Colbert Landfill Remediation Project Annual Report 2018

Progress Report for

July 2017 through April 2018

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1.0 Colbert Landfill Remediation Project Summary

The Colbert Landfill Superfund site is a closed, 40-acre, municipal solid waste landfill located approximately 15 miles north of Spokane, Washington, and about 2.5 miles north of Colbert, Washington. The landfill received waste from 1968 to 1986 when it became filled to capacity. Groundwater in the vicinity of the landfill was found to be contaminated with volatile organic compounds and in 1983, the landfill was place on the National Priorities List (NPL) by EPA. In 1989, a consent decree was executed to implement a site remedy. The site remedy includes:

- An available alternate water supply for residential wells impacted by groundwater contamination originating from the landfill.
- Institutional Controls
- Construction and operation of a pump and treat system to capture and prevent further spread of groundwater contaminants.
- Landfill closure according to the State of Washington regulations Minimal Functional Standards (WAC173-304).
- Monitoring of contaminants to protect human health and the environment at the site.

Construction of a pump and treat (P&T) system was completed in 1994. The P&T system operated successfully for 20 years. In 2014, an EPA recommended shut-down test was initiated to determine if the facility was continuing to add any significant benefit to the clean-up.

The programs currently in place include a Shut-down Test (lower aquifer) for the pump and treat system; and upper aquifer compliance groundwater monitoring (includes 1-4,dioxane monitoring' and MFS monitoring of the upper aquifer); residential well monitoring (includes both upper and lower aquifers); supplemental sampling (includes both upper and lower aquifers); and landfill cover maintenance and monitoring. The groundwater monitoring programs and criteria are summarized below.

Current Monitoring Programs

Program	Aquifer	Parameters	Schedule
Shut-down Test	Lower	VOC's	Annual (Extraction wells Quarterly)
Upper Aquifer Compliance	Upper	VOC's	Annual (Extraction wells Quarterly)
1,4-Dioxane Sampling	Upper	1,4-Dioxane	Annual
MFS Monitoring	Upper	Cl/NH3/NO2/NH3/SO4/Fe/Mn/Zn/TOC/COD	Annual
Residential Monitoring	Lower/Upper	VOC's	Monthly/Quarterly/SemiAnnual/Annual/BiAnnual
Supplemental Sampling	Lower/ Upper	VOC's	Every five years

Program Criteria

PROGRAM	CRITERIA	TCA	DCE	DCA	TCE	PCE	MC	1,4-Dioxane		Units
CONSENT DECREE	Performance	200	7	4050	5	0.7	2.5			
	Evaluation	200	7	4050	5	0.7	2.5	7		
SHUT-DOWN TEST	Action Level	130	4.55	2632	3.25	0.5	1.63			ug/L
	Evaluation	200	7	4050	5	0.7	2.5			
RESIDENTIAL Monthly sampling initiated, evaluated in 12 months	Action Level	130	4.55	2632	3.25	0.5	1.63			
Exeedance requires alternative drinking w ater source be supplied	MCL	200	7	4050	5	0.7	2.5			
		Cl	**Fe**	**Mn**	**Zn**	**TOC**	**COD**	**SO4**	**NO3**	
MFS	(mg/L)	250	0.3	0.05	5	NA	NA	250	10	mg/L

1.1 Geology/Hydrogeology

The geology beneath the Site consists of six vertically stratified and laterally discontinuous geologic units derived from glacial and fluvial material, modified by erosional (and possibly landslide) processes, overlaid on granitic bedrock. There are two primary aquifers that include the saturated portion of the Upper Sand and Gravel Unit and the saturated portion of the Lower Sand and Gravel Unit, which are separated by a Lacustrine Unit that serves as an aquitard. The Latah Formation serves as an aquitard that underlies the Lower Sand and Gravel Aquifer at most locations. A basalt unit forms a secondary aquifer interbedded in the Latah Aquitard and is referred to as the Basalt Aquifer. The Granite Unit is an aquitard that underlies the Latah Formation and serves as the lower boundary to the regional flow system. For more information, please refer to the Phase I Engineering Report (Landau Associates 1991).

The Upper Sand and Gravel Unit aquifer (Upper Aquifer) is unconfined with a water table that lies approximately 90 ft below the ground surface. Groundwater flow in this aquifer is generally north to south, changing to the southeast approximately 1 mile south of the Site. The direction of flow appears to be influenced by the topography of the upper surface of the Lacustrine Aquitard (Landau Associates 1991).

The Lower Sand and Gravel Unit aquifer (Lower Aquifer) is confined to the west of the landfill and unconfined to the east of the landfill. To the west of the landfill, the Upper and Lower aquifers are separated by the Lacustrine unit, which causes the confined conditions in that area. Groundwater flow in the Lower Aquifer is predominantly toward the west with discharge to the Little Spokane River.

1.2 Shut-down Test-Lower Aquifer

A pump and treat system was successfully operated from 1994 through March 31, 2014 to prevent further spread of groundwater contamination emanating from the landfill. A shut-down test for the lower aquifer pump and treat system was deemed appropriate for the site after a Remedial System Evaluation (RSE) was performed as recommended in the 2009 Five Year Review (EPA). The RSE recommendation stated that with the extensive groundwater monitoring programs in place and with concentrations having decreased substantially after 20 years of operation, the current pump and treat system may not be adding significant benefit to the overall protectiveness of the remedy and that a shut-down test would help determine its efficacy. The shut-down test procedures are outlined in the *Final Work Plan, Groundwater Pump and Treat System Shut-down Test, Colbert Landfill CERCLA Site, Spokane County Utilities/ Landau Assoc. 2013*. See Section 2 of this report for more details. The upper aquifer monitoring wells are governed by the Consent Decree compliance, Post Closure (MFS), and 1,4-dioxane sampling programs and are not included in the Shut-down test work plan.

1.3 Upper Aquifer Monitoring

1.3.1 Compliance Monitoring (VOC's)

The compliance monitoring sampling program is outlined in the Consent Decree and performed according to the Colbert Landfill Operations and Maintenance manual *(Colbert Landfill Operations and Maintenance Manual, 1998*.). During implementation of the lower aquifer system Shut-down Test, the compliance monitoring will only apply to the upper aquifer. Per conditions set forth in the consent decree (Appendix B, page V-7), the south system extraction wells are not required to be in operation and have been on stand-by status since 2004, and therefore are included in the compliance monitoring program.

1.3.2 1, 4-Dioxane Sampling

During the 2005 (3rd) Five Year Site Review, EPA specified an additional constituent (1,4-Dioxane) for evaluation at the Colbert Landfill site. After extensive monitoring in both the upper and lower aquifers, it was determined that an ongoing monitoring program would apply to selected wells in the upper aquifer only. The selected upper aquifer well locations are sampled for 1,4-dioxane according to the *1,4-Dioxane Work Plan for the Colbert Landfill (December 2007)*.

1.3.3 Minimal Functional Standards Post Closure

The landfill was closed pursuant to requirements of the Minimal Functional Standards for Solid Waste Handling (MFS, WAC173-304). Lower aquifer locations, as outlined in the MFS Groundwater Monitoring Plan (Landau Assoc., 1996), require no additional monitoring after the 2 year monitoring period, which ended in January 1999. Monitoring for the upper aquifer continue according to the *Colbert Landfill Operations and Maintenance Manual, 1998*., and the *MFS Groundwater Monitoring Plan, 1996* .

1.4 Residential Well Monitoring

The Consent Decree specified that domestic wells within the vicinity of the landfill be monitored to protect human health. Domestic well locations and schedules for this program were selected by proximity to landfill contamination and are evaluated on a regular basis to accommodate any changes in groundwater contamination. This program includes well locations in both the upper and lower aquifers. Sampling for this program is done in accordance with the *Quality Assurance and Field Sampling Plan-Colbert Residential Well Sampling, 1991* and is governed by the Consent Decree.

1.5 Supplemental Sampling

Supplemental sampling occurs every five years and is intended to collect additional data from monitoring and residential wells not regularly sampled. Although there are no criteria for monitoring or reporting associated with supplemental sampling, data collected helps provide a more accurate snapshot of groundwater flow and contamination throughout the area.

1.6 Landfill Operations and Maintenance

In 1997, the landfill closure construction (cover system and components) was completed as part of the MFS requirements. The landfill gas collection and treatment system is monitored and maintained on a regular basis as outlined in the *Operations and Maintenance Manual for Colbert Landfill Closure, CH2MHill, May 1997*.

2.0 Shut-down Test

A shut-down test of the Colbert Landfill Groundwater Pump and Treat facility was initiated April 1, 2014 when all lower aquifer extraction wells were turned off and placed in standby mode. The shut-down test was deemed appropriate for the site after a Remedial System Evaluation (RSE) was performed as recommended in the 2009 Five Year Review (EPA). The shut-down test is performed according to the *Final Work Plan, Groundwater Pump and Treat System Shut-down Test, Colbert Landfill CERCLA Site, Spokane County Utilities/ Landau Assoc. 2013*.

2.1 Shut-down Testing Locations and Schedule

The lower aquifer wells selected as monitoring locations for the Colbert Landfill pump and treat system shut-down test include: the compliance monitoring well clusters (CD-41, CD-42, CD-43, CD-44, CD-45, and CD-48), monitoring well CD-49, and the lower aquifer extraction wells (CP-E1, CP-E2, CP-E3, CP-W1, CP-W2, and CP-W3). Locations are presented in Figure 2-1 . Collection of groundwater samples (contaminant sampling) from the shut-down locations, along with the collection of water level measurements, was performed as outlined in Table 2-1.

2.2 Shut-down Test Monitoring

The lower aquifer extraction wells, the compliance monitoring well clusters (CD-41, CD-42, CD-43, CD-44, CD-45, and CD-48) and monitoring well CD-49 were sampled according to the *Colbert Landfill Operations and Maintenance Manual, 1998.* Field parameters were taken and VOC samples were collected. There were no problems/issues associated with sampling during the reporting period.

2.2.1 Groundwater Elevations

Groundwater elevations for the reporting period are shown in Table 2-2 and in Figure 2-2. Estimated groundwater contours and flow are shown in Figure 2-3. Measurements were consistent and followed typical seasonal variation with levels slightly higher in the spring and slightly lower during the fall. Extraction well hydrographs show the increase in groundwater levels at the immediate vicinity of those wells in April 2014 when the system was shut down.

2.2.2 Field Parameters

Field parameters taken at the shut-down test locations are shown in Table 2-2. The highest conductivities were mostly seen in the east system extraction wells. Conductivity values in monitoring wells ranged from 261 to 1224 umhos/cm. Measurements of pH ranged from 6.97 to 7.98, with the lowest pH values generally found in the east system extraction wells.

2.2.3 Constituents of Concern (COC's)

Constituent of concern concentrations for Shut-down Test locations are presented Table 2-4. Concentrations versus time for Shut-down locations are presented in Figure 2-4. All detected concentrations found in the shut-down test compliance wells were well below any applicable criteria. Criteria are shown in Table 3-2. The COC's found in the shut-down program criteria dependent wells were TCA and DCE and at low concentrations. Although the concentrations found in the wells were far below any criteria, monitoring well CD-49 was kept on a quarterly sampling schedule to better evaluate the increasing TCA concentrations found in this well. See Figure 2-9 for the estimated TCA plume boundaries in the lower aquifer.

Lower aquifer extraction wells are not criteria dependent locations, and therefore actions during the shut-down test are not governed by COC concentrations in these wells. Analytical results from the extraction well sampling are shown in Table 2-5. Time versus concentration plots are found in Figure 2-5 through Figure 2-8. In general, concentrations of COC's have remained relatively stable in east system wells and have significantly increased in CP-W3. Concentrations in CP-W2, after noticeably decreasing three months after the wells were inactivated, have remained low.

2.3 Data Evaluation

Data indicates a slight shift in plume concentrations toward the western edge of landfill, evident by the emerging concentrations of TCA and DCE found in CD-49 and increasing concentrations (rebound) found in CP-W3. Supplemental sampling wells in the center of the landfill showed significant TCA concentrations and indicated a more connective plume than historically mapped. TCA data for supplemental sampling can be found in Table 5-3.

2.4 Program Changes or Modifications

No criteria were exceeded during the reporting period. As stated in the work plan, sampling at the lower aquifer compliance monitoring wells is now on an annual schedule and will be sampled again in April 2019. The exception to this is monitoring well CD-49. Quarterly sampling will continue at CD-49 to monitor the increasing trend in concentrations. Per the EPA's Optimization Report (2017) recommendations, the sampling frequency at well clusters CD-43 and CD-42 will be re-evaluated and a sampling plan to monitor the area around CD-49 will be submitted later in 2018.

Quarterly sampling will continue at the extraction wells, as running the wells periodically will assist with preventive maintenance and provide indicators for any possible changes in COC concentrations near the landfill boundaries.

2.5 Cost Savings

Typical electrical costs associated with operating the pump and treat system for the lower aquifer on a continual basis for a period of one year were approximately $59,000. From May 2017 through April 2018 the cost for electricity at the facility during the third year of the shut-down test was $10,873.

Increases in lab costs were minimal when compared to the savings in electricity.

Typical Annual Electrical Costs		**$60,000**
Electrical Costs for Fourth Year of Shut-down Test		-$10,873
Estimated Total Cost Savings		$49,127

Figure 2-1 Shut-down Test Locations

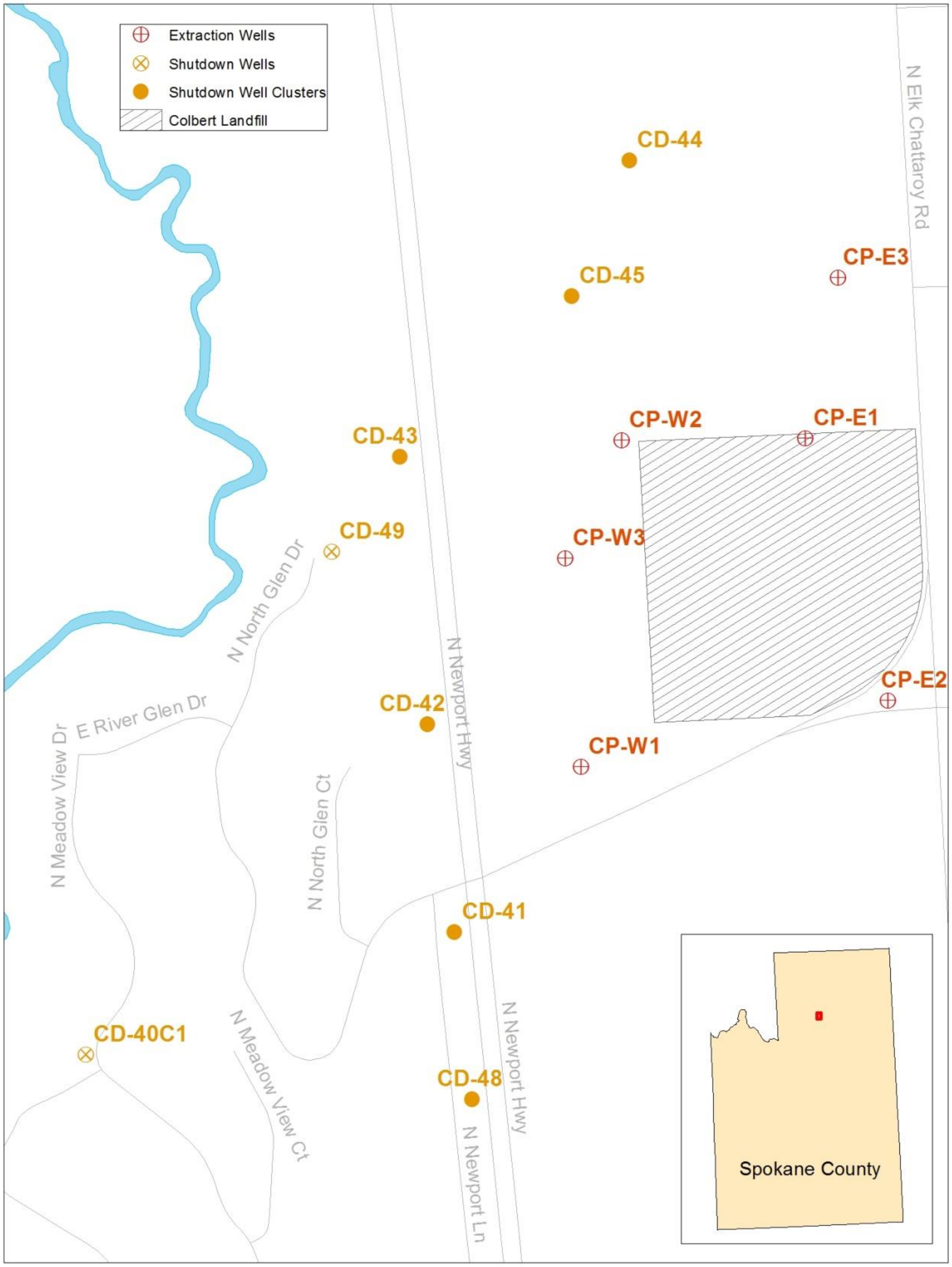
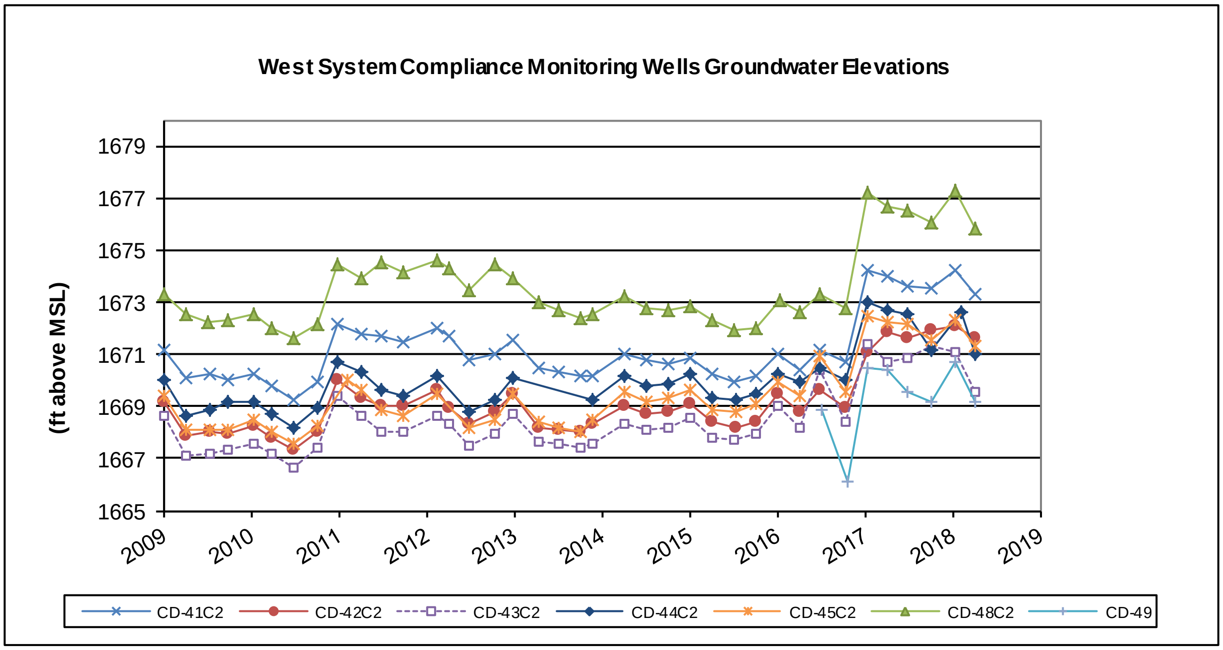


