Third Five-Year Review Report

for

Queen City Farms Superfund Site

City of Maple Valley
King County, Washington

September 2008

Prepared by:

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Region 10
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9/29/08

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List of Acronyms

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
BDA	Buried Drum Area
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DCE	Dichloroethene
DCM	Dichloromethane (a.k.a. methylene dichloride)
EPA	United States Environmental Protection Agency
FFS	Focused Feasibility Study
IRIS	Integrated Risk Information System
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MTCA	Model Toxic Control Act
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PAH	Polyaromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene (a.k.a. perchloroethene)
PCP	Pentachlorophenol
PRP	Potentially Responsible Party
QCF	Queen City Farms
RA	Remedial Action
RAO	Remedial Action Order
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RP	Responsible Party
RPM	Remedial Project Manager
TCE	Trichloroethene
VOC	Volatile Organic Compound

Executive Summary

The Queen City Farms (QCF) Superfund site is located on 324 acres of land within the Cedar-Sammamish Watershed of Washington State, approximately 2.5 miles north of Maple Valley and 5.5 miles south of Issaquah. This site is currently in the long term groundwater monitoring phase. No construction activity related to site remediation has occurred on site since the previous Five Year Review in 2003. As the remedy for the Queen City Farms site results in hazardous substances, pollutants or contaminants remaining on site and was selected after passage of the Superfund Amendments and Reauthorization Act (post-SARA), this is a statutory Five-Year Review.

This site has two separate areas of contamination: the former waste ponds and Buried Drum Area in the eastern portion of the property (i.e. the Containment Area) and the former 4-Tek processing area just slightly west of the center of the property. The 4-Tek processing area had a relatively limited level of contamination; a surface soil removal action was performed to prevent contact with contaminated soil. Groundwater monitoring at this area of the site is conducted every five years.

The main area of contamination was the result of buried drums and unlined ponds which were used to dispose of hazardous waste, including solvents, polychlorinated biphenyls (PCBs) and heavy metals. The start of the site clean up involved an extensive removal action to properly dispose of the contaminated soil and sludge from the waste ponds and as remedial activity to clean up the surface soils. The groundwater and soil beneath the old pond area, which was the source of the groundwater contamination, were contained with a Vertical Barrier Wall (slurry wall) and multilayered cap. This area is now known as the Containment Area.

The construction of the Vertical Barrier Wall and cap over the old waste pond area was completed in 1996. The Second Five Year Review reported that the O&M of the cap/cover system is functioning well. With the exception of some minor recommendations included in this review, on-site O&M has also been conducted appropriately over the five year period covered in this review.

A protectiveness determination of the remedy at Queen City Farms cannot be made at this time until further information is obtained. Further information will be obtained when the following evaluations are completed: containment of groundwater plumes, sufficiency of the monitoring well network, the proposed action to restore groundwater at and outside the conditional point of compliance to productive use. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.

<u>Cross Program Measures</u>

Human Exposure:	Current human exposures are under control.
Groundwater Migration:	Contaminated groundwater migration is not under control
Ready for Reuse:	26 acres of the site are in use by a regional composting operation. The reuse determination is deferred until the remedy conforms to the Record of Decision, as those changes may impact reusability.

Five-Year Review Summary

SITE IDENTIFICATION		
Site name *(from WasteLAN)*:	**Queen City Farms**	
EPA ID *(from WasteLAN)*:	**WAD098511745**	
Region: 10	**State: WA**	**City/County: Maple Valley / King County**
SITE STATUS		
NPL status: ■ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ■ Operating ■ Construction Complete		
Multiple OUs? ☐ YES ■ NO	**Construction completion date:** 9 / 9 / 1997	
Has site been put into reuse? ☐ YES ■ NO[1]		
REVIEW STATUS		
Lead agency: ■ EPA ☐ State ☐ Tribe ☐ Other Federal Agency _____		
Author name: Chris Bellovary		
Author title: RPM	**Author affiliation: EPA Region 10**	
Review period: 9 / 30 / 2003 to 9 / 29 / 2008		
Date(s) of site inspection: 9 / 2 / 2008		
Type of review: ■ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☐ 2 (second) ■ 3 (third) ☐ Other:		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ■ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 9 / 29 / 2003		
Due date *(five years after triggering action date)*: 9 / 29 / 2008		

[1] Part of the site was used by a regional composting business at the time of NPL listing, and remains in that same use.

Five-Year Review Summary (continued)

Issues

This five year review identified several issues, all of which will need to be evaluated and/or corrected. The issues identified include the following items:

- The Remedial Objective of preventing migration of the groundwater contaminant plume has not been achieved.
- The monitoring well network may be insufficient
- The Remedial Action Objective of restoring groundwater at or outside of the Conditional Point of Compliance was not achieved within 10 years
- Geochemical properties to establish the suitability for biodegradation are not monitored in Aquifer 3, where intrinsic biodegradation appears to be a viable attenuation process.

Recommendations and Follow-up Actions

The recommended and follow-up actions identified for this site during this Five Year Review are as follows:

- Demonstrate plume containment or take action to contain the groundwater plume.
- Demonstrate sufficiency of the monitoring network or add additional wells to make it adequate.
- Implement either the contingent pump and treat action or an equally effective alternate method
- Evaluate monitoring Aquifer 3 groundwater for geochemical and conventional groundwater parameters.

Protectiveness Statement

A protectiveness determination of the remedy at Queen City Farms cannot be made at this time until further information is obtained. Further information will be obtained when the following evaluations are completed: containment of groundwater plumes, sufficiency of the monitoring well network, the proposed action to restore groundwater at and outside the conditional point of compliance to productive use. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.

Third Five Year Review
Queen City Farms Superfund Site
Maple Valley, Washington

1. Introduction

1.1 Purpose of the Five-Year Review

The purpose of this five-year review is to determine whether the remedy at the Queen City Farms Superfund site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Reviews identify the issues identified during the review, if any, and provides recommendations for addressing those issues.

1.2 Authority for Conducting the Five-Year Review

The U.S. Environmental Protection Agency (EPA) is preparing this Five-Year Review report pursuant to CERCLA § 121 and the National Contingency Plan (NCP). CERCLA § 121(c), codified at 42 U.S.C. 9621(c), states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR § 300.430(f)(4)(ii) which states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

1.3 Who Conducted the Five-Year Review

EPA Region 10 conducted the Five-Year Review of the remedy implemented at the Queen City Farms Site, located in Maple Valley, Washington. The Third Five-Year Review for Queen City Farms site was conducted by the EPA Remedial Project Manager (RPM) covering the period from October 2003 through September 2008. This report documents the results of the review.

1.4 Review Status

This is the third Five-Year Review for the Queen City Farms site. The triggering action for this review was the completion of the Second Five-Year Review Report, dated September 29, 2003. The five-year review is required because hazardous substances, pollutants, or contaminants remain in the soil and groundwater above levels that allow for unlimited use and unrestricted exposure.

2. Site Chronology

Event	Area	Date
Site begins accepting industrial wastes		1957
Initial Site Discovery		11/1979
Preliminary Assessment/Site Investigation		06/1983
AOC for Shallow Groundwater Investigation		08/1983
Site placed on NPL		**09/1984**
Focused Remedial Investigation		02/1985
Focused Feasibility Study - Waste Ponds Area	IRM	06/1985
AOC for Interim Remedial Measures (IRM)	IRM	10/1985
Record of Decision issued		**10/1985**
Completion of IRM	IRM	10/1986
AOC for RI/FS - Waste Ponds	IRM	05/1988
AOC restricting areas of the site available for mining		05/1990
Emergency removal of site wastes	4-Tek	05/1990
AOC for Groundwater Monitoring by King Co.		05/1992
Record of Decision issued		**06/1993**
Administrative Order, CERCLA § 106(a), RD / RA	4-Tek	03/1994
Consent Decree for Vertical Barrier[2]	IRM / BDA	09/1994
Design (RD) Start for Vertical Barrier	IRM / BDA	09/1994
Construction (RA) Start for Vertical Barrier[3]	IRM / BDA	07/1995
Design (RD) Complete for 4-Tek Area	4-Tek	08/1995
Emergency removal of site wastes	BDA	09/1995
Design (RD) Complete for Vertical Barrier	IRM / BDA	04/1996
Preliminary Construction Close-Out Report		09/1997
First Five Year Review		**09/1998**
Construction (RA) Complete for Vertical Barrier[4]	IRM	09/2001
Second Five Year Review		**09/2003**

[2] Only the court documents that were significant for remedy implementation are listed in the timeline.
[3] This design/construction project included construction elements which occurred prior to design.
[4] The vertical barrier was completed in 1996. Although no site construction occurred after 1997, the ROD required a five year evaluation for the vertical barrier to ensure that it was functioning as designed. As a result, the status of construction completion was not determined until 2001.

3. Background

3.1 Site Location and Surface Characteristics

The 324-acre Queen City Farms site (QCF) is located in a rolling upland area adjacent to Cedar Grove Road, approximately 2.5 miles north of Maple Valley and 5.5 miles south of Issaquah in King County, Washington. (See Figures 1, 2 and 3.) This site was previously used as a pig farm, an airport, a chemical mixing operation, a gravel source, and for waste disposal ponds. It is bounded on the north by a 960-acre regional landfill (Cedar Hills) operated by King County, to the west by undeveloped land zoned for timber which is owned by Reeve Resources LLC, and to the southwest by the Stoneway Sand and Gravel mining and sorting operation. Private residences adjoin the site on the southern and eastern borders. Cedar Grove Road runs through the southeastern portion of the site. The vast majority of the contamination is north of Cedar Grove Road, but the solvent plume associated with the waste disposal ponds and buried drum area extends past Cedar Grove Road into a wetland area that is located on the site property.

The surface of the Queen City Farms site ranges from 350' to 535' above mean sea level and is above the 500 year flood plain. Native surface soils for the site largely consist of Alderwood gravelly sandy loam and Everett gravelly sandy loam.[5] As of the 2000 census, 2,191 people lived within one mile of the site and 17,316 people lived within three miles of the site. As this area of King County has seen rapid population growth, these values are likely higher today.[6] The King County Cedar Hills Regional Landfill is located immediately to the north of the site. Twelve public water system (PWS) wells are located within a half mile of Queen City Farms.[7]

Within the site boundaries are two additional operations. A regional composting operation is located on 26 acres in the northwest section of the site. Gravel mining and sorting occurred in the southwest section of the site but these operations were phased out in 1992 as the available gravel deposits were depleted. Surface grading operations, associated with land reclamation for the former gravel mining, are currently occurring in this area of the site.

3.1.1 Surface Water

Two lakes exist on site. Queen City Lake, a kettle lake, is located immediately to the northwest of the Containment Area, and Main Gravel Pit Lake is located southwest of the Containment Area. Main Gravel Pit Lake formed in a mining depression, has no surface water outlet, and is a source of direct recharge to Aquifer 2. (See Figures 3 and 4.)

The water balance for the area is positive, as precipitation exceeds evapotranspiration by at least 20 inches per year. During the rainy season (late fall through spring), the slope between the Main Gravel Pit Lake and the Containment Area has several

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[5] Natural Resources Conservation Service, U.S. Dept. of Agriculture, Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov. Last accessed on Feb. 26, 2008.

[6] Between 2000 and 2008, the population in Maple Valley increased by 44% while Issaquah increased by 135%. Reference: Washington State Dept. of Financial Management, *April 1 Population of Cities, Towns, and Counties* (June 27, 2007). Available online at http://www.ofm.wa.gov/pop/april1/finalpop2008.pdf, last visited on Sept. 15, 2008.

[7] It is more difficult to determine the location of private wells, but EPA estimates that there are 93 private wells within a half mile of the Queen City Farms site. The two private wells closest to the site are included in the monitoring network.

surface springs and seeps. Most of the water from these springs enters Main Gravel Pit Lake, but some springs discharge to Cedar River Tributary 316A, an intermittent stream which originates west of the Cedar Hills Regional Landfill, flows in a southerly direction on the east side of the compost facility and the former 4-Tek site, and eventually discharges into the Cedar River.

3.2 Subsurface Characteristics

The Queen City Farms site is located within the Puget Sound Lowland, a north-south oriented trough between the Cascade Range to the east and the Olympic Mountains to the West. The regional geology is comprised of a series of glacial and interglacial deposits often overlain with post-glacial sands, silts, peat, and/or gravels. King County designated areas where the ground water is highly susceptible to contamination;[8] Queen City Farms is included as one of those critical areas in part because the property acts as a groundwater recharge zone. There are five water bearing zones at this location. (See Figures 5 and 6.)

3.2.1 Near Surface Water Bearing Zone

This zone is composed of weathered glacial till and is found north of the Containment Area and Queen City Lake. It is directly recharged by precipitation and discharges to Queen City Lake. This water bearing zone was impacted by the contamination in the 4-Tek area and affected the hydrology near Aquifer 1, but was not impacted by the contamination from the waste disposal ponds or buried drums at Queen City Farms.

3.2.2 Aquifer 1

Aquifer 1 is a perched sand and gravel aquifer that is highly permeable and flows towards the south. Aquifer 1 is located in the upland area of the site, and the base of this aquifer generally lies between 420’ and 450’ above mean sea level. It is only found in the northeast quadrant of the site, in the vicinity of the Containment Area; and does not extend to the 4-Tek site. This perched aquifer is directly recharged by the near surface water bearing zone and leakage from Queen City Lake. Aquifer 1 fills and then spills over the edge of the underlying aquitard during the rainy season, which acts as a direct recharge to Aquifer 2. The aquitard is leaky, so some recharge from Aquifer 1 to Aquifer 2 occurs even during the dry months.

3.2.3 Aquifer 2

Aquifer 2 is an unconfined aquifer that extends throughout the site, flows outward in all directions from an area of focused recharge, and serves as a drinking water source for several residences in the area. An unsaturated zone 40’ to 50’ in thickness separates Aquifers 1 & 2, and a number of horizontal silt layers and lenses are present within Aquifer 2. The saturated thickness of Aquifer 2 is between 30 and 55 feet, being greatest during the rainy (winter) months. The closest private well is southwest of the site and draws its water from Aquifer 2. The responsible parties sample this private well twice a year for signs of contamination.

Site documents refer to the upper part of this aquifer as Aquifer 2a and the lower part of this aquifer as Aquifer 2. The main reason for this distinction is because the upper and lower part of this aquifer have different characteristics. The upper part of Aquifer 2

[8] Critical Aquifer Recharge Areas, King County, 2004. Available online at http://www.metrokc.gov/ddes/cao/PDFs/mapKC-CARA-15051AttachB.pdf. Last accessed on Sept. 19, 2008.

consists of a very coarse sand and gravel while the lower part of this aquifer is composed of finer silts, sands and gravels, and as a result, the upper portion of the aquifer has a higher hydraulic conductivity than the lower part of the aquifer. The hydraulic conductivity for this aquifer ranges from 6 x 10^{-5} to 2 x 10^{-3} cm/s horizontally[9] and roughly 4 x 10^{-6} cm/s vertically.

Contaminants were flushed out of Aquifer 1 and into Aquifer 2a during the winter months, and as a result, Aquifer 2/2a holds almost all of the groundwater contamination outside of the Containment Area at this time. The radial plume of contaminants within lower Aquifer 2 extends underneath the wetlands south of Cedar Grove Road.

Direction of groundwater flow in this aquifer is highly influenced by Main Gravel Pit Lake. North of Main Gravel Pit Lake, upper Aquifer 2 groundwater flows to the north-northwest; south of Main Gravel Pit Lake, upper Aquifer 2 groundwater flows to south-southeast. In contrast, groundwater in lower Aquifer 2 flows radially outward in all directions except east from Main Gravel Pit Lake. This means that at some monitoring locations, groundwater in the upper and lower part of the Aquifer 2 flows in different directions.[10]

3.2.4 Aquifer 3

Aquifer 3 is a confined aquifer that extends throughout the site; groundwater flows toward the southwest throughout the area affected by the contaminant plume. The saturated thickness of Aquifer 3 is between 15 and 50 feet. The vertical hydraulic gradients are downward, and contaminated water from Aquifer 2 flows through the leaky aquitard into Aquifer 3, which appears to occur between the Containment Area and the I well cluster. Hydraulic conductivities in Aquifer 3 range from 10^{-5} to 10^{-3} cm/s. The soils in Aquifer 3 are relatively homogenous and are similar in composition to the soils found in lower Aquifer 2. One notable exception is the lack of horizontal silt layers found in Aquifer 2, and another notable exception is that the deoxygenated conditions in the aquitard and Aquifer 3 appear to be suitable for the natural decomposition of trichloroethene (TCE) and its breakdown products, especially with increasing depth.

