DRAFT
FOCUSED REMEDIAL INVESTIGATION SUMMARY
HEXCEL PLANT 1
KENT, WASHINGTON

Prepared for:

HEXCEL CORPORATION
6700 West 5400 South
Salt Lake City, Utah 84118

Prepared by:

CLEAR CREEK ASSOCIATES, LLC
221 North Court Avenue, Suite 101
Tucson, Arizona 85071
(520) 622-3222

August 31, 2018

DRAFT
FOCUSED REMEDIAL INVESTIGATION SUMMARY
HEXCEL PLANT 1
KENT, WASHINGTON

Prepared for:
HEXCEL CORPORATION
6700 West 5400 South
Salt Lake City, Utah 84118

Approved by:	Reviewed by:
James R. Norris Licensed Geologist No. 1404	John Villinski, Ph.D. Hydrochemist

August 31, 2018

TABLE OF CONTENTS

FIGURES

APPENDICES

1. INTRODUCTION

The Hexcel Corporation (Hexcel) Plant 1 is located at 19819 84th Ave S in Kent, Washington (Figure 1). Hexcel prepared this Focused Remedial Investigation (FRI) Summary to describe the environmental conditions at Plant 1 as a requirement of Enforcement Order No. DE 2552 (EO) issued by the State of Washington Department of Ecology (Ecology).

According to Washington Administrative Code (WAC) 173-340-350(7)(a), the purpose of the remedial investigation is to "adequately characterize the site for the purpose of developing and evaluating cleanup action alternatives". The nature and extent of contaminants at Plant 1 are described based on the results of environmental investigations conducted over more than 30 years. The data from these investigations provide a context for understanding the progression of events and the degree of contaminant reduction that has occurred at Plant 1. Although the historical data are useful, it is the data for current conditions that provide the information most relevant for the Focused Feasibility Study (FFS) to develop, evaluate, and select a cleanup action.

The remainder of this document is structured as follows:

- Section 2 summarizes background information for the Plant 1 property, such as the history of ownership, operation, and regulatory actions.

- Section 3 briefly discusses the environmental setting of the site, including the geography, climate, geology, and hydrology.

- Section 4 describes the nature and extent of contamination. The information is presented in two subsections: Section 4.1 summarizes historical conditions and Section 4.2 presents current conditions. Historical conditions are considered to be those prior to 2012 when an upgradient source of contaminants was isolated. Current conditions are considered to be those postdating the isolation of the upgradient source.

- Section 5 reviews remedial actions on the Plant 1 property including the operation of a groundwater extraction remediation system and the current status of natural attenuation and *in situ* bioremediation.

- Section 6 presents an updated site conceptual model based on current conditions and the results of remedial actions.

- Section 7 provides the references cited in the text.

2. PROPERTY BACKGROUND

2.1 Property Ownership

The Plant 1 property is on King County Parcel No. 012204-9061, bounded on the south by South 200th Street, on the west by 81st Avenue South, on the north by South 196th Street, and on the east by 84th Avenue South. Figures 2, 3, and 4 show the Plant 1 vicinity, historical parcel designations referenced in the following discussion, and Plant 1 buildings, respectively. Hexcel acquired the Plant 1 property in 1996, although the property has been used for industrial purposes since about 1956. This review of historical site ownership is based on information in the EO and a review reported by PES Environmental, Inc. (PES) (2005b).

The Hytek Finishes Company (Hytek), a division of Criton Technologies, operated a metal finishing and electroplating plant at 8202 South 200th Street (now part of Plant 1). Criton Technologies also had an adjacent composite products manufacturing division named Heath Tecna Aerospace Company (Heath Tecna) at 19819 84th Avenue South. The Hytek division ceased treatment, storage, and disposal operations regulated under the Resource Conservation and Recovery Act (RCRA) in 1985.

In 1987, B.S.B. Diversified, Inc. (BSB) acquired both Hytek and Heath Tecna, including the real property described as Parcels A through G (Figure 3). In 1988, BSB sold Heath Tecna and Parcels A through F to the Phoenix Washington Corporation, a wholly owned subsidiary of Ciba-Geigy Corporation. BSB relocated Hytek's operations offsite in 1989, retaining ownership of Parcel G. Sometime between 1988 and 1996, Heath Tecna merged into the Ciba-Geigy Corporation.

In 1996, Hexcel acquired Parcels A through F from the Ciba-Geigy Corporation. In August 2003, Hexcel sold Parcel F, south of Plant 1 and east of Parcel G, to Carr Prop II, LLC.

2.2 Property Development

The area around Plant 1 was farmland prior to about 1956 when the first building was erected on the site, although the exact use of Plant 1 property prior to 1956 is uncertain. The Plant 1 buildings were constructed over time and have housed different manufacturing activities.

The Hexcel Plant 1 facility is divided into five buildings (Figure 4), which are contiguous and have common interior hallways and doors. Parking lots are located on the north, east, and south sides of Plant 1. The original building is now part of the former Hytek building. A plating shop was constructed by 1958 that also is part of the former Hytek building. Buildings 1 and 2 were constructed in 1963 and 1965, respectively. Buildings 3 and 4 were constructed in 1969. Aerial photographs show a gas station at the southeast corner of the Plant 1 property from at least 1968 through 1985, although the exact period of its operation is uncertain. Aerial photographs showing the development of the Plant 1 property from 1960 to 2003 are provided in a data summary report by Hydro Geo Chem, Inc. (HGC) (2010b).

2.3 Property Operations and Regulatory Actions

Prior to 1988, Parcels A through G housed BSB's Hytek and Heath Tecna divisions. Hytek provided metal finishing and electroplating services at the former Hytek building from approximately 1958 to 1987. Solutions used at Hytek were piped from the former Hytek building beneath 200th Street to Parcel G for treatment. Parcel G housed impoundments, lagoons, and units for managing waste through treatment and disposal, including hazardous wastes. The wastes at Parcel G included chlorinated solvents, including trichloroethene (TCE). BSB closed the storage and disposal units before 1988. The waste treatment and storage operations at Parcel G are described by PES (2005a).

Heath Tecna manufactured aircraft components at Buildings 1 through 4 on Parcels B through D. Hexcel currently uses Buildings 1 through 4 and the former Hytek building as production and testing areas for the manufacture of composite materials for use in the aerospace industry.

Parcels A through G were operated as a dangerous waste management facility on or after November 1980; once the facilities became subject to permitting under RCRA. In 1988 Ecology and the United States Environmental Protection Agency (EPA) issued Post Closure Permit WAD 07-665-5182 (EPA, 1989) to Hytek (subsequently BSB) under the authority of the Washington Hazardous Waste Management Act and RCRA. Pursuant to the Post Closure Permit, BSB installed and operated a groundwater pumping system, called the Corrective Measures System (CMS), which had extraction wells on the north side of Parcel G to control contaminated groundwater from that property and extraction wells on the east side of Parcels C, D, and E to prevent contaminated groundwater beneath Plant 1 from flowing off the property. BSB continued operating the CMS after Hexcel's acquisition of the Plant 1 property.

In 2005 Ecology issued the EO requiring Hexcel to take over operation of the portion of the CMS on its property and to conduct groundwater monitoring. The separation of the two portions of the groundwater pumping system, and subsequent groundwater monitoring and operational reporting were described in an Interim Action Plan (HGC, 2005a) submitted to Ecology and implemented by Hexcel. In April 2006, Hexcel assumed responsibility for operation of the groundwater pumping system on Plant 1 property. The remedial actions at Plant 1 are described further in Section 5.

The Plant 1 EO also required Hexcel to conduct and submit an FRI and a FFS. Hexcel submitted a work plan for a FRI (HGC 2005b). The FRI work plan included tasks aimed at sampling groundwater, soil, and indoor air to characterize existing contaminant concentrations, evaluate potential sources, and develop a site conceptual model.

While the FRI work was proceeding, BSB proposed a containment-based cleanup action for Parcel G (PES, 2008a), which is considered to be the source of the contaminants on the Plant 1 property. Because the remedy on Parcel G would isolate the source and allow flushing of the Plant 1 property by ambient groundwater, it had the potential to result in a significant change in groundwater conditions at Plant 1 and to make some of the proposed FRI work unnecessary. Consequently, Ecology modified the FRI requirement in the EO in 2009 (Ecology, 2009). The modified FRI approach consisted of completing a vadose zone soil investigation, a compilation and evaluation of site investigation and monitoring data, and continued groundwater monitoring during the implementation of the Parcel G remedy. The vadose zone soil investigation (HGC, 2010a) and the compilation and evaluation of site environmental data (HGC, 2010b) were submitted to Ecology in 2010. Sections 4 and 5 review the historical and current environmental conditions at Plant 1 and the status of remedial actions, respectively.

In 2005, Ecology also issued Agreed Order No. DE 2551 (AO) to BSB for environmental actions on Parcel G. The AO required BSB to continue operation of the groundwater pumping system on Parcel G and to submit an FRI/FFS (PES, 2005a) and a deep aquifer investigation (PES, 2010). In 2011, BSB entered into Consent Decree No. 11-2-27288-5 with Ecology. The Consent Decree contained a Cleanup Action Plan stipulating a remedy consisting of a surface cap and a sub-surface soil-bentonite cutoff wall for containment of contaminants on Parcel G, and the use of a zero valent iron reactor to treat water removed from the containment zone for hydraulic gradient control. Construction of the Parcel G remedy was completed in 2012. The outline of the soil bentonite cutoff wall is shown on Figure 4.

Hexcel conducted groundwater monitoring and operated the groundwater pumping system at Plant 1 after the completion of the Parcel G remedy which isolated an offsite source of contaminants. Starting in 2014, groundwater pumping at Plant 1 was phased out by conducting a sequence of shutdown tests at the CG extraction wells (the CG Well Shutdown Tests) and monitoring water quality for any changes, as described in Section 5.2. The motivation for terminating pumping was that continued groundwater extraction provided no remedial benefit as the groundwater being pumped met cleanup levels. Also in 2014, Hexcel implemented laboratory and field studies of *in situ* bioremediation and monitored natural attenuation. An Interim Action consisting of enhanced *in situ* bioremediation was implemented in 2017, as discussed in Section 5.3.

3. ENVIRONMENTAL SETTING

This section summarizes of the geographic, climatic, geologic, and groundwater hydrologic setting at the Plant 1 property. The summaries are meant as general contextual information rather than detailed site description; which can be obtained from the references cited. Section 4 provides information on the historical and current distribution of contaminants at Plant 1.

3.1 Geography

Kent, Washington is in the Green River Valley which contains the wide flood plains of the lower Green and Duwamish Rivers, and includes the cities of Renton, Tukwila, and Auburn. The Green River Valley is in the southeastern portion of the Puget Lowland (Lowland) geologic province, which is a wide low-lying area between the Cascade Range to the east and the Olympic Mountains to the west. Alluvial valleys and plains, and glacially formed or modified hills and ridges dominate the area around Kent. Kent has three major regions: East Hill, the Valley, and West Hill. Plant 1 and downtown Kent are located on the east side of the Valley. Land use in the Kent area in the vicinity of Plant 1 has shifted almost entirely from rural farming to commercial and industrial uses during the last 60 years. Most of the Valley area in the vicinity of Plant 1 is covered by warehouses and industrial facilities.

3.2 Climate

The climate is typical of mid-latitude, Pacific marine areas, with prevailing winds moving moist air inland from the Pacific Ocean and moderating temperatures in both winter and summer. Rains come primarily in the winter, and the summers tend to be dry. The maritime air cools as it pushes up against the Cascade Range, reaching the condensation point to form rain or snow. Precipitation supplies stream flow and groundwater recharge. Average annual precipitation recorded at the Sea-Tac Airport 5 miles west of Kent is about 38 inches per year. Temporal variation and trends in precipitation occur on a seasonal basis**. A**pproximately seventy-five percent of the annual precipitation falls in the six months between October and March. Annual evaporation averages approximately 25 inches.

3.3 Geologic Setting

The Kent Valley is a north-south elongated topographic depression filled with glacial and nonglacial sediments that overlie bedrock. Published geologic mapping (Pacific Northwest Center for Geologic Mapping Studies, 2006) (Figure 5) indicates that the Fraser glaciation deposited most of the geologic units in the Kent area. However, some previous glaciations left deposits in the hills at the edge of the valley. Vashon Till mantles the ground surface across the upland hills. Recent alluvium includes water-deposited sediments that have accumulated in the Green River Valley since the glacial period. The alluvium may contain clay, silt, peat, sand, and gravel. Modified land makes up the youngest deposits in the project area. Modified land consists primarily of fill placed by humans which can have widely variable properties, but mostly consists of silty sand to gravelly sand placed during construction activities. Plant 1 is in the Kent Valley underlain by Recent Alluvium (Qal on Figure 5) and Modified Land (m on Figure 5).

3.4 Groundwater Hydrologic Setting

The Plant 1 is in the South King County Groundwater Management Area. The Green River is the major drainage for the City of Kent. The water table at Plant 1 occurs at depths ranging from about 1.5 to 8 feet below land surface (ft bls). Water level fluctuations occur in response to seasonal changes in the distribution and rate of recharge and discharge throughout the region. Groundwater and surface water in the vicinity of Plant 1 generally flow northward toward Puget Sound, although the direction of groundwater flow in the Kent valley can vary locally.

Figure 6 shows the locations of wells at Plant 1 for reference in subsequent sections. The wells at Plant 1 were installed for groundwater monitoring and remediation over several decades as follows.

- The HY-2, HY-4 through HY-8, OW, Cd, Cs, D, E, and F wells at Plant 1 are monitoring wells installed during the 1980s and early 1990s.
- The CG wells were installed in the early 1990s as groundwater pumping wells for remediation.
- The HEX-1 through HEX-10 monitoring wells were installed by Hexcel in 2003 for a voluntary source investigation (HGC, 2003a).
- The HY-12s and HY-13s wells (installed in October 2003), HY-14s and HY-15s wells (installed in December 2005), and HY-16s and HY-17s wells (installed in January 2008) are monitoring wells for a downgradient area investigation conducted by BSB (PES, 2009a).
- The HY-119, HY-120 and HY-121 wells are monitoring wells installed by BSB in the deep aquifer in 2010 (PES, 2010).

- The HEX-11 through HEX-15 wells are monitoring wells installed in the deep aquifer in November 2010 by Hexcel (Clear Creek Associates [CCA], 2011a).

The majority of geologic and well construction logs for monitoring wells at Plant 1 are contained in the Data Compilation and Evaluation report (HGC, 2010b). PES (2010) and CCA (2011a) contain data for the deep aquifer wells installed since 2010.

3.4.1 Plant 1 Hydrostratigraphy

The generalized hydrostratigraphy at Plant 1 has been described based on geologic logs from numerous borings installed for well construction and soil sampling. The shallow deposits of sediment at Plant 1 have been divided into six hydrostratigraphic units (Units A, B, C, D, E, and F) distinguished by their material type and relative permeability. The water table typically occurs in Unit A. East-west and north-south geologic cross sections showing the relationships between these units are shown in Figures 7 and 8, respectively. Material descriptions of the units and their relative permeability follow.

- Unit A is the shallowest unit and consists primarily of silt. Unit A extends from near the land surface to a depth of about 10 feet. The hydraulic conductivity of Unit A was reported by Sweet-Edwards/EMCON, Inc. (SEE)(1988) to be on the order of 1 x 10^{-4} centimeters per second (cm/s) or 0.3 feet per day (ft/d). Based on this information, the transmissivity of Unit A is approximately 3 feet squared per day (ft^2/d) or less.

- Unit B underlies Unit A and consists primarily of sand and silty sand. Unit B ranges in thickness from about 5 to 30 feet and extends to maximum depths of 35 to 40 feet ft bls. According to S.S. Papadopulos and Associates, Inc. (SSPA) (1993), Unit B is the most permeable unit beneath Plant 1 with an average transmissivity of 1,300 ft^2/d based on a single well test. This transmissivity and the range in thickness correspond to a hydraulic conductivity range of 43 to 260 ft/day. As a practical matter, SSPA (1993) found that a hydraulic conductivity range of 40 to 80 ft/day for Layer B best replicated the average behavior of measured water levels for calibration of a groundwater flow model of the area of Parcels A through G. SSPA (2003) changed the average hydraulic conductivity in the model to 51 ft/day during a subsequent model refinement.

- Unit C is present under Parcel G and the southern portion of the Hexcel Property at depths ranging from 35 to 40 ft bls. Unit C consists of silt and silty sand. As shown in Figure 5, Unit C is not present on the northeast side of the Hexcel property or may be present only as discontinuous lenses as indicated by SSPA (1993). SSPA interpreted the transmissivity and hydraulic conductivity of Unit C to be on the order of 10 ft^2/d and 1 ft/day, respectively. Where present, Unit C is interpreted to be a low permeability layer that limits groundwater flow between Unit B and the underlying Unit D (PES, 2009b). Measured vertical hydraulic conductivities for Unit C at Parcel G range from 1.1 x 10^{-7} to 5.1 x 10^{-6} cm/s (PES, 2010).

- Unit D is 10 to 30 feet thick and consists of sand to a depth of 65 to 70 ft bls. Both SEE (1988) and SSPA (1993) interpreted this unit to be less permeable than Unit B but more permeable than Unit C. The transmissivity of Unit D was reported to be 500 ft^2/d based on a single well test. SSPA (1993) identified calibrated transmissivities of 200 to 400 ft^2/d for Unit D and a corresponding hydraulic conductivity of 40 ft/day. Units B and D appear to form a continuous hydrogeologic unit north of the pinch-out of Unit C (Figure 8).

- Units E and F, underlying Unit D, consist of silty sand and silty clay, respectively. Unit F is an aquitard approximately 100 feet thick that separates the groundwater flow system in Units A to E from a deeper regional aquifer. Units E and F are not expected to contribute significantly to groundwater flow beneath the site.

The generalized hydrostratigraphy is a framework for the gross distribution of subsurface materials at Plant 1. Specific attributes of the units, such as average grain size, average thickness, and continuity, can vary spatially.

There are two groundwater flow systems at Plant 1, informally called the shallow and deep aquifers. The vinyl chloride (VC) and cis-1,2-dichloroethene (cDCE) contamination that is the subject of remedial actions at Plant 1 is in the shallow aquifer which consists of the Units A and B in areas where Unit C is present. Information in HGC (2003a) indicates that Unit C is present in the southern half of the Plant 1, but is absent in the northeastern part of Plant 1. Where Unit C is absent the distinction between shallow and deep is based on depth, with the shallow aquifer considered to be less than 40 feet deep. The deep aquifer consists of the Unit D sand. Unit D at Plant 1 contains low levels of VC contamination which is believed to be due to groundwater flow from Parcel G. The nature and extent of contamination in the deep aquifer at Parcel G has been the subject of detailed investigations (PES, 2011). Unit C, where present, acts as an aquitard between the shallow and deep aquifers.

3.4.2 Groundwater Elevation and Flow

Groundwater elevation data at Plant 1 have been collected by both BSB and Hexcel. Prior to April 2006, water level data for the HY, OW, Cd, Cs, D, E, and F wells at Plant 1 were collected by BSB and are reported by PES (2007b). Hexcel began measuring water levels in 2003 and continues to do so today. Water level measurements for Plant 1 wells since 2003 when Hexcel began groundwater monitoring are in Appendix A.

Figures 9 and 10 show depth to groundwater and groundwater elevation data from 2009 to 2018 at shallow aquifer wells across the Plant 1 property as an illustration of annual patterns. Water levels are most shallow in the winter when the majority of precipitation occurs and are deepest during the summer. Groundwater elevations range from about 17 feet above mean sea level (ft amsl) to 23 ft amsl.

Historically, groundwater pumping at CG-1, CG-2, CG-3, and CG-4 from 1992 to 2016 depressed water levels along the east boundary of the property to control the migration of VOCs. Lower water elevations were measured in the vicinity of the CG groundwater extraction wells due to drawdown from pumping when they were operational. Groundwater extraction at the CG wells was terminated between 2013 and 2016 when there was no longer a remedial benefit from pumping (Section 5.2).

Figures 11 and 12 are groundwater elevation contour maps for the shallow aquifer in July 2017 and January 2018, to illustrate current conditions during which there is no groundwater pumping. These maps show conditions during the dry and wet times of the year, respectively. Groundwater flow beneath Plant 1 is generally northeasterly to northerly, and can vary slightly through the year in response to seasonal precipitation.

Groundwater elevations in the deep aquifer dip to the north and northeast, indicating a northerly to northeasterly groundwater flow directions, based on groundwater monitoring data in annual reports for the CMS (e.g., PES, 2007b and prior annual reports) and a study of the deep aquifer (PES, 2011). Groundwater elevations in deep aquifer wells show the similar annual variations as the shallow aquifer wells (Figure 9). Where Unit C is present, an upward hydraulic gradient exists between Units B and D most of the year (PES, 2009b). Figure 9 shows the upward hydraulic gradient between co-located shallow and deep aquifer wells, HEX-1 and HEX-10, on the south side of Plant 1.

3.5 Surface Water

Northwest of Plant 1 is an engineered drainage ditch containing surface water that is tributary to Springbrook Creek (Figure 4). Surface flow in the ditch is northerly.

A preliminary evaluation of groundwater and surface water interactions in the vicinity of the ditch was reported by PES (2005b, 2007a, and 2009a). PES (2007a) concluded that groundwater and surface water elevations suggested that the drainage ditch near HY-14s (Figure 6) may be a source of recharge to the shallow aquifer. However, PES (2009a) used additional surface water elevation data using staff gage measurements to conclude that the ditch is potentially a receptor of groundwater near HY-14s and likely a source of recharge to the shallow aquifer upstream of the HY-15s more than 1,000 feet east of Plant 1.

A consistent aspect of the groundwater elevation data in the vicinity of the ditch is a persistent northwest dipping hydraulic gradient (Figures 11 and 12) which indicates that if the ditch is a gaining reach near HY-14s it is recharged by groundwater from the east rather than groundwater flow from the vicinity of Plant 1. For this reason, there is no migration pathway between groundwater at Plant 1 and surface water.

Hexcel monitored water quality in samples from the ditch pursuant to the FRI work plan (HGC, 2005b), which was implemented prior to the work reported by PES (2009). Twenty-one grab samples were collected from surface flow in the ditch between 2005 and 2013 and analyzed for VOCs. VOCs were not detected in any of the samples except for trace levels of common laboratory contaminants (see Appendix B of CCA, 2017 for data). Sampling of the ditch water was suspended with the permission of Ecology (Ecology, 2014).

Water elevation data indicate that the ditch is not on a flow path from Plant 1 and water quality sampling from the ditch over 10 years did not detect VOCs.

4. NATURE AND EXTENT OF CONTAMINATION

Numerous environmental investigations have been conducted at Plant 1 and adjacent properties since the early 1980s to document the occurrence of hazardous substances, primarily volatile organic compounds (VOCs) in groundwater, surface water, soil, soil gas, and indoor air.

4.1 Historical Conditions

This review of historical conditions includes data and interpretations from studies of groundwater, surface water, soil, soil gas, and indoor air conducted since 1980. The historical data document the extent of site characterization activities, but are not representative of the current conditions described in Section 4.2. However, comparison of the historical conditions with current conditions illustrates the large degree of cleanup that has occurred over time at Plant 1. Consistent with WAC 173-340-350(6), Section 4.1 only summarizes the key findings of prior site investigation reports to avoid unnecessary duplication of the information in those documents.

Environmental investigations conducted through 2009 were compiled and summarized by HGC (2010b) as part of a phased FRI pursuant to the EO. HGC (2010b) summarized the results of prior investigations to describe the historical nature and extent of contamination. HGC (2010b) should be referred to if additional information is needed regarding the studies cited or data for specific contaminants. The description of historical conditions is based on the following investigations and data sources reviewed by HGC (2010b).