Table 2-1 Colbert Landfill Shut-down Test Sampling Schedule (May 2017 through April 2018)

System	Well ID	Monitoring Frequency		Shut-down Criteria Applies?
		Water Levels	Sampling	
West	CD-40C1 CD-41C2 CD-41C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-42C1 CD-42C2 CD-42C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-43C1 CD-43C2 CD-43C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-44C1 CD-44C2 CD-44C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-45C1 CD-45C2 CD-45C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-48C1 CD-48C2 CD-48C3	Quarterly Quarterly Quarterly	Annual Annual Annual	Yes
	CD-49	Quarterly	Quarterly	Yes
	CP-W1 CP-W2 CP-W3	Quarterly Quarterly Quarterly	Quarterly Quarterly Quarterly	No
East	CP-E1 CP-E2 CP-E3	Quarterly Quarterly Quarterly	Quarterly Quarterly Quarterly	No

Figure 2-2 Lower Aquifer Groundwater Elevations



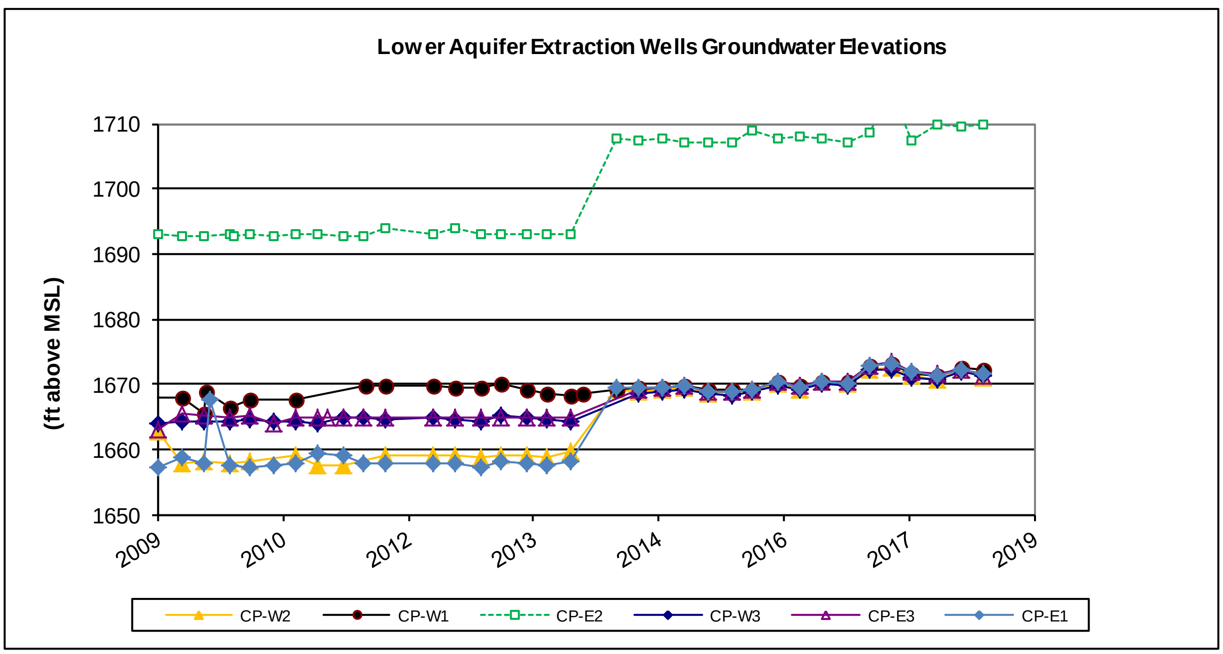


Figure 2-3 Lower Aquifer Groundwater Contours

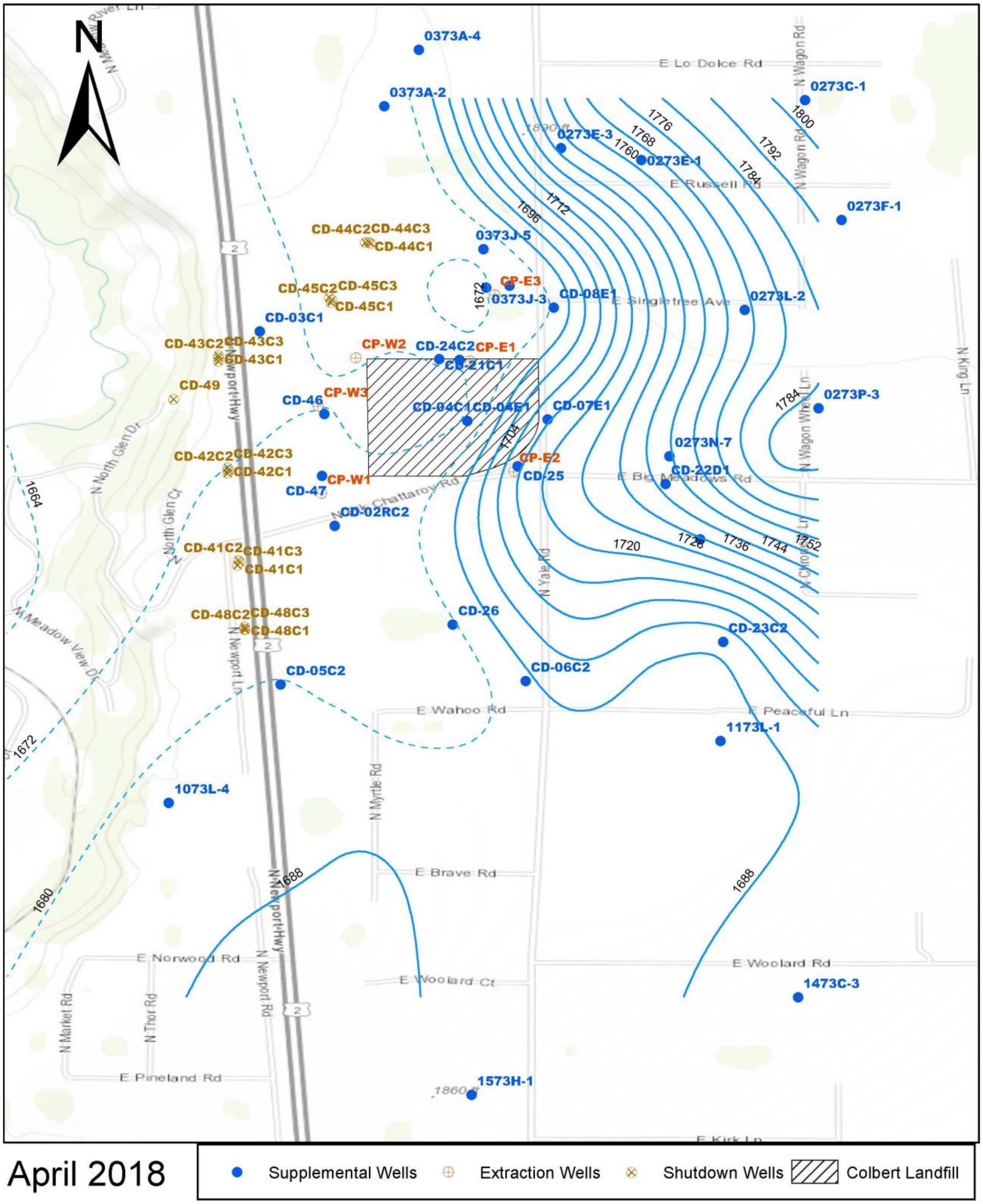


Table 2-2 Shut-down Test Location Field Parameters

StationID	SampleDate	WtrElev	FieldTemp	FieldPH	FieldConductivity	FieldTurbidity	Aquifer	Program
CD-40C1	4/18/18	1662.79	9.8	7.77	553	0.47	lower	SD
CD-41C1	4/17/18	1674.31	11.4	7.87	348	0.15	lower	SD
CD-41C1	4/18/18	1676.65	15.4	7.58	474	0.26	lower	SD
CD-41C2	4/17/18	1674.26	11.2	7.96	349	0.19	lower	SD
CD-41C3	4/17/18	1674.43	11.9	7.79	400	0.14	lower	SD
CD-42C1	4/17/18	1672.28	11.7	7.77	411	0.17	lower	SD
CD-42C2	4/17/18	1672.05	11.4	7.84	409	0.19	lower	SD
CD-42C3	4/17/18	1672.33	12.1	7.83	350	0.94	lower	SD
CD-43C1	4/17/18	1671	9.9	7.81	418	0.11	lower	SD
CD-43C2	4/17/18	1671.12	10.3	7.86	337	0.14	lower	SD
CD-43C3	4/17/18	1672.3	10.6	7.74	261	0.17	lower	SD
CD-44C2	5/9/18	1672.6	12.5	7.33	452	0.35	lower	SD
CD-44C3	5/9/18	1672.35	13.1	7.31	445	0.29	lower	SD
CD-45C1	4/18/18	1672.26	9.9	7.63	489	0.17	lower	SD
CD-45C2	4/18/18	1672.32	10.3	7.59	464	0.07	lower	SD
CD-45C3	4/18/18	1673.48	10.1	7.98	329	0.13	lower	SD
CD-48C1	4/17/18	1676.86	11.5	7.76	419	0.04	lower	SD
CD-48C2	4/17/18	1677.32	11.4	7.8	403	0.24	lower	SD
CD-48C3	4/17/18	1676.57	11.5	7.79	397	0.16	lower	SD
CD-49	7/12/17	1670.36	12.7	7.6	479	0.07	LOWER	SD
CD-49	10/4/17	1669.52	12.5	7.79	521	0.08	LOWER	SD
CD-49	1/10/18	1669.16	12.2	7.76	450	0.13	LOWER	SD
CD-49	4/17/18	1670.68	12.2	7.83	516	0.21	LOWER	SD
CP-E1	7/12/17	1673.11	12.8	7.01	1130	1.48	lower	SD
CP-E1	10/4/17	1671.91	12.6	6.97	1110	0.97	lower	SD
CP-E1	1/10/18	1671.24	11.9	7.05	1165	1.1	lower	SD
CP-E1	4/18/18	1672.32	11.7	7.06	1129	1.11	lower	SD
CP-E2	7/12/17	1714.98	14.6	6.98	1144	0.83	lower	SD
CP-E2	10/4/17	1707.28	13.9	7	1144	0.61	lower	SD
CP-E2	1/10/18	1709.75	14.1	7.07	1224	0.61	lower	SD
CP-E2	4/18/18	1709.42	12.5	7.11	1170	0.89	lower	SD
CP-E3	7/12/17	1673.27	12.3	7.14	808	1.77	lower	SD
CP-E3	10/4/17	1671.9	11.8	7.07	838	1.01	lower	SD
CP-E3	1/10/18	1671.58	11.7	7.17	812	1.41	lower	SD
CP-E3	4/18/18	1672.33	11.5	7.2	825	0.89	lower	SD
CP-W1	7/12/17	1673.04	12	7.81	474	0.89	lower	SD
CP-W1	10/4/17	1671.56	11.6	7.86	479	0.61	lower	SD
CP-W1	1/10/18	1671.2	11.4	7.87	495	0.57	lower	SD
CP-W1	4/18/18	1672.61	11.7	7.91	491	0.71	lower	SD
CP-W2	7/12/17	1672.45	10.6	7.82	491	1.01	lower	SD
CP-W2	10/4/17	1671.15	10.7	7.79	454	0.81	lower	SD
CP-W2	1/10/18	1670.57	10.9	7.9	491	0.89	lower	SD
CP-W2	4/18/18	1672.18	10	7.7	494	0.8	lower	SD
CP-W3	7/12/17	1672.17	12.1	7.41	792	1.21	lower	SD
CP-W3	10/4/17	1670.83	11.7	7.33	771	0.91	lower	SD
CP-W3	1/10/18	1670.61	11.6	7.47	794	0.89	lower	SD
CP-W3	4/18/18	1671.96	12	7.48	803	0.8	lower	SD

Temp=degrees C; Conductivity=umhos/cm; Turbidity= NTU

Table 2-3 Colbert Landfill Shut-down Test Criteria

	SHUT-DOWN TEST CRITERIA	
COC	ACTION LEVEL CRITERIA (ug/L)	CONSENT DECREE EVALUATION CRITERIA (ug/L)
TCA	130	200
DCA	2632	4050
DCE	4.55	7
MC	1.6	2.5
PCE	0.5	0.7
TCE	3.25	5

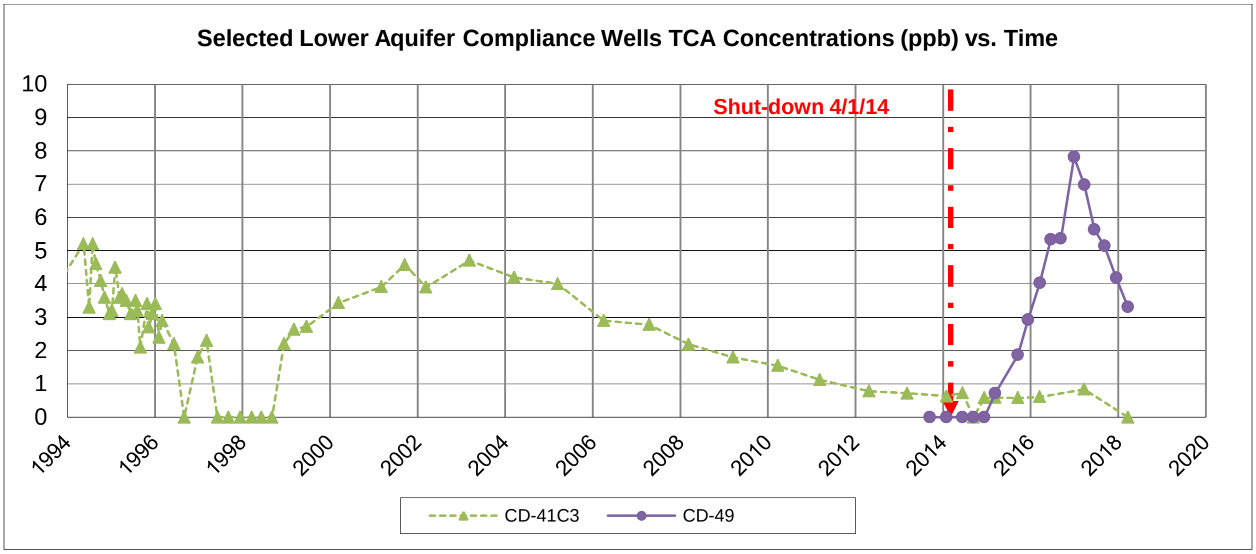
Table 2-4 Shut-down Test Compliance Well Analytical Results (reported in ug/l)

