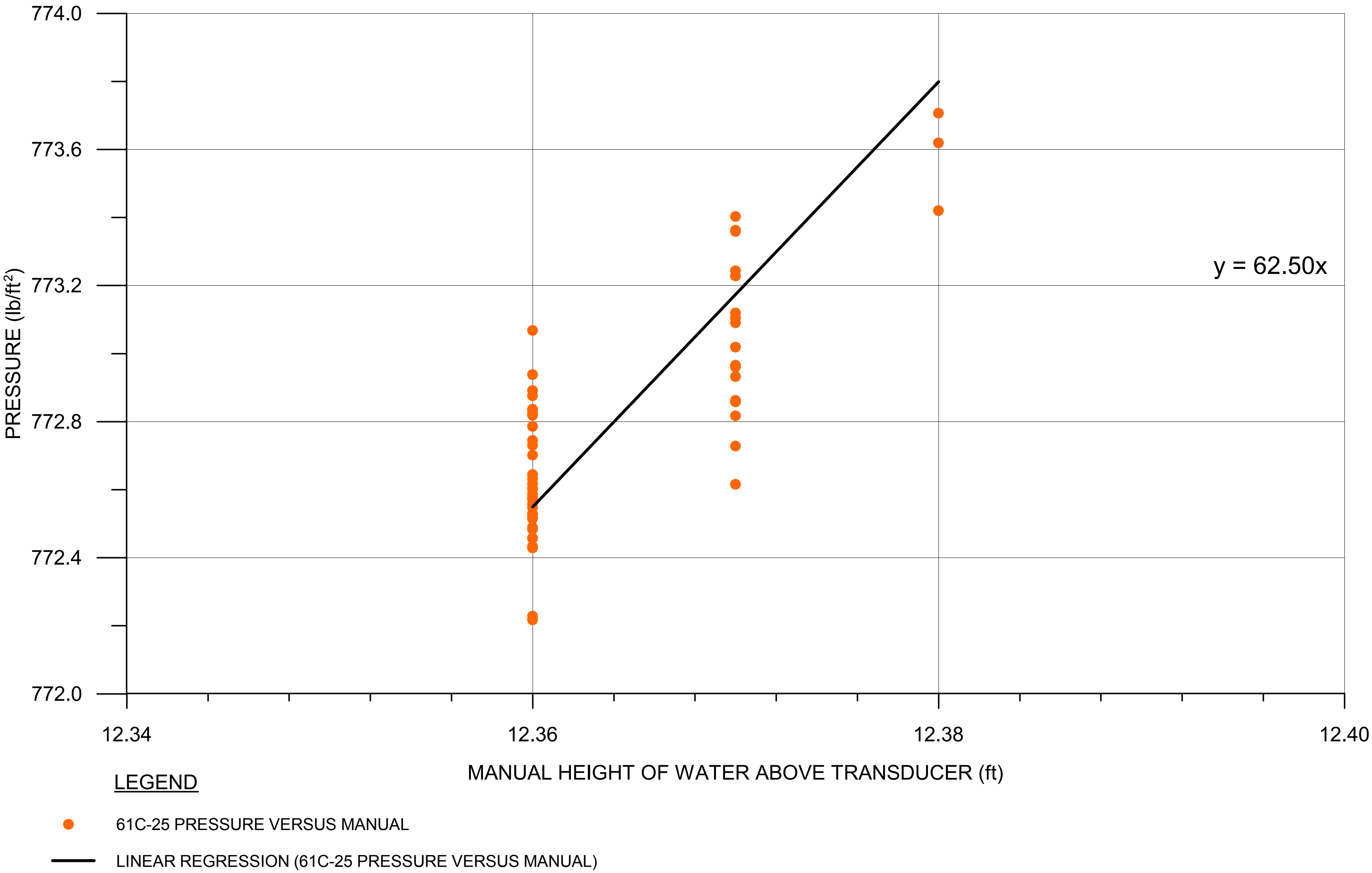


figure 8

NOVEMBER 14, 2013 61C-25 MANUAL HEIGHT OF WATER VERSUS PRESSURE
Occidental Chemical Corporation, Tacoma, Washington

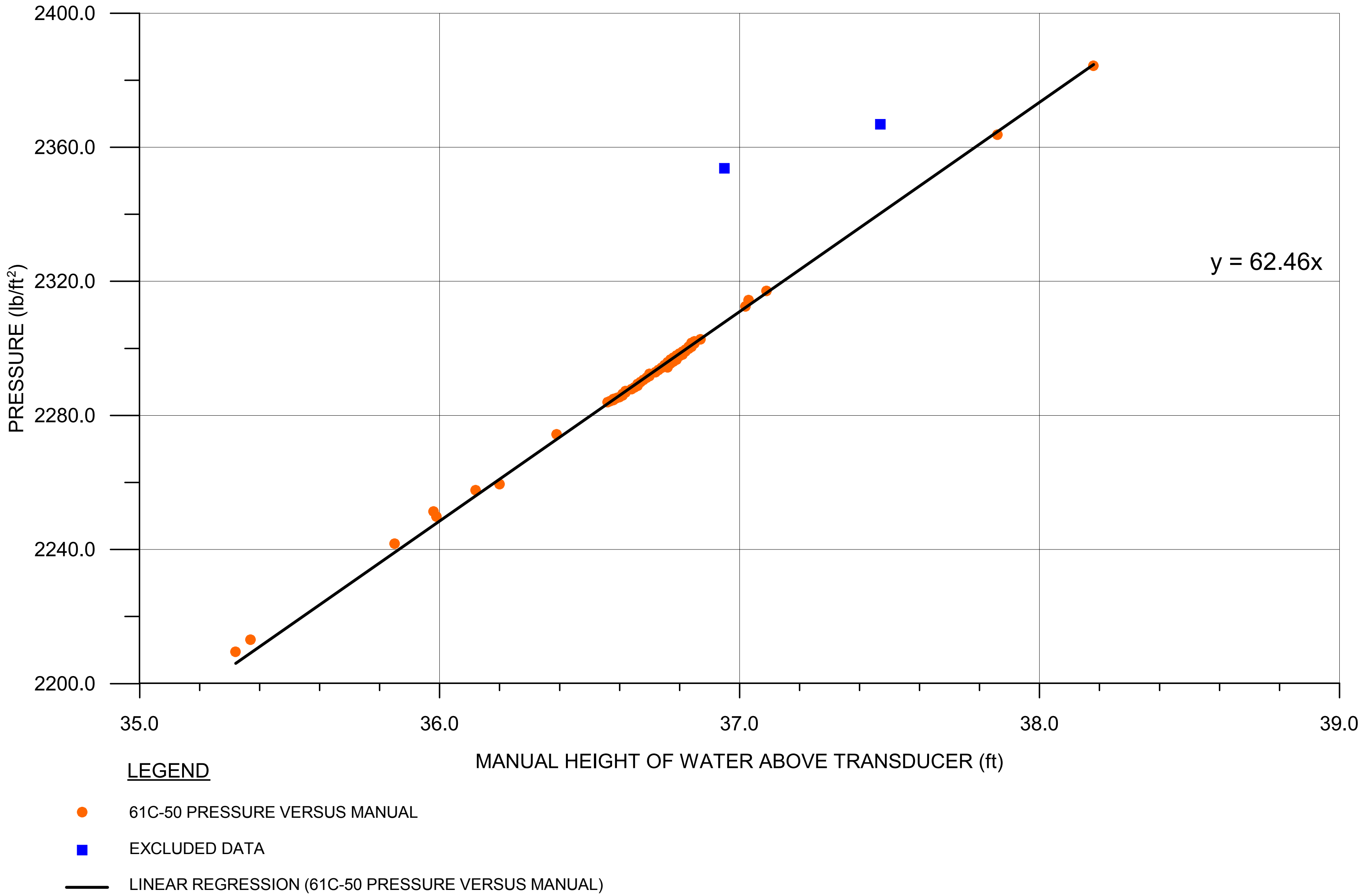


figure 9

2012 61C-50 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

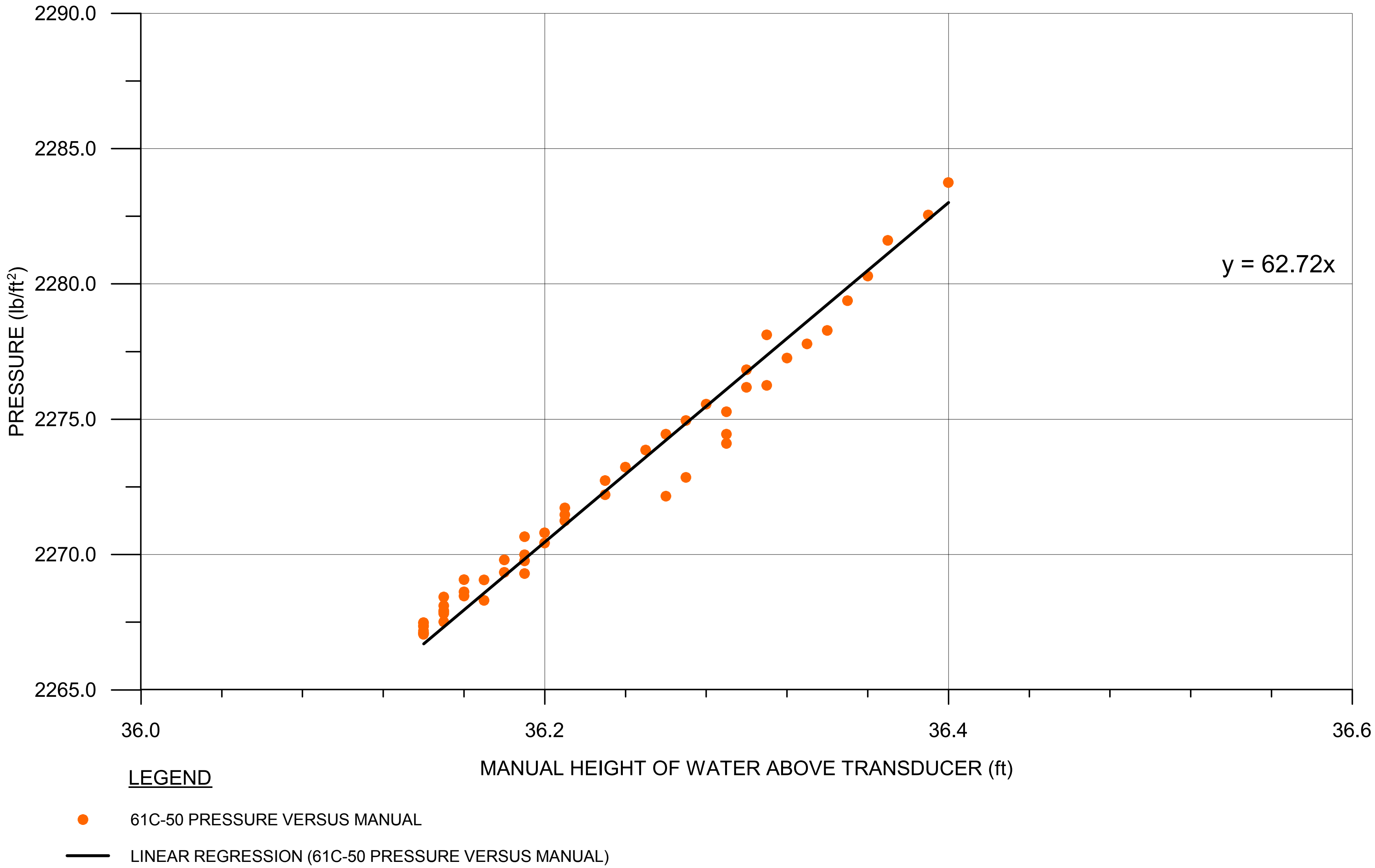


figure 10

NOVEMBER 14,2013 61C-50 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- November 14, 2013 61C-50 Pressure Versus Manual Height of Water.grf) JAN 30/2014

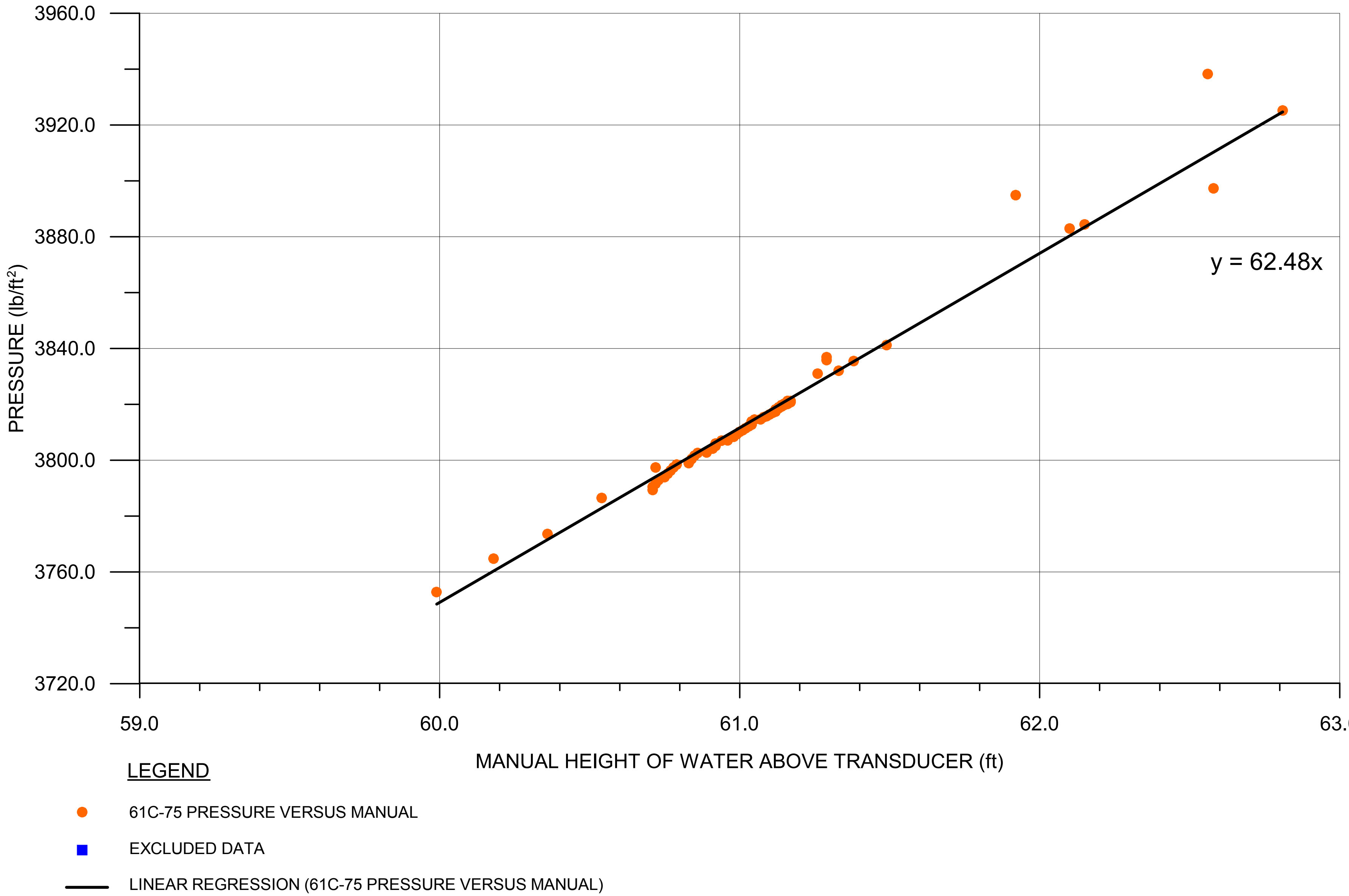
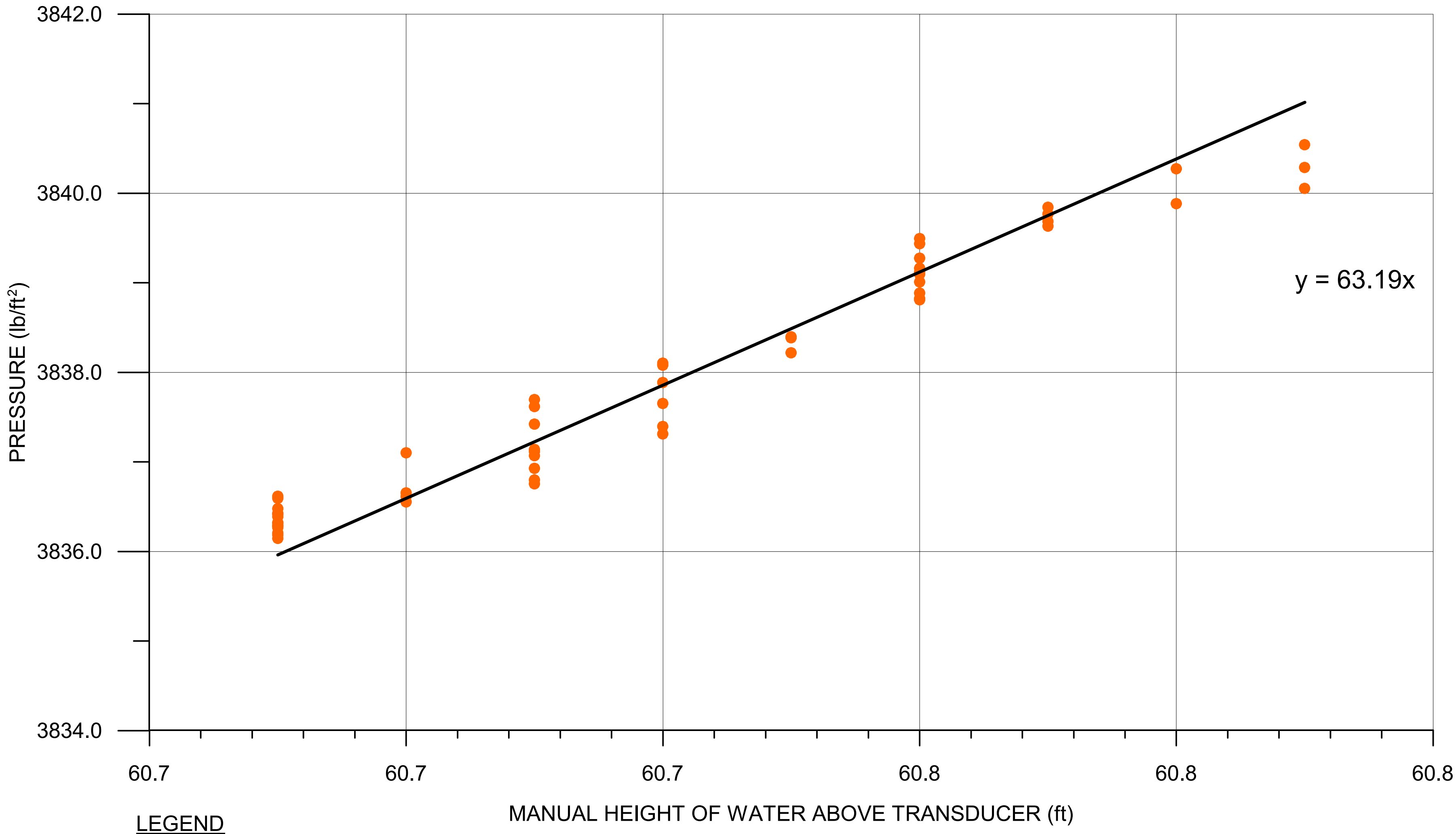


figure 11

2012 61C-75 MANUAL HEIGHT OF WATER VERSUS PRESSURE
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- 61C-75 Pressure Versus Manual Height of Water.grf) FEB 3/2014



LEGEND

61C-75 PRESSURE VERSUS MANUAL

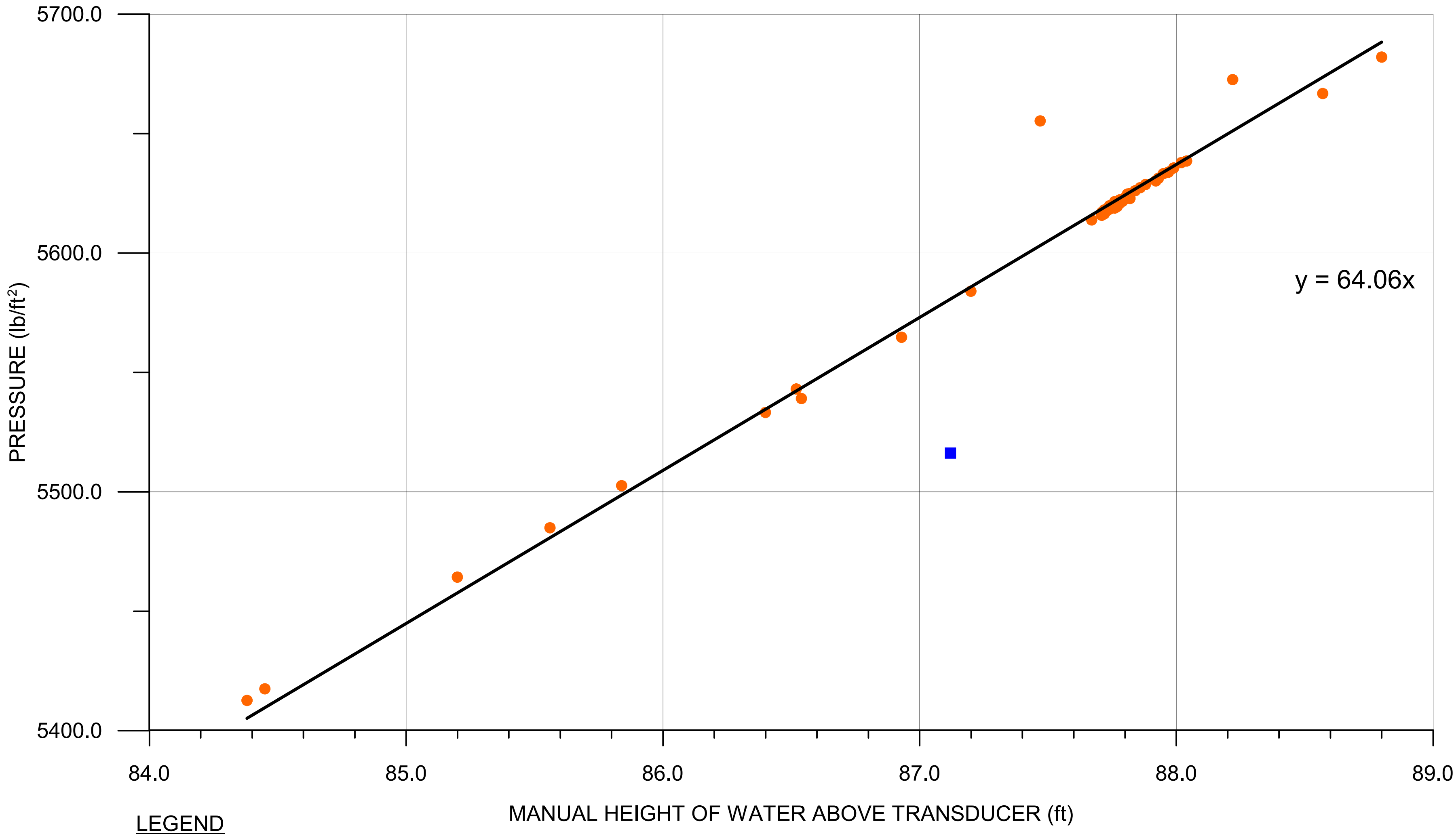
LINEAR REGRESSION (61C-75 PRESSURE VERSUS MANUAL)

figure 12

NOVEMBER 14,2013 61C-75 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843- November 14, 2013 61C-75 Pressure Versus Manual Height of Water.grf) JAN 30/2014



LEGEND

- 61C-100 PRESSURE VERSUS MANUAL
- EXCLUDED DATA
- LINEAR REGRESSION (61C-100 PRESSURE VERSUS MANUAL)

figure 13

2012 61C-100 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843-61C-100 Pressure Versus Manual Height of Water.grf) FEB 3/2014

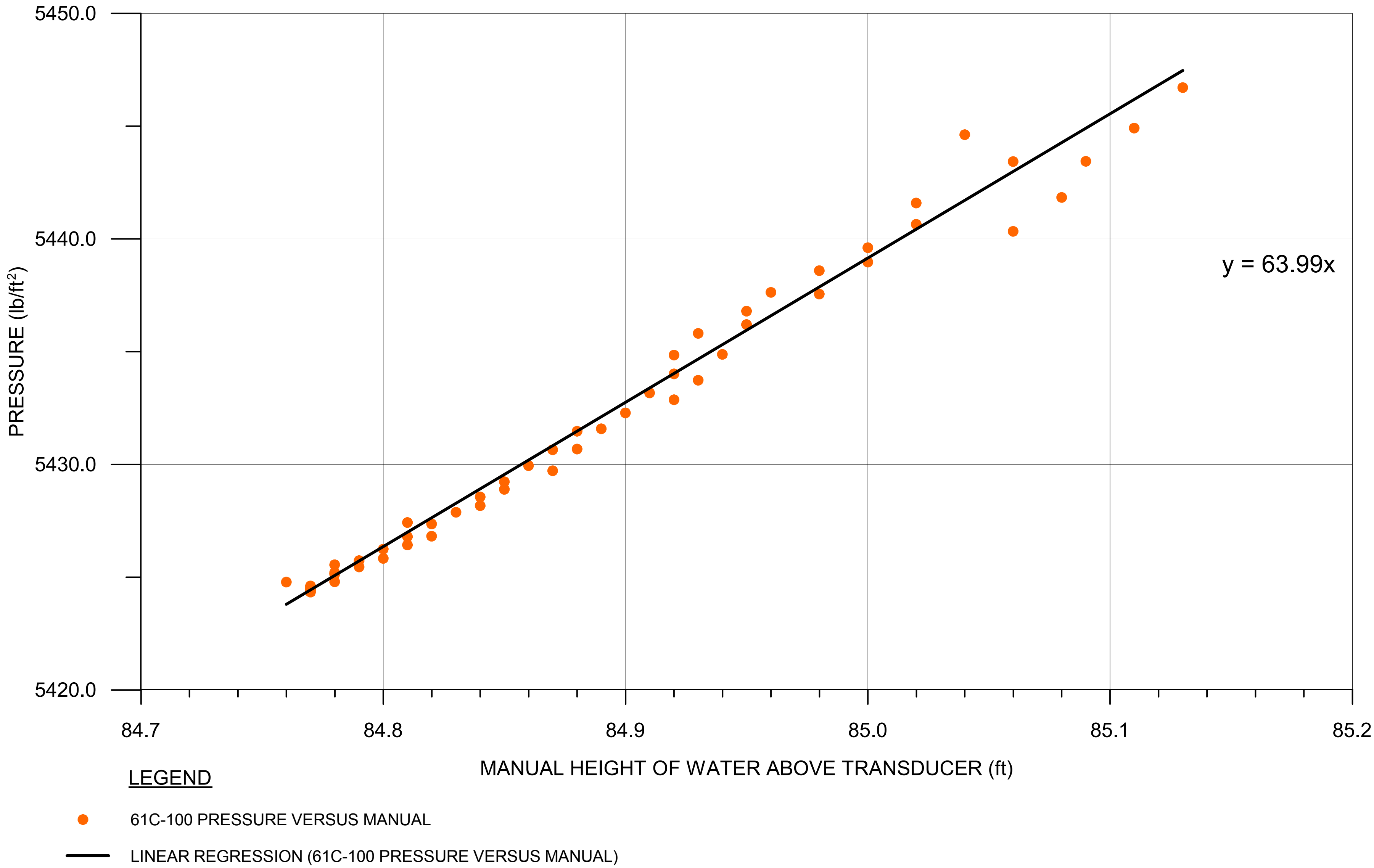


figure 14

NOVEMBER 14,2013 61C-100 MANUAL HEIGHT OF WATER VERSUS PRESSURE

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Memo072-FEH Categories\Reduced Workbooks and Figures\007843-November 14,2013 61C-100 Pressure Versus Manual Height of Water.grf) JAN 30/2014

$C = A{*}R_1^2 + B{*}R_1$, A = -2.695E-09 & B = -0.01357

1. **ZERO READING - INITIAL**

   R_1 = 8,901.6

   $C^{1.}$ = 121.008 psi

2. **ZERO READING - HAND GRIPPED**

   R_1 = 8,914.8

   $C^{2.}$ = 121.188 psi

3. **ZERO READING - TIGHTENED CLAMP**

   R_1 = 8,921.1

   $C^{3.}$ = 121.274 psi

DIFFERENCE BETWEEN C VALUES:

$C^{2.} - C^{1.}$ = 0.180 psi (0.41 ft H_2O)

$C^{3.} - C^{1.}$ = 0.266 psi (0.61 ft H_2O)

figure 15

GEOKON STRESSING BY HAND AND CLAMP

Occidental Chemical Corporation, Tacoma, Washington

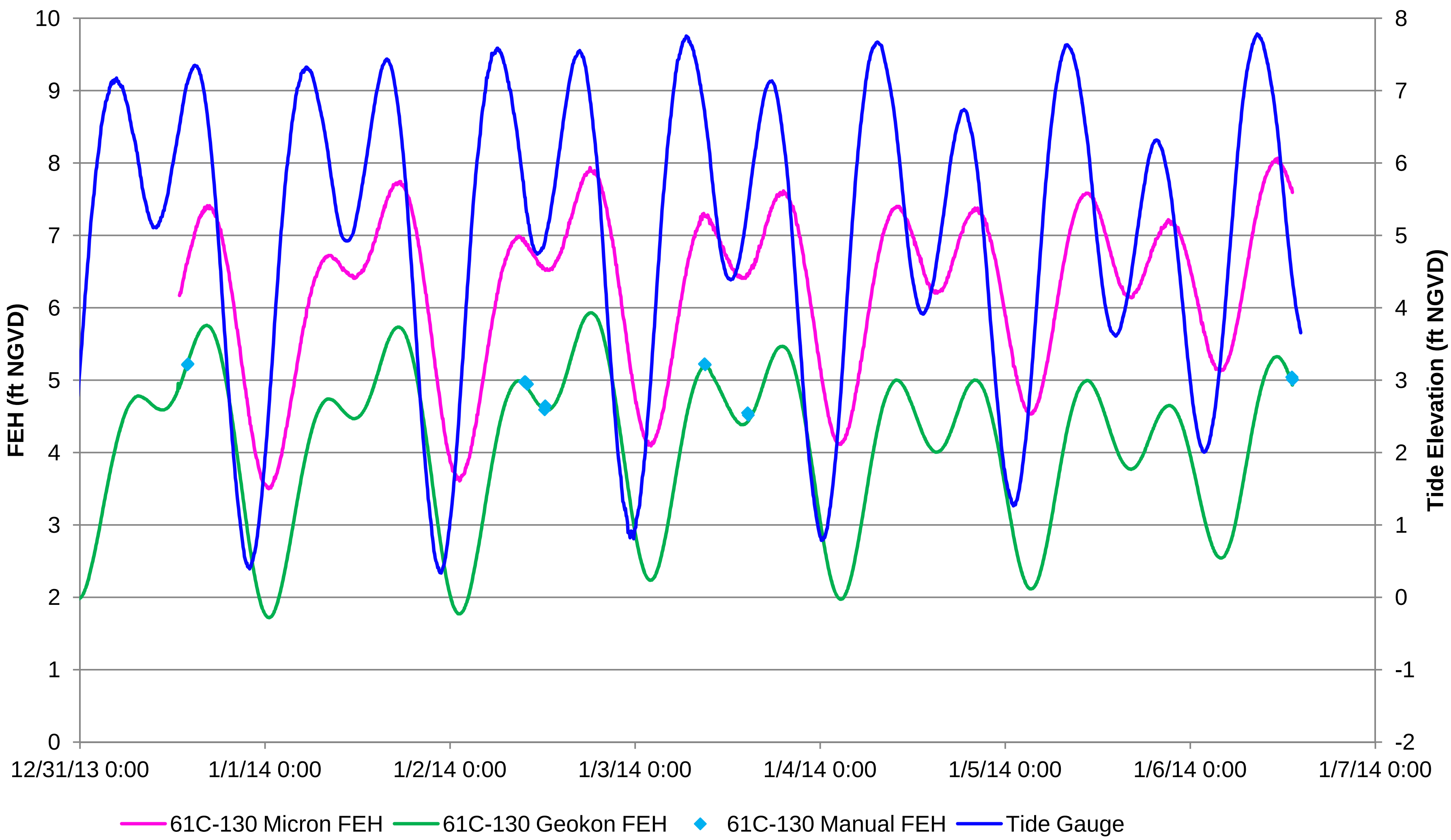
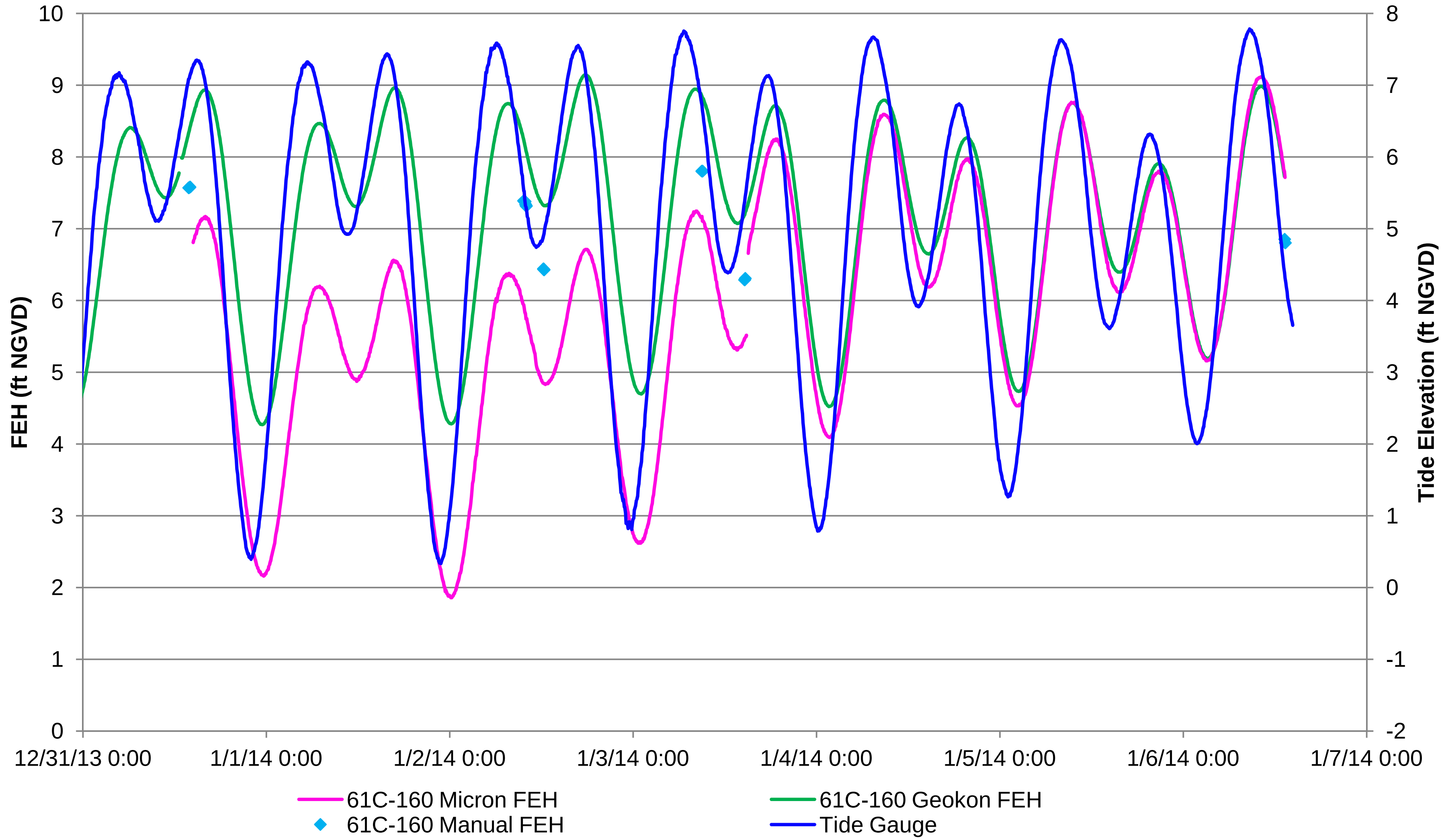


figure 16

61C-130

COMPARISON OF HYDRAULIC MONITORING - GEOKON/MICRON/MANUAL MEASUREMENTS

Occidental Chemical Corporation, Tacoma, WA



Note:

(1) 61C-160 Micron data shift occurred at 1/3/2014 14:55 to 1/3/2014 15:10

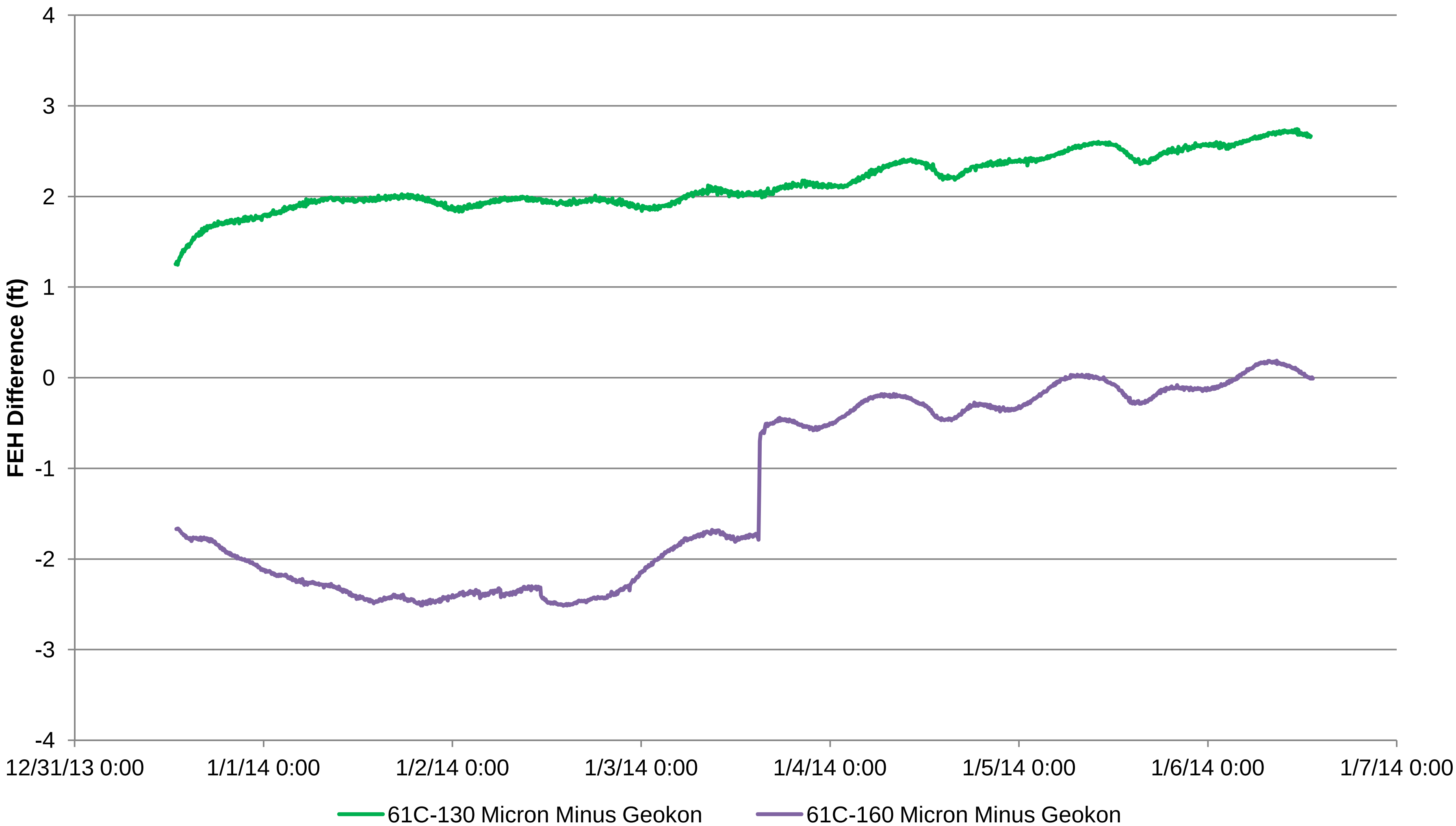
figure 17

61C-160

COMPARISON OF HYDRAULIC MONITORING - GEOKON/MICRON/MANUAL MEASUREMENTS

Occidental Chemical Corporation, Tacoma, WA

007843-A6(128)GN-HYD (N:\HEG\07843\Event 3 CSI\2013 FEH Confirmation\Nov 2013 FEH and prep for EXT9 test\007843-A6-MEMO-72-T15&T16 61C-130&160 Geokon Micron Comparison) APR 24/2014



Note:
(1) FEH difference determined as Micron FEH minus Geokon FEH
(2) 61C-160 Micron data shift occurred at 1/3/2014 14:55 to 1/3/2014 15:10

figure 18

61C-130 AND 61C-160
MICRON MINUS GEOKON FEH
Occidental Chemical Corporation, Tacoma, WA

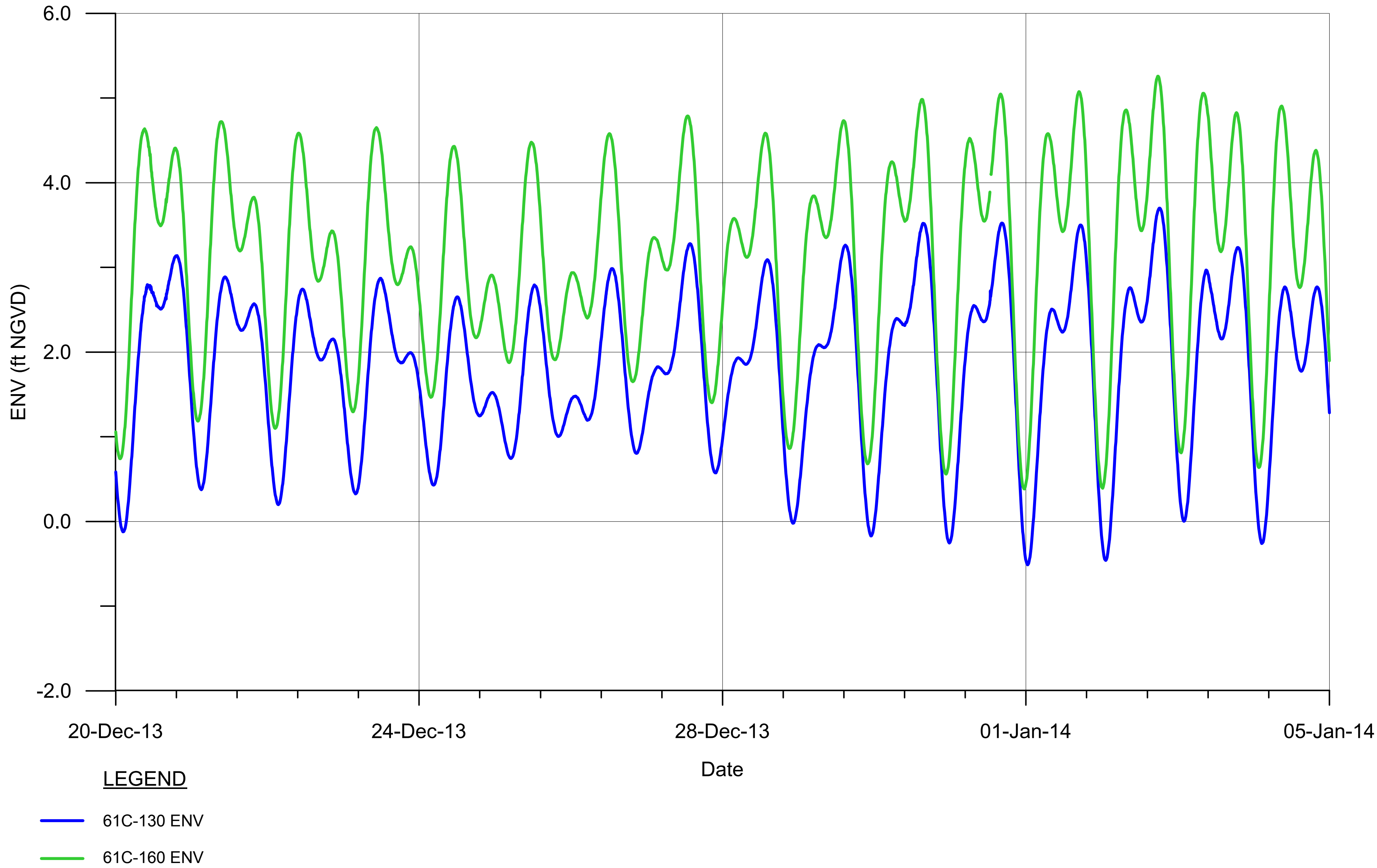


figure 19

61C-130 AND 61C-160 ENVs

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\2013 FEH Confirmation\Nov 2013 FEH and prep for EXT9 test\61C-130-160 ENV Plot.grf) FEB 3/2014

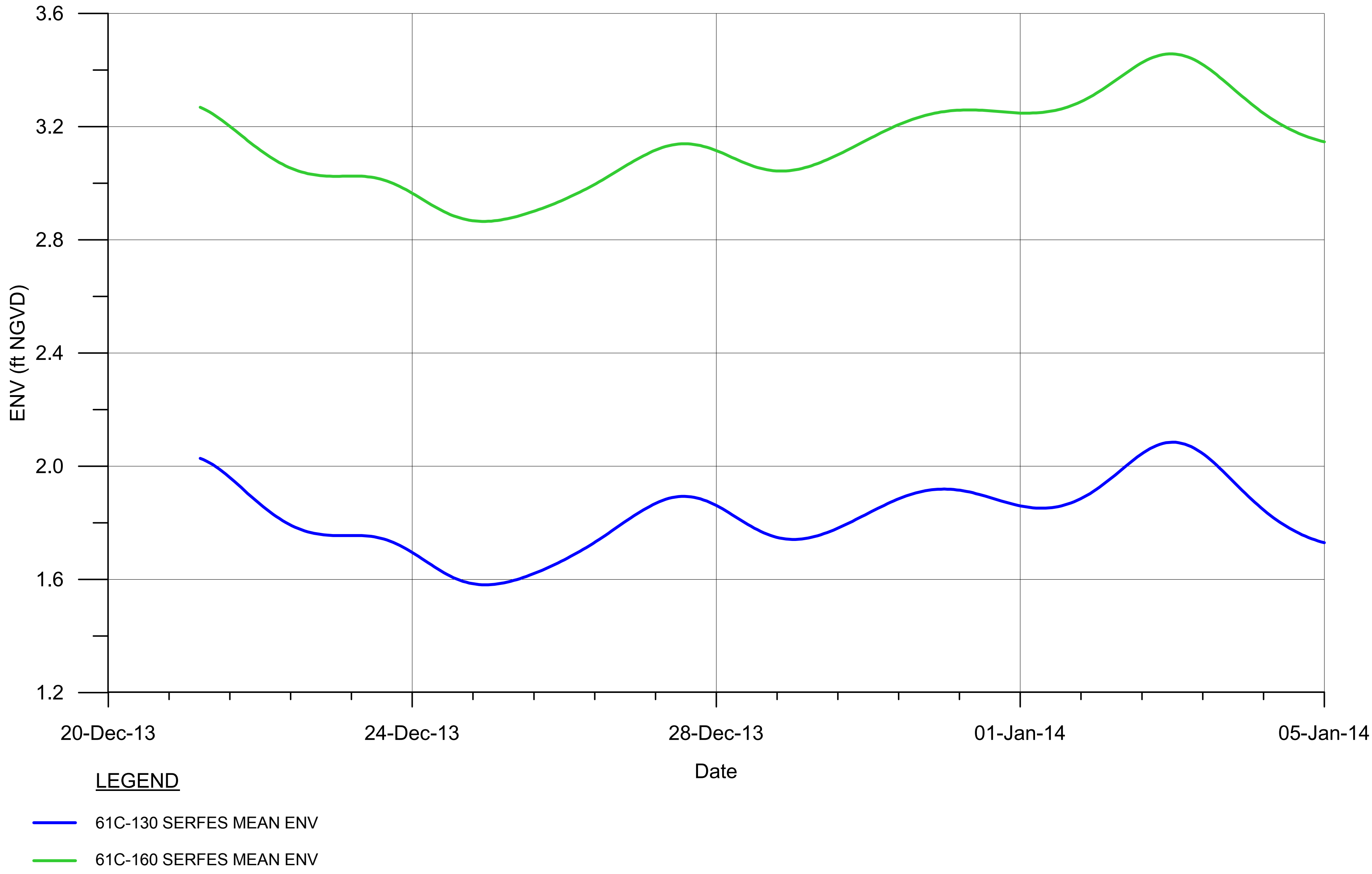


figure 20

61C-130 AND 61C-160 SERFES MEAN ENVs

Occidental Chemical Corporation, Tacoma, Washington

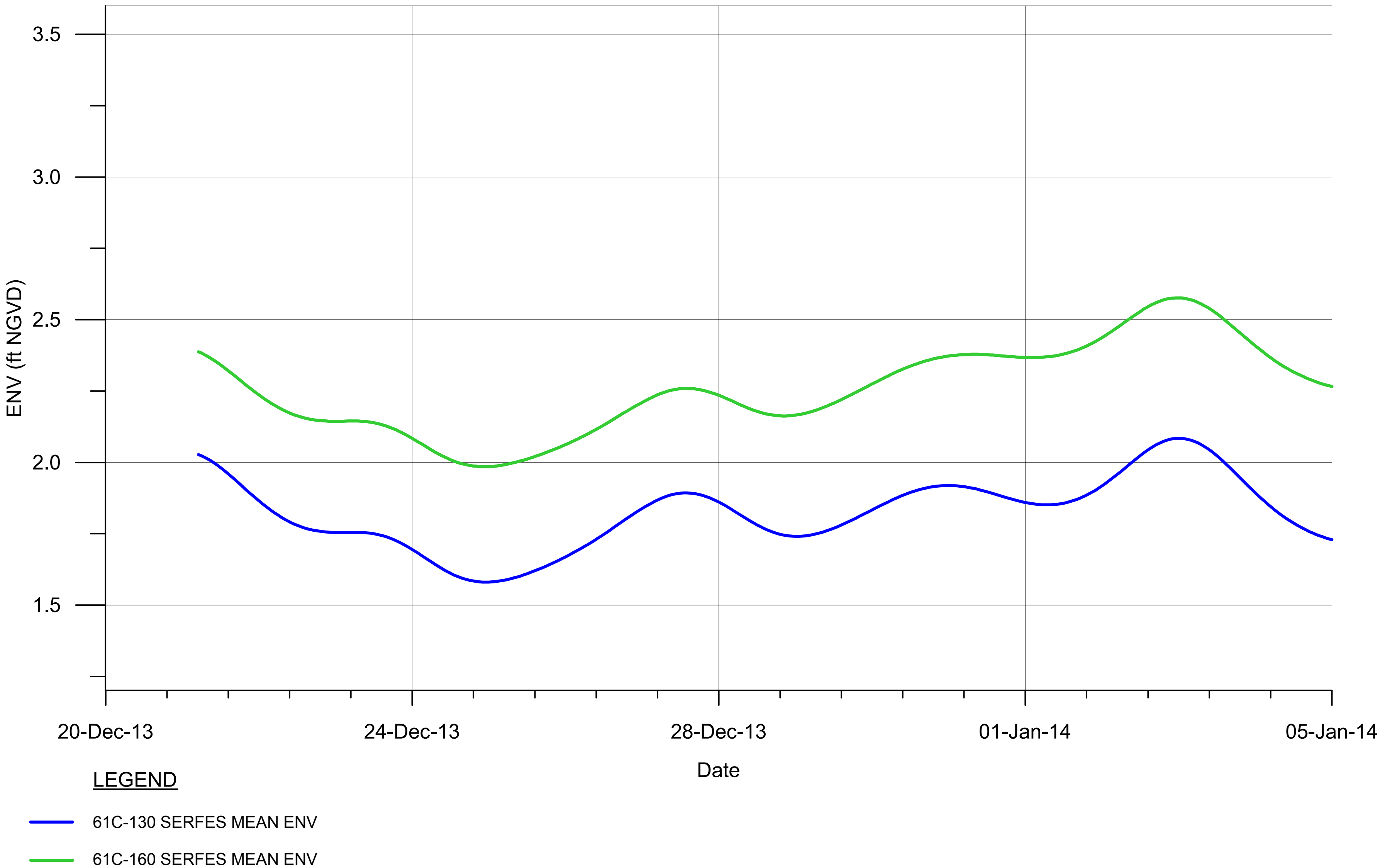


figure 21

61C-130 AND 61C-160 SERFES MEAN ENVs
ACCOUNTING FOR 61C-160 AVERAGE FEH OFFSET OF -0.88 FT
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\2013 FEH Confirmation\Nov 2013 FEH and prep for EXT9 test\61C-130-160 Serfes Mean ENV Plot-minus 0.88ft.grf) APR 21/2014

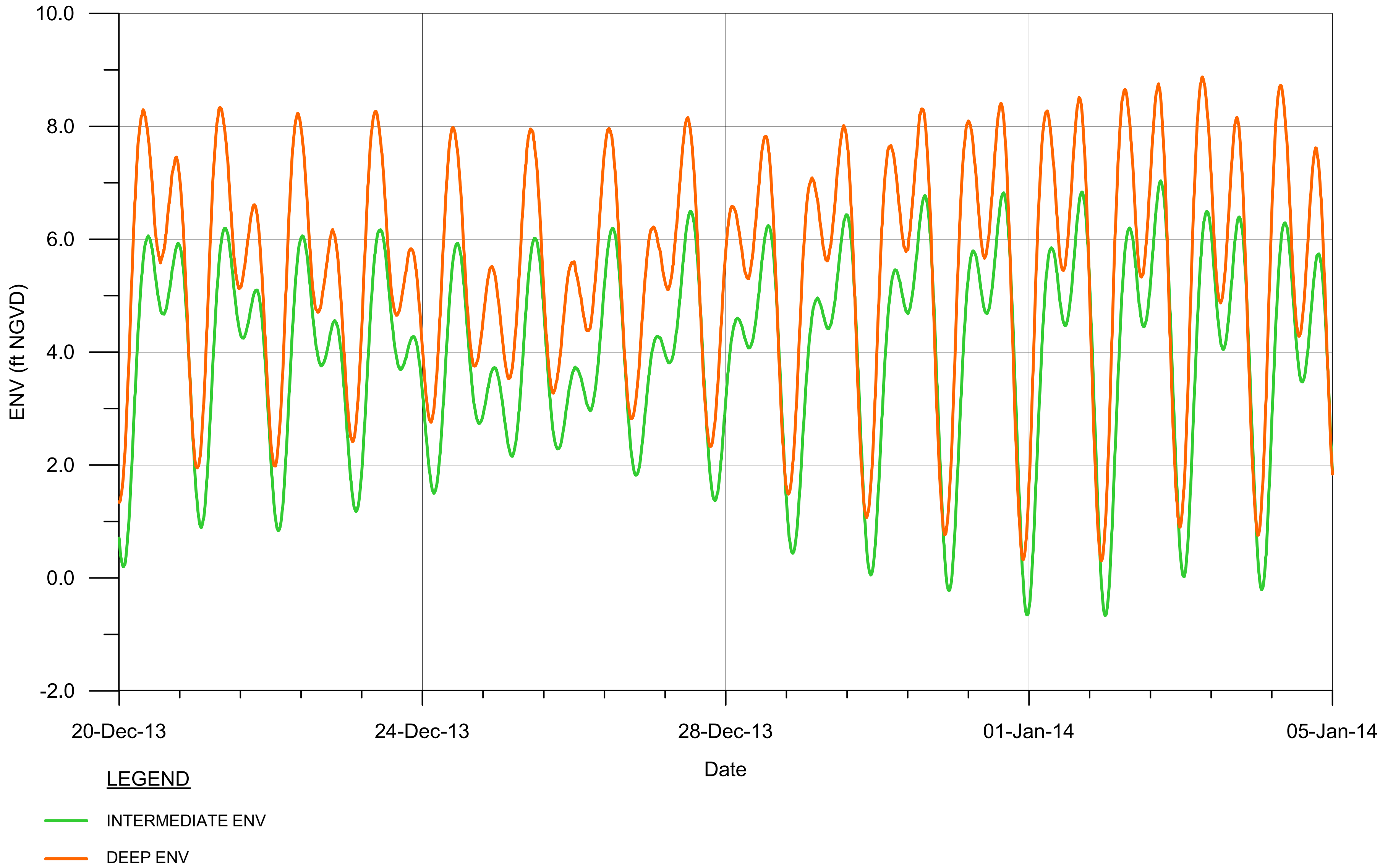


figure 22

MW-F ENVs

Occidental Chemical Corporation, Tacoma, Washington

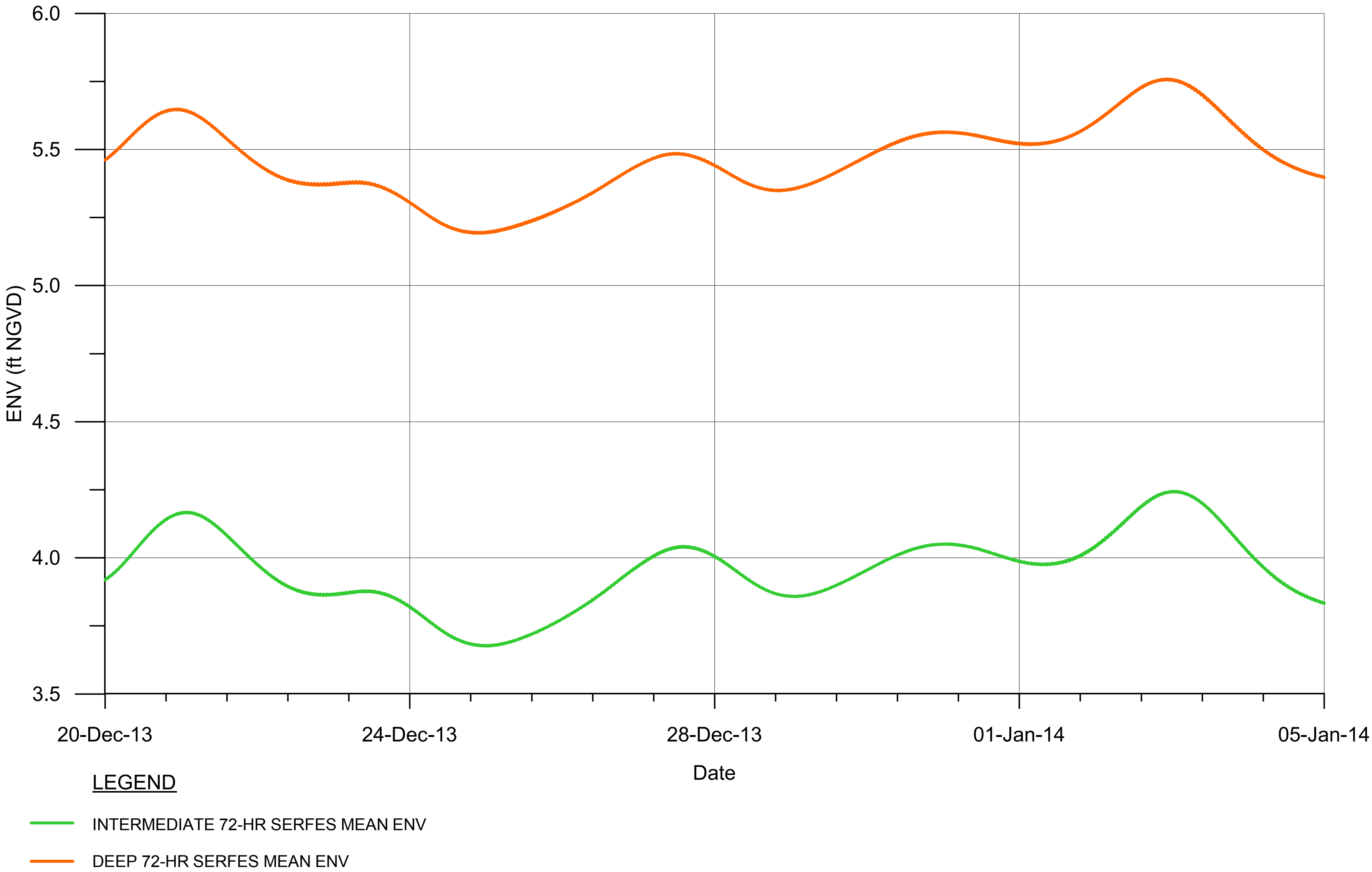


figure 23

SERFES MEAN MW-F ENVs

Occidental Chemical Corporation, Tacoma, Washington

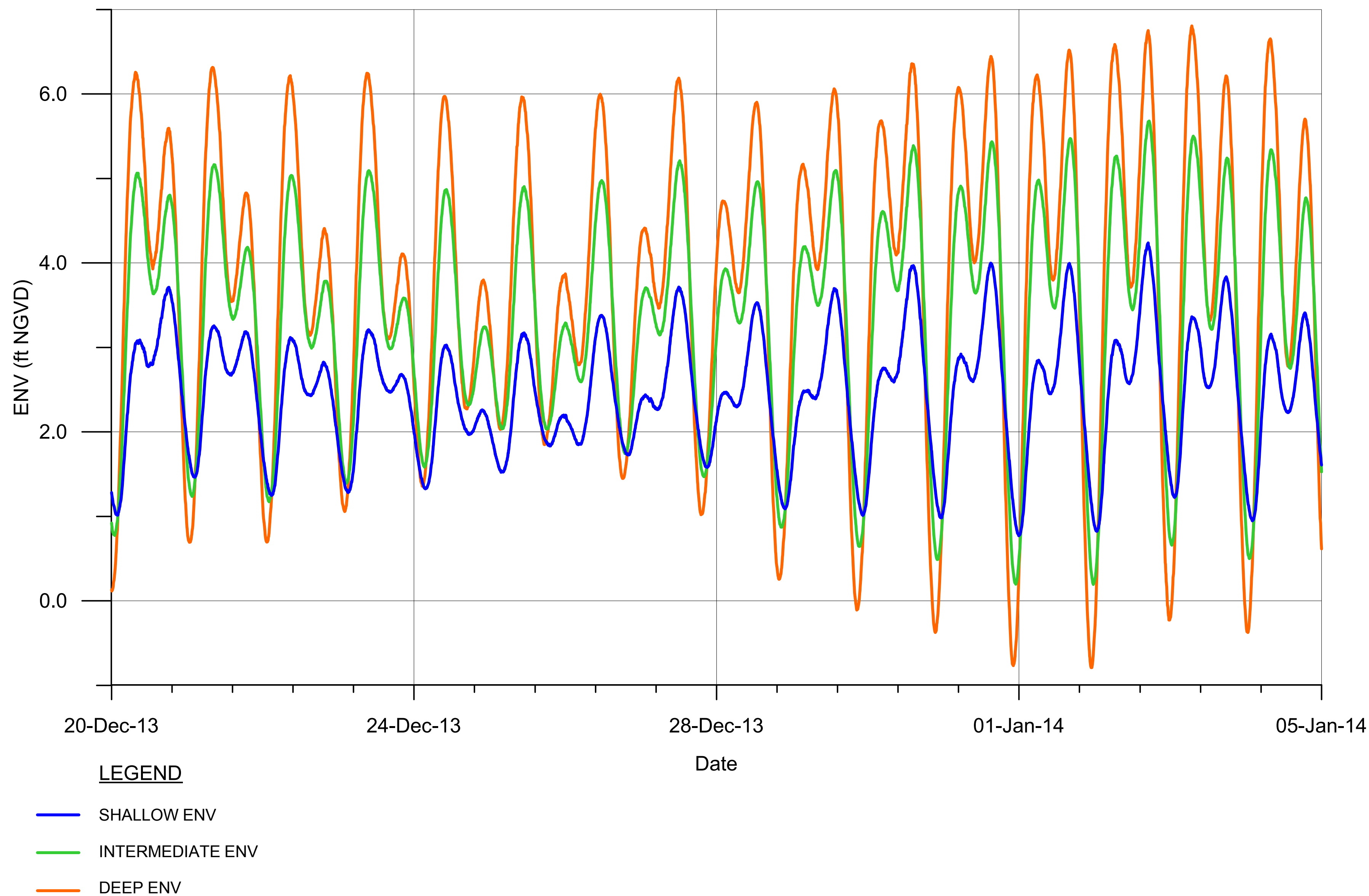


figure 24

MW-G ENVs

Occidental Chemical Corporation, Tacoma, Washington

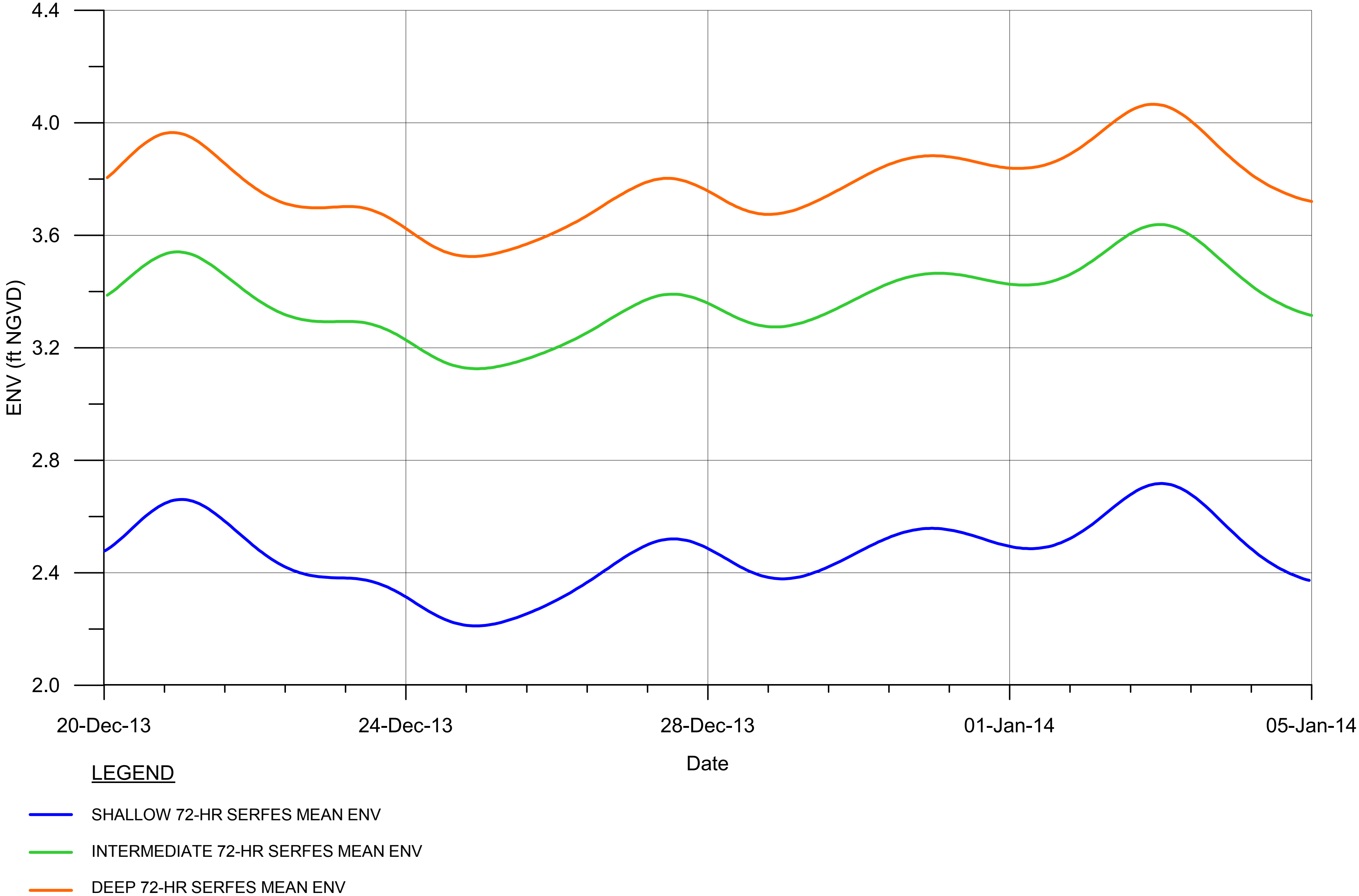


figure 25

SERFES MEAN MW-G ENVs

Occidental Chemical Corporation, Tacoma, Washington

TABLE 1

**FEHs BY CATEGORY - STANDARD WELLS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON**

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy [1] (ft H_2O)	Manual DTW Measurement Accuracy [2] (ft)	Manual FEH Accuracy [3] (ft H_2O)	Total Accuracy [4] (ft H_2O)	Average Offset Between 2012 Manual and Transducer FEHs [5] (ft)	Average Offset Within Total Accuracy [6] (Yes/No)	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity [7] SG	2012 Lab Measured Specific Gravity [7] (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH SG	2012 Density From Linear Regression of Manual vs. Transducer FEH (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)	Classification [8]	Is the 2012 Regression Density Comparable to the Lab Density?	Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)
								Category 1 FEH at ZGP															*Category 2 FEH at ZGP*									*Category 3 FEH at ZGP*		*Category 4 FEH at ZGP*	
5-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	0.17	Yes	1.89	2.16	1.008 *	62.92 *	0.995	62.10	**1.20**	1.002	62.53	0.64	1.49	2.54	A	-	-	-	-	-	-	-	-	-	-	-	-	-
5-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.72	No	-	-	1.019	63.61	1.000	62.42	**1.75**	1.019	63.56	**1.67**	31.00	65.00	A	No	No	-	-	-	-	-	-	-	-	-	1.57	1.86
5-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.677	± 0.752	0.86	No	-	-	1.039	64.80	1.024	63.93	**1.29**	1.036	64.66	**1.07**	12.00 / 12.00	0.07	A	No	No	-	-	-	-	-	-	-	-	-	1.92	2.39
5-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	0.69	No	-	-	1.017	63.46	1.009	62.96	0.73	1.016	63.41	0.66	47.30	0.50	T	Yes	Yes	2.35	2.78	-	-	-	-	-	-	-	-	-
6A-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.97	2.27	1.008	62.92	1.007	62.83	0.13	1.008	62.93	0.15	6.60	1.00	T	-	-	-	-	-	-	-	-	-	-	-	-	-
6A-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	0.78	No	-	-	1.019	63.57	1.010	63.01	0.82	1.018	63.50	0.71	48.00	0.50	T	Yes	Yes	2.16	2.46	-	-	-	-	-	-	-	-	-
7-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	-0.07	Yes	1.20	1.89	1.001	62.47	1.007	62.82	0.51	1.000	62.41	0.60	0.36	146,600	A	-	-	-	-	-	-	-	-	-	-	-	-	-
7-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	0.10	Yes	1.84	2.75	1.017	63.48	1.016	63.41	0.11	1.015	63.35	0.08	44.10	0.30	T	-	-	-	-	-	-	-	-	-	-	-	-	-
7-181	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.253	± 0.442	0.24	Yes	6.17	6.32	1.005	62.71	1.004	62.62	0.12	1.004	62.65	0.05	10.60	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
8-23	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.00	Yes	3.14	3.30	1.003	62.56	1.002	62.54	0.02	1.000	62.39	0.23	0.06	0.43	F	-	-	-	-	-	-	-	-	-	-	-	-	-
9-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.13	No	-	-	1.001	62.45	1.010	63.05	0.89	1.001	62.44	0.90	0.11	1.55	F	Yes	Yes	2.19	2.36	-	-	-	-	-	-	-	-	-
9-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.10	Yes	1.84	2.19	1.003	62.58	1.000	62.41	0.25	1.001	62.47	0.09	2.17	1.20	F	-	-	-	-	-	-	-	-	-	-	-	-	-
9-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.496	± 0.685	1.52	No	-	-	1.019	63.60	1.002	62.53	**1.57**	1.017	63.48	**1.40**	49.30	0.77	S	No	No	-	-	-	-	-	-	-	-	-	2.79	3.13
11-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	-0.05	Yes	1.50	1.97	1.002	62.51	1.006	62.75	0.35	1.000	62.38	0.54	0.13	1,248.5	A	-	-	-	-	-	-	-	-	-	-	-	-	-
11-45	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.04	Yes	0.56	1.77	1.007	62.85	1.006	62.78	0.11	1.006	62.80	0.03	14.60 / 15.60	108.80	T	-	-	-	-	-	-	-	-	-	-	-	-	-
11-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.677	± 0.752	0.25	Yes	0.88	2.03	1.010	63.03	1.006	62.78	0.37	1.011	63.10	0.47	21.70	6,928	A	-	-	-	-	-	-	-	-	-	-	-	-	-
11-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	3.89	No	-	-	1.053	65.69	1.008	62.91	**4.07**	1.053	65.71	**4.10**	30.00	183,200	A	No	No	-	-	-	-	-	-	-	-	-	1.80	2.98
11-183	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.253	± 0.442	0.68	No	-	-	1.007	62.87	1.004	62.62	0.36	1.006	62.76	0.20	16.30	15.70	T	Yes	Yes	5.88	6.03	-	-	-	-	-	-	-	-	-
12-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.04	Yes	1.27	1.93	1.000	62.43	0.997	62.21	0.32	0.999	62.35	0.21	0.20	0.69	F	-	-	-	-	-	-	-	-	-	-	-	-	-
12-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.05	Yes	1.10	2.17	1.011	63.11	1.011	63.06	0.07	1.010	63.03	0.04	28.50	13.00	T	-	-	-	-	-	-	-	-	-	-	-	-	-
12-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	1.40	No	-	-	1.015	63.35	1.000	62.37	**1.43**	1.013	63.20	**1.22**	17.70	6,200	A	No	No	-	-	-	-	-	-	-	-	-	0.29	1.30
12-160	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.253	± 0.442	-0.29	Yes	7.03	7.18	1.004	62.65	1.006	62.77	0.18	1.003	62.58	0.28	8.30	0.50	F	-	-	-	-	62.34	62.65	62.61	62.92	NA	NA	NA	-	-
12A-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.03	Yes	1.87	2.56	1.002	62.52	1.000	62.38	0.21	0.999	62.36	0.03	0.07	9.64	F	-	-	-	-	-	-	-	-	-	-	-	-	-
12A-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.03	Yes	1.47	2.60	1.003	62.58	1.002	62.53	0.07	1.001	62.49	0.06	2.56	11.40	F	-	-	-	-	-	-	-	-	-	-	-	-	-
14-25R	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	0.01	Yes	1.47	1.73	1.002	62.51	1.001	62.46	0.07	1.001	62.45	0.01	1.77	1,410	A	-	-	-	-	-	-	-	-	-	-	-	-	-
15-50R	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.13	Yes	1.54	1.74	1.023	63.83	1.019	63.61	0.31	1.021	63.71	0.15	17.00	1.20	A	-	-	-	-	-	-	-	-	-	-	-	-	-
18-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.01	Yes	1.59	1.75	1.004	62.62	1.005	62.69	0.10	1.002	62.53	0.24	0.40	0.60	F	-	-	-	-	-	-	-	-	-	-	-	-	-
18-50R	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.42	Yes	1.98	2.19	1.039	64.83	1.027	64.10	**1.07**	1.038	64.78	1.00	7.00	2.30	A	-	-	-	-	-	-	-	-	-	-	-	-	-
22-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.24	Yes	1.97	2.53	1.015	63.32	1.008	62.87	0.65	1.012	63.15	0.41	29.20	7,658	A	-	-	-	-	-	-	-	-	-	-	-	-	-
23-25R	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.01	Yes	1.66	1.88	1.003	62.60	1.004	62.65	0.08	1.002	62.51	0.20	0.40	1.10	F	-	-	-	-	-	-	-	-	-	-	-	-	-
32-50R	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.02	Yes	0.91	1.84	1.001	62.48	1.001	62.45	0.04	1.000	62.38	0.10	0.71	4,260	A	-	-	-	-	-	-	-	-	-	-	-	-	-
34-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.52	No	-	-	1.012	63.18	1.004	62.65	0.77	1.012	63.12	0.69	17.30	7.11	T	Yes	Yes	1.09	2.11	-	-	-	-	-	-	-	-	-
34-25R	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.02	Yes	1.24	1.95	1.002	62.53	1.001	62.44	0.14	1.000	62.37	0.10	0.02	896	F	-	-	-	-	-	-	-	-	-	-	-	-	-
34-50R	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.05	1.96	1.001	62.49	1.000	62.40	0.13	1.000	62.37	0.04	0.11	313	F	-	-	-	-	-	-	-	-	-	-	-	-	-
35-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.02	Yes	2.38	2.86	1.002	62.55	1.001	62.46	0.14	1.000	62.39	0.09	0.03 / 0.04	213	F	-	-	-	-	-	-	-	-	-	-	-	-	-
35-100R	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.496	± 0.685	0.09	Yes	2.15	2.81	1.022	63.78	1.021	63.71	0.10	1.019	63.61	0.15	54.20	0.10	S	-	-	-	-	-	-	-	-	-	-	-	-	-
36-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.06	Yes	2.13	2.68	1.001	62.48	1.006	62.78	0.43	1.000	62.37	0.60	0.65	9.34	F	-	-	-	-	-	-	-	-	-	-	-	-	-
36-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.15	Yes	1.42	2.12	1.001	62.47	1.005	62.71	0.36	0.999	62.35	0.53	0.07	0.24	F	-	-	-	-	-	-	-	-	-	-	-	-	-
36-100R	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	-0.32	Yes	2.28	2.94	1.001	62.49	1.005	62.71	0.33	1.000	62.39	0.48	0.31	21.45	F	-	-	-	-	-	-	-	-	-	-	-	-	-
40-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.02	Yes	2.44	2.75	1.001	62.49	0.999	62.34	0.22	0.999	62.37	0.05	0.12	0.21	F	-	-	-	-	-	-	-	-	-	-	-	-	-
40-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.279	± 0.337	0.39	No	-	-	1.020	63.65	1.008	62.91	**1.09**	1.018	63.53	0.90	51.30	0.50	S	No	Yes	1.35	2.75	-	-	-	-	-	-	-	-	-
40-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.70	No	-	-	1.018	63.55	1.007	62.84	**1.04**	1.017	63.47	0.93	43.40	4.47	T	No	Yes	0.91	2.31	-	-	-	-	-	-	-	-	-
40-100R	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	1.11	Yes	2.19	3.42	1.024	63.91	1.011	63.11	**1.17**	1.024	63.88	**1.12**	50.60	5,970	A	-	-	-	-	-	-	-	-	-	-	-	-	-
42-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.00	Yes	2.30	2.54	1.003	62.58	1.003	62.56	0.03	1.000	62.39	0.24	0.03	0.49	F	-	-	-	-	-	-	-	-	-	-	-	-	-
42-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.01	Yes	1.38	2.14	1.004	62.63	1.004	62.64	0.02	1.002	62.50	0.21	2.47	0.25	F	-	-	-	-	-	-	-	-	-	-	-	-	-
43-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.08	Yes	1.19	2.14	1.008	62.88	1.006	62.75	0.19	1.006	62.78	0.05	18.40	0.45	T	-	-	-	-	-	-	-	-	-	-	-	-	-
44-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.00	Yes	2.16	2.38	1.002	62.55	1.002	62.54	0.02	1.000	62.40	0.21	0.01	0.15	F	-	-	-	-	-	-	-	-	-	-	-	-	-
44-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.41	1.93	1.007	62.83	1.005	62.74	0.13	1.005	62.73	0.01	15.60	0.09	T	-	-	-	-	-	-	-	-	-	-	-	-	-
45-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.71	2.20	1.003	62.61	1.002	62.53	0.12	1.002	62.51	0.02	2.28	0.65	F	-	-	-	-	-	-	-	-	-	-	-	-	-
45-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	1.48	No	-	-	1.023	63.86	1.007	62.81	**1.54**	1.020	63.68	**1.27**	39.00	0.50	T	No	No	-	-	-	-	-	-	-	-	-	2.40	2.89
49-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.04	No	-	-	1.003	62.61	1.011	63.10	0.72	1.002	62.53	0.83	6.65	4.11	F	Yes	Yes	3.67	3.71	-	-	-	-	-	-	-	-	-
50-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.037	Yes	3.69	3.60	1.002	62.52	1.009	62.98	0.68	1.000	62.38	0.88	0.20	17.03	F	-	-	-	-	-	-	-	-	-	-	-	-	-
52-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.07	No	-	-	0.999	62.36	1.014	63.25	**1.30**	0.999	62.31	**1.37**	0.20 / 0.20	24.30	F	No	No	-	-	-	-	-	-	-	-	-	4.08	4.02
55-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.02	Yes	1.85	2.17	1.002	62.50	1.003	62.58	0.11	1.000	62.43	0.22	0.10	10.22	F	-	-	-	-	-	-	-	-	-	-	-	-	-
55-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.04	Yes	1.43	2.01	1.008	62.88	1.009	62.94	0.10	1.006	62.80	0.21	8.71	0.23	T	-	-	-	-	-	-	-	-	-	-	-	-	-
64-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	0.51	No	-	-	1.020	63.67	1.015	63.31	0.53	1.018	63.55	0.36	43.00	1.32	T	Yes	Yes	2.12	2.81	-	-	-	-	-	-	-	-	-
64-170	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.253	± 0.442	0.48	No	-	-	1.010	63.03	1.007	62.84	0.27	1.008	62.90	0.09	20.00	0.84	T	Yes	Yes	5.71	5.82	-	-	-	-	-	-	-	-	-
65-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.06	Yes	1.84	1.93	1.008	62.89	1.004	62.62	0.40	1.006	62.79	0.25	17.00	6.44	T	-	-	-	-	-	-	-	-	-	-	-	-	-
65-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.04	Yes	1.39	1.55	1.027	64.08	1.026	64.01	0.10	1.023	63.87	0.21	9.00	141.40	A	-	-	-	-	-	-	-	-	-	-	-	-	-
65-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	7.01	No	-	-	1.094	68.25	1.014	63.26	**7.33**	1.094	68.25	**7.32**	13.00	0.50	A	No	No	-	-	-	-	-	-	-	-	-	2.91	3.09
65-130	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.222	± 0.411	1.29	No	-	-	1.003	62.59	0.993	61.94	0.97	1.002	62.54	0.88	7.50	0.50	F	Yes	Yes	5.20	5.34	-	-	-	-	-	-	-	-	-
67-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.00	Yes	1.88	1.97	1.003	62.59	1.003	62.59	0.00	1.002	62.52	0.10	5.55	3.66	F	-	-	-	-	-	-	-	-	-	-	-	-	-
67-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.30	No	-	-	1.001	62.47	1.009	62.98	0.75	1.014	63.24	0.38	22.00 / 22.00	1.12	T	Yes	Yes	1.35	1.54	-	-	-	-	-	-	-	-	-
69-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	-0.02	Yes	2.41	2.65	1.009	62.94	1.010	63.00	0.09	1.007	62.81	0.28	5.20	4.60	A	-	-	-	-	-	-	-	-	-	-	-	-	-
70-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.31	No	-	-	1.015	63.32	1.041	64.95	**2.39**	1.012	63.17	**2.61**	32.80	0.37	T	No	No	-	-	-	-	-	-	-	-	-	1.23	1.68
71-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.13	No	-	-	1.013	63.23	1.024	63.89	0.97	1.012	63.16	**1.08**	32.00	0.12	T	Yes	No	1.54	1.74	-	-	-	-	-	-	-	-	-
71-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.26	No	-	-	1.021	63.72	1.014	63.28	0.64	1.020	63.66	0.56	45.00	0.50	T	Yes	Yes	1.00	1.73	-	-	-	-	-	-	-	-	-
74-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.20	No	-	-	1.018	63.50	1.012	63.16	0.51	1.016	63.41	0.38	38.50	0.50	T	Yes	Yes	0.66	1.91	-	-	-	-	-	-	-	-	-
74-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.338	± 0.412	1.28	No	-	-	1.023	63.81	1.002	62.54	**1.87**	1.022	63.78	**1.83**	57.30	0.50	S	No	No	-	-	-	-	-	-	-	-	-	1.24	2.31
74-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	1.14	Yes	2.18	2.96	1.024	63.91	1.011	63.09	**1.19**	1.023	63.84	**1.09**	53.80	6.85	A	-	-	-	-	-	-	-	-	-	-	-	-	-
75-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.35	Yes	1.90	2.10	1.020	63.67	1.011	63.09	0.86	1.018	63.54	0.66	12.00	2.50	A	-	-	-	-	-	-	-	-	-	-	-	-	-
75-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.677	± 0.752	0.94	No	-	-	1.080	67.42	1.065	66.43	**1.45**	1.081	67.47	**1.53**	15.00	0.29	A	No	No	-	-	-	-	-	-	-	-	-	2.70	2.93
75-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.177	± 0.366	0.21	Yes	3.00	3.33	1.006	62.79	1.004	62.64	0.22	1.004	62.67	0.04	13.00 / 0.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
75-130	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.222	± 0.411	0.34	Yes	3.12	3.43	1.001	62.44	0.998	62.26	0.26	0.999	62.36	0.14	0.82 / 0.00	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
80-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	-0.26	No	-	-	1.008	62.91	1.029	64.23	**1.94**	1.006	62.77	**2.15**	1.34	0.56	A	No	No	-	-	-	-	-	-	-	-	-	1.78	1.89
81-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	0.72	No	-	-	1.055	65.86	1.035	64.60	**1.85**	1.043	65.11	0.75	4.90	0.50	A	No	Yes	1.16	1.38	-	-	-	-	-	-	-	-	-
82-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	0.66	Yes	3.38	3.60	1.094	68.26	1.086	67.74	0.76	1.088	67.90	0.24	20.00 / 0.00	2.50	A	-	-	-	-	-	-	-	-	-	-	-	-	-
95-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.08	No	-	-	1.000	62.40	0.978	61.02	**2.02**	0.999	62.32	**1.91**	0.38	0.84	F	No	No	-	-	-	-	-	-	-	-	-	2.93	2.95
709-MW5-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.08	No	-	-	1.017	63.46	0.997	62.24	**1.79**	1.000	62.40	0.24	39.00	44.78	T	No	Yes	3.11	3.30	-	-	-	-	-	-	-	-	-
709-MW6-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.05	No	-	-	1.001	62.49	0.992	61.88	0.89	1.000	62.39	0.75	0.19	57.97	F	Yes	Yes	3.55	3.50	-	-	-	-	-	-	-	-	-
709-MW6-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.10	No	-	-	1.025	63.94	1.016	63.41	0.78	1.023	63.84	0.62	1.90	3.55	T	Yes	Yes	1.48	1.64	-	-	-	-	-	-	-	-	-
709-MW6-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.03	Yes	1.78	2.07	1.003	62.57	1.004	62.62	0.07	1.002	62.51	0.17	5.23	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW9-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.01	Yes	3.60	3.53	1.002	62.51	0.999	62.34	0.26	0.999	62.35	0.02	0.20	3.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW9-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.01	Yes	1.73	1.87	1.002	62.54	1.001	62.48	0.09	1.000	62.41	0.10	0.14	32.80	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW11-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.00	Yes	3.44	3.36	1.001	62.48	1.000	62.43	0.08	1.000	62.40	0.04	0.02	0.52	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW11-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.01	Yes	1.86	2.01	1.002	62.52	1.001	62.49	0.05	1.000	62.40	0.13	0.03	2.54	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW15A-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.22	No	-	-	1.009	62.94	1.003	62.57	0.54	1.008	62.87	0.43	6.50	0.75	T	Yes	Yes	1.65	1.96	-	-	-	-	-	-	-	-	-
709-MW16-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.04	No	-	-	1.001	62.48	0.992	61.88	0.89	-	-	-	0.20	2.88	F	Yes	No	3.61	3.54	-	-	-	-	-	-	-	-	-
709-MW16-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.02	Yes	1.82	1.97	1.001	62.48	1.000	62.38	0.15	1.000	62.38	0.00	0.06	10.52	F	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 1

FEHs BY CATEGORY - STANDARD WELLS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy (1) (ft H_2O)	Manual DTW Measurement Accuracy (2) (ft)	Manual FEH Accuracy (3) (ft H_2O)	Total Accuracy (4) (ft H_2O)	Category 1 FEH at ZGP: Average Offset Between 2012 Manual and Transducer FEHs (5) (ft)	Category 1 FEH at ZGP: Average Offset Within Total Accuracy (6) (Yes/No)	Category 1 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 1 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity (7): SG	2012 Lab Measured Specific Gravity (7): (lbs/ft³)	2012 Density From Linear Regression of Manual vs. Transducer FEH: SG	2012 Density From Linear Regression of Manual vs. Transducer FEH: (lbs/ft³)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: (lbs/ft³)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)	Classification (8)	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to the Lab Density?	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Category 2 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 2 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft³)	2013 Density Based on Field Measured Specific Gravity (lbs/ft³)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft³)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft³)	2013 "In Situ" Geokon C Value (psi)	Category 3 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 3 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 4 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 4 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)
709-MW16-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.65	1.96	1.003	62.59	1.002	62.51	0.12	1.001	62.44	0.09	2.06	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW16-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	-0.52	No	-	-	1.001	62.49	1.010	63.01	0.76	1.000	62.39	0.91	1.85	0.37	F	Yes	Yes	1.87	2.13	-	-	-	-	-	-	-	-	-
709-MW18-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.04	Yes	3.37	3.32	1.002	62.53	1.010	63.02	0.71	-	-	-	0.20	72.01	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW18-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.05	Yes	1.80	1.95	1.002	62.53	0.998	62.27	0.39	1.000	62.39	0.18	0.04	880.80	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW18-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.01	Yes	1.69	2.00	1.002	62.52	1.002	62.54	0.02	1.000	62.42	0.18	0.94	6.20	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW20-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.06	Yes	1.11	1.28	1.001	62.48	0.997	62.19	0.44	1.001	62.47	0.42	0.90	81.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW20-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.01	Yes	1.39	1.57	1.002	62.51	1.002	62.52	0.02	1.001	62.48	0.06	4.76	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW20-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.74	No	-	-	1.016	63.39	1.004	62.65	1.08	1.014	63.30	0.95	40.90	0.50	T	No	Yes	1.96	2.22	-	-	-	-	-	-	-	-	-
709-MW21-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.03	Yes	3.51	3.45	1.001	62.47	1.008	62.88	0.60	0.999	62.37	0.75	0.02	2.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW21-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.03	Yes	1.87	2.01	1.002	62.51	0.999	62.34	0.25	1.000	62.38	0.06	-	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-
709-MW21-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.03	Yes	1.69	1.99	1.002	62.54	1.001	62.48	0.08	0.999	62.36	0.17	1.23	3.97	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW5-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.03	Yes	3.58	3.50	1.000	62.43	1.007	62.83	0.59	0.999	62.33	0.73	0.09	4.07	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW5-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.01	Yes	1.45	1.58	1.004	62.66	1.005	62.72	0.08	1.002	62.56	0.24	1.32	12.30	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW5-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.16	No	-	-	1.006	62.80	1.002	62.52	0.40	1.004	62.68	0.23	6.90	18.40	T	Yes	Yes	1.55	1.82	-	-	-	-	-	-	-	-	-
721-MW5-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.93	No	-	-	1.018	63.53	1.003	62.59	1.37	1.016	63.41	1.19	45.80	0.50	T	No	No	-	-	-	-	-	-	-	-	-	1.91	2.19
721-MW6-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.01	Yes	3.56	3.48	1.002	62.50	1.004	62.66	0.23	0.999	62.33	0.48	0.08	50.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW6-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.01	Yes	1.45	1.59	1.003	62.57	1.002	62.52	0.07	1.000	62.39	0.18	0.80 / 0.81	5.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW6-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.16	No	-	-	1.007	62.85	1.003	62.57	0.41	1.004	62.65	0.11	8.10	0.50	T	Yes	Yes	1.58	1.84	-	-	-	-	-	-	-	-	-
721-MW9-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.06	No	-	-	1.003	62.56	1.019	63.56	1.47	0.999	62.32	1.81	0.02	0.23	F	No	No	-	-	-	-	-	-	-	-	-	2.97	3.09
721-MW9-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.03	Yes	1.08	1.24	1.004	62.66	1.001	62.46	0.29	1.003	62.57	0.16	3.70	65.80	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW9-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.03	Yes	1.48	1.74	1.009	62.97	1.008	62.92	0.08	1.007	62.82	0.15	21.90	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW10-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.05	No	-	-	1.006	62.78	0.993	61.97	1.19	1.005	62.74	1.13	17.30	0.50	T	No	No	-	-	-	-	-	-	-	-	-	2.97	2.99
721-MW10-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	-0.01	Yes	1.04	1.20	1.001	62.49	1.003	62.57	0.12	1.000	62.39	0.26	0.65	0.39	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW10-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.20	No	-	-	1.001	62.49	1.007	62.81	0.47	1.007	62.86	0.07	13.80 / 14.30	1.48	T	Yes	Yes	1.84	2.07	-	-	-	-	-	-	-	-	-
721-MW10-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.15	Yes	1.91	2.15	1.018	63.51	1.015	63.36	0.22	1.015	63.35	0.01	41.70	0.11	T	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW11-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.05	No	-	-	1.001	62.46	1.014	63.30	1.24	0.999	62.35	1.40	0.43	25.00	F	No	No	-	-	-	-	-	-	-	-	-	3.47	3.40
721-MW11-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.01	Yes	1.28	1.42	1.002	62.53	1.001	62.48	0.07	1.000	62.41	0.10	0.71	1.30	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW11-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.09	Yes	1.62	1.87	1.004	62.63	1.001	62.48	0.21	1.002	62.54	0.08	5.72	6.08	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW11-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.71	No	-	-	1.018	63.53	1.007	62.82	1.04	1.015	63.35	0.77	46.60	0.50	T	No	Yes	1.84	2.10	-	-	-	-	-	-	-	-	-
721-MW12-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.06	No	-	-	1.001	62.44	1.015	63.35	1.33	0.999	62.31	1.52	0.03	10.00	F	No	No	-	-	-	-	-	-	-	-	-	3.71	3.64
721-MW12-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.00	Yes	1.89	2.02	1.002	62.51	1.002	62.50	0.01	1.000	62.38	0.18	0.03	5.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW12-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.04	Yes	1.66	1.93	1.002	62.55	1.001	62.48	0.10	1.000	62.39	0.13	0.34	0.12	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW13-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	0.03	Yes	3.70	3.64	1.000	62.39	0.993	61.93	0.67	0.998	62.29	0.52	0.20	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW13-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.06	Yes	1.80	1.92	1.001	62.48	0.996	62.18	0.45	0.999	62.35	0.25	0.02	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW13-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.06	Yes	1.67	1.94	1.003	62.57	1.001	62.48	0.14	1.000	62.43	0.07	1.97	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW14-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.06	No	-	-	1.000	62.40	1.012	63.16	1.12	0.999	62.32	1.24	0.01	5.00	F	No	No	-	-	-	-	-	-	-	-	-	3.49	3.43
721-MW14-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.06	Yes	1.85	1.99	1.001	62.45	0.996	62.13	0.47	1.000	62.38	0.37	0.04	8.10	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW14-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	-0.04	Yes	1.77	2.05	1.001	62.48	1.002	62.54	0.09	1.000	62.41	0.18	1.16	0.62	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW15-15	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.000	± 0.041	-0.04	Yes	3.50	3.45	1.001	62.47	1.012	63.12	0.95	0.999	62.33	1.16	0.30	50.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW15-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.023	± 0.064	0.02	Yes	1.82	1.95	1.001	62.47	0.999	62.35	0.18	0.999	62.37	0.03	0.17	25.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
721-MW15-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.05	Yes	1.63	1.90	1.002	62.54	1.001	62.46	0.12	1.000	62.40	0.08	1.14	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ-SHI-2-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.677	± 0.752	0.20	Yes	2.11	2.30	1.037	64.70	1.034	64.50	0.29	1.036	64.63	0.18	16.00	75,350	A	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ-SHI-2-100	Standard	Levelogger	F300	± 0.164	± 0.025	± 0.994	± 1.183	0.13	Yes	2.96	3.18	1.075	67.06	1.073	66.96	0.14	1.072	66.91	0.07	18.00	3,250	A	-	-	-	-	-	-	-	-	-	-	-	-	-
PZ-SHI-3-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.677	± 0.752	0.26	Yes	1.85	2.03	1.036	64.62	1.031	64.35	0.39	1.035	64.58	0.34	5.00	1.65	A	-	-	-	-	-	-	-	-	-	-	-	-	-
T3-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.559	± 0.617	-0.15	Yes	2.24	2.78	1.021	63.72	1.025	63.97	0.37	1.025	63.93	0.05	41.00 / 41.00	2.23	A	-	-	-	-	-	-	-	-	-	-	-	-	-
T5-120	Standard	Levelogger	F300	± 0.164	± 0.025	± 1.249	± 1.438	0.49	Yes	7.19	7.42	1.111	69.34	1.106	69.03	0.45	1.107	69.08	0.07	17.00	2.50	A	-	-	-	-	69.40	69.39	69.01	69.70	NA	NA	NA	-	-
41-130	Standard	Levelogger	F300	± 0.164	± 0.025	± 1.249	± 1.438	1.74	No	-	-	1.020	63.65	1.005	62.73	1.34	1.019	63.58	1.24	18.90 / 19.20	7,370	A	No	No	-	-	-	-	-	-	-	-	-	3.12	3.72
89-25	Standard	Levelogger	F30	± 0.016	± 0.025	± 0.129	± 0.171	0.00	Yes	1.35	1.95	0.999	62.34	0.999	62.32	0.03	0.998	62.26	0.09	0.16	1,872	A	-	-	-	-	-	-	-	-	-	-	-	-	-
89-50	Standard	Levelogger	F65	± 0.033	± 0.025	± 0.099	± 0.157	0.10	Yes	1.20	1.91	1.004	62.66	1.001	62.49	0.25	1.003	62.58	0.13	10.10	4.28	F	-	-	-	-	-	-	-	-	-	-	-	-	-
89-75	Standard	Levelogger	F100	± 0.049	± 0.025	± 0.121	± 0.195	0.36	No	-	-	1.012	63.16	1.006	62.80	0.53	1.010	63.05	0.37	37.70	0.30	T	Yes	Yes	1.39	2.32	-	-	-	-	-	-	-	-	-

139 = Number of Standard Wells

Number of Standard Well FEHs in Category 1 = 91

Number of CMT Well Micron FEHs in Category 2 = 28

Number of Standard Well FEHs in Category 3 = 0

Number of Standard Well FEHs in Category 4 = 20

Notes:

* Applied the December 29, 2012 Agency recommended specific gravity value with temperature correction to obtain density.

NA Standard well; in situ C-value does not apply. FEHs determined from 2013 field FEH checking for standard wells applies to time of field checking and not Event 3.

1.31 Orange coloring indicates that the standard deviation is equal to or greater than 1 and that the probability of that magnitude of error occurring is less than or equal to 0.3.

(1) Transducer accuracy based on manufacturer specifications:
Solinst Levelogger (all models have an accuracy of +/- 0.05% full scale):

Full Scale of Model F30 =	32.8	feet H_2O	Accuracy =	± 0.0164	feet H_2O
Full Scale of Model F65 =	65.6	feet H_2O	Accuracy =	± 0.0328	feet H_2O
Full Scale of Model F100 =	98.4	feet H_2O	Accuracy =	± 0.0492	feet H_2O
Full Scale of Model F300 =	328.1	feet H_2O	Accuracy =	± 0.1641	feet H_2O

(2) Manual Depth to Water (DTW) measurements are considered accurate to ±0.025 ft considering that they can be somewhat subjective hand-measurements performed using a water level tape by different field staff and complicated by tidal fluctuations and variable field conditions.

(3) Manual FEH accuracy based on analysis of water column density variations presented in Table 5 (summarized below). Classification of wells as Fresh/Transient, Salt, or ADP to apply manual FEH accuracy is based on measured density only (and not bromide and TCVOCs).

	Fresh/ Transient	Salt	ADP	
15-ft Zone	± 0.00	± 0.00	± 0.00	feet H_2O
25-ft Zone	± 0.02	± 0.06	± 0.13	feet H_2O
50-ft Zone	± 0.10	± 0.28	± 0.56	feet H_2O
75ft -Zone	± 0.12	± 0.34	± 0.68	feet H_2O
100-ft Zone	± 0.18	± 0.50	± 0.99	feet H_2O
130-ft Zone	± 0.22	± 0.62	± 1.25	feet H_2O
160-ft Zone	± 0.25	± 0.71	± 1.42	feet H_2O

(4) Total accuracy is the sum of the transducer accuracy, DTW accuracy, and manual FEH accuracy.

(5) Manual FEH minus transducer FEH, where FEH is at transducer elevation.

(6) Average absolute offset is less than or equal to the total accuracy.

(7) Laboratory measured specific gravity corrected to temperature at time of sampling multiplied by a fresh water density of 62.4 lbs/ft³.

(8) Categories of Fresh (F), Transition (T), Salt (S), or ADP (A) determined from the examination of density, TCVOCs, and bromide data identified as per the following criteria:

Category	Density (lbs/ft³)	Specific Gravity	TCVOCs (µg/L)	Bromide (mg/L)
Fresh	62.4 - 62.712	1 – 1.005	<500	0.1028 – 13.22
Transition	> 62.712 - 63.5856	> 1.005 –	<500	> 13.22 – 49.94
Salt	> 63.5856 - 63.8976	> 1.019 –	<500	> 49.94 – 60.43
ADP	> 63.8976	> 1.023	>= 500	> 60.43

Note that if bromide indicates that a location is fresh but lab density reported a density greater than fresh, ADP was assumed.

TABLE 2

FEHs BY CATEGORY - CMT WELLS USING ORIGINAL C VALUE
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy (1) (ft H_2O)	Manual DTW Measurement Accuracy (2) (ft)	Manual FEH Accuracy (3) (ft H_2O)	Total Accuracy (4) (ft H_2O)	Geokon C Value (psi)	Category 1 FEH at ZGP: Average Offset Between 2012 Manual and Transducer FEHs (5) (ft)	Category 1 FEH at ZGP: Average Offset Within Total Accuracy (6) (Yes/No)	Category 1 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 1 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity (7): SG	2012 Lab Measured Specific Gravity (7): (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH: SG	2012 Density From Linear Regression of Manual vs. Transducer FEH: (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)	Classification (8)	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to the Lab Density?	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Category 2 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 2 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Category 3 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 3 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 4 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 4 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)
17C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	148.8137	0.80	No	-	-	1.016	63.39	0.954	59.56	1.79	1.013	63.21	1.75	25.00 / 33.00	1.47	T	No	No	-	-	-	-	-	-	-	-	-	1.28	1.37
17C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	214.0396	1.40	No	-	-	1.003	62.57	0.990	61.78	0.37	1.000	62.41	0.31	1.27	5.00	F	Yes	Yes	2.40	2.59	-	-	-	-	-	-	-	-	-
17C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	207.2093	1.66	No	-	-	1.002	62.55	0.992	61.91	0.30	1.000	62.42	0.25	1.98	0.50	F	Yes	Yes	5.52	5.64	-	-	-	-	-	-	-	-	-
21C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	140.5233	0.52	No	-	-	1.002	62.52	0.959	59.86	1.24	1.000	62.37	1.20	0.08	155.4	F	No	No	-	-	-	-	-	-	-	-	-	2.67	2.61
21C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	114.1412	0.60	Yes	1.18	1.71	1.010	63.00	0.993	61.96	0.48	1.007	62.84	0.42	8.00 / 8.00	46.80	A	-	-	-	-	-	-	-	-	-	-	-	-	-
21C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	144.3995	1.88	No	-	-	1.024	63.90	0.993	61.99	0.89	1.022	63.75	0.84	18.00	38.72	A	Yes	Yes	1.21	1.66	-	-	-	-	-	-	-	-	-
21C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	125.7522	1.66	No	-	-	1.039	64.81	1.019	63.57	0.58	1.036	64.63	0.51	14.00	6.30	A	Yes	Yes	3.55	3.97	-	-	-	-	-	-	-	-	-
21C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	213.4420	1.29	Yes	-(9)	-(9)	1.007	62.83	0.995	62.11	0.34	1.002	62.51	0.19	8.20	3.04	A	-	-	-	-	62.67	62.77	62.65	62.67	213.84	3.10	3.71	-	-
21C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	234.0362	0.23	Yes	6.70	6.83	1.007	62.85	1.006	62.76	0.04	1.004	62.65	0.05	8.80	1.70	A	-	-	-	-	-	-	-	-	-	-	-	-	-
34C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	218.0618	1.39	No	-(9)	-(9)	1.019	63.61	1.007	62.85	0.36	1.018	63.50	0.31	51.20	18.40	S	-	-	-	-	63.75	63.65	63.53	63.75	218.31 (12)	3.22 (12)	3.89 (12)	-	-
34C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	225.9752	0.96	No	-(9)	-(9)	1.005	62.74	0.999	62.36	0.18	1.003	62.58	0.10	8.70	10.10	T	-	-	-	-	62.78	62.71	62.58	78.79 (12)	226.40 (10)(12)	-	-	3.29 (10)	3.80 (10)
41C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	126.2242	0.19	No	-	-	1.008	62.90	0.994	62.01	0.42	1.004	62.67	0.32	12.00	0.11	T	Yes	Yes	1.89	1.96	-	-	-	-	-	-	-	-	-
41C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	148.1828	0.85	No	-	-	1.015	63.34	0.993	61.93	0.66	1.011	63.11	0.56	32.10	8.45	T	Yes	Yes	1.10	1.42	-	-	-	-	-	-	-	-	-
41C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	142.8807	1.09	No	-	-	1.013	63.20	0.995	62.12	0.51	1.010	63.01	0.43	21.10	10.15	T	Yes	Yes	1.47	1.93	-	-	-	-	-	-	-	-	-
41C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	137.7534	1.19	No	-	-	1.018	63.55	1.005	62.71	0.40	1.014	63.28	0.28	40.80	4.68	T	Yes	Yes	2.05	2.61	-	-	-	-	-	-	-	-	-
41C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	215.1942	2.13	No	-	-	1.009	62.93	0.995	62.11	0.39	1.006	62.78	0.32	13.00	1.01	T	Yes	Yes	4.63	4.75	-	-	-	-	-	-	-	-	-
46C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	146.7662	0.20	No	-	-	1.001	62.47	0.986	61.52	0.44	1.000	62.38	0.41	0.15	2.08	F	Yes	Yes	1.55	1.81	-	-	-	-	-	-	-	-	-
46C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	146.8470	0.60	No	-	-	1.008	62.93	0.993	61.96	0.45	1.007	62.84	0.42	5.30	0.84	T	Yes	Yes	1.12	1.62	-	-	-	-	-	-	-	-	-
46C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	124.7957	1.44	No	-	-	1.013	63.20	0.990	61.77	0.67	1.011	63.12	0.64	6.70	0.50	T	Yes	Yes	0.95	1.46	-	-	-	-	-	-	-	-	-
46C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	146.8127	1.48	No	-	-	1.021	63.73	1.005	62.69	0.49	1.021	63.70	0.48	9.60	0.95	T	Yes	Yes	1.92	2.39	-	-	-	-	-	-	-	-	-
46C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	219.3983	1.50	No	-	-	1.016	63.38	1.003	62.59	0.37	1.014	63.26	0.32	30.20	0.14	T	Yes	Yes	2.55	2.91	-	-	-	-	-	-	-	-	-
46C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	221.4862	1.72	No	-	-	1.011	63.08	1.000	62.41	0.32	1.009	62.95	0.26	23.10	0.21	T	Yes	Yes	2.91	3.22	-	-	-	-	-	-	-	-	-
53C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	143.6656	0.11	Yes	2.44	2.59	1.001	62.45	0.992	61.93	0.24	0.999	62.36	0.21	0.09	3,033	A	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	124.0118	0.42	Yes	0.54	1.55	1.006	62.79	0.995	62.11	0.32	1.004	62.63	0.25	2.40	74,500	A	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	149.8019	-44.75	No	-	-	1.017	63.48	1.739	108.53	-	1.013	63.23	-	5.80	51,000	A	No	No	-	-	-	-	-	-	-	-	-	46.30	47.29
53C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	224.5964	3.20	No	-(9)	-(9)	1.078	67.28	1.050	65.55	0.81	1.073	66.98	0.68	11.00	3,424	A	-	-	-	-	69.48	68.76	68.72	68.72	223.49 (11)	5.25	5.66	-	-
53C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	211.4060	0.90	No	-	-	1.004	62.62	0.998	62.29	0.16	1.003	62.58	0.14	7.60	28.30	F	Yes	Yes	5.63	5.77	-	-	-	-	-	-	-	-	-
61C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	147.2537	0.27	No	-	-	1.003	62.59	0.982	61.30	0.60	1.000	62.41	0.53	2.20	9.86	F	Yes	Yes	2.28	2.26	-	-	-	-	-	-	-	-	-
61C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	151.4427	0.36	No	-	-	1.005	62.73	0.995	62.12	0.28	1.002	62.56	0.21	6.68	88.90	T	Yes	Yes	1.38	1.77	-	-	-	-	-	-	-	-	-
61C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	137.4138	0.62	No	-	-	1.003	62.56	0.992	61.93	0.29	1.010	63.01	0.52	28.00	111.10	T	Yes	Yes	0.69	1.54	-	-	-	-	-	-	-	-	-
61C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	123.6609	1.96	No	-	-	1.026	64.04	1.004	62.64	0.65	1.023	63.81	0.56	18.00 / 19.00	2,920	A	Yes	Yes	1.37	2.57	-	-	-	-	-	-	-	-	-
61C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	220.9218	5.62	No	-(9)	-(9)	1.070	66.75	1.021	63.72	1.41	1.068	66.67	1.41	22.00	34,610	A	-	-	-	-	66.85	66.77	67.12	66.85	221.55	3.75	4.82	-	-
61C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	208.3939	9.48	No	-(9)	-(9)	1.021	63.70	0.962	60.03	1.72	1.018	63.51	1.66	10.00	40,040	A	-	-	-	-	62.98	63.02	62.98	62.98	211.96	7.52	7.55	-	-
77C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	144.3154	-1.35	No	-	-	1.013	63.19	1.152	71.86	4.05	1.009	62.98	4.25	24.30	6.55	T	No	No	-	-	-	-	-	-	-	-	-	4.01	4.03
77C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	150.2600	0.96	No	-	-	1.004	62.67	0.981	61.24	0.67	1.010	63.03	0.86	24.00	565.00	T	Yes	Yes	0.58	0.93	-	-	-	-	-	-	-	-	-
77C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	143.9683	1.02	No	-	-	1.014	63.30	0.998	62.26	0.48	1.011	63.09	0.40	30.00	332.00	T	Yes	Yes	1.43	1.82	-	-	-	-	-	-	-	-	-
77C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	148.7306	1.14	No	-	-	1.010	63.05	0.997	62.24	0.38	1.008	62.93	0.33	20.10	745.00	A	Yes	Yes	1.72	2.30	-	-	-	-	-	-	-	-	-
77C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	212.7773	4.87	No	-(9)	-(9)	1.051 *	65.55 *	1.009	62.93	1.22	1.049	65.46	1.21	17.00	32,770	A	-	-	-	-	66.11	65.96	65.91	66.11	213.59	3.72	4.73	-	-
77C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	213.2446	3.58	No	-(9)	-(9)	1.026	64.05	1.004	62.64	0.66	1.025	63.94	0.62	17.50 / 18.00	221,600	A	-	-	-	-	64.75	64.65	64.54	64.75	214.05	5.98	6.85	-	-
78C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	154.8145	0.60	No	-	-	1.002	62.53	1.003	62.57	0.02	1.000	62.37	0.09	0.05	3.90	F	Yes	Yes	1.21	1.84	-	-	-	-	-	-	-	-	-
78C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	145.3772	0.72	No	-	-	1.003	62.56	0.984	61.39	0.55	1.000	62.41	0.49	1.19	2.05	F	Yes	Yes	0.09	1.36	-	-	-	-	-	-	-	-	-
78C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	146.0758	0.29	No	-	-	1.011	63.10	1.007	62.81	0.14	1.008	62.92	0.05	14.00	314.80	T	Yes	Yes	0.11	1.37	-	-	-	-	-	-	-	-	-
78C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	143.9961	4.60	No	-	-	1.045 *	65.21 *	0.993	61.99	1.50	1.043	65.08	1.48	21.00	14,940	A	*	*	0.01	1.15	-	-	-	-	-	-	-	-	-
78C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	218.1067	-3.10	No	-(9)	-(9)	1.006	62.78	1.028	64.17	0.65	1.003	62.57	0.76	8.20	69.30	T	-	-	-	-	62.75	62.40	62.57	62.75	216.74	6.88	7.02	-	-
78C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	205.2207	0.68	No	-	-	1.006	62.80	1.002	62.54	0.12	1.004	62.62	0.04	9.60	16.31	T	Yes	Yes	5.70	5.83	-	-	-	-	-	-	-	-	-
83C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	131.5764	0.14	Yes	2.11	2.25	1.019	63.61	1.009	62.96	0.30	1.016	63.40	0.21	43.00	452.00	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	139.6025	0.64	Yes	1.00	1.40	1.016	63.43	1.000	62.38	0.49	1.012	63.17	0.38	33.00	5,330	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	126.1219	1.86	No	-	-	1.027	64.08	0.998	62.26	0.85	1.023	63.85	0.76	25.00	8,090	A	Yes	Yes	1.31	1.57	-	-	-	-	-	-	-	-	-
83C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	219.7522	13.15	No	-	-	1.160	72.38	1.047	65.32	3.30	1.144	71.41	2.91	17.00	9,350	A	No	No	-	-	-	-	-	-	-	-	-	5.25	5.43
83C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	224.9133	1.81	No	-	-	1.009	62.97	0.998	62.27	0.33	1.008	62.88	0.29	16.00	2,760	A	Yes	Yes	5.04	5.16	-	-	-	-	-	-	-	-	-
84C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	149.5403	0.26	No	-	-	1.003	62.58	0.985	61.48	0.51	1.002	62.53	0.50	0.24	0.50	F	Yes	Yes	1.40	No Data	-	-	-	-	-	-	-	-	-
84C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	136.9787	0.93	No	-	-	1.009	62.99	0.986	61.51	0.69	1.006	62.78	0.61	16.00	0.50	T	Yes	Yes	1.01	No Data	-	-	-	-	-	-	-	-	-
84C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	152.7416	1.03	No	-	-	1.008	62.88	0.992	61.87	0.47	1.015	63.31	0.69	40.00 / 42.00	0.50	T	Yes	Yes	1.10	No Data	-	-	-	-	-	-	-	-	-
84C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	145.5488	1.16	No	-	-	1.010	63.01	0.997	62.20	0.38	1.017	63.44	0.59	47.00	0.50	T	Yes	Yes	1.59	No Data	-	-	-	-	-	-	-	-	-
84C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	225.3643	-13.47	No	-	-	1.010	63.00	1.123	70.06	3.30	1.017	63.44	3.17	47.00	0.50	T	No	No	-	-	-	-	-	-	-	-	-	16.51	No Data
84C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	218.8475	2.56	No	-(9)	-(9)	1.009	62.94	0.993	61.94	0.47	1.006	62.76	0.39	13.70	1.26	T	-	-	-	-	62.79	62.84	62.74	62.79	219.75	6.62	No Data	-	-
85C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	137.4884	-0.40	No	-	-	1.002	62.55	1.033	64.47	0.90	1.000	62.41	0.99	0.01	0.78	F	Yes	Yes	3.29	3.32	-	-	-	-	-	-	-	-	-
85C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	141.7513	0.16	Yes	1.35	1.97	1.006	62.78	1.002	62.52	0.12	1.003	62.60	0.04	7.90	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
85C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	144.5684	0.68	No	-	-	1.020	63.64	1.009	62.97	0.31	1.017	63.45	0.23	48.00	0.50	T	Yes	Yes	1.70	2.15	-	-	-	-	-	-	-	-	-
85C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	144.4399	0.68	No	-	-	1.018 *	63.52 *	1.010	63.04	0.22	1.017	63.43	0.19	51.00	0.50	T	*	*	2.06	2.54	-	-	-	-	-	-	-	-	-
85C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	220.5654	1.02	No	-	-	1.022	63.77	1.013	63.23	0.25	1.020	63.63	0.19	51.00	0.50	S	Yes	Yes	2.50	2.99	-	-	-	-	-	-	-	-	-
85C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	225.9176	1.62	No	-(9)	-(9)	1.022 *	63.77 *	1.011	63.10	0.31	1.020	63.65	0.26	54.00	0.50	S	-	-	-	-	63.88	63.65	63.66	63.88	226.72	4.41	4.91	-	-
86C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	143.9064	-0.08	Yes	1.98	2.17	1.002	62.52	1.008	62.91	0.18	1.000	62.39	0.25	0.05	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	131.0217	-2.53	No	-	-	1.002	62.53	1.068	66.65	1.93	1.001	62.45	2.01	2.65	5.00	F	No	No	-	-	-	-	-	-	-	-	-	4.16	4.58
86C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	151.7898	1.30	No	-	-	1.018	63.55	0.998	62.25	0.61	1.015	63.35	0.53	44.00	0.50	T	Yes	Yes	1.31	1.73	-	-	-	-	-	-	-	-	-
86C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	216.8058	-1.61	No	-	-	1.022	63.79	1.036	64.63	0.39	1.020	63.65	0.47	55.00	0.50	S	Yes	Yes	6.42	6.83	-	-	-	-	-	-	-	-	-
86C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	188.8518	3.27	No	-	-	1.023	63.82	1.002	62.53	0.60	1.020	63.66	0.54	54.70	0.50	S	Yes	Yes	3.08	3.44	-	-	-	-	-	-	-	-	-
87C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	149.1936	0.35	No	-	-	1.001	62.47	0.973	60.70	0.83	1.000	62.40	0.81	0.03	0.50	F	Yes	Yes	1.69	1.89	-	-	-	-	-	-	-	-	-
87C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	146.9934	0.38	No	-	-	1.002	62.52	0.992	61.88	0.30	1.000	62.42	0.26	0.99	2.50	F	Yes	Yes	1.19	1.66	-	-	-	-	-	-	-	-	-
87C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	218.3647	2.34	No	-	-	1.021	63.72	1.001	62.48	0.58	1.018	63.51	0.50	55.00	0.50	S	Yes	Yes	2.32	2.80	-	-	-	-	-	-	-	-	-
87C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	216.5937	3.27	No	-	-	1.022	63.78	1.001	62.48	0.60	1.019	63.60	0.53	52.00	0.50	S	Yes	Yes	2.73	3.09	-	-	-	-	-	-	-	-	-
88C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	127.7989	0.46	No	-	-	1.001	62.49	0.968	60.39	0.98	1.000	62.38	0.95	0.03	0.15	F	Yes	Yes	1.40	1.57	-	-	-	-	-	-	-	-	-
88C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	146.4456	0.62	No	-	-	1.004	62.68	0.989	61.69	0.46	1.002	62.53	0.40	5.70	0.50	F	Yes	Yes	1.18	1.52	-	-	-	-	-	-	-	-	-
88C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	146.8837	1.33	No	-	-	1.018	63.53	0.997	62.24	0.60	1.017	63.45	0.58	48.50	0.50	T	Yes	Yes	1.45	1.79	-	-	-	-	-	-	-	-	-
88C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	151.0050	1.89	No	-	-	1.019	63.56	0.997	62.23	0.62	1.017	63.43	0.58	48.70	0.50	T	Yes	Yes	1.71	2.04	-	-	-	-	-	-	-	-	-
88C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	233.1299	2.63	No	-(9)	-(9)	1.019	63.57	0.997	62.19	0.65	1.017	63.46	0.61	50.10	0.50	T	-	-	-	-	63.71	63.65	63.51	63.71	233.54 (13)	3.66 (13)	3.96 (13)	-	-
88C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	216.0617	3.62	No	-(9)	-(9)	1.022	63.77	0.999	62.35	0.66	1.019	63.59	0.59	60.30	0.50	S	-	-	-	-	63.85	63.65	63.62	63.85	216.78 (13)	4.41 (13)	4.69 (13)	-	-
89C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	133.2559	0.75	No	-	-	1.016	63.43	1.008	62.90	0.25	1.016	63.37	0.23	45.40	74.30	T	Yes	Yes	2.19	2.99	-	-	-	-	-	-	-	-	-
89C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	221.8160	2.30	No	-	-	1.020	63.65	1.001	62.44	0.57	1.017	63.46	0.49	43.90	1.10	T	Yes	Yes	1.92	2.54	-	-	-	-	-	-	-	-	-
89C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	223.7300	0.14	Yes	5.46	5.83	1.011	63.11	1.010	63.05	0.03	-	-	-	-	-	T	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	138.6344	0.17 (12)	Yes	1.48	1.82	1.003	62.59	0.990	61.80 (12)	-	1.001	62.48	-	1.21	3,530	A	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	142.2675	2.98 (12)	No	-	-	1.046	65.30	1.013	63.20 (12)	0.98	1.043	65.09	0.91	8.40	1,172	A	Yes	Yes	2.94	3.20	-	-	-	-	-	-	-	-	-
90C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	214.2387	12.37 (12)	No	-	-	1.151	71.85	1.045	65.23 (12)	3.10	1.141	71.21	2.86	15.00	15.30	A	No	No	-	-	-	-	-	-	-	-	-	5.71	5.93
90C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	207.8550	-27.01 (12)	No	-(9)	-(9)	1.006	62.79	1.173	73.17 (12)	4.85	1.004	62.67	5.02	13.10	3.97	T	-	-	-	-	62.84	62.87	62.62	62.84	196.15 (12)	6.94 (12)	7.05 (12)	-	-
91C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	112.5198	1.31 (12)	No	-	-	1.002	62.55	0.912	56.92 (12)	2.63	1.000	62.38	2.61	0.04	0.40	F	No	No	-	-	-	-	-	-	-	-	-	0.85	1.07
91C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	144.0060	1.92 (12)	No	-	-	1.007	62.81	0.958	59.76 (12)	1.43	1.005	62.69	1.40	9.70	1.10	T	No	No	-	-	-	-	-	-	-	-	-	-0.13	0.29
91C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	148.9520	0.32 (12)	No	-	-	1.007	62.82	1.002	62.50 (12)	0.15	1.004	62.62	0.06	16.70	1.94	T	Yes	Yes	1.66	2.12	-	-	-	-	-	-	-	-	-
91C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	150.5853	2.50 (12)	No	-	-	1.003	62.60	0.976	60.87 (12)	0.81	1.001	62.48	0.77	7.20	1.57	F	Yes	Yes	-0.33	0.41	-	-	-	-	-	-	-	-	-
91C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	223.1769	0.63 (12)	No	-	-	1.008	62.92	1.003	62.59 (12)	0.16	1.005	62.69	0.05	11.00	33.40	T	Yes	Yes	2.95	3.43	-	-	-	-	-	-	-	-	-
91C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	222.9534	2.33 (12)	No	-	-	1.007	62.83	0.993	61.94 (12)	0.42	1.004	62.68	0.35	11.00	40.50	T	Yes	Yes	4.42	4.57	-	-	-	-	-	-	-	-	-

TABLE 2

FEHs BY CATEGORY - CMT WELLS USING ORIGINAL C VALUE
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy [1] ($ft\ H_2O$)	Manual DTW Measurement Accuracy [2] (ft)	Manual FEH Accuracy [3] ($ft\ H_2O$)	Total Accuracy [4] ($ft\ H_2O$)	Geokon C Value (psi)	Category 1 FEH at ZGP: Average Offset Between 2012 Manual and Transducer FEHs [5] (ft)	Category 1 FEH at ZGP: Average Offset Within Total Accuracy [6] (Yes/No)	Category 1 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 1 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity [7]: SG	2012 Lab Measured Specific Gravity [7]: (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH: SG	2012 Density From Linear Regression of Manual vs. Transducer FEH: (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density
92C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	152.9306	-0.01 (12)	Yes	1.52	1.68	1.002	62.54	1.003	62.58 (12)	0.02	1.000	62.38	0.10
92C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	150.2304	-0.01 (12)	Yes	1.38	1.63	1.006	62.80	1.006	62.80 (12)	0.00	1.003	62.59	0.10
92C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.338	± 0.480	154.6158	-	-	-	-	1.012	63.12	-	NM	-	1.018	63.51	-
92C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.496	± 0.638	153.9862	0.05 (12)	Yes	1.39	1.69	1.009	62.99	1.009	62.95 (12)	0.02	1.016	63.41	0.22
92C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	220.1344	0.01 (12)	Yes	2.08	2.38	1.008	62.90	1.008	62.89 (12)	0.00	1.014	63.27	0.18
92C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	214.3657	0.14 (12)	Yes	2.88	3.15	1.012	63.14	1.011	63.09 (12)	0.03	1.017	63.48	0.19
93C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	137.9402	0.32 (12)	No	-	-	1.002	62.55	0.981	61.20 (12)	0.63	0.999	62.36	0.56
93C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	152.3786	1.39 (12)	No	-	-	1.014	63.30	0.980	61.14 (12)	1.01	1.002	62.51	0.65
93C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	122.9579	-2.01 (12)	No	-	-	1.018	63.51	1.049	65.44 (12)	0.90	1.015	63.32	1.02
93C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	152.8048	-0.05 (12)	Yes	2.96	3.20	1.017	63.48	1.018	63.51 (12)	0.02	1.014	63.26	0.12
93C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	220.4309	2.77 (12)	No	-[9]	-[9]	1.019	63.61	0.996	62.16 (12)	0.68	1.016	63.39	0.59
93C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	231.9488	3.82 (12)	No	-[9]	-[9]	1.021	63.74	0.998	62.25 (12)	0.70	1.018	63.50	0.60
94C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.065	± 0.207	147.3683	0.43 (12)	No	-	-	1.018	63.52	0.987	61.57 (12)	0.92	1.015	63.33	0.84
94C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	144.9189	0.80 (12)	No	-	-	1.022	63.76	1.000	62.41 (12)	0.63	1.019	63.58	0.56
94C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	146.8811	1.99 (12)	No	-	-	1.026	64.00	1.003	62.58 (12)	0.66	1.023	63.81	0.59
94C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	210.3590	7.46 (12)	No	-	-	1.088	67.87	1.024	63.91 (12)	1.85	1.082	67.54	1.74
94C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	224.7843	2.16 (12)	No	-	-	1.009	62.94	0.995	62.11 (12)	0.39	1.007	62.82	0.34
95C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	137.3846	0.02 (12)	Yes	1.09	1.25	1.002	62.51	1.000	62.42 (12)	0.04	1.010	63.00	0.28
95C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	137.8341	0.19 (12)	Yes	1.22	1.46	1.003	62.58	0.998	62.27 (12)	0.14	1.009	62.97	0.33
95C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.338	± 0.480	140.3637	1.36 (12)	No	-	-	1.020 *	63.64 *	0.998	62.28 (12)	0.63	1.018	63.54	0.60
95C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	142.9036	1.27 (12)	No	-	-	1.010	63.04	0.996	62.14 (12)	0.42	1.018	63.52	0.66
95C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	207.8727	1.58 (12)	No	-	-	1.011	63.12	0.998	62.28 (12)	0.39	1.018	63.54	0.60
95C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	212.7818	2.07 (12)	No	-	-	1.021	63.71	1.007	62.85 (12)	0.40	1.017	63.45	0.29

Location	Bromide (mg/L)	TCVOCs (µg/L)	Classification [8]	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to the Lab Density?	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Category 2 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 2 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Category 3 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 3 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 4 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 4 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)
92C-25	0.19	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-50	9.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-75	50.00	0.50	S	No	No	-	-	-	-	-	-	-	-	-	1.30	1.61
92C-100	52.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-130	39.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-160	49.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-25	0.20	0.50	F	Yes	Yes	1.99	2.08	-	-	-	-	-	-	-	-	-
93C-50	5.92 / 6.10	0.50	T	No	Yes	0.88	1.13	-	-	-	-	-	-	-	-	-
93C-75	43.90	0.50	T	Yes	No	4.74	4.99	-	-	-	-	-	-	-	-	-
93C-100	40.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-130	52.00	0.50	S	-	-	-	-	63.64	63.55	63.39	63.64	221.09 (12)	3.33 (12)	3.53 (12)	-	-
93C-160	50.00	0.50	S	-	-	-	-	63.76	63.68	63.62	63.76	232.84 (12)	4.25 (12)	4.43 (12)	-	-
94C-25	56.00	9.44	S	Yes	Yes	1.33	1.56	-	-	-	-	-	-	-	-	-
94C-50	46.00	295	A	Yes	Yes	0.69	1.36	-	-	-	-	-	-	-	-	-
94C-100	29.00 / 31.00	124,500	A	Yes	Yes	1.64	2.15	-	-	-	-	-	-	-	-	-
94C-130	12.00 / 13.00	16,184	A	No	No	-	-	-	-	-	-	-	-	-	4.13	4.43
94C-160	16.00	1,102	A	Yes	Yes	4.57	4.69	-	-	-	-	-	-	-	-	-
95C-25	28.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-50	28.50	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-75	58.00	0.50	S	*	*	1.39	1.60	-	-	-	-	-	-	-	-	-
95C-100	44.00	0.50	T	Yes	Yes	1.60	1.78	-	-	-	-	-	-	-	-	-
95C-130	45.00	0.50	T	Yes	Yes	1.98	2.17	-	-	-	-	-	-	-	-	-
95C-160	53.00	0.50	S	Yes	Yes	2.51	2.70	-	-	-	-	-	-	-	-	-

113 = Number of CMT Wells

Number of CMT Well FEHs in Category 1 = 18

Number of CMT Well Micron FEHs in Category 2 = 67

Number of CMT Well FEHs in Category 3 = 15

Number of CMT Well FEHs in Category 4 = 13

Notes:

* Applied the December 29, 2012 Agency recommended specific gravity value with temperature correction to obtain density

NM No Manual

1.31 Orange coloring indicates that the standard deviation is equal to or greater than 1 and that the probability of that magnitude of error occurring is less than or equal to 0.3

(1) Transducer accuracy based on manufacturer specifications:
Geokon (all models have an accuracy of +/- 0.1% full scale):

Full Scale of Model 4500s-350KPa =	117	feet H2O	Accuracy =	± 0.117	feet H2O
Full Scale of Model 4500s-700KPa =	234	feet H2O	Accuracy =	± 0.234	feet H2O

(2) Manual Depth to Water (DTW) measurements are considered accurate to ±0.025 ft considering that they can be somewha
subjective hand-measurements performed using a water level tape by different field staff and complicated by tidal fluctuations and variable field conditions.

(3) Manual FEH accuracy based on analysis of water column density variations presented in Table 5 (summarized below). Classification of wells as Fresh/Transient, Salt, or ADP to apply manual FEH accuracy is based on measured density only (and not bromide and TCVOCs)

	Fresh/ Transient	Salt	ADP	
15-ft Zone	± 0.00	± 0.00	± 0.00	feet H_2O
25-ft Zone	± 0.02	± 0.06	± 0.13	feet H_2O
50-ft Zone	± 0.10	± 0.28	± 0.56	feet H_2O
75ft -Zone	± 0.12	± 0.34	± 0.68	feet H_2O
100-ft Zone	± 0.18	± 0.50	± 0.99	feet H_2O
130-ft Zone	± 0.22	± 0.62	± 1.25	feet H_2O
160-ft Zone	± 0.25	± 0.71	± 1.42	feet H_2O

(4) Total accuracy is the sum of the transducer accuracy, DTW accuracy, and manual FEH accuracy

(5) Manual FEH minus transducer FEH, where FEH is at transducer elevation. For Geokon transducers, the FEH is based on the original "C" value determined at the time of the Geokon transducer factory calibration check in the DI wel

(6) Average absolute offset is less than or equal to the total accuracy.

(7) Laboratory measured specific gravity corrected to temperature at time of sampling multiplied by a fresh water density of 62.4 lbs/ft^3.

(9) Categories of Fresh (F), Transition (T), Salt (S), or ADP (A) determined from the examination of density, TCVOCs, and bromide data identified as per the following criteria:

Category	Density (lbs/ft3)	Specific Gravity	TCVOCs (µg/L)	Bromide (mg/L)
Fresh	62.4 - 62.712	1 – 1.005	<500	0.1028 – 13.22
Transition	> 62.712 - 63.5856	> 1.005 –	<500	> 13.22 – 49.94
Salt	> 63.5856 - 63.8976	> 1.019 –	<500	> 49.94 – 60.43
ADP	> 63.8976	> 1.023	>= 500	> 60.43

Note that if bromide indicates that a location is fresh but lab density reported a density greater than fresh, ADP was assumed

(9) Carried directly to Category 3 where in situ Summer 2013 C value determined.

(10) The original C value provided a reasonable match for the 2012 manual DTW measurements and was selected as the 2012 best-fit C value. The 2012 manual DTW measurements varied over a range of approximately 1.9 ft
The manual DTW measurements used to determine the 2013 in situ C value only varied over a range of approximately 0.03 ft
which makes the 2013 in situ C value less reliable than the 2012 best-fit C value. Thus, the FEHs determined using the 2012 best-fit C value are retained, but are included in Category 4

(11) The 2013 density based on laboratory measured specific gravity is elevated compared to the density based on field measured specific gravity and the Agency TDS vs. specific gravity relationship
Thus, the C value is based on matching the density based on Agency TDS vs. specific gravity relationship.

(12) Change in value due to reference elevation correction.

(13) Change in value due correction in transducer zero readings and/or calibration factors.