Since 2001, but most noticeably since 2005, samples from Well O-3a[11] on the southern border to the site are showing an increase in dichloroethene (DCE). This could indicate that the capacity for reductive dechlorination in Aquifer 3 is weakening over time.

3.2.5 Deep Water Bearing Zone

This confined aquifer is located underneath Aquifer 3 and extends throughout the region. This zone was not part of the remedial investigation and is largely uncharacterized. As a result of the natural attenuation that occurs in Aquifer 3, this zone is not believed to have been impacted by any contaminants from the Queen City Farms site.

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[9] Horizontal hydraulic conductivities for Aquifer 2a at the northern site border are 6.4 x 10^{-5} to 6.4 x 10^{-4}; an average flowrate of 0.18 ft/day. *Environmental Monitoring Report for Cedar Hills Landfill, Appendix A*; King County (June 2008).

[10] For example, at well cluster S, the upper part of Aquifer 2 groundwater flows toward the SSE but the lower part of Aquifer 2 flows toward the SSW. (See Appendix, Figures 7-10)

[11] The designation of wells as 3a or 3 is solely to identify if they are near the top (O-3a) or bottom (O-3) of Aquifer 3.

3.3 Nearby Public Water Systems

With the exception of the portion of the plume that extends underneath the Cedar Hills Regional Landfill, the contamination plume for Queen City Farms is contained entirely within the property boundaries. None of the nearby public water systems have been impacted by the Queen City Farms Superfund site.

3.3.1 PWSID 02996 - Cedar Mountain Homeowners Association

This public water system consists of two wells located east of the Queen City Farms Superfund site. The wells are screened at depths of 186' and 200' bgs and service approximately 37 homes. The last routine volatile organic chemical analysis for this well occurred on April 25, 2006; no detections of Volatile Organic Compounds (VOCs) were reported.[12] This is as expected, because Aquifers 2 and 3 both appear to pinch out at the eastern boundary of the site due to the presence of thick silt and clay deposits that characterize much of the Issaquah Creek Valley.

3.3.2 PWSID 26461 - Cedar Grove Composting Water System

This public water system is located on the Queen City Farms Superfund site. This well is located approximately 40' to the south of monitoring well H-3. No drilling records were available to describe the depth of the well or the geology around it, so a camera was used to scan the inside of this well in 1988. Based on those results, PWSID is believed to be over 150' deep and screened in the deep water bearing zone beneath Aquifer 3.

3.3.3 PWSID 11915 - Cedar Grove Mobile Home Park

This public water system consists of two shallow wells that are located a half-mile west of the Queen City Farms Superfund site. The last routine volatile organic chemical analysis for this well occurred on October 25, 2006; no detections of VOCs were reported.[12]

3.3.4 Private drinking water wells

Several drinking water studies were conducted prior to the establishment of the monitoring well network. The largest study occurred in 1983 and sampled forty-three private drinking water wells within a 3.2 mile radius of Queen City Farms and resampled eleven of those wells in 1986 and 1991. Other private drinking water well studies for the immediate area sampled fourteen wells in 1981 and nineteen wells in 1993. The two local private drinking water wells which were determined to be at greatest risk are still monitored twice a year. During these tests, only one well showed what appeared to be contamination associated with Queen City Farms.[13]

3.4 History of Contamination

The Queen City Farms site was previously used as a pig farm, an airport, a chemical mixing operation, a gravel quarry, and for industrial waste disposal ponds. The site was listed on the National Priorities List (NPL) as a result of the contamination found in and

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[12] Washington State Department of Health, Office of Drinking Water, Sentry Internet database. Available online at http://www4.doh.wa.gov/SentryInternet/Intro.aspx. Last accessed on August 25, 2008.

[13] Samples from one well in the 1991 study had 0.3 µg/L of TCE, which is an estimate as it was beneath the practical quantitation level. The Safe Drinking Water Act has a MCL of 5.0 µg/L of TCE. This residence is one of the two residences that are monitored twice a year.

around the waste disposal ponds as well as in the vicinity of that portion of the property used by a chemical formulator. The site was given a Hazard Ranking System (HRS) score of 34.4 before it was listed on the NPL.[14]

3.4.1 Ponds 1, 2 and 3

Industrial waste liquids, including paint and petroleum products, organic solvents, and oils were transported to Queen City Farms in tanker trucks and drums and then discharged directly into three, unlined, one-acre ponds located in the northeastern portion of the site. Occasionally the drums themselves were placed in the ponds. These ponds were periodically burned to reduce the volume and lower the risk of accidental fires posed by floating flammable products in these ponds. Disposal occurred from approximately 1955 through the late 1960's.

The water in Ponds 1, 2, and 3 contained RCRA[15] listed hazardous waste. The closure of the three waste ponds and their contents was the focus of the Interim Remedial Measure (IRM) in 1986.

3.4.2 Ponds 4, 5 and 6

Ponds 4, 5 and 6 were unlined ponds that were located immediately southwest of Queen City Lake. (See Figure 6.) These ponds were dry at the time of the Remedial Investigation and Feasibility Study (RI/FS); soil samples from these ponds detected both heavy metals and organic compounds at concentrations that decreased with depth. Metal concentrations were at or below background levels at a depth of 10 feet below ground surface (bgs) while organic contaminants were generally not detected below 2 feet bgs.

Some soil and sediment samples also detected polyaromatic hydrocarbons (PAHs), polycyclic biphenyls (PCBs), cyanide, and pesticides. Ponds 4, 5 and 6 are believed to have been predominantly used for disposal of whey and animal waste produced by the hog farming operation that was conducted on site between the mid-1950's and 1964. No groundwater contamination associated with Ponds 4, 5 and 6 was detected.

3.4.3 Buried Drums

The site included several areas of buried drums, some of which were removed during the 1986 Interim Remedial Measure (IRM). Samples from the drums and surrounding soil were collected to develop a plan of action for identifying where buried drums were located around the site. In March 1988, gravel mining operations encountered additional buried drums in an area 300’-400’ south of Queen City Lake. Samples from the drums and the soils around the drums revealed a range of contaminants, including heavy metals, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pentachlorophenol (PCP), and solvents such as tetrachloroethene and toluene.

3.4.4 4-Tek Industries

4-Tek Industries (4-Tek) leased a vacant building on the western portion of the Site for the purpose of recycling and reformulating solvents. The plant operated for several years and closed in 1986. Surface water runoff from chemical storage and mixing areas drained to a sump with a discharge pipe. Soil samples taken in the vicinity of the 4-Tek drainage contained detectable levels of volatile organic compounds that

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[14] Sites need to have a HRS score is 28.5 or greater to be eligible for listing on the NPL.

[15] Resource Conservation and Recovery Act of 1976, with major amendments in 1984 and 1986.

were probably due to spillage. Sample results from the intermittent stream did not detect any contamination.

3.5 Remedial Investigation and Planning

Remedial and removal activities have addressed the three contaminated areas of the Site: (1) the three waste ponds, (2) the Buried Drum Area, and (3) the area around the 4-Tek operations.

3.5.1 Waste Ponds / Containment Area

The waste ponds were first sampled by EPA in October 1980. The analyses of water, sludge, and sediment samples identified 44 contaminants including metals, volatile and semi-volatile organics, and polychlorinated biphenyls (PCBs). The owners of the Queen City Farms site signed a Consent Order in 1983 to investigate the extent of soil and groundwater contamination and monitoring wells were installed that same year. The analyses of soil and groundwater samples from these field investigations confirmed the presence of 24 of the original 44 contaminants.

In 1984-85, additional field investigation was conducted to determine the volume of the industrial waste sludge in the ponds and the volume of contaminated soil adjacent and beneath these ponds. Samples taken from the sludge and soil confirmed the presence of significant concentrations of heavy metals, volatile organics, semi-volatile organics, PAHs and PCBs.

In June 1985, a Focused Feasibility Study (FFS) was completed to examine initial remedial measures for the removal and/or containment of the waste in the ponds. A Consent Order with the property owner was signed in October 1985, which implemented an Interim Remedial Measure (IRM). The IRM called for:

- separation of chemical sludge into liquid and solid phases;
- stabilization of the liquid;
- disposal of the stabilized sludge at an off-site hazardous waste landfill;
- installation of surface and groundwater diversion systems to prevent surface water and near-surface groundwater from migrating through the contaminated soil left behind after the pond cleanup;
- installation of a multi-layered cap over the contaminated soils; and
- installation of a groundwater monitoring system.

3.5.2 Buried Drum Area

Several methods were used to identify areas of buried drums, including magnetic surveys and ground penetrating radar. Magnetically anomalous areas were investigated for buried drums. The most significant area was located in 1988 to the southwest of the IRM, which contained buried drums, some of which were already crushed. Due to the quantity of drums located and its proximity to the waste ponds, this area became known as the Buried Drum Area (BDA).

BDA material that was suitable for removal was removed and disposed of offsite in 1988: thirty-two over-pack drums and three roll-off truck boxes were used to transport the recovered drums and heavily contaminated soils to an acceptable off-site disposal facility. The remaining slightly contaminated soil (estimated at 7500 yd^3) was stockpiled for disposal after the Remedial Investigation and Feasibility Study (RI/FS) was complete.

3.5.3 4-Tek Industries

Soil sampling in 1985 and 1987 confirmed the presence of volatile organics including tetrachloroethene (PCE), trichloroethene (TCE), toluene, and dichloromethane (DCM) around a Class V UIC well.

3.5.4 Off-Site Studies

Off-site drinking water studies were discussed in § 3.3.4. In addition to the drinking water studies, wells at the Cedar Hills Regional Landfill were studied for the purpose of determining if the landfill was contributing any contamination to the Queen City Farms site. The sampling results determined that the landfill was not contributing contamination to the Queen City Farms site.

3.6 Enforcement Activities

The first Consent Order for this site was signed in 1983 to conduct a shallow groundwater investigation. The site was listed on the NPL in 1984. A series of request and notice letters were sent to Potentially Responsible Parties (PRPs) ultimately resulting in a Consent Order in May 1988, which required two of the PRPs, Queen City Farms, Inc. and The Boeing Company, to undertake a Remedial Investigation / Feasibility Study (RI/FS). Additional rounds of notice letters were sent which resulted in work exclusion zones for Stoneway Sand and Gravel and RI/FS work being initiated at the Cedar Hills Regional Landfill. In May 1990, a Consent Order was signed requiring Queen City Farms, Inc. to undertake removal activities for the contamination associated with 4-Tek Industries. In May 1992, King County (owners of the Cedar Hills Regional Landfill) signed an EPA consent order to undertake a long-term surface water and groundwater monitoring program. In March 1994, EPA issued a unilateral administrative order, requiring Queen City Farms, Inc. to develop and implement a field investigation and monitoring work plans for the contamination associated with 4-Tek Industries. Pursuant to the 1992 Record of Decision (ROD), a Consent Decree was signed with The Boeing Company in September 1994 to implement the ROD.

4. Remedial Actions

The initial cleanup activity at the site included both removal and containment measures to address the sludge and liquid contamination. The IRM only partially addressed soil contamination and did not address the groundwater contamination.

The 1992 Record of Decision (ROD) was issued to address the short-term and long-term threats to groundwater and soils posed by TCE and other contaminants at the Site. Institutional controls are required to maintain the integrity of the remedy.

4.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) in the ROD were developed to control and mitigate risks to human health and the environment. The control strategy was to manage or mitigate these risks through source control, contaminant removal, and contaminant treatment methods. Long-term monitoring and institutional controls were required to prevent exposure to on-site contaminated media.

RAOs for the soil:
- To prevent exposure to contaminated surface and subsurface soil.
- To prevent IRM and BDA soils from causing further groundwater contamination.
- To reduce the concentrations of contaminants in IRM and BDA soils.

RAOs for the groundwater:
- To prevent exposure to contaminated groundwater.
- To prevent migration of the contaminant plume.
- To restore groundwater for future beneficial use.

4.2 Established Cleanup Levels

Site cleanup levels were established in the ROD. Table 1 (below) establishes maximum contaminant concentrations for BDA soils that were to be left in place.

Table 1: Cleanup Levels for BDA Soils

Hazardous Substance	Concentration (mg/kg)
Arsenic	20
Cadmium	40
Chromium	400
Lead	250
PCBs (total)	1.0
PAHs (carcinogenic)	1.0

Table 2 (below) identifies the cleanup levels for Aquifer 1 groundwater outside the Containment Area. Although Aquifer 1 meets the definition of an underground source of drinking water (40 CFR 144.3), it was not being used as a source of drinking water at the time of the ROD and does not meet the definition of an aquifer used by the Washington State Department of Ecology. The ROD established cleanup levels for Aquifer 1 that will be protective of Aquifer 2. These cleanup levels also apply to the shallow groundwater zone at the 4-Tek facility.

Table 2: Cleanup Levels for Aquifer 1

Hazardous Substance	Concentration (µg/l)	Risk Level
Chromium (total)	80	HI = 1.0 (non-cancer)
PCBs (total)	0.01	1×10^{-6} (cancer)
Carcinogenic PAHs	0.01	1×10^{-6}
Tetrachloroethene (PCE, PERC)	1.0	1×10^{-6} (cancer)
1,1,1-Trichloroethene (TCE)	5.0	1×10^{-6} (cancer)
cis-1,2-Dichloroethene (*cis*-DCE)	70	HI = 0.2 (non-cancer)
trans-1,2-Dichloroethene (*trans*-DCE)	100	HI = 0.1 (non-cancer)
Chloroethene (i.e. Vinyl Chloride)	0.02	1×10^{-6} (cancer)

Table 3: Cleanup Levels for Aquifer 2

Hazardous Substance	Concentration (µg/l)	Risk Level
Tetrachloroethene (PCE, PERC)	1.0	1×10^{-6} (cancer)
1,1,1-Trichloroethene (TCE)	5.0	2×10^{-6} (cancer)
cis-1,2-Dichloroethene (*cis*-DCE)	70	HI = 0.2 (non-cancer)
trans-1,2-Dichloroethene (*trans*-DCE)	100	HI = 0.1 (non-cancer)
Chloroethene (i.e. Vinyl Chloride)	0.02	1×10^{-6} (cancer)

Table 3 (above) identifies the established cleanup levels for Aquifer 2. Aquifer 2 is used as an off-site drinking water source.

4.3 Containment Area

4.3.1 Interim Remedial Measure (IRM) Area

The Interim Remedial Measures occurred in 1986 and focused on Ponds 1, 2 and 3. These measures were implemented to minimize the threat to Aquifer 1 and included the following elements:

- Sludge Removal:
  Water and sludge in and around Ponds 1, 2, and 3 were excavated until native soil was encountered, and then another foot of native soil under the sludge was also removed. Deeper contaminated soils were left in place. Approximately 23,750 tons of solid waste was stabilized with limestone flour and/or kiln dust and disposed of at the Class I hazardous waste disposal facility in Arlington, Oregon. Approximately 2,000 tons of contaminated water was also sent offsite for treatment and disposal.
- Surface Water and Ground Water Diversion System:
  A diversion system was constructed along the northern side of the former ponds to prevent surface water and near-surface water from migrating through the contaminated soils that remained under what used to be Ponds 1, 2 and 3.
- Capping Ponds 1, 2 and 3:
  The former ponds were capped to prevent precipitation from migrating through the contaminated soils. The former ponds were first filled to grade with soils, most of which came from elsewhere on the Queen City Farms site. The cap consists of a silt base, a 30-mil (0.76 mm) thick PVC geomembrane, 2’ of sand, 2’ of cobbles, 6” of silty sand and gravel, 6” of sand and gravel, and included drainage channels to dewater the soils above the geomembrane. The topmost layer was seeded for erosion control.
- Initial Monitoring Wells:
  Three wells were installed in what was believed to be upgradient of the IRM area, and five wells were installed in what was believed to be downgradient of the IRM area.
- Vertical Barrier:
  The monitoring well network determined that the Surface Water and Ground Water Diversion System and multilayer cap had not achieved the goal of isolating the contaminated soils from the ground water. In response, a vertical barrier wall was constructed around the IRM area in 1995-96. The 3’-4’ thick barrier wall was designed to have a maximum permeability of $1x10^{-7}$ cm/s; the depth of this wall ranges from 38’ to 73’ below ground surface (bgs). The existing IRM cap was also expanded at that time to cover a 5.3 acre area, which is discussed in further detail at § 4.3.2 (below).
- Soil Venting:
  The ROD called for a study to determine if the Containment Area should be vented. This study tested the air above the Containment Area and was conducted in 1999. The study concluded that venting the IRM soils was not necessary because the concentrations of Volatile Organic Compounds (VOCs) in the samples collected did not exceed background levels.
- Portions of the ROD which were not implemented:

The ROD also called for removal of Light Non-Aqueous Phase Liquid (LNAPL)[16] within the Containment Area, and to pump out any water inside the Containment Area. Extracted ground water was to be treated on-site and then discharged to nearby bodies of surface water.