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CD-40C1	4-2018	**1.72**	<0.5	<0.5	<0.5	**2.04**	<0.5
CD-41C1	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C3	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C1	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	4-2018	<0.5	<0.5	<0.5	<0.5	**1.45**	<0.5
CD-43C2	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C2	5-2018	<0.5	<0.5	<0.5	<0.5	**1.93**	<0.5
CD-44C3	5-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C1	4-2018	<0.5	<0.5	<0.5	<0.5	**1.31**	<0.5
CD-45C2	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	10-2017	<0.5	**3.04**	<0.5	<0.5	**5.14**	<0.5
CD-49	1-2018	<0.5	**3.17**	<0.5	<0.5	**4.18**	<0.5
CD-49	4-2018	<0.5	**2.59**	<0.5	<0.5	**3.31**	<0.5
CD-49	7-2017	<0.5	**1.76**	<0.5	<0.5	**5.63**	<0.5

Table 2-5 Lower Aquifer Extraction Well Analytical Results (reported in ug/l)

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CP-E1	10-2017	9.87	23.1	<0.5	2.35	9.23	8.48
CP-E1	1-2018	7.54	13.4	<0.5	3	5.9	7.55
CP-E1	4-2018	9.66	<0.5	<0.5	2.85	8.58	9.93
CP-E1	7-2017	8.12	13.7	<0.5	2.57	7.18	7.48
CP-E2	10-2017	30.6	135	<0.5	0.63	51.5	81.6
CP-E2	1-2018	26.4	107	<0.5	0.69	49.9	92.5
CP-E2	4-2018	38.6	<0.5	<0.5	0.69	62.3	116
CP-E2	7-2017	26	101	<0.5	0.69	48.8	85.2
CP-E3	10-2017	2.87	12.3	<0.5	<0.5	7.15	2.03
CP-E3	1-2018	2.51	11.9	<0.5	<0.5	6.52	2.05
CP-E3	4-2018	3.89	<0.5	<0.5	<0.5	7.53	3.23
CP-E3	7-2017	2.76	13.6	<0.5	<0.5	10.1	2.36
CP-S1	10-2017	3.24	0.85	<0.5	<0.5	1	1.94
CP-S1	1-2018	2.19	0.58	<0.5	<0.5	0.72	1.65
CP-S1	4-2018	1.48	0.58	<0.5	<0.5	0.7	1.73
CP-S1	7-2017	2.83	0.56	<0.5	<0.5	0.88	1.82
CP-S4	10-2017	<0.5	<0.5	<0.5	<0.5	<0.5	1.04
CP-S4	1-2018	0.67	<0.5	<0.5	<0.5	<0.5	1.31
CP-S4	7-2017	<0.5	<0.5	<0.5	<0.5	<0.5	0.79
CP-S5	10-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S5	1-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S5	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S5	7-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S6	10-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S6	1-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S6	4-2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-S6	7-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CP-W1	10-2017	<0.5	3.76	<0.5	<0.5	1.9	<0.5
CP-W1	1-2018	<0.5	2.97	<0.5	<0.5	2.03	<0.5
CP-W1	4-2018	<0.5	<0.5	<0.5	<0.5	2.54	<0.5
CP-W1	7-2017	<0.5	4.14	<0.5	<0.5	4.39	<0.5
CP-W2	10-2017	<0.5	0.55	<0.5	<0.5	3.98	<0.5
CP-W2	1-2018	<0.5	<0.5	<0.5	<0.5	4.61	<0.5
CP-W2	4-2018	0.78	<0.5	<0.5	<0.5	7.38	1.1
CP-W2	7-2017	<0.5	<0.5	<0.5	<0.5	1.76	<0.5
CP-W3	10-2017	26.4	66.8	<0.5	<0.5	73.3	48.4
CP-W3	1-2018	10.7	32.9	<0.5	<0.5	43.7	35.3
CP-W3	4-2018	8.87	<0.5	<0.5	<0.5	43.5	36.6
CP-W3	7-2017	35.9	73.9	<0.5	<0.5	85.2	39.5

Figure 2-4 Lower Aquifer Monitoring Well COC Concentrations



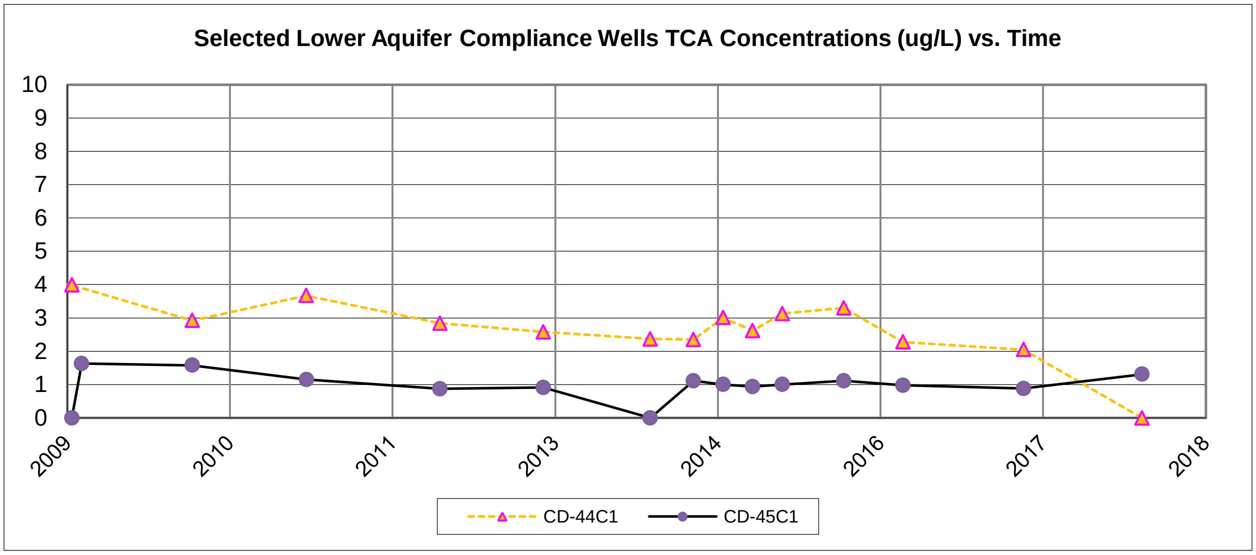
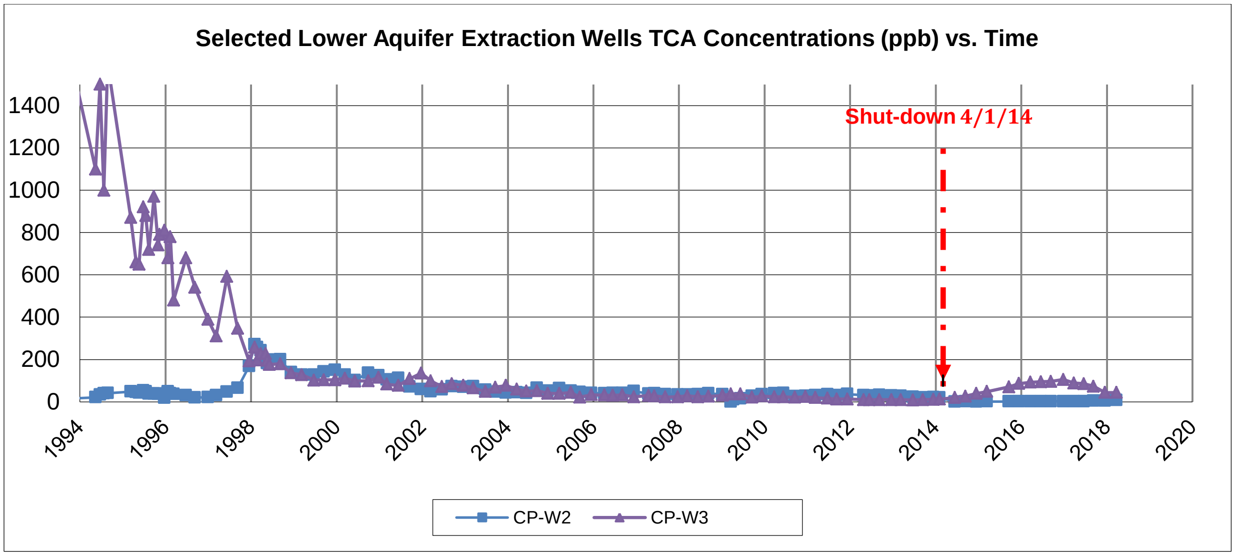
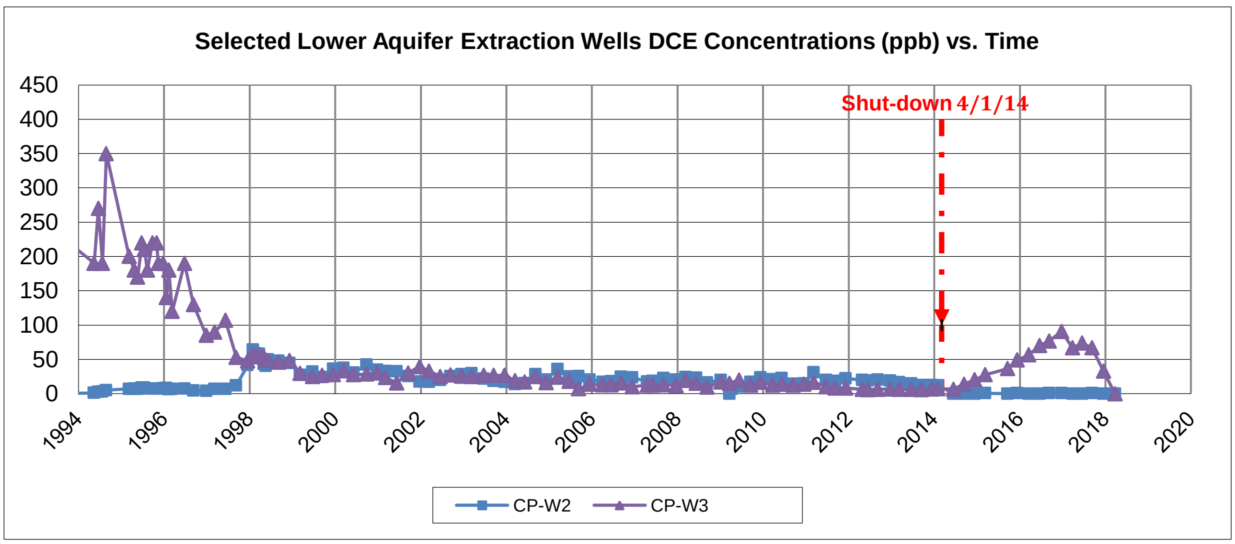


Figure 2-5 Lower Aquifer Extraction Well COC Concentrations





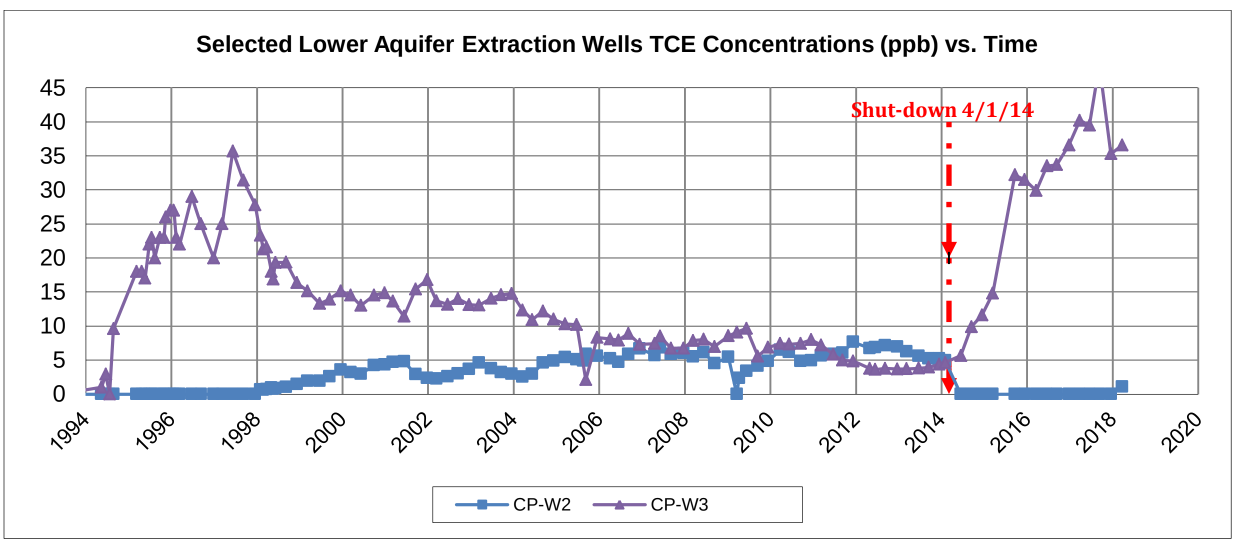
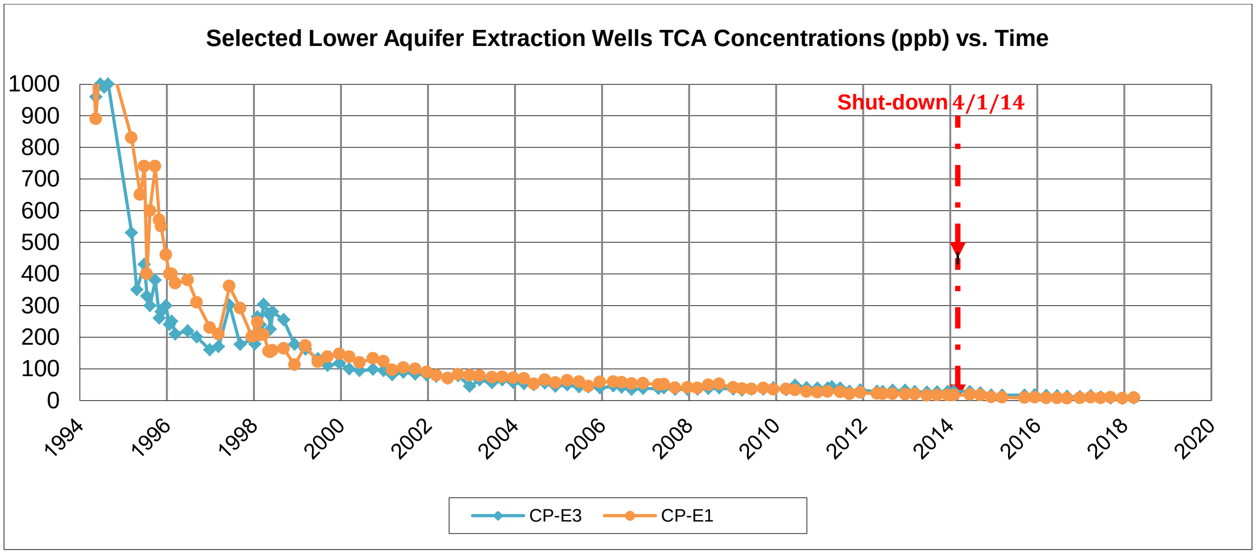