TABLE 3

FEHs BY CATEGORY - CMT WELLS USING BEST-FIT C VALUE
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

										Category 1 FEH at ZGP															Category 2 FEH at ZGP									Category 3 FEH at ZGP		Category 4 FEH at ZGP	
Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy [1] (ft H_2O)	Manual DTW Measurement Accuracy [2] (ft)	Manual FEH Accuracy [3] (ft H_2O)	Total Accuracy [4] (ft H_2O)	Geokon C Value (psi)	Geokon Original C Value (OC) or Best-Fit C Value (BFC)	Average Offset Between 2012 Manual and Transducer FEHs [5] (ft)	Average Offset Within Total Accuracy [6] (Yes/No)	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity [7] SG	2012 Lab Measured Specific Gravity [7] (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH SG	2012 Density From Linear Regression of Manual vs. Transducer FEH (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)	Classification [8]	Is the 2012 Regression Density Comparable to the Lab Density?	Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Event 3b Serfes Mean FEH at ZGP (ft NGVD)
17C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	149.0965	BFC	0.15	Yes	1.94	2.02	1.016	63.39	1.004	62.66	0.66	1.013	63.21	0.50	25.00 / 33.00	1.47	T	-	-	-	-	-	-	-	-	-	-	-	-	-
17C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	214.0396	OC (9)	1.40	No	-	-	1.003	62.57	0.990	61.78	0.72	1.000	62.41	0.58	1.27	5.00	F	Yes	Yes	2.40	2.59	-	-	-	-	-	-	-	-	-
17C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	207.2093	OC (9)	1.66	No	-	-	1.002	62.55	0.992	61.91	0.58	1.000	62.42	0.47	1.98	0.50	F	Yes	Yes	5.52	5.64	-	-	-	-	-	-	-	-	-
21C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	140.7552	BFC	-0.01	Yes	3.20	3.15	1.002	62.52	1.003	62.58	0.05	1.000	62.37	0.19	0.08	155.40	F	-	-	-	-	-	-	-	-	-	-	-	-	-
21C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	114.4092	BFC	-0.01	Yes	1.80	2.33	1.010	63.00	1.010	63.02	0.02	1.007	62.84	0.16	8.00 / 8.00	46.80	A	-	-	-	-	-	-	-	-	-	-	-	-	-
21C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	145.2188	BFC	-0.01	Yes	3.10	3.55	1.024	63.90	1.024	63.91	0.01	1.022	63.75	0.15	18.00	38.72	A	-	-	-	-	-	-	-	-	-	-	-	-	-
21C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	125.7522	OC (9)	1.66	No	-	-	1.039	64.81	1.019	63.57	1.13	1.036	64.63	0.96	14.00	6.30	A	No	Yes	3.55	3.97	-	-	-	-	-	-	-	-	-
21C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	213.4420	OC (9)	1.29	Yes	-[10]	-[10]	1.007	62.83	0.995	62.11	0.66	1.002	62.51	0.37	8.20	3.04	A	-	-	-	-	62.67	62.77	62.65	62.67	213.84	3.10	3.71	-	-
21C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	234.1420	BFC	-0.01	Yes	6.94	7.07	1.007	62.85	1.007	62.85	0.00	1.004	62.65	0.18	8.80	1.70	A	-	-	-	-	-	-	-	-	-	-	-	-	-
34C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	219.2330	BFC	-1.31	No	-[10]	-[10]	1.019	63.61	1.031	64.32	0.65	1.018	63.50	0.74	51.20	18.40	S	-	-	-	-	63.75	63.65	63.53	63.75	218.31 (13)	3.22 (13)	3.89 (13)	-	-
34C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	225.9752	OC (9)	0.96	No	-[10]	-[10]	1.005	62.74	0.999	62.35	0.35	1.003	62.58	0.21	8.70	10.10	T	-	-	-	-	62.78	62.71	62.58	78.79 (13)	226.40 (11)(13)	-	-	3.29 (11)	3.80 (11)
41C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	126.3097	BFC	-0.01	Yes	2.09	2.15	1.008	62.90	1.008	62.93	0.02	1.004	62.67	0.23	12.00	0.11	T	-	-	-	-	-	-	-	-	-	-	-	-	-
41C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	148.5992	BFC	-0.11	Yes	2.06	2.38	1.015	63.34	1.018	63.52	0.16	1.011	63.11	0.37	32.10	8.45	T	-	-	-	-	-	-	-	-	-	-	-	-	-
41C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	143.4109	BFC	-0.13	Yes	2.70	3.16	1.013	63.20	1.015	63.33	0.12	1.010	63.01	0.28	21.10	10.15	T	-	-	-	-	-	-	-	-	-	-	-	-	-
41C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	138.3085	BFC	-0.09	Yes	3.33	3.89	1.018	63.55	1.019	63.62	0.06	1.014	63.28	0.30	40.80	4.68	T	-	-	-	-	-	-	-	-	-	-	-	-	-
41C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	216.1251	BFC	-0.01	Yes	6.78	6.90	1.009	62.93	1.009	62.94	0.00	1.006	62.78	0.14	13.00	1.01	T	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	146.8571	BFC	-0.01	Yes	1.76	2.02	1.001	62.47	1.002	62.50	0.03	1.000	62.38	0.11	0.15	2.08	F	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	147.1109	BFC	-0.01	Yes	1.73	2.22	1.008	62.93	1.009	62.95	0.02	1.007	62.84	0.10	5.30	0.84	T	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	125.4296	BFC	-0.02	Yes	2.42	2.92	1.013	63.20	1.013	63.20	0.01	1.011	63.12	0.08	6.70	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	147.4144	BFC	0.09	Yes	3.30	3.77	1.021	63.73	1.020	63.67	0.06	1.021	63.70	0.03	9.60	0.95	T	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	220.0513	BFC	-0.01	Yes	4.05	4.41	1.016	63.38	1.016	63.39	0.01	1.014	63.26	0.12	30.20	0.14	T	-	-	-	-	-	-	-	-	-	-	-	-	-
46C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	222.2357	BFC	-0.01	Yes	4.64	4.95	1.011	63.08	1.011	63.09	0.00	1.009	62.95	0.12	23.10	0.21	T	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	143.7235	BFC	-0.02	Yes	2.57	2.72	1.001	62.45	1.002	62.53	0.07	0.999	62.36	0.15	0.09	3,033	A	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	124.2005	BFC	-0.01	Yes	0.97	1.99	1.006	62.79	1.007	62.82	0.02	1.004	62.63	0.17	2.40	74,500	A	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	130.4144	BFC	-0.01	Yes	1.55	2.55	1.017	63.48	1.017	63.48	0.01	1.013	63.23	0.23	5.80	51,000	A	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	225.9281	BFC	0.13	Yes	-[10]	-[10]	1.078	67.28	1.077	67.21	0.06	1.073	66.98	0.21	11.00	3,424	A	-	-	-	-	69.48	68.76	68.72	68.72	223.49 (12)	5.25	5.66	-	-
53C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	211.4060	OC (9)	0.90	No	-	-	1.004	62.62	0.998	62.29	0.30	1.003	62.58	0.26	7.60	28.30	F	Yes	Yes	5.63	5.77	-	-	-	-	-	-	-	-	-
61C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	147.3273	BFC	0.10	Yes	2.45	2.43	1.003	62.59	0.995	62.11	0.44	1.000	62.41	0.27	2.20	9.86	F	-	-	-	-	-	-	-	-	-	-	-	-	-
61C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	151.5300	BFC	0.16	Yes	1.58	1.97	1.005	62.73	1.001	62.46	0.24	1.002	62.56	0.09	6.68	88.90	T	-	-	-	-	-	-	-	-	-	-	-	-	-
61C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	137.6492	BFC	0.07	Yes	1.24	2.08	1.003	62.56	1.001	62.48	0.07	1.010	63.01	0.48	28.00	111.10	T	-	-	-	-	-	-	-	-	-	-	-	-	-
61C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	124.5227	BFC	-0.03	Yes	3.36	4.56	1.026	64.04	1.027	64.06	0.02	1.023	63.81	0.23	18.00 / 19.00	2,920	A	-	-	-	-	-	-	-	-	-	-	-	-	-
61C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	223.3592	BFC	-0.01	Yes	-[10]	-[10]	1.070	66.75	1.070	66.75	0.00	1.068	66.67	0.07	22.00	34,610	A	-	-	-	-	66.85	66.77	67.12	66.85	221.55	3.75	4.82	-	-
61C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	208.3939	OC (9)	9.48	No	-[10]	-[10]	1.021	63.70	0.962	60.03	3.34	1.018	63.51	3.16	10.00	40,040	A	-	-	-	-	62.98	63.02	62.98	62.98	211.96	7.52	7.55	-	-
77C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	143.73	BFC	-0.01	Yes	2.67	2.68	1.013	63.19	1.013	63.22	0.03	1.009	62.98	0.22	24.30	6.55	T	-	-	-	-	-	-	-	-	-	-	-	-	-
77C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	150.69 (14)	BFC	-0.03	Yes	1.57	1.92	1.004	62.67	1.005	62.71	0.04	1.010	63.03	0.29	24.00	565	T	-	-	-	-	-	-	-	-	-	-	-	-	-
77C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	144.42 (14)	BFC	-0.02	Yes	2.47	2.86	1.014	63.30	1.015	63.32	0.02	1.011	63.09	0.20	30.00	332	T	-	-	-	-	-	-	-	-	-	-	-	-	-
77C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	149.23 (14)	BFC	-0.03	Yes	2.88	3.46	1.010	63.05	1.011	63.07	0.02	1.008	62.93	0.13	20.10	745	A	-	-	-	-	-	-	-	-	-	-	-	-	-
77C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	212.76	BFC	4.91	No	-[10]	-[10]	1.051 *	65.55 *	1.008	62.91	2.40	1.049	65.46	2.32	17.00	32,770	A	-	-	-	-	66.11	65.96	65.91	66.11	213.59	3.72	4.73	-	-
77C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	214.81	BFC	-0.04	Yes	-[10]	-[10]	1.026	64.05	1.027	64.06	0.02	1.025	63.94	0.12	17.50 / 18.00	221,600	A	-	-	-	-	64.75	64.65	64.54	64.75	214.05	5.98	6.85	-	-
78C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	154.4993	BFC	0.00	Yes	0.48	1.11	1.002	62.53	1.002	62.52	0.01	1.000	62.37	0.13	0.05	3.90	F	-	-	-	-	-	-	-	-	-	-	-	-	-
78C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	145.6922	BFC	-0.01	Yes	0.82	2.09	1.003	62.56	1.003	62.57	0.01	1.000	62.41	0.15	1.19	2.05	F	-	-	-	-	-	-	-	-	-	-	-	-	-
78C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	146.2038	BFC	0.00	Yes	0.41	1.67	1.011	63.10	1.011	63.10	0.00	1.008	62.92	0.16	14.00	314.80	T	-	-	-	-	-	-	-	-	-	-	-	-	-
78C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	144.4907	BFC	3.45	No	-	-	1.045 *	65.21 *	1.006	62.79	2.20	1.043	65.08	2.08	21.00	14,940	A	*	*	1.15	2.30	-	-	-	-	-	-	-	-	-
78C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	216.7912	BFC	-0.06	Yes	-[10]	-[10]	1.006	62.78	1.006	62.80	0.02	1.003	62.57	0.21	8.20	69.30	T	-	-	-	-	62.75	62.40	62.57	62.75	216.74	6.88	7.02	-	-
78C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	205.4884	BFC	0.08	Yes	6.31	6.45	1.006	62.80	1.006	62.77	0.03	1.004	62.62	0.14	9.60	16.31	T	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	131.6433	BFC	-0.01	Yes	2.26	2.40	1.019	63.61	1.020	63.66	0.04	1.016	63.40	0.24	43.00	452	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	139.8794	BFC	0.00	Yes	1.64	2.04	1.016	63.43	1.016	63.42	0.01	1.012	63.17	0.23	33.00	5,330	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.677	± 0.819	126.9321	BFC	-0.01	Yes	3.18	3.44	1.027	64.08	1.027	64.10	0.01	1.023	63.85	0.22	25.00	8,090	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	219.7522	OC (9)	13.15	No	-	-	1.160	72.38	1.047	65.32	6.42	1.144	71.41	5.53	17.00	9,350	A	No	No	-	-	-	-	-	-	-	-	-	5.25	5.43
83C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	224.9133	OC (9)	1.81	No	-	-	1.009	62.97	0.998	62.27	0.64	1.008	62.88	0.55	16.00	2,760	A	Yes	Yes	5.04	5.16	-	-	-	-	-	-	-	-	-
84C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	149.6348	BFC	0.04	Yes	1.62	No Data	1.003	62.58	1.000	62.40	0.17	1.002	62.53	0.12	0.24	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
84C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	137.3641	BFC	0.04	Yes	1.90	No Data	1.009	62.99	1.008	62.92	0.06	1.006	62.78	0.13	16.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
84C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	153.2063	BFC	-0.04	Yes	2.17	No Data	1.008	62.88	1.008	62.92	0.03	1.015	63.31	0.35	40.00 / 42.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
84C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	146.0763	BFC	-0.06	Yes	2.81	No Data	1.010	63.01	1.011	63.06	0.04	1.017	63.44	0.35	47.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
84C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	219.5703	BFC	-0.10	Yes	3.14	No Data	1.010	63.00	1.010	63.05	0.05	1.017	63.44	0.36	47.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
84C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	219.9578	BFC	0.00	Yes	-[10]	-[10]	1.009	62.94	1.009	62.94	0.00	1.006	62.76	0.16	13.70	1.26	T	-	-	-	-	62.79	62.84	62.74	62.79	219.75	6.62	No Data	-	-
85C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	137.3267	BFC	-0.03	Yes	2.92	2.95	1.002	62.55	1.004	62.68	0.11	1.000	62.41	0.25	0.01	0.78	F	-	-	-	-	-	-	-	-	-	-	-	-	-
85C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	141.8200	BFC	0.00	Yes	1.51	2.13	1.006	62.78	1.006	62.79	0.00	1.003	62.60	0.17	7.90	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
85C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	144.8926	BFC	-0.07	Yes	2.45	2.90	1.020	63.64	1.021	63.71	0.06	1.017	63.45	0.24	48.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
85C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	144.1947	BFC	1.25	No	-	-	1.018 *	63.52 *	1.004	62.64	0.80	1.017	63.43	0.72	51.00	0.50	T	*	*	1.50	1.97	-	-	-	-	-	-	-	-	-
85C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	221.0280	BFC	-0.05	Yes	3.57	4.06	1.022	63.77	1.022	63.80	0.02	1.020	63.63	0.16	51.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
85C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	225.3695	BFC	2.88	No	-[10]	-[10]	1.022 *	63.77 *	1.003	62.58	1.09	1.020	63.65	0.98	54.00	0.50	S	-	-	-	-	63.88	63.65	63.66	63.88	226.72	4.41	4.91	-	-
86C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	143.8713	BFC	0.01	Yes	1.90	2.08	1.002	62.52	1.001	62.48	0.03	1.000	62.39	0.08	0.05	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	129.9185	BFC	0.01	Yes	1.61	2.03	1.002	62.53	1.002	62.50	0.02	1.001	62.45	0.05	2.65	5.00	F	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	152.3567	BFC	-0.01	Yes	2.62	3.04	1.018	63.55	1.019	63.56	0.01	1.015	63.35	0.19	44.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	216.1113	BFC	0.00	Yes	4.81	5.22	1.022	63.79	1.022	63.79	0.00	1.020	63.65	0.12	55.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	190.2764	BFC	-0.02	Yes	6.37	6.73	1.023	63.82	1.023	63.83	0.01	1.020	63.66	0.16	54.70	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	149.3470	BFC	0.00	Yes	2.04	2.24	1.001	62.47	1.001	62.47	0.01	1.000	62.40	0.07	0.03	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	147.1597	BFC	0.00	Yes	1.58	2.05	1.002	62.52	1.002	62.52	0.00	1.000	62.42	0.09	0.99	2.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	219.3595	BFC	0.05	Yes	4.61	5.09	1.021	63.72	1.021	63.69	0.02	1.018	63.51	0.16	55.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	217.9914	BFC	0.04	Yes	5.96	6.31	1.022	63.78	1.022	63.76	0.02	1.019	63.60	0.15	52.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
88C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	128.00 (14)	BFC	0.00 (14)	Yes	1.88 (14)	2.05 (14)	1.001	62.49	1.002	62.51 (14)	0.01	1.000	62.38	0.12	0.03	0.15	F	-	-	-	-	-	-	-	-	-	-	-	-	-
88C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	146.72 (14)	BFC	-0.01 (14)	Yes	1.82 (14)	2.15 (14)	1.004	62.68	1.005	62.69 (14)	0.01	1.002	62.53	0.15	5.70	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
88C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	147.45 (14)	BFC	-0.02 (14)	Yes	2.76 (14)	3.10 (14)	1.018	63.53	1.018	63.51 (14)	0.02	1.017	63.45	0.05	48.50	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
88C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	151.84 (14)	BFC	-0.02 (14)	Yes	3.62 (14)	3.96 (14)	1.019	63.56	1.019	63.58 (14)	0.01	1.017	63.43	0.13	48.70	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
88C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	234.27 (14)	BFC	-0.01 (14)	Yes	-[10]	-[10]	1.019	63.57	1.019	63.58 (14)	0.01	1.017	63.46	0.10	50.10	0.50	T	-	-	-	-	63.71	63.65	63.51	63.71	233.54 (14)	3.66 (14)	3.96 (14)	-	-
88C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	217.63 (14)	BFC	0.01 (14)	Yes	-[10]	-[10]	1.022	63.77	1.022	63.76 (14)	0.00	1.019	63.59	0.16	60.30	0.50	S	-	-	-	-	63.85	63.65	63.62	63.85	216.78 (14)	4.41 (14)	4.69 (14)	-	-
89C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	133.5728	BFC	0.02	Yes	2.92	3.72	1.016	63.43	1.016	63.41	0.01	1.016	63.37	0.04	45.40	74.30	T	-	-	-	-	-	-	-	-	-	-	-	-	-
89C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	222.8095	BFC	0.01	Yes	4.21	4.83	1.020	63.65	1.020	63.65	0.00	1.017	63.46	0.17	43.90	1.10	T	-	-	-	-	-	-	-	-	-	-	-	-	-
89C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	223.7300	OC (9)	0.14	Yes	5.46	5.83	1.011	63.11	1.010	63.05	0.05	-	-	-	-	-	T	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.129	± 0.271	138.71 (14)	BFC	0.00 (13)	Yes	1.65 (13)	1.99 (13)	1.003	62.59	1.003	62.60 (13)	0.00	1.001	62.48	0.10	1.21	3,530	A	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	143.57 (14)	BFC	-0.02 (13)	Yes	5.94 (13)	6.20 (13)	1.046	65.30	1.047	65.31 (13)	0.01	1.043	65.09	0.20	8.40	1,172	A	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	214.24 (14)	OC (9)	12.37 (13)	No	-	-	1.151	71.85	1.045	65.23 (13)	6.03	1.141	71.21	5.44	15.00	15.30	A	No	No	-	-	-	-	-	-	-	-	-	5.71	5.93
90C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	196.17 (14)	BFC	-0.04 (13)	Yes	-[10]	-[10]	1.006	62.79	1.007	62.81 (13)	0.02	1.004	62.67	0.13	13.10	3.97	T	-	-	-	-	62.84	62.87	62.62	62.84	196.15 (13)	6.94 (13)	7.05 (13)	-	-
91C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	113.08 (13)	BFC	0.02	Yes	2.14 (13)	2.36 (13)	1.002	62.55	1.001	62.46	0.08	1.000	62.38	0.07	0.04	0.40	F	-	-	-	-	-	-	-	-	-	-	-	-	-
91C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	144.84 (13)	BFC	-0.01	Yes	1.80 (13)	2.22 (13)	1.007	62.81	1.007	62.83	0.02	1.005	62.69	0.13	9.70	1.10	T	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 3

FEHs BY CATEGORY - CMT WELLS USING BEST-FIT C VALUE
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy [1] (ft H_2O)	Manual DTW Measurement Accuracy [2] (ft)	Manual FEH Accuracy [3] (ft H_2O)	Total Accuracy [4] (ft H_2O)	Geokon C Value (psi)	Geokon Original C Value (OC) or Best-Fit C Value (BFC)	Category 1 FEH at ZGP: Average Offset Between 2012 Manual and Transducer FEHs [5] (ft)	Category 1 FEH at ZGP: Average Offset Within Total Accuracy [6] (Yes/No)	Category 1 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 1 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity [7]: SG	2012 Lab Measured Specific Gravity [7]: (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH: SG	2012 Density From Linear Regression of Manual vs. Transducer FEH: (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)	Classification [8]	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to the Lab Density?	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Category 2 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 2 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Category 3 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 3 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 4 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 4 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)
91C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	149.07 (13)	BFC	0.04	Yes	1.93 (13)	2.40 (13)	1.007	62.82	1.006	62.78	0.04	1.004	62.62	0.14	16.70	1.94	T	-	-	-	-	-	-	-	-	-	-	-	-	-
91C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	151.67 (13)	BFC	0.00	Yes	2.17 (13)	2.91 (13)	1.003	62.60	1.003	62.60	0.00	1.001	62.48	0.11	7.20	1.57	F	-	-	-	-	-	-	-	-	-	-	-	-	-
91C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	223.44 (13)	BFC	0.03	Yes	3.55 (13)	4.03 (13)	1.008	62.92	1.008	62.90	0.02	1.005	62.69	0.19	11.00	33.40	T	-	-	-	-	-	-	-	-	-	-	-	-	-
91C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	223.97 (13)	BFC	-0.01	Yes	6.76 (13)	6.91 (13)	1.007	62.83	1.007	62.83	0.00	1.004	62.68	0.14	11.00	40.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	153.03 (13)	BFC	-0.01	Yes	1.74 (13)	1.90 (13)	1.002	62.54	1.003	62.57	0.03	1.000	62.38	0.17	0.19	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	150.43 (13)	BFC	-0.01	Yes	1.83 (13)	2.09 (13)	1.006	62.80	1.006	62.80	0.00	1.003	62.59	0.19	9.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.338	± 0.480	154.6158	OC (9)	NM	-	-	-	1.012	63.12	-	NM	-	1.018	63.51	-	50.00	0.50	S	No	No	-	-	-	-	-	-	-	-	-	1.30	1.61
92C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.496	± 0.638	154.53 (13)	BFC	0.05	Yes	2.64 (13)	2.95 (13)	1.009	62.99	1.009	62.95	0.03	1.016	63.41	0.42	52.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	220.61 (13)	BFC	0.02	Yes	3.17 (13)	3.47 (13)	1.008	62.90	1.008	62.89	0.01	1.014	63.27	0.34	39.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
92C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.253	± 0.512	214.88 (13)	BFC	0.08	Yes	4.07 (13)	4.34 (13)	1.012	63.14	1.011	63.11	0.03	1.017	63.48	0.34	49.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	138.08 (13)	BFC	-0.02 (13)	Yes	2.33 (13)	2.42 (13)	1.002	62.55	1.004	62.64 (13)	0.08	0.999	62.36	0.25	0.20	0.50	F	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	152.99 (13)	BFC	-0.01 (13)	Yes	2.28 (13)	2.53 (13)	1.014	63.30	1.015	63.32 (13)	0.01	1.002	62.51	0.74	5.92 / 6.10	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.121	± 0.263	122.09 (13)	BFC	-0.01 (13)	Yes	2.74 (13)	2.99 (13)	1.018	63.51	1.018	63.52 (13)	0.01	1.015	63.32	0.18	43.90	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	152.79 (13)	BFC	-0.01 (13)	Yes	2.92 (13)	3.16 (13)	1.017	63.48	1.017	63.49 (13)	0.00	1.014	63.26	0.21	40.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
93C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.624	± 0.883	221.64 (13)	BFC	-0.01 (13)	Yes	- (10)	- (10)	1.019	63.61	1.019	63.61 (13)	0.01	1.016	63.39	0.20	52.00	0.50	S	-	-	-	-	63.64	63.55	63.39	63.64	221.09 (13)	3.33 (13)	3.53 (13)	-	-
93C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	233.61 (13)	BFC	-0.02 (13)	Yes	- (10)	- (10)	1.021	63.74	1.022	63.75 (13)	0.01	1.018	63.50	0.23	50.00	0.50	S	-	-	-	-	63.76	63.68	63.62	63.76	232.84 (13)	4.25 (13)	4.43 (13)	-	-
94C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.065	± 0.207	147.56 (13)	BFC	-0.01	Yes	1.77 (13)	2.01 (13)	1.018	63.52	1.019	63.57	0.04	1.015	63.33	0.22	56.00	9.44	S	-	-	-	-	-	-	-	-	-	-	-	-	-
94C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.559	± 0.701	145.23 (13)	BFC	0.07	Yes	1.42 (13)	2.09 (13)	1.022	63.76	1.020	63.64	0.11	1.019	63.58	0.05	46.00	295	A	-	-	-	-	-	-	-	-	-	-	-	-	-
94C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.994	± 1.136	147.70 (13)	BFC	0.10	Yes	3.54 (13)	4.05 (13)	1.026	64.00	1.025	63.93	0.06	1.023	63.81	0.11	29.00 / 31.00	124,500	A	-	-	-	-	-	-	-	-	-	-	-	-	-
94C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.249	± 1.508	210.3590	OC (9)	7.46 (13)	No	-	-	1.088	67.87	1.024	63.91 (13)	3.60	1.082	67.54	3.30	12.00 / 13.00	16,184	A	No	No	-	-	-	-	-	-	-	-	-	4.13	4.43
94C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 1.422	± 1.681	224.7843	OC (9)	2.16 (13)	No	-	-	1.009	62.94	0.995	62.11 (13)	0.76	1.007	62.82	0.65	16.00	1,102	A	Yes	Yes	4.57	4.69	-	-	-	-	-	-	-	-	-
95C-25	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.023	± 0.165	137.41 (13)	BFC	-0.04	Yes	1.15 (13)	1.31 (13)	1.002	62.51	1.005	62.72	0.19	1.010	63.00	0.26	28.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-50	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.099	± 0.241	137.92 (13)	BFC	-0.02	Yes	1.42 (13)	1.66 (13)	1.003	62.58	1.003	62.61	0.02	1.009	62.97	0.33	28.50	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-75	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.338	± 0.480	140.51 (13)	BFC	1.03	No	-	-	1.020 *	63.64 *	1.003	62.61	0.94	1.018	63.54	0.85	58.00	0.50	S	*	*	1.73 (13)	1.93 (13)	-	-	-	-	-	-	-	-	-
95C-100	CMT	Geokon	4500s-350KPa	± 0.117	± 0.025	± 0.177	± 0.319	143.47 (13)	BFC	-0.03	Yes	2.90 (13)	3.08 (13)	1.010	63.04	1.011	63.06	0.02	1.018	63.52	0.42	44.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-130	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.222	± 0.481	208.57 (13)	BFC	-0.04	Yes	3.60 (13)	3.79 (13)	1.011	63.12	1.012	63.14	0.02	1.018	63.54	0.36	45.00	0.50	T	-	-	-	-	-	-	-	-	-	-	-	-	-
95C-160	CMT	Geokon	4500s-700KPa	± 0.234	± 0.025	± 0.710	± 0.969	213.70 (13)	BFC	-0.05	Yes	4.63 (13)	4.82 (13)	1.021	63.71	1.021	63.73	0.02	1.017	63.45	0.25	53.00	0.50	S	-	-	-	-	-	-	-	-	-	-	-	-	-

113 = Number of CMT Wells

Number of CMT Well FEHs in Category 1 = 84
Number of CMT Well FEHs in Category 1 with Fresh/Transition Water = 61

Number of CMT Well Micron FEHs in Category 2 = 9
Number of CMT Well FEHs in Category 1 with Fresh/Transition Water = 4

Number of CMT Well FEHs in Category 3 = 15

Number of CMT Well FEHs in Category 4 = 5

Notes:
* Applied the December 29, 2012 Agency recommended specific gravity value with temperature correction to obtain density.
NM No Manual
1.31 Orange coloring indicates that the standard deviation is equal to or greater than 1 and that the probability of that magnitude of error occurring is less than or equal to 0.3
(1) Transducer accuracy based on manufacturer specifications:
Geokon (all models have an accuracy of +/- 0.1% full scale):
Full Scale of Model 4500s-350KPa = 117 feet H2O Accuracy = ± 0.117 feet H2O
Full Scale of Model 4500s-700KPa = 234 feet H2O Accuracy = ± 0.234 feet H2O
(2) Manual Depth to Water (DTW) measurements are considered accurate to ±0.025 ft considering that they can be somewhat subjective hand-measurements performed using a water level tape by different field staff and complicated by tidal fluctuations and variable field conditions.
(3) Manual FEH accuracy based on analysis of water column density variations presented in Table 5 (summarized below). Classification of wells as Fresh/Transient, Salt, or ADP to apply manual FEH accuracy is based on measured density only (and not bromide and TCVOCs).

	Fresh/ Transient	Salt	ADP	
15-ft Zone	± 0.00	± 0.00	± 0.00	feet H_2O
25-ft Zone	± 0.02	± 0.06	± 0.13	feet H_2O
50-ft Zone	± 0.10	± 0.28	± 0.56	feet H_2O
75ft -Zone	± 0.12	± 0.34	± 0.68	feet H_2O
100-ft Zone	± 0.18	± 0.50	± 0.99	feet H_2O
130-ft Zone	± 0.22	± 0.62	± 1.25	feet H_2O
160-ft Zone	± 0.25	± 0.71	± 1.42	feet H_2O

(4) Total accuracy is the sum of the transducer accuracy, DTW accuracy, and manual FEH accuracy.
(5) Manual FEH minus transducer FEH, where FEH is at transducer elevation. For Geokon transducers, the FEH is based on the best-fit "C" value determined using the 2012 manual DTW measurements, which in some cases, as noted, corresponds to the original "C" value determined at the time of the Geokon transducer factory calibration check in the DI well.
(6) Average absolute offset is less than or equal to the total accuracy.
(7) Laboratory measured specific gravity corrected to temperature at time of sampling multiplied by a fresh water density of 62.4 lbs/ft^3.
(8) Categories of Fresh (F), Transition (T), Salt (S), or ADP (A) determined from the examination of density, TCVOCs, and bromide data identified as per the following criteria:

Category	Density (lbs/ft3)	Specific Gravity	TCVOCs (µg/L)	Bromide (mg/L)
Fresh	62.4 - 62.712	1 – 1.005	<500	0.1028 – 13.22
Transition	> 62.712 - 63.5856	> 1.005 –	<500	> 13.22 – 49.94
Salt	> 63.5856 - 63.8976	> 1.019 –	<500	> 49.94 – 60.43
ADP	> 63.8976	> 1.023	>= 500	> 60.43

Note that if bromide indicates that a location is fresh but lab density reported a density greater than fresh, ADP was assumed.
(9) The original C value provided a reasonable match to the 2012 manual DTW measurements and was selected as the 2012 best-fit C value.
(10) Carried directly to Category 3 where in situ Summer 2013 C value determined.
(11) The original C value provided a reasonable match for the 2012 manual DTW measurements and was selected as the 2012 best-fit C value. The 2012 manual DTW measurements varied over a range of approximately 1.9 ft. The manual DTW measurements used to determine the 2013 in situ C value only varied over a range of approximately 0.03 ft, which makes the 2013 in situ C value less reliable than the 2012 best-fit C value. Thus, the FEHs determined using the 2012 best-fit C value are retained, but are included in Category 4.
(12) The 2013 density based on laboratory measured specific gravity is elevated compared to the density based on field measured specific gravity and the Agency TDS vs. specific gravity relationship. Thus, the C value is based on matching the density based on Agency TDS vs. specific gravity relationship.
(13) Change in value due to reference elevation correction.
(14) Change in value due correction in transducer zero readings and/or calibration factors.

TABLE 4

FEHs BY CATEGORY - CMT WELLS USING MICRONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	Type of Well (Standard or CMT)	Type of Transducer (Levelogger or Geokon)	Transducer Model	Transducer Accuracy (1) (ft H_2O)	Manual DTW Measurement Accuracy (2) (ft)	Manual FEH Accuracy (3) (ft H_2O)	Total Accuracy (4) (ft H_2O)	Category 1 FEH at ZGP: Average Offset Between 2012 Manual and Transducer FEHs (5) (ft)	Category 1 FEH at ZGP: Average Offset Within Total Accuracy (6) (Yes/No)	Category 1 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 1 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2012 Lab Measured Specific Gravity (7): SG	2012 Lab Measured Specific Gravity (7): (lbs/ft^3)	2012 Density From Linear Regression of Manual vs. Transducer FEH: SG	2012 Density From Linear Regression of Manual vs. Transducer FEH: (lbs/ft^3)	Standard Deviations of Difference Between Lab and Regression Density	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: SG	Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn: (lbs/ft^3)	Standard Deviations of Difference Between Regression and TDS Density	Bromide (mg/L)	TCVOCs (µg/L)
17C-50	CMT	Micron	Micron	± 0.865	± 0.025	± 0.559	± 1.449	-0.34	Yes	2.98	2.30	1.015	63.34	1.051	65.60	**1.24**	1.013	63.22	**1.31**	12.00	0.50
17C-75	CMT	Micron	Micron	± 0.865	± 0.025	± 0.677	± 1.568	2.24	No	-	-	1.024	63.88	0.988	61.65	**1.23**	1.021	63.70	**1.13**	3.60	0.50
17C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.177	± 1.067	-3.76	No	-	-	1.002	62.53	1.046	65.27	**1.51**	1.001	62.44	**1.56**	3.28	0.50
34C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.177	± 1.067	0.94	Yes	2.82	3.14	1.015	63.36	1.004	62.66	0.38	1.014	63.26	0.33	39.20	32.00
53C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.994	± 1.884	-0.16	Yes	3.26	3.92	1.023	63.86	1.025	63.98	0.07	1.022	63.76	0.12	12.00	30,000
83C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.994	± 1.884	0.33	Yes	7.73	8.04	1.057	65.97	1.053	65.72	0.14	1.055	65.81	0.05	18.00	87,200
86C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.496	± 1.386	-0.48	Yes	4.23	5.06	1.021	63.71	1.027	64.06	0.19	1.018	63.54	0.29	53.00	0.50
87C-75	CMT	Micron	Micron	± 0.865	± 0.025	± 0.338	± 1.229	0.59	Yes	2.58	3.52	1.018	63.51	1.008	62.91	0.33	1.015	63.35	0.25	77.00	0.50
87C-100	CMT	Micron	Micron	± 0.865	± 0.025	± 0.496	± 1.386	-1.07	Yes	4.26	5.16	1.020	63.62	1.032	64.39	0.43	1.017	63.45	0.52	52.00	0.50
90C-50	CMT	Micron	Micron	± 0.865	± 0.025	± 0.559	± 1.449	-2.43	No	-	-	1.018	63.52	1.085	67.72	**2.32**	1.016	63.38	**2.40**	15.00 / 15.00	1,280
90C-75	CMT	Micron	Micron	± 0.865	± 0.025	± 0.677	± 1.568	-5.94	No	-	-	1.001	62.45	1.111	69.34	-	1.009	62.98	-	5.90 / 19.00	12,580
94C-75	CMT	Micron	Micron	± 0.865	± 0.025	± 0.677	± 1.568	0.00	Yes	1.14 (9)	2.09 (9)	1.023	63.83	1.023	63.84	0.01	1.020	63.63	0.12	50.00 / 55.00	5,650

Location	Classification (8)	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to the Lab Density?	Category 2 FEH at ZGP: Is the 2012 Regression Density Comparable to The TDS Calculated Density?	Category 2 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 2 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)	2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)	2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)	2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)	2013 "In Situ" Geokon C Value (psi)	Category 3 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 3 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP Using "In Situ" C Value (ft NGVD)	Category 4 FEH at ZGP: Event 3a Serfes Mean FEH at ZGP (ft NGVD)	Category 4 FEH at ZGP: Event 3b Serfes Mean FEH at ZGP (ft NGVD)
17C-50	A	-	-	-	-	-	-	-	-	-	-	-	-	-
17C-75	A	No	No	-	-	-	-	-	-	-	-	-	0.15	0.70
17C-100	F	No	No	-	-	-	-	-	-	-	-	-	3.89	4.84
34C-100	T	-	-	-	-	-	-	-	-	-	-	-	-	-
53C-100	A	-	-	-	-	-	-	-	-	-	-	-	-	-
83C-100	A	-	-	-	-	-	-	-	-	-	-	-	-	-
86C-100	S	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-75	S	-	-	-	-	-	-	-	-	-	-	-	-	-
87C-100	S	-	-	-	-	-	-	-	-	-	-	-	-	-
90C-50	A	No	No	-	-	-	-	-	-	-	-	-	2.40 (9)	3.51 (9)
90C-75	A	No	No	-	-	-	-	-	-	-	-	-	8.68 (9)	9.41 (9)
94C-75	A	-	-	-	-	-	-	-	-	-	-	-	-	-

12 = Number of CMT Wells with Microns

Number of CMT Well Micron FEHs in Category 2 = 8

Number of CMT Well Micron FEHs in Category 2 = 0

Number of CMT Well Micron FEHs in Category 3 = 0

Number of CMT Well Micron FEHs in Category 4 = 4

Notes:

1.31 Orange coloring indicates that the standard deviation is equal to or greater than 1 and that the probability of that magnitude of error occurring is less than or equal to 0.3

(1) Transducer accuracy based on manufacturer specifications:
Micron (all models have an accuracy of +/- 0.5% full scale):
Full Scale of Micron = 173.1 feet H2O Accuracy = +/- 0.8654 feet H2O

(2) Manual Depth to Water (DTW) measurements are considered accurate to ±0.025 ft considering that they can be somewhat subjective hand-measurements performed using a water level tape by different field staff and complicated by tidal fluctuations and variable field conditions.

(3) Manual FEH accuracy based on analysis of water column density variations presented in Table 5 (summarized below). Classification of wells as Fresh/Transient, Salt, or ADP to apply manual FEH accuracy is based on measured density only (and not bromide and TCVOCs).

	Fresh/ Transient	Salt	ADP	
15-ft Zone	± 0.00	± 0.00	± 0.00	feet H_2O
25-ft Zone	± 0.02	± 0.06	± 0.13	feet H_2O
50-ft Zone	± 0.10	± 0.28	± 0.56	feet H_2O
75ft -Zone	± 0.12	± 0.34	± 0.68	feet H_2O
100-ft Zone	± 0.18	± 0.50	± 0.99	feet H_2O
130-ft Zone	± 0.22	± 0.62	± 1.25	feet H_2O
160-ft Zone	± 0.25	± 0.71	± 1.42	feet H_2O

(4) Total accuracy is the sum of the transducer accuracy, DTW accuracy, and manual FEH accuracy.

(5) Manual FEH minus transducer FEH, where FEH is at transducer elevation.

(6) Average absolute offset is less than or equal to the total accuracy.

(7) Laboratory measured specific gravity corrected to temperature at time of sampling multiplied by a fresh water density of 62.4 lbs/ft^3.

(8) Categories of Fresh (F), Transition (T), Salt (S), or ADP (A) determined from the examination of density, TCVOCs, and bromide data identified as per the following criteria:

Category	Density (lbs/ft3)	Specific Gravity	TCVOCs (µg/L)	Bromide (mg/L)
Fresh	62.4 - 62.712	1 – 1.005	<500	0.1028 – 13.22
Transition	> 62.712 - 63.5856	> 1.005 – 1.019	<500	> 13.22 – 49.94
Salt	> 63.5856 - 63.8976	> 1.019 – 1.023	<500	> 49.94 – 60.43
ADP	> 63.8976	> 1.023	>= 500	> 60.43

Note that if bromide indicates that a location is fresh but lab density reported a density greater than fresh, ADP was assumed.

(9) Change in value due to reference elevation correction.

TABLE 5

UNCERTAINTY IN WATER COLUMN FEH DUE TO DENSITY VARIATIONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Sample Date*	*Water Column Height Above Transducer, H (1) (ft)*	*Laboratory SG at 60°F*	*Field Temp (°C)*	*Temperature Corrected Laboratory SG (2)*	*Δ SG*	*Δ SG Outlier*
Fresh/Transition Groundwater Density (5)							
40-25	8/21/2012	8.97	1.001	17.7	1.0002		
40-25	12/5/2013		1.0018	14.12	1.0023	0.0021	
61C-25	7/17/2012	13.00	1.0026	15.63	1.0026		
61C-25	11/12/2013		1.0016	15.38	1.0017	-0.0009	
11-25	8/6/2012	12.22	1.0016	19.02	1.0004		
11-25	12/10/2013		1.0006	15.44	1.0006	0.0003	
11-45	8/7/2012	29.21	1.0071	17.07	1.0066		
11-45	12/10/2013		1.0084	15.31	1.0085	0.0019	
21C-130	7/25/2012	110.67	1.0063	20.47	1.0045		
21C-130	6/21/2013		1.0037	19.45	1.0023	-0.0022	
61C-50	7/17/2012	36.71	1.0046	17.38	1.0039		
61C-50	11/12/2013		1.0045	14.56	1.0049	0.0009	
74-50	8/20/2012	36.34	1.017	19.6	1.0155		
74-50	12/10/2013		1.013	13.46	1.0138	-0.0018	
40-75	8/21/2012	61.64	1.0175	21.4	1.0154		
40-75	12/5/2013		1.0179	13.82	1.0185	0.0031	
61C-75	7/17/2012	61.11	1.0016	16.63	1.0012		
61C-75	11/13/2013		1.0116	14.93	1.0118		0.0106
65-130	8/12/2012	121.94	1.0028	17	1.0023		
65-130	7/9/2013		1.0043	16.1	1.0041	0.0018	
75-130	8/9/2012	118.96	1.0005	20.92	0.9986		
75-130	7/24/2013		1.0017	19.28	1.0004	0.0018	
78C-130	7/19/2012	138.63	1.005	10.54	1.0068		
78C-130	8/3/2013		1.0045	15.58	1.0045	-0.0023	
12-160	8/24/2012	149.99	1.0029	19.79	1.0014		
12-160	6/27/2013		0.9979	13.86	0.9985	-0.0029	
34C-160	8/20/2012	155.78	1.0045	21.51	1.0024		
34C-160	8/1/2013		1.0051	17.12	1.0045	0.0022	
84C-160	7/18/2012	159.89	1.0071	13.38	1.0079		
84C-160	6/20/2013		1.0048	14.86	1.0051	-0.0028	
90C-160	7/23/2012	159.42	1.0065	16.4	1.0062		
90C-160	6/26/2013		1.0072	18.28	1.0062	0.0000	
93C-130	7/17/2012	120.04	1.0184	20.5	1.0166		
93C-130	6/24/2013		1.019	19.54	1.0176	0.0009	
			Average Fresh/Transition Groundwater Standard Deviation of Δ SG =			**0.0020**	
Salt Water Density (5)							
11-75	8/7/2012	62.06	1.0099	18	1.0090		
11-75	12/10/2013		1.0226	15.18	1.0227	0.0137	
36-100R	8/1/2012	87.56	1.0006	17.43	0.9999		
36-100R	7/23/2013		1.0222	14.36	1.0226		0.0227
88C-130	8/16/2012	118.76	1.0178	23.34	1.0150		
88C-130	7/30/2013		1.02	20.7	1.0181	0.0032	
40-50	8/21/2012	33.13	1.0195	19.8	1.0180		
40-50	12/5/2013		1.019	13.24	1.0198	0.0019	
74-75	8/20/2012	62.18	1.0218	26.3	1.0179		
74-75	12/11/2013		1.0223	13.39	1.0231	0.0051	
34C-130	8/20/2012	114.46	1.0185	24.68	1.0152		
34C-130	8/1/2013		1.021	16.11	1.0208	0.0056	
61C-160	7/17/2012	160.82	1.0196	20.77	1.0177		
61C-160	6/22/2013		1.0079	17.81	1.0071	-0.0106	
61C-160	11/12/2013		1.0095	15.41	1.0096	0.0025	
61C-160	12/19/2013		1.0088	11.7	1.0102	0.0006	
85C-160	7/20/2012	150.62	1.0017	17.6	1.0010		
85C-160	8/5/2013		1.0226	16.82	1.0221		0.0212
88C-160	8/16/2012	159.49	1.0208	19.04	1.0195		
88C-160	7/30/2013		1.0221	16.23	1.0219	0.0023	
93C-160	7/17/2012	160.30	1.0204	18.7	1.0193		
93C-160	6/24/2013		1.0207	16.99	1.0202	0.0009	
94C-75	7/24/2012	62.27	1.0214	19.09	1.0201		
94C-75	9/24/2013		1.0229	15.18	1.0230	0.0029	
				Average Salt Water Standard Deviation of Δ SG =		**0.0057**	

TABLE 5

UNCERTAINTY IN WATER COLUMN FEH DUE TO DENSITY VARIATIONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Sample Date*	*Water Column Height Above Transducer, H [1] (ft)*	*Laboratory SG at 60°F*	*Field Temp (°C)*	*Temperature Corrected Laboratory SG [2]*	*Δ SG*	*Δ SG Outlier*
ADP Density[5]							
90C-75	7/23/2012	53.59	1.0018	18.6	1.0007		
90C-75	9/25/2013		1.0385	18.7	1.0374		0.0367
11-100	8/7/2012	87.44	1.0526	21.89	1.0503		
11-100	12/10/2013		1.0418	14.45	1.0422	-0.0081	
40-100R	8/21/2012	86.50	1.0232	19.6	1.0217		
40-100R	7/25/2013		1.0222	17.3	1.0216	-0.0002	
40-100R	12/5/2013		1.0229	13.62	1.0236	0.0020	
61C-100	7/17/2012	87.51	1.0041	16.49	1.0038		
61C-100	11/13/2013		1.0243	14.06	1.0248		0.0211
74-100	8/20/2012	87.36	1.0233	26.2	1.0195		
74-100	12/11/2013		1.0229	12.3	1.0241	0.0046	
94C-100	7/24/2012	88.34	1.0245	17.27	1.0239		
94C-100	9/24/2013		1.0287	15.36	1.0288	0.0049	
53C-130	7/24/2012	115.12	1.0779	16.52	1.0776		
53C-130	7/10/2013		1.1131	19.21	1.1118	0.0342	
61C-130	7/17/2012	115.99	1.0684	23.74	1.0655		
61C-130	6/22/2013		1.0701	18.24	1.0691	0.0037	
61C-130	11/12/2013		1.0696	15.21	1.0697	0.0006	
61C-130	12/19/2013		1.0696	13.88	1.0702	0.0005	
77C-130	7/16/2012	115.94	1.0066	22.1	1.0042		
77C-130	6/23/2013		1.0581	19.46	1.0567		0.0525
94C-130	7/24/2012	117.92	1.0868	17.17	1.0862		
94C-130	9/24/2013		1.0982	16.73	1.0978	0.0116	
T5-120	8/25/2012	100.77	1.1143	23.56	1.1114		
T5-120	6/26/2013		1.1153	21.69	1.1131	0.0017	
77C-160	7/16/2012	158.31	1.0141	17.29	1.0135		
77C-160	6/23/2013		1.0362	17.75	1.0354	0.0219	
					Average Salt Water Standard Deviation of Δ SG =	**0.0114**	

Accuracy, or Uncertainty, in Water Column FEH Due to Density Variations [3]

	Average Water Column Height Above Transducer, H [4] (ft)	*Fresh/Transient Groundwater*	*Salt Water*	*ADP*
Std. Dev. in Δ SG	-	± 0.0020	± 0.0057	± 0.0114
25-ft Zone (ft H_2O)	11.40	± 0.02	± 0.06	± 0.13
50-ft Zone (ft H_2O)	49.21	± 0.10	± 0.28	± 0.56
75-ft Zone (ft H_2O)	59.63	± 0.12	± 0.34	± 0.68
100-ft Zone (ft H_2O)	87.45	± 0.18	± 0.50	± 0.99
130-ft Zone (ft H_2O)	109.93	± 0.22	± 0.62	± 1.25
160-ft Zone (ft H_2O)	125.16	± 0.25	± 0.71	± 1.42

Notes:

(1) Average water column height determined as average manual depth water measurement minus the transducer elevation.

(2) Temperature corrected laboratory specific gravity is calculated using:

$SG_{TEMP} = SG_{LAB} - 0.0002 \times [(Temp \times 9) / 5 + 32) - 60]$

Where:

SG_{TEMP} is the temperature corrected laboratory reported specific gravity

SG_{LAB} is the laboratory reported specific gravity at 60°F

Temp is the field temperature (°C)

(3) Accuracy, or uncertainty, in water column FEH calculated using Equation 3.1.

(4) Average water column height per aquifer depth zone based on water column heights for wells corresponding to Δ SG data within each aquifer depth zone.

(5) Location is placed in category based on the greater of the observed densities in 2012 and 2013.

TABLE 6

COMPARISON OF 2012 BEST-FIT AND SUMMER 2013 IN SITU C VALUES
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

CMT Well	*Original C Value (psi)*	*2012 Best-Fit C Value (psi)*	*Summer 2013 In Situ C Value (psi)*	*2012 Best-Fit C Value Minus 2013 in Situ C Value (psi)*	*2012 Best-Fit C Value Minus Summer 2013 In Situ C Value (feet H_2O)*	*Total Accuracy (feet H_2O)*	*2012 Density Based on Lab Measured Specific Gravity*		*2012 Density From Linear Regression of Manual vs. Transducer FEHs Using Best-Fit C Values*		*Temperature Corrected Density Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn*		*Classification[2]*	*Summer 2013 Density Based on Lab Measured Specific Gravity (lbs/ft^3)*		*Summer 2013 Density Based on Field Measured Specific Gravity (lbs/ft^3)*		*Summer 2013 Density Based on Agency Specific Gravity vs. TDS Relationship (lbs/ft^3)*		*Summer 2013 Density From Linear Regression of Manual vs. Transducer FEHs (lbs/ft^3)*	
							SG	*(lbs/ft^3)*	*SG*	*(lbs/ft^3)*	*SG*	*(lbs/ft^3)*		*SG*	*(lbs/ft^3)*	*SG*	*(lbs/ft^3)*	*SG*	*(lbs/ft^3)*	*SG*	*(lbs/ft^3)*
21C-130	213.442	213.442	213.835	-0.393	-0.91	1.30	1.007	62.83	0.995	62.11	1.002	62.51	ADP	1.004	62.67	1.006	62.77	1.004	62.65	1.004	62.67
34C-130	218.062	219.233	218.864	0.369	0.85	0.90	1.019	63.61	1.031	64.32	1.018	63.50	SALT	1.022	63.75	1.020	63.65	1.018	63.53	1.022	63.75
34C-160	225.975	225.975	226.944	-0.969	-2.24	0.65	1.005	62.74	0.999	62.35	1.003	62.58	TRANSITION	1.006	62.78	1.005	62.71	1.003	62.58	1.006	62.78
53C-130	224.596	225.928	223.494 (1)	2.434	5.62	1.30	1.078	67.28	1.077	67.21	1.073	66.98	ADP	1.114	69.48	1.102	68.76	1.101	68.72	1.101	68.72
61C-130	220.922	223.359	221.548	1.812	4.18	1.30	1.070	66.75	1.070	66.75	1.068	66.67	ADP	1.071	66.85	1.070	66.77	1.076	67.12	1.071	66.85
61C-160	208.394	208.394	211.961	-3.567	-8.23	1.65	1.021	63.70	0.962	60.03	1.018	63.51	ADP	1.009	62.98	1.010	63.02	1.009	62.98	1.009	62.98
77C-130	212.777	212.758	213.594	-0.836	-1.93	1.30	1.051	65.55 *	1.008	62.91	1.049	65.46	ADP	1.059	66.11	1.057	65.96	1.056	65.91	1.059	66.11
77C-160	213.245	214.814	214.055	0.759	1.75	1.65	1.026	64.05	1.027	64.06	1.025	63.94	ADP	1.038	64.75	1.036	64.65	1.034	64.54	1.038	64.75
78C-130	218.107	216.791	216.738	0.053	0.122	0.55	1.006	62.78	1.006	62.80	1.003	62.57	TRANSITION	1.006	62.75	1.000	62.40	1.003	62.57	1.006	62.75
84C-160	218.847	219.958	219.747	0.211	0.486	0.65	1.009	62.94	1.009	62.94	1.006	62.76	TRANSITION	1.006	62.79	1.007	62.84	1.005	62.74	1.006	62.79
85C-160	225.918	225.370	226.716	-1.346	-3.11	1.11	1.022	63.77 *	1.003	62.58	1.020	63.65	SALT	1.024	63.88	1.020	63.65	1.020	63.66	1.024	63.88
88C-130	233.130	225.364	226.048	-0.684	-1.58	0.55	1.019	63.57	0.996	62.14	1.017	63.46	TRANSITION	1.021	63.71	1.020	63.65	1.018	63.51	1.021	63.71
88C-160	216.062	212.022	211.205	0.817	1.88	1.11	1.022	63.77	1.022	63.77	1.019	63.59	SALT	1.023	63.85	1.020	63.65	1.020	63.62	1.023	63.85
90C-160	207.855	194.884	194.867	0.017	0.039	0.65	1.006	62.79	1.007	62.81	1.004	62.67	TRANSITION	1.007	62.84	1.008	62.87	1.004	62.62	1.007	62.84
93C-130	220.431	221.827	221.285	0.542	1.25	0.90	1.019	63.61	1.019	63.61	1.016	63.39	SALT	1.020	63.64	1.019	63.55	1.016	63.39	1.020	63.64
93C-160	231.949	233.804	233.032	0.772	1.78	1.11	1.021	63.74	1.022	63.75	1.018	63.50	SALT	1.022	63.76	1.021	63.68	1.020	63.62	1.022	63.76

Notes:

Well screened in fresh water to salt water transition zone.

Difference between 2012 best-fit C value and Summer 2013 in situ C value is within total transducer accuracy and is due to near-fresh water in well casing water column.

The original C value provided a reasonable match to the 2012 manual water levels and was selected as the 2012 best-fit C value. The change to the Summer 2013 in situ C value is related to achieving a better match to the 2013 laboratory measured density using the Summer 2013 manual water levels than is achieved to the 2012 laboratory measured density using the 2012 manual water levels

The original C value provided a reasonable match to the 2012 manual water levels and was selected as the 2012 best-fit C value. The change to the Summer 2013 in situ C value is related to the Summer 2103 manual water levels only varying over a range of approximately 0.03 ft. The 2012 manual water levels used to determine the 2012 best-fit C value for 34C-160 varied over a range of approximately 1.9 ft. Thus, the 2012 best-fit C value is considered more reliable than the Summer 2013 in situ C value.

232.978 Summer 2013 in situ C value is lower than the 2012 best-fit C value and this is attributed to density stratification in the well casing water column where the well is screened in salt water or the ADP. By not accounting for the density stratification, the water column was assumed more dense than it actually was, which biased high the 2012 best-fit C value.

226.048 Summer 2013 in situ C value is not lower than the 2012 best-fit C value (as it is conceptually expected due to density stratification in the well casing water column where the well is screened in salt water or the ADP) and this is related to achieving a better match to the 2013 laboratory measured density using the Summer 2013 manual water levels than is achieved to the 2012 laboratory measured density using the 2012 manual water levels.

226.048 Summer 2013 in situ C value is not within transducer accuracy when compared to the 2012 best-fit C value because of density stratification since the measured density in on the upper range of the transition zone

* Applied the December 29, 2012 Agency recommended specific gravity value with temperature correction to obtain density.

(1) The 2013 density based on laboratory measured specific gravity is elevated compared to the density based on field measured specific gravity and the Agency TDS vs. specific gravity relationship.

(2) Classification of Fresh, Transition, Salt, or ADP as presented in Tables 1 through 4

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TABLE 7

COMPARISON OF 61C-130/160 IN SITU C VALUES
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	Summer 2013	*November 14, 2013*	*December 20, 2013*
61C-130			
Field Measured Specific Gravity	1.07	1.07	1.07
Density Based on Field Measured Specific Gravity (lbs/ft^3)	66.77	66.77	66.77
Laboratory Measured Specific Gravity	1.0701	1.0696	1.0696
Temperature (^{o}C)	12.06	12.07	12.08
Temperature Corrected Laboratory Measured Specific Gravity	1.0714	1.0709	1.0709
Density Based on Temp. Corrected Laboratory Specific Gravity (lbs/ft^3)	66.85	66.82	66.82
Total Dissolved Solids (TDS) (mg/L)	106,000	104,000	105,000
Temp. Corrected Specific Gravity Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn	1.0744	1.0730	1.0737
Density Based on Temp. Corrected Specific Gravity From TDS (lbs/ft^3)	67.05	66.96	67.00
Range in Manual Water Levels (ft)	1.89	0.42	0.40
Linear Regression Density (lbs/ft^3)	66.85	66.82	66.82
Figure Presenting Linear Regression Density	Figure 8	Figure 9	Figure 10
In Situ C Value (psi)	221.548	221.521	221.552
Summer 2013 Minus November 14, 2013 In Situ C Value (psi)	0.027		
Summer 2013 Minus November 14, 2013 In Situ C Value (ft H_2O)	0.06		
Summer 2013 Minus December 20, 2013 In Situ C Value (psi)	-0.004		
Summer 2013 Minus December 20, 2013 In Situ C Value (ft H_2O)	-0.01		
61C-160			
Field Measured Specific Gravity	1.01	1.01	1.0105
Density Based on Field Measured Specific Gravity (lbs/ft^3)	63.02	63.02	63.06
Laboratory Measured Specific Gravity	1.0079	1.0095	1.0088
Temperature (^{o}C)	11.90	11.90	11.91
Temperature Corrected Laboratory Measured Specific Gravity	1.0092	1.0108	1.0101
Density Based on Temp. Corrected Laboratory Specific Gravity (lbs/ft^3)	62.98	63.07	63.03
Total Dissolved Solids (TDS) (mg/L)	12,900	13,600	14,300
Temp. Corrected Specific Gravity Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn	1.0079	1.0084	1.0089
Density Based on Temp. Corrected Specific Gravity From TDS (lbs/ft^3)	62.89	62.93	62.96
Range in Manual Water Levels (ft)	3.65	0.81	1.13
Linear Regression Density (lbs/ft^3)	62.98	63.07	63.03
Figure Presenting Linear Regression Density	Figure 11	Figure 12	Figure 13
In Situ C Value (psi)	211.961	211.849	211.633
Summer 2013 Minus November 14, 2013 In Situ C Value (psi)	0.112		
Summer 2013 Minus November 14, 2013 In Situ C Value (ft H_2O)	0.26		
Summer 2013 Minus December 20, 2013 In Situ C Value (psi)	0.328		
Summer 2013 Minus December 20, 2013 In Situ C Value (ft H_2O)	0.76		

TABLE 8

COMPARISON OF 61C-25 to 61C-100 IN SITU C VALUES
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

	61C-25		*61C-50*		*61C-75*		*61C-100*	
	2012 Best-Fit C Value	***November 14, 2013 In Situ Calibration***	***2012 Best-Fit C Value***	***November 14, 2013 In Situ Calibration***	***2012 Best-Fit C Value***	***November 14, 2013 In Situ Calibration***	***2012 Best-Fit C Value***	***November 14, 2013 In Situ Calibration***
Field Measured Specific Gravity	NM	1.001	NM	1.004	NM	1.012	NM	1.026
Density Based on Field Measured Specific Gravity (lbs/ft^3)	- -	62.46	- -	62.65	- -	63.15	- -	64.02
Laboratory Measured Specific Gravity	1.0026	1.0016	1.0046	1.0045	1.0016	1.0116	1.0251	1.0243
Temperature (^oC)	14.23	15.39	13.83	13.735	12.87	12.814	12.36	12.359
Temperature Corrected Laboratory Measured Specific Gravity	1.0031	1.0017	1.0052	1.0052	1.0026	1.0126	1.0263	1.0255
Density Based on Temp. Corrected Laboratory Specific Gravity (lbs/ft^3)	62.59	62.50	62.73	62.72	62.56	63.19	64.04	63.99
Total Dissolved Solids (TDS) (mg/L)	1,390	1,330	4,430	5,490	14,100	15,400	31,800	33,300
Specific Gravity Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqn	0.9997	0.9997	1.0019	1.0026	1.0088	1.0097	1.0214	1.0225
Temp. Corrected Specific Gravity Calculated From TDS using Agency Dec-29-2012 Fig 2 Eqr	1.0002	0.9997	1.0025	1.0033	1.0097	1.0107	1.0226	1.0236
Density Based on Temp. Corrected Specific Gravity From TDS (lbs/ft^3)	62.41	62.38	62.56	62.60	63.01	63.07	63.81	63.88
Range in Manual Water Levels (ft)	1.16	0.02	2.86	0.26	2.82	0.08	4.42	0.37
Linear Regression Density (lbs/ft^3)	62.11	62.50	62.46	62.72	62.48	63.19	64.06	63.99
Figure Presenting Linear Regression Density	Figure 14	Figure 15	Figure 16	Figure 17	Figure 18	Figure 19	Figure 20	Figure 21
In Situ C Value (psi)	147.327	147.486	151.530	151.634	137.649	137.926	124.523	124.271
2012 Best-Fit Minus November 14, 2013 In Situ C Value (psi)	-0.159		-0.104		-0.277		0.252	
2012 Best-Fit Minus November 14, 2013 In Situ C Value (ft H_2O)	-0.37		-0.24		-0.64		0.58	

Notes:
NM Not measured.

TABLE 9

CHANGE IN ZERO DIGITS READING
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

350 kPa Transducer

Serial Number:	1409481	
Model:	4500S-350kpa	
Polynomial Gage Factor, A:	-1.762E-08	$psi/digit^2$
Polynomial Gage Factor, B:	-0.01716	psi/digit
Thermal Gage Factor, K:	-0.01922	$psi/^oC$

Testing Case	***Transducer Digits Reading for Zero in Air (digits)***	***Change in Transducer Digits Reading for Zero in Air from Unclamped Calibration Check (digits)***
Unclamped Calibration Check	8690.562	-
Clamped Transducer - Torque 1	8699.000	8.438
Clamped Transducer - Torque 2	8711.900	21.338
Clamped Transducer - Torque 3	8719.100	28.538

700 kPa Transducer

Serial Number:	1407273	
Model:	4500S-700kpa	
Polynomial Gage Factor, A:	-9.387E-08	$psi/digit^2$
Polynomial Gage Factor, B:	-0.02512	psi/digit
Thermal Gage Factor, K:	-0.004138	$psi/^oC$

Testing Case	***Transducer Digits Reading for Zero in Air (digits)***	***Change in Transducer Digits Reading for Zero in Air from Unclamped Calibration Check (digits)***
Unclamped Calibration Check	8744.563	-
Clamped Transducer - Torque 1	8760.300	15.737
Clamped Transducer - Torque 2	8767.700	23.137
Clamped Transducer - Torque 3	8773.200	28.637

Note:
(1) Original zero C value for unclamped transducer calculated as $C = -(A*R_0^2 + B*R_0)$

TABLE 10

UNCLAMPED CALIBRATION CHECK AND
WATER DEPTH ERROR USING ORGINAL C VALUE FOR CLAMPED TRANSDUCERS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

350 kPa Transducer

Factory Calibration Factors:			Zero Readings:		
Serial Number:	1409481		Unclamped Zero Transducer Digits Reading, R_0:	8690.562	digits
Model:	4500S-350kpa		Zero Transducer Temperature Reading, T_0:	19.1	°C
Polynomial Gage Factor, A:	-1.762E-08	psi/digit^2	Zero Barometric Pressure, S_0:	14.7126	psi
Polynomial Gage Factor, B:	-0.01716	psi/digit			
Thermal Gage Factor, K:	-0.01922	psi/°C	Original Zero C Value for Unclamped Transducer (1):	150.461	psi
			Transducer Accuracy (+/- 0.1% full scale):	0.117	ft H_2O

Unclamped Calibration Check

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
50	7455.245	14.6	14.7028	49.95	-0.05
75	6833.338	14.1	14.7055	74.96	-0.04
100	6210.202	14.0	14.7045	99.97	-0.03
75	6832.884	14.0	14.7096	74.97	-0.03
50	7455.056	14.6	14.7055	49.95	-0.05
				Average Difference =	**-0.04**

Clamped Transducer - Torque 1

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
48	7516.401	15.1	14.832	47.17	-0.83
73	6895.945	14.2	14.830	72.15	-0.85
98	6274.375	14.0	14.832	97.10	-0.90
73	6898.427	14.1	14.824	72.07	-0.93
48	7518.718	14.7	14.821	47.12	-0.88
				Average Difference =	**-0.88**

Clamped Transducer - Torque 2

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
48	7524.656	14.8	14.8138	46.90	-1.10
73	6904.738	14.1	14.8129	71.84	-1.16
98	6283.037	13.9	14.8118	96.81	-1.19
73	6904.399	14.1	14.8136	71.85	-1.15
48	7524.602	14.6	14.8133	46.91	-1.09
				Average Difference =	**-1.14**

Clamped Transducer - Torque 3

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
48	7529.654	15.0	14.801	46.72	-1.28
73	6909.146	14.2	14.801	71.69	-1.31
98	6288.558	14.0	14.801	96.60	-1.40
73	6907.326	14.1	14.798	71.77	-1.23
48	7526.400	14.6	14.795	46.88	-1.12
				Average Difference =	**-1.27**

700 kPa Transducer

Factory Calibration Factors:			Zero Readings:		
Serial Number:	1407273		Unclamped Zero Transducer Digits Reading, R_0:	8744.563	digits
Model:	4500S-700kpa		Zero Transducer Temperature Reading, T_0:	13.9	°C
Polynomial Gage Factor, A:	-9.387E-08	psi/digit^2	Zero Barometric Pressure, S_0:	14.849	psi
Polynomial Gage Factor, B:	-0.02512	psi/digit			
Thermal Gage Factor, K:	-0.004138	psi/°C	Original Zero C Value for Unclamped Transducer (1):	226.841	psi
			Transducer Accuracy (+/- 0.1% full scale):	0.234	ft H_2O

Unclamped Calibration Check

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
50	7939.310	14.6	14.7028	49.92	-0.08
75	7530.355	14.1	14.7055	75.00	0.00
100	7120.498	13.9	14.7045	100.06	0.06
75	7529.736	14.7	14.7096	75.02	0.02
50	7938.638	14.7	14.7055	49.95	-0.05
				Average Difference =	**-0.01**

Clamped Transducer - Torque 1

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
50	7950.715	15.1	14.832	48.92	-1.08
75	7545.077	14.2	14.830	73.81	-1.19
100	7137.156	14.0	14.832	98.75	-1.25
75	7544.526	14.0	14.824	73.86	-1.14
50	7952.731	14.6	14.821	48.82	-1.18
				Average Difference =	**-1.17**

Clamped Transducer - Torque 2

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
50	7959.302	14.7	14.8138	48.44	-1.56
75	7552.165	14.1	14.8129	73.41	-1.59
100	7145.219	13.9	14.8118	98.30	-1.70
75	7551.600	14.1	14.8136	73.45	-1.55
50	7958.833	14.6	14.8133	48.47	-1.53
				Average Difference =	**-1.59**

Clamped Transducer - Torque 3

DI Well Depth Setting ($ft\ H_2O$)	Transducer Digits Reading, R_1 (digits)	Transducer Temperature Reading, T_1 (°C)	Barometric Pressure, S_1 (psi)	Transducer Pressure, P, Converted to Water Column Depth (2) ($ft\ H_2O$)	Transducer Water Column Depth Difference From DI Well Depth Setting ($ft\ H_2O$)
50	7963.110	14.9	14.801	48.23	-1.77
75	7555.824	14.1	14.801	73.22	-1.78
100	7150.352	14.0	14.801	98.01	-1.99
75	7556.942	14.0	14.798	73.16	-1.84
50	7964.869	14.6	14.795	48.14	-1.86
				Average Difference =	**-1.85**

Notes:

(1) Original zero C value for unclamped transducer calculated as $C = -(A*R_0^2 + B*R_0)$

(2) Transducer pressure calculated using the polynomial equation, $P = A*R_1^2 + B*R_1 + C + K*(T_1 - T_0) - (S_1 - S_0)$

TABLE 11

IN SITU C VALUE CALIBRATION FOR CLAMPED TRANSDUCERS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

350 kPa Transducer

Factory Calibration Factors:

Serial Number:	1409481	
Model:	4500S-350kpa	
Polynomial Gage Factor, A:	-1.762E-08	psi/digit^2
Polynomial Gage Factor, B:	-0.01716	psi/digit
Thermal Gage Factor, K:	-0.01922	psi/^{o}C

Zero Readings:

Zero Transducer Digits Reading, R_0:	8690.562	digits
Zero Transducer Temperature Reading, T_0:	19.1	^{o}C
Zero Barometric Pressure, S_0:	14.7126	psi
Original Zero C Value for Unclamped Transducer (1):	150.461	psi
Transducer Accuracy (+/- 0.1% full scale):	0.117	ft H_2O

In Situ Calibrated C Value for Torque 1 (3):	150.840	psi
Change from Original Zero C Value:	**0.379**	**psi**
In Situ Calibrated C Value for Torque 2 (3):	150.955	psi
Change from Original Zero C Value:	**0.494**	**psi**
In Situ Calibrated C Value for Torque 3 (3):	151.010	psi
Change from Original Zero C Value:	**0.549**	**psi**

Clamped Transducer - Torque 1

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
48	7516.401	15.1	14.832	48.05	0.05
73	6895.945	14.2	14.830	73.03	0.03
98	6274.375	14.0	14.832	97.98	-0.02
73	6898.427	14.1	14.824	72.94	-0.06
48	7518.718	14.7	14.821	48.00	0.00
				Average Difference =	**0.00**

Clamped Transducer - Torque 2

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
48	7524.656	14.8	14.8138	48.04	0.04
73	6904.738	14.1	14.8129	72.98	-0.02
98	6283.037	13.9	14.8118	97.95	-0.05
73	6904.399	14.1	14.8136	72.99	-0.01
48	7524.602	14.6	14.8133	48.05	0.05
				Average Difference =	**0.00**

Clamped Transducer - Torque 3

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
48	7529.654	15.0	14.801	47.98	-0.02
73	6909.146	14.2	14.801	72.96	-0.04
98	6288.558	14.0	14.801	97.87	-0.13
73	6907.326	14.1	14.798	73.04	0.04
48	7526.400	14.6	14.795	48.15	0.15
				Average Difference =	**0.00**

700 kPa Transducer

Factory Calibration Factors:

Serial Number:	1407273	
Model:	4500S-700kpa	
Polynomial Gage Factor, A:	-9.387E-08	psi/digit^2
Polynomial Gage Factor, B:	-0.02512	psi/digit
Thermal Gage Factor, K:	-0.004138	psi/^{o}C

Zero Readings:

Zero Transducer Digits Reading, R_0:	8744.563	digits
Zero Transducer Temperature Reading, T_0:	13.9	^{o}C
Zero Barometric Pressure, S_0:	14.849	psi
Original Zero C Value for Unclamped Transducer (1):	226.841	psi
Transducer Accuracy (+/- 0.1% full scale):	0.234	ft H_2O

In Situ Calibrated C Value for Torque 1 (3):	227.350	psi
Change from Original Zero C Value:	**0.509**	**psi**
In Situ Calibrated C Value for Torque 2 (3):	227.53	psi
Change from Original Zero C Value:	**0.689**	**psi**
In Situ Calibrated C Value for Torque 3 (3):	227.643	psi
Change from Original Zero C Value:	**0.802**	**psi**

Clamped Transducer - Torque 1

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
50	7950.715	15.1	14.832	50.09	0.09
75	7545.077	14.2	14.830	74.98	-0.02
100	7137.156	14.0	14.832	99.92	-0.08
75	7544.526	14.0	14.824	75.03	0.03
50	7952.731	14.6	14.821	50.00	0.00
				Average Difference =	**0.00**

Clamped Transducer - Torque 2

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
50	7959.302	14.7	14.8138	50.03	0.03
75	7552.165	14.1	14.8129	75.00	0.00
100	7145.219	13.9	14.8118	99.89	-0.11
75	7551.600	14.1	14.8136	75.04	0.04
50	7958.833	14.6	14.8133	50.06	0.06
				Average Difference =	**0.00**

Clamped Transducer - Torque 3

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth (2) (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
50	7963.110	14.9	14.801	50.08	0.08
75	7555.824	14.1	14.801	75.07	0.07
100	7150.352	14.0	14.801	99.86	-0.14
75	7556.942	14.0	14.798	75.01	0.01
50	7964.869	14.6	14.795	49.99	-0.01
				Average Difference =	**0.00**

Notes:
(1) Original zero C value for unclamped transducer calculated as $C = -(A*R_0^2 + B*R_0)$
(2) Transducer pressure calculated using the polynomial equation, $P = A*R_1^2 + B*R_1 + C + K*(T_1 - T_0) - (S_1 - S_0)$ using the in situ calibrated C value and holding A and B consistent with the factory calibration.
(3) In situ calibrated C value adjusted to provide a zero average difference between transducer water column depth and DI well depth setting.

TABLE 12

IN SITU C VALUE CALIBRATION FOR 350KPa TRANSDUCER OVER 73 TO 98 FT DEPTH SETTINGS FOR TORQUE 3
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

350 kPa Transducer

Factory Calibration Factors:

Serial Number:	1409481	
Model:	4500S-350kpa	
Polynomial Gage Factor, A:	-1.762E-08	psi/digit^2
Polynomial Gage Factor, B:	-0.01716	psi/digit
Thermal Gage Factor, K:	-0.01922	psi/^{o}C

Zero Readings:

Zero Transducer Digits Reading, R_0:	8690.562	digits
Zero Transducer Temperature Reading, T_0:	19.1	^{o}C
Zero Barometric Pressure, S_0:	14.7126	psi
Original Zero C Value for Unclamped Transducer [(1)]:	150.461	psi
Transducer Accuracy (+/- 0.1% full scale):	0.117	ft H_2O

In Situ Calibrated C Value for Torque 3 [(3)]:	151.030	psi
Change from Original Zero C Value:	**0.569**	**psi**

Clamped Transducer - Torque 3

DI Well Depth Setting (ft H_2O)	*Transducer Digits Reading, R_1 (digits)*	*Transducer Temperature Reading, T_1 (^{o}C)*	*Barometric Pressure, S_1 (psi)*	*Transducer Pressure, P, Converted to Water Column Depth [(2)] (ft H_2O)*	*Transducer Water Column Depth Difference From DI Well Depth Setting (ft H_2O)*
73	6909.146	14.2	14.801	73.00	0.00
98	6288.558	14.0	14.801	97.92	-0.08
73	6907.326	14.1	14.798	73.08	0.08
				Average Difference =	**0.00**

Notes:

(1) Original zero C value for unclamped transducer calculated as $C = -(A*R_0^2 + B*R_0)$

(2) Transducer pressure calculated using the polynomial equation, $P = A*R_1^2 + B*R_1 + C + K*(T_1 - T_0) - (S_1 - S_0)$ using the in situ calibrated C value and holding A and B consistent with the factory calibration.

(3) In situ calibrated C value adjusted to provide a zero average difference between transducer water column depth and DI well depth setting.

TABLE 13

CHANGE IN DIGITS READING PER FOOT RELATED TO A AND B SLOPE FACTORS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

350 kPa Transducer

Serial Number:	1409481	
Model:	4500S-350kpa	
Polynomial Gage Factor, A:	-1.762E-08	$psi/digit^2$
Polynomial Gage Factor, B:	-0.01716	psi/digit
Thermal Gage Factor, K:	-0.01922	$psi/^oC$
Zero Digits Reading:	8690.562	digits
Zero C Value:	150.461	psi

Unclamped Calibration Check			*Clamped Transducer - Torque 1*			*Clamped Transducer - Torque 2*			*Clamped Transducer - Torque 3*		
DI Well Water Depth Setting ($ft\ H_2O$)	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*
50	7455.245	-	48	7516.401	-	48	7524.656	-	48	7524.656	-
75	6833.338	621.907	73	6895.945	620.456	73	6904.738	619.918	73	6909.146	615.510
100	6210.202	623.136	98	6274.375	621.570	98	6283.037	621.701	98	6288.558	620.588
75	6832.884	622.682	73	6898.427	624.052	73	6904.399	621.362	73	6907.326	618.768
50	7455.056	622.172	48	7518.718	620.291	48	7524.602	620.203	48	7526.400	619.074
Average Digits Change per 25 ft =		622.474	Average Digits Change per 25 ft =		621.592	Average Digits Change per 25 ft =		620.796	Average Digits Change per 25 ft =		618.485
Average Digits Change per 1 ft =		**24.899 (A)**	Average Digits Change per 1 ft =		24.864	Average Digits Change per 1 ft =		24.832	Average Digits Change per 1 ft =		**24.739 (B)**

Maximum Difference in Average Digits Change per 1 ft Change in Water Level, DDigits, from Unclamped Calibration Check to Torque 3[1] =	0.160	digits per 1 ft Change in Water Level
Maximum Error by Holding A and B Constant due to DDigits[2] =	0.003	psi per 1 ft Change in Water Level
=	0.0063	$ft\ H_2O$ per 1 ft Change in Water Level
Maximum Error by Holding A and B Constant due to DDigits Projected over a 10 ft Change in Water Level[3] =	**0.063**	$ft\ H_2O$ per 10 ft Change in Water Level

700 kPa Transducer

Serial Number:	1407273	
Model:	4500S-700kpa	
Polynomial Gage Factor, A:	-9.387E-08	$psi/digit^2$
Polynomial Gage Factor, B:	-0.02512	psi/digit
Thermal Gage Factor, K:	-0.004138	$psi/^oC$
Zero Digits Reading:	8744.563	digits
Zero C Value:	226.841	psi

Unclamped Calibration Check			*Clamped Transducer - Torque 1*			*Clamped Transducer - Torque 2*			*Clamped Transducer - Torque 3*		
DI Well Water Depth Setting ($ft\ H_2O$)	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*	*DI Well Water Depth Setting ($ft\ H_2O$)*	*Transducer Digits Reading (digits)*	*Absolute Change per 25 ft in Transducer Digits Reading Btwn Water Depth Setting (digits)*
50	7939.310	-	50	7950.715	-	50	7959.302	-	50	7959.302	-
75	7530.355	408.955	75	7545.077	405.638	75	7552.165	407.137	75	7555.824	403.478
100	7120.498	409.857	100	7137.156	407.921	100	7145.219	406.946	100	7150.352	405.472
75	7529.736	409.238	75	7544.526	407.370	75	7551.600	406.381	75	7556.942	406.590
50	7938.638	408.902	50	7952.731	408.205	50	7958.833	407.233	50	7964.869	407.927
Average Digits Change per 25 ft =		409.238	Average Digits Change per 25 ft =		407.284	Average Digits Change per 25 ft =		406.924	Average Digits Change per 25 ft =		405.867
Average Digits Change per 1 ft =		**16.370 (A)**	Average Digits Change per 1 ft =		16.291	Average Digits Change per 1 ft =		16.277	Average Digits Change per 1 ft =		**16.235 (B)**

Maximum Difference in Average Digits Change per 1 ft Change in Water Level, DDigits, from Unclamped Calibration Check to Torque 3[1] =	0.135	digits per 1 ft Change in Water Level
Maximum Error by Holding A and B Constant due to DDigits[2] =	0.003	psi per 1 ft Change in Water Level
=	0.0078	$ft\ H_2O$ per 1 ft Change in Water Level
Maximum Error by Holding A and B Constant due to DDigits Projected over a 10 ft Change in Water Level[3] =	**0.078**	$ft\ H_2O$ per 10 ft Change in Water Level

Notes:
(1) Maximum difference in average digits change per 1 ft from unclamped calibration check to Torque 3 clamped transducer calculated as A minus B.
(2) Maximum error by holding A and B constant due to DDigits calculated as, Error = $A*(DDigits)^2 + B*(DDigits)$
(3) The typical maximum change in groundwater levels at the Site due to tidal fluctuations is approximately 10 ft. The Pressure Error by holding A and B constant due to
maximum difference in average digits change per 10 ft change in water level calculated as Potential Error per 1 ft change in water level multiplied by 10

TABLE 14

COMPARISON OF CHANGES FROM ORIGINAL TO 2012 BEST-FIT C VALUES
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

CMT Well Location	Original Geokon C-Value (psi)	*2012/2013 Best-Fit C Value* C Value (psi)	Original C Value (OC), 2012 Best-Fit C Value (2012 BFC), or Summer 2013 In Situ C Value (2013 BFC)	Original Minus Best-Fit C Value (psi)	Change in C Value Less Than 0.8 psi (psi)	Change in C Value Greater Than 0.8 psi (psi)
17C-25	148.8137	149.0965	2012 BFC	-0.2828	-0.2828	
17C-130	214.0396	214.0396	OC	0.0000		
17C-160	207.2093	207.2093	OC	0.0000		
21C-25	140.5233	140.7552	2012 BFC	-0.2319	-0.2319	
21C-50	114.1412	114.4092	2012 BFC	-0.2680	-0.2680	
21C-75	144.3995	145.2188	2012 BFC	-0.8193		-0.8193
21C-100	125.7522	125.7522	OC	0.0000		
21C-130	213.4420	213.8353	2013 BFC	-0.3933	-0.3933	
21C-160	234.0362	234.1420	2012 BFC	-0.1058	-0.1058	
34C-130	218.0618	218.3148	2013 BFC	-0.2530	-0.2530	
34C-160	225.9752	225.9752	OC	0.0000		
41C-25	126.2242	126.3097	2012 BFC	-0.0855	-0.0855	
41C-50	148.1828	148.5992	2012 BFC	-0.4165	-0.4165	
41C-75	142.8807	143.4109	2012 BFC	-0.5302	-0.5302	
41C-100	137.7534	138.3085	2012 BFC	-0.5551	-0.5551	
41C-160	215.1942	216.1251	2012 BFC	-0.9309		-0.9309
46C-25	146.7662	146.8571	2012 BFC	-0.0909	-0.0909	
46C-50	146.8470	147.1109	2012 BFC	-0.2639	-0.2639	
46C-75	124.7957	125.4296	2012 BFC	-0.6339	-0.6339	
46C-100	146.8127	147.4144	2012 BFC	-0.6017	-0.6017	
46C-130	219.3983	220.0513	2012 BFC	-0.6530	-0.6530	
46C-160	221.4862	222.2357	2012 BFC	-0.7495	-0.7495	
53C-25	143.6656	143.7235	2012 BFC	-0.0579	-0.0579	
53C-50	124.0118	124.2005	2012 BFC	-0.1887	-0.1887	
53C-75	149.8019	130.4144	2012 BFC	19.3875		19.3875
53C-130	224.5964	223.4939	2013 BFC	1.1025		1.1025
53C-160	211.4060	211.4060	OC	0.0000		
61C-25	147.2537	147.3273	2012 BFC	-0.0736	-0.0736	
61C-50	151.4427	151.5300	2012 BFC	-0.0873	-0.0873	
61C-75	137.4138	137.6492	2012 BFC	-0.2354	-0.2354	
61C-100	123.6609	124.5227	2012 BFC	-0.8618		-0.8618
61C-130	220.9218	221.5475	2013 BFC	-0.6258	-0.6258	
61C-160	208.3939	211.9606	2013 BFC	-3.5667		-3.5667
77C-25	144.3154	143.7310	2012 BFC	0.5844	0.5844	
77C-50	150.2600	150.6893	2012 BFC	-0.4293	-0.4293	
77C-75	143.9683	144.4184	2012 BFC	-0.4502	-0.4502	
77C-100	148.7306	149.2333	2012 BFC	-0.5027	-0.5027	
77C-130	212.7773	213.5941	2013 BFC	-0.8168		-0.8168
77C-160	213.2446	214.0546	2013 BFC	-0.8100		-0.8100
78C-25	154.8145	154.4993	2012 BFC	0.3152	0.3152	
78C-50	145.3772	145.6922	2012 BFC	-0.3149	-0.3149	
78C-75	146.0758	146.2038	2012 BFC	-0.1280	-0.1280	
78C-100	143.9961	144.4907	2012 BFC	-0.4946	-0.4946	
78C-130	218.1067	216.7383	2013 BFC	1.3684		1.3684
78C-160	205.2207	205.4884	2012 BFC	-0.2677	-0.2677	
83C-25	131.5764	131.6433	2012 BFC	-0.0670	-0.0670	
83C-50	139.6025	139.8794	2012 BFC	-0.2769	-0.2769	
83C-75	126.1219	126.9321	2012 BFC	-0.8102		-0.8102
83C-130	219.7522	219.7522	OC	0.0000		
83C-160	224.9133	224.9133	OC	0.0000		
84C-25	149.5403	149.6348	2012 BFC	-0.0945	-0.0945	
84C-50	136.9787	137.3641	2012 BFC	-0.3854	-0.3854	
84C-75	152.7416	153.2063	2012 BFC	-0.4647	-0.4647	
84C-100	145.5488	146.0763	2012 BFC	-0.5275	-0.5275	
84C-130	225.3643	219.5703	2012 BFC	5.7940		5.7940
84C-160	218.8475	219.7472	2013 BFC	-0.8997		-0.8997
85C-25	137.4884	137.3267	2012 BFC	0.1617	0.1617	

CMT Well Location	Original Geokon C-Value (psi)	*2012/2013 Best-Fit C Value* C Value (psi)	Original C Value (OC), 2012 Best-Fit C Value (2012 BFC), or Summer 2013 In Situ C Value (2013 BFC)	Original Minus Best-Fit C Value (psi)	Change in C Value Less Than 0.8 psi (psi)	Change in C Value Greater Than 0.8 psi (psi)
85C-50	141.7513	141.8200	2012 BFC	-0.0687	-0.0687	
85C-75	144.5684	144.8926	2012 BFC	-0.3242	-0.3242	
85C-100	144.4399	144.1947	2012 BFC	0.2452	0.2452	
85C-130	220.5654	221.0280	2012 BFC	-0.4626	-0.4626	
85C-160	225.9176	226.7158	2013 BFC	-0.7982	-0.7982	
86C-25	143.9064	143.8713	2012 BFC	0.0352	0.0352	
86C-50	131.0217	129.9185	2012 BFC	1.1032		1.1032
86C-75	151.7898	152.3567	2012 BFC	-0.5669	-0.5669	
86C-130	216.8058	216.1113	2012 BFC	0.6945	0.6945	
86C-160	188.8518	190.2764	2012 BFC	-1.4247		-1.4247
87C-25	149.1936	149.3470	2012 BFC	-0.1534	-0.1534	
87C-50	146.9934	147.1597	2012 BFC	-0.1663	-0.1663	
87C-130	218.3647	219.3595	2012 BFC	-0.9948		-0.9948
87C-160	216.5937	217.9914	2012 BFC	-1.3977		-1.3977
88C-25	127.7989	128.0037	2012 BFC	-0.2048	-0.2048	
88C-50	146.4456	146.7225	2012 BFC	-0.2769	-0.2769	
88C-75	146.8837	147.4516	2012 BFC	-0.5679	-0.5679	
88C-100	151.0050	151.8351	2012 BFC	-0.8300		-0.8300
88C-130	233.1299	233.5432	2013 BFC	-0.4133	-0.4133	
88C-160	216.0617	216.7780	2013 BFC	-0.7163	-0.7163	
89C-100	133.2559	133.5728	2012 BFC	-0.3168	-0.3168	
89C-130	221.8160	222.8095	2012 BFC	-0.9935		-0.9935
89C-160	223.7300	223.7300	OC	0.0000		
90C-25	138.6344	138.7082	2012 BFC	-0.0738	-0.0738	
90C-100	142.2675	143.5666	2012 BFC	-1.2991		-1.2991
90C-130	214.2387	214.2387	OC	0.0000		
90C-160	207.8550	196.1543	2013 BFC	11.7007		11.7007
91C-25	112.5198	113.0777	2012 BFC	-0.5579	-0.5579	
91C-50	144.0060	144.8427	2012 BFC	-0.8367		-0.8367
91C-75	148.9520	149.0725	2012 BFC	-0.1205	-0.1205	
91C-100	150.5853	151.6683	2012 BFC	-1.0830		-1.0830
91C-130	223.1769	223.4380	2012 BFC	-0.2611	-0.2611	
91C-160	222.9534	223.9686	2012 BFC	-1.0151		-1.0151
92C-25	152.9306	153.0269	2012 BFC	-0.0963	-0.0963	
92C-50	150.2304	150.4278	2012 BFC	-0.1973	-0.1973	
92C-75	154.6158	154.6158	OC	0.0000	0.0000	
92C-100	153.9862	154.5313	2012 BFC	-0.5451	-0.5451	
92C-130	220.1344	220.6070	2012 BFC	-0.4726	-0.4726	
92C-160	214.3657	214.8813	2012 BFC	-0.5157	-0.5157	
93C-25	137.9402	138.0839	2012 BFC	-0.1437	-0.1437	
93C-50	152.3786	152.9860	2012 BFC	-0.6074	-0.6074	
93C-75	122.9579	122.0894	2012 BFC	0.8685		0.8685
93C-100	152.8048	152.7903	2012 BFC	0.0145	0.0145	
93C-130	220.4309	221.0948	2013 BFC	-0.6639	-0.6639	
93C-160	231.9488	232.8415	2013 BFC	-0.8928		-0.8928
94C-25	147.3683	147.5614	2012 BFC	-0.1931	-0.1931	
94C-50	144.9189	145.2345	2012 BFC	-0.3156	-0.3156	
94C-100	146.8811	147.7036	2012 BFC	-0.8225		-0.8225
94C-130	210.3590	210.3590	OC	0.0000		
94C-160	224.7843	224.7843	OC	0.0000		
95C-25	137.3846	137.4100	2012 BFC	-0.0254	-0.0254	
95C-50	137.8341	137.9217	2012 BFC	-0.0876	-0.0876	
95C-75	140.3637	140.5085	2012 BFC	-0.1448	-0.1448	
95C-100	142.9036	143.4673	2012 BFC	-0.5637	-0.5637	
95C-130	207.8727	208.5739	2012 BFC	-0.7012	-0.7012	
95C-160	212.7818	213.6982	2012 BFC	-0.9164		-0.9164

Number of CMT Wells with Geokons Installed = 113

Number of CMT Wells Where Original C Value Set as Best-Fit C Value = 12

Number of CMT Wells Where Original C Value Changed = 101

Number of Original to 2012/2130 Best-Fit C Value Changes Less Than 0.8 psi = 75
Minimum Change in C Value For Changes Less Than 0.8 psi (psi) = 0.0000
Maximum Change in C Value For Changes Less Than 0.8 psi (psi) = 0.7982
Average[1] Change in C Value For Changes Less Than 0.8 psi (psi) = 0.3355
Average Change in C Value For Changes Less Than 0.8 psi (ft H_2O) = 0.77

Number of Original to2012/2013 Best-Fit C Value Changes Greater Than 0.8 psi = 27
Minimum Change in C Value For Changes Greater Than 0.8 psi (psi) = 0.8100
Maximum Change in C Value For Changes Greater Than 0.8 psi (psi) = 19.3875
Average[1] Change in C Value For Changes Greater Than 0.8 psi (psi) = 2.3462
Average Change in C Value For Changes Greater Than 0.8 psi (ft H_2O) = 5.41

Note:
(1) Average of the absolute value for the change in C values.

TABLE 15

COMPARISON OF 61C-130/160 MANUAL VS. GEOKON TRANSDUCER FEHs
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

61C-130:

TOC (ft NGVD)	10.19	
Geokon Transducer Elevation (ft NGVD)	-114.56	
Laboratory Temp. Corr. SG Converted to Density (lbs/ft^3)	66.82	(A) 1.0709 = Temp. Corr. Laboratory SG Based on Temp. Corr. Density
Conversion Factor (psi to ft H_2O)	2.3077	
Linear Regression Density[(1)] (lbs/ft^3)	66.80	(B) 1.0705 = Temp. Corr. SG Based on Linear Regression Density
Average FEH Offset (ft)	0.04	0.0004 = Absolute Difference in SG (ABS[(A) - (B)])

Date	*DTW (ft)*	*Manual Height of Water Column (ft)*	*Geokon Transducer Pressure (lbs/ft^2)*	*Manual FEH[(2)] (ft NGVD)*	*Transducer FEH (ft NGVD)*	*FEH Offset (ft)*
12/31/13 13:55	12.9	111.85	7474.36	5.21	5.22	-0.01
12/31/13 14:00	12.89	111.86	7476.08	5.23	5.25	-0.02
1/2/14 9:40	13.12	111.63	7457.53	4.98	4.95	0.03
1/2/14 9:45	13.12	111.63	7456.54	4.98	4.94	0.04
1/2/14 9:50	13.13	111.62	7455.75	4.97	4.92	0.05
1/2/14 9:55	13.14	111.61	7454.76	4.96	4.91	0.05
1/2/14 10:00	13.15	111.60	7454.76	4.95	4.91	0.04
1/2/14 12:15	13.48	111.27	7434.97	4.59	4.59	0.00
1/2/14 12:20	13.43	111.32	7434.77	4.65	4.59	0.06
1/3/14 9:00	12.89	111.86	7473.12	5.23	5.20	0.02
1/3/14 9:05	12.9	111.85	7473.16	5.21	5.20	0.01
1/3/14 14:35	13.52	111.23	7424.71	4.55	4.43	0.13
1/3/14 14:40	13.55	111.20	7425.26	4.52	4.43	0.08
1/6/14 13:10	13.06	111.69	7458.46	5.04	4.97	0.08
1/6/14 13:15	13.09	111.66	7456.34	5.01	4.93	0.08

61C-160:

TOC (ft NGVD)	10.19	
Geokon Transducer Elevation (ft NGVD)	-155.46	
Laboratory Temp. Corr. SG Converted to Density (lbs/ft^3)	63.03	(C) 1.0101 = Temp. Corr. Laboratory SG Based on Temp. Corr. Density
Conversion Factor (psi to ft H_2O)	2.3077	
Linear Regression Density[(1)] (lbs/ft^3)	63.37	(D) 1.0156 = Temp. Corr. SG Based on Linear Regression Density
Average FEH Offset (ft)	-0.88	0.0055 = Absolute Difference in SG (ABS[(C) - (D)])

Date	*DTW (ft)*	*Manual Height of Water Column (ft)*	*Geokon Transducer Pressure (lbs/ft^2)*	*Manual FEH[(2)] (ft NGVD)*	*Transducer FEH (ft NGVD)*	*FEH Offset (ft)*
12/31/2013 13:50	4.25	161.40	10218.47	7.57	8.30	-0.73
12/31/2013 14:00	4.24	161.41	10225.27	7.58	8.41	-0.82
1/2/2014 9:40	4.43	161.22	10217.41	7.39	8.28	-0.89
1/2/2014 9:45	4.44	161.21	10212.81	7.38	8.21	-0.83
1/2/2014 9:50	4.44	161.21	10210.47	7.38	8.17	-0.79
1/2/2014 9:55	4.48	161.17	10207.68	7.34	8.12	-0.78
1/2/2014 10:00	4.5	161.15	10207.68	7.32	8.12	-0.80
1/2/2014 12:15	5.37	160.28	10158.53	6.44	7.34	-0.90
1/2/2014 12:20	5.38	160.27	10158.05	6.43	7.33	-0.90
1/3/2014 9:00	4.02	161.63	10252.95	7.80	8.85	-1.05
1/3/2014 9:05	4.02	161.63	10250.73	7.80	8.81	-1.01
1/3/2014 14:35	5.52	160.13	10148.68	6.29	7.18	-0.89
1/3/2014 14:40	5.5	160.15	10151.37	6.31	7.22	-0.91
1/6/2014 13:10	4.96	160.69	10186.65	6.86	7.79	-0.93
1/6/2014 13:15	5.01	160.64	10182.88	6.80	7.73	-0.92

Example 61C-160 FEH Offset Calculation Using Linear Regression Density Instead of Laboratory Density to Calculate Manual FEH:

TOC (ft NGVD)	10.19	
Geokon Transducer Elevation (ft NGVD)	-155.46	
Conversion Factor	2.3077	psi to ft
Linear Regression Density[(1)] (lbs/ft^3)	63.37	1.0156 = Temp. Corr. SG Based on Linear Regression Density
Average FEH Offset (ft)	0.00	

Date	*DTW (ft)*	*Manual Height of Water Column (ft)*	*Geokon Transducer Pressure (lbs/ft^2)*	*Manual FEH[(3)] (ft NGVD)*	*Transducer FEH (ft NGVD)*	*FEH Offset (ft)*
12/31/2013 13:50	4.25	161.40	10218.47	8.45	8.30	0.15
12/31/2013 14:00	4.24	161.41	10225.27	8.46	8.41	0.06
1/2/2014 9:40	4.43	161.22	10217.41	8.27	8.28	-0.01
1/2/2014 9:45	4.44	161.21	10212.81	8.26	8.21	0.05
1/2/2014 9:50	4.44	161.21	10210.47	8.26	8.17	0.09
1/2/2014 9:55	4.48	161.17	10207.68	8.22	8.12	0.09
1/2/2014 10:00	4.5	161.15	10207.68	8.20	8.12	0.07
1/2/2014 12:15	5.37	160.28	10158.53	7.31	7.34	-0.02
1/2/2014 12:20	5.38	160.27	10158.05	7.30	7.33	-0.03
1/3/2014 9:00	4.02	161.63	10252.95	8.69	8.85	-0.17
1/3/2014 9:05	4.02	161.63	10250.73	8.69	8.81	-0.13
1/3/2014 14:35	5.52	160.13	10148.68	7.16	7.18	-0.02
1/3/2014 14:40	5.5	160.15	10151.37	7.18	7.22	-0.04
1/6/2014 13:10	4.96	160.69	10186.65	7.73	7.79	-0.06
1/6/2014 13:15	5.01	160.64	10182.88	7.68	7.73	-0.05

Notes

(1) Linear regression density determined from manual height of water column and Geokon transducer pressure.
(2) Manual FEH calculated using laboratory temperature corrected SG converted to density.
(3) Manual FEH calculated using linear regression density.

TABLE 16

SUMMARY OF MW-F AND MW-G MANUAL VS. TRANSDUCER FEHs AND DI WELL CHECKS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Monitoring Well	*Transducer Serial Number*	*Pressure Rating (ft) (feet)*	*Transducer Accuracy (±0.05%FS) (feet)*	*Manual Depth to Water Accuracy (feet)*	*Total Accuracy (feet)*	*December 2013 Lab Measured Temperature Corrected Specific Gravity*	*Average Transducer FEH [(1)] (feet)*	*Average Manual FEH [(1)] (feet)*	*Average Manual FEH Minus Average Transducer FEH (feet)*	*Is Difference Less Than Total Accuracy? (Y/N)*
MW-F-SHALLOW	2011911	F100	± 0.050	± 0.025	0.075	1.0139	90.46	89.19	-1.27	N
MW-F-INTERMEDIATE	2011197	F300	± 0.150	± 0.025	0.175	1.0367	131.85	132.40	-0.57	N
MW-F-DEEP	2011223	F300	± 0.150	± 0.025	0.175	1.0087	170.11	170.50	-0.39	N
MW-G-SHALLOW	2011214	F300	± 0.150	± 0.025	0.175	1.0551	137.42	137.79	-0.38	N
MW-G-INTERMEDIATE	2011227	F300	± 0.150	± 0.025	0.175	1.0060	165.14	165.80	-0.66	N
MW-G-DEEP	2011213	F300	± 0.150	± 0.025	0.175	1.0080	217.63	218.18	-0.55	N

				December 2013 DI Well Checks					
Monitoring Well	*Transducer Serial Number*	*Pressure Rating (ft) (feet)*	*Transducer Accuracy (±0.05%FS) (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 39.4 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 49.4 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 59.4 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 69.4 ft BTOR (feet)*	*Avg. Difference Over All Depths (feet)*	*Is Avg. Difference Over All Depths Less Than Transducer Accuracy? (Y/N)*
MW-F-SHALLOW	2011911	F100	± 0.050	-0.184	-0.155	-0.128	-0.422	-0.222	N
MW-F-DEEP	2011223	F300	± 0.150	-0.005	0.019	0.044	-0.066	-0.002	Y
MW-G-SHALLOW	2011214	F300	± 0.150	-0.037	-0.010	0.006	-0.093	-0.034	Y
MW-G-INTERMEDIATE	2011227	F300	± 0.150	-0.132	-0.126	-0.125	-0.373	-0.189	N
MW-G-DEEP	2011213	F300	± 0.150	-0.004	0.017	0.051	-0.101	-0.009	Y

				January 2014 DI Well Checks					
Monitoring Well	*Transducer Serial Number*	*Pressure Rating (ft) (feet)*	*Transducer Accuracy (±0.05%FS) (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 30 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 40 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 50 ft BTOR (feet)*	*Avg. Difference Btwn. Transducer Pressure and Water Column Depth Setting at 60 ft BTOR (feet)*	*Avg. Difference Over All Depths (feet)*	*Is Avg. Difference Over All Depths Less Than Transducer Accuracy? (Y/N)*
MW-F-SHALLOW (Replacement)	2011918	F100	± 0.050	0.010	0.013	0.059	0.009	0.023	Y
MW-F-INTERMEDIATE	2011197	F300	± 0.150	-0.001	-0.003	-0.016	0.032	0.003	Y

Notes:
ft BTOR Feet below top of riser within the DI well.
(1) FEH is presented in terms of fresh water column height above transducer.

Attachment A

Geokon "C" Calculation Summary

Table of Contents

List of Tables
(Following Text)

1.0 Introduction

This attachment presents the procedure for reviewing results of the Comprehensive Supplemental Investigation (CSI) Work Plan (CRA, 2012) field monitoring data and the field verification of Freshwater Equivalent Head (FEH) conducted at selected groundwater monitoring wells at the Site in 2013. Three types of pressure transducer/datalogger instruments were used during CSI 2012 hydraulic monitoring based on the monitoring location (i.e., standard monitoring well, Continuous Multi-Channel Tubing (CMT) multilevel monitoring well or subtidal waterway installation). The field verification of FEH was conducted in 2013 based on the memorandum entitled *"Scope of Work and Methodology for Field Verification of FEH at Selected Groundwater Monitoring Wells"*, dated June 12, 2013 (Work Plan). The purpose of the Work Plan was to verify previous FEH calculations at the selected monitoring well locations by correlating readings recorded by the pressure transducers installed in the wells with accurately measured manual FEHs.

The 2013 field verification of FEH was initially implemented at ten CMT wells equipped with Geokon™ vibrating wire pressure transducers and two standard wells equipped with Solinst Levelogger Edge pressure transducers. Following the initial field activities and discussions with the Agencies, six additional CMT wells and six additional standard monitoring wells were selected to be sampled and monitored.

1.1 Solinst Levelogger® Edge Pressure Transducer/Dataloggers

The Solinst Levelogger® Edge (Levelogger) series of pressure transducer/dataloggers (transducers) are sealed non-vented instruments with an internal power supply and data logging capabilities. The Levelogger measures total pressure (i.e., water pressure plus atmospheric pressure) and temperature. These transducers were programmed to record pressures in pounds per square inch (psi) and temperature in degrees Celsius. These transducers were installed in standard monitoring wells, suspended using stainless steel cables at elevations corresponding to the 15-feet (ft), 25-ft, 50-ft, 75-ft, 100-ft, 130-ft, and 160-ft zone grouping planes. The raw transducer readings consist of date, time, total pressure, and temperature. A Solinst Barologger® Edge (barologger) pressure transducer/datalogger was used to record barometric pressure at the Site and synchronized to taking readings at the same time as the pressure transducers. The barometric pressure was then subtracted from the total pressure readings to give water column pressure for each monitoring well location.

The transducers were installed in the standard monitoring wells listed in Table 3.11 of the CSI, with the exception of eight wells that were damaged/destroyed or obstructed (6A-24.5, 22-25R, 23-50, 74-130, PZ-SHI-1-75, PZ-SHI-1-100, PZ-SHI-1-126, and 709-MW15A-25). A total of 140 transducers were installed in standard monitoring wells plus one installed at Dock 1 within the Hylebos Waterway at an elevation close to the 25-ft zone grouping plane elevation.

1.2 Geokon Vibrating Wire Pressure Transducers

The Geokon Model 4500 Vibrating Wire Piezometers (Geokon) series of pressure transducers use vibrating wire technology to produce a signal that is proportional to pressure. The electronic components (batteries, datalogger) are contained within a weather-resistant datalogger box at the surface, such that the downhole component consists solely of the communication cable and pressure sensor. These transducers were installed at CMT monitoring well locations with the transducers fastened to the outside of the CMT tubing at elevations corresponding to the 25-ft, 50-ft, 75-ft, 100-ft, 130-ft, and 160-ft zone grouping planes.

At each of the 22 CMT well locations, 6 Geokon pressure transducers were installed, with the exception of 34C and 89C where three transducers were installed with a CMT along with three standard monitoring wells (-25, -50, -75), and at 41C where the 41C-130 monitoring interval was inadvertently sealed at the time of installation (sealing the port and Geokon transducer in bentonite) and was replaced with a standard monitoring well (41-130). At four CMT well locations (46C-250, 89C-185, 93C-220, and 95C-198), additional Geokon transducers were installed beneath the bottom of the CMT below the 160-ft zone. An additional transducer was installed below the 160-ft zone at 93C (93C-286), but the instrument immediately malfunctioned after well completion. These 5 deeper transducers were installed in boreholes that extended below the base of the CMT wells, where the transducer was suspended by the logger communication cable at the selected elevation, set into a short sand pack and then sealed into place with bentonite.

During previous investigations in 2005/2006, transducers were installed in subtidal waterway borings. Transducers installed in three of the waterway borings were incorporated into the CSI hydraulic monitoring program (WW-A-1, WW-B-1, WW-C-1). These transducer installations were documented in previous reports.

The raw transducer readings consist of date plus time, vibrating wire readout value, and temperature in degrees Celsius. The polynomial conversion equation incorporating the barometric correction is as follows (Equation 1):

$$P = (A \times R_1^2) + (B \times R_1) + C + [(T_1 - T_0) \times K] - (S_1 - S_0) \qquad \text{Equation 1}$$

Where:

P	Is the computed gauge pressure (psi)
A , B	Are polynomial gage factors supplied by Geokon®
R_1	Is the digit reading recorded by the pressure transducer (digits)
C	Is calculated by inserting the initial zero reading, R_0, into the polynomial equation, with the pressure, P, set to zero (initial calibration at atmospheric pressure)
T_1	Is the temperature reading recorded by the pressure transducer (°C)
T_0	Is the Site temperature reading determined prior to installation (°C) (initial calibration)
K	Is the thermal factor supplied by Geokon® (psi/°C)
S_1	Is the barometric pressure reading from the dedicated barometric pressure transducer corresponding to the time of the digits and temperature readings (psi)
S_0	Is the initial barometric pressure taken at the time of the zero pressure digits reading prior to installation of the transducer (psi) (initial calibration)

The parameter C in Equation 2 is calculated using:

$$C = -[(A \times R_0^2) + (B \times R_0)] \qquad \text{Equation 2}$$

Where:

R_0	Is the Site zero pressure digits reading (atmospheric pressure, initial calibration) determined prior to installation (digits)

Following installation, 12 of the transducers were noted to have malfunctioned and were replaced by narrow diameter Micron pressure transducers installed within the CMT well channel. At these locations where the transducer malfunctioned, only the pressure sensor malfunctioned. The temperature sensor continued to function appropriately, with temperature values consistent with other sensors in the vicinity.

1.3 Micron Pressure Transducers

Micron narrow-diameter pressure transducers (Micron) were installed within the CMT well channels at 12 locations. The Micron transducer contains a pressure sensor coupled to direct-read vented cable. The power source and datalogger unit are contained within weather-resistant boxes at ground surface. The transducers were deployed to similar elevations as the initially installed Geokon transducers that malfunctioned, with the exception of 17C-50 that was set at a depth of 22 ft below the top of casing (approximately 27 ft above the 50-ft zone grouping plane elevation) due to a constriction in the CMT well channel.

The Micron transducers are vented such that barometric correction of the data was not required. The raw data from the transducers consist of date plus time and pressure (psi).

2.0 2012 Data Corrections, Reduction, FEH Calculations

This section describes the process used to correct the pressure data for rapid data shifts, spikes, and related short-term data issues, pressures inconsistent with field measured depth to water and inconsistent with Event 1 and Event 2 pressures, and datalogger pressure drift. The calculations of pressure in psi to freshwater equivalent head (FEH) and calculations of FEH at the zone grouping plane are also presented.

For each monitoring well included in the CSI hydraulic monitoring network, the measured transducer pressure signals were plotted and visually examined to ensure that the data were suitable for application in the hydraulic evaluation, or whether data corrections were required. The visual review of the transducer pressure signals included identifying:

- Periods during the monitoring event in which some transducer pressure signals were incomplete
- Increasing or decreasing trends in the transducer pressure signals over time indicative of drift in the transducer signal
- Transducer pressure signals exhibiting abnormal fluctuations relative to tidal fluctuations
- Abrupt shifts in the transducer pressure signals

2.1 Solinst Levelogger® Edge Pressure Transducer/Dataloggers

The Levelogger® transducers were deployed suspended on stainless steel cables with a direct-read cable to the surface for downloading data without moving the pressure transducer. At many locations, communication with the datalogger using the direct-read cable was lost periodically. At these locations, the datalogger was removed from the well and downloaded at the surface. This resulted in the datalogger recording atmospheric pressures and temperatures. These data spikes were removed using linear interpolation across the non-representative pressure and temperature data periods (typically less than 15 minutes). Occasionally, other random electronic data spikes occurred and were removed in a similar fashion.

Occasionally, the stainless steel clamp fastening the pressure transducer to the stainless steel deployment cable would corrode and fail, resulting in the transducer dropping to the bottom of the direct-read cable or well bottom (still fastened to the direct-read cable). Additionally, the removal of the datalogger for download and reintroduction into the water column could occasionally result in tangling of the two cables. Both of these caused the pressure transducer to shift vertical locations within the water column, resulting in a shift in the pressure readings. Once noted, the pressure transducers were reset to their correct depth in the field. The shift in the pressure readings was corrected by projecting over the shift using the average of the 5-minute incremental pressures measured before and after the shift. The corrections to the data shifts were also checked graphically and the corrections were adjusted, where necessary, to ensure a smooth pressure transition over the duration of the shift.

During the initial pressure transducer installations, a few pressure transducers were set to incorrect elevations, but these installations were corrected. In these cases, the data shift corrections were applied from the time of initial installation to when the transducer elevation was corrected.

In one instance a pressure transducer failed (74-75), resulting in a large data gap (September 20, 2012 to October 5, 2012) that could not be filled. A few other locations have short data gaps, due to reprogramming of the transducer at the surface, replacement of transducers that were difficult to communicate with, or other extended periods of time where linear interpolation could not be used to fill the data gap.

2.2 Geokon Vibrating Wire Pressure Transducers

The Geokon Model 4500 Vibrating Wire Piezometers series of pressure transducers were permanently installed in the boreholes alongside of the CMT tubing. The Geokon pressure transducer readings were corrected by removing null values (e.g., -99998) related to electrical interference, and other electronic data spikes, using linear interpolation across the non-representative pressure and temperature data. For several of the Geokon data sets, there were substantial amounts of electrical interference causing numerous small pressure spikes (as compared to large pressure spiked generated by null values). The larger of these pressure spikes were also removed using linear interpolation, but the numerous small pressure spikes of generally less than 0.2 ft pressure were commonly left without correction.

During the CSI monitoring period, the Geokon datalogger battery voltage would suddenly decline as the batteries ended their useful life, and the vibrating wire readings would rapidly change, followed by no data being recorded. The pressure data was reviewed and professional judgment used to remove non-representative pressures from the data sets. These data gaps are present in most Geokon data records.

Following installation of the Geokon transducers, it was noted that many returned digit values, that when converted to pressures, were inconsistent with expected pressures for those locations. In several cases these pressures were significantly different (by several to tens of feet water pressure). Following this determination, the data for all Geokon transducers were reviewed by plotting the measured height of water against pressure calculated from the digit values. This initial check confirmed that the pressure calculated from the digit values could be erroneous. Discussions with Geokon, and a review of the Geokon transducer manual, indicated a recalibration of the constant could be made using site data after installation. In order to better accomplish this, water level measurements were collected at 5-minute intervals for a period of several hours at each transducer location. The accumulated data was then used to calculate an in-situ constant "C" using Equation 1 rearranged to solve for "C". This revised "C" was used to recalculate pressures from the digit values. In a few cases, the original, field-determined "C" at atmospheric pressure provided a better pressure value when converted to FEH.

2.3 Micron Pressure Transducers

Micron narrow-diameter pressure transducers were installed within the CMT well channels. Similar to the Levelogger® and Geokon transducers, electronic data spikes were removed and replaced using linear interpolation. The battery power supply for the Microns became drained periodically resulting in rapid declines in the recorded pressure readings, followed by gaps in the readings until the battery was replaced.

The Micron pressure data were often noted to drift in a linear fashion, while still exhibiting a tidal based response. This drift was necessarily corrected to provide useful pressure data. The correction followed the tidal filtering process described in the Draft Model Calibration Report (CRA, October 2011).

The tidal effect was removed through the tidal filtering process, the linear drift was determined, and subtracted from the tidal effect removed data, and the tidal effect was added back in to the data.

2.4 Calculation of FEH from Pressure Data

The calculation of FEH and FEH to zone grouping plane elevation, are described below.

FEH is calculated from the corrected pressure readings as follows (Equation 3):

$$FEH = C \times \frac{P}{\rho_f\, g} \qquad \text{Equation 3}$$

Where:

FEH Is the height of an equivalent fresh water column above the transducer (ft) converted to elevation (ft NGVD) based on the transducer elevation

P Is the barometrically corrected pressure transducer reading (psi)

ρ_f g Is the unit weight of fresh water at 62.4 pounds-force per cubic foot (lbf/ft^3)

C Is a conversion factor of 144 square inches per square foot.

The bulk of the Levelogger® transducers were installed at elevations corresponding to the zone grouping plane elevations, or very close to the zone grouping plane elevations. The Geokon and Micron transducers were generally installed at elevations near the zone grouping plane, except where moved due to the presence of low permeability stratigraphy at the proposed installation elevation. Where transducers were not installed at the zone grouping plane, the FEH at the zone grouping plane elevation was calculated by adjusting the measured pressure to account for the pressure difference between the transducer elevation and the zone grouping elevation. The incremental pressure was calculated as follows (Equation 4):

$$\Delta P = SG \times \rho_f\, g \times \Delta h \qquad \text{Equation 4}$$

Where:

ΔP Is the incremental pressure from the transducer elevation to the zone grouping plane elevation (psi)

SG Is the specific gravity measured at the well screen (unitless)

ρ_f g Is the unit weight of fresh water at 62.4 lbf/ft^3

Δh Is the elevation difference from the transducer elevation to the zone grouping plane elevation (ft)

The incremental pressure was added to the pressure reading P in Equation 1 to determine the FEH at the zone grouping plane.

2.5 Review of Measured Pressure Signals

This section describes the mathematical review of the measured pressure signals to ensure the data were suitable for usage.

The corrected transducer pressure data were further reviewed by plotting recorded pressures (in pounds per square foot) versus corresponding (generally weekly) manual depth to water measurements (converted to height of water in feet above the transducer elevation) taken at each monitoring well during the CSI hydraulic monitoring event.

All wells included in the monitoring program were purged and sampled prior to the CSI hydraulic monitoring program. A density profile for the water column within the casing of each monitoring well was not obtained. As a result, the manual water level measurements could not be converted to pressures for direct comparison to the pressures measured by the transducers. For the initial purposes of the data quality assessment, it was assumed that the specific gravity of the entire water column was equal to the specific gravity at the time of groundwater sampling.

An indirect comparison was conducted where a linear regression analysis was conducted of the manually determined height of water versus the measured transducer pressures. The slope of the linear regression line corresponds to an estimated composite density of the well casing water column density. The estimated well casing water column density was then compared to the measured density at the well screen from groundwater sampling conducted prior to the start of CSI hydraulic monitoring, and evaluated for being indicative of potential transducer errors. The linear regression analysis equation has the form (Equation 5):

$$P = \rho \times g \times H \qquad \text{Equation 5}$$

Where;

P Is the transducer measured pressure (psi converted to lbs/ft^2)

H Is the manually determined height of the water column within the well casing above the transducer (ft)

$\rho \times g$ Is the unit weight of the water within the well casing column above the transducer (lbs/ft^3), equal to the product of the water density ρ and the gravitation acceleration constant g. On the Earth's surface the unit weight of water essentially is equal to the density of water.

Given the above relationship, a plot of the manually determined height of water above the transducer versus the measured transducer pressures should follow a linear trend with a slope equal to the composite unit weight of the water column above the transducer. A linear regression analysis of the plotted points for each transducer was performed to determine the slope of the best fit line, or trend line, through the plotted points.

Once the manual water levels (converted to water column height above the transducer) and corresponding transducer pressure data were plotted, the plots were reviewed to determine if there were any individual data points that did not fall along the trend line. In most cases, points that did not fall along the trend line were caused by what was determined to likely be a misreported manual water level. These manual water levels did not appear to affect the integrity of the data but were removed from the linear regression calculation (shown as excluded data), so that an accurate linear slope could be determined. This slope, or estimated composite water column density, was compared to the measured groundwater density at the well screen (see Table 2a/b/c), and evaluated as described below.

The estimated composite water column density (slope of the linear trend line) data were reviewed and placed into categories based on the comparison to the freshwater density and the measured groundwater density at each location (following the methodology described in the report text):

Category 1) The slope of the trend line, or regression density, is greater than the density of fresh water (62.4 lbs/ft^3) and less than the measured groundwater density at the well screen interval. This would be an expected condition since the stagnant water within the well casing could be stratified such that fresh (or fresher) water exists in the upper portion of the water column and more dense water exists in the lower portion of the water column. The overall composite density of the water column would then be less than the measured groundwater density at the well screen interval. Also, the slope of the trend line must be greater than or equal to the density of fresh water. In shallow monitoring wells, it is possible for the entire water column within the well casing to be comprised of water with a fresh water density. Category 1 values are considered acceptable for use.

Category 2) The slope of the trend line, or regression density, is greater than the groundwater density measured at the well screen interval. In addition, the pressures calculated based on the manual water column height and the regression density, when compared to the pressure calculated based on the manual water column height and the measured density, are within the transducer pressure range margin of error. Category 2 values are considered acceptable for use.

Category 3) The slope of the trend line, or regression density, is greater than the groundwater density measured at the well screen interval. In addition, the pressures calculated based on the manual water column height and the regression density, when compared to the pressure calculated based on the manual water column height and the measured density, are outside the transducer pressure range margin of error. However, the FEH at zone grouping plane values fall within expected values based on values at nearby locations and knowledge of the Site conditions. Thus these Category 3 values are considered acceptable for use.

Category 4) The slope of the trend line, or regression density, is less than the density of freshwater. In addition, the pressures calculated based on the manual water column height and the density of freshwater, when compared to the transducer measured pressure, are within the transducer pressure range margin of error. Category 4 values are considered acceptable for use.

Category 5) The slope of the trend line, or regression density, is less than the density of freshwater. In addition, the pressures calculated based on the manual water column height and the density of freshwater, when compared to the transducer measured pressure, are outside the transducer pressure range margin of error. However, the FEH at zone grouping plane values fall within expected values based on values at nearby locations and knowledge of the Site conditions. Thus these Category 5 values are considered acceptable for use.

Pressure transducer data that fell into the Category 1) needed no further evaluation and were applied in the hydraulic evaluation. Pressure transducer data that fell into Categories 2) and 4) were determined to be suitable for application in the hydraulic evaluation since they were within the margin of error of the transducer. Pressure transducer data that fell into Categories 3) and 5) were further evaluated for inclusion in the hydraulic evaluation based on the FEH at zone grouping plane contours developed for each of the zone grouping planes. If the transducer pressure at a monitoring well falling into Categories 3) or 5) fits the FEH at zone grouping plane contours, and is representative of actual groundwater flow conditions based upon knowledge of the local hydrogeologic setting obtained from previous investigations and monitoring events (e.g., Event 1 and Event 2 hydraulic monitoring), the data were determined to be suitable for analysis.

Two further categories were established for data quality assessment. These are:

Category 6) FEH at zone grouping plane value did not fit the contours and was deemed to be not representative of actual hydrogeologic conditions. These data were excluded from further consideration. These data may include values previously deemed acceptable for use.

Category 7) Pressure data in the data plots were visually reviewed and rejected as being non-representative of groundwater conditions, whether in a tidally influenced zone grouping plane or not. These data were excluded from further consideration.

The data quality review based on the review of the manual water levels versus the transducer pressures is presented in Table 2a (Solinst Leveloggers), Table 2b (Geokon), Table 2c (Micron), and a summary of the review results is presented in Table 3a (Solinst Leveloggers), Table 3b (Geokon), and Table 3c (Micron). Based on the transducer data evaluation, there were no Category 7 transducers.

3.0 2013 Field Verification Activities

The field activities included: groundwater purging; groundwater sampling and laboratory analysis for specific gravity and Total Dissolved Solids (TDS); and manual depth to water monitoring. The field and laboratory data were used to perform re-calibration of the pressure transducers as installed. The re-calibration was then used to re-calculate the Event 3 FEH values. The locations for this Event 3 FEH re-calculation included:

- 130-ft zone: CMT wells 21C-130, 34C-130, 53C-130, 61C-130, 77C-130, 78C-130, 88C-130, and 93C-130, and standard well T5-120
- 160-ft zone: CMT wells 34C-160, 61C-160, 77C-160, 84C-160, 85C-160, 88C-160, 90C-160, and 93C-160, and standard well 12-160

In addition, groundwater samples were collected from standard monitoring wells 20-50, 36-100R, 40-100R, 53-100, 65-130, and 75-130 for analysis of specific gravity and TDS. These locations were sampled to further evaluate the groundwater density at these locations. Proposed monitoring locations 11-100, 65-100 and PZ-SHI-1-100 were not monitored, as described in Section 2.4.

3.1 Field Activities

The field activities were performed during the weeks of June 17 and June 24 (installation of pressure transducers/data loggers, groundwater sampling and monitoring of groundwater levels), July 8, July 29, and August 5 (groundwater sampling and monitoring of groundwater levels).

3.2 Groundwater Sampling

Groundwater samples were collected following the purging and sampling techniques described in the CSI Work Plan.

The CMT wells were purged from a depth of approximately 30 feet below ground surface (feet bgs), slightly greater than the maximum suction lift of the peristaltic pump. Three to six well volumes were purged, with sampling occurring once field parameters stabilized after purging. The field parameters were recorded at regular intervals using a flow-through cell. In addition, specific gravity was measured regularly using two different field hydrometers (different specific gravity ranges).

The standard wells were purged using a submersible pump set at a depth of 20 to 30 feet bgs. Three well volumes were purged from the standard wells, with sampling occurring once field parameters stabilized after purging. The field parameters were recorded at regular intervals using either a flow-through cell or a multi-parameter water quality meter (when the pumping rate was too high for the flow-through cell). In addition, specific gravity was measured regularly using two different field hydrometers (having different specific gravity ranges).

Groundwater samples were collected once purging was completed. Groundwater samples were submitted to ALS Environmental Laboratory for analysis of specific gravity (ASTM Method D 1429D) and TDS (SM 2540C). Groundwater samples were collected into laboratory-supplied containers, labeled, wrapped in packing material, and placed in a cooler with ice. Samples were delivered to the laboratory under approved Chain-of-Custody protocols consistent with the Comprehensive Supplemental Investigation Work Plan. Field duplicate samples were collected at two locations: T5-120, which had one of the higher specific gravity values from Event 3 (1.1143), and 12-160.

3.3 Water Level Monitoring

Once the groundwater samples were collected, measurements of depth to water were collected within 48 hours. The depth to water measurements were collected at approximately 0.5 to 1.0 hour intervals for several hours before and/or after a major tidal trough, and at

5-minute intervals (coincident with the transducer recording frequency) for an approximate 2 to 3 hour period coinciding with the expected major tidal trough at the individual monitoring location (as determined by the NOAA predicted tide schedule and the individual monitoring location time-lag calculation). The manual depth to water measurements were successful in capturing the tidal-response major trough for every CMT and standard well. The water level measurement periods and calculated peak tidal trough are presented in Table 4.

3.4 MODIFICATION OF SAMPLING PROCEDURE

Due to the inability to re-establish good field parameter stability quickly after purging the upper portion of the water column (after purging a minimum of three water column volumes as outlined in the Work Plan), the methodology was revised to purge the upper portion of the water column after purging the first one-half to one water column volume.

3.5 FIELD SAMPLING OBSERVATIONS

The field activities encountered variable well conditions affecting groundwater sampling and/or groundwater level monitoring due to the Site conditions. As indicated below, the following three locations were not sampled:

- 11-100 Difficult to purge due to plugging of tubing; well not sampled
- 65-100 Obstructed at approximately 8 feet below top of riser (well scaled over); well not sampled
- PZ-SHI-1-100 Could not locate; well nest apparently destroyed

4.0 2013 Field Verification Results

The results of the groundwater sampling and depth to water level monitoring (for calculation of FEH) are presented below.

4.1 Analytical Results

The analytical results for the specific gravity samples and the temperature corrected (using pressure transducer recorded in-situ groundwater temperatures) density from Event 3 (2012 results) and the 2013 resampling results are presented in Table 5. The field measured specific gravity results are also presented in Table 5 and generally are in close agreement with the laboratory-measured specific gravity values. The use of field measured specific gravity results may provide a useful means to confirm the lab measured specific gravity results for future sampling.

4.2 Determination pf FEH at CMT Locations

During and following completion of Event 3, inconsistent pressures were noted at some Geokon locations. Discussions with Geokon, and a review of the Geokon transducer manual, indicated a recalibration of the constant could be made using site data after installation. In order to better accomplish this, water level measurements were collected during the later stages of Event 3 at 5-minute intervals for a period of several hours at each transducer location. The accumulated data was then used to calculate an in-situ constant "C" using Equation 1 rearranged to solve for "C". This revised "C" was used to recalculate pressures from the digit values. In a few cases, the original, field-determined "C" at atmospheric pressure provided a better pressure value when converted to FEH at zone grouping plane, and compared to nearby FEH values on contour plots. However, questions about the representativeness of the calculated FEH values remained for selected locations, triggering the resampling and re-measuring of water levels described above.

The recalculation of "C" was accomplished as described above, using the data collected over the monitoring period described in Section 2.0, with an assumed uniform water column density due to the resampling activities completed within the previous 48 hours. The recalculated in-situ "C" (different that the value recalculated in 2012, see Table 6) was then used to prepare graphs of the pressure transducer recorded pressures (pounds per square foot) versus the manually measured height of water column above the transducer (determined from the manual depth to water measurements) for each of the manual water measurements at each of the 16 CMT locations. The slope of the best-fit linear regression line (through the origin) is in units of pounds per cubic feet (density). This slope of the best-fit line is the mathematically determined density, and should closely match the density calculated from the specific gravity data (as presented in Table 5).

4.3 Determination of FEH at Standard Well Locations

The determination of FEH for the two standard well locations also follows procedures used and described previously. The Levelogger® transducers were deployed suspended on stainless steel cables with a direct-read cable to the surface for downloading data without moving the pressure transducer. Data spikes were removed, when necessary. The measured length of the installation cable from the reference point to the transducer sensor is used to determine the transducer elevation. As these two transducers were reinstalled following removal, the exact depth of installation is slightly different than during Event 3.

Graphs of the pressure transducer recorded pressures (pounds per cubic foot) versus the manually measured height of water column above the transducer (determined from depth to water measurements) for each of the manual water measurements at each of the two standard well locations were prepared. The slope of the best-fit linear regression line (through the origin) is in units of pounds per cubic feet (density). This slope of the best-fit line is the mathematically determined density, and should closely match the density calculated from the specific gravity data.

5.0 References

CRA, 2011. Draft Model Calibration Report, Groundwater and Sediment Remediation, Occidental Chemical Corporation, Tacoma, Washington, October.

CRA, 2012. Comprehensive Supplemental Investigation Work Plan, ref no. 7843 (111), April.