- 1980-1981 EPA Site Investigation
- 1982 Hytek Phase 1 Investigation
- 1983-1984 Hytek Phase 2 Investigation
- 1984 Hytek Phase 3 Investigation
- 1985 Hytek Monitor Well Installation
- 1986 Hytek Soil Gas Survey
- 1987 Hytek Groundwater Investigation
- 1988 Hytek Polychlorinated Biphenyls (PCBs)
- 1989 BSB Pilot Recovery Program Investigation
- 1988 through 2005 Groundwater Monitoring by BSB
- 1992 Soil Sampling at Proposed Chemical Storage Facility
- 1995 Heath Tecna Facility Phase 1 Environmental Site Assessment
- 2000 Hexcel Facility Phase 1 Environmental Site Assessment

- 2002 Hexcel Facility Plant 1 Vaults Sludge and Water Sampling
- 2003 Hexcel Facility Source Investigation
- 2003 through 2009 Groundwater Monitoring by Hexcel
- 2003 Interim Technical Memorandum: Bioremediation Screening
- 2005 Interim Action Plan
- 2006 Hexcel Facility CNC Pad Soil Borings
- 2007 Development of Groundwater Cleanup Levels
- 2008 Deep Aquifer Investigation
- 2008 Downgradient Area Groundwater Investigation
- 2008 Indoor Air Sampling at Plant 1
- 2009 Vadose Zone Soil Sampling

HGC (2010b) evaluated the analytical results for samplings of groundwater, soil, soil gas, and indoor air with respect to potentially applicable Model Toxics Control Act (MTCA) cleanup levels or other relevant guidelines. Although there have been a variety of contaminants detected at the Plant 1 property, VOCs, primarily cDCE and VC in groundwater, were the contaminants of concern with concentrations in excess of MTCA cleanup levels. HGC (2010b) discussed the nature and extent of contamination through 2009 with respect to changes in contaminant concentrations over time, and the potential for ongoing sources. The review below is organized first by environmental medium and secondly contaminant type, mirroring the format of HGC (2010b).

4.1.1 Groundwater

HGC (2010b) reviewed groundwater monitoring data for Plant 1 from 1982 through October 2009 and provided a compilation of analytical results for the Plant 1 wells monitored from 1982 through 2009. Constituents monitored at one time or another in groundwater samples at Plant 1 included VOCs, semi-volatile organic compounds (SVOCs), metals, cyanide, PCBs, and organochlorine pesticides. These constituents are discussed below.

4.1.1.1 Volatile Organic Compounds

4.1.1.1.1 Shallow Aquifer

VOCs are the primary focus of historical and current investigations and remedial actions at Plant 1. The primary VOCs which have occurred in groundwater samples from shallow aquifer wells at levels potentially exceeding applicable standards are cDCE, VC, and TCE. TCE is an important VOC because nonaqueous phase TCE in groundwater at Parcel G acted as a source that resulted in elevated concentrations of TCE, cDCE and VC at the downgradient Plant 1. VC and cDCE are degradation byproducts of TCE, formed by the naturally occurring dechlorination of TCE in the subsurface.

Figures 13, 14, and 15 show the temporal change in the distribution of cDCE, VC, and TCE concentrations in the shallow aquifer at Plant 1 using samples from 1988, 1998, and 2008, respectively. Other than a single TCE detection in HEX-1 in October 2006, cDCE and VC are the only VOCs detected in excess of potentially applicable standards in groundwater at Plant 1 between 2003 and 2009. In general, TCE has primarily been associated with samples collected at Parcel G rather than at Plant 1.

As described by HGC (2010b), the number and magnitude of VOCs detected in groundwater decreased with time. The largest number of VOCs and the highest concentrations were measured in the 1980s to mid-1990s. In addition to TCE, cDCE and VC, early groundwater monitoring detected methylene chloride, trans-1,2-DCE, 1,1-dichloroethene, and benzene in excess of potentially applicable standards. The frequency and magnitude of methylene chloride, trans-1,2-DCE, 1,1-dichloroethene, and benzene detections also decreased over time through the 1980s and 1990s. Methylene chloride, trans-1,2-DCE, and 1,1-dichloroethene were not detected in excess of a potentially applicable standard after 1994. Benzene has not been detected in excess of the MTCA Method A groundwater cleanup level since October 2001.

4.1.1.1.2 Deep Aquifer

The water quality of the deep aquifer at Plant 1 has not been studied as intensively as that of the shallow aquifer because the occurrence of contaminants and their concentrations are less than in the shallow aquifer. Historically, groundwater analytical data for deep aquifer (Unit D) at Plant 1 showed only sporadic and isolated detections of VOCs, although the detections sometimes did exceed MTCA Method A groundwater cleanup levels for VC, TCE, and methylene chloride. However, none of the anomalous VOC detections in the deep aquifer wells on Plant 1 were reproducible over time.

Water quality data for deep aquifer monitor wells at Plant 1 are available for samples collected from 2003 to 2009 at HEX-10, a sample at Cd collected in 2008 (PES, 2009a), and sample collected from HY-7d in 2005 (PES, 2007b). VC is the only VOC detected in excess of potentially applicable standards in samples from HEX-10. Detected concentrations of VC ranged from 0.14 µg/L to 63.2 µg/L. VOCs were not detected in the 2008 sample from Cd or the 2005 sample from HY-7d.

In 2008, contamination was identified in the deep aquifer at Parcel G (PES, 2009). The deep aquifer at Parcel G contains TCE, VC, and cDCE in excess of potentially applicable cleanup levels. Although VOC contaminants remain in the deep aquifer at Parcel G their plumes appear to be stable or contracting (PES, 2011).

Monitoring wells in the deep aquifer were installed along the upgradient boundary of Plant 1 in response to the discovery of deep aquifer contamination at Parcel G, as described by PES (2010) and CCA (2011a). Groundwater samples from some of the new aquifer wells installed after 2008 had exceedances of the VC groundwater cleanup level. The results of groundwater monitoring in the deep aquifer at Plant 1 are described in Section 4.2.2.

4.1.1.1.3 Discussion of Groundwater VOC Data for the Shallow Aquifer

Historical water quality data for wells in the shallow aquifer show a groundwater VOC plume extending northeast from Parcel G to Plant 1 (Figures 13, 14, and 15). Groundwater sampling results since 2003 indicate that cDCE and VC were the only constituents that exceeded potentially applicable standards beneath Plant 1. CDCE and VC are the products of reductive dehalogenation of TCE. Historically, TCE was detected in Plant 1 wells through the 1980s and 1990s. However, between 2003 and 2009, TCE was only infrequently detected in groundwater samples from HEX-1 and HEX-2 on the upgradient boundary of Plant 1. Thus, TCE is not a constituent of concern at Plant 1 and its historical occurrence is believed to be due to transport from an offsite upgradient source to Plant 1.

VOC concentrations in shallow aquifer wells at Plant 1 declined significantly between 1982 and 2009. Figure 16 illustrates the magnitude of the decline in VC concentrations since the 1980s at wells HY-2 and HEX-2 on the upgradient side of Plant 1 and wells HY-6 and CG-1 at the downgradient side of Plant 1. HGC (2010b) explained the magnitude and extent of VOCs in the shallow aquifer at Plant 1 as being the result of the migration of a VOC plume from the source of TCE at Parcel G. The decrease in the number and magnitude of VOCs between the 1980s and 2009 are cleanup trends due to reduced source loading over time as historical waste management practices at the former Hytek operation ended and groundwater pumping for plume control was implemented at Parcel G and Plant 1. HGC (2003a) considered the persistence of the cDCE and VC plume beneath Plant 1 to be due to periodic shutdowns and underperformance of the groundwater containment system on Parcel G which resulted in VOC-bearing groundwater flowing northeasterly to Plant 1.

An upgradient source for the cDCE and VC at Plant 1 is indicated by the lack of residual TCE in groundwater at Plant 1, the occurrence of a plume at Plant 1 consisting only of TCE degradation products, and the sporadic TCE detections at wells HEX-1 and HEX-2 on the upgradient boundary of Plant 1. Source investigation work (HGC, 2003a and 2010b) and groundwater monitoring have not identified a source of TCE at Plant 1 that would be capable of creating the historical plume of cDCE and VC. The area around HEX-8 was identified as a zone of persistent elevated concentrations of cDCE and VC due to desorption of those constituents from fine grained sediment.

4.1.1.2 Semivolatile Organic Compounds

HGC (2010b) reviewed analyses of SVOC in 35 samples from six Plant 1 wells (Cs, Cd, HY-5, HY-6, HY-7ss and HY-8d) collected pursuant to operation of the CMS. HGC (2010b) concluded that SVOCs are not constituents of concern at Plant 1 due to their lack of occurrence in groundwater samples.

4.1.1.3 Metals

Groundwater studies have evaluated the following metals: antimony, arsenic, barium, beryllium, cadmium, total chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc. HGC (2010b) identified arsenic as the only metal detected at elevated concentrations with respect to a MTCA cleanup level for groundwater or an EPA Maximum Contaminant Level (MCL) for drinking water. The only persistent occurrences of elevated arsenic are localized at upgradient wells HY-2, HY-4, and HEX-2 at the south end of Plant 1.

HGC (2007b) presented data indicating that naturally occurring concentrations of arsenic in the Kent region can exceed the MTCA Method A groundwater cleanup level of 5 µg/L. PES (2005a) presented data showing that arsenic concentrations range from 5 µg/L to 35 µg/L in the shallow aquifer well on the upgradient boundary of Parcel G. HGC (2010b) concluded that arsenic is not a constituent of concern because it is a background constituent occurring at concentrations exceeding the MTCA Method A groundwater cleanup level due to a natural or an area-wide phenomenon.

4.1.1.4 Cyanide

HGC (2010b) reported that total cyanide in groundwater samples was monitored from the 1980s through 2005 and that the majority of samples had no detectable cyanide although there were isolated and sporadic detections. HGC (2010b) concluded that cyanide is not a constituent of concern at Plant 1 based on its low detection frequency in groundwater samples.

4.1.1.5 Polychlorinated Biphenyls

HGC (2010b) reviewed PCB analytical results for 33 samples collected from Plant 1 wells Cs, Cd, HY-5, HY-6, and HY-8d between 1992 and 2005 pursuant to the Post Closure Permit. PCBs were not detected in the groundwater samples from the Plant 1. HGC (2010b) concluded PCBs are not constituents of concern for groundwater at Plant 1 because of their lack of detection in groundwater.

4.1.1.6 Organochlorine Pesticides

HGC (2010b) reviewed the results of eight groundwater samples collected and analyzed for organochlorine pesticides between 1994 and 1998. HGC (2010b) concluded that organochlorine pesticides are not constituents of concern at Plant 1 because they were not detected in groundwater samples.

4.1.2 Soil

HGC (2010b) reviewed the result of soil analyses for samples collected from both the vadose and saturated zones. The soil samples were evaluated with respect to MTCA Method A cleanup levels for soil.

4.1.2.1 Vadose Zone Soil

Several investigations between 1984 and 2009 collected vadose zone soil samples for analysis of VOCs, PCBs, cyanide, metals, and petroleum hydrocarbons. These investigations were conducted by early environmental characterization studies and studies conducted for the EO.

4.1.2.1.1 Volatile Organic Compounds

Methylene chloride and TCE were detected in some vadose zone soil samples at levels exceeding the MTCA Method A soil cleanup level during investigations in the 1980s. Subsequent investigations in 1991, 2003, and 2006 did not detect VOCs in soil at concentrations greater than MTCA Method A soil cleanup levels for unrestricted land use. A vadose zone soil investigation conducted in 2009 as part of the phased FRI specifically sampled sites identified during the 1980s as having TCE detections greater than the MTCA Method A soil cleanup level (HGC, 2010a). The only TCE detection at these sites in 2009 was in one sample of vadose zone fill material beneath asphalt. The vadose zone samples collected in 2009 did not detect VOC soil concentrations in excess of MTCA Method A soil cleanup levels nor did it replicate previously measured VOC concentrations. VOCs are not considered constituents of concern in vadose zone soil due to their lack of occurrence and their low concentration when detected.

4.1.2.1.2 Metals

The following metals were detected in vadose zone soil samples from various locations: arsenic, barium, total chromium, and lead. Hexavalent chromium was not detected. The concentrations of the metals detected in the vadose zone soils were below the MTCA Method A soil cleanup levels for industrial properties for those metals with cleanup levels. Based on the lack of metals concentrations in excess of MCTA cleanup levels for soils, HGC (2010b) concluded that metals are not constituents of concern in vadose zone soil.

4.1.2.1.3 Cyanide

Cyanide was not detected in any of the discrete or composite vadose zone soil samples. HGC (2010b) concluded that cyanide is not COCs in vadose zone soil due to the lack of detectable concentrations.

4.1.2.1.4 Polychlorinated Biphenyls

PCBs were detected in 12 of 17 samples of the foundation fill beneath the concrete floor in the east room of the former Hytek building (OHM, 1988a). HGC (2010b) evaluated the PCB data with respect to the MCTA Method A soil cleanup level for industrial uses and used Ecology's SITE97 statistical analysis tool to calculate a lognormal 95 percent upper confidence level mean concentration of 4.5 mg/kg, which is less than the MTCA Method A soil cleanup level for industrial use of 10 mg/kg. PCBs are not a constituent of concern in vadose zone soil at the former Hytek building due to their low concentration.

4.1.2.1.5 Petroleum Hydrocarbons

HGC (2010b) reviewed vadose zone soil sampling results collected between 2006 and 2009. Petroleum hydrocarbons are not constituents of concern because they are not detected in excess of MTCA Method A soil cleanup levels for unrestricted land uses.

4.1.2.2 Saturated Zone Soil

Several investigations between 1984 and 2006 collected saturated zone soil samples for analysis of VOCs, SVOCs, metals, and petroleum hydrocarbons. The sampling was conducted for various environmental investigations and in accordance with the EO.

4.1.2.2.1 Volatile Organic Compounds

The only VOCs that exceeded MTCA soil cleanup levels in historical saturated zone soil samples were methylene chloride and TCE. All other VOCs were at concentrations lower than applicable MTCA soil cleanup levels. Methylene chloride was detected above MTCA soil cleanup levels in three samples collected in 1984, but did not exceed soil cleanup levels in 21 samples collected between 1987 and 2006. Methylene chloride is not considered a constituent of concern in saturated zone soil because of low detection frequency in samples collected subsequent to 1984 and its occurrence, when detected, at concentrations below soil cleanup levels. TCE was detected at concentrations exceeding MTCA Method A soil cleanup levels in 7 of 32 samples collected between 1984 and 2006. TCE is not considered a constituent of concern in saturated zone soil due to its low detection frequency and the lack of TCE in groundwater samples at Plant 1.

4.1.2.2.2 Semivolatile Organic Compounds

SVOCs were not detected in saturated zone soil samples collected in 2006. Based on the lack of detections, HGC (2010b) concluded that SVOCs are not constituents of concern in saturated zone soils.

4.1.2.2.3 Metals

Saturated zone soil samples had detections of arsenic, barium, total chromium, and lead at concentrations below the MTCA Method A soil cleanup levels for industrial properties for constituents with cleanup levels. Silver, cadmium, hexavalent chromium, mercury and selenium were not detected at minimum detection limits below MTCA soil cleanup levels. Based on the lack of metals concentrations in excess of MCTA soil cleanup levels, HGC (2010b) concluded that metals are not constituents of concern in saturated zone soil.

4.1.2.2.4 Petroleum Hydrocarbons

BTEX, gasoline-range, diesel-range, kerosene-range, and lube oil-range petroleum hydrocarbons were not detected in four saturated zone soil samples collected in 2006. The detection limits for all analyses were below the applicable MTCA soil cleanup levels. Petroleum hydrocarbons are not considered to be constituents of concern in saturated zone soil based on their lack of detection.

4.1.3 Soil Gas

Soil gas sampling was conducted during two investigations. An investigation in 1986 detected DCE and TCE, but there are no MTCA guidelines for soil gas with which to compare these historical data. A soil gas survey beneath the Hytek building in 2003 detected acetone, 1,1-DCE, 2-butanone, cDCE, toluene, TCE, perchloroethene, and m,p-xylenes in more than 50 percent of the samples. None of the detected concentrations exceeded Occupational Safety and Health Administration or National Institute for Occupational Safety and Health permissible exposure limits for an 8-hour work day. The maximum total soil concentrations of VOCs determined from equilibrium partitioning calculations were less than potentially applicable MTCA soil cleanup levels. VOCs in soil gas are not considered constituents of concern due to their low concentrations with respect to permissible exposure limits and MTCA soil cleanup levels.

4.1.4 Indoor and Outdoor Air

Indoor air sampling was conducted in 2008 to evaluate whether the groundwater VOC plume and soil gas levels beneath Plant 1 posed a threat to workers from migration of VOCs in indoor air (HGC, 2008). Prior to sampling a screening level analysis determined that VC and TCE were the only VOC's that posed a risk based on their concentrations in groundwater or soil gas samples (HGC, 2007a).

All VOC concentrations in the eight indoor and two outdoor air samples were below the Washington Industrial Safety and Health Act (WISHA) limits. VC was below detection limits in all of the indoor and outdoor samples at detection limits ranging from 0.26 µg/m^3 to 4.1 µg/m^3; well below the WISHA limit of 2,600 µg/m^3 . TCE was detected in 3 indoor samples and 2 outdoor samples at concentrations between 1.2 µg/m^3 to 1.8 µg/m^3; well below the WISHA limit of 273,287 µg/m^3.

The results of VOC sampling of indoor air at Plant 1 indicated that VC was below detection limits and TCE was 4 to 5 orders of magnitudes less than the WISHA limits. The absence of VC in all samples indicates that VC flux by vapor intrusion does not occur or that it occurs only in negligible amounts. The occurrence of TCE at equivalent concentration in both indoor and outdoor air samples indicates that TCE in the indoor samples is likely derived from ventilation with outdoor air. The indoor and outdoor air TCE concentrations were consistent with background concentrations reported elsewhere for indoor and outdoor air (Washington State Department of Health, 2002). Based on the data from indoor and outdoor air sampling, HGC (2010b) concluded that the vapor intrusion pathway at Plant 1 is absent or negligible given the current land use.

4.2 Current Conditions

Current conditions are considered for the purpose of this FFS summary to be those since 2012 when the offsite, upgradient contaminant source at Parcel G was contained. The containment of the offsite source was a significant remediation milestone at Plant 1 and resulted in a declining mass of contaminants flowing to Plant 1. As of June 2018, VC is the only VOC in groundwater in excess of MTCA Method A groundwater cleanup levels, and VC concentrations are declining due to a combination of natural attenuation and focused treatment using *in situ* bioremediation.

Current conditions are documented by routine groundwater monitoring conducted by Hexcel pursuant to the *Work Plan for Focused Remedial Investigation* (WPFRI) (HGC, 2005b), the *Interim Action Plan* (IAP) (HGC, 2005a) contained in the EO, and the Groundwater Monitoring Plan Revision (Hexcel, 2014). Monitoring pursuant to the WPFRI consists of water level measurement and water quality sampling at the HEX wells. In April 2006, pursuant to the EO and the IAP, Hexcel assumed responsibility for:

- groundwater pumping at the CG wells;

- water level measurement at Plant 1 wells, with the exception of wells monitored by BSB (HY-119, HY-120, and HY-121), and offsite wells Ks, Ki, HY-9, and HY-12s to HY-15s; and
- water quality sampling at the HEX, CG, Ks, Ki, HY-9, HY-12s and HY-13s wells.

Per the IAP, CG well pumping rates and water level measurements at Plant 1 have been reported in monthly operations summaries submitted to Ecology since April 2006. Per the Groundwater Monitoring Plan Revision in 2014, the frequency of groundwater monitoring was reduced to annual, surface water sampling of the drainage ditch tributary of Springbrook Creek was eliminated, and analysis of arsenic in groundwater samples was eliminated.

4.2.1 Water Levels and Groundwater Flow

Water level data collected since 2003 are contained in Appendix A. Figures 11 and 12 are water level maps for the shallow aquifer for July 2017 and January 2018, respectively, to compare dry and wet season water levels. The water level maps indicate a north dipping hydraulic gradient of on the east side of Plant 1 and a northeast dipping hydraulic gradient on the west side of Plant 1. Water elevations were about a foot higher in January 2018 than in May 2018. The hydraulic gradient on the east side of Plant 1, as calculated between wells HEX-6 and HY-6, was 0.0011 feet per foot in July 2017 and 0.0012 feet per foot in January 2018. The hydraulic gradient on the west side of Plant 1, as calculated between wells HEX-4 and HY-6, ranged from 0.0012 feet per foot in July 2017 to 0.0014 feet per foot in January 2018.

The current groundwater flow direction in the shallow aquifer is northerly on the east side of Plant 1 and northeasterly on the west side of Plant 1. The groundwater flow pattern on the east side of Plant 1 differs from the pattern observed prior to 2016, when the CG wells ceased pumping (Section 5.2), because the drawdown-caused easterly flow directions from the center of the property toward the CG wells along the east property boundary no longer exist. The post-CG pumping groundwater flow direction on the west side of Plant 1 is similar to the flow direction observed when the CG extraction wells were operating. The average groundwater velocity in the shallow aquifer in July 2017 and January 2018 likely ranged from about to 82 to 104 ft/year assuming an average hydraulic conductivity of 51 ft/day for Unit B, the range of measured hydraulic gradients, and a porosity of 0.25.

The most current property-scale water level map of the deep aquifer reviewed for this FRI summary is for June 2013 (PES, 2013). The June 2013 water level map shows a north to northeast dipping water table, typical of historical deep aquifer water level conditions. Water elevations in the deep aquifer wells at Plant 1 are consistent with the north to northeast dipping hydraulic gradient that has been observed over time. The hydraulic gradient between the shallow and deep aquifers remains upward at well HEX-10, as shown by Figure 9.

4.2.2 Water Quality

Current water quality data are available from routine monitoring and special projects conducted for evaluation of cleanup actions. Groundwater samples are collected annually HEX, CG, HY-9, Ki, and Ks wells according to the revised groundwater monitoring plan (Hexcel, 2014). Additional samplings of the CG wells were conducted from 2014 to 2016 for the CG Shutdown tests (CCA, 2017). Additional samplings of CG-4, HEX-8, and PS-1 occurred during the initial EISB field test in 2015 (Geosyntec, 2015c) and additional quarterly samplings of the CG-1, CG-2, HEX-1, HEX-6, HEX-7, HEX-8, HY-9, Ki, Ks, and PS-1 were conducted for the ongoing expanded scale EISB field testing program in 2017 (Geosyntec, 2017). The water quality data for groundwater samples collected by Hexcel from 2003 through 2018 are in Appendix B.

Since 2011, VC and cDCE have been the only VOC's detected in groundwater samples at concentrations exceeding MTCA Method A groundwater cleanup levels or MCLs, although cDCE exceeded the MCL only in well HEX-8.

4.2.2.1 Vinyl Chloride

VC concentrations in samples from Plant 1 in the shallow and deep aquifer wells in September 2017 (CCA, 2017), the most recent annual sampling event, are shown on Figures 17A and 17B, respectively. Also shown on Figure 17A are the results from sampling HY-7s and HY-7ss in June 2018, the most recent samples. HY-7s and HY-7ss were added to the sampling plan in May 2018 to provide additional monitoring north of HEX-8.

In September 2017, VC was the only VOC detected at Plant 1 in excess of a groundwater cleanup level. The VC concentrations at Plant 1 were all less than the 2 ug/L MCL, but ten wells exceeded the MTCA Method A groundwater cleanup level of 0.2 ug/L. VC concentrations between 1 ug/L and 1.9 ug/L were measured at shallow aquifer wells HEX-2, HEX-6, HEX-7 and HEX-8, and the deep aquifer wells HEX-10 and HEX-12. The VC concentrations at the former CG extraction wells and offsite monitoring wells to the east were less than the MTCA Method A groundwater cleanup level.

Time series graphs of VC concentrations in groundwater monitoring samples collected from the shallow aquifer between 2003 and 2018 from the HEX and CG wells are presented in Figures 18 through 20. The time series graphs show that VC concentrations declined by two to three orders of magnitude in many wells since 2003 and that concentrations in 2018 are a historically low levels. VC concentration data for HY-7s and HY-7ss illustrate large declines since the 1990s, with concentrations in the milligram per liter range in 1994 decreasing to less than 0.2 ug/L in 2018 (Figure 21).

