***[Note: Responses are embedded in these comments received from George Rice during the public comment period from June 10, 2010 to July 10, 2010 for the LHAAP-17 Proposed Plan. Responses are in italic font.]***

**Comments on the**
***Final Proposed Plan for LHAAP-17,* Burning Ground No. 2/Flashing Area Group 2, *Longhorn Army Ammunition Plant, Karnack, Texas*, May 10, 2010**

George Rice
July 9, 2010

## Introduction

These comments were prepared for the Caddo Lake Institute. They are based on evaluations of the final Proposed Plan and the final Feasibility Study for the Longhorn Army Ammunition Plant (LHAAP) site 17 (see references).

Between 1942 and 1997, explosives (TNT), pyrotechnic devices (flares, photoflash bombs), and propellants (rocket motors) were manufactured at LHAAP[1].

Site 17 covers about 3.9 acres[2]. Between 1959 and 1980, waste TNT, photo flash powder, rocket fuel, and material from the Universal Match Corporation were burned at the site. It was also used as a flashing area for decontaminating metals.[3]

Soils at site 17 are contaminated with explosives (TNT, DNT), dioxin, perchlorate, and barium[4]. Groundwater occurs in three zones: shallow, intermediate, and deep[5]. The shallow groundwater is contaminated with VOCs[6] (e.g., TCE, DCE) and perchlorate[7]. Groundwater in the intermediate zone is contaminated with TCE[8] and perchlorate[9].

The Army's preferred remedial alternative is Alternative 4. Under this alternative, contaminated soil would be excavated and disposed off-site.[10] In the shallow zone, contaminated groundwater would be extracted through wells and treated at the existing water treatment plant (pump and treat)[11]. Pump and treat would continue until perchlorate concentrations are less than 20,000 µg/L[12]. Then, natural attenuation (MNA)[13] would be relied on to reduce contaminant concentrations. In the intermediate

---

[1] EPA 2009a, page 3.
[2] US Army, 2010b, page 3.
[3] US Army, 2010b, page 3; US Army, 2010a, page 2-12.
[4] US Army, 2010b, page 5.
[5] US Army, 2010b, page 5.
[6] VOC: volatile organic compound.
[7] US Army, 2010a, page 2-13.
[8] US Army, 2010a, page 2-13.
[9] US Army, 2010a, appendix A, table A-1.
[10] US Army, 2010b, page 16.
[11] US Army, 2010a, page 5-9.
[12] US Army, 2010b, page 16. If perchlorate concentrations have not been reduced to 20,000 µg/L within 1.5 years, a contingency action may be performed (e.g., in-situ bioremediation, US Army, 2010b, page 16).
[13] MNA: monitored natural attenuation.

zone, only MNA would be relied on to reduce contaminant concentrations[14]. Land use controls (LUCs) would be maintained until contaminant concentrations are reduced to acceptable levels (clean-up levels, i.e., MCLs or State of Texas standards)[15]. The estimated cost of this alternative is $2,090,000[16].

## Comments

### 1. Trigger for stopping pump and treat

1a. The Army intends to stop pumping and treating groundwater once average perchlorate concentrations are reduced to 20,000 µg/L[17]. According to the Army, high concentrations of perchlorate inhibit the natural attenuation of TCE[18].

However, the Army has not presented any evidence to show that there are significant differences in the attenuation of TCE when the perchlorate concentration is below 20,000 µg/L. In fact, TCE concentrations are increasing at monitor wells 130 and 17WW03, even though perchlorate concentrations at these wells are well below 20,000 µg/L (see figures 1a, 1b, 2a, and 2b). On the other hand, perchlorate concentrations in monitor well 17WW06 are much higher than 20,000 µg/L, but TCE concentrations are decreasing (see figures 3a and 3b).

Thus, there does not appear to be a strong relationship between perchlorate concentrations and the attenuation of TCE. The Army should not rely on a reduction in perchlorate concentrations to result in the attenuation of TCE.