TABLE 1

SUMMARY OF HYDRAULIC MONITORING LOCATIONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WA

15-ft Zone

Well I.D.	Type of Well	Type of Transducer
49-15	Standard	Levelogger
50-15	Standard	Levelogger
52-15	Standard	Levelogger
95-15	Standard	Levelogger
709-MW5-15	Standard	Levelogger
709-MW6-15	Standard	Levelogger
709-MW9-15	Standard	Levelogger
709-MW11-15	Standard	Levelogger
709-MW16-15	Standard	Levelogger
709-MW18-15	Standard	Levelogger
709-MW20-15	Standard	Levelogger
709-MW21-15	Standard	Levelogger
721-MW5-15	Standard	Levelogger
721-MW6-15	Standard	Levelogger
721-MW9-15	Standard	Levelogger
721-MW10-15	Standard	Levelogger
721-MW11-15	Standard	Levelogger
721-MW12-15	Standard	Levelogger
721-MW13-15	Standard	Levelogger
721-MW14-15	Standard	Levelogger
721-MW15-15	Standard	Levelogger

25-ft Zone

Well I.D.	Type of Well	Type of Transducer
5-25	Standard	Levelogger
7-25	Standard	Levelogger
8-23	Standard	Levelogger
9-25	Standard	Levelogger
11-25	Standard	Levelogger
12-25	Standard	Levelogger
12A-25	Standard	Levelogger
14-25R	Standard	Levelogger
17C-25	CMT	Geokon
18-25	Standard	Levelogger
21C-25	CMT	Geokon
23-25R	Standard	Levelogger
34-25R	Standard	Levelogger
35-25	Standard	Levelogger
36-25	Standard	Levelogger
40-25	Standard	Levelogger
41C-25	Standard	Geokon
42-25	Standard	Levelogger
44-25	Standard	Levelogger

25-ft Zone (cont'd)

Well I.D.	Type of Well	Type of Transducer
46C-25	CMT	Geokon
53C-25	CMT	Geokon
55-25	Standard	Levelogger
61C-25	CMT	Geokon
65-25	Standard	Levelogger
67-25	Standard	Levelogger
69-25	Standard	Levelogger
70-25	Standard	Levelogger
71-25	Standard	Levelogger
77C-25	CMT	Geokon
78C-25	CMT	Geokon
80-25	Standard	Levelogger
83C-25	CMT	Geokon
84C-25	CMT	Geokon
85C-25	CMT	Geokon
86C-25	CMT	Geokon
87C-25	CMT	Geokon
88C-25	CMT	Geokon
89-25	Standard	Levelogger
90C-25	CMT	Geokon
91C-25	CMT	Geokon
92C-25	CMT	Geokon
93C-25	CMT	Geokon
94C-25	CMT	Geokon
95C-25	CMT	Geokon
709-MW6-25	Standard	Levelogger
709-MW9-25	Standard	Levelogger
709-MW11-25	Standard	Levelogger
709-MW16-25	Standard	Levelogger
709-MW18-25	Standard	Levelogger
709-MW20-25	Standard	Levelogger
709-MW21-25	Standard	Levelogger
721-MW5-25	Standard	Levelogger
721-MW6-25	Standard	Levelogger
721-MW9-25	Standard	Levelogger
721-MW10-25	Standard	Levelogger
721-MW11-25	Standard	Levelogger
721-MW12-25	Standard	Levelogger
721-MW13-25	Standard	Levelogger
721-MW14-25	Standard	Levelogger
721-MW15-25	Standard	Levelogger

50-ft Zone

Well I.D.	Type of Well	Type of Transducer
5-50	Standard	Levelogger
6A-50	Standard	Levelogger
9-50	Standard	Levelogger
11-45	Standard	Levelogger
12A-50	Standard	Levelogger
15-50R	Standard	Levelogger
17C-50	CMT	Micron
18-50R	Standard	Levelogger
21C-50	CMT	Geokon
22-50	Standard	Levelogger
32-50R	Standard	Levelogger
34-50R	Standard	Levelogger
36-50	Standard	Levelogger
40-50	Standard	Levelogger
41C-50	Standard	Geokon
42-50	Standard	Levelogger
43-50	Standard	Levelogger
44-50	Standard	Levelogger
45-50	Standard	Levelogger
46C-50	CMT	Geokon
53C-50	CMT	Geokon
55-50	Standard	Levelogger
61C-50	CMT	Geokon
65-50	Standard	Levelogger
67-50	Standard	Levelogger
71-50	Standard	Levelogger
74-50	Standard	Levelogger
75-50	Standard	Levelogger
77C-50	CMT	Geokon
78C-50	CMT	Geokon
81-50	Standard	Levelogger
83C-50	CMT	Geokon
84C-50	CMT	Geokon
85C-50	CMT	Geokon
86C-50	CMT	Geokon
87C-50	CMT	Geokon
88C-50	CMT	Geokon
89-50	Standard	Levelogger
90C-50	CMT	Micron
91C-50	CMT	Geokon
92C-50	CMT	Geokon
93C-50	CMT	Geokon
94C-50	CMT	Geokon

50-ft Zone (cont'd)

Well I.D.	Type of Well	Type of Transducer
95C-50	CMT	Geokon
709-MW6-50	Standard	Levelogger
709-MW15A-50	Standard	Levelogger
709-MW16-50	Standard	Levelogger
709-MW18-50	Standard	Levelogger
709-MW20-50	Standard	Levelogger
709-MW21-50	Standard	Levelogger
721-MW5-50	Standard	Levelogger
721-MW6-50	Standard	Levelogger
721-MW9-50	Standard	Levelogger
721-MW10-50	Standard	Levelogger
721-MW11-50	Standard	Levelogger
721-MW12-50	Standard	Levelogger
721-MW13-50	Standard	Levelogger
721-MW14-50	Standard	Levelogger
721-MW15-50	Standard	Levelogger
T3-50	Standard	Levelogger
WW-A1-2	CMT	Geokon

75-ft Zone

Well I.D.	Type of Well	Type of Transducer
5-75	Standard	Levelogger
11-75	Standard	Levelogger
12-75	Standard	Levelogger
17C-75	CMT	Micron
21C-75	CMT	Geokon
34-75	Standard	Levelogger
40-75	Standard	Levelogger
41C-75	Standard	Geokon
46C-75	CMT	Geokon
53C-75	CMT	Geokon
61C-75	CMT	Geokon
74-75	Standard	Levelogger
75-75	Standard	Levelogger
77C-75	CMT	Geokon
78C-75	CMT	Geokon
83C-75	CMT	Geokon
84C-75	CMT	Geokon
85C-75	CMT	Geokon
86C-75	CMT	Geokon
87C-75	CMT	Micron
88C-75	CMT	Geokon
89-75	Standard	Levelogger

TABLE 1

SUMMARY OF HYDRAULIC MONITORING LOCATIONS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WA

75-ft Zone (cont'd)

Well I.D.	Type of Well	Type of Transducer
90C-75	CMT	Micron
91C-75	CMT	Geokon
92C-75	CMT	Geokon
93C-75	CMT	Geokon
94C-75	CMT	Micron
95C-75	CMT	Geokon
709-MW16-75	Standard	Levelogger
709-MW20-75	Standard	Levelogger
721-MW5-75	Standard	Levelogger
721-MW10-75	Standard	Levelogger
721-MW11-75	Standard	Levelogger
PZ-SHI-2-75	Standard	Levelogger
PZ-SHI-3-75	Standard	Levelogger
WW-A1-75	CMT	Geokon
WW-B1-2	CMT	Geokon
WW-B1-75	CMT	Geokon
WW-C1-2	CMT	Geokon
WW-C1-75	CMT	Geokon

100-ft Zone

Well I.D.	Type of Well	Type of Transducer
5-100	Standard	Levelogger
6A-100	Standard	Levelogger
7-100	Standard	Levelogger
9-100	Standard	Levelogger
11-100	Standard	Levelogger
12-100	Standard	Levelogger
17C-100	CMT	Micron
21C-100	CMT	Geokon
34C-100	Standard	Micron
35-100R	Standard	Levelogger
36-100R	Standard	Levelogger
40-100R	Standard	Levelogger
41C-100	Standard	Geokon
45-100	Standard	Levelogger
46C-100	CMT	Geokon
53C-100	CMT	Micron
61C-100	CMT	Geokon
64-100	Standard	Levelogger
65-100	Standard	Levelogger
74-100	Standard	Levelogger
75-100	Standard	Levelogger

100-ft Zone (cont'd)

Well I.D.	Type of Well	Type of Transducer
77C-100	CMT	Geokon
78C-100	CMT	Geokon
82-100	Standard	Levelogger
83C-100	CMT	Micron
84C-100	CMT	Geokon
85C-100	CMT	Geokon
86C-100	CMT	Micron
87C-100	CMT	Micron
88C-100	CMT	Geokon
89C-100	CMT	Geokon
90C-100	CMT	Geokon
91C-100	CMT	Geokon
92C-100	CMT	Geokon
93C-100	CMT	Geokon
94C-100	CMT	Geokon
95C-100	CMT	Geokon
PZ-SHI-2-100	Standard	Levelogger
WW-A1-100	CMT	Geokon
WW-B1-100	CMT	Geokon
WW-C1-100M	CMT	Geokon
WW-C1-100S	CMT	Geokon

130-ft Zone

Well I.D.	Type of Well	Type of Transducer
17C-130	CMT	Geokon
21C-130	CMT	Geokon
34C-130	CMT	Geokon
41C-130	Standard	Geokon
46C-130	CMT	Geokon
53C-130	CMT	Geokon
61C-130	CMT	Geokon
65-130	Standard	Levelogger
75-130	Standard	Levelogger
77C-130	CMT	Geokon
78C-130	CMT	Geokon
83C-130	CMT	Geokon
84C-130	CMT	Geokon
85C-130	CMT	Geokon
86C-130	CMT	Geokon
87C-130	CMT	Geokon
88C-130	CMT	Geokon
89C-130	CMT	Geokon

130-ft Zone (cont'd)

Well I.D.	Type of Well	Type of Transducer
90C-130	CMT	Geokon
91C-130	CMT	Geokon
92C-130	CMT	Geokon
93C-130	CMT	Geokon
94C-130	CMT	Geokon
95C-130	CMT	Geokon
T5-120	Standard	Levelogger
WW-A1-130	CMT	Geokon
WW-B1-130	CMT	Geokon

160-ft Zone

Well I.D.	Type of Well	Type of Transducer
7-181	Standard	Levelogger
11-183	Standard	Levelogger
12-160	Standard	Levelogger
17C-160	CMT	Geokon
21C-160	CMT	Geokon
34C-160	Standard	Geokon
41C-160	Standard	Geokon
46C-160	CMT	Geokon
53C-160	CMT	Geokon
61C-160	CMT	Geokon
64-170	Standard	Levelogger
77C-160	CMT	Geokon
78C-160	CMT	Geokon
83C-160	CMT	Geokon
84C-160	CMT	Geokon
85C-160	CMT	Geokon
86C-160	CMT	Geokon
87C-160	CMT	Geokon
88C-160	CMT	Geokon
89C-160	CMT	Geokon
90C-160	CMT	Geokon
91C-160	CMT	Geokon
92C-160	CMT	Geokon
93C-160	CMT	Geokon
94C-160	CMT	Geokon
95C-160	CMT	Geokon
WW-A1-160	CMT	Geokon
WW-B1-160	CMT	Geokon

Below 160-ft Zone

Well I.D.	Type of Well	Type of Transducer	
46C-250	Below CMT	Geokon	
89C-185	Below CMT	Geokon	*Malfunctioned*
93C-220	Below CMT	Geokon	
93C-286	Below CMT	Geokon	
95C-198	Below CMT	Geokon	

TABLE 2a

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - SOLINST LEVELOGGER PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

							Category 1)			*Categories 2) & 3)*			*Categories 4) & 5)*			*Category 6)*
Monitoring Well	*Transducer Accuracy [1] (ft H_2O)*	*Average of Manual Water Column Height [2] (ft)*	*Average of Corresponding Transducer Pressure (lbs/ft^2)*	*Measured Density at Time of Sampling [3] (lbs/ft^3)*	*Density Based on Linear Regression Analysis [4] (lbs/ft^3)*	*Difference Between Measured Density and Linear Regression Density (lbs/ft^3)*	*Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No*	*Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No*	*Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No*	*Pressure Difference Between Measured Density and Regression Density [5] (PSI)*	*Category 2): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Pressure Difference Between Freshwater Column Pressure and Transducer Pressure [6] (PSI)*	*Category 4): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation [7]*
5-25	± 0.0071	12.88	5.56	63.74	62.09	1.65	No	No	Yes	--	--	--	0.0265	Yes (Acceptable)	--	--
5-50	± 0.0142	37.62	16.31	63.61	62.42	1.19	No	No	Yes	--	--	--	-0.0058	No	Yes (Acceptable)	--
5-75	± 0.0213	61.40	27.25	64.80	63.93	0.88	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
5-100	± 0.0711	87.47	38.25	63.46	62.96	0.50	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
6A-50	± 0.0142	37.70	16.45	62.92	62.83	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
6A-100	± 0.0711	87.27	38.19	63.57	63.01	0.56	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
7-25	± 0.0071	11.99	5.23	62.47	62.82	-0.34	No	Yes	No	-0.02871	No	Yes (Acceptable)	--	--	--	--
7-100	± 0.0711	86.37	38.03	63.48	63.41	0.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
7-181	± 0.0711	170.89	74.31	62.71	62.62	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
8-23	± 0.0071	13.68	5.94	62.56	62.54	0.01	Yes (Acceptable)	--	--	--	--	--	--	--	--	Not Acceptable
9-25	± 0.0071	12.72	5.57	62.45	63.05	-0.60	No	Yes	No	-0.05341	No	Yes (Acceptable)	--	--	--	--
9-50	± 0.0142	38.07	16.50	62.58	62.41	0.17	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
9-100	± 0.0711	88.49	38.43	63.60	62.53	1.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
11-25	± 0.0071	12.24	5.33	62.51	62.75	-0.24	No	Yes	No	-0.02012	No	Yes (Acceptable)	--	--	--	--
11-45	± 0.0142	29.24	12.75	62.85	62.78	0.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
11-75	± 0.0213	62.09	27.04	63.03	62.78	0.25	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
11-100	± 0.0711	87.44	38.20	65.69	62.91	2.77	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
11-183	± 0.0711	172.00	74.80	62.87	62.62	0.24	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
12-25	± 0.0071	11.97	5.17	62.43	62.21	0.22	No	Yes	No	0.01803	No	Yes (Acceptable)	--	--	--	--
12-75	± 0.0213	61.12	26.77	63.11	63.06	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
12-100	± 0.0711	89.53	38.78	63.35	62.37	0.97	No	No	Yes	--	--	--	0.0174	Yes (Acceptable)	--	--
12-160	± 0.0711	150.19	65.47	62.65	62.77	-0.12	No	Yes	No	-0.12956	No	Yes (Acceptable)	--	--	--	--
12A-25	± 0.0071	12.61	5.46	62.52	62.38	0.14	No	No	Yes	--	--	--	0.0018	Yes (Acceptable)	--	--
12A-50	± 0.0142	37.26	16.18	62.58	62.53	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
14-25R	± 0.0071	12.67	5.50	62.51	62.46	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
15-50R	± 0.0142	37.19	16.43	63.83	63.61	0.21	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
18-25	± 0.0071	12.26	5.33	62.62	62.69	-0.07	No	Yes	No	-0.00568	Yes (Acceptable)	--	--	--	--	--
18-50R	± 0.0142	35.68	15.88	64.83	64.10	0.73	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
22-50	± 0.0142	34.86	15.22	63.32	62.87	0.45	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
23-25R	± 0.0071	12.32	5.36	62.60	62.65	-0.05	No	Yes	No	-0.00465	Yes (Acceptable)	--	--	--	--	--
32-50R	± 0.0142	36.68	15.91	62.48	62.45	0.03	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
34-25R	± 0.0071	11.86	5.14	62.53	62.44	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
34-50R	± 0.0142	36.78	15.94	62.49	62.40	0.09	No	No	Yes	--	--	--	0.0003	Yes (Acceptable)	--	--
34-75	± 0.0213	61.51	26.76	63.18	62.65	0.52	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
35-25	± 0.0071	12.23	5.30	62.55	62.46	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
35-100R	± 0.0711	86.63	38.33	63.78	63.71	0.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
36-25	± 0.0071	12.62	5.50	62.48	62.78	-0.30	No	Yes	No	-0.02588	No	Yes (Acceptable)	--	--	--	--
36-50	± 0.0142	37.12	16.17	62.47	62.71	-0.25	No	Yes	No	-0.06350	No	Yes (Acceptable)	--	--	--	--
36-100R	± 0.0711	87.47	38.09	62.49	62.71	-0.22	No	Yes	No	-0.13491	No	Yes (Acceptable)	--	--	--	--
40-25	± 0.0071	8.96	3.88	62.49	62.34	0.15	No	No	Yes	--	--	--	0.0033	Yes (Acceptable)	--	--
40-50	± 0.0142	33.17	14.49	63.65	62.91	0.74	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
40-75	± 0.0213	61.64	26.90	63.55	62.84	0.71	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
40-100R	± 0.0711	86.48	37.90	63.91	63.11	0.80	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
41-130	± 0.0711	118.81	51.76	63.65	62.73	0.91	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
42-25	± 0.0071	12.81	5.56	62.58	62.56	0.02	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
42-50	± 0.0142	36.96	16.08	62.63	62.64	-0.02	No	Yes	No	-0.00412	Yes (Acceptable)	--	--	--	--	--
43-50	± 0.0142	36.82	16.04	62.88	62.75	0.13	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
44-25	± 0.0071	12.60	5.48	62.55	62.54	0.01	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
44-50	± 0.0142	37.31	16.26	62.83	62.74	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
45-50	± 0.0142	38.01	16.51	62.61	62.53	0.08	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
45-100	± 0.0711	88.27	38.51	63.86	62.81	1.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
49-15	± 0.0071	4.99	2.19	62.61	63.10	-0.49	No	Yes	No	-0.01706	No	Yes (Acceptable)	--	--	--	--
50-15	± 0.0071	4.97	2.17	62.52	62.98	-0.46	No	Yes	No	-0.01601	No	Yes (Acceptable)	--	--	--	--
52-15	± 0.0071	5.29	2.32	62.36	63.25	-0.89	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
55-25	± 0.0071	12.54	5.45	62.50	62.58	-0.08	No	Yes	No	-0.00681	Yes (Acceptable)	--	--	--	--	--
55-50	± 0.0142	37.34	16.32	62.88	62.94	-0.07	No	Yes	No	-0.01729	No	Yes (Acceptable)	--	--	--	--
64-100	± 0.0711	87.50	38.47	63.67	63.31	0.36	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
64-170	± 0.0711	167.54	73.12	63.03	62.84	0.18	Yes (Acceptable)	--	--	--	--	--	--	--	--	--

TABLE 2a

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - SOLINST LEVELOGGER PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

							Category 1)			*Categories 2) & 3)*			*Categories 4) & 5)*			*Category 6)*
Monitoring Well	*Transducer Accuracy [(1)] (ft H_2O)*	*Average of Manual Water Column Height [(2)] (ft)*	*Average of Corresponding Transducer Pressure (lbs/ft^2)*	*Measured Density at Time of Sampling [(3)] (lbs/ft^3)*	*Density Based on Linear Regression Analysis [(4)] (lbs/ft^3)*	*Difference Between Measured Density and Linear Regression Density (lbs/ft^3)*	*Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No*	*Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No*	*Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No*	*Pressure Difference Between Measured Density and Regression Density [(5)] (PSI)*	*Category 2): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Pressure Difference Between Freshwater Column Pressure and Transducer Pressure [(6)] (PSI)*	*Category 4): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation [(7)]*
65-25	± 0.0071	12.78	5.56	62.89	62.62	0.27	No	No	Yes	--	--	--	-0.0190	No	Yes (Acceptable)	--
65-50	± 0.0142	36.17	16.08	64.08	64.01	0.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
65-100	± 0.0711	87.58	38.47	68.25	63.26	4.99	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
65-130	± 0.0711	121.86	52.41	62.59	61.94	0.66	No	No	Yes	--	--	--	0.3933	No	Yes (Acceptable)	--
67-25	± 0.0071	12.97	5.64	62.59	62.59	0.00	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
67-50	± 0.0142	37.34	16.33	62.47	62.98	-0.51	No	Yes	No	-0.13178	No	Yes (Acceptable)	--	--	--	--
69-25	± 0.0071	13.44	5.88	62.94	63.00	-0.06	No	Yes	No	-0.00567	Yes (Acceptable)	--	--	--	--	--
70-25	± 0.0071	11.11	5.02	63.32	64.95	-1.63	No	Yes	No	-0.12575	No	Yes (Acceptable)	--	--	--	--
71-25	± 0.0071	12.31	5.46	63.23	63.89	-0.66	No	Yes	No	-0.05665	No	Yes (Acceptable)	--	--	--	--
71-50	± 0.0142	36.88	16.20	63.72	63.28	0.43	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
74-50	± 0.0142	36.39	15.96	63.50	63.16	0.35	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
74-75	± 0.0213	62.54	27.16	63.81	62.54	1.28	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
74-100	± 0.0711	87.38	38.29	63.91	63.09	0.81	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
75-50	± 0.0142	37.39	16.38	63.67	63.09	0.58	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
75-75	± 0.0213	59.12	27.27	67.42	66.43	0.99	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
75-100	± 0.0711	88.39	38.45	62.79	62.64	0.15	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
75-130	± 0.0711	119.06	51.48	62.44	62.26	0.18	No	No	Yes	--	--	--	0.1140	No	Yes (Acceptable)	--
80-25	± 0.0071	12.34	5.51	62.91	64.23	-1.32	No	Yes	No	-0.11320	No	Yes (Acceptable)	--	--	--	--
81-50	± 0.0142	35.76	16.04	65.86	64.60	1.26	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
82-100	± 0.0711	79.76	37.52	68.26	67.74	0.52	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89-25	± 0.0071	12.02	5.20	62.34	62.32	0.02	No	No	Yes	--	--	--	0.0066	No	Yes (Acceptable)	--
89-50	± 0.0142	36.80	15.97	62.66	62.49	0.17	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89-75	± 0.0213	62.17	27.11	63.16	62.80	0.36	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
95-15	± 0.0071	3.66	1.55	62.40	61.02	1.38	No	No	Yes	--	--	--	0.0360	No	Yes (Acceptable)	--
DOCK	± 0.0071	12.52	5.49	63.83	63.11	0.73	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
PZ-SHI-2-75	± 0.0213	61.40	27.50	64.70	64.50	0.20	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
PZ-SHI-2-100	± 0.0711	83.66	38.90	67.06	66.96	0.10	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
PZ-SHI-3-75	± 0.0213	60.65	27.10	64.62	64.35	0.27	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
T3-50	± 0.0142	38.08	16.92	63.72	63.97	-0.25	No	Yes	No	-0.06584	No	Yes (Acceptable)	--	--	--	--
T5-120	± 0.0711	100.93	48.38	69.34	69.03	0.31	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW5-15	± 0.0071	4.12	1.78	63.46	62.24	1.22	No	No	Yes	--	--	--	0.0049	Yes (Acceptable)	--	--
709-MW6-15	± 0.0071	4.87	2.09	62.49	61.88	0.61	No	No	Yes	--	--	--	0.0154	No	Yes (Acceptable)	--
709-MW6-25	± 0.0071	12.00	5.28	63.94	63.41	0.53	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW6-50	± 0.0142	37.13	16.15	62.57	62.62	-0.05	No	Yes	No	-0.01243	No	Yes (Acceptable)	--	--	--	--
709-MW9-15	± 0.0071	4.29	1.86	62.51	62.34	0.17	No	No	Yes	--	--	--	0.0004	Yes (Acceptable)	--	--
709-MW9-25	± 0.0071	12.23	5.31	62.54	62.48	0.06	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW11-15	± 0.0071	4.00	1.74	62.48	62.43	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW11-25	± 0.0071	12.33	5.35	62.52	62.49	0.03	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW15A-50	± 0.0142	37.15	16.14	62.94	62.57	0.37	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW16-15	± 0.0071	4.49	1.93	62.48	61.88	0.61	No	No	Yes	--	--	--	0.0158	No	Yes (Acceptable)	--
709-MW16-25	± 0.0071	12.17	5.27	62.48	62.38	0.10	No	No	Yes	--	--	--	0.0018	Yes (Acceptable)	--	--
709-MW16-50	± 0.0142	37.14	16.12	62.59	62.51	0.08	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
709-MW16-75	± 0.0213	61.78	27.03	62.49	63.01	-0.52	No	Yes	No	-0.22335	No	Yes (Acceptable)	--	--	--	--
709-MW18-15	± 0.0071	4.02	1.76	62.53	63.02	-0.49	No	Yes	No	-0.01359	No	Yes (Acceptable)	--	--	--	--
709-MW18-25	± 0.0071	12.21	5.28	62.53	62.27	0.27	No	No	Yes	--	--	--	0.0105	No	Yes (Acceptable)	--
709-MW18-50	± 0.0142	37.28	16.19	62.52	62.54	-0.02	No	Yes	No	-0.00431	Yes (Acceptable)	--	--	--	--	--
709-MW20-15	± 0.0071	4.09	1.80	62.56	63.22	-0.66	No	Yes	No	-0.01867	No	Yes (Acceptable)	--	--	--	--
709-MW20-25	± 0.0071	12.19	5.27	62.48	62.19	0.30	No	No	Yes	--	--	--	0.0103	No	Yes (Acceptable)	--
709-MW20-50	± 0.0142	37.23	16.17	62.51	62.52	-0.01	No	Yes	No	-0.00363	Yes (Acceptable)	--	--	--	--	--
709-MW20-75	± 0.0213	62.18	27.05	63.39	62.65	0.74	Yes (Acceptable)	--	--	--	--	--	--	--	--	--

TABLE 2a

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - SOLINST LEVELOGGER PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

							Category 1)			*Categories 2) & 3)*			*Categories 4) & 5)*			*Category 6)*
Monitoring Well	*Transducer Accuracy [1] ($ft\ H_2O$)*	*Average of Manual Water Column Height [2] (ft)*	*Average of Corresponding Transducer Pressure (lbs/ft^2)*	*Measured Density at Time of Sampling [3] (lbs/ft^3)*	*Density Based on Linear Regression Analysis [4] (lbs/ft^3)*	*Difference Between Measured Density and Linear Regression Density (lbs/ft^3)*	*Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No*	*Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No*	*Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No*	*Pressure Difference Between Measured Density and Regression Density [5] (PSI)*	*Category 2): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Pressure Difference Between Freshwater Column Pressure and Transducer Pressure [6] (PSI)*	*Category 4): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation [7]*
709-MW21-15	± 0.0071	3.95	1.73	62.47	62.88	-0.41	No	Yes	No	-0.01118	No	Yes (Acceptable)	--	--	--	--
709-MW21-25	± 0.0071	12.36	5.35	62.51	62.34	0.17	No	No	Yes	--	--	--	0.0055	Yes (Acceptable)	--	--
709-MW21-50	± 0.0142	37.58	16.30	62.54	62.48	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW5-15	± 0.0071	4.15	1.81	62.43	62.83	-0.40	No	Yes	No	-0.01154	No	Yes (Acceptable)	--	--	--	--
721-MW5-25	± 0.0071	12.12	5.28	62.66	62.72	-0.06	No	Yes	No	-0.00465	Yes (Acceptable)	--	--	--	--	--
721-MW5-50	± 0.0142	37.21	16.16	62.80	62.52	0.28	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW5-75	± 0.0213	62.47	27.15	63.53	62.59	0.93	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW6-15	± 0.0071	3.89	1.69	62.50	62.66	-0.16	No	Yes	No	-0.00425	Yes (Acceptable)	--	--	--	--	--
721-MW6-25	± 0.0071	11.98	5.20	62.57	62.52	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW6-50	± 0.0142	37.21	16.17	62.85	62.57	0.28	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW9-15	± 0.0071	3.62	1.60	62.56	63.56	-1.00	No	Yes	No	-0.02511	No	Yes (Acceptable)	--	--	--	--
721-MW9-25	± 0.0071	12.00	5.21	62.66	62.46	0.20	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW9-50	± 0.0142	36.94	16.14	62.97	62.92	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW10-15	± 0.0071	3.65	1.57	62.78	61.97	0.81	No	No	Yes	--	--	--	0.0106	No	Yes (Acceptable)	--
721-MW10-25	± 0.0071	12.69	5.51	62.49	62.57	-0.08	No	Yes	No	-0.00691	Yes (Acceptable)	--	--	--	--	--
721-MW10-50	± 0.0142	37.52	16.37	62.49	62.81	-0.32	No	Yes	No	-0.08402	No	Yes (Acceptable)	--	--	--	--
721-MW10-75	± 0.0213	61.97	27.27	63.51	63.36	0.15	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW11-15	± 0.0071	3.89	1.71	62.46	63.30	-0.84	No	Yes	No	-0.02275	No	Yes (Acceptable)	--	--	--	--
721-MW11-25	± 0.0071	12.10	5.25	62.53	62.48	0.05	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW11-50	± 0.0142	37.38	16.22	62.63	62.48	0.15	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW11-75	± 0.0213	62.28	27.17	63.53	62.82	0.71	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW12-15	± 0.0071	4.01	1.77	62.44	63.35	-0.90	No	Yes	No	-0.02522	No	Yes (Acceptable)	--	--	--	--
721-MW12-25	± 0.0071	12.36	5.36	62.51	62.50	0.01	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW12-50	± 0.0142	37.17	16.13	62.55	62.48	0.07	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW13-15	± 0.0071	4.04	1.74	62.39	61.93	0.46	No	No	Yes	--	--	--	0.0128	No	Yes (Acceptable)	--
721-MW13-25	± 0.0071	12.50	5.40	62.48	62.18	0.30	No	No	Yes	--	--	--	0.0180	No	Yes (Acceptable)	--
721-MW13-50	± 0.0142	37.37	16.22	62.57	62.48	0.09	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
721-MW14-15	± 0.0071	3.88	1.71	62.40	63.16	-0.76	No	Yes	No	-0.02050	No	Yes (Acceptable)	--	--	--	--
721-MW14-25	± 0.0071	12.42	5.36	62.45	62.13	0.32	No	No	Yes	--	--	--	0.0228	No	Yes (Acceptable)	--
721-MW14-50	± 0.0142	37.28	16.19	62.48	62.54	-0.06	No	Yes	No	-0.01537	No	Yes (Acceptable)	--	--	--	--
721-MW15-15	± 0.0071	3.58	1.57	62.47	63.12	-0.65	No	Yes	No	-0.01608	No	Yes (Acceptable)	--	--	--	--
721-MW15-25	± 0.0071	12.22	5.29	62.47	62.35	0.12	No	No	Yes	--	--	--	0.0044	Yes (Acceptable)	--	--
721-MW15-50	± 0.0142	37.44	16.24	62.54	62.46	0.08	Yes (Acceptable)	--	--	--	--	--	--	--	--	--

Notes:

(1) Transducer accuracy based on manufacturer specifications:
Solinst Levelogger (all models have an accuracy of +/- 0.05% full scale):

Full Scale of Model F30 =	32.8	feet H_2O	Accuracy =	± 0.0071	psi
Full Scale of Model F65 =	65.6	feet H_2O	Accuracy =	± 0.0142	psi
Full Scale of Model F100 =	98.4	feet H_2O	Accuracy =	± 0.0213	psi
Full Scale of Model F300 =	328.1	feet H_2O	Accuracy =	± 0.0711	psi

(2) Manual water column height is determined by subtracting the manual depth to water from the installed depth of the transducer.

(3) Measured Density determined from specific gravity samples collected during the water quality monitoring event. Event 3 groundwater sampling May 31 through August 13, 2012.

(4) Density determined by linear regression analysis of transducer pressure versus manual water column height.

(5) Pressure Difference between regression density and measured density determined using the following equation:

$$Pressure\ Difference = \left(\frac{Measured\ Density \times Manual\ Water\ Column\ Height\ -\ Regression\ Density \times Manual\ Water\ Column\ Height}{144}\right)$$

(6) Pressure difference between freshwater column and transducer pressure:

$$Pressure\ Difference = \left(\frac{Freshwater\ Density \times Manual\ Water\ Column\ Height}{144}\right) - Transducer\ Pressure$$

(7) Category 6 locations may exhibit acceptable regression density and not reasonable FEH at zone grouping plane elevation.

TABLE 2b

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - GEOKON VIBRATING WIRE PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

	Geokon Transducer Calibration Data										Category 1)			Categories 2) & 3)			Categories 4) & 5)			Category 6)
Monitoring Well	Linear Gage Factor (PSI/digit) G	Thermal Factor (PSI/°C) K	Polynomial Gage Factors A	Polynomial Gage Factors B	Polynomial Gage Factors Field C Value	Polynomial Gage Factors Best Fit C Value	Polynomial Gage Factors Best Fit C QAQC Stage	Site Zero Reading (digits) R_0	Site Temperature Reading (°C) T_0	Site Barometric Pressure Reading (PSI) S_0	Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No	Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No	Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No	Pressure Difference Between Measured Density and Regression Density [5] (PSI)	Category 2): Pressure Difference Within Transducer Accuracy Yes/No	Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Pressure Difference Between Freshwater Column Pressure and Transducer Pressure [6] (PSI)	Category 4): Pressure Difference Within Transducer Accuracy Yes/No	Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation [7]
17C-25	0.01725	-0.009003	-6.546E-08	-0.01629	148.81	149.10	6	8822.5	13.8	14.5472	Yes (Acceptable)	--	--	--	--	--	--	--	--	Not Acceptable
17C-130	0.02449	0.015690	-1.151E-07	-0.02291	214.04	214.04	6	8941.0	14.5	14.6808	No	No	Yes	--	--	--	1.2556	No	Yes (Acceptable)	--
17C-160	0.02381	-0.000647	-1.207E-07	-0.02217	207.21	207.21	6	8913.8	19.9	14.8522	No	No	Yes	--	--	--	0.5102	No	Yes (Acceptable)	--
21C-25	0.01602	0.011290	-4.434E-08	-0.01537	140.52	140.76	4	8913.5	15.5	14.63	No	Yes	No	-0.00473	Yes (Acceptable)	--	--	--	--	--
21C-50	0.01286	-0.007451	-3.948E-08	-0.0123	114.14	114.41	4	9018.7	20.1	14.7226	No	Yes	No	-0.00572	Yes (Acceptable)	--	--	--	--	--
21C-75	0.01660	-0.007228	-4.741E-08	-0.01591	144.40	145.22	4	8843.0	20.6	14.7267	No	Yes	No	-0.00328	Yes (Acceptable)	--	--	--	--	--
21C-100	0.01444	-0.004841	-6.101E-08	-0.01357	125.75	125.75	1	8910.0	14.0	14.6805	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
21C-130	0.02436	0.001276	-8.914E-08	-0.02314	213.44	213.44	1	8917.6	13.4	14.6851	No	No	Yes	--	--	--	0.2131	No	No	Not Acceptable
21C-160	0.02622	0.007311	-1.156E-07	-0.02455	234.04	234.14	4	9139.7	19.8	14.8512	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
34C-130	0.02512	0.006709	-1.088E-07	-0.02362	218.06	219.23	6	8869.7	14.0	14.7887	No	Yes	No	-0.56713	No	Yes (Acceptable)	--	--	--	--
34C-160	0.02540	0.003619	-1.129E-07	-0.02379	225.98	225.98	1	9105.3	17.7	14.8885	No	No	Yes	--	--	--	0.0074	Yes (Acceptable)	--	Not Acceptable
41C-25	0.01479	-0.004691	-4.231E-08	-0.0142	126.22	126.31	4	8665.3	19.8	14.7818	No	Yes	No	-0.00210	Yes (Acceptable)	--	--	--	--	--
41C-50	0.01712	0.008899	-6.515E-08	-0.01616	148.18	148.60	4	8853.7	19.1	14.6139	No	Yes	No	-0.02063	Yes (Acceptable)	--	--	--	--	--
41C-75	0.01685	-0.000102	-9.244E-08	-0.01551	142.88	143.41	4	8755.3	22.8	14.4709	No	Yes	No	-0.04449	Yes (Acceptable)	--	--	--	--	--
41C-100	0.01586	-0.009405	-6.252E-08	-0.01495	137.75	138.31	4	8884.2	20.3	14.7602	No	Yes	No	-0.02817	Yes (Acceptable)	--	--	--	--	--
41C-160	0.02440	0.007107	-8.937E-08	-0.02317	215.19	216.13	4	8976.8	19.8	14.8313	No	Yes	No	-0.00659	Yes (Acceptable)	--	--	--	--	--
46C-25	0.01726	0.009689	-5.653E-08	-0.01645	146.77	146.86	4	8664.0	15.0	14.6725	No	Yes	No	-0.00306	Yes (Acceptable)	--	--	--	--	--
46C-50	0.01648	0.011160	-5.813E-08	-0.0156	146.85	147.11	4	9104.4	19.3	14.6717	No	Yes	No	-0.00551	Yes (Acceptable)	--	--	--	--	--
46C-75	0.01409	0.008420	-3.683E-08	-0.01356	124.80	125.43	4	8984.0	19.0	14.6413	No	Yes	No	-0.00323	Yes (Acceptable)	--	--	--	--	--
46C-100	0.01704	-0.007029	-4.589E-08	-0.01638	146.81	147.41	4	8748.5	21.2	14.7704	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
46C-130	0.02534	0.006931	-1.072E-07	-0.02387	219.40	220.05	4	8840.4	14.5	14.7431	No	Yes	No	-0.00503	Yes (Acceptable)	--	--	--	--	--
46C-160	0.02505	0.017370	-1.220E-07	-0.02333	221.49	222.24	4	9064.0	14.0	14.7453	No	Yes	No	-0.00584	Yes (Acceptable)	--	--	--	--	--
46C-250	0.04043	0.043170	-1.742E-07	-0.038	347.28	--	--	8785.1	23.6	14.8546	--	--	--	--	--	--	--	--	--	Not At Zone Grouping Plane
53C-25	0.01681	-0.001453	-5.199E-08	-0.01606	143.67	143.72	4	8700.5	17.9	14.6645	No	Yes	No	-0.00708	Yes (Acceptable)	--	--	--	--	--
53C-50	0.01402	-0.002085	-2.579E-08	-0.01365	124.01	124.20	4	8934.3	19.0	14.685	No	Yes	No	-0.00585	Yes (Acceptable)	--	--	--	--	--
53C-75	0.01721	-0.007365	-4.656E-08	-0.01652	149.80	130.41	4	8847.3	15.2	14.8162	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
53C-130	0.02532	0.008884	-1.013E-07	-0.02389	224.60	225.93	4	9053.7	14.4	14.7272	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
53C-160	0.02496	0.005254	-1.186E-07	-0.02338	211.41	211.41	1	8661.6	20.6	14.6828	No	No	Yes	--	--	--	0.1154	No	Yes (Acceptable)	--
61C-25	0.01690	-0.002471	-4.817E-08	-0.01619	147.25	147.33	6	8861.7	20.5	14.7242	No	No	Yes	--	--	--	-0.0086	Yes (Acceptable)	--	--
61C-50	0.01738	-0.007668	-5.681E-08	-0.01654	151.44	151.53	6	8885.0	19.0	14.6843	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
61C-75	0.01547	0.002726	-3.910E-08	-0.0149	137.41	137.65	6	9009.4	20.3	14.7221	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
61C-100	0.01367	-0.009252	-1.906E-08	-0.01339	123.66	124.52	4	9117.0	20.3	14.7064	No	Yes	No	-0.01144	Yes (Acceptable)	--	--	--	--	--
61C-130	0.02507	0.008143	-8.907E-08	-0.02383	220.92	223.36	4	8970.0	20.0	14.8667	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
61C-160	0.02284	0.016810	-9.029E-08	-0.02156	208.39	208.39	1	9303.3	24.0	14.8479	No	No	Yes	--	--	--	2.0644	No	No	Not Acceptable
77C-25	0.01689	0.001833	-5.343E-08	-0.01612	144.32	143.73	4	8701.6	9.9	14.6263	No	Yes	No	-0.00239	Yes (Acceptable)	--	--	--	--	--
77C-50	0.01734	-0.003127	-5.236E-08	-0.01656	150.26	150.69	4	8827.3	33.5	14.8161	No	Yes	No	-0.01398	Yes (Acceptable)	--	--	--	--	--
77C-75	0.01655	-0.002764	-4.358E-08	-0.01591	143.97	144.42	4	8835.1	35.9	14.8161	No	Yes	No	-0.01056	Yes (Acceptable)	--	--	--	--	--
77C-100	0.01714	-0.003433	-4.581E-08	-0.01647	148.73	149.23	4	8814.3	30.8	14.8161	No	Yes	No	-0.01313	Yes (Acceptable)	--	--	--	--	--
77C-130	0.02477	0.007493	-9.743E-08	-0.02346	212.78	212.76	4	8751.7	18.3	14.8149	No	Yes	No	-0.00812	Yes (Acceptable)	--	--	--	--	Not Acceptable
77C-160	0.02456	0.010590	-1.000E-07	-0.0232	213.24	214.81	4	8853.7	25.3	14.6597	No	Yes	No	-0.01779	No	Yes (Acceptable)	--	--	--	--
78C-25	0.01756	0.004424	-5.403E-08	-0.01675	154.81	154.50	4	8982.4	14.0	14.5629	No	Yes	No	-0.00176	Yes (Acceptable)	--	--	--	--	--
78C-50	0.01744	0.000849	-7.423E-08	-0.01639	145.38	145.69	4	8539.6	14.0	14.7003	No	Yes	No	-0.00286	Yes (Acceptable)	--	--	--	--	--
78C-75	0.01673	-0.005311	-3.407E-08	-0.01624	146.08	146.20	4	8831.2	20.2	14.8066	No	Yes	No	-0.01725	Yes (Acceptable)	--	--	--	--	--
78C-100	0.01643	0.001474	-2.550E-08	-0.01606	144.00	144.49	4	8842.0	14.0	14.702	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
78C-130	0.02534	0.006808	-1.178E-07	-0.02374	218.11	216.79	4	8802.8	19.9	14.8568	No	Yes	No	-0.02457	Yes (Acceptable)	--	--	--	--	--
78C-160	0.02340	0.001805	-1.083E-07	-0.02193	205.22	205.49	4	8961.4	17.0	14.8725	No	Yes	No	-0.02938	Yes (Acceptable)	--	--	--	--	--
83C-25	0.01530	0.018670	-4.534E-08	-0.01466	131.58	131.64	4	8739.0	16.5	14.6099	No	Yes	No	-0.00451	Yes (Acceptable)	--	--	--	--	--
83C-50	0.01618	-0.001135	-4.368E-08	-0.01555	139.60	139.88	4	8762.0	14.5	14.6683	No	Yes	No	-0.00275	Yes (Acceptable)	--	--	--	--	--
83C-75	0.01417	0.008069	-3.006E-08	-0.01373	126.12	126.93	4	9008.2	14.7	14.7126	No	Yes	No	-0.00538	Yes (Acceptable)	--	--	--	--	--
83C-130	0.02562	0.008270	-1.232E-07	-0.02395	219.75	219.75	4	8779.0	14.5	14.7297	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
83C-160	0.02601	0.018290	-1.270E-07	-0.02424	224.91	224.91	1	8866.7	19.9	14.8516	No	No	Yes	--	--	--	0.1877	No	Yes (Acceptable)	--
84C-25	0.01760	0.004377	-8.645E-08	-0.01634	149.54	149.63	6	8747.0	19.7	14.7868	No	No	Yes	--	--	--	-0.0202	Yes (Acceptable)	--	--
84C-50	0.01577	-0.005158	-5.329E-08	-0.01499	136.98	137.36	6	8859.0	19.4	14.8174	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
84C-75	0.01745	-0.008166	-5.25E-08	-0.01667	152.74	153.21	6	8912.5	20.2	14.8365	No	Yes	No	-0.01630	Yes (Acceptable)	--	--	--	--	--
84C-100	0.01712	0.002360	-5.041E-08	-0.01639	145.55	146.08	6	8650.2	19.0	14.8419	No	Yes	No	-0.02559	Yes (Acceptable)	--	--	--	--	--
84C-130	0.02578	0.009764	-1.012E-07	-0.02436	225.36	219.57	6	8920.8	19.4	14.8495	No	Yes	No	-0.04193	Yes (Acceptable)	--	--	--	--	--
84C-160	0.02543	0.005745	-7.337E-08	-0.02444	218.85	219.96	4	8725.9	18.9	14.8485	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
85C-25	0.01570	-0.005379	-5.333E-08	-0.01492	137.49	137.33	6	8930.0	22.5	14.6222	No	Yes	No	-0.01125	Yes (Acceptable)	--	--	--	--	--
85C-50	0.01624	-0.007208	-5.451E-08	-0.01543	141.75	141.82	6	8906.5	18.8	14.7939	No	Yes	No	-0.00136	Yes (Acceptable)	--	--	--	--	--
85C-75	0.01705	0.007283	-6.059E-08	-0.01619	144.57	144.89	6	8649.5	22.7	14.6002	No	Yes	No	-0.02990	Yes (Acceptable)	--	--	--	--	--

TABLE 2b

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - GEOKON VIBRATING WIRE PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

	Geokon Transducer Calibration Data										Category 1)			Categories 2) & 3)			Categories 4) & 5)			Category 6)
Monitoring Well	Linear Gage Factor (PSI/digit) G	Thermal Factor (PSI/°C) K	Polynomial Gage Factors A	Polynomial Gage Factors B	Field C Value	Best Fit C Value	Best Fit C QAQC Stage	Site Zero Reading (digits) R_0	Site Temperature Reading (°C) T_0	Site Barometric Pressure Reading (PSI) S_0	Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No	Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No	Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No	Pressure Difference Between Measured Density and Regression Density (5) (PSI)	Category 2): Pressure Difference Within Transducer Accuracy Yes/No	Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Pressure Difference Between Freshwater Column Pressure and Transducer Pressure (6) (PSI)	Category 4): Pressure Difference Within Transducer Accuracy Yes/No	Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation (7)
85C-100	0.01652	0.004988	-6.440E-08	-0.01557	144.44	144.19	4	8945.8	20.7	14.6141	No	Yes	No	-0.01293	Yes (Acceptable)	--	--	--	--	--
85C-130	0.02507	0.012530	-9.208E-08	-0.02378	220.57	221.03	4	8964.1	19.5	14.7644	No	Yes	No	-0.01906	Yes (Acceptable)	--	--	--	--	--
85C-160	0.02529	0.013610	-7.144E-08	-0.02428	225.92	225.37	4	9063.0	20.6	14.7644	No	Yes	No	-0.01136	Yes (Acceptable)	--	--	--	--	Not Acceptable
86C-25	0.01627	0.000542	-5.627E-08	-0.01543	143.91	143.87	6	9029.1	21.2	14.5621	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
86C-50	0.01507	0.001281	-5.454E-08	-0.01428	131.02	129.92	6	8874.4	20.2	14.5655	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
86C-75	0.01764	-0.003306	-7.651E-08	-0.01651	151.79	152.36	4	8832.3	16.9	14.5523	No	Yes	No	-0.00409	Yes (Acceptable)	--	--	--	--	--
86C-130	0.02484	0.003189	-1.016E-07	-0.02345	216.81	216.11	4	8902.1	20.2	14.5945	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
86C-160	0.02138	0.016590	-9.351E-08	-0.02014	188.85	190.28	4	9000.8	21.4	14.5239	No	Yes	No	-0.00806	Yes (Acceptable)	--	--	--	--	--
87C-25	0.01724	0.005959	-6.478E-08	-0.01628	149.19	149.35	6	8852.4	20.3	14.771	No	Yes	No	-0.00054	Yes (Acceptable)	--	--	--	--	--
87C-50	0.01689	-0.003119	-6.138E-08	-0.01598	146.99	147.16	6	8894.7	22.3	14.631	No	Yes	No	-0.00139	Yes (Acceptable)	--	--	--	--	--
87C-130	0.02500	0.007493	-1.191E-07	-0.02335	218.36	219.36	6	8943.8	21.5	14.6339	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
87C-160	0.02489	0.012770	-9.613E-08	-0.02357	216.59	217.99	6	8868.6	21.0	14.6307	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
88C-25	0.01457	-0.003339	-7.386E-08	-0.01348	127.80	128.00	4	9033.5	21.3	14.7741	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
88C-50	0.01677	0.002547	-7.316E-08	-0.01569	146.45	146.72	4	8959.4	21.7	14.5005	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
88C-75	0.01696	0.002517	-6.171E-08	-0.01606	146.88	147.45	4	8845.3	10.4	14.4967	No	Yes	No	-0.00262	Yes (Acceptable)	--	--	--	--	--
88C-100	0.01787	0.010490	-6.722E-08	-0.0169	151.01	151.84	4	8638.4	10.2	14.4961	No	Yes	No	-0.01173	Yes (Acceptable)	--	--	--	--	--
88C-130	0.02625	0.012700	-1.093E-07	-0.02469	233.13	234.27	2	9077.5	22.1	14.5505	No	No	Yes	--	--	--	0.1993	No	No	Not Acceptable
88C-160	0.02463	0.016790	-1.104E-07	-0.02311	216.06	217.63	4	8965.3	22.0	14.7741	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89C-100	0.01527	-0.005768	-4.232E-08	-0.01466	133.26	133.57	4	8863.0	14.4	14.6705	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89C-130	0.02590	0.005027	-1.193E-07	-0.02428	221.82	222.81	4	8758.8	20.0	14.8582	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89C-160	0.02514	0.021780	-1.244E-07	-0.02337	223.73	223.73	1	9129.7	14.4	14.7043	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
89C-185	0.04244	0.039620	-2.045E-07	-0.03959	359.18	--	--	8683.0	23.5	14.8615	--	--	--	--	--	--	--	--	--	Not At Zone Grouping Plane
90C-25	0.01557	-0.002400	-4.599E-08	-0.01489	138.63	138.71	4	9057.2	20.6	14.7163	No	Yes	No	-0.00004	Yes (Acceptable)	--	--	--	--	Not Acceptable
90C-100	0.01635	0.000915	-3.960E-08	-0.01577	142.27	143.57	4	8825.8	19.5	14.6396	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
90C-130	0.02521	0.015420	-1.253E-07	-0.02353	214.24	214.24	1	8701.7	13.6	14.7096	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
90C-160	0.02373	0.021250	-1.123E-07	-0.0222	207.85	196.17	4	8957.0	15.5	14.7353	No	Yes	No	-0.01853	Yes (Acceptable)	--	--	--	--	--
91C-25	0.01295	0.002953	-5.264E-08	-0.01222	112.52	113.08	6	8869.0	21.2	14.5811	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
91C-50	0.01658	0.009031	-6.946E-08	-0.01555	144.01	144.84	4	8906.5	19.9	14.7108	No	Yes	No	-0.00411	Yes (Acceptable)	--	--	--	--	--
91C-75	0.01731	-0.006318	-7.370E-08	-0.01623	148.95	149.07	6	8824.0	22.4	14.6413	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
91C-100	0.01726	-0.004454	-7.037E-08	-0.01621	150.59	151.67	4	8942.5	20.3	14.7636	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
91C-130	0.02555	0.006084	-1.329E-07	-0.02369	223.18	223.44	6	8969.4	21.1	14.5886	No	Yes	No	-0.23291	No	Yes (Acceptable)	--	--	--	--
91C-160	0.02497	0.003165	-8.732E-08	-0.02374	222.95	223.97	4	9087.7	19.3	14.8293	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
92C-25	0.01743	-0.000890	-7.570E-08	-0.01629	152.93	153.03	6	9010.7	10.2	14.6524	No	Yes	No	-0.00167	Yes (Acceptable)	--	--	--	--	--
92C-50 (8)	0.01728	-0.000733	-9.077E-08	-0.01592	150.23	150.43	6	8977.1	21.1	14.6524	No	Yes	No	-0.00008	Yes (Acceptable)	--	--	--	--	--
92C-75	0.01774	-0.001908	-6.284E-08	-0.0168	154.62	154.62	1	8906.6	10.1	14.6524	--	--	--	--	--	--	--	--	--	Not Acceptable
92C-100	0.01780	-0.003493	-6.354E-08	-0.01686	153.99	154.53	6	8838.8	20.1	14.6524	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
92C-130	0.02479	0.010010	-1.075E-07	-0.02327	220.13	220.61	6	9079.2	10.5	14.6524	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
92C-160	0.02459	-0.001038	-1.075E-07	-0.02312	214.37	214.88	6	8903.3	23.1	14.6524	No	Yes	No	-0.00850	Yes (Acceptable)	--	--	--	--	--
93C-25	0.01596	0.007725	-6.063E-08	-0.01508	137.94	138.08	4	8833.5	21.7	14.7284	No	Yes	No	-0.00651	Yes (Acceptable)	--	--	--	--	--
93C-50	0.01750	0.010350	-5.569E-08	-0.01667	152.38	152.99	4	8877.6	20.9	14.7284	No	Yes	No	-0.00495	Yes (Acceptable)	--	--	--	--	--
93C-75	0.01431	-0.001753	-4.774E-08	-0.01365	122.96	122.09	4	8740.7	21.1	14.7284	No	Yes	No	-0.00408	Yes (Acceptable)	--	--	--	--	--
93C-100	0.01740	-0.003397	-5.335E-08	-0.0166	152.80	152.79	4	8947.8	21.4	14.7865	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
93C-130	0.02482	-0.006568	-1.040E-07	-0.02335	220.43	221.64	4	9073.6	20.1	14.7577	No	Yes	No	-0.00507	Yes (Acceptable)	--	--	--	--	--
93C-160	0.02623	0.007836	-9.378E-08	-0.0249	231.95	233.61	4	9009.5	20.7	14.7284	No	Yes	No	-0.00977	Yes (Acceptable)	--	--	--	--	--
93C-220	0.04038	0.016780	-1.715E-07	-0.038	345.142578	--	--	8738.1	18.7	14.7952	--	--	--	--	--	--	--	--	--	Not At Zone Grouping Plane
93C-286	-	0.024690	-1.872E-07	-0.03824	352.371308	--	--	8832.8	19.8	14.681	--	--	--	--	--	--	--	--	--	Not At Zone Grouping Plane
94C-25	0.01699	0.000775	-8.887E-09	-0.01686	147.37	147.56	4	8700.8	20.2	14.5871	No	Yes	No	-0.00425	Yes (Acceptable)	--	--	--	--	--
94C-50	0.01624	0.001095	-3.705E-08	-0.01568	144.92	145.23	6	9048.8	18.1	14.7361	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
94C-100	0.01690	0.000652	-5.976E-08	-0.01601	146.88	147.70	6	8880.0	15.7	14.8071	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
94C-130	0.02422	0.016560	-1.055E-07	-0.02278	210.36	210.36	1	8870.0	19.4	14.6084	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
94C-160	0.02574	0.009191	-1.141E-07	-0.02414	224.78	224.78	1	8934.4	20.7	14.6965	No	No	Yes	--	--	--	5.6058	No	Yes (Acceptable)	--
95C-25	0.01570	-0.002785	-5.391E-08	-0.0149	137.38	137.41	4	8931.8	20.2	14.777	No	Yes	No	-0.01770	Yes (Acceptable)	--	--	--	--	--
95C-50	0.01557	-0.007084	-3.332E-08	-0.01508	137.83	137.92	4	8962.7	21.3	14.5374	No	Yes	No	-0.00687	Yes (Acceptable)	--	--	--	--	--
95C-75	0.01580	-0.007513	-2.184E-08	-0.01548	140.36	140.51	4	8954.3	20.1	14.8087	No	Yes	No	-0.01428	Yes (Acceptable)	--	--	--	--	--
95C-100	0.01614	0.002926	-4.081E-08	-0.01554	142.90	143.47	4	8983.9	20.4	14.7637	No	Yes	No	-0.01201	Yes (Acceptable)	--	--	--	--	--
95C-130	0.02387	0.016720	-1.025E-07	-0.02248	207.87	208.57	4	8886.9	20.6	14.5948	No	Yes	No	-0.01643	Yes (Acceptable)	--	--	--	--	--
95C-160	0.02453	0.012770	-1.103E-07	-0.02303	212.78	213.70	4	8863.1	20.2	14.7571	No	Yes	No	-0.01998	Yes (Acceptable)	--	--	--	--	--
95C-198	0.04157	0.022380	-2.054E-07	-0.03875	349.676219	--	--	8629.2	21.7	14.4889	--	--	--	--	--	--	--	--	--	Not At Zone Grouping Plane
WW-A1-2'	0.01687	-0.016740	9.573E-09	-0.01701	147.882245	--	--	8736.8	20.8	14.09	Acceptable	--	--	--	--	--	--	--	--	--
WW-A1-75'	0.01610	-0.014840	-7.228E-09	-0.01599	143.044749	--	--	8910.0	10.7	14.2	--	--	--	--	--	--	--	--	--	Not Acceptable

TABLE 2b

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - GEOKON VIBRATING WIRE PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

	Geokon Transducer Calibration Data										Category 1)			Categories 2) & 3)			Categories 4) & 5)			Category 6)
			Polynomial Gage Factors																	
					Field C	Best Fit C														
Monitoring Well	Linear Gage Factor (PSI/digit) G	Thermal Factor (PSI/°C) K	A	B	Value	Value	QAQC Stage	Site Zero Reading (digits) R_0	Site Temperature Reading (°C) T_0	Site Barometric Pressure Reading (PSI) S_0	Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No	Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No	Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No	Pressure Difference Between Measured Density and Regression Density (5) (PSI)	Category 2): Pressure Difference Within Transducer Accuracy Yes/No	Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Pressure Difference Between Freshwater Column Pressure and Transducer Pressure (6) (PSI)	Category 4): Pressure Difference Within Transducer Accuracy Yes/No	Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No	Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation (7)
WW-A1-100'	0.01745	-0.008420	1.841E-09	-0.01748	153.836709	--	--	8808.9	18.0	14.04	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-A1-130'	0.02192	-0.004550	-2.896E-08	-0.02155	191.225617	--	--	8770.2	18.9	14.04	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-A1-160'	0.02232	-0.006970	-4.140E-08	-0.02177	196.280452	--	--	8866.6	15.2	14.04	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-B1-2'	0.01808	-0.018550	-2.561E-09	-0.01804	159.935952	--	--	8854.5	6.3	13.87	Acceptable	--	--	--	--	--	--	--	--	--
WW-B1-75'	0.01654	-0.026540	2.354E-09	-0.01658	147.501253	--	--	8907.6	6.3	13.87	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-B1-100'	0.01618	-0.016600	3.678E-10	-0.01618	141.315561	--	--	8735.7	7.1	13.87	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-B1-130'	0.02121	-0.011120	-1.032E-09	-0.02119	183.771546	--	--	8668.9	8.7	13.87	Acceptable	--	--	--	--	--	--	--	--	--
WW-B1-160'	0.02173	-0.006800	-4.798E-08	-0.02112	185.560194	--	--	8617.3	6.4	13.87	Acceptable	--	--	--	--	--	--	--	--	--
WW-C1-2'	0.01585	-0.013910	1.031E-09	-0.01586	136.99624	--	--	8642.7	15.2	13.95	Acceptable	--	--	--	--	--	--	--	--	--
WW-C1-75'	0.01714	-0.015710	-1.133E-08	-0.01698	147.03249	--	--	8609.7	10.7	13.97	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-C1-100'M	0.01711	-0.010080	5.643E-09	-0.01719	146.413291	--	--	8541.3	15.7	13.95	--	--	--	--	--	--	--	--	--	Not Acceptable
WW-C1-100'S	0.01816	-0.007410	-1.194E-08	-0.01799	158.945203	--	--	8784.0	9.3	14.16	--	--	--	--	--	--	--	--	--	Not Acceptable

Notes:

(1) Transducer accuracy based on manufacturer specifications:
Geokon (all models have an accuracy of +/- 0.1% full scale):

Full Scale of Model 4500s-350KPa =	117	feet H2O	Accuracy =	± 0.051	psi
Full Scale of Model 4500s-700KPa =	234	feet H2O	Accuracy =	± 0.101	psi

(2) Manual water column height is determined by subtracting the manual depth to water from the installed depth of the transducer.

(3) Measured Density determined from specific gravity samples collected during the water quality monitoring event. Event 3 groundwater sampling May 31 through August 13, 2012.

(4) Density determined by linear regression analysis of transducer pressure versus manual water column height (see corresponding figure).

(5) Pressure Difference between regression density and measured density determined using the following equation:

$$\text{Pressure Difference} = \left(\frac{\text{Measured Density} \times \text{Manual Water Column Height - Regression Density} \times \text{Manual Water Column Height}}{144} \right)$$

(6) Pressure difference between freshwater column and transducer pressure:

$$\text{Pressure Difference} = \left(\frac{\text{Freshwater Density} \times \text{Manual Water Column Height}}{144} \right) - \text{Transducer Pressure}$$

(7) Category 6 locations may exhibit acceptable regression density and not reasonable FEH at zone grouping plane elevation.

(8) Difficult to monitor due to the presence of a white gooey substance

(9) Not monitored due to the presence of a white gooey substance

TABLE 2c

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT - MICRON PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

							Category 1)			*Categories 2) & 3)*			*Categories 4) & 5)*			*Category 6)*
Monitoring Well	*Transducer Accuracy [(1)] (PSI)*	*Average of Manual Water Column Height [(2)] (ft)*	*Average of Corresponding Transducer Pressure (lbs/ft^2)*	*Measured Density at Time of Sampling [(3)] (lbs/ft^3)*	*Density Based on Linear Regression Analysis [(4)] (lbs/ft^3)*	*Difference Between Measured Density and Linear Regression Density (lbs/ft^3)*	*Regression Density is Less Than Measured Density But Greater Than Fresh Water Yes/No*	*Regression Density is Greater Than Measured Density (Categories 2) & 3)) Yes/No*	*Regression Density is Less Than Freshwater Density (Categories 4) & 5)) Yes/No*	*Pressure Difference Between Measured Density and Regression Density [(5)] (PSI)*	*Category 2): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 3): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Pressure Difference Between Freshwater Column Pressure and Transducer Pressure [(6)] (PSI)*	*Category 4): Pressure Difference Within Transducer Accuracy Yes/No*	*Category 5): Pressure Difference Outside Transducer Accuracy and Reasonable FEH at Zone Grouping Plane Elevation Yes/No*	*Rejected Based on Not Reasonable FEH at Zone Grouping Plane Elevation [(7)]*
17C-50	+/- 0.38	9.32	4.25	63.34	65.60	-2.25	No	Yes	No	-0.14581	Yes (Acceptable)	--	--	--	--	--
17C-75	+/- 0.38	62.68	26.83	63.88	61.65	2.22	No	No	Yes	--	--	--	0.3290	No	No	Not Acceptable
17C-100	+/- 0.38	85.72	38.85	62.53	65.27	-2.74	No	Yes	No	-1.63064	No	Yes (Acceptable)	--	--	--	--
34C-100	+/- 0.38	84.84	36.92	63.36	62.66	0.70	Yes (Acceptable)	--	--	--	--	--	--	--	--	
53C-100	+/- 0.38	86.30	38.34	63.86	63.98	-0.12	No	Yes	No	-0.07210	Yes (Acceptable)	--	--	--	--	--
83C-100	+/- 0.38	87.92	40.13	65.97	65.72	0.25	Yes (Acceptable)	--	--	--	--	--	--	--	--	Not Acceptable
86C-100	+/- 0.38	86.60	38.63	63.71	64.06	-0.35	No	Yes	No	-0.20976	Yes (Acceptable)	--	--	--	--	--
87C-75	+/- 0.38	62.33	27.23	63.51	62.91	0.60	Yes (Acceptable)	--	--	--	--	--	--	--	--	--
87C-100	+/- 0.38	87.15	38.97	63.62	64.39	-0.77	No	Yes	No	-0.46668	Yes (Acceptable)	--	--	--	--	Not Acceptable
90C-50	+/- 0.38	36.02	16.94	63.52	67.72	-4.20	No	Yes	No	-1.05077	No	Yes (Acceptable)	--	--	--	Not Acceptable
90C-75	+/- 0.38	53.87	25.94	62.45	69.34	-6.89	No	Yes	No	-2.57590	No	Yes (Acceptable)	--	--	--	Not Acceptable
94C-75	+/- 0.38	62.64	27.76	63.83	63.84	-0.01	No	Yes	No	-0.00600	Yes (Acceptable)	--	--	--	--	--

Notes:

(1) Transducer accuracy based on manufacturer specifications:
Micron (all models have an accuracy of +/- 0.5% full scale):
Full Scale of Micron = 173.3 feet H2O Accuracy = +/- 0.3754 feet H2O

(2) Manual water column height is determined by subtracting the manual depth to water from the installed depth of the transducer.

(3) Measured Density determined from specific gravity samples collected during the water quality monitoring event. Event 3 groundwater sampling May 31 through August 13, 2012.

(4) Density determined by linear regression analysis of transducer pressure versus manual water column height (see corresponding figure).

(5) Pressure Difference between regression density and measured density determined using the following equation:

$$Pressure\ Difference = \left(\frac{Measured\ Density \times Manual\ Water\ Column\ Height - Regression\ Density \times Manual\ Water\ Column\ Height}{144}\right)$$

(6) Pressure difference between freshwater column and transducer pressure:

$$Pressure\ Difference = \left(\frac{Freshwater\ Density \times Manual\ Water\ Column\ Height}{144}\right) - Transducer\ Pressure$$

(7) Category 6 locations may exhibit acceptable regession density and not reasonable FEH at zone grouping plane elevation.

TABLE 3a

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT SUMMARY - SOLINST LEVELOGGER PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

Category 1				*Category 2*		*Category 3*		*Category 4*		*Category 5*		*Category 6*	
Regression Density is Between Fresh Water Density and Measured Density (Data Acceptable)				*Regression Density is Greater Than The Measured Density But Within The Transducer Accuracy (Data Acceptable)*		*Regression Density is Greater Than The Measured Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)*		*Regression Density is Less Than Fresh Water Density But Within The Transducer Accuracy (Data Acceptable)*		*Regression Density is Less Than Fresh Water Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)*		*Data Rejected Based On Not Reasonable FEH at Zone Grouping Plane Elevation*	
Well	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***
5-75	63.93	67-25	62.59	18-25	62.69	7-25	62.82	5-25	62.09	5-50	62.42	8-23	62.54
5-100	62.96	71-50	63.28	23-25R	62.65	9-25	63.05	12-100	62.37	65-25	62.62		
6A-50	62.83	74-50	63.16	42-50	62.64	11-25	62.75	12A-25	62.38	65-130	61.94		
6A-100	63.01	74-75	62.54	55-25	62.58	12-25	62.21	34-50R	62.40	75-130	62.26		
7-100	63.41	74-100	63.09	69-25	63.00	12-160	62.77	40-25	62.34	89-25	62.32		
7-181	62.62	75-50	63.09	709-MW18-50	62.54	36-25	62.78	709-MW5-15	62.24	95-15	61.02		
9-50	62.41	75-75	66.43	709-MW20-50	62.52	36-50	62.71	709-MW9-15	62.34	709-MW6-15	61.88		
9-100	62.53	75-100	62.64	721-MW5-25	62.72	36-100R	62.71	709-MW11-25	62.49	709-MW16-15	61.88		
11-45	62.78	81-50	64.60	721-MW6-15	62.66	49-15	63.10	709-MW16-25	62.38	709-MW18-25	62.27		
11-75	62.78	82-100	67.74	721-MW10-25	62.57	50-15	62.98	709-MW21-25	62.34	709-MW20-25	62.19		
11-100	62.91	89-50	62.49			55-50	62.94	721-MW15-25	62.35	721-MW10-15	61.97		
11-183	62.62	89-75	62.80			67-50	62.98			721-MW13-15	61.93		
12-75	63.06	DOCK	63.11			70-25	64.95			721-MW13-25	62.18		
12A-50	62.53	PZ-SHI-2-75	64.50			71-25	63.89			721-MW14-25	62.13		
14-25R	62.46	PZ-SHI-2-100	66.96			80-25	64.23						
15-50R	63.61	PZ-SHI-3-75	64.35			T3-50	63.97						
18-50R	64.10	T5-120	69.03			709-MW6-50	62.62						
22-50	62.87	709-MW6-25	63.41			709-MW16-75	63.01						
32-50R	62.45	709-MW9-25	62.48			709-MW18-15	63.02						
34-25R	62.44	709-MW11-15	62.43			709-MW20-15	63.22						
34-75	62.65	709-MW16-50	62.51			709-MW21-15	62.88						
35-25	62.46	709-MW20-75	62.65			721-MW5-15	62.83						
35-100R	63.71	709-MW21-50	62.48			721-MW9-15	63.56						
40-50	62.91	721-MW5-50	62.52			721-MW10-50	62.81						
40-75	62.84	721-MW5-75	62.59			721-MW11-15	63.30						
40-100R	63.11	721-MW6-25	62.52			721-MW12-15	63.35						
41-130	62.73	721-MW6-50	62.57			721-MW14-15	63.16						
42-25	62.56	721-MW9-25	62.46			721-MW14-50	62.54						
43-50	62.75	721-MW9-50	62.92			721-MW15-15	63.12						
44-25	62.54	721-MW10-75	63.36										
44-50	62.74	721-MW11-25	62.48										
45-50	62.53	721-MW11-50	62.48										
45-100	62.81	721-MW11-75	62.82										
52-15	63.25	721-MW12-25	62.50										
64-100	63.31	721-MW12-50	62.48										
64-170	62.84	721-MW13-50	62.48										
65-50	64.01	721-MW15-50	62.46										
65-100	63.26												

TABLE 3b

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT SUMMARY - GEOKON VIBRATING WIRE PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

Category 1

Regression Density is Between Fresh Water Density and Measured Density (Data Acceptable)

Well	*Slope*
21C-100	63.57
21C-160	62.85
46C-100	63.67
53C-75	63.48
53C-130	67.21
61C-50	62.46
61C-75	62.48
61C-130	66.75
78C-100	62.79
83C-130	65.32
84C-50	62.92
84C-160	62.94
86C-25	62.48
86C-50	62.50
86C-130	63.79
87C-130	63.69
87C-160	63.76
88C-25	62.51
88C-50	62.69
88C-160	63.76
89C-100	63.41
89C-130	63.65
89C-160	63.05
90C-100	65.31
90C-130	65.23
91C-25	62.46
91C-75	62.78
91C-100	62.60
91C-160	62.83
92C-100	62.95
92C-130	62.89
93C-100	63.49
94C-50	63.64
94C-100	63.93
94C-130	63.91

Category 2

Regression Density is Greater Than The Measured Density But Within The Transducer Accuracy (Data Acceptable)

Well	*Slope*	*Well*	*Slope*
21C-25	62.58	84C-130	63.05
21C-50	63.02	85C-25	62.68
21C-75	63.91	85C-50	62.79
41C-25	62.93	85C-75	63.71
41C-50	63.52	85C-100	62.64
41C-75	63.33	85C-130	63.80
41C-100	63.62	86C-75	63.56
41C-160	62.94	86C-160	63.83
46C-25	62.50	87C-25	62.47
46C-50	62.95	87C-50	62.52
46C-75	63.20	88C-75	63.51
46C-130	63.39	88C-100	63.58
46C-160	63.09	90C-160	62.81
53C-25	62.53	91C-50	62.83
53C-50	62.82	92C-25	62.57
61C-100	64.06	92C-50	62.80
77C-25	63.22	92C-160	63.11
77C-50	62.71	93C-25	62.64
77C-75	63.32	93C-50	63.32
77C-100	63.07	93C-75	63.52
78C-25	62.52	93C-130	63.61
78C-50	62.57	93C-160	63.75
78C-75	63.10	94C-25	63.57
78C-130	62.80	95C-25	62.72
78C-160	62.77	95C-50	62.61
83C-25	63.66	95C-75	62.61
83C-50	63.42	95C-100	63.06
83C-75	64.10	95C-130	63.14
84C-75	62.92	95C-160	63.73
84C-100	63.06		

Category 3

Regression Density is Greater Than The Measured Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)

Well	*Slope*
34C-130	64.32
77C-160	64.06
91C-130	62.90

Category 4

Regression Density is Less Than Fresh Water Density But Within The Transducer Accuracy (Data Acceptable)

Well	*Slope*
61C-25	62.11
84C-25	62.40

Data Acceptable Based on FEH Elevation, No Regreesion Density Available

Well
46C-250
89C-185
92C-75
93C-220
93C-286
95C-198
WW-A1-2'
WW-B1-2'
WW-B1-130'
WW-B1-160'
WW-C1-2'

Category 5

Regression Density is Less Than Fresh Water Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)

Well	*Slope*
17C-130	61.78
17C-160	61.91
53C-160	62.29
83C-160	62.27
94C-160	62.11

Category 6

Data Rejected Based On Not Reasonable FEH at Zone Grouping Plane Elevation

Well	*Slope*
17C-25	62.66
21C-130	62.11
34C-160	62.35
61C-160	60.03
77C-130	62.91
85C-160	62.58
88C-130	63.58
90C-25	62.60
WW-A1-75'	--
WW-A1-100'	--
WW-A1-130'	--
WW-A1-160'	--
WW-B1-75'	--
WW-B1-100'	--
WW-C1-75'	--
WW-C1-100'M	--
WW-C1-100'S	--

TABLE 3c

CSI HYDRAULIC MONITORING DATA QUALITY ASSESSMENT SUMMARY - MICRON PRESSURE TRANSDUCERS
OCCIDENTAL CHEMICAL COMPANY
TACOMA, WASHINGTON

Category 1: Regression Density is Between Fresh Water Density and Measured Density (Data Acceptable)		Category 2: Regression Density is Greater Than The Measured Density But Within The Transducer Accuracy (Data Acceptable)		Category 3: Regression Density is Greater Than The Measured Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)		Category 4: Regression Density is Less Than Fresh Water Density But Within The Transducer Accuracy (Data Acceptable)		Category 5: Regression Density is Less Than Fresh Water Density and Outside The Transducer Accuracy (Data Acceptable Based On Reasonable FEH at Zone Grouping Plane Elevation)		Category 6: Data Rejected Based On Not Reasonable FEH at Zone Grouping Plane Elevation	
Well	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***	***Well***	***Slope***
34C-100	62.66	17C-50	65.60	17C-100	65.27					17C-75	61.65
87C-75	62.91	53C-100	63.98							83C-100	65.72
		86C-100	64.06							87C-100	64.39
		94C-75	63.84							90C-50	67.90
										90C-75	69.25

TABLE 4

TIDAL MEASURE PERIODS FOR MANUAL WATER LEVELS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	***Calculated Time of Tidal Peak/Trough***	***Tidal Measure Period Start***		***Tidal Measure Period End***
21C-130	6/22/2013 12:50	6/22/2013 10:20	to	6/22/2013 17:10
34C-130	8/2/2013 10:15	8/2/2013 7:20	to	8/2/2013 16:50
34C-160	8/2/2013 8:35	8/2/2013 7:20	to	8/2/2013 16:30
53C-130	7/11/2013 15:45	7/11/2013 10:45	to	7/11/2013 17:55
61C-130	6/23/2013 12:48	6/23/2013 10:18	to	6/23/2013 17:03
61C-160	6/23/2013 11:43	6/23/2013 10:18	to	6/23/2013 17:03
77C-130	6/24/2013 13:35	6/24/2013 13:15	to	6/24/2013 17:00
77C-130 con't	-	6/25/2013 9:20	to	6/25/2013 10:35
77C-160	6/24/2013 14:10	6/24/2013 13:15	to	6/24/2013 17:00
77C-160 con't	-	6/25/2013 9:20	to	6/25/2013 10:35
78C-130	8/4/2013 10:15	8/4/2013 8:40	to	8/4/2013 15:05
84C-160	6/21/2013 8:50	6/21/2013 7:40	to	6/21/2013 13:45
85C-160	8/6/2013 11:45	8/6/2013 10:15	to	8/6/2013 13:05
88C-130	7/31/2013 8:21	7/31/2013 7:30	to	7/31/2013 12:35
88C-160	7/31/2013 8:31	7/31/2013 7:30	to	7/31/2013 12:35
90C-160	6/27/2013 13:55	6/27/2013 8:50	to	6/27/2013 16:30
93C-130	6/25/2013 16:00	6/25/2013 12:30	to	6/25/2013 18:20
93C-160	6/25/2013 14:05	6/25/2013 12:30	to	6/25/2013 18:20
T5-120	6/27/2013 14:36	6/27/2013 9:20	to	6/27/2013 16:40
12-160	6/28/2013 14:50	6/28/2013 8:25	to	6/28/2013 15:30

TABLE 5

SPECIFIC GRAVITY AND TOTAL DISSOLVED SOLIDS COMPARISON BETWEEN 2012 AND 2013
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	*Lab Measured Specific Gravity*		*Field Measured Specific Gravity*	*Temperature Corrected Density (lbs/ft^3)*		*Lab Measured TDS (mg/L)*	
	(2012 Results)	*(2013 Results)*		*(2012 Results)*	*(2013 Results)*	*(2012 Results)*	*(2013 Results)*
21C-130	1.0063	1.0037	1.0060	62.8339	62.6726	3,330	6,390
34C-130	1.0185	1.0210/1.0204	1.0200	63.6075	63.7516	25,400	25,800/26,000
34C-160	1.0045	1.0051	1.0050	62.7384	62.7819	4,470	4,480
53C-130	1.0779	1.1131	1.1020	67.2847	69.4834	104,000	143,000
61C-130	1.0684	1.0701	1.0700	66.7462	66.8528	95,800	106,000
61C-160	1.0196	1.0079	1.0100	63.7047	62.9751	24,800	12,900
77C-130	**1.0490**	1.0581	1.0570	65.5516	66.1111	68,400	78,600
77C-160	1.0249	1.0362	1.0360	64.0478	64.7536	33,100/34,200	47,600
78C-130	1.0050	1.0045	1.0000	62.7761	62.7499	4,290	4,050
84C-160	1.0071	1.0048	1.0070	62.9364	62.7929	7,880	7,360
85C-160	**1.0210**	1.0226	1.0200	63.7723	63.8764	28,500	28,500
88C-130	1.0178	1.0200	1.0200	63.5724	63.7108	24,300	25,400
88C-160	1.0208	1.0221	1.0200	63.7654	63.8477	27,000	27,700
90C-160	1.0065	1.0072	1.0075	62.7911	62.8370	8,100	7,060
93C-130	1.0184	1.0190	1.0185	63.6069	63.6446	22,800	22,700
93C-160	1.0204	1.0207	1.0205	63.7412	63.7602	24,900	27,600
T5-120	1.1143	1.1153/1.1153	1.1120	69.3557	69.4040	156,000	156,000/153,000
12-160	1.0029	0.9979/0.9980	1.0040	62.6458	62.3428	4,350	5,070/5,110
20-50	1.002 (4/19/2006)	1.0322	1.0320	--	--	3,300 (4/19/2006)	38,800
36-100R	1.0006	1.0222	1.0230	--	--	358	26,700
40-100R	1.0232	1.0222	1.0210	--	--	33,600	29,000
53-100	1.003 (12/8/2008)	1.0024	1.0010	--	--	4,200 (7/31/2006)	2,870
65-130	1.0028	1.0043/1.0043	1.0050/1.0050	--	--	4,430	4,130/4,120
75-130	1.0005	1.0017	1.0090	--	--	673	599

Notes:

The 77C-130 Event 3 specific gravity sample value was 1.0066. The EPA recommended value based on TDS calculation was 1.049, which was used for the calculation of unit weight (above).

The 88C-160 Event 3 specific gravity sample value was 1.0017. The EPA recommended value based on TDS calculation was 1.021, which was used for the calculation of unit weight (above).

TABLE 6

CALCULATED BEST-FIT GAUGE FACTOR "C" FOR CMT WELLS
OCCIDENTAL CHEMICAL CORPORATION
TACOMA, WASHINGTON

Location	*Original Field Determined "C"*	*2012 Best-Fit "C"*	*2013 Best-Fit "C"*
21C-130	213.442	213.442	213.835
34C-130	218.062	219.233	218.315
34C-160	225.975	225.975	226.404
53C-130	224.596	225.928	223.494
61C-130	220.922	223.359	221.548
61C-160	208.394	208.394	211.961
77C-130	212.777	212.756	213.594
77C-160	213.245	214.814	214.055
78C-130	218.107	216.791	216.738
84C-160	218.847	219.958	219.747
85C-160	225.918	225.370	226.716
88C-130	233.130	234.274	233.543
88C-160	216.062	217.628	216.778
90C-160	207.855	196.170	196.154
93C-130	220.431	221.637	221.095
93C-160	231.949	233.613	232.842

Note:

The value of "C" is expressed in psi.

Attachment B

Geokon Transducer Bench Testing and DI Well Testing

ATTACHMENT B

GEOKON TRANSDUCER BENCH TESTING AND DI WELL TESTING

This Attachment describes the testing conducted to evaluate changes to the Geokon transducer calibration factors (i.e., A, B, and C) due to clamping the transducer to the CMT casing, and by applying alternative stresses to the transducer housing. Figure 1 shows a schematic of the Geokon vibrating wire transducer construction. The components expected to be most sensitive to stresses placed on the transducer housing include the pressure sensitive diaphragm located approximately 0.75 inches from the bottom of the transducer, and the vibrating wire that extends from just above the transducer mid-point into the lower half of the transducer. Bench testing was performed to evaluate changes in the transducer zero reading caused by different clamp positions on the transducer, and by applying alternative stresses on the transducer. DI well testing was conducted where Geokon transducers were clamped with increasing torque and lowered to specific water depth settings within the DI well to evaluate whether changes occur to the transducer calibration factors. The bench testing and DI well testing procedures and results are described below.

Bench Testing

The bench testing consisted of evaluating changes in the transducer zero digits reading caused by:

- Clamps tightened at different positions on the transducer
- Bending a section of CMT casing about a transducer clamped to the casing
- Suspending weight from the transducer

The three different bench tests are described below.

Clamp Position Test

A clamp position test was conducted to determine the location of a tightened hose clamp on the transducer housing that caused the greatest change to the transducer zero digits reading. First, a zero digits reading was recorded with no clamp. Clamps then were tightened onto the middle of the transducer, over the pressure sensitive diaphragm near the bottom of the transducer, and between the diaphragm and the middle of the transducer. The clamps were tightened to a torque of 20 inch-pounds (in-lbs), measured using a torque wrench. Figure 2 shows the tightened clamp positions and zero digits readings for each position. The zero digits readings are summarized below.

Clamp Position	*Zero Digits Reading (Digits)*	*Zero Temperature Reading (°C)*	*Change in Zero Digits Reading from No Clamp (Digits)*
No Clamp	8,863.6	16.4	-
Middle	8,865.2	18.8	1.6
Diaphragm	8,881.8	19.3	18
Between Middle and Diaphragm	8,878.1	20.7	14.5

The greatest change in the zero digits reading occurs when the clamp is tightened over the pressure sensitive diaphragm. Thus, the results of this test show that clamping the transducer over the diaphragm has the greatest potential to change the transducer calibration factors, and subsequent tests were conducted by positioning clamps over the diaphragm.

For the bulk of the CMT well installations, two clamps were used to secure the Geokon transducers to the CMT casing. It was determined early during the CMT well installation process that a single clamp would not prevent the transducers from shifting from their measured positions as the CMT well assembly was coiled so it could be carried to the drill rig for installation. The two clamps were positioned approximately 1 inch from the transducer top and bottom.

For the pipe bending test and the DI well test, two clamps were used and positioned approximately 1 inch from the top and bottom of the transducer. The bottom clamp lies over the pressure sensitive diaphragm located approximately 0.75 inches from the bottom of the transducer. For the weight test, the weight suspended from the transducer was position at the diaphragm.

Pipe Bending Test

Two clamps were used to attach a transducer to the middle of a section of CMT casing approximately 6 ft long. One end of the casing was secured in a bench vice. The casing was then bent by hand from a straight position about the clamped transducer, with the transducer on the inside of the bend. The casing was bent 12 inches from a straight position, 16 inches from a straight position, and then as far as possible from a straight position, or maximum bend, without crimping the CMT casing. Figure 3 shows the bending positions and zero digits readings for each position. The zero digits readings are summarized below.

Bending Position	***Zero Digits Reading[(1)] (Digits)***	***Zero Temperature Reading[(1)] (°C)***	***Change in Zero Digits Reading from No Bend (Digits)***
Straight (No Bend)	8,864.9	16.1	-
12 inches from Straight	8,865.1	16.2	0.2
16 inches from Straight	8,863.8	16.1	-1.1
Maximum Bend	8,862.4	16.1	-2.5

Note:
(1) Zero readings taken after clamping the transducer to the CMT casing using two clamps.

The maximum bending position results in a change of 2.5 digits from the zero readings taken with no bending. This change occurs in addition to the change in zero readings that would have occurred due to the two tightened hose clamps. The maximum bending position approaches the degree of bending that occurred as the CMT well assembly was coiled so it could be carried to the drill rig for installation. Thus, coiling the CMT well assembly could have applied further stress on the transducer, in addition to clamping, and resulted in further potential changes to the transducer calibration factors.

Weight Test

A transducer was supported on its top and bottom ends. A weight was placed in a bucket, and the bucket was suspended by a rope from the transducer to impart a bending moment stress on the transducer. The rope was positioned at the approximate location of the pressure sensitive diaphragm. Weights of approximately 10 lbs, 20 lbs, 30 lbs, and 40 lbs were used. Figure 4 shows the weight applications and zero digits readings for each weight. The zero digits readings are summarized below.

Weight	***Zero Digits Reading (Digits)***	***Zero Temperature Reading (^oC)***	***Change in Zero Digits Reading from No Weight (Digits)***
No Weight	8,718.4	19.0	-
10 lbs	8,721.0	17.7	2.6
20 lbs	8,723.0	17.0	4.6
30 lbs	8,720.9	17.1	2.5
40 lbs	8,724.4	17.1	6

The maximum weight of 40 lbs suspended from the transducer results in a change of 6 digits from the zero readings taken with no weight. Thus, a bending moment stress placed on the transducer during the CMT well installation process could have resulted in potential changes to the transducer calibration factors.

DI Well Testing

For the DI well testing, two Geokon transducers were clamped to a PVC rod approximately 3 ft long. The pressure sensitive diaphragms were set 2 ft apart. The clamps were successively tightened to three increased levels of torque. For each torque level, the transducer assembly was lowered to specific water depth settings within the DI well to evaluate whether changes occur to the transducer calibration factors. The DI well testing proceeded as follows:

- DI well construction:
  - A 2-inch diameter DI well was constructed inside extraction well EXT-9 to a depth of 140 ft. The joints in the DI well casing were made water-tight, and the DI well was filled with deionized water (having a fresh water density).
- Two Geokon transducers were used: one Model 4500s-350kPa; and one Model 4500s-700kPa, which are the two types of Geokon transducers installed for the CMT wells.
- On-Site barometric pressure readings were synchronized with the reading times of the Geokon transducers.
- The factory calibration of the two unclamped transducers was confirmed. Factory calibration sheets are provided in Attachment B-1. For each transducer, zero readings in air were recorded, and then the transducer was lowered into the DI well to depth settings of 50 ft, 75 ft, and 100 ft, followed by raising the transducer to depth settings of 75 ft and 50 ft.
- Each transducer was attached to the PVC rod with hose two clamps positioned approximately 1 inch from the top and bottom of the transducer, as shown on Figure 1.

- – The two transducers were positioned so that there was a 2-ft separation between the pressure sensitive diaphragms positioned 0.75 inches from the bottom of the transducer.
- – A measuring tape was fastened to the transducer assembly with its zero reading aligned with the pressure sensitive diaphragm of the bottom transducer. Steel wire was fastened to the top of the assembly and was used to suspend the assembly in the DI well.
- – The 700 kPa transducer was positioned as the bottom transducer, and the 350 kPa transducer was positioned as the top transducer. In this manner, the depth settings for the 350 kPa transducer were 2 ft less than for the 700 kPa transducer when lowered into the DI well while attached to the transducer assembly.

- Zero readings in air were recorded for each transducer after being clamped to the PVC pipe.
- The transducer assembly was suspended in the DI well at the same depths used to confirm the unclamped transducer calibration for the 700 kPa transducer, and 2 ft less for the 350 kPa transducer.
- The DI well testing was performed for three levels of torque, as follows:
  - 350 kPa transducer: Torque 1 was set between 25 and 30 in-lbs; Torque 2 was set at 35 in-lbs; and Torque 3 was set at 45 in-lbs.
  - 700 kPa transducer: Torque 1 was set between 25 and 30 in-lbs; Torque 2 was set at 40 in-lbs; and Torque 3 was set at 50 in-lbs.
- The torque level used to tighten the clamps was measured using a torque wrench.
- The three torque levels were tested in sequence. The clamps were tightened to Torque 1, zero readings were obtained, and the transducer assembly was lowered into the DI well to the depth settings. For the 700 kPa transducer, the depth settings were the same as that applied to confirm the unclamped transducer calibration (i.e., 50 ft, 75, 100 ft, 75 ft, and 50 ft). For the 350 kPa transducer, the depth settings were 2 ft less than that applied to confirm the unclamped transducer calibration (i.e., 48 ft, 73 ft, 98 ft, 73 ft, and 48 ft). After completing the test at Torque 1, the clamps were tightened to Torque 2, new zero readings were obtained, and the transducer assembly was lowered into the DI well to the depth settings. After completing the test at Torque 2, the clamps were tightened to Torque 3, new zero readings were obtained, and the transducer assembly was lowered into the DI well to the depth settings.
- After tightening the clamps to Torque 3, it appeared that a higher torque level might cause the clamps to fail by stripping the clamp screw and/or clamp treads. Thus, a higher torque level was not tested.

Figure 5a/b shows the transducer assembly and transducer zero digits readings for each torque level. The DI well results are presented in Section 5.0 of the Memorandum.

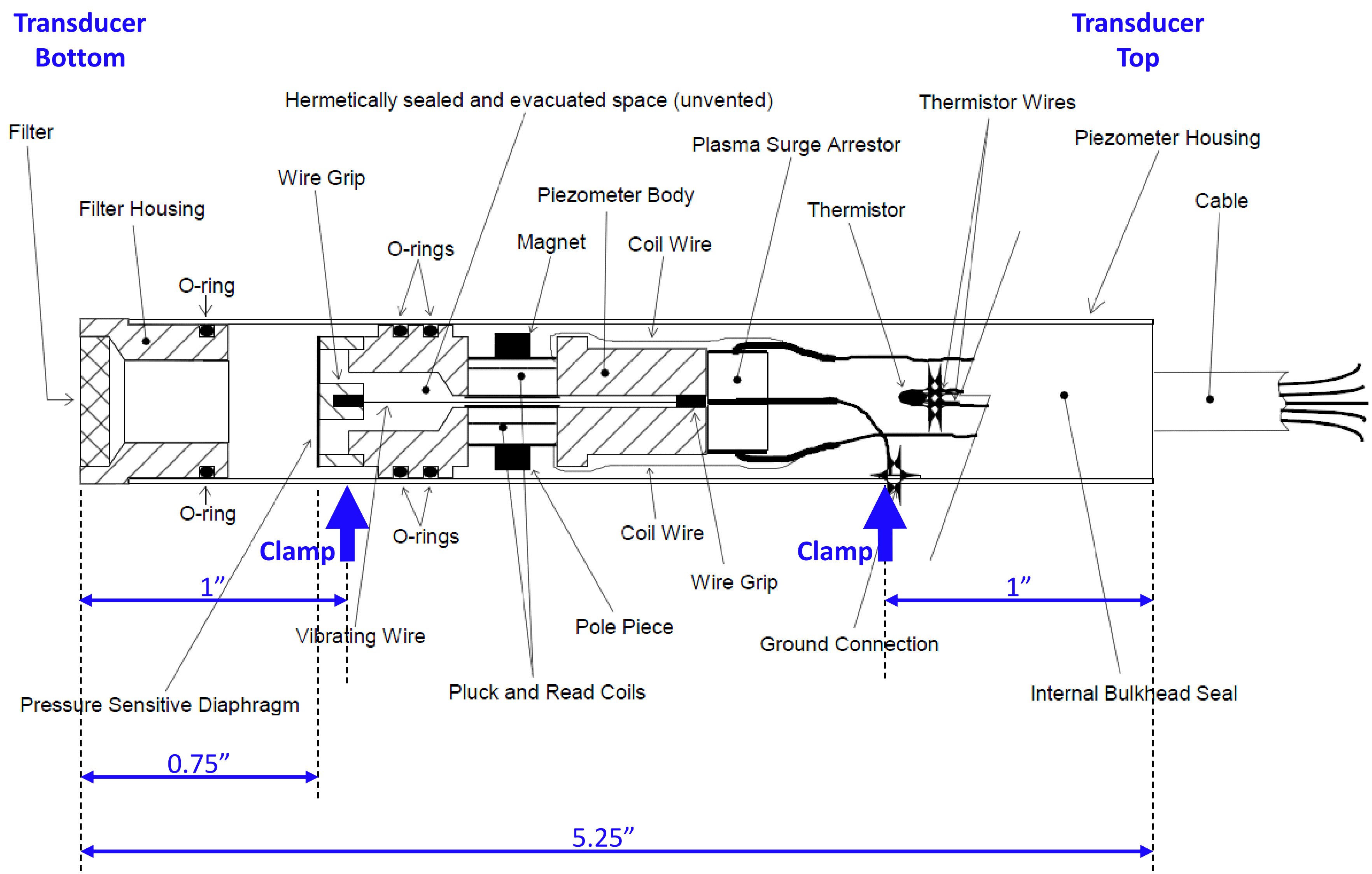

figure 1

SCHEMATIC OF GEOKON VIRATING WIRE TRANSDUCER CONSTRUCTION

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(MEMO072)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\MEMO072 FEH Categories\007843Memo-72-AppCFigure1_Geokon Schematic.srf) APR 20/2014

NO CLAMP

CLAMP IN MIDDLE OF TRANSDUCER

CLAMP OVER DIAPHRAGM

CLAMP BETWEEN DISPHRAGM AND MIDDLE OF TRANSDUCER

figure 2

CLAMP POSITION TEST

Occidental Chemical Corporation, Tacoma, Washington

NO BENDING IN CASING

CASING BENT 12 INCHES FROM STRAIGHT

CASING BENT 16 INCHES FROM STRAIGHT

MAXIMUM BEND IN CASING

figure 3

PIPE BENDING TEST

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(MEMO072)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\MEMO072 FEH Categories\007843Memo-72-AppCFigure3_PipeBendingTest.srf) APR 20/2014

NO WEIGHT

10 LBS WEIGHT

20 LBS WEIGHT

30 LBS WEIGHT

40 LBS WEIGHT

figure 4

WEIGHT TEST

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(MEMO072)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\MEMO072 FEH Categories\007843Memo-72-AppCFigure4_WeightTest.srf) APR 20/2014

DI WELL TRANSDUCER ASSEMBLY

350 KPa PRE-TIGHTENING

350 KPa TIGHTENED TO TORQUE 1

700 KPa PRE-TIGHTENING

700 KPa TIGHTENED TO TORQUE 1

figure 5a

DI WELL TEST - SET-UP AND TORQUE 1

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(MEMO072)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\MEMO072 FEH Categories\007843Memo-72-AppCFigure5a_DIWellTest1.srf) APR 20/2014

350 KPa TIGHTENED TO TORQUE 2

350 KPa TIGHTENED TO TORQUE 3

700 KPa TIGHTENED TO TORQUE 3

700 KPa TIGHTENED TO TORQUE 3

figure 5b

DI WELL TEST - TORQUE 2 AND TORQUE 3

Occidental Chemical Corporation, Tacoma, Washington

07843-A6(MEMO072)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\MEMO072 FEH Categories\007843Memo-72-AppCFigure5b_DIWellTest2&3.srf) APR 20/2014

Attachment B-1

Factory Calibration Sheets

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: March 25, 2014

This calibration has been verified/validated as of 04/03/2014

Serial Number: 1409481

Temperature: 22.30 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 996.8 mbar

Cable Length: 125 feet

Technician: [signature]

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8703	8704	8704	0.060	0.02	-0.023	-0.01
69.9	8122	8122	8122	69.89	-0.01	69.98	0.01
139.9	7540	7540	7540	139.8	-0.03	140.0	0.01
209.9	6958	6958	6958	209.7	-0.06	209.8	-0.01
279.9	6374	6374	6374	279.8	-0.02	279.9	0.00
349.9	5790	5790	5790	350.0	0.02	349.9	0.00

(kPa) Linear Gage Factor (G): -0.1201 (kPa/ digit) **Regression Zero: 8704**

Polynomial Gage factors: A: -1.215E-07 B: -0.1183 C: ______

Thermal Factor (K): -0.1325 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.01742 (psi/ digit)

Polynomial Gage Factors: A: -1.762E-08 B: -0.01716 C: ______

Thermal Factor (K): -0.01922 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: March 20, 2014

This calibration has been verified/validated as of 03/27/2014

Serial Number: 1407273

Temperature: 20.40 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 982.4 mbar

Cable Length: 150 feet

Technician: KW Bellavance

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8760	8761	8761	1.183	0.17	-0.005	0.00
140.0	8000	8001	8001	139.5	-0.06	139.9	-0.01
280.0	7234	7234	7234	279.1	-0.13	280.2	0.03
419.9	6467	6467	6467	418.7	-0.17	419.8	-0.01
559.9	5694	5694	5694	559.4	-0.07	559.8	-0.02
699.9	4915	4916	4916	701.2	0.18	700.0	0.01

(kPa) Linear Gage Factor (G): -0.1820 (kPa/ digit)

Regression Zero: 8767

Polynomial Gage factors: **A: -6.472E-07** **B: -0.1732** **C: ________**

Thermal Factor (K): -0.02853 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02640 (psi/ digit)

Polynomial Gage Factors: **A: -9.387E-08** **B: -0.02512** **C: ________**

Thermal Factor (K): -0.004138 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

Attachment 9

Shallow Zone Monitoring Well Hydrographs for Continuous Monitoring

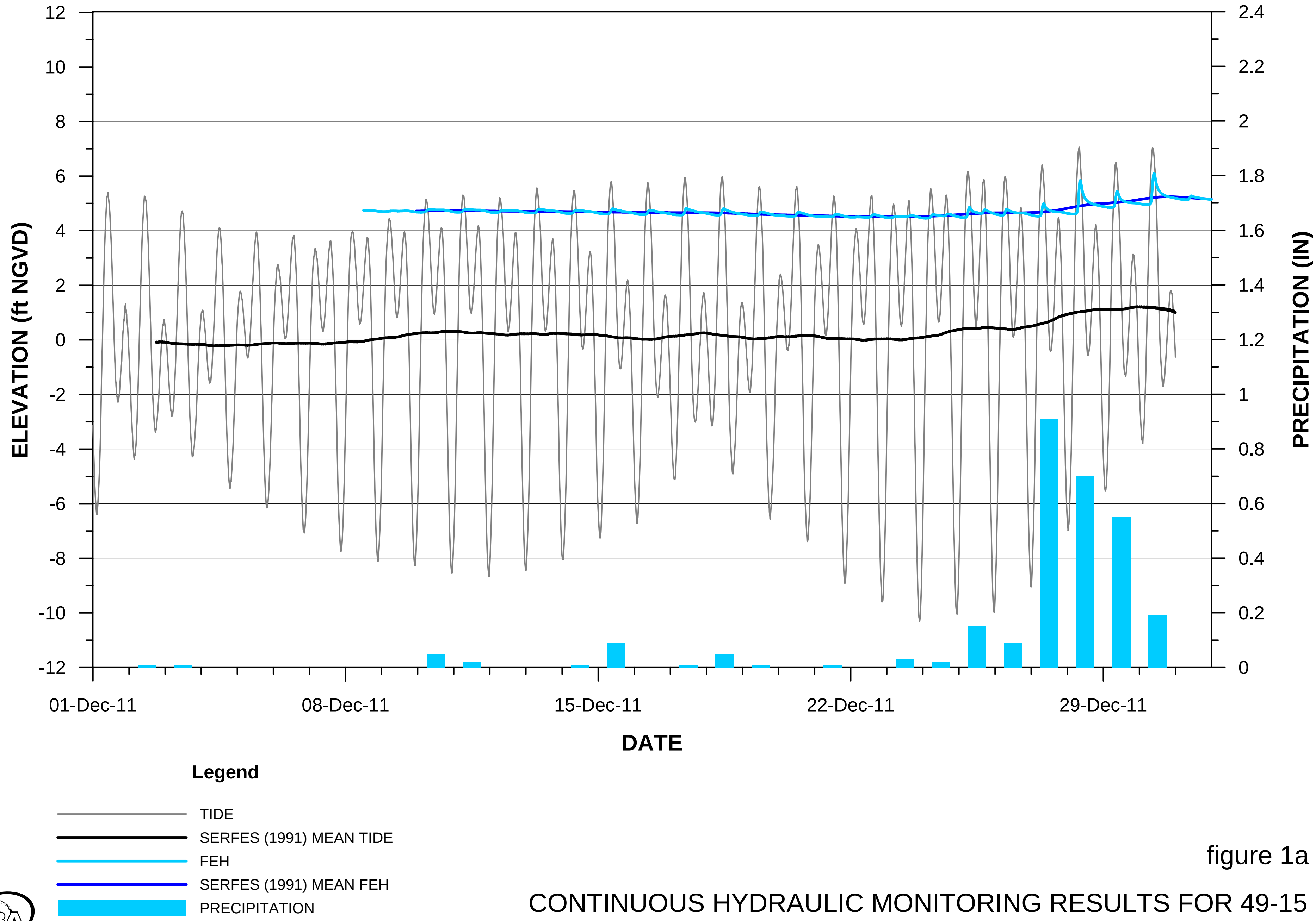

figure 1a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_December 2011.grf) AUG 5/2014

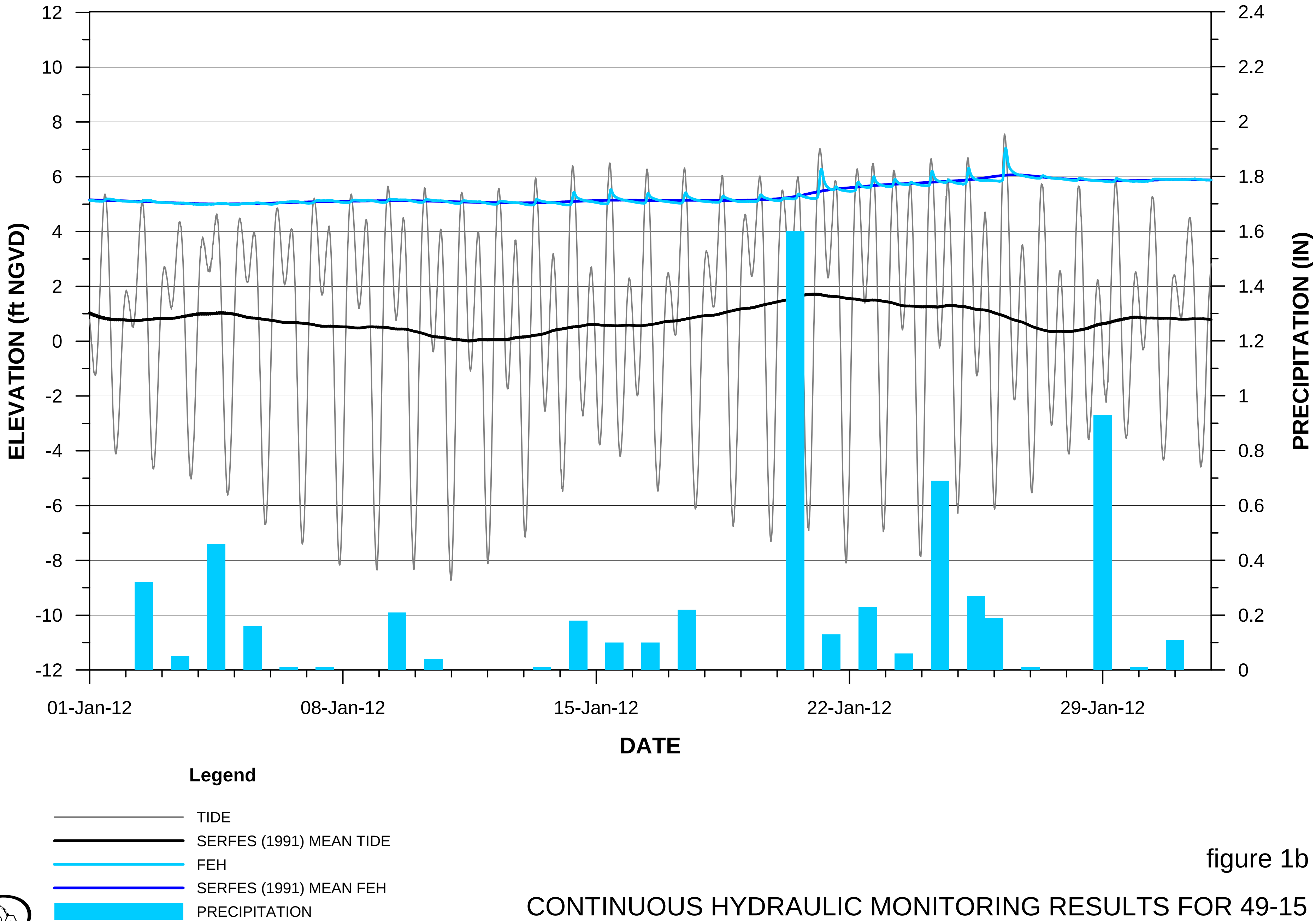

figure 1b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_January 2012.grf) AUG 5/2014

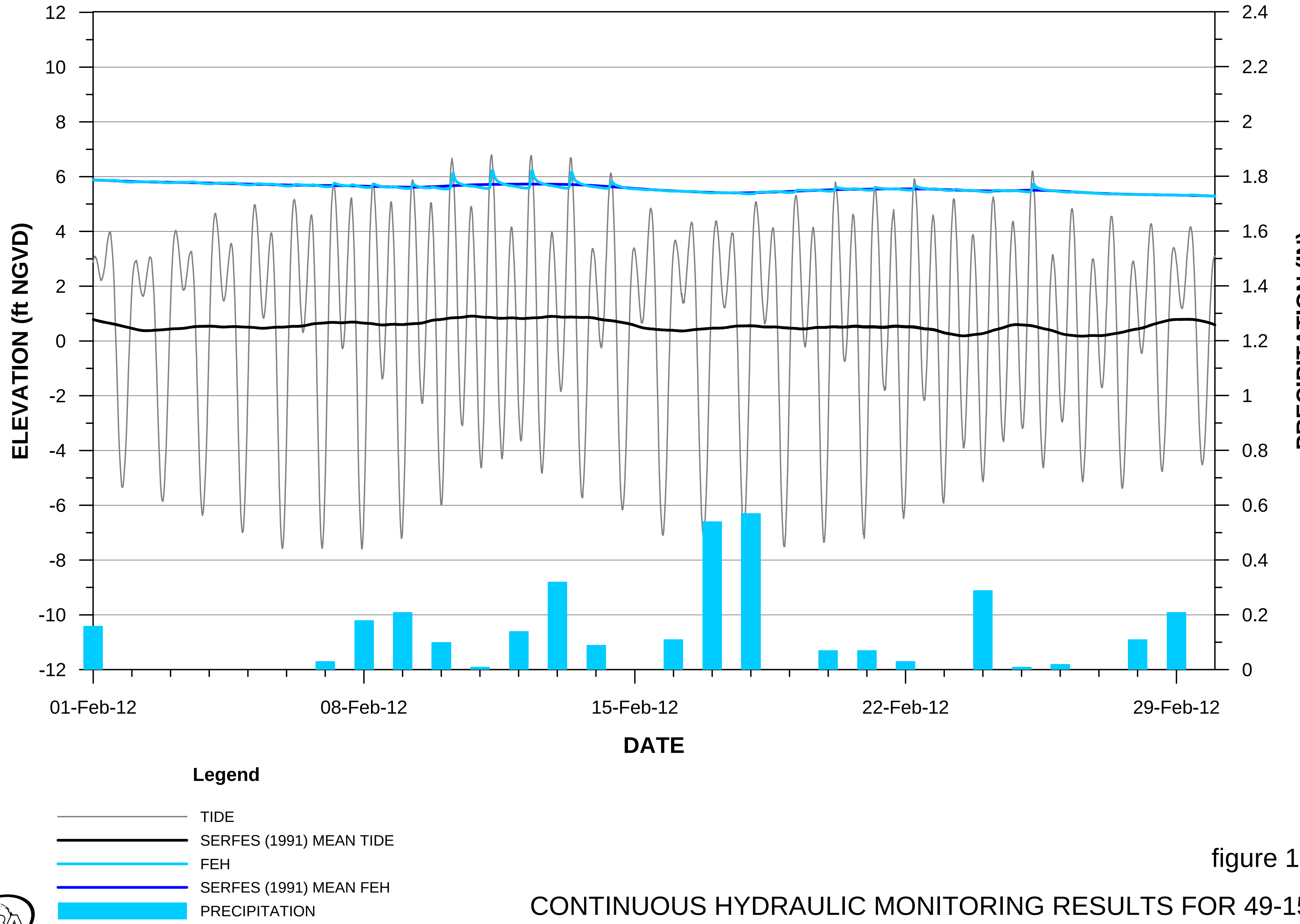

figure 1c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

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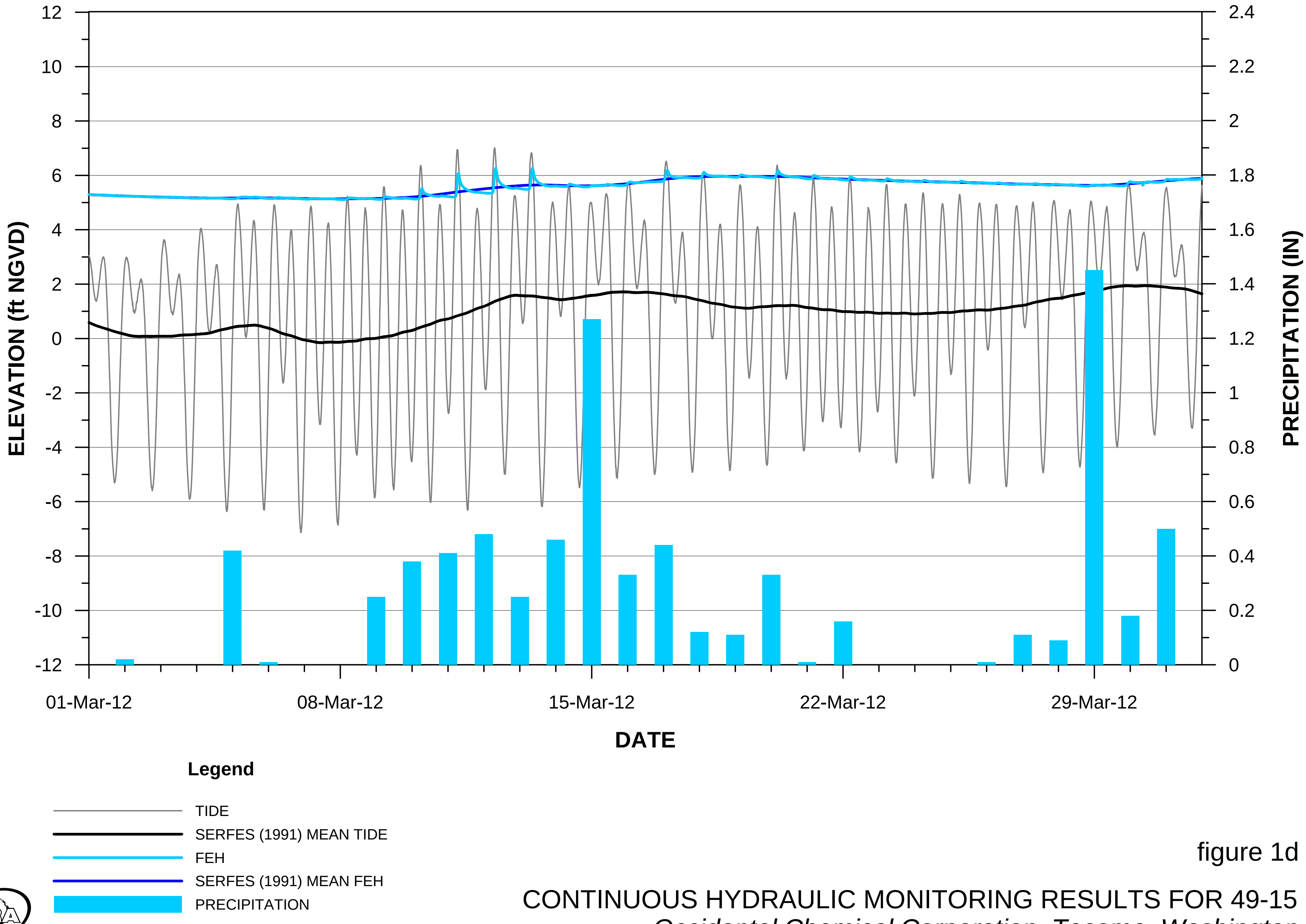

figure 1d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_March 2012.grf) AUG 5/2014

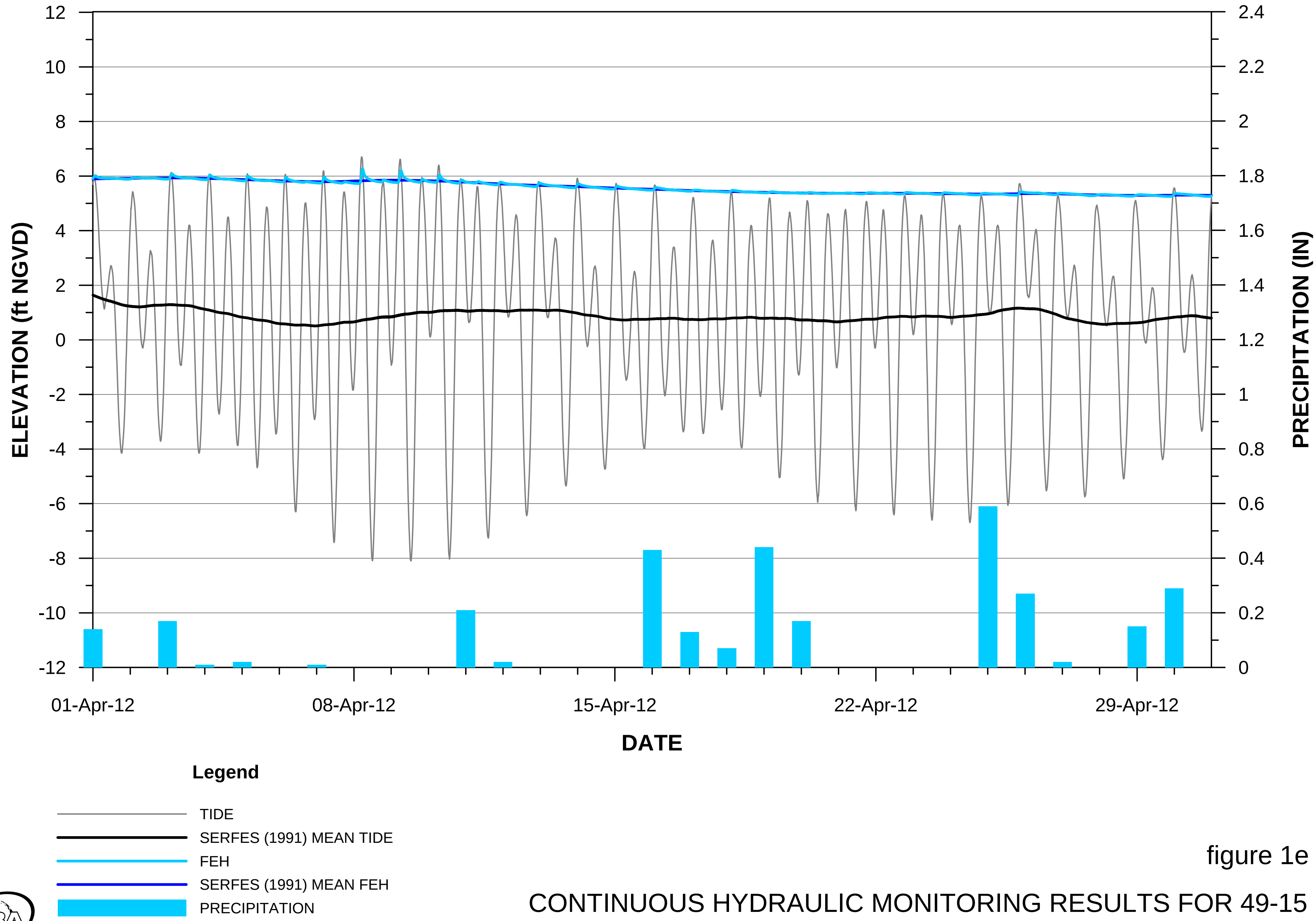

figure 1e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_April 2012.grf) AUG 5/2014

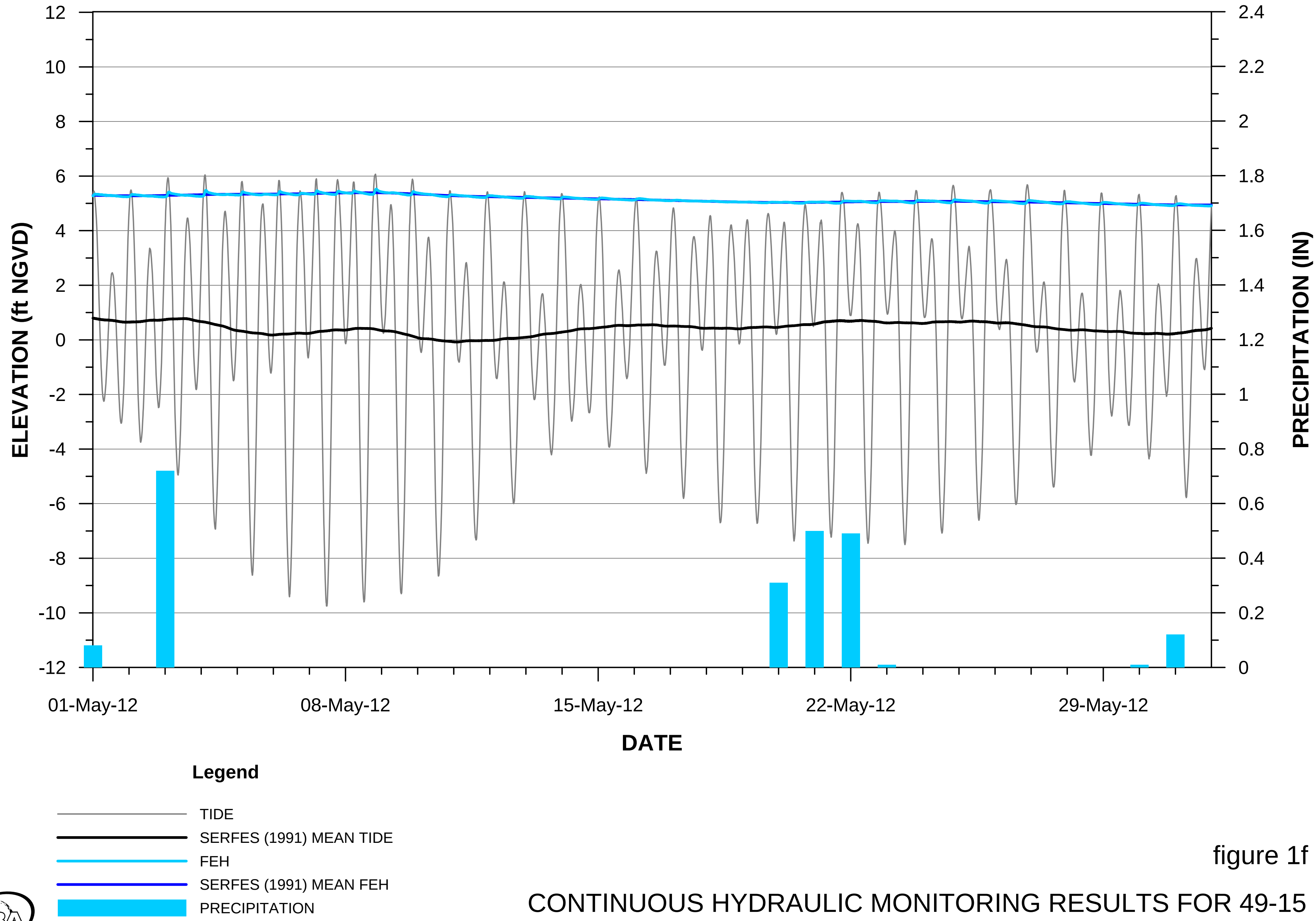

figure 1f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

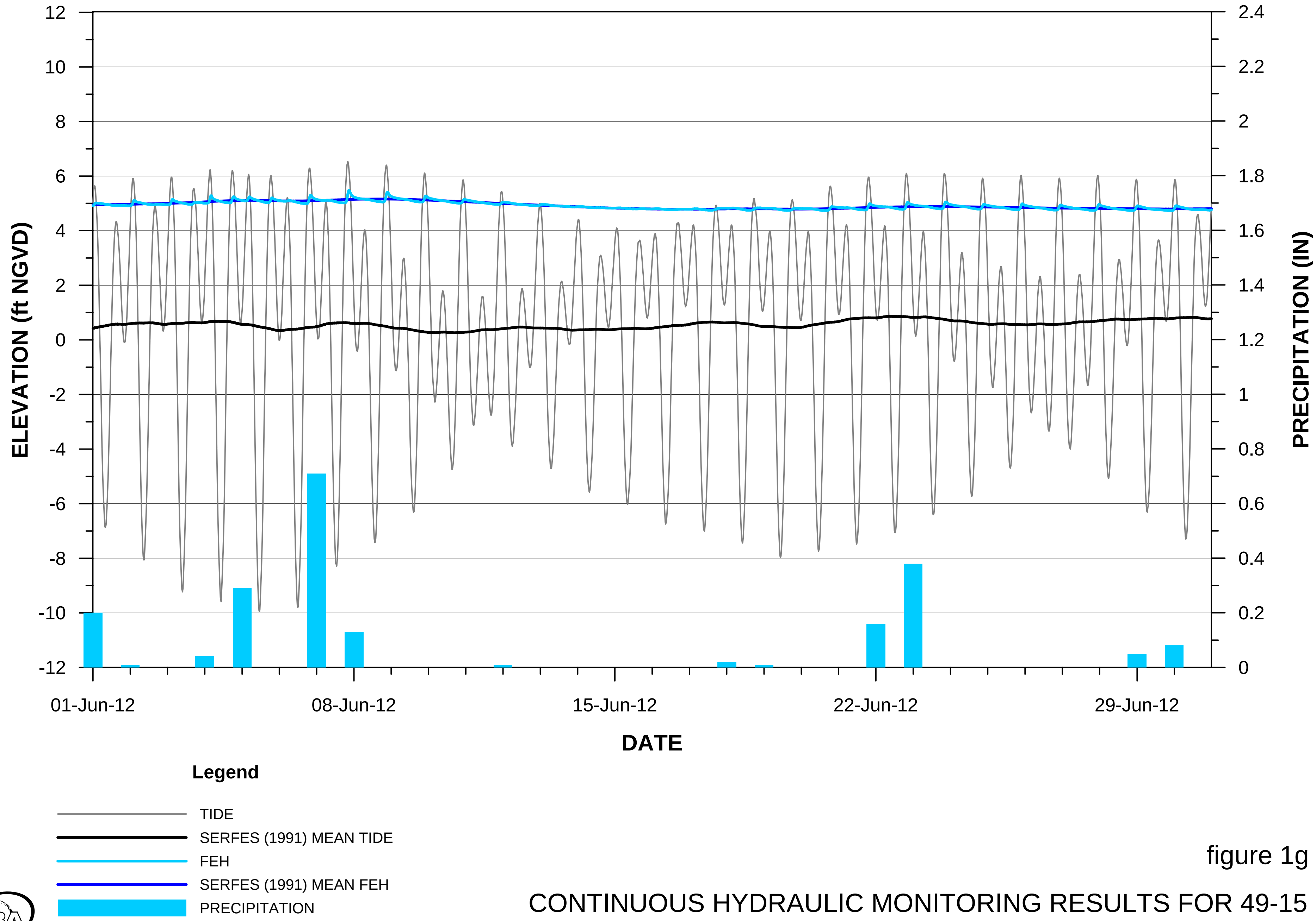

figure 1g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

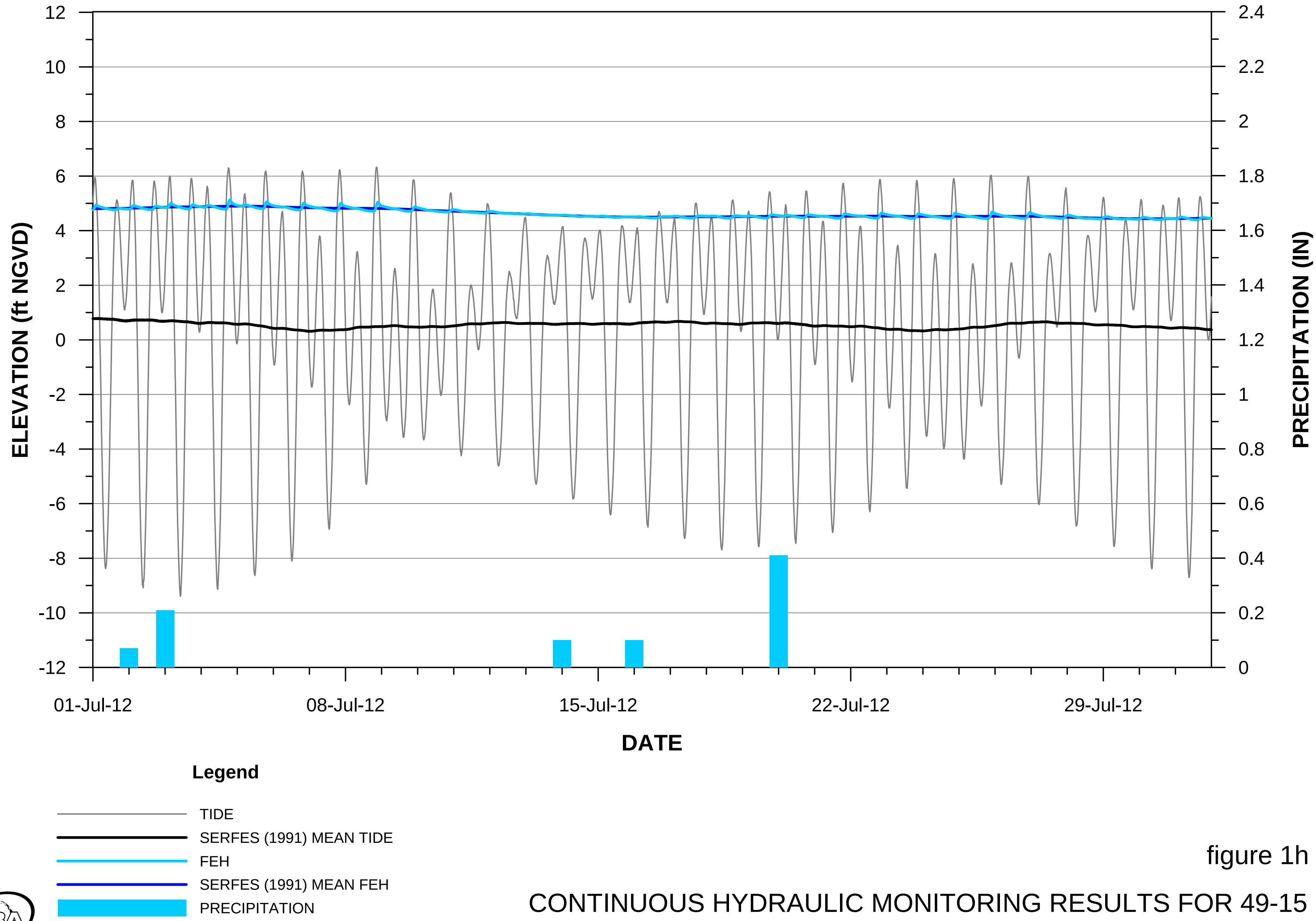

figure 1h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_July 2012.grf) AUG 5/2014

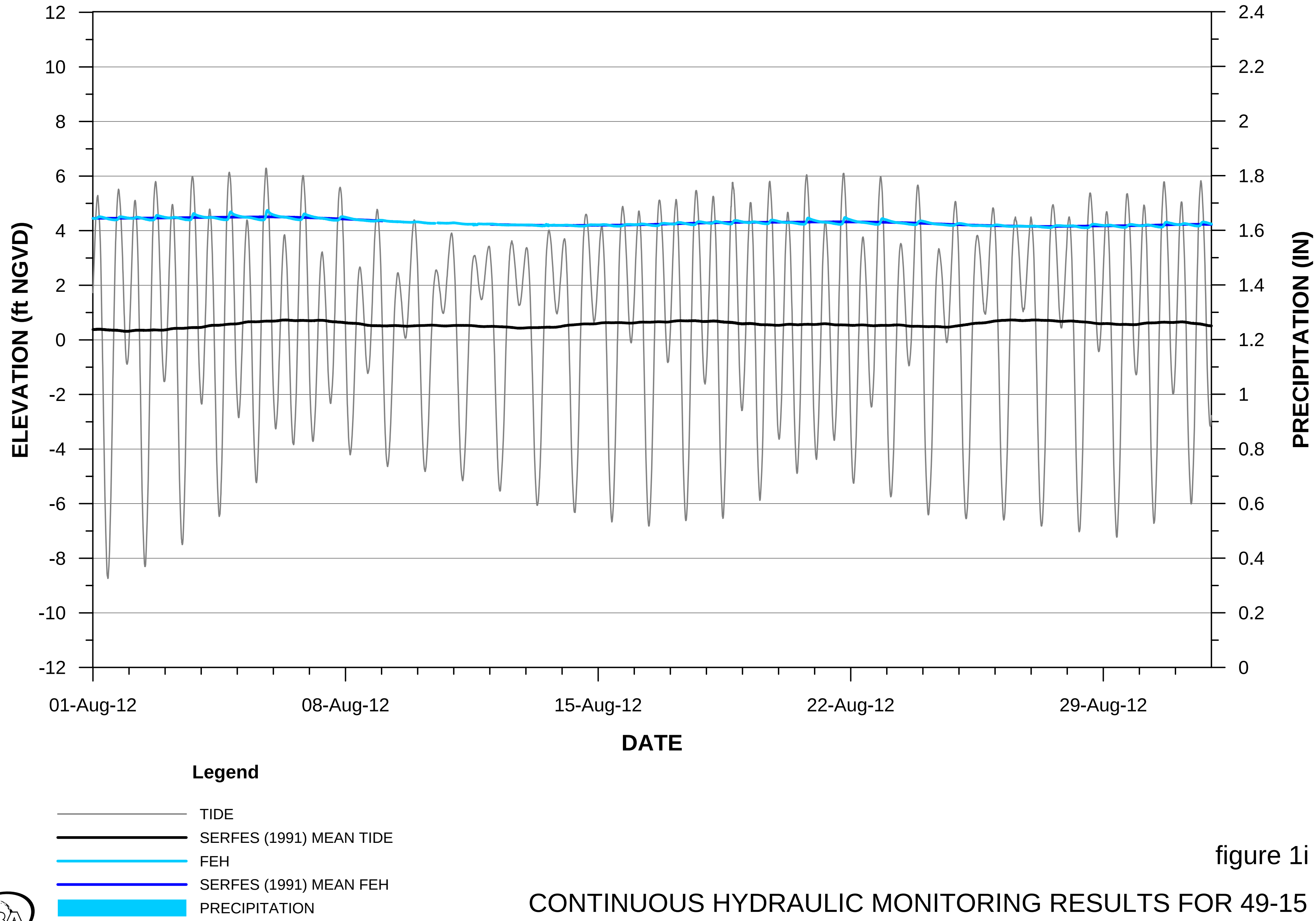

figure 1i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_August 2012.grf) AUG 5/2014

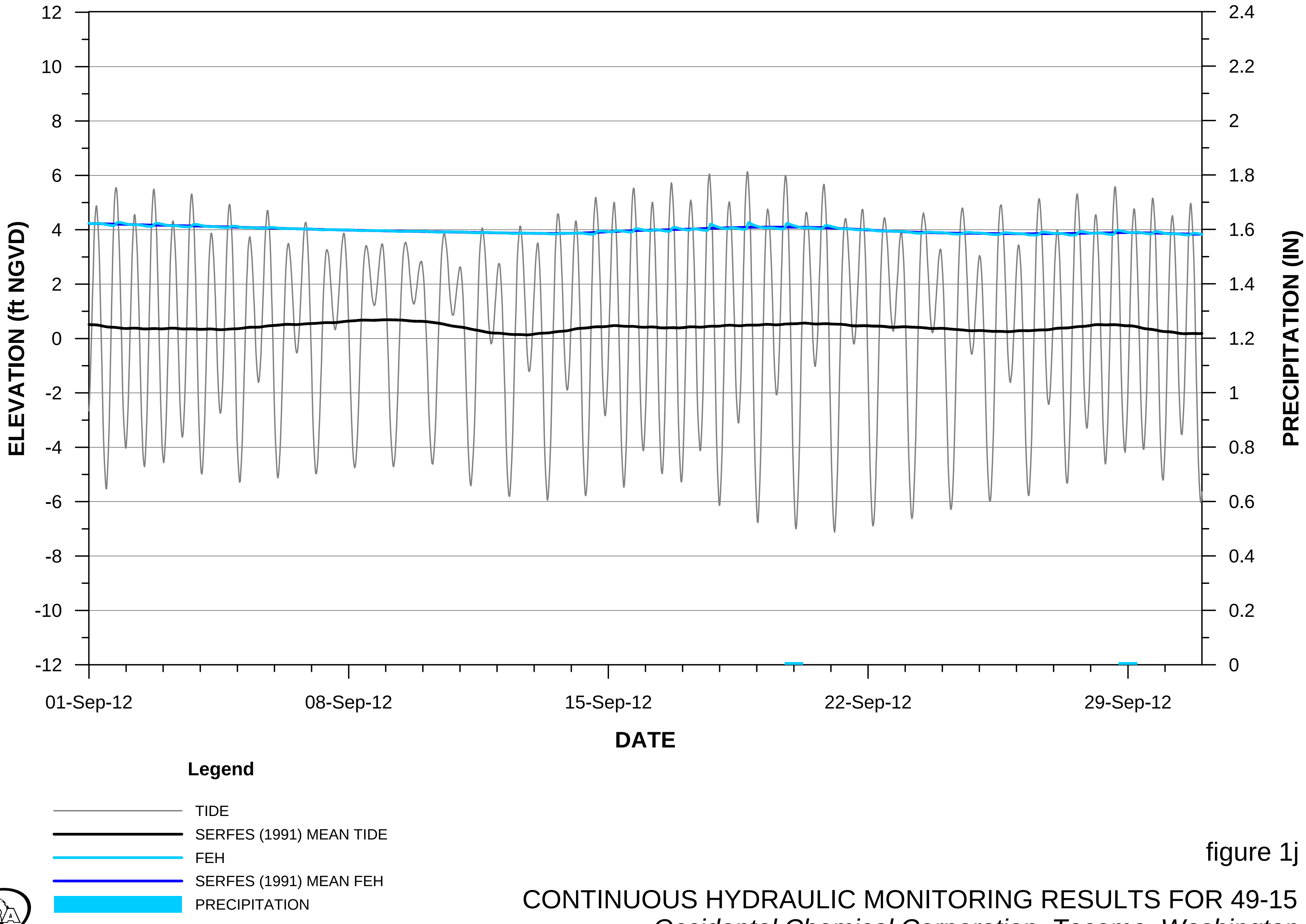

figure 1j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_September 2012.grf) AUG 5/2014

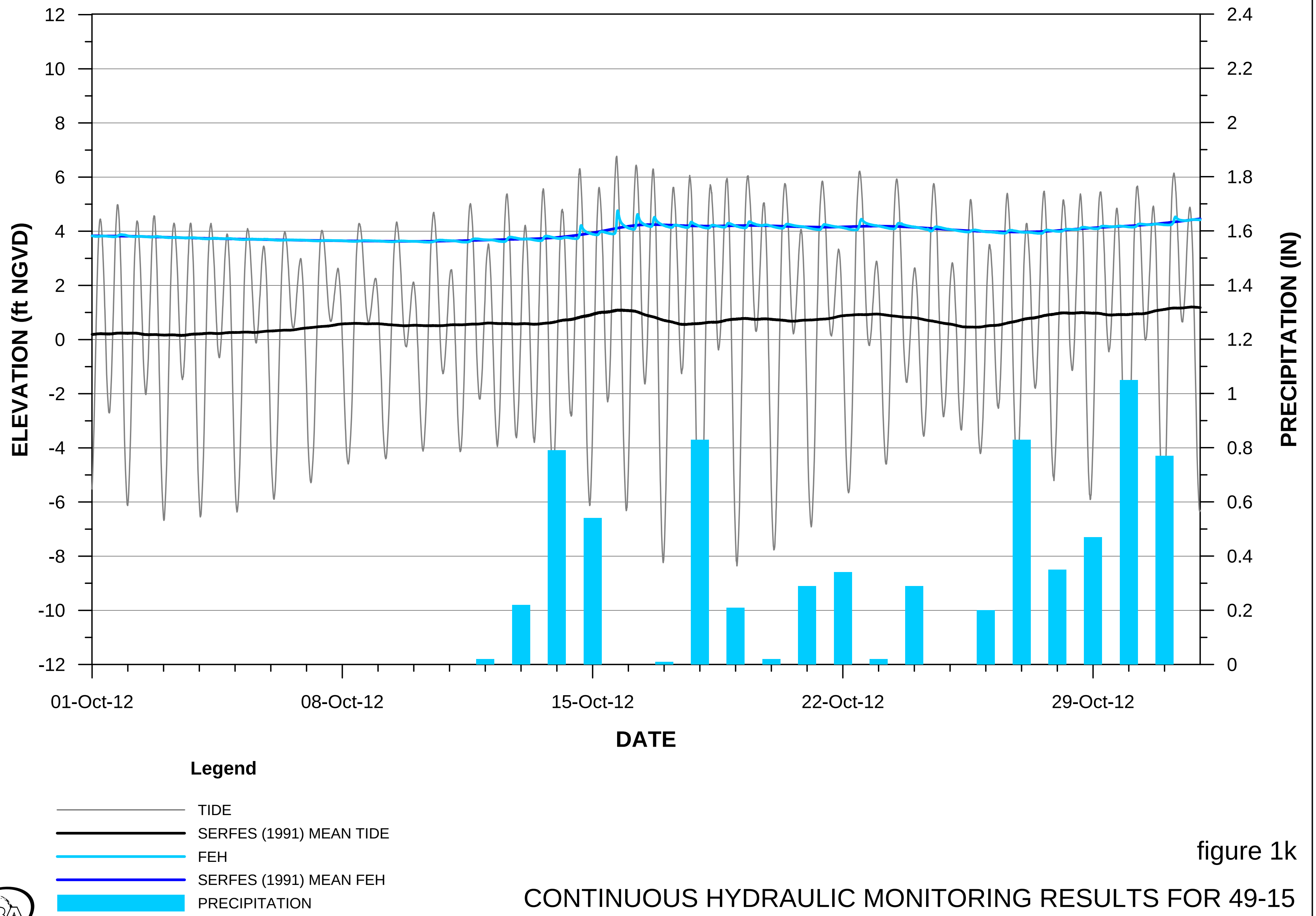

figure 1k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_October 2012.grf) AUG 5/2014

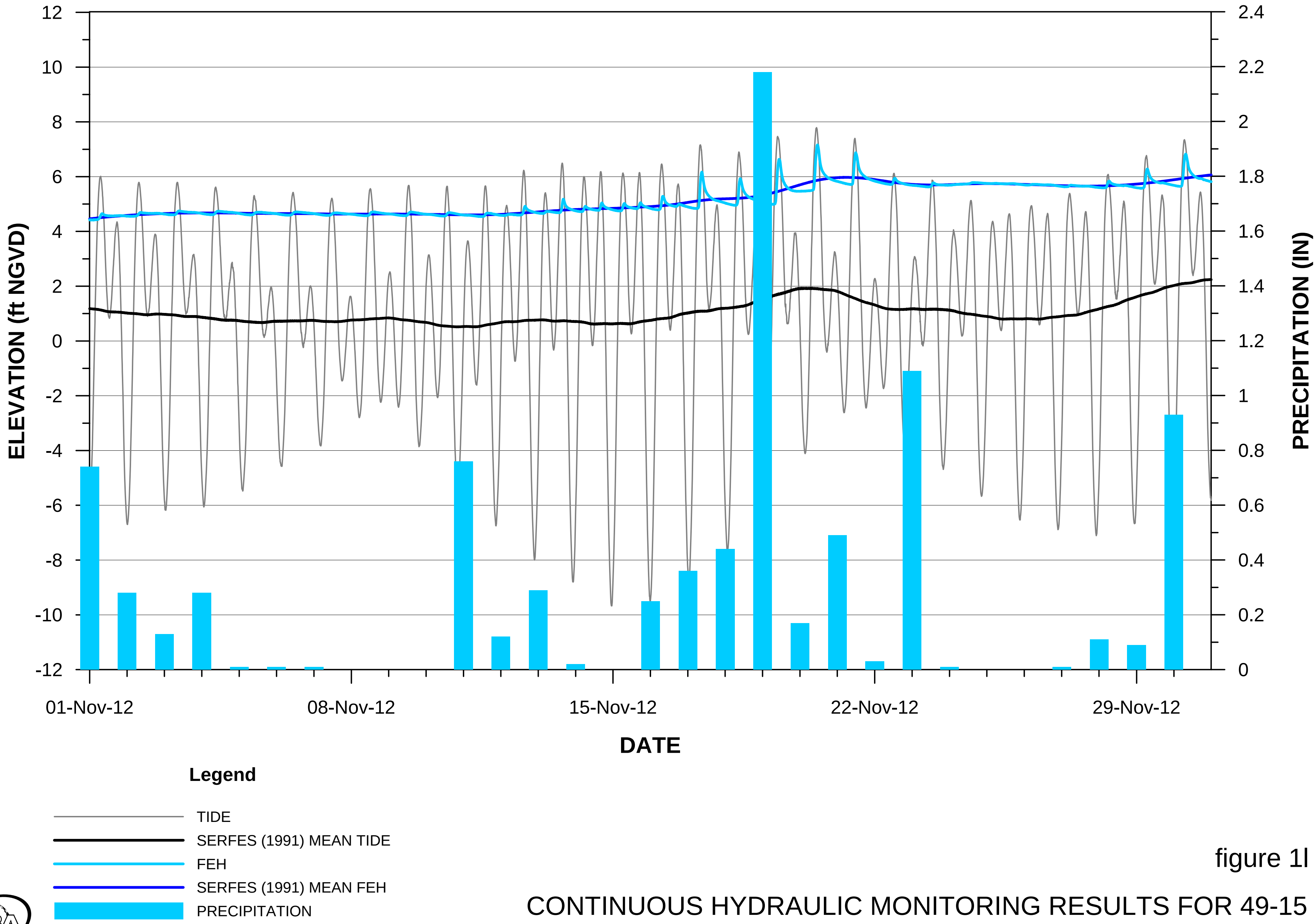

figure 1l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

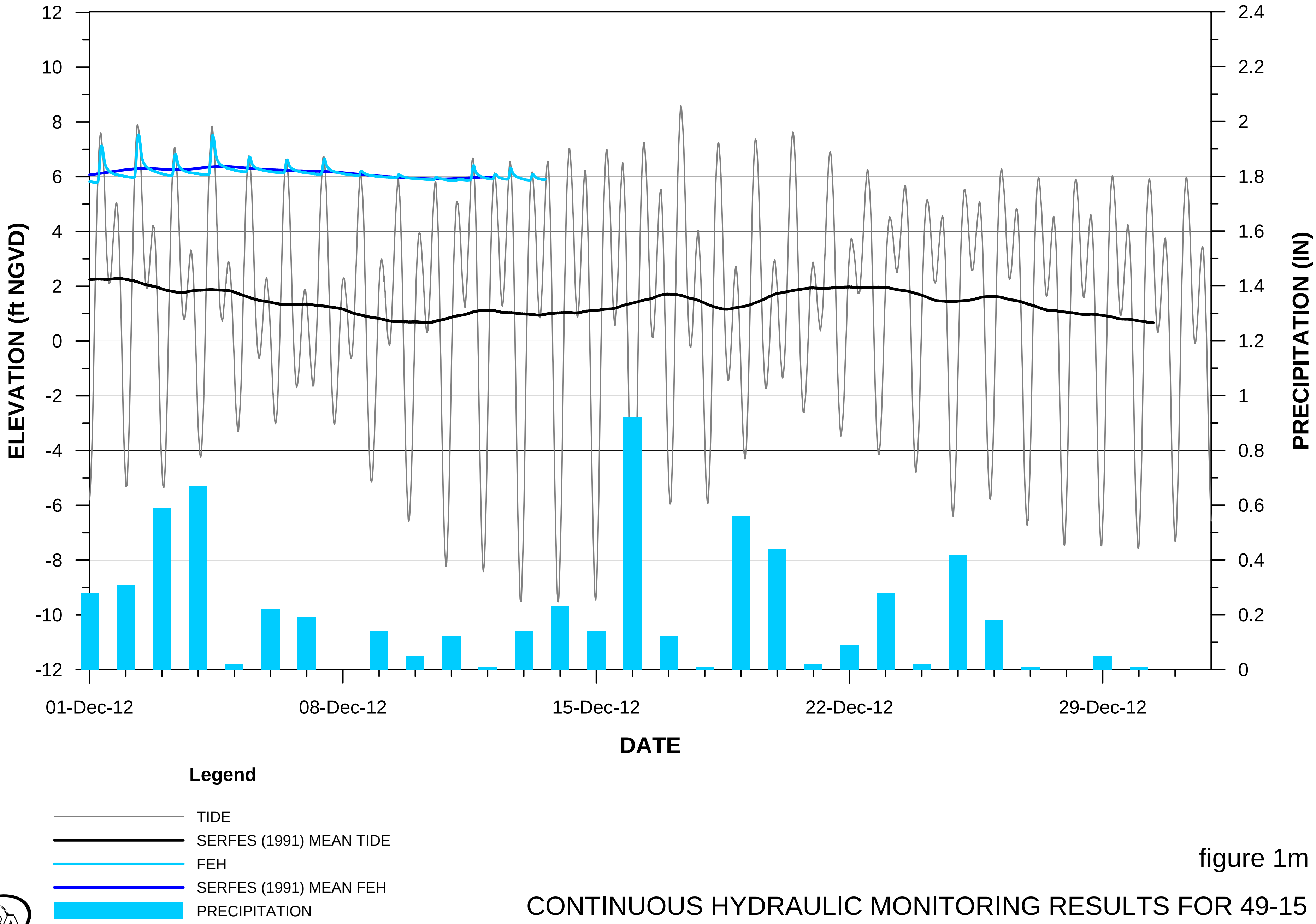

figure 1m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 49-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\49-15\07843_49-15_December 2012.grf) AUG 5/2014

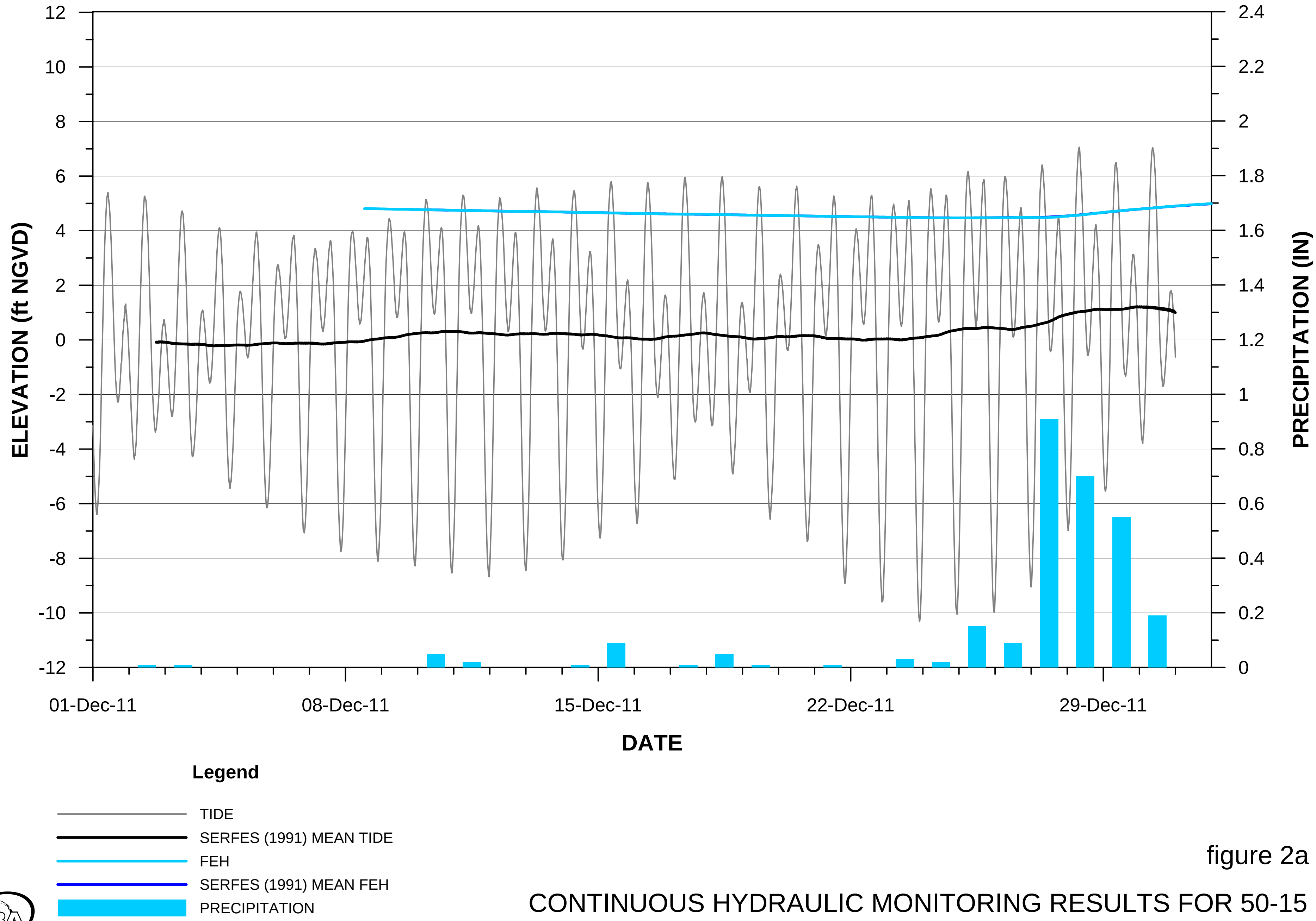

figure 2a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

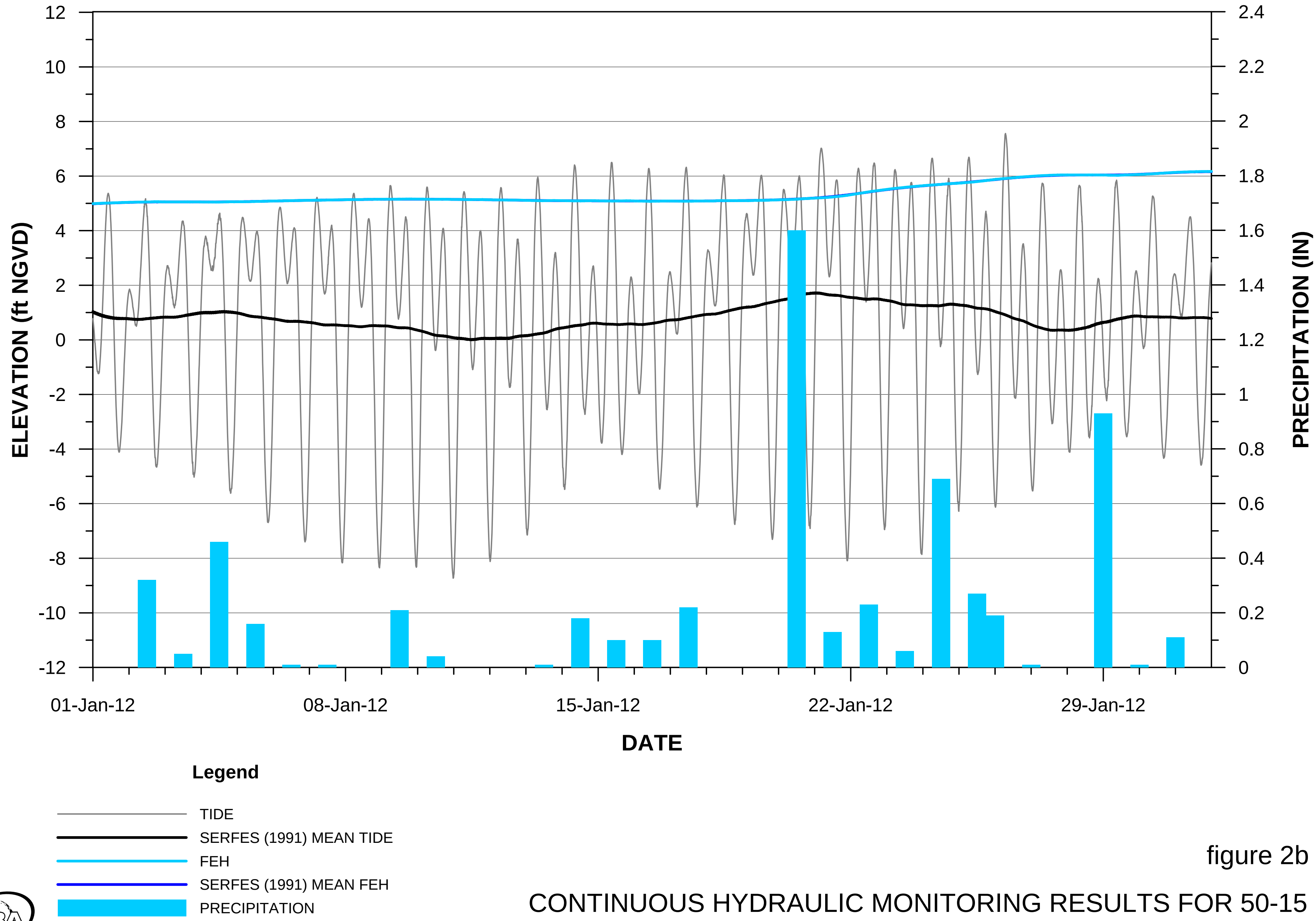

figure 2b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_January 2012.grf) AUG 5/2014