This proved to be impossible after the slurry wall was constructed. The slurry wall intersected a former streambed or other underground channel which allowed the bentonite slurry to infiltrate Aquifer 1. Subsequent studies determined that it was no longer feasible to dewater the IRM or remove the LNAPL, as these materials were immobilized within the bentonite slurry that saturated most of Aquifer 1 within the Containment Area.

4.3.2 Buried Drum Area (BDA)

In 1995, the stockpiled slightly contaminated soil (estimated at 7500 yd^3) from the BDA and other lightly contaminated soils from elsewhere around the site (estimated at 4500 yd^3) were consolidated at the BDA. The vertical barrier wall was then constructed to enclose the IRM and the BDA. Next, the cap over the IRM was expanded to include the BDA in 1996. After the construction of the barrier wall and the expansion of the containment cap, the combined BDA / IRM became known as the Containment Area.

4.4 Contaminated Aquifers

The remedy selected within the Record of Decision (ROD) includes isolating the Aquifer 1 source area (completed successfully in 1996), followed by natural attenuation of the underlying Aquifer 2. The long-term remedial objective is to restore the groundwater to beneficial use; the primary method of attenuation is dilution and dispersion.[17]

4.4.1 Aquifer 1

Outside of the Containment Area, contaminants are no longer detected in Aquifer 1. As a result of the vertical barrier wall, containment cap, and leaky aquitard, water no longer exists within the Containment Area. Aquifer 1 is recharged by precipitation during the rainy season, spilling over the edge of the aquitard into Aquifer 2. It is assumed that any contaminants that were remaining in Aquifer 1 outside of the Containment Area have been flushed into Aquifer 2.

4.4.2 Aquifer 2

Although filtered water samples from Aquifer 2 did not reveal the presence of heavy metals during the remedial investigation, the samples detected significant concentrations of trichloroethene (TCE) and dichloroethene (DCE) within the groundwater (see Figures 7-10), along with trace amounts of tetrachloroethene (PCE). These contaminants had formed a plume which was believed to have already crossed the northern property boundary and to be as close as 200' from the southern property boundary. Since the remedy was implemented, King County has drilled additional monitoring wells which demonstrate that the plume extends further north across the property boundary than was assumed when the ROD was written.

The primary remedial action objective stated in the ROD was the on-site containment of the Aquifer 2 TCE and DCE plumes. The short-term remedial action objective for this element is to reduce the size of the Aquifer 2 plume; the ROD defined a Conditional Point of Compliance beneath the Aquifer 1 source area at the boundaries

[16] LNAPL was detected in one of the monitoring wells (MW-8) beneath the IRM prior to installation of the slurry wall.
[17] The remedy selection for the Queen City Farms site predates EPA's 1997 Monitored Natural Attenuation Guidance.

of the IRM as the goal for the short-term remedial action objective. The long-term objective of the remedial action is to restore Aquifer 2 to its beneficial use.

In order to achieve the cleanup objectives established for Aquifer 2 ground water, the ROD included the following contingent remedial action:

> "Three years after construction of the IRM vertical barrier system, [a] historical and statistical analysis of Aquifer 2 contaminant concentrations will be conducted. If this analysis indicates that contaminant concentrations in Aquifer 2 are not likely to decline to cleanup levels [at and outside the Conditional Point of Compliance] within 10 years after construction of the vertical barrier system, ground-water extraction shall be implemented. The determination as to whether Aquifer 2 cleanup levels are achievable within the required time frame will be made by EPA, in consultation with Ecology." (Queen City Farms ROD, § 10.1.6, 1993)

The contingency provision was evaluated in May 2000. If any monitoring wells at or outside the conditional point of compliance were expected to exceed cleanup levels in 2006, that was supposed to trigger the contingency provision of extraction and treatment of Aquifer 2 groundwater. The evaluation concluded that eight of the twenty eight relevant wells were not expected to meet the required cleanup levels by 2006. At that time, EPA's project manager believed that although the contingency trigger was met, it was not necessary to implement the pump and treat contingency.

EPA has eleven years of monitoring data since the construction of the vertical barrier wall; the ROD anticipated all of the wells from the Conditional Point of Compliance outward would be at or below cleanup levels by this time. Seven of the twenty-one relevant wells inside the site and an additional two wells outside the site still have not achieved cleanup levels.

EPA is currently in the process of re-evaluating the containment and restoration strategy for returning Aquifer 2 to beneficial use in a timely manner, and intends to actively pursue a resolution to the issues discussed above.

4.4.3 Aquifer 3

Unlike the soils in Aquifer 2, the soils in Aquifer 3 are relatively homogenous. A leaky aquitard separates Aquifers 2 and 3. Due to a downward hydraulic gradient, water from Aquifer 2 recharges Aquifer 3. During the initial remedial investigation (1985), no site-related contamination was detected in Aquifer 3, and the ROD did not specify cleanup levels for that aquifer. During the supplemental remedial investigation (1991), indications of contamination were present, but were unverifiable because the concentrations were lower than the quantitation limit.

In 1995, DCE was detected at Well I-3. In response, Well I-3a was drilled to sample near the top of Aquifer 3. Initial samples from Well I-3a, taken at the end of 1996, contained 40 µg/L of DCE and 26 µg/L of TCE, which is in excess of the TCE cleanup levels that were established for Aquifers 1 and 2. Nine wells[18] are actively monitored in Aquifer 3, and contaminants are currently detected in five of those wells, although

[18] A tenth well, D-3, is present but is not actively monitored. An eleventh well, T-3a, was abandoned in 2001.

only Well I-3a exceeds cleanup levels if Aquifer 2 cleanup levels were applied to Aquifer 3. (See Figures 11 and 12.)

4.5 4-Tek Industries

The 8" drain pipe, sump, and surrounding soils were excavated in 1990, and subsequent testing revealed that groundwater contamination remained. In 1991, three monitoring wells were installed in the uppermost saturated zone to monitor the groundwater contamination in this area over time.

In 1994, three additional monitoring wells were installed, this time in Aquifer 2 to determine whether contamination in the uppermost saturated zone had migrated downward and contaminated Aquifer 2. No PCBs or VOCs were detected in Aquifer 2, and all of the tested metals were below primary Maximum Contaminant Levels (MCLs) of the Safe Drinking Water Act.

The 4-Tek monitoring wells were originally sampled twice a year, with a plan for onsite groundwater extraction and treatment if contamination in Aquifer 2 was ever found above cleanup levels. Based on a history of decreasing concentration of contaminants in the uppermost saturated zone, and a lack of contamination in Aquifer 2, EPA reduced the sampling frequency in 2003 to once every five years, and authorized the abandonment of one monitoring well in the uppermost saturated zone and one monitoring well in Aquifer 2. The 2008 sample results show that conditions have continued to improve as expected and as a result, EPA sees no reason to adjust the sampling frequency for these wells at this time.

During the 2008 site inspection, several issues were observed that need to be corrected:[19]

- MW-1: Vegetative overgrowth obstructs access to this monitoring well.
- MW-3: This upgradient well has not been properly plugged and abandoned.
- MW-4: This upgradient well needs to be located and checked for proper abandonment.
- MW-3 and MW-4: Unless Queen City Farms intends to include these wells in the next sampling event, these wells must be closed and abandoned in accordance with Washington State requirements.
- MW-5: This well was not properly locked, as it is currently too difficult to thread the shackle of the lock through the hasp.[20]
- Drum: A 55 gallon drum containing purge water from the 2008 sampling event was still present on site. The contents of that drum need to be properly disposed.

4.6 Site-Wide Actions

4.6.1 Institutional Controls

Deed restrictions have been implemented on the site, primarily to prevent unauthorized extraction of ground water and to prevent disturbance of any of the equipment used to implement or maintain the remedy. The deed restrictions for the site were originally thought to have been implemented in April 2002, but a November 2007 title search revealed that the 2002 restrictive covenants had not been filed in a

[19] For additional details, please refer to the inspection report in § A.2 of the Appendix of this review.

[20] Queen City Farms' consultant brought this to the attention of Cedar Grove Composting's Plant Manager during the inspection, and the plant manager stated that they would correct it.

manner that was legally enforceable. The responsible parties corrected the restrictive covenants and filed the document with King County on September 10, 2008.

4.6.2 Groundwater Monitoring

A groundwater monitoring network was established and is monitored. The monitoring plan has been modified over time in response to changes in site conditions. Groundwater monitoring is necessary to ensure that the Containment Area continues to function, and EPA will continue to conduct reviews of this site every five years until all hazardous substances, pollutants, or contaminants in the soil and groundwater have declined to levels that will allow for unlimited use and unrestricted exposure. As a result, it is expected that groundwater monitoring will continue until site conditions allow for unlimited use and unrestricted exposure.

4.7 Off-Site Areas

4.7.1 Private domestic well monitoring

Private domestic well monitoring is occurring at the two nearest residences southwest of the site, one of which uses Aquifer 2 as a source. Both of these residences adjoin the Queen City Farms property. Monitoring wells are positioned between the current extent of the plume and these wells, and these monitoring wells would detect an expansion of the plume before it reached external drinking water wells. Should either of these wells become contaminated, alternate water will be provided under the conditions of § 10.5.1 of the Decision Summary in the Consent Decree[21]. To date, no contamination from the Queen City Farms site above the MCLs has been documented at these residences.

4.7.2 Cedar Hills Regional Landfill

A Consent Order with King County assures that long-term monitoring of surface and groundwater at the adjacent Cedar Hills Regional Landfill will continue for at least 30 years. The monitoring is conducted “to ensure that surface water and ground-water quality and flows from the Cedar Hills Landfill do not impact the remedial action at the QCF Site” and “to ensure that Site-related contaminants are not migrating to the landfill”. (ROD § 10.5.2; Consent Decree 1085-10-12-106, App. A § 10.5.2)

4.8 Progress Towards Remedial Objectives

4.8.1 RAOs for the Soil

- <u>Prevent exposure to contaminated surface and subsurface soil</u>
  This remedial action objective has been achieved. The removal action from the Buried Drum Area and Ponds 1, 2 and 3, and the construction of the cap to cover remaining contaminants in the Containment Area have been completed. These measures removed the contaminated surface soils and still act to properly isolate exposure routes to the subsurface soil.

- <u>Prevent IRM and BDA soils from causing further groundwater contamination</u>.
  At present, this remedial action objective is being achieved. Aquifer 1 water is prevented from further contamination due to the cap and the barrier wall, which prevent precipitation and Aquifer 1 groundwater from contacting the contaminated soil within the Containment Area. Since 2002, Aquifer 2 water has been protected from further contamination because Aquifer 2 waters are 30’ deeper than the

[21] This is also discussed in Appendix A, § 3.8.2.1, of the Consent Decree.

contaminated soils in the Containment Area, and no mobile water remains inside the Containment Area to transport contaminants down to Aquifer 2. The infiltration of the Containment Area with bentonite, which made it infeasible to remove LNAPL and water for treatment and/or disposal, immobilized much of the contamination inside the Containment Area.

After the completion of the slurry wall, water levels inside the Containment Area quickly dropped. By April 1998, water levels in seven of the nine monitoring wells located inside the Containment Area were dry. The remaining two wells were dry by October 1999[22]. Obviously that water went somewhere – some of it may have been absorbed by the bentonite that infiltrated the Containment Area, with the remainder draining through the leaky aquitard into Aquifer 2. The cap and barrier wall are successfully keeping water from recharging the Containment Area.

- Reduce the concentrations of contaminants in IRM and BDA soils
  This remedial action objective has been achieved. The removal action for the ponds and the BDA removed 23,750 tons of materials with high levels of contaminants, leaving only soils with lower levels of contamination.

4.8.2 RAOs for the Groundwater

- Prevent exposure to contaminated groundwater
  To date, this remedial action objective has been achieved. The ability to achieve this RAO in the future is dependent on the ability to prevent migration of the contaminant plume.

- Prevent migration of the contaminant plume
  This remedial action objective has not been achieved. Although most of the wells near the outer plume boundary are seeing a trend of decreasing contaminants, some wells are seeing an increasing trend in contaminants. Four of the highest priority wells are listed in Table 4, below.

Table 4: Measurements of contaminants at selected wells.

Well	Contaminant	Earlier Concentration	Current Concentration
S-2	TCE	1997: < 0.5 µg/L	2008: 8.4 µg/L
O-3a	1,2-DCE	1997: < 0.5 µg/L	2008: 4.5 µg/L
MW-76	TCE	1997: < 0.5 µg/L	2008: 8.7 µg/L
MW-76	TCE	2000: 14 µg/L	2008: 8.7 µg/L
MW-82	TCE	2002: 9 µg/L	2008: 7.3 µg/L

Well S-2 is located southwest of the Containment Area. Table 4 shows that the concentration of TCE used to be less than the quantitation level in that area of lower Aquifer 2, but it has since increased to being in excess of the site cleanup levels. That indicates the TCE plume in Aquifer 2 is expanding toward the southwest. This portion of the plume is still within the site boundaries, but it is also the closest portion of the plume to human receptors.

[22] Well X-5, which is no longer monitored, does continue to have a small and stable amount of water in it. These interior wells are important as they are the mechanism that verifies the that containment area continues to keep groundwater and precipitation from reaching the contaminants.

Well O-3a is one of the perimeter wells that was required under section 13.3 of the ROD to monitor for plume expansion. Table 4 shows that the 1,2-DCE plume in upper Aquifer 3 is expanding southward, and probably has started to expand past the southern site border.[23]

As discussed in § 4.7.2, the ROD intended for the monitoring wells at the property line between QCF and the landfill to be monitored to ensure that site-related contaminants did not migrate to the landfill. Well MW-76 is located just north of the border between Queen City Farms and the Cedar Hills Regional Landfill. Results from MW-76 show that the TCE plume continued to expand northward under the southern part of the Cedar Hills Landfill property after the ROD was issued. Similarly, MW-82 is 500 feet north of the border between the Queen City Farms site and the landfill. TCE was detected above MCLs when MW-82 started being for VOCs, but results from both MW-76 and MW-82 have declined since that time. The contours of the TCE plume under the landfill appear to be contracting, but remain above MCLs.

- To restore groundwater for future beneficial use
  This remedial action objective has not been achieved. Contaminant mass in the groundwater is declining and progress is being made in most areas of the plume. Even so, contaminant concentrations in numerous wells still exceed both the MCLs of the Safe Drinking Water Act and the cleanup levels established in the ROD. This goal of restoring groundwater to beneficial use is still considered achievable but probably not in a 30-year timeframe.

4.8.3 Site-wide RAOs

The ROD requires long-term monitoring and institutional controls to prevent exposure to on-site contaminated media. At this time, the institutional controls have been properly implemented and a monitoring well network has been established.

However, it is not clear that the monitoring well network is adequate to properly achieve the remedial objectives. For example, the monitoring well that currently has the highest measured TCE concentrations is Well E-2 in Aquifer 2. Based on recent piezometric groundwater contours, we expect that part of the plume to move in a northerly direction from E-2.

However, if the lower Aquifer 2 plume was to move to the north-northwest, it is possible that the movement would not be detected with any of the wells in the current monitoring well network until it reached King County monitoring wells MW-56 and MW-57.[24] That would indicate a failure of the remedial action objective, to prevent migration of the contaminant plume, as discussed in § 4.8.2 on the previous page.

5. Progress since Last Review

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[23] The MCL and the cleanup level for *cis*-1,2-Dichloroethene and *trans*-1,2-Dichloroethene is 70 and 100 ug/l, respectively, which is more than an order of magnitude greater than what is currently detected at Well O-3a.

[24] Although the current monitoring well network has wells to the northeast of E-2 (Wells C-2 and L-2) and a well west of E-2 (Well D-2), it does not have any monitoring wells located in between those points. See Figures 9-10 in Appendix 1 for more detail.

5.1 Protectiveness Statement from the Second Five-Year Review

"Because the remedial actions for the entire site are protective, the site is protective of human health and the environment."

5.2 Status of Recommendations from the Second Five-Year Review

The Second Five Year Review identified Scotch broom (*Cytisus scoparius*) as a potential threat to the integrity of the multi-layer cap and 1,4-dioxane as a possible contaminant of concern that might exist on the site. These issues were evaluated.

- Although it is an invasive species, Scotch broom was determined to have a shallow root system that would not adversely affect the cap.
- Sampling for 1,4-dioxane was conducted, but 1,4-dioxane was not detected in any of the samples.

6. Five-Year Review Process

The Five Year Review was conducted according to procedures in OSWER Directive 9355.7-03B-P, Comprehensive Five-Year Review Guidance.