***Response:*** *Studies of natural attenuation and guidance for implementing MNA presume that biologically assisted attenuation proceeds from the most easily reduced compounds to the ones that are most difficult. Perchlorate is more easily reduced than TCE. The microbes that metabolize perchlorate are ubiquitous in the natural environment, and there appears to be no potential "stalling" at daughter products (which can happen with TCE). The perchlorate concentration of 20,000 µg/L was selected based on data from LHAAP-17 and another site at Longhorn. At LHAAP-17, observation of the subsurface conditions is complicated by the perchlorate contaminated soil which may add perchlorate to the groundwater via percolation. The performance of natural attenuation to meet remedial action objectives will be evaluated after soil removal, groundwater pumping, and eight quarterly sampling events. If it is found that the performance objectives are not being met with natural attenuation, a contingent remedy such as in situ bioremediation would be implemented.*

1b. It appears that the Army intends to stop pump and treat once the trigger is reached, regardless of the effect that pump and treat is having on

[14] US Army, 2010b, page 12.
[15] US Army, 2010b, page 10. MCL: EPA maximum contaminant limit for drinking water. Because there is no MCL for perchlorate, the State of Texas standard will be used (72 µg/L, GW-Ind; US Army, 2010a, appendix A, page 3-1).
[16] US Army, 2010b, page 13.
[17] US Army, 2010b, page 16.
[18] US Army, 2010a, appendix A, page 3-3.

contaminant concentrations[19]. This is not a reasonable approach to contaminant clean-up. The Army should evaluate the effectiveness of pump and treat when the trigger is reached. Then, if it is still having a substantial effect on contaminant concentrations, pump and treat should be continued. The pump and treat system should be operated as long as it is causing significant reductions in contaminant concentrations.

***Response:*** *The U.S. Army has chosen to implement pump and treat to reduce the highest contaminant concentrations at LHAAP-17 to make conditions more favorable for MNA. Contaminant removal by pump and treat methods operates with diminishing returns – as concentrations decrease, the mass removal rate also falls. Inevitably, a point is reached at which remediation by pump and treat is no longer cost effective. The pump and treat system in conjunction with the site hydrogeological conditions may also be considered ineffective if the system is incapable of reducing perchlorate concentrations at a rate that would be considered productive. As the wording in the comment implies, "substantial effect" and "significant reductions", there is some amount of interpretation involved in deciding when to turn off the pumps. However, pump and treat is not the primary remedy selected or evaluated for LHAAP-17. It is used to assist the primary remedy of MNA by reducing the highest contaminant concentrations. If the pump and treat does not effectively reduce the highest contaminant concentrations in the reasonable time allowed, a contingency remedy will be implemented.*

**2. Increasing TCE concentrations and effectiveness of MNA**

TCE samples have been collected from 11 monitor wells in the shallow zone[20]. TCE concentrations have exceeded the 5 µg/L MCL in six of these wells[21]. Of these six wells TCE concentrations are rising in four, and dropping in two (see figures 1b, 2b, 3b, 4, 5, and 6). The table below shows the most recent TCE concentrations found in the six wells.

**Table 1**
**Most Recent TCE Concentrations in Shallow Zone Monitor Wells[22]**

| **Wells with increasing concentrations of TCE** | | **Wells with decreasing concentrations of TCE** | |
|---|---|---|---|
| Well ID | TCE (µg/L) | Well ID | TCE (µg/L) |
| 130 | 31.1 | 17WW04 | 0.9 |
| 17WW01 | 6090 | 17WW06 | 176 |
| 17WW02 | 867 | | |
| 17WW03 | 12.8 | | |

Clearly, natural attenuation is not acting to reduce TCE concentrations throughout the site. Although the Army claims that high concentrations of perchlorate are inhibiting the attenuation of TCE, this assertion is not supported by the data (see comment 1a). The Army should reevaluate its reliance on natural attenuation to reduce TCE concentrations at site 17.

[19] US Army, 2010b, page 16.
[20] US Army, 2010a, appendix A, table A-1.
[21] US Army, 2010a, appendix A, table A-1.
[22] Data source: US Army, 2010a, appendix A, table A-1.