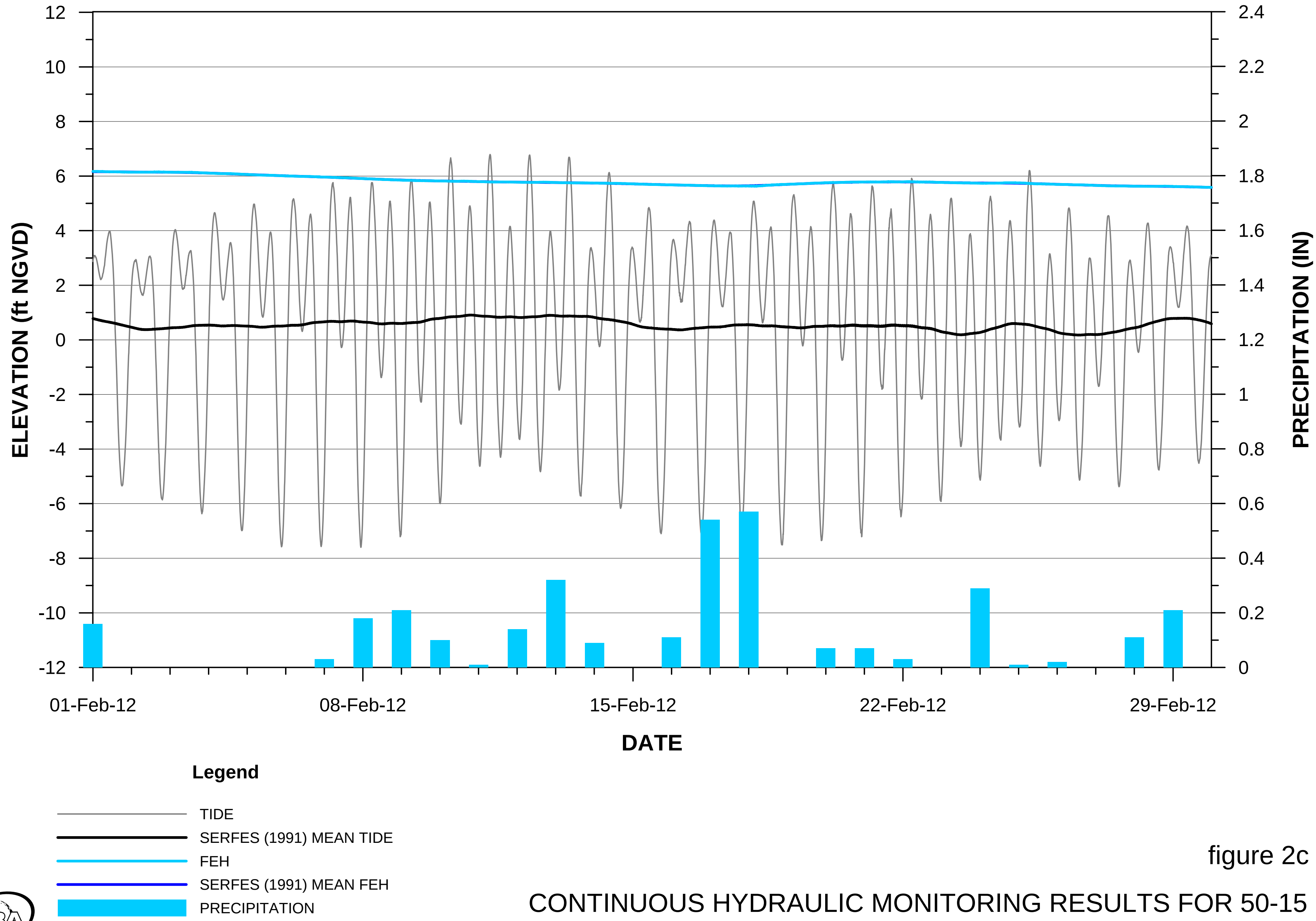

figure 2c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

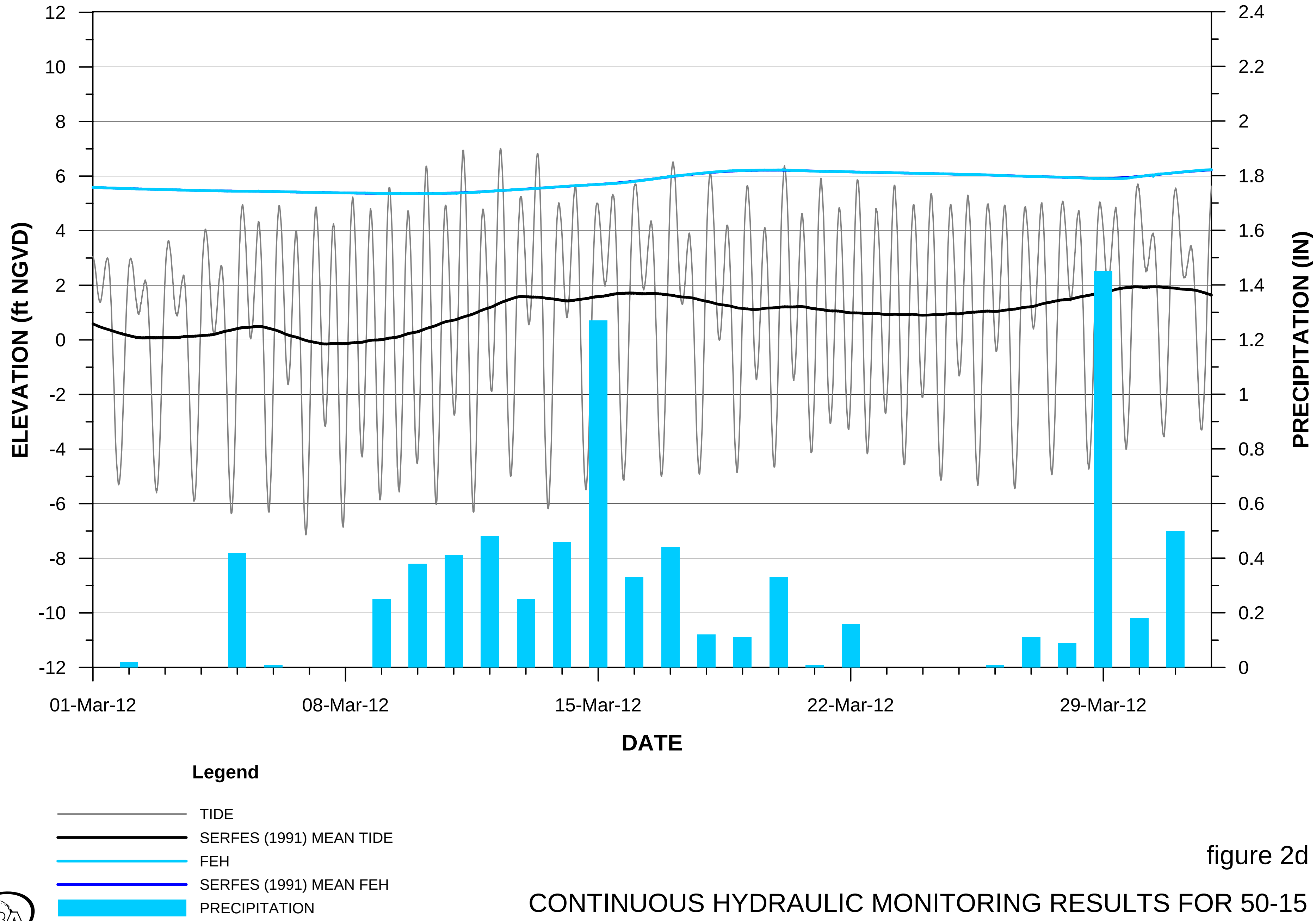

figure 2d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

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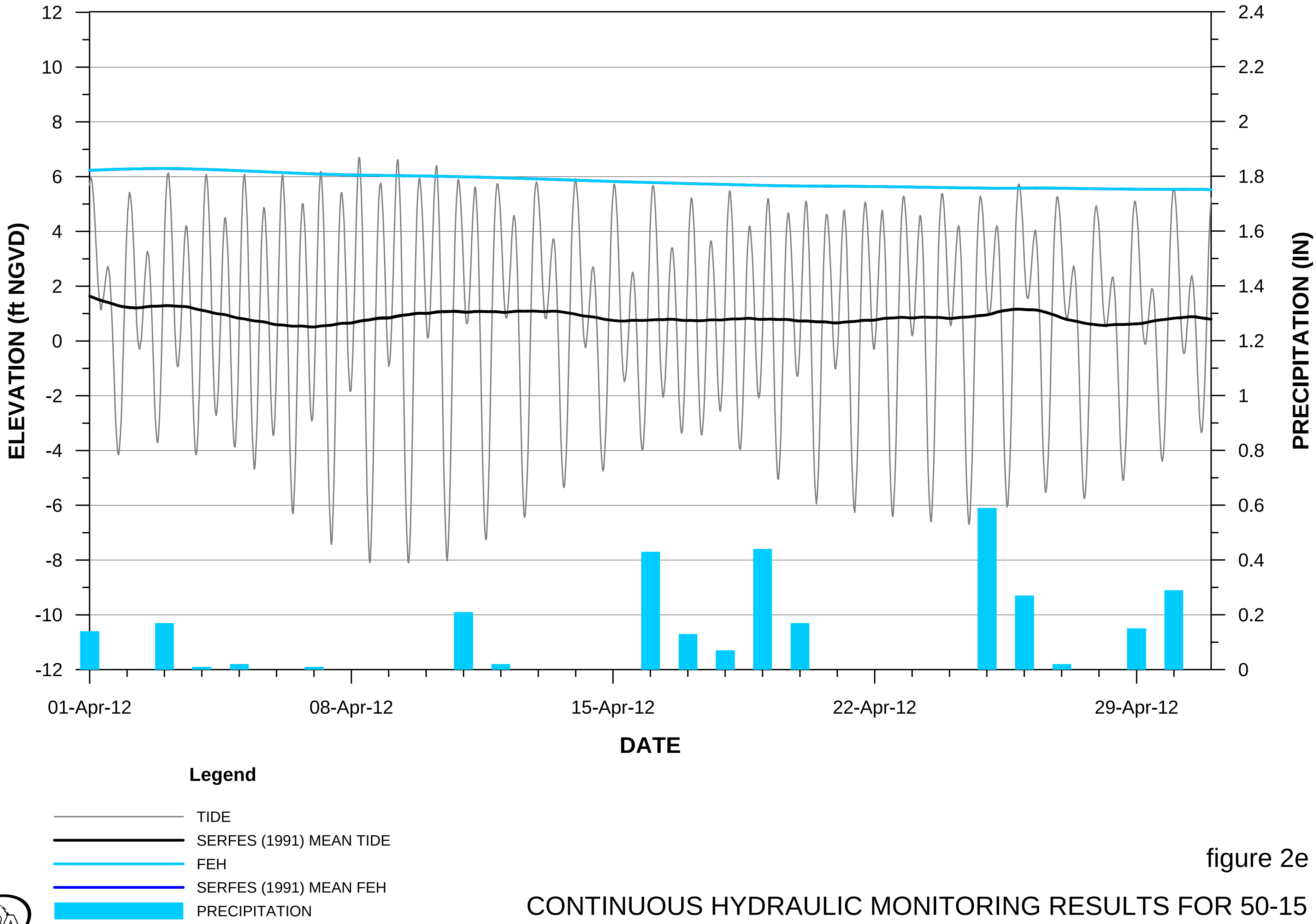


figure 2e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_April 2012.grf) AUG 5/2014

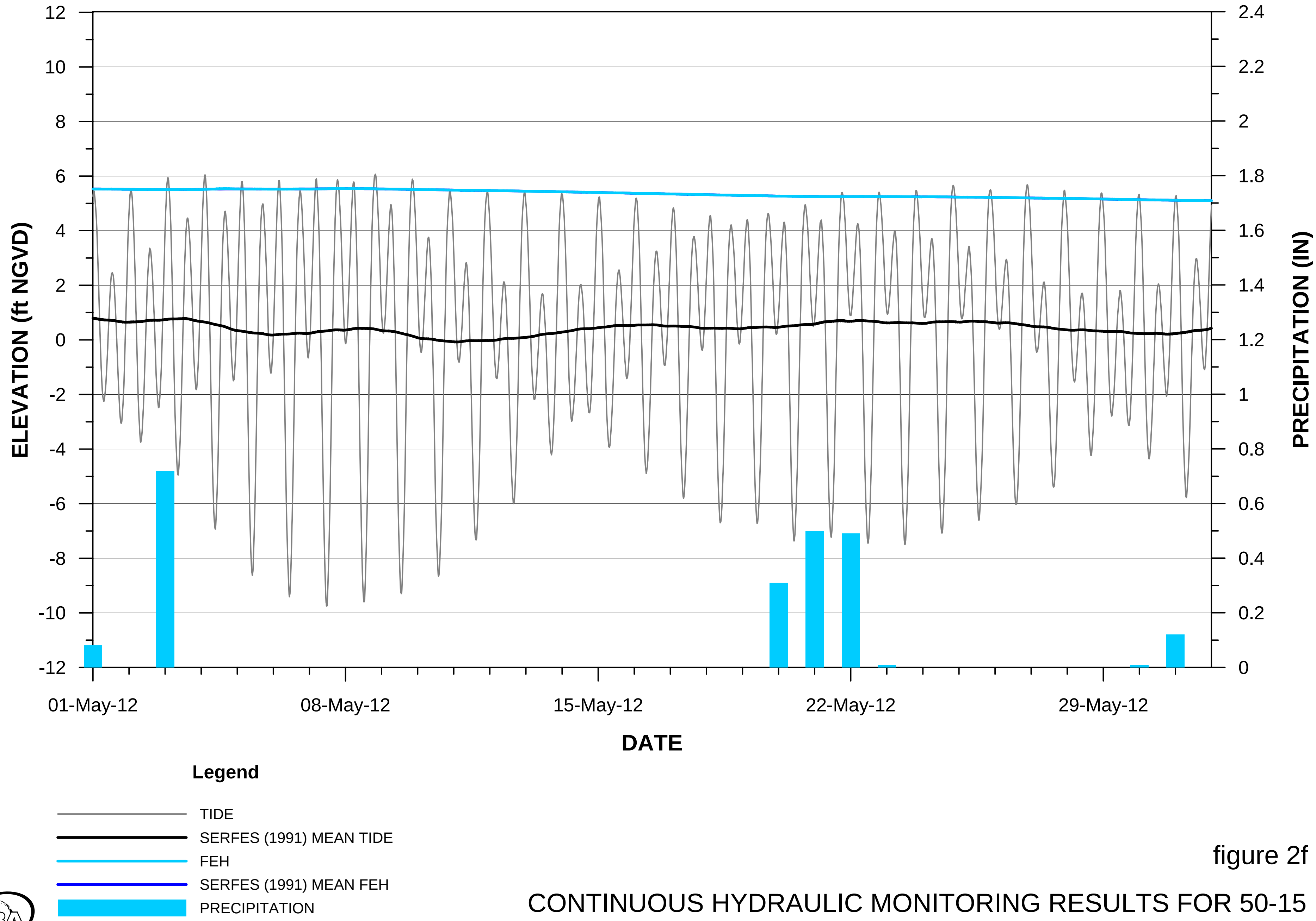
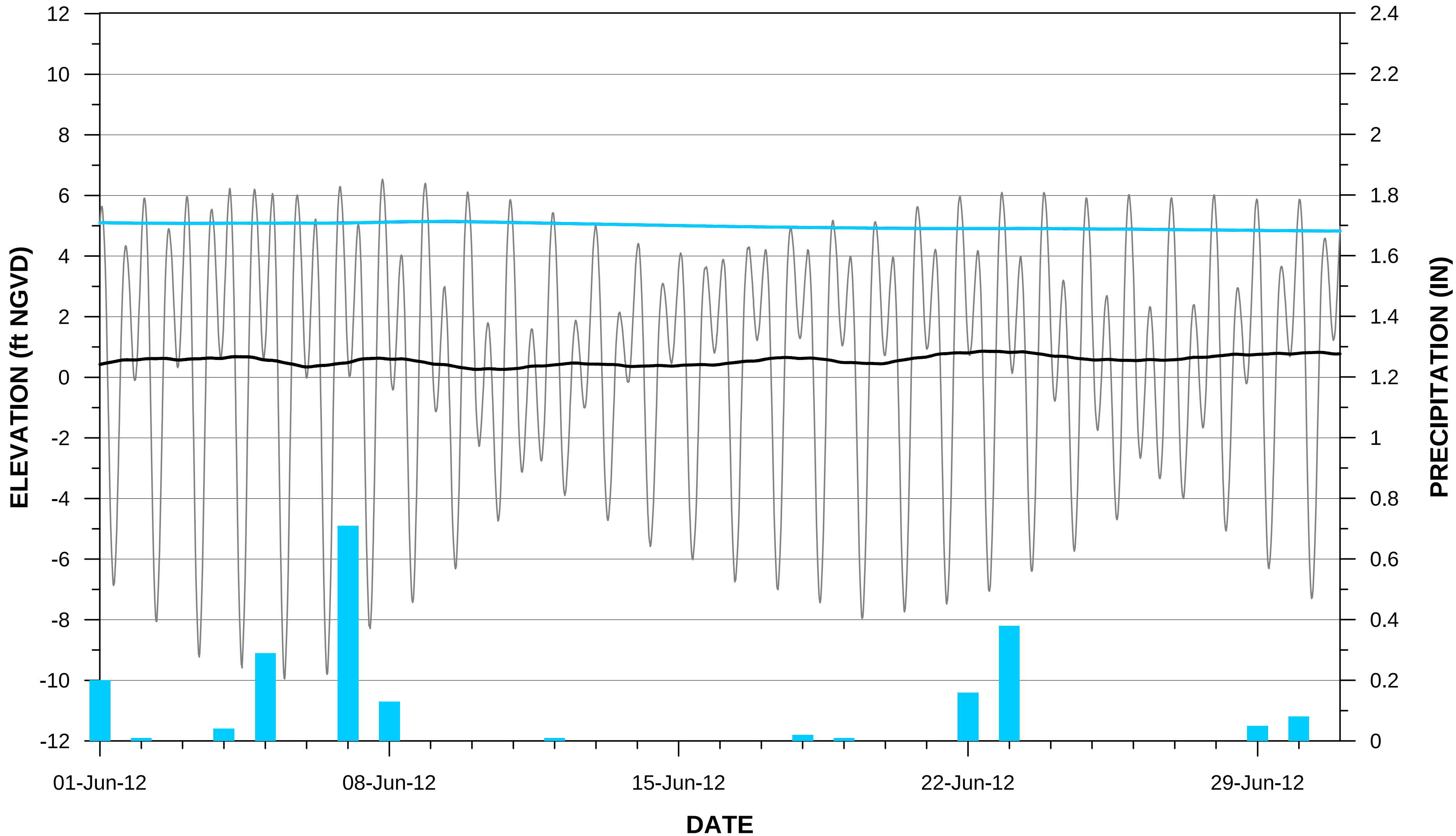


figure 2f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_May 2012.grf) AUG 5/2014



Legend

- TIDE
- SERFES (1991) MEAN TIDE
- FEH
- SERFES (1991) MEAN FEH
- PRECIPITATION

figure 2g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

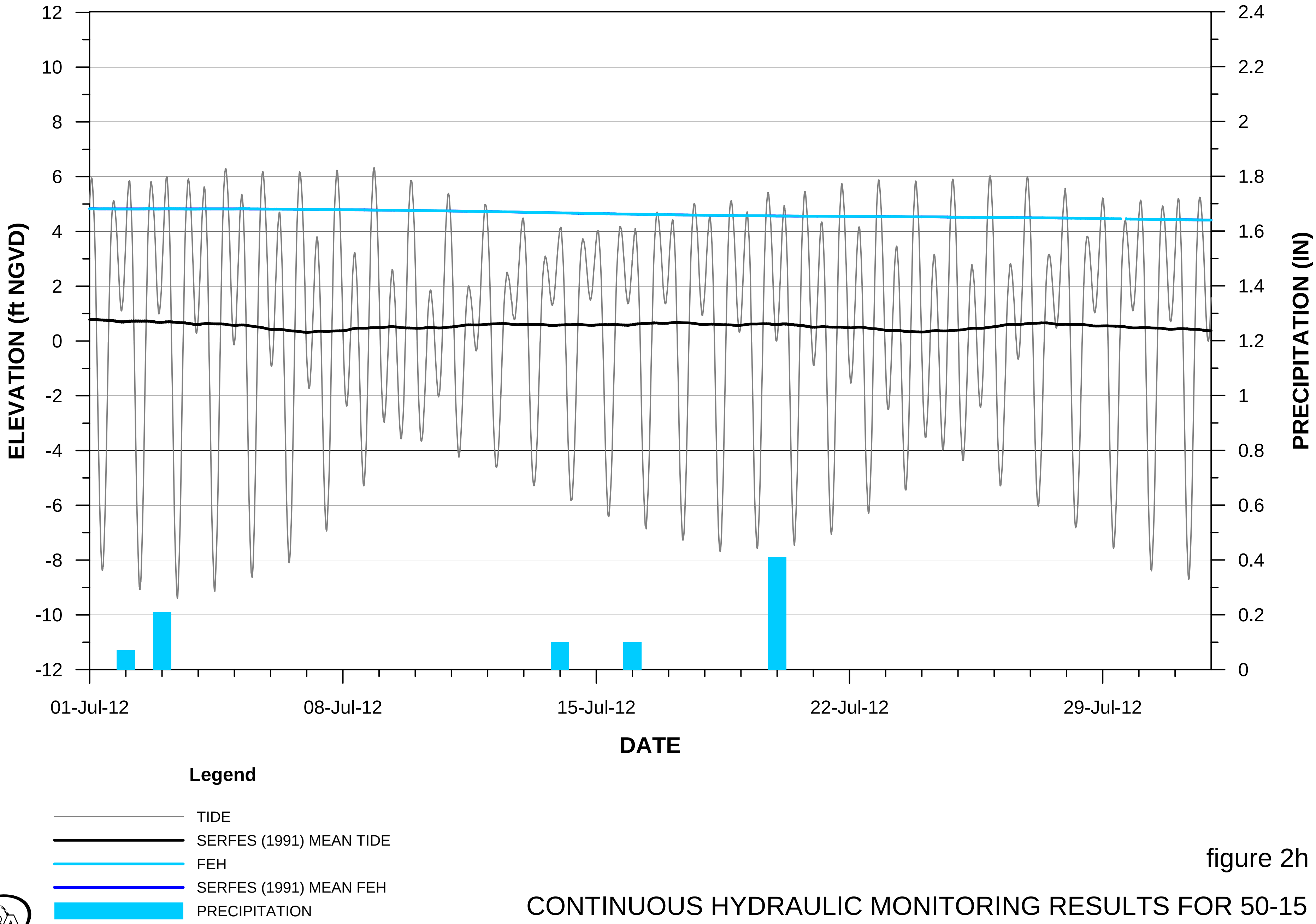


figure 2h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_July 2012.grf) AUG 5/2014

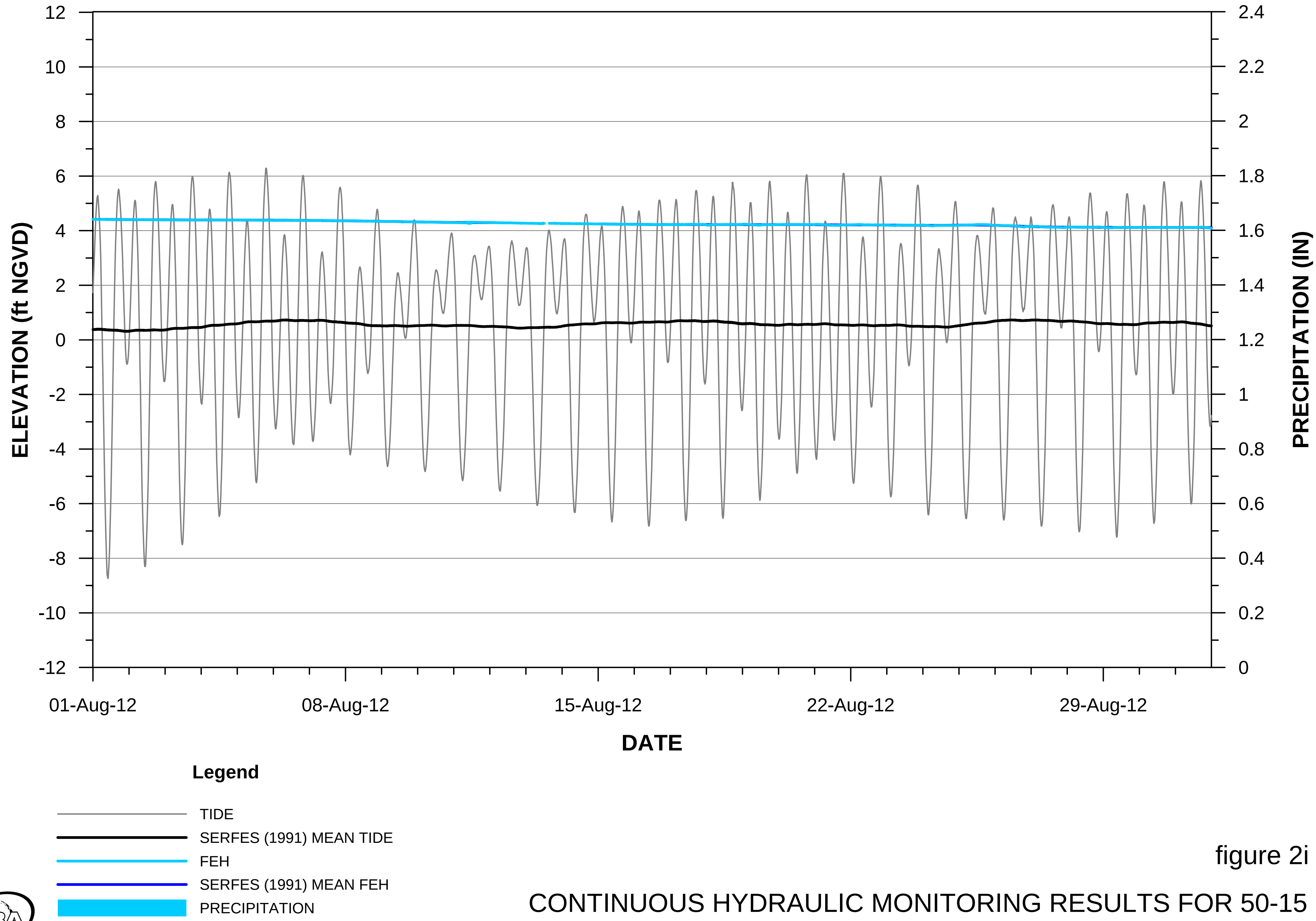


figure 2i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_August 2012.grf) AUG 5/2014

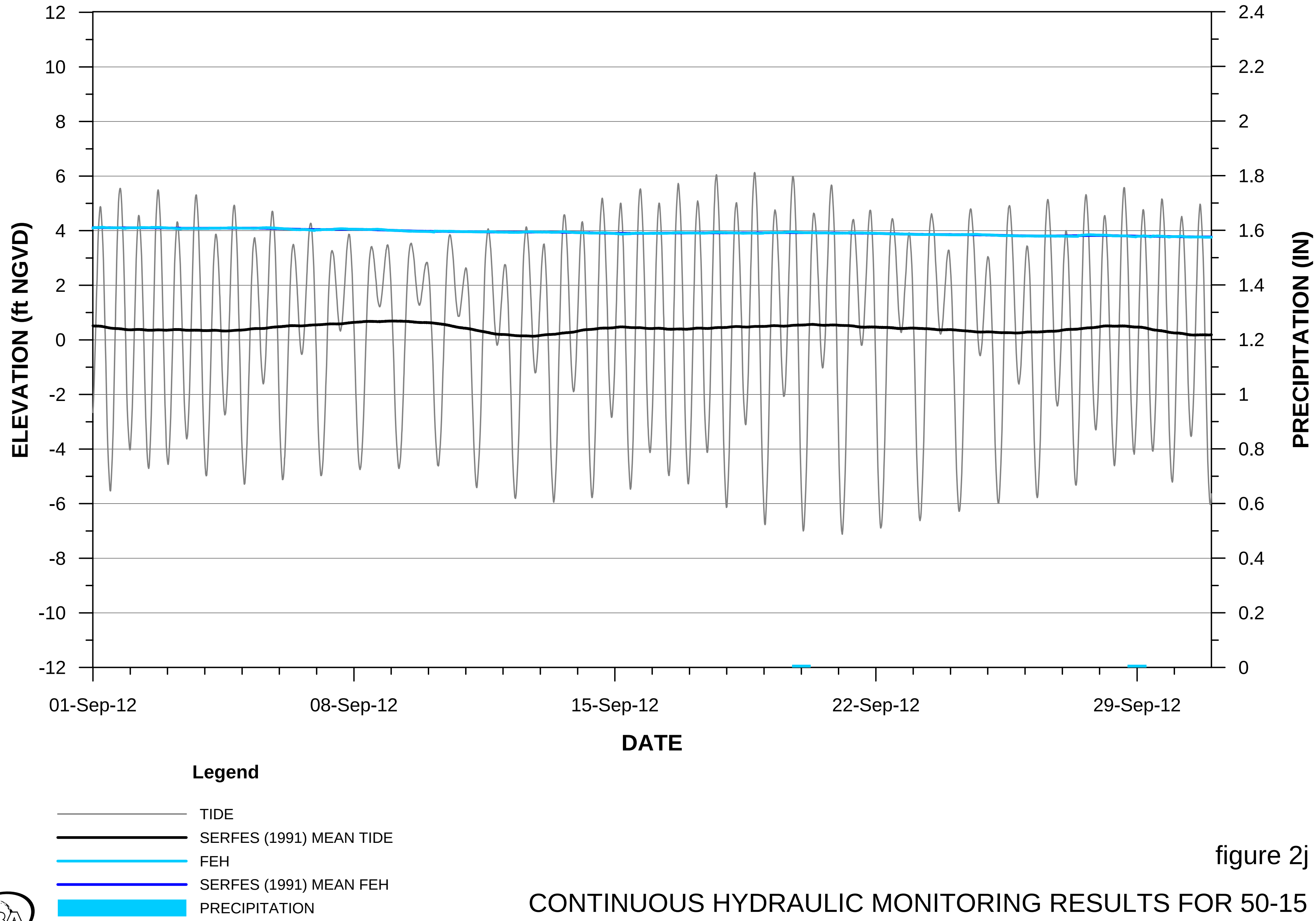


figure 2j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_September 2012.grf) AUG 5/2014

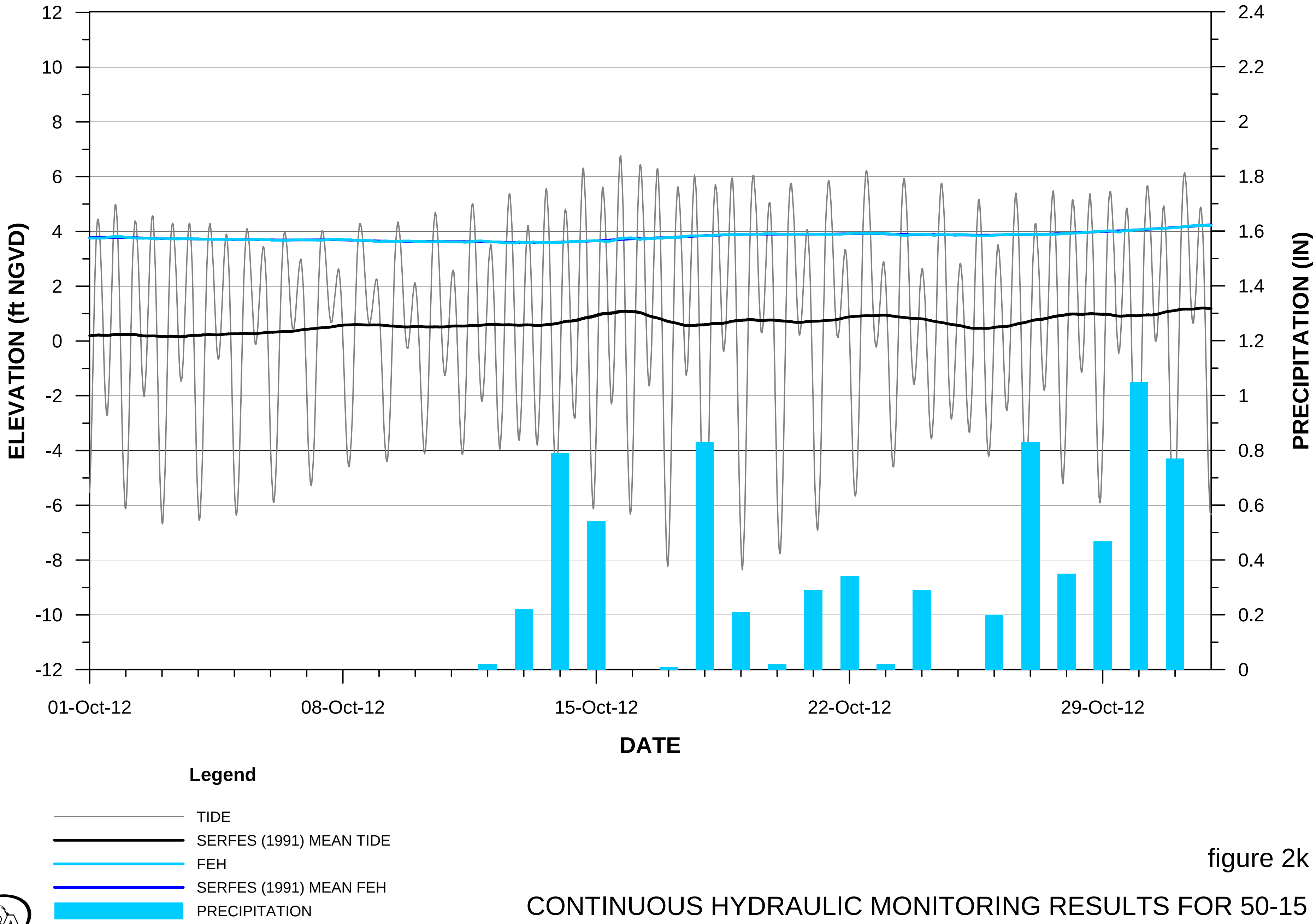


figure 2k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_October 2012.grf) AUG 5/2014

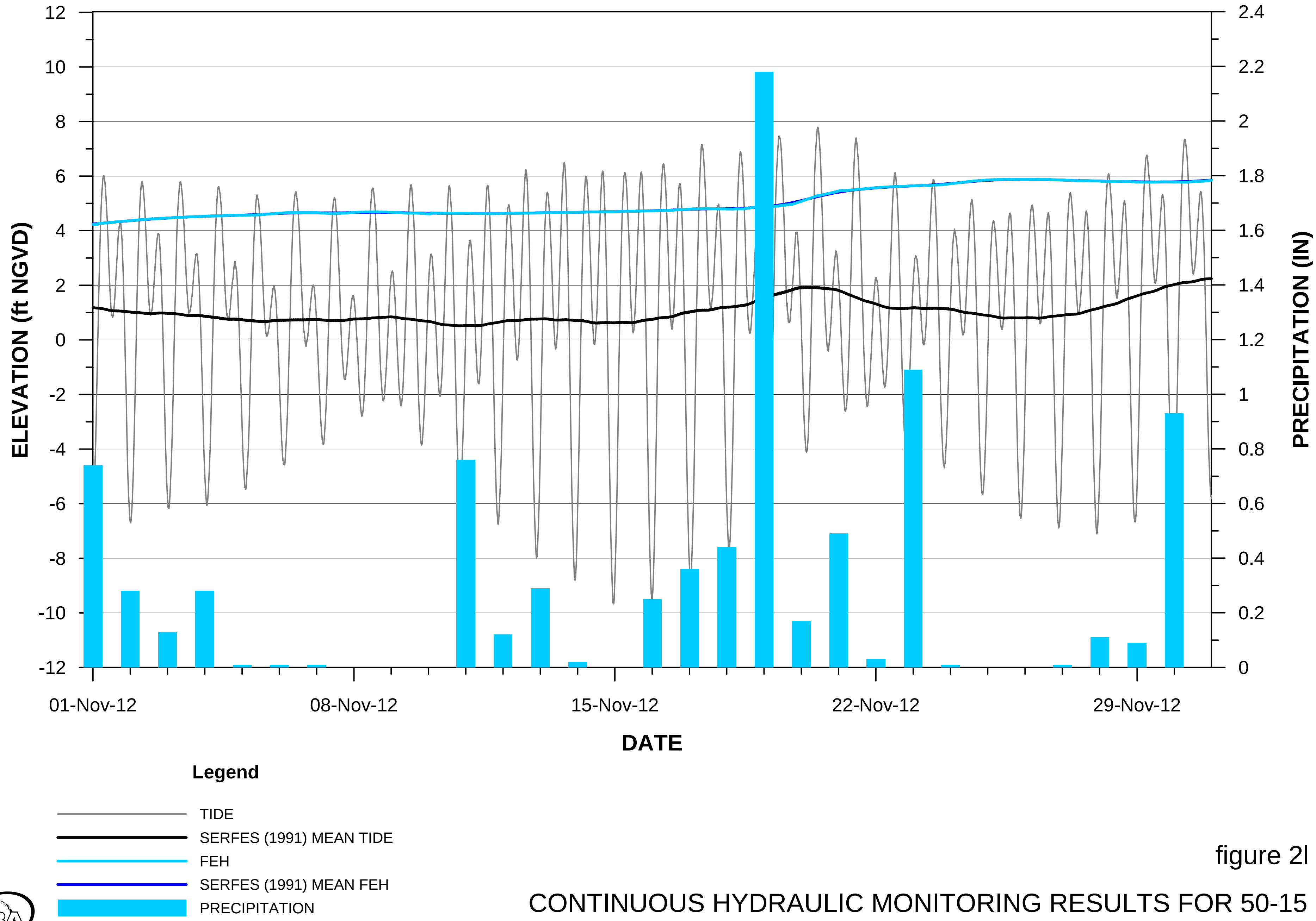


figure 2l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

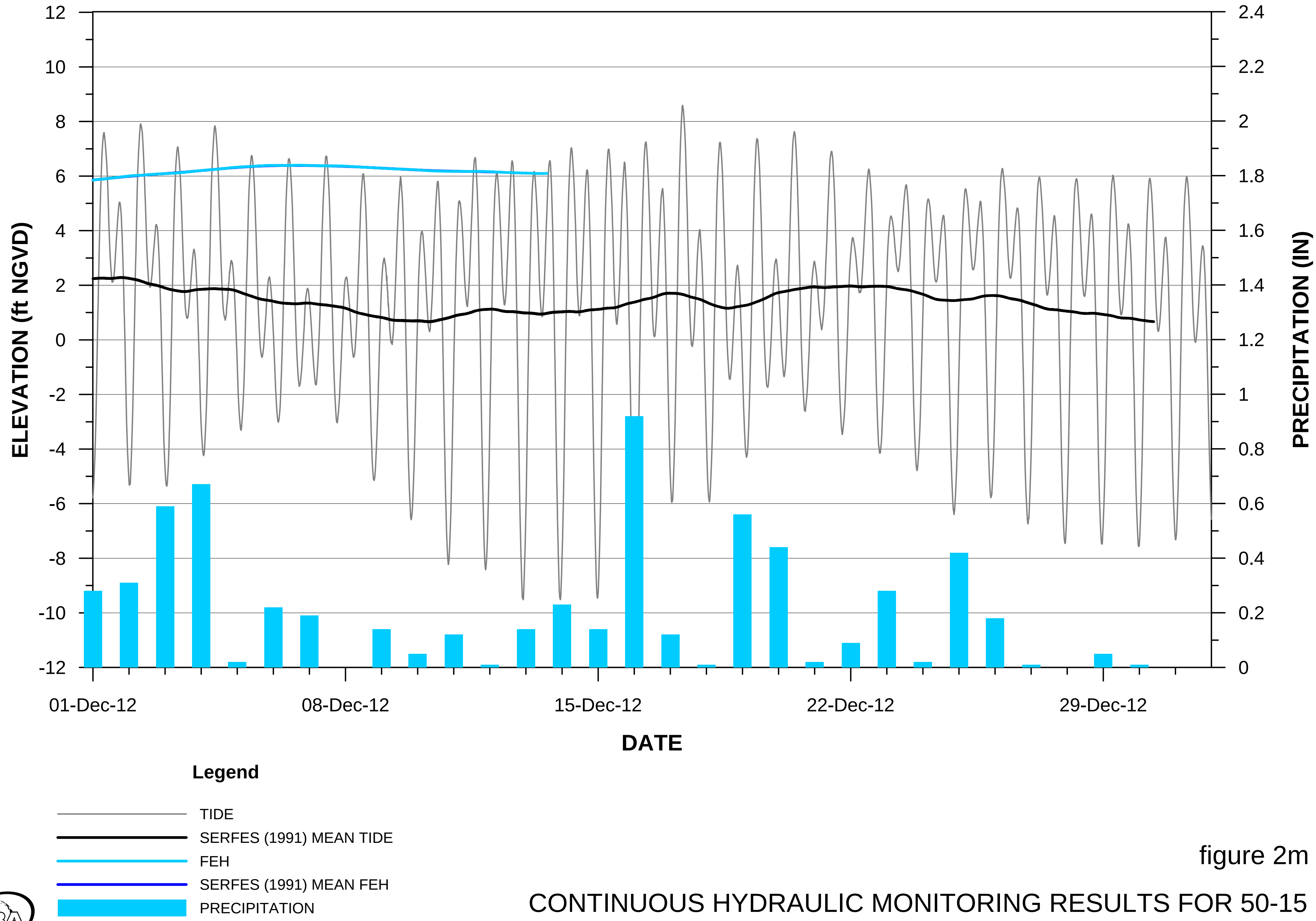


figure 2m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 50-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\50-15\07843_50-15_December 2012.grf) AUG 5/2014

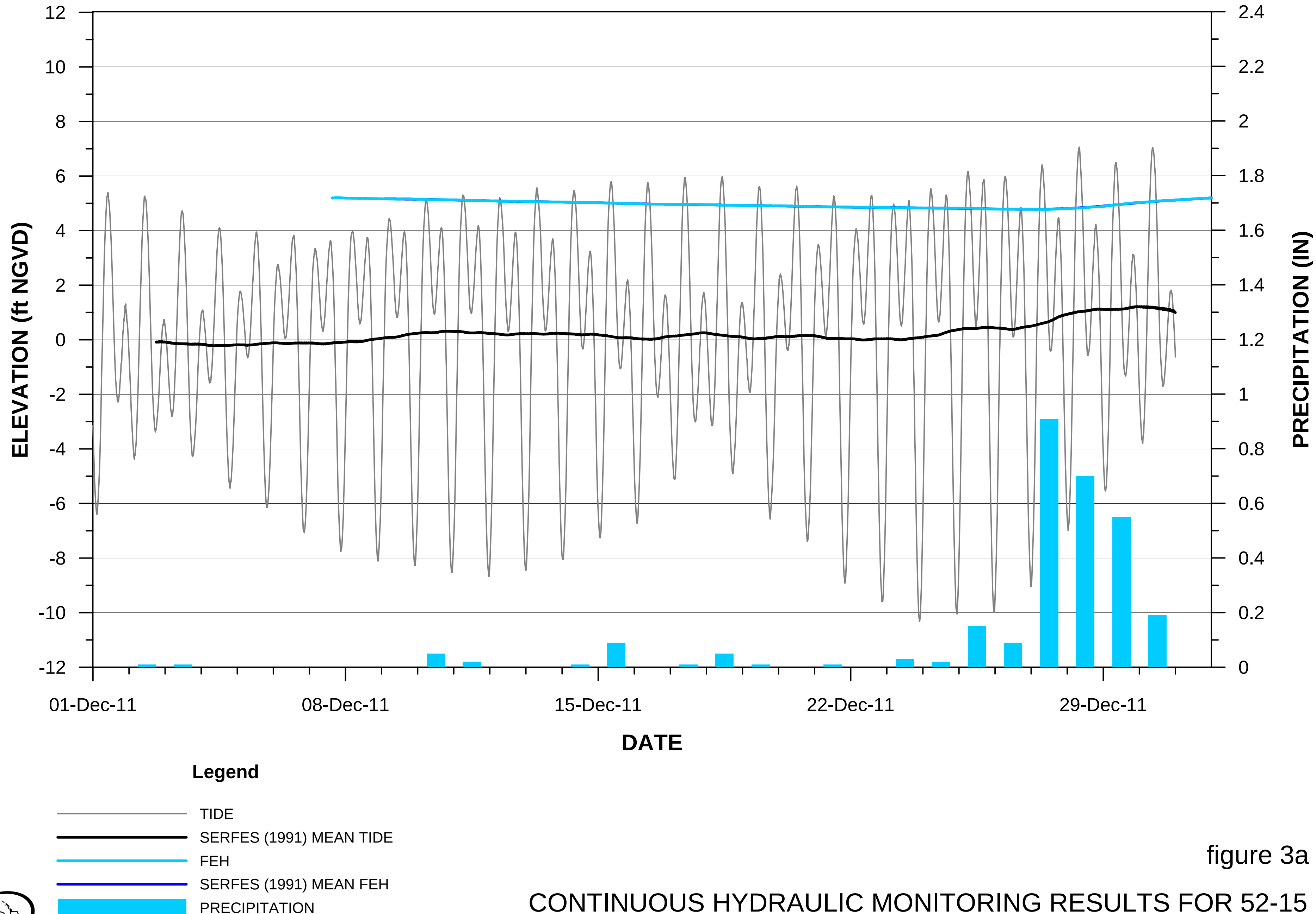
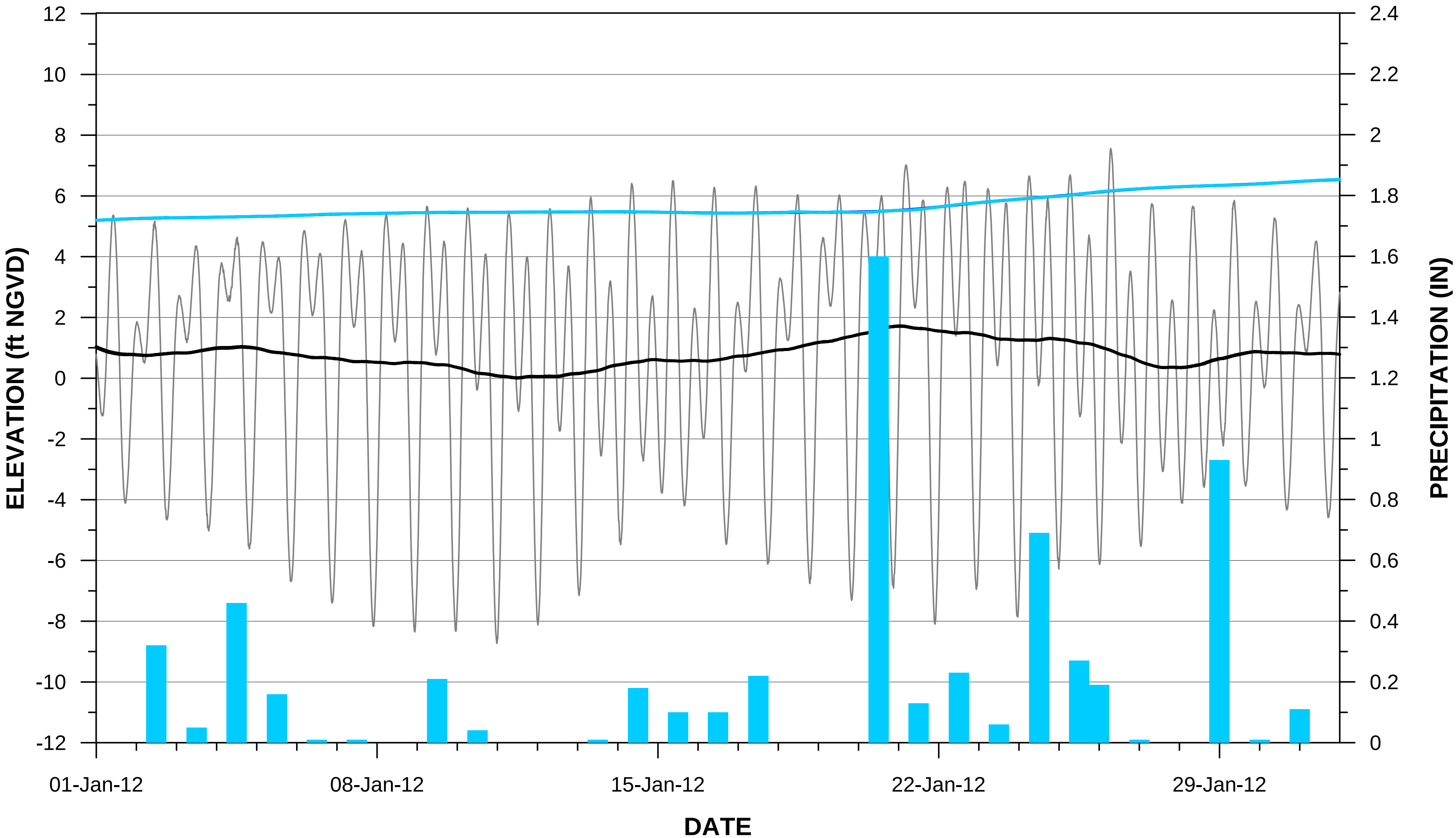


figure 3a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington



Legend

- TIDE
- SERFES (1991) MEAN TIDE
- FEH
- SERFES (1991) MEAN FEH
- PRECIPITATION

figure 3b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_January 2012.grf) AUG 5/2014

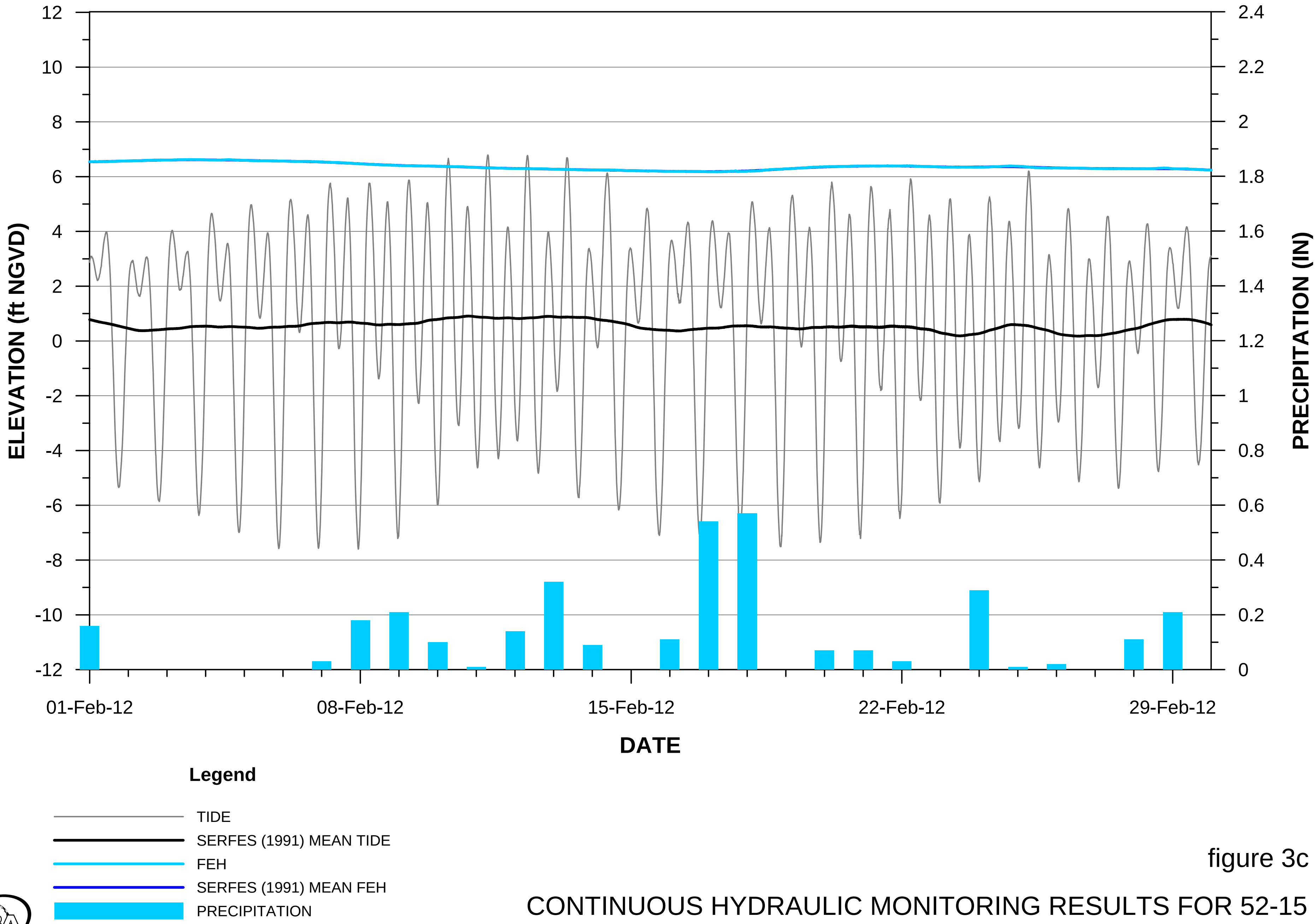


figure 3c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

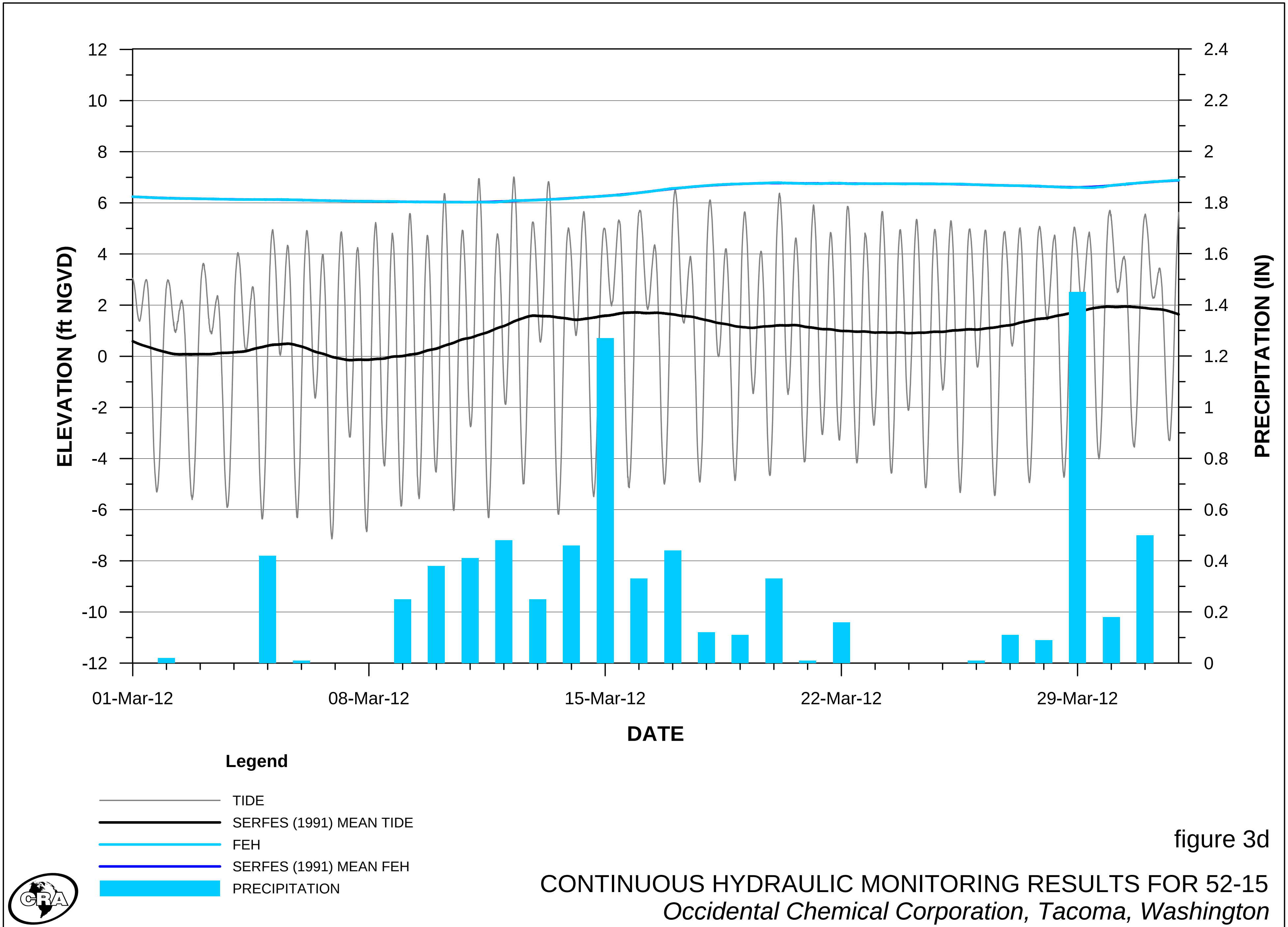


figure 3d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_March 2012.grf) AUG 5/2014

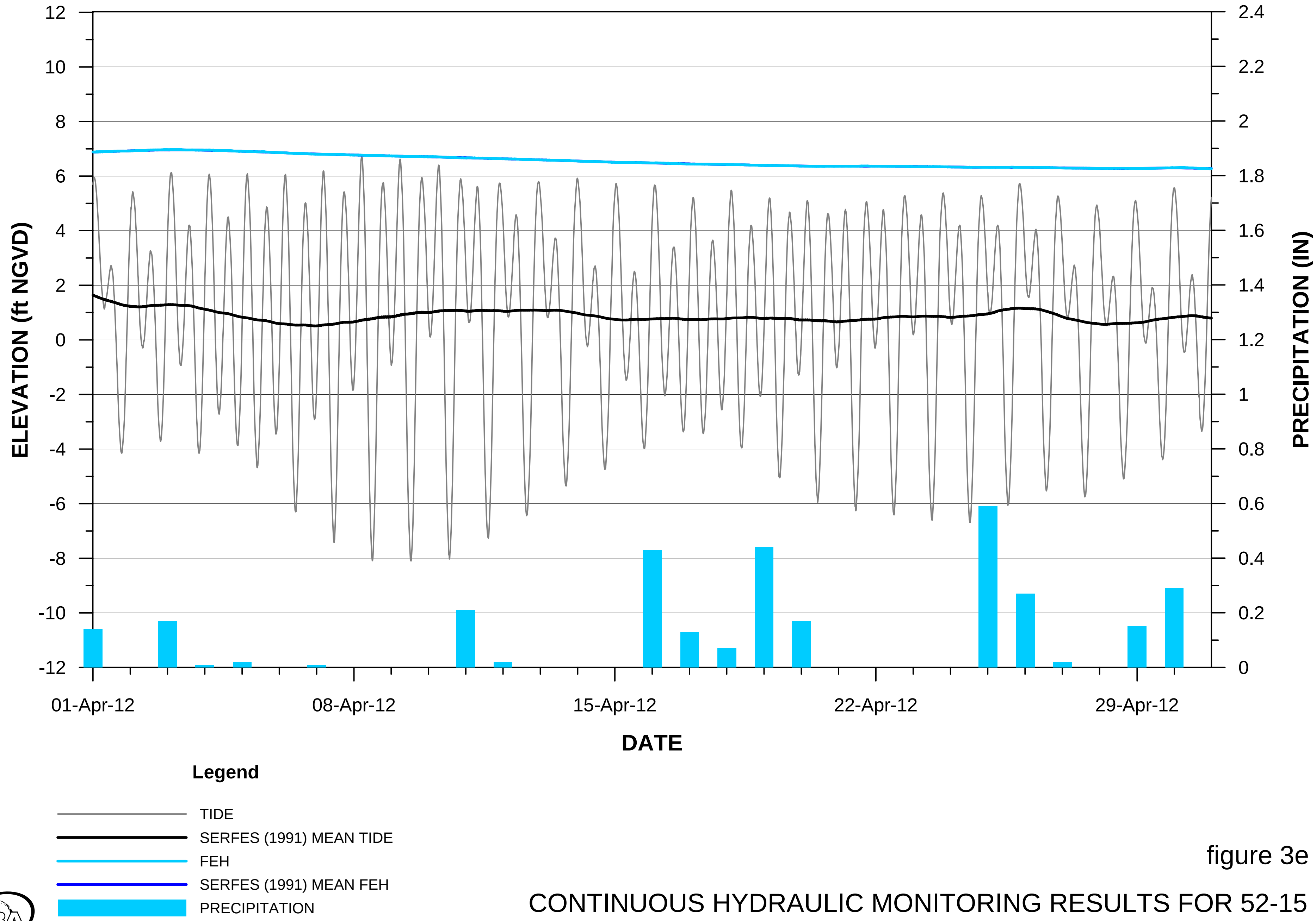


figure 3e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_April 2012.grf) AUG 5/2014

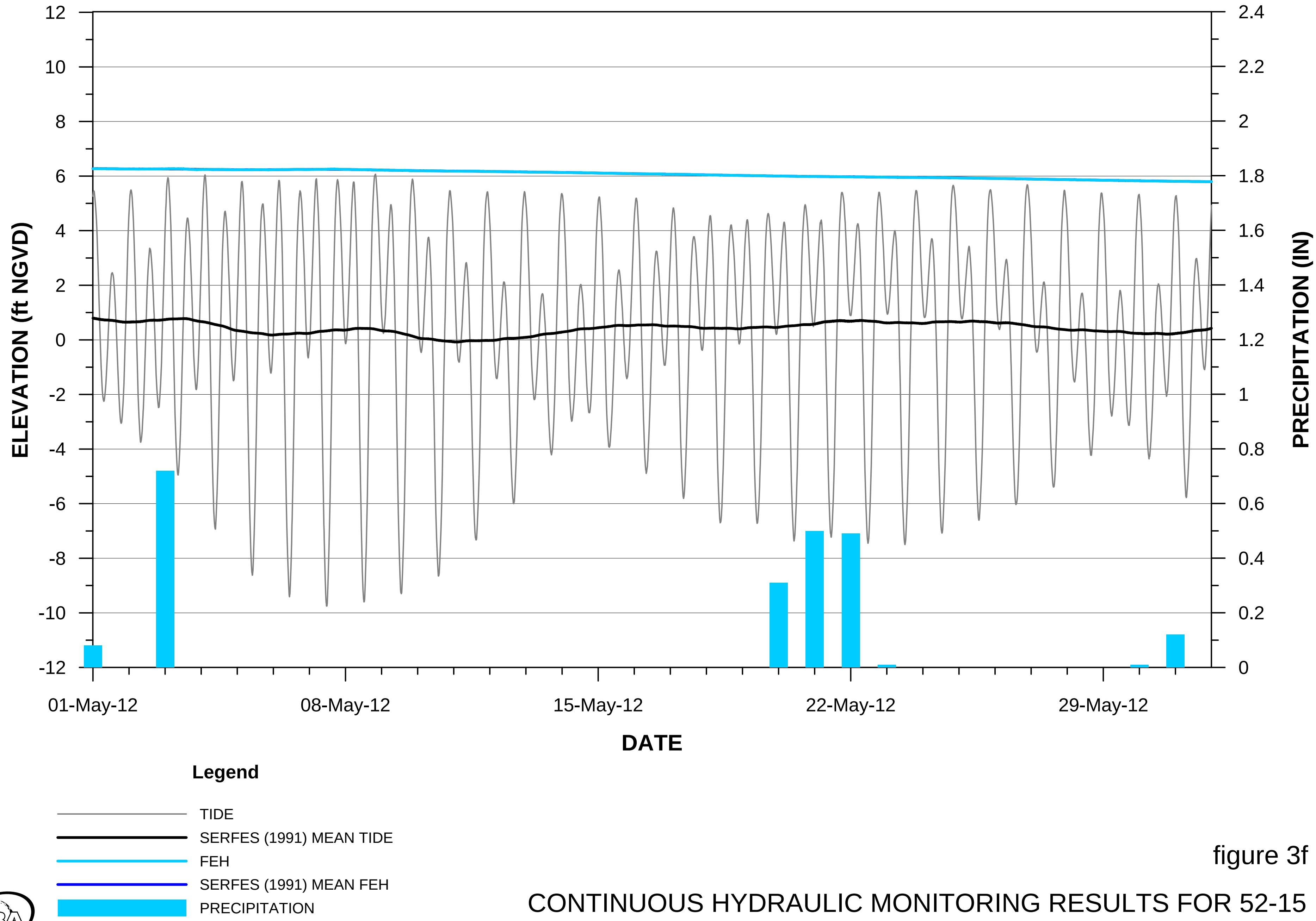


figure 3f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

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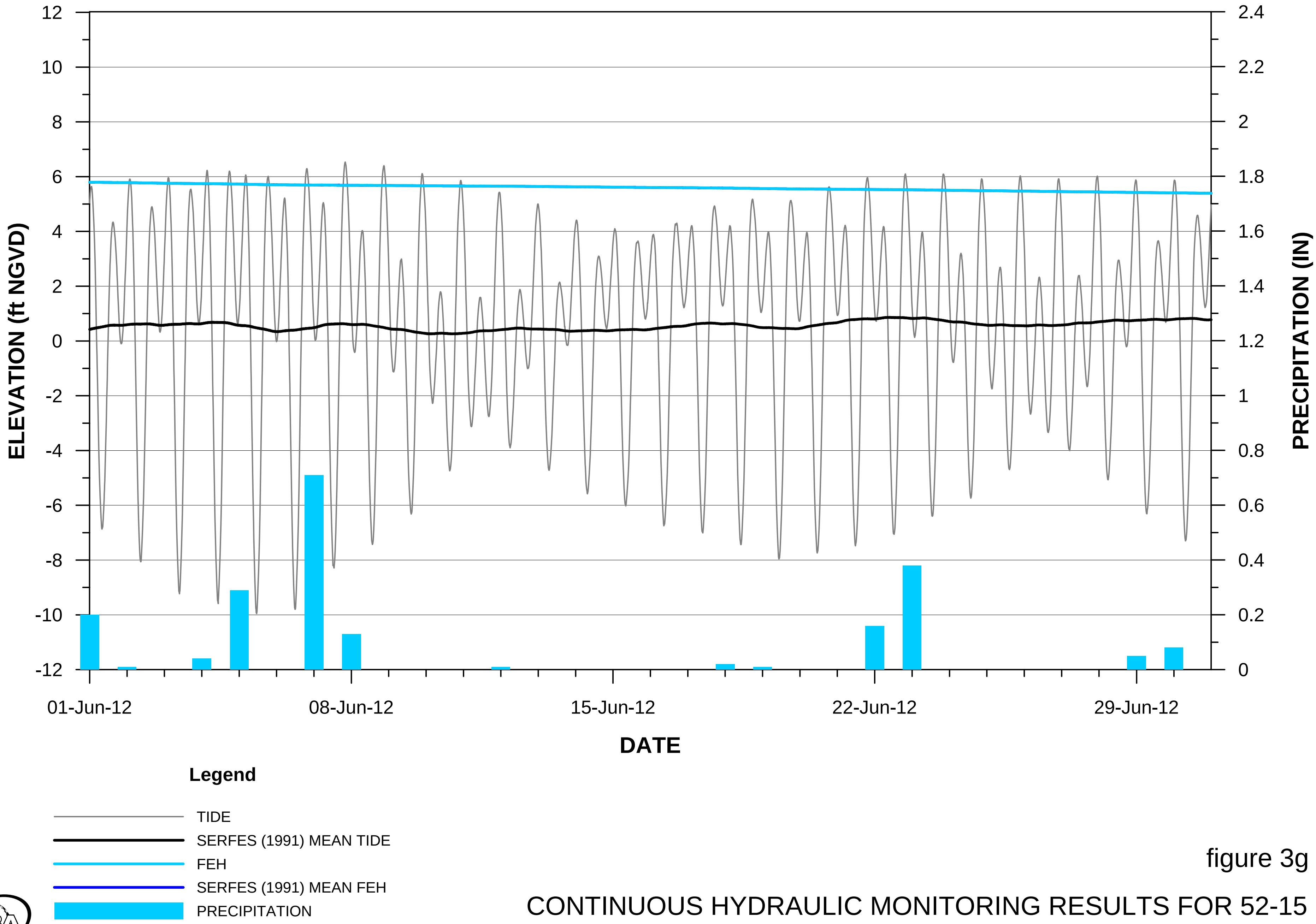

figure 3g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

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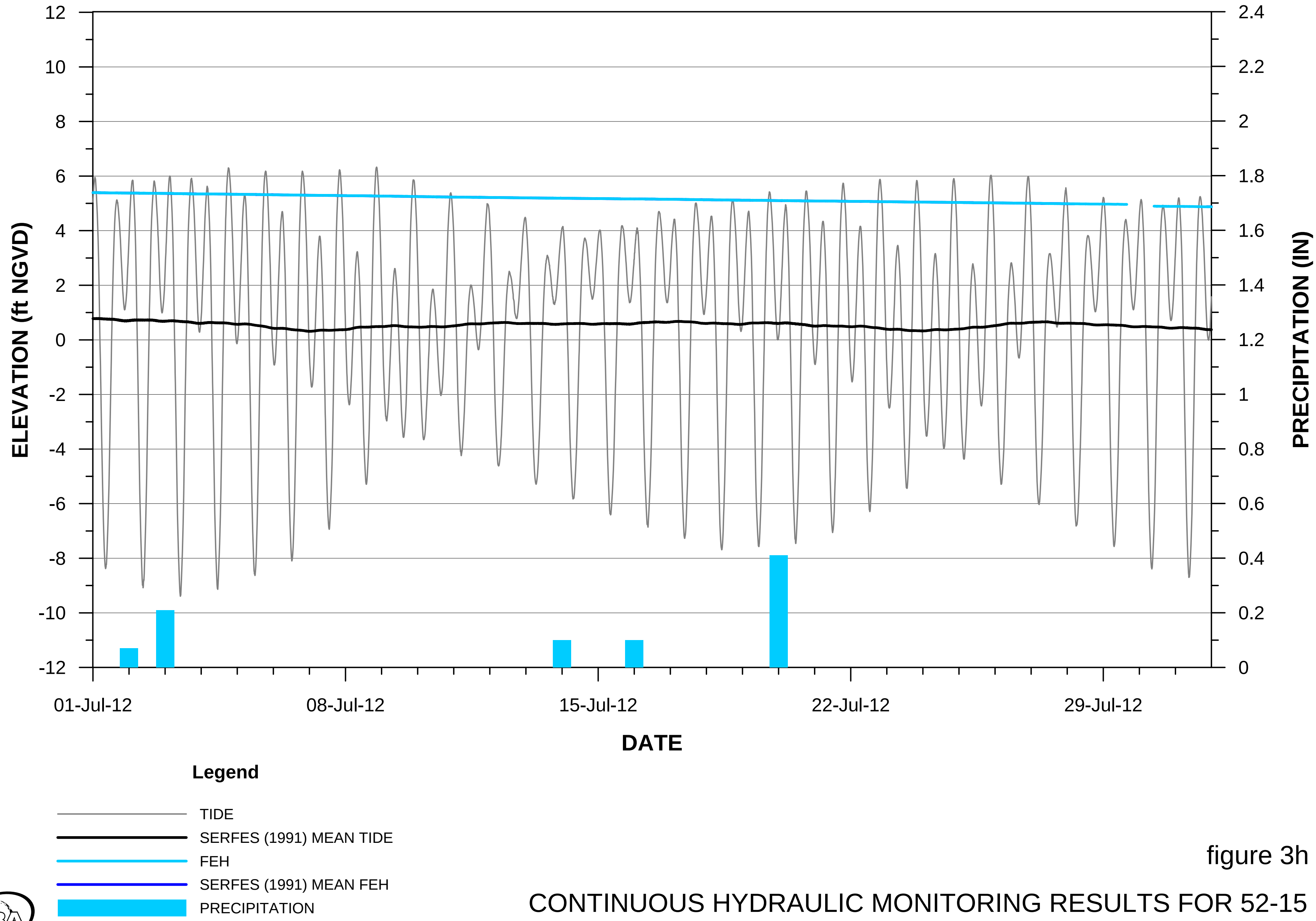

figure 3h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_July 2012.grf) AUG 5/2014

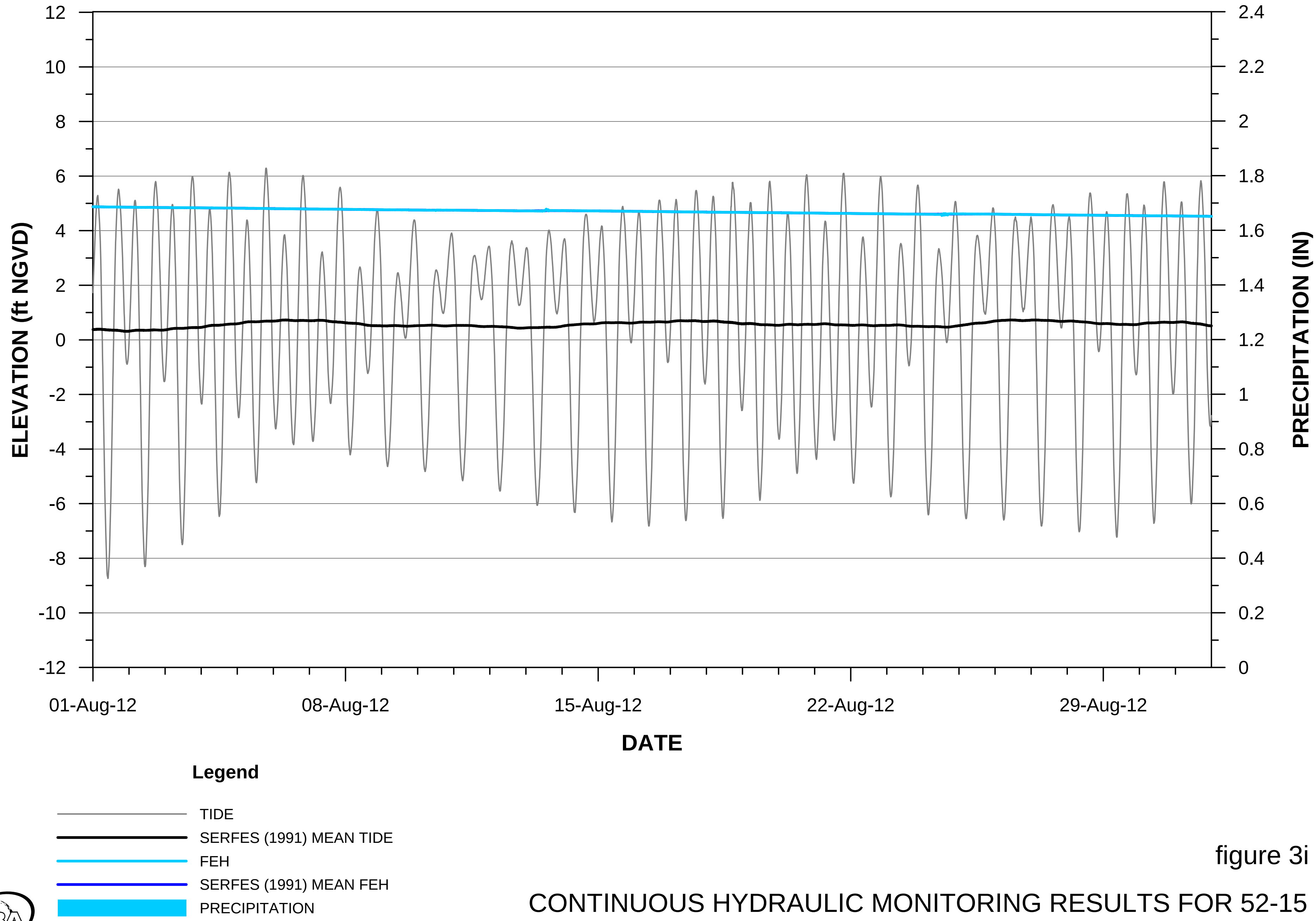

figure 3i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_August 2012.grf) AUG 5/2014

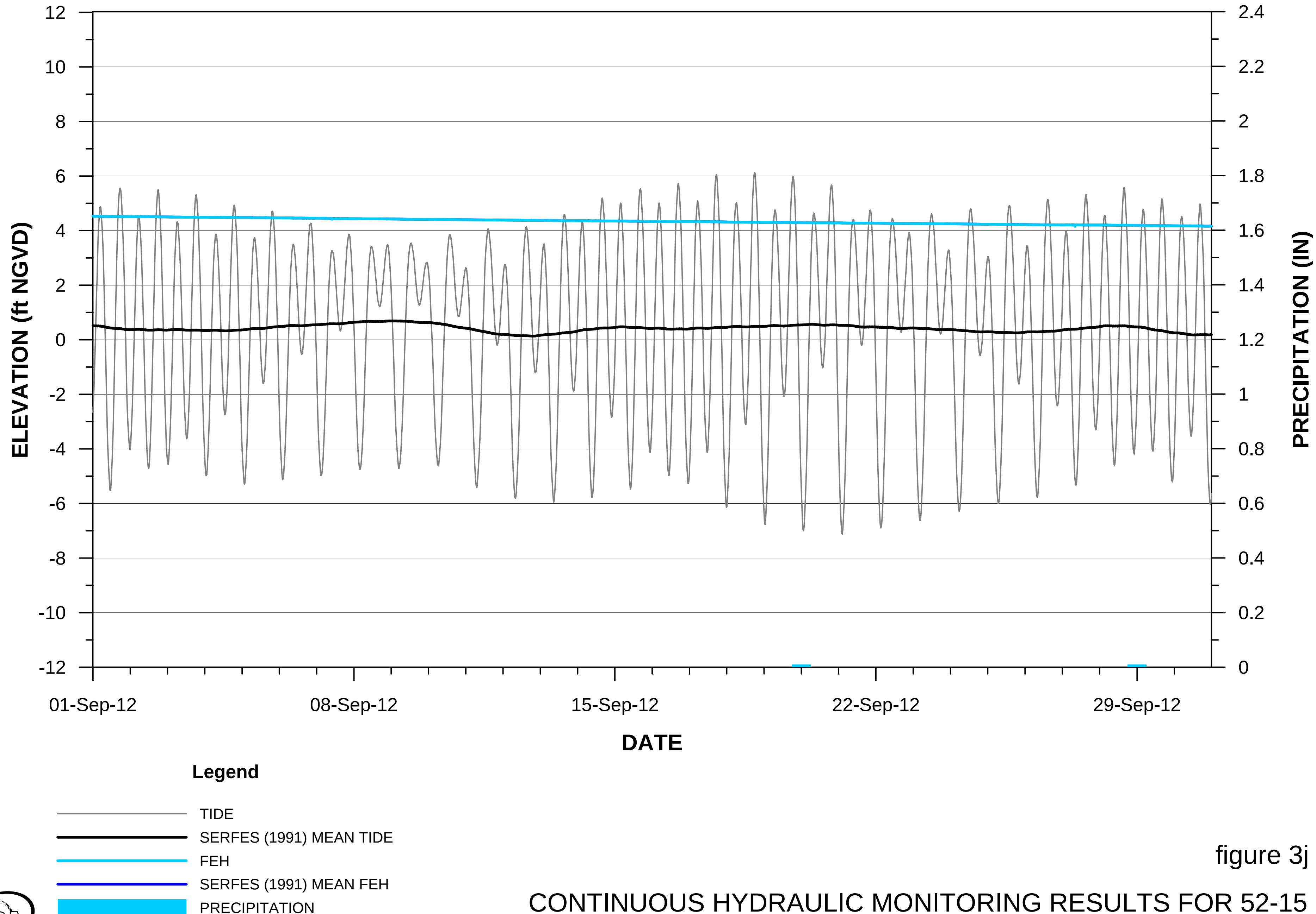

figure 3j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_September 2012.grf) AUG 5/2014

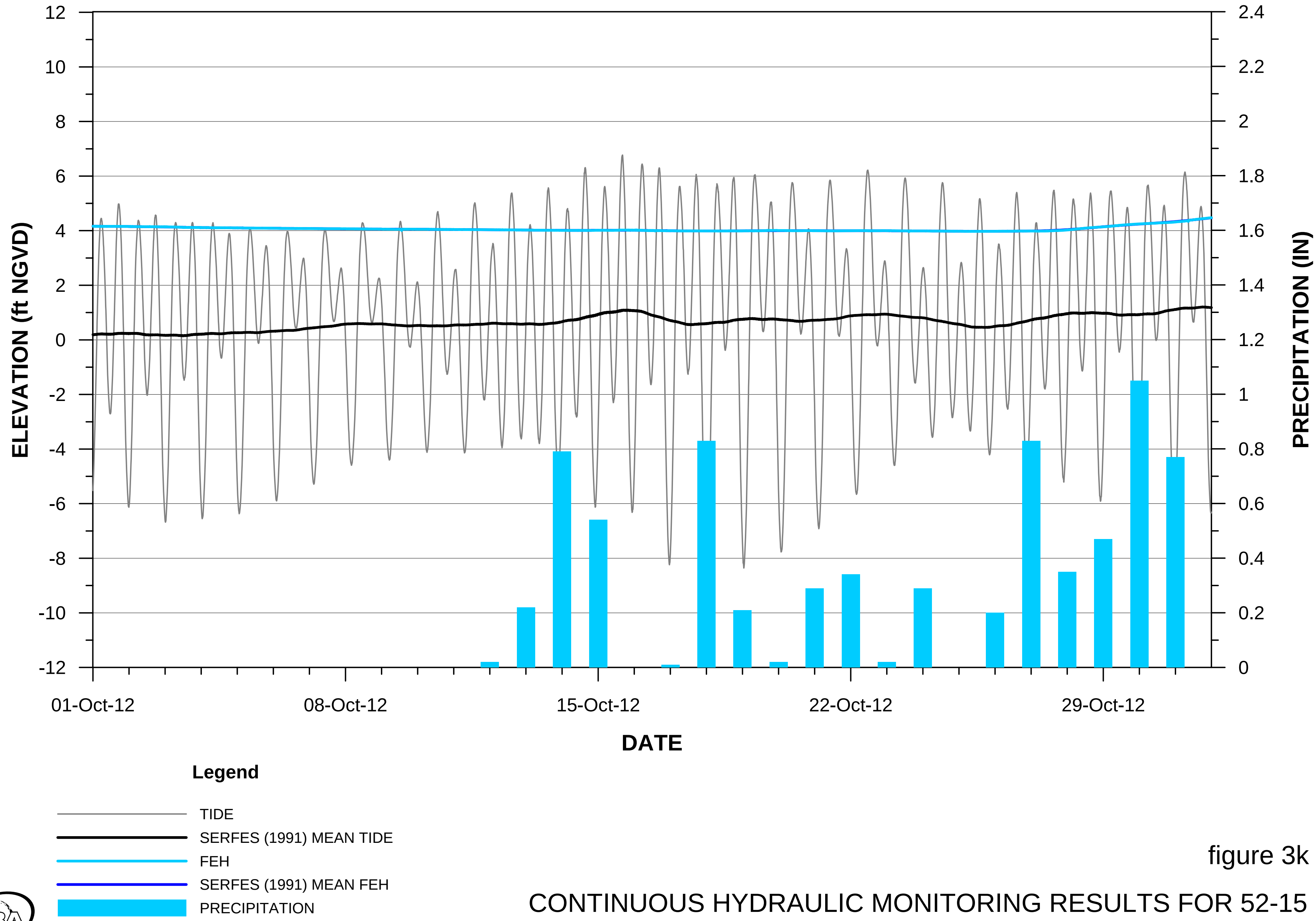

figure 3k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_October 2012.grf) AUG 5/2014

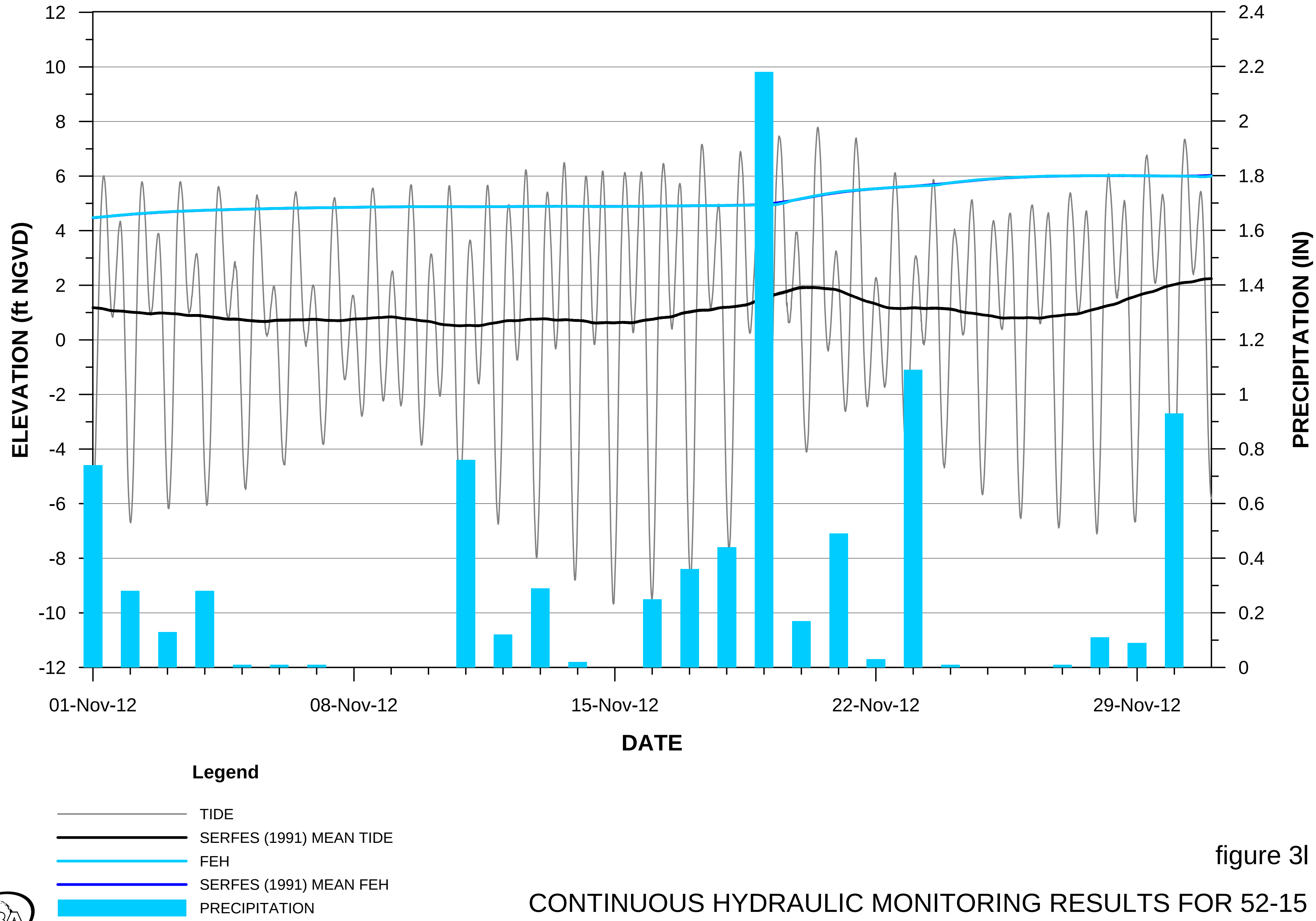

figure 3l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(123)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_November 2012.grf) AUG 5/2014

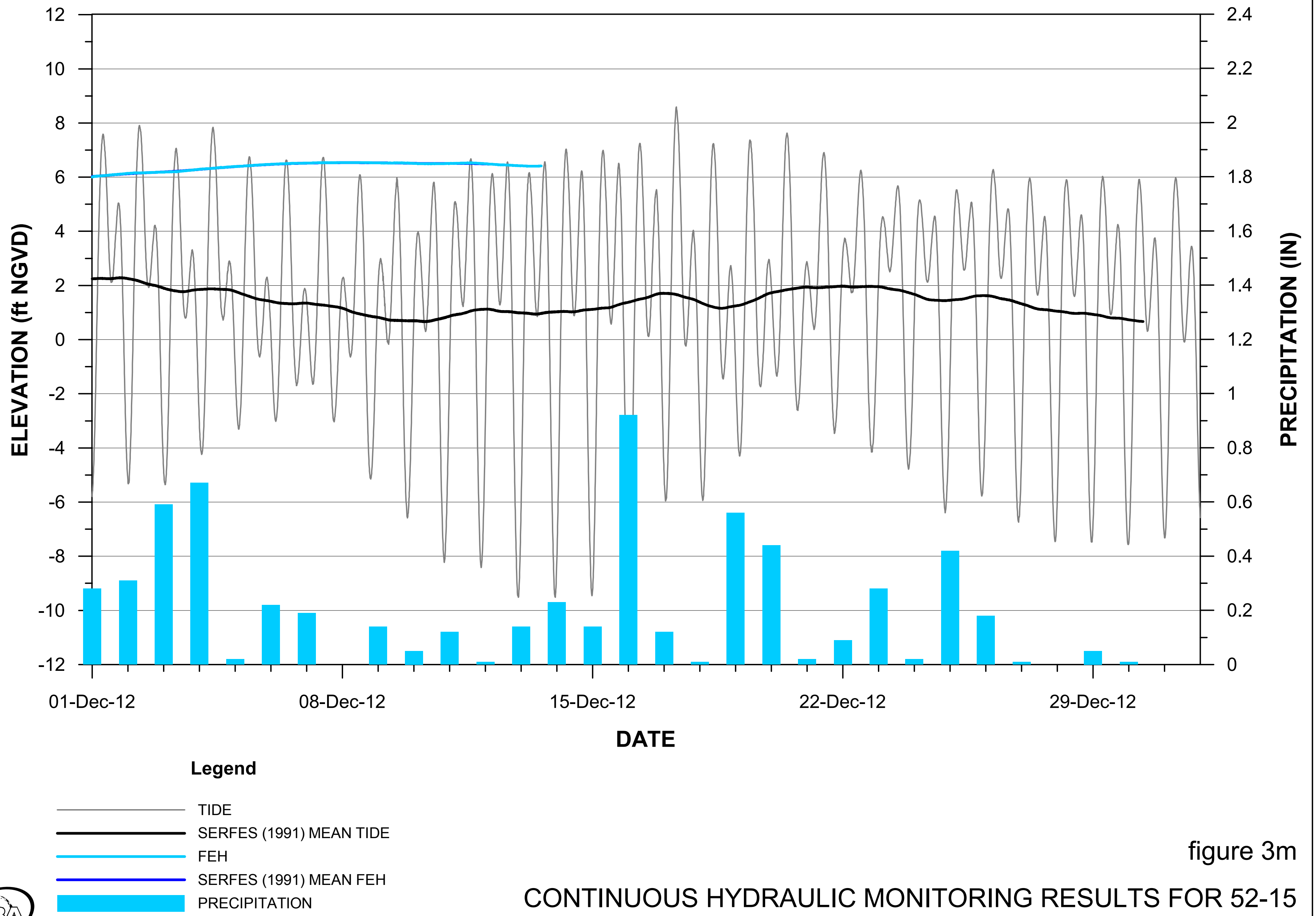

figure 3m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 52-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\52-15\07843_52-15_December 2012.grf) AUG 5/2014

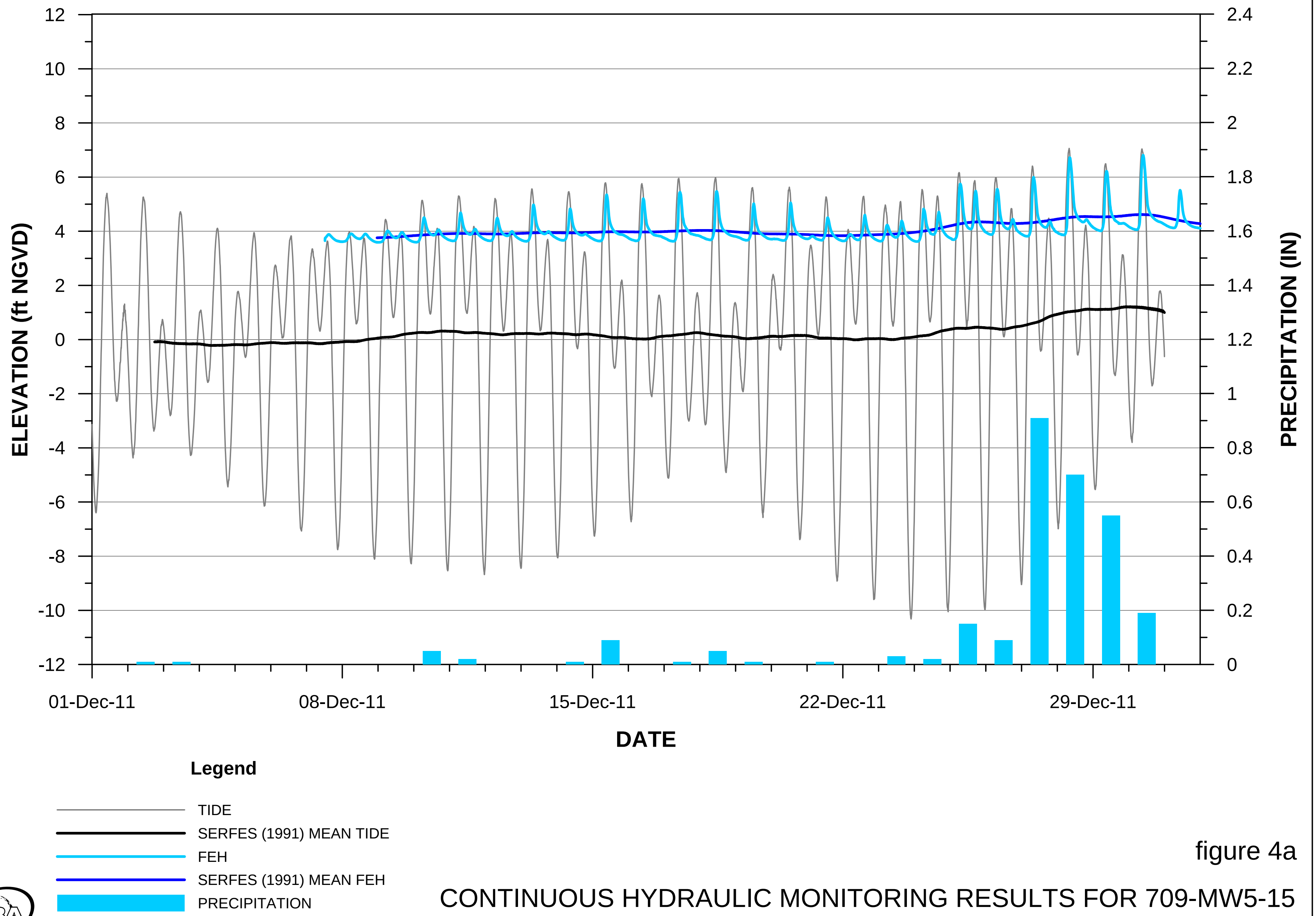

figure 4a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW5-15\07843_709-MW5-15_December 2011.grf) AUG 5/2014

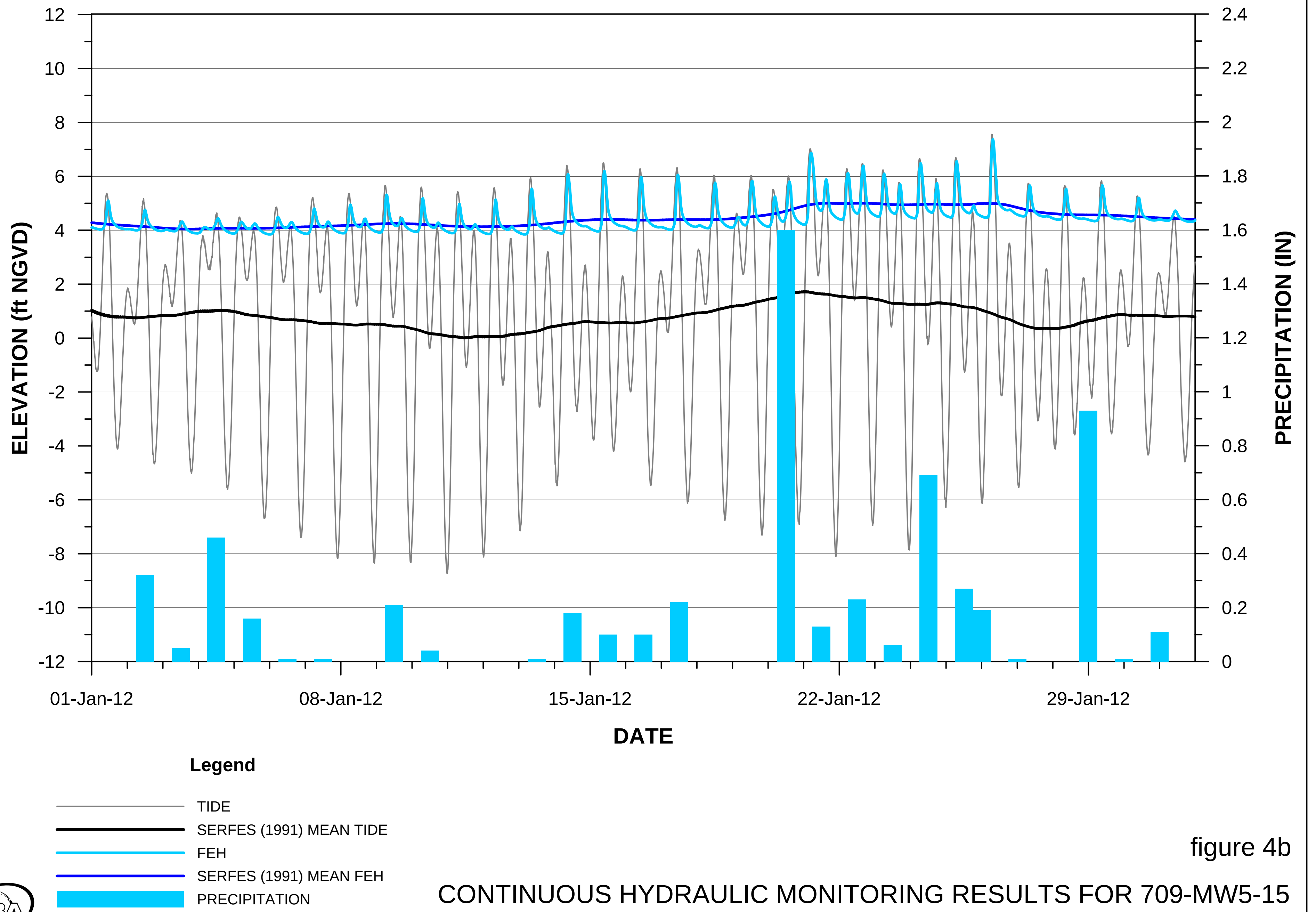

figure 4b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW5-15\07843_709-MW5-15_January 2012.grf) AUG 5/2014

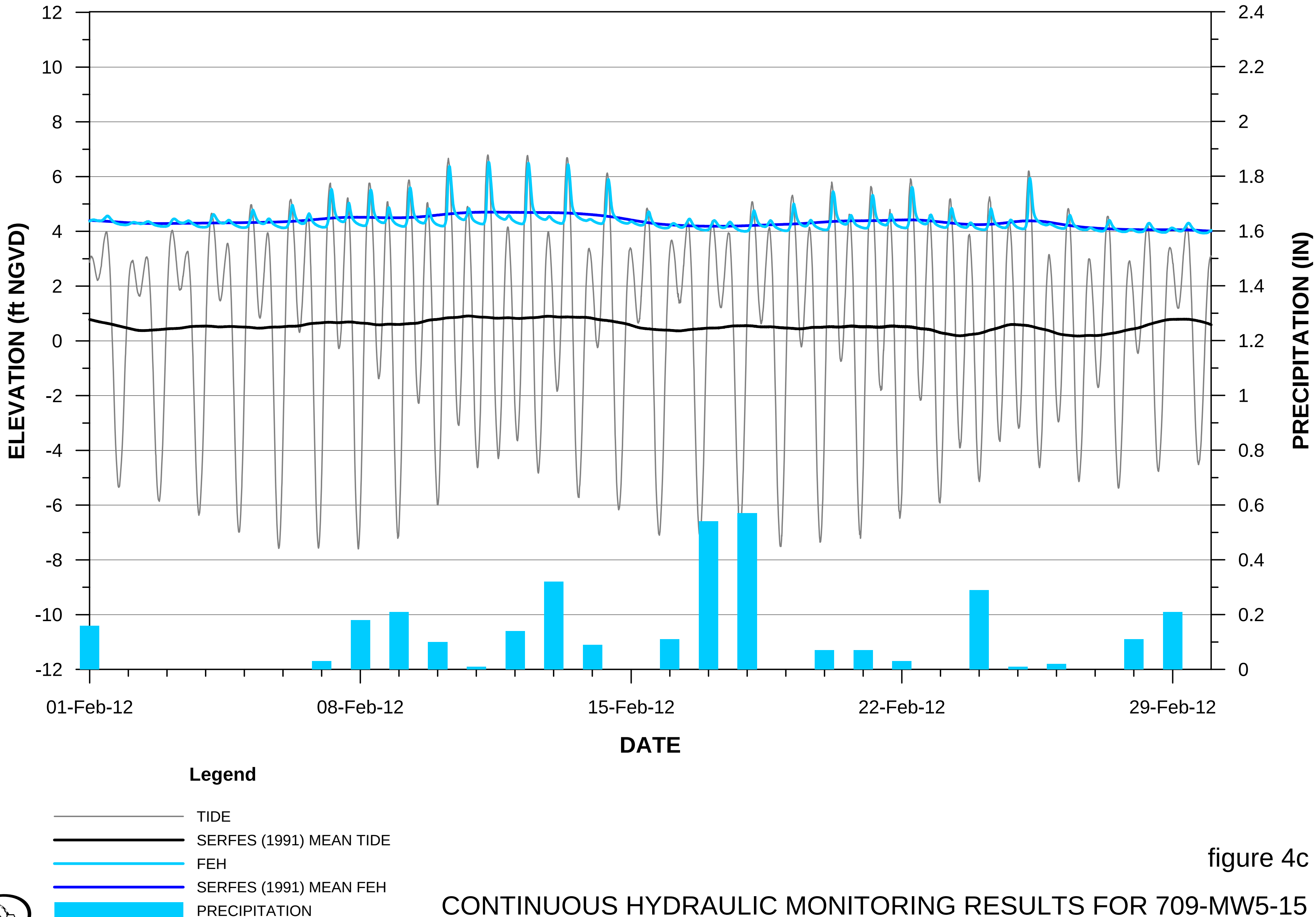

figure 4c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW5-15\07843_709-MW5-15_February 2012.grf) AUG 5/2014

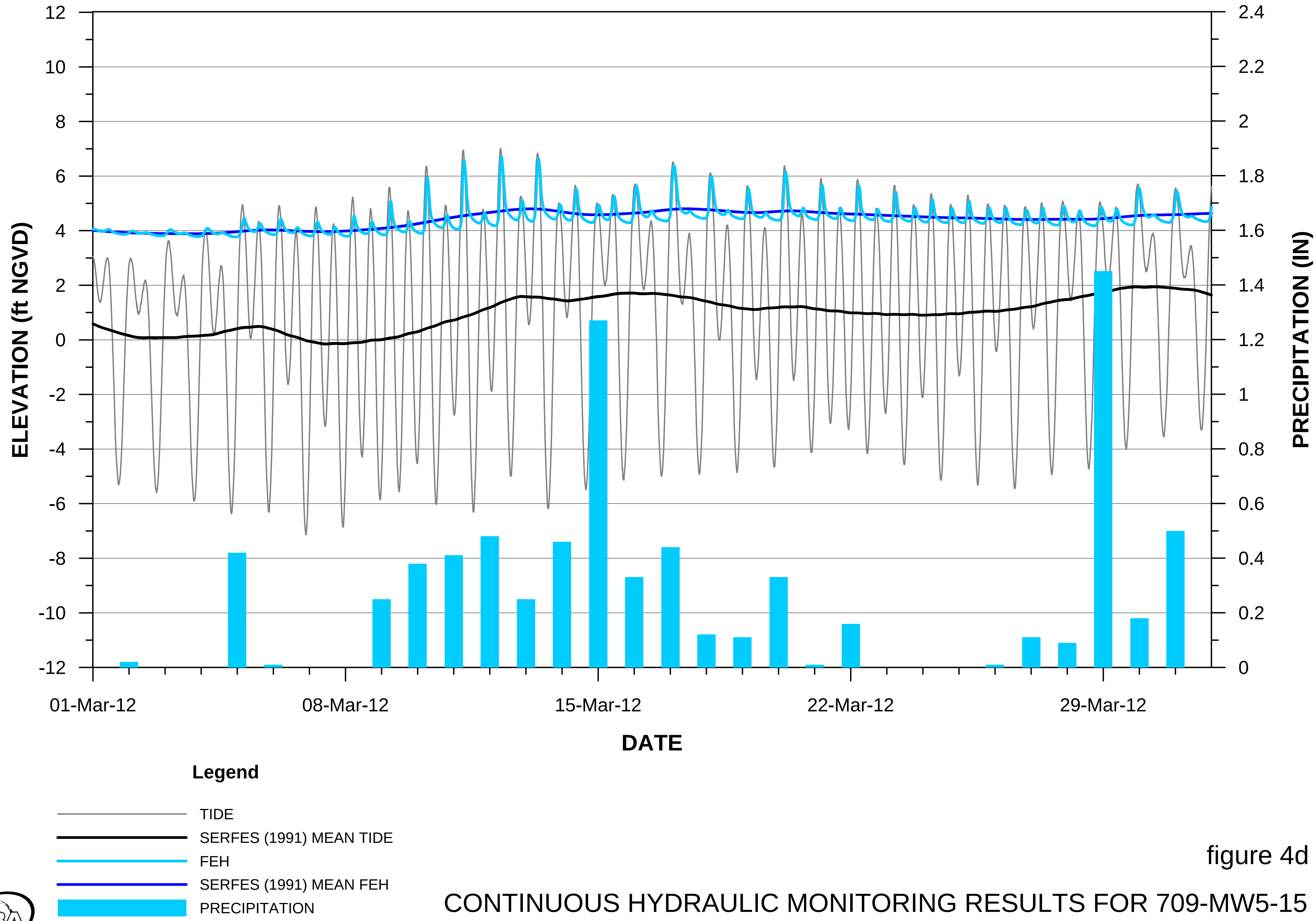

figure 4d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

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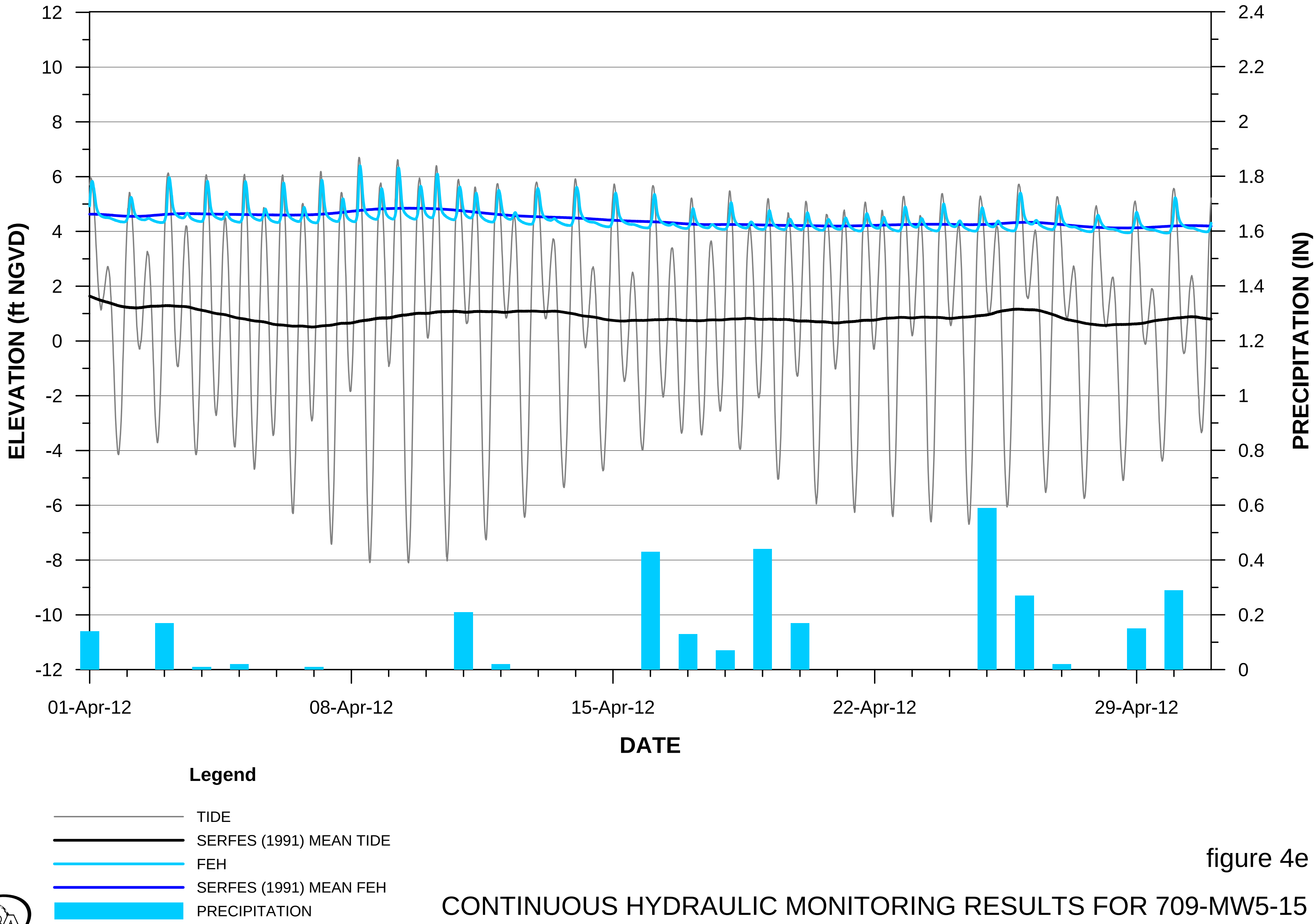

figure 4e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

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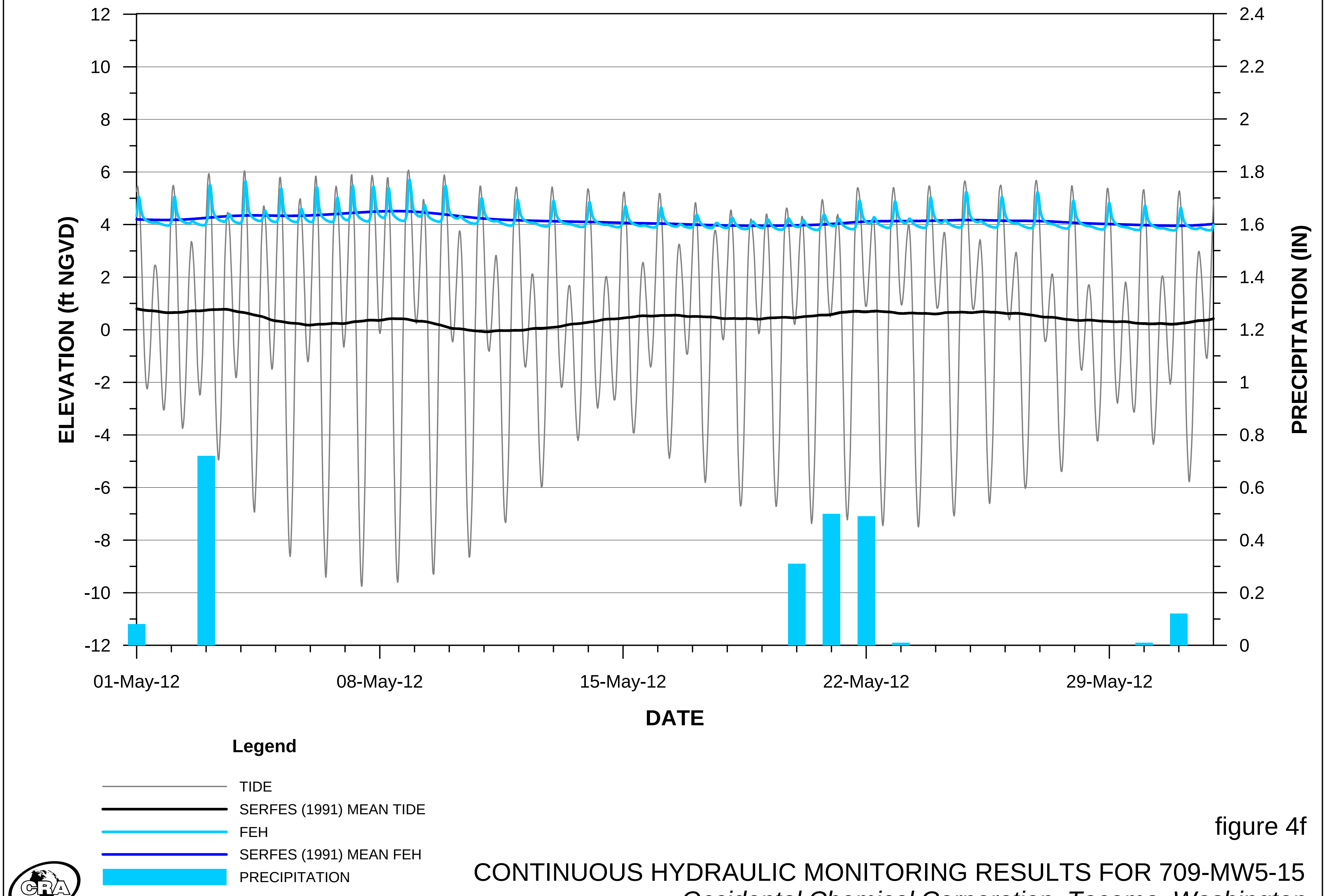

figure 4f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

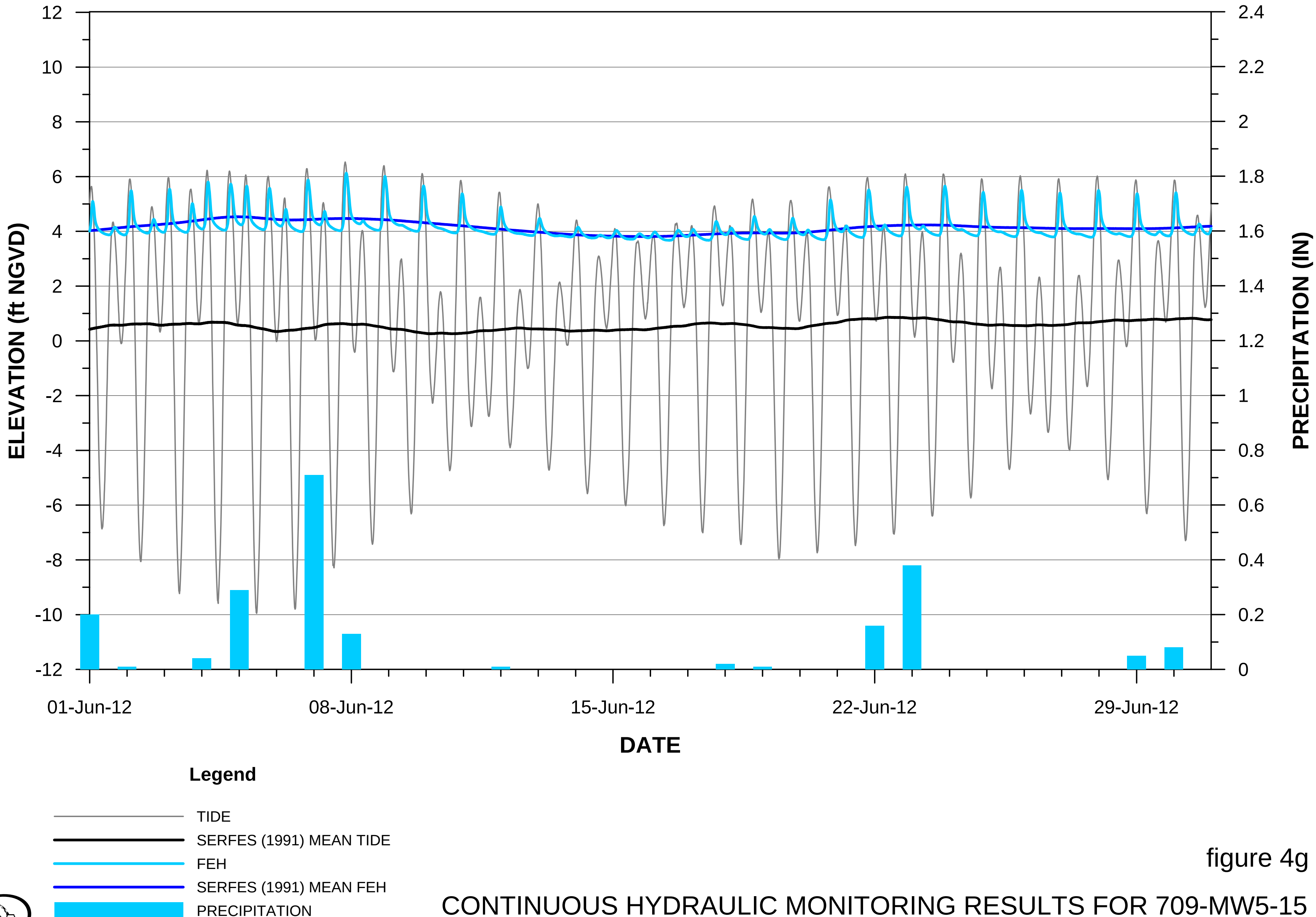

figure 4g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW5-15\07843_709-MW5-15_June 2012.grf) AUG 5/2014