6.1 Administrative Components

Activities in this review consisted of:

a) Community notification,
b) Review of site-related documents
c) Review of monitoring data,
d) Discussions with the Responsible Parties and/or their representatives.
e) Site visit and inspection, and,
f) Preparation of the Five-Year Review report.

6.2 Community Notification

There has been minimal interest expressed from the community in the last five years for community involvement in regards to this project, so no community involvement activities have occurred since the last Five Year Review. Community interest in this site is considered relatively low.

On April 29, 2008, a Public Notice was placed in a local newspaper, Voice of the Valley, stating that EPA was doing this Five-Year Review and to solicit any comments. The following day, EPA mailed postcard to the contacts on the site mailing list announcing the beginning of the Five-Year Review.

EPA did receive some questions from the public during the comment period, in the form of requests for additional information on the site location and activities, but no comments were received by EPA as a result of the notifications. Upon completion and acceptance of this review, a public notice will be put into the local newspaper to inform citizens that the finished report is available. A copy of the Five Year Review will also be sent to the Responsible Parties.

6.3 Document Review

The following documents were evaluated as part of the 2008 Five Year Review:

Record of Decision; EPA Region 10, Oct. 1985
Remedial Investigation Report, Queen City Farms; Landau Associates, April 1990
Supplemental Remedial Investigation Report, Queen City Farms; Landau Associates, Dec. 1991
4-Tek Industries Groundwater Monitoring Results; Parametrix, April 1995
Monitoring Well Installation Report; Golder Associates, Jan. 1996
95% Task Remedial Design Report; Kennedy/Jenks Consultants, Feb. 1996.
LNAPL Imobilization, Queen City Farms; Landau Associates, Aug. 1996
First Five Year Report for the Queen City Farms Superfund Site; EPA Region 10, Sept. 1998
Performance Evaluation of Remedial Action, Queen City Farms; King Groundwater Science, May 2000
Second Five Year Report for the Queen City Farms Superfund Site; EPA Region 10, Sept. 2003
Technical Information Report, Queen City Farms Refill Project; Landau Associates, Jan. 2007
Cedar Hills Regional Landfill Quarterly Environmental Monitoring Report; King County, April 2007
Cedar Hills Regional Landfill Quarterly Environmental Monitoring Report; King County, July 2007
2006 Annual Monitoring Data Report, Queen City Farms; EcoChem, Sept. 2007
Cedar Hills Regional Landfill Quarterly Environmental Monitoring Report; King County, Oct. 2007
Cedar Hills Regional Landfill Quarterly Environmental Monitoring Report; King County, Jan. 2008
Cedar Hills Regional Landfill Quarterly Environmental Monitoring Report; King County, April 2008
Evaluation of Remedial Action, 10 Year Review, Queen City Farms; Landau Associates, April 2008.
4-Tek Industries Groundwater Monitoring Results from June 2008 Sampling Event, Landau Associates, Aug. 2008.
2007 Annual Monitoring Data Report, Queen City Farms; EcoChem, Sept. 2008.

6.4 Data Review

Contamination at the QCF site migrated from the area of the disposal ponds to perched Aquifer 1 and to Aquifer 2, where it formed a plume which flowed radially from a point of focused recharge. EPA's understanding of the extent of groundwater contamination and how contamination migrates has changed over time with additional wells and contaminant trends from long-term monitoring. With gravel mining and the formation of the Gravel Pit Lake, that historical point of focused recharge moved a few hundred feet to the south, but the plume still migrates radially. Since the ROD was signed, contamination was detected in Aquifer 3, and TCE has been found at significant levels in well I-3a. This contamination presumably leaks from Aquifer 2 to Aquifer 3 somewhere between the Containment Area and the I well cluster, and the plume appears to be laterally contained by intrinsic biodegradation within Aquifer 3. Since the Containment Area cap and vertical barrier were installed, contaminant migration from the source area

has been effectively stopped; however, contamination in upper Aquifer 2 has been discovered to extend further north than was recognized in the ROD. Overall, TCE mass in the Aquifer 2 plume has been declining. However, since the last five-year review, TCE levels in the southwestern corner of the lower Aquifer 2 plume have increased from barely detectable to above the MCL and are currently at 8.4 µg/L in well S-2, suggesting instability in that area of the plume. (See Figure 9.)

A Ten Year Review that was produced by Landau Associates for The Boeing Company included a Mann-Kendall statistical analysis of the wells to determine the trend in VOC concentrations at those wells. Of the wells analyzed, twenty-two wells had statistically relevant trends. Decreasing concentrations were found in seventeen of those wells, and were projected to reach the MCL for trichloroethene (TCE) between 2016 and 2046. Another two wells were found to have stable concentrations (i.e. not projected to reach MCLs), and three were found to have increasing concentrations.

This result is similar to what was anticipated in the projections prepared in the year 2000, as previously discussed in § 4.4.2 of this report. As was discussed earlier in § 4.8, although the remedial action objectives for soil are currently being achieved at Queen City Farms, the site is not achieving the remedial action objectives for groundwater. EPA intends to bring these issues to resolution.

6.5 Site Inspection

A site inspection was conducted on September 2, 2008. One of the purposes for the site inspection was to observe site conditions and conduct interviews as part of the five-year review. A site inspection report is attached in the Appendix with labeled photographs that support the findings from that visit.

1. The Containment Area for the Queen City Farms site remains fenced behind locked gates, and the fence is adequately maintained.
2. The cap and drainage system for the Containment Area appear to be properly maintained and functioning as designed.
3. Monitoring wells associated with the Containment Area appear to be properly maintained.
4. Monitoring wells associated with the former 4-Tek facility had some minor issues, as detailed in § 4.5, but otherwise appear to be properly maintained.

6.6 Interviews

The following people were interviewed during the process of preparing this Five Year Review:

Wayne Schlappi	The Boeing Company	Project Manager
Kurt Easthouse	Parametrix	Agent for Queen City Farms, Inc.
Brad Marten	Marten Law Group;	Attorney for Queen City Farms, Inc.
Eric Weber	Landau Associates	Agent for Queen City Farms, Inc.

7. Technical Assessment:

Question A: Is the remedy functioning as intended by the decision documents?

No. Although the remedy for the soils is functioning as intended by the decision documents, the current state of the remedy fails to prevent migration of the contaminant plume and did not restore groundwater at and outside the Conditional Point of Compliance within ten years.

7.1.1 4-Tek Industries

The primary objective for this area was to confirm that any residual contaminants did not reach Aquifer 2, and if they did, to begin remediation efforts to reduce any contamination to cleanup levels. The remedy continues to be successful in this area and is functioning as intended by the decision documents.

7.1.2 Containment Area

The primary objective for the Containment Area is to prevent water (recharge from precipitation and lateral inflow from Queen City Lake) from coming into contact with the contaminated soils for a minimum of 30 years. The remedy appears to be successful at achieving the primary objective.

A secondary objective for the Containment Area was to extract LNAPL and contaminated groundwater from within the Containment Area so that it would not discharge through the aquitard into Aquifer 2. Infiltration of bentonite into the Containment Area made it infeasible to remove either the LNAPL or the contaminated groundwater. However, groundwater levels dropped within the Containment Area, which indicates that it was escaping the area. It is unclear how much of the contaminants were immobilized in the bentonite slurry and how much of the contaminants were discharged into Aquifer 2.

7.1.3 Contaminated Aquifers

The primary objective of the remedy is containment of the Aquifer 2 TCE and DCE plume, with a secondary objective of reducing the size of this plume to a conditional point of compliance within 10 years of source containment. The long term remedial goal is restoration of Aquifer 2 to beneficial use. As was previously discussed in § 4.4.2 and § 4.8, these objectives are currently not being achieved at the Queen City Farms site.

7.1.4 Monitoring Well Network

The Record of Decision (ROD) requires long-term monitoring of groundwater and surface water as a site-wide action to evaluate remedy progress and to ensure protectiveness. The monitoring well network has been established. However, as was discussed in § 4.8.3, it is not clear that the monitoring network is sufficient to properly monitor the existing plume. Only one monitoring well remains within the Containment Area for monitoring long-term integrity of the containment structures. In addition, although natural attenuation through dilution is part of the selected remedy for Aquifers 1 and 2, geochemical properties to establish the suitability and progress of biodegradation are not currently monitored.

Monitoring geochemical properties would be particularly useful for Aquifer 3, where reductive dechlorination does appear to be occurring. This would be helpful for monitoring the progress of the natural attenuation, and could help answer questions such as whether the increase of DCE at Well O-3a is a result of a decrease in the capacity for reductive dechlorination in Aquifer 3, or due to other causes. The value of monitoring additional parameters should be evaluated prior to the next five year review.

7.1.5 Institutional Controls

The Record of Decision (ROD) requires institutional controls to prevent exposure to on-site contaminated media.

The restrictive covenants that were placed on the property are intended to protect the remedy and to notify any potential purchaser that the land has been used to manage hazardous waste. The covenants prevent extraction of contaminated groundwater and prevent development of the land above the Containment Area for residential or agricultural uses. The covenants also place restrictions on the use of Queen City Lake and requirements in regards to the monitoring well network. The restrictive covenants have been properly implemented.

7.1.6 Operations and Maintenance

The ROD requires ongoing operations and maintenance to ensure that the remedy is properly maintained, which includes maintenance and protection of the ground water monitoring network. A monitoring well network has been installed and is being maintained. As was discussed in § 4.8.3, it is not clear that the monitoring well network is adequate to properly achieve the remedial objectives, and so this element of the institutional controls should be reevaluated.

Other key elements of the operations and maintenance plan include:

- Security: Inspect for signs of unauthorized entry, vandalism, or other damage.
- Cover: Inspect for erosion, sloughing, cracking, or other signs of failure.
- Drainage: Inspect system to identify clogged or crushed drainage courses, visually assess accumulated material in catch basins.
- Monitoring wells: Maintain access to the wells, and condition of the wells.
- Recordkeeping: Maintain a record of inspections and inspection results.

With minor exceptions, inspections have shown that operations and maintenance is performed appropriately at the site.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

Yes. Review of the exposure assumptions, toxicity data, cleanup levels, and RAOs indicate that the remedy selected at the time of the ROD is still properly supported.

7.2.1 Review of Applicable or Relevant and Appropriate Requirements (ARARs)

On-site remedial actions must attain (or waive) Federal and more stringent State ARARs of environmental laws upon completion of the remedial action, and the ARARs are applied as written and interpreted at the time the Record of Decision (ROD) is

signed.[25] EPA reviews changes in ARARs that have occurred during the previous five years during each Five Year Review, to determine whether the change in regulation calls into question the protectiveness of the remedy.[26]

For purposes of this review EPA considered whether there have been changes in promulgated standards identified as ARARs, the basis for cleanup levels, or new toxicity information which call into question the protectiveness of the remedy. For TCE, the groundwater cleanup level selected in the 1993 Record of Decision is based on the MCL of 5.0 µg/L, which according to that ROD equated to an excess cancer risk of approximately $1x10^{-6}$, based on an oral cancer slope factor of 0.011 per mg/kg-day. In addition to Federal Drinking Water Standards, Washington State's Model Toxic Control Act (MTCA) groundwater cleanup standards were identified as ARARs, specifically Method B for groundwater. Based on those calculations and WAC section 173-340-720 (7)(b), the MCL was deemed to be sufficiently protective and was selected as the groundwater cleanup standard.

However, since that time EPA and others have been re-evaluating cancer risks associated with inhalation and ingestion of TCE. The value for TCE that was originally used in remedy selection for this site has been withdrawn by EPA and a new value has yet to be included in the Integrated Risk Information System (IRIS) database. In October 2004 the Washington State Department of Ecology (Ecology) updated its guidance for calculating risk levels for TCE under Washington State's Model Toxic Control Act to include a more protective cancer slope factor for ingestion and inhalation of trichloroethene (TCE).[27] The slope factor recommended in the Ecology guidance, 0.4 per mg/kg-day, is the high end (most protective) of the slope factor range provided in *Trichloroethylene Health Risk Assessment: Synthesis and Characterization (External Review Draft)* (U.S. EPA, 2001)[28] and has until recently also been recommended for use by EPA Region 10. Based on new scientific information, EPA Region 10 now recommends the midpoint, 0.089 per mg/kg-day, of the slope factor range in EPA, 2001 be used as an interim value until EPA provides toxicity values on the IRIS database or other information becomes available to suggest a different value would be more appropriate. Ecology is considering adopting the midpoint for use under MTCA.

Using the cancer potency factor of 0.4 per mg/kg-day recommended by Ecology since 2004, the MTCA Method B groundwater cleanup level that equates to an estimated excess cancer risk of $1x10^{-6}$ is 0.11 µg/L (so 1.1 µg/L would equate to $1x10^{-5}$ and 11.0 would equate to $1x10^{-4}$). Applying the slope factor of 0.4 per mg/kg-day, the risk at the

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25 "Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy." Preamble to the National Contingency Plan, 55 FR 8757.

26 "[A] policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment." Preamble to the National Contingency Plan, 55 FR 8758.

27 Ref: *Trichloroethylene Toxicity Information*, Ecology, October 2004. Available at: https://fortress.wa.gov/ecy/clarc/focussheets/tce%20pce%20oct%202004%20final.pdf. Last accessed on September 10, 2008.

28 Available at: http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=4580. Last accessed on September 29, 2008.

MCL would be approximately $5x10^{-5}$,[29] which falls within the acceptable risk range of 10^{-4} to 10^{-6} of the NCP, and cleanup to the MCL would be protective. However, if a slope factor is used or adopted that is more protective than the one available at the time of the ROD, then EPA will reevaluate (1) whether cleanup to the MCL will meet ARARs,[30] (2) the impact it would have on the time to achieve cleanup goals, and (3) the impact it would have on risk levels for the air pathway.

EPA expects to complete its own review of the carcinogenicity of TCE by late 2010.[31] Given these uncertainties, EPA has determined no changes in cleanup levels or RAOs are warranted at this time, however the remedy should continue to operate and the TCE cleanup goals should be re-evaluated for protectiveness and compliance with ARARs when TCE toxicity values are published in IRIS or before the next five-year review, whichever is sooner.

7.2.2 Human Exposure

Although population density has increased in the area, the basic assumptions about exposure routes remain valid.

7.2.3 Groundwater Migration

This remedial action objective is still valid. As discussed earlier in § 4.8.2, the remedial action objective of preventing migration of the contaminant plume has not been achieved.

7.2.4 Ready for Reuse

Twenty-six acres of the site are in use by a regional composting operation, and have been used for that purpose since before the site was listed on the National Priorities List (NPL). Institutional controls have been properly implemented, so most of the surface of the site is appropriate for reuse.

However, there are open questions in regards to migration of the groundwater contaminant plumes, and what measures may be necessary to achieve the remedial action objectives. EPA is deferring the formal reuse determination until those questions are answered. The reason for the deferment is that site changes on the surface may be necessary in order to achieve the remedial action objectives, which may have an impact on which areas of the site are ready for reuse. Moreover, proposed gravel mine reclamation activities may change surface contours in ways that could affect localized recharge and consequently plume migration in Aquifer 2. A reuse determination will be made after the relevant questions have been resolved.

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29 If the newly recommended slope factor of 0.089 is applied, the risk at the MCL would equate to $1x10^{-5}$.

30 If other applicable laws such as MCLs pose an excess cancer risk greater than $1x10^{-5}$ or an HI greater than 1, then both the MTCA Method B cleanup level requirements and the site cleanup goals would be adjusted downward so that the cumulative excess cancer risk for all contaminants does not exceed $1x10^{-5}$ or an HI greater than 1.

31 Ref: *Economic Impact Analysis of the Halogenated Solvent Cleaners Residual Risk Standard*, EPA, April 2007. Available at http://www.epa.gov/ttnecas1/regdata/EIAs/hsceconanalysisreportfinaldraft60000.pdf. Last accessed on September 10, 2008.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. The only issues that were revealed during this five year review which may adversely affect the protectiveness of the remedy were already discussed in Questions A and B of the Technical Assessment.

7.3.1 Potential Climate Change Impacts.

The elevation for the Queen City Farms Superfund site ranges from 350' to 500' above the current mean sea level and will not see any direct impacts from sea level rise.

Average annual temperatures in the Pacific Northwest are projected to increase by 2°F by the 2020s and 3°F by the 2040s when compared with a 1970 to 1999 reference period. This increase is projected to occur in all seasons, but most models project the largest temperature increases in summer (June-August).[32] The remedy selected at the Queen City Farms Superfund site has been used in similar sites throughout the United States, including those in much warmer climates, so the anticipated increase in temperature does not pose an area for concern.

The Queen City Farms Superfund site is within a groundwater recharge area, so changes in the rate and locations for peak groundwater recharge could impact contaminants that are currently outside of the containment wall. Most climate models for the Pacific Northwest project a slight increase in precipitation during the fall and winter months.[33] However, unlike climate models for temperature or sea level rise, there is a lower degree of certainty in the climate models for precipitation changes in the Pacific Northwest. At this time, climate change impacts do not appear to be an area for concern, but this should be revisited in future five year reviews.