***Response:*** *The most significant increase in TCE concentrations is seen at well 17WW01 between 1998 and 2004. TCE concentrations have declined in this well since 2004. Increases in TCE concentrations at wells 130, 17WW02, and 17WW03 are not as significant and may reflect seasonal variations instead of an overall increase in mass. The groundwater gradient at LHAAP-17 is fairly flat and the diffusion of TCE away from 17WW01 may cause a rise in concentrations in the surrounding wells (i.e. 17WW02 and 17WW03). Even though there are fluctuations in the wells at LHAAP-17, the plume is bounded and there does not appear to be a significant migration of the plume. Additionally, pump and treat will contain the plume and will reduce TCE concentrations (prior to MNA evaluation) as well as the perchlorate.*

*Under current conditions at LHAAP-17, with the addition of perchlorate from contaminated soil by percolation, natural attenuation cannot be effectively evaluated since the high perchlorate concentrations are inhibiting TCE attenuation. After contaminated soil is removed, groundwater pumping will still disturb natural conditions. It is only after soil is removed and pumping is stopped that an effective MNA evaluation may be made. When that evaluation is complete, and if it is favorable, MNA will continue as the remedy. However, if the evaluation is not favorable, another remedy (e.g. in situ bioremediation) will be implemented to reduce the TCE concentrations.*

**3. Time required for MNA to achieve TCE clean-up level**

3a. The Army estimates that natural attenuation will reduce TCE concentrations in the shallow groundwater zone to the clean-up level (5 µg/L) in less than 120 years[23]. It is not reasonable to propose a plan that could require the maintenance of LUCs for a century.

***Response:*** *The reasonably anticipated future use of the site is as a wildlife refuge (i.e., Caddo Lake National Wildlife Refuge). Once the property is transferred into the refuge system, the property must be kept as a National Wildlife Refuge unless there is an act of Congress which removes the parcel or the land is exchanged in accordance with the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Act Amendments of 1974. This proposed transfer as a national wildlife refuge, which by its very nature includes physical access and use restrictions, is subject to control and continual inspection by Refuge personnel. Also, the property is intended to remain under ownership and management of a federal government agency. The LUC will restrict access to the groundwater for purposes other than environmental testing until cleanup levels are met. Maintenance of the LUC for groundwater use restrictions would require minimal effort and would be reasonable for extended lengths of time. Effectiveness of the LUC will be evaluated as part of the statutory five-year reviews and does not pose additional burden. Additionally, access of groundwater through well installations requires a permit from the Texas Department of Licensing and Regulation or Texas Water District authority. The department will be provided a copy of the county recordation that indicates the location of contaminated groundwater at the site and associated restriction.*

[23] US Army, 2010b, page 13; and US Army, 2010a, appendix A, page 4-3.

3b. The clean-up time estimate is based on data from monitor well 17WW06, where TCE concentrations are declining (see figure 3b)[24]. However, this estimate does not apply to those portions of site 17 where TCE concentrations are increasing (see comment 2). The Army should provide an estimate of clean-up time for the entire site.

***Response:*** *Although there is some uncertainty associated with the cleanup time for the entire site because of the inhibitive effects of perchlorate, the data collected during the two year period of natural attenuation monitoring (post pump and treat) will be used to remove some of the uncertainties associated with the estimate of time to achieve MCLs. The statutory five-year reviews will evaluate the effectiveness of the remedy and estimated durations to reach MCLs and would recommend implementation of other measures if needed.*

**4. Time required for MNA to achieve perchlorate clean-up level**

The Army estimates that natural attenuation will reduce perchlorate concentrations to the clean-up level (72 µg/L) within 15 years[25]. This estimate is based on perchlorate degradation rates (half-lives) calculated for eight monitor wells[26]. However, the Army did not calculate degradation rates for two monitor wells that currently contain high perchlorate concentrations: well 17WW01 (56,000 µg/L) and well 17WW02 (160,000 µg/L)[27]. Over the entire period of record, perchlorate concentrations in these two wells have increased, although concentrations in both wells are currently decreasing (see figures 7 and 8).

Wells 17WW01 and 17WW02 are important data points that the Army has not accounted for in its estimate. The Army should explain why it did not use data from these wells to estimate the clean-up time for perchlorate at site 17.

***Response:*** *Data from wells 17WW01 and 17WW02 were not used because those two wells appear to be receiving additional perchlorate as it leaches into groundwater from the overlying contaminated soil. The removal of contaminated soil will end this influx, and the pump and treat activity will reduce perchlorate concentrations in the groundwater at those two wells (to 20,000 µg/L). As the perchlorate concentration at 17WW06 (74,000 µg/L) is significantly higher, the U.S. Army feels that the cleanup time estimated for perchlorate at 17WW06 by MNA provides a reasonable estimate.*

[24] US Army, 2010a, appendix A, table A-4.
[25] US Army, 2010a, appendix A, page 4-2.
[26] US Army, 2010a, appendix A, table A-4.
[27] US Army, 2010a, appendix A, table A-1. The Army did calculate a distance-dependent degradation rate for these wells (US Army, 2010a, appendix A, table A-5). However, the EPA has stated that distance dependent attenuation rates should not be used to directly estimate contaminant plume lifetimes (US Army, 2010a, appendix A, page 3-9).