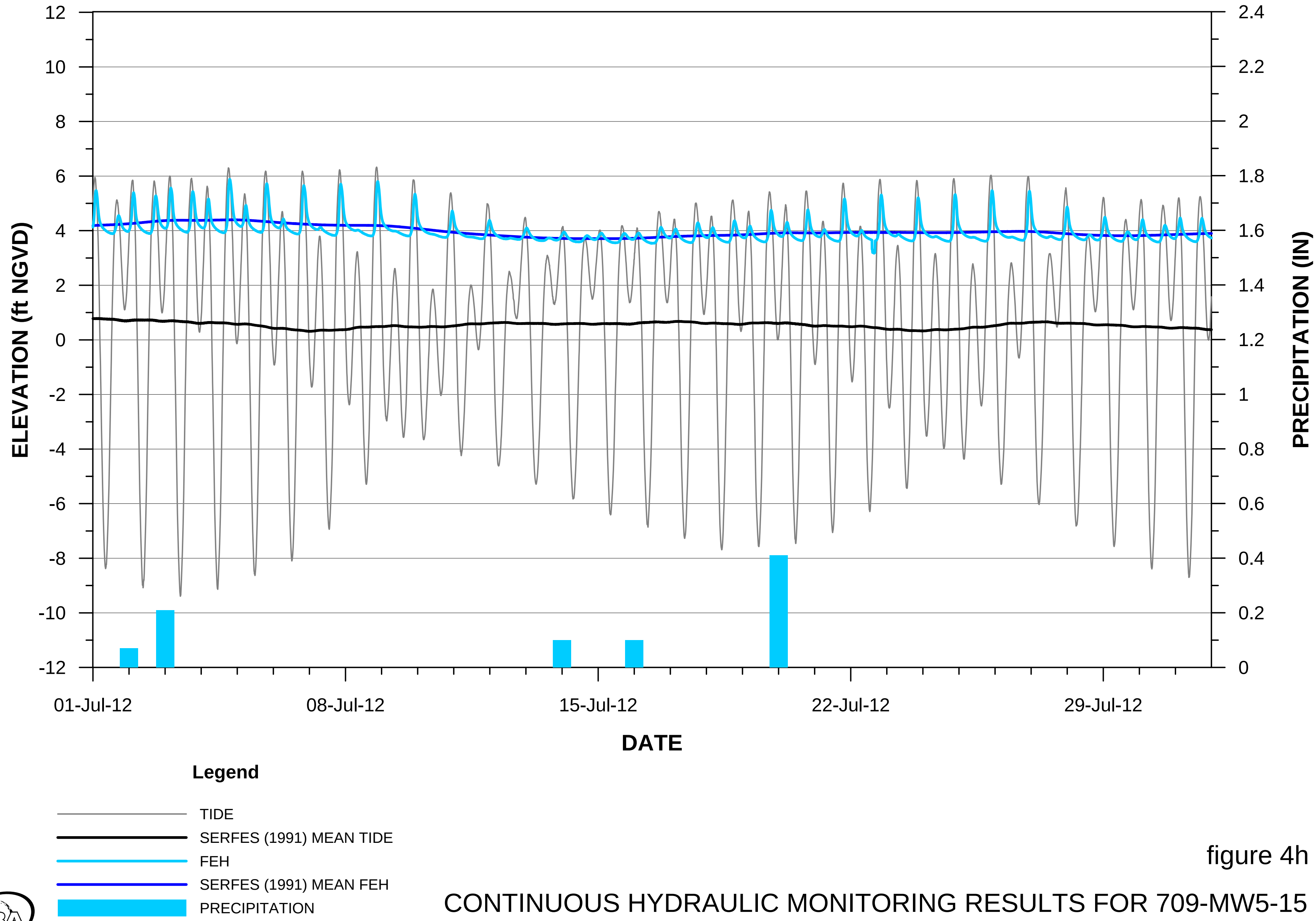

figure 4h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

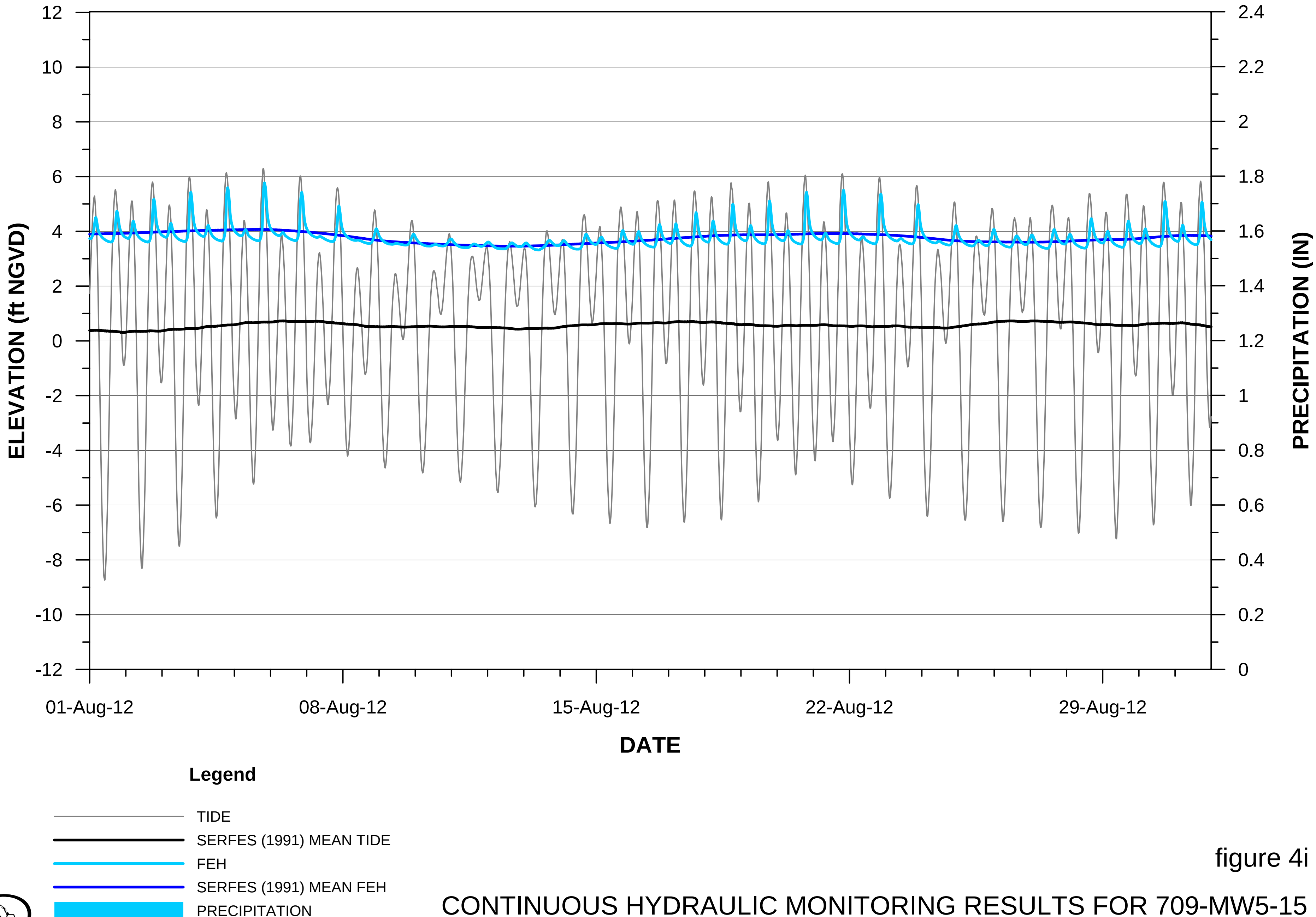

figure 4i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

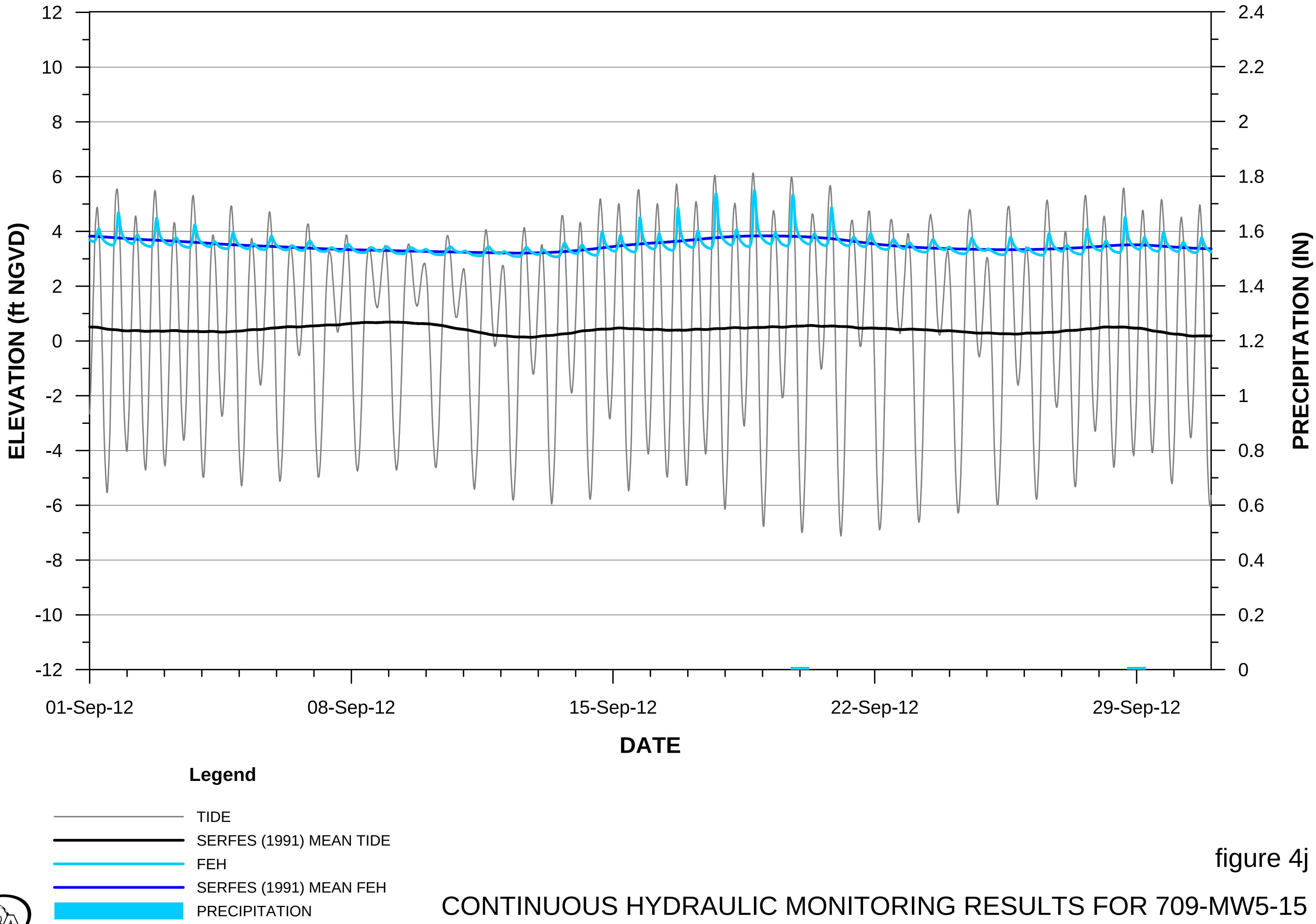

figure 4j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

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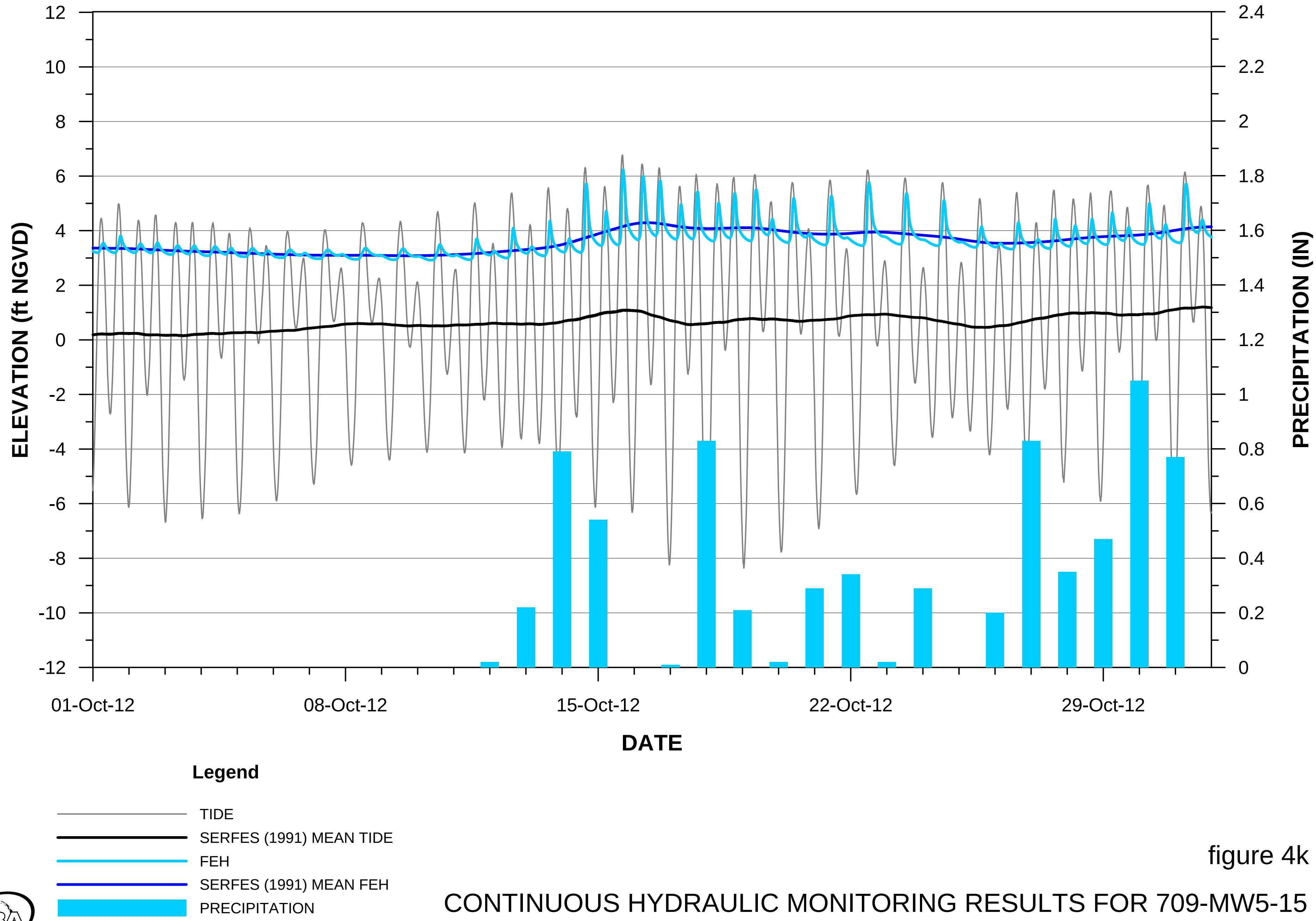

figure 4k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

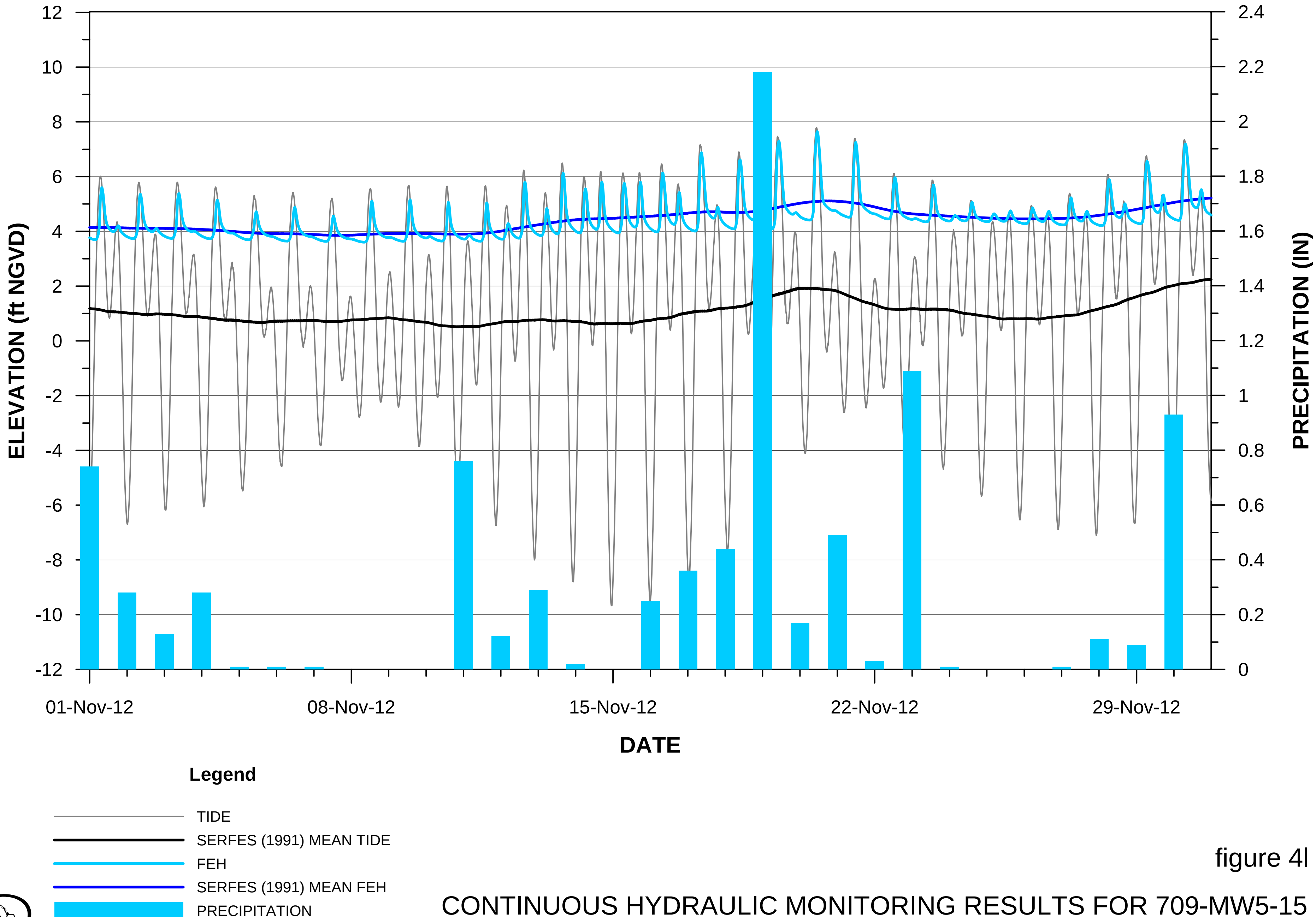

figure 4l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

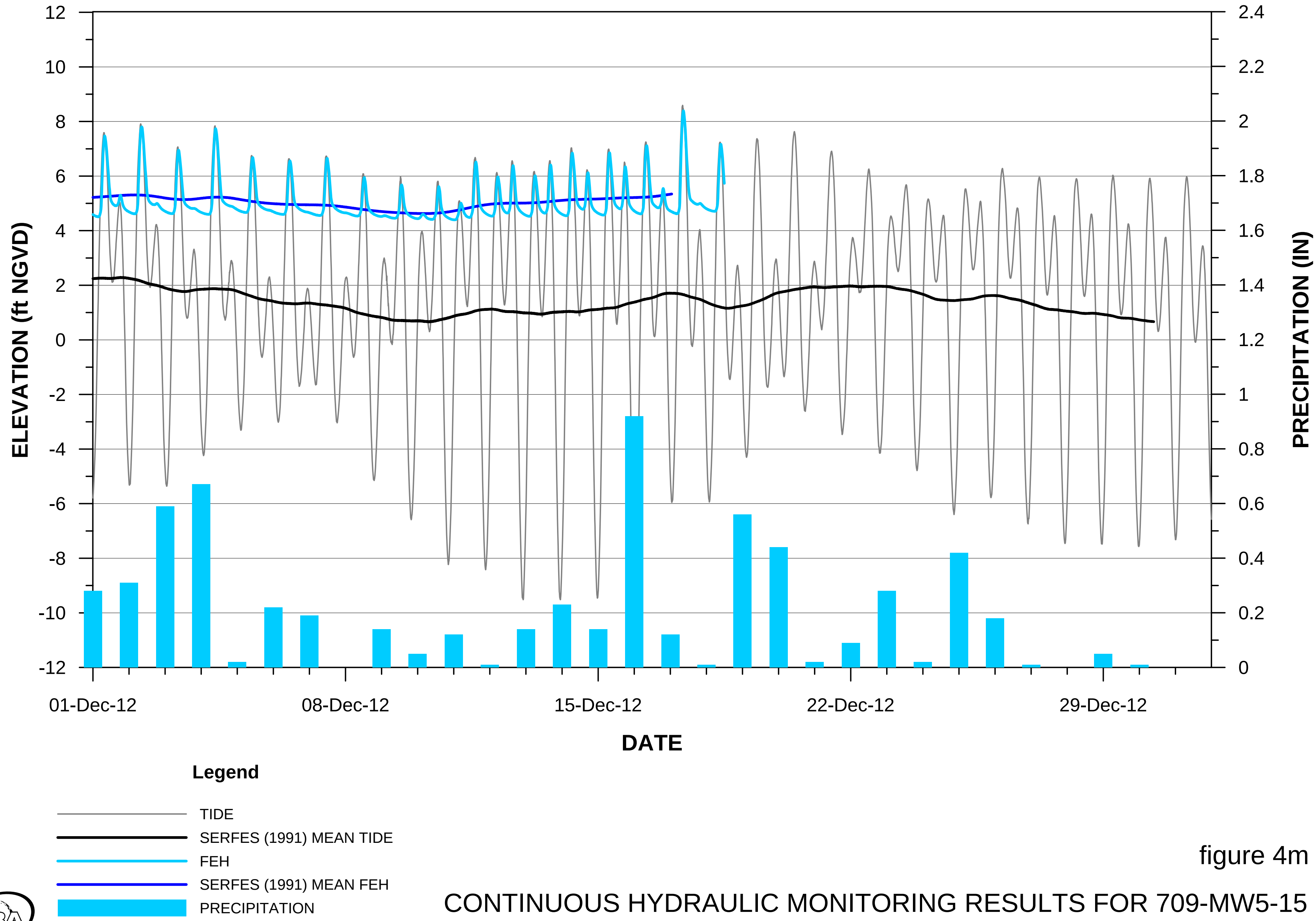

figure 4m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW5-15

Occidental Chemical Corporation, Tacoma, Washington

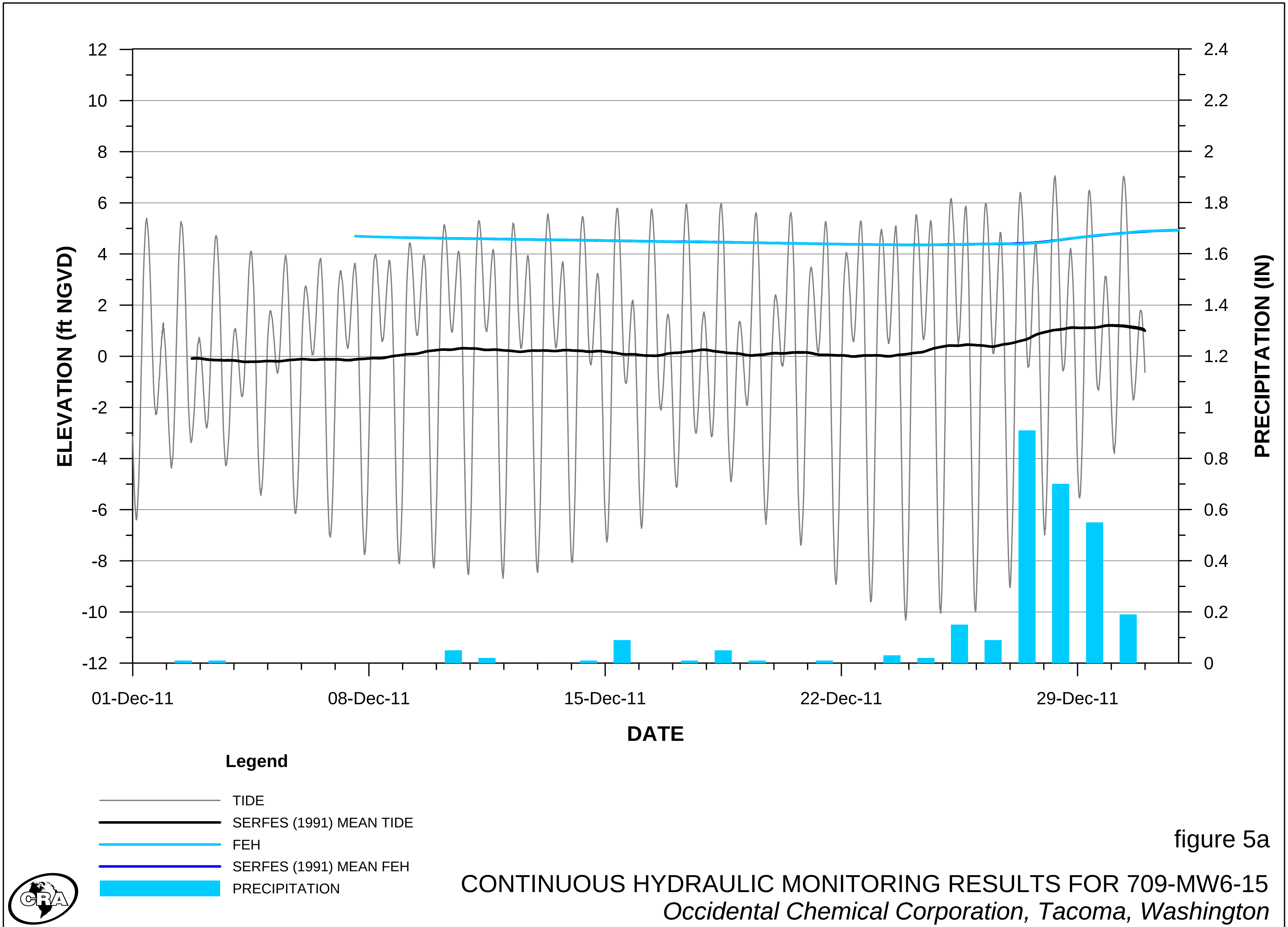

figure 5a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

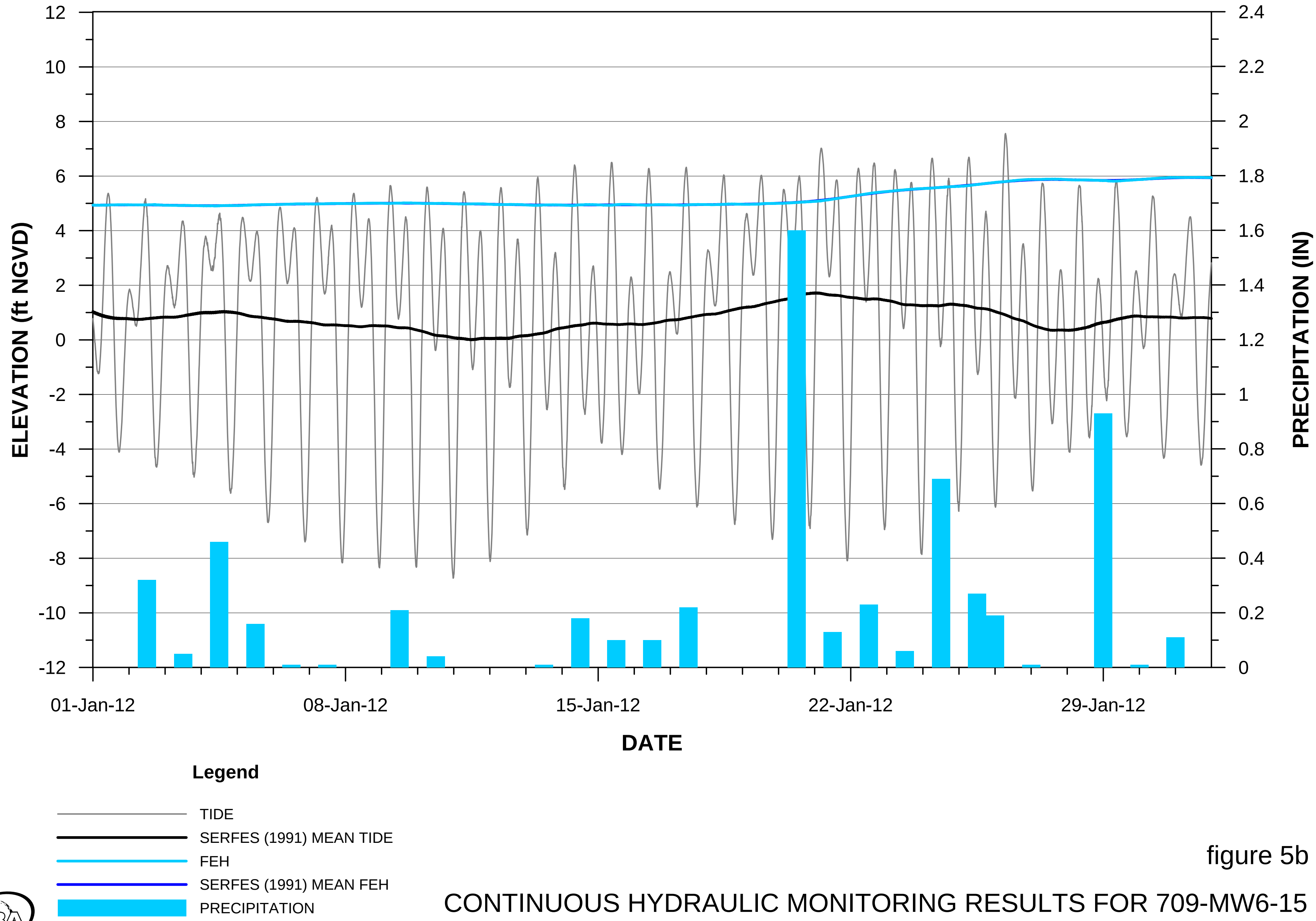

figure 5b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

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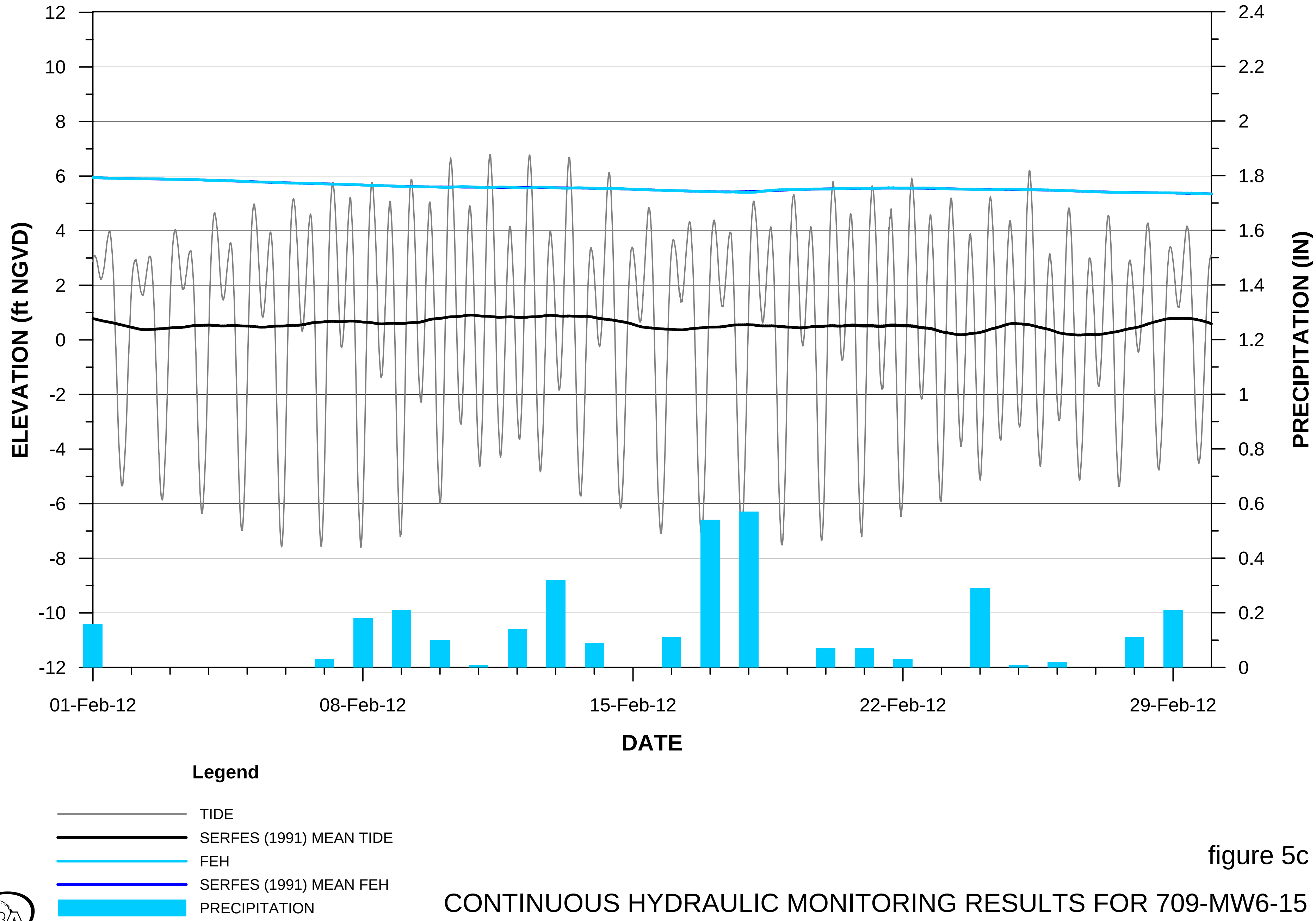

figure 5c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

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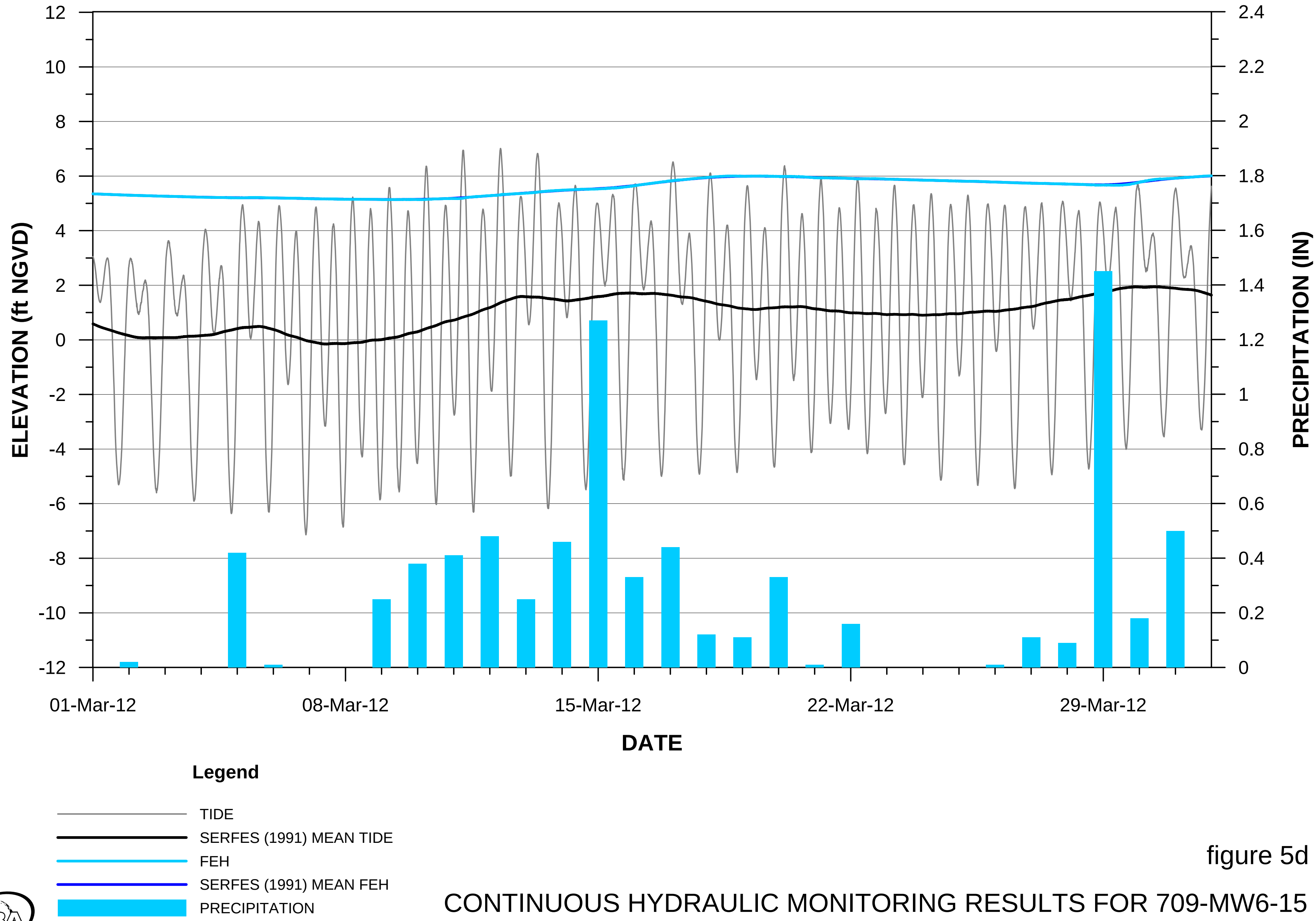

figure 5d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

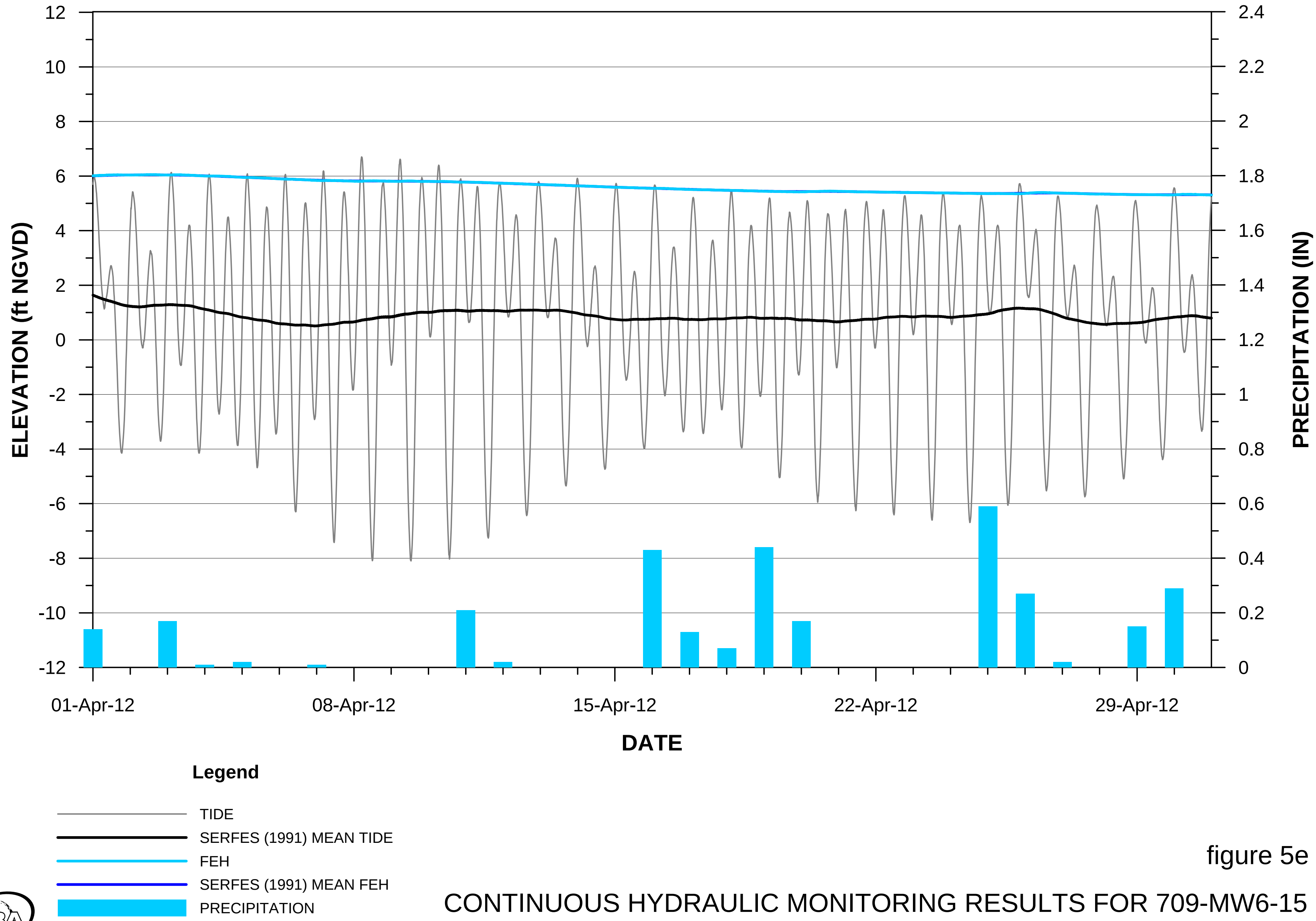

figure 5e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

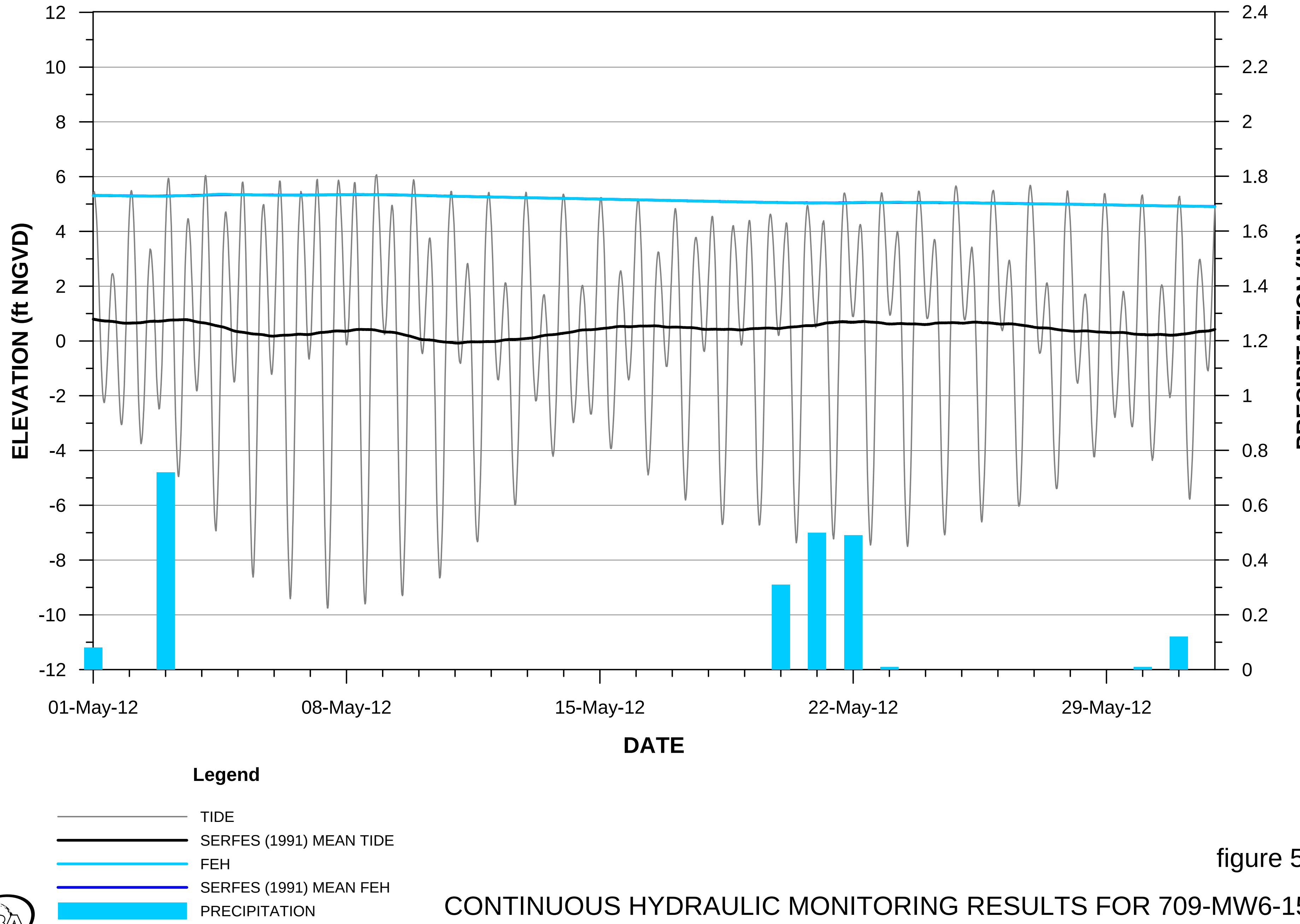

figure 5f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

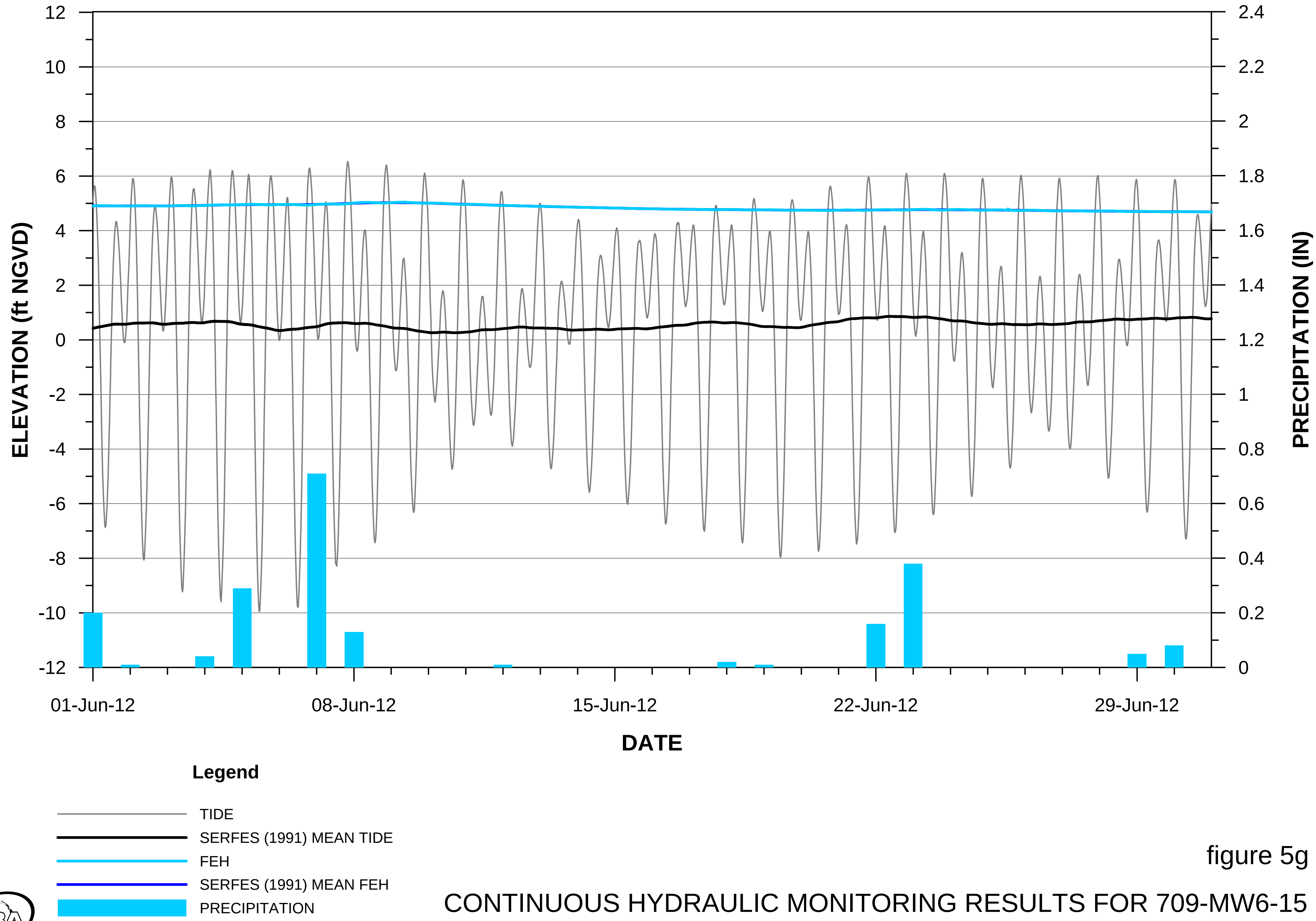

figure 5g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

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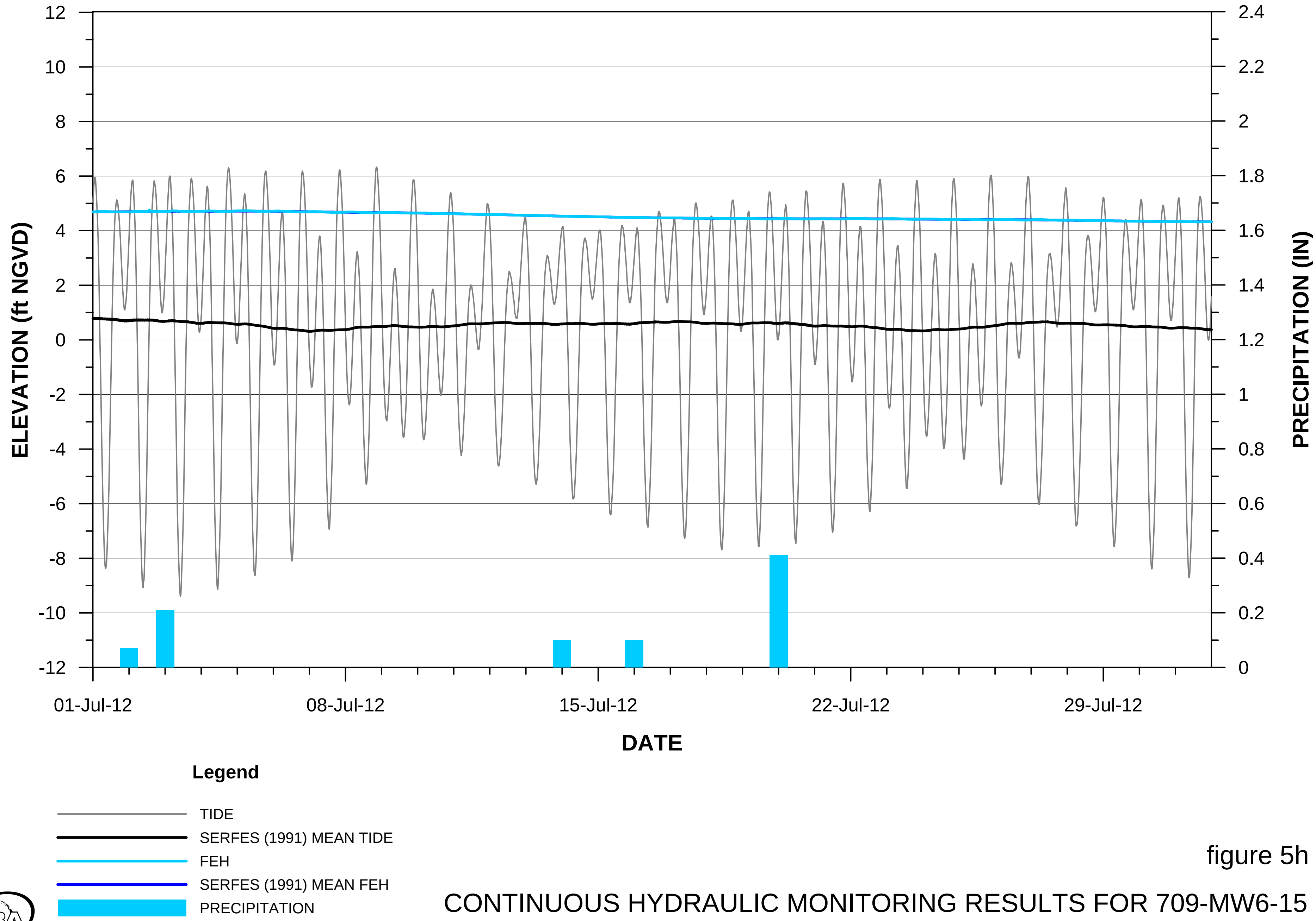


figure 5h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

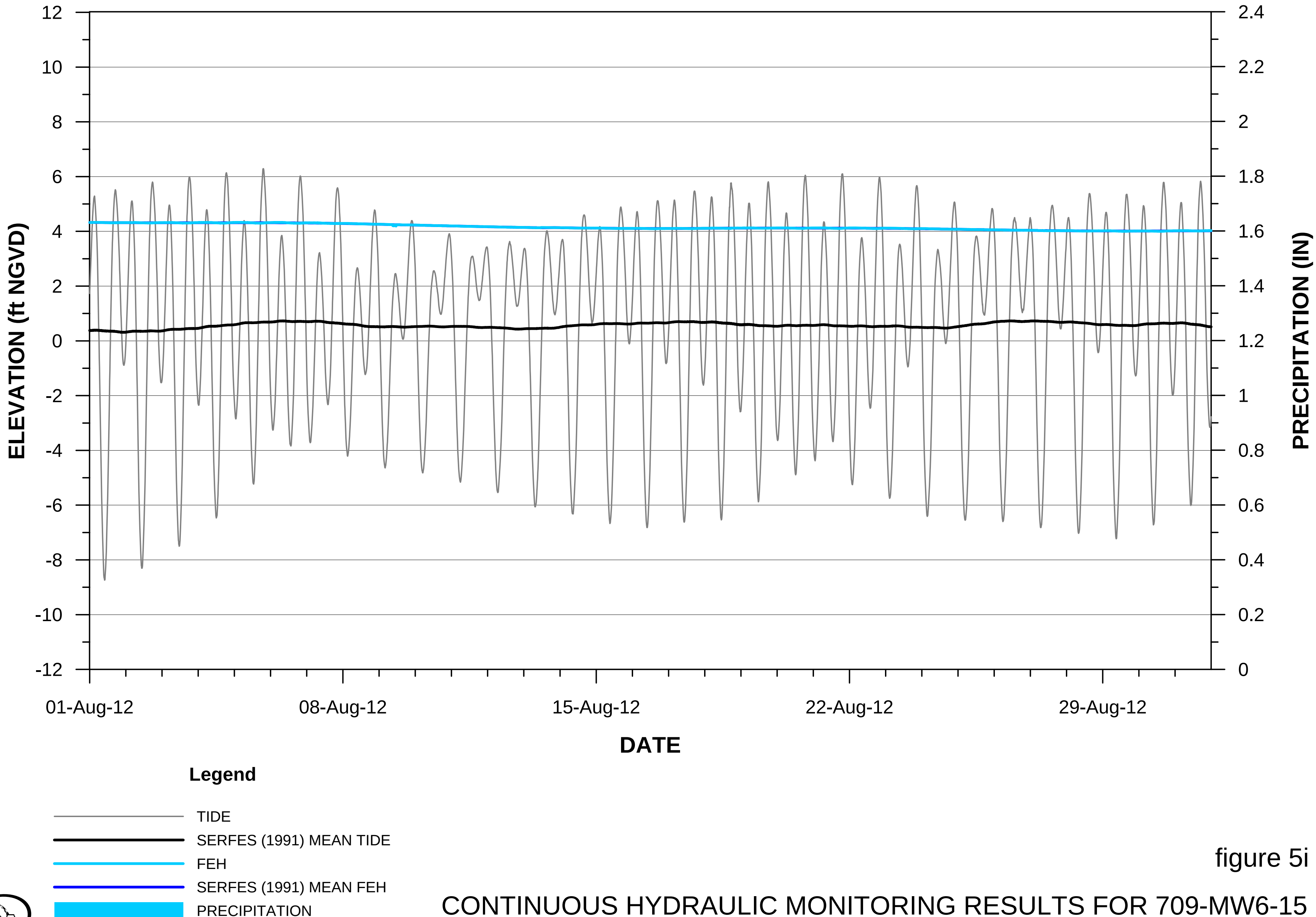


figure 5i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW6-15\07843_709-MW6-15_August 2012.grf) AUG 5/2014

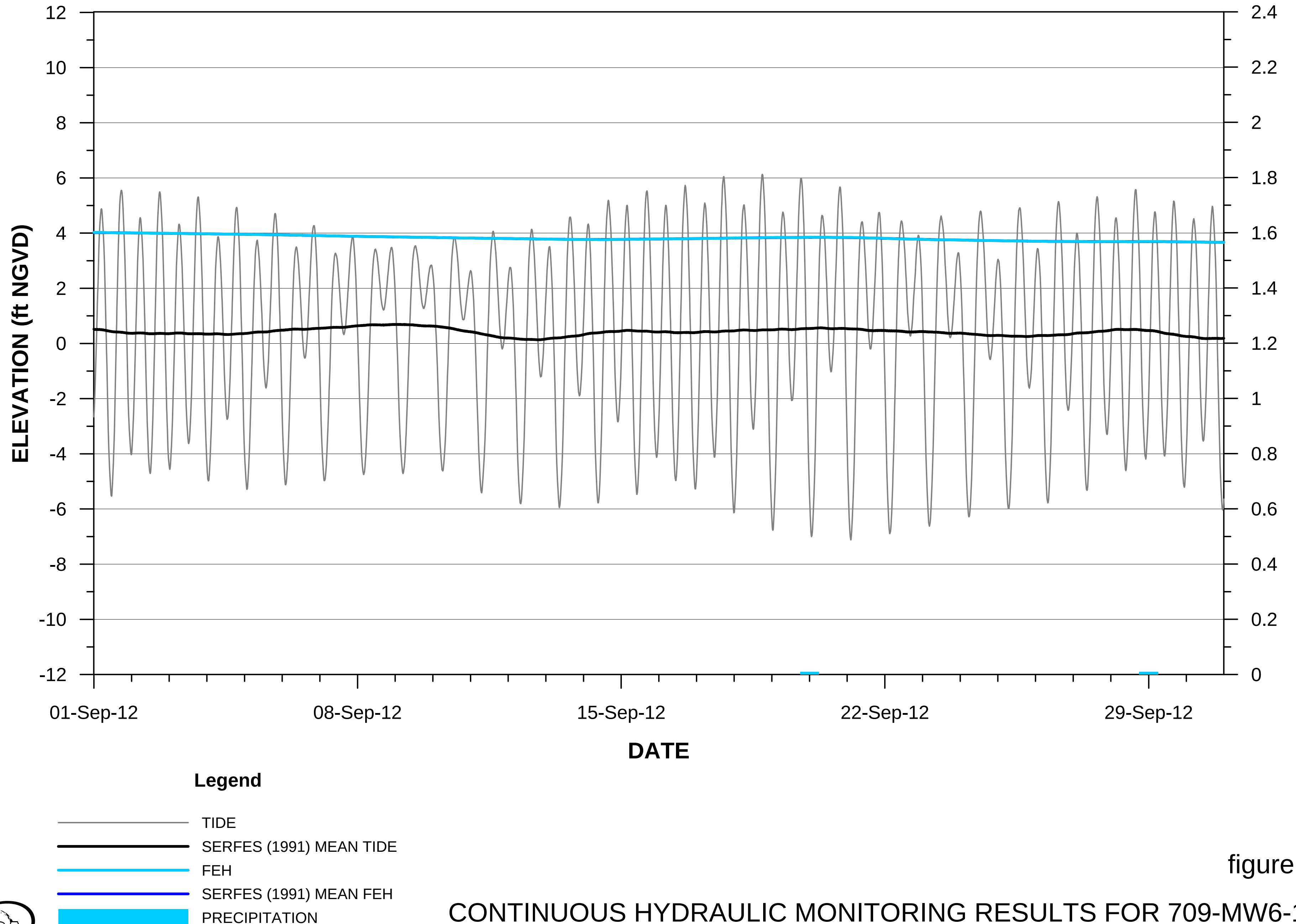
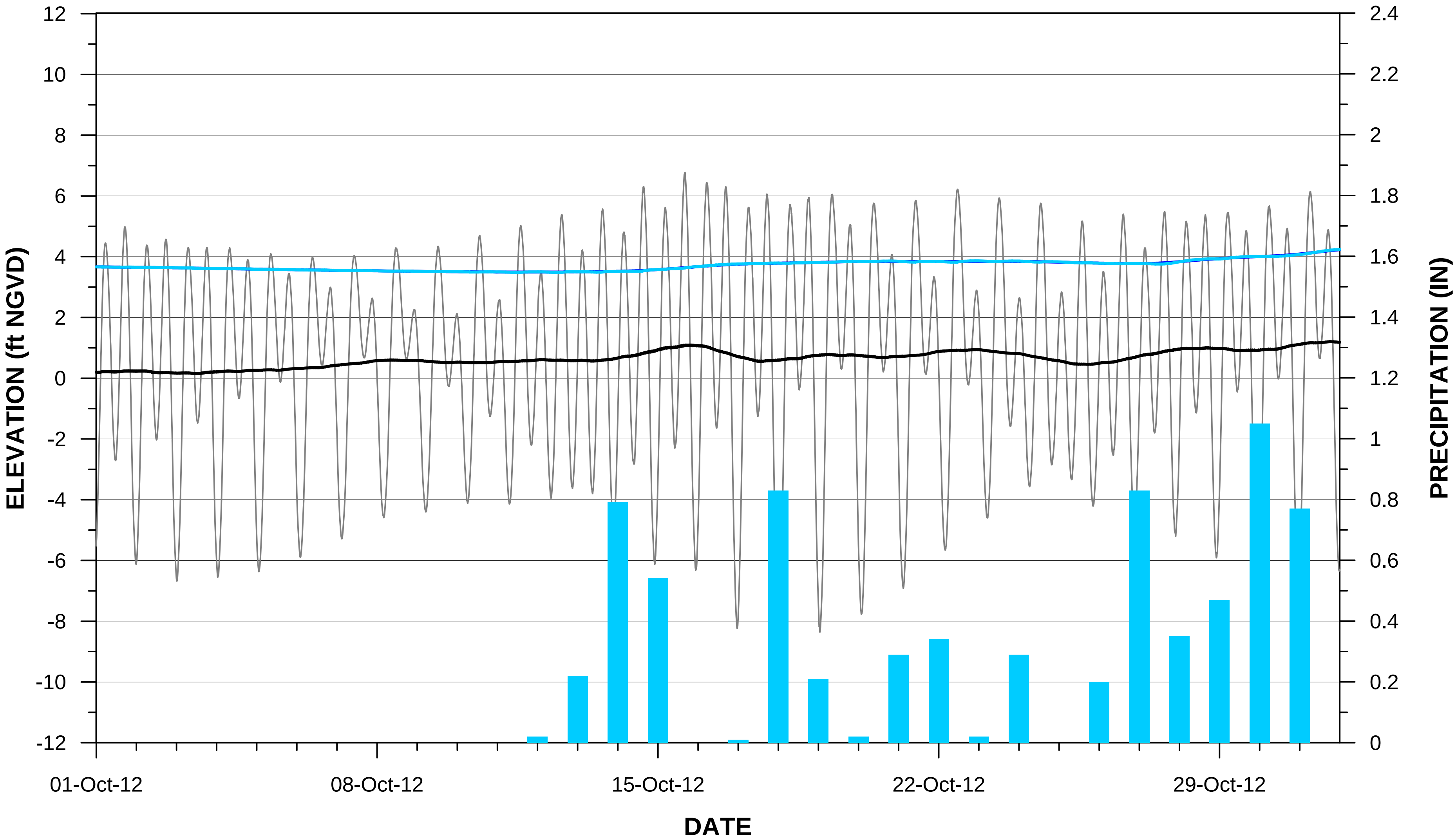


figure 5j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington



Legend

- TIDE
- SERFES (1991) MEAN TIDE
- FEH
- SERFES (1991) MEAN FEH
- PRECIPITATION

figure 5k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

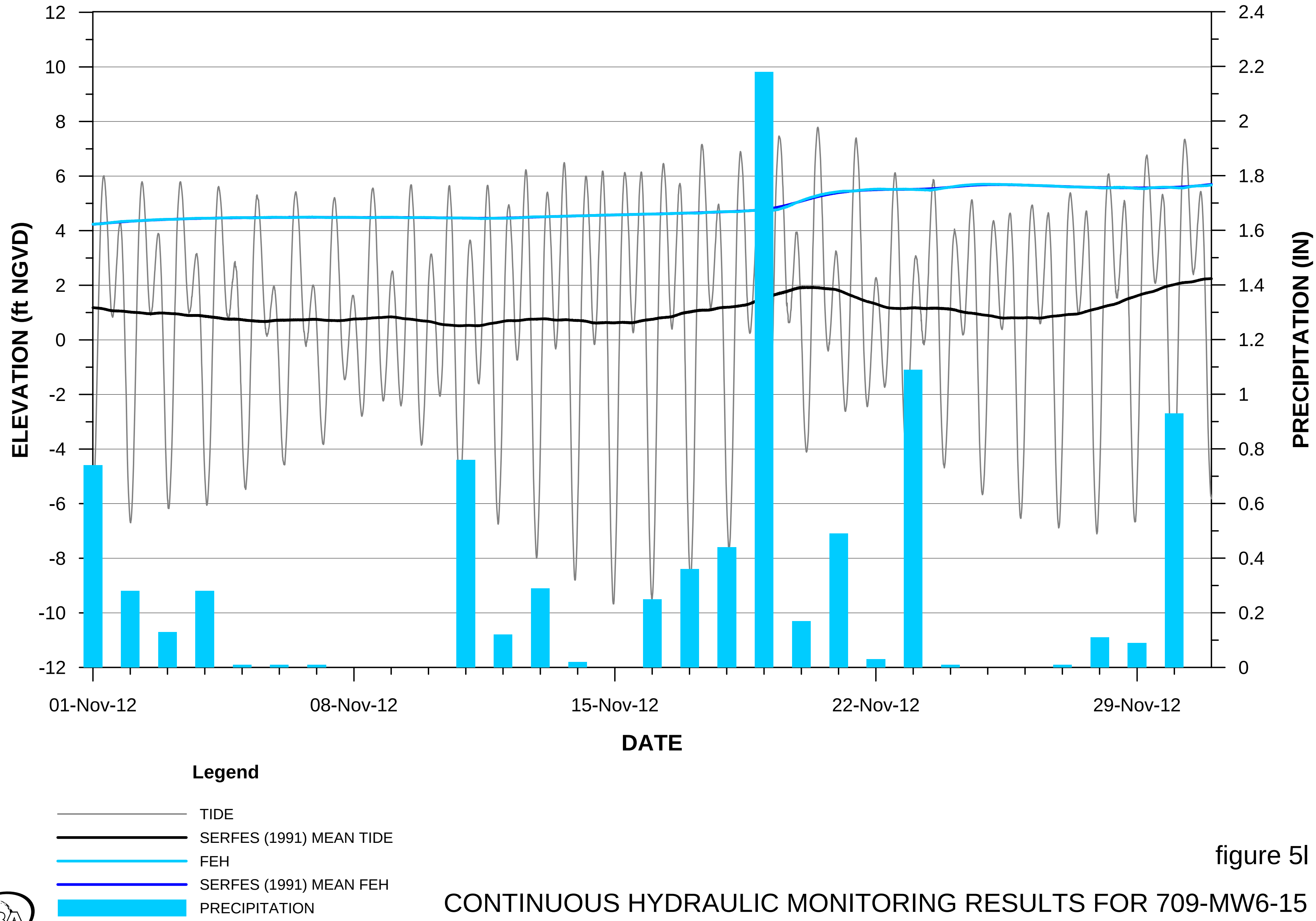


figure 5l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

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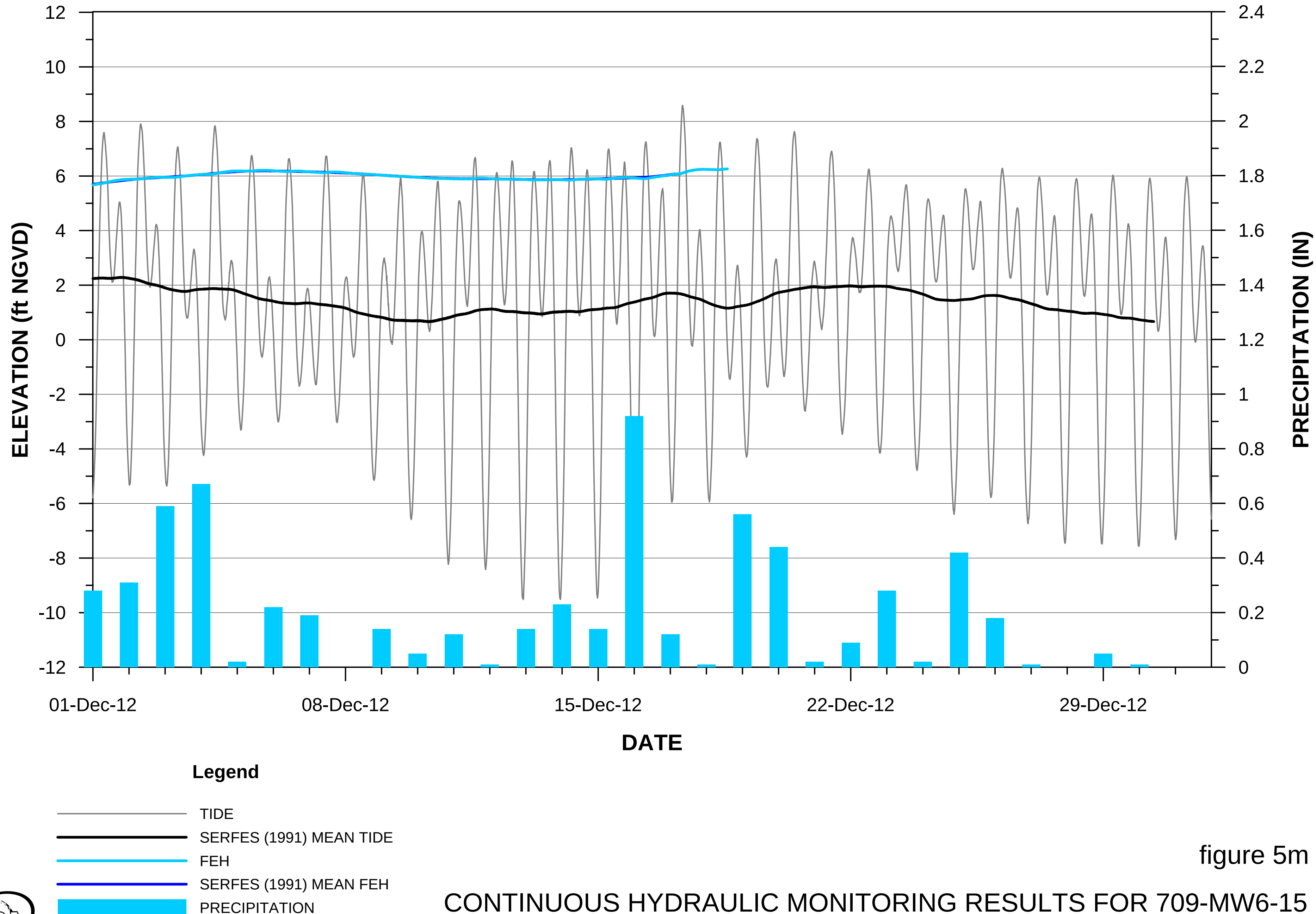

figure 5m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW6-15

Occidental Chemical Corporation, Tacoma, Washington

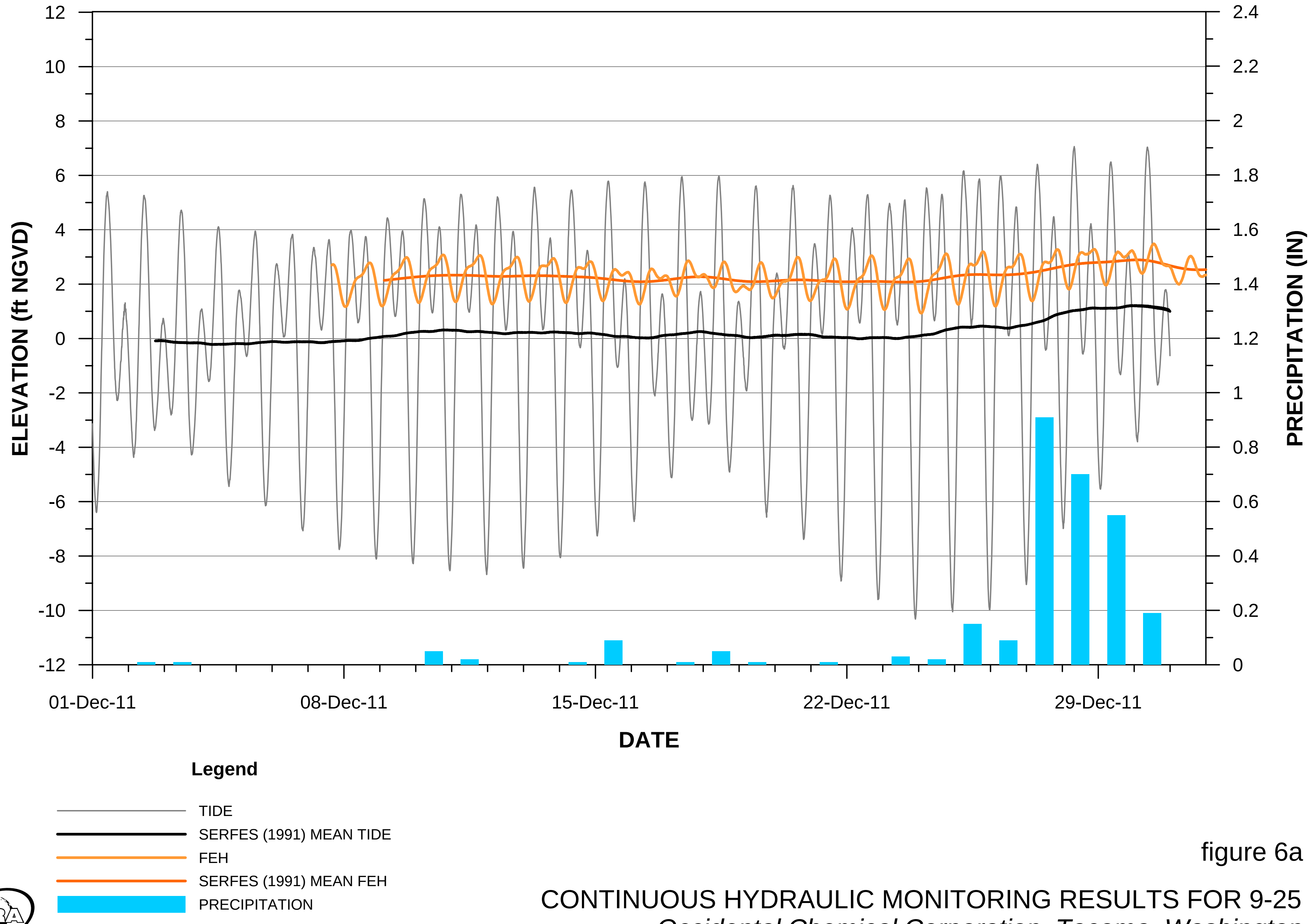

figure 6a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\9-25\07843_9-25_December 2011.grf) AUG 5/2014

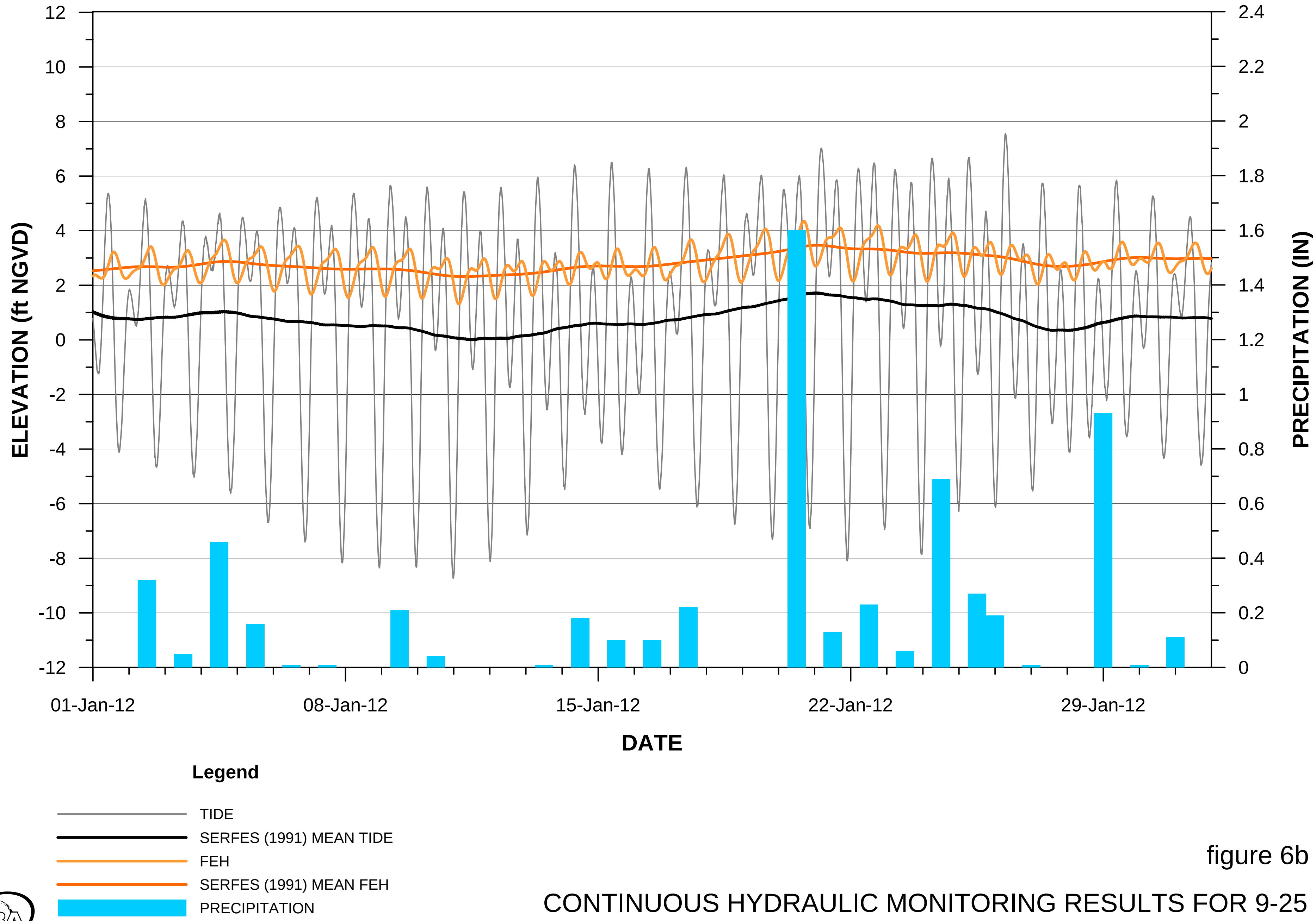

figure 6b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\9-25\07843_9-25_January 2012.grf) AUG 5/2014

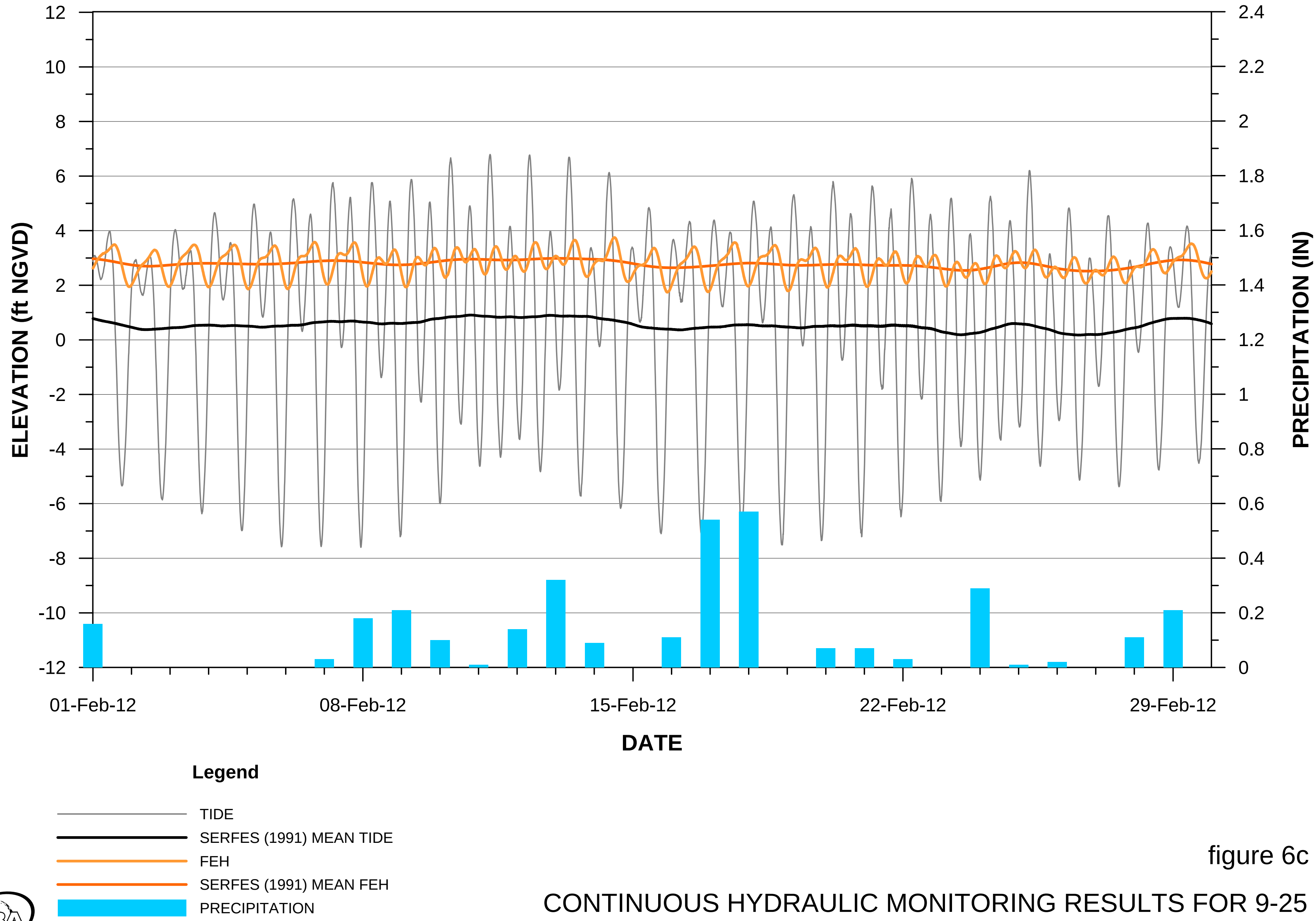

figure 6c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

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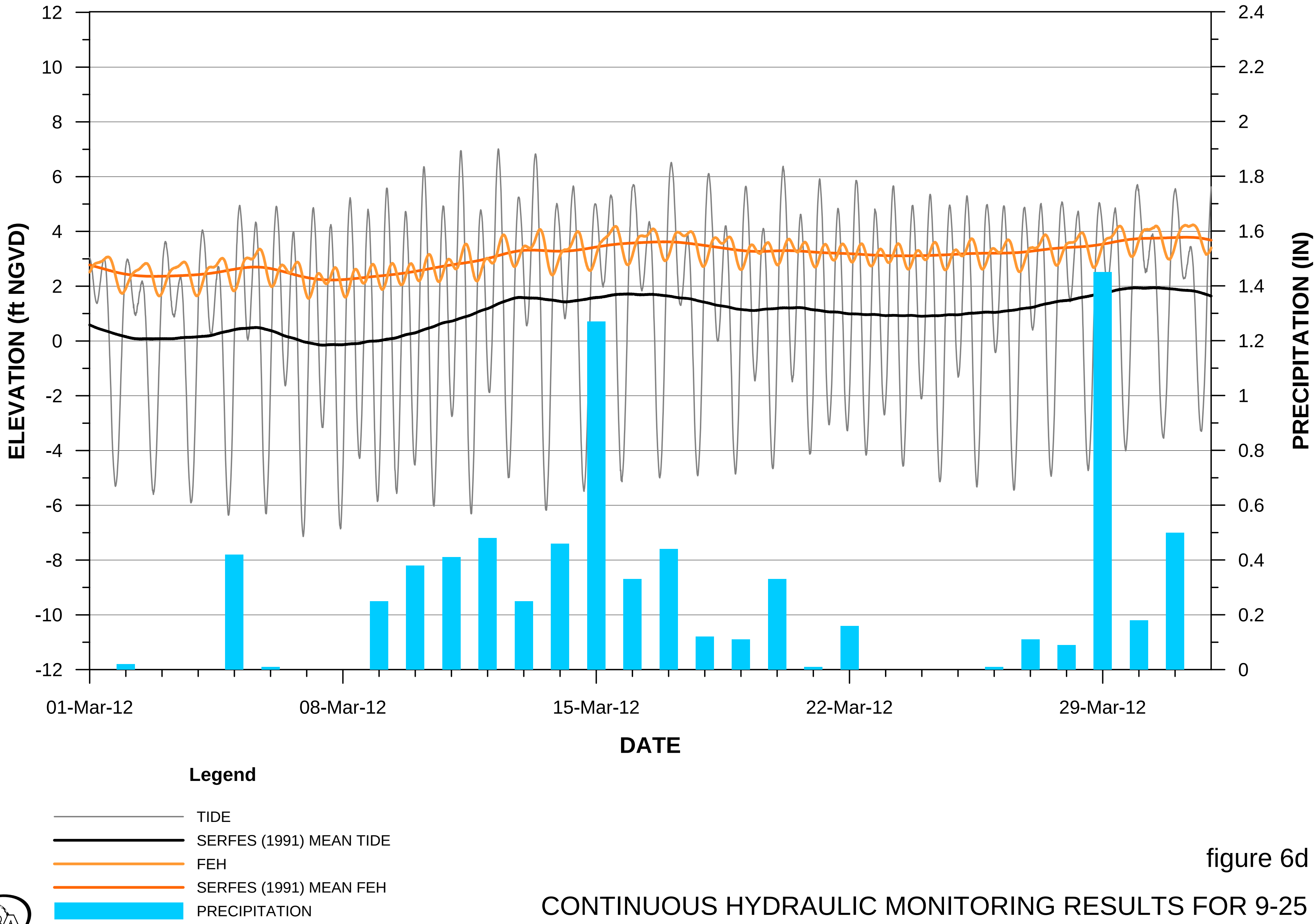

figure 6d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

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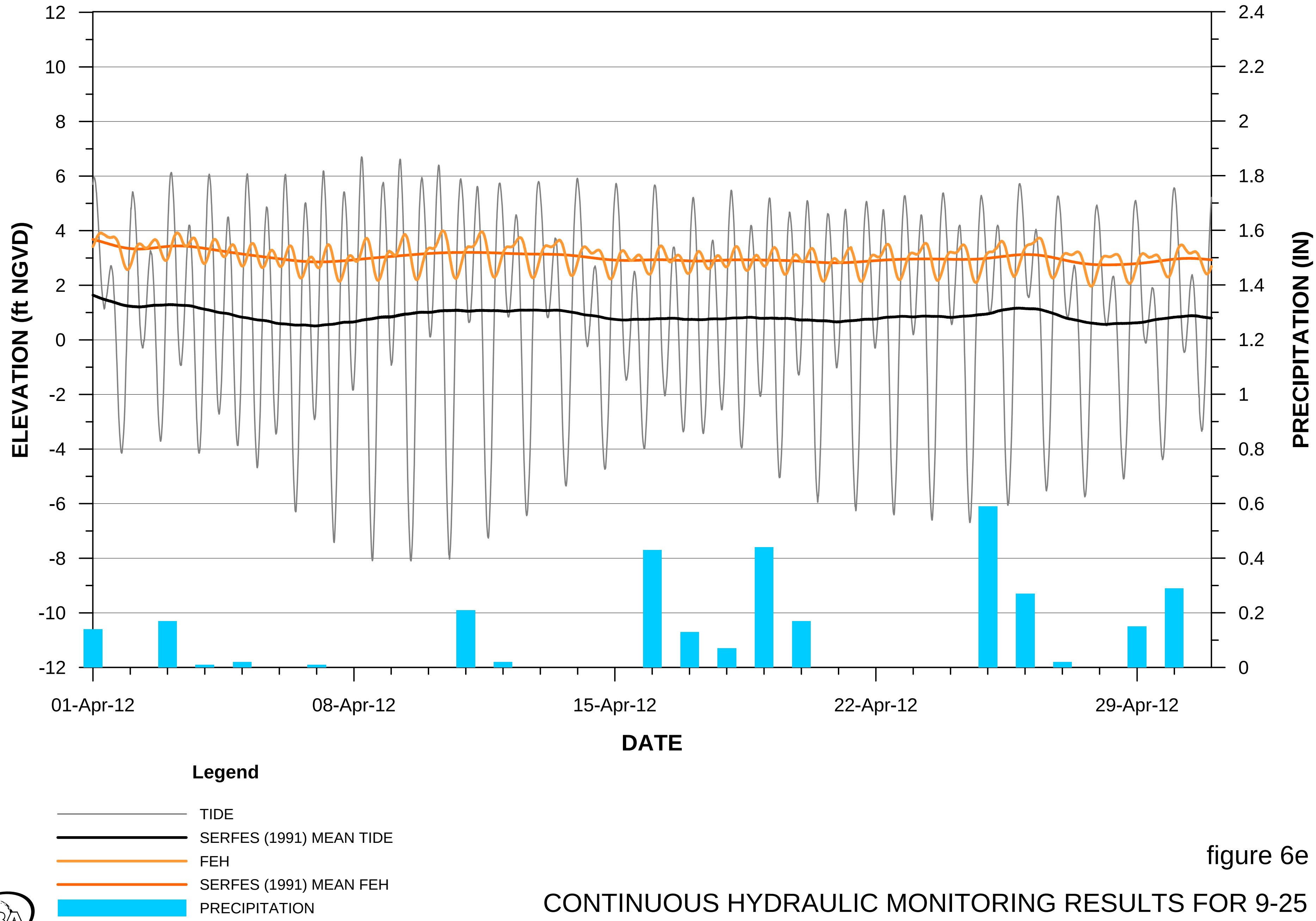

figure 6e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

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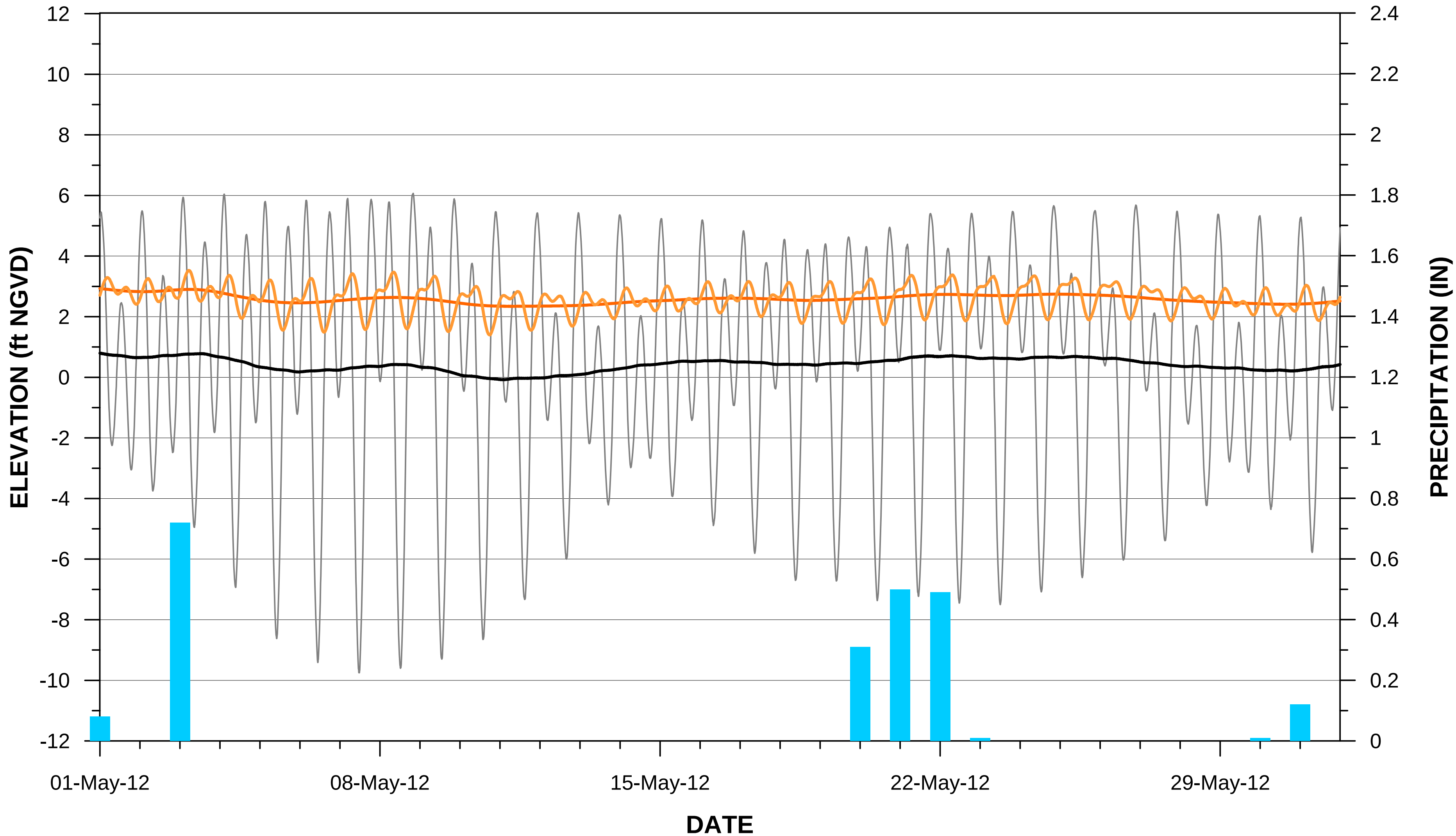

Legend

- TIDE
- SERFES (1991) MEAN TIDE
- FEH
- SERFES (1991) MEAN FEH
- PRECIPITATION

figure 6f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

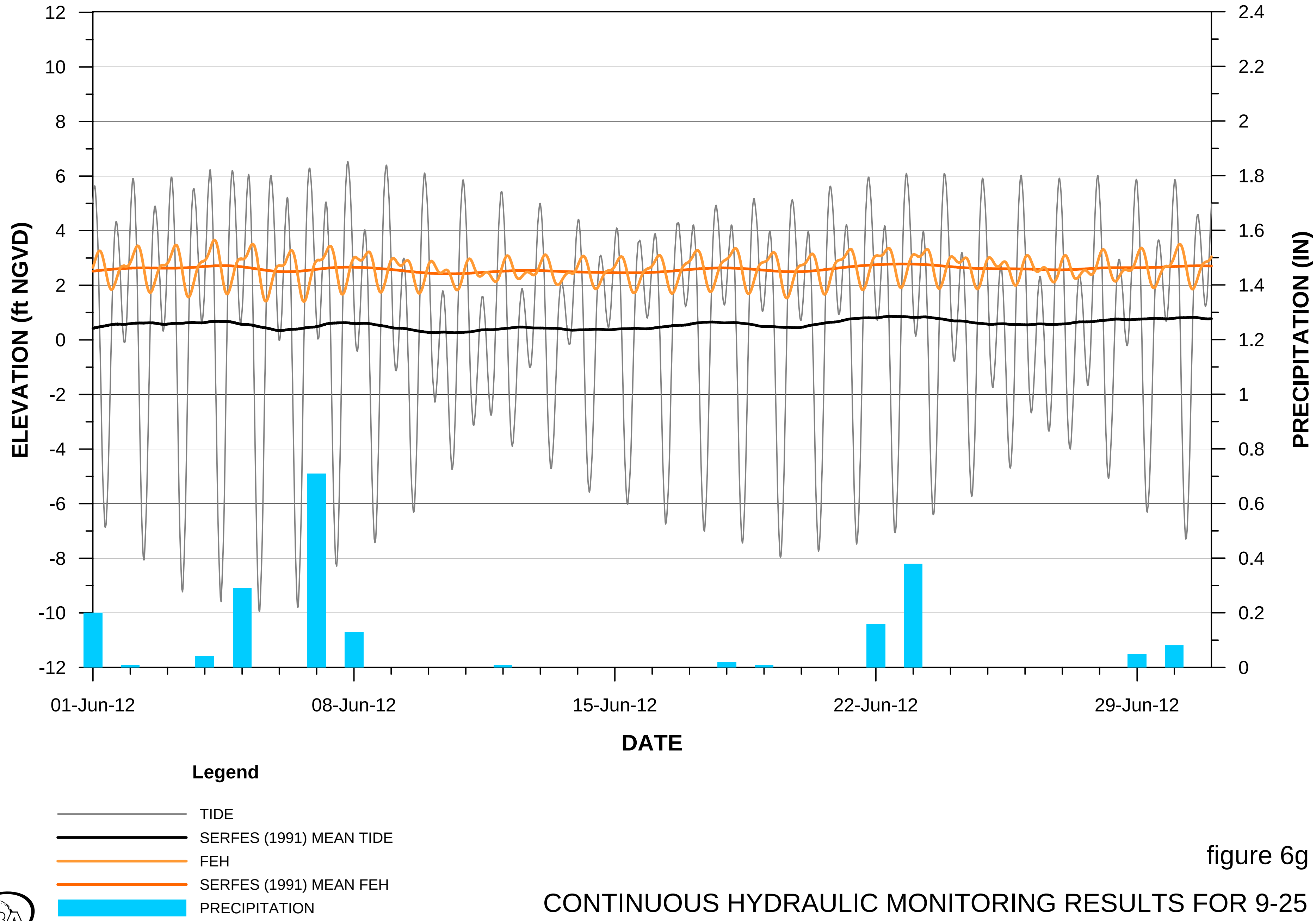

figure 6g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

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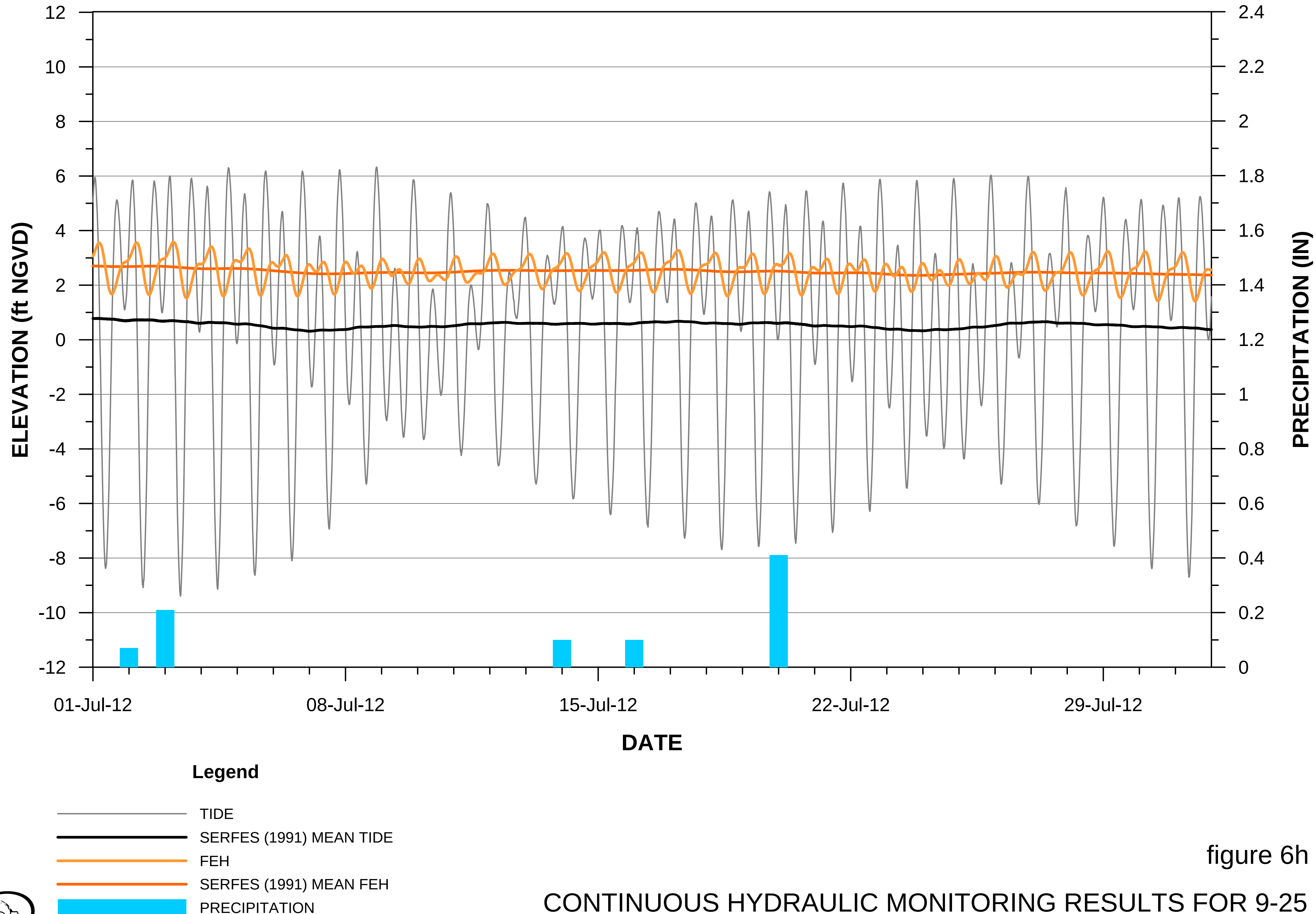

figure 6h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

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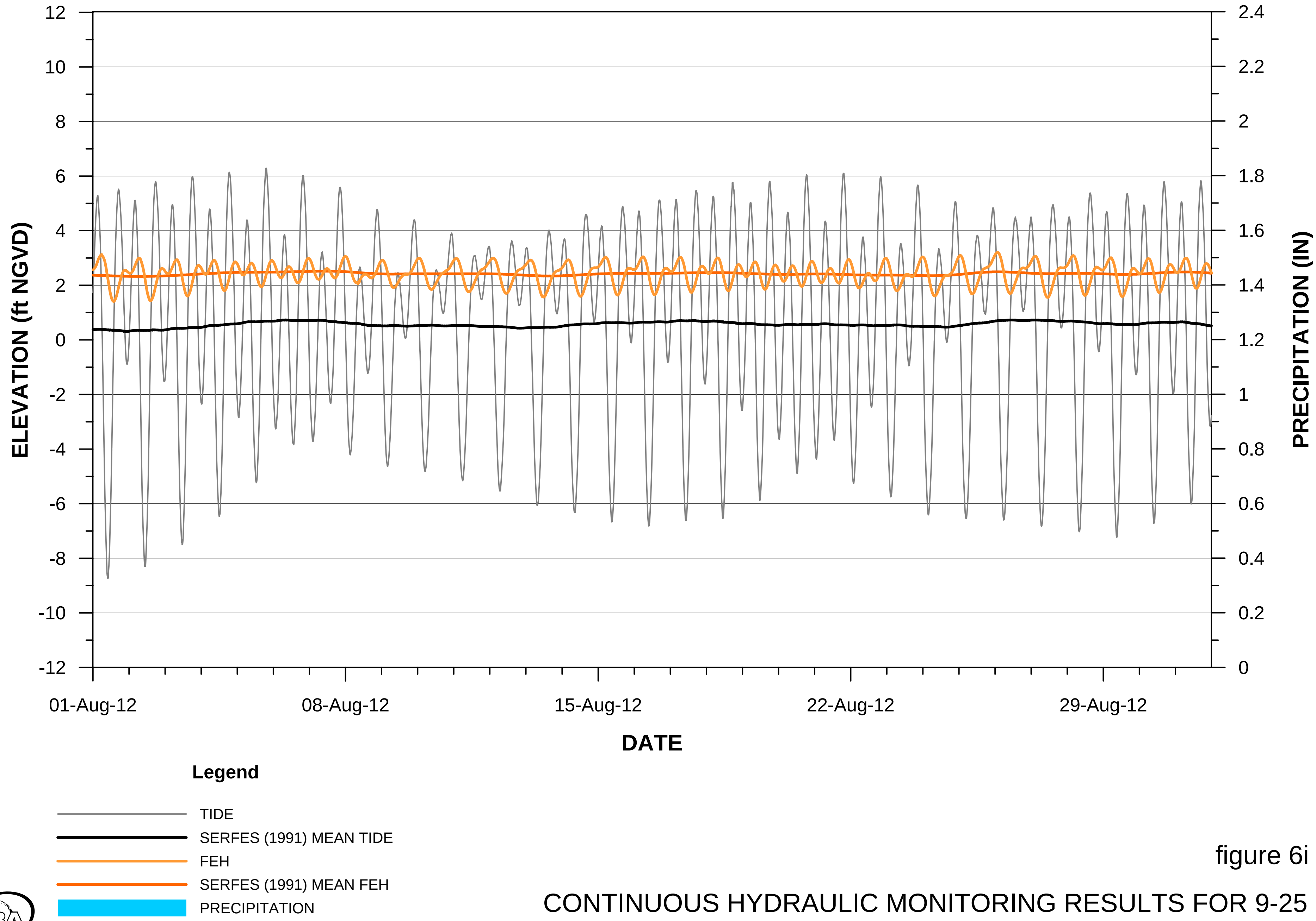


figure 6i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\9-25\07843_9-25_August 2012.grf) AUG 5/2014

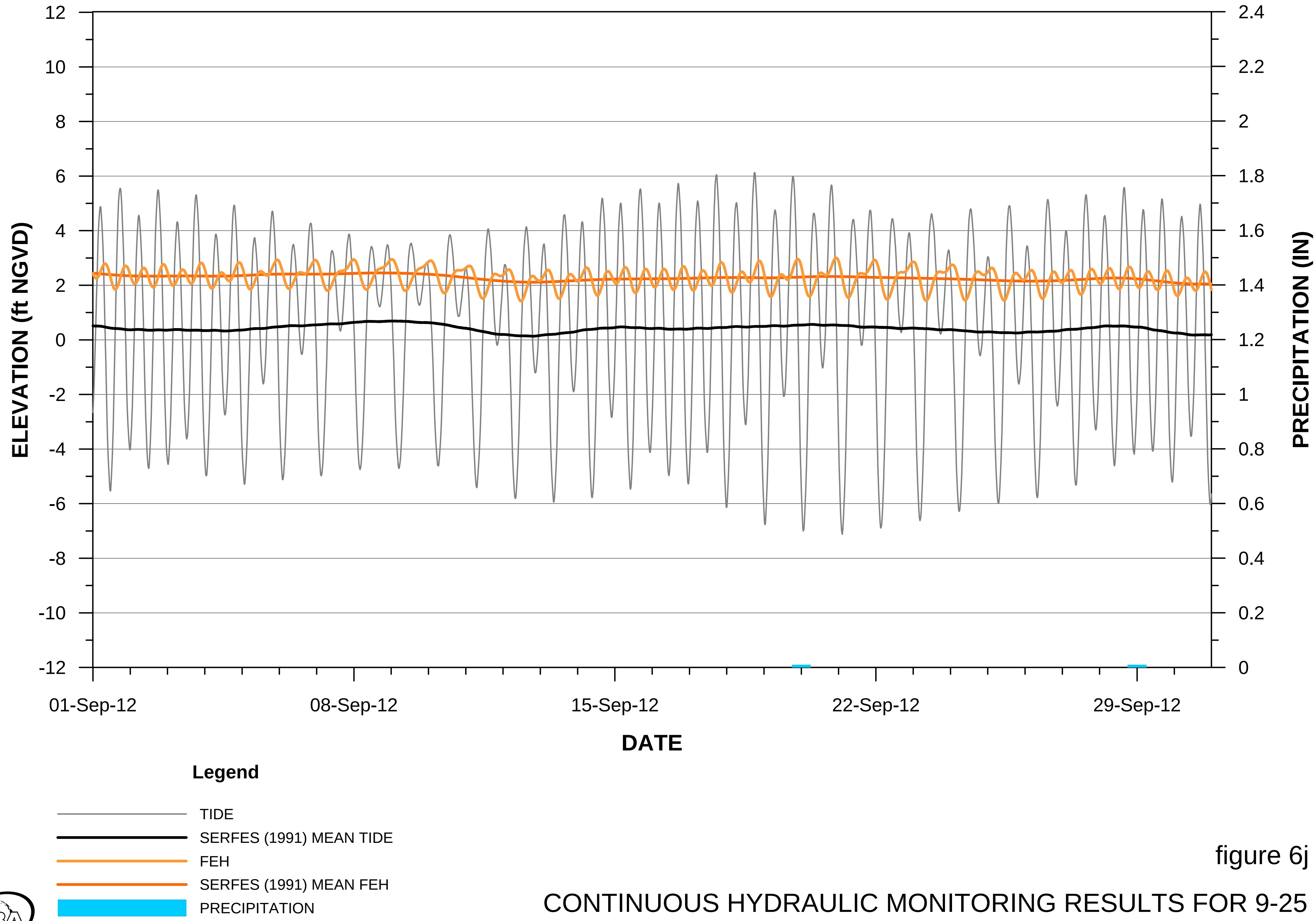


figure 6j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\9-25\07843_9-25_September 2012.grf) AUG 5/2014

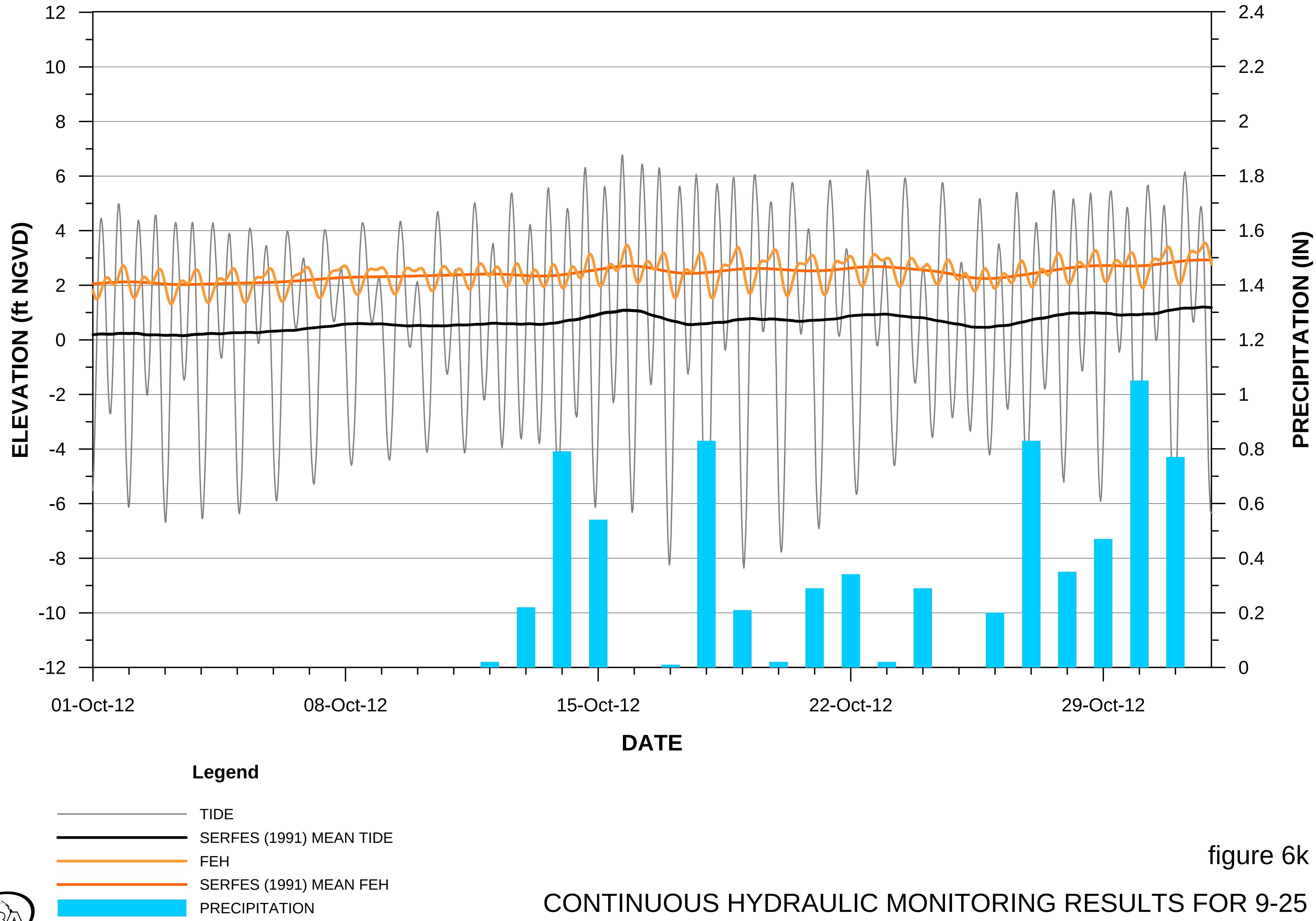


figure 6k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

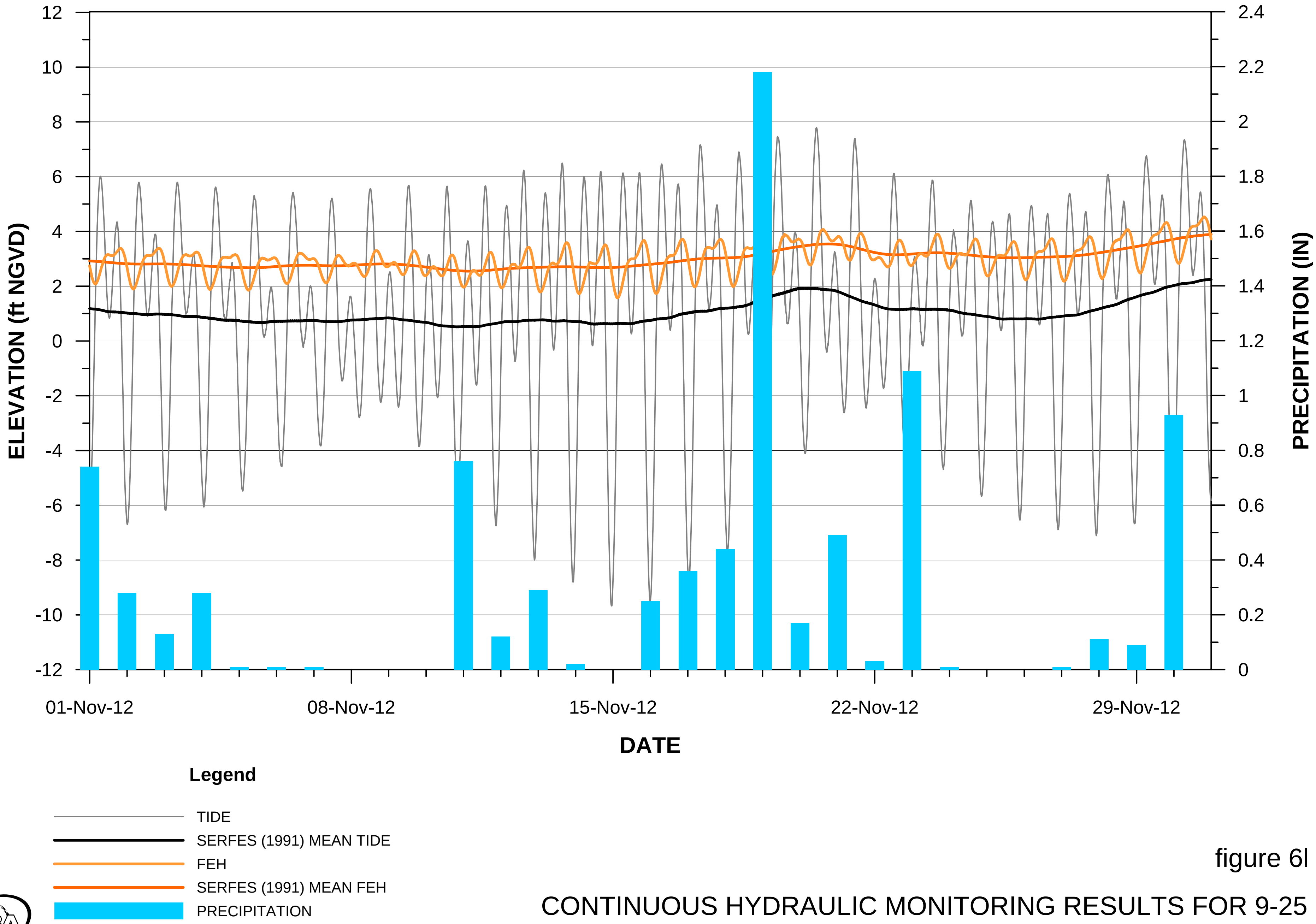


figure 6l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\9-25\07843_9-25_November 2012.grf) AUG 5/2014

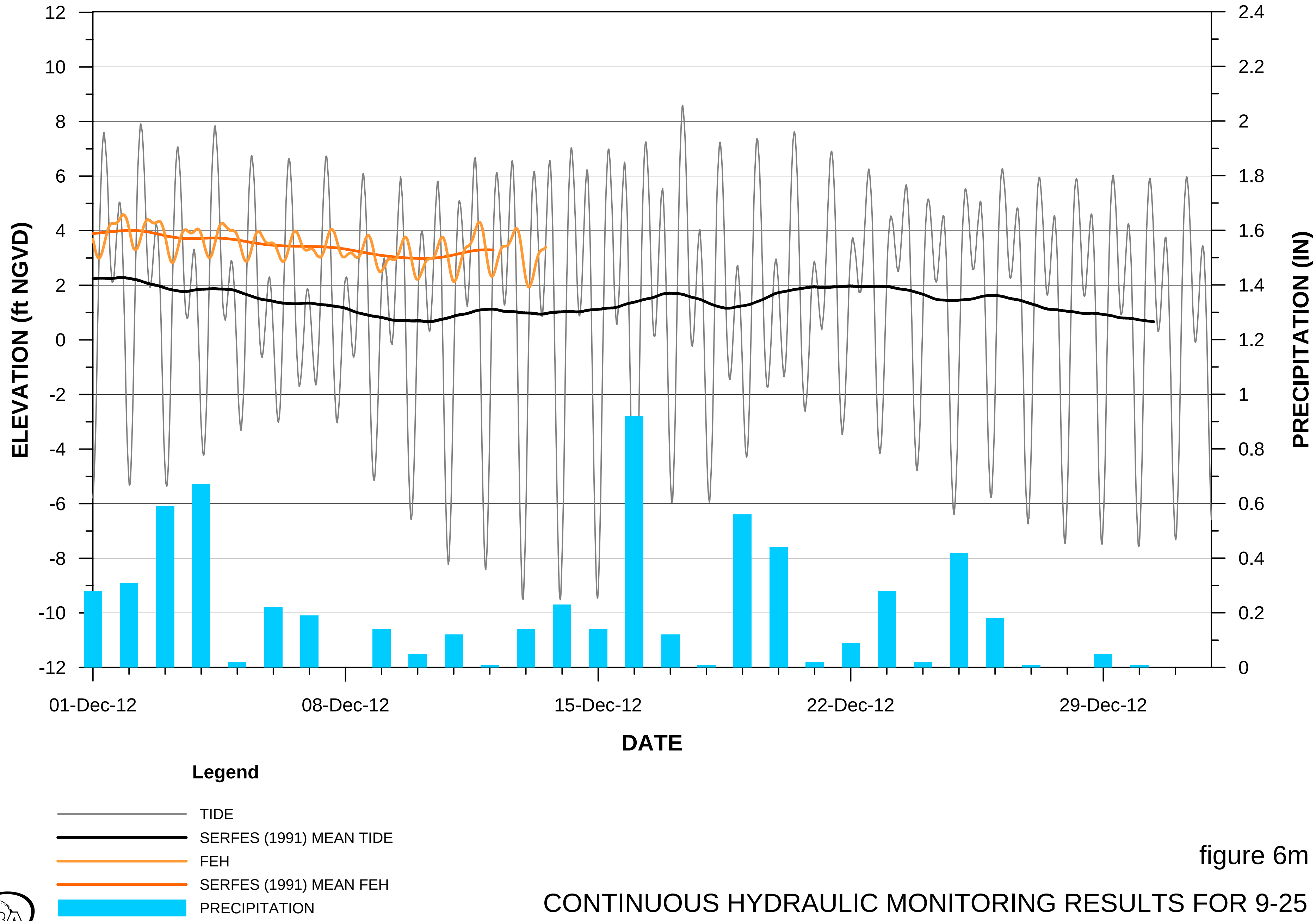


figure 6m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 9-25

Occidental Chemical Corporation, Tacoma, Washington

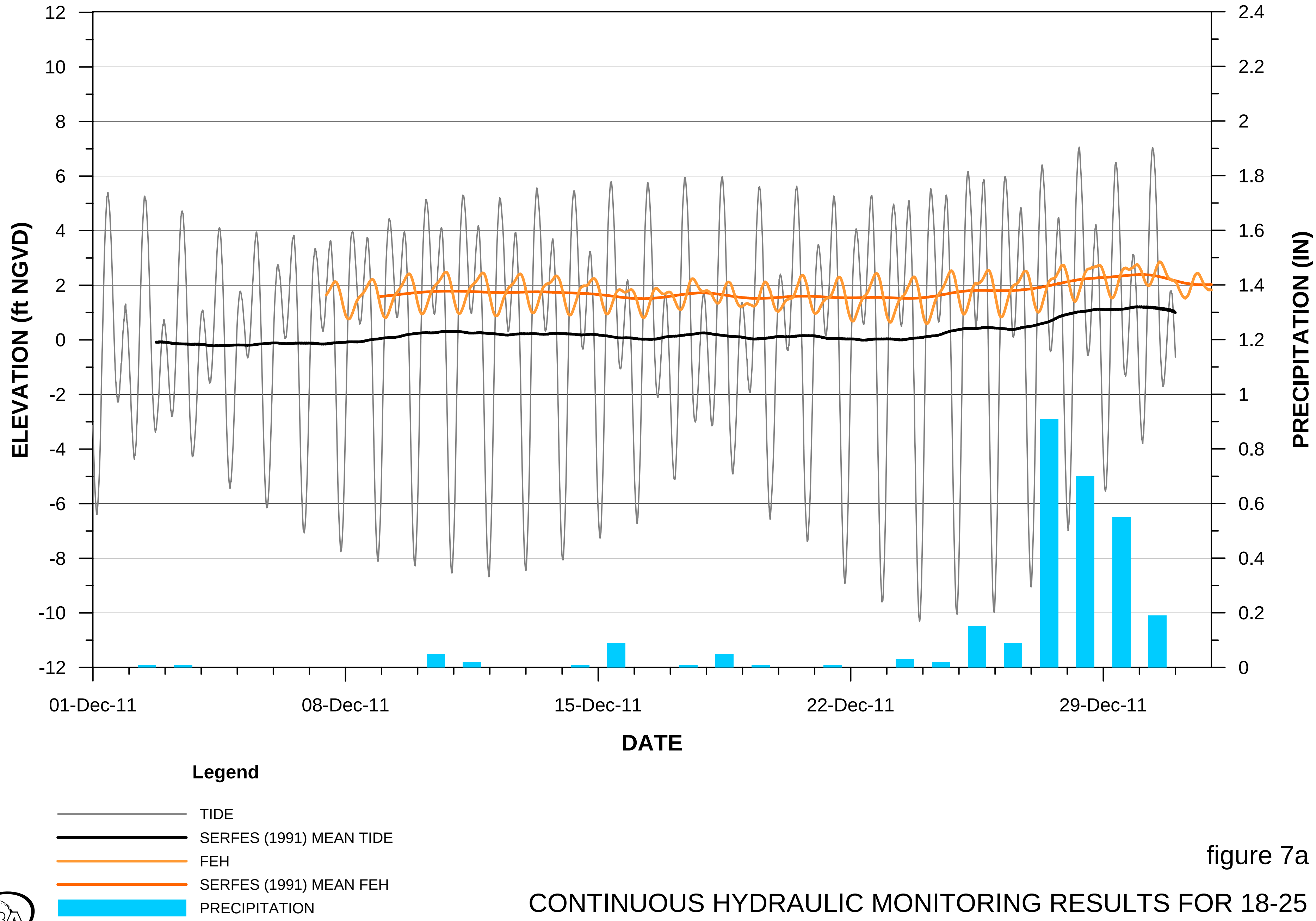


figure 7a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

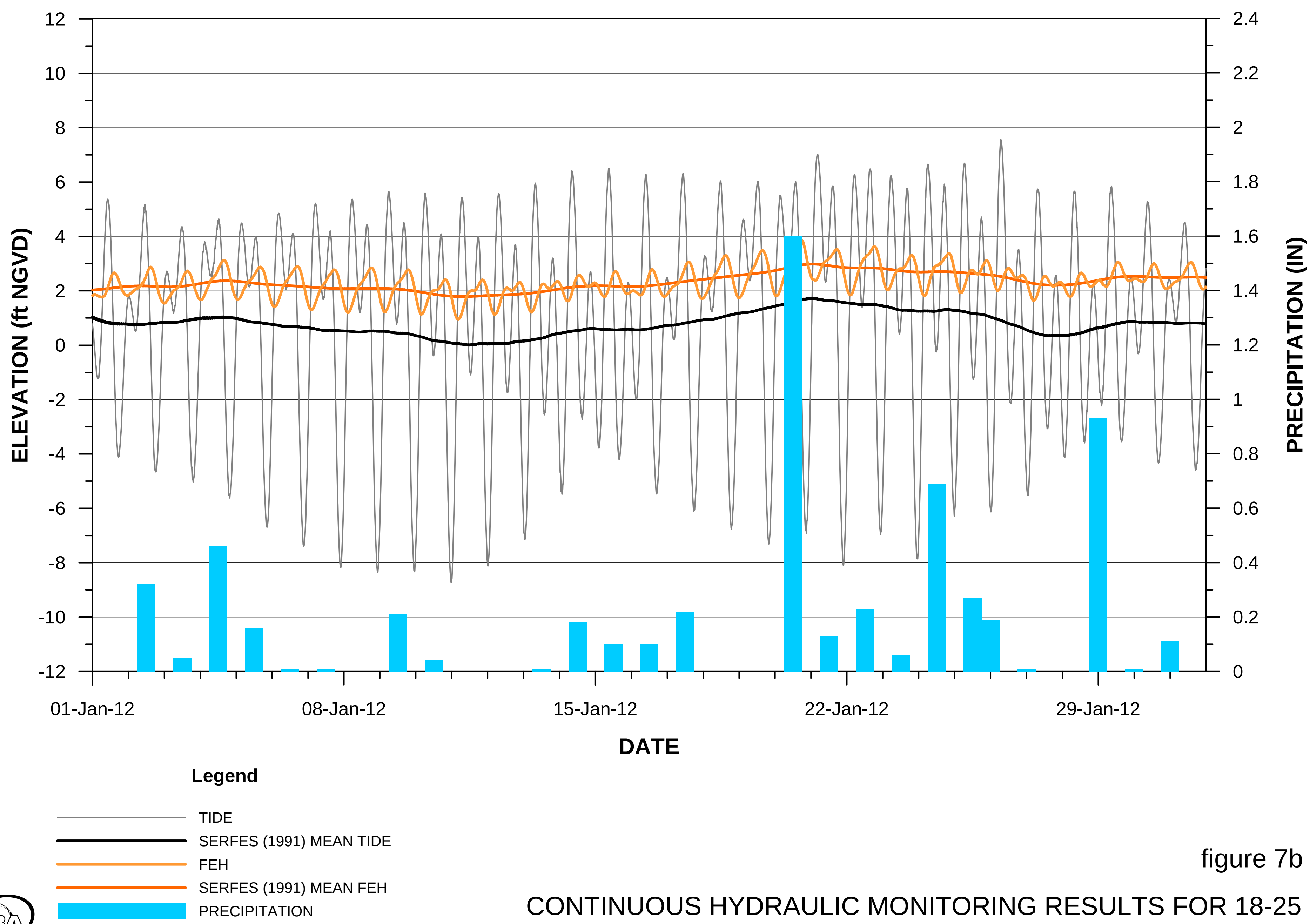


figure 7b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_January 2012.grf) AUG 5/2014

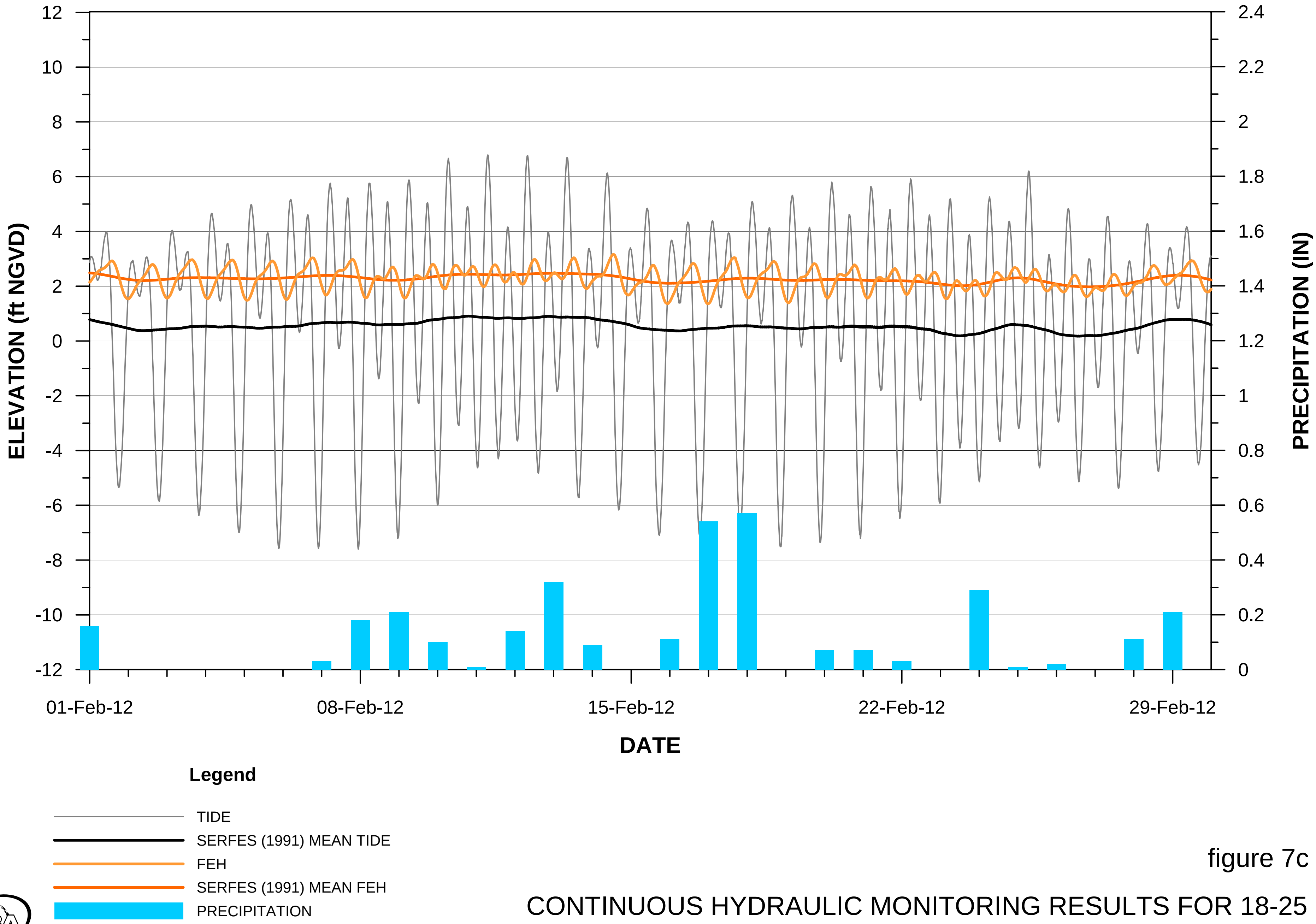


figure 7c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

CRA

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_February 2012.grf) AUG 5/2014

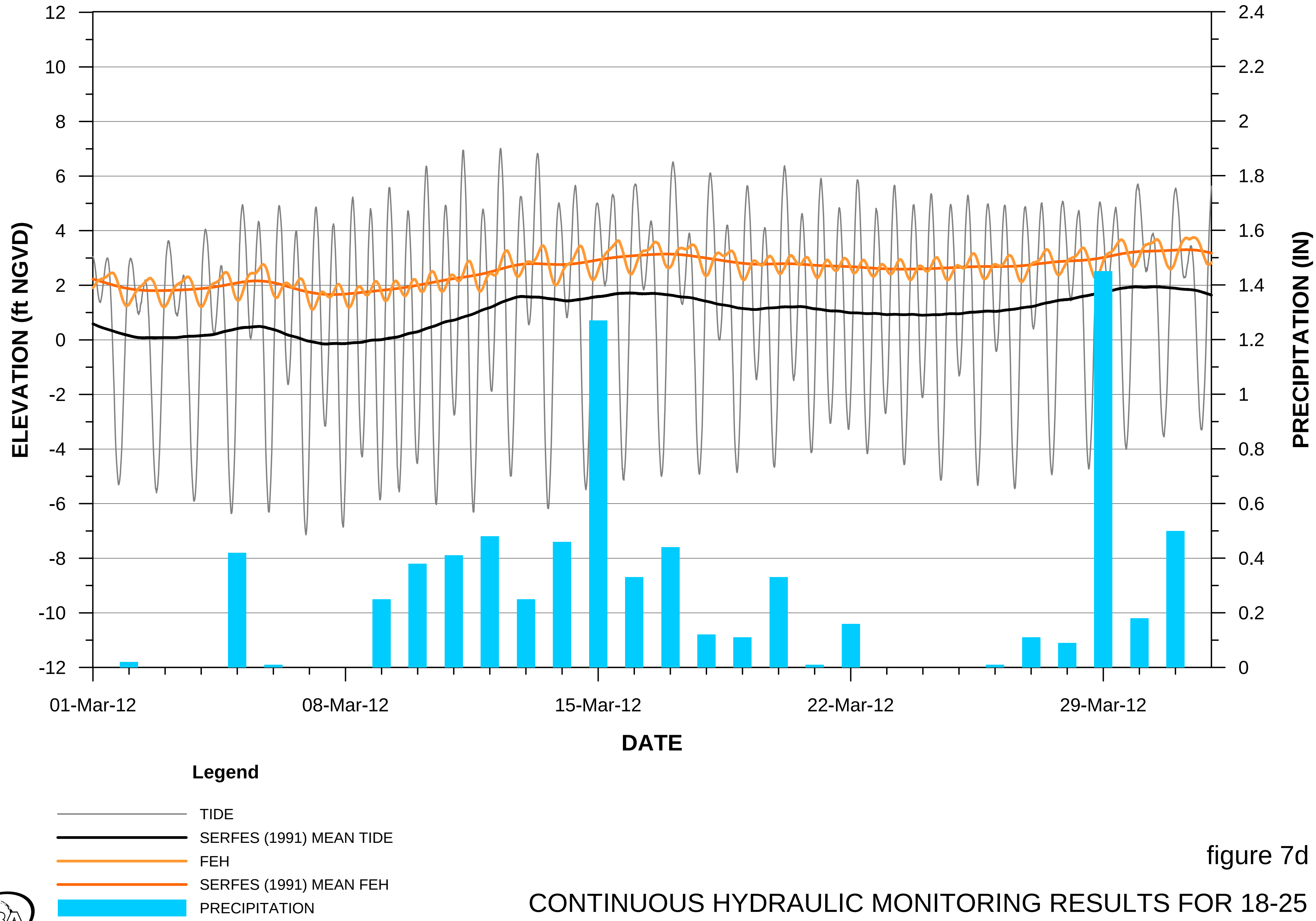


figure 7d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

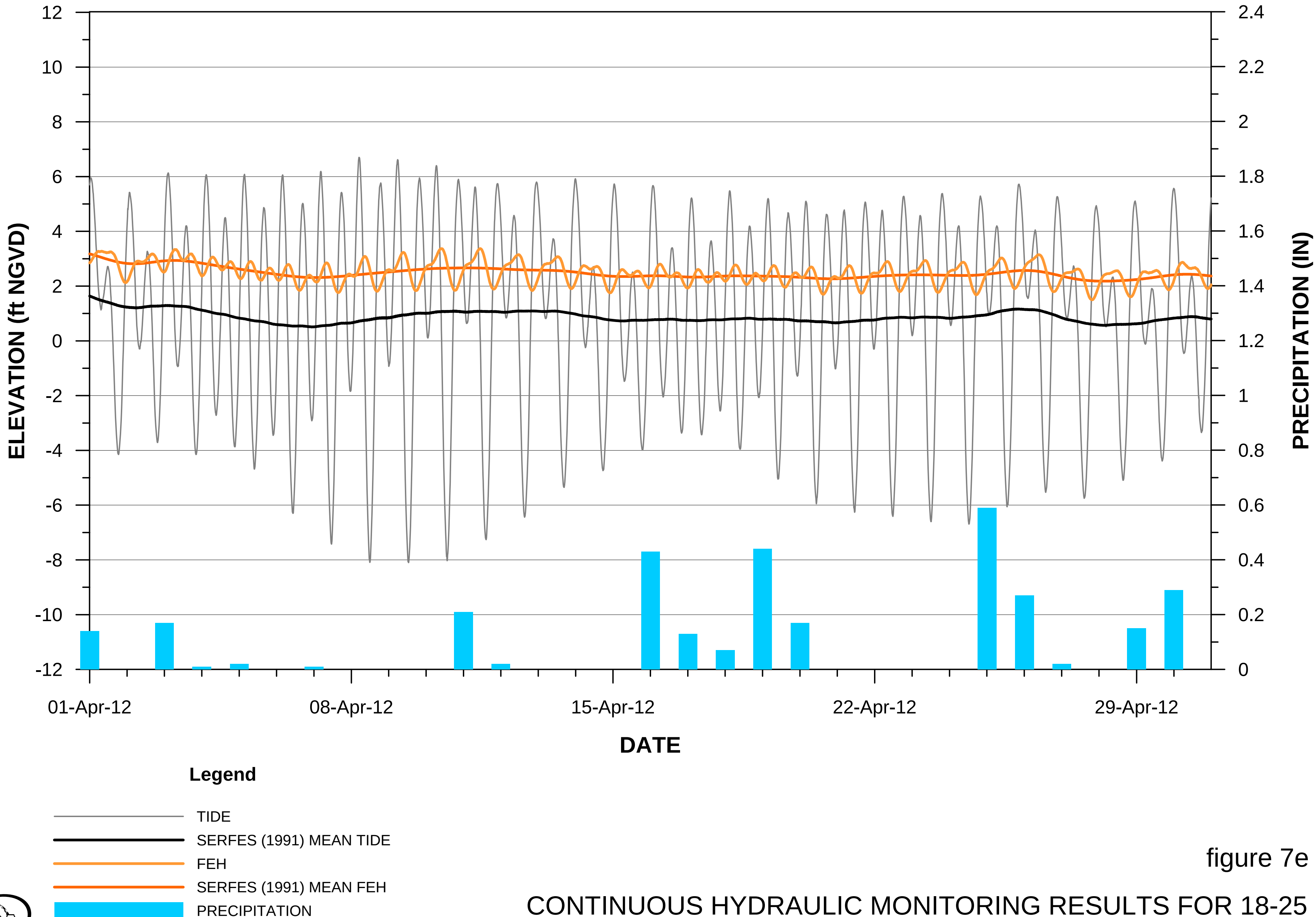


figure 7e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_April 2012.grf) AUG 5/2014

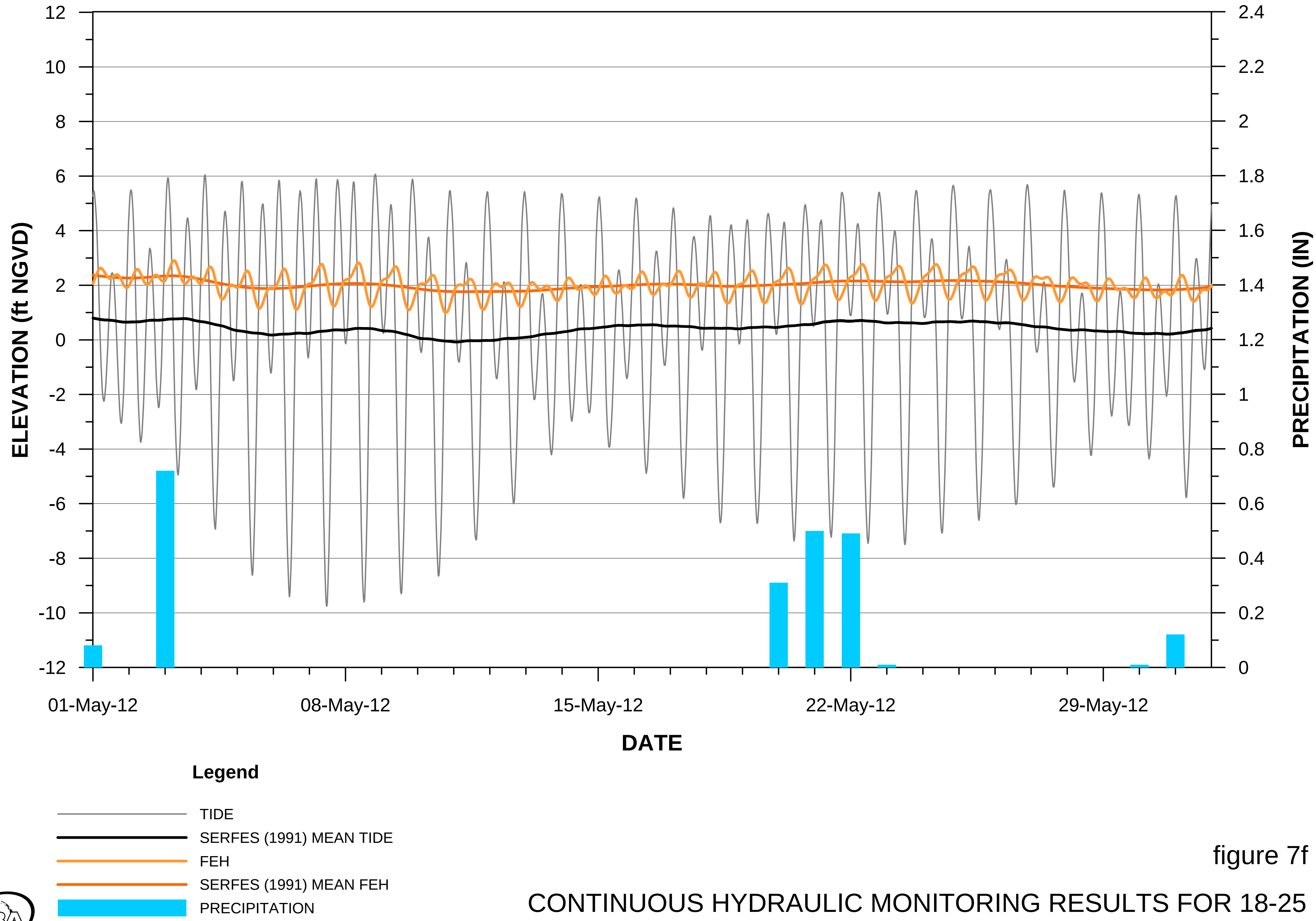


figure 7f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_May 2012.grf) AUG 5/2014

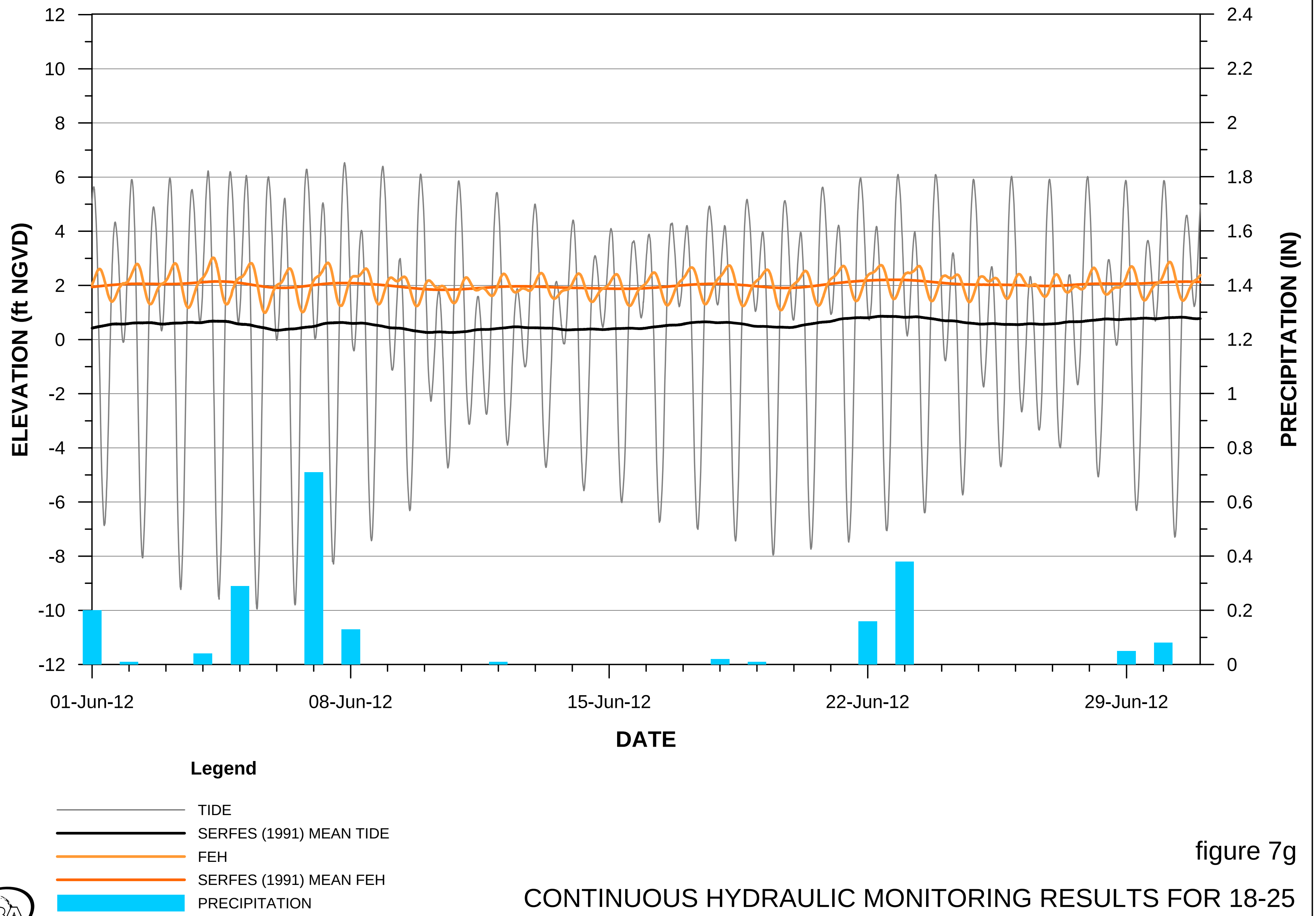


figure 7g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

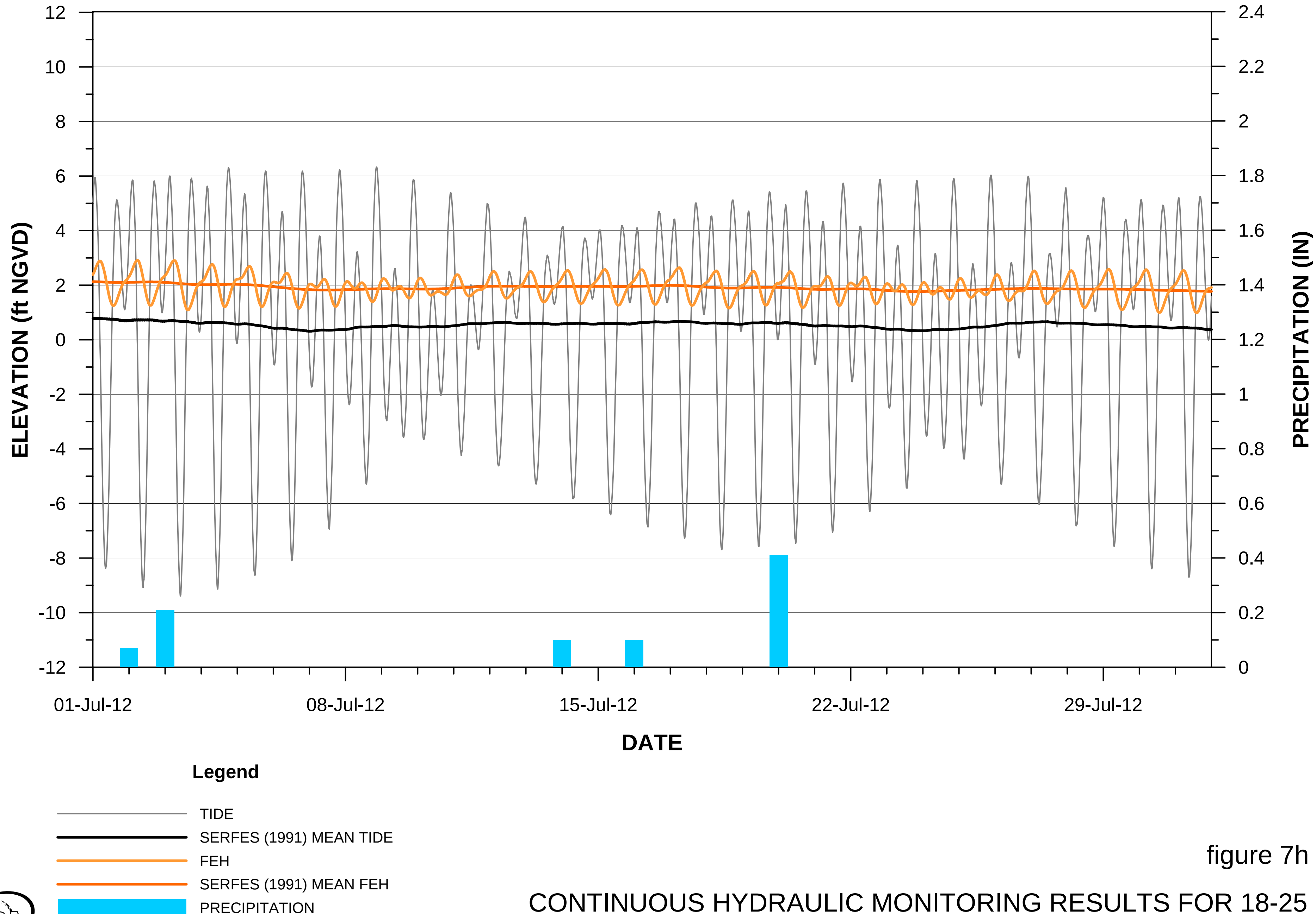


figure 7h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_July 2012.grf) AUG 5/2014

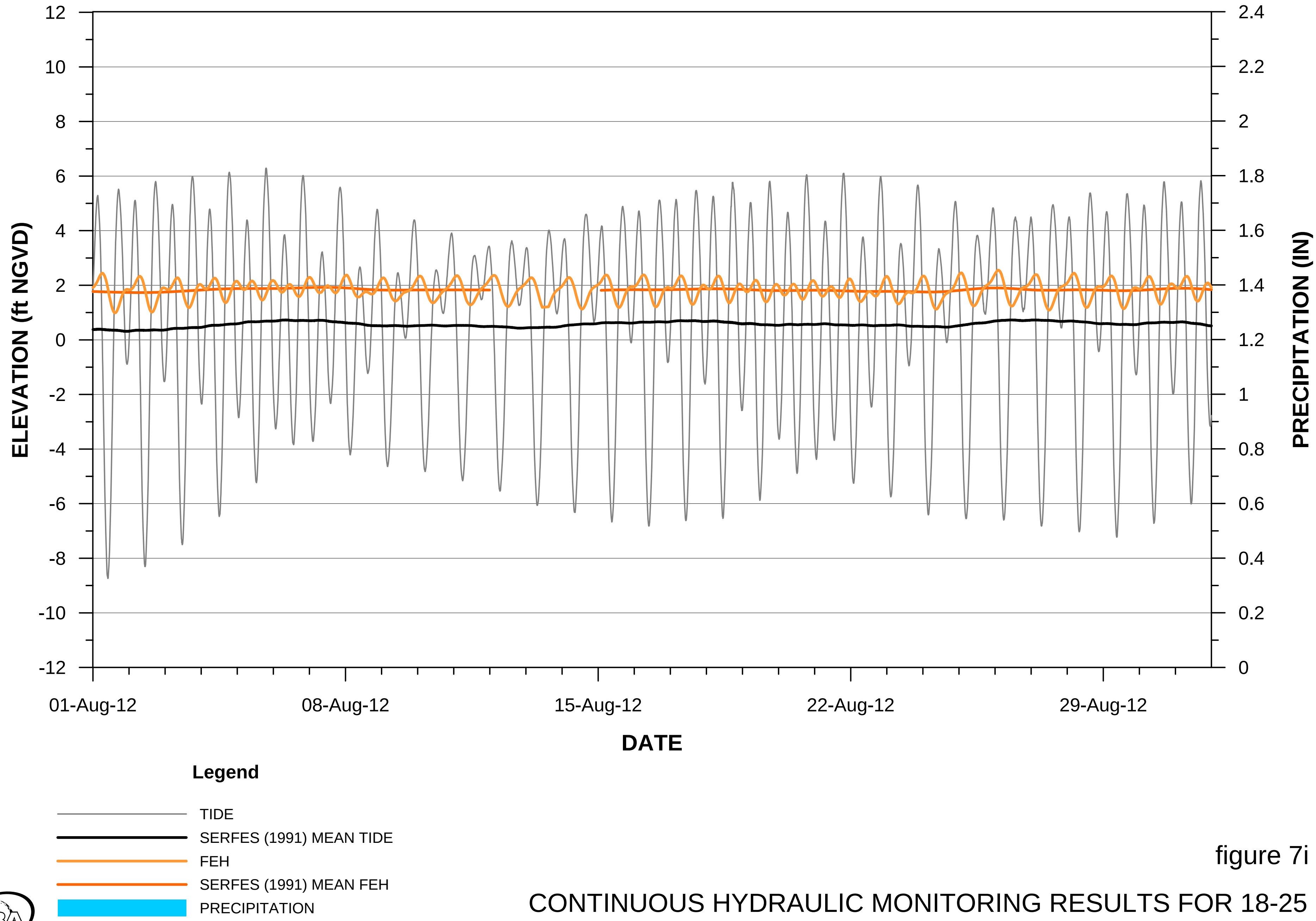


figure 7i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

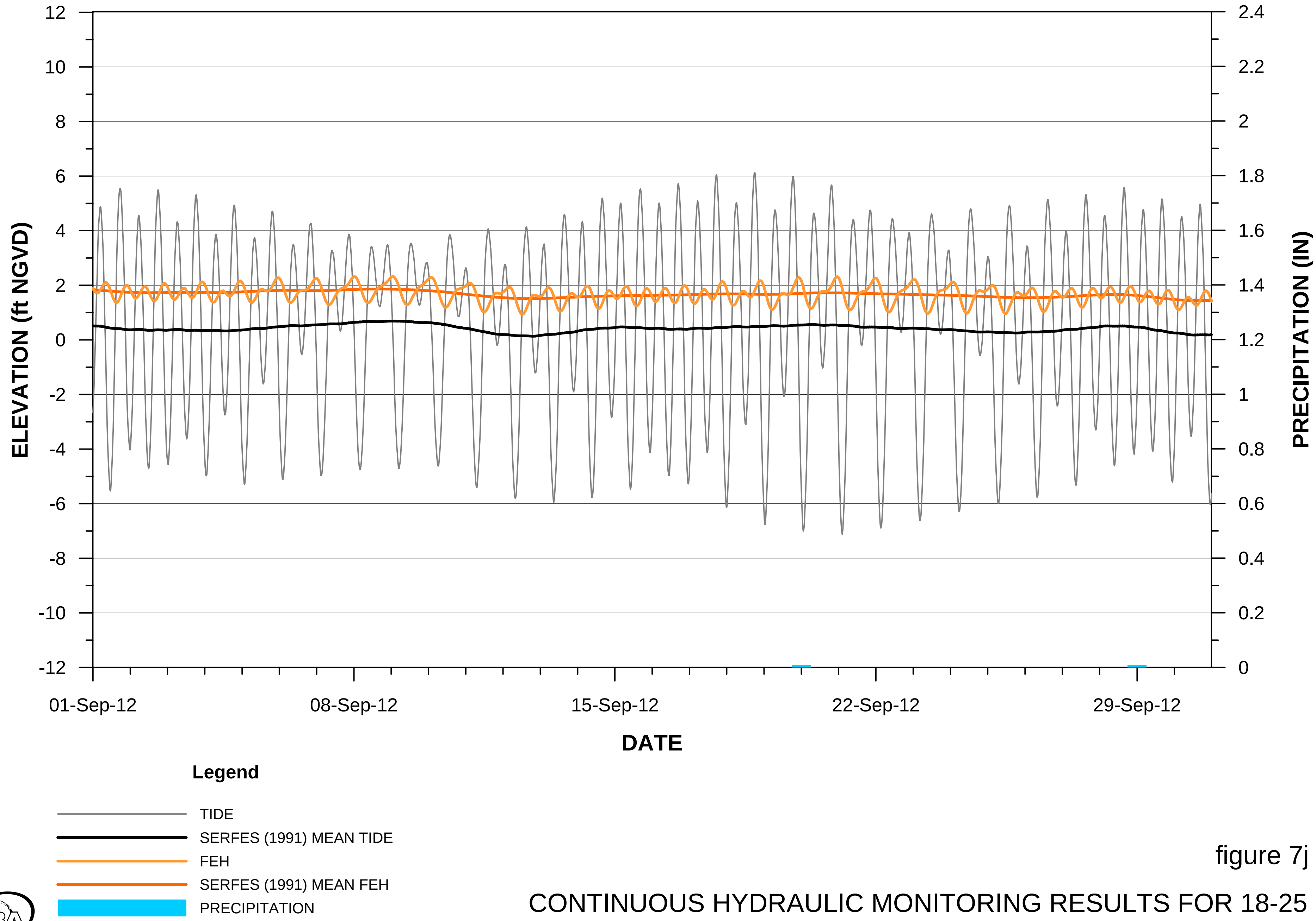


figure 7j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_September 2012.grf) AUG 5/2014