Technical Assessment Summary

Many of the remedial action objectives for soil contaminants, institutional controls, and operations and maintenance are currently proceeding as intended within the ROD, however, some of the remedial action objectives (e.g. monitoring, containment, and groundwater remediation) either are not or may not be proceeding as intended. At this time, there is no current exposure pathway to the site contaminants. Changes will need to be implemented in order to ensure that there continues to be no exposure pathway and to properly implement the remedial action objectives. EPA intends to continue to discuss these issues with the responsible parties in order to bring them to a resolution.

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32 Climate Impacts Group, University of Washington, *Climate Change Scenarios*. Available at http://www.cses.washington.edu/data/ipccar4/. Last accessed on Feb. 5, 2008.

33 Climate Impacts Group, University of Washington, *Scenarios of future climate for the Pacific Northwest*. Available at http://cses.washington.edu/db/pdf/kc05scenarios462.pdf. Last accessed on September 10, 2008.

8. Issues, Recommendations and Follow-up Actions

Major issues concerning this site are presented in the table below:

Table 5: Issues

Issues	Affects Protectiveness	
	Current	**Future**
The Remedial Action Objective of preventing migration of the groundwater contaminant plume is not being achieved	Possibly	Yes
The monitoring well network may be insufficient	Possibly	Yes
The Remedial Action Objective of restoring groundwater at or outside of the Conditional Point of Compliance was not achieved within 10 years	No	Yes
Geochemical properties to establish the suitability for biodegradation are not monitored in Aquifer 3, where intrinsic biodegradation appears to be a viable attenuation process.	No	Yes
The 2008 site inspection identified several follow-up items for 4-Tek monitoring wells MW-1, MW-3, MW-4, and MW-5.	No	Yes

Table 6: Recommendations and Follow-up Actions

Recommendations / Follow-up Actions	Responsible Party	Oversight Agency	Milestone Date	Affects Protectiveness	
				Current	**Future**
Demonstrate plume containment or take action to contain the groundwater plume.	Boeing	EPA	Dec. 2010	Yes	Yes
Demonstrate sufficiency of the monitoring network or add additional wells to make it adequate.	Boeing	EPA	June 2010	Yes	Yes
Implement either the contingent pump and treat action or an equally effective alternate method	Boeing	EPA	Dec. 2010	Yes	Yes
Evaluate monitoring Aquifer 3 groundwater for geochemical and conventional groundwater parameters.	Boeing	EPA	Dec. 2009	No	Yes

Recommendations / Follow-up Actions (continued)	Responsible Party	Oversight Agency	Milestone Date	Affects Protectiveness	
				Current	Future
MW-1: Restore proper access to this well	QCF	EPA	March 2009	No	No
MW-3: Properly close and abandon this well	QCF	EPA	March 2009	No	Yes
MW-4: Locate well & check for abandonment	QCF	EPA	March 2009	No	Yes
MW-5: Repair well cap so it can be locked	QCF	EPA	March 2009	No	Yes

9. Protectiveness Summary

A protectiveness determination of the remedy at Queen City Farms cannot be made at this time until further information is obtained. Further information will be obtained when the following evaluations are completed: containment of groundwater plumes, sufficiency of the monitoring well network and the proposed action to restore groundwater at and outside the conditional point of compliance to productive use. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.

10. Next Review

Hazardous substances remain on site. An update to the Third Five-Year Review for the Queen City Farms Superfund Site will be issued when a protectiveness determination is made, and is anticipated around two years from the date of this review. The Fourth Five-Year Review for the Queen City Farms Superfund Site is scheduled to be complete by September 29, 2013.

Appendix 1: Figures and Tables

Figure 1: Site Location

Figure 2: Section Map

Figure 3: General Site Diagram

Figure 4: Site Diagram with Elevation Contours

Figure 5: Simplified Conceptual Site Model

Figure 6: Geologic Cross Section

Figure 7: Upper Aquifer 2 – Average TCE Concentrations

Figure 8: Upper Aquifer 2 – Average DCE Concentrations

Figure 9: Lower Aquifer 2 – Average TCE Concentrations

Figure 10: Lower Aquifer 2 – Average DCE Concentrations

Figure 11: Upper Aquifer 3 – Average DCE and TCE Concentrations

Figure 12: Lower Aquifer 3 – Average DCE Concentrations

Table 1: Cleanup Levels for BDA Soils

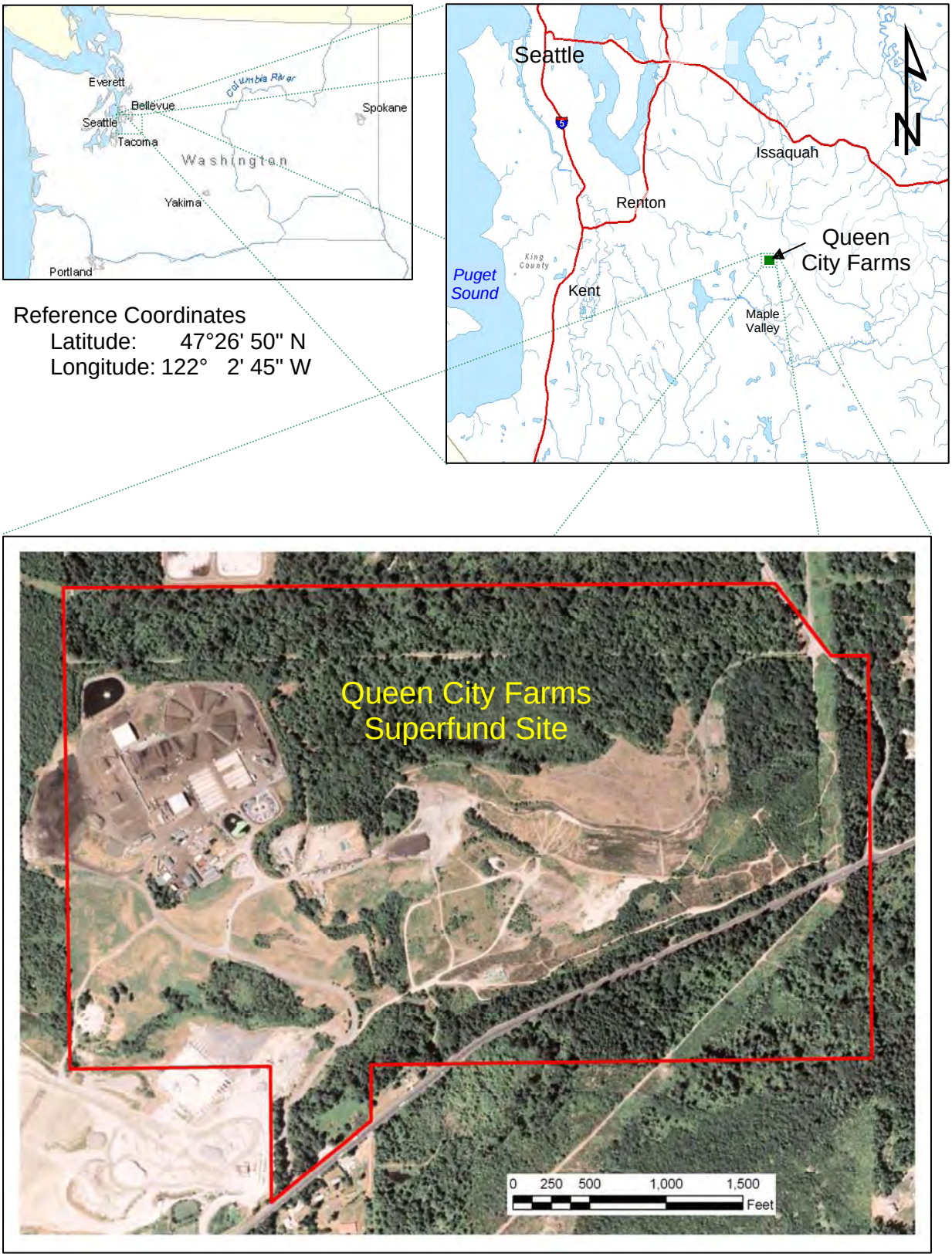
Table 2: Cleanup Levels for Aquifer 1

Table 3: Cleanup Levels for Aquifer 2

Table 7: 2007 Environmental Monitoring Schedule

Table 8: Environmental Monitoring Target Compound List

Figure 1: Site Location



Reference Coordinates
Latitude: 47°26' 50" N
Longitude: 122° 2' 45" W

Figure 2: Site Location - Section Map

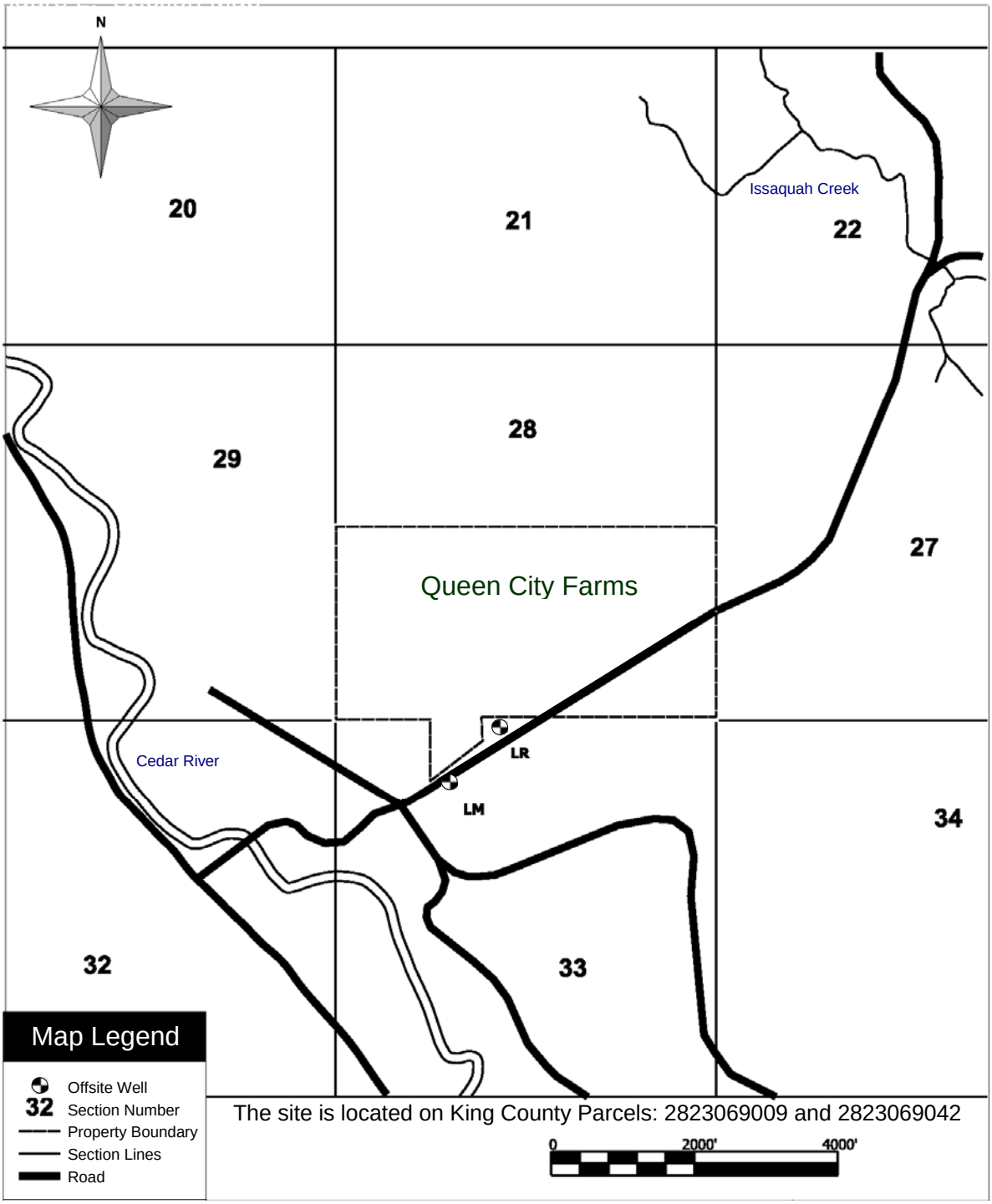


Figure 2 is adapted from *2006 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2007).

Figure 3: General Site Diagram

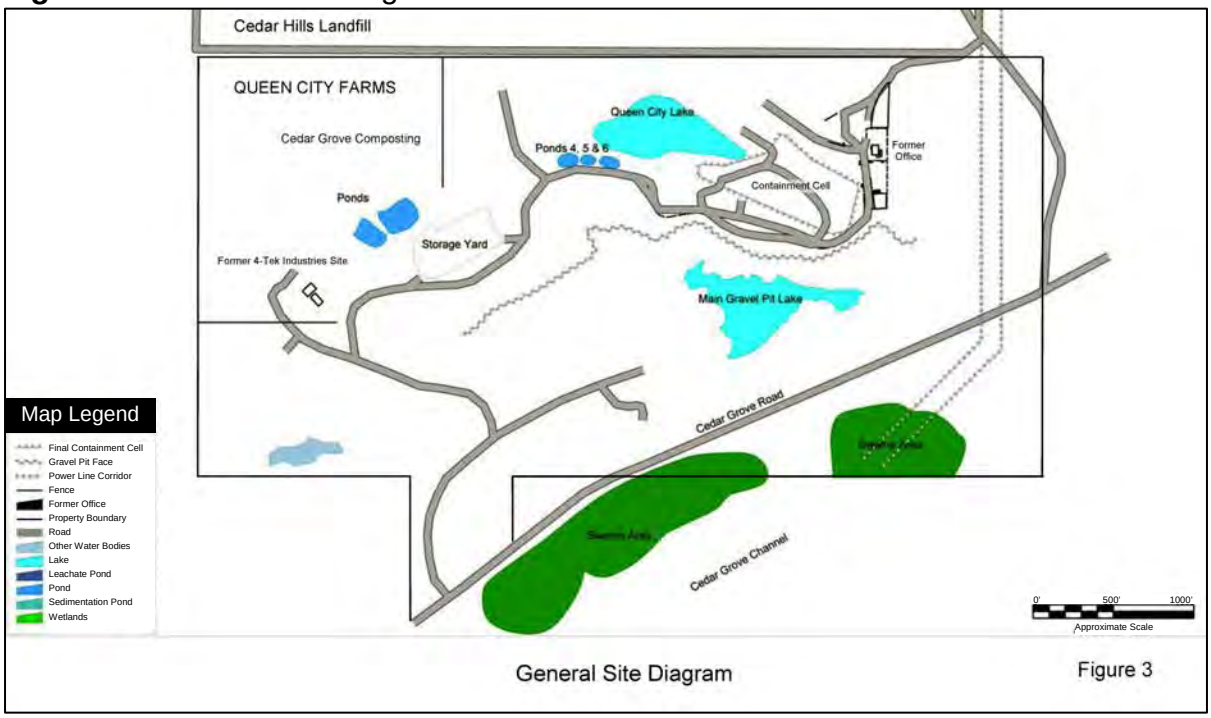


Figure 3 is adapted from *2007 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2008).