Figure 2-6 Lower Aquifer Extraction Well COC Concentrations



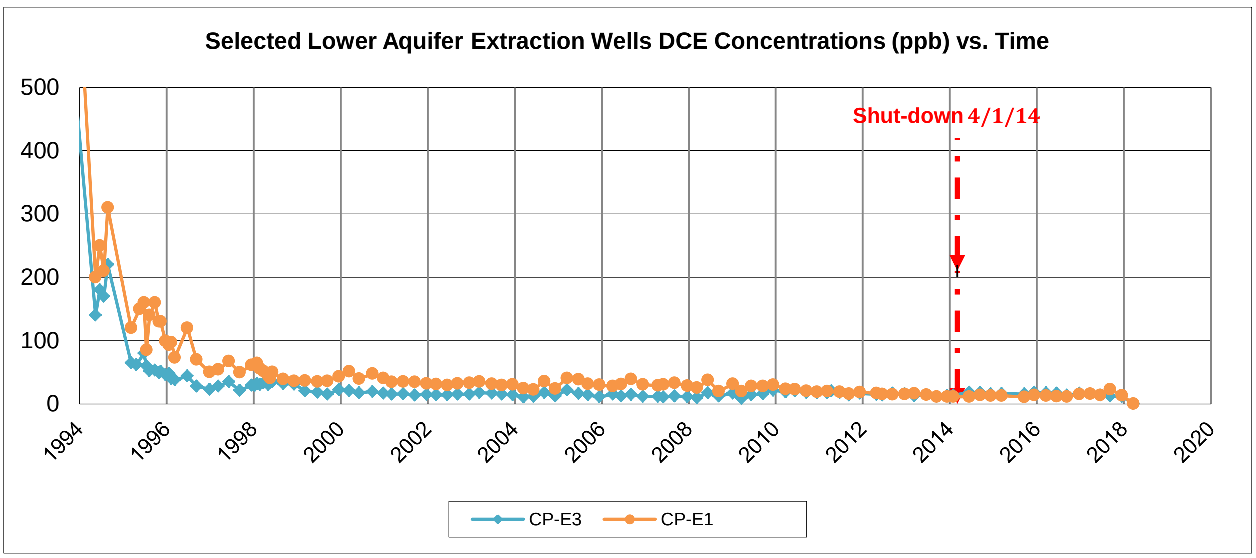
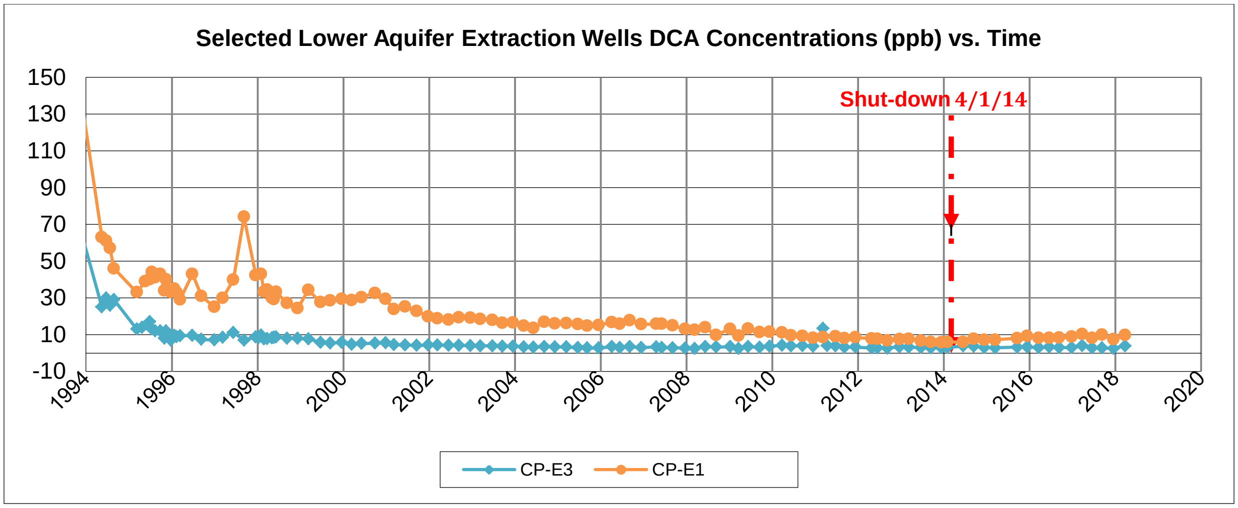
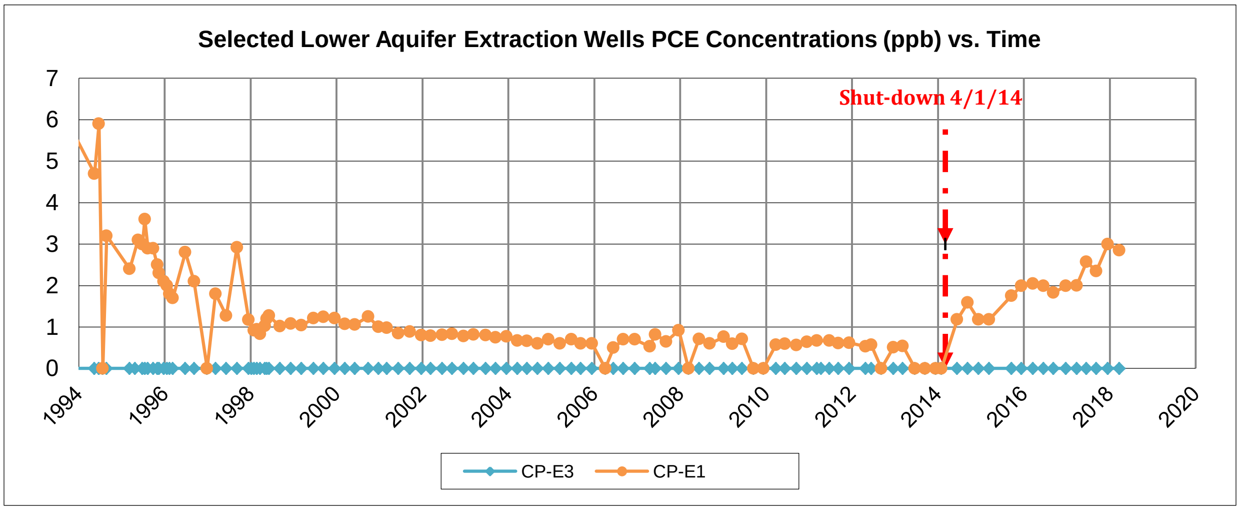


Figure 2-7 Lower Aquifer Extraction Well Concentrations





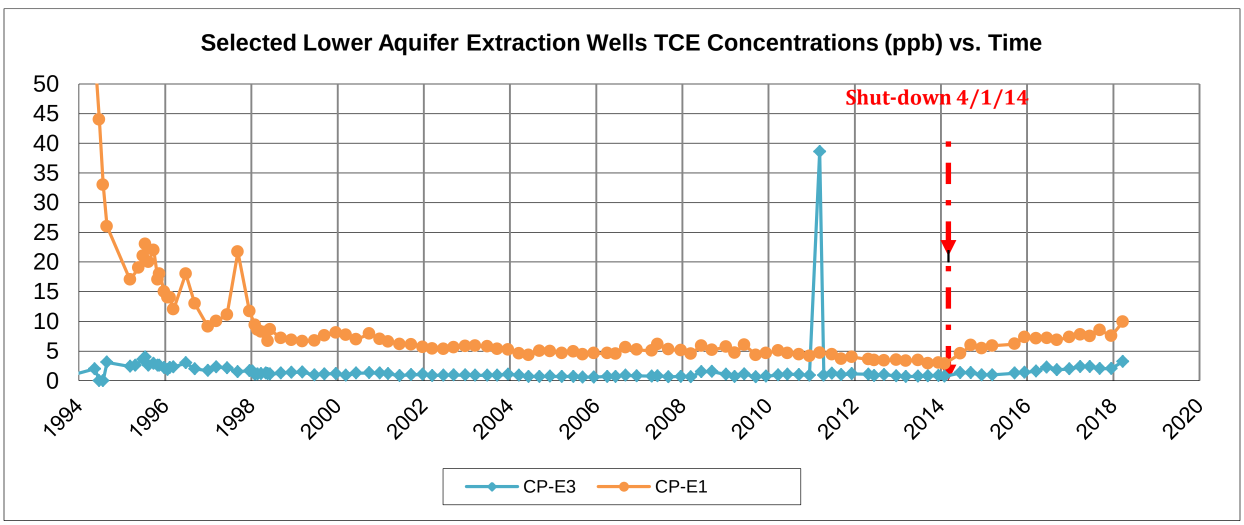
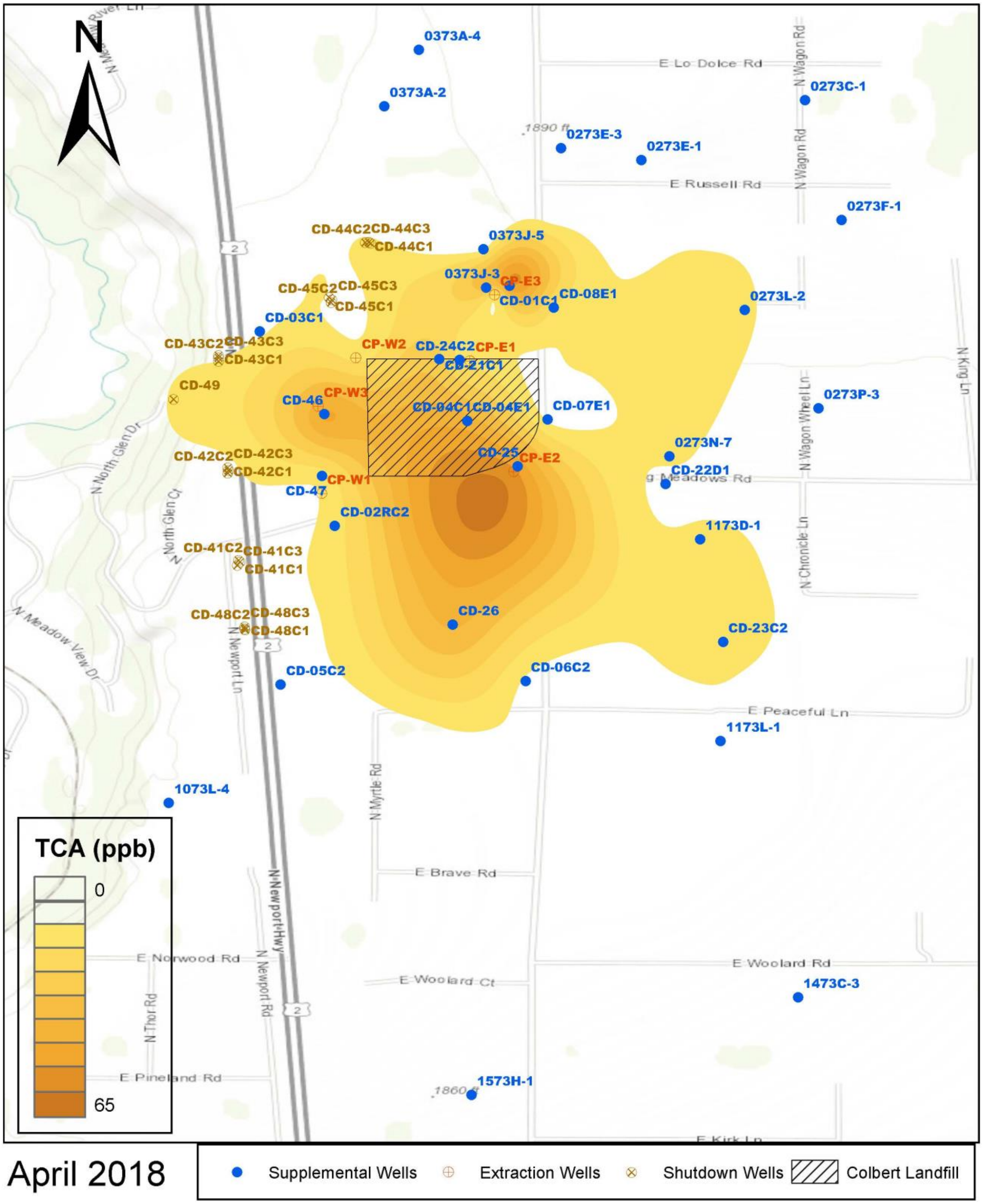


Figure 2-8 Lower Aquifer Estimated TCA Plume



3.0 Upper Aquifer Monitoring

The upper aquifer monitoring program includes the sampling of compliance indicator COC's (VOC's), 1,4-dioxane sample collection, and MFS sampling from selected monitoring wells. Table 3-1 presents all wells located in the upper aquifer monitoring program and the sample analyses assigned to each well. Upper aquifer monitoring locations are presented in Figure 3-1. All upper aquifer monitoring occurs on an annual basis with the exception of extraction wells, which are operated and sampled quarterly.

3.1 Field Data and Groundwater Elevations

All upper aquifer compliance monitoring field parameters and groundwater elevations for this reporting period are shown in Table 3-3. Conductivity values ranged from 370 to 706 umhos/cm. Field pH values ranged from 6.54 to 7.69. Upper aquifer groundwater elevation contours and flow paths are presented in Figure 3-3.

3.2 Compliance Monitoring (VOC's)

All wells in the upper aquifer have VOC samples collected from them and analyzed, even though the VOC analysis is not required in the MFS or 1,4-Dioxane work plan specifications.

3.2.1 Chemical Data

Constituent of concern concentrations at the south system extraction wells were consistent with previous quarters (see Table 3-4). Selected upper aquifer wells TCA concentrations versus time are presented in Figure 3-4. Upper aquifer TCA plume boundaries are shown in Figure 3-5.

3.2.2 Criteria

Criteria for the upper aquifer programs are presented in Table 3-2. There were no criteria exceeded in any of the upper aquifer compliance monitoring wells or extraction wells during this reporting period.

3.3 1,4-Dioxane Sampling

As outlined in the *1,4-Dioxane Workplan for the Colbert Landfill (December 2007)*, five locations were selected for one year of Quarterly 1,4-dioxane sampling to further evaluate the extent of this analyte as well as protect residential wells at the Colbert Landfill site (see Table 3-1). In April 2009, that sample event concluded the year of quarterly sampling at these locations. Since then, Spokane County has continued sampling these wells on an annual basis. The 2018 1,4-dioxane sampling was performed during the month of April. 1073D-1 was not sampled because the resident had shut off the well.

3.3.1 Chemical Data

The results for April 2018 1,4-dioxane sampling are shown in Table 3-5. Concentrations versus time are presented Figure 3-6.

3.4 Upper Aquifer MFS Monitoring

Upper aquifer locations designated in the MFS groundwater monitoring program were sampled in April 2018.

3.4.1 Chemical Data

Concentrations of analytes tested for under MFS monitoring were consistent with previous results (see Figure 3-7 and Figure 3-8). Zinc was not detected in the MFS wells during this reporting period.

3.4.2 Criteria

None of the MFS sampling locations exceeded any of the applicable criteria during this reporting period.

3.4.3 Statistical Analysis

The MFS Groundwater Monitoring Plan (Landau Assoc., 1996) requires three statistical methods be used when evaluating groundwater Quality in accordance with MFS requirements. Time series plots were performed and discussed previously. Box plots were required after one year of data was collected. Box plots are presented in Figure 3-9.

The third statistical method required is the Mann-Whitney nonparametric significance test. The summary results for this test are presented in Table 3-6 . Although lower aquifer locations are no longer scheduled for sampling, previous results are shown here as well. A statistically significant change (less than 0.05 level of significance) from this test indicates that a difference may exist between background and downgradient wells but does not differentiate between sets. While it is true that a difference in nitrate and chloride concentrations may exist between background and downgradient wells, when taking time series plots and box plots into consideration, it is not likely these differences were due to influence by the landfill.

Table 3-1 Upper Aquifer Monitoring Programs and Locations

Program	Schedule	Parameters	Wells
Compliance Monitoring	Annual Quarterly at extraction wells	VOC's	CD-31A1, CD-34A1, CD-36A1, CD-37A1, CD-38A1, CP-S1, CP-S3, CP-S4, CP-S5, CP-S6
1,4-Dioxane Sampling	Annual	1,4-Dioxane	CP-S1, 1073D-1*, 1473M-1*, 1573A-1*, CD-40C1**
MFS Monitoring	Annual	Cl/NH3/NO2/NH3/SO4 /Fe/Mn/Zn/TOC/COD	CD-03A1, CD-60A1, CD-61A1, CS-04A1

* Residential use wells

**Well considered to be screened in fluvial aquifer and COC source is from upper aquifer west of Hwy 2 (see *Phase 1 Engineering Report. Landau Assoc, 1991*.)