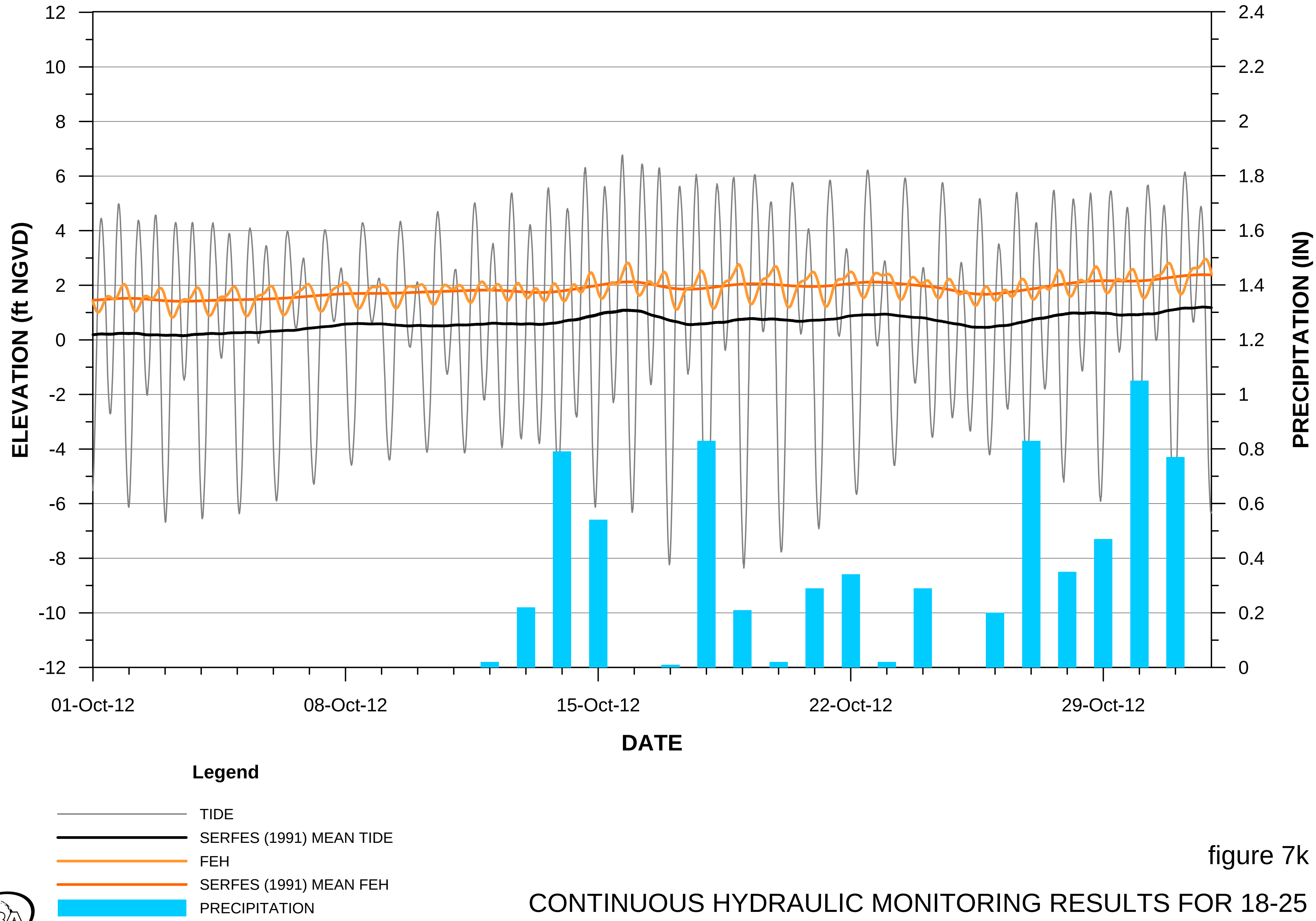


figure 7k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_October 2012.grf) AUG 5/2014

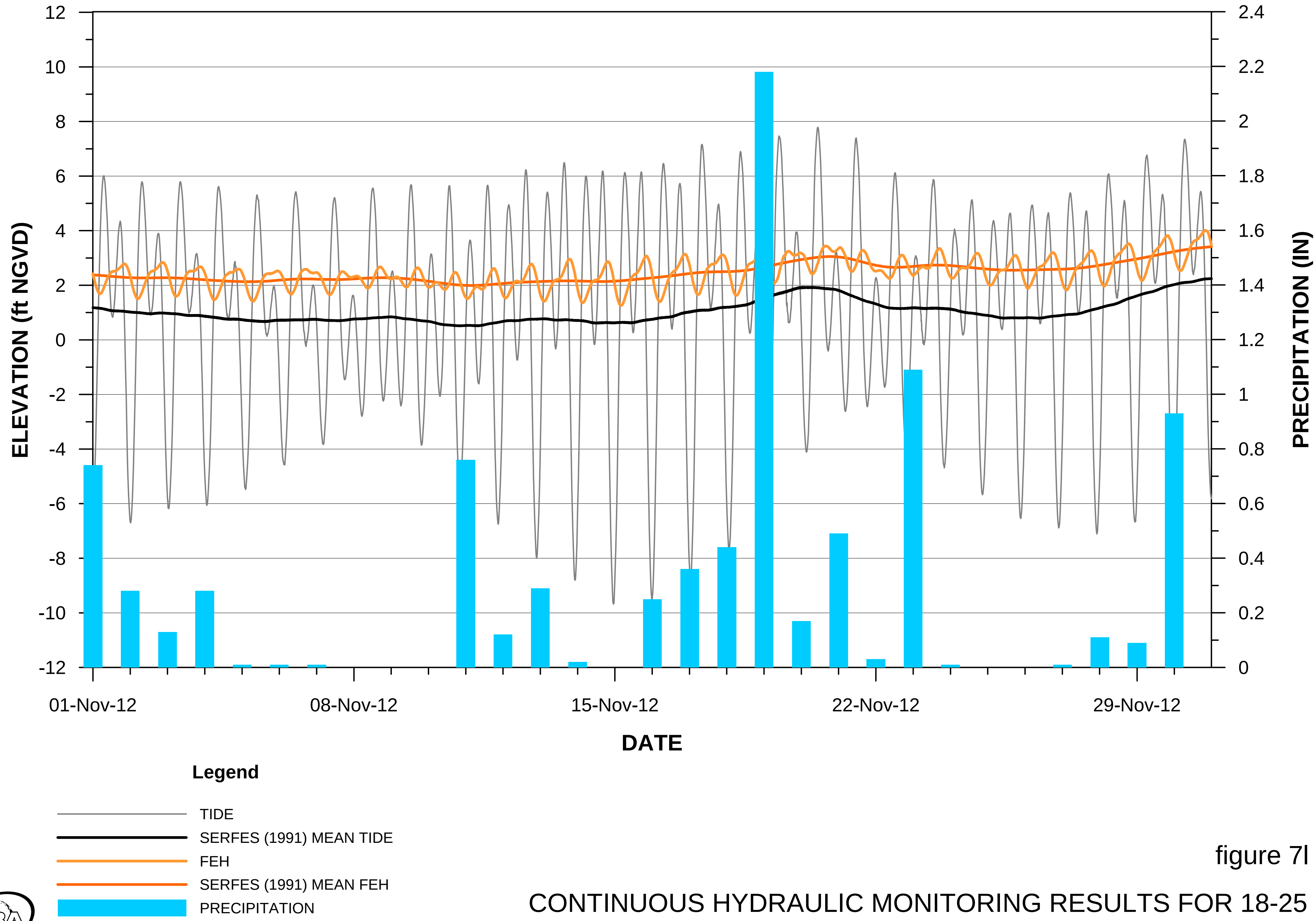


figure 7I

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

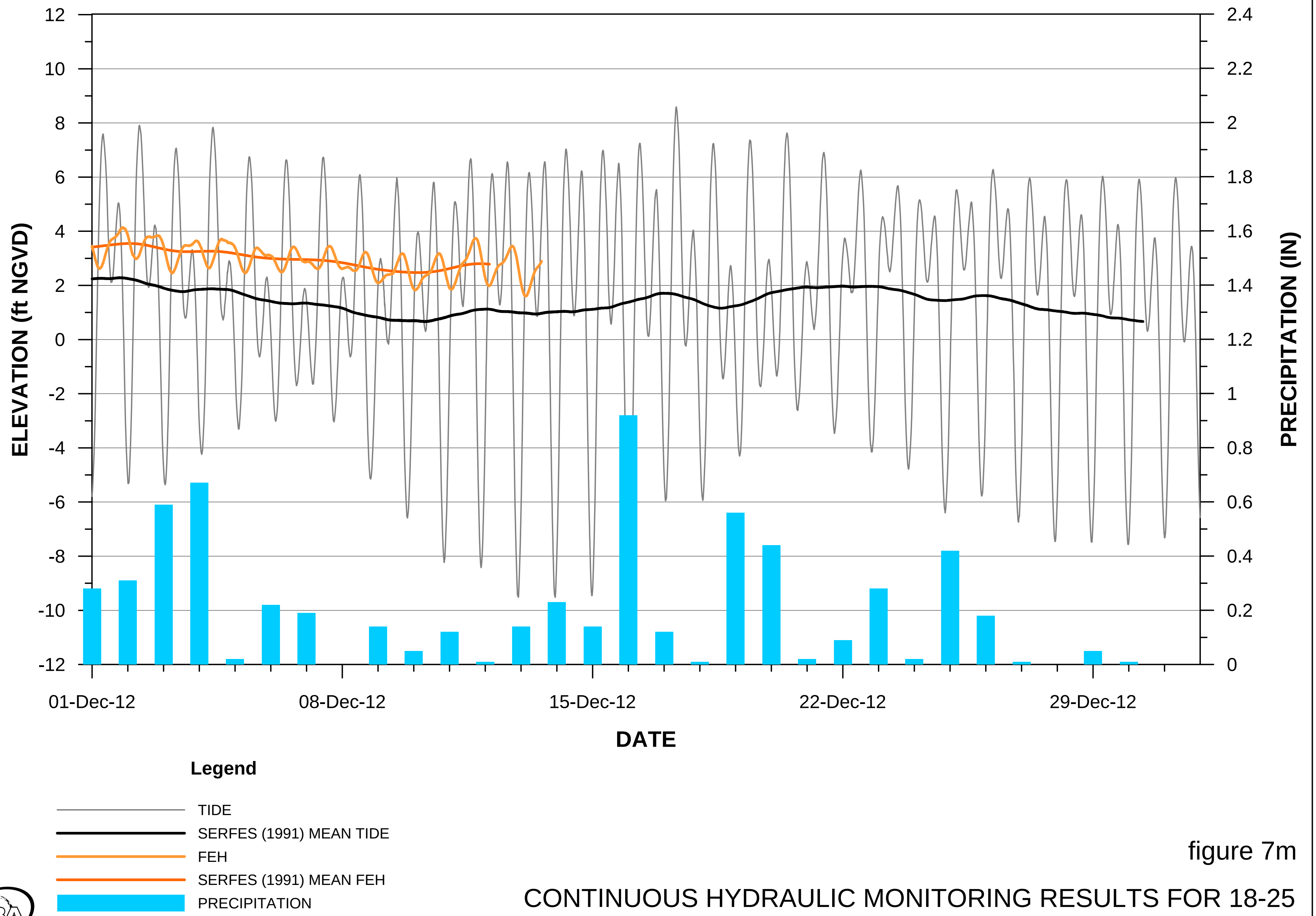


figure 7m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 18-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\18-25\07843_18-25_December 2012.grf) AUG 5/2014

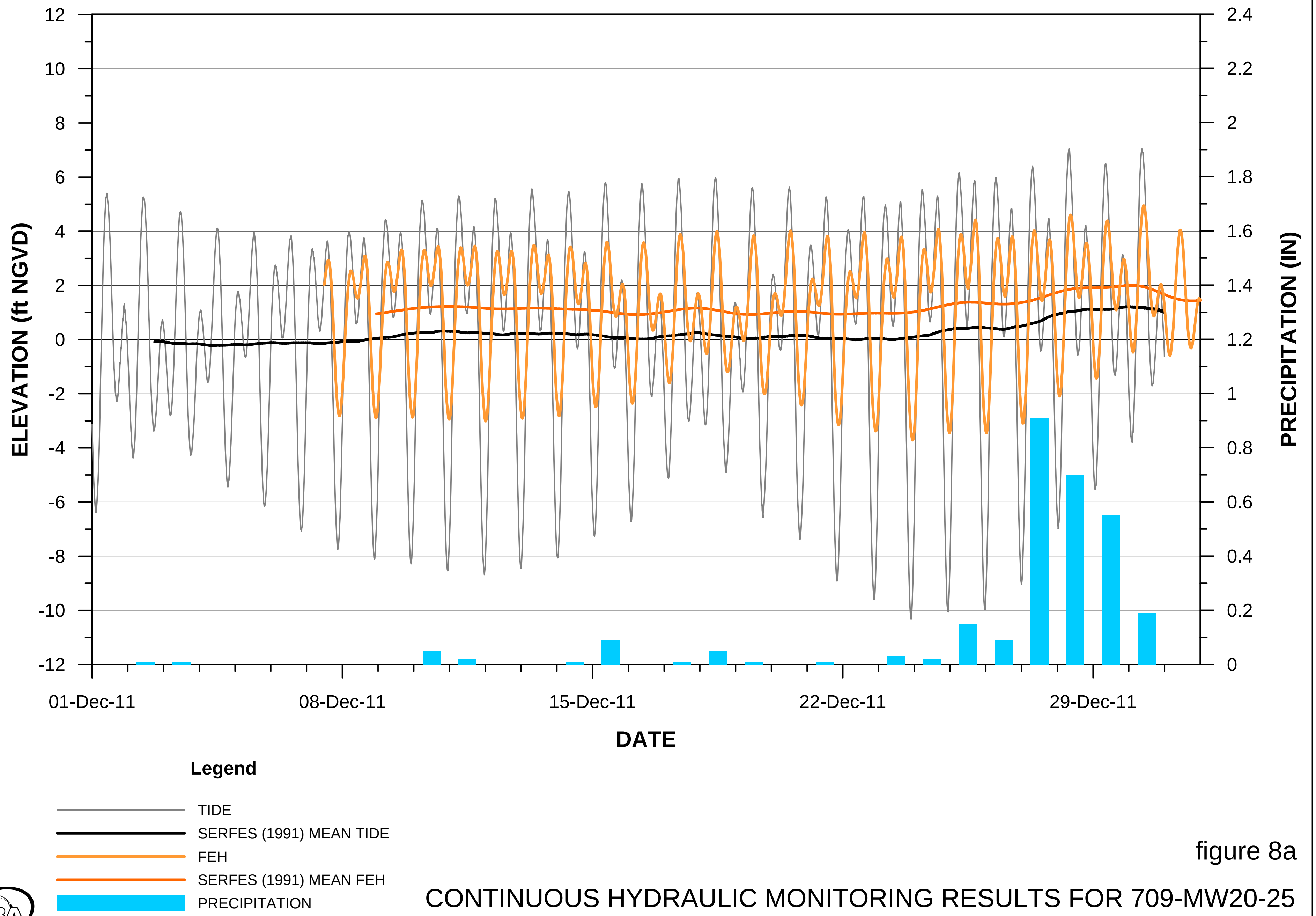


figure 8a

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_December 2011.grf) AUG 5/2014

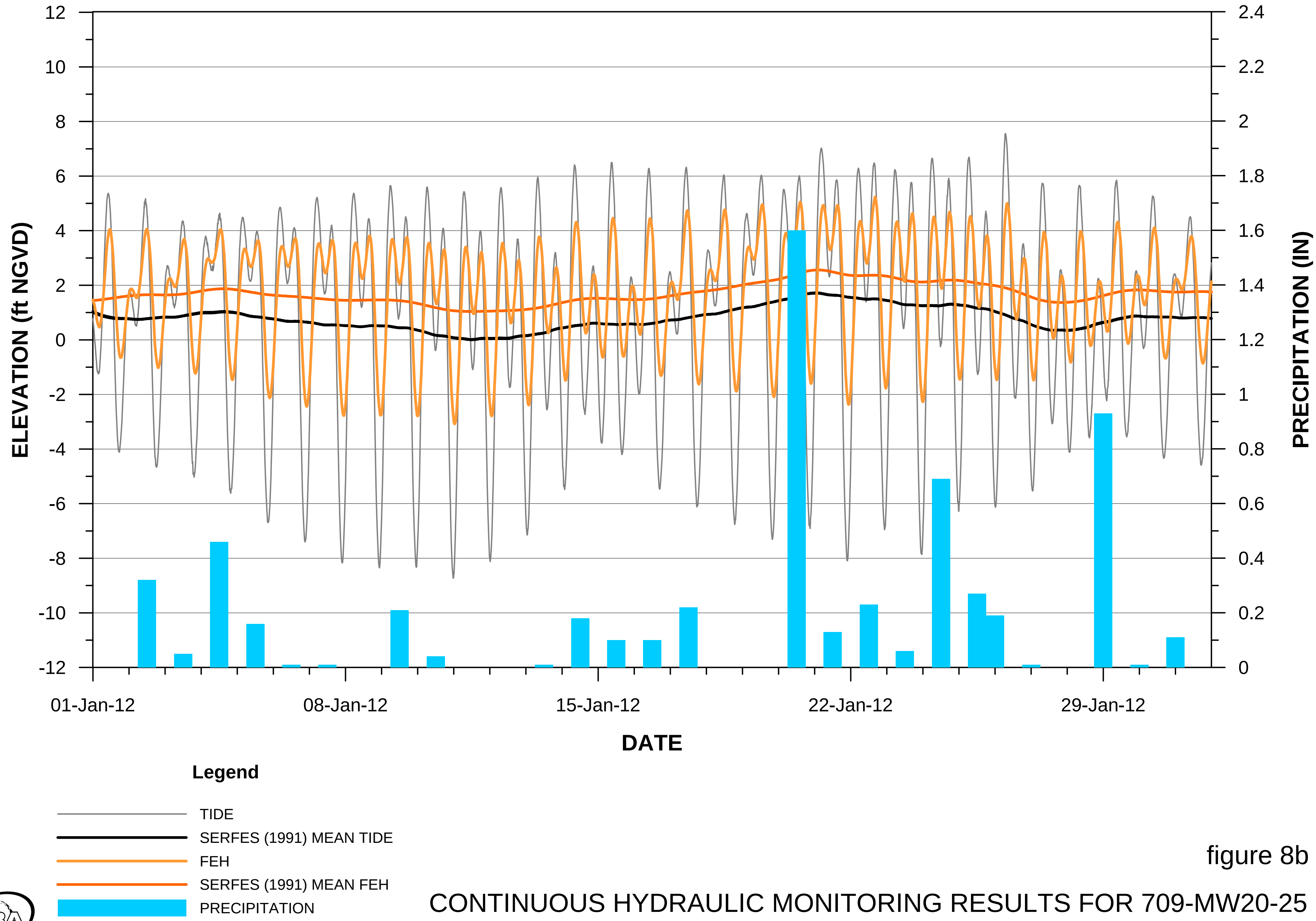


figure 8b

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_January 2012.grf) AUG 5/2014

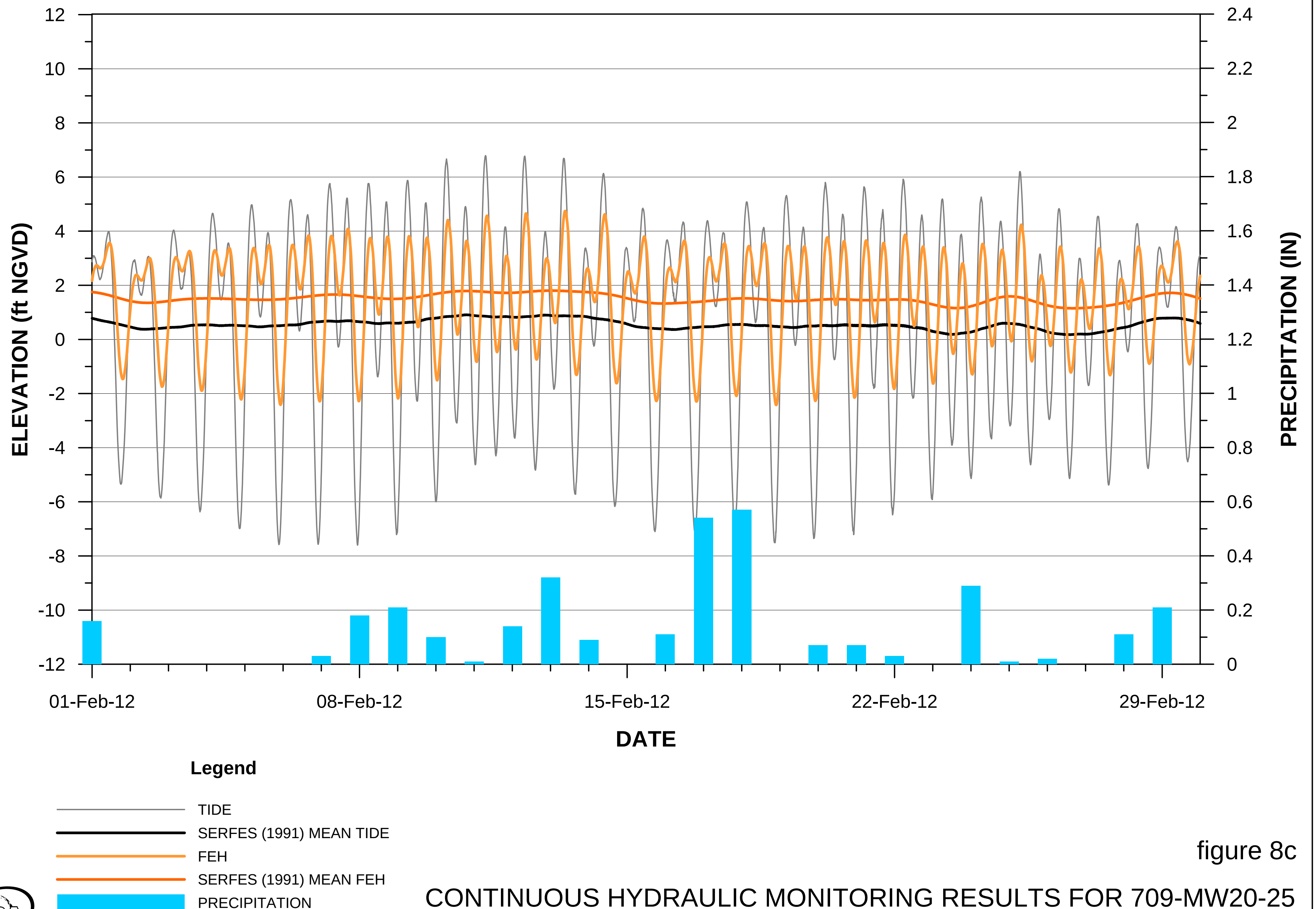


figure 8c

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_February 2012.grf) AUG 5/2014

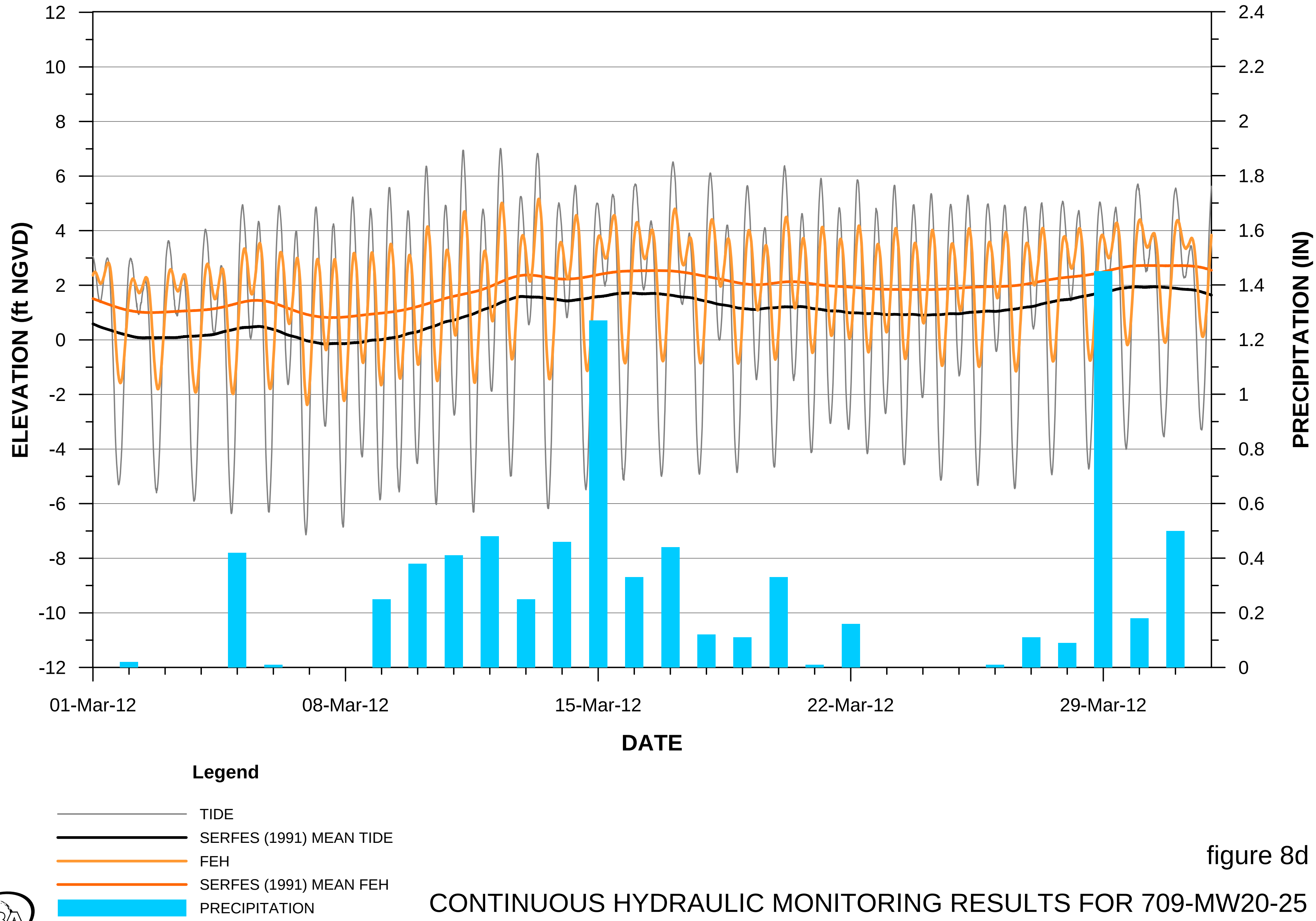


figure 8d

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_March 2012.grf) AUG 5/2014

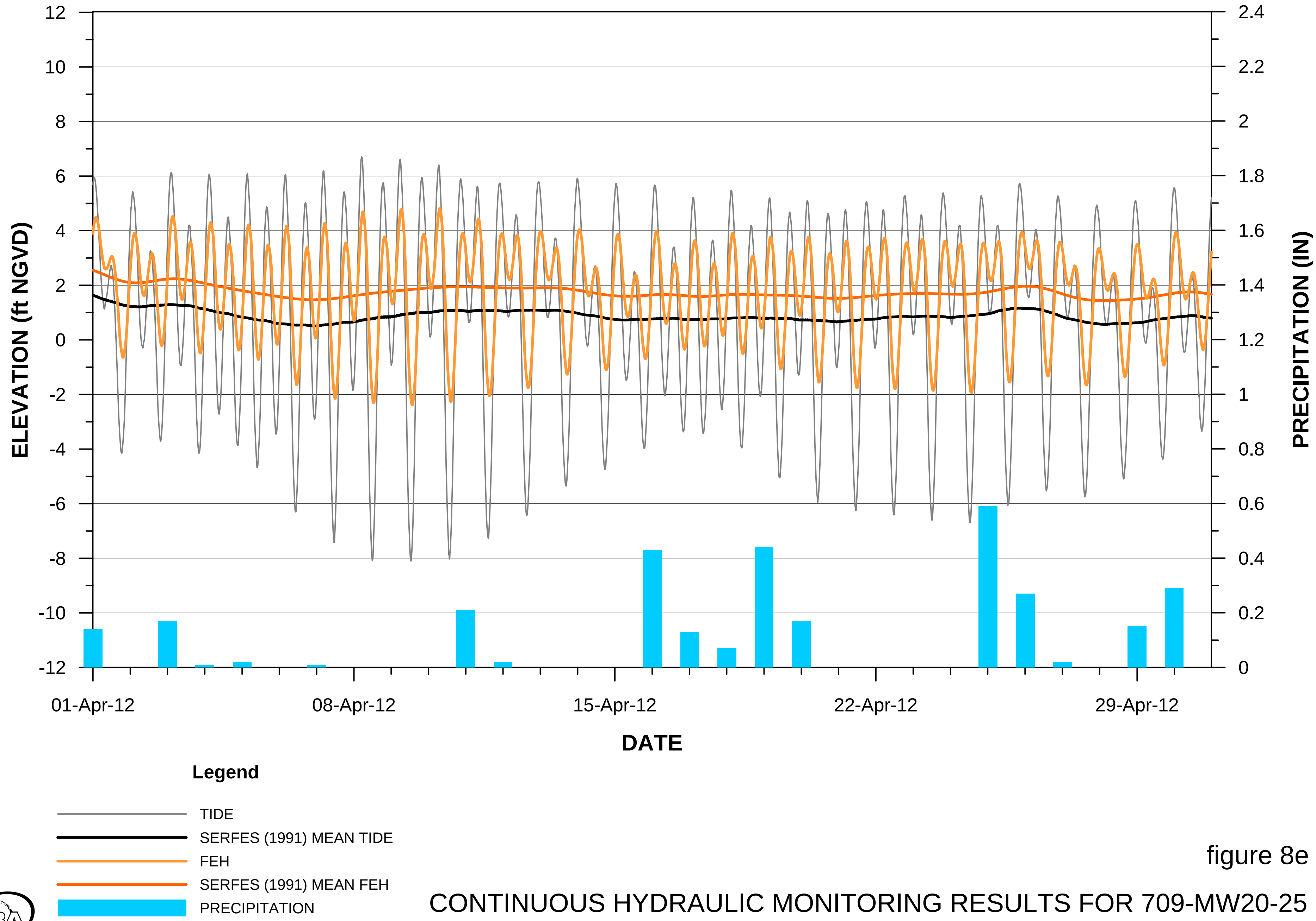


figure 8e

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_April 2012.grf) AUG 5/2014

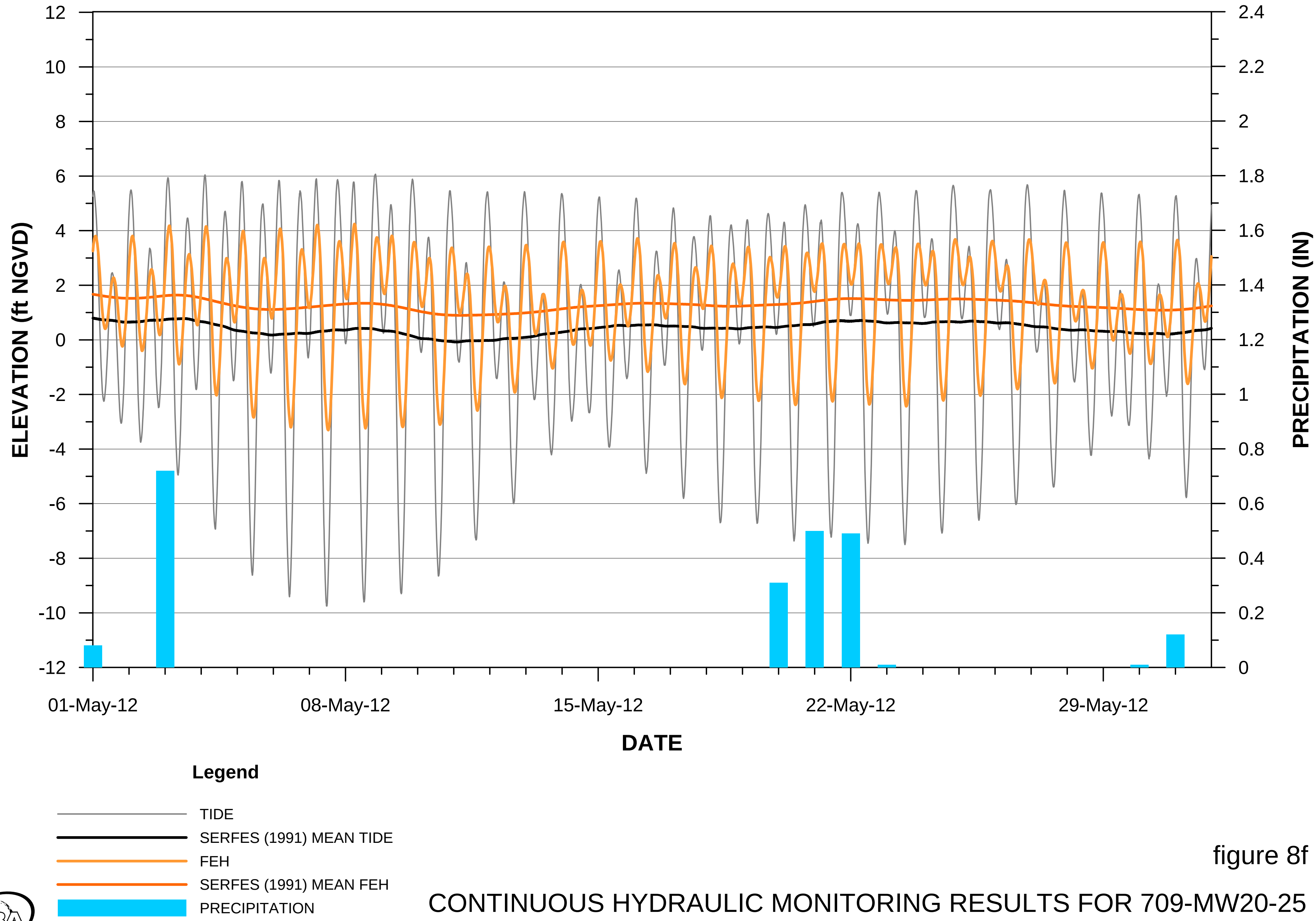


figure 8f

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_May 2012.grf) AUG 5/2014

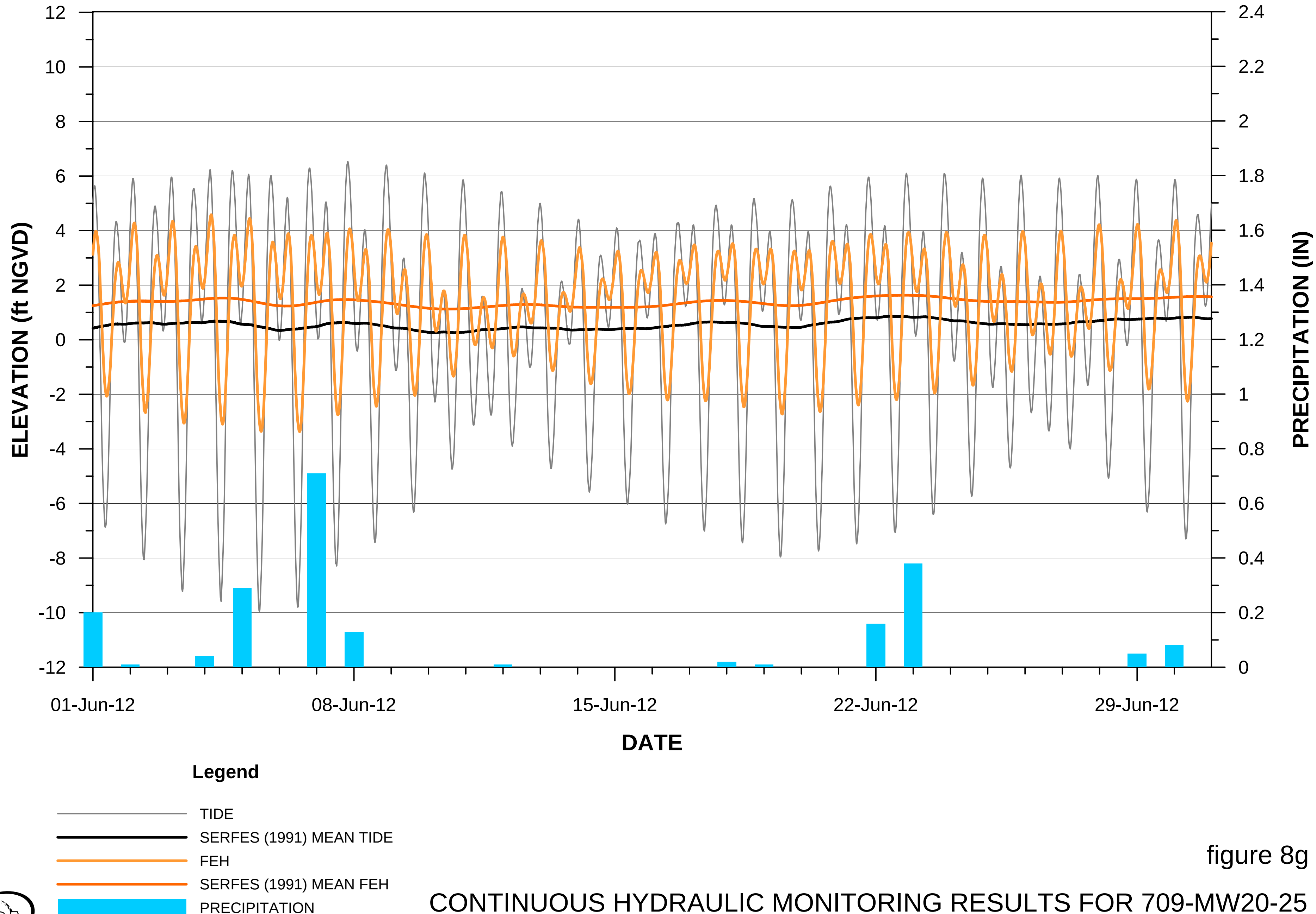


figure 8g

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_June 2012.grf) AUG 5/2014

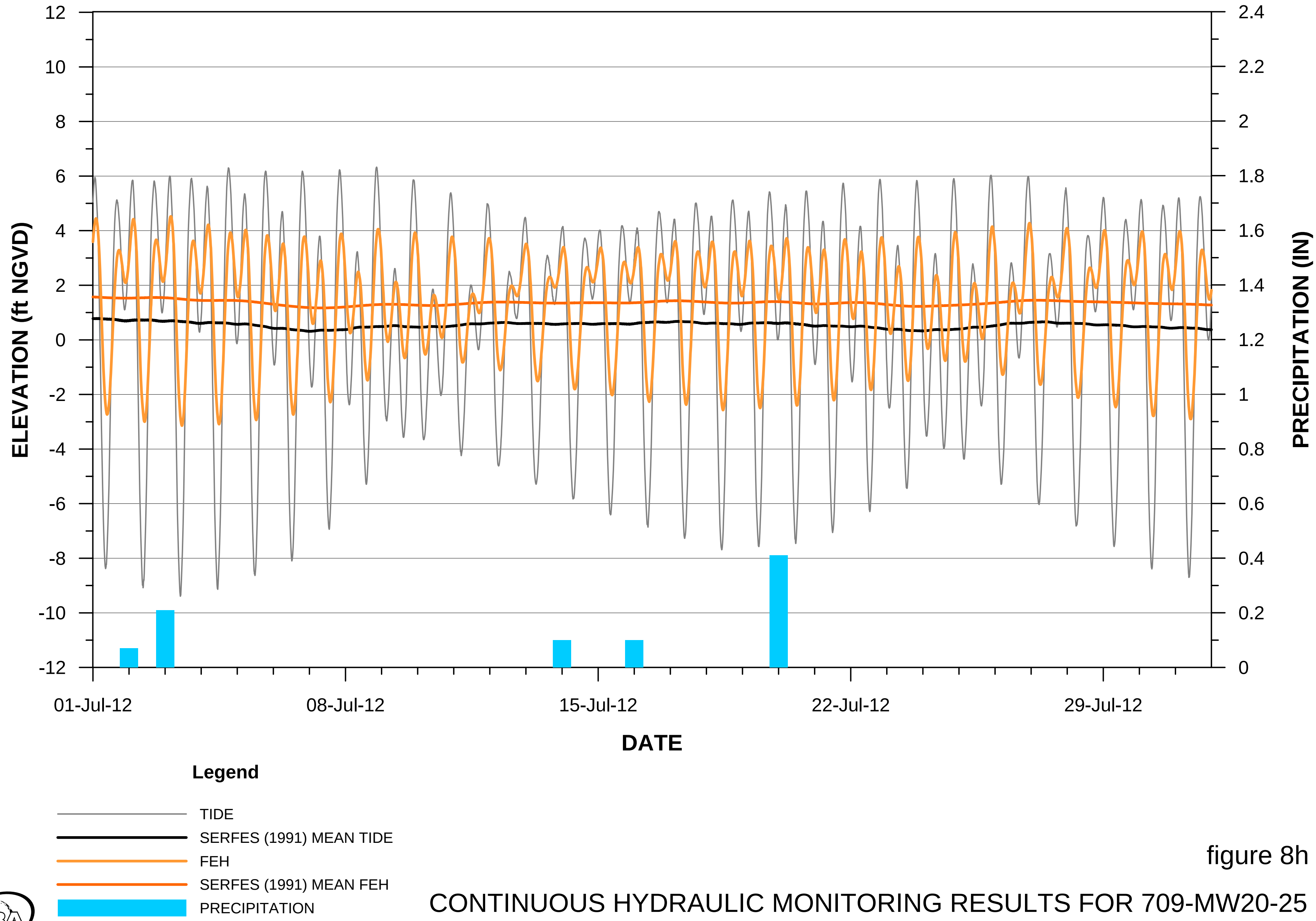


figure 8h

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_July 2012.grf) AUG 5/2014

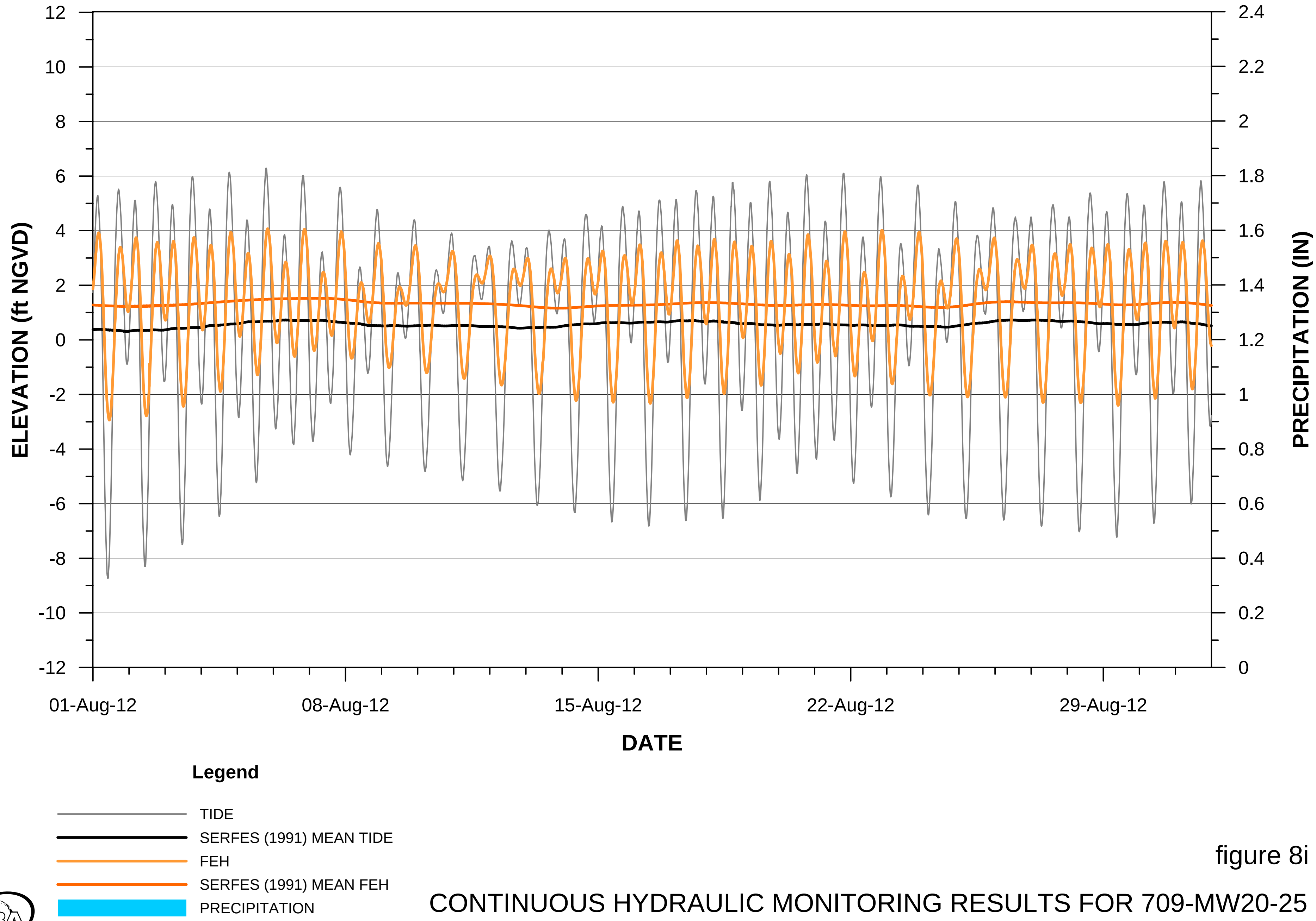


figure 8i

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_August 2012.grf) AUG 5/2014

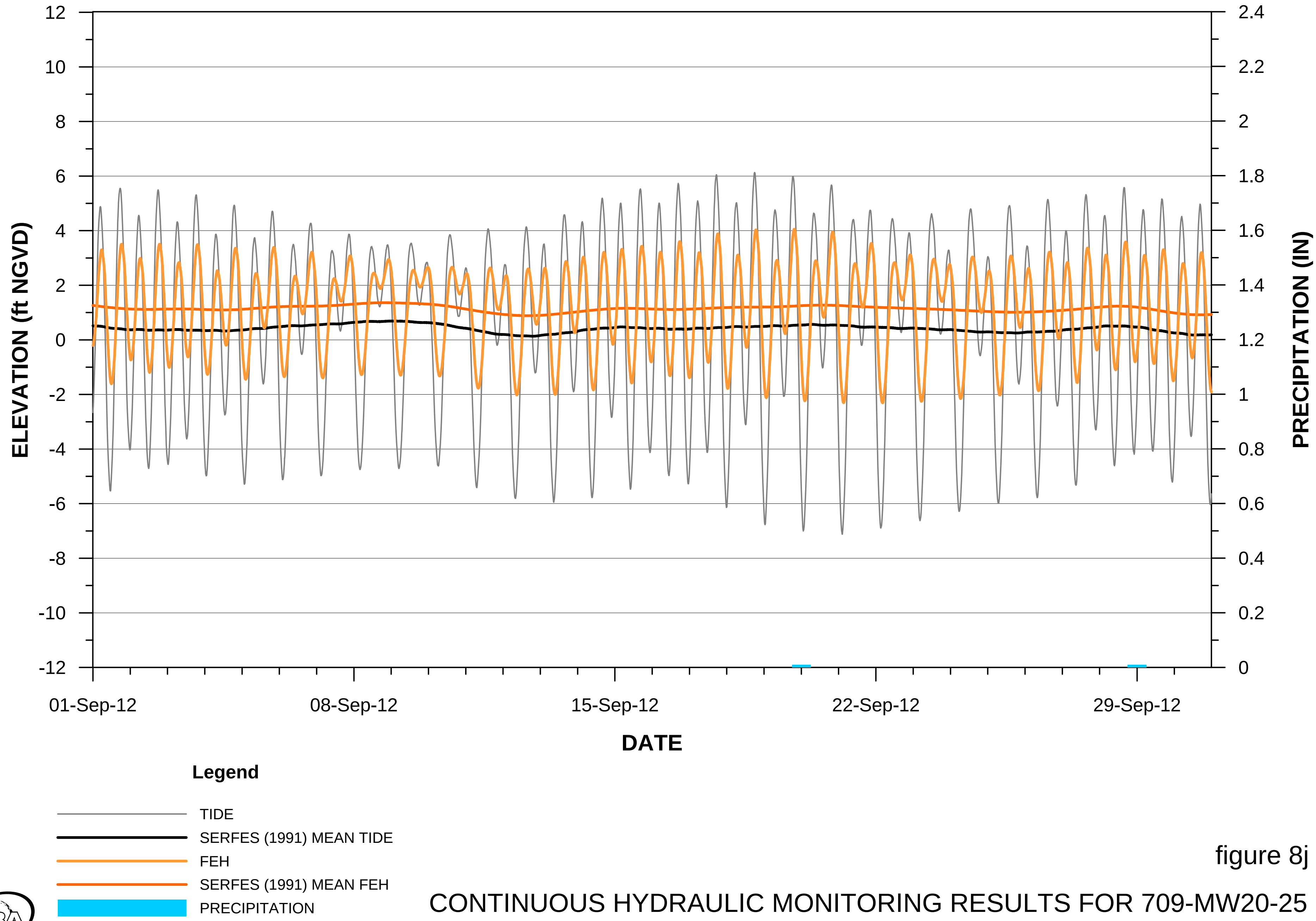


figure 8j

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

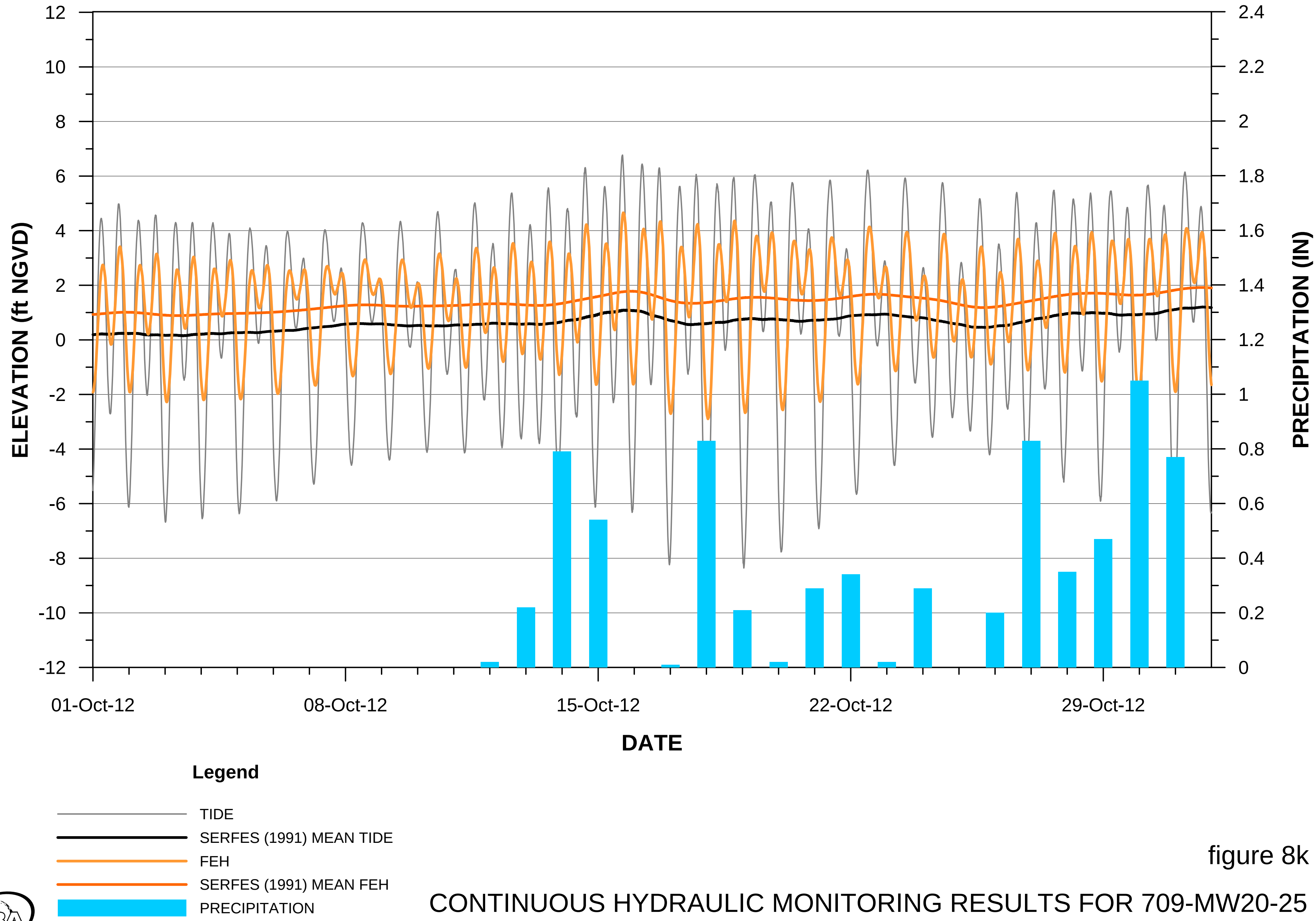


figure 8k

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_October 2012.grf) AUG 5/2014

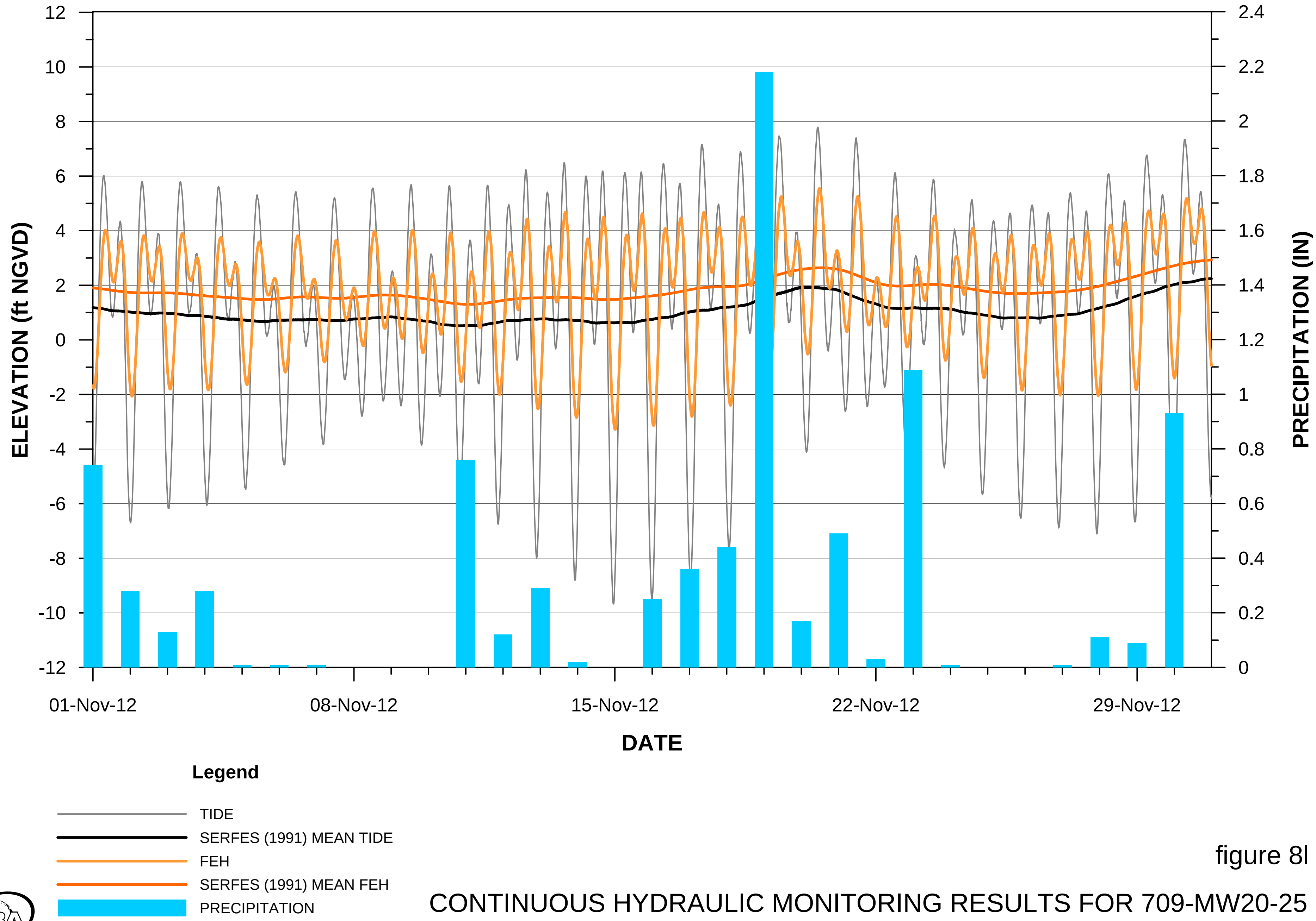


figure 8l

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_November 2012.grf) AUG 5/2014

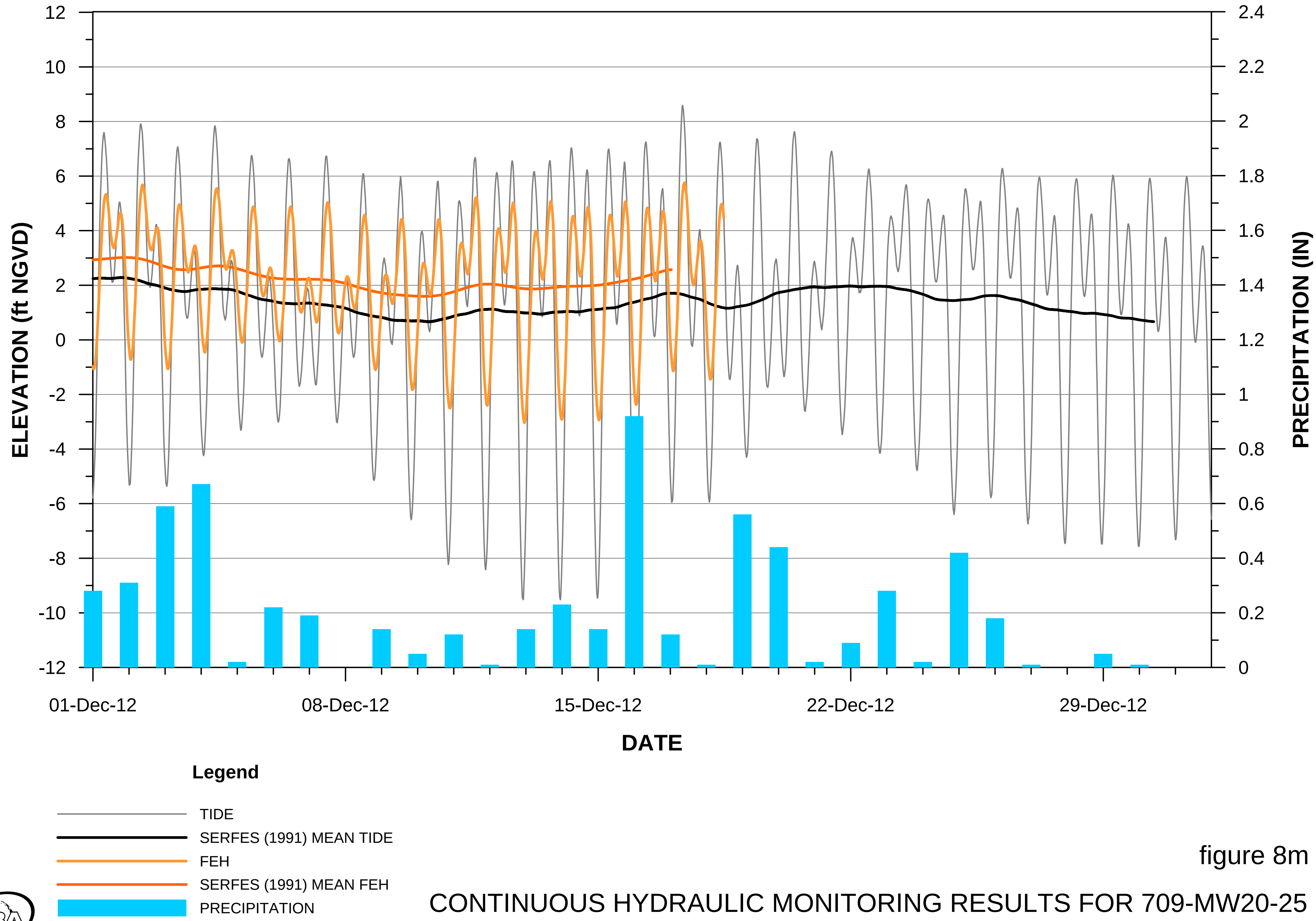


figure 8m

CONTINUOUS HYDRAULIC MONITORING RESULTS FOR 709-MW20-25

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Hydrographs -DRAFT\2013 February shallow zone monthly hydrographs\709-MW20-25\07843_709-MW20-25_December 2012.grf) AUG 5/2014

Attachment 10

Shallow Zone Monitoring Well Hydrographs for CSI Hydraulic Monitoring

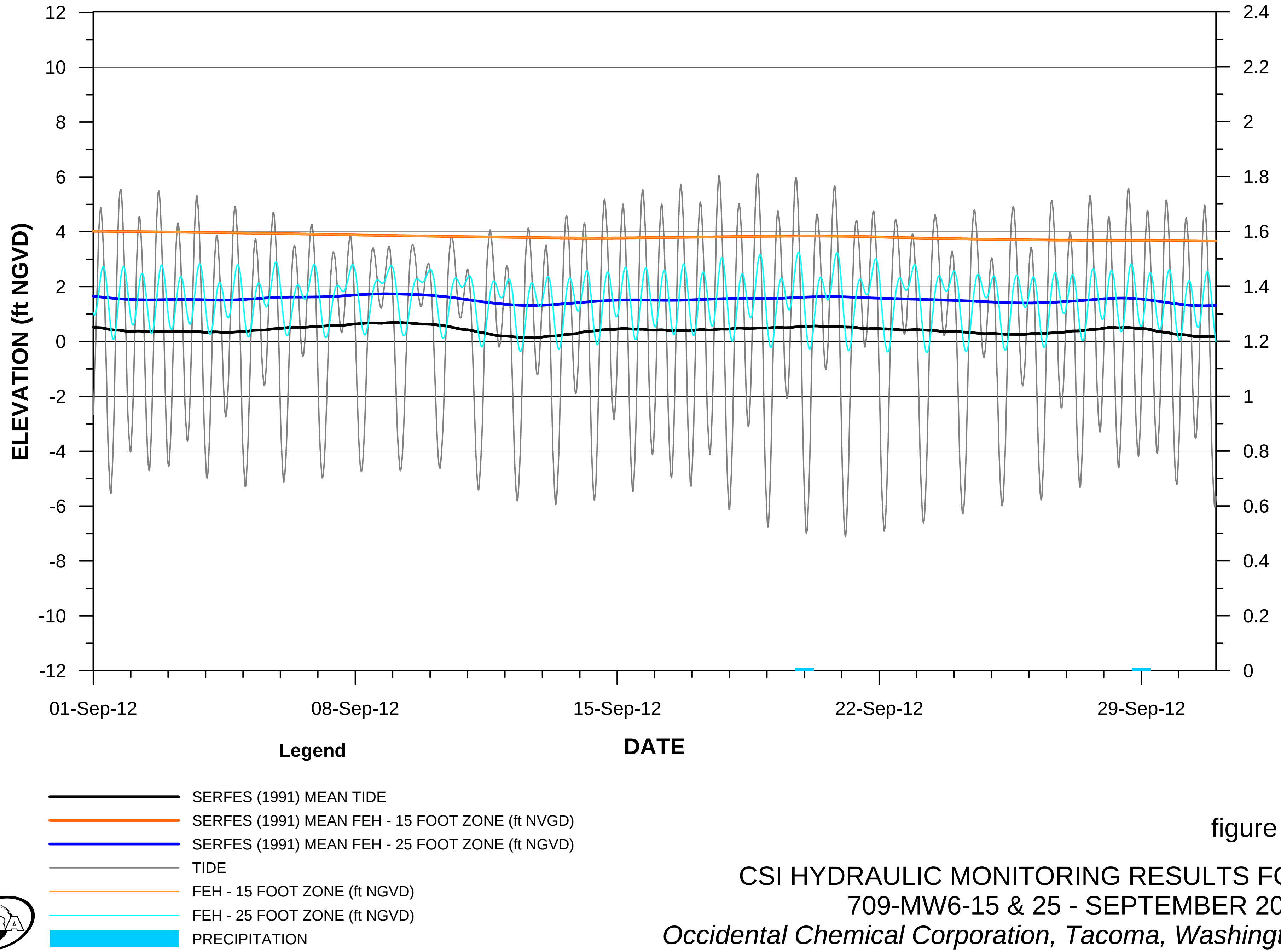


figure 1a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW6-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

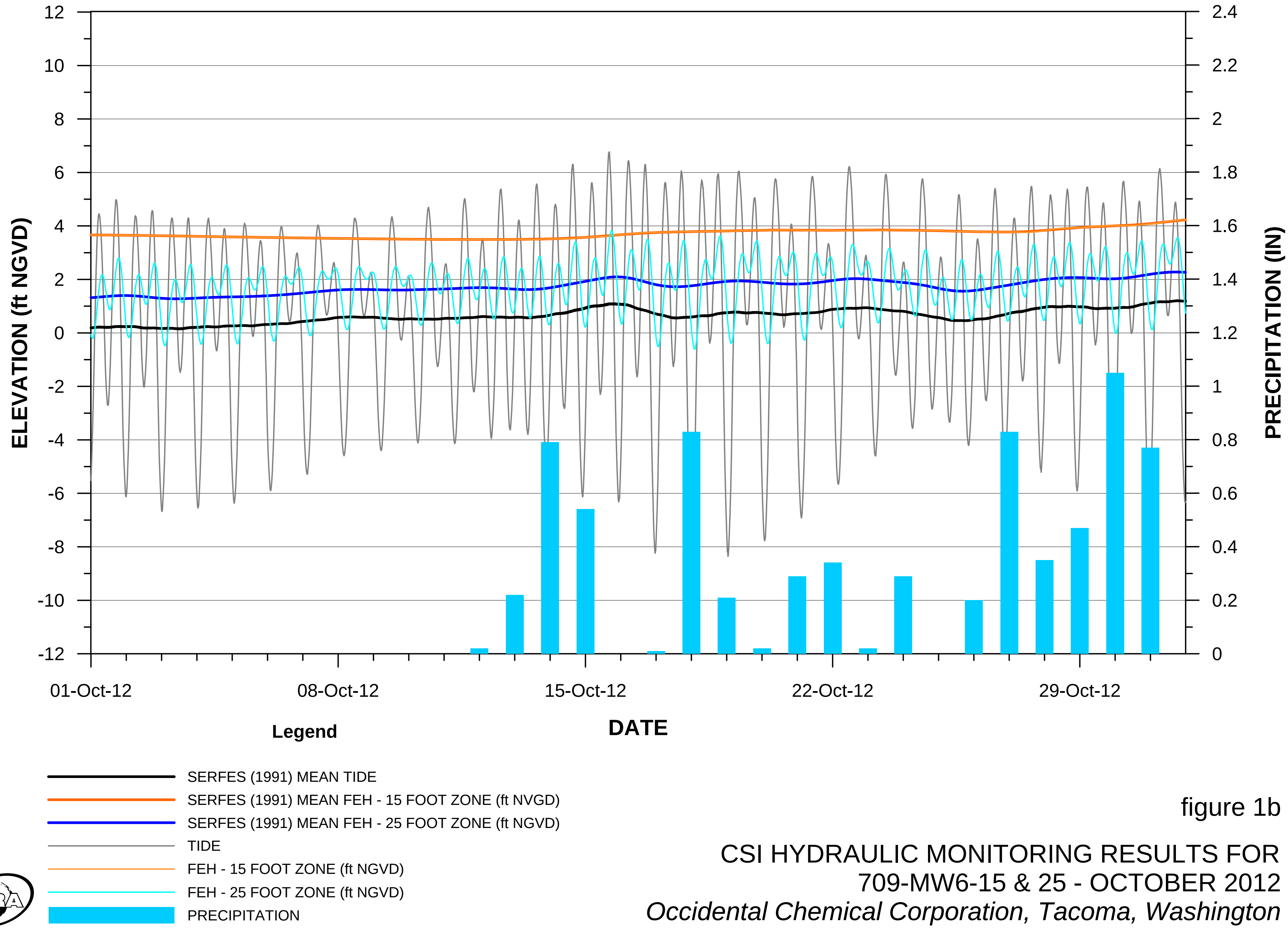


figure 1b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW6-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW6\07843-709-MW6-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

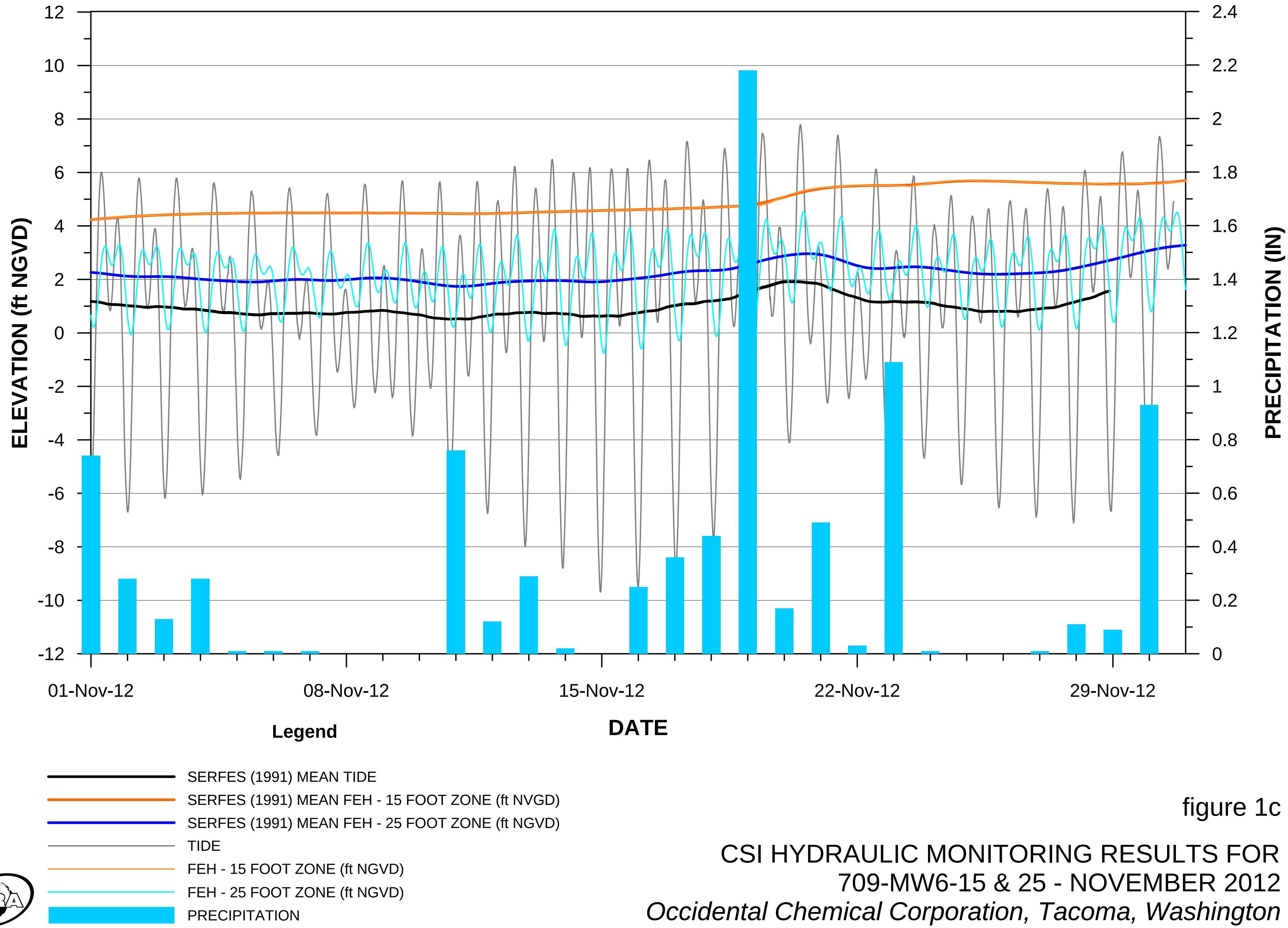


figure 1c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW6-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW6\07843-709-MW6-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

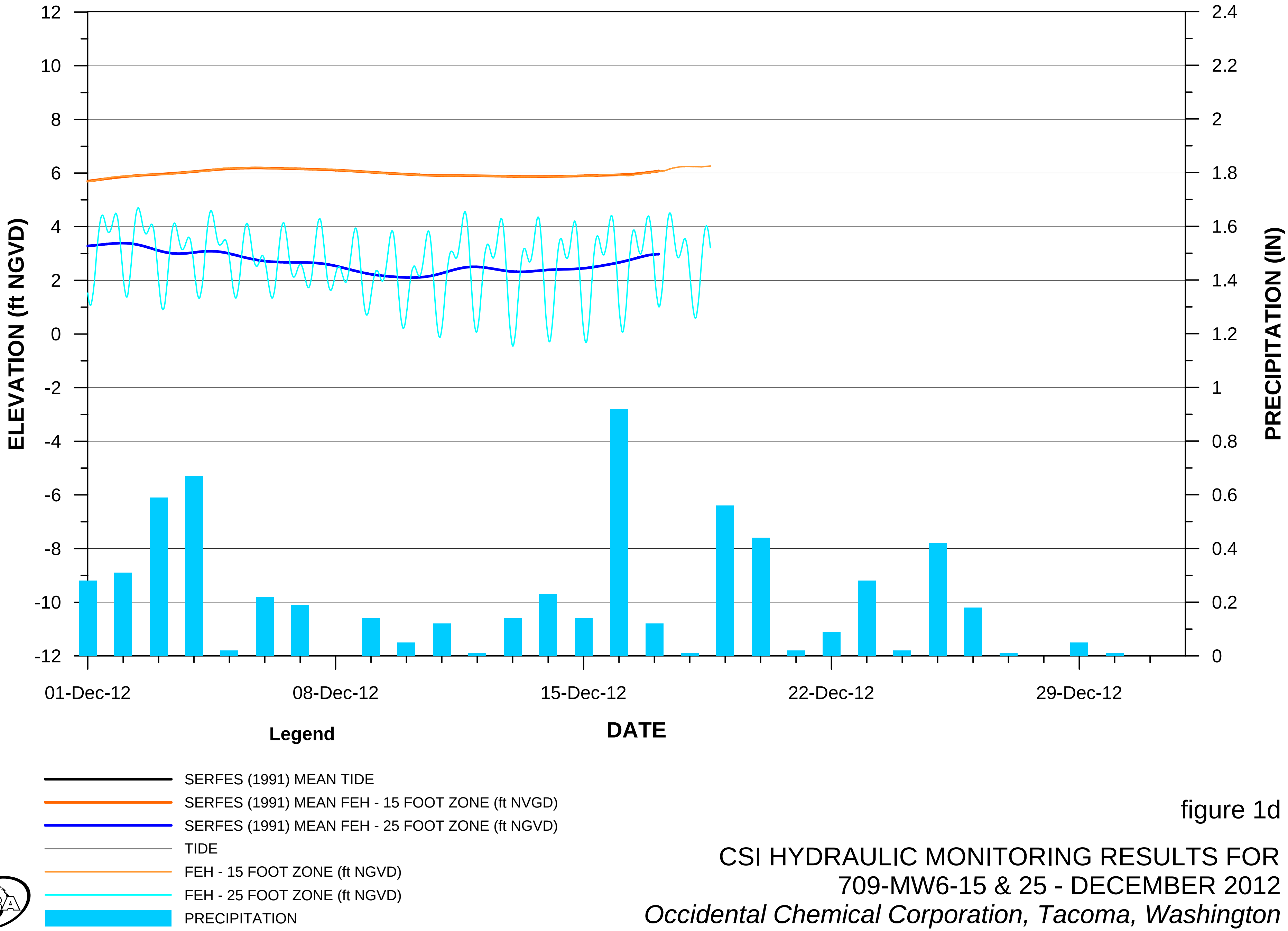


figure 1d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW6-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW6\07843-709-MW6-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

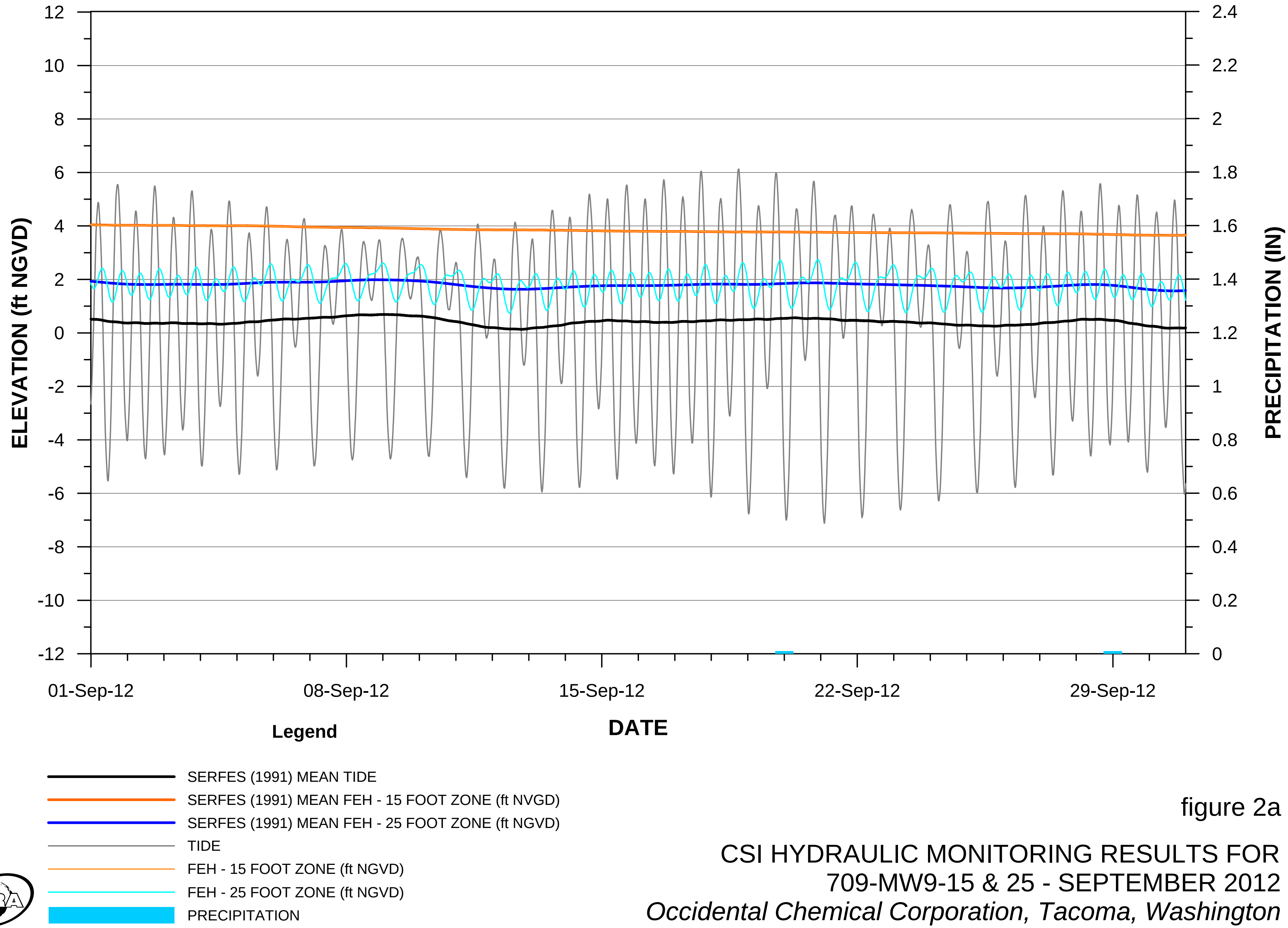
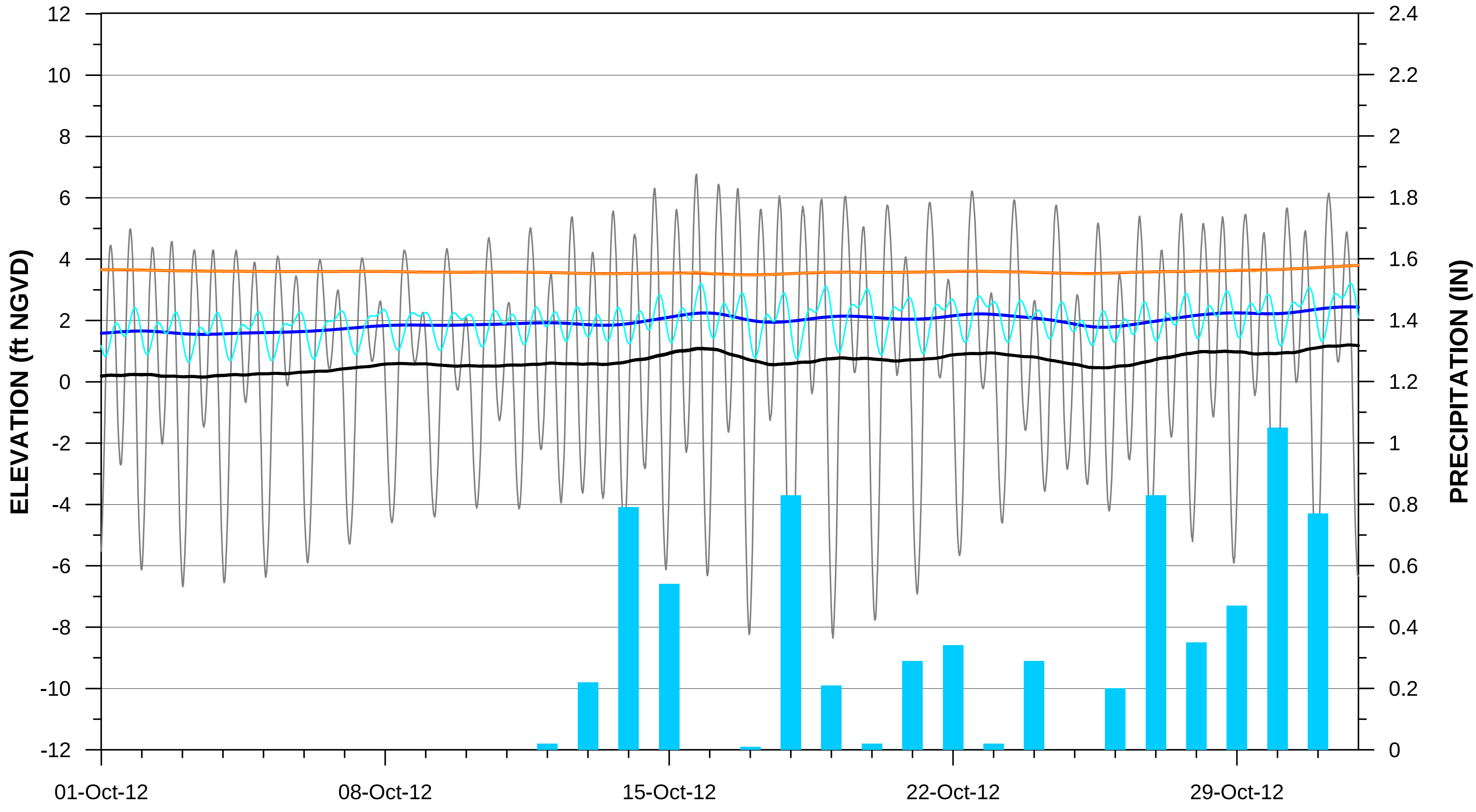


figure 2a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW9-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington



Legend

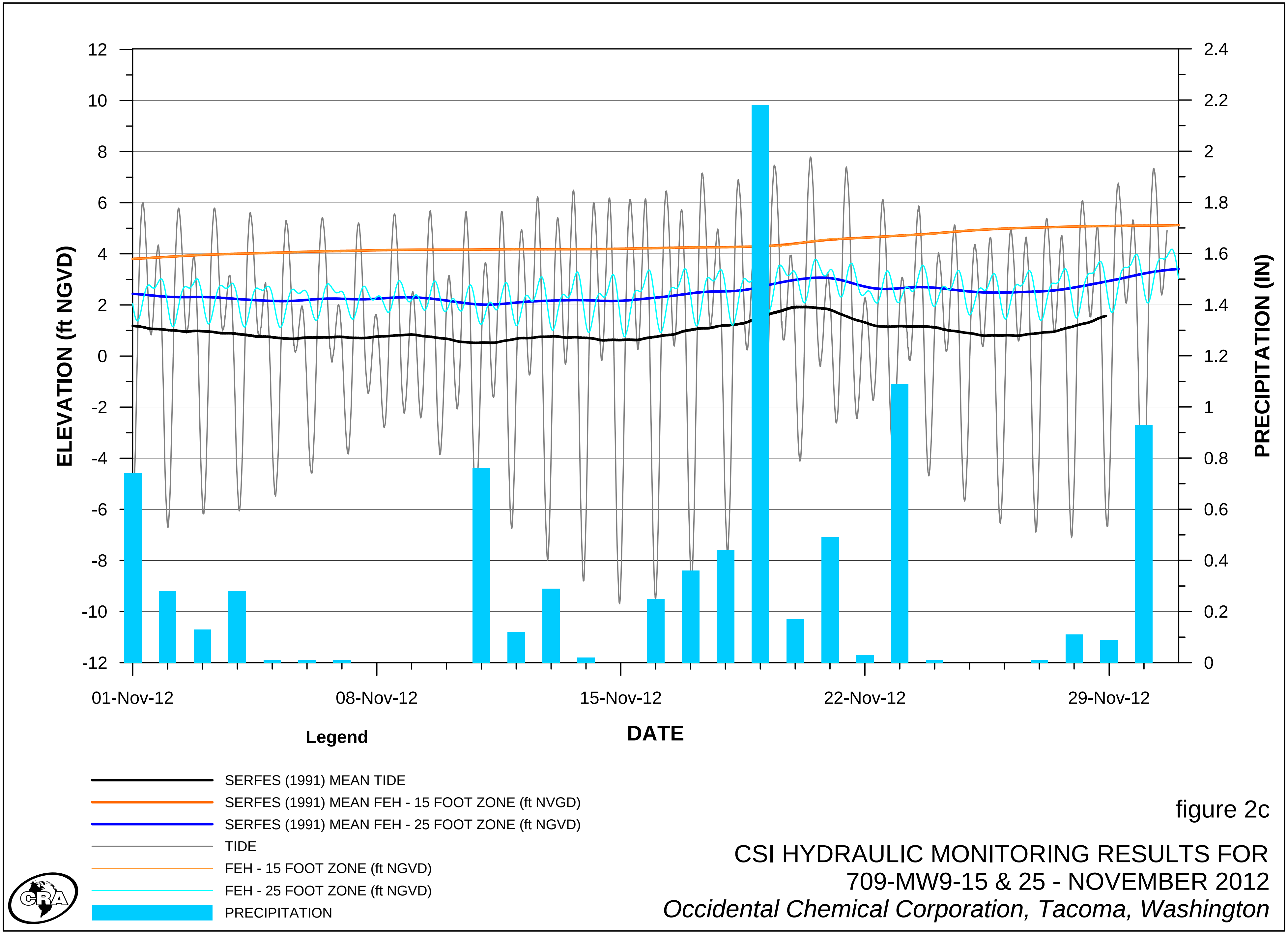
SERFES (1991) MEAN TIDE
SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
TIDE
FEH - 15 FOOT ZONE (ft NGVD)
FEH - 25 FOOT ZONE (ft NGVD)
PRECIPITATION

figure 2b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW9-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

CRA

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW9\07843-709-MW9-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014


ELEVATION (ft NGVD)
PRECIPITATION (IN)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01-Nov-12
08-Nov-12
15-Nov-12
22-Nov-12
29-Nov-12
DATE
Legend
SERFES (1991) MEAN TIDE
SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
TIDE
FEH - 15 FOOT ZONE (ft NGVD)
FEH - 25 FOOT ZONE (ft NGVD)
PRECIPITATION
CRA
figure 2c
CSI HYDRAULIC MONITORING RESULTS FOR
709-MW9-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

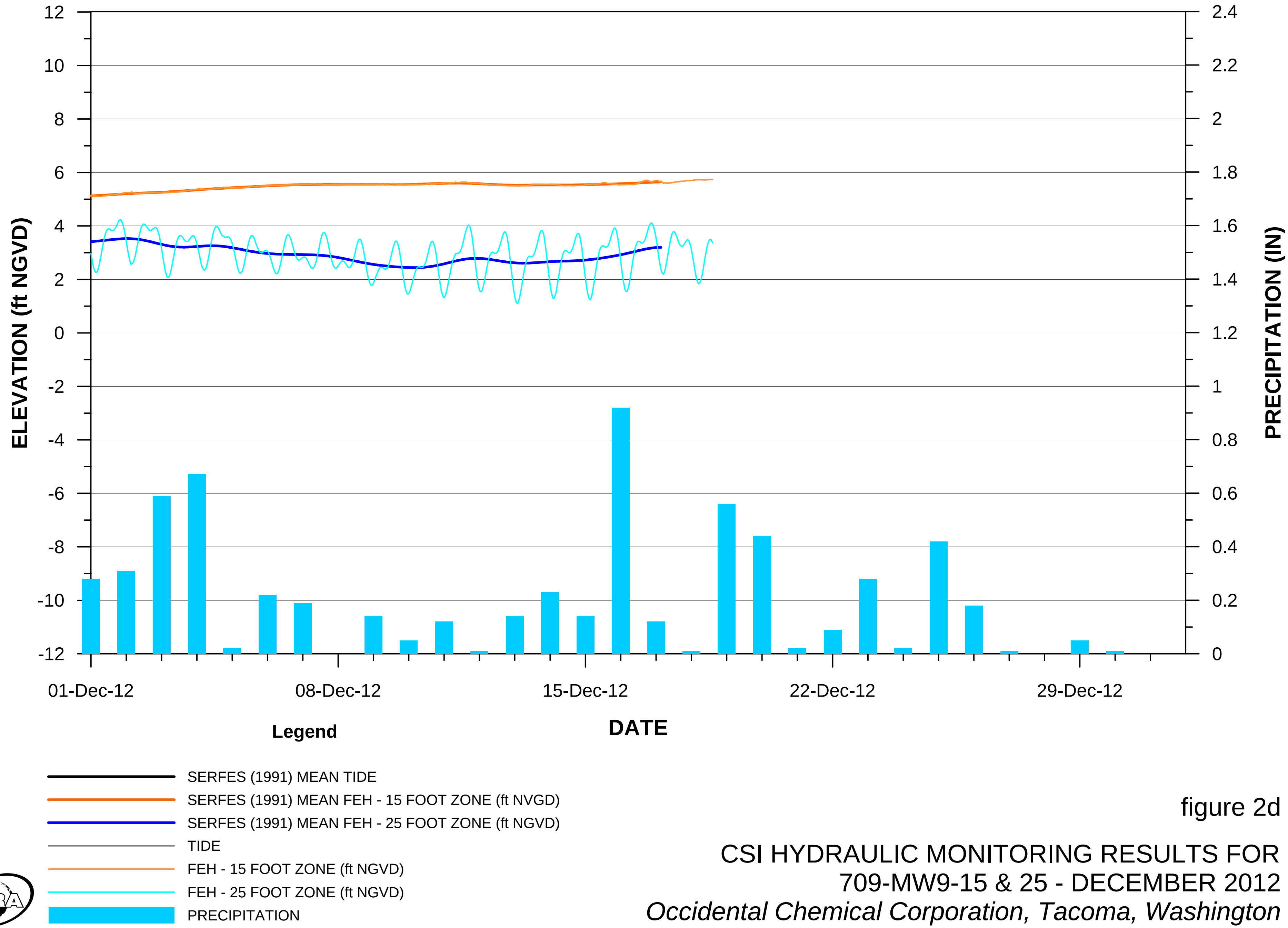


figure 2d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW9-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW9\07843-709-MW9-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

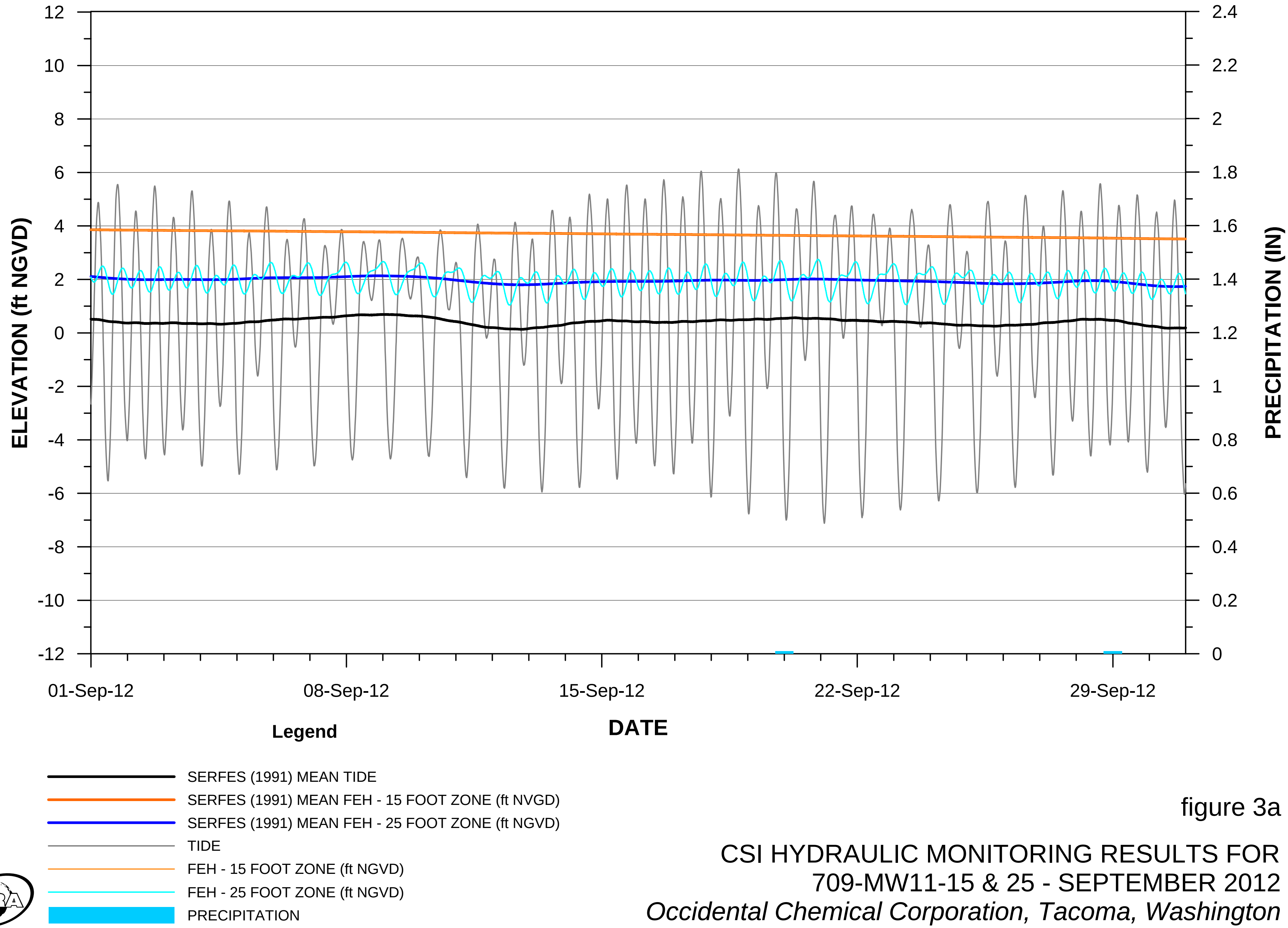


figure 3a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW11-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW11\07843-709-MW11-15 & 25 Foot Zones HydrographsSeptember 2012.grf) AUG 5/2014

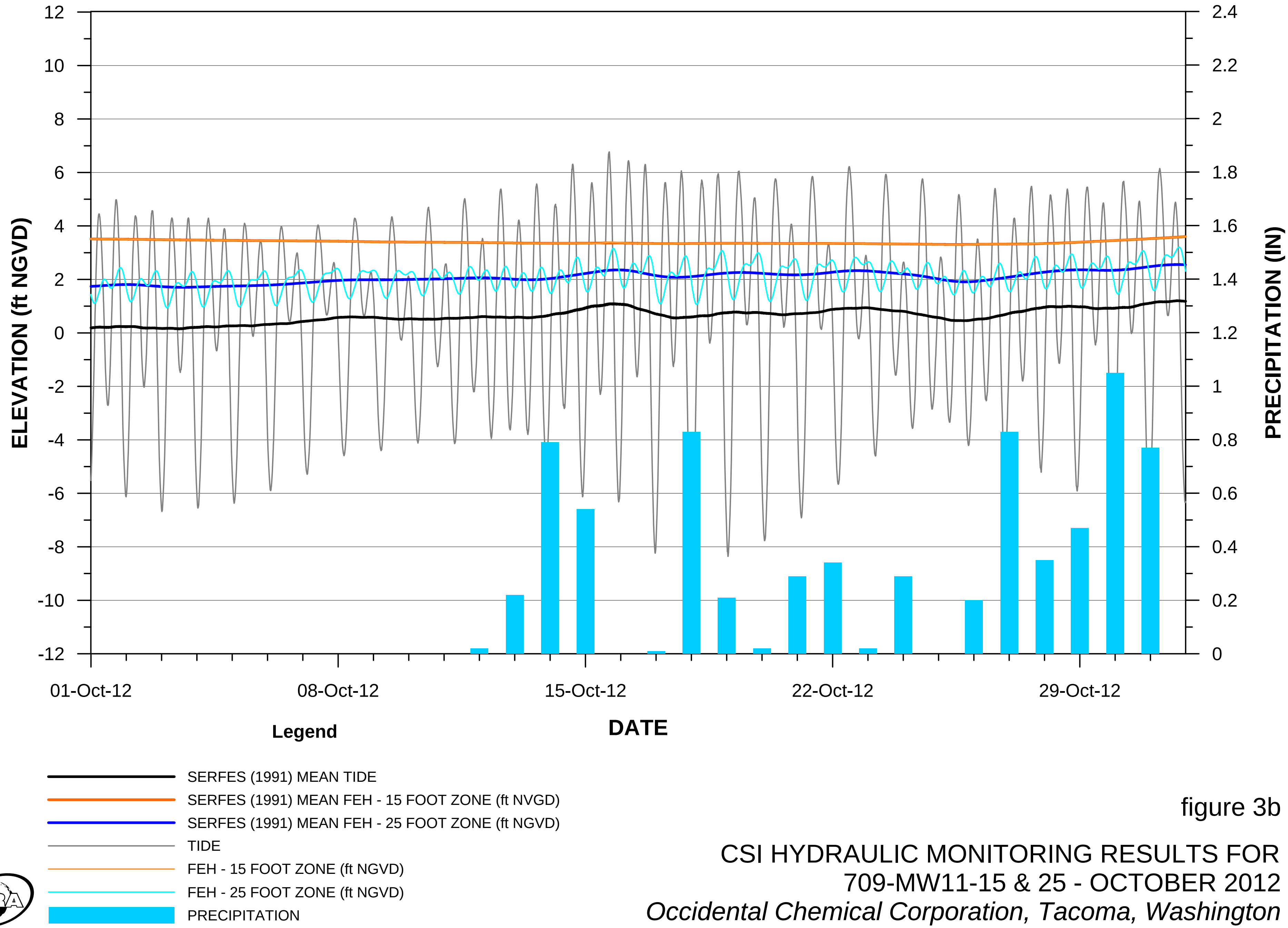


figure 3b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW11-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW11\07843-709-MW11-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

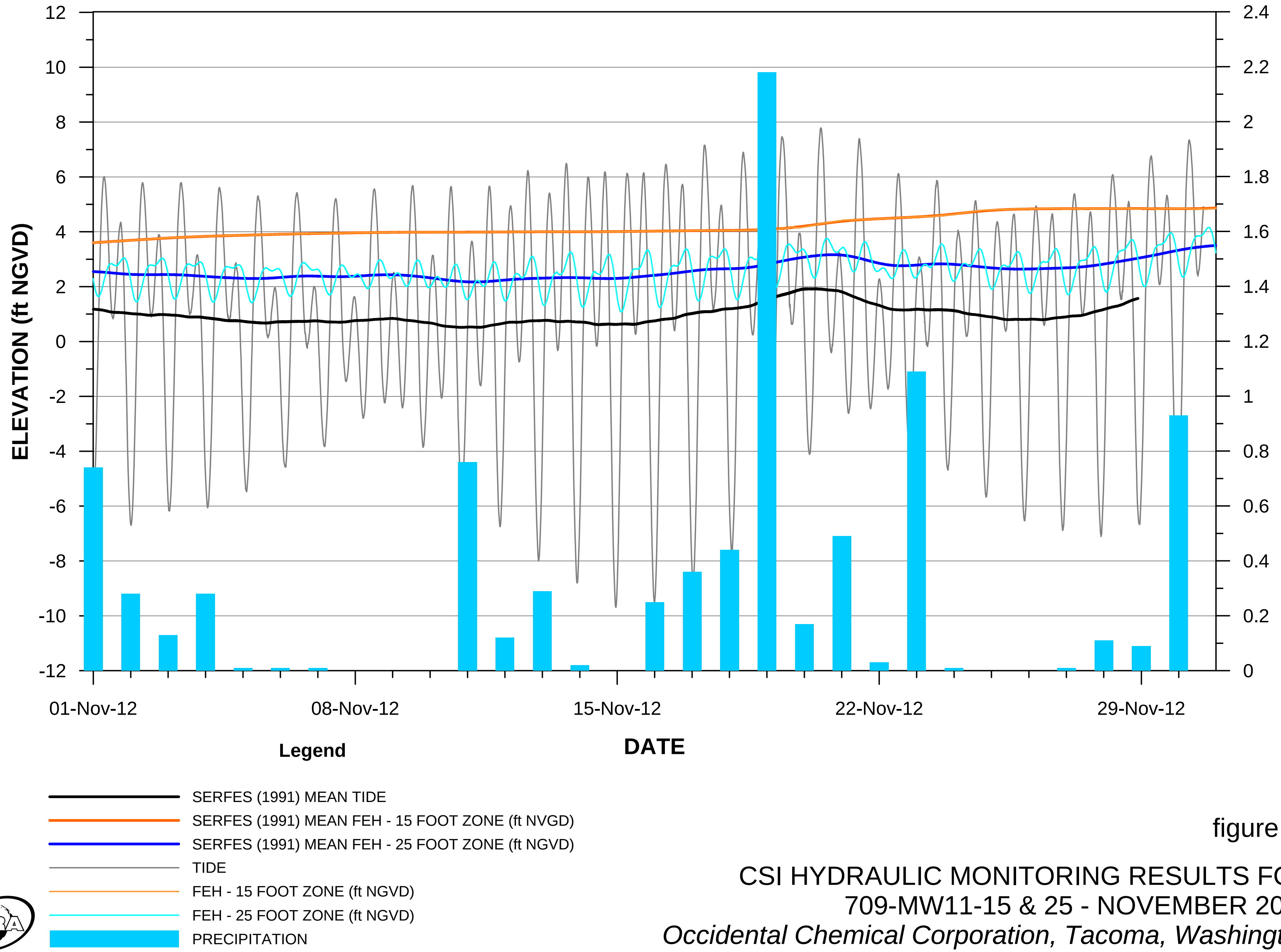


figure 3c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW11-15 & 25 - NOVEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW11\07843-709-MW11-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

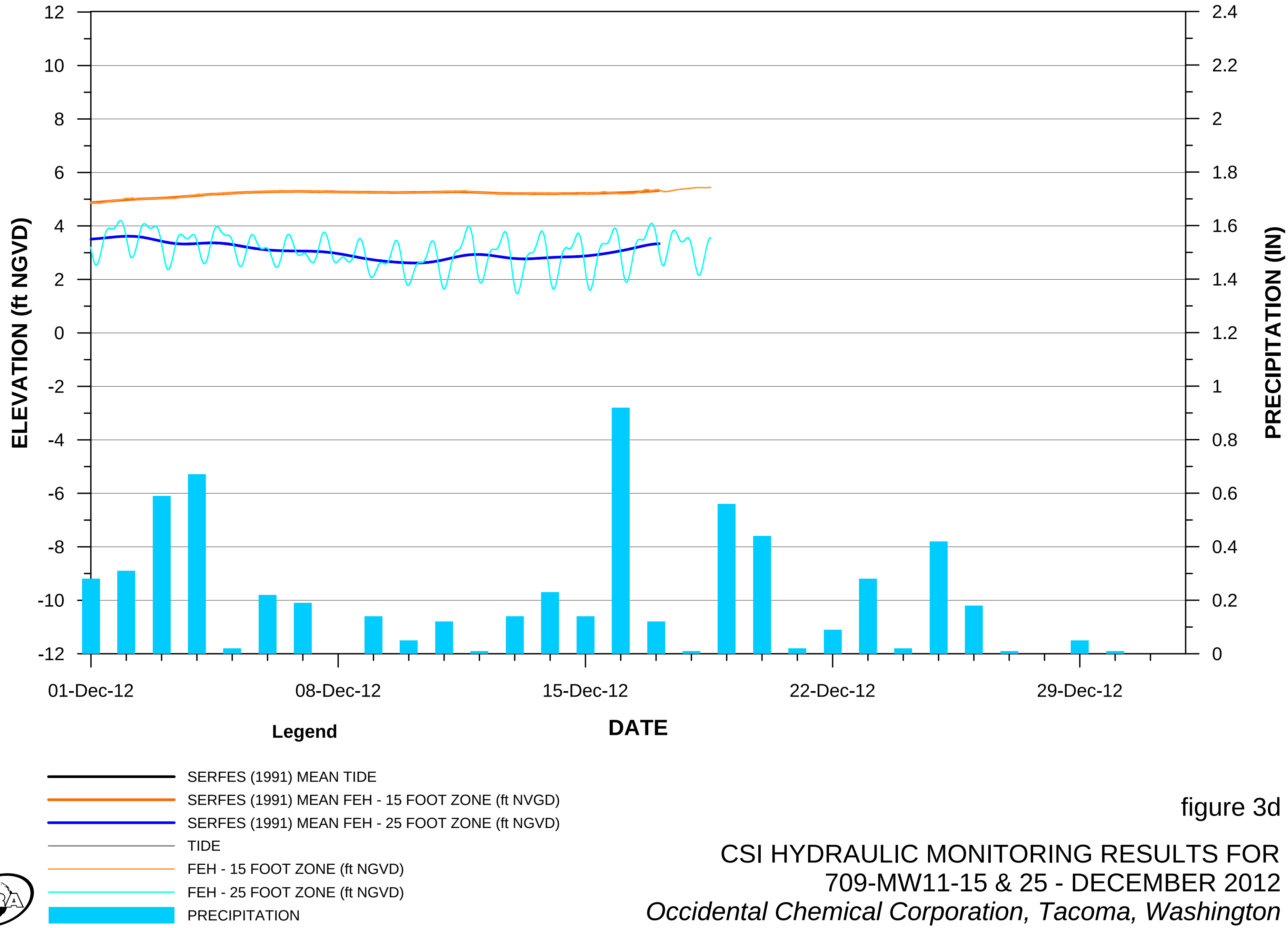


figure 3d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW11-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW11\07843-709-MW11-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

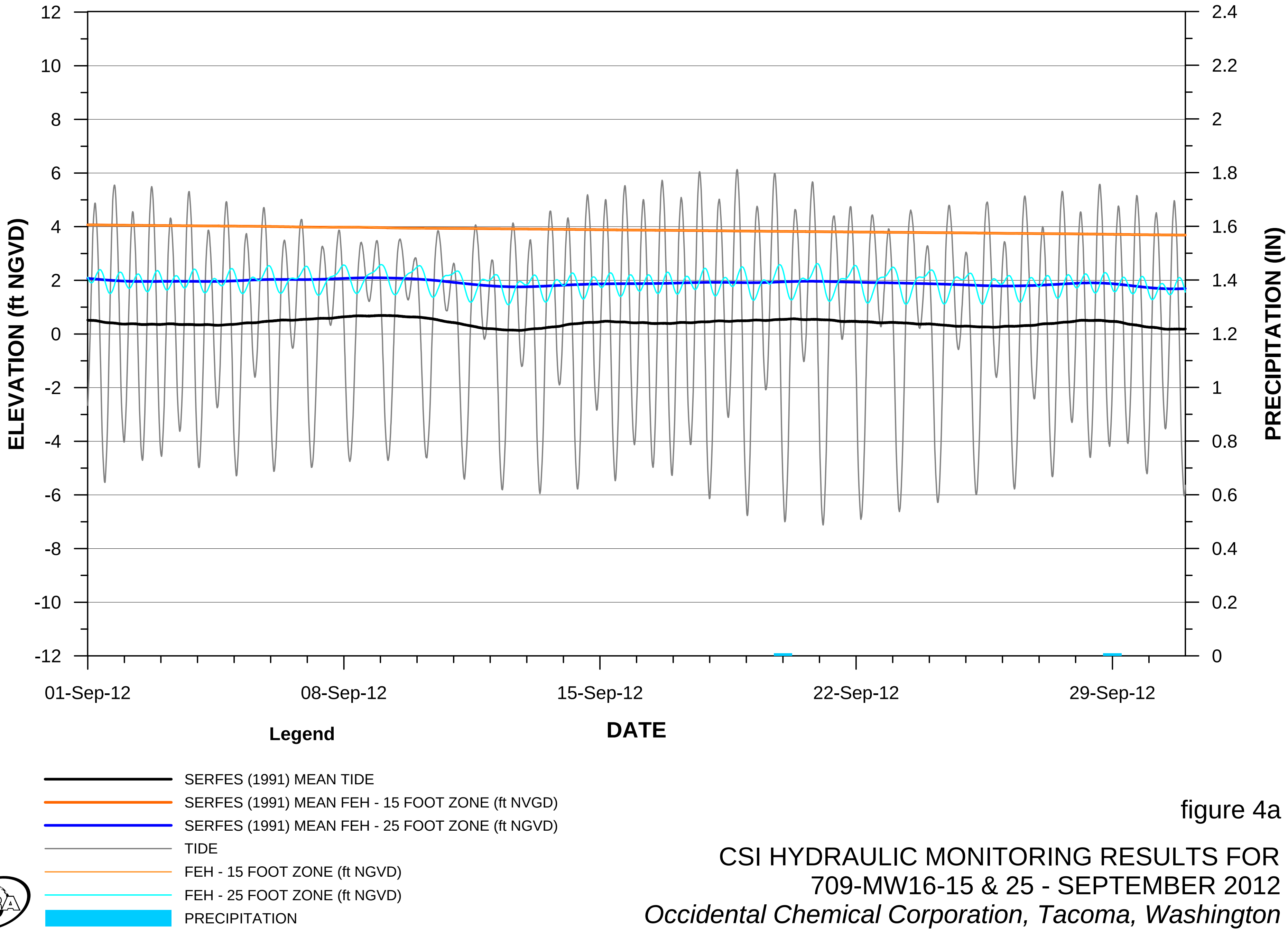


figure 4a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW16-15 & 25 - SEPTEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW16\07843-709-MW16-15 & 25 Foot Zones HydrographsSeptember 2012.grf) AUG 5/2014

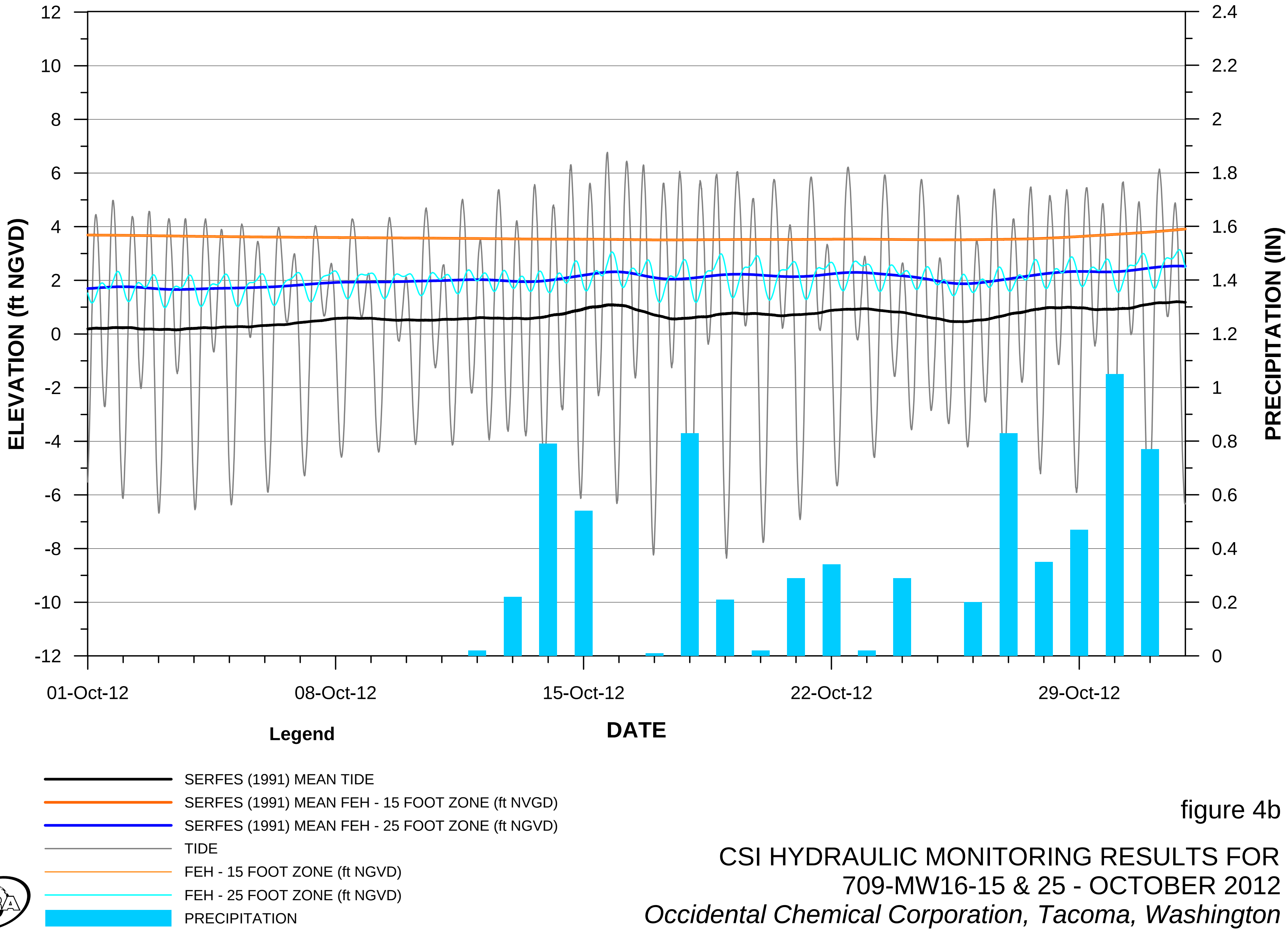


figure 4b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW16-15 & 25 - OCTOBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW16\07843-709-MW16-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

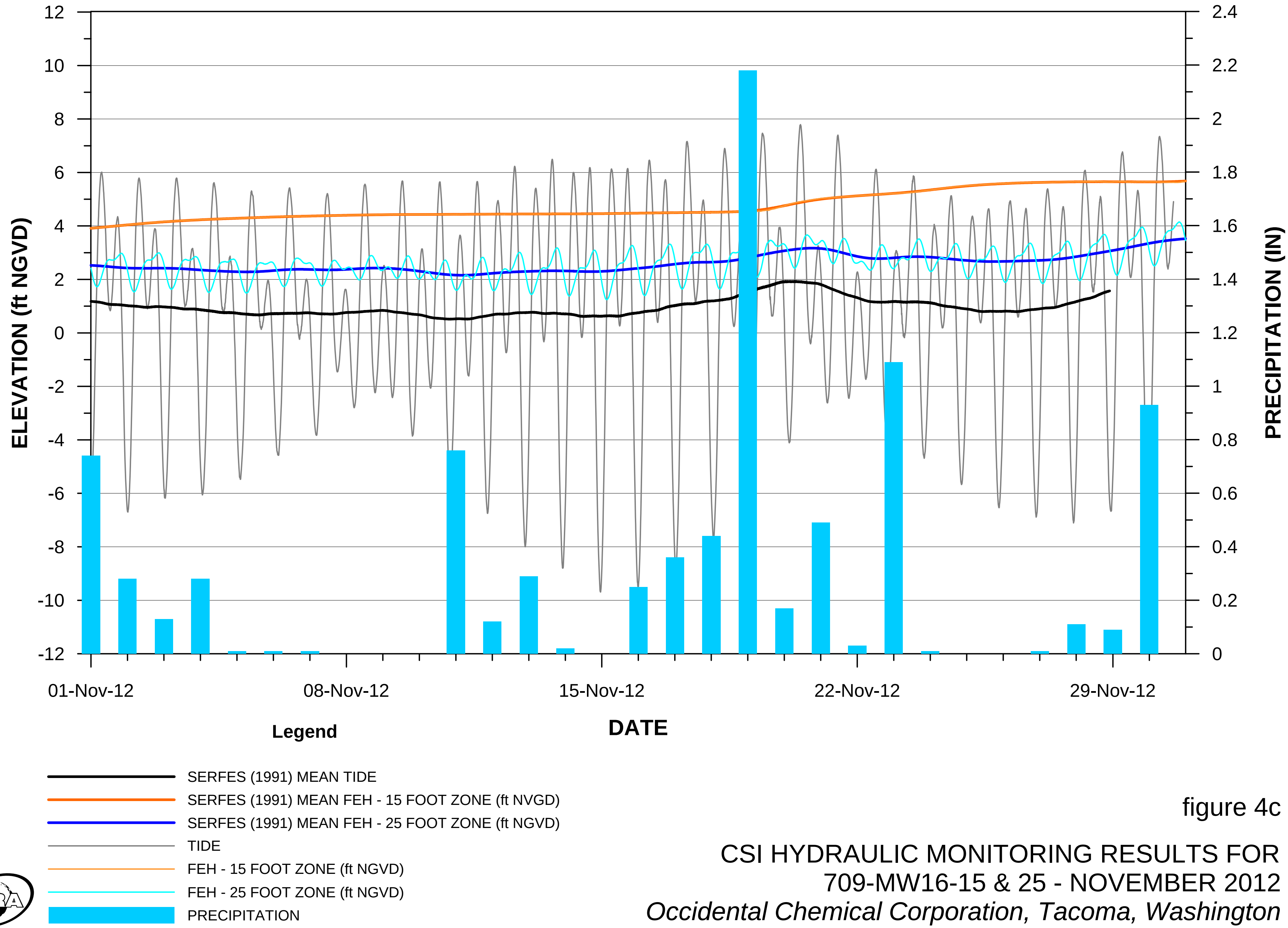


figure 4c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW16-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

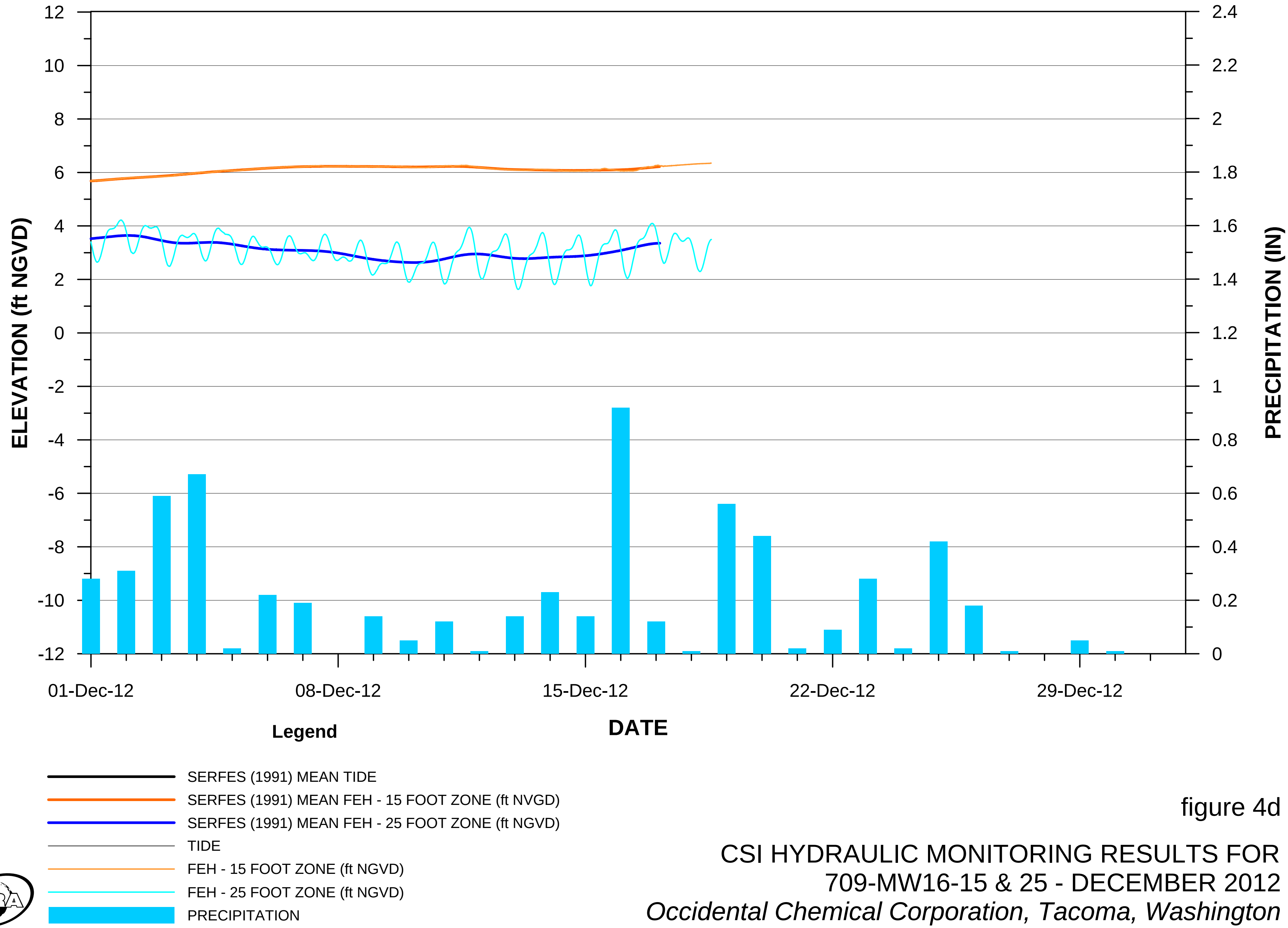


figure 4d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW16-15 & 25 - DECEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW16\07843-709-MW16-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

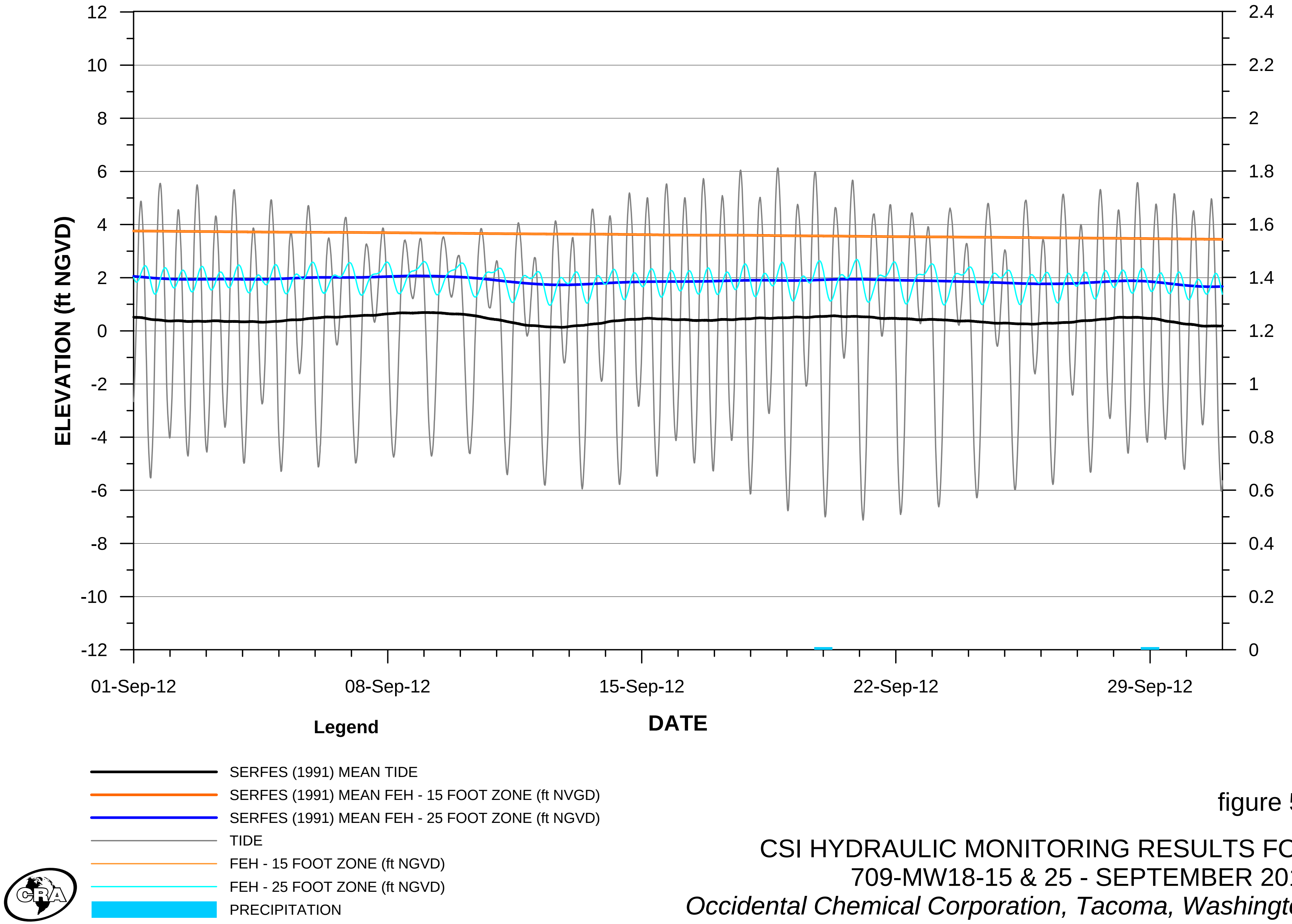


figure 5a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW18-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW18\07843-709-MW18-15 & 25 Foot Zones HydrographsSeptember 2012.grf) AUG 5/2014

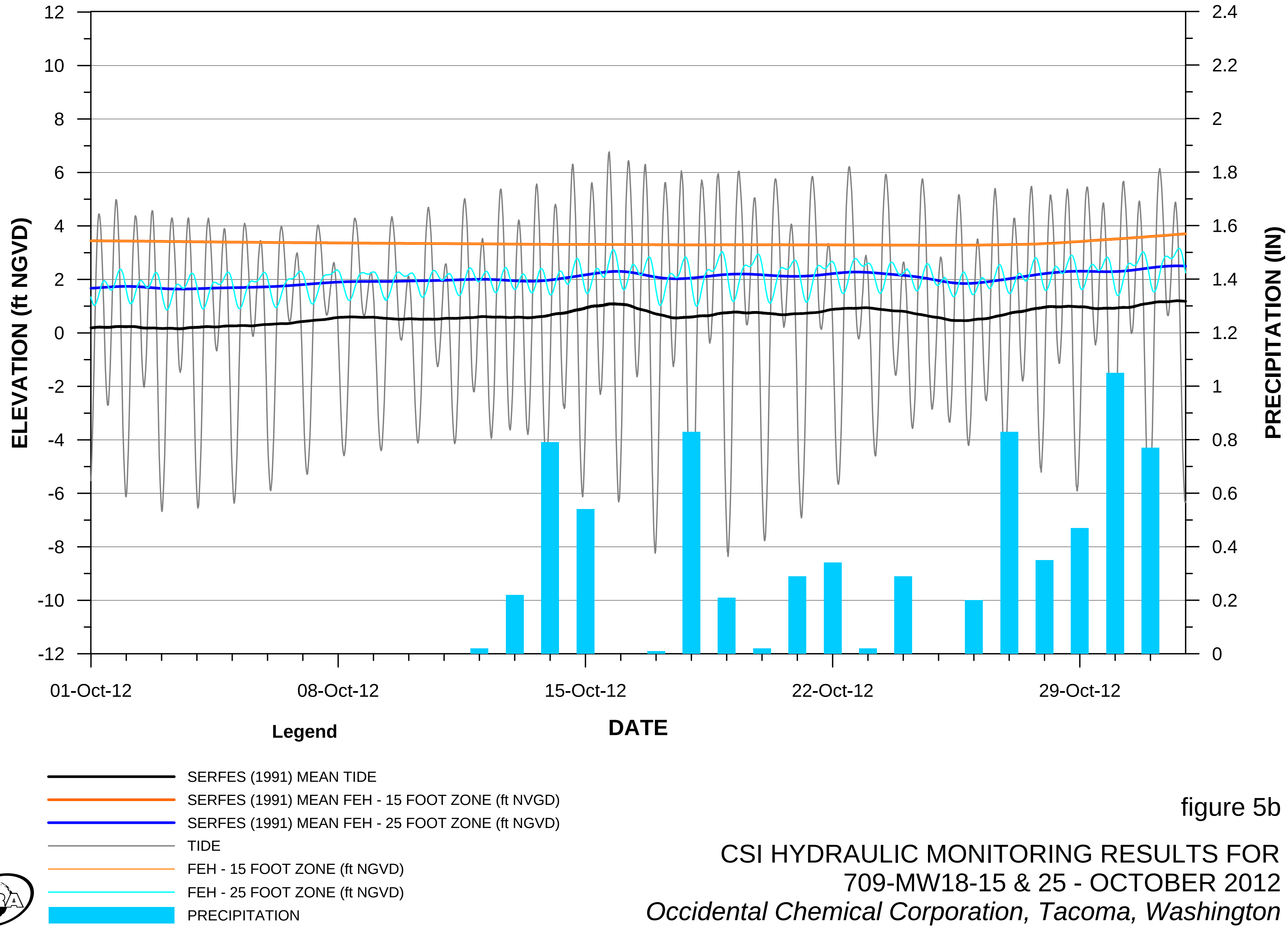
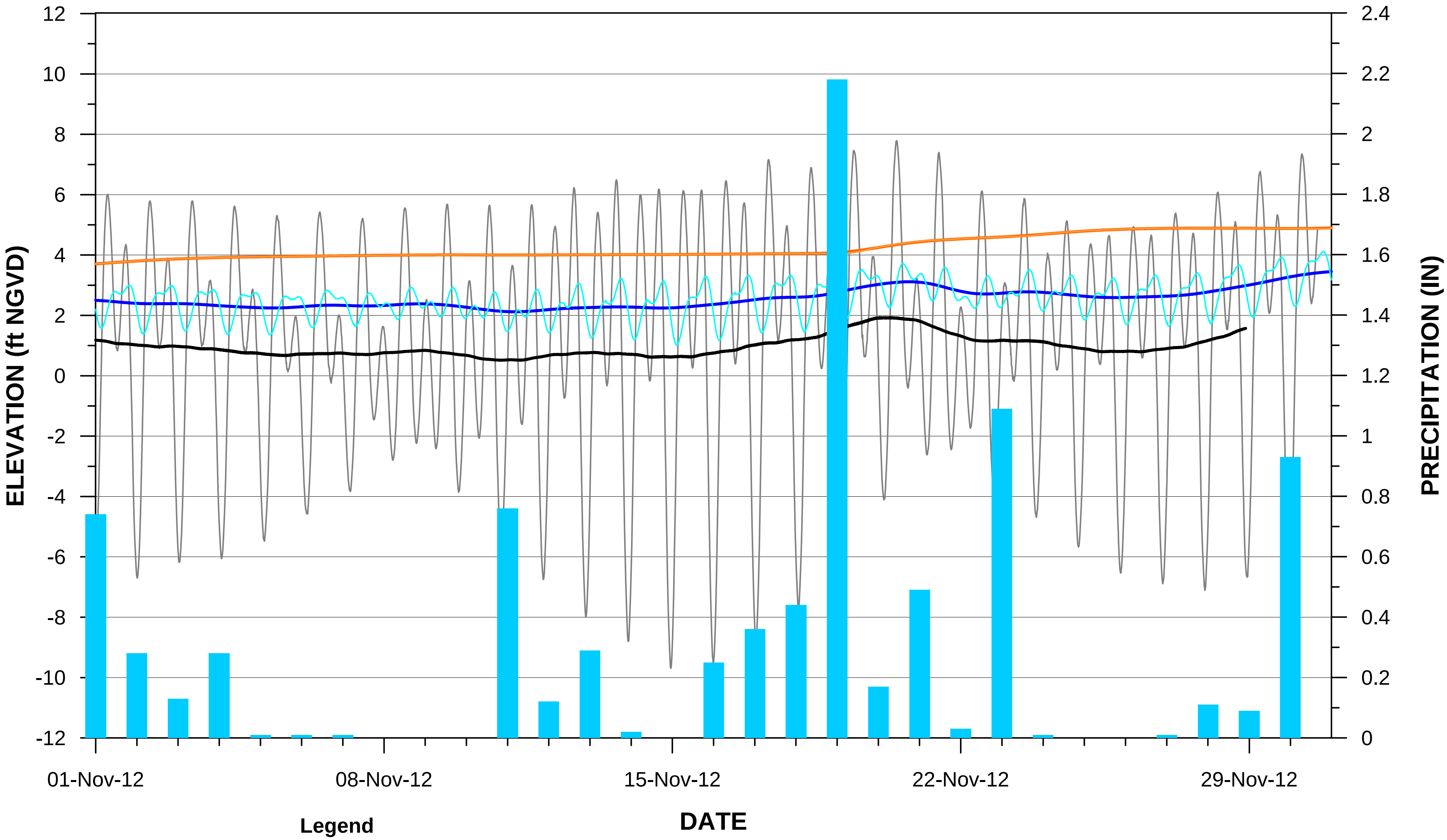


figure 5b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW18-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington



Legend

SERFES (1991) MEAN TIDE
SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
TIDE
FEH - 15 FOOT ZONE (ft NGVD)
FEH - 25 FOOT ZONE (ft NGVD)
PRECIPITATION

figure 5c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW18-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

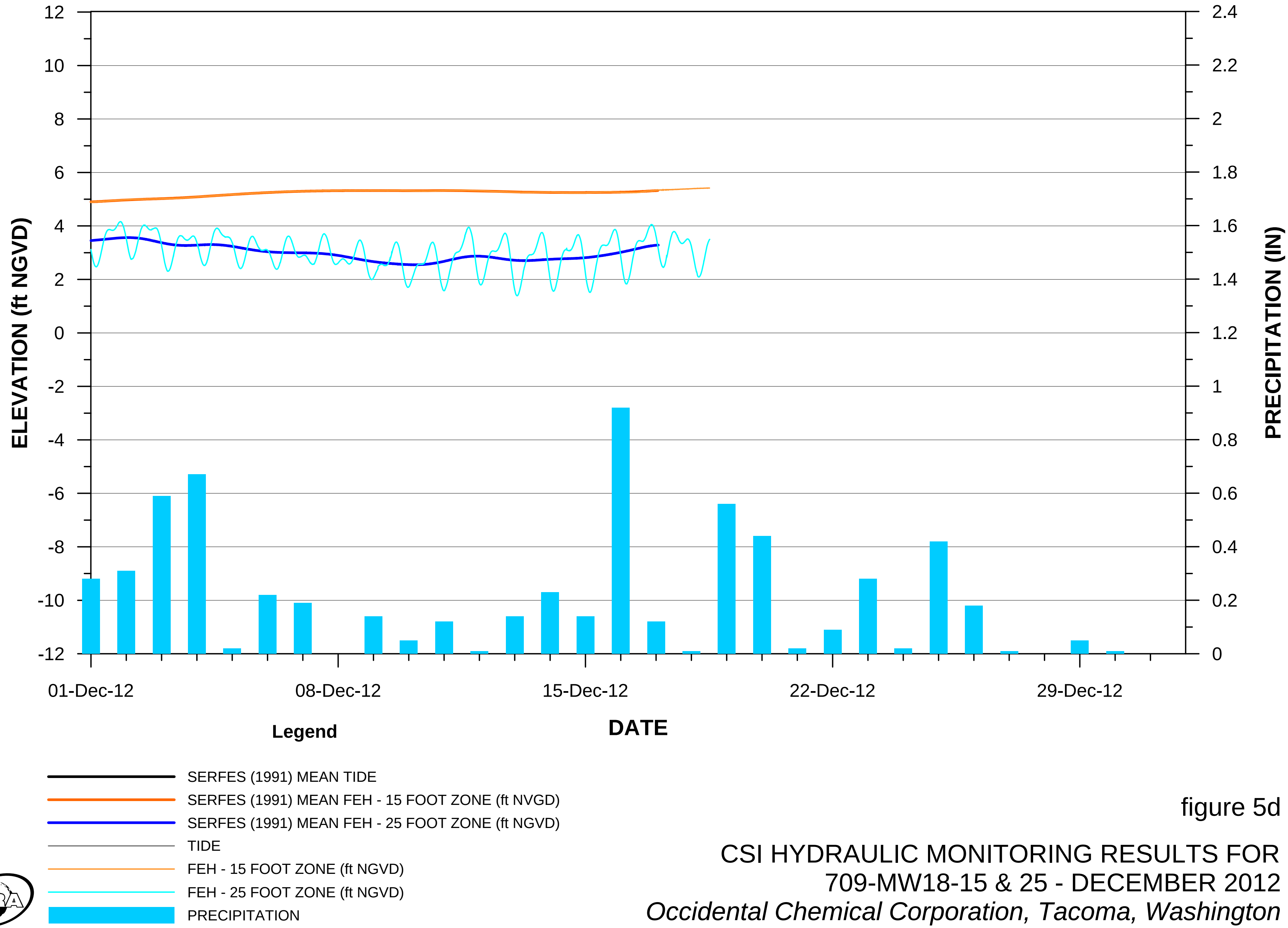


figure 5d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW18-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