## 5. Perchlorate in the intermediate zone

The Army does not consider perchlorate to be a contaminant of concern (COC) in the intermediate groundwater zone[28]. However, high concentrations of perchlorate have been detected in intermediate zone monitor well 17WW11[29]. Therefore, perchlorate should be a COC in the intermediate zone.[30]

***Response:*** *Well 17WW11 is considered a shallow-intermediate well. There was no distinct clay layer to separate the shallow and intermediate zones. Boring logs for it and surrounding wells were inspected along with groundwater elevations, and it appears to be more reasonably connected with nearby shallow zone monitoring wells than with nearby intermediate zone monitoring wells. As a result, the well 17WW11 has been included with the shallow wells, and within the defined perchlorate plume. Also, perchlorate concentrations were below the detection limit in the intermediate groundwater zone wells (17WW07, 17WW09, 17WW15, and 17WW17).*

## 6. Remedial Design

The Army will present details of the soil excavation plan, the pump and treat system, the groundwater remediation performance objectives, the plan for implementing and evaluating MNA, and the LUC implementation plan, in the Remedial Design (RD)[31]. However, the RD has not yet been produced. Given its importance, the Army should make the RD available for public review and comment as soon as practicable.

***Response:*** *The public will be provided with updates on remedial design and remedial action status through the RAB meeting and any concerns can be addressed through this forum. The RD will include performance objectives, schedule and other design criteria and will follow established regulatory guidance for MNA.*

---

[28] US Army, 2010a, page 2-13.

[29] The most recent sample collected from well 17WW11 contained 990 µg/L perchlorate (US Army, 2010a, appendix A, table A-1).

[30] It should be noted that the Army classifies well 17WW11 as shallow/intermediate because there is no distinct layer of clay separating the shallow and intermediate zones at this location (US Army, 2010a, appendix A, page 3-10). However, the perchlorate in well 17WW11 probably comes from the intermediate zone because a shallow zone well immediately adjacent to well 17WW11, well 17WW12, contains no perchlorate (US Army, 2010a, figure 2-2; US Army, 2010a, appendix A, table A-1; and appendix B, figure B-3).

[31] US Army, 2010b, page 17.