Table 3-2 Upper Aquifer Criteria

PROGRAM	CRITERIA	TCA	DCE	DCA	TCE	PCE	MC	1,4-Dioxane	Units
CONSENT DECREE	Performance	200	7	4050	5	0.7	2.5		ug/L
(Compliance)	Evaluation	200	7	4050	5	0.7	2.5	7	
		Cl	Fe	Mn	Zn	TOC	COD	SO4 / NO3	
MFS	(mg/L)	250	0.3	0.05	5	NA	NA	250 / 10	mg/L

Figure 3-1 Upper Aquifer Compliance Monitoring Locations

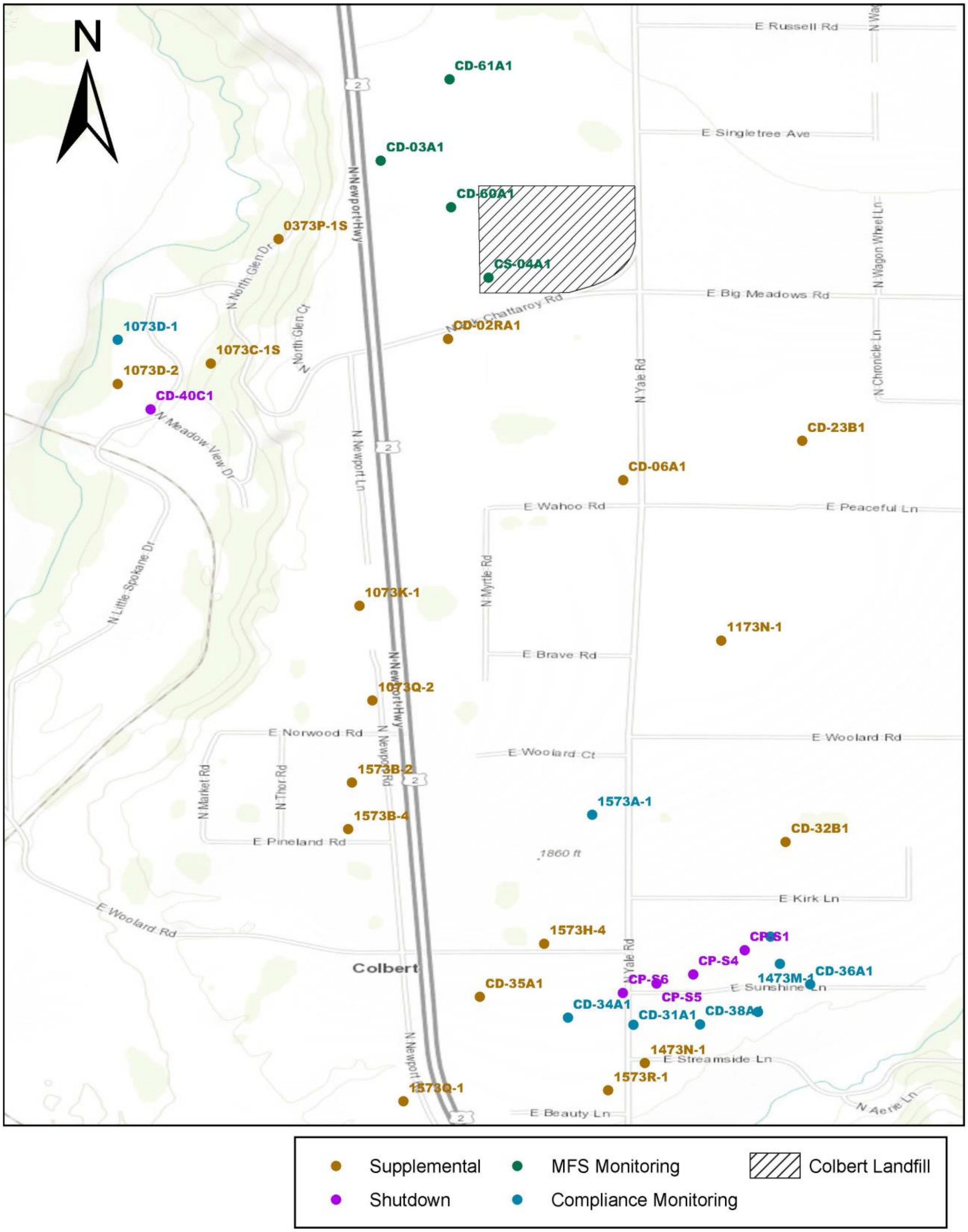
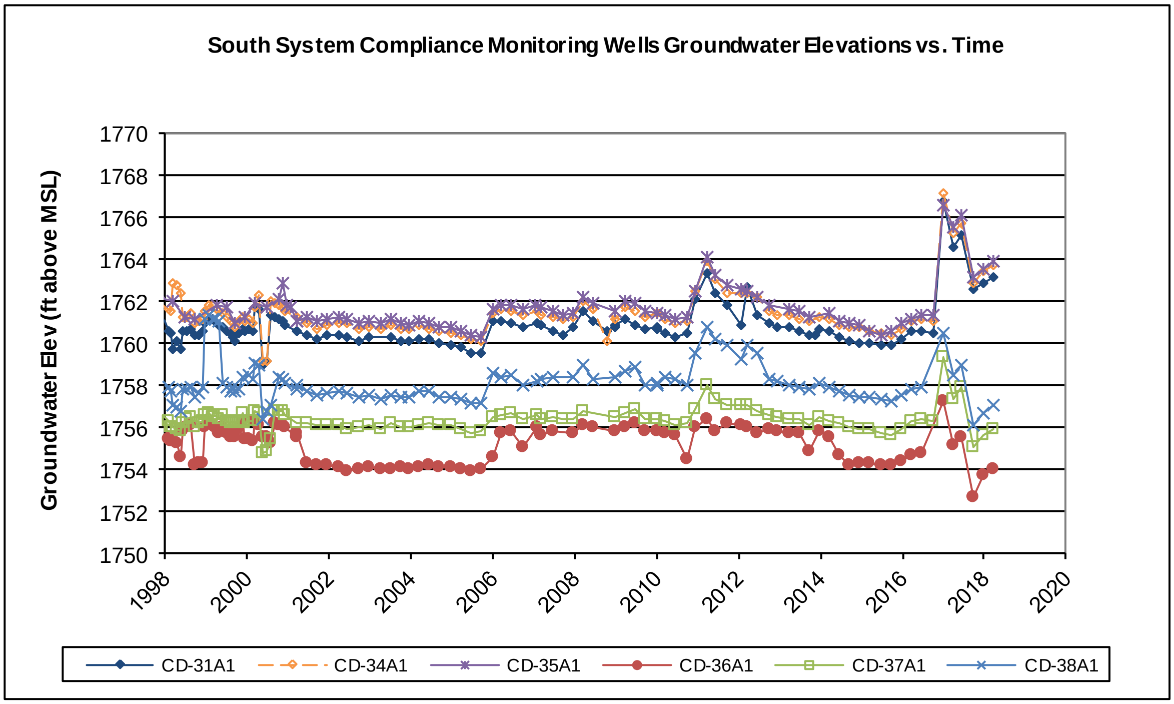


Table 3-3 Upper Aquifer Field Parameters

StationID	SampleDate	WtrElev	FieldTemp	FieldPH	FieldConductivity	FieldTurbidity	Aquifer	Program
1473M-1	4/17/18		11.5	7.52	642	0.21	upper	CCM
1573A-1	4/17/18	1763.36	10.1	7.57	608	1.68	upper	CCM
CD-31A1	4/17/18	1762.89	9	7.65	445	0.6	upper	CCM
CD-34A1	4/17/18	1763.46	9.1	7.41	592	0.4	upper	CCM
CD-36A1	4/18/18	1753.74	9.3	7.47	568	0.87	upper	CCM
CD-37A1	4/17/18	1755.66	9.8	7.55	528	0.41	upper	CCM
CD-38A1	4/17/18	1756.7	9.2	7.69	430	4.58	upper	CCM
CP-S3	4/17/18	1760.25	11.9	7.49	633	0.89	upper	CCM
CD-03A1	4/18/18	1775.28	9.2	7.56	370	0.4	upper	MFS
CD-60A1	4/18/18	1774.69	10.3	7.03	553	0.21	upper	MFS
CD-61A1	4/18/18	1776.06	9.7	7.47	417	0.18	upper	MFS
CS-04A1	4/18/18	1774.35	9.3	6.54	706	2.16	upper	MFS
CP-S1	7/12/17	1762.62	11.6	7.36	704	0.31	upper	SD
CP-S1	10/4/17	1761.47	11.5	7.33	703	0.29	upper	SD
CP-S1	1/10/18	1760.86	10.9	7.3	675	0.27	upper	SD
CP-S1	4/18/18	1759.54	11.5	7.43	703	0.29	upper	SD
CP-S4	7/12/17	1764.07	11.5	7.33	629	0.89	upper	SD
CP-S4	10/4/17	1763.48	11.5	7.31	625	0.79	upper	SD
CP-S4	1/10/18	1762.73	11.1	7.33	626	0.81	upper	SD
CP-S4	4/18/18	1761.12	11.4	7.34	630	0.79	upper	SD
CP-S5	7/12/17		12	7.49	540	1.49	upper	SD
CP-S5	10/4/17		11	7.4	519	1.11	upper	SD
CP-S5	1/10/18		12	7.45	559	1.01	upper	SD
CP-S5	4/18/18		10.8	7.53	551	1.08	upper	SD
CP-S6	7/12/17	1765.05	11.5	7.45	517	1.29	upper	SD
CP-S6	10/4/17	1764.67	11.3	7.47	506	0.89	upper	SD
CP-S6	1/10/18	1762.79	11.1	7.46	533	1.11	upper	SD
CP-S6	4/18/18	1763	10.5	7.4	515	0.98	upper	SD

Figure 3-2 Upper Aquifer Groundwater Elevations vs. Time



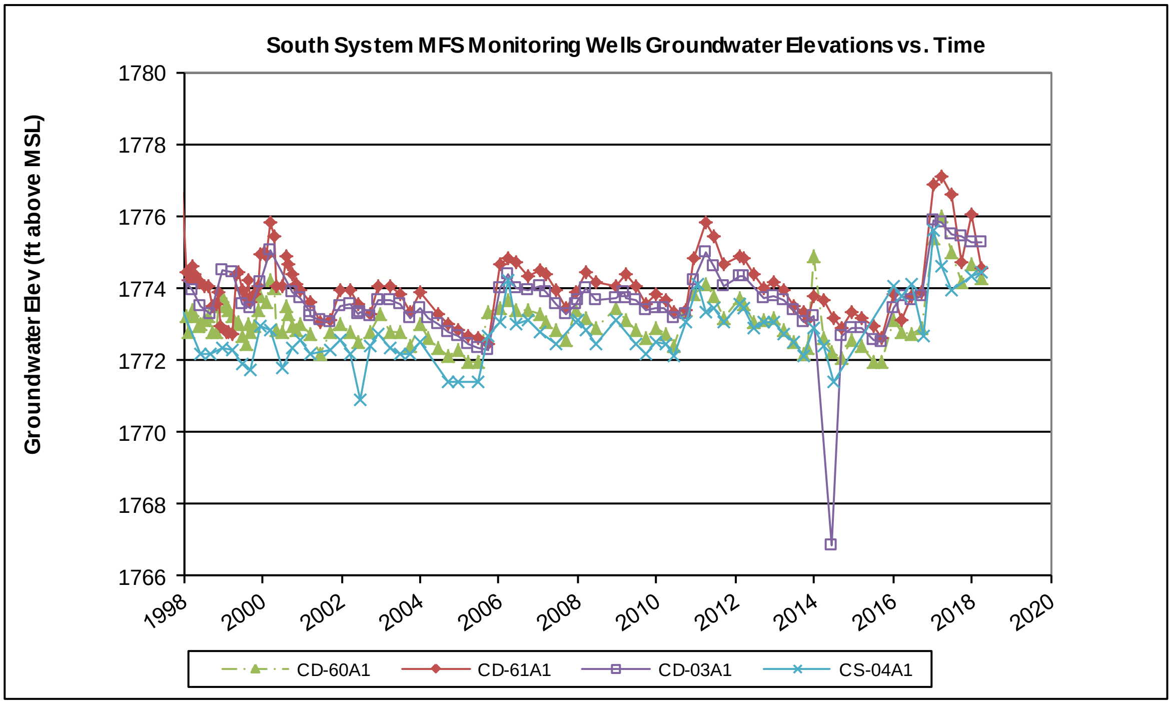


Figure 3-3 Upper Aquifer Estimated Groundwater Elevation Contours

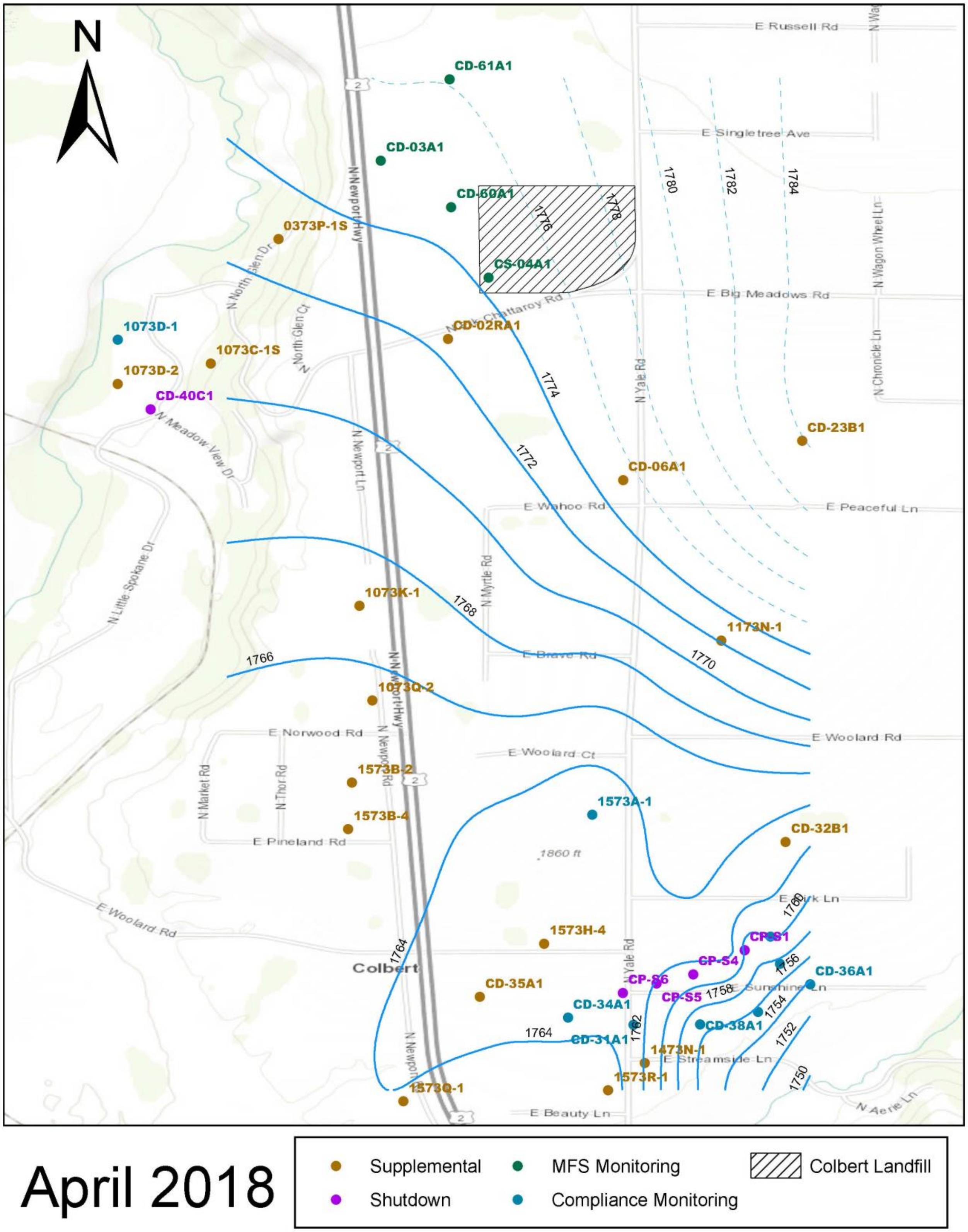


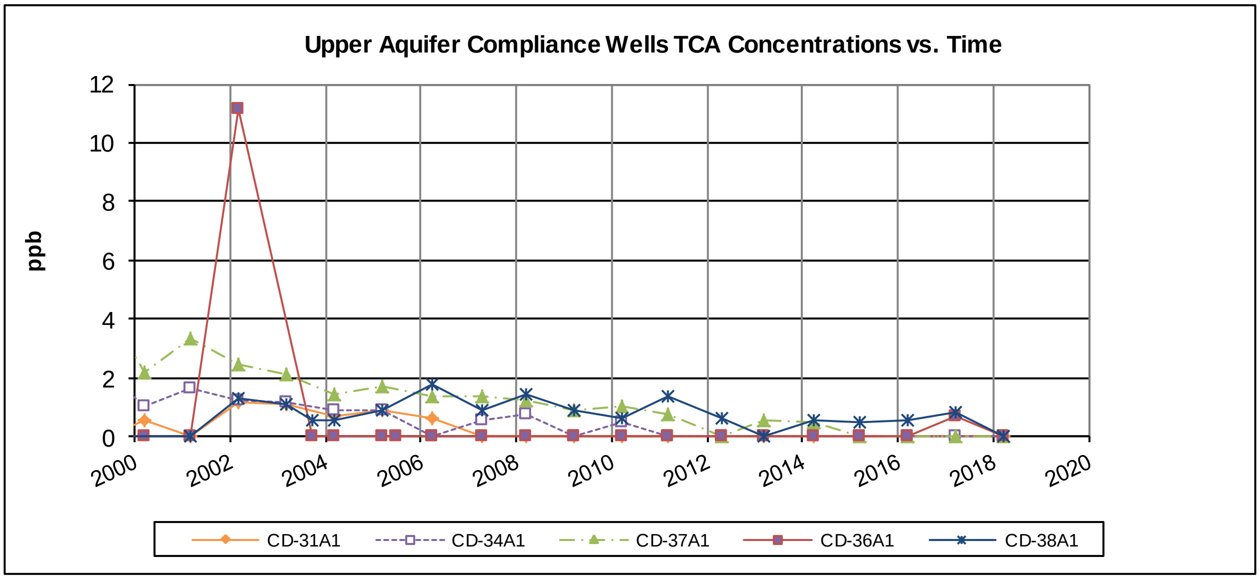
Table 3-4 Upper Aquifer Groundwater Monitoring Results