The VC occurrences in deep aquifer wells HEX-10 and HEX-12 are due to groundwater flow from Parcel G to Plant 1. There is no clear trend to the VC concentration data at HEX-10 and HEX-12. PES (2011) provides a detailed review of water quality conditions in the deep aquifer on Parcel G.

4.2.2.2 Cis-1,2-Dichloroethene

CDCE concentrations in samples from the shallow and deep aquifers in September 2017 are shown on Figures 22A and 22B, respectively. The cDCE concentrations in all wells at Plant 1 were less than the MCL of 70 ug/L. There is no MTCA Method A groundwater cleanup level for cDCE.

Time series graphs of cDCE concentrations in groundwater monitoring samples collected from the shallow aquifer between 2003 and 2018 from the HEX and CG wells are presented in Figures 23 through 25. The time series graphs show that cDCE concentrations declined by two to three orders of magnitude in many wells since 2003 and that concentrations in 2018 are at historically low levels. By 2014, the concentration of cDCE in all wells was less than the MCL. The last groundwater sample to exceed the cDCE MCL was collected in September 2014 at HEX-8. CDCE is no longer a constituent of concern based on the low concentrations remaining in Plant 1 groundwater.

CDCE does not exceed the MCL in samples from the deep aquifer wells at Plant 1, although concentrations up to 53 ug/L have been measured in HEX-12. Since 2013, cDCE concentrations in HEX-12 have been less than 5 ug/L.

4.2.2.3 Trichloroethene

Figures 26A and 26B are maps showing the results of analyses for TCE in samples collected from the shallow and deep aquifers, respectively, in September 2017. TCE was not detected at a 0.018 ug/L detection limit in thirteen of the sixteen shallow aquifer samples in September 2017. The three samples in which TCE was detected were estimated values between the method detection level and the method reporting level.

TCE was detected in HEX-1 at concentration exceeding the MTCA Method A groundwater cleanup between March 2010 and September 2011 due to a shutdown of the groundwater extraction system on Parcel G (CCA, 2011b). The TCE in HEX-1 declined to nondetect levels after installation of the Parcel G remedy. TCE has been less than the MTCA Method A groundwater cleanup level in all samples collected since October 2011. As discussed in Section 4.1.1, TCE was never a significant component of the VOC plume at Plant 1 and is not a constituent of concern at Plant 1.

4.2.2.4 Summary of Current Water Quality Conditions

VC in groundwater remains a constituent of concern and is being addressed by monitored natural attenuation and *in situ* biological remediation. The historical and current remedial actions at Plant 1 are described in Section 5. The results of groundwater monitoring indicate that cDCE is no longer a constituent of concern at Plant 1, having been reduced to concentrations less than the MCL since 2014.

Comparison of the historical distributions of VC, cDCE, and TCE (Figures 13, 14, and 15) and the current conditions (Figures 17, 22, and 26) indicates that there was a substantial reduction in the size of the groundwater plumes for these VOCs over time, The shrinkage of the plumes was due to groundwater remedial actions between 1992 and present which removed contaminant mass and isolated the source at Parcel G.

Figures 27 and 28 show pH and oxidation-reduction (redox) potential measurements for the shallow aquifer in September 2017. The pH and redox measurements are shown against the contours of VC concentration taken from Figure 17. The pH measurements range from 6.15 to 8.18, or from slightly acidic to slightly alkaline. The redox potential measurements range from -189 to -15.7 millivolts; indicating that reducing conditions predominate in the shallow aquifer. The data show that groundwater in the VC plume is circumneutral and reduced, which are chemically favorable for the reductive dechlorination of VC (Wiedemeier et. al., 1996).

5. REMEDIAL ACTIONS

Remedial actions at Plant 1 have consisted of the operation of a groundwater extraction system from 1992 to 2016, and EISB from 2015 to 2018. Natural attenuation, primarily microbial dechlorination of VOCs and dilution, was active throughout the remedial actions and is responsible for a portion of the observed concentration declines.

5.1 Groundwater Extraction System

The groundwater extraction system installed pursuant to BSB's Post Closure Permit was called the Corrective Measures System (CMS). The CMS consisted of wells on the north side of Parcel G and the east side of Plant 1. The extraction wells on Parcel G were operated to prevent contaminated groundwater at Parcel G from flowing northward beneath 200th Street to Plant 1. The extraction wells at Plant 1 were operated to prevent contaminants that had flowed on to the Plant 1 property from flowing offsite.

BSB installed the CG extraction wells in 1989 and operated the CMS at Plant 1 until April 2006 when Hexcel assumed responsibility for the system pursuant to the EO. Hexcel operated the CG extraction wells from April 2006 to December 2016. Hexcel reported the status of the CG extraction well pumping in monthly Operation Summaries submitted to Ecology from 2006 through present (e.g., CCA, 2018b), and in Annual Groundwater Monitoring Summaries submitted to Ecology from 2007 to 2013 (e.g., CCA, 2013). The CG wells were retired in a phased progression based on the results of the CG Well Shutdown Tests (Section 5.2) after the Parcel G remedy was in place, and it was determined that continued groundwater extraction at Plant 1 had no benefit for the remediation (CCA, 2017).

5.2 Parcel G Groundwater Remedy

The groundwater remedy at Parcel G was fully implemented in 2012. The Parcel G remedy terminated groundwater extraction at the property and isolated the VOC source by surrounding it with a subsurface low permeability soil-bentonite cutoff wall around the perimeter of the property (Figure 4). The water level within the cutoff wall containment cell is controlled to maintain a hydraulic gradient that dips inward to the cell from the surrounding aquifer. An asphalt cap over Parcel G limits infiltration into the containment zone. Isolation of the source on

Parcel G has significantly reduced the VOC loading at the south end of Plant 1 and allows the flushing of Plant 1 by ambient groundwater flow from outside the Parcel G containment system.

Groundwater monitoring results for the Parcel G remedy are contained in quarterly monitoring reports submitted to Ecology (e.g., PES, 2018). Although there is still VC-bearing groundwater and soil between the containment zone and the Plant 1 property that will continue to impact the south end of Plant 1 (Figure 17A), the degree of loading to Plant 1 will decrease over time as the zone of residual contamination is naturally attenuated by flushing with ambient groundwater and biodegradation.

5.3 CG Well Shutdown Tests

In January 2014, Hexcel submitted a work plan for the phased elimination of groundwater pumping at CG-1 and CG-2 pending the results of VC monitoring during shutdown tests at CG-1 and CG-2 (Hexcel, 2014). The work plan for the shutdown tests was conditionally approved by Ecology in April 2014 (Ecology, 2014).

Under the work plan, pumping at CG-1 was shut down on May 8, 2014 for a period of three months while groundwater pumping continued at wells CG-2, CG-3, and CG-4. Groundwater sampling at CG-1 and CG-2 was conducted according to the work plan to monitor VC concentrations during the CG-1 shutdown. CG-2 was shut down on September 4, 2014 because VC concentrations at CG-1 and CG-2 were less than the cleanup level during the CG-1 shutdown test (CCA, 2014). Groundwater sampling at CG-1 and CG-2 during the CG-2 shut down test was conducted until December 1, 2014 pursuant to the work plan.

In January 2015, Hexcel reported the results of the CG-1 and CG-2 shutdown tests (CCA, 2015). The report requested elimination of the groundwater pumping requirements for CG-1 and CG-2 because the VC concentrations at CG-1 and CG-2 were at or below the cleanup level and continued pumping at those wells provided no containment or VC mass removal benefits. The report also recommended quarterly sampling at CG-1 and CG-2 during 2015 to verify the results of the shutdown tests before reducing sampling at those wells to annual in 2016.

In January 2016, Hexcel reported the results of monitoring at CG-1, CG-2, and CG-3 during 2015 (CCA, 2016). The report requested that the pumping requirement for CG-3 be suspended because VC concentrations at CG-3 were less than the MTCA Method A groundwater cleanup level and continued pumping provided no mass removal benefit. Hexcel also recommended quarterly sampling at CG-3 through 2016 to verify the concentrations measured in 2015. In

February 2016, Ecology approved the shutdown of CG-3, quarterly sampling for CG-3 during 2016, and annual sampling for CG-1 and CG-2 (Ecology 2016a). CG-3 was shut down on February 5, 2016. VC concentrations in CG-1 and CG-2 remained at less than the MTCA Method A cleanup level following the shutdown of CG-3. The VC concentration in CG-3 temporarily increased in the first half of 2016 probably due to winter recharge by aerobic water, but declined to less than the groundwater cleanup level in the second half of 2016. The VC concentration in CG-3 was less than the cleanup level in 2017 and the first quarter of 2018.

Pumping continued at well CG-4 until December 22, 2016 when the well was shut down for the expanded scale EISB field test approved by Ecology (Hexcel, 2016 and Ecology 2016b).

5.3.1 Results of Groundwater Monitoring at the CG Extraction Wells

Appendix B contains analytical results for VOCs in samples collected from the CG wells since the start of the shutdown tests in May 2014. Figure 29 shows VC concentrations at the CG wells from May 2014 through June 2018, the period of the CG shutdown tests and EISB pilot testing.

VC concentrations in CG-1, CG-2, and CG-3 were near or below the groundwater cleanup level during the CG shutdown tests. VC concentrations in the CG-3 samples were at or less than the MTCA Method A cleanup level in all samples except those collected in April and May of 2016. The two-month spike in VC concentrations at CG-3 occurred following a rise in groundwater levels due to recharge from winter precipitation. VC was less than the cleanup level in the subsequent ten sampling events between June 2016 and June 2018.

CDCE was detected in CG-1, CG-2, and CG-3 samples at concentrations up to 2.4 ug/L, which is more than an order of magnitude less than the MCL of 70 ug/L. TCE was not detected in any of the samples from the CG-1, CG-2, and CG-3 at a method detection limit of 0.10 ug/L, which is more than an order of magnitude less than the MTCA Method A cleanup level of 5 ug/L.

Figure 20 shows that VC concentrations at CG-1 and CG-2 were less than the MTCA cleanup level most of the time starting in 2004 and that VC concentrations in CG-3 declined by more than three orders of magnitude since 2004. The low VC concentrations at CG-1, CG-2, and CG-3 prior to the remedy at Parcel G are likely due to the reduced loading from offsite sources as a result of the CMS and natural attenuation processes occurring in the shallow aquifer.

CG-4 continued pumping during the CG shutdown tests. Although VC concentrations in CG-4 were declining during the tests, they were higher than the MTCA Method A groundwater cleanup level. The VC concentration in CG-4 declined after the nearby area was treated for the expanded scale EISB field test (Section 5.3) and was less than the groundwater cleanup level in samples from September and December 2017. The VC concentration increase to 1.8 ug/L in the March 2018 sample of CG-4, but declined to 0.17 ug/L in the June 2018 sample. The low levels of VC in September and December 2017 and June 2018 show the effectiveness of the EISB treatment. The March 2018 increase could be a seasonal effect after the winter rainfall or a concentration rebound. In either case, ongoing monitoring will determine the significance of the increase and whether it is a transient phenomenon.

5.4 Enhanced *In Situ* Bioremediation

It was suspected that naturally occurring biodegradation of TCE, cDCE, and VC was active at Plant 1 due to the observed cleanup trends over time as groundwater extraction was implemented, the presence of dechlorination byproducts (i.e., VC and cDCE), and the presence of reducing conditions in the subsurface. In 2003, as part of Hexcel's voluntary source investigation, data were collected to assess the site's suitability for natural attenuation of VOCs (HGC, 2003b). The results of the assessment provided evidence that conditions were appropriate for biodegradation to be occurring at the site. Genetic marker testing in 2003 (HGC, 2004) confirmed the subsurface presence of Dehalococcoides, the primary microbe responsible for the dechlorination of VC and cDCE, further supporting the conclusion that *in situ* biodegradation was naturally occurring at Plant 1.

In 2014, following isolation of the Parcel G source, Hexcel implemented a project to use EISB to reduce concentrations of residual VOCs at the site (Geosyntec, 2014). After a program of laboratory testing to show the conceptual feasibility of EISB (Geosyntec, 2015a and 2015b), a pilot test was conducted in 2015. The pilot test consisted of injecting a vegetable oil and microbial culture mix into the shallow aquifer in the vicinity of HEX-8 in October 2015 followed by 6 months of groundwater monitoring to track reductions in the concentrations of VC and cDCE, and other biogeochemical parameters. Due to the positive results of the pilot test, an Interim Action of expanded scale EISB field testing was proposed (Geosyntec, 2017).

Groundwater pumping at extraction well CG-4 was discontinued in December 2016 in anticipation of the expanded scale EISB field test (Hexcel, 2016 and Ecology, 2016b) which was implemented in June 2017 with the injection of approximately 70,000 gallons of treatment compounds into the area between PS-1 and CG-4 (Figure 6). As of the June 2018 sampling, the results of groundwater sampling were encouraging; showing appropriate geochemical transitions, significant VOC reductions, and the production of ethene from the breakdown of VC

(Geosyntec, 2018). Figure 30 shows VC concentration data for PS-1 and HEX-8 for the EISB interim action. The data are fitted with exponential curves indicating the rate of VC reduction. Geosyntec prepared this plot to illustrate potential remediation timeframes based on the data collected to date for PS-1 and HEX-8. Although preliminary because data collection is ongoing, the results indicate that VC concentrations at PS-1 and HEX-8 can be expected to be in the range of or below the MTCA Method A cleanup level within the next 4 to 5 years. Ongoing groundwater monitoring for the expanded scale EISB program is scheduled through the second quarter of 2019. The FFS report will contain additional discussion of the feasibility of EISB and monitored natural attenuation as remedial actions for Plant 1.

The expanded scale EISB field test demonstrates the ability of the vegetable oil-microbial culture injections to enhance the naturally occurring *in situ* biological degradation of VC and cDCE. The EISB work in the vicinity of HEX-8 has destroyed VC in the subsurface, as evidenced by the presence of ethene, thereby reducing the residual VC mass to a level that can be managed by monitored natural attenuation.

5.5 Monitored Natural Attenuation

The monitored natural attenuation approach is feasible at this time because the Parcel G remedy has contained the source of VC, cDCE, and TCE; naturally occurring biodegradation of VC is occurring; and *in situ* biodegradation of VC can be stimulated to enhance its effectiveness, if needed. The pH and redox conditions of the shallow aquifer are in ranges considered appropriate for reductive dechlorination (Wiedemeier et. al, 1996). Dehalococcoides is present and has been dechlorinating TCE for decades, as evidenced by the presence of cDCE and VC in shallow groundwater samples collected since the 1980s. As indicated by Figures 13, 14, 15, 17, 22, and 26 the groundwater plumes of VC, cDCE, and TCE have been shrinking over time. In September 2017, there were no detections of cDCE above MTCA Method A cleanup levels for groundwater, making VC the sole constituent of concern (Section 4.2.2). Natural attenuation, due in part to the intrinsic biodegradation of VC, in the shallow aquifer at Plant 1 has reduced concentrations in the CG wells on the east side of Plant 1. For example, the VC concentrations in wells CG-1, CG-2, and CG-3 declined from a range of 35 to 1,000 ug/L in 1995 and 1996 to less than the MTCA Method A cleanup level of 0.2 ug/L in 2016 (Figure 31).

Figure 32 is a plot of VC concentration versus distance downgradient of the upgradient southern boundary of Plant 1 in approximately decadal intervals since 1986. This figure uses data for HY-4 and HEX-6 to approximate the upgradient boundary. Progressing downgradient from the upgradient boundary, wells HEX-8, HY-7s, HY-7ss, CG3, CG-2, CG-1, and HY-6 are used to show the change in VC concentrations over time. Figure 32 shows the decline in VC concentrations at the downgradient edge of Plant 1 from concentrations approximately 200 ug/L in 1986 to concentrations less than the cleanup level in 2015 and 2018. Figure 32 also shows that the downgradient edge of the plume, as defined by the most downgradient concentration exceeding the cleanup level, has receded upgradient over time indicating shrinkage of the plume.

Concentrations of VC in groundwater in samples from wells on the upgradient boundary of Plant 1 (i.e., HEX-1, HEX-2, HEX-3, HEX-4, and HEX-5) ranged from 0.14 ug/L to 1.9 ug/L in September 2017, indicating an ongoing loading of VC from offsite sources. Despite the loading from offsite sources, VC concentrations at Plant 1 have declined to non-detect at the downgradient wells CG-1, CG-2, and CG-3 The historical reductions in VC, cDCE, and other VOCs indicate that natural attenuation can be sufficient to control VC at Plant 1 once the residual zone of elevated concentrations is treated by EISB.

As described by Washington Department of Ecology guidance (Ecology 2005), several factors are affirmative indicators of the potential feasibility of monitored natural attenuation. These factors include:

- Source control to the maximum extent practicable
- Evidence that natural biodegradation is occurring and will continue at a reasonable rate
- Leaving contaminants on site during the restoration does not pose an unacceptable risk to human health or the environment
- Adequate monitoring is conducted to evaluate attenuation.

The Plant 1 property meets the factors needed for monitored natural attenuation.

The Parcel G remedy has isolated the source of VOCs, a prerequisite for natural attenuation. The Parcel G remedy used a reliable containment method to isolate the source from the ambient groundwater flow system. The Parcel G remedy is source control to the maximum extent practicable.

Naturally occurring biodegradation is occurring and is expected to continue at rates that would reduce VC concentrations to less than the MTCA Method A groundwater cleanup level by the boundary of Plant 1. As discussed above, several studies have documented that the biogeochemical conditions and the microorganism needed to degrade VC to ethene or water and carbon dioxide are present and that biodegradation has been actively occurring. Furthermore, ethene and carbon dioxide, the breakdown products of VC, are nonhazardous materials.

There is still a low level of VC loading at the upgradient boundary of Plant 1, but VC concentrations are declining (Figures 18 and 19) and groundwater monitoring conducted for the CG well shutdown tests demonstrated that the plume is not migrating under current conditions. The VC plume has been shrinking over time, indicating that natural attenuation rates equal or exceed the VC loading rate at the edge of the plume.

Figure 32 shows information documenting the reduction in plume extent over time. The fact that the concentrations of VC at downgradient wells CG-2, CG-3, CG-4, HY-7s, and HY-7ss, HY-9, Ki, and Ks remain less than the MTCA Method groundwater cleanup level after the termination of groundwater extraction is another indication that the plume is not migrating and that biodegradation is occurring at a rate needed to control the plume by the property boundary.

Contaminants in the subsurface of Plant 1 are restricted to groundwater and, possibly, soil in the saturated zone. There is no demand for or use of the shallow groundwater projected for the area, as alternative sources are available. The primary potential risk to human health is for workers that might contact contaminated water or soil during environmental sampling or excavation. Such work is conducted under health and safety plans developed to protect workers from unsafe exposure to workplace hazards. Vadose zone and indoor air studies show there is no VC transfer to the vapor phase at levels that represent a risk to the workers at Plant 1. Potential exposure pathways are described further in Section 6.

Groundwater monitoring would be a critical component of a cleanup action plan using monitored natural attenuation. After the expanded-scale EISB Interim Action is complete, groundwater monitoring will be conducted to determine the degree to which natural attenuation controls the VC load impinging on Plant 1 from upgradient areas. The degradation of VC should become more efficient over time as loading declines due to the source control on Parcel G, as expected. Additional EISB applications could be used in the future to control VC concentrations on Plant 1 property should post-expanded-scale EISB groundwater monitoring data indicate the presence of VC at concentrations requiring action. Any additional focused applications of EISB, if needed, would be an effective means of destroying VC *in situ* to meet the groundwater cleanup level at the property boundary.

5.6 Deep Aquifer Monitored Natural Attenuation

The deep aquifer is monitored due to the contamination at Parcel G and VC occurrences at some wells along the upgradient boundary. PES (2011) indicates that VOCs in the deep aquifer on Parcel G form plumes that extends to the south end of Plant 1. The VOC plumes are believed to be stable or contracting, being kept in check by naturally occurring microbial degradation. Conditions in the deep aquifer at Parcel G and Plant 1 are documented by ongoing monitoring programs to verify the extent of the VOC plumes and test the hypothesis that the deep aquifer plumes are stable and not migrating.

6. UPDATED CONCEPTUAL SITE MODEL

The conceptual site model identifies the types and concentrations of hazardous substances, potential sources of hazardous substances, potentially contaminated media, and potential exposure pathways to provide a conceptual tool for decision making (WAC 173-340-200). This section updates the conceptual site model for the shallow aquifer at Plant (HGC, 2005) based on information in the data compilation and evaluation (HGC, 2010) and the data for current conditions (Section 4.2).

6.1 Potential Hazardous Substances

The potential hazardous substance associated with the Plant 1 property is VC. Although various VOCs have been present historically, VC is the only VOC that currently occurs at concentrations exceeding MTCA Method A cleanup levels for groundwater. In September 2017 the detectable concentrations of VC measured in samples from Plant 1 wells ranged from 0.017 to 1.9 ug/L. VC concentrations in groundwater are highest in the vicinity of well HEX-8, which is the location of EISB treatment. CDCE is often associated with VC in groundwater, but the concentrations of cDCE are less than the MCL. Although less than the MCL, cDCE can degrade into VC which has a low cleanup level.

6.2 Potential Sources of Hazardous Substances

Potential historical sources of VOCs at Plant 1 could have been leaks or disposal practices from the historical operations at the Hytek building and conveyances to Parcel G, but there is no evidence of a current source at Plant 1. The potentially contaminating operations at Plant 1 were discontinued in the 1980s, more than 30 years ago.

The VC and cDCE currently at Plant 1 are due to a residual plume of contaminants from Parcel G. The VOCs historically present at Plant 1 were reduced through groundwater extraction remedial actions at Parcel G and Plant 1 between 1992 and 2016 and the isolation of the offsite source in 2012 by the Parcel G remedy. However, groundwater flow to the upgradient boundary of Plant 1 still contains low levels of VC and cDCE due to residual contamination outside of the Parcel G isolation system (Section 4.2.2). VC and cDCE that does migrate to Plant 1 is reduced to less than cleanup level by natural attenuation as groundwater flows across the site.

The concentrations of VC in groundwater are declining as described in Section 4.2.2, but elevated concentrations of VC were persistent in the vicinity of HEX-8. The elevated concentrations of VC around HEX-8 are believed to be due to the diffusion of sorbed VC from fine grained sediment that was in contact with affected groundwater for decades along the axis of the former VOC plume from Parcel G. The EISB treatment of the groundwater and soil around HEX-8 has reduced the groundwater concentrations of VC in that area. The EISB program observed that the seasonal recharge of oxidized water is sometimes associated with temporary increases in VC concentrations at some wells, but that the increases are transitory and can be accounted for by adjusting the dose rate of injected amendments.

6.3 Potentially Contaminated Media

The results of investigations and samplings of groundwater, saturated and vadose zone soils, soil gas, and indoor air were summarized in Sections 4.1 and 4.2. The available data indicate that groundwater containing VC is the primary contaminated medium.

VC in groundwater is partitioned between the aqueous phase and aquifer material based on factors such as the contaminant concentration, contaminant specific partitioning coefficients, and the grain size and organic carbon content of soil. For this reason, the saturated soil in areas with VC in groundwater can store and release VC depending on the relative concentration gradients and chemical contrasts of the groundwater and aquifer solids. VC in groundwater can also partition into the vapor phase at the interface between the groundwater surface and unsaturated soil. The degree of vapor phase partitioning is dependent on factors such as the contaminant concentration and volatility, soil gas permeability, and the organic carbon content of unsaturated soil.

VC in groundwater at Plant 1 is destroyed by naturally occurring biodegradation as described in Sections 5.3 and 5.4. The degradation process can be accelerated by the introduction of microbes and nutrients as demonstrated by the EISB interim action. The degradation products of VC are the nonhazardous substances ethene and carbon dioxide.

6.4 Potential Exposure Pathways

An exposure pathway describes the course a contaminant takes from a source to a potential receptor. Exposure pathways are statements describing a unique source, transport mechanism, exposure point, and exposure route. Transport mechanisms are not involved in pathways for which the contaminated medium is the exposure point, such as soil left in place.