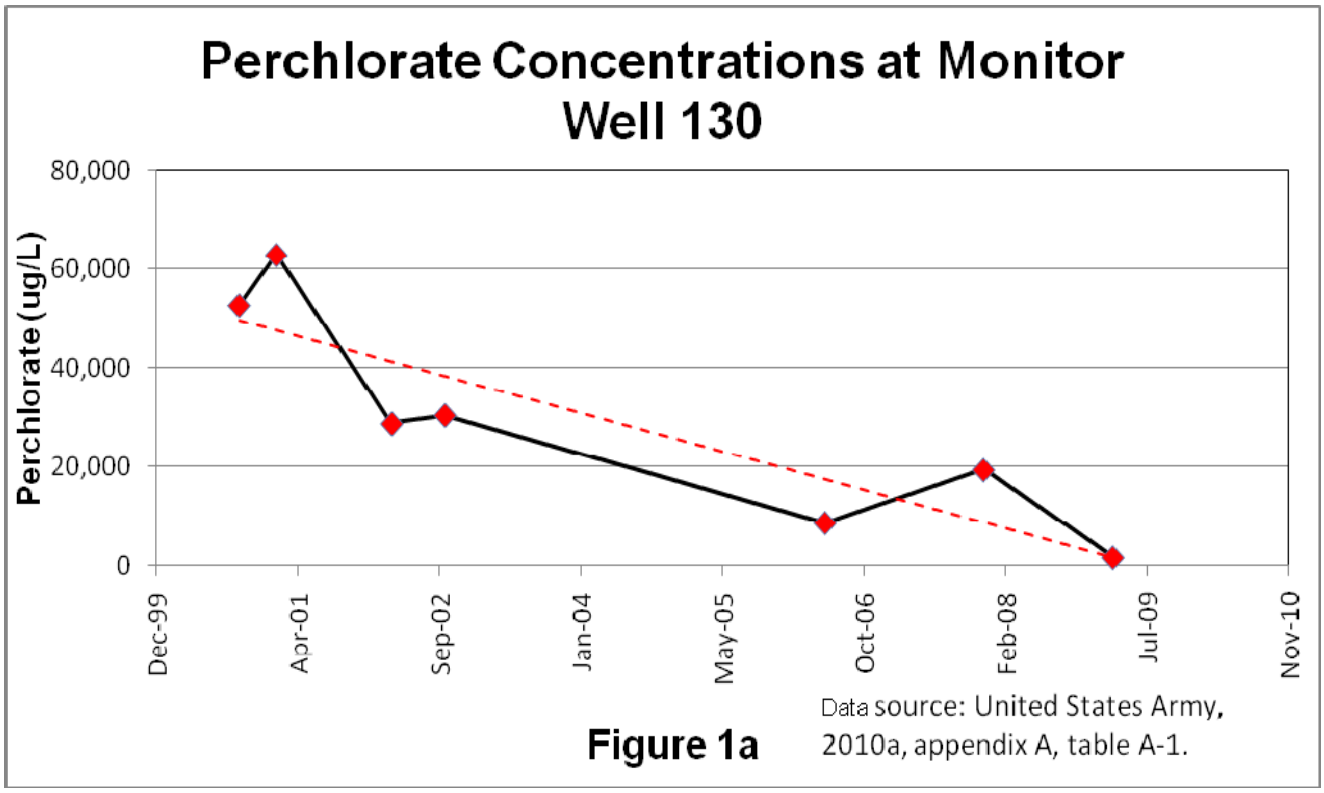
## References

EPA, 2009a, *Longhorn Army Ammunition Plant, Harrison County, Texas,* November 2009.

United States Army, 2010a, Final Feasibility Study, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, , *Longhorn Army