Figure 4: Site Diagram with elevation contours

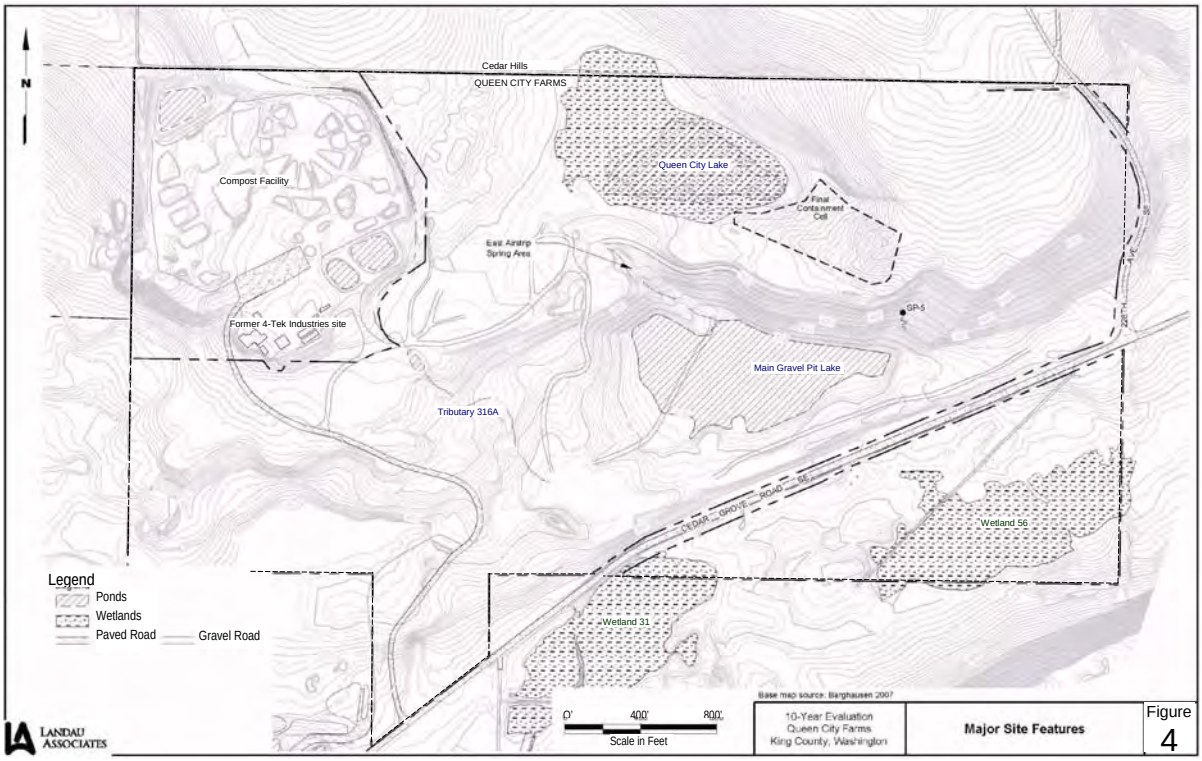


Figure 4 is adapted from *Evaluation of Remedial Action, 10-Year Review*, *Queen City Farms, King County, Washington,* Landau Associates (2007).

Figure 5: Simplified Conceptual Site Model

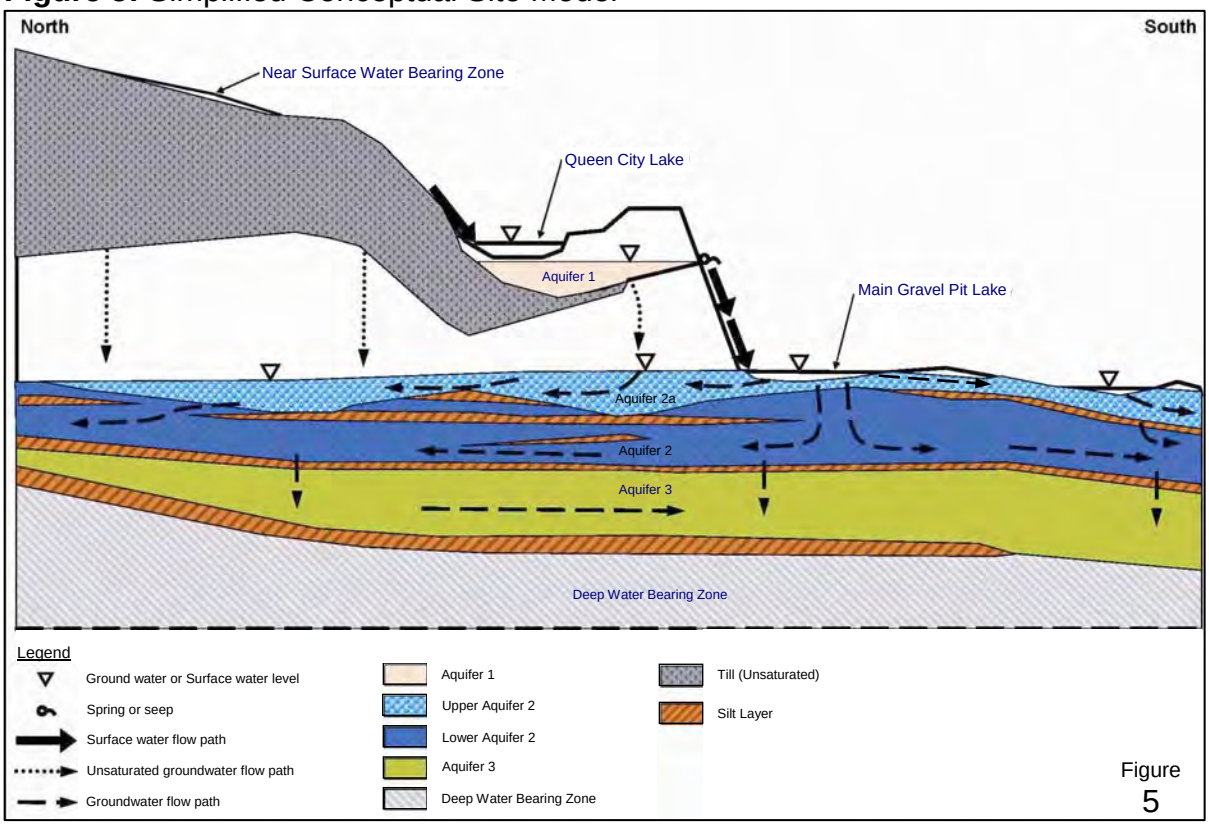
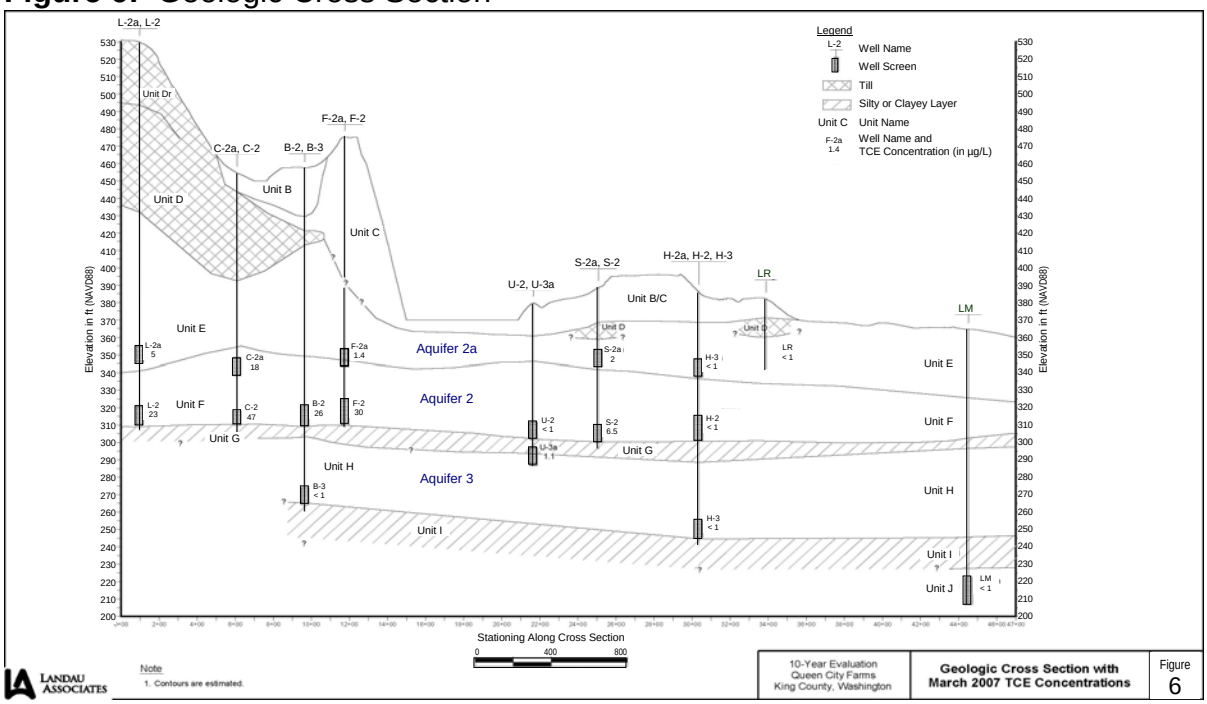
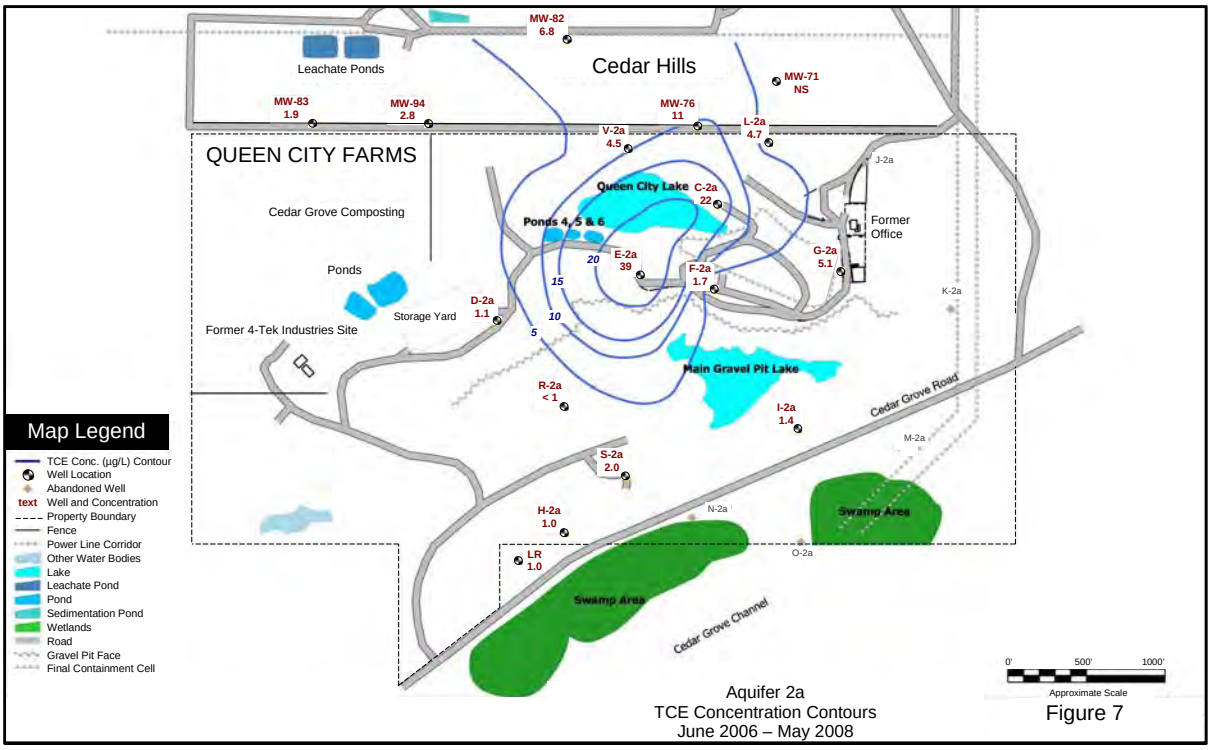


Figure 6: Geologic Cross Section



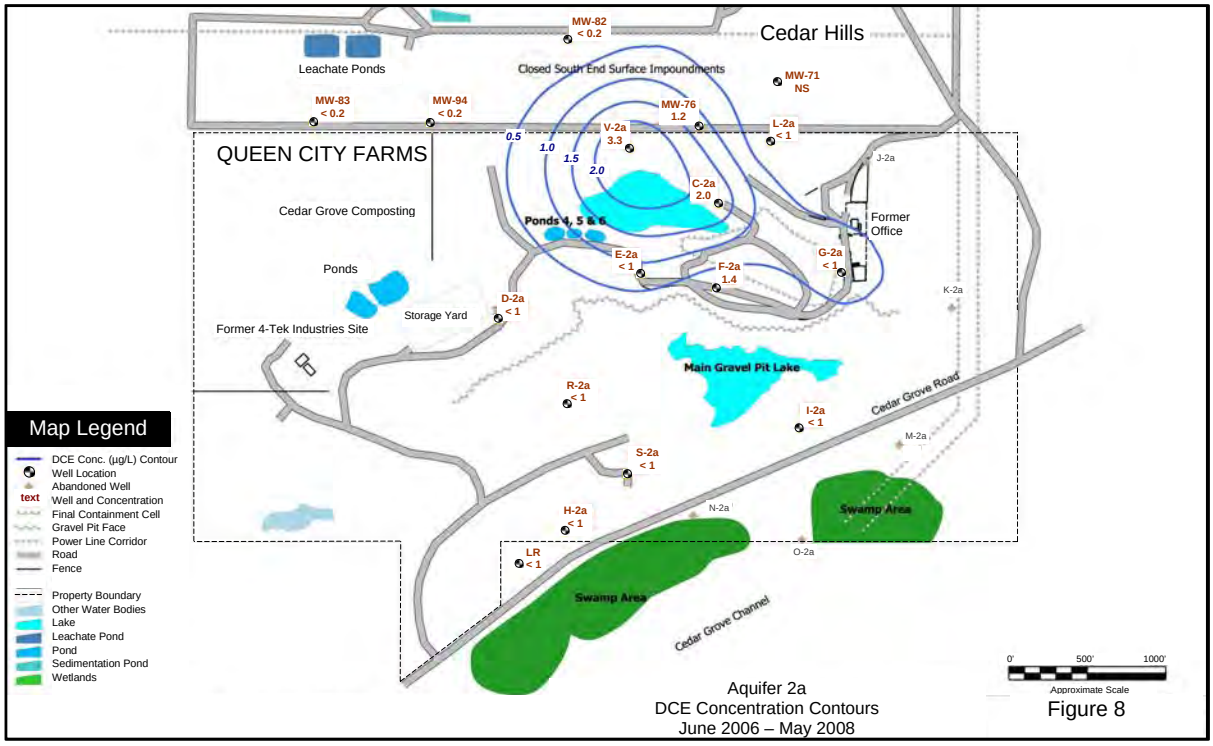
Figures 5 and 6 are originally from *Evaluation of Remedial Action, 10-Year Review*, *Queen City Farms, King County, Washington,* Landau Associates (2007).

Figure 7: Upper Aquifer 2 – Average TCE Concentrations (July 2007- June 2008)



Aquifer 2a
TCE Concentration Contours
June 2006 – May 2008
Figure 7

Figure 8: Upper Aquifer 2 – Average DCE Concentrations (July 2007- June 2008)



Aquifer 2a
DCE Concentration Contours
June 2006 – May 2008
Figure 8

Figures 7 and 8 are adapted from *2007 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2008). Data points are for average concentrations from 6/2006 through 5/2008, concentration contours represent August 2007.