VC in groundwater is the hazardous constituent at Plant 1 and its extent at concentrations exceeding the MTCA Method A define the current source area for the purpose of this pathways analysis. The extent of groundwater with VC concentrations exceeding the cleanup level is shown by Figure 17A. The VC contained in groundwater can migrate with the ambient groundwater flow system, sorb to sediment in the saturated zone, volatilize into soil gas in the vadose zone above the water table, or be destroyed by biologically mediated reductive dehalogenation.

Potential exposure points and exposure routes for VC are constrained by the current and future land uses at Plant 1. The current and planned future use of the Plant 1 property is as an industrial facility for manufacturing. Potential receptors at Plant 1 would be adult workers that could come into contact with VC bearing environmental media during workplace activities. VC does not occur in downgradient offsite wells at concentrations exceeding the MTCA Method A groundwater cleanup standard (Figure 17A). Therefore, the potential for an offsite exposure is negligible because the VC plume exceeding the groundwater cleanup standard is restricted to the Plant 1 property and is not expected to migrate offsite in the future. The predominant offsite land uses in the vicinity of Plant 1 are industrial and commercial, although there are a few residential properties east of Plant 1 across 84th Avenue.

The VC source area, the potential migration mechanism, potential exposure points, and potential exposure routes are used to describe hypothetical exposure pathways. Figure 33 illustrates the source area, potentially affected medium, migration mechanisms, possible exposure routes, and potential receptors associated with Plant 1 along with an evaluation of whether the pathway is applicable or not given site specific information. Some of the exposure pathways are considered to be not applicable because they are unrealistic given current site specific data and expected future conditions. For example, the exposure pathway for unsaturated soil in the source area is considered not applicable because vadose zone sampling did not detect VC in excess of MTCA Method A soil cleanup levels (Section 4.1.2.1). Additionally, soil gas sampling and indoor air sampling did not find VC at levels of concern, indicating that the potential volatilization of VC from groundwater to soil gas is not an exposure pathway (Sections 4.1.3 and 4.1.4). Another example is an offsite exposure pathway for groundwater, which is considered to be not applicable because VC is currently restricted to Plant 1 and is not expected to migrate offsite in the future.

The fate and transport of VC in groundwater and saturated soil will be evaluated further as these media are associated with current and potential future pathways.

6.4.1 Groundwater

VC dissolved in groundwater can migrate by advection, dispersion, and diffusion. The concentration of VC in groundwater is reduced naturally by reductive dechlorination which destroys VC and dilution which reduces it mass per unit volume of water. Both of these processes are active at Plant 1 and work to reduce the concentrations of VC in groundwater flowing beneath the Plant 1 property. EISB is being used treat areas of high residual VC by enhancing the naturally occurring dechlorination process.

Groundwater flow directions beneath Plant 1 are northerly to northeasterly (Section 4.2.1). The concentration of VC in groundwater flowing beneath Plant 1 is expected to be reduced to less than the groundwater cleanup level by the property boundary through natural attenuation and the use of EISB. Thus, an offsite exposure pathway is not being considered.

Exposure to VC in groundwater at Plant 1 is limited to activities that can potentially bring workers in contact with groundwater, such as groundwater sampling and excavation below the water table. Dermal contact, ingestion and inhalation would be the potential exposure routes for VC affected groundwater. The risk of contacting, ingesting, or inhaling vapors from affected groundwater is negligible during groundwater sampling and construction because health and safety precautions are required and followed as a matter of standard operating procedure during those activities. The health and safety precautions include hazard recognition awareness and personal protective equipment training for the prevention of exposure to hazardous chemicals.

6.4.2 Saturated Zone Soil

Exposure to saturated zone soil containing sorbed VC is a possibility for construction activities that involve excavation below the water table, such as excavation, trenching, or drilling. Dermal contact, ingestion and inhalation are the potential exposure routes for affected saturated zone soil. The risk of contacting, ingesting, and inhaling vapors volatilizing from saturated soil during construction activities is negligible because health and safety precautions are followed as a matter of standard operating procedure. The health and safety precautions include hazard recognition awareness and personal protective equipment training for the prevention of exposure to hazardous chemicals.

6.5 Site Conceptual Model Summary

In summary, low levels of VC in groundwater and soil beneath Plant 1 are due to a residual groundwater contaminant plume from Parcel G. VC concentrations are declining due to installation of the Parcel G remedy, natural attenuation, and spot treatment with EISB. The majority of Plant 1 is paved or covered by buildings, which makes access to the subsurface limited except in the cases of subsurface environmental sampling or certain construction activities. Potential exposure to VC affected groundwater and saturated soil is limited to onsite work activities for which health and safety protocols are established. There is no potential for an downgradient offsite exposure because the future Corrective Action Plan will use monitored natural attenuation, possibly augmented by EISB, to reduce VC to acceptable levels. There is no potential for future residential and recreational exposures to VC in groundwater at Plant 1 because an environmental covenant would place deed restrictions on the types of acceptable land use and would inform future owners of environmental conditions.

7. REFERENCES

Clear Creek Associates. 2011a. Monitor Well Installation Completion Report, Hexcel Facility, Kent, Washington. January 26, 2011.

Clear Creek Associates. 2011b. Correspondence from James Norris, Clear Creek Associates, to Hideo Fujita, Washington Department of Ecology, Re: Water Quality at Well HEX-1, Hexcel Plant 1 Facility, Kent, Washington, Enforcement Order No. DE 2552. July 12, 2011.

Clear Creek Associates. 2013. Annual Groundwater Monitoring Summary June 2012 through May 2013, Hexcel Plant 1 Facility, Kent, Washington. August 21, 2013.

Clear Creek Associates. 2014. Correspondence from James R. Norris, Clear Creek Associates, to Hideo Fujita, Department of Ecology, RE: Hexcel Plant 1 – Update on CG-1 Shutdown Test, Enforcement Order No. DE 2552. August 27, 2014.

Clear Creek Associates. 2015. Correspondence from James R. Norris, Clear Creek Associates, to Hideo Fujita, Department of Ecology, RE: Hexcel Plant 1 – Results of CG-1 and CG-2 Shutdown Tests, Enforcement Order No. DE 2552. January 21, 2015.

Clear Creek Associates. 2016. Correspondence from James R. Norris, Clear Creek Associates, to Hideo Fujita, Department of Ecology, RE: 2015 Groundwater Monitoring Results for CG-1, CG-2, and CG-3. January 11, 2016.

Clear Creek Associates. 2017. Environmental Monitoring Report September 2017, Hexcel Plant 1 Facility, Kent, Washington. December 7, 2017.

Clear Creek Associates. 2018. May 2018 Operations Summary, Hexcel Plant 1 Facility. Correspondence from James Norris, Clear Creek Associates, to Hideo Fujita, Department of Ecology. June 1, 2018.

Geosyntec. 2014. Evaluation of Cleanup and Regulatory Options for the Hexcel Plant 1 Facility Located in Kent, Washington. March 14, 2014.

Geosyntec. 2015a. Microcosm Study and Pilot Study Work Plan: Hexcel Corporation Plant 1 Facility, 19819 84th Ave. South, Kent, Washington, 98032. March 6, 2015.

Geosyntec. 2015b. Update on Microcosm Study. Hexcel Corporation Plant 1 Facility, Kent, Washington. July _, 2015.

Geosyntec. 2015c. Work Plan Addendum: *In Situ* Bioremediation Pilot Test. Hexcel Plant 1 Facility. Kent, WA. August 11, 2015.

Geosyntec. 2017. Enhanced *In Situ* Bioremediation Work Plan Addendum. Hexcel Plant 1 Facility. Kent, WA. April 18, 2017.

Geosyntec. 2018. First Quarter 2018 Enhanced *In Situ* Bioremediation Monitoring Report, Hexcel Plant 1 Facility, Kent, WA. June 2018.

Hexcel Corporation, 2014. Correspondence from Tim L. Sturdivant, Hexcel Corporation, to Hideo Fujita, Department of Ecology, RE: Hexcel Plant 1, Enforcement Order No. DE 2552. January 10, 2014.

Hexcel Corporation. 2016. Correspondence from Tim Sturdavant, Hexcel Corporation, to Hideo Fujita, Department of Ecology, RE: Request from Hexcel Corporation to shut down groundwater extraction pump CG #4 at the Hexcel Plant 1 Facility in Kent, Washington. December 15, 2016.

Hydro Geo Chem, Inc. 2003a. Interim Report, Hexcel Facility Source Investigation, Kent, Washington. July 3, 2003.

Hydro Geo Chem, Inc. 2003b. DRAFT Interim Technical Memorandum: Screening of Bioremediation Verification Results, Hexcel Kent Facility. December 3, 2003.

Hydro Geo Chem, Inc. 2004. Hexcel Kent Biological Groundwater Assessment. Memorandum to Jim Norris from Bill Kight. January 23, 2004.

Hydro Geo Chem, Inc. 2005a. Interim Action Plan, Hexcel Plant 1 Facility, Kent, Washington. June 20, 2005.

Hydro Geo Chem, Inc. 2005b. Work Plan for Focused Remedial Investigation, Hexcel Plant 1 Facility, Kent, Washington. December 21, 2005.

Hydro Geo Chem, Inc. 2007a. Work Plan for Indoor Air Sampling At the Hexcel Plant 1 Facility, Kent, Washington. November 7, 2007.

Hydro Geo Chem, Inc. 2007b. Preliminary Development of Groundwater Cleanup Levels, Hexcel Plant 1 Facility, Kent, Washington. November 30, 2007.

Hydro Geo Chem, Inc. 2008. Sampling and Assessment of Indoor Air, Hexcel Plant 1 Facility, Kent, Washington. June 20, 2008.

Hydro Geo Chem, Inc. 2010a. Vadose Zone Soil Sampling for Additional Source Characterization, Hexcel Plant 1 Facility, Kent, Washington. January 5, 2010.

Hydro Geo Chem, Inc. 2010b. Data Compilation and Evaluation, Hexcel Plant 1 Facility, Kent, Washington. January 28, 2010.

IT Corporation. 2001. Kent Facility Source Area Investigation Report, Kent, Washington. March 5, 2007.

O.H. Materials Corp. 1988a. Proposal for the Cleaning of CIBA-GEIGY Corporation's Facility Located in Kent, Washington. April 11, 1988.

Pacific Northwest Center for Geologic Mapping Studies. 2006. Geologic map of King County, Washington: D.B. Booth and A. P. Wisher, compilers, scale 1:100,000 (available at: (http://geomapnw.ess.washington.edu/services/publications/map/data/KingCocomposite.pdf).

PES Environmental, Inc. 2005a. Focused RI Summary/FS Report, BSB Property, Kent, Washington. June 20, 2005.

PES Environmental, Inc. 2005b. Downgradient Area Groundwater Investigation, Revised Scope of Work Addendum, Kent Facility, Kent, Washington. December 5, 2005.

PES Environmental, Inc. 2007a. Downgradient Area Groundwater Investigation Final Report, Agreed Order No. DE2553, Kent, Washington. February 14, 2007.

PES Environmental, Inc. 2007b. 2006 Progress Report, Kent Facility Corrective Measures System. March 29, 2007.

PES Environmental, Inc. 2008a. Draft Cleanup Action Plan, BSB Property, Kent, Washington. April 14, 2008.

PES Environmental, Inc. 2009a. Downgradient Area Groundwater Investigation Final Report, Agreed Order No. DE 2553, Kent, Washington. January 22, 2009.

PES Environmental, Inc. 2009b. Deep Aquifer Investigation Evaluation Report, Agreed Order No. DE 2553, Kent, Washington. January 29, 2009.

PES Environmental, Inc. 2010. Phase 2 Deep Aquifer Investigation Data Summary Report, BSB Property, Kent, Washington. July 27, 2010.

PES Environmental, Inc. 2011. Remedial Investigation Report Addendum, BSB Property, Kent, Washington. April 29, 2011.

PES Environmental, Inc. 2013. Data Summary and Monitoring Reduction Request, Parcel G Deep Aquifer Monitoring, BAB Property, Kent, Washington. September 13, 2013.

PES Environmental, Inc. 2018. Cleanup Progress Report, Second Quarter, 2018, BSB Property, Kent, Washington, Consent Decree No. 11-2-27288-5. July 19, 2018.

S.S. Papadopulos & Associates, Inc. 1993. Hydraulic Evaluation of Recovery Well System Performance at BSB Diversified Company, Inc. Prepared for Heath Tecna Aerospace Company. September, 1993.

S.S. Papadopulos & Associates Inc. 2003. BSB Diversified Company, Inc., Kent, Wa. , Modification to Groundwater Flow Model and Containment Well Network. Memorandum from Michael J. Riley to Paul Beveridge.

Sweet-Edwards/EMCON, Inc. 1988. Hytek Finishes 1987 Ground Water Investigation Report. January 22, 1988.

U.S. Environmental Protection Agency. 1989. Final Post Closure Permit, Hytek Finishes Company, WAD 07 665 5182. Prepared by USEPA Region 10. February 27, 1989.

Washington State Department of Ecology. 2009. Correspondence Hideo Fujita Ecology) to A. William Nosil (Hexcel). August 3, 2009.

Washington State Department of Ecology. 2010. Cleanup Levels and Risk Calculation Database CLARC: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.

Washington State Department of Ecology, 2014. Email correspondence from Hideo Fujita, Department of Ecology, to Tim Sturdavant and Ronald A. Burt, RE: Hexcel - Kent, WA groundwater monitoring & hydraulic extraction system modifications. April 21, 2014.

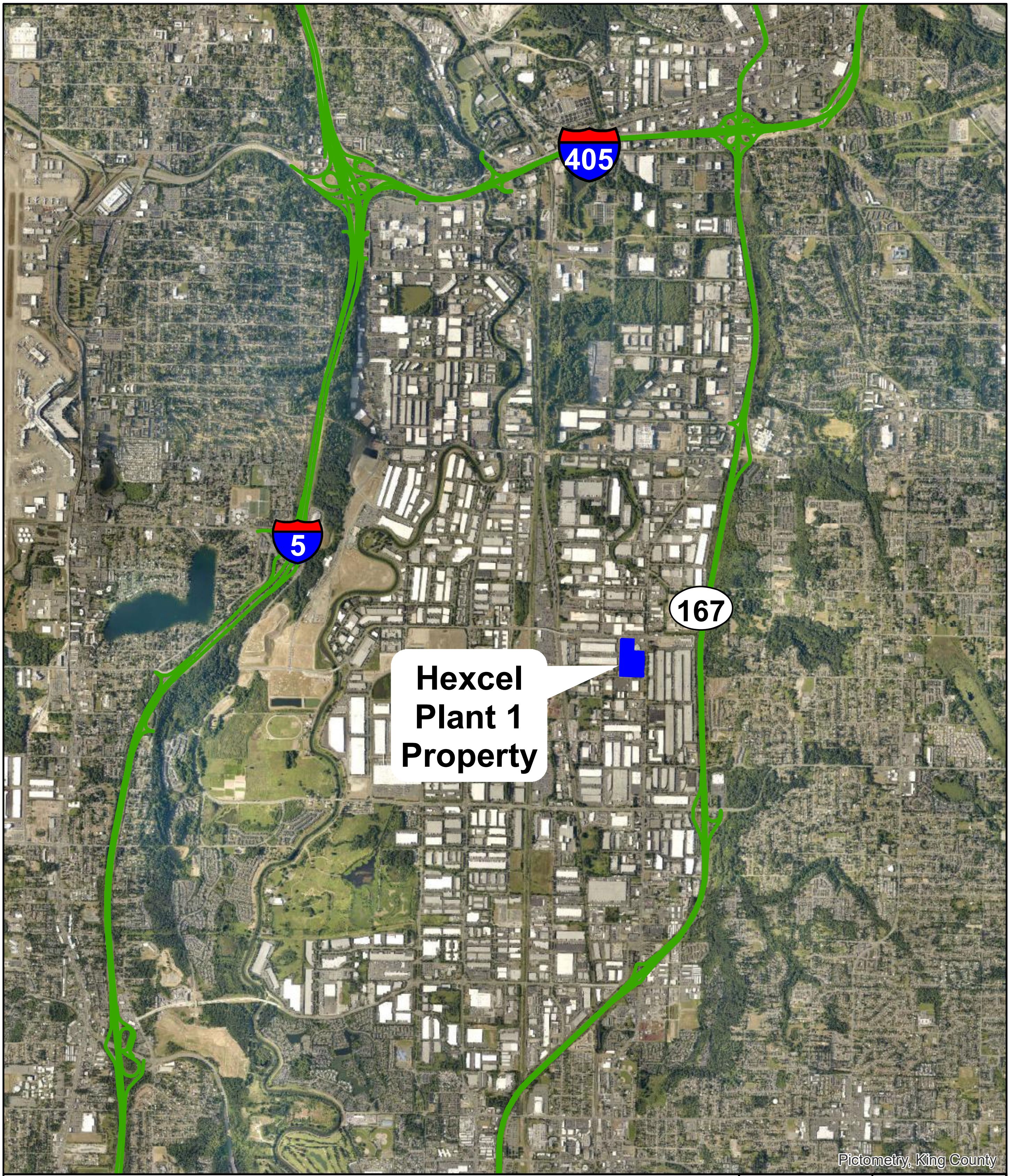
Washington State Department of Ecology. 2016a. Email Correspondence from Hideo Fujita, Department of Ecology, to Tim Sturdavant, Hexcel Corporation, Subject: FW: 02/04/16 Meeting Notes --> ECY approvals. February 17, 2016.

Washington State Department of Ecology. 2016. Email Correspondence from Hideo Fujita, Department of Ecology, to Tim Sturdavant, Hexcel Corporation, Subject: The WA State Dept. of Ecology conditionally approves Hexcel's proposal for the CG-4 Well Shutdown. December 15, 2016.

Washington State Department of Health. 2002. Health Consultation, Indoor Air Quality Evaluation, Philip Services Corporation (Burlington Environmental Incorporated, Georgetown Facility), Seattle, King County, Washington. Appendix A: Evaluation of Indoor Air Studies. December 23, 2002. http://www.atsdr.cdc.gov/HAC/pha/philipservices/psc_toc.html.

Wiedemeier, T.H., Swanson, M.A., Moutoux, D.E., Gorden, E.K., Wilson, J.I., Wilson, B.H., Kampbell, D.H., Hansen, J.E., Haas, P., and Chapelle, F.H. 1996. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. November 1996.

FIGURES



CLEAR CREEK ASSOCIATES

File ID	273-007
Date	6/18/18

FIGURE 1
Plant 1 Location Map

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet

CLEAR CREEK ASSOCIATES

File ID	273-008
Date	6/18/18

FIGURE 2
Plant 1 Local Area

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet

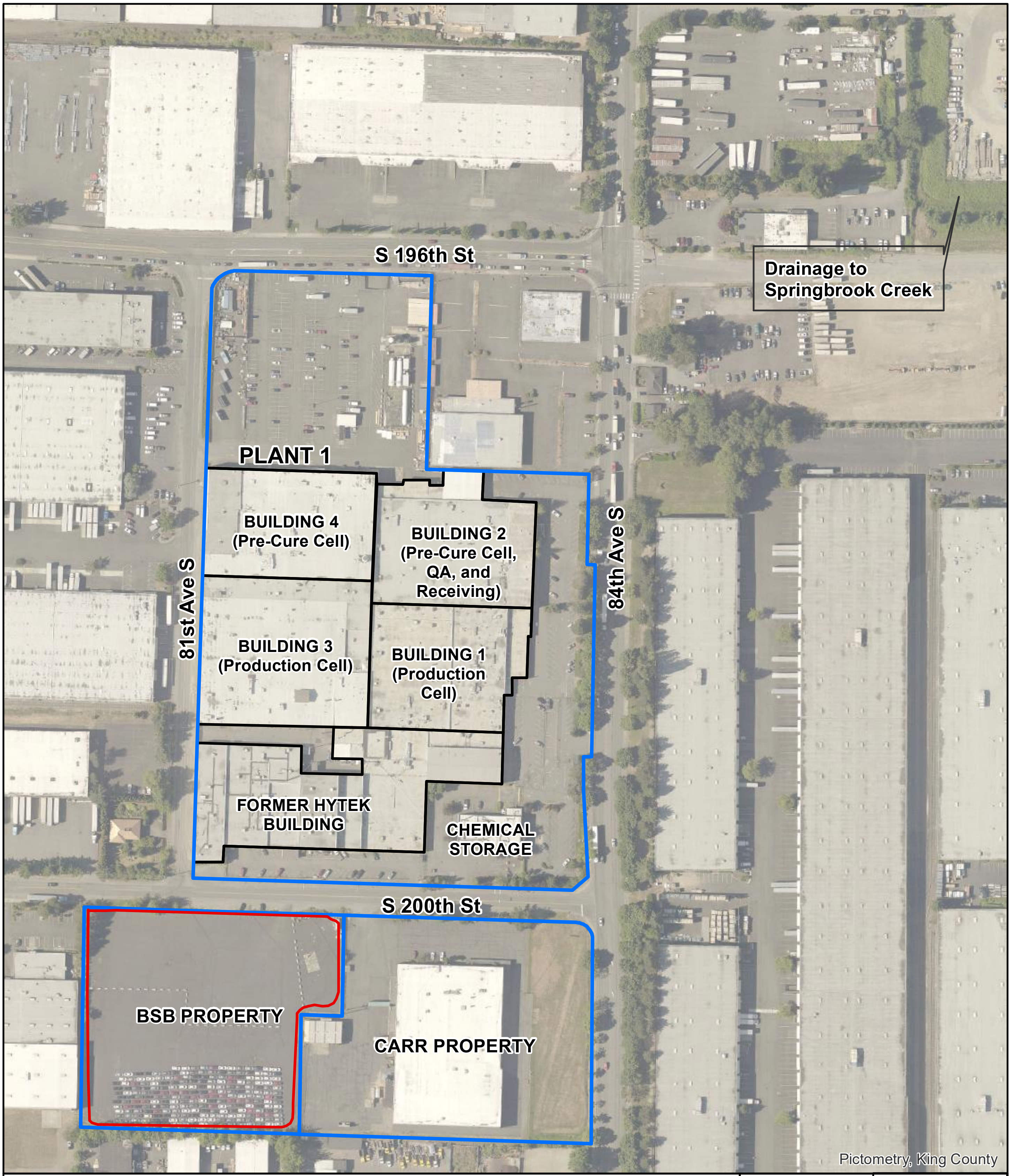
DRAFT

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet
Parcel data provided by permission of King County Source: King County GIS Data Portal
(https://www5.kingcouny.gov/gisdataportal/)