Ammunition Plant, Karnack, Texas*, April 10, 2010.

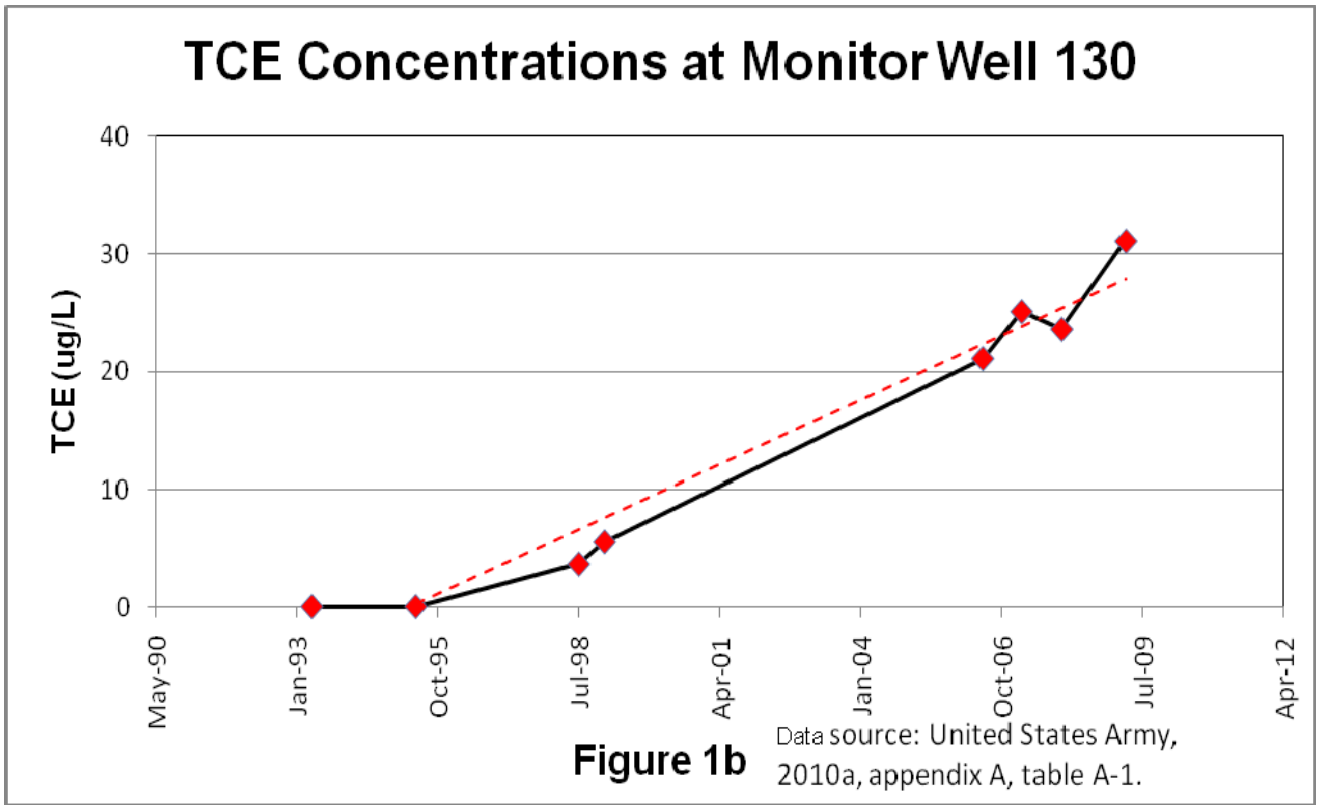
United States Army, 2010b, *Final Proposed Plan for LHAAP-17,* Burning Ground No. 2/Flashing Area Group 2, *Longhorn Army Ammunition Plant, Karnack, Texas*, May 10, 2010.