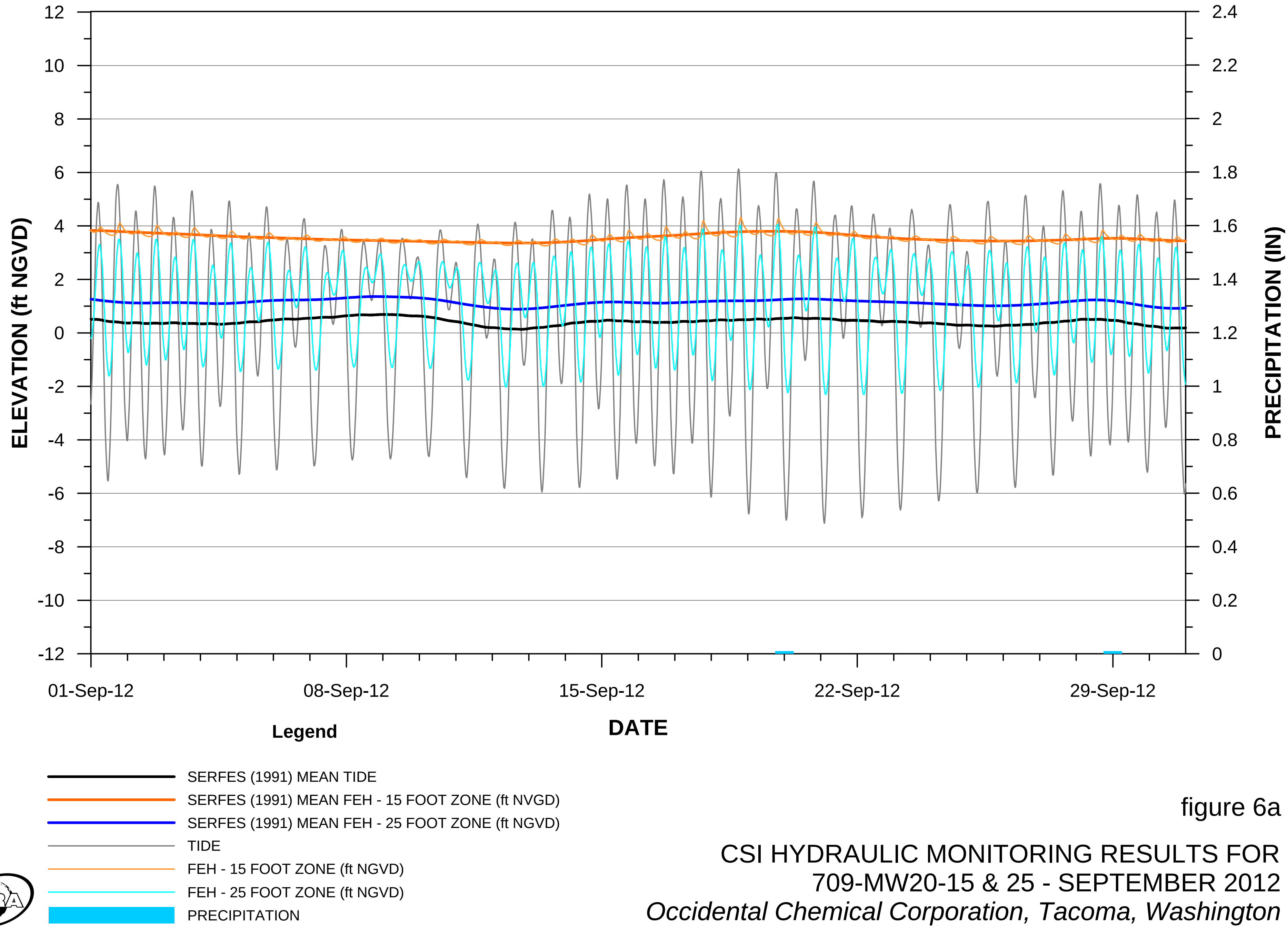
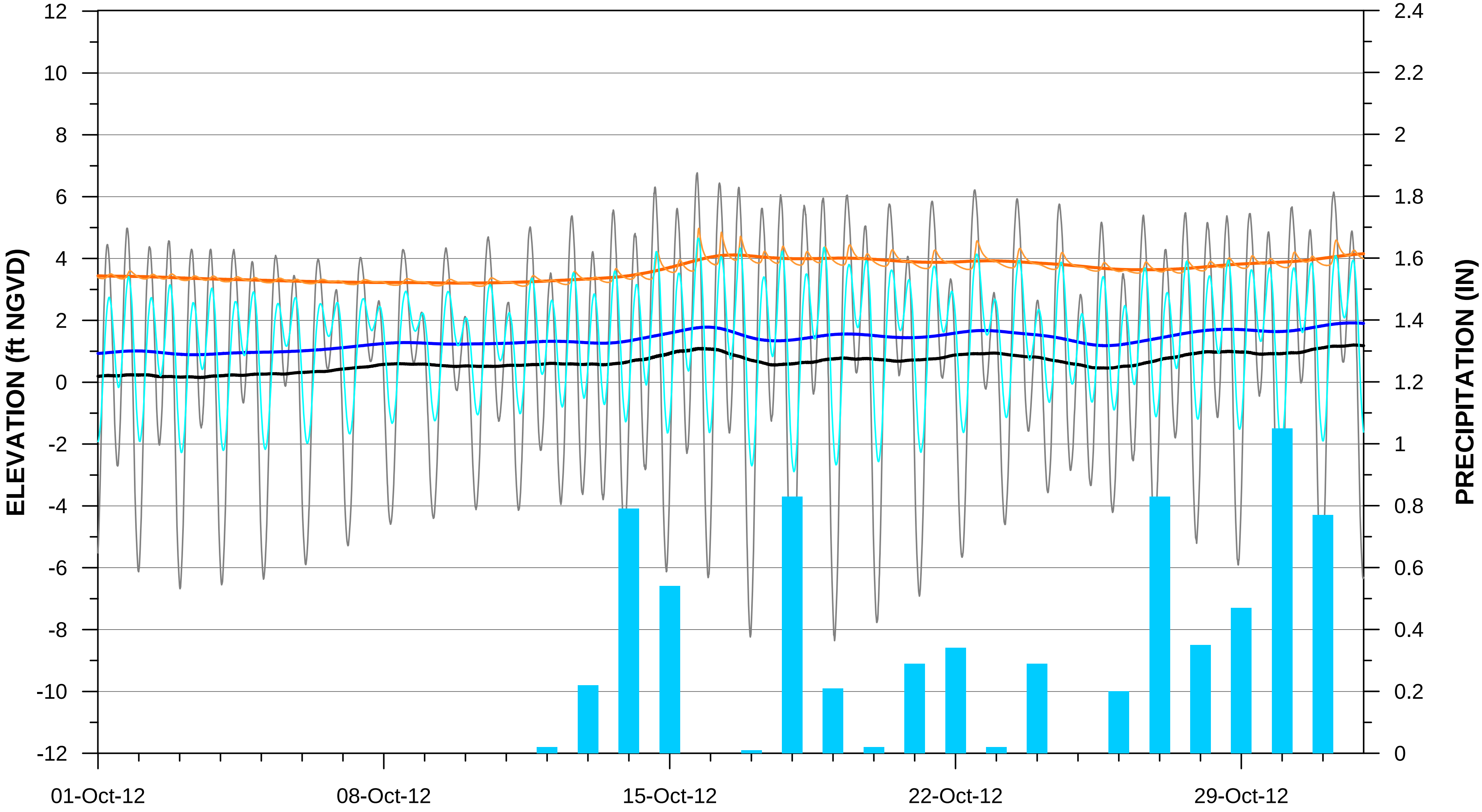


figure 6a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW20-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW20\07843-709-MW20-15 & 25 Foot Zones HydrographsSeptember 2012.grf) AUG 5/2014



Legend

SERFES (1991) MEAN TIDE
SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
TIDE
FEH - 15 FOOT ZONE (ft NGVD)
FEH - 25 FOOT ZONE (ft NGVD)
PRECIPITATION

figure 6b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW20-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW20\07843-709-MW20-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

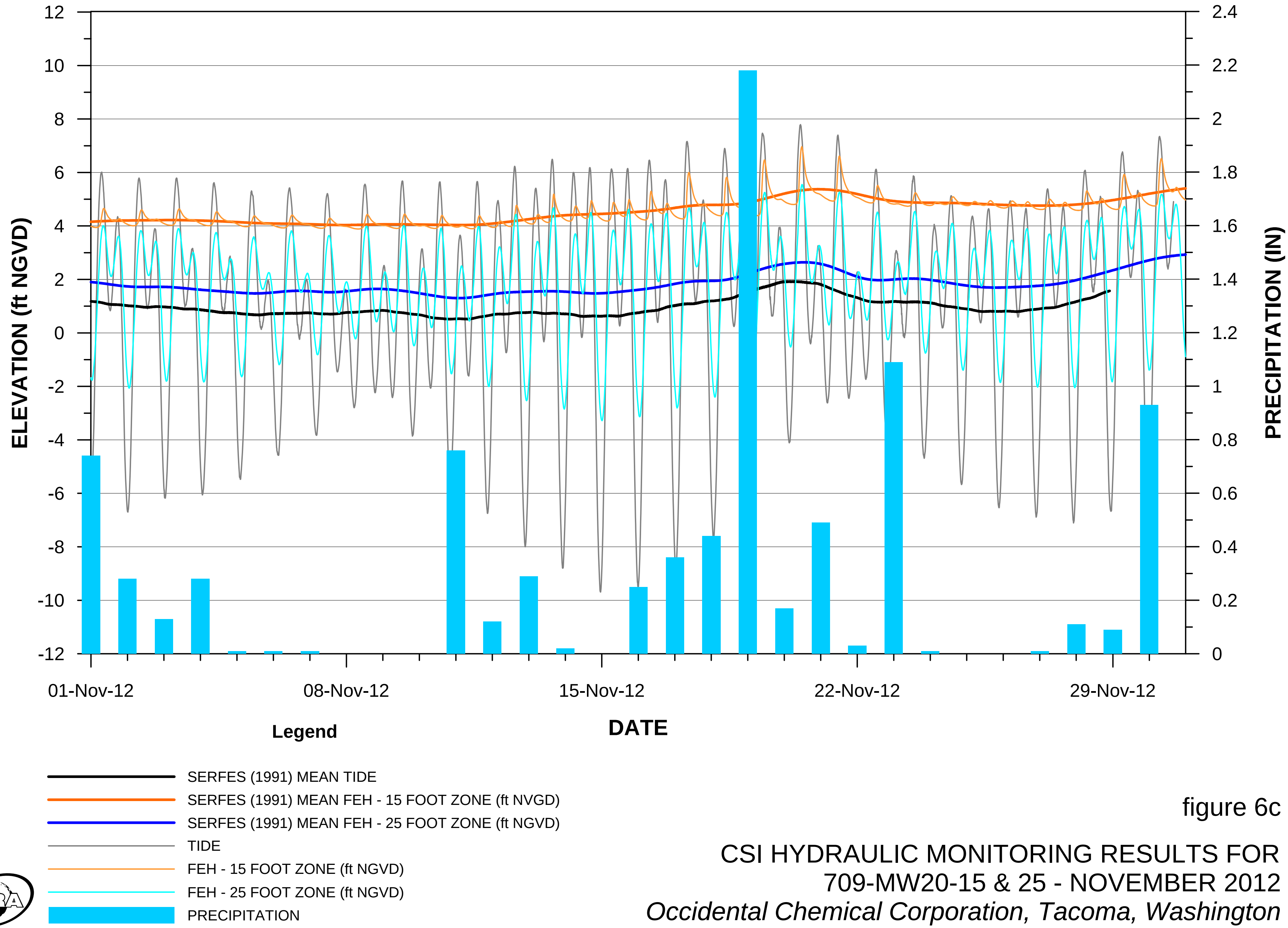


figure 6c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW20-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW20\07843-709-MW20-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

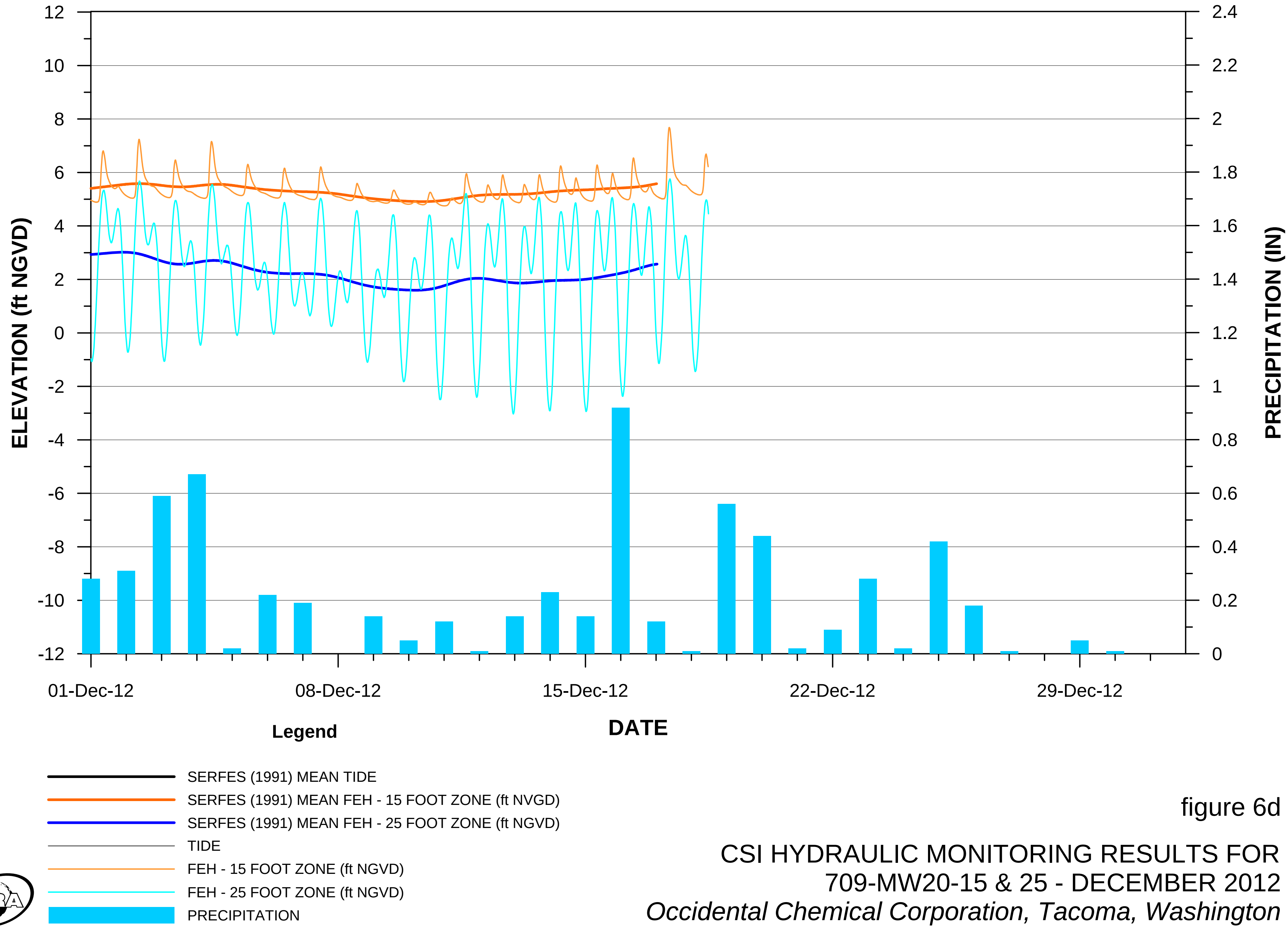


figure 6d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW20-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW20\07843-709-MW20-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

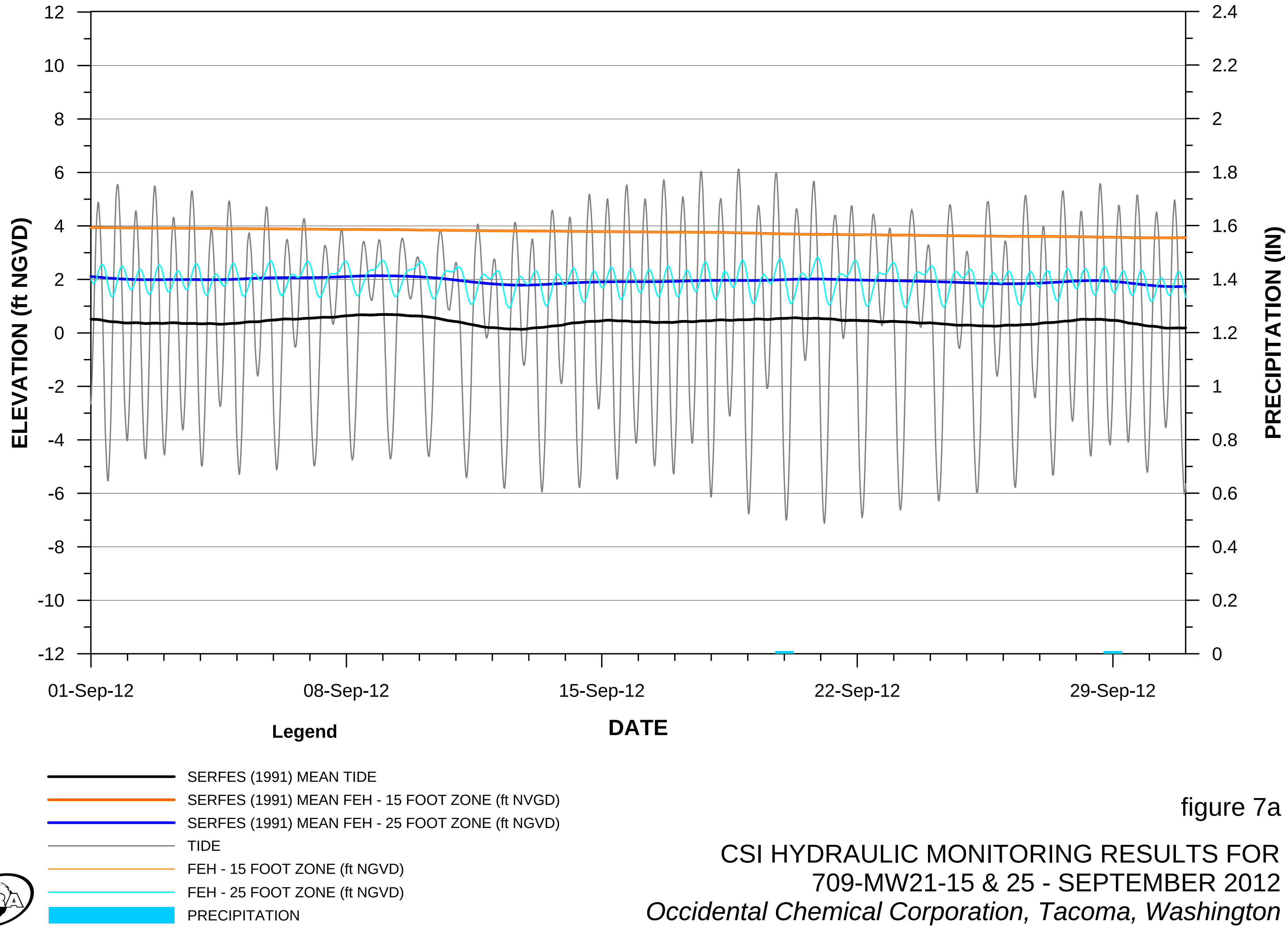
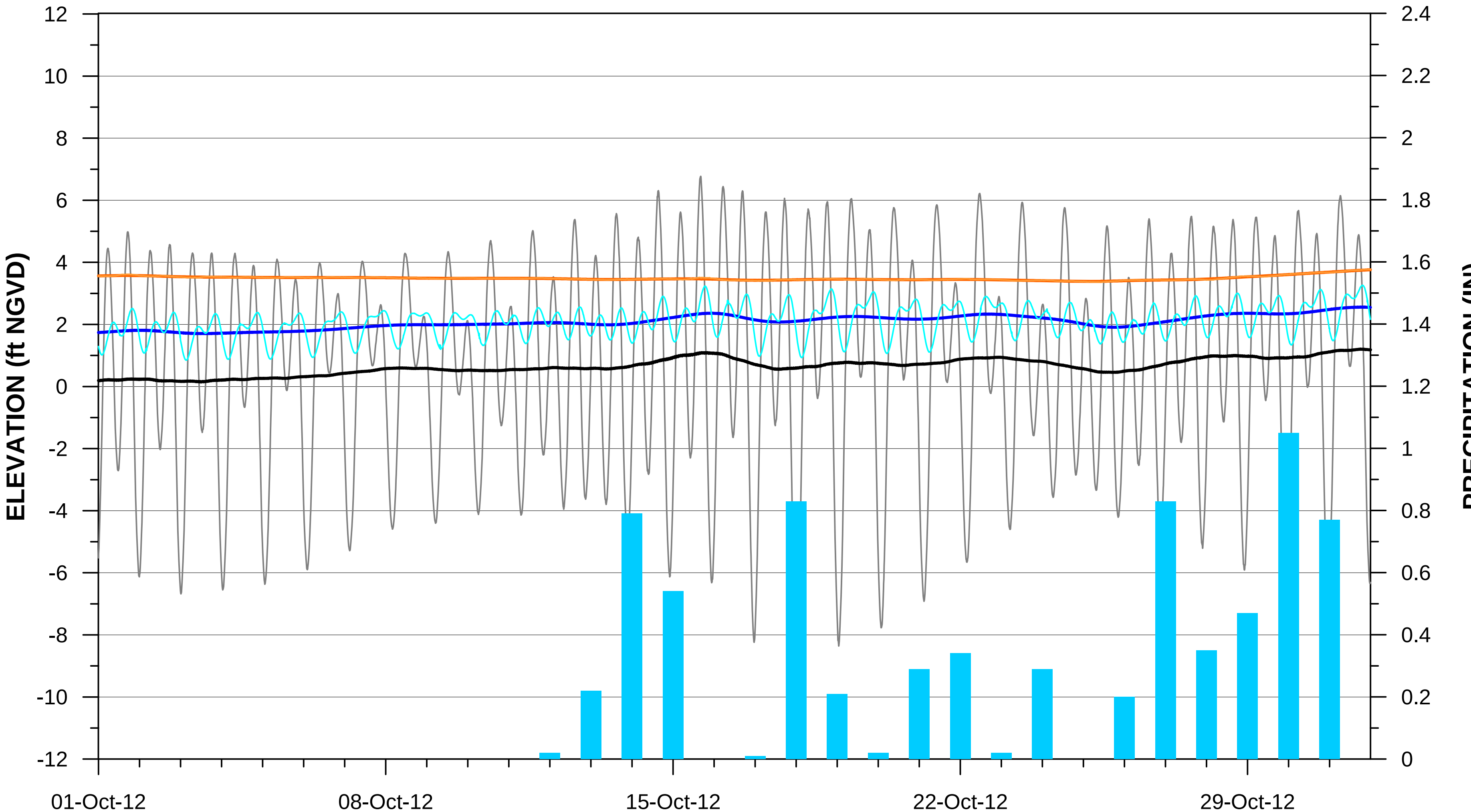


figure 7a

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW21-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington



Legend

- SERFES (1991) MEAN TIDE
- SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
- SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
- TIDE
- FEH - 15 FOOT ZONE (ft NGVD)
- FEH - 25 FOOT ZONE (ft NGVD)
- PRECIPITATION

figure 7b

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW21-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW21\07843-709-MW21-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

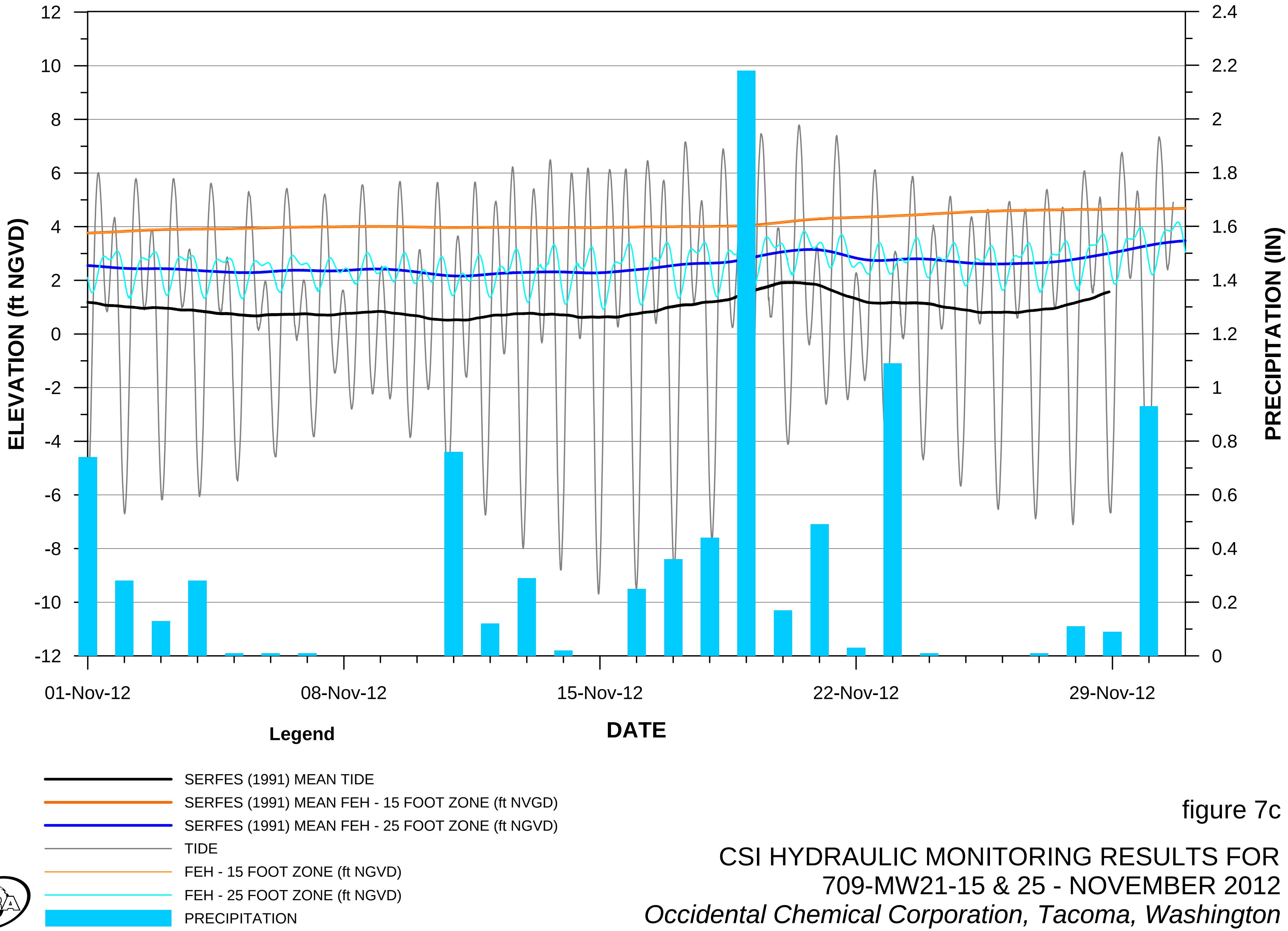


figure 7c

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW21-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW21\07843-709-MW21-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

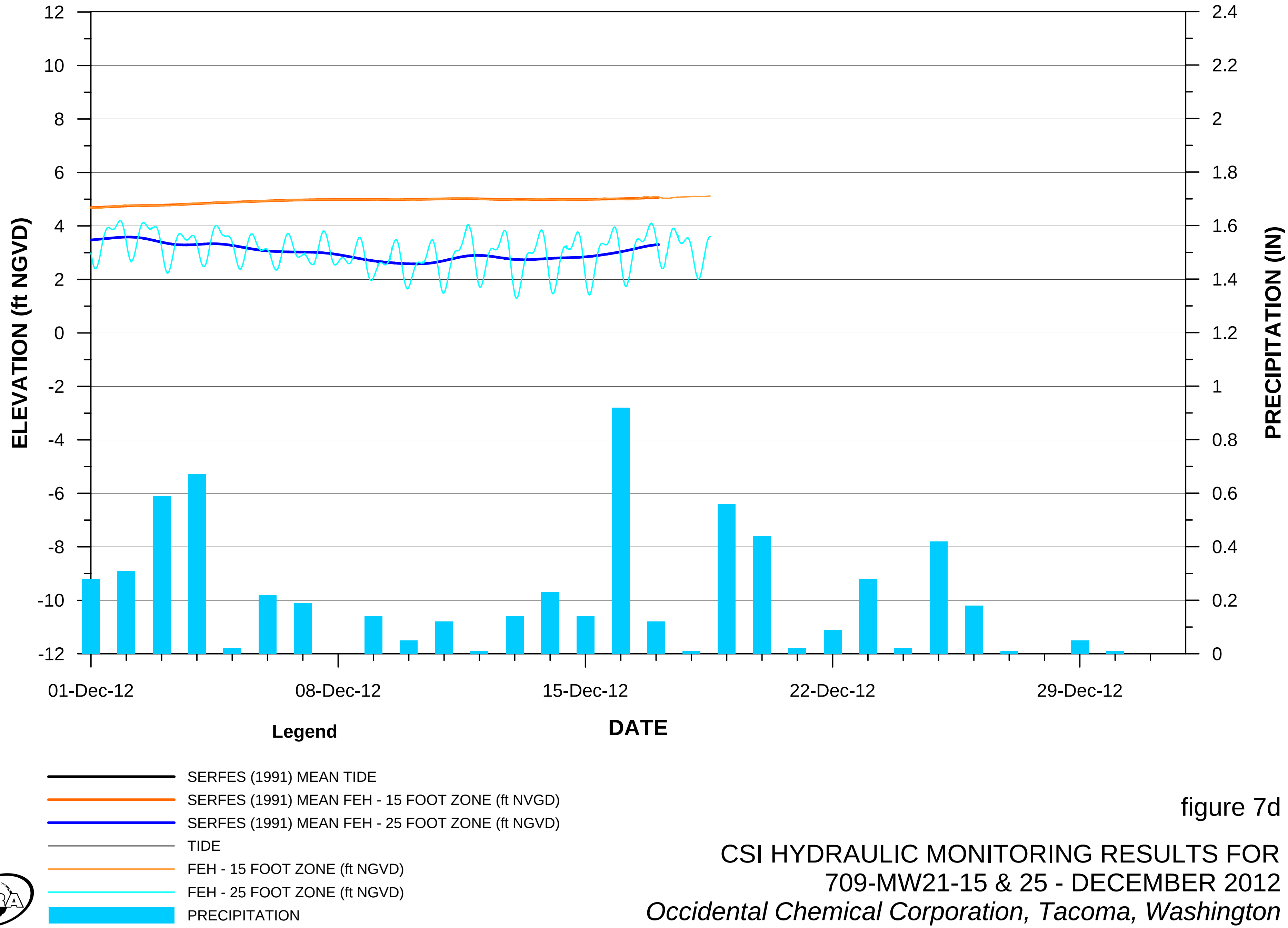


figure 7d

CSI HYDRAULIC MONITORING RESULTS FOR
709-MW21-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\709-MW21\07843-709-MW21-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

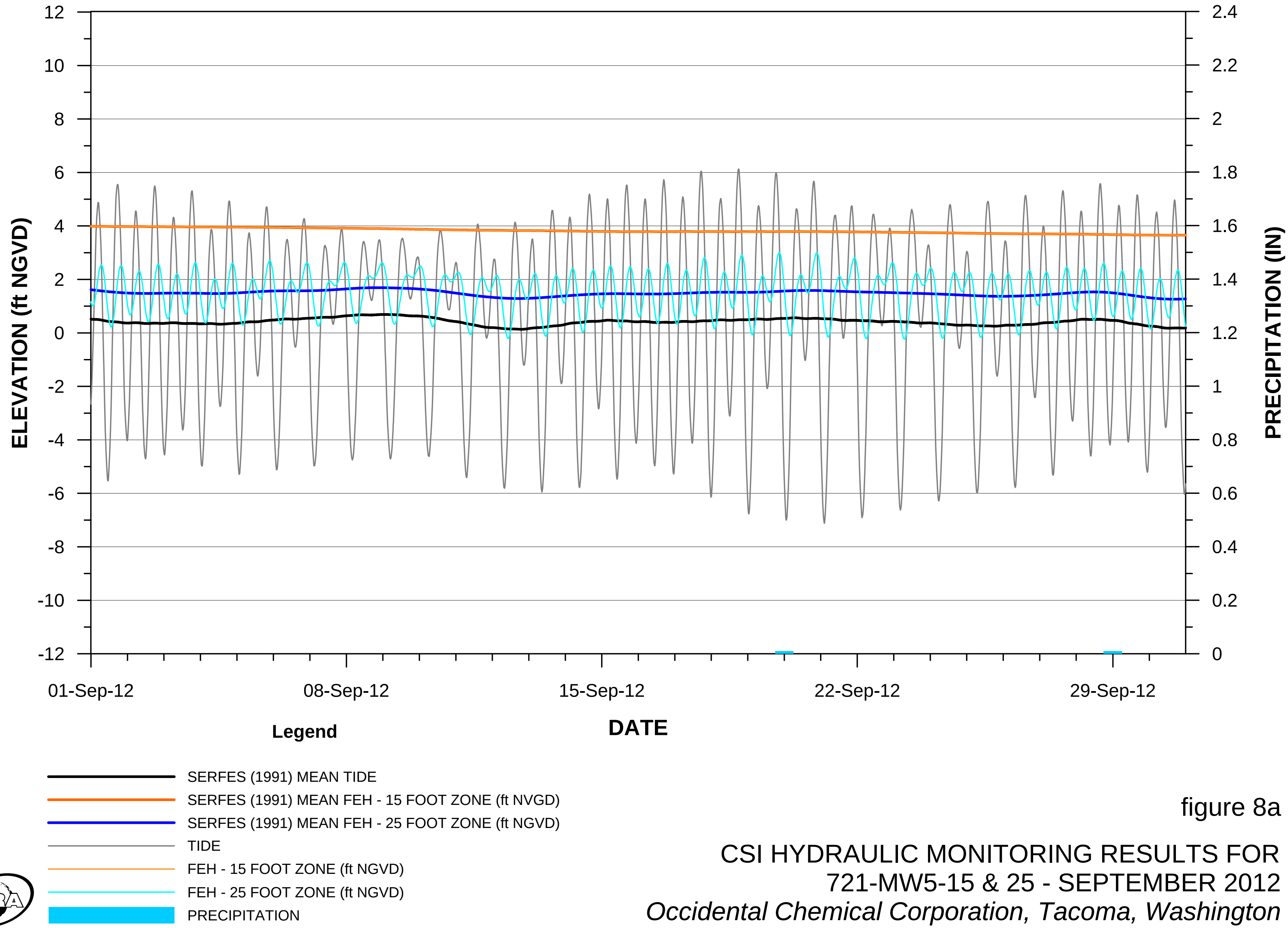
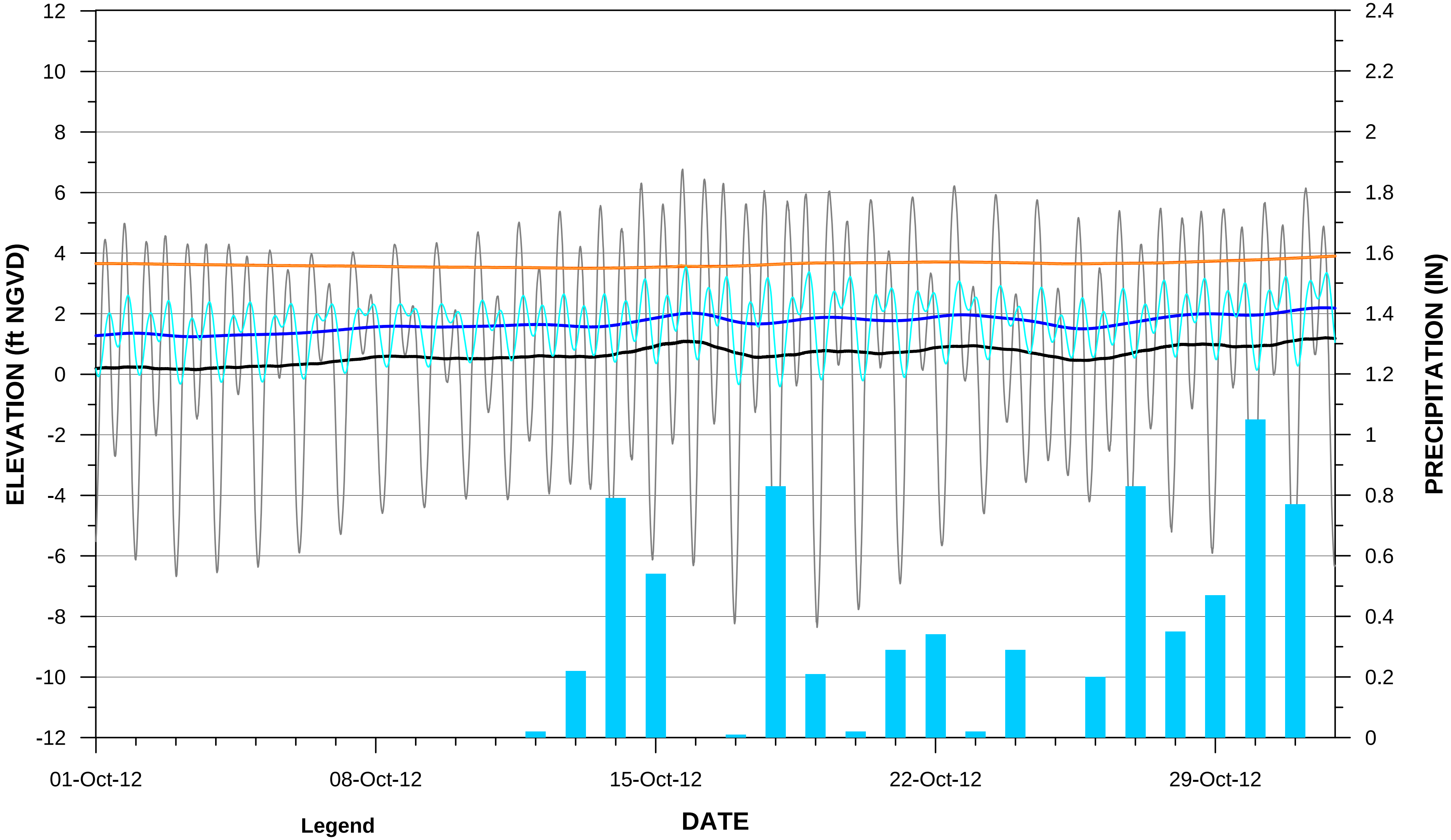


figure 8a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW5-15 & 25 - SEPTEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW5\07843-721-MW5-15 & 25 Foot Zones HydrographsSeptember 2012.grf) AUG 5/2014



Legend

- SERFES (1991) MEAN TIDE
- SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
- SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
- TIDE
- FEH - 15 FOOT ZONE (ft NGVD)
- FEH - 25 FOOT ZONE (ft NGVD)
- PRECIPITATION

figure 8b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW5-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

CRA

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW5\07843-721-MW5-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

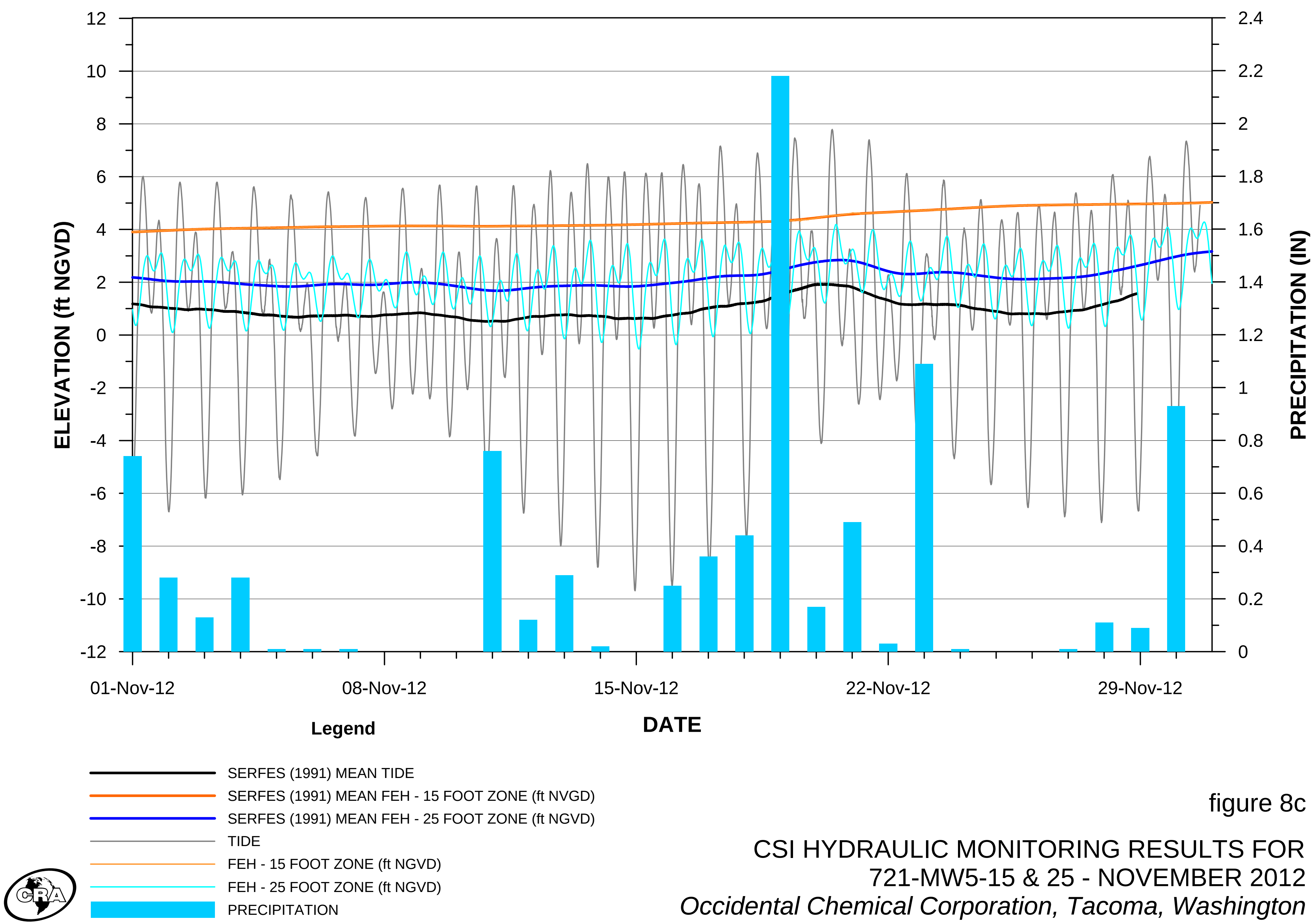


figure 8c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW5-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW5\07843-721-MW5-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

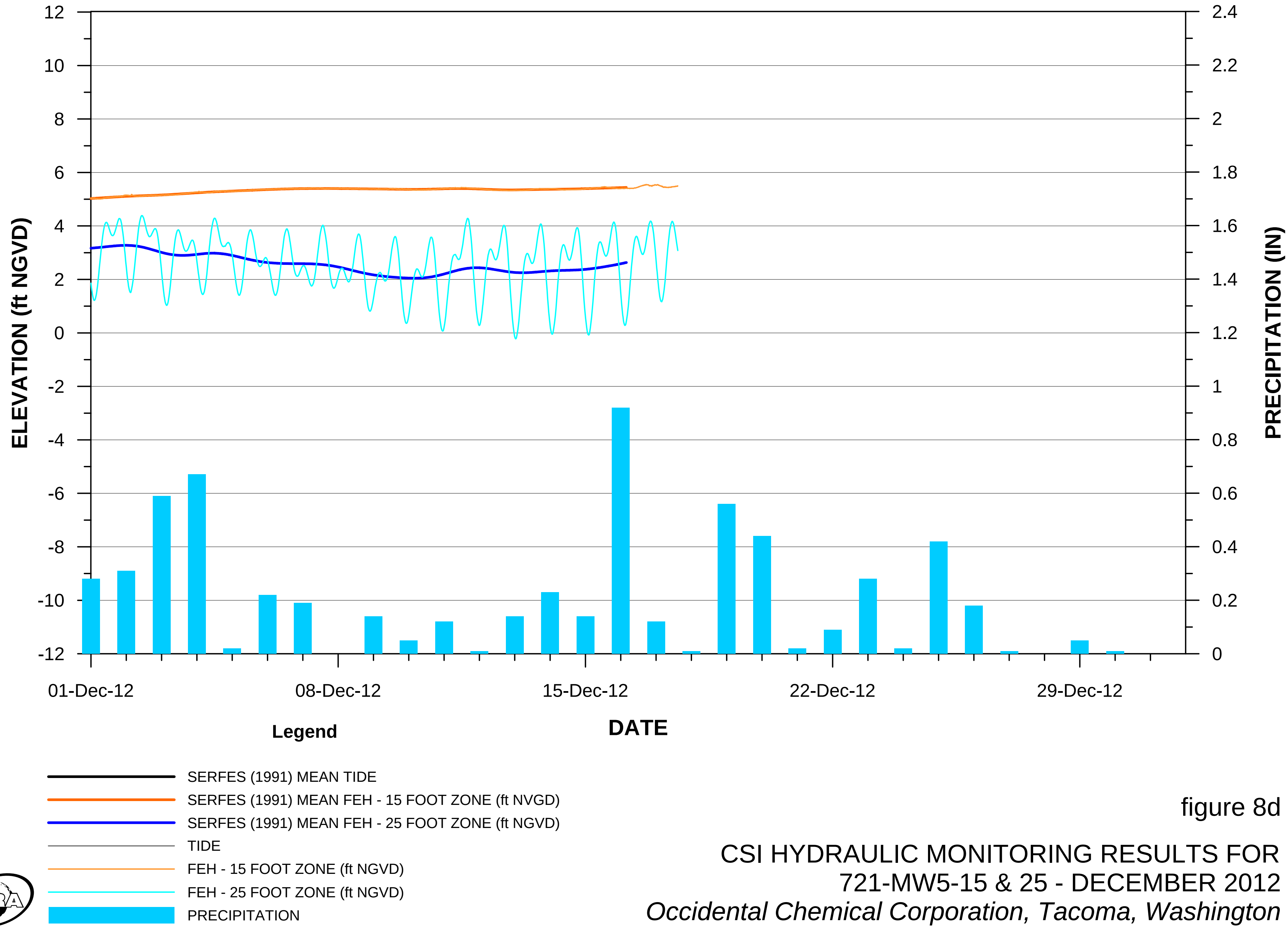


figure 8d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW5-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW5\07843-721-MW5-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

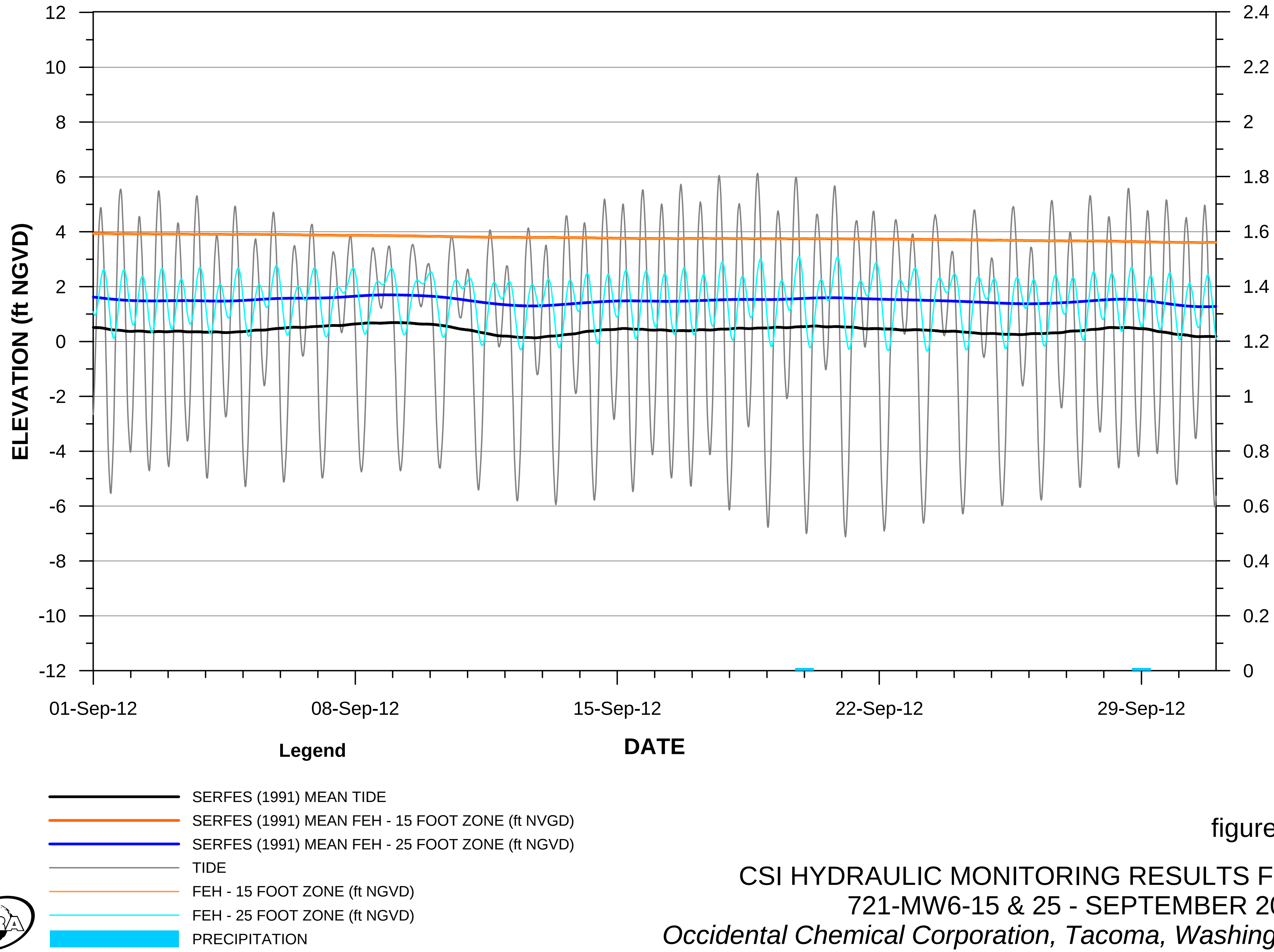


figure 9a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW6-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

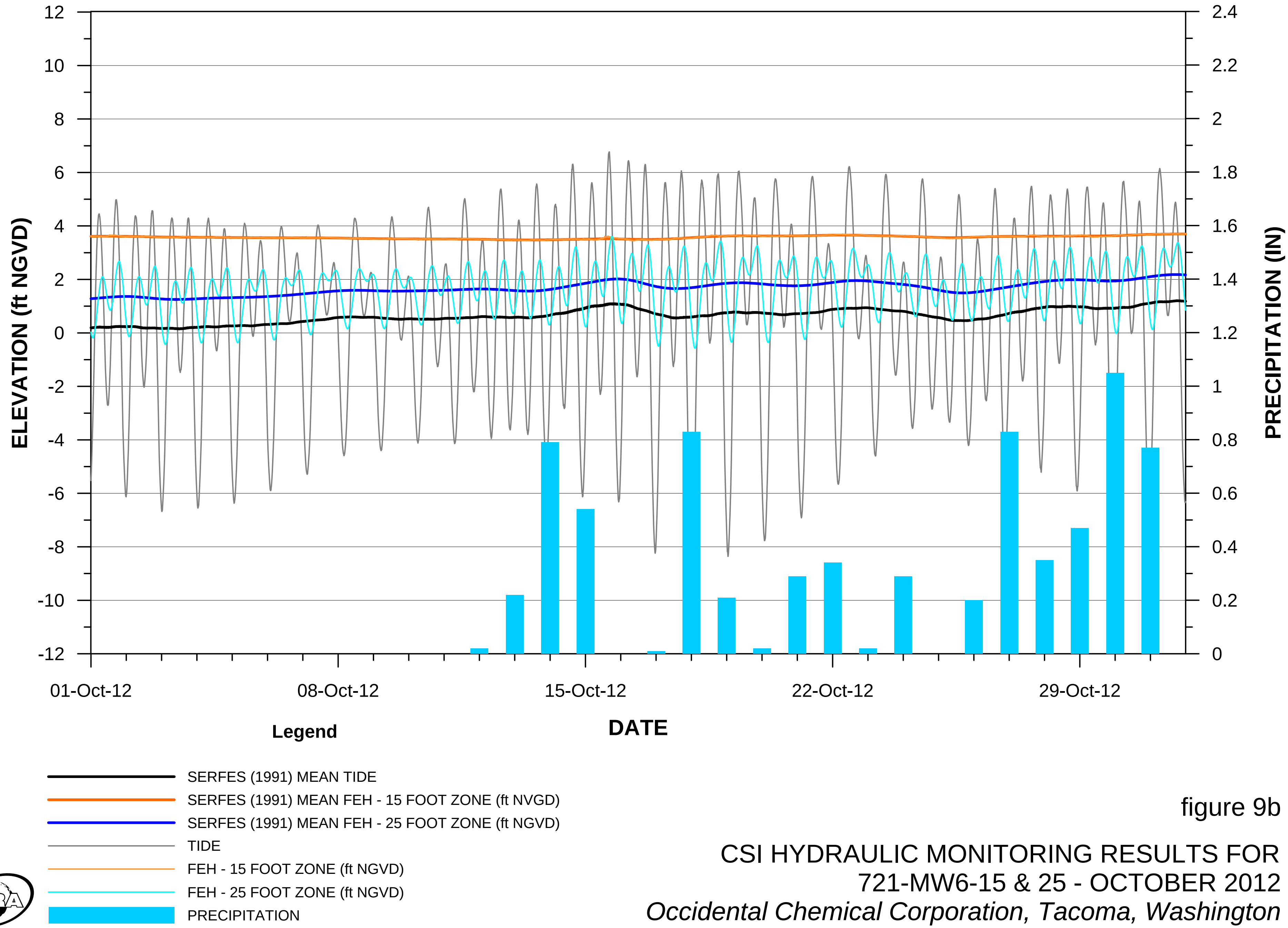


figure 9b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW6-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW6\07843-721-MW6-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

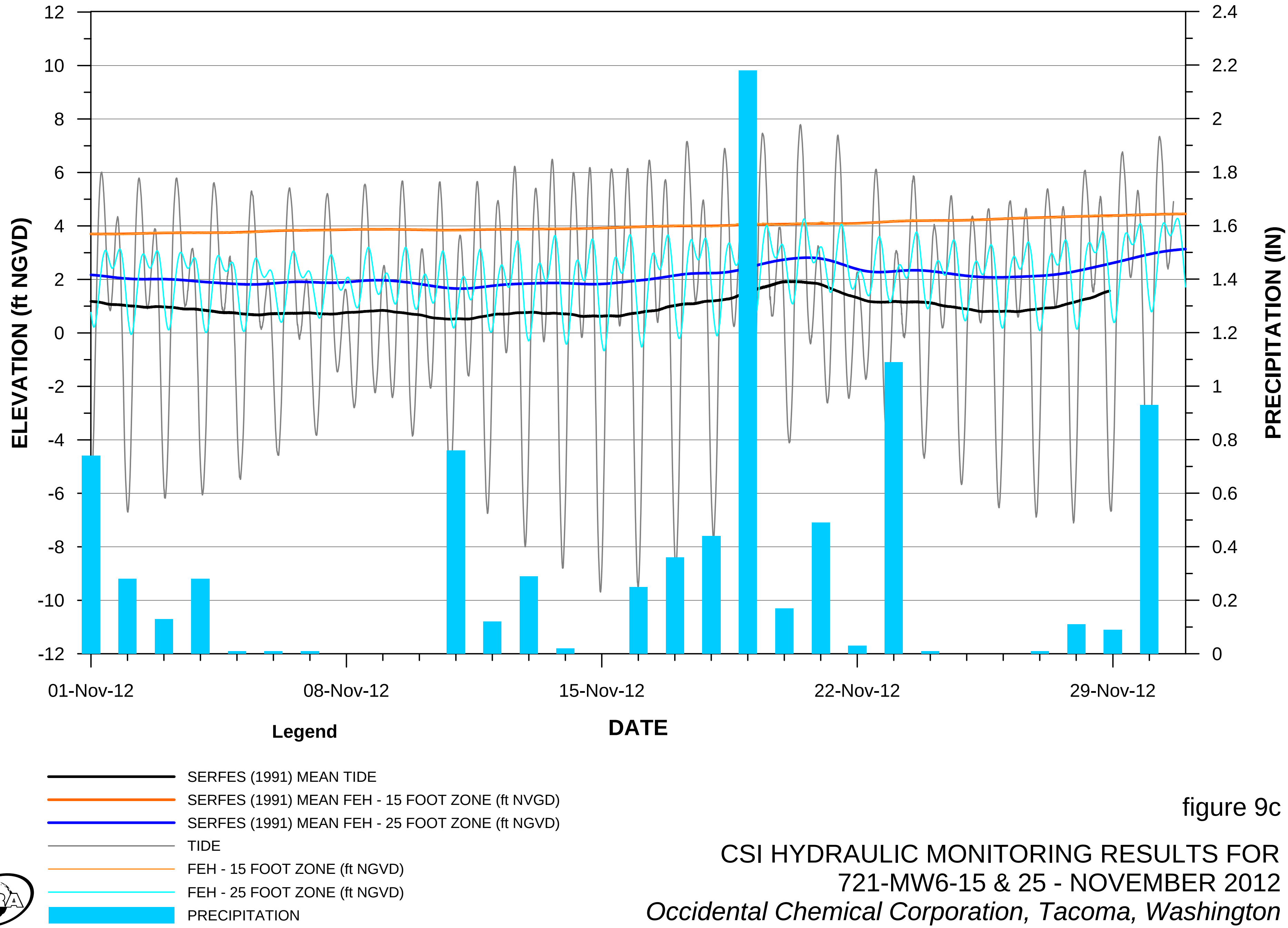


figure 9c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW6-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW6\07843-721-MW6-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

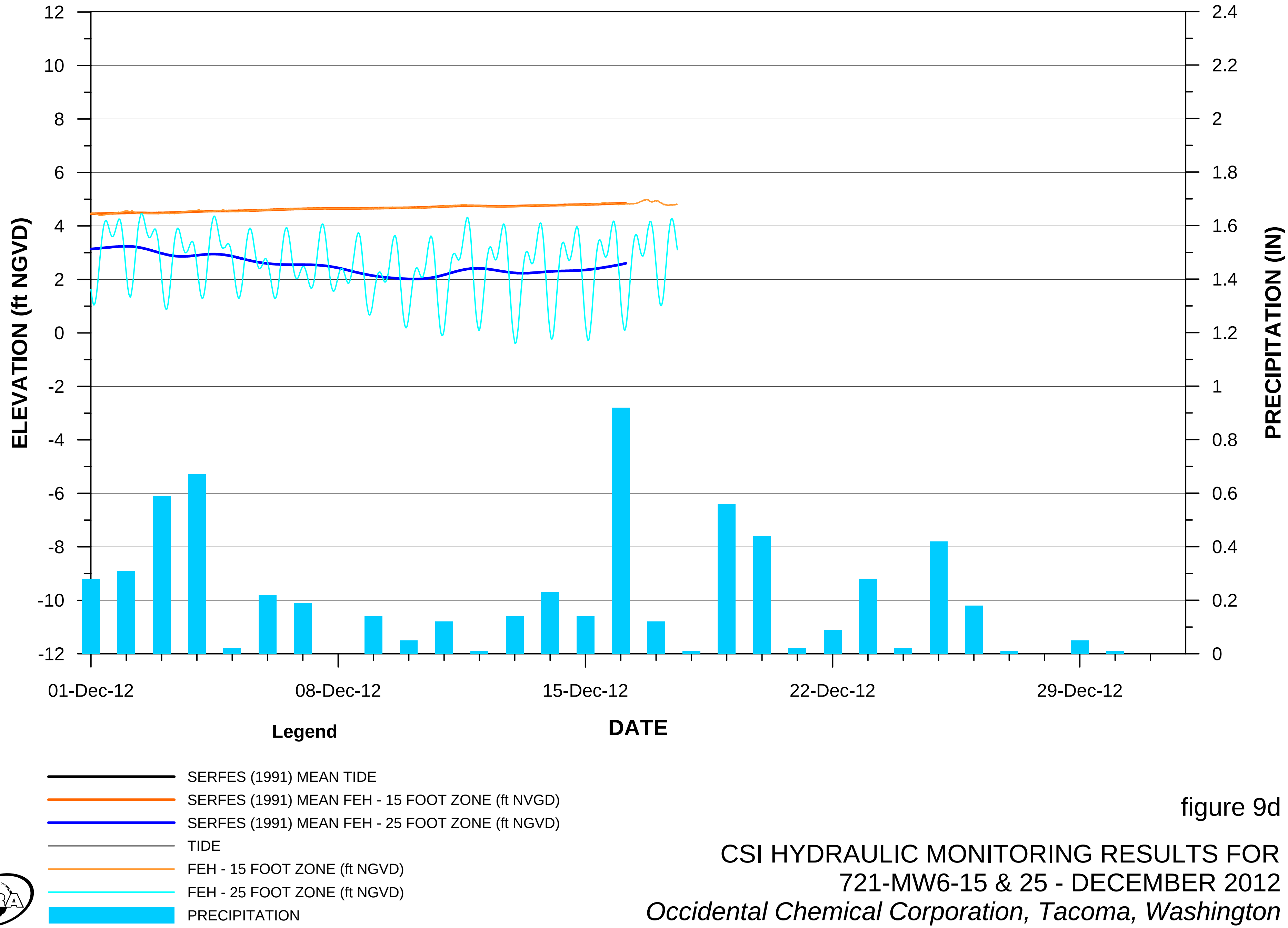
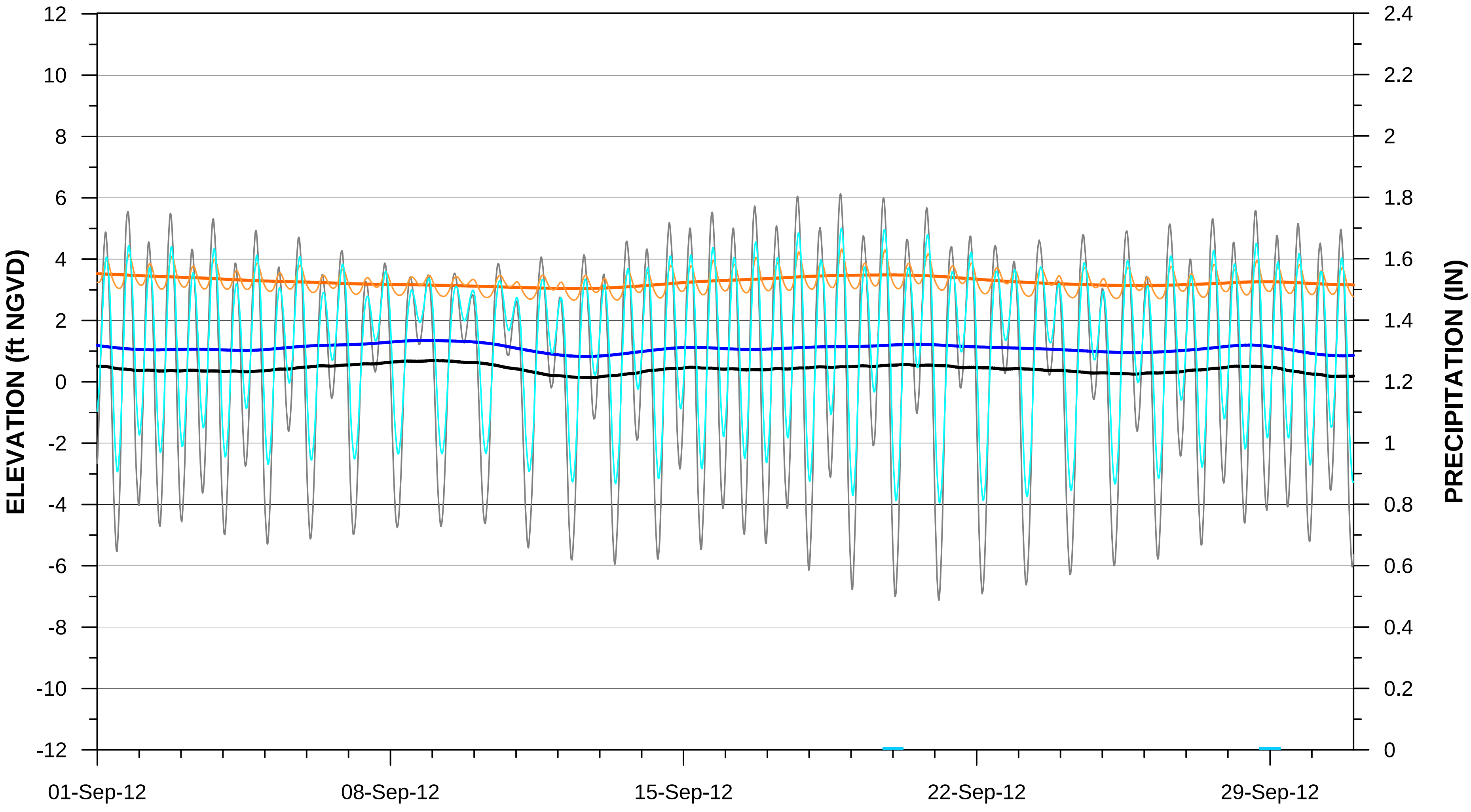


figure 9d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW6-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW6\07843-721-MW6-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

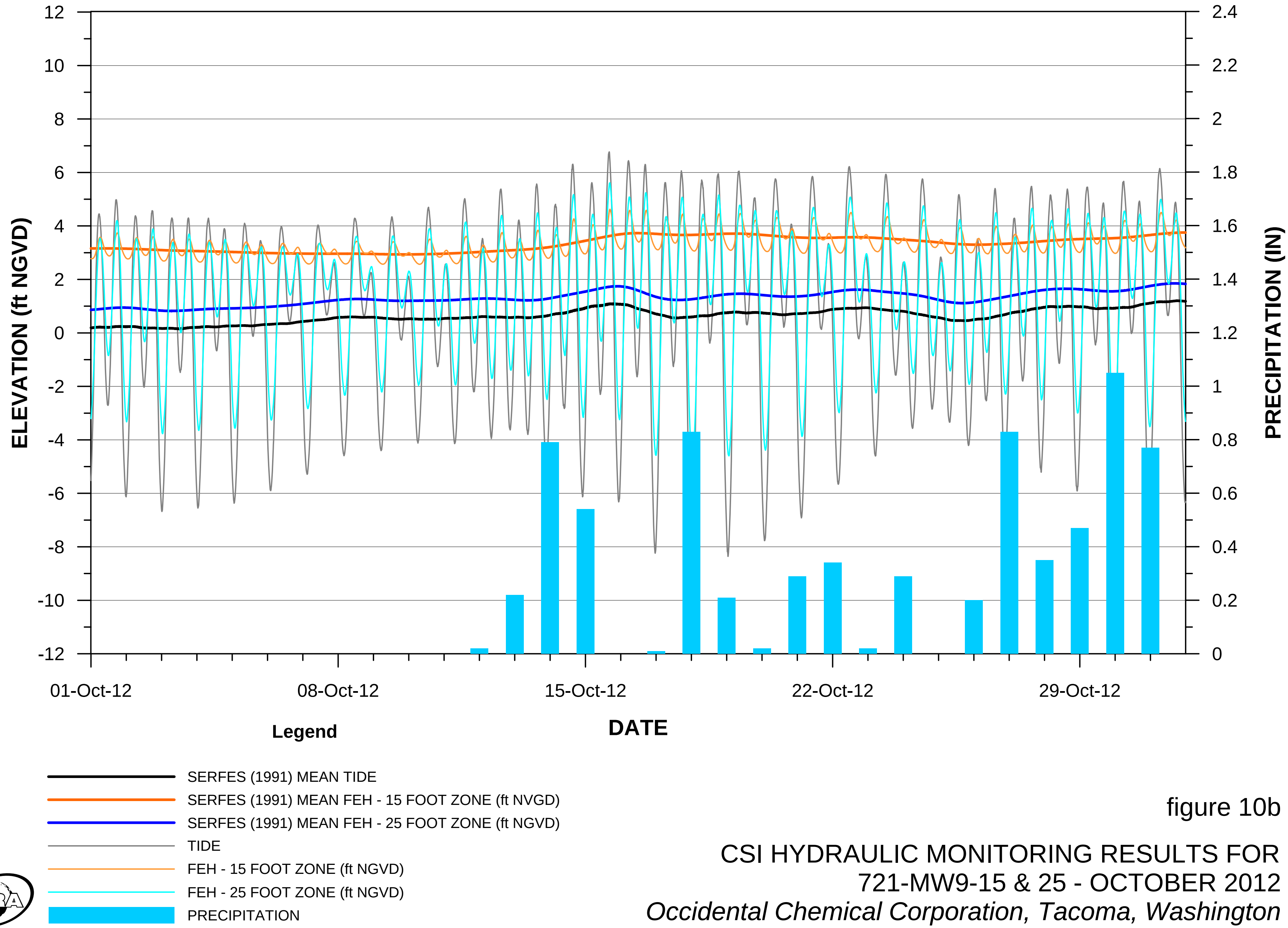


Legend

SERFES (1991) MEAN TIDE
SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
TIDE
FEH - 15 FOOT ZONE (ft NGVD)
FEH - 25 FOOT ZONE (ft NGVD)
PRECIPITATION

figure 10a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW9-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington



CRA

figure 10b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW9-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW9\07843-721-MW9-15 & 25 Foot Zones HydrographsOctober 2012.grf) AUG 5/2014

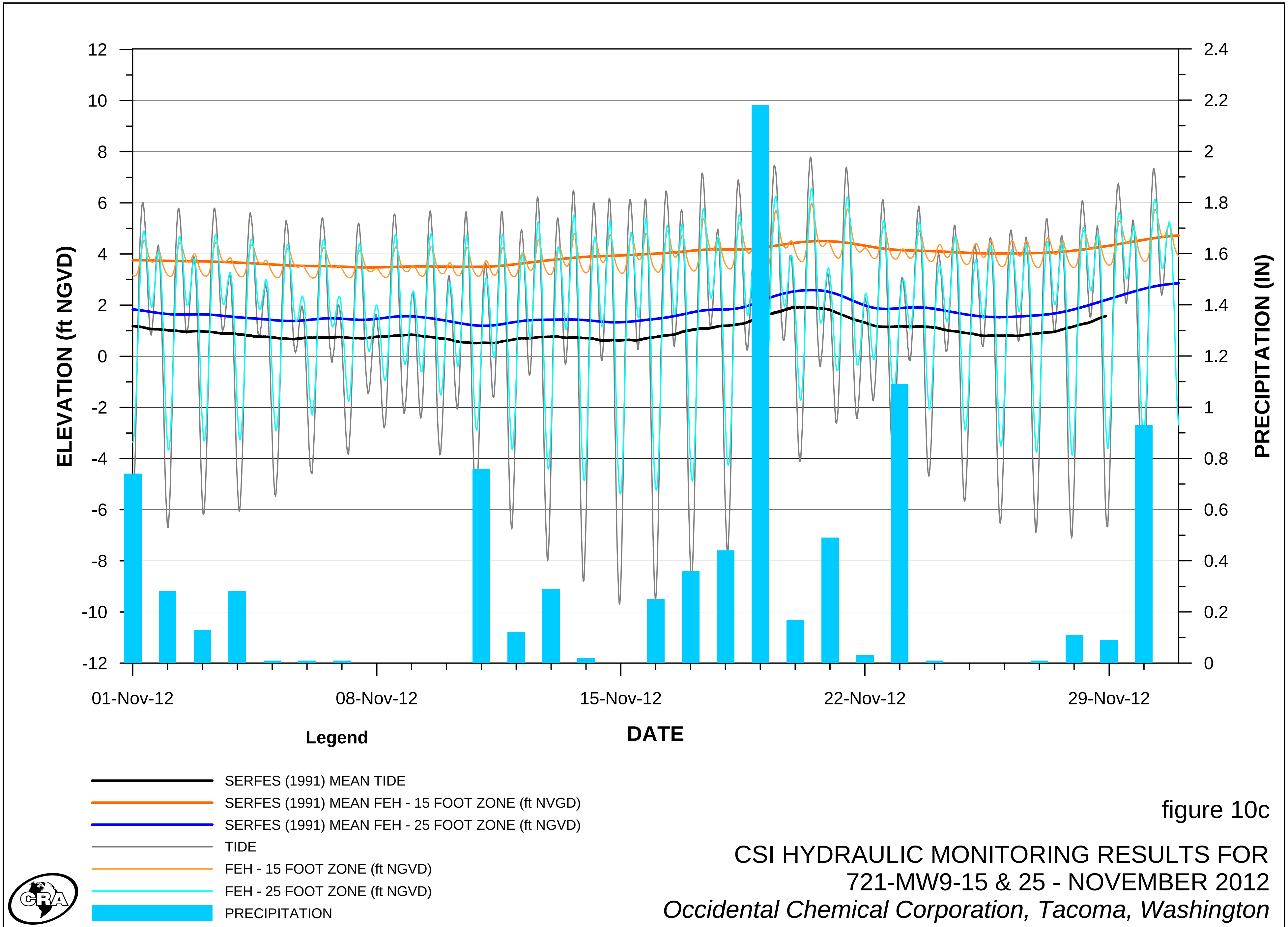


figure 10c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW9-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW9\07843-721-MW9-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

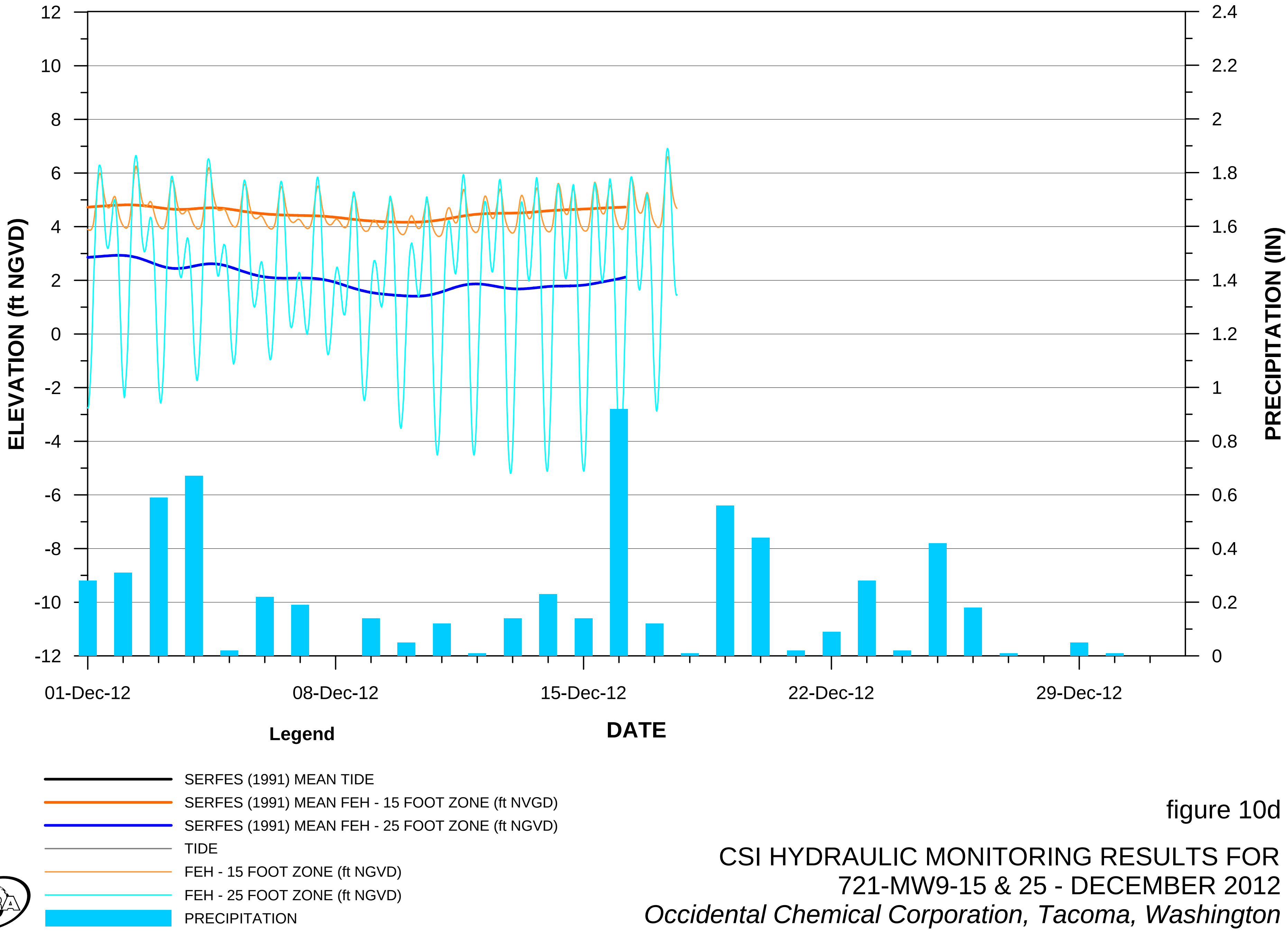


figure 10d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW9-15 & 25 - DECEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW9\07843-721-MW9-15 & 25 Foot Zones HydrographsDecember 2012.grf) AUG 5/2014

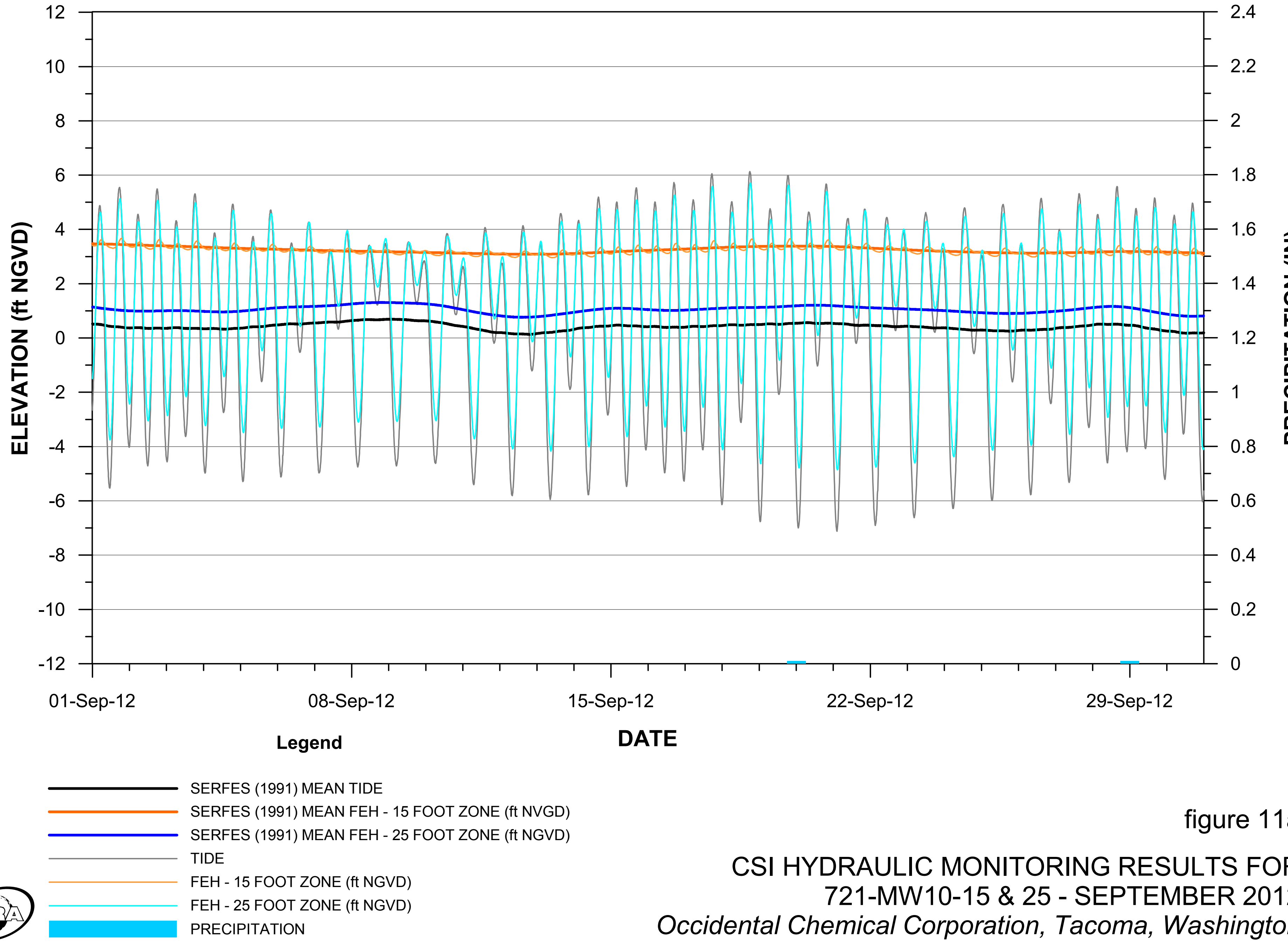


figure 11a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW10-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

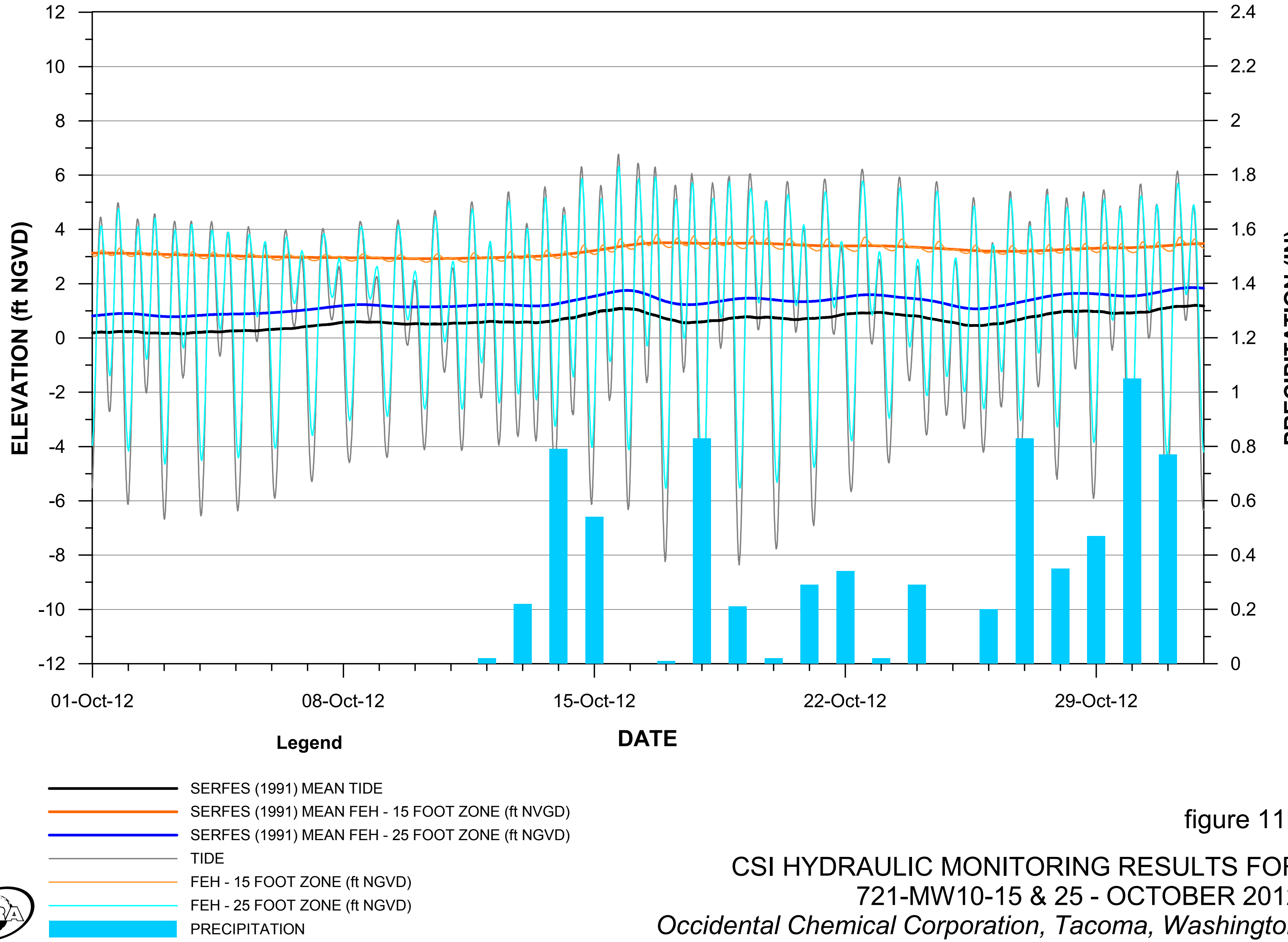


figure 11b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW10-15 & 25 - OCTOBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW10\07843-721-MW10-15 & 25 Foot Zones HydrographsOctober 2012.grf) MAR 6/2013

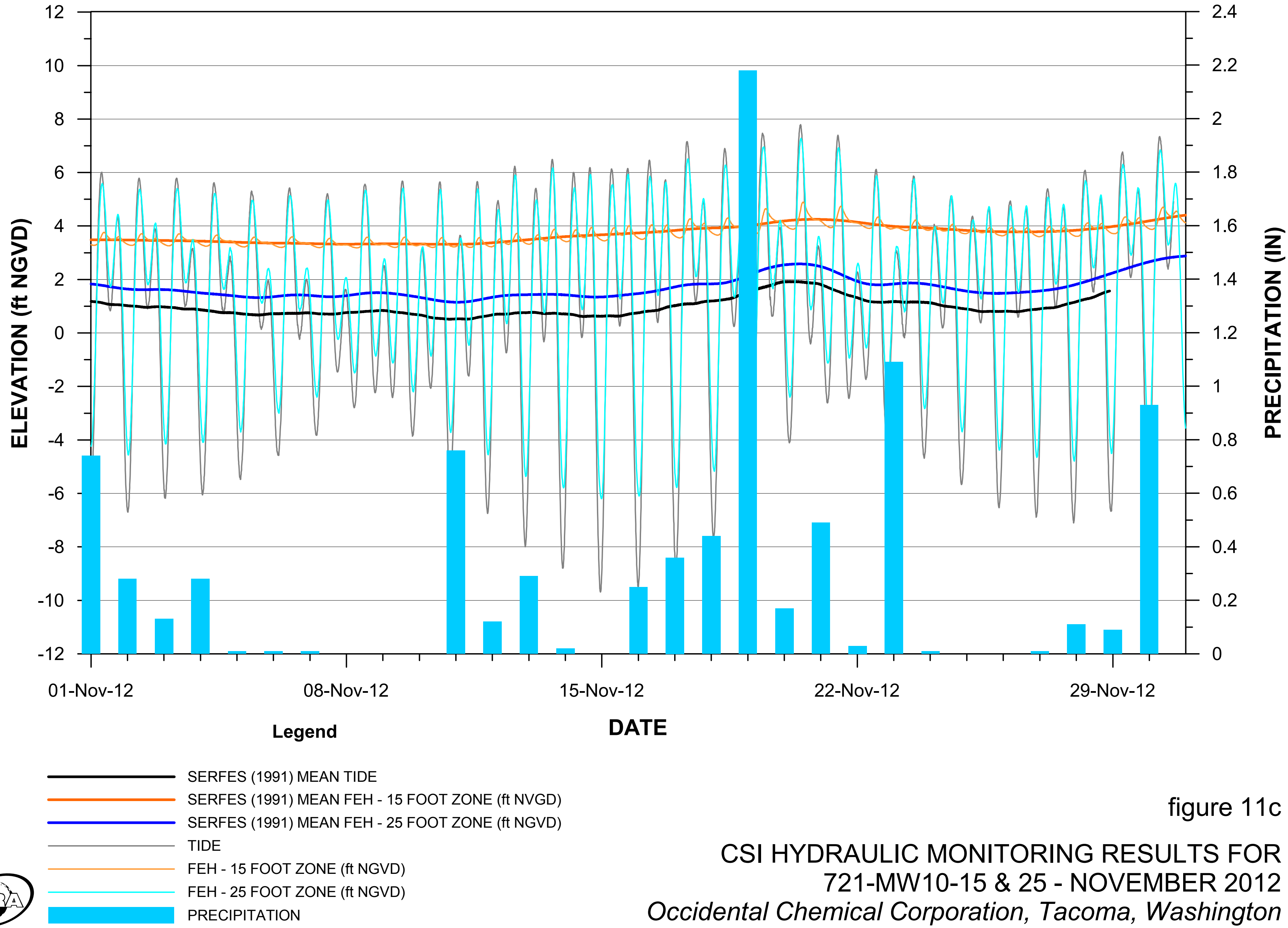


figure 11c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW10-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW10\07843-721-MW10-15 & 25 Foot Zones HydrographsNovember 2012.grf) MAR 6/2013

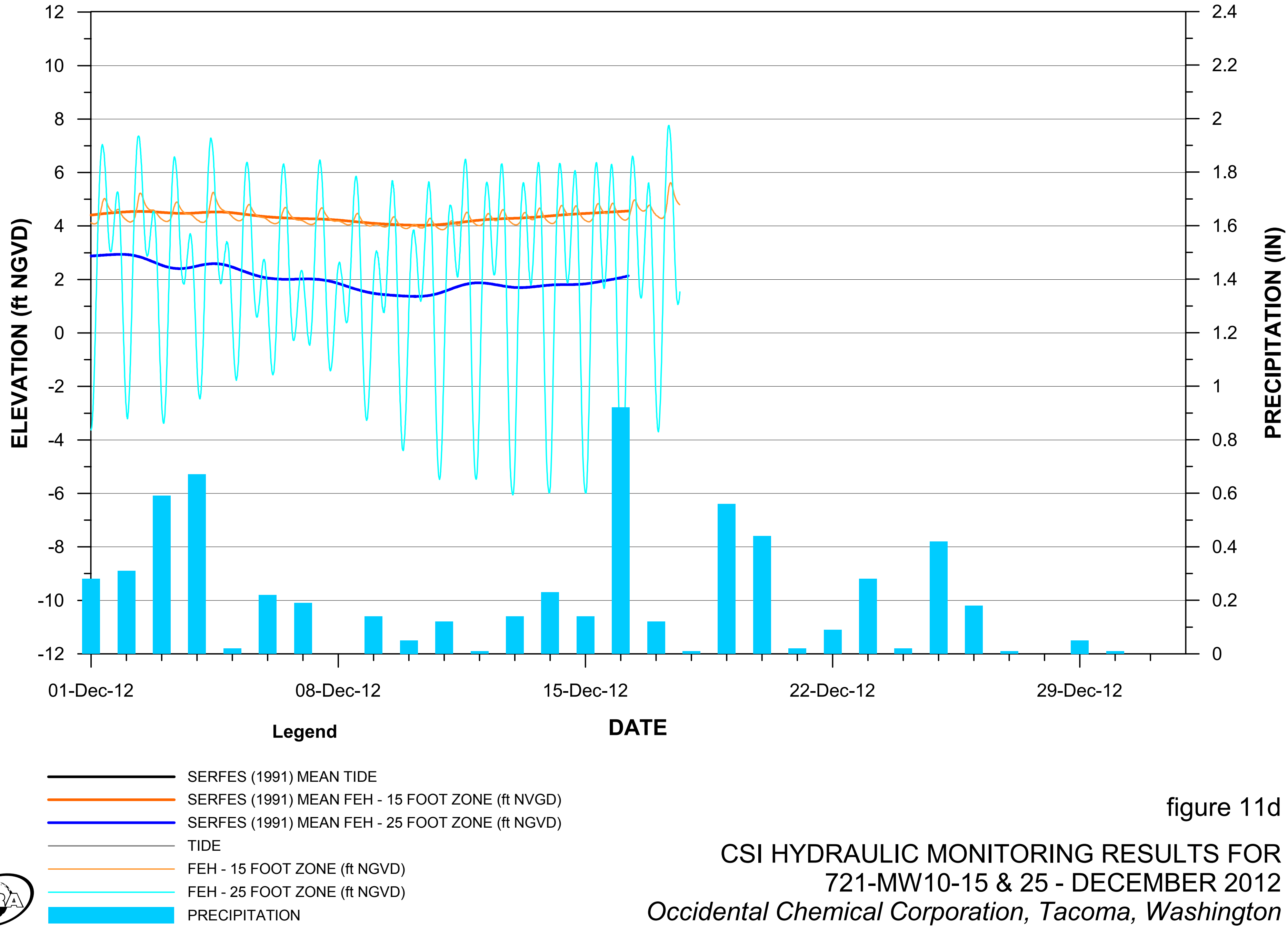


figure 11d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW10-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW10\07843-721-MW10-15 & 25 Foot Zones HydrographsDecember 2012.grf) MAR 6/2013

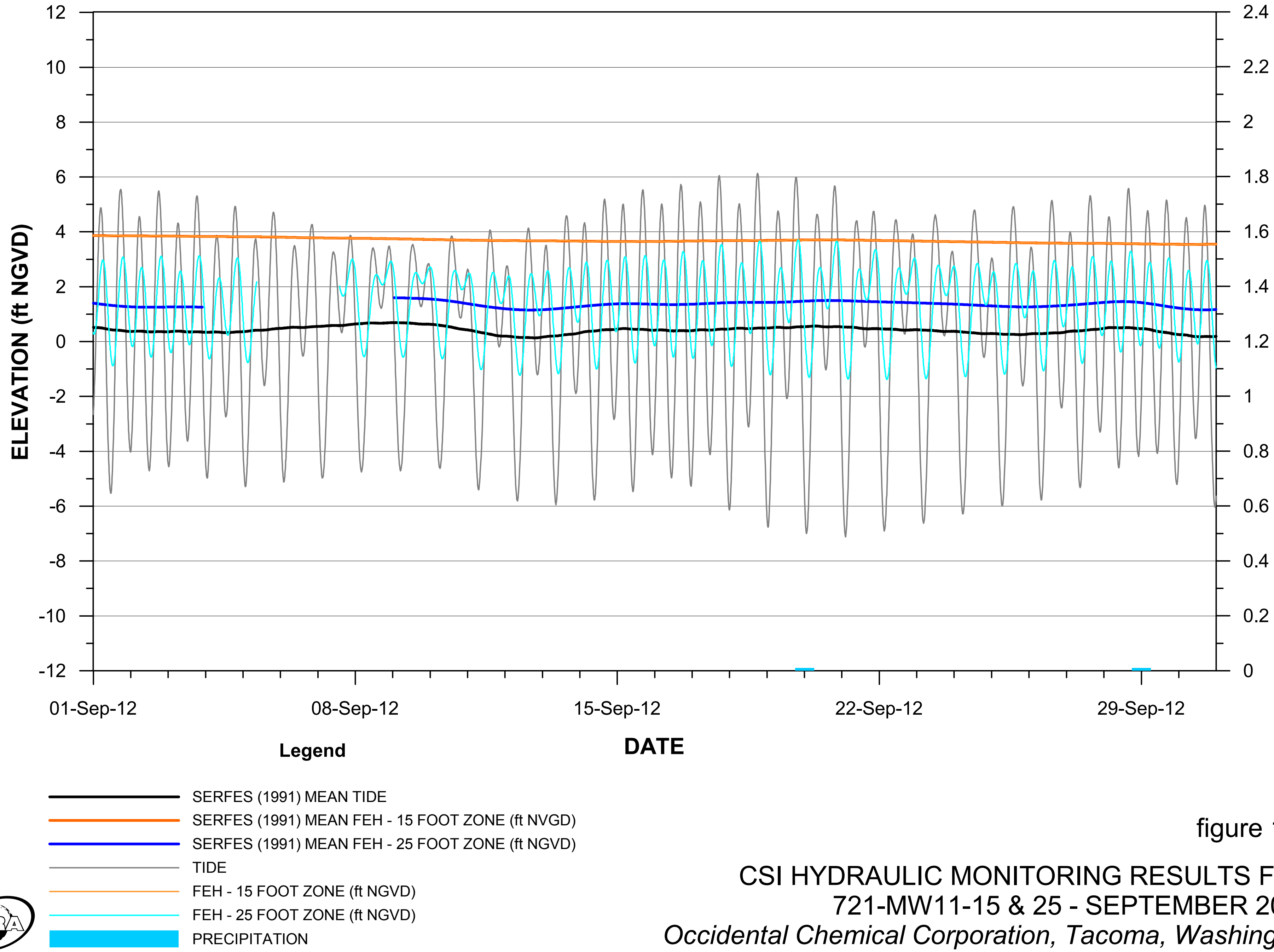


figure 12a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW11-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW11\07843-721-MW11-15 & 25 Foot Zones HydrographsSeptember 2012.grf) MAR 6/2013

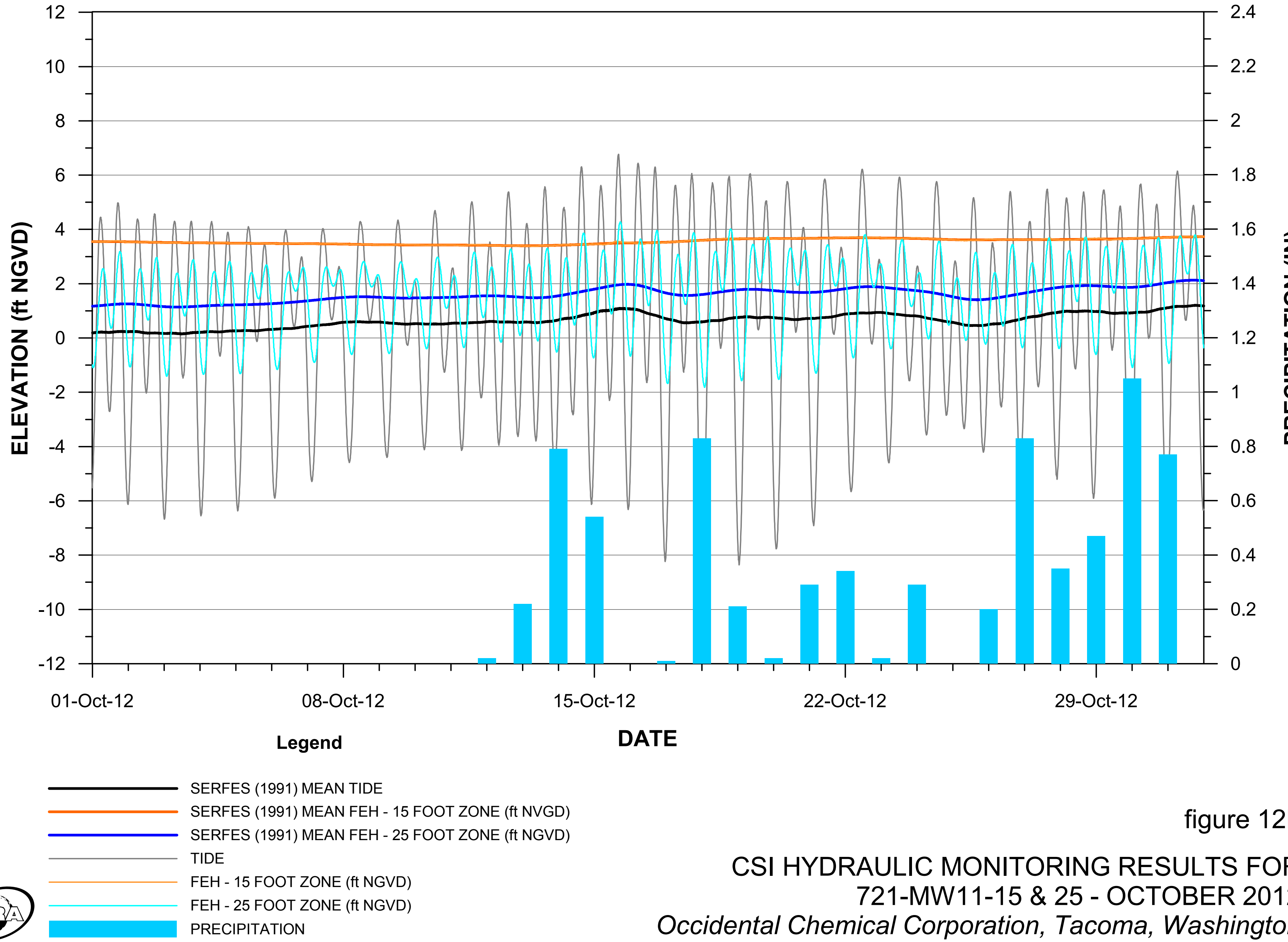


figure 12b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW11-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW11\07843-721-MW11-15 & 25 Foot Zones HydrographsOctober 2012.grf) MAR 6/2013

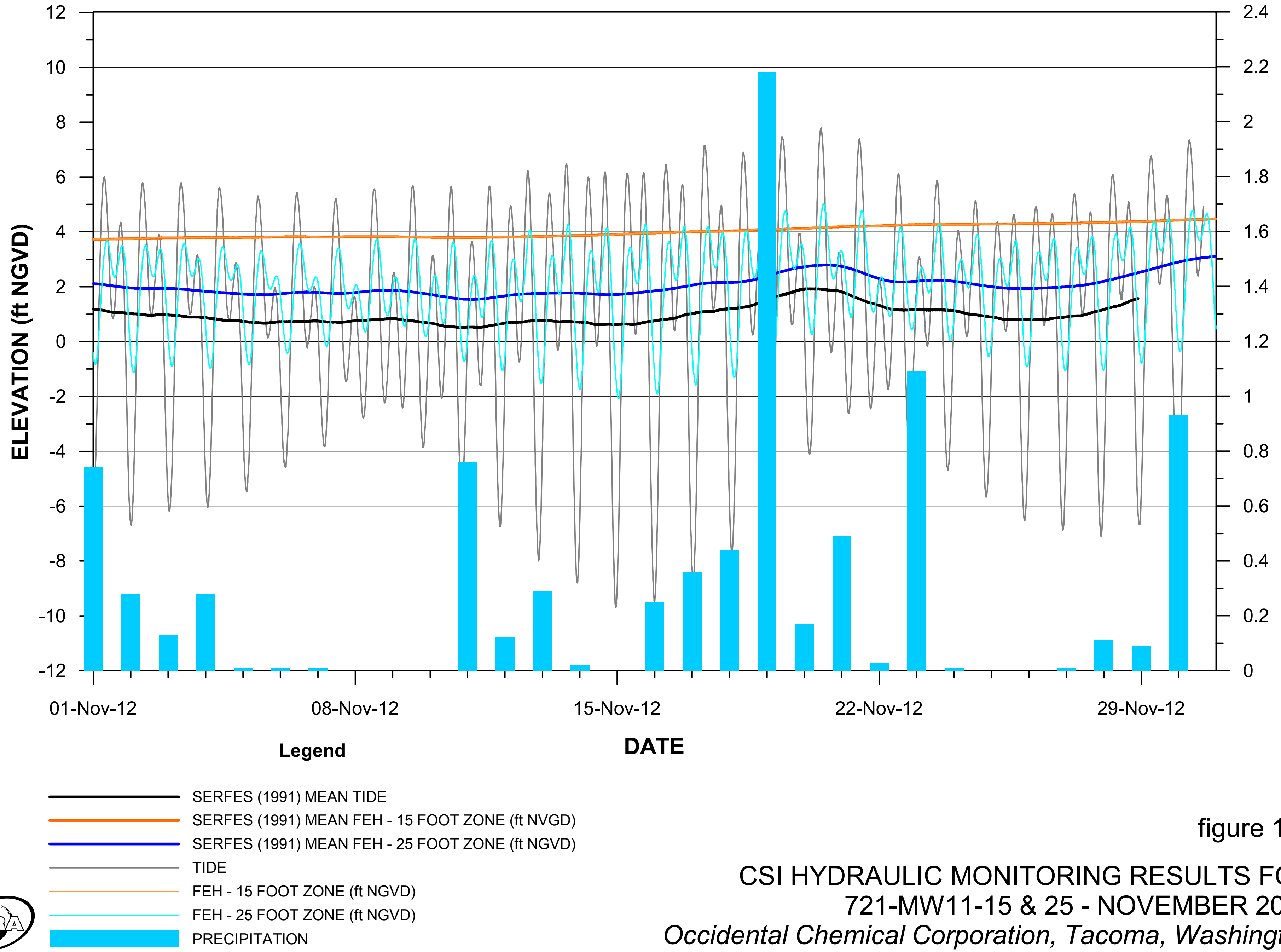


figure 12c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW11-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW11\07843-721-MW11-15 & 25 Foot Zones HydrographsNovember 2012.grf) MAR 6/2013

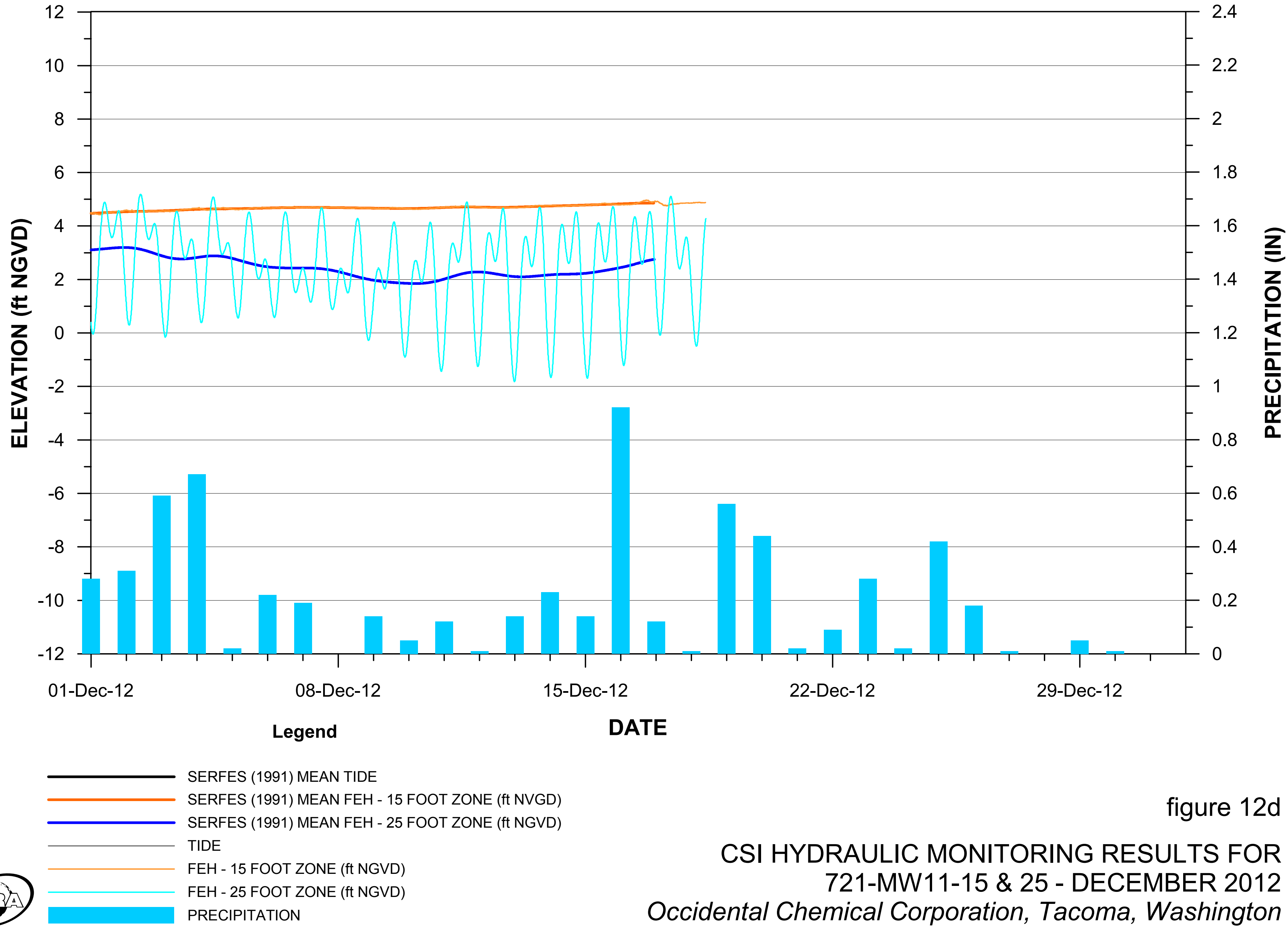


figure 12d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW11-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW11\07843-721-MW11-15 & 25 Foot Zones HydrographsDecember 2012.grf) MAR 6/2013

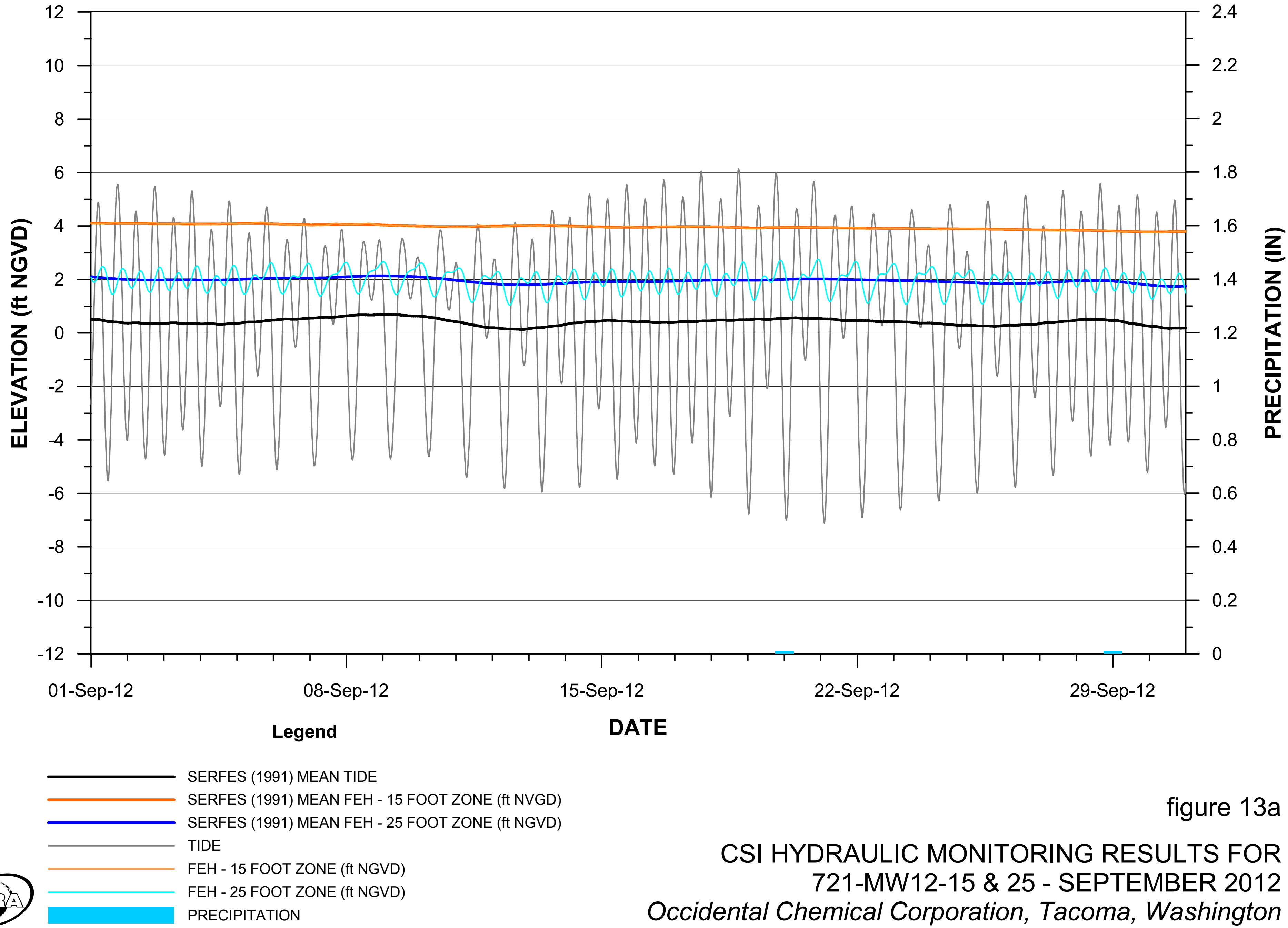


figure 13a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW12-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW12\07843-721-MW12-15 & 25 Foot Zones HydrographsSeptember 2012.grf) MAR 6/2013

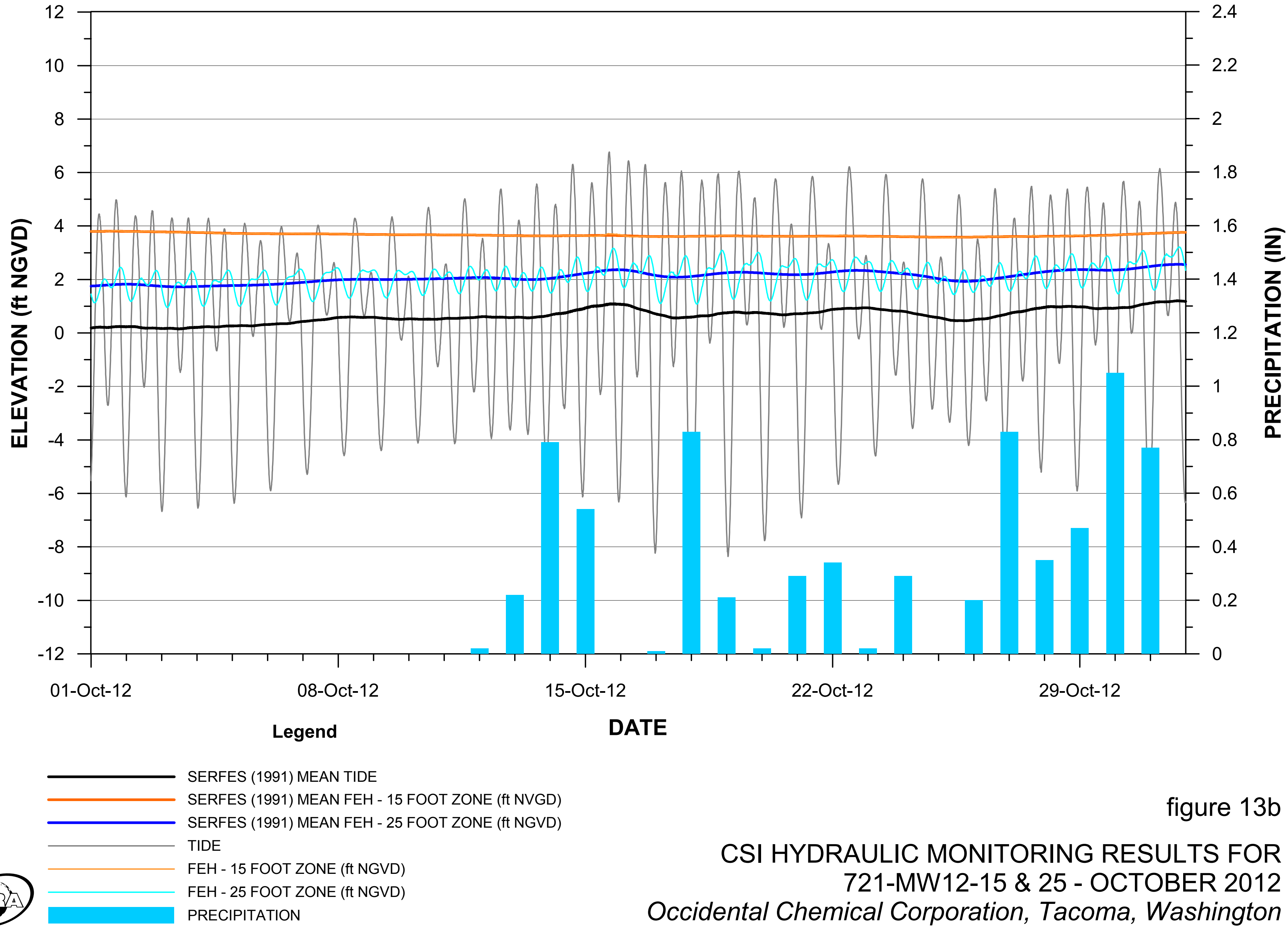


figure 13b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW12-15 & 25 - OCTOBER 2012

Occidental Chemical Corporation, Tacoma, Washington

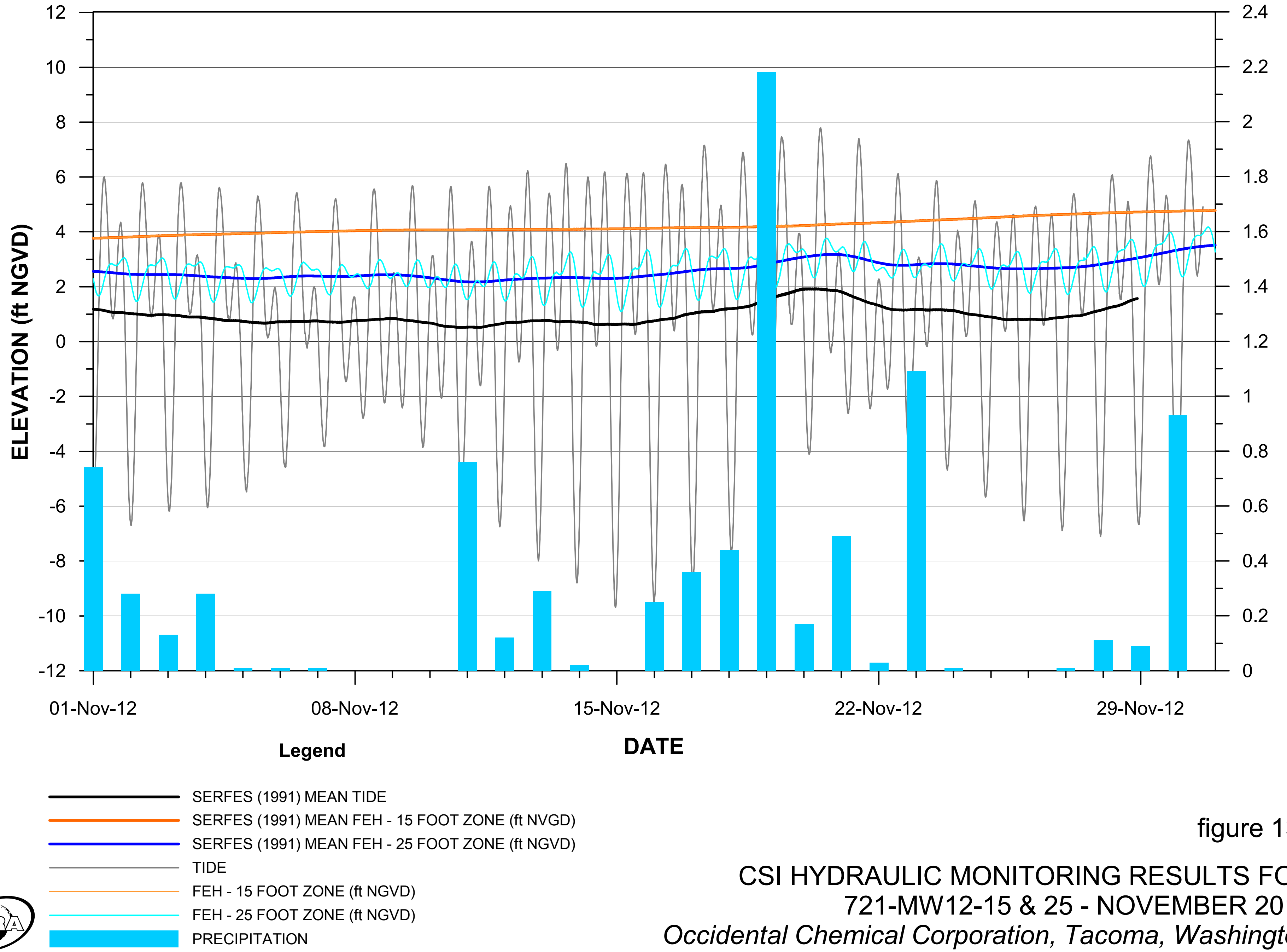


figure 13c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW12-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW12\07843-721-MW12-15 & 25 Foot Zones HydrographsNovember 2012.grf) MAR 6/2013

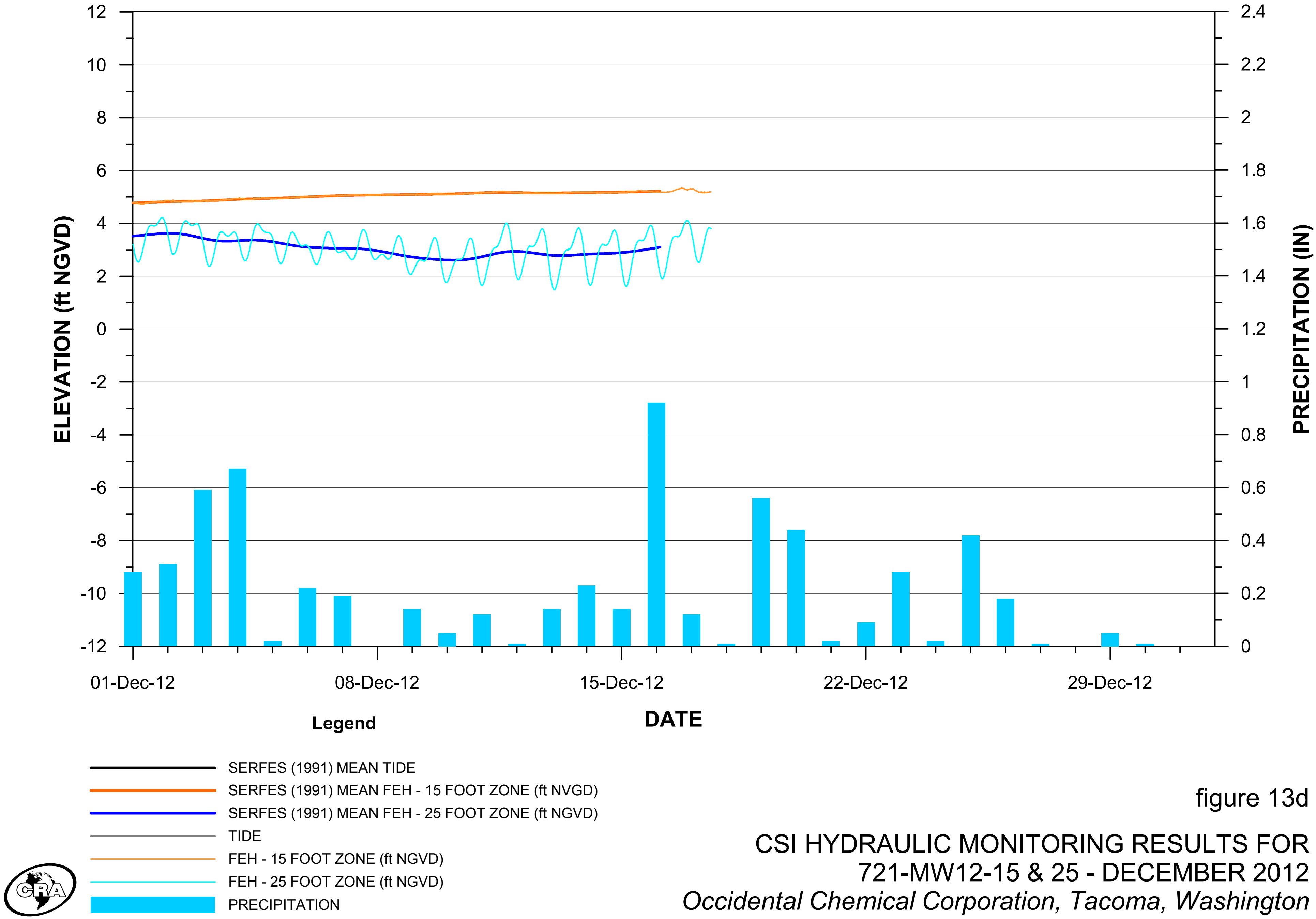


figure 13d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW12-15 & 25 - DECEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW12\07843-721-MW12-15 & 25 Foot Zones HydrographsDecember 2012.grf) MAR 6/2013

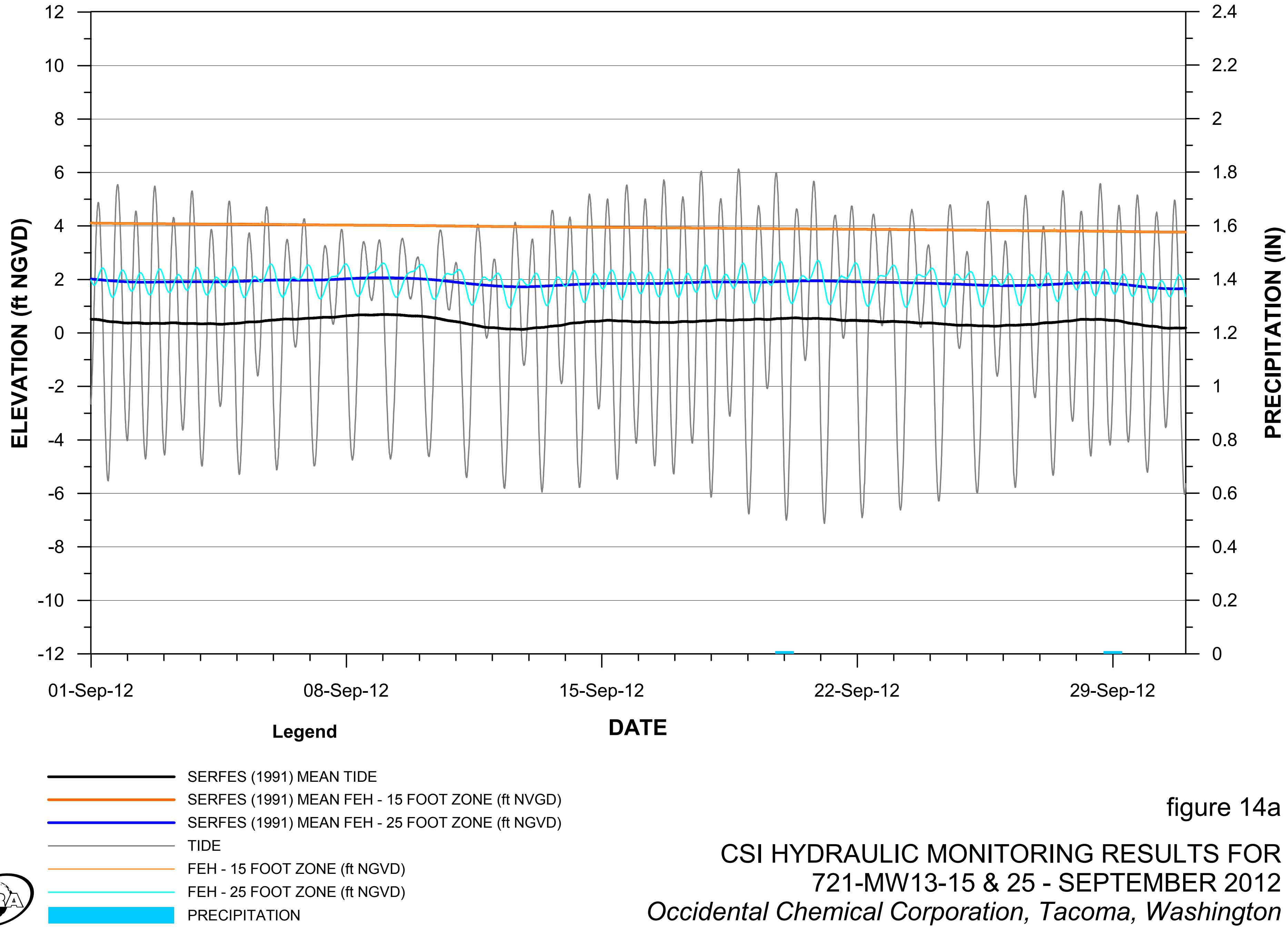


figure 14a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW13-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW13\07843-721-MW13-15 & 25 Foot Zones HydrographsSeptember 2012.grf) MAR 6/2013

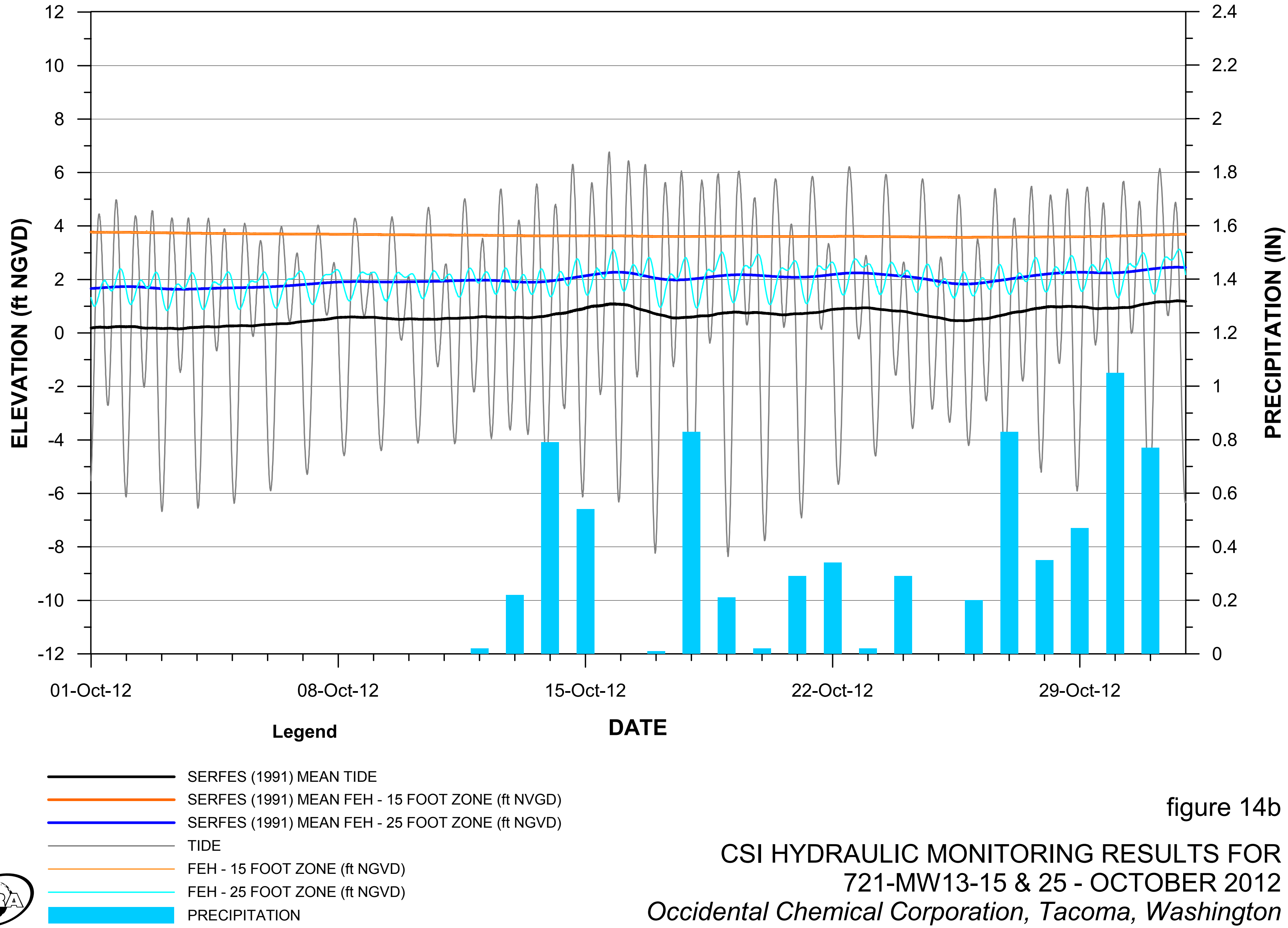


figure 14b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW13-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

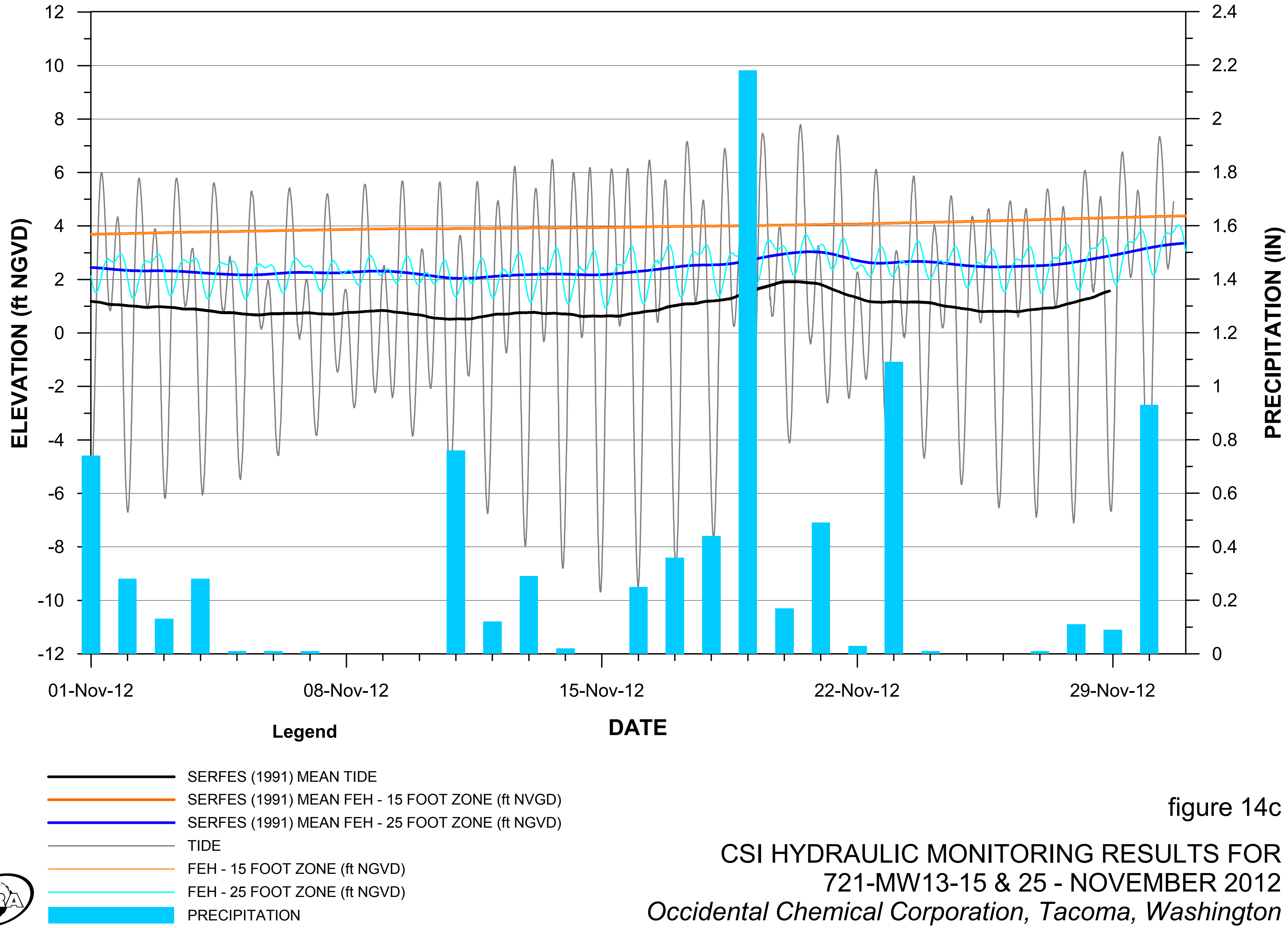


figure 14c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW13-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW13\07843-721-MW13-15 & 25 Foot Zones HydrographsNovember 2012.grf) MAR 6/2013