CLEAR CREEK ASSOCIATES

File ID	273-015
Date	6/18/18

FIGURE 3
Historical Parcel Designations



Legend

▭ Parcel Boundaries

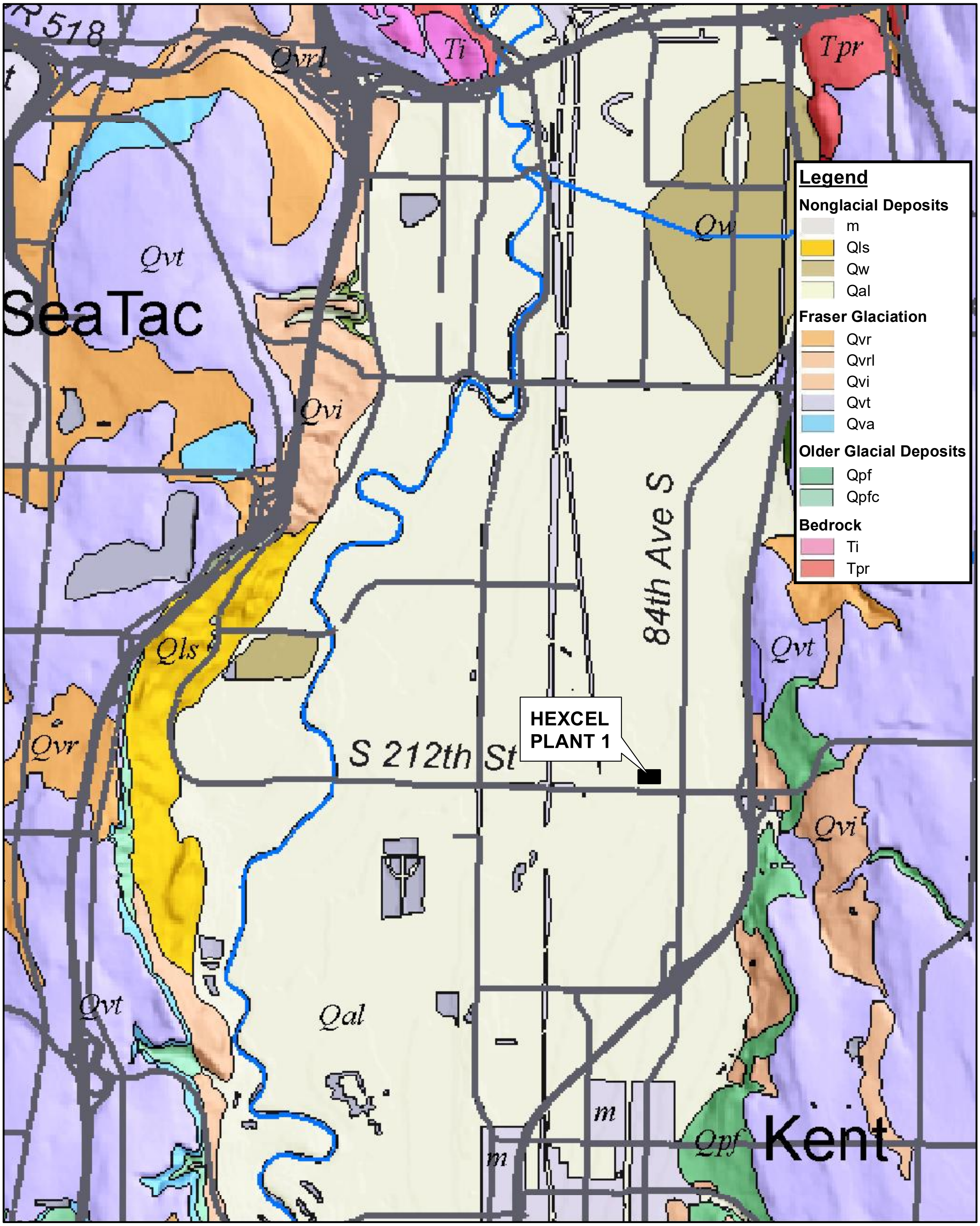
— Subsurface Soil-Bentonite Cutoff

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet
Parcel data provided by permission of King County Source: King County GIS Data Portal
(https://www5.kingcouny.gov/gisdataportal/)

CLEAR CREEK ASSOCIATES

File ID	273-009
Date	8/14/18

FIGURE 4
Plant 1 Site Plan



CLEAR CREEK ASSOCIATES

File ID 273-008

Date 6/18/18

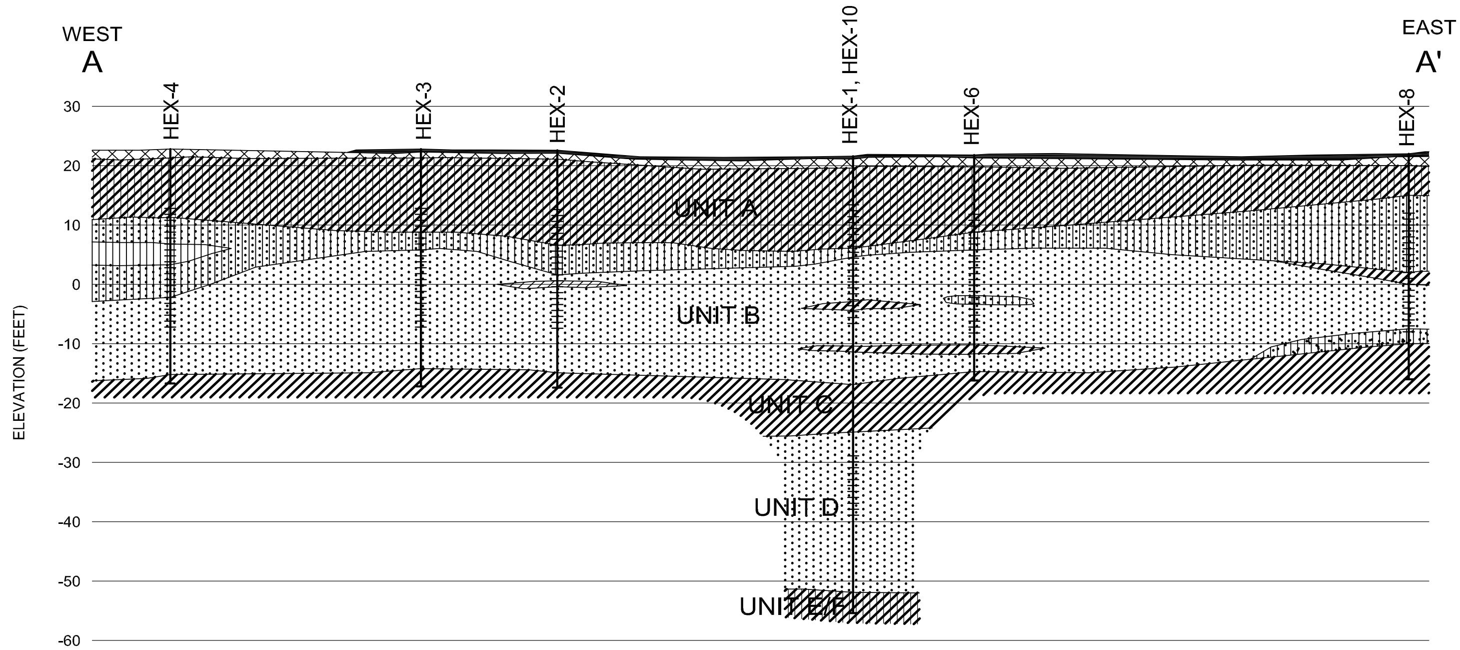
FIGURE 5
Geology Map

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet

Date	File ID
8/13/18	273-010

CLEAR CREEK ASSOCIATES

FIGURE 6
Well Location Map



0 60 120 180

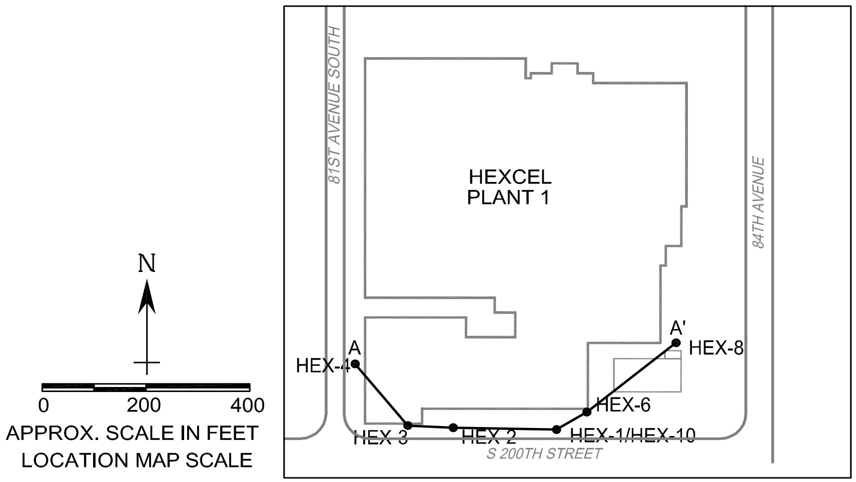
HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION: 4X

EXPLANATION

▩	ASPHALT	▥	SILT	▦	SILTY SAND
▩	FILL	▨	SILTY CLAY	HEX-1	WELL LOCATION
▨	CLAY	⋯	SAND	≡	SCREENED INTERVAL

CROSS SECTION LOCATION



CLEAR CREEK ASSOCIATES

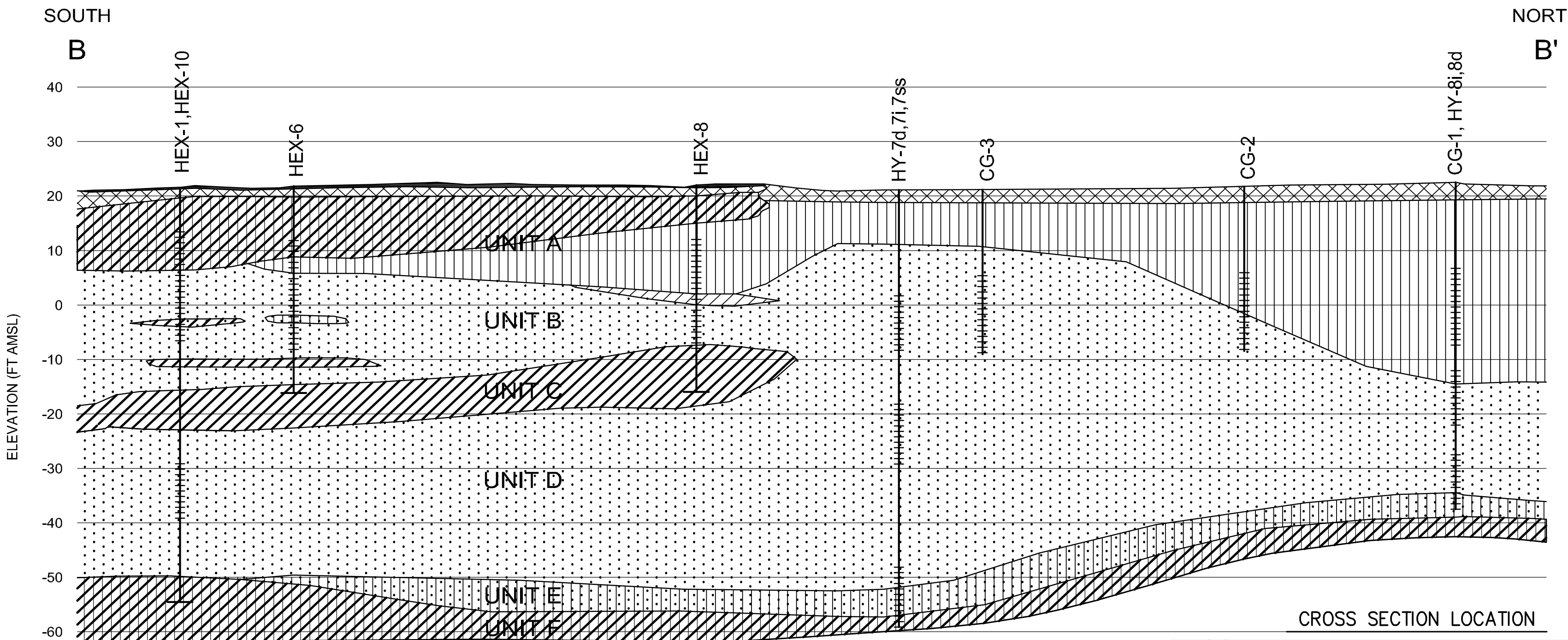
File: A273-002

Date: 6/20/18

FIGURE 7

East-West Cross Section

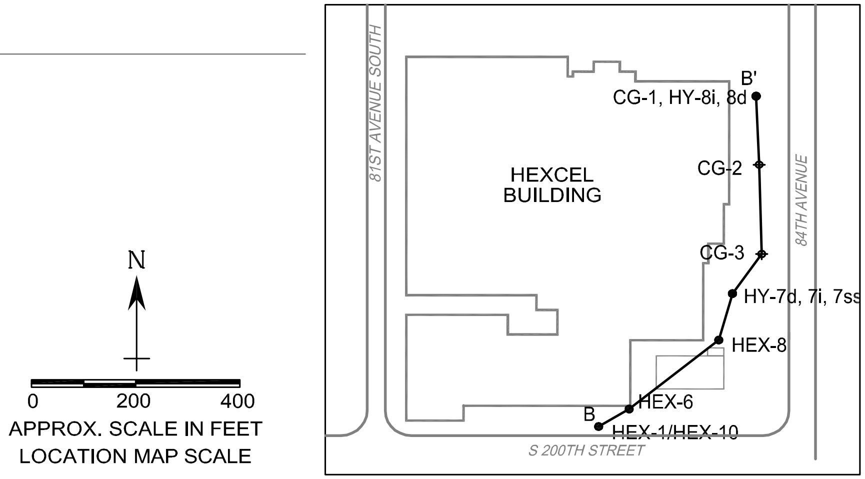
Figure after HGC (2010b)



0 60 120 180

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION: 4X

CROSS SECTION LOCATION



APPROX. SCALE IN FEET
LOCATION MAP SCALE

EXPLANATION

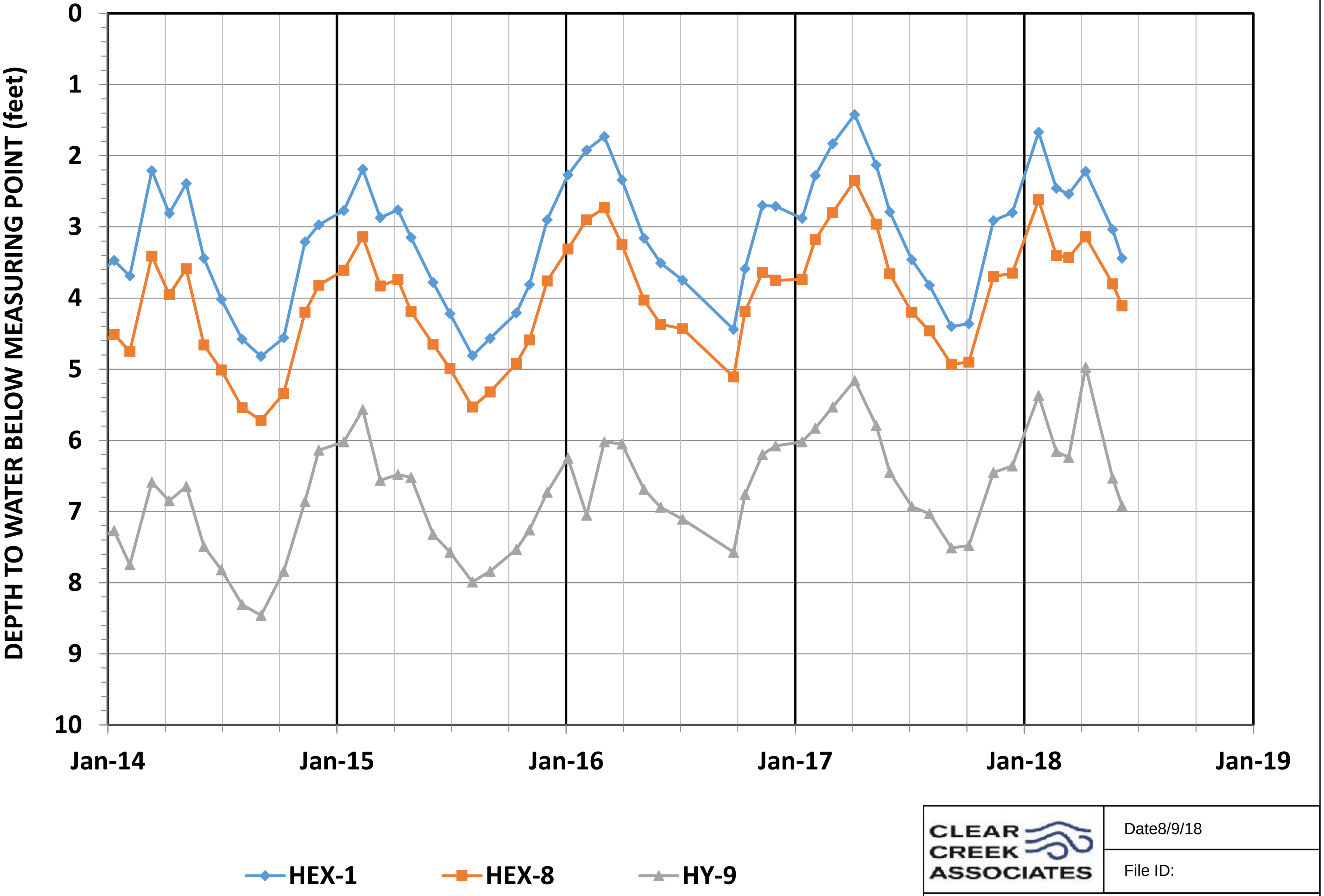
■	ASPHALT	▥	SILT	▦	SILTY SAND
▩	FILL	▨	SILTY CLAY	HEX-1	WELL LOCATION
▨	CLAY	⁘	SAND	≡	SCREENED INTERVAL

NOTE: CROSS SECTION BASED ON FIGURE 7.1-1 FROM SWEET-EDWARDS/ EMCON (1988), FIGURE 13 FROM IT CORPORATION (2001), AND HEX WELLS

CLEAR CREEK ASSOCIATES

File: A273-001
Date: 6/20/18

FIGURE 8
North-South Cross Section

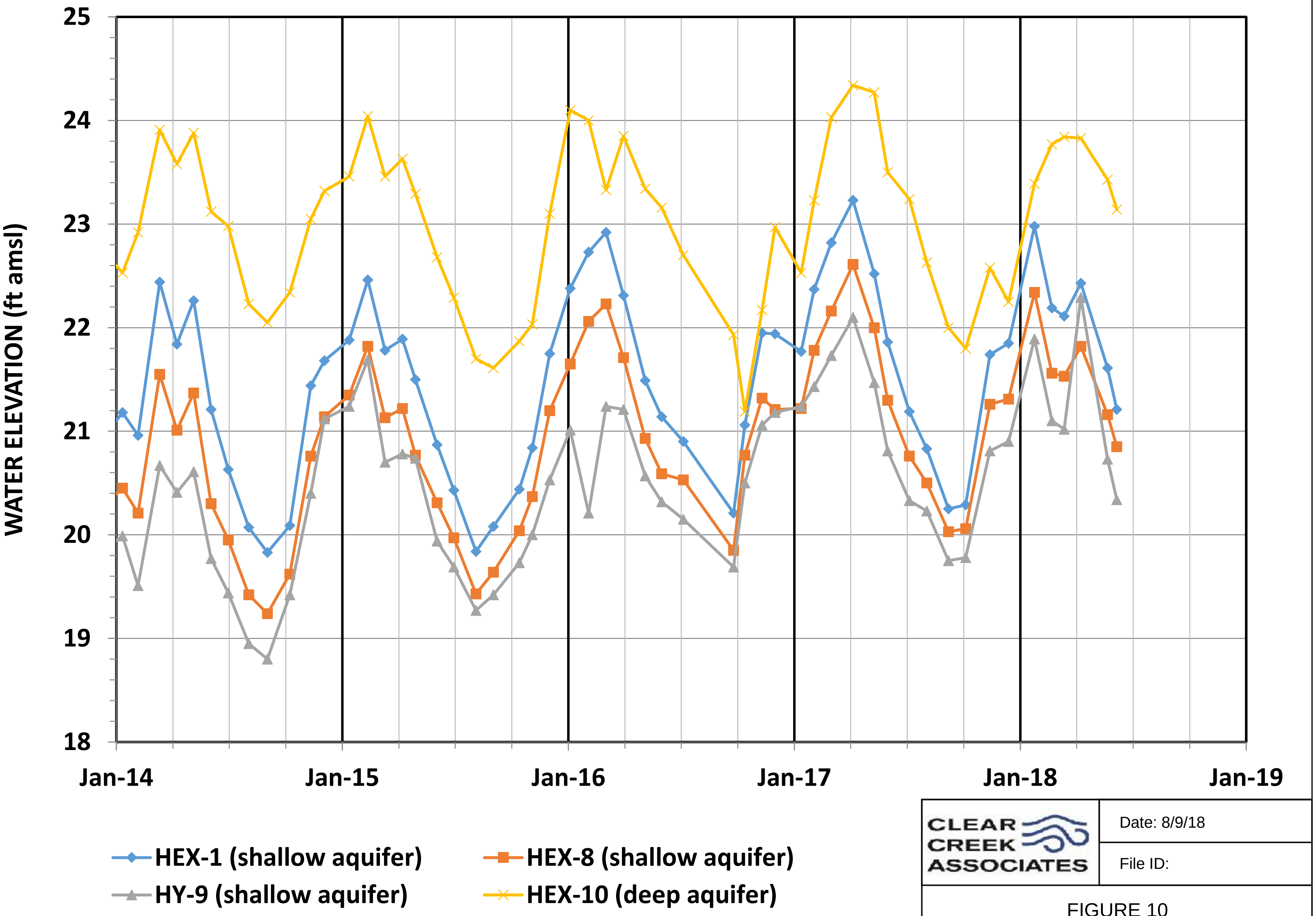


Note: measuring points are approximately land surface

CLEAR CREEK ASSOCIATES

CLEAR CREEK ASSOCIATES	Date8/9/18
	File ID:

FIGURE 9
Depths to Groundwater



Note: ft amsl = feet above mean sea levelsurface

CLEAR CREEK ASSOCIATES

Date: 8/9/18

File ID:

FIGURE 10
Groundwater Elevations

Legend

● Remedial Pumping Well in Shallow Aquifer

● Shallow Aquifer Monitoring Well

● Intermediate Aquifer Monitoring Well

— Groundwater Elevation Contour (dashed where inferred)

Scale (Feet)

0 75 150 300

Notes:

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet
Vertical Datum: NAVD88
Water elevation at HY-12s, HY-13s, HY-16s, and HY-17s not measured due to lack of an access agreement with property owners.
Water elevation at HY-14s not measured due to landscaping activities by the City of Kent.
Water elevations at HY-7i, HY-8i, and Ks not used for contouring.
Water elevation at HEX-5 not measured due to the well vault being submerged under six inches of water.

Date	File ID
8/15/18	273-073

CLEAR CREEK ASSOCIATES

FIGURE 11
Contour Map of Shallow Groundwater Elevations
July 7, 2017

Legend

- ● Remedial Pumping Well in Shallow Aquifer
- ● Shallow Aquifer Monitoring Well
- ● Intermediate Aquifer Monitoring Well
- — Groundwater Elevation Contour (dashed where inferred)

Scale (Feet)

0 75 150 300

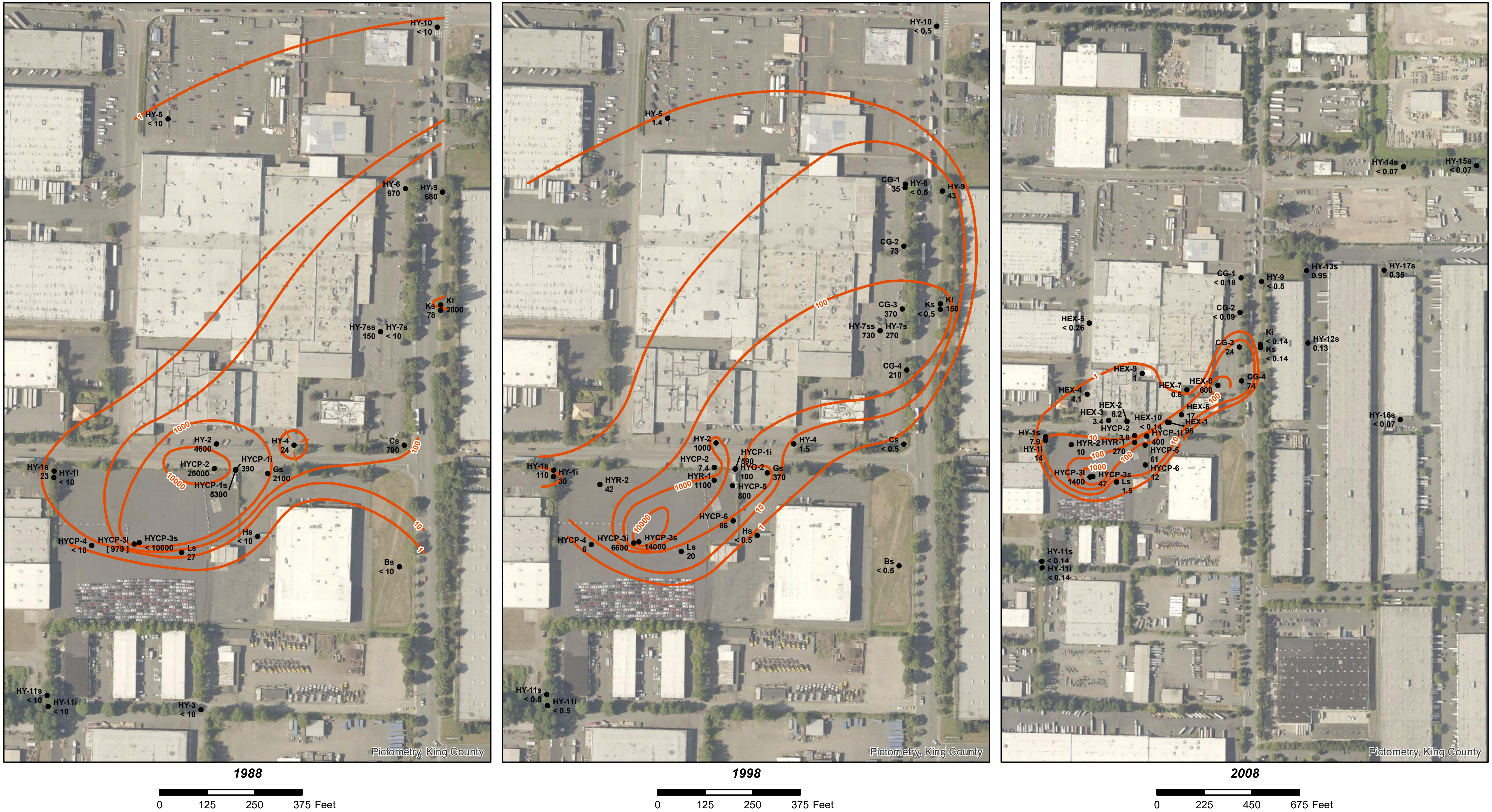
Notes:

Projection: NAD 1983 State Plane Washington North FIPS 4601 Feet
Vertical Datum: NAVD88
Water elevation at HY-12s, HY-13s, HY-16s, and HY-17s not measured due to lack of an access agreement with property owners.
Water elevation at HY-14s not measured due to landscaping activities by the City of Kent.
Water elevations at HY-7i, HY-8i, and Ks not used for contouring.
Water elevation at HEX-5 not measured due to the well vault being submerged under six inches of water.