StationID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Cl	COD	Fe	Mn	N-NH3	N-NO3	SO4	TOC	Zn
1573A-1	4/17/2018	0.84	<0.5	<0.5	<0.5	1.18	0.56									
CD-03A1	4/18/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.95	<5	<0.1	<0.008	<0.03	0.433	6.61	<1	<0.01
CD-31A1	4/17/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-34A1	4/17/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-36A1	4/18/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-37A1	4/17/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-38A1	4/17/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-60A1	4/18/2018	<0.5	<0.5	<0.5	0.61	<0.5	<0.5	3.16	<5	<0.1	<0.008	<0.03	1.11	6.11	<1	<0.01
CD-61A1	4/18/2018	<0.5	<0.5	<0.5	<0.5	1.98	<0.5	0.58	<5	<0.1	<0.008	<0.03	0.143	8.96	<1	<0.01
CP-S1	7/12/2017	2.83	0.56	<0.5	<0.5	0.88	1.82									
CP-S1	10/4/2017	3.24	0.85	<0.5	<0.5	1	1.94									
CP-S1	1/10/2018	2.19	0.58	<0.5	<0.5	0.72	1.65									
CP-S1	4/18/2018	1.48	0.58	<0.5	<0.5	0.7	1.73									
CP-S3	4/17/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S4	7/12/2017	<0.5	<0.5	<0.5	<0.5	<0.5	0.79									
CP-S4	10/4/2017	<0.5	<0.5	<0.5	<0.5	<0.5	1.04									
CP-S4	1/10/2018	0.67	<0.5	<0.5	<0.5	<0.5	1.31									
CP-S5	7/12/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	10/4/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	1/10/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	4/18/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	7/12/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	10/4/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	1/10/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	4/18/2018	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CS-04A1	4/18/2018	0.61	<0.5	<0.5	<0.5	<0.5	0.55	2.08	<5	<0.1	<0.008	<0.03	0.077	6.21	1.28	<0.01

Table 3-5 1,4-Dioxane Monitoring Results

Aquifer	StationID	SampleDate	Analyte	Result	Qualifier	Units
upper	CP-S1	4/18/2018	1,4-Dioxane	3.4		ug/L
lower	CD-40C1	4/18/8018	1,4-Dioxane	2	U	ug/L
upper	1473M-1	4/17/2018	1,4-Dioxane	2	U	ug/L

Figure 3-4 Upper Aquifer COC Concentrations vs Time



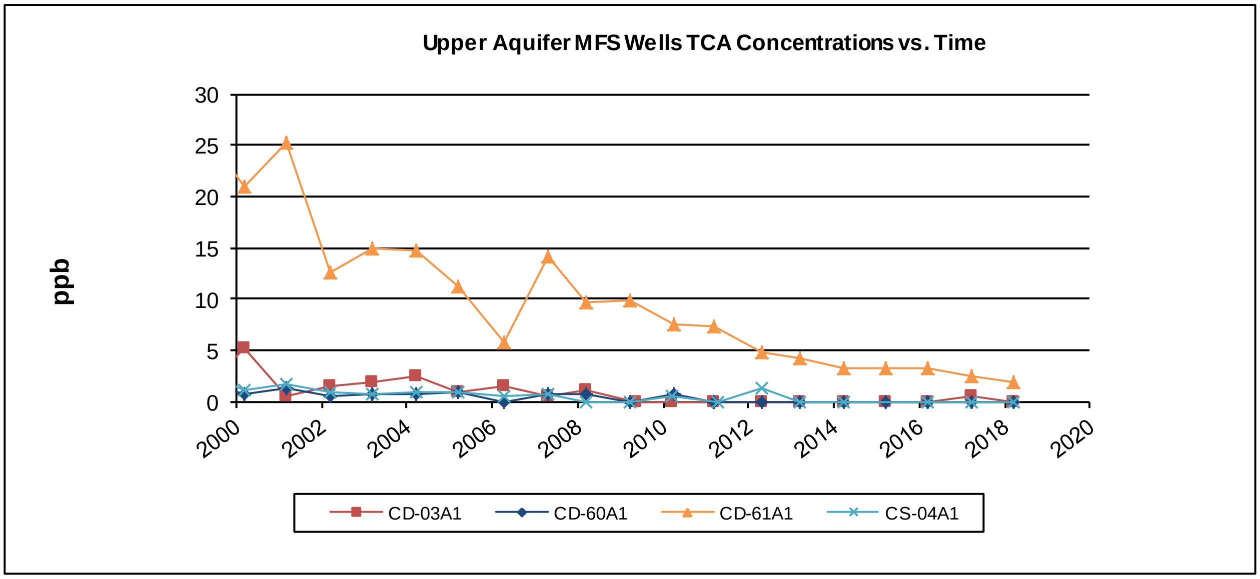


Figure 3-5 Upper Aquifer Estimated TCA Plume Boundaries

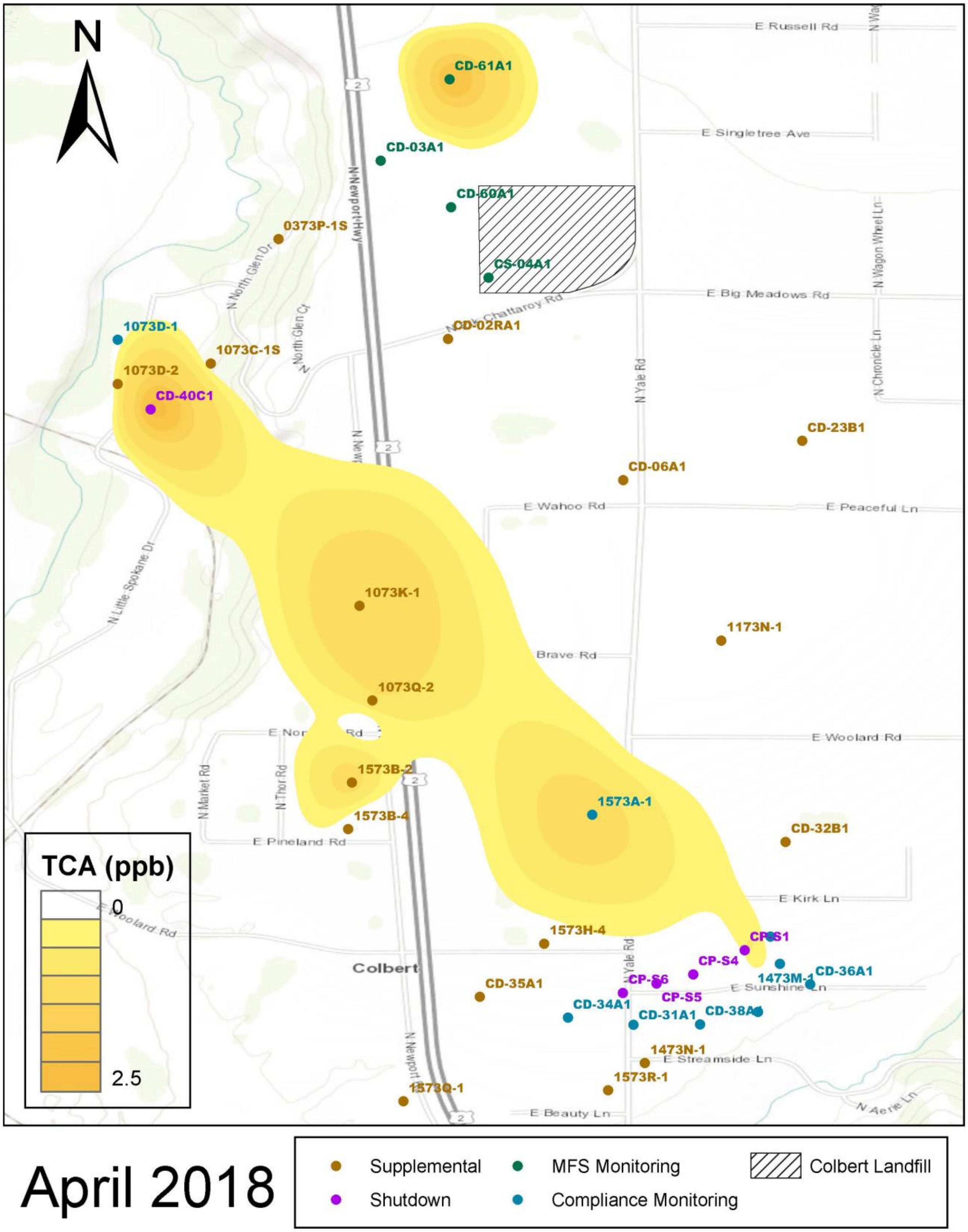


Figure 3-6 1,4-Dioxane Concentrations vs Time

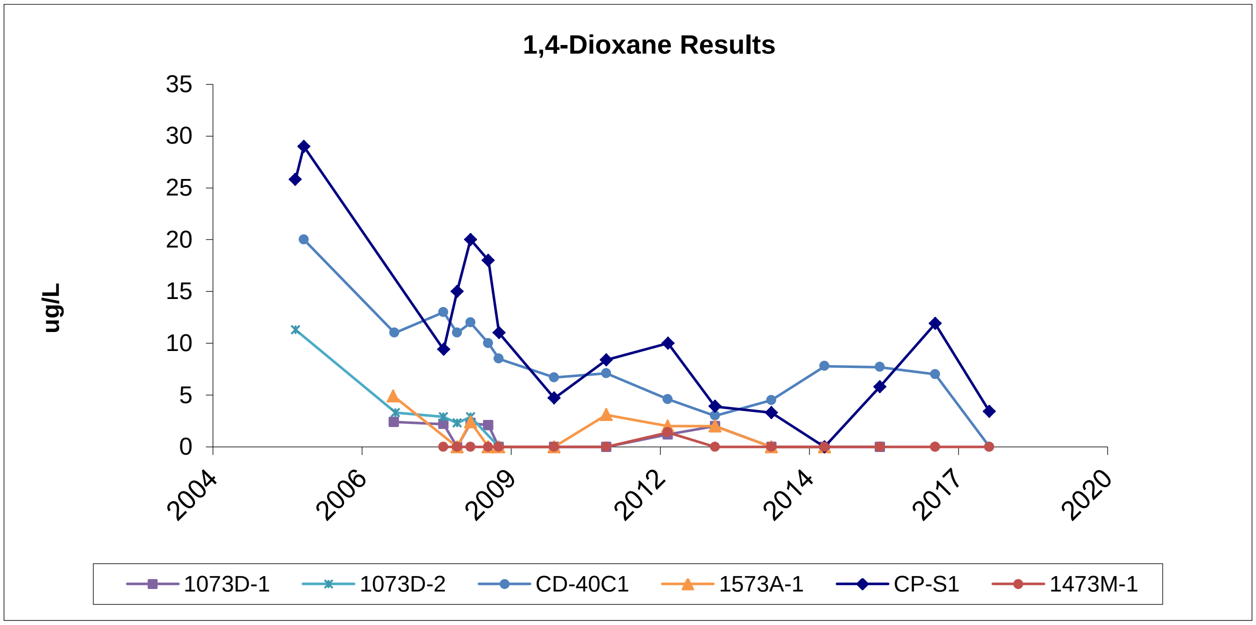
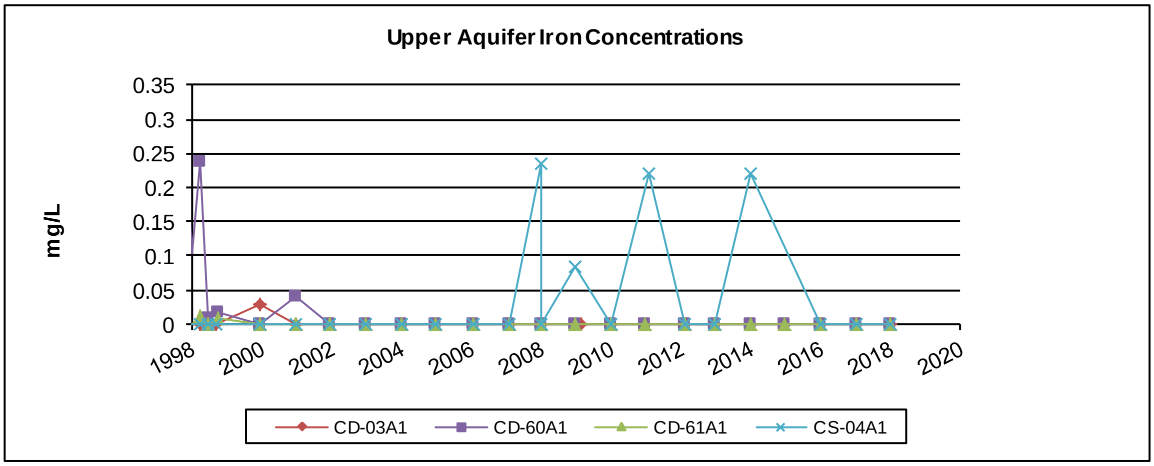
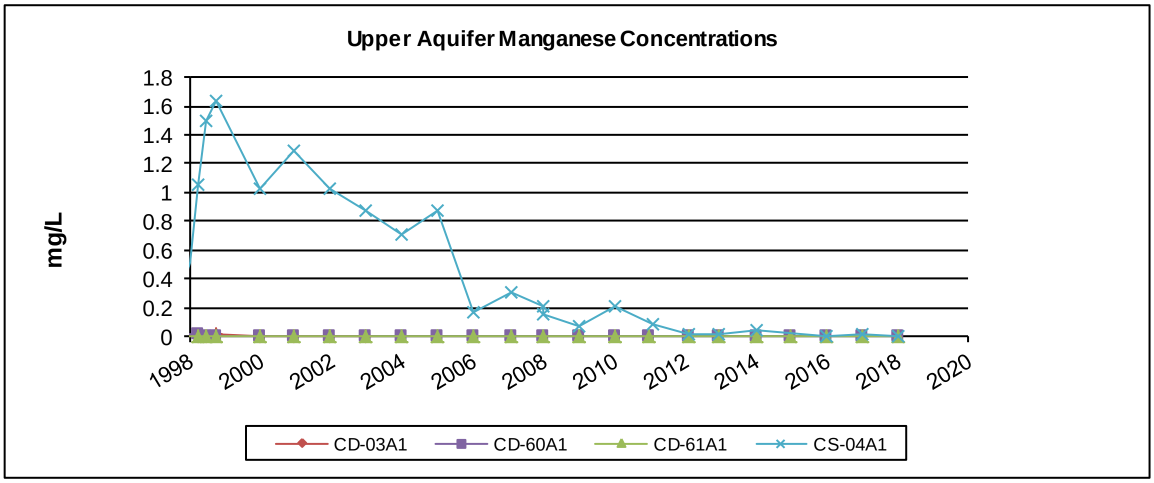