Figure 9: Lower Aquifer 2 – Average TCE Concentrations (July 2007- June 2008)

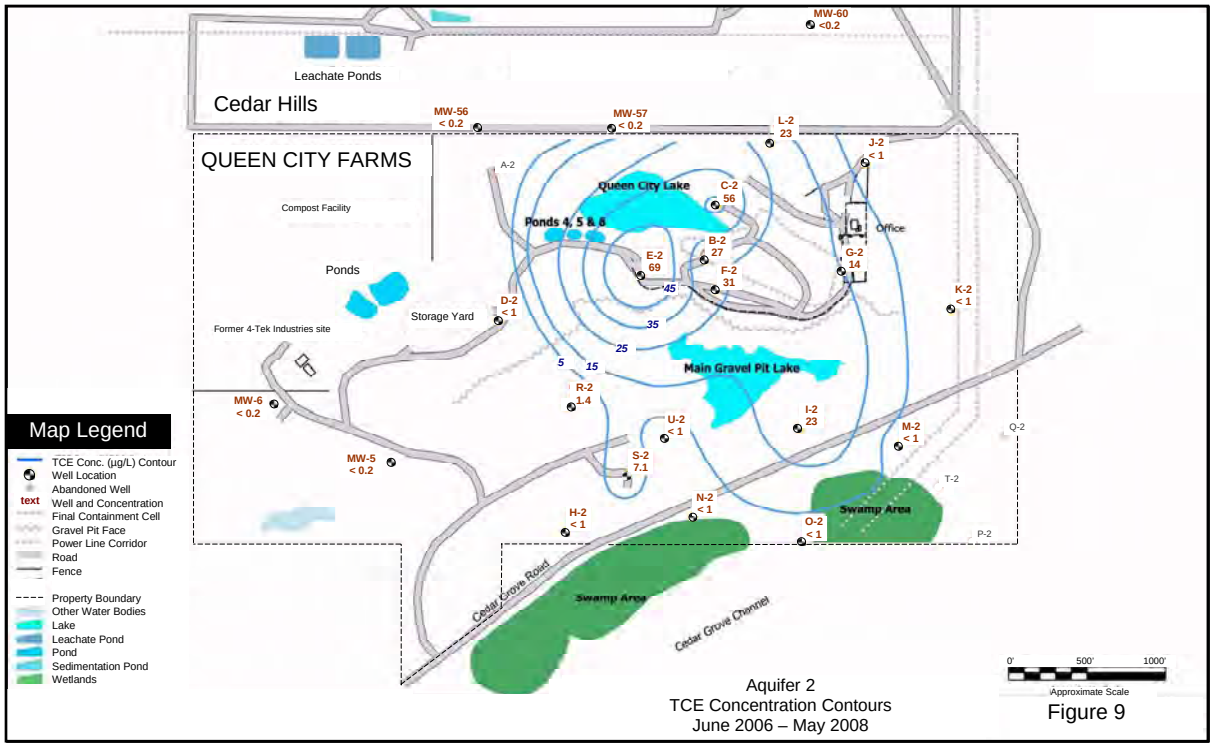
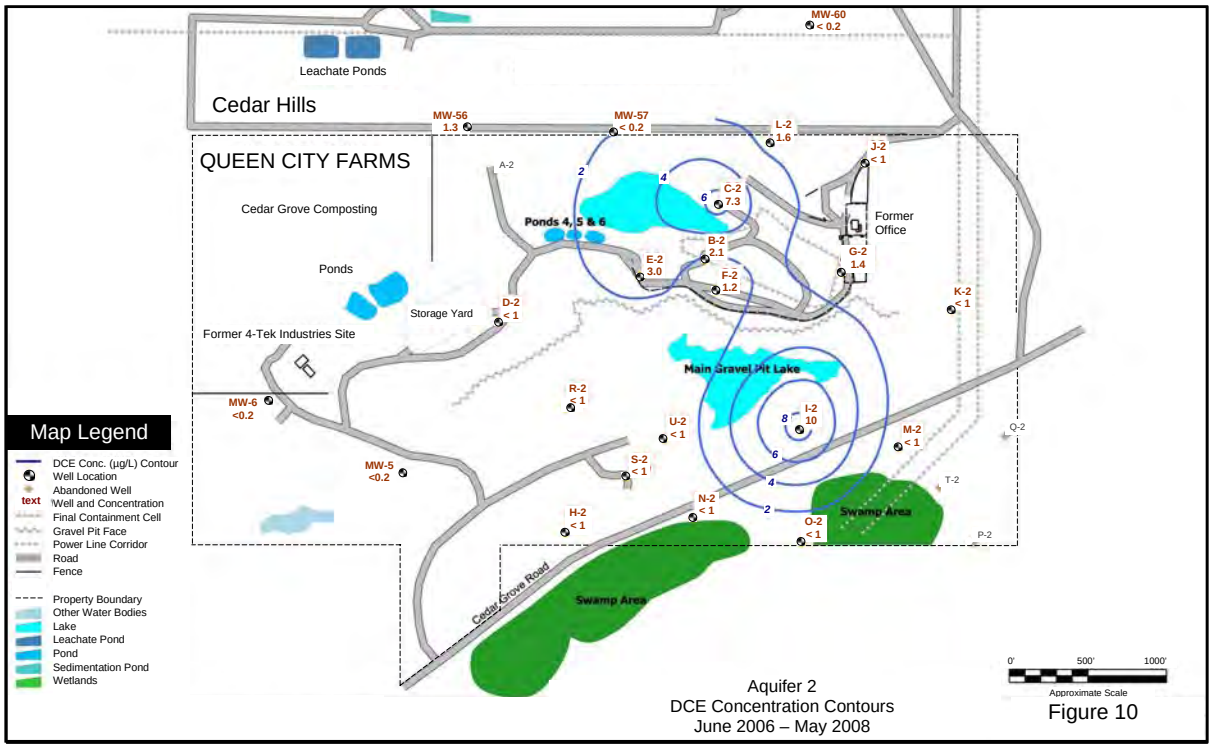
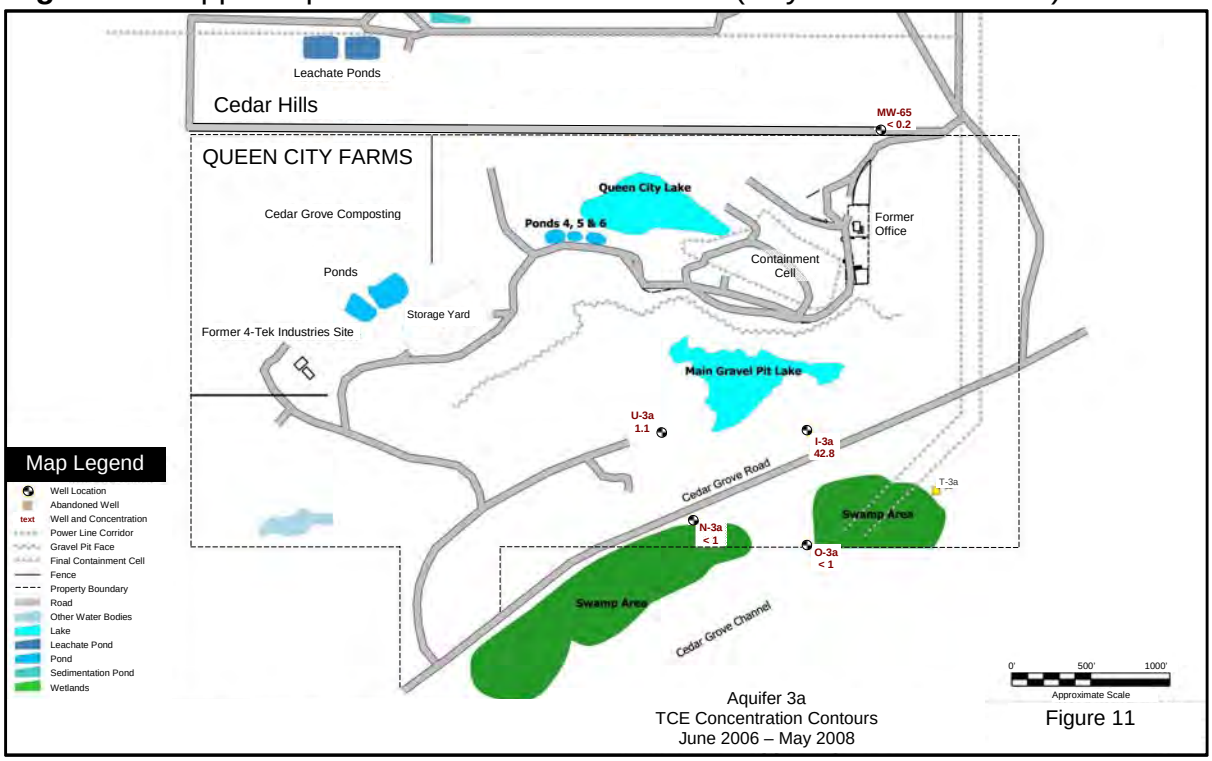


Figure 10: Lower Aquifer 2 – Average DCE Concentrations (July 2007- June 2008)



Figures 9 and 10 are adapted from *2007 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2008). Data points are for average concentrations from 6/2006 through 5/2008, concentration contours represent August 2007.

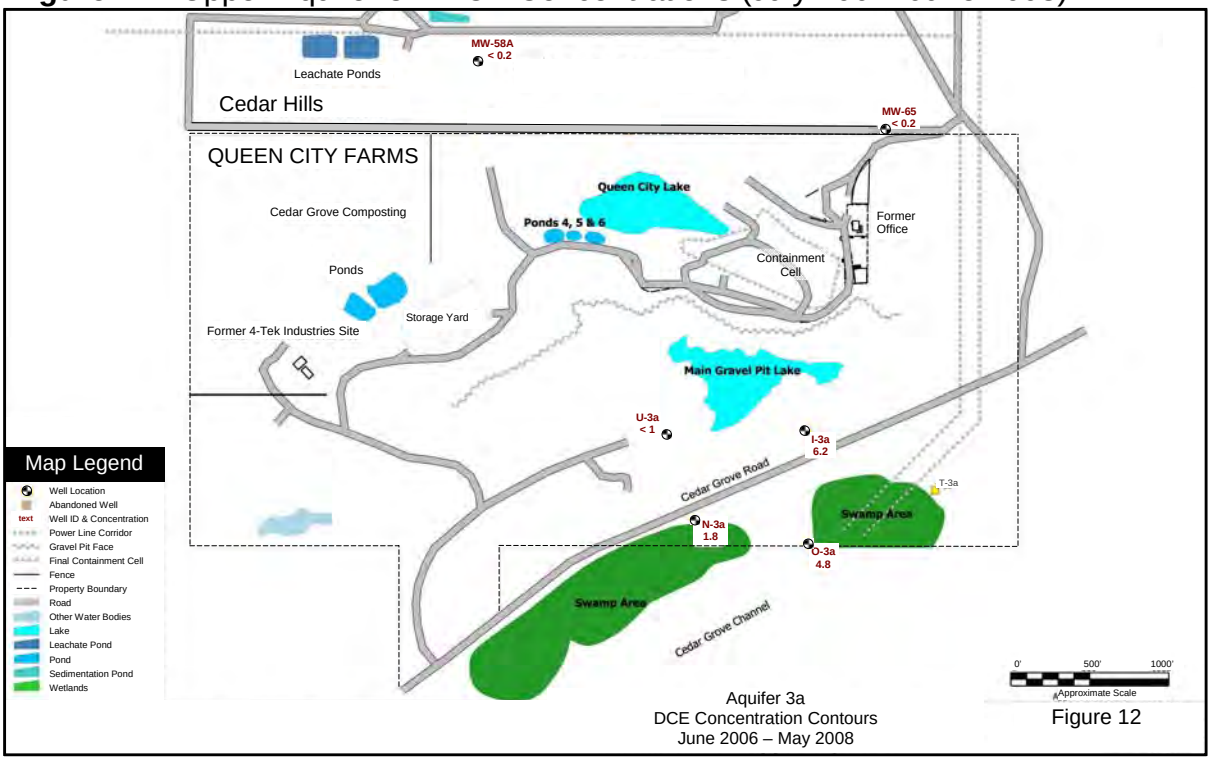
Figure 11: Upper Aquifer 3 – TCE Concentrations (July 2007- June 2008)



Aquifer 3a
TCE Concentration Contours
June 2006 – May 2008

Figure 11

Figure 12: Upper Aquifer 3 – DCE Concentrations (July 2007- June 2008)

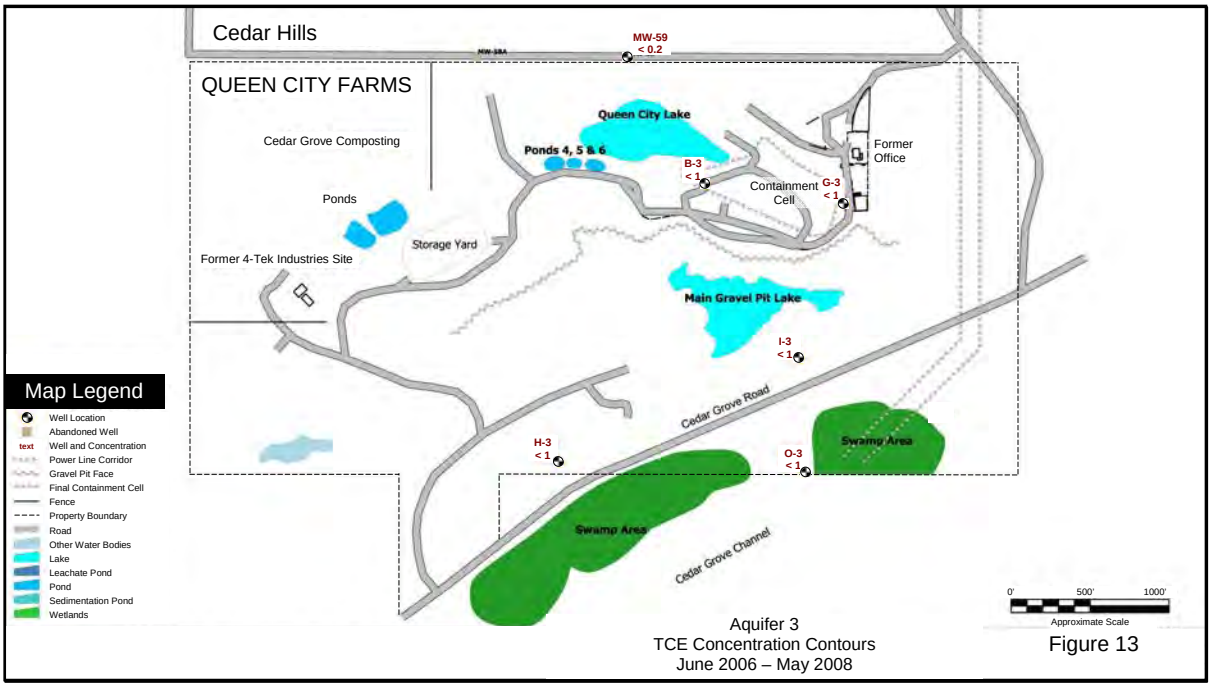


Aquifer 3a
DCE Concentration Contours
June 2006 – May 2008

Figure 12

Figures 11 and 12 are adapted from *2007 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2008).

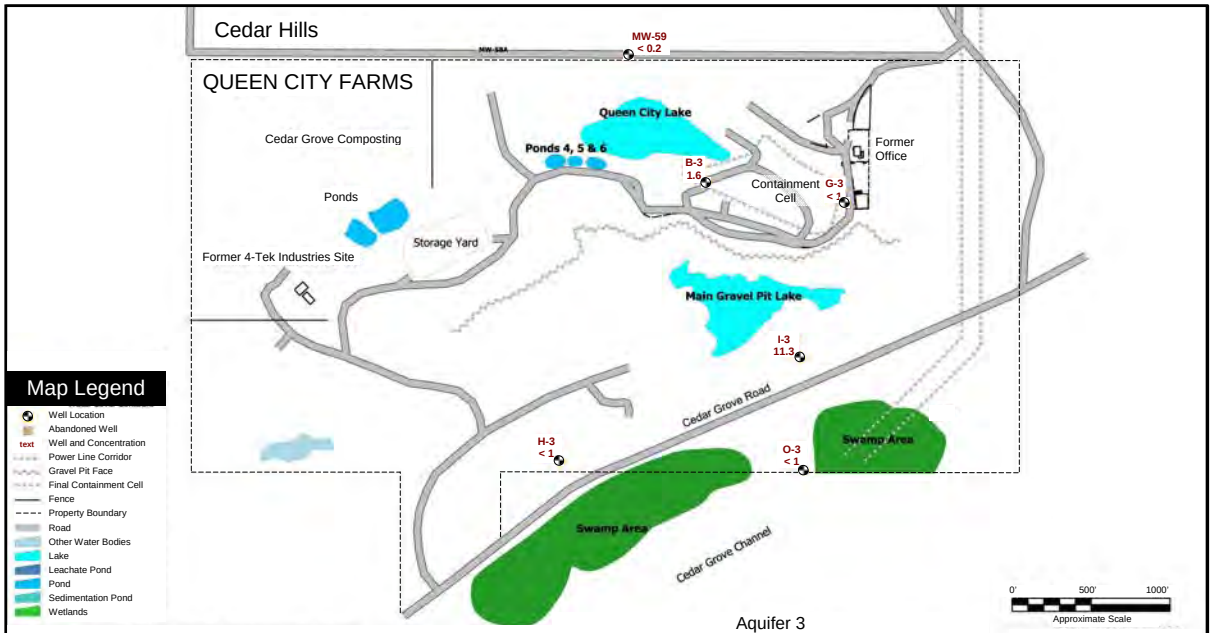
Figure 13: Lower Aquifer 3 – TCE Concentrations (July 2007- June 2008)



Aquifer 3
TCE Concentration Contours
June 2006 – May 2008

Figure 13

Figure 14: Lower Aquifer 3 – DCE Concentrations (July 2007- June 2008)



Aquifer 3
DCE Concentration Contours
June 2006 – May 2008

Figure 14

Figures 13 and 14 are adapted from *2006 Annual Monitoring Data Report, Queen City Farms,* EcoChem (2007).