Date	File ID
8/15/18	273-072

CLEAR CREEK ASSOCIATES

FIGURE 12
Contour Map of Shallow Groundwater Elevations
January 25, 2018



Legend

● VC Concentration (µg/L)

— VC Concentration Contour (µg/L)

PROJECTION: State Plane WA N FIPS 4601 NAD 83

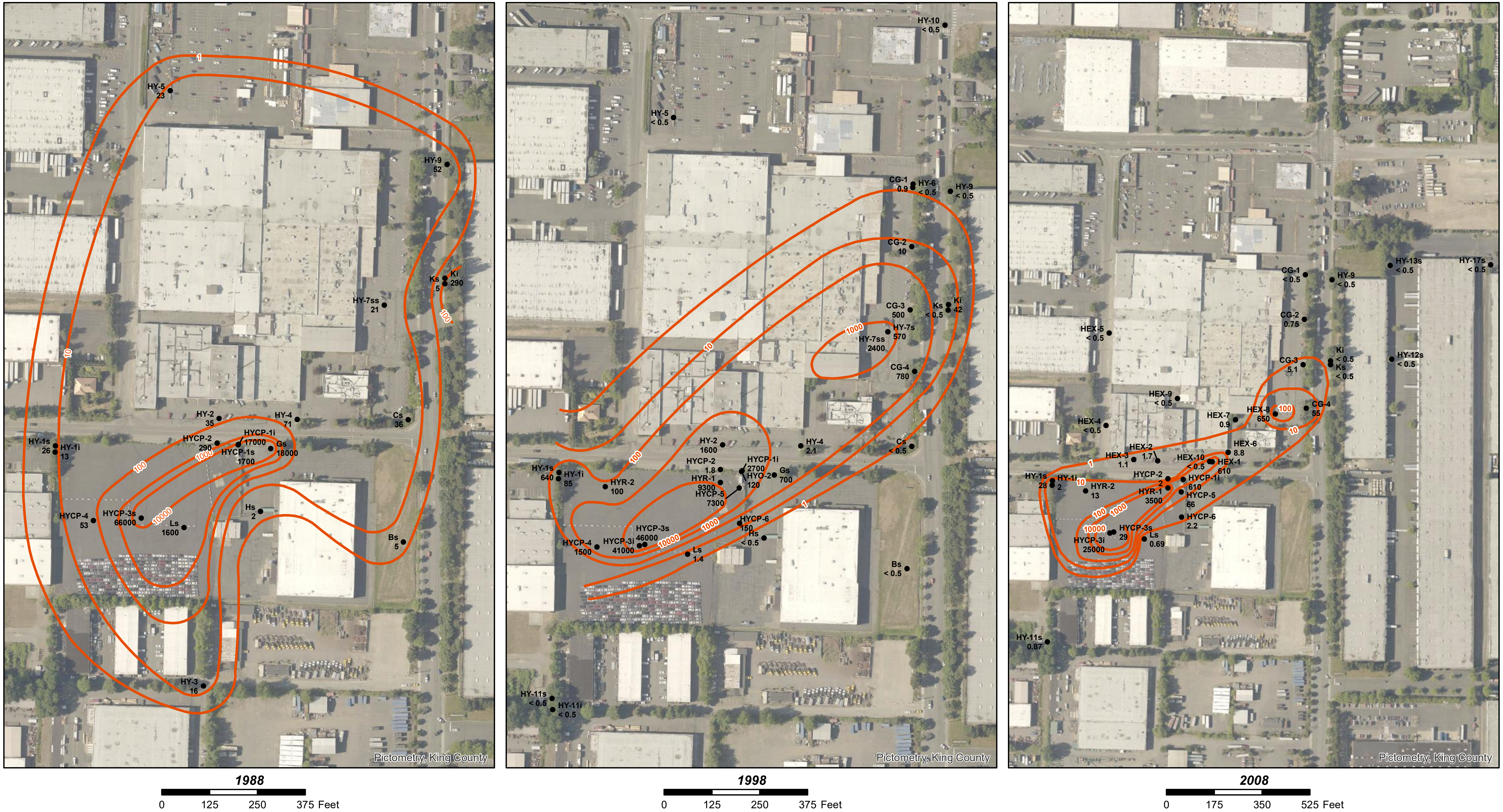
Concentration data and contours from HGC (2010b)
1988, 1998 and 2008 contours based on highest detected concentration in each well for that year. 2008 contours also augmented with September 2007 data.

Source: PES Environmental, Inc. Focused RI Summary/FS Report, BSB Property, Kent Washington. December 5, 2005
PES Environmental, Inc. Downgradient Area Groundwater Investigation, Agreed Order No. DE2553, Kent Washington. January 22, 2009.

CLEAR CREEK ASSOCIATES

File ID	273-011
Date	8/13/18

FIGURE 13
Vinyl Chloride Concentrations
in Shallow Aquifer Groundwater
1988, 1998, and 2008



Legend

● CIS - 1, 2 Dichloroethylene Concentration (μg/L)

— CIS - 1, 2 Dichloroethylene Concentration Contour (μg/L)

PROJECTION: State Plane WA N FIPS 4601 NAD 83

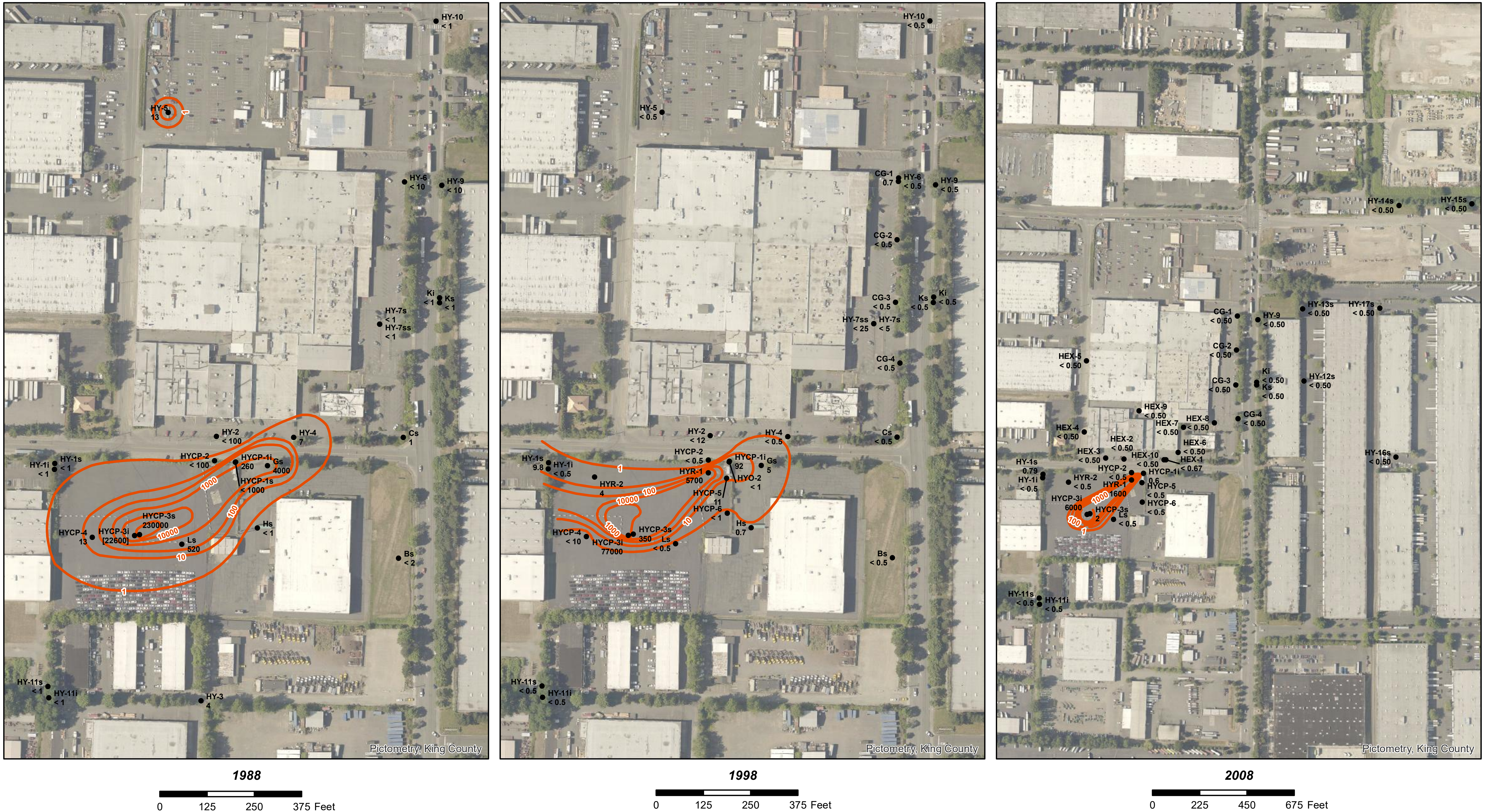
Concentration data and contours from HGC (2010b)
1988, 1998 and 2008 contours based on highest detected concentration in each well for that year. 2008 contours also augmented with September 2007 data.

Source: PES Environmental, Inc. Focused RI Summary/FS Report, BSB Property, Kent Washington. December 5, 2005
PES Environmental, Inc. Downgradient Area Groundwater Investigation, Agreed Order No. DE2553, Kent Washington. January 22, 2009.

CLEAR CREEK ASSOCIATES

File ID	273-012
Date	8/13/18

FIGURE 14
cis - 1,2 Dichloroethene
Concentrations
in Shallow Aquifer Groundwater
1988, 1998, and 2008



Legend

- ● TCE Concentration (µg/L)
- ▬ TCE Concentration Contour (µg/L)

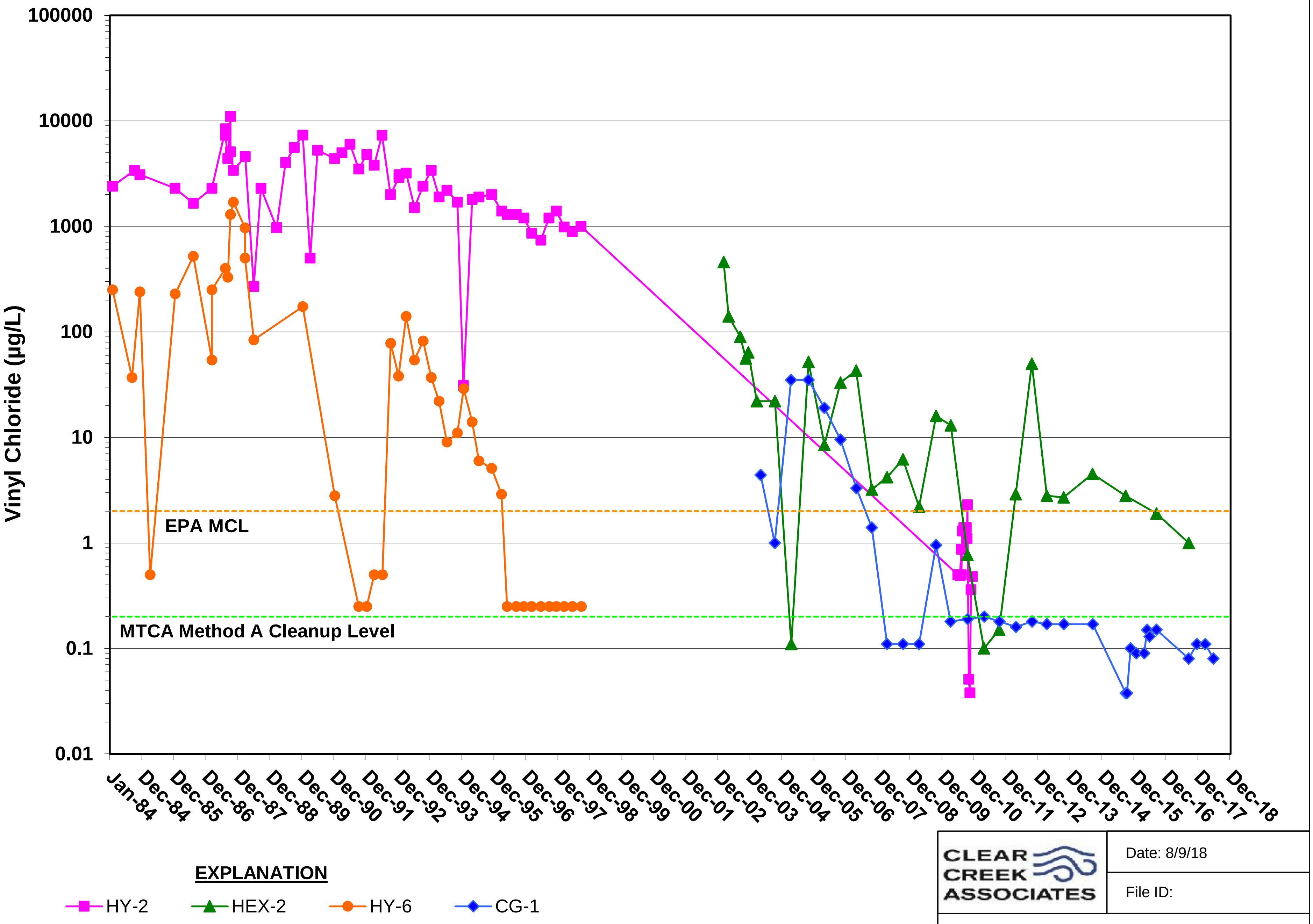
PROJECTION: State Plane WA N FIPS 4601 NAD 83

Concentration data and contours from HGC (2010b)
1988, 1998 and 2008 contours based on highest detected concentration in each well for that year. 2008 contours also augmented with September 2007 data.
Source: PES Environmental, Inc. Focused RI Summary/FS Report, BSB Property, Kent Washington. December 5, 2005
PES Environmental, Inc. Downgradient Area Groundwater Investigation, Agreed Order No. DE2553, Kent Washington. January 22, 2009.

CLEAR CREEK ASSOCIATES

File ID	273-013
Date	8/13/18

FIGURE 15
Trichloroethene Concentrations in Shallow Aquifer Groundwater
1988, 1998, and 2008



Notes: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES	Date: 8/9/18
	File ID:

FIGURE 16
Vinyl Chloride
in Wells HY-2, HEX-2, HY-6, and GG-1

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: VC Chart Mult Wells

Legend

— Vinyl Chloride Contour

— Depression

— Soil-Bentonite Cutoff Wall

● Shallow Aquifer Monitoring Well

● Intermediate Aquifer Monitoring Well

● CG-1 Well Name
0.038 J Vinyl Chloride Concentration (µg/L)

MTCA Method A Groundwater Cleanup Level = 0.2 µg/L
EPA MCL = 2 µg/L

Scale (Feet)
0 100 200

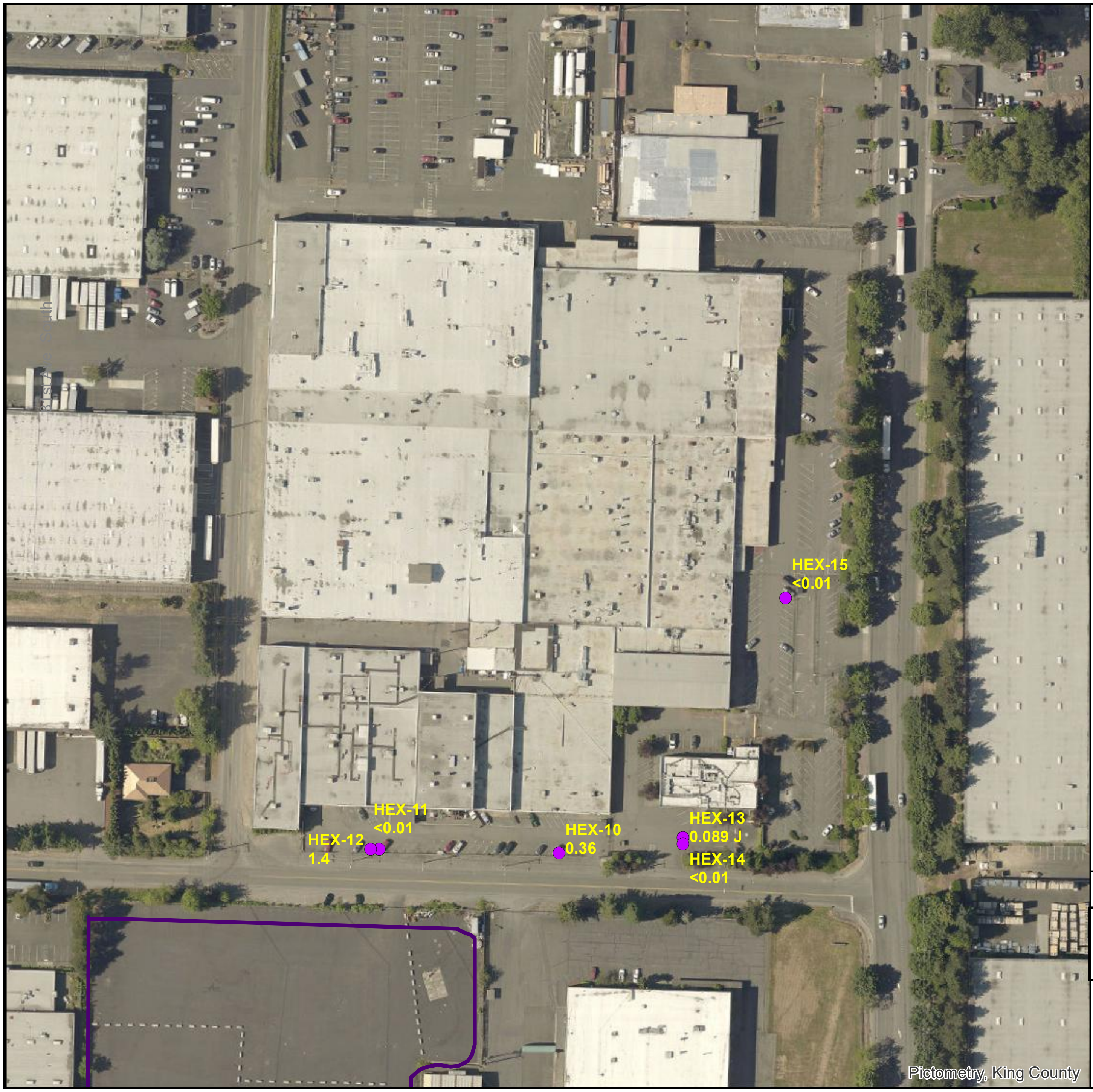
Notes:

Projection: STATE PLANE WA NORTH FIPS 4601 FEET
NS = no sample
"J" indicates an estimated value between the Minimum Detection Limit and the Minimum Reporting Limit.
Data for HY-7s and HY-7ss from May 2018
Data for HYCP-7s and HYCP-7i from October 2017
Data for HY-1s, HY-1i, HYCP-2, HYCP-7s, HYCP-7i, Gs, and Gi from PES (2018)

Date	File ID
8/15/18	273-067

CLEAR CREEK ASSOCIATES

FIGURE 17A
Vinyl Chloride (µg/L)
in Shallow Aquifer
September 2017



Legend

— Soil-Bentonite Cutoff Wall

● Deep Aquifer Monitoring Well

● HEX-10 Well Name
0.36 Vinyl Chloride Concentration (µg/L)

MTCA Method A Groundwater
Cleanup Level = 0.2 µg/L
EPA MCL = 2 µg/L

Scale (Feet)
0 100 200

Notes:

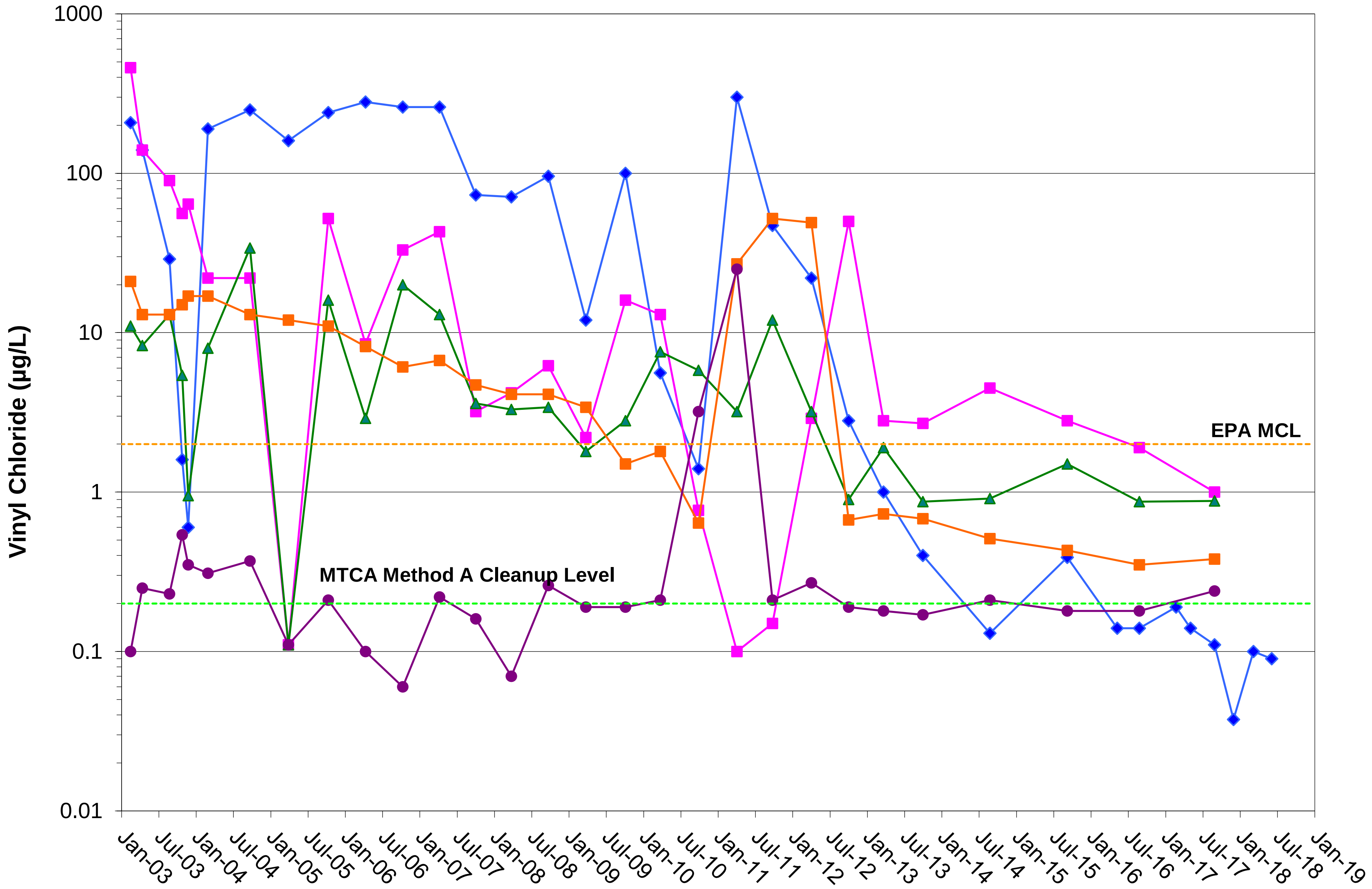
Projection: STATE PLANE
WA NORTH FIPS 4601 FEET
"J" indicates an estimated value between the Minimum Detection Limit and the Minimum Reporting Limit.