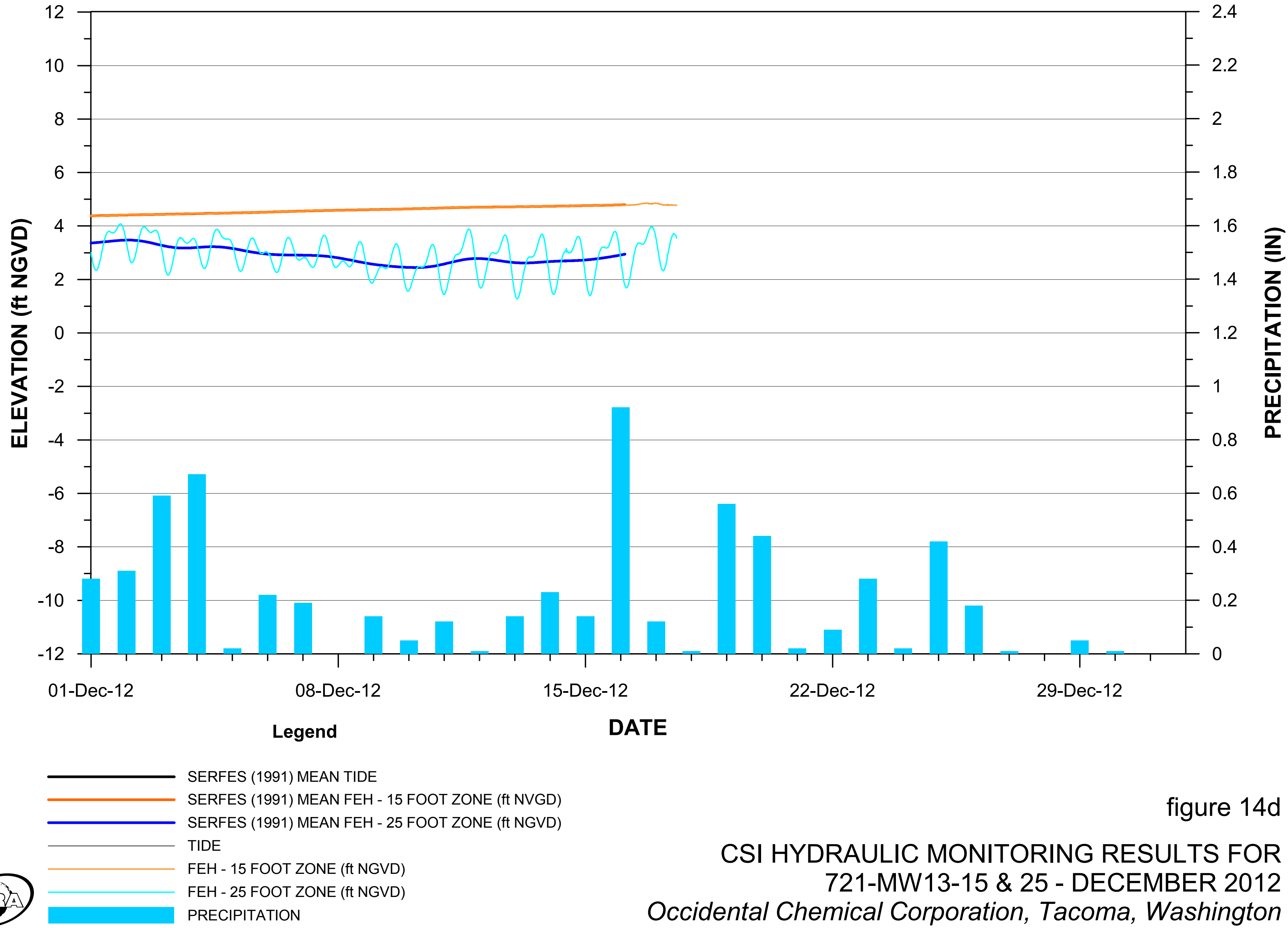
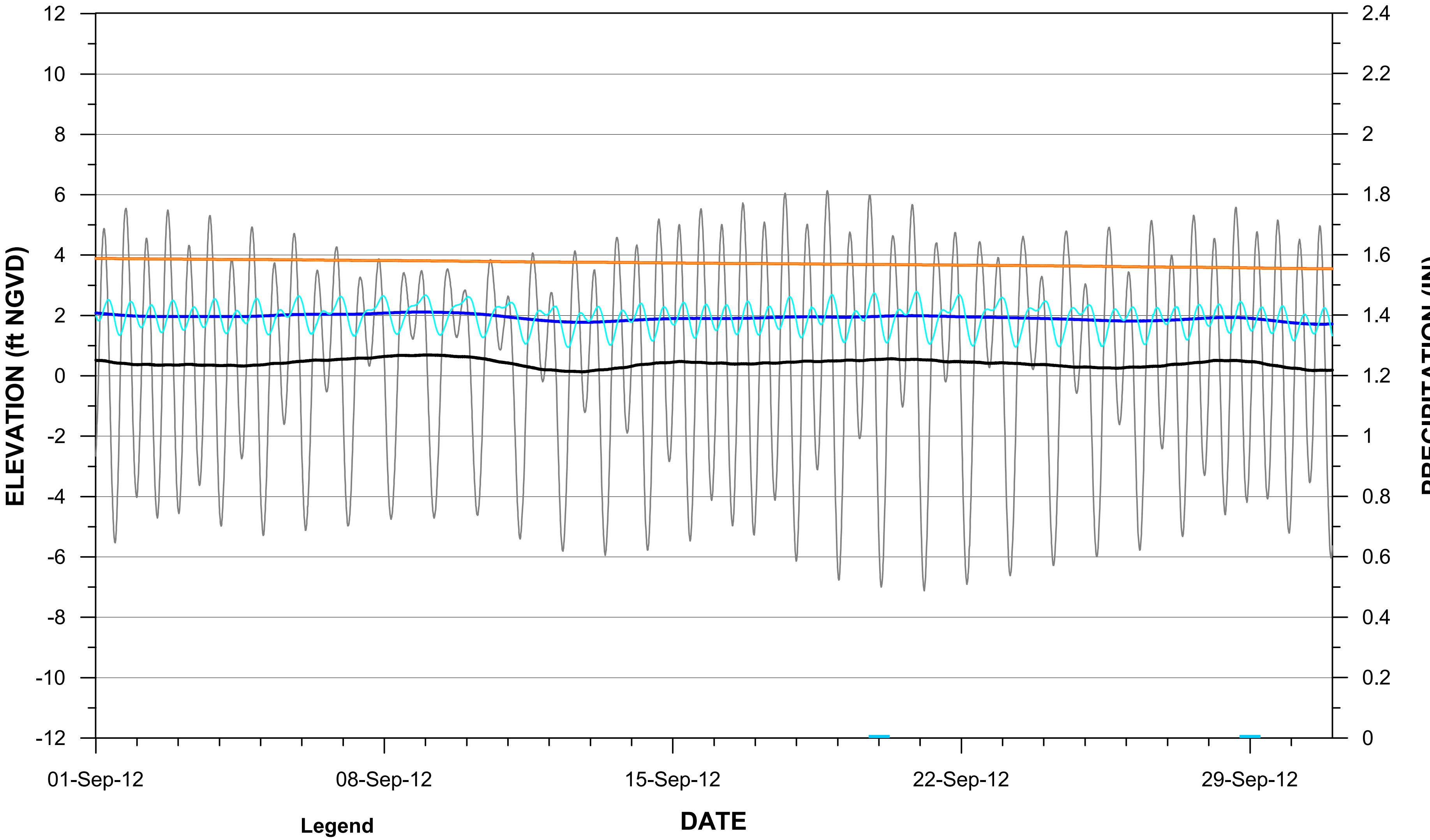


figure 14d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW13-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW13\07843-721-MW13-15 & 25 Foot Zones HydrographsDecember 2012.grf) MAR 6/2013



Legend

- SERFES (1991) MEAN TIDE
- SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
- SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
- TIDE
- FEH - 15 FOOT ZONE (ft NGVD)
- FEH - 25 FOOT ZONE (ft NGVD)
- PRECIPITATION

figure 15a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW14-15 & 25 - SEPTEMBER 2012

Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW14\07843-721-MW14-15 & 25 Foot Zones HydrographsSeptember 2012.grf) MAR 6/2013

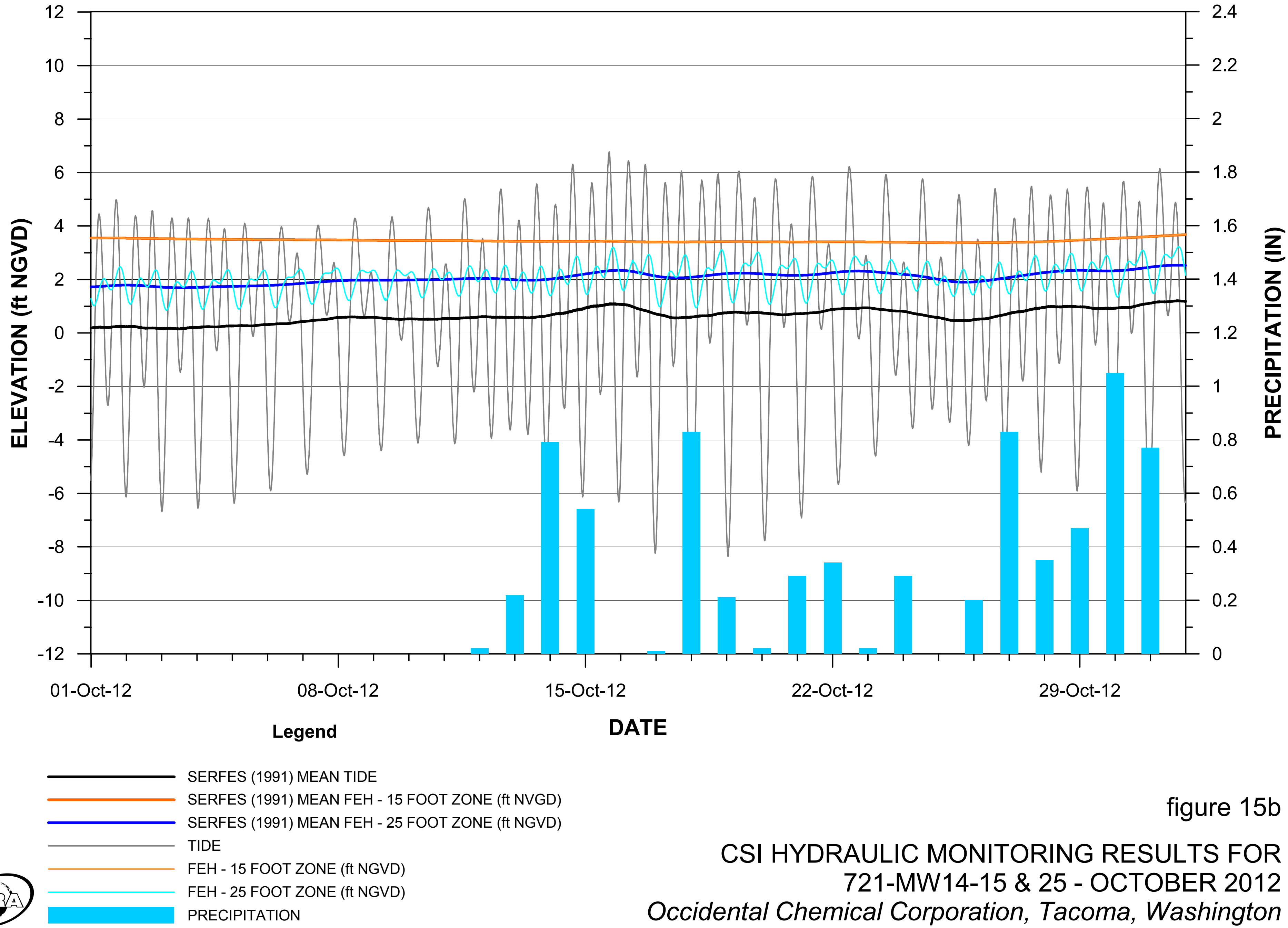


figure 15b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW14-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW14\07843-721-MW14-15 & 25 Foot Zones HydrographsOctober 2012.grf) MAR 6/2013

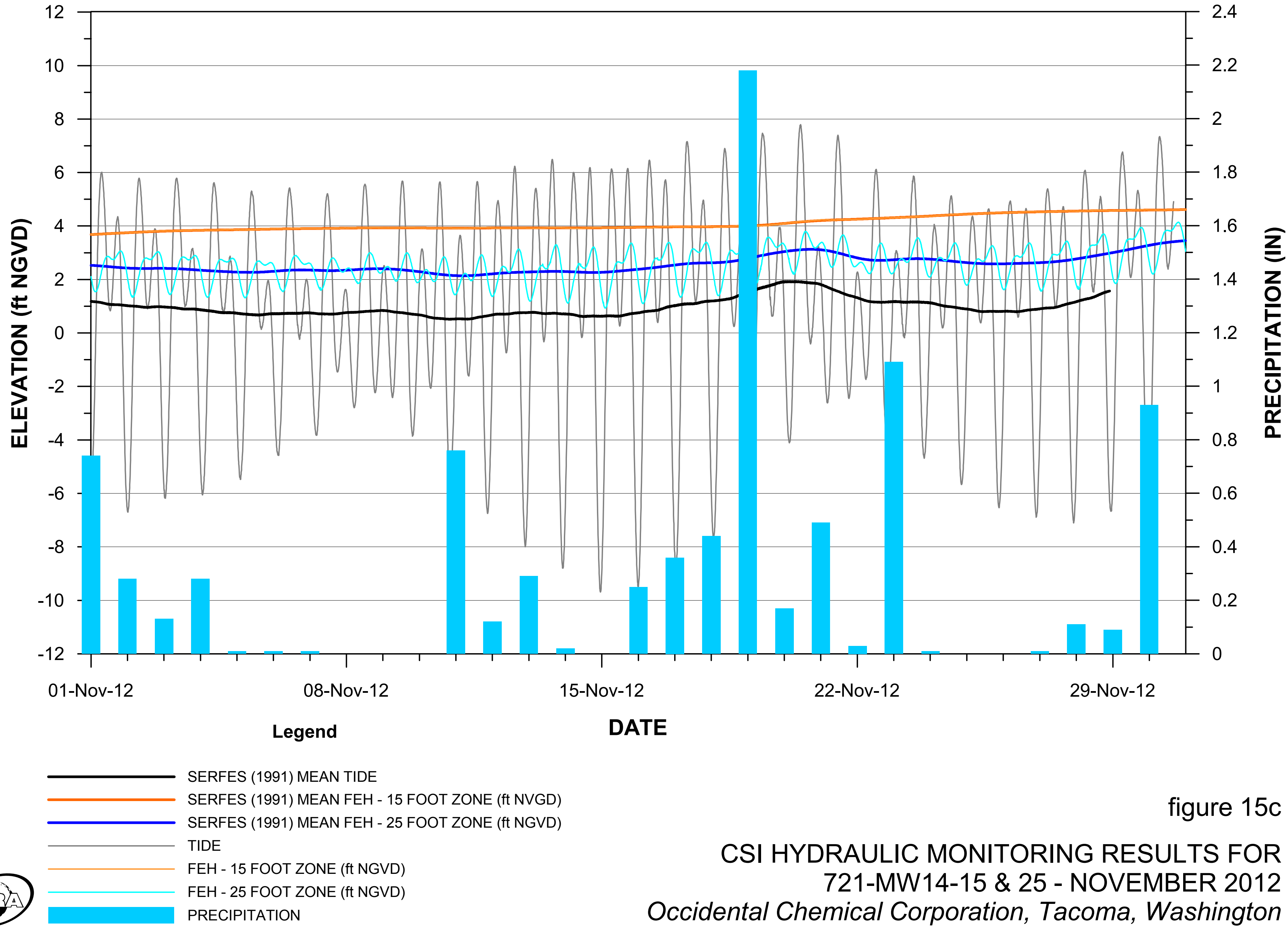
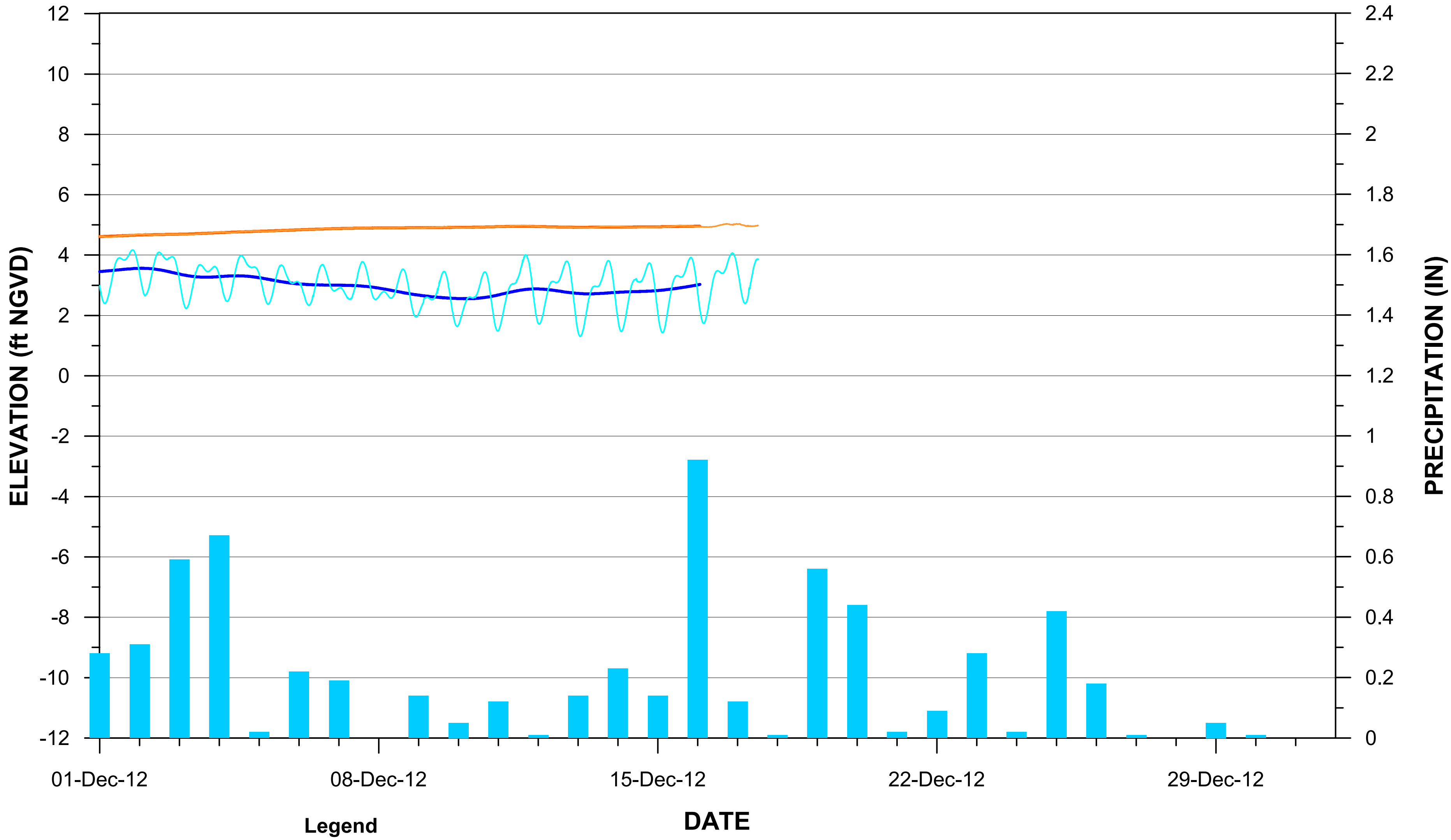


figure 15c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW14-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW14\07843-721-MW14-15 & 25 Foot Zones HydrographsNovember 2012.grf) MAR 6/2013



Legend

- SERFES (1991) MEAN TIDE
- SERFES (1991) MEAN FEH - 15 FOOT ZONE (ft NVGD)
- SERFES (1991) MEAN FEH - 25 FOOT ZONE (ft NGVD)
- TIDE
- FEH - 15 FOOT ZONE (ft NGVD)
- FEH - 25 FOOT ZONE (ft NGVD)
- PRECIPITATION

figure 15d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW14-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

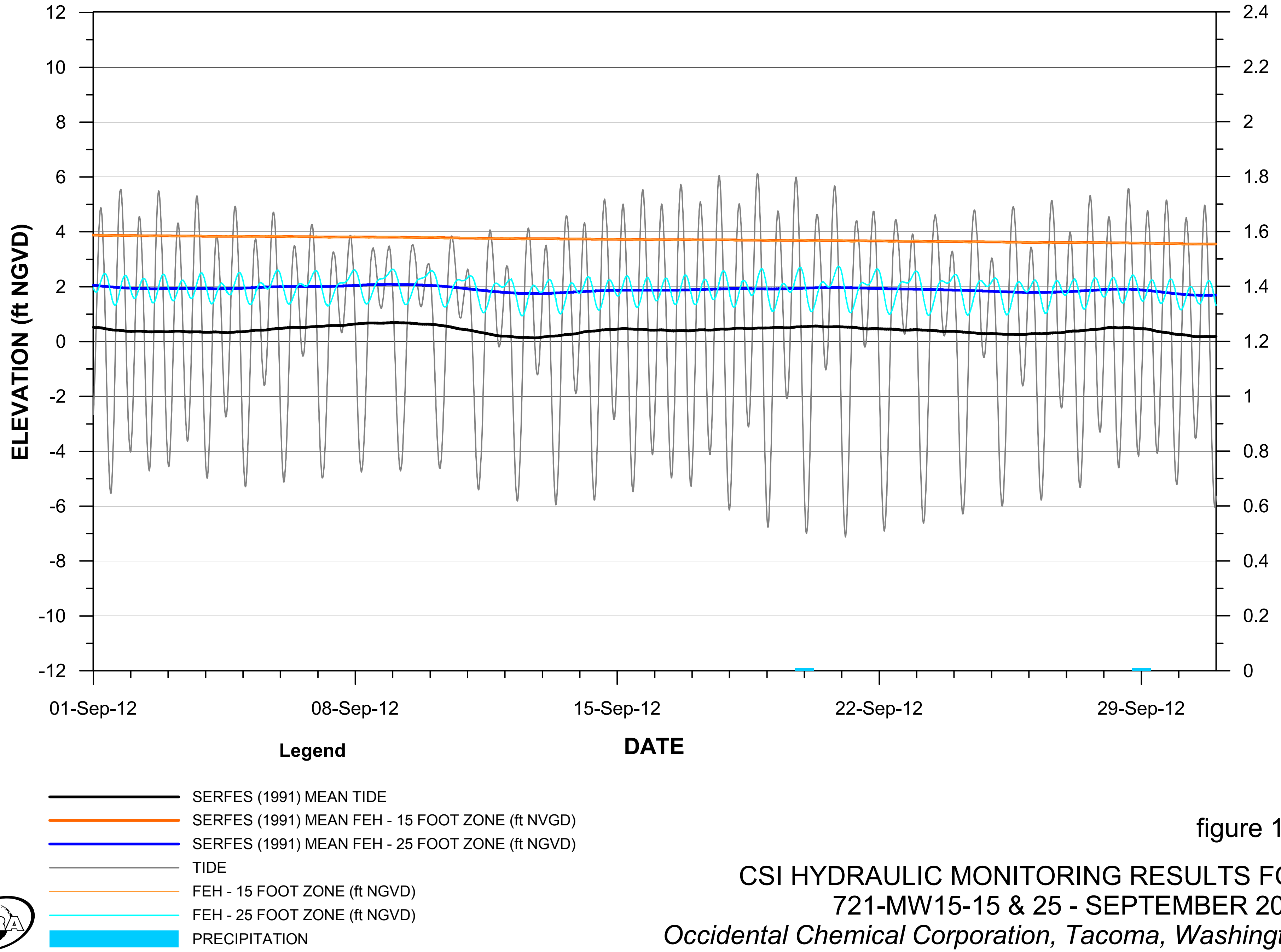


figure 16a

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW15-15 & 25 - SEPTEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW15\07843-721-MW15-15 & 25 Foot Zones HydrographsSeptember 2012.grf) MAR 6/2013

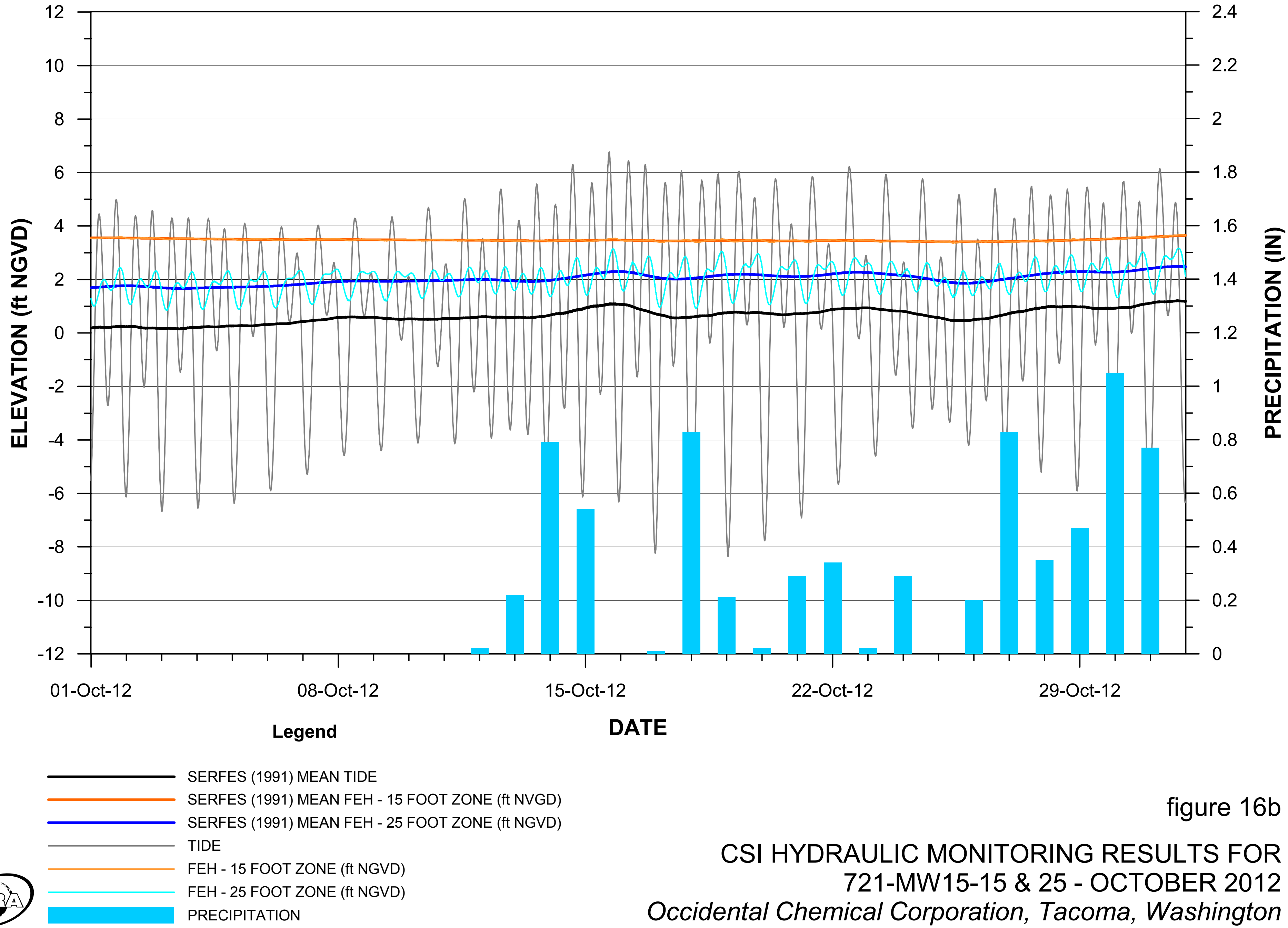


figure 16b

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW15-15 & 25 - OCTOBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW15\07843-721-MW15-15 & 25 Foot Zones HydrographsOctober 2012.grf) MAR 6/2013

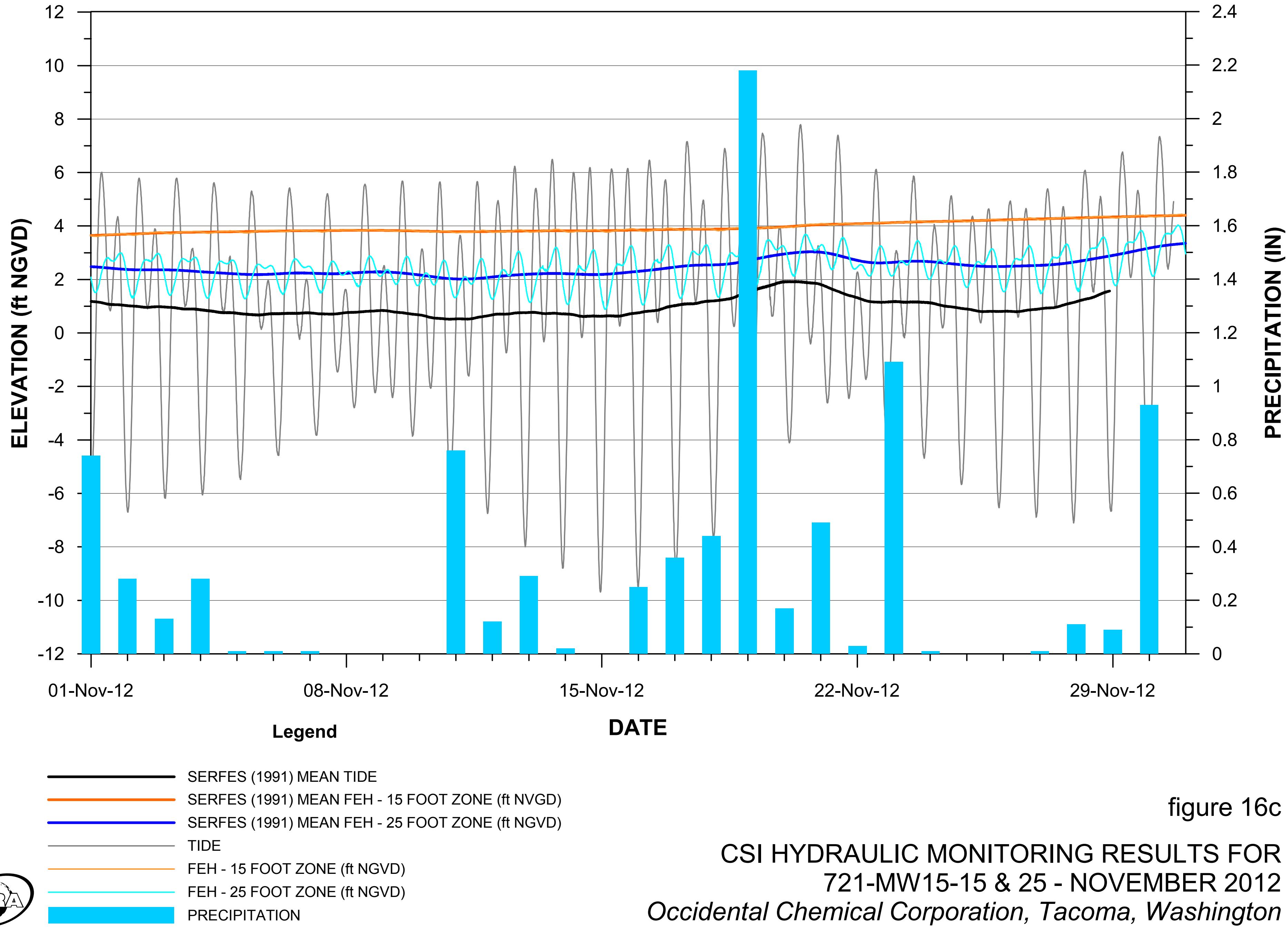


figure 16c

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW15-15 & 25 - NOVEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW15\07843-721-MW15-15 & 25 Foot Zones HydrographsNovember 2012.grf) AUG 5/2014

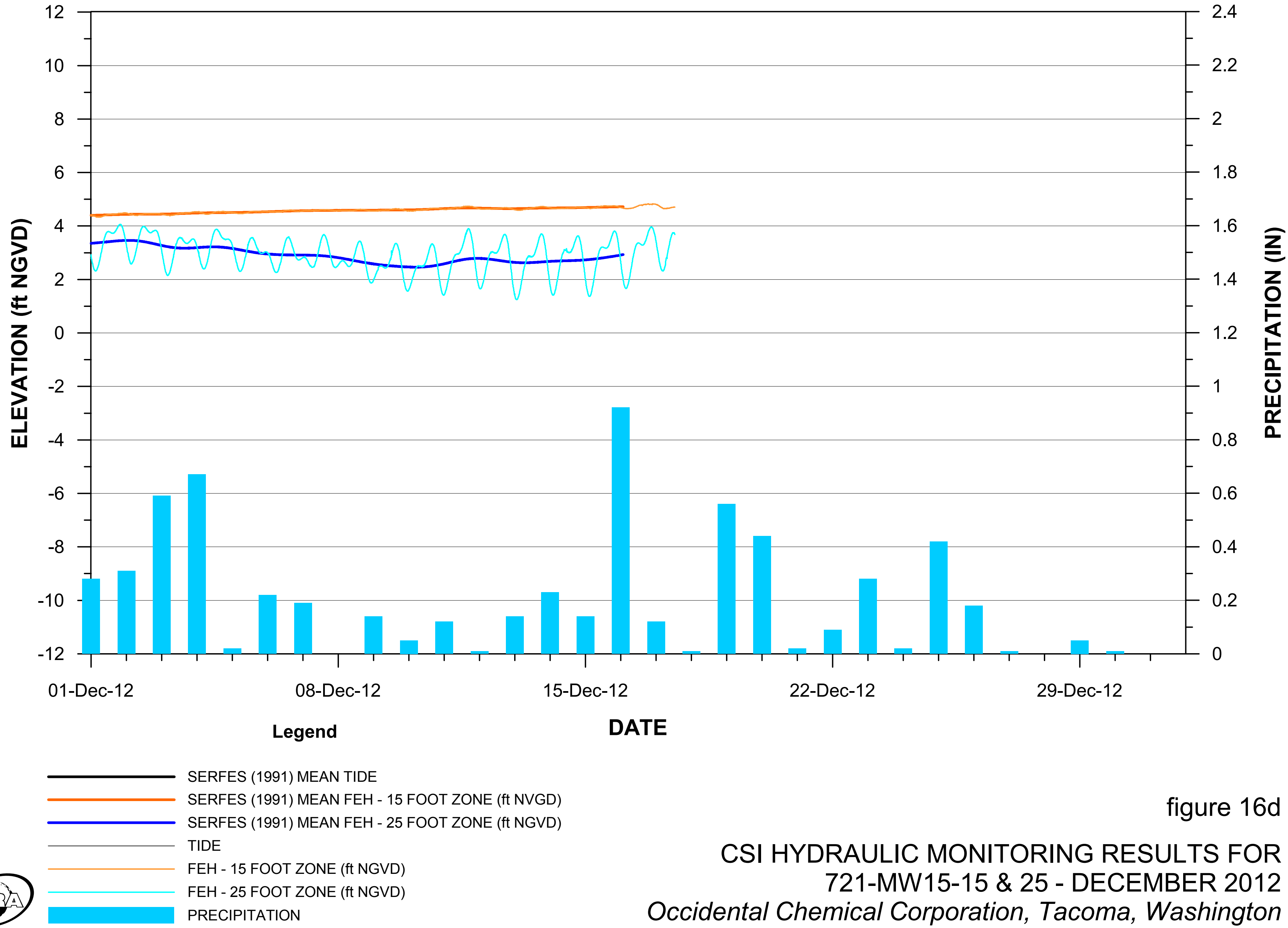


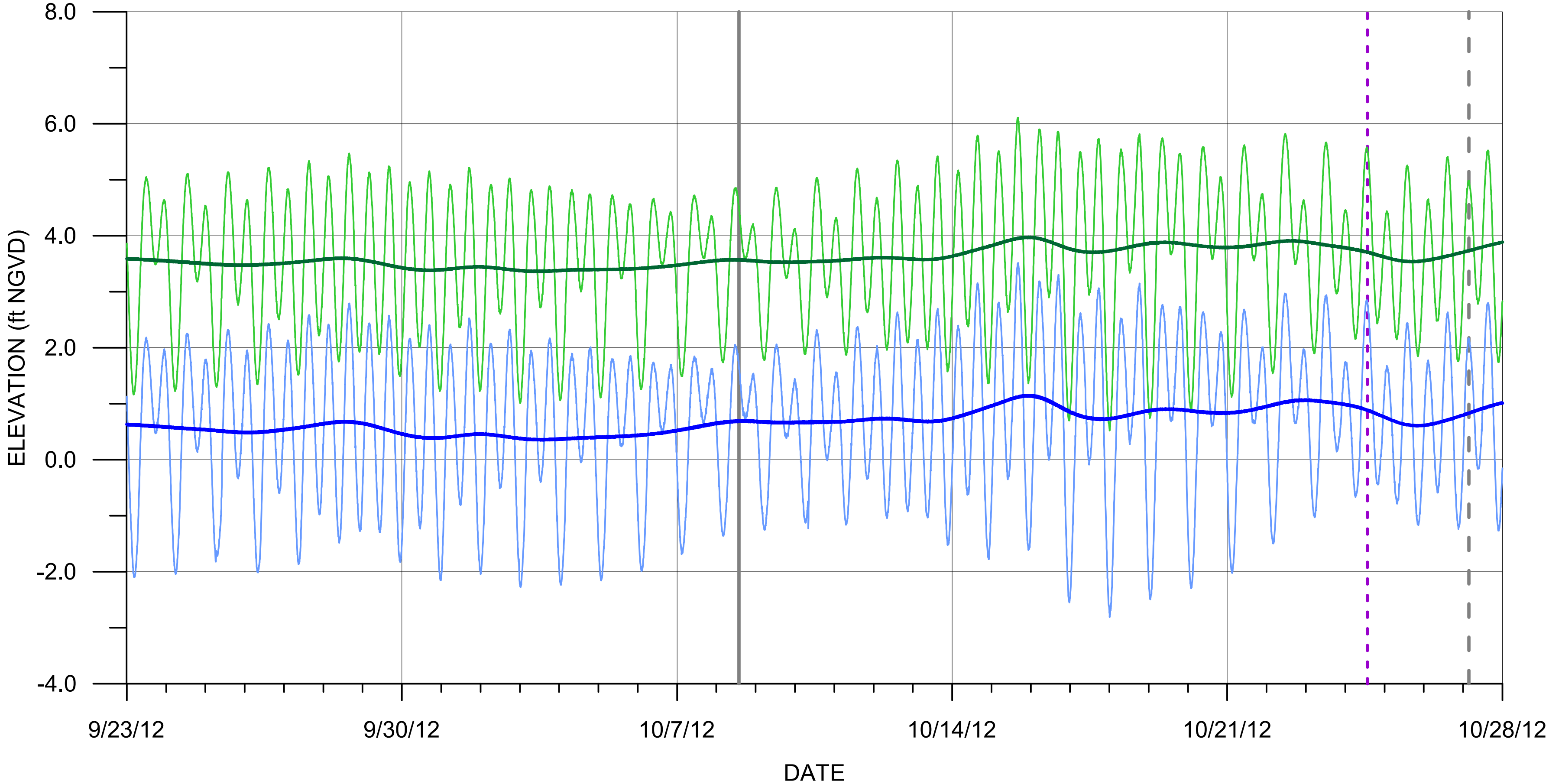
figure 16d

CSI HYDRAULIC MONITORING RESULTS FOR
721-MW15-15 & 25 - DECEMBER 2012
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Solinst Hydrographs\Transducer Data\SERFES Mean For Plotting\Figures\721-MW15\07843-721-MW15-15 & 25 Foot Zones HydrographsDecember 2012.grf) MAR 6/2014

Attachment 11

Event 3A and 3B Deep Zone ENV Hydrographs



LEGEND

- 17C-160
- 17C-160 SERFES (1991) MEAN ENV
- 17C-130
- 17C-130 SERFES (1991) MEAN ENV
- EXTRACTION SYSTEM OFF
- EXTRACTION SYSTEM ON
- EXTRACTION SYSTEM DOWN (SEAWATER PUMP FAILURE)

figure 1

ENVIRONMENTAL HEAD
17C-130 AND 17C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

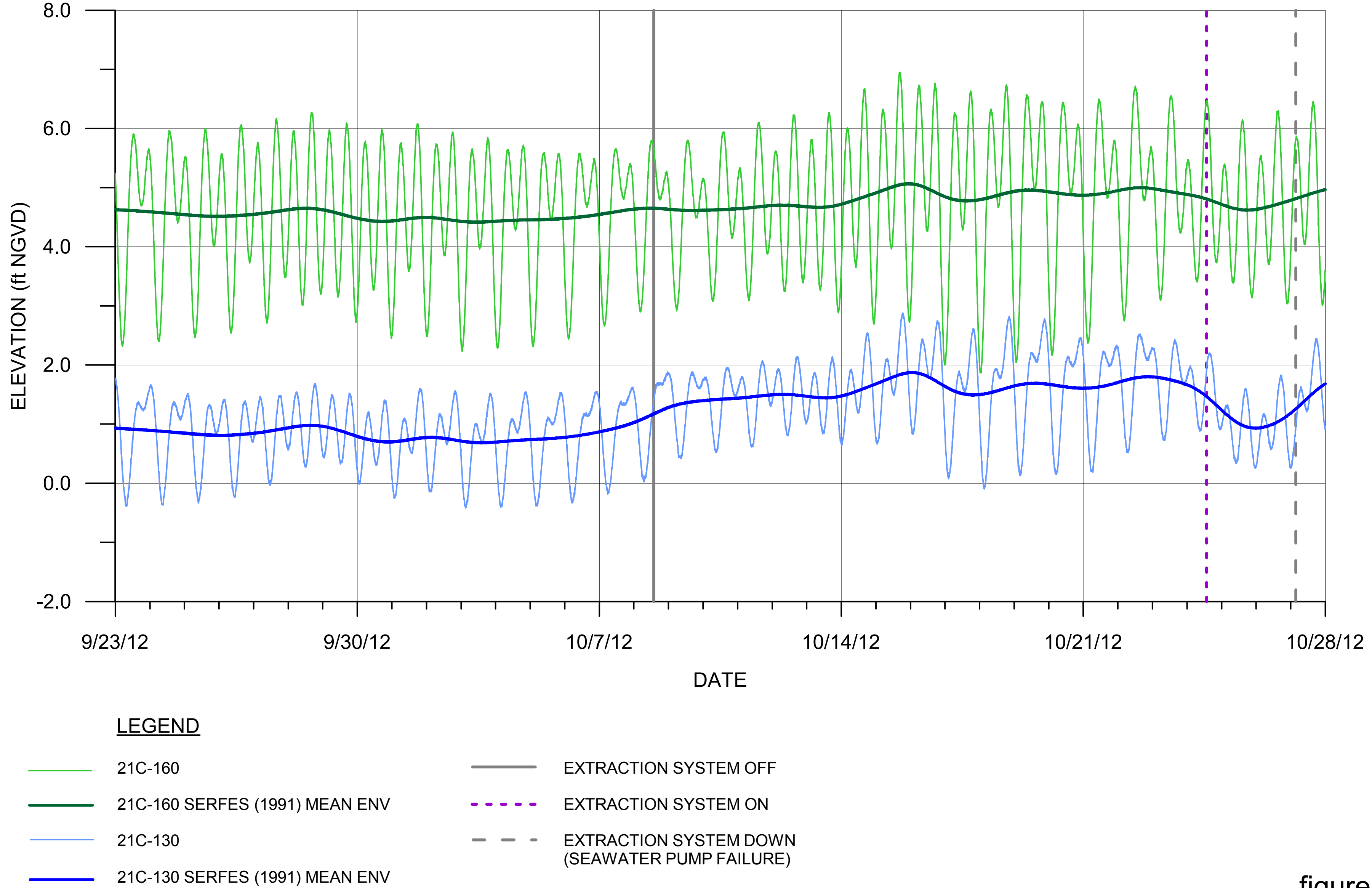


figure 2

ENVIRONMENTAL HEAD
21C-130 AND 21C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

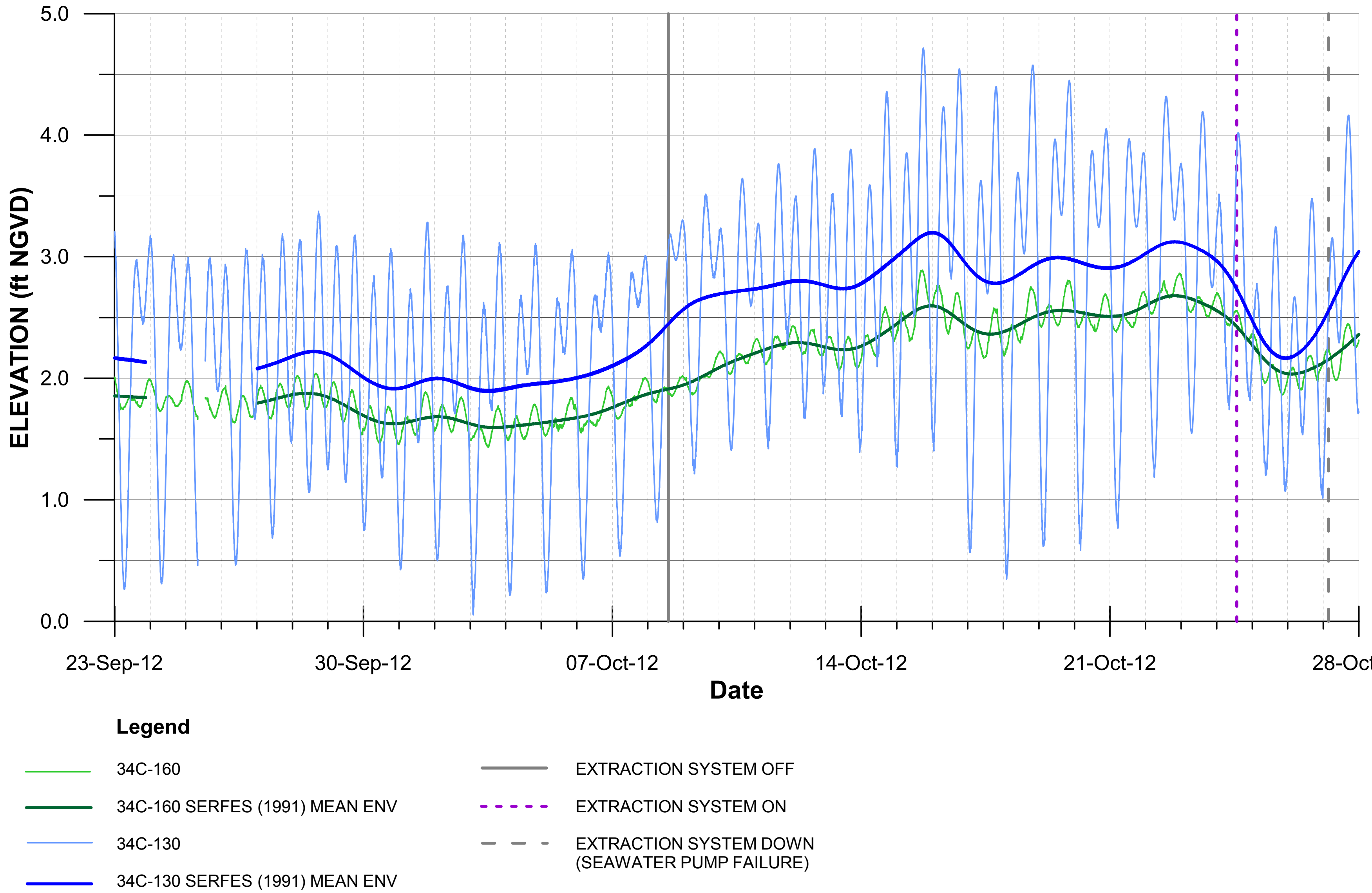


figure 3

ENVIRONMENTAL HEAD
34C-130 AND 34C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (34C-130 AND 34C-160).grf) AUG 4/2014

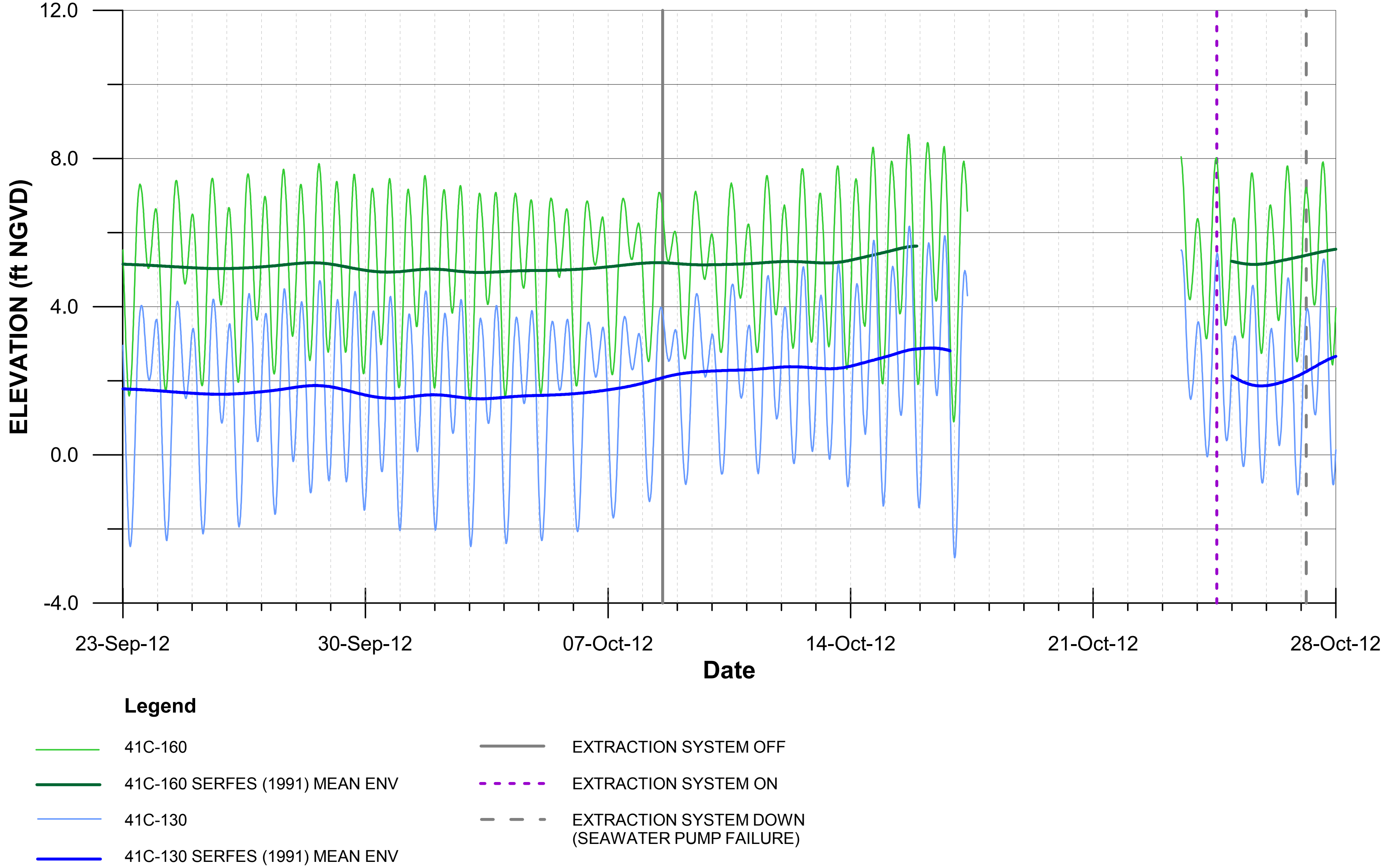


figure 4

ENVIRONMENTAL HEAD
41-130 AND 41C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (41-130 AND 41C-160).grf) AUG 4/2014

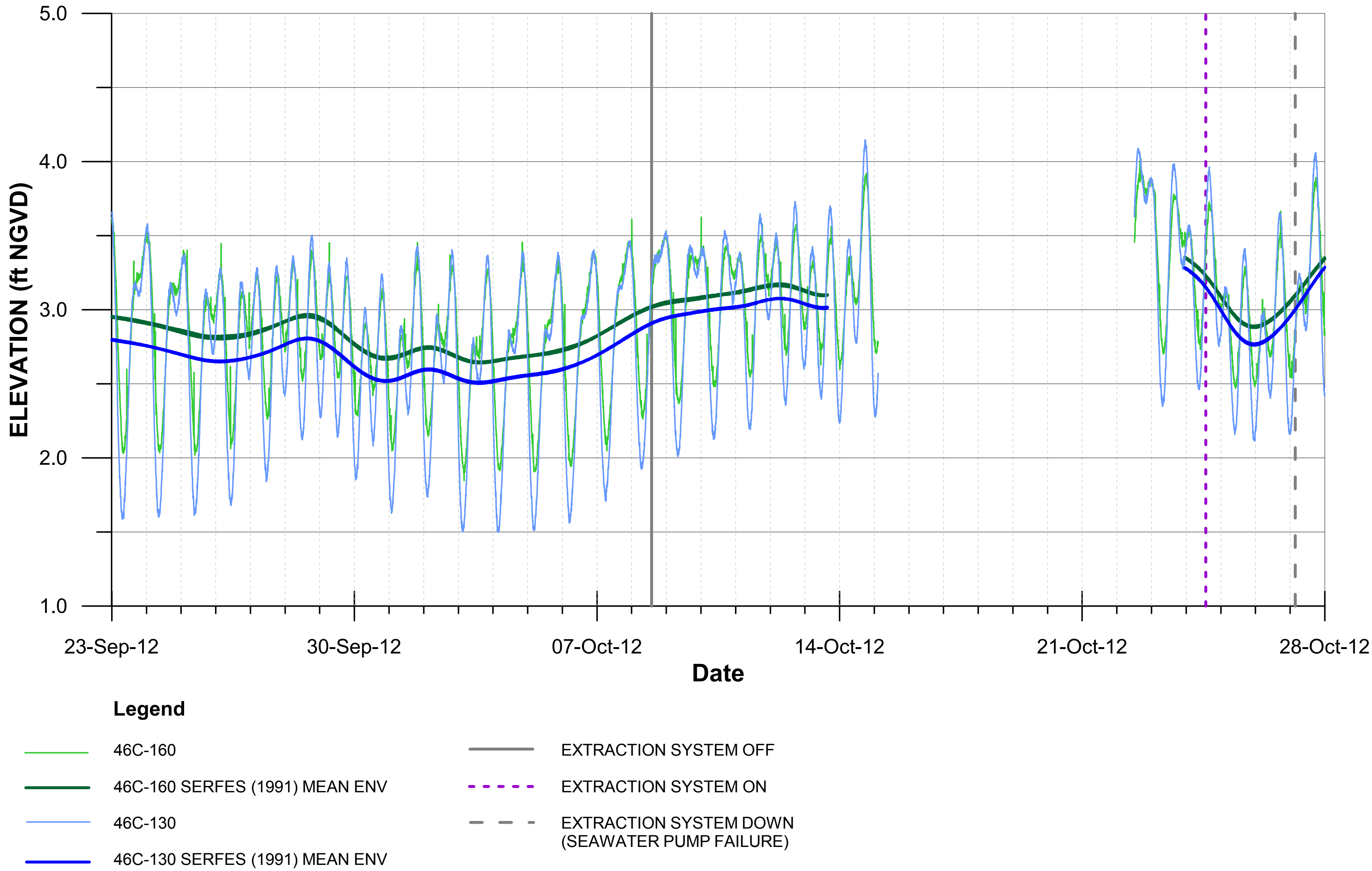


figure 5

ENVIRONMENTAL HEAD
46C-130 AND 46C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (46C-130 AND 46C-160).grf) AUG 5/2014

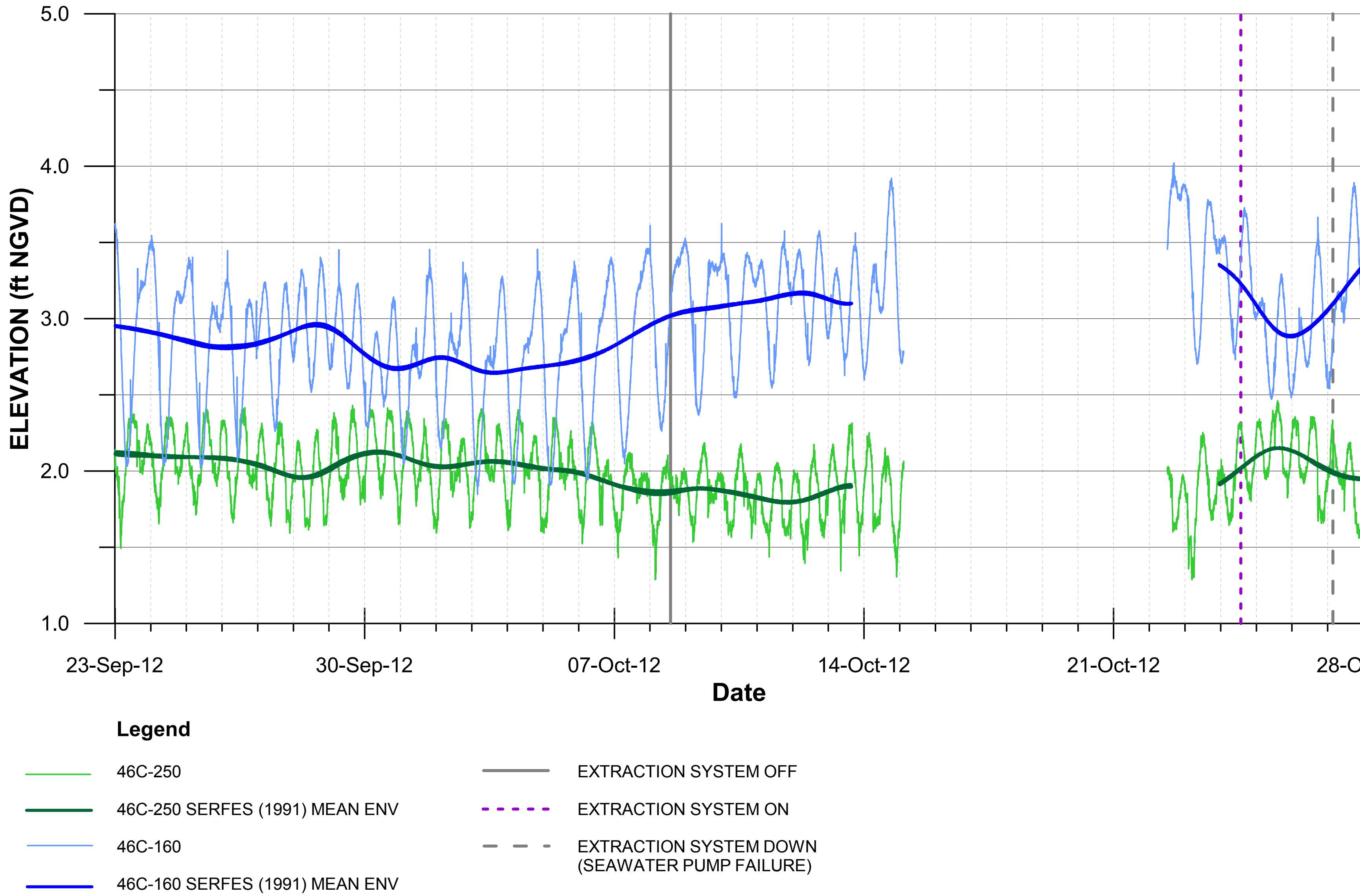


figure 6

ENVIRONMENTAL HEAD
46C-160 AND 46C-250 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (46C-160 AND 46C-250).grf) AUG 4/2014

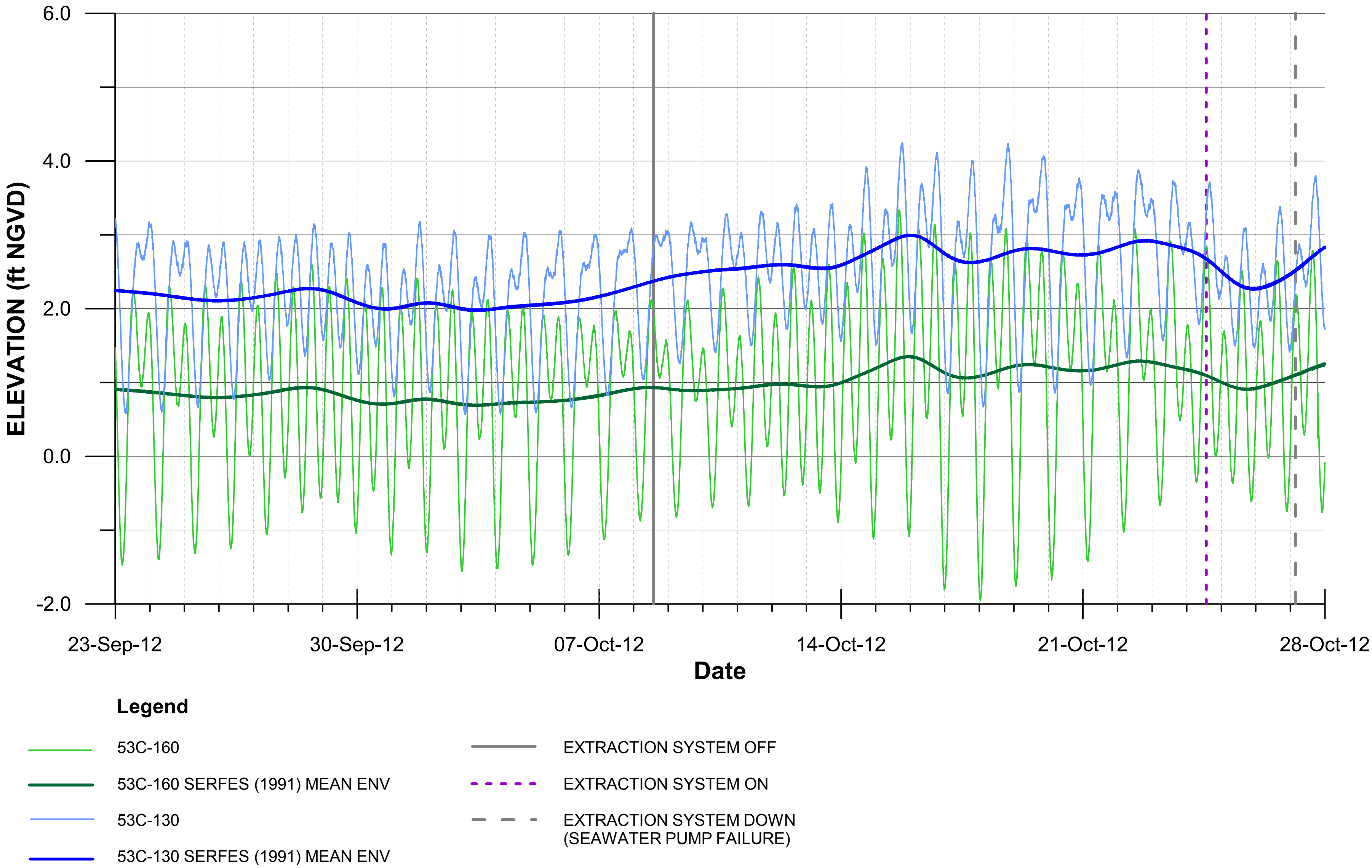


figure 7

ENVIRONMENTAL HEAD
53C-130 AND 53C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

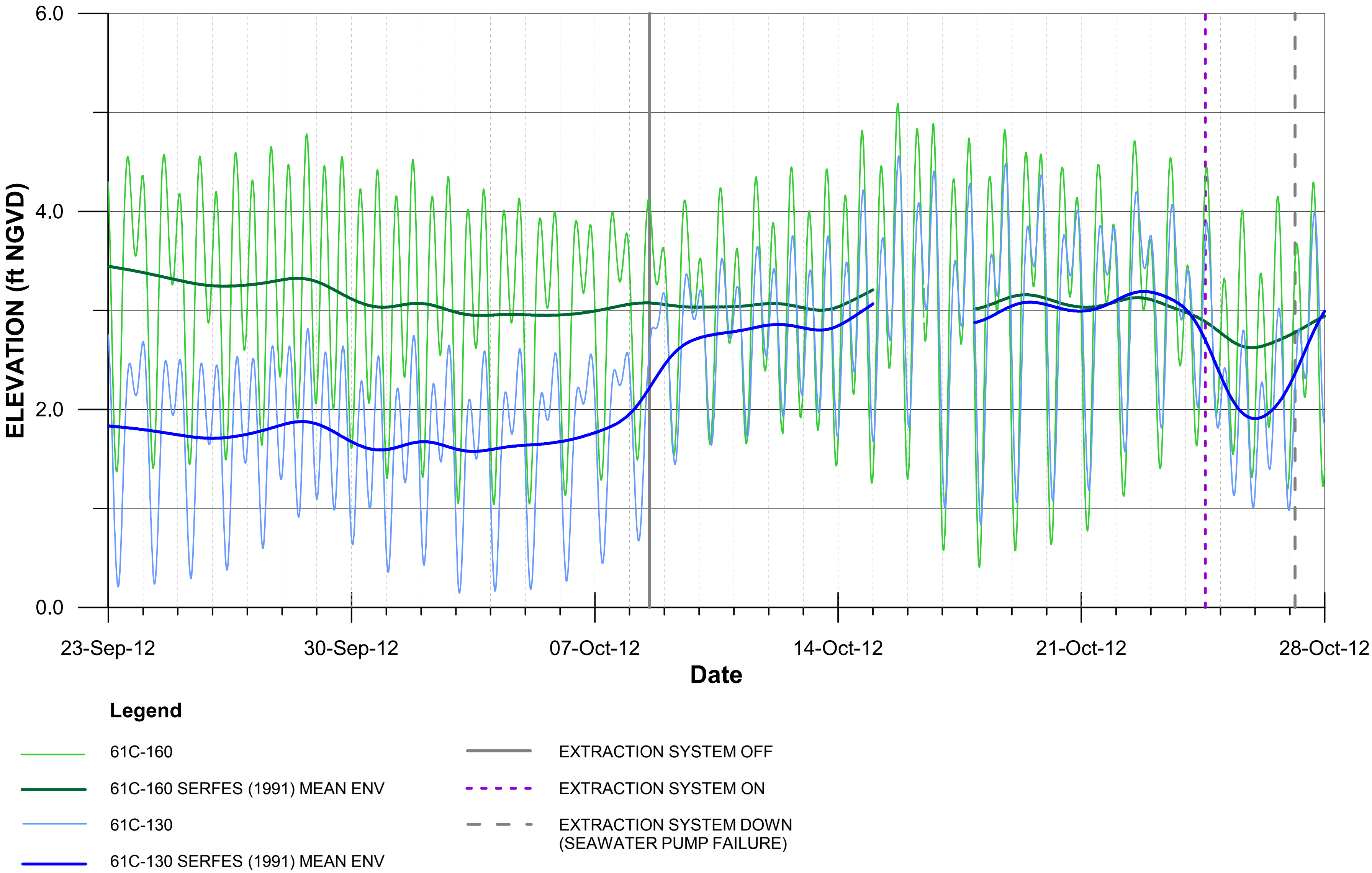
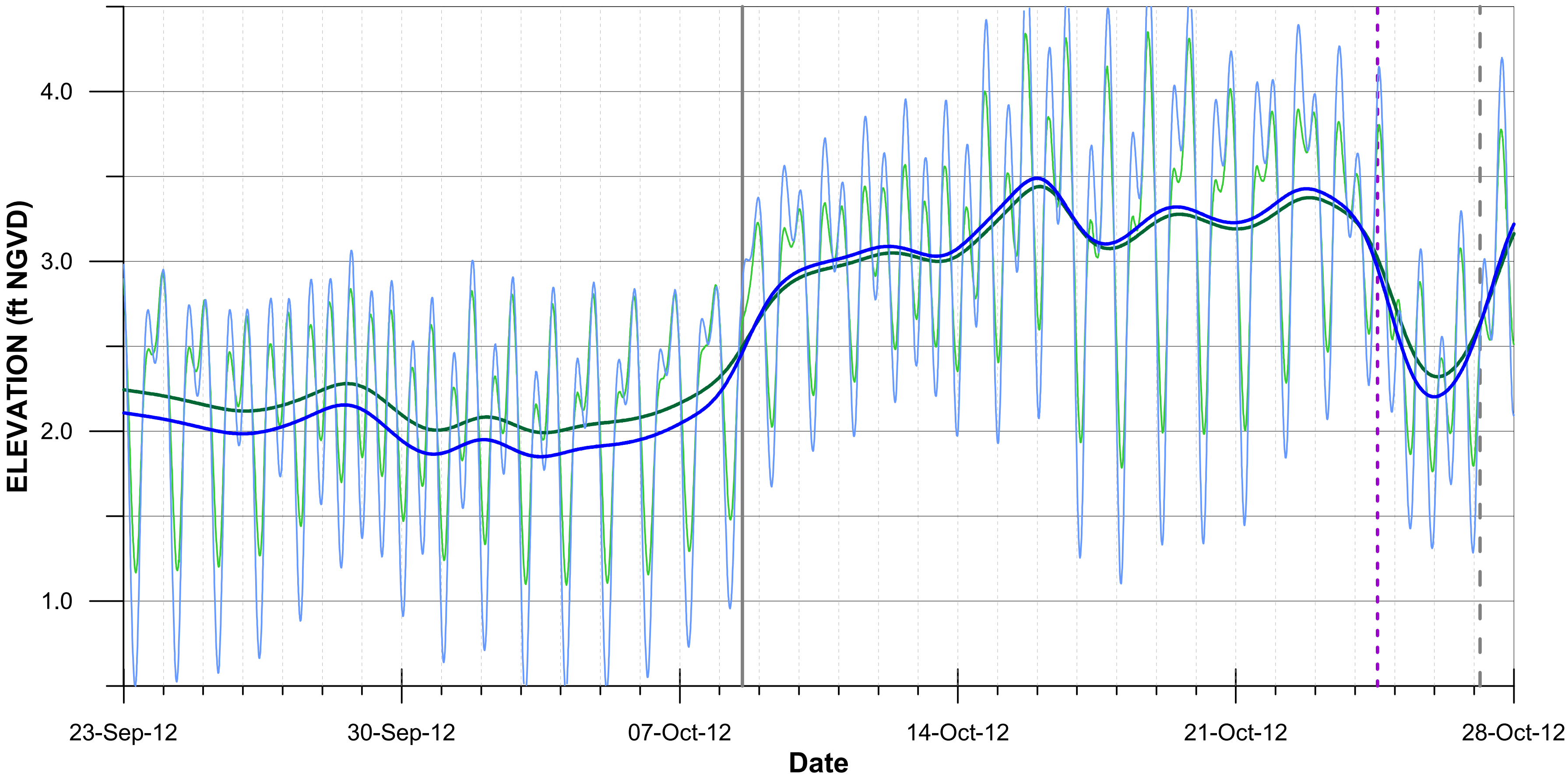


figure 8

ENVIRONMENTAL HEAD
61C-130 AND 61C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington



Legend

77C-160

77C-160 SERFES (1991) MEAN ENV

77C-130

77C-130 SERFES (1991) MEAN ENV

EXTRACTION SYSTEM OFF

EXTRACTION SYSTEM ON

EXTRACTION SYSTEM DOWN (SEAWATER PUMP FAILURE)

figure 9

ENVIRONMENTAL HEAD
77C-130 AND 77C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

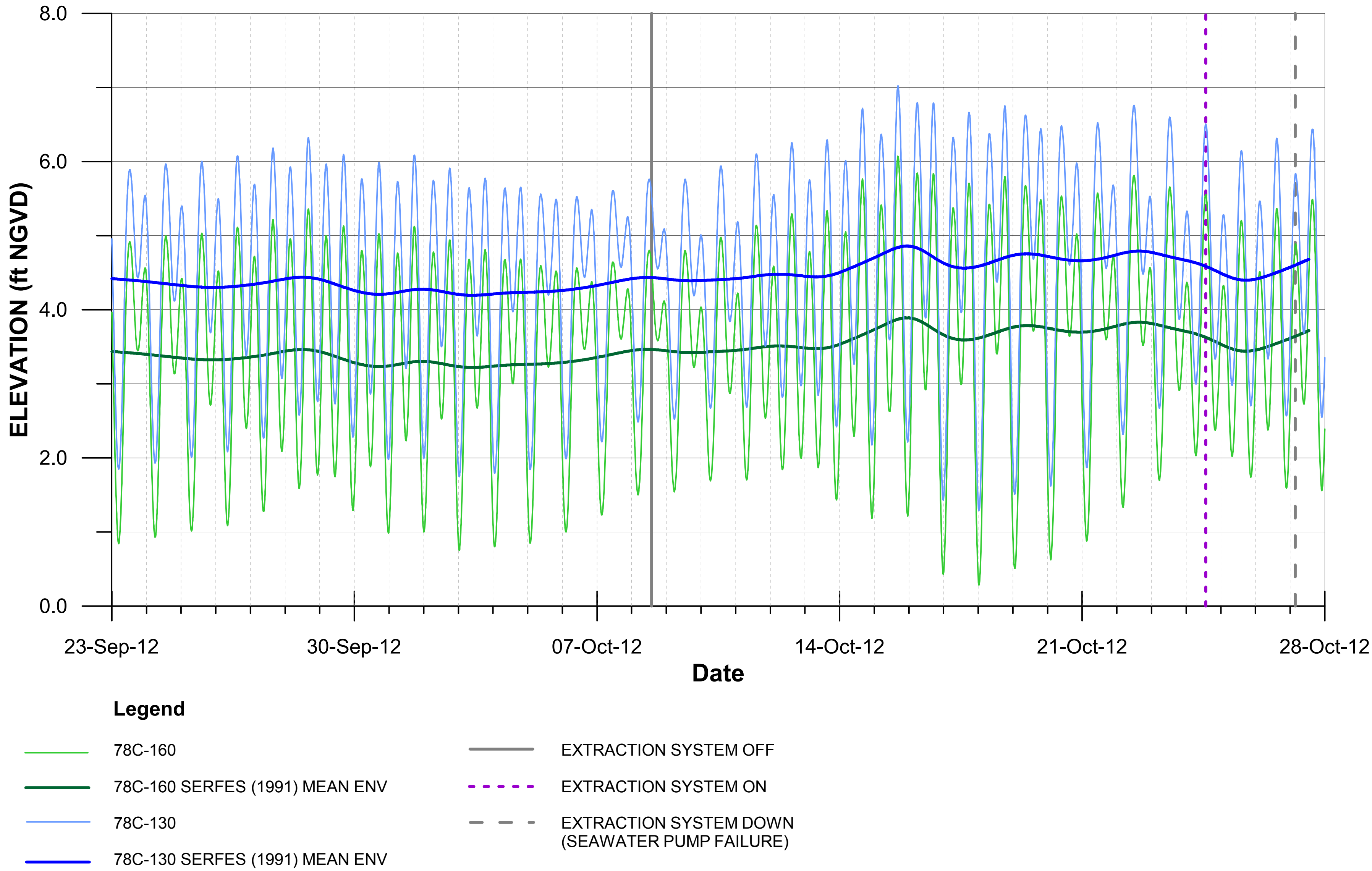


figure 10

ENVIRONMENTAL HEAD
78C-130 AND 78C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (78C-130 AND 78C-160).grf) AUG 4/2014

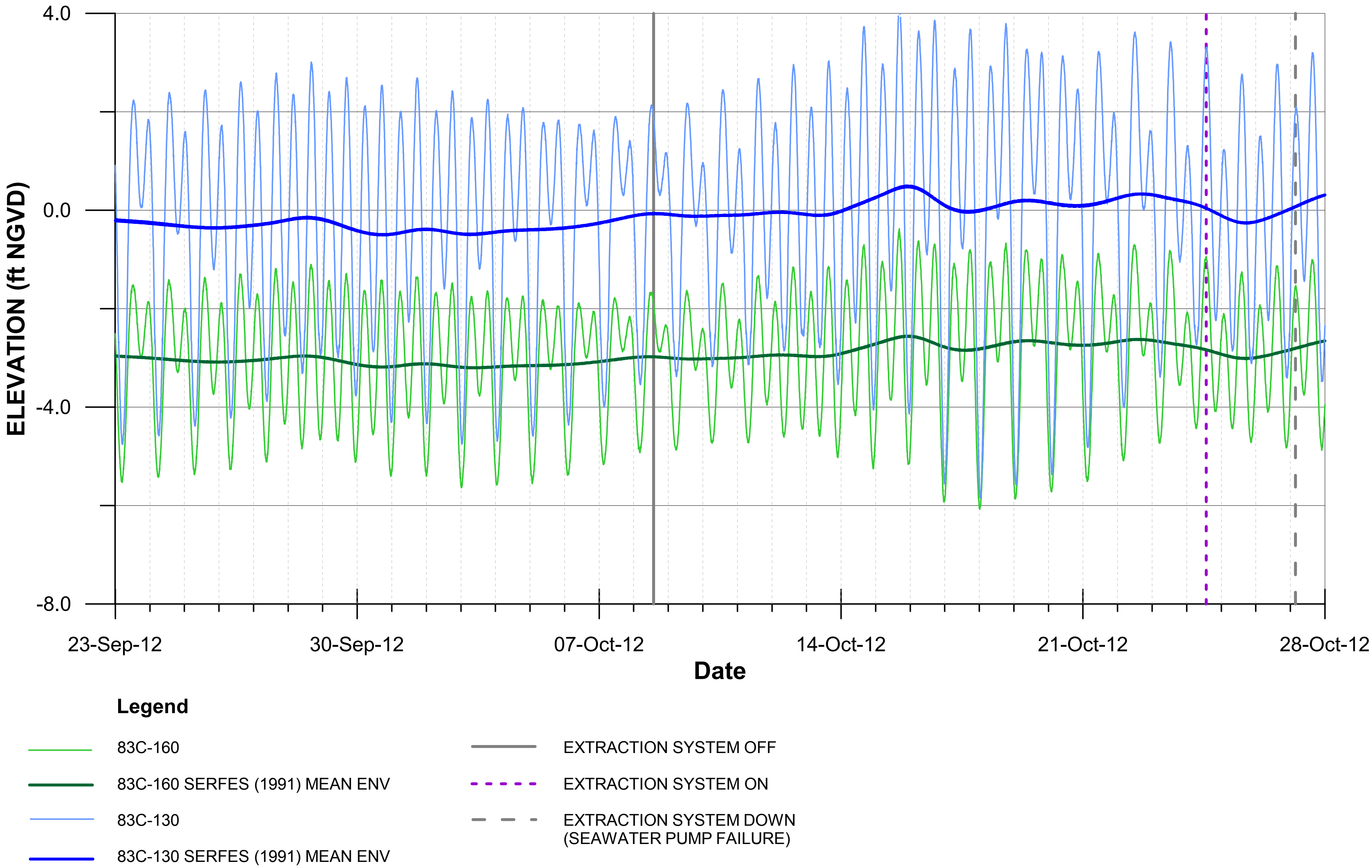


figure 11

ENVIRONMENTAL HEAD
83C-130 AND 83C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (83C-130 AND 83C-160).grf) AUG 4/2014

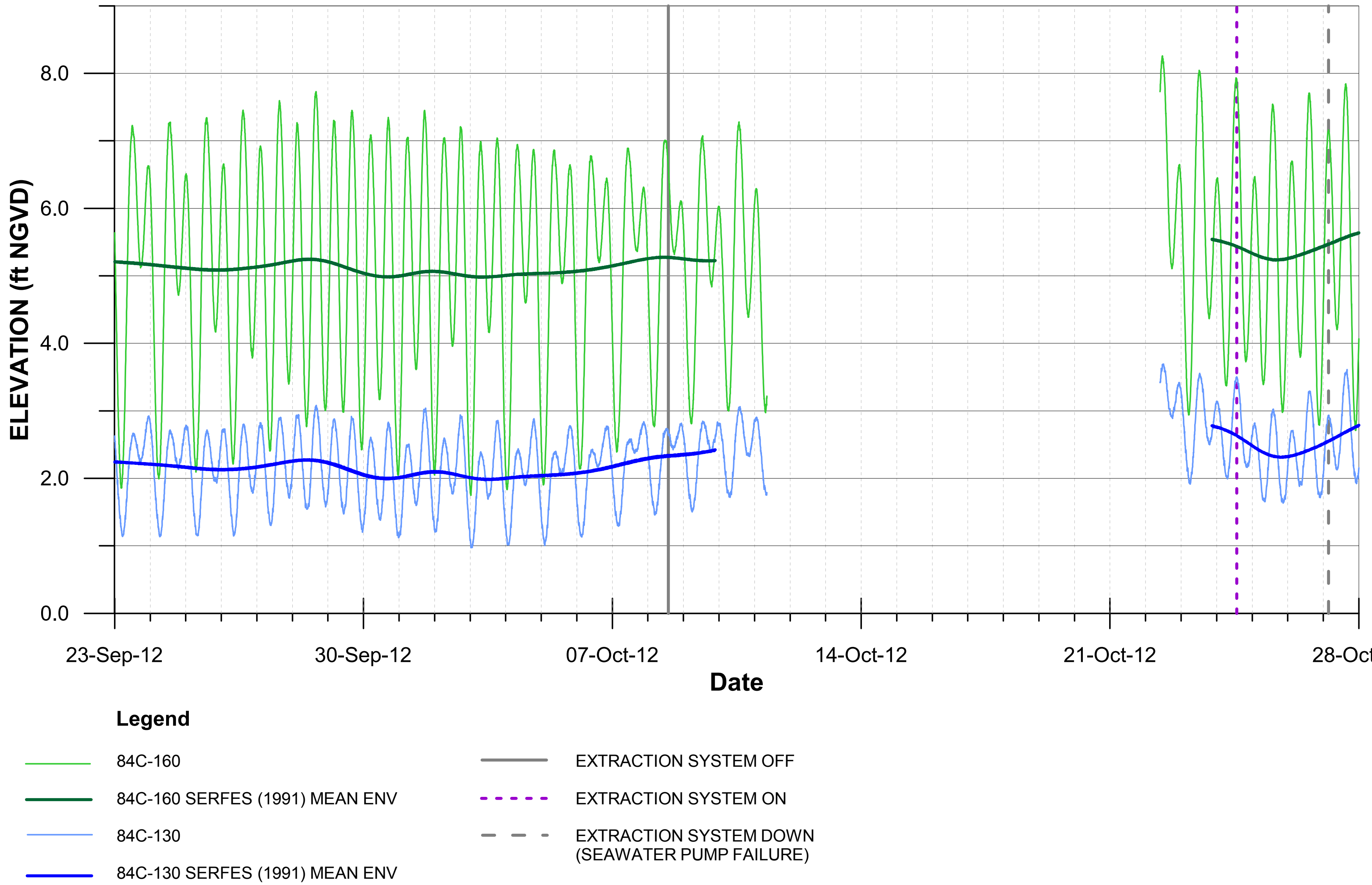


figure 12

ENVIRONMENTAL HEAD
84C-130 AND 84C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (84C-130 AND 84C-160).grf) AUG 4/2014

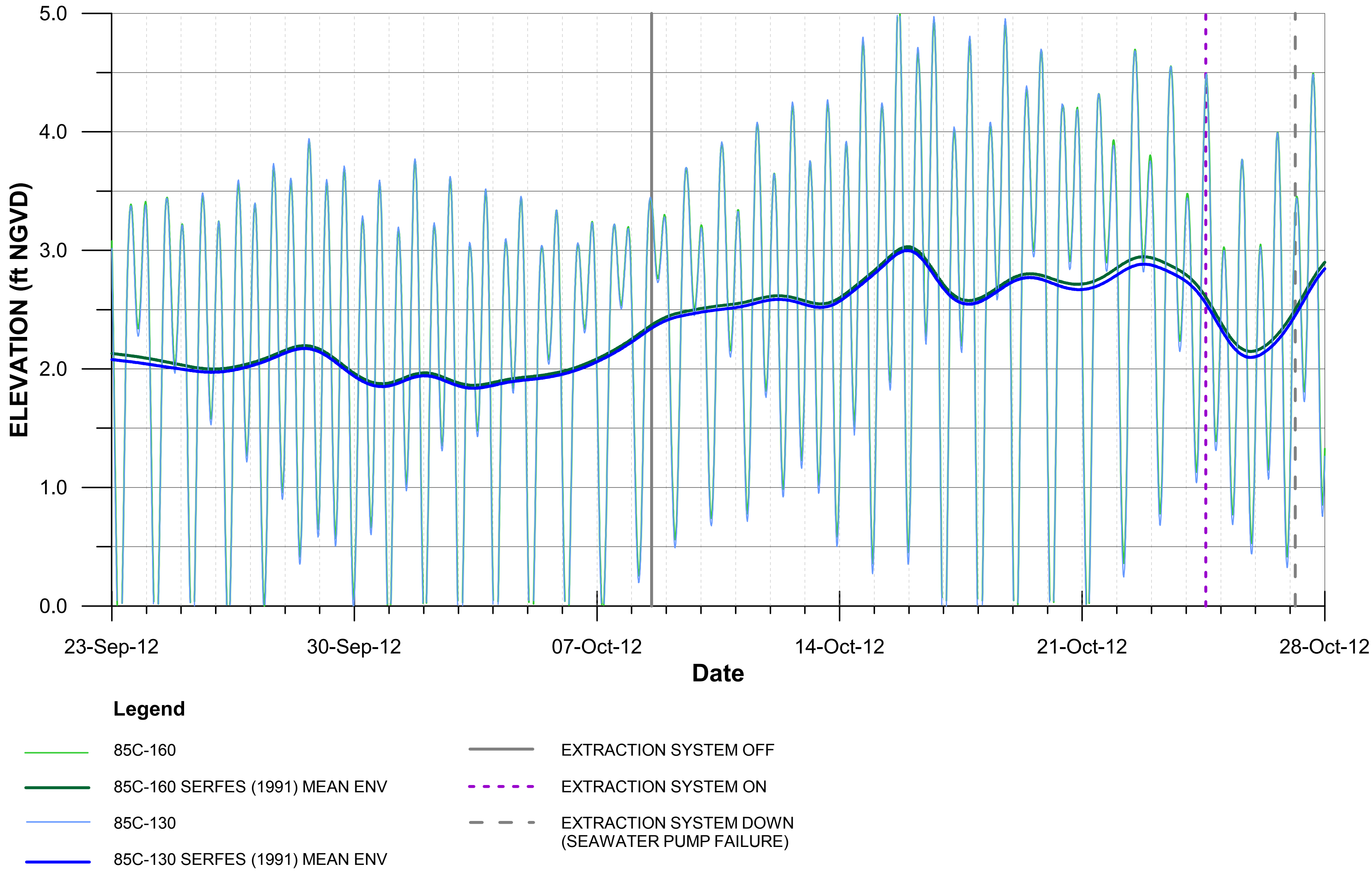


figure 13

ENVIRONMENTAL HEAD
85C-130 AND 85C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (85C-130 AND 85C-160).grf) AUG 4/2014

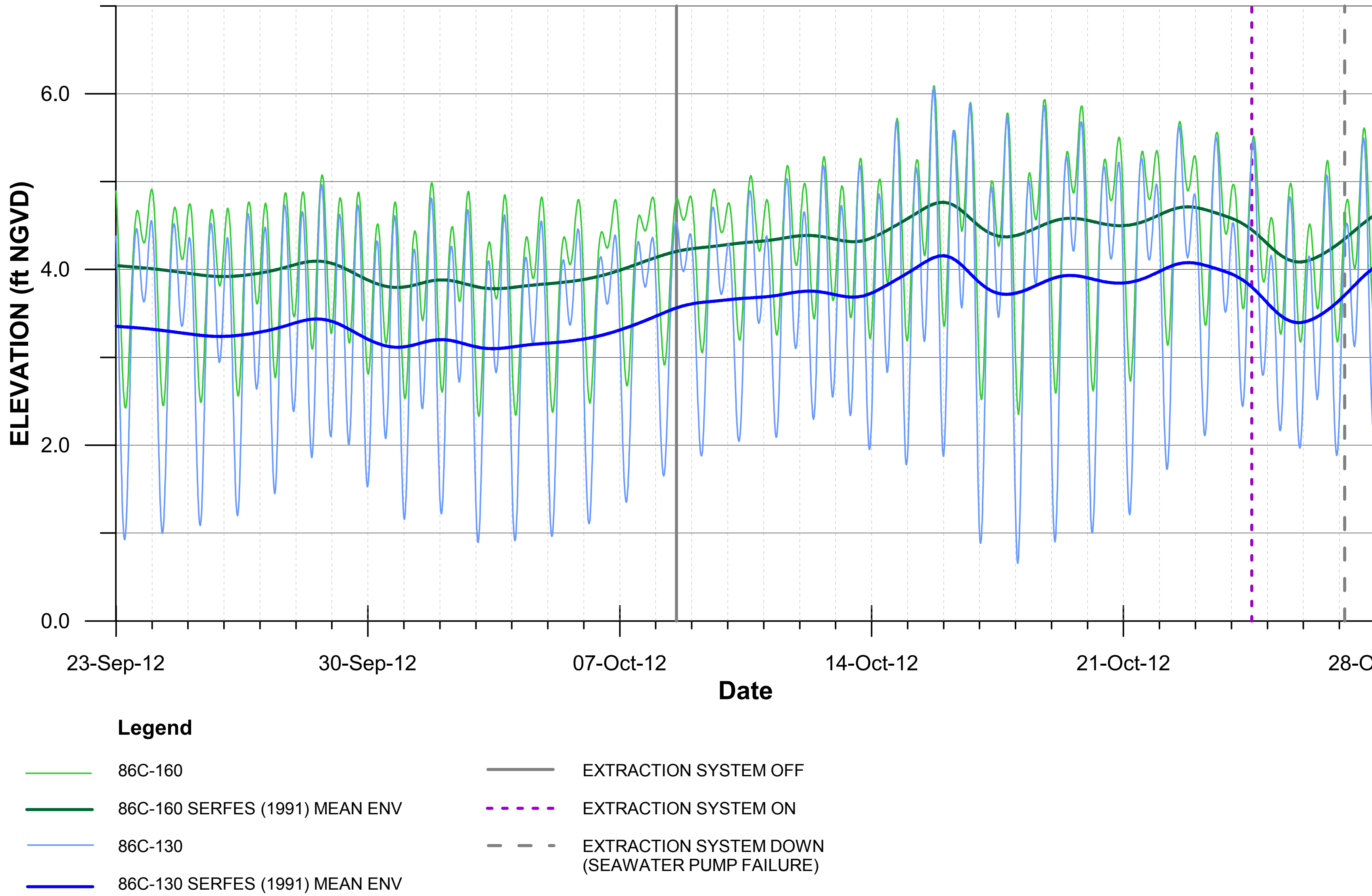


figure 14

ENVIRONMENTAL HEAD
86C-130 AND 86C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (86C-130 AND 86C-160).grf) AUG 5/2014

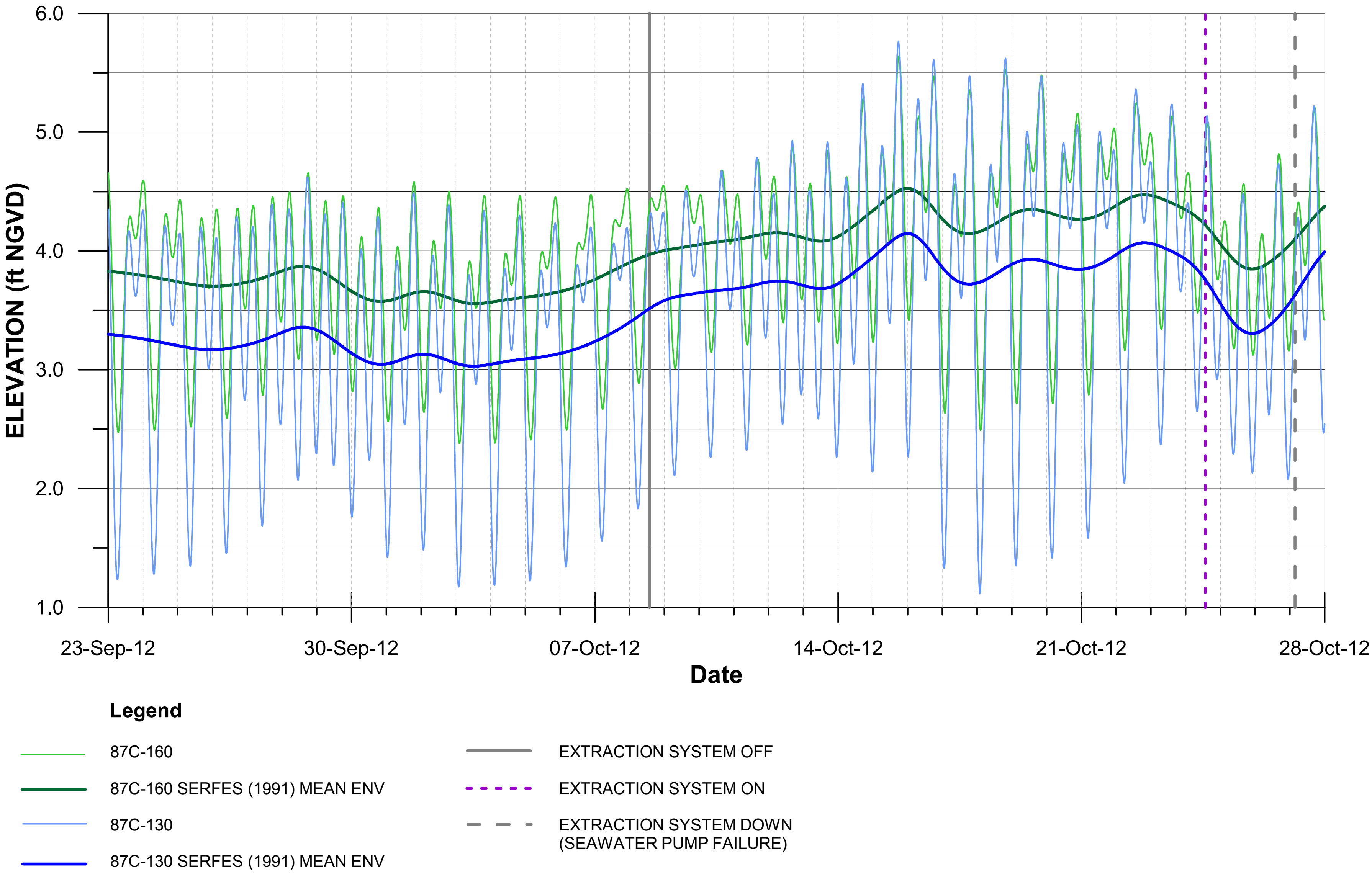


figure 15

ENVIRONMENTAL HEAD
87C-130 AND 87C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (87C-130 AND 87C-160).grf) AUG 5/2014

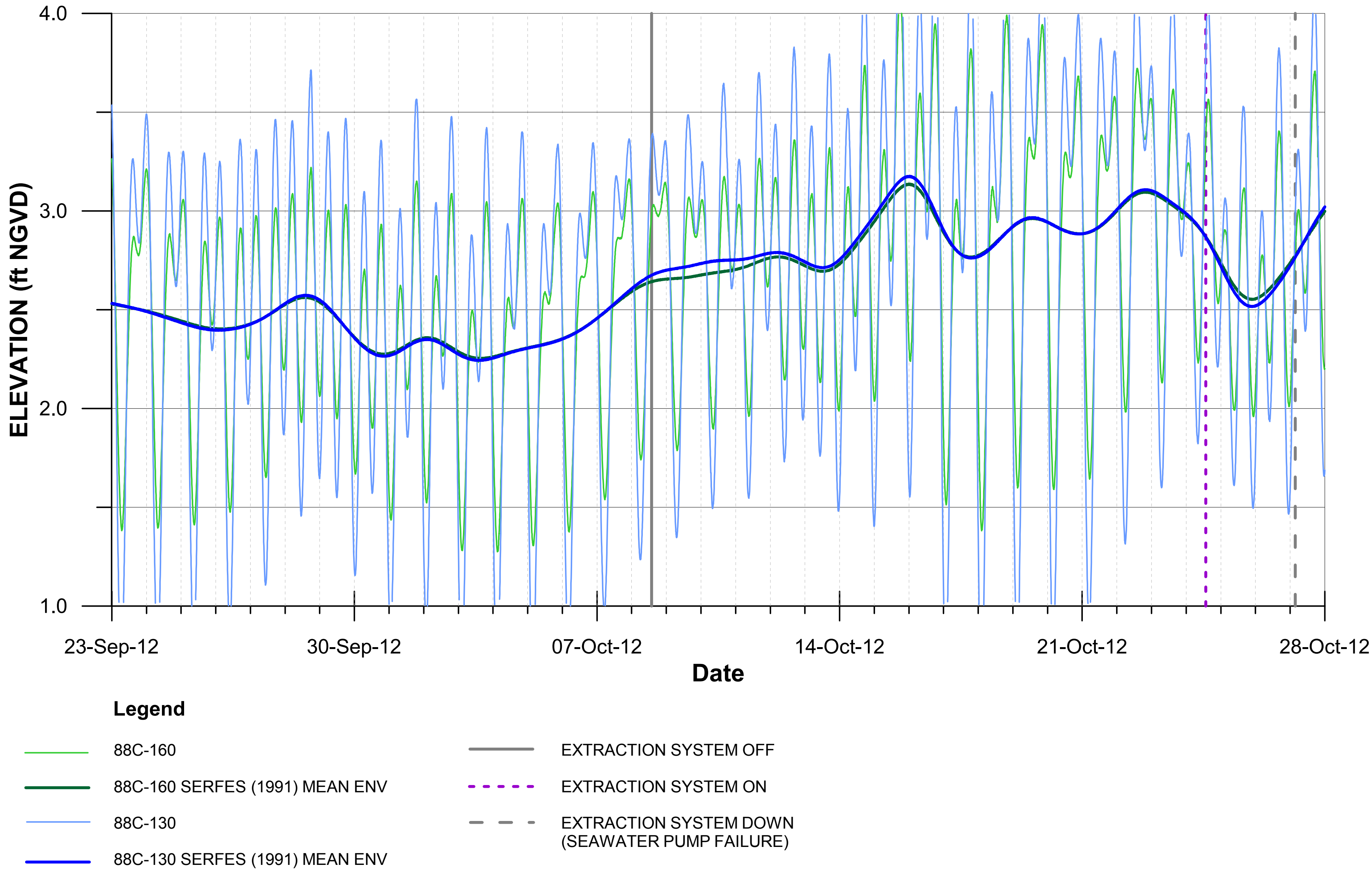


figure 16

ENVIRONMENTAL HEAD
88C-130 AND 88C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (88C-130 AND 88C-160).grf) AUG 5/2014

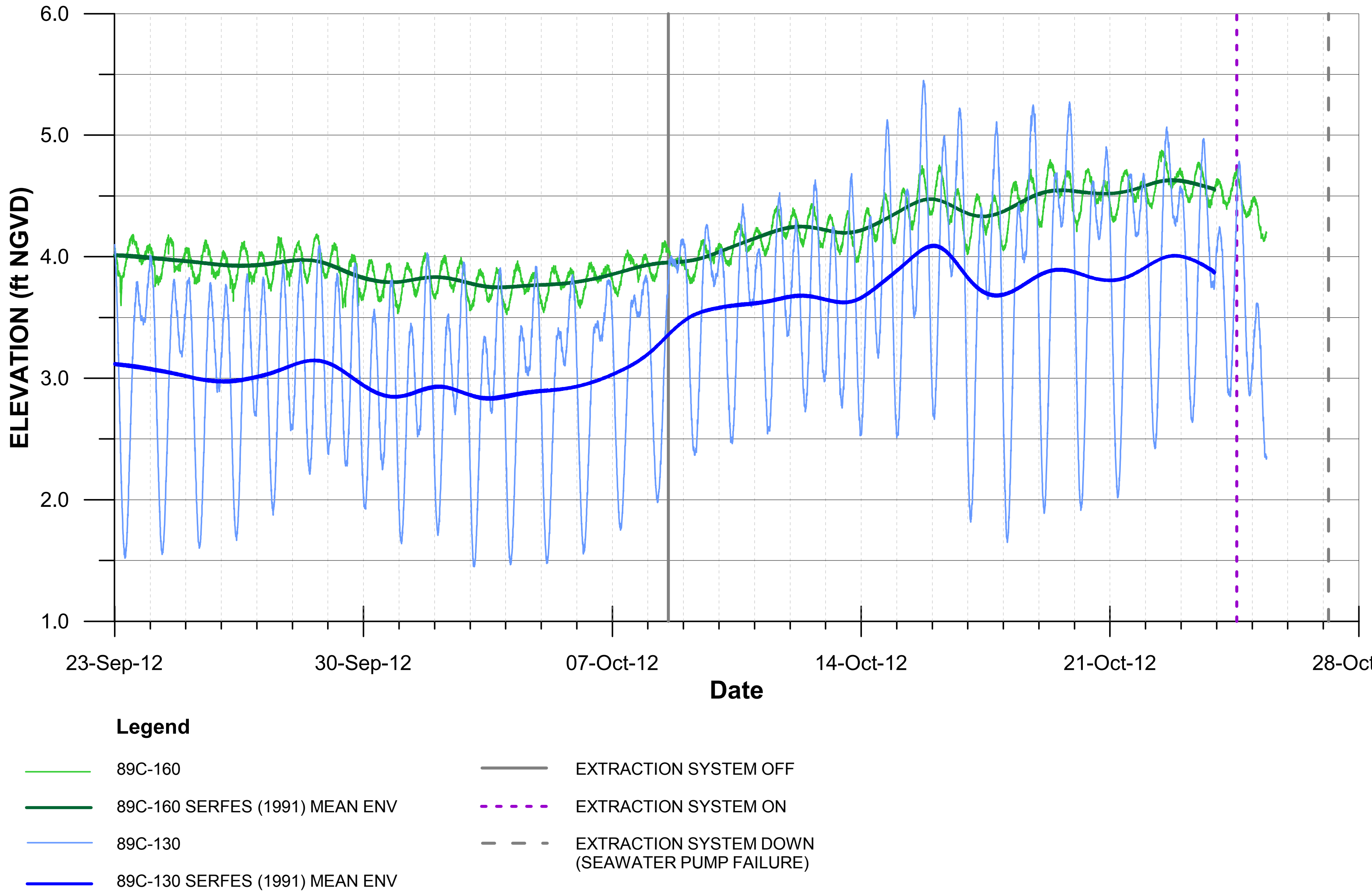


figure 17

ENVIRONMENTAL HEAD
89C-130 AND 89C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (89C-130 AND 89C-160).grf) AUG 5/2014

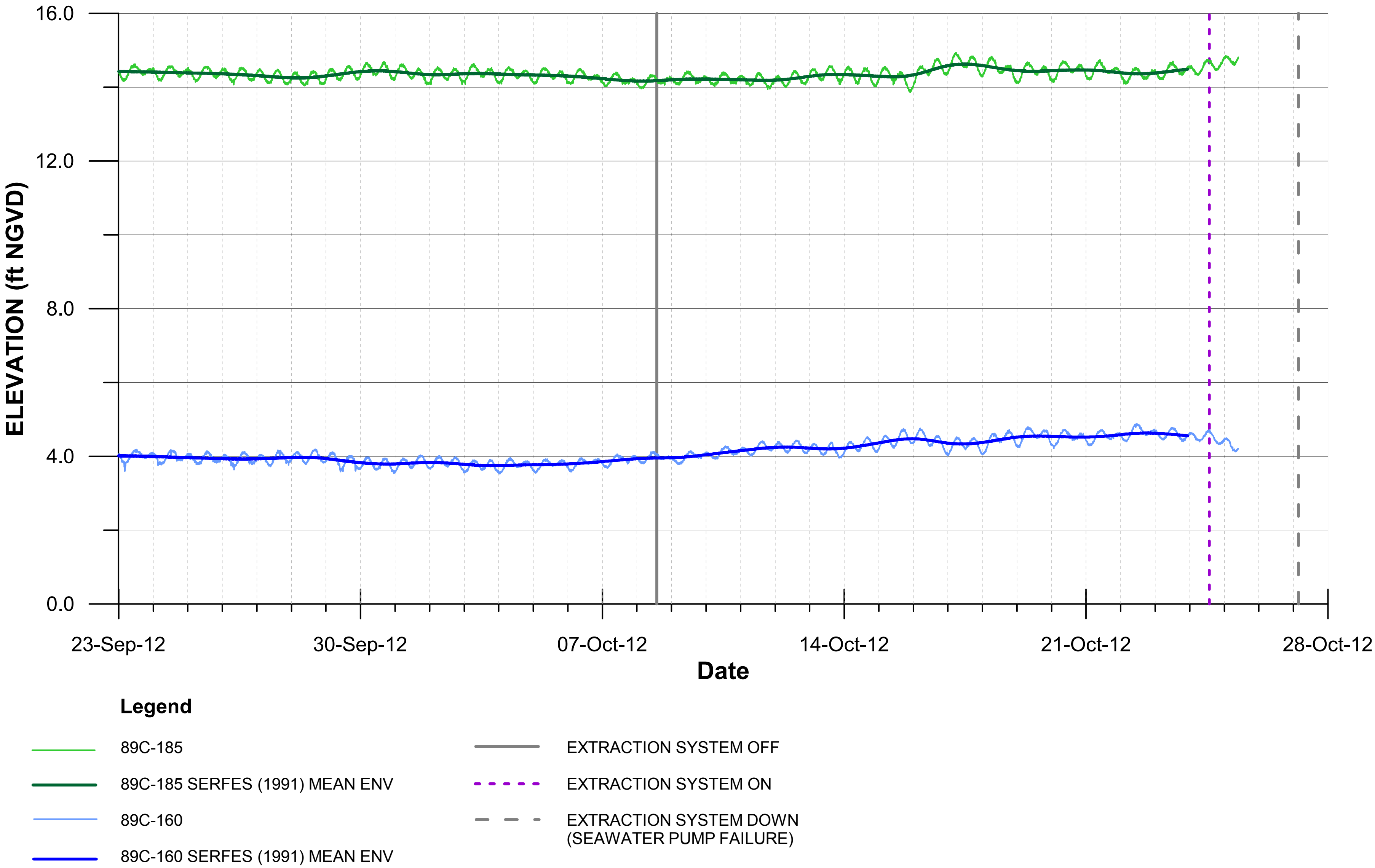
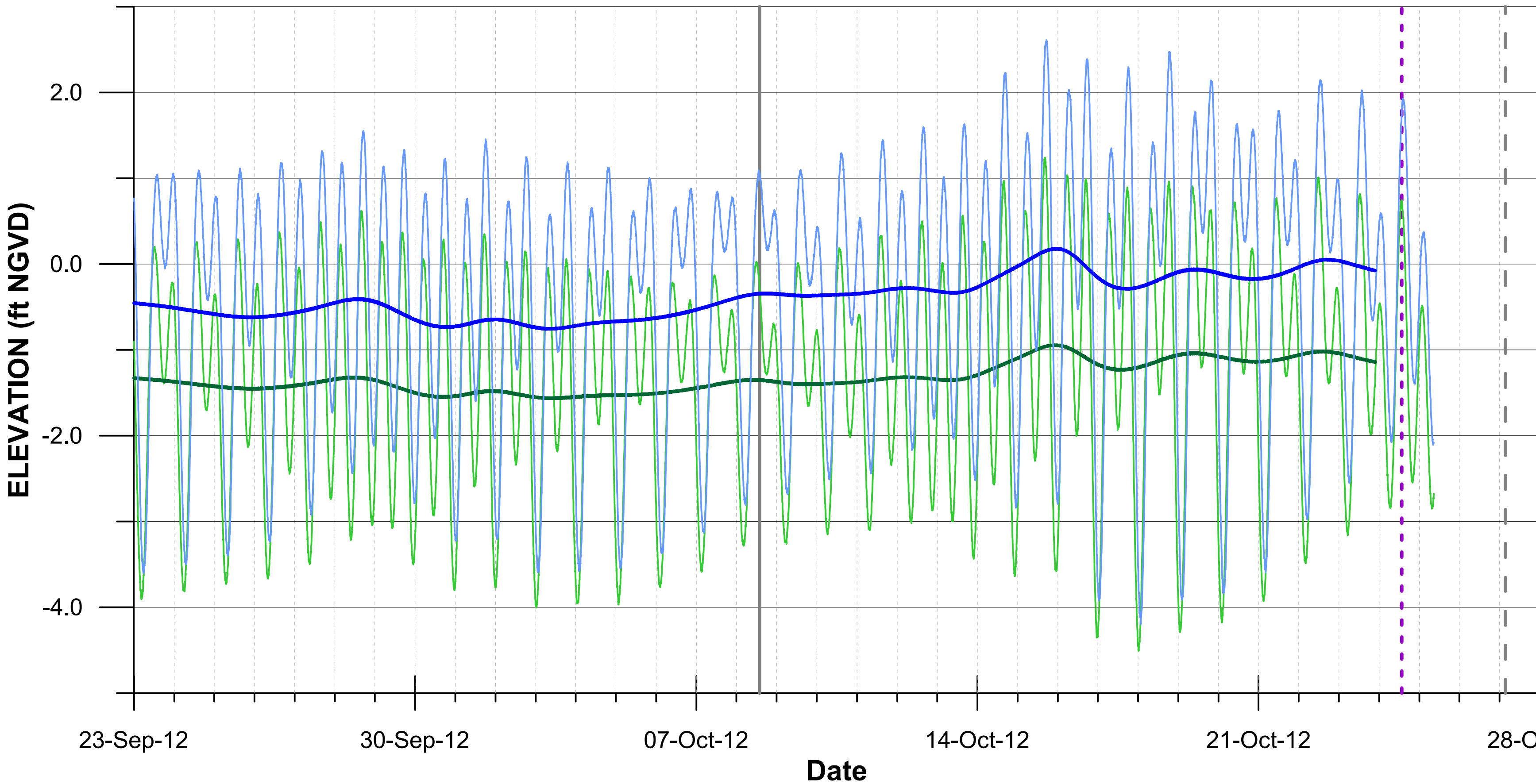


figure 18

ENVIRONMENTAL HEAD
89C-160 AND 89C-185 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington



Legend

90C-160	EXTRACTION SYSTEM OFF
90C-160 SERFES (1991) MEAN ENV	EXTRACTION SYSTEM ON
90C-130	EXTRACTION SYSTEM DOWN (SEAWATER PUMP FAILURE)
90C-130 SERFES (1991) MEAN ENV	

figure 19

ENVIRONMENTAL HEAD
90C-130 AND 90C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

CRA

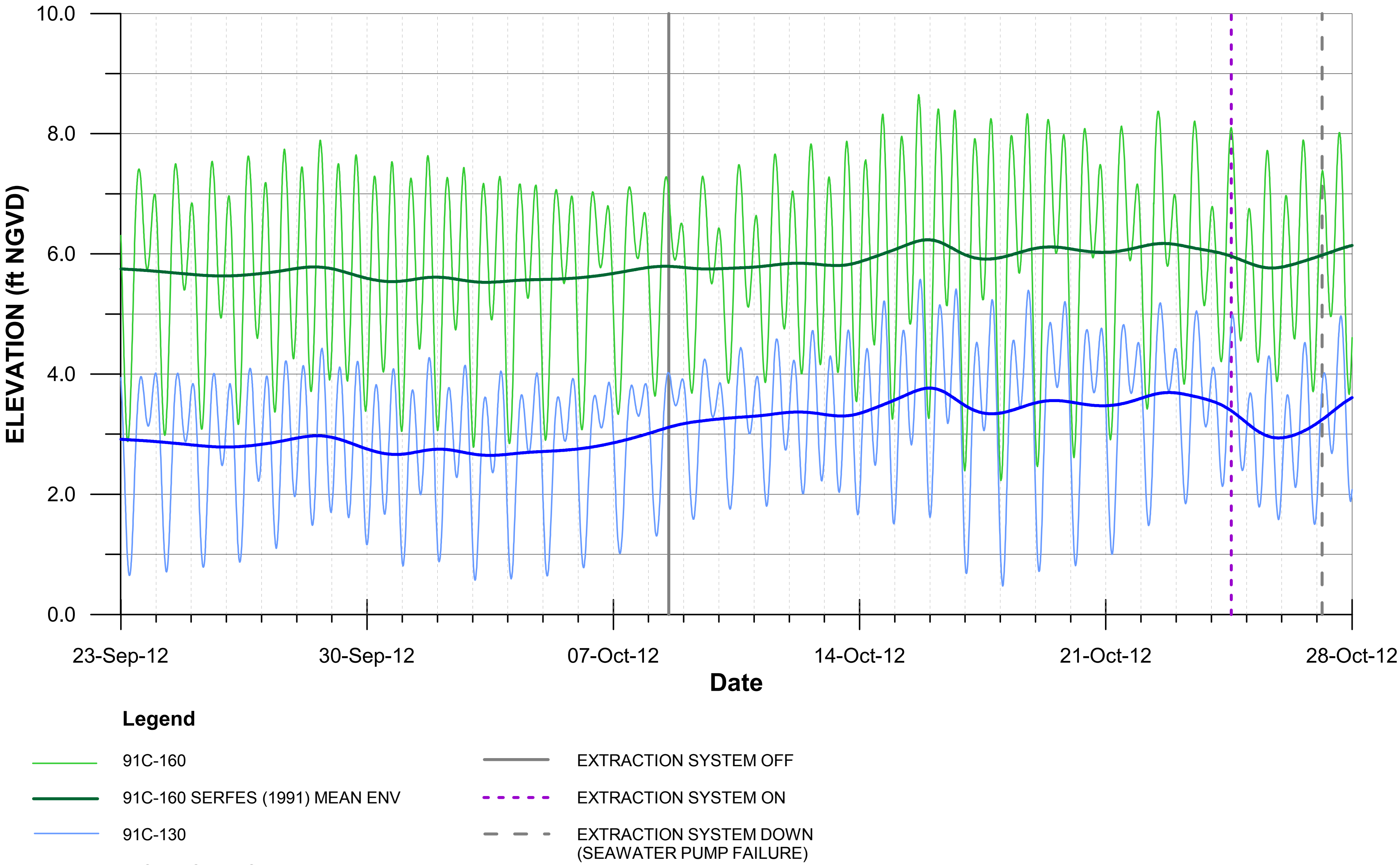


figure 20

ENVIRONMENTAL HEAD
91C-130 AND 91C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (91C-130 AND 91C-160).grf) AUG 5/2014

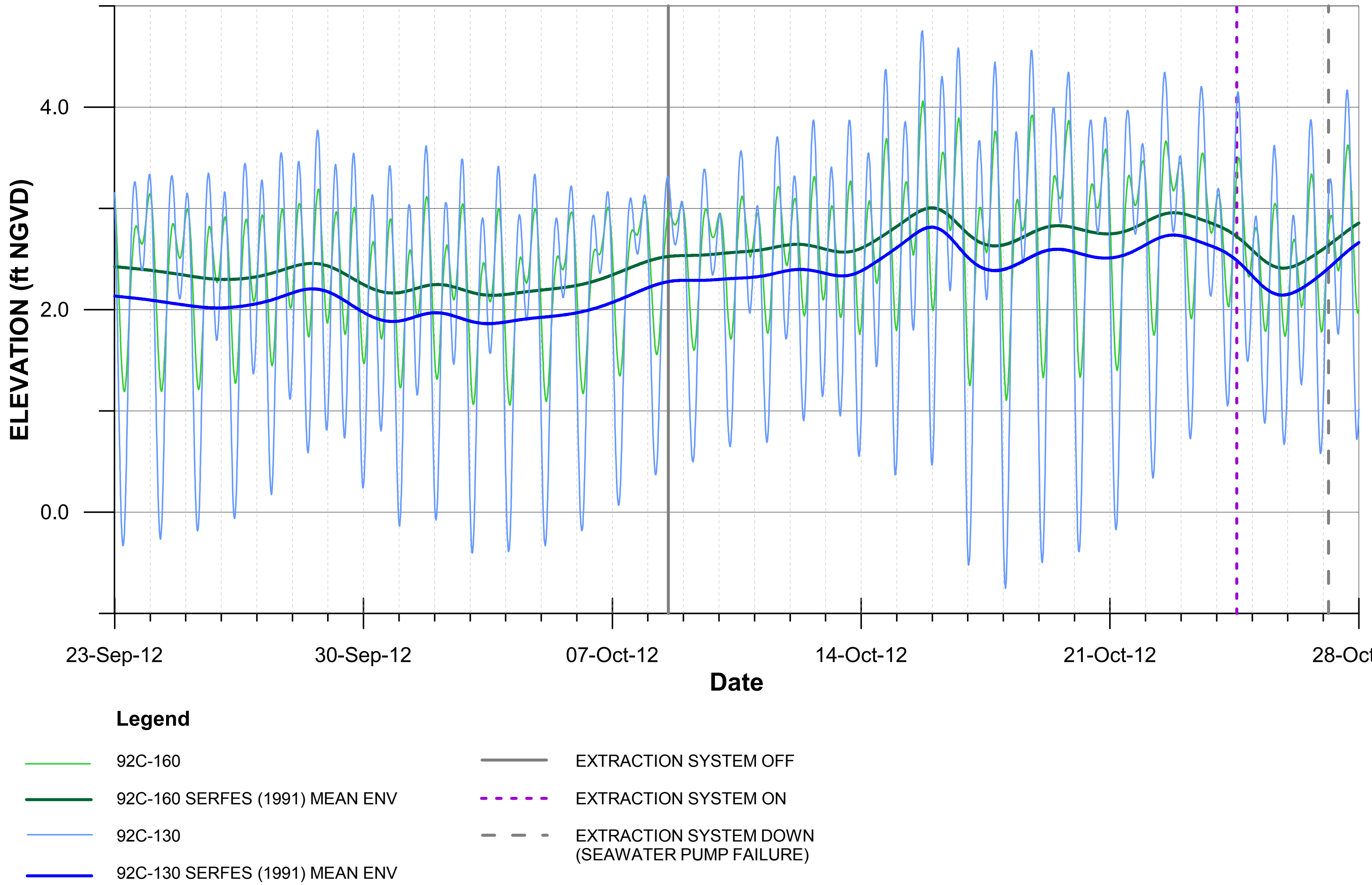
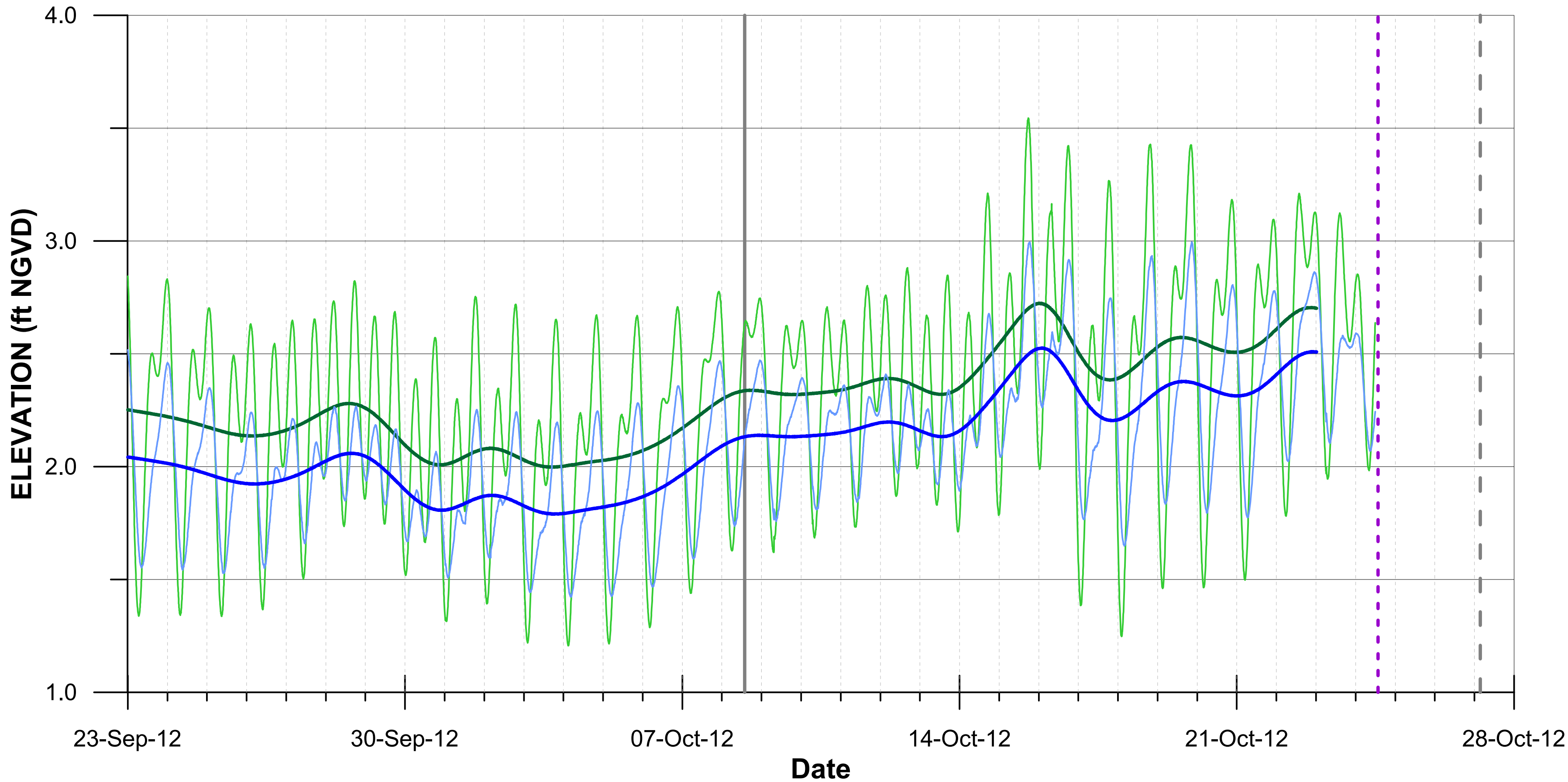


figure 21

ENVIRONMENTAL HEAD
92C-130 AND 92C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (92C-130 AND 92C-160).grf) AUG 5/2014



Legend

93C-160

93C-160 SERFES (1991) MEAN ENV

93C-130

93C-130 SERFES (1991) MEAN ENV

EXTRACTION SYSTEM OFF

EXTRACTION SYSTEM ON

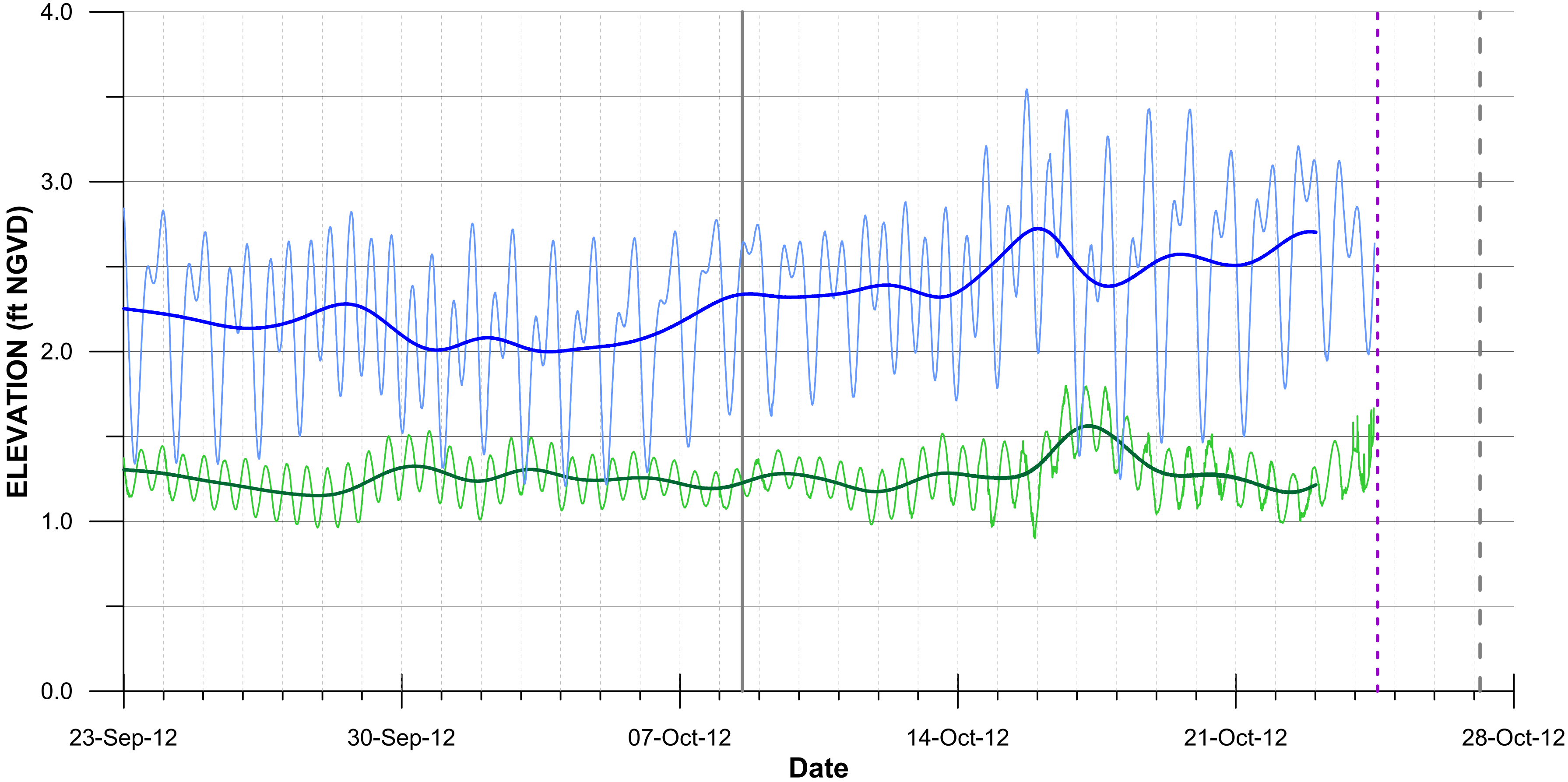
EXTRACTION SYSTEM DOWN (SEAWATER PUMP FAILURE)

figure 22

ENVIRONMENTAL HEAD
93C-130 AND 93C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

CRA

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (93C-130 AND 93C-160).grf) AUG 5/2014



Legend

93C-220

93C-220 SERFES (1991) MEAN ENV

93C-160

93C-160 SERFES (1991) MEAN ENV

EXTRACTION SYSTEM OFF

EXTRACTION SYSTEM ON

EXTRACTION SYSTEM DOWN
(SEAWATER PUMP FAILURE)

figure 23

ENVIRONMENTAL HEAD
93C-160 AND 93C-220 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (93C-160 AND 93C-220).grf) AUG 5/2014

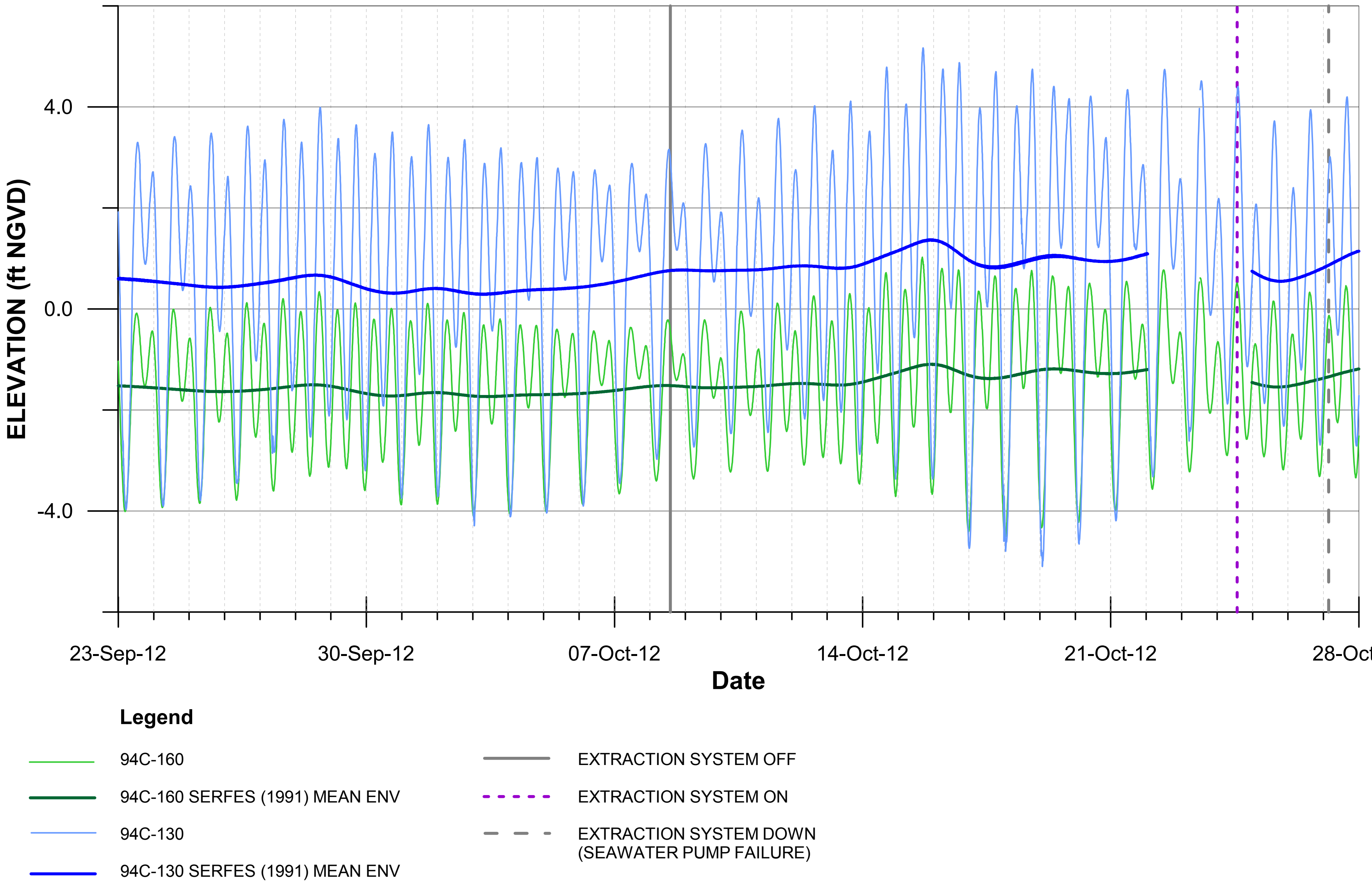


figure 24

ENVIRONMENTAL HEAD
94C-130 AND 94C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (94C-130 AND 94C-160).grf) AUG 5/2014

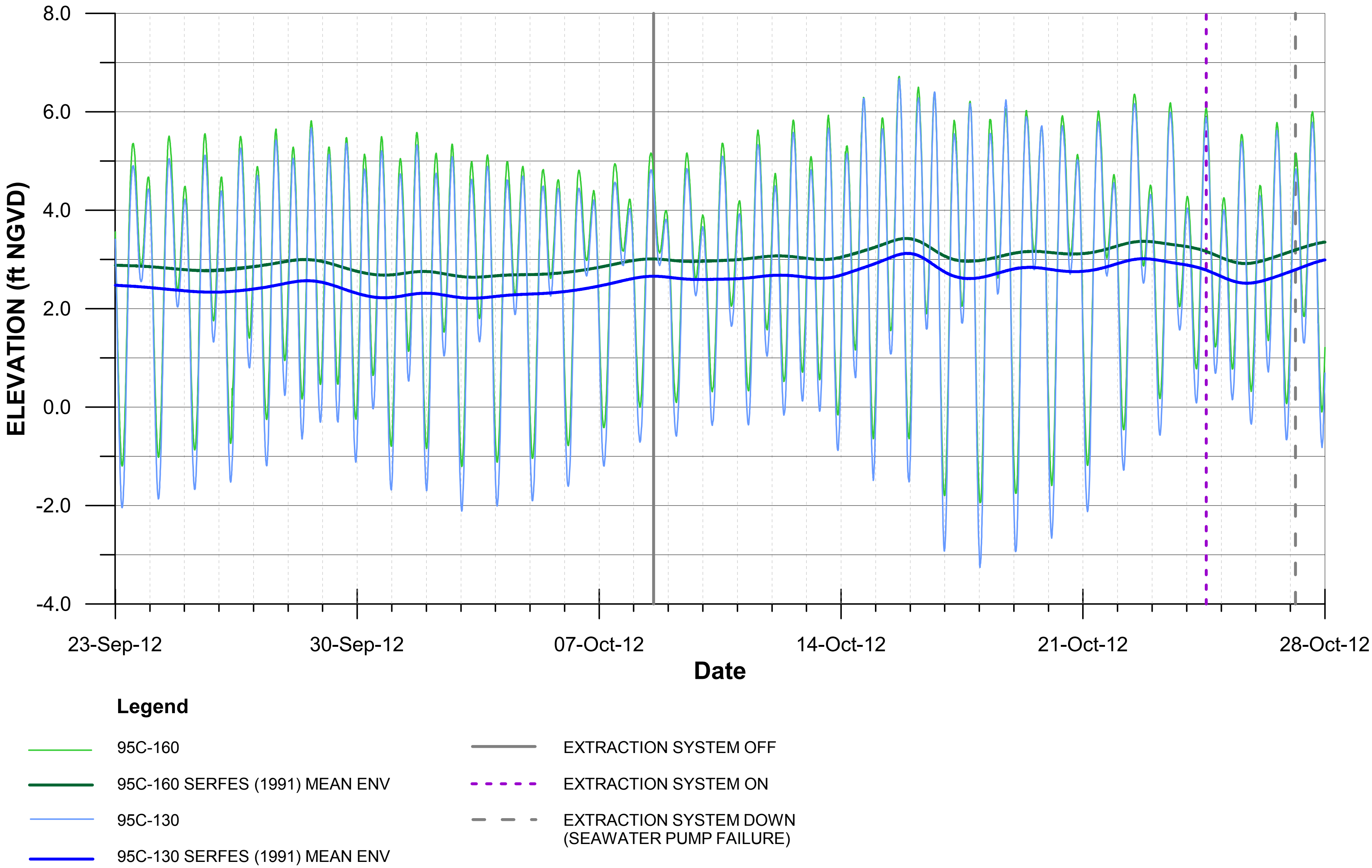


figure 25

ENVIRONMENTAL HEAD
95C-130 AND 95C-160 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington

007843-A6(128)GN-WA-HYD (N:\HEG\07843\Event 3 CSI\Geokon Transducer Hydrographs\Geokon Transducer Data (EPA recommended SG)\ENV-Plots\07843- Vertical Gradient (95C-130 AND 95C-160).grf) AUG 5/2014

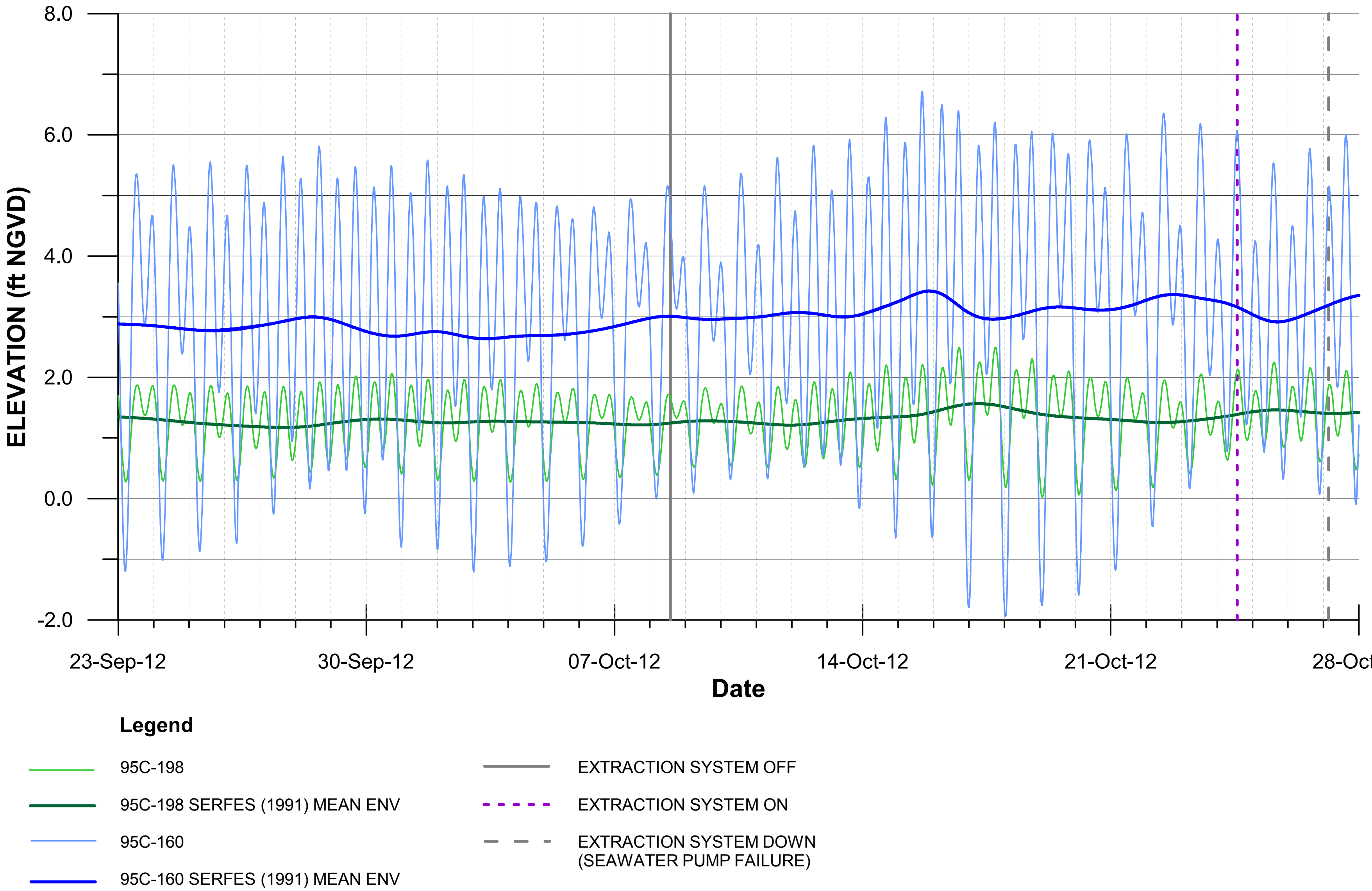


figure 26

ENVIRONMENTAL HEAD
95C-160 AND 95C-198 WELL PAIR
Occidental Chemical Corporation, Tacoma, Washington