Table 1: Cleanup Levels for BDA Soils

Hazardous Substance	Concentration (mg/kg)
Arsenic	20
Cadmium	40
Chromium	400
Lead	250
PCBs (total)	1.0
PAHs (carcinogenic)	1.0

Table 2: Cleanup Levels for Aquifer 1

Hazardous Substance	Concentration (µg/l)	Risk Level
Chromium (total)	80	HI = 1.0 (non-cancer)
PCBs (total)	0.01	1×10^{-6} (cancer)
Carcinogenic PAHs	0.01	1×10^{-6}
Tetrachloroethene (PCE, PERC)	1.0	1×10^{-6} (cancer)
1,1,1-Trichloroethene (TCE)	5.0	1×10^{-6} (cancer)
cis-1,2-Dichloroethene (*cis*-DCE)	70	HI = 0.2 (non-cancer)
trans-1,2-Dichloroethene (*trans*-DCE)	100	HI = 0.1 (non-cancer)
Chloroethene (i.e. Vinyl Chloride)	0.02	1×10^{-6} (cancer)

Table 3: Cleanup Level for Aquifer 2

Hazardous Substance	Concentration (µg/l)	Risk Level
Tetrachloroethene (PCE, PERC)	1.0	1×10^{-6} (cancer)
1,1,1-Trichloroethene (TCE)	5.0	2×10^{-6} (cancer)
cis-1,2-Dichloroethene (*cis*-DCE)	70	HI = 0.2 (non-cancer)
trans-1,2-Dichloroethene (*trans*-DCE)	100	HI = 0.1 (non-cancer)
Chloroethene (i.e. Vinyl Chloride)	0.02	1×10^{-6} (cancer)

Table 7: 2008 Environmental Monitoring Schedule

Analyte	Frequency	Aquifer 1	1a	2a	2	3a	3
VOCs	Semiannual			C, D, E, G, H, I, L, R, S, V, LR	B, C, E, F, G, I, L, M, S	I	I, LM
VOCs	Annual	E		F	D, H, J, K, N, O, R, U	H, N, O, U	B, G, O
Not Scheduled							D
Abandoned (2001)		B, ~~Z~~	E	J, K, M, N, O	~~A~~, ~~P~~, ~~Q~~, ~~T~~	~~T~~	

Perimeter wells: ~~A~~, H, J, K, L, N, O, ~~P~~, ~~T~~, V
Interior Wells: B, C, D, E, F, G, I, M, R, S, U, ~~Z~~
Offsite Residential Wells: LM, LR

Note 1: Wells shown in a rust font indicate that one or more wells in that well cluster have been abandoned. Wells shown in a ~~rust strikethrough font~~ indicate that all of the wells in that well cluster have been abandoned.

Note 2: King County has a network of monitoring wells on the Cedar Hills Regional Landfill. Wells MW-56, MW-57, MW-58A, MW-59, MW-65, MW-83, and MW-94 are located Queen City Farm's northern border and MW-71 and MW-82 are slightly north of that border. King County samples most of these wells quarterly, and shares this data with EPA and with the responsible parties for the Queen City Farms site. In 2008, the responsible parties resumed sharing their monitoring data with King County.

Table 8: Environmental Monitoring Target Compound List

Volatile Organic Compounds

Tetrachloroethene
Trichloroethene
Dichloroethene
Chloroethene (vinyl chloride)

Tetrachloroethane
Trichloroethane
Dichloroethane
Chloroethane

Dichloropropene
Trichloropropane
Dichloropropane
Dibromochloropropane

Dibromoethane
Bromoethane

Tetrachloromethane
Trichloromethane
Tribromomethane
Trichlorofluoromethane
Dichlorodifluoromethane
Dibromochloromethane

Bromodichloromethane
Bromochloromethane
Dibromomethane
Chloromethane

Trichlorobenzene
Dichlorobenzene
Chlorobenzene
Bromobenzene
Styrene
Trimethylbenzene
Butylbenzene
Isopropylbenzene
Propylbenzene
Ethylbenzene
Chlorotoluene
Isopropyltoluene
Toluene
Benzene
o-Xylene
m,p-Xylene

Hexachlorobutadiene
Naphthalene

Appendix 2

A1: Community Notification

A2: Site Inspection Report

A3: Site Photographs

A1: **Community Notification**

The following notice was placed in the *Voice of the Valley* on April 29, 2008.

EPA to Review Cleanup at Queen City Farms Superfund Site
Your Comments Invited through June 30, 2008

The U.S. Environmental Protection Agency (EPA) is beginning the third Five-Year Review of the Queen City Farms Superfund Site on Cedar Grove Road in Maple Valley, Washington. EPA reviews cleanups at Superfund sites every five years, to make sure the cleanup continues to protect people and the environment.

The 324 acre Queen City Farms site includes two separate areas of contamination; the former waste pond and buried drum area in the eastern part of the property, and the former processing area in the center of the property. The processing area had relatively less contamination and the surface soils were removed to prevent contact with contaminated soil. Groundwater monitoring at this area of the site is conducted every five years.

The main area of contamination was the result of buried drums and unlined ponds which were used to dispose of hazardous waste, including solvents, PCBs, and heavy metals. The start of the cleanup of this site involved an extensive removal action to properly dispose of the contaminated soil and sludge from the waste ponds. A barrier wall and a protective cap were used to contain the groundwater and soil beneath the former pond area. This area is now known as the Containment Area and contamination here is monitored regularly.

EPA welcomes your participation in this review. If you have any information that may help with the review, or concerns you would like to share about the site, call Chris Bellovary, EPA Project Manager by June 30, 2008 at (800) 424-4372, extension 2723, or e-mail *bellovary.chris@epa.gov*

To learn more, visit ***http://www.epa.gov/r10earth*** and click on the A-to-Z Subject Index, then Q, then Queen City Farms.

TTY users may call the Federal Relay Service at (800) 877-8339 and give the operator Chris Bellovary's phone number.

A2: **Site Inspection Checklist**

I. SITE INFORMATION			
Site name:	Queen City Farms	**Dates of inspection:**	August 17, 2007 September 2, 2008
Location and Region:	Maple Valley, WA; R10	**EPA ID:**	WAD0980511745
Agency leading the five-year review: EPA Region 10 Office of Environmental Cleanup 1200 Sixth Ave, Suite 900 Seattle, WA 98101		**Weather** 2007 Inspection: 2008 Inspection:	 70°F, wind ~7mph partly cloudy 65-70°F, wind ~ 5 mph clear skies, sunny

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Other_____
- ☒ Monitored natural attenuation
- ☒ Groundwater containment
- ☒ Vertical barrier walls
- ☐ Surface water collection and treatment

Attachments: ☐ Inspection team roster attached ☒ Site map included (within this review)
☒ Inspection team roster on bottom of page

II. INTERVIEWS (Check all that apply)

1. **O&M site manager:** Wayne Schlappi (Name) Project Manager (Title) Aug. 17, 2007 & Sept. 2, 2008 (Dates)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. 425-965-4177
   Problems, suggestions; ☐ Report attached_____

2. **O&M staff:** Ken Brown (Name) Senior Technician 3 (Title) August 17, 2007 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached_____

3. **Site Consultant:** Eric Weber (Name) Principal Hydrogeologist (Title) September 2, 2008 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. 253-926-2493
   Problems, suggestions; ☐ Report attached_____

Inspection Team 2007:

Chris Bellovary	EPA Region 10, Remedial Project Manager	206-553-2723

Inspection Team 2008:

Chris Bellovary	EPA Region 10, Remedial Project Manager	206-553-2723
Marica Knadle	EPA Region 10, Hydrogeologist	206-553-1641

4. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency	King County, Dept. of Natural Resources and Parks, Solid Waste Division			
Contact	Victor Orekeke	Managing Engineer	Aug. 11, 2008	(206) 296-4422
	Name	Title	Date	Phone no.

This discussion revolved around the impacts that the Queen City Farms Superfund site has on the Cedar Hills Regional Landfill, and vice versa. The TCE plume extends under the southern border of Cedar Hills, and differences in water quality measurements and water quality standards between the two sites adds difficulty to the operations of the Cedar Hills Regional Landfill.

Agency	Washington State Dept. of Ecology, NW Regional Office			
Contact	Krystyna Kowalik	Env. Hydrogeologist	Aug. 11, 2008	(425) 649-7051
	Name	Title	Date	Phone no.

Ms. Kowalik was at the same meeting as Mr. Orekeke. Although the Department of Ecology does not have any toxics cleanup staff members assigned to the Queen City Farms site, Ms. Kowalik's projects include the Cedar Hills Regional Landfill, which is impacted by plume migration from the Queen City Farms site.

Agency	Washington State Dept. of Health, Office of Drinking Water			
Contact	Steve Hulsman	Program Manager	Aug. 26, 2008	(253) 395-6777
	Name	Title	Date	Phone no.

This discussion revolved around public drinking water systems and private drinking water wells near the Queen City Farms Superfund site, and Mr. Hulsman's knowledge of the history for this site. Mr. Hulsman put me in contact with Mr. Navarro (below).

Agency	King County, Department of Public Health, Drinking Water Program			
Contact	Ernesto Navarro	Env. Health Specialist	Aug. 27, 2008	206-296-9772
	Name	Title	Date	Phone no.

This discussion revolved around the public drinking water system on the Queen City Farms Superfund site.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

No onsite office remains at this site. The records for the Queen City Farms Superfund site are kept at the Boeing office on the Western Processing Superfund site, which is approximately 9.5 miles to the west-southwest. A follow-up inspection will be scheduled to verify the records for Queen City Farms.

1.	**O&M Documents**			
	☐ O&M manual	☐ Readily available	☐ Up to date	☐ N/A
	☐ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
	☐ Maintenance logs	☐ Readily available	☐ Up to date	☐ N/A
2.	**Site-Specific Health and Safety Plan**	☐ Readily available	☐ Up to date	☒ N/A
	☐ Contingency/emergency response plan	☐ Readily available	☐ Up to date	☐ N/A
3.	**O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☐ N/A
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
	☐ Other permits_____	☐ Readily available	☐ Up to date	☒ N/A
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
7.	**Groundwater Monitoring Records**	☐ Readily available	☐ Up to date	☐ N/A
	No onsite office remains on site. Records kept at Boeing office			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
9.	**Discharge Compliance Records**	☐ Readily available	☐ Up to date	☒ N/A
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
	Access to the Containment Area of the site is restricted via a padlocked fence, and the keys are kept by the responsible parties. Access is limited to maintenance, monitoring, and inspections.			

	IV. O&M COSTS	
1.	**O&M Organization**	
	☐ State in-house	☐ Contractor for State
	☒ PRP in-house	☒ Contractor for PRP
	☐ Federal Facility in-house	☐ Contractor for Federal Facility
	☐ Other_____	
2.	**O&M Cost Records**	
	O&M Costs are managed by the responsible parties, and currently average around $100,000 a year, and are generally limited to maintenance, monitoring, and preparation of the annual monitoring report. Monitoring of the wells associated with the main Containment Area occur twice a year while monitoring of the wells associated with the 4-Tek site occurs once every five years.	
3.	**Unanticipated or Unusually High O&M Costs During Review Period**	
	Costs for 2008 were slightly above average, as the responsible party developed a 10 Year Review for the site, and EPA developed this 5 Year Review for the site.	

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing** ☒ Damaged (2007) ☐ Location shown on site map ☒ Gates secured

2007: One hole was located in the fence. Project Manager for the PRPs stated that they would repair that right away. This is an occasional but ongoing problem, particularly during hunting season, and there are even two duck hunting blinds that were set up on the property.

2008: No holes in the fence were found. No hunting blinds were found on the property. The project manager for the responsible parties stated that he spoke with various people who may have set up the original blinds, and no new hunting blinds have been found since then.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Warning signs are located on the roadside gate to the fence as well as along the fence line. During the inspection, some fallen signs were found (2 in 2008); the inspectors also identified that more recent signs had been erected. It appears that the warning signs are being maintained.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring	Self-Reporting
Frequency (main Containment Area)	Twice / year
Responsible party	The Boeing Company
Contact	Wayne Schlappi, 425-965-4177
Frequency (4-Tek Industries area)	Once / five years
Responsible party	Queen City Farms, Inc.
Contact	Steve Banchero, 425-832-3000

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in deed or decision documents have been met	☐ Yes	☒ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A

In preparation for this Five Year Review, EPA identified that the previous restrictive covenants were implemented in a way that made them unenforceable. EPA brought this to the attention of the responsible parties, who agreed to correct the deficiency.

At this point, EPA has not received confirmation that the deficiency has been corrected, so this portion of the remedy is incomplete.

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Restrictive covenants still need to be properly implemented.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident

Multiple indications of trespassing were identified within the fenced in Containment Area during the 2007 inspection. No signs of vandalism or trespassing were found during the 2008 inspection.

2. **Land use changes on site** ☐ N/A

Main Gravel Pit Lake is highly seasonal, and there was no water at all in the lake during the 2008 inspection. Over time, this lake has been shrinking so that it no longer reaches the width or depth that it used to achieve during the rainy season.

Further land use changes will be occurring in that area of the site, as First South Properties plans to fill and restore the area, in accordance with Washington State Department of Natural Resources reclamation permit number 70-010880. The change in topography will alter the current surface and subsurface drainage patterns.

3. **Land use changes off site** ☐ N/A

The number of residential household around the site is slowly increasing over time.
King County's Cedar Hills Regional Landfill has changed its water management techniques over time, which has had some impact on both surface and subsurface drainage patterns.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

The roads have deteriorated, but they still provide adequate access to the site.

B. Other Site Conditions

Remarks

_____
_____
_____
_____
_____
_____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent_____ Depth_____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths_____ Widths_____ Depths_____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Areal extent_____ Depth_____

5. **Vegetative Cover** ☒ Cover properly established ☒ No signs of stress
☒ Grass ☐ Trees/Shrubs (indicate size and locations on a diagram)

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
Areal extent_____ Height_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____
_____

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive ☒ N/A

2. **Gas Monitoring Probes** ☒ N/A

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

4. **Leachate Extraction Wells** ☒ N/A

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
Remarks_____
_____

2.	**Outlet Rock Inspected**	☐ Functioning	☐ N/A
	Remarks_____		

G.	**Detention/Sedimentation Ponds**	☐ Applicable	☒ N/A
1.	**Siltation** Areal extent_____ Depth_____ ☒ N/A ☐ Siltation not evident Remarks_____		
2.	**Erosion** Areal extent_____ Depth_____ ☒ Erosion not evident Remarks_____		
3.	**Outlet Works**	☒ Functioning	☐ N/A
	Remarks_____		
4.	**Dam**	☒ Functioning	☐ N/A
	Remarks_____		

H.	**Retaining Walls**	☐ Applicable	☒ N/A
I.	**Perimeter Ditches/Off-Site Discharge**	☒ Applicable	☐ N/A
1.	**Siltation**	☐ Location shown on site map Areal extent_____	☒ Siltation not evident Depth_____
	A minor amount of detritus was observed in the drainage channels after they leave the cap. No issues were identified for the drainage channels on the cap.		
2.	**Vegetative Growth**	☐ Location shown on site map Areal extent_____	☒ Vegetation does not impede flow Type: ground cover vegetation
	No problems were vegetation intrusion into the drainage channels were identified on the cap. Vegetation is beginning to grow over and into the drainage channel after it leaves the cap. The vegetation does not currently impede flow, but it is getting to the point where that may soon change. This was pointed out to Boeing's project manager, and he stated that would be take care of.		
3.	**Erosion**	☐ Location shown on site map Areal extent_____	☒ Erosion not evident Depth_____
4.	**Discharge Structure**	☐ Functioning	☐ N/A
	Remarks_____		

	VIII. VERTICAL BARRIER WALLS	☒ Applicable	☐ N/A
1.	**Settlement**	☐ Location shown on site map	☒ Settlement not evident

2. **Performance Monitoring** Type of monitoring_____
☐ Performance not monitored ☐ Evidence of breaching
Frequency_____
Head differential_____
Remarks_____

K. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A

The monitoring wells over by the 4-Tek site are in worse condition than the monitoring wells that are associated with the waste lagoons and buried drum area.

Access to MW-1 needs to be improved (§ A.4, photo 1).

MW-3 was not properly abandoned (§ A.4, photo 2).

L. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining.

Some areas of the site have contaminant concentrations that are increasing, but the total mass of groundwater contaminants is declining over time.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A3: Site Photographs

Photo 1: Monitoring Well MW-1 (4-Tek) is currently obstructed by vegetation. The property owner will be informed of the need to provide adequate access.

Photos 2-3: Former Monitoring Well MW-3 was located near the center of this shop, by the former 4-Tek facility. The property owner will be informed of the need to close the well in accordance with Washington State regulations.

Photo 4: The drainage channel from the cap over the Containment Area.

The flowpath for the drainage is currently unobstructed, but the vegetation will need to be trimmed back before obstruction begins.

The discharge for this drainage channel is located by the figures in the background, and is in the direction of Queen City Lake.

Photo 5: Monitoring Well B-2

Photo 6: Monitoring Well R-2a, facing north toward monitoring well cluster D.

Photo 6: Monitoring Well S-2, facing north-northeast toward the Containment Area, which is located on the rise that can be seen in the background of this photograph.

Photo 7: Monitoring wells U-2 [left] and U-3a [right] facing north-northeast toward the Containment Area, which is located on the rise that can be seen in the background of this photograph.

Photo 8: A view inside the well cap of monitoring well H-2, and was typical of all of the monitoring wells we opened that were associated with the Containment Area.