Date	File ID
8/14/18	273-069

N

CLEAR CREEK ASSOCIATES

FIGURE 17B
Vinyl Chloride (µg/L)
in Deep Aquifer
September 2017



Note: Non-detect results shown at half the detection; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES

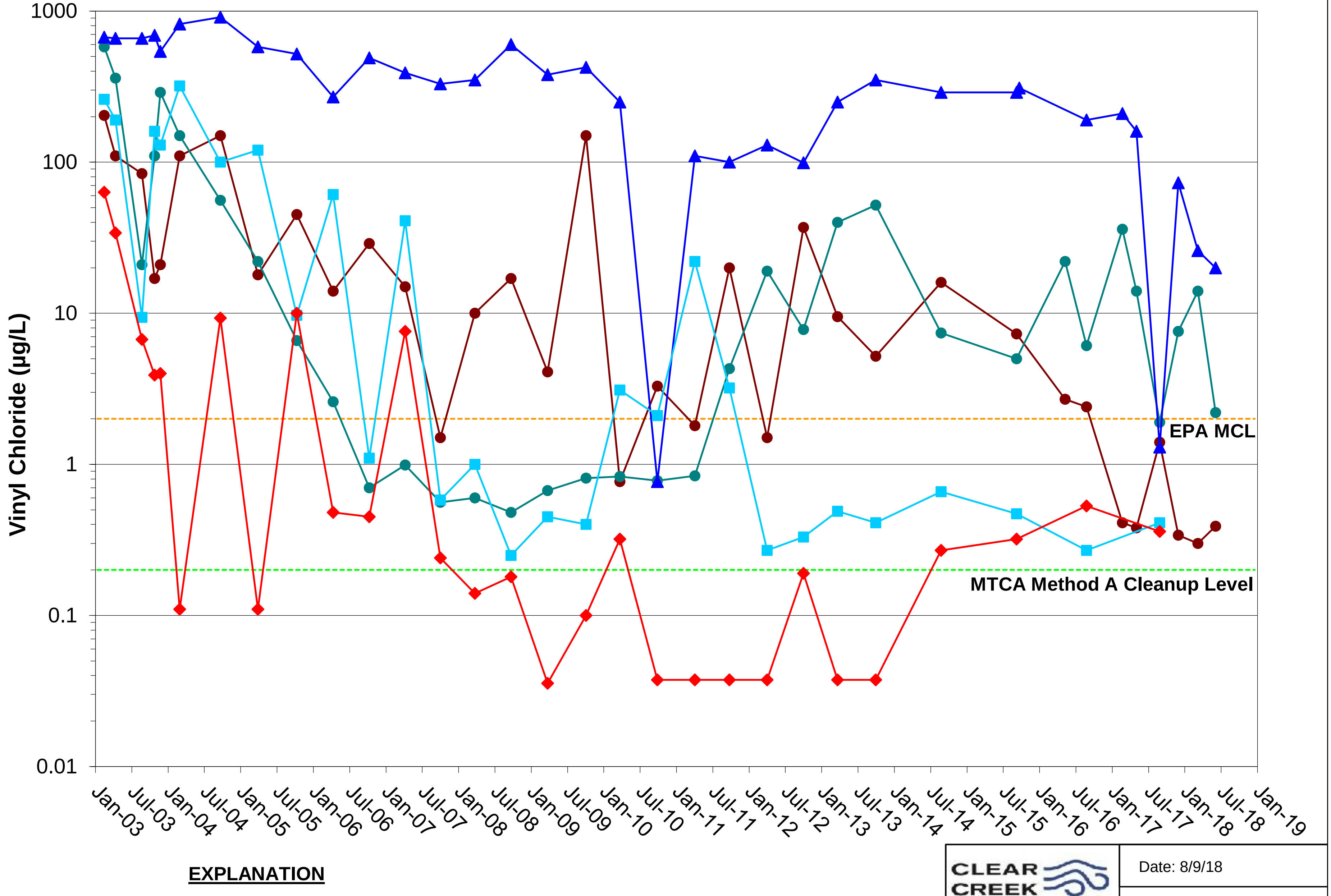
Date: 8/9/18

File ID:

FIGURE 18
Vinyl Chloride in
Wells HEX-1 through HEX-5
2003 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: VC Chart HEX1-5

DRAFT



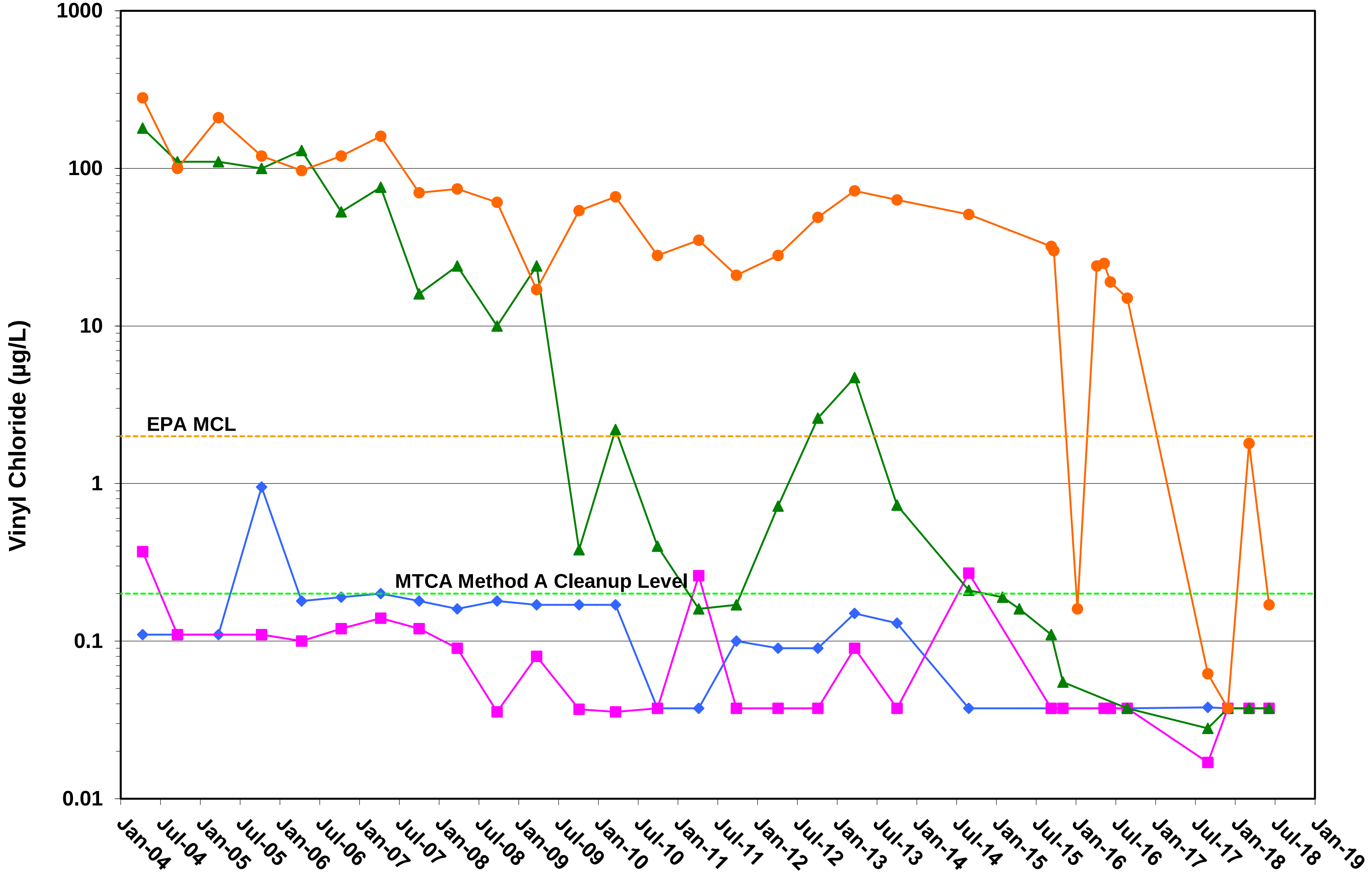
Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES	Date: 8/9/18
	File ID:

FIGURE 19
Vinyl Chloride
in Wells HEX-6 through HEX-10
2003 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: VC Chart HEX6-10

DRAFT



Notes: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

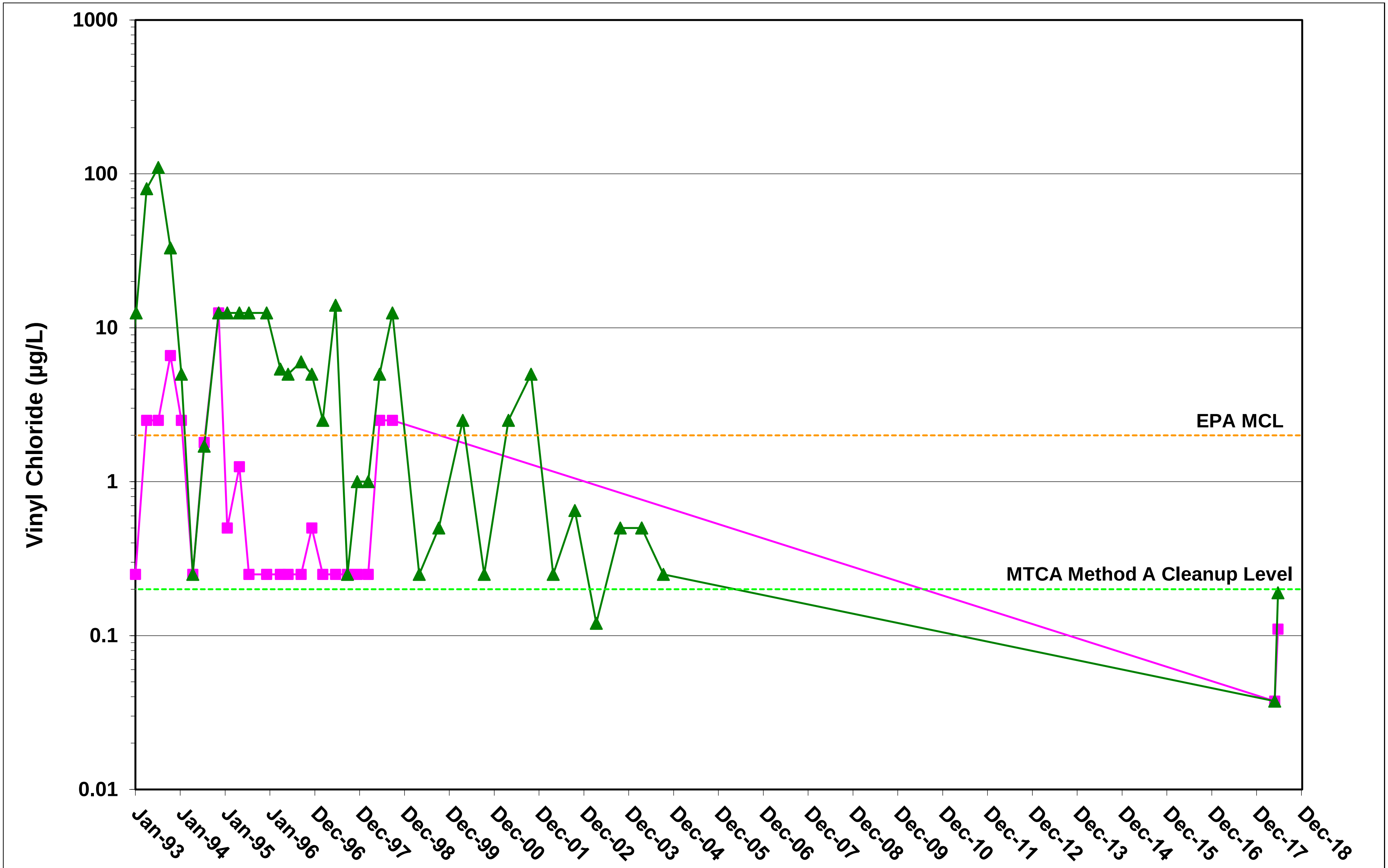
CLEAR CREEK ASSOCIATES

Date: 8/9/18

File ID:

FIGURE 20
Vinyl Chloride
in Wells CG-1 through CG-4
2004 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: VC Chart CG



Notes: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES

Date: 8/14/18

File ID:

FIGURE 21
Vinyl Chloride
in Wells HY-7s and HY-7ss,
1993 to June 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: HY-7s Wells

Legend

● Monitoring Well in Shallow Aquifer

● Monitoring Well in Intermediate Aquifer

— Soil-Bentonite Cutoff Wall

● CG-1 Well Name
<0.023 cis-1,2-Dichloroethene Concentration (µg/L)

No sample results in excess of 70 µg/L EPA MCL

Scale (Feet)
0 100 200

Notes:

Projection: STATE PLANE
WA NORTH FIPS 4601 FEET
NS = no sample
"J" indicates an estimated value between the Minimum Detection Limit and the Minimum Reporting Limit.
Data for HY-7s and HY-7ss from May 2018
Data for HYCP-7s and HYCP-7i from October 2017
Data for HY-1s, HY-1i, HYCP-2, HYCP-7s, HYCP-7i, Gs, and Gi from PES (2018)

Date	File ID
8/14/18	273-068

CLEAR CREEK ASSOCIATES

FIGURE 22A
cis-1,2-Dichloroethene (µg/L)
in Shallow Aquifer
September 2017

Pictometry, King County

Legend

— Soil-Bentonite Cutoff Wall

● Deep Aquifer Monitoring Well

● HEX-10 Well Name
<0.023 cis-1,2-Dichloroethene Concentration (µg/L)

MTCA Method A Groundwater
Cleanup Level = 0.2 µg/L
EPA MCL = 2 µg/L

Scale (Feet)
0 100 200

Notes:

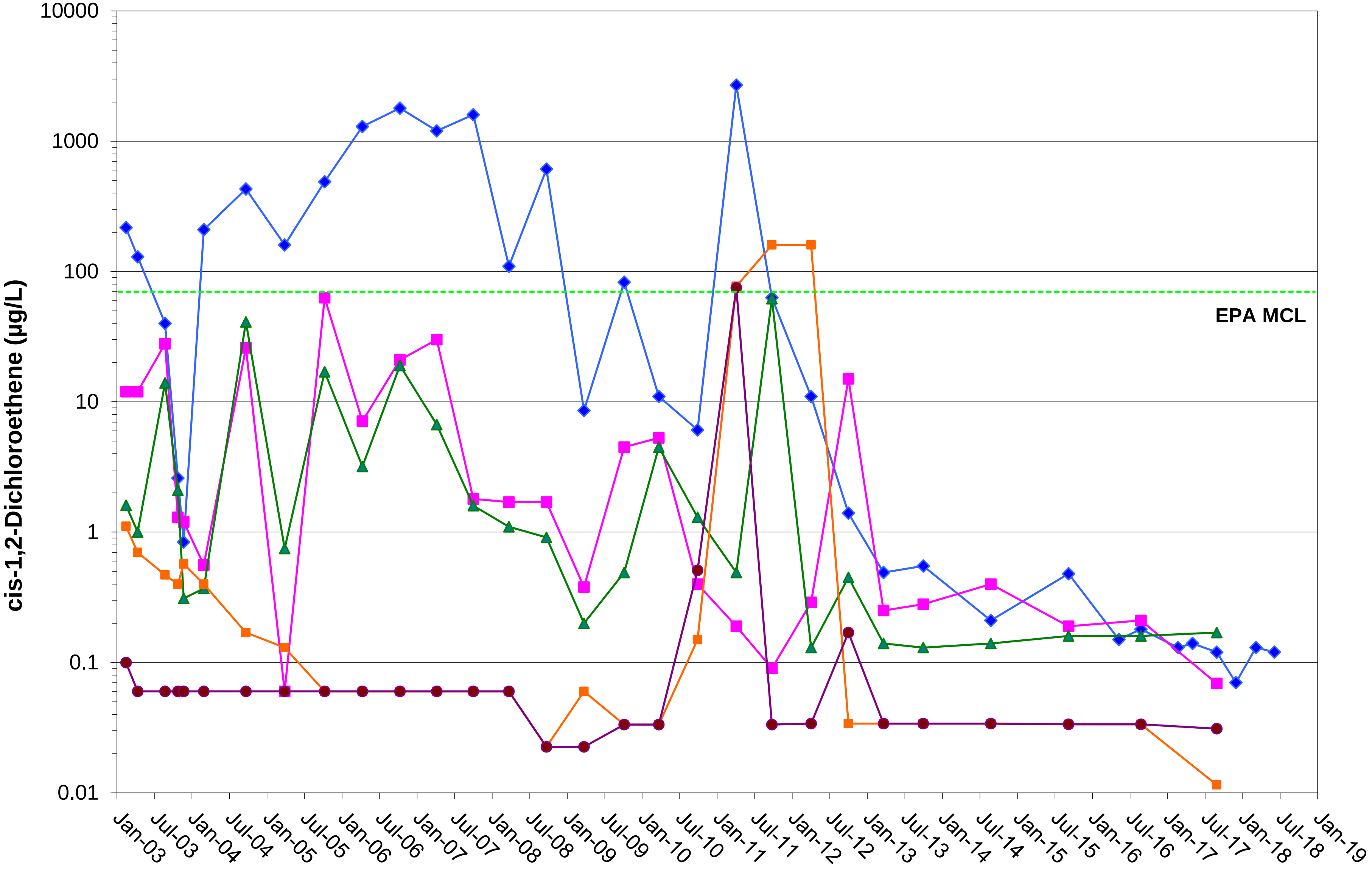
Projection: STATE PLANE
WA NORTH FIPS 4601 FEET

Date	File ID
8/16/18	273-074

N

CLEAR CREEK ASSOCIATES

FIGURE 22B
cis-1,2-Dichloroethene (µg/L)
in Deep Aquifer
September 2017



Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

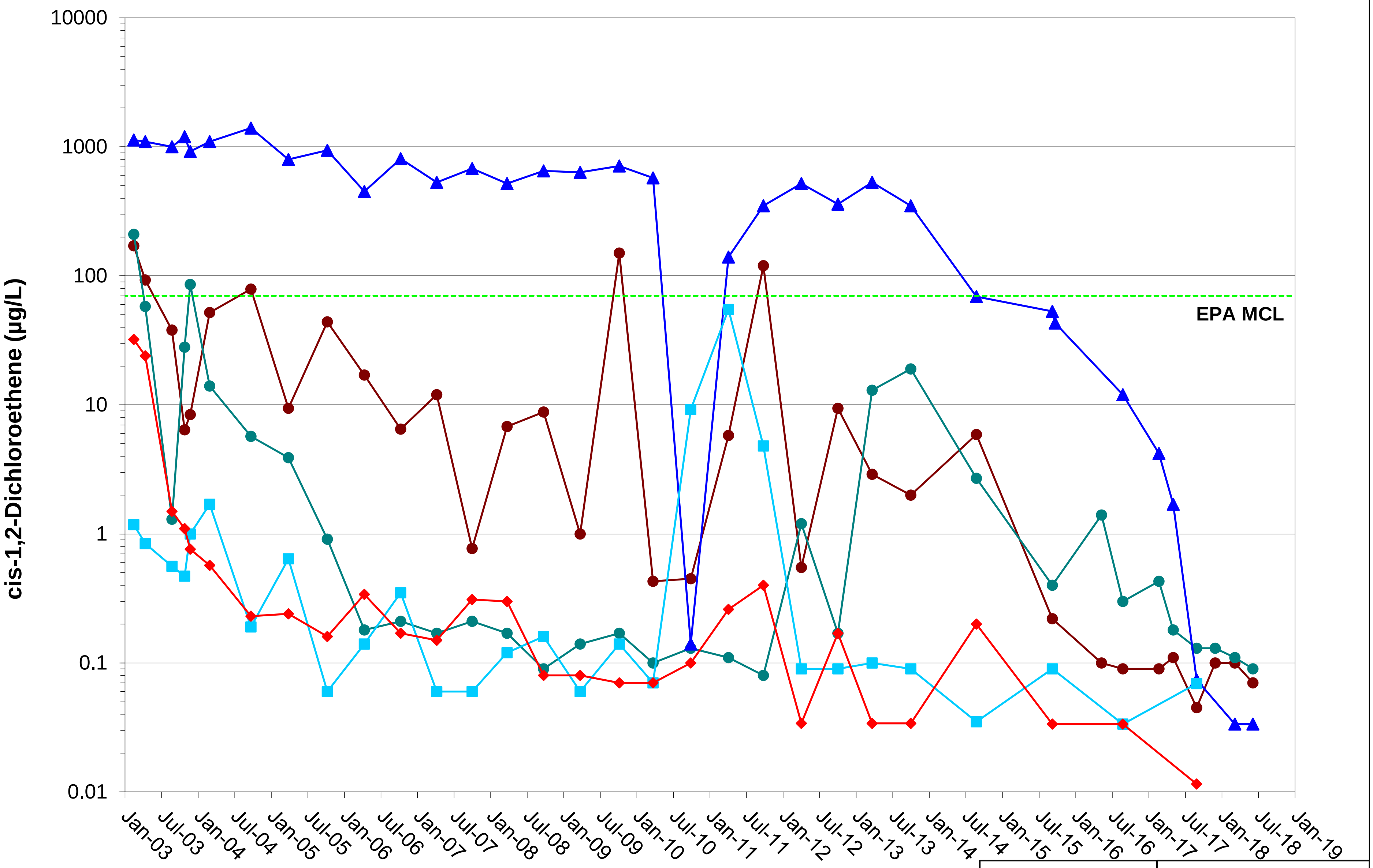
CLEAR CREEK ASSOCIATES

Date: 8/8/18

File ID:

FIGURE 23
cis-1,2-Dichloroethene
in Wells HEX-1 through HEX-5
2003 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: Cis-1,2-DCE Chart HEX1-5



Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

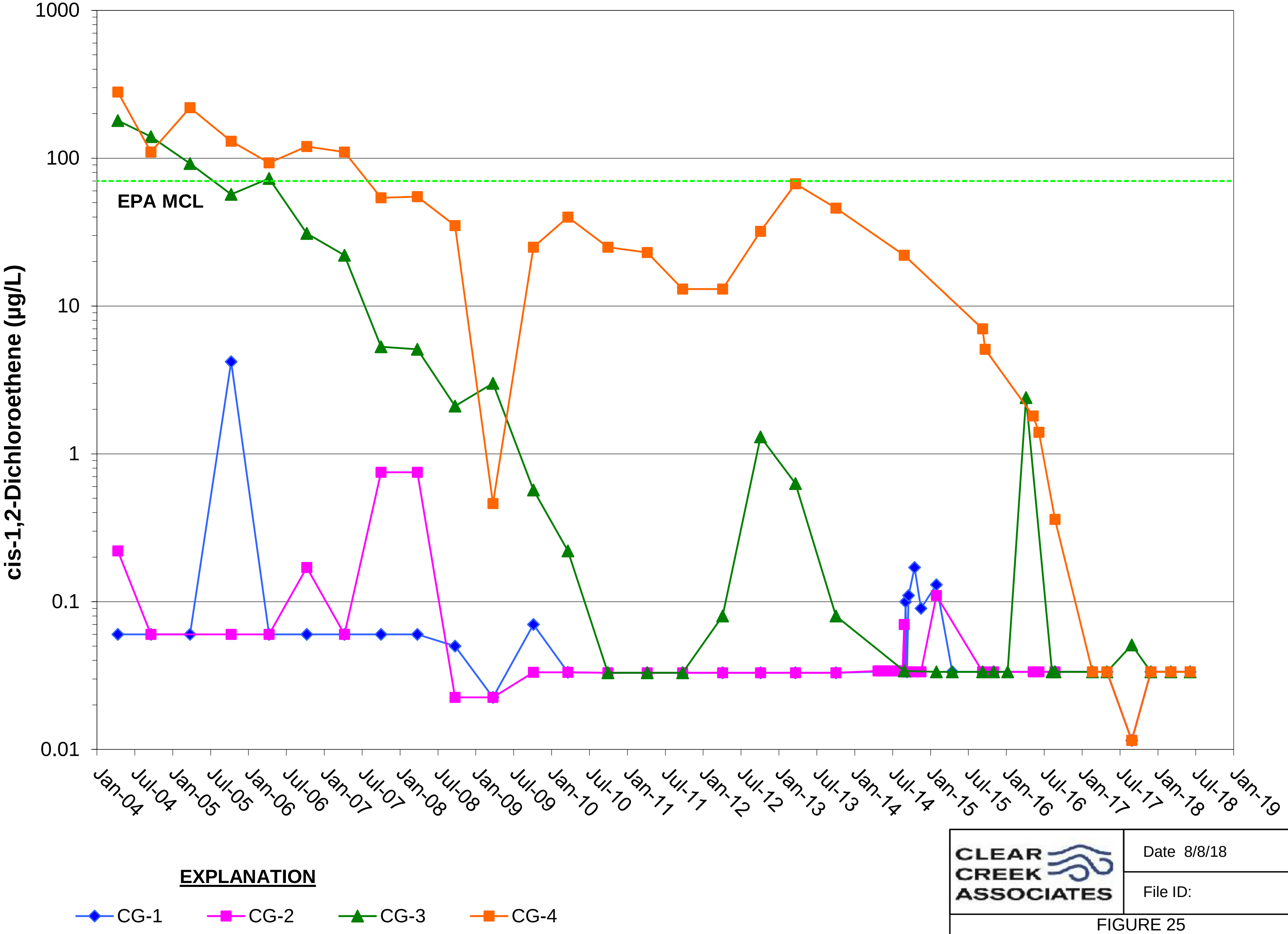
CLEAR CREEK ASSOCIATES

Date: 8/8/18

File ID:

FIGURE 24
cis-1,2-Dichloroethene
in Wells HEX-6 through HEX-10
2003 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: Cis-1,2-DCE Chart HEX6-10



Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES

Date 8/8/18

File ID:

FIGURE 25
cis-1,2-Dichloroethene
in Wells CG-1 through CG-4
2003 to 2018

N:\Projects\Hexcel\Consent Decree\FRI\Figures\VOC Plots: Cis-1,2-DCE Chart CG

Legend

● Monitoring Well in Shallow Aquifer

● Monitoring Well in Intermediate Aquifer

— Soil-Bentonite Cutoff Wall

● CG-1 Well Name
<0.018 TCE Concentration (µg/L)

No sample results in excess of 5 µg/L MTCA Method A Groundwater Cleanup Level

Scale (Feet)
0 100 200

Notes:

Projection: STATE PLANE
WA NORTH FIPS 4601 FEET
NS = no sample
"J" indicates an estimated value between the Minimum Detection Limit and the Minimum Reporting Limit.
Data for HY-7s and HY-7ss from May 2018
Data for HYCP-7s and HYCP-7i from October 2017
Data for HY-1s, HY-1i, HYCP-2, HYCP-7s, HYCP-7i, Gs, and Gi from PES (2018)

Date	File ID
8/14/18	273-065

CLEAR CREEK ASSOCIATES

FIGURE 26A
Trichloroethene (µg/L)
in Shallow Aquifer
September 2017

Legend

— Soil-Bentonite Cutoff Wall

● Deep Aquifer Monitoring Well

● HEX-10 Well Name
<0.018 TCE Concentration (µg/L)

MTCA Method A Groundwater
Cleanup Level = 0.2 µg/L
EPA MCL = 2 µg/L

Scale (Feet)
0 100 200

Notes:

Projection: STATE PLANE
WA NORTH FIPS 4601 FEET

Date	File ID
8/16/18	273-074

CLEAR CREEK ASSOCIATES

FIGURE 26B
Trichloroethene (µg/L)
in Deep Aquifer
September 2017

Legend

Vinyl Chloride Contour

Depression

Soil-Bentonite Cutoff Wall

● Shallow Aquifer Monitoring Well

● Intermediate Aquifer Monitoring Well

● CG-1 Well Name
8.18 pH

MTCA Method A Groundwater
Cleanup Level = 0.2 μg/L
EPA MCL = 2 μg/L

Scale (Feet)
0 100 200

Notes:

Projection: STATE PLANE
WA NORTH FIPS 4601 FEET
NS = no sample
ND = no data
Data for HY-7s and HY-7ss from June 2018

Date	File ID
8/14/18	273-070

CLEAR CREEK ASSOCIATES

FIGURE 27
pH (standard units)
in Shallow Aquifer
September 2017

Legend

Vinyl Chloride Contour

Depression

Soil-Bentonite Cutoff Wall

● Shallow Aquifer Monitoring Well

● Intermediate Aquifer Monitoring Well

● CG-1 -189	Well Name ORP

MTCA Method A Groundwater
Cleanup Level = 0.2 µg/L
EPA MCL = 2 µg/L

Scale (Feet)
0 100 200

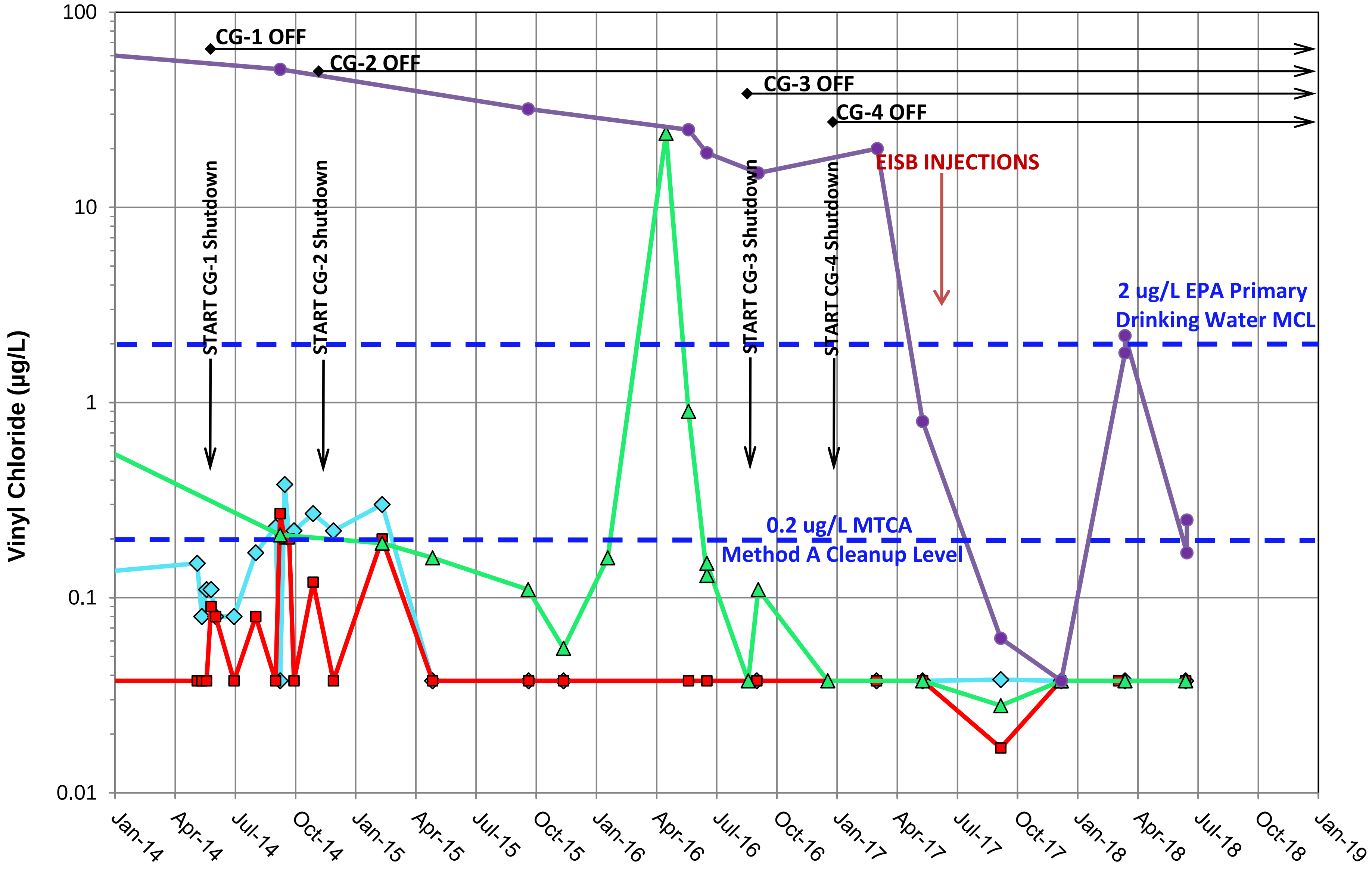
Notes:

Projection: STATE PLANE
WA NORTH FIPS 4601 FEET
NS = no sample
ND = no data
Data for HY-7s and HY-7ss from June 2018

Date	File ID
8/15/18	273-071

CLEAR CREEK ASSOCIATES

FIGURE 28
Oxidation Reduction Potential (mV)
in Shallow Aquifer
September 2017



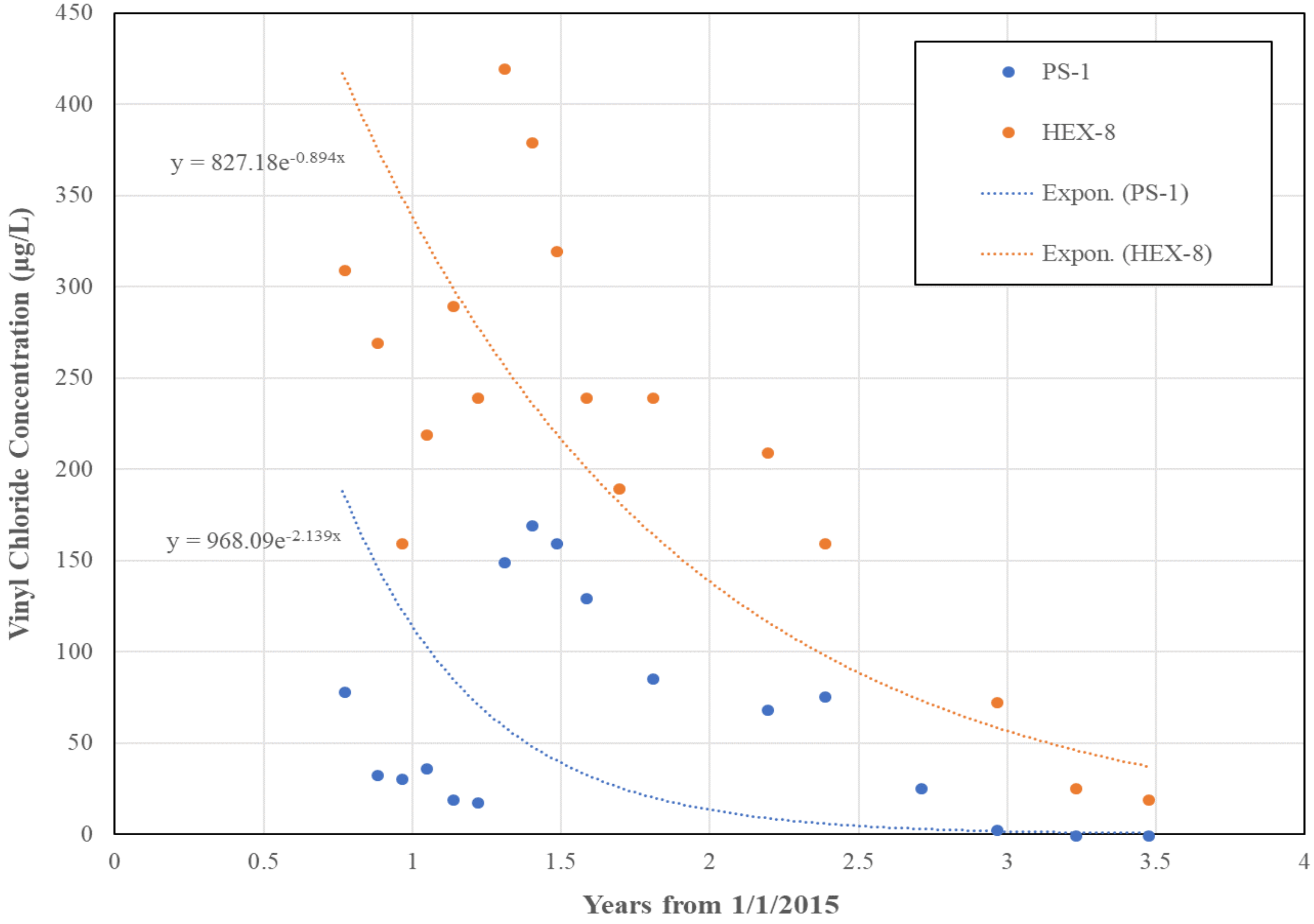
Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES

Date: 8/8/18

File ID:

FIGURE 29
Vinyl Chloride in Wells
CG-1 through CG-4
May 2014 through June 2018

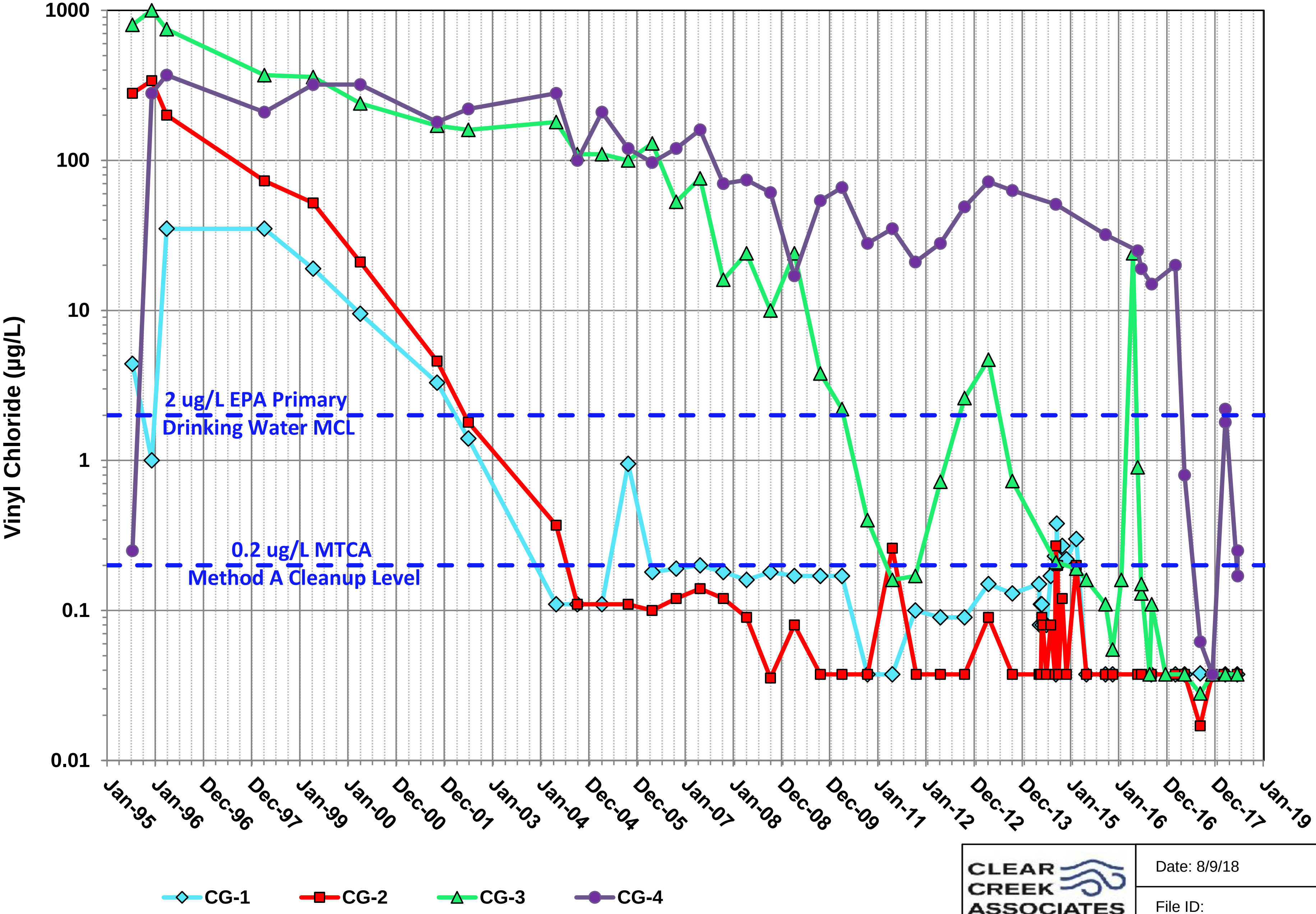


CLEAR CREEK ASSOCIATES

Date: 8/22/18

File No.: AI273-004

FIGURE 30
Exponential Decay Curves for Vinyl Chloride from EISB Test
(Prepared by Geosyntec)



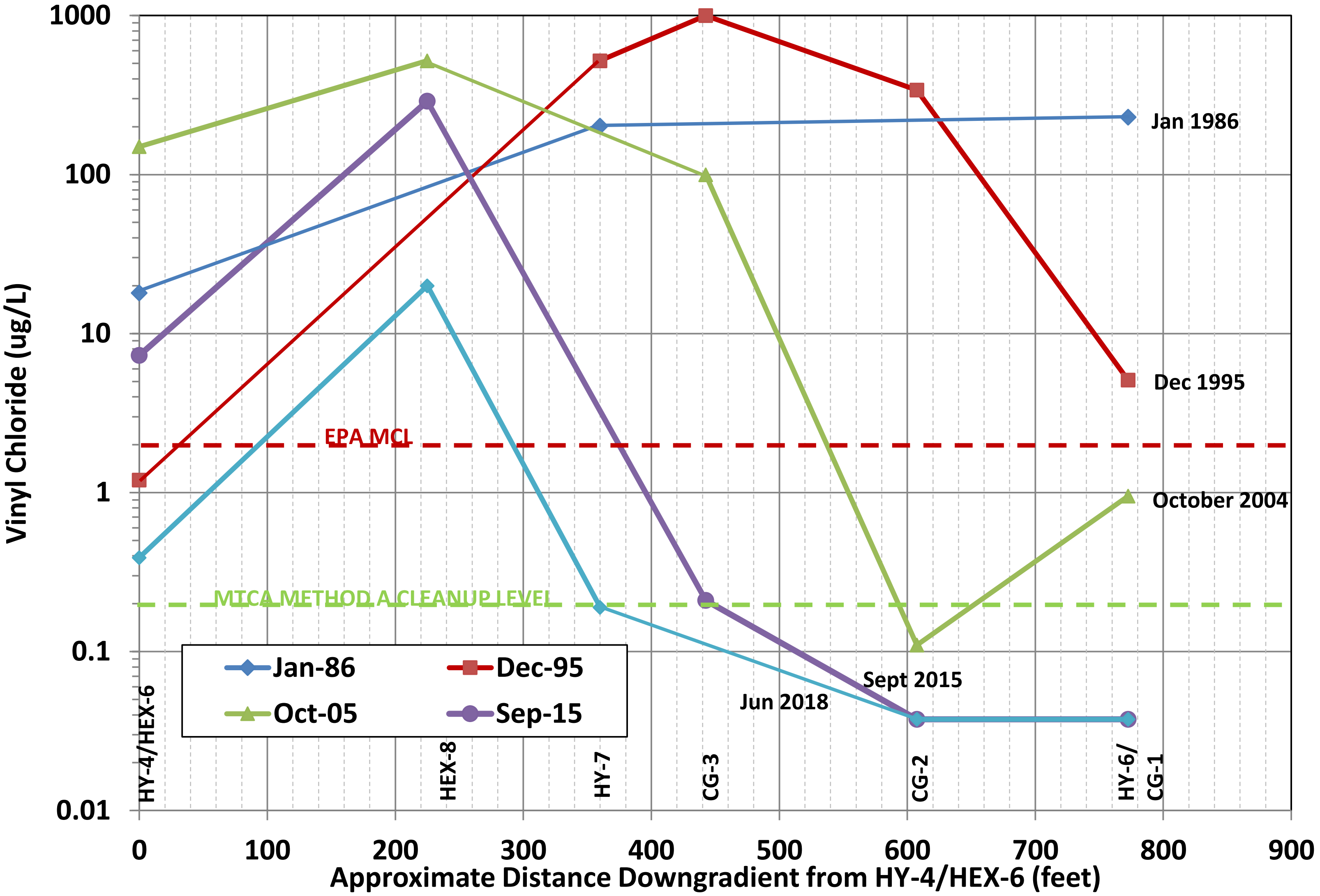
Note: Non-detect results shown at half the detection limit; µg/L = micrograms per Liter

CLEAR CREEK ASSOCIATES

Date: 8/9/18

File ID:

FIGURE 31
Vinyl Chloride in Wells
at CG-1 through CG-4
1995 through June 2018



CLEAR CREEK ASSOCIATES

Date: 8/16/18

File No.: AI273-002

FIGURE 32
Concentration versus Downgradient Distance

SOURCE AREA	POTENTIALLY AFFECTED MEDIUM	MIGRATION MECHANISM	EXPOSURE POINT	EXPOSURE ROUTE	EVALUATION
Groundwater beneath Plant 1 containing vinyl chloride in excess of MTCA Method A groundwater cleanup level	Groundwater	Groundwater flow, vinyl chloride migrates in groundwater flow beneath Plant 1 until it is destroyed by in situ biodegredation	Plant 1 Property	Ingestion	Potentially applicable to workers excavating the subsurface or conducting environmental sampling
				Dermal Contact	
				Inhalation of Vapors	
			Downgradient Offsite Area	None, Vinyl Chloride Plume is not expected to migrate offsite	Not Applicable
	Saturated Soil in Source Area	None, vinyl chloride sorbs to saturated zone sediment in the source area	Plant 1 Property	Ingestion	Potentially applicable to workers excavating the subsurface or conducting environmental sampling
				Dermal Contact	
				Inhalation of Vapors	
	Unsaturated Soil in Source Area	Vinyl chloride volatilization into vadose zone soil and soil vapor in the source area	Plant 1 Property	Ingestion	Not Applicable, vadose zone sampling did not detect vinyl chloride at levels exceeding MTCA soil cleanup levels
				Dermal Contact	
				Inhalation of Vapors	

CLEAR CREEK ASSOCIATES

Date: 8/16/18

File No.: AI273-001

FIGURE 33
Hypothetical Exposure Pathways

APPENDIX A
GROUNDWATER LEVEL DATA 2003 TO 2013
(ON COMPACT DISC)

APPENDIX B

WATER QUALITY DATA COLLECTED BY HEXCEL 2003 TO 2018

(ON COMPACT DISC)