Figure 3-7 Upper Aquifer MFS Parameters vs Time





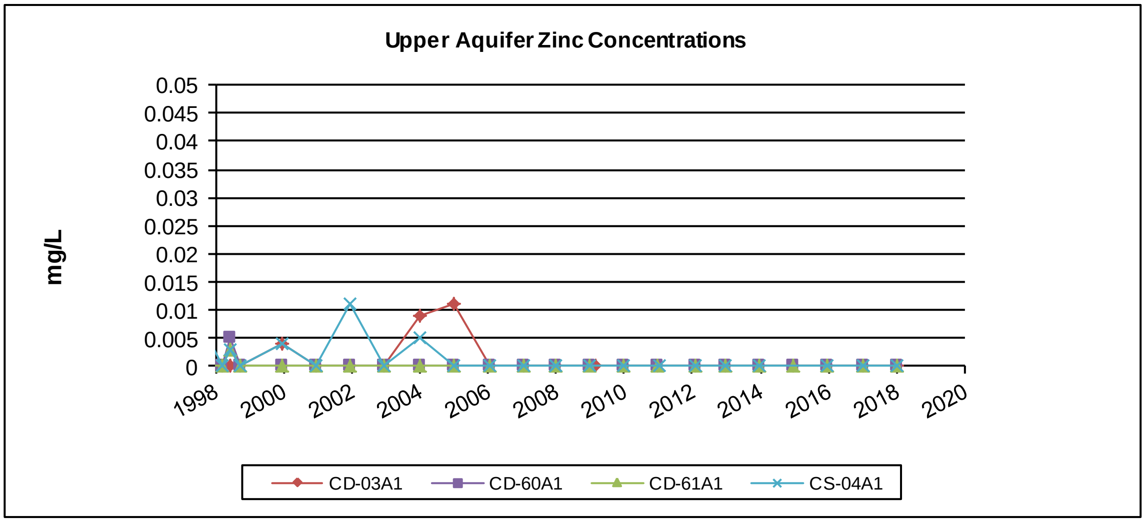
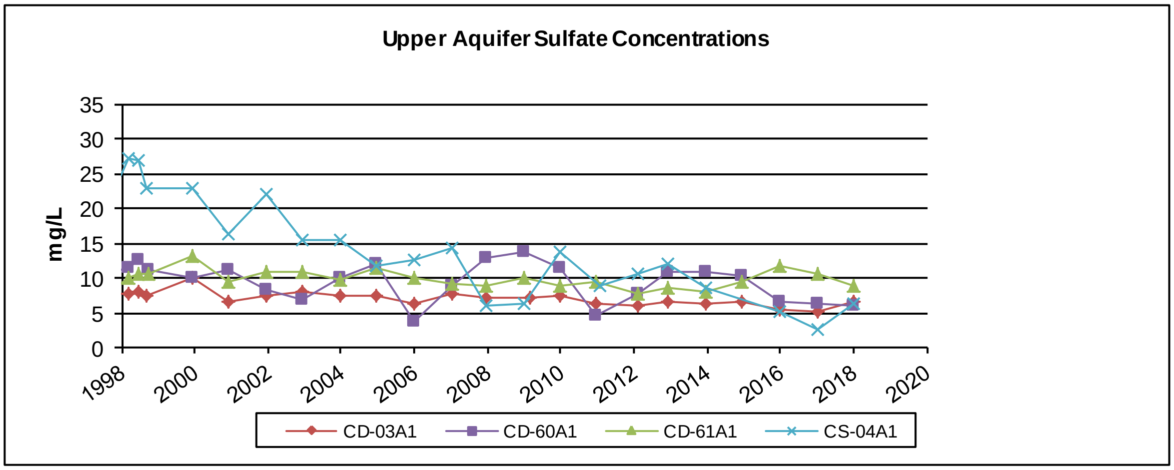
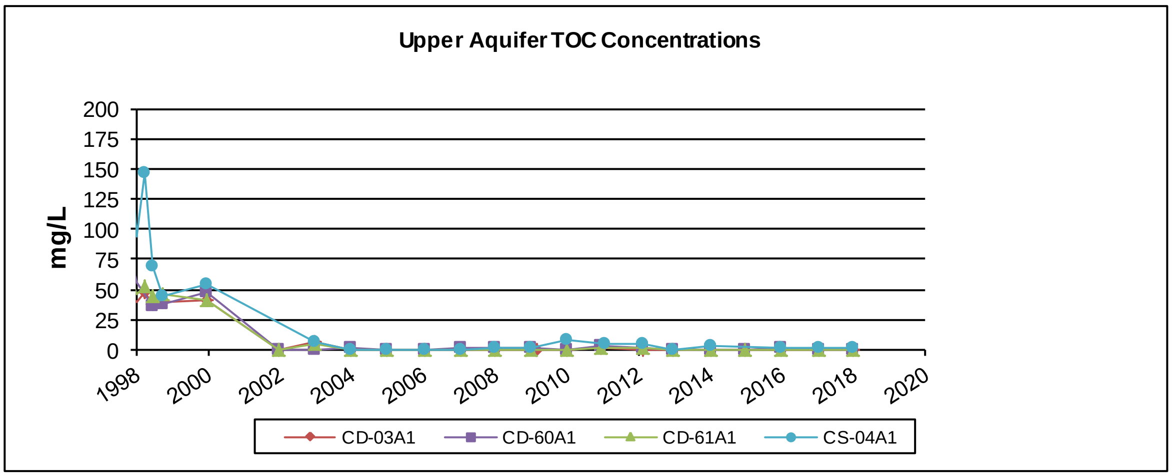


Figure 3-8 Upper Aquifer MFS Parameters vs Time





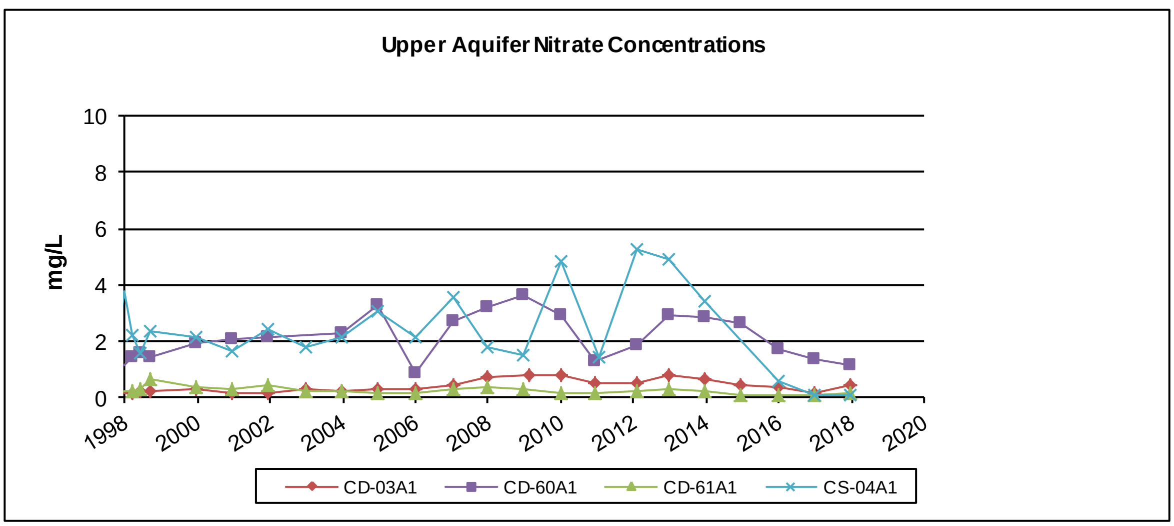


Table 3-6 Summary Results for the Mann-Whitney Nonparametric Significance Test (2018)

	Level of Significance (p)	
Constituent	**Upper Aquifer**	***Lower Aquifer (1999)**
Chloride	**5.17e-05**	**0.006**
Chemical Oxygen Demand	0.463	0.48
Iron	0.145	0.17
Manganese	0.0628	0.86
Ammonia	0.471	0.42
Nitrite	0.430	1.13
Nitrate	**7.69e-06**	0.08
Sulfate	0.808	**0.0006**
Total Organic Carbon	0.714	0.32
Zinc	0.063	0.06

*Lower aquifer results from January 1999 using CP-E2 and CD-48C2 analytical results for calculations.
Bold number indicates a level of significance under 0.05, test run as two-tailed method

Figure 3-9 Box Plots for Background and Downgradient MFS Wells (2018)

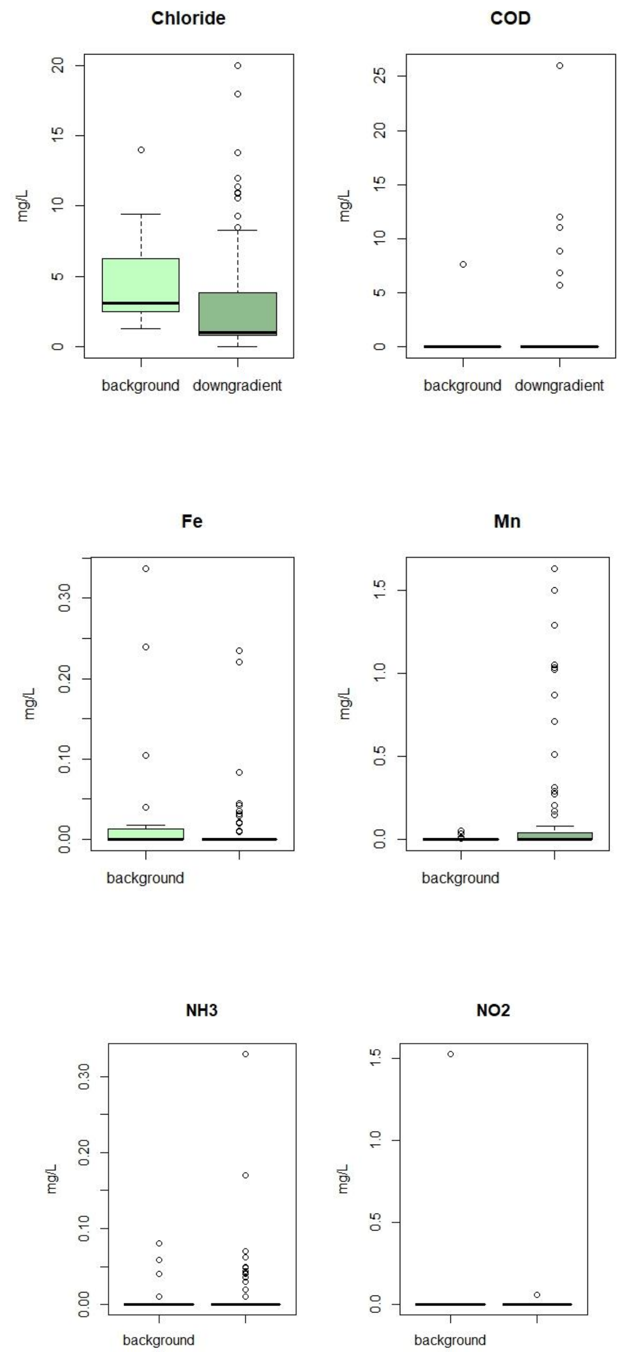
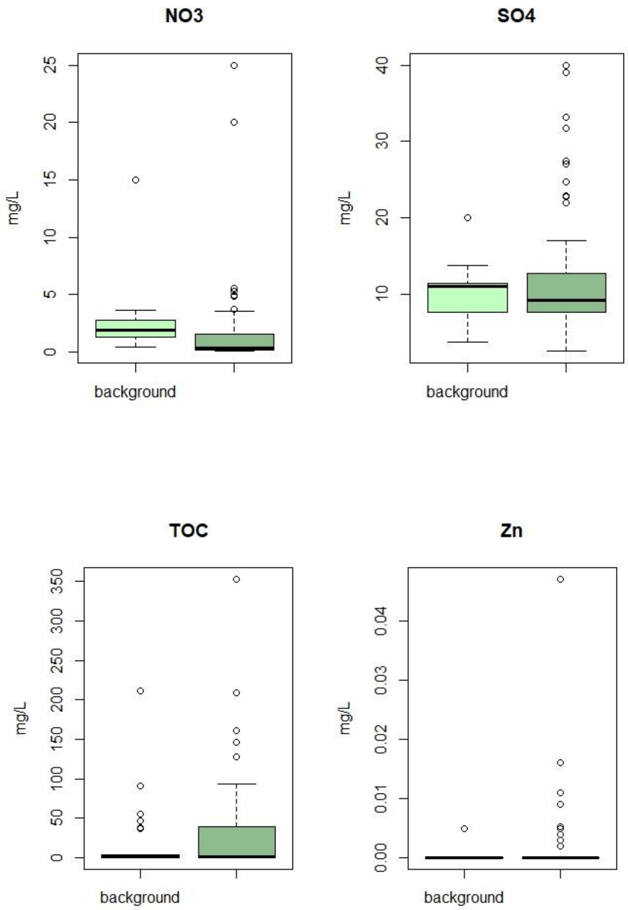


Figure 4-9 continued



4.0 Residential Program

4.1 Locations and Schedule

Current residential well sampling locations can be found in Figure 4-1. The residential sampling schedule is included in Table 4-1.

4.2 Monitoring Results and Criteria

Criteria for residential use wells were established in the Consent Decree. The Consent Decree states that if any residential well with a concentration over the evaluation criteria OR any residential well that has an average concentration over 65% of the evaluation criteria over a 12 month period, the county shall supply that residence with an alternative water source.

All residential well results were well below established criteria. Results from sampling are presented in Table 4-2. Time series plots for wells with COC detections are shown in Figure 4-2.

4.3 Data Evaluation

Only two of the residential wells measured concentrations above the method detection limits for the 2017-2018 sampling year (June 2017). These detections were only slightly above the detection limit and far below any criteria.

4.4 Program Modifications

On a regular basis, the program schedule is re-evaluated to determine if any changes are needed. With the initiation of the Shut-down test, a re-evaluation was performed comparing plume maps and well locations as well as a list of residences connected to a public water supply. Some modifications to increase sampling in specific areas were made to the schedule to ensure a conservative approach with regard to public health.

No modifications have been made to the schedule for the upcoming 2017-2018 sampling year. However, minor adjustments can be made to the schedule to temporarily increase monitoring in the area just west of the landfill near the Little Spokane River if needed to monitor very low concentration changes in DCA and TCE if measured. Changes are not required by any documentation or work plan.

The 2018 residential well sampling schedule is presented in Table 4-3.

Figure 4-1 Residential Well Sampling Locations

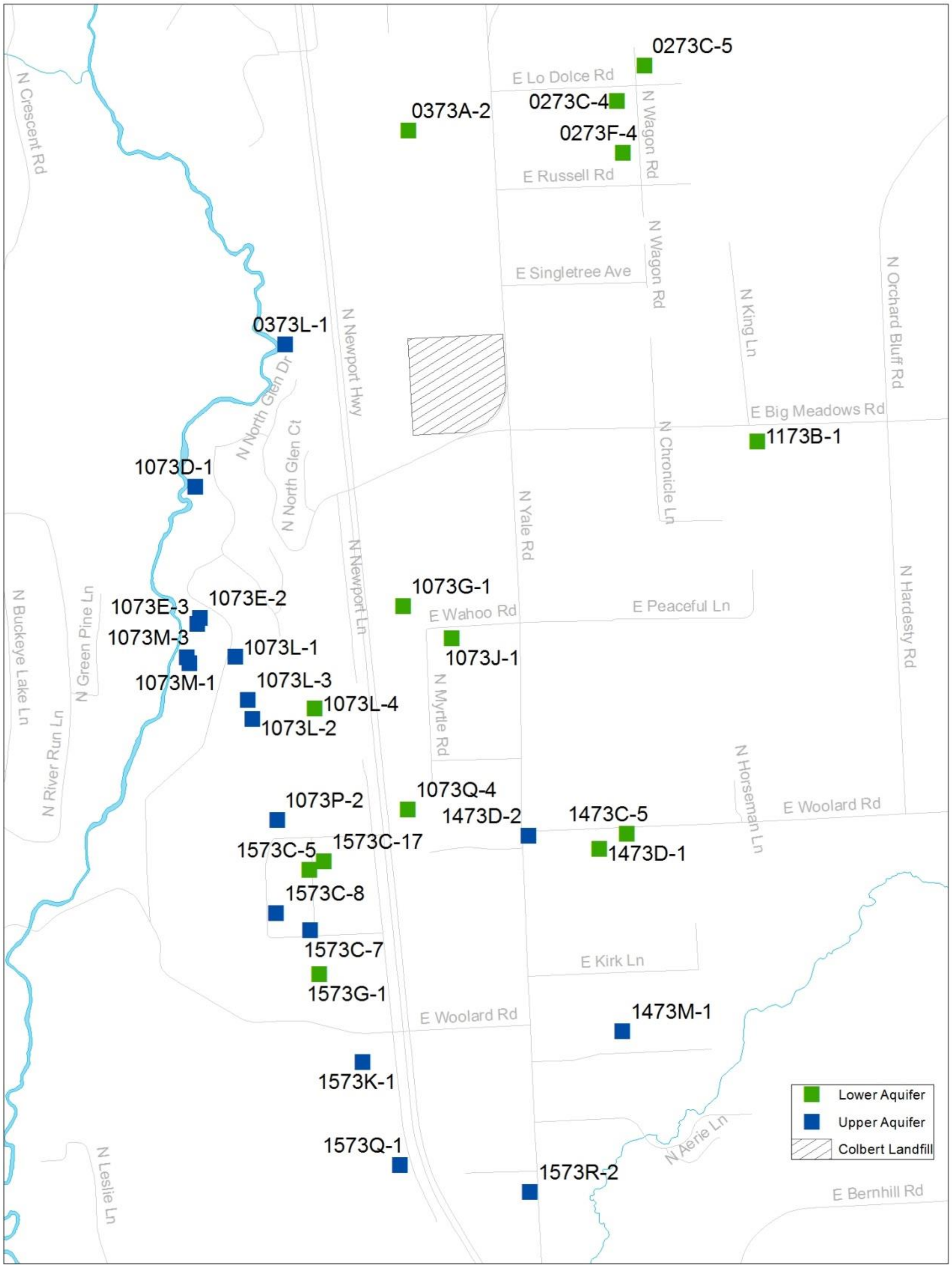


Table 4-1 Residential Well Sampling Schedule for Reporting Period

Colbert Residential Sampling Plan 2016

StationID	LastName	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Sched Comments
0273C-2	Vannatter	☐	☐	✔	☐	☐	☐	☐	☐	☐	✔	☐	☐	
0273C-3	Kramer	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	☐	BiAnnual 10'
0273C-4	McQuesten	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	
0273C-5	Hogan	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	many years no detects, wells btwn this and plume
0273D-6	Thornton	☐	✔	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	
0273F-4	Gander	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	✔	
0373A-2	Resseman	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	
0373A-4	Vansickel	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	
0373J-3	Golding	☐	☐	☐	☐	✔	✔	☐	☐	☐	☐	☐	☐	
0373L-1	Sterling	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	✔	☐	
1073D-1	Coats	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	
1073E-2	Pullen	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	Alt w/1073E-3
1073E-3	Clark	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	Alt w/1073E-2
1073E-4	Carpenter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
1073G-1	Rux	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	
1073J-1	Moreno	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	
1073L-1	Halpin	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	
1073L-2	Countryman	☐	☐	☐	✔	☐	☐	☐	☐	☐	✔	☐	☐	Alt w/1073L-3
1073L-3	Anderson	☐	✔	☐	☐	✔	☐	☐	✔	☐	☐	✔	☐	Alt w/1073L-2
1073L-4	Crabb	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐	☐	
1073M-1	Bertholf	✔	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	Alt w/1073M-3
1073M-3	Lane	☐	☐	☐	☐	☐	✔	☐	☐	✔	☐	☐	☐	Alt w/1073M-1
1073M-5	Swenson	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
1073P-1	Greenen	☐	☐	☐	✔	☐	☐	☐	☐	☐	✔	☐	☐	
1073P-2	Petrelli	☐	✔	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	

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StationID	LastName	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Sched Comments
1073Q-4	NORTH MEADOWS W	☐	☐	☑	☐	☐	☑	☐	☐	☑	☐	☐	☑	
1173B-1	Bise	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	
1473C-5	Overmyer	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	BiAnnual (11) Alt w/1473D-1
1473D-1	Farris	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Alt w/1473C-5
1473D-2	Wardian	☐	☑	☐	☐	☑	☐	☐	☑	☐	☐	☑	☐	Alt w/1473C
1473M-1	Ennis	☑	☐	☐	☑	☐	☐	☑	☐	☐	☑	☐	☐	
1573C-10	Lake	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	
1573C-17	RESIDENT	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	
1573C-5	Nelson	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
1573C-7	Brown	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	
1573C-8	Williams	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	BiAnnual (10)
1573G-1	Gano	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	BiAnnual (11)
1573H-1	Hunter	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	
1573K-1	Eschenbacher	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	
1573Q-1	Saunder	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	
1573R-2	Hunter	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	
3483M-1	Campbell	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	

Table 4-2 Residential Groundwater Monitoring Program Results

(May 2017 through April 2018)

StationID	Aquifer	SampleDate	LastName	TCA	DCA	DCE	MC	PCE	TCE
1573G-1		5/10/2017	Gano	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273C-2	lower	10/11/2017	Vannatter	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273C-3	lower	6/21/2017	Kramer	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273C-4	lower	11/14/2017	McQuesten	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273D-6	lower	8/30/2017	Thornton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273D-6	lower	2/6/2018	Thornton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273F-4	lower	6/21/2017	Gander	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0273F-4	lower	12/4/2017	Gander	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373A-2	lower	6/20/2017	Resseman	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373A-2	lower	9/27/2017	Resseman	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373A-2	lower	12/4/2017	Resseman	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373A-2	lower	3/15/2018	Resseman	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373A-4	lower	10/11/2017	Vansickel	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073G-1	lower	6/20/2017	Rux	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073G-1	lower	9/27/2017	Rux	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073G-1	lower	12/4/2017	Rux	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073G-1	lower	3/15/2018	Rux	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073J-1	lower	7/12/2017	Moreno	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073J-1	lower	10/11/2017	Moreno	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073J-1	lower	2/6/2018	Moreno	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-4	lower	9/27/2017	Crabb	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073Q-4	lower	6/20/2017	NORTH MEADOWS WATER	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073Q-4	lower	9/27/2017	NORTH MEADOWS WATER	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073Q-4	lower	12/4/2017	NORTH MEADOWS WATER	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073Q-4	lower	3/15/2018	NORTH MEADOWS WATER	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473C-5	lower	8/30/2017	Overmyer	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573C-10	lower	6/21/2017	Lake	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573C-17	lower	10/11/2017	RESIDENT	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573C-5	lower	8/31/2017	Nelson	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-3	upper	5/10/2017	Clark	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-3	upper	8/30/2017	Clark	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-3	upper	11/15/2017	Clark	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-3	upper	2/7/2018	Clark	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-2	upper	7/12/2017	Pullen	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-2	upper	10/11/2017	Pullen	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073E-2	upper	2/7/2018	Pullen	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373L-1	upper	5/10/2017	Sterling	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0373L-1	upper	11/14/2017	Sterling	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073D-1	upper	5/11/2017	Coats	0.54	<0.5	<0.5	<0.5	<0.5	<0.5
1073D-1	upper	5/11/2017	Coats	0.53	<0.5	<0.5	<0.5	<0.5	<0.5
1073D-1	upper	8/31/2017	Coats	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 3-2 Continued

StationID	Aquifer	SampleDate	LastName	TCA	DCA	DCE	MC	PCE	TCE
1073L-1	upper	6/20/2017	Halpin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-1	upper	9/27/2017	Halpin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-1	upper	12/5/2017	Halpin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-1	upper	12/5/2017	Halpin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-1	upper	3/15/2018	Halpin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-2	upper	10/11/2017	Countryman	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-3	upper	5/10/2017	Anderson	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-3	upper	8/30/2017	Anderson	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073L-3	upper	11/15/2017	Anderson	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073M-1	upper	7/12/2017	Bertholf	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073M-3	upper	6/20/2017	Lane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073P-1	upper	10/11/2017	Greenen	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1073P-2	upper	8/30/2017	Petrelli	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473D-2	upper	5/10/2017	Wardian	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473D-2	upper	8/31/2017	Wardian	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473D-2	upper	11/15/2017	Wardian	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473D-2	upper	2/7/2018	Wardian	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1473M-1	upper	7/12/2017	Ennis	<0.5	0.76	<0.5	<0.5	<0.5	<0.5
1473M-1	upper	10/11/2017	Ennis	<0.5	0.88	<0.5	<0.5	<0.5	<0.5
1473M-1	upper	2/7/2018	Ennis	<0.5	0.73	<0.5	<0.5	<0.5	<0.5
1573C-7	upper	10/11/2017	Brown	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573C-8	upper	2/7/2018	Williams	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573K-1	upper	10/11/2017	Eschenbacher	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573Q-1	upper	7/12/2017	Saunder	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573R-2	upper	5/10/2017	Hunter	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1573R-2	upper	11/15/2017	Hunter	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Figure 4-2 Upper Aquifer Residential Wells Concentrations vs Time

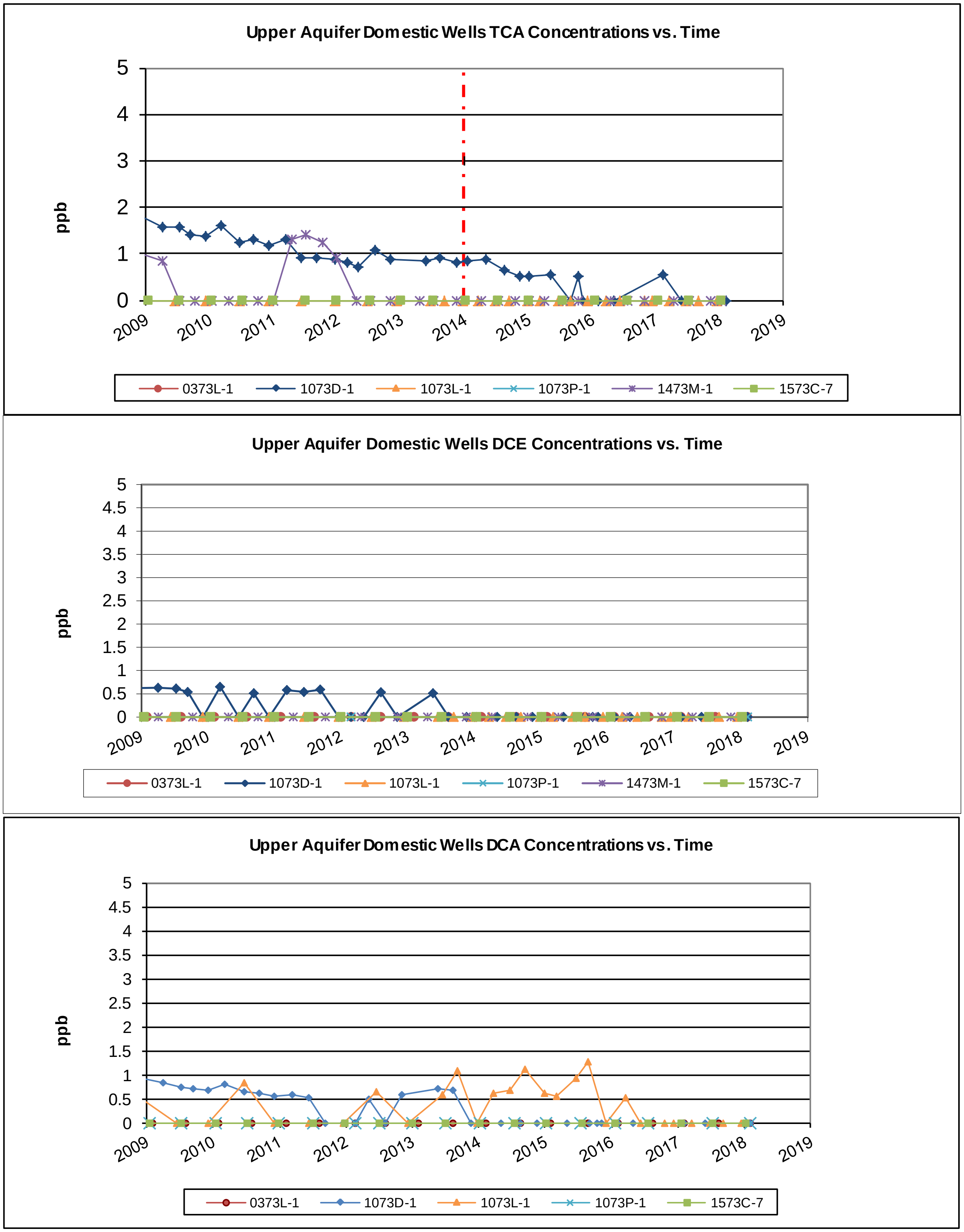
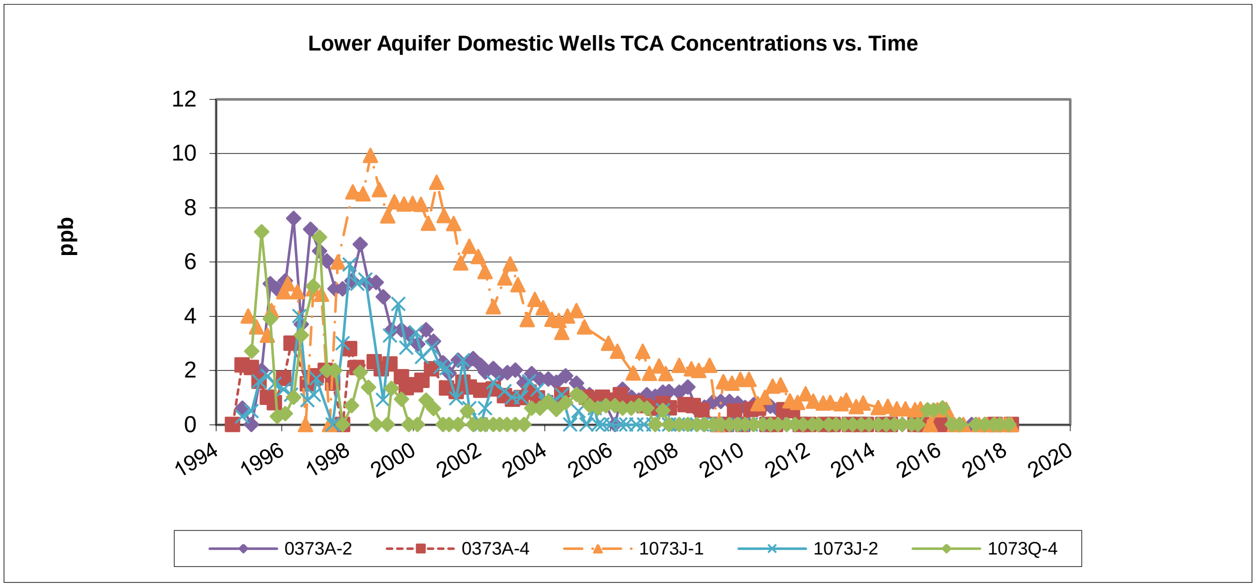


Figure 4-3 Lower Aquifer Residential Wells Concentrations vs Time



5.0 Landfill Operations and Maintenance

From May 1, 2014 through April, 2018 the following routine landfill cover and gas system monitoring and maintenance was accomplished at the Colbert Landfill. Data collected is included in this section.

- Monthly monitoring at gas probes and exhaust system
- Monthly condensate tank levels
- Monthly gas fan maintenance (greasing, belt tension adjustments, etc.)
- Landfill gas sampling and analysis (Method TO-15) was performed in April 2017.
- Quarterly monitoring of trench risers (June, October, February and April).

Other notable items include:

- Cover and ditch weed control was ongoing throughout the growing season.
- Carbon tub change outs were performed in November 2016 and April 2017.
- A cost-benefit analysis was conducted for the option to switch from the activated carbon gas filtration system to a biofilter system at the Colbert site in the fall of 2017. The practice had been to change out the activated carbon every 6 months, but due to the rising costs of purchasing new carbon material and disposing of the old, the annual cost of this practice had risen to $25,000. Taking into account the higher upfront costs of constructing a biofilter, with lower lifetime costs of this system, we found that the financial break-even point over a 20 year period would be to change out the activated carbon every 1.5 years. In other words, if the activated carbon required changing more frequently than once per every 1.5 years, it is financially beneficial to undertake the construction and maintenance of a biofilter system.

  From the fall of 2016 to the spring of 2018, Environmental techs had been sampling the effluent gas every 3 months for signs of "break-out," or when compounds were no longer adsorbing to the carbon material. TO-15 samples for study were collected on 12/14/2016, 3/30/2017, 11/21/2017, and 3/21/2018. After a year and a half, the quarterly samples began to show small signs of mal-adsorption, with emissions of just a few compounds still less than De Minimus thresholds. Because of the financial modeling and the quarterly sampling results, the staff feel comfortable with a new plan to change out the activated carbon material once every 1.5 years now instead of the unnecessary 6-month change out.

Landfill Operations and Maintenance Field Data

6.0 References

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