## Figures




Data source: United States Army, 2010a, appendix A, table A-1.

**Figure 1a**




Data source: United States Army, 2010a, appendix A, table A-1.

**Figure 1b**

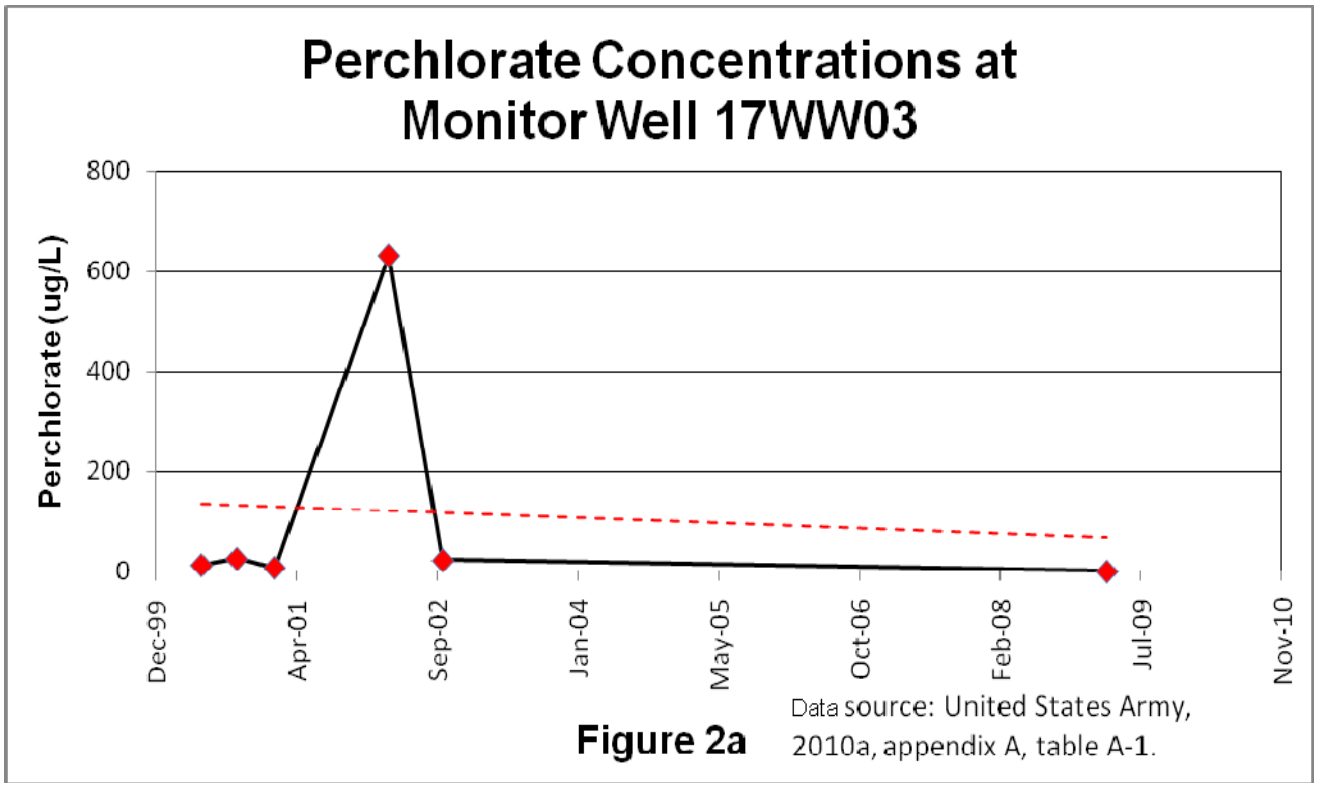



Figure 2a Data source: United States Army, 2010a, appendix A, table A-1.

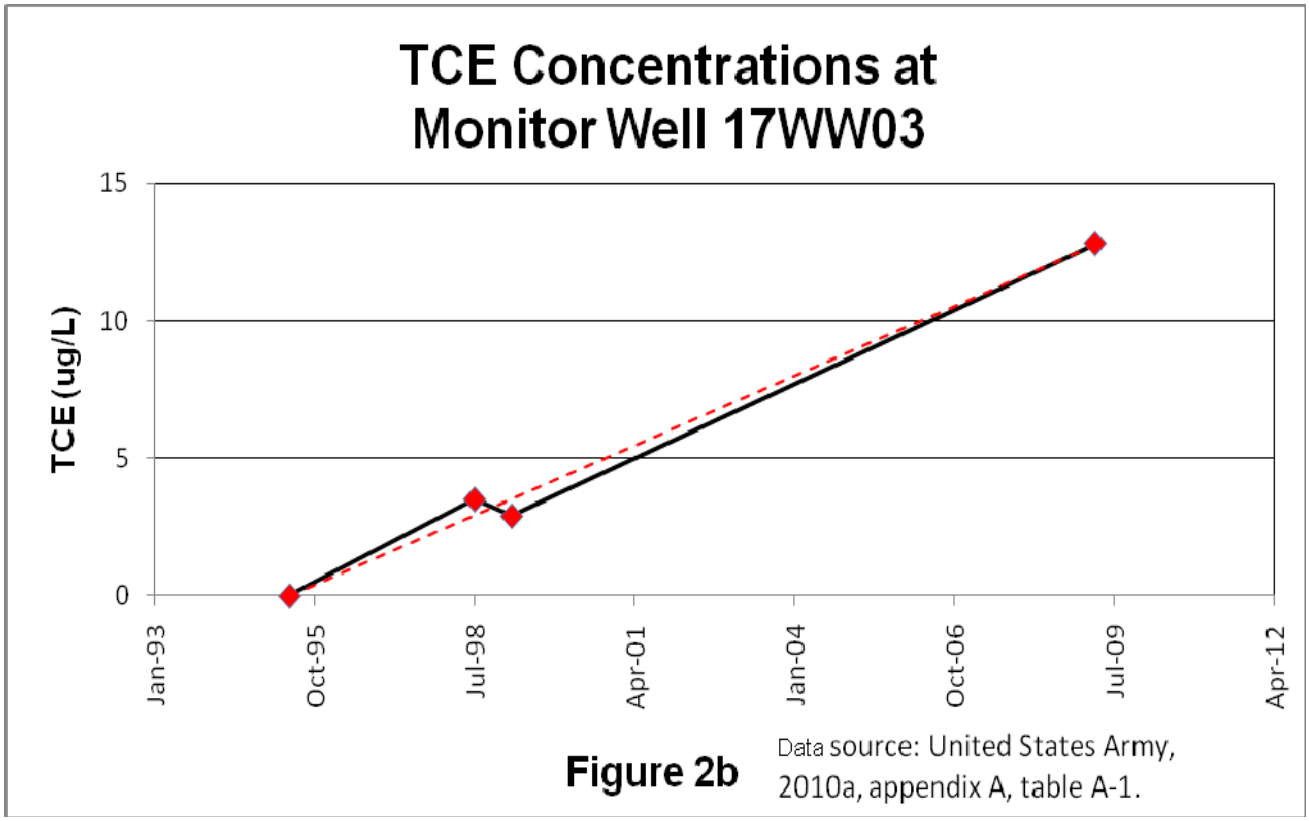



Figure 2b Data source: United States Army, 2010a, appendix A, table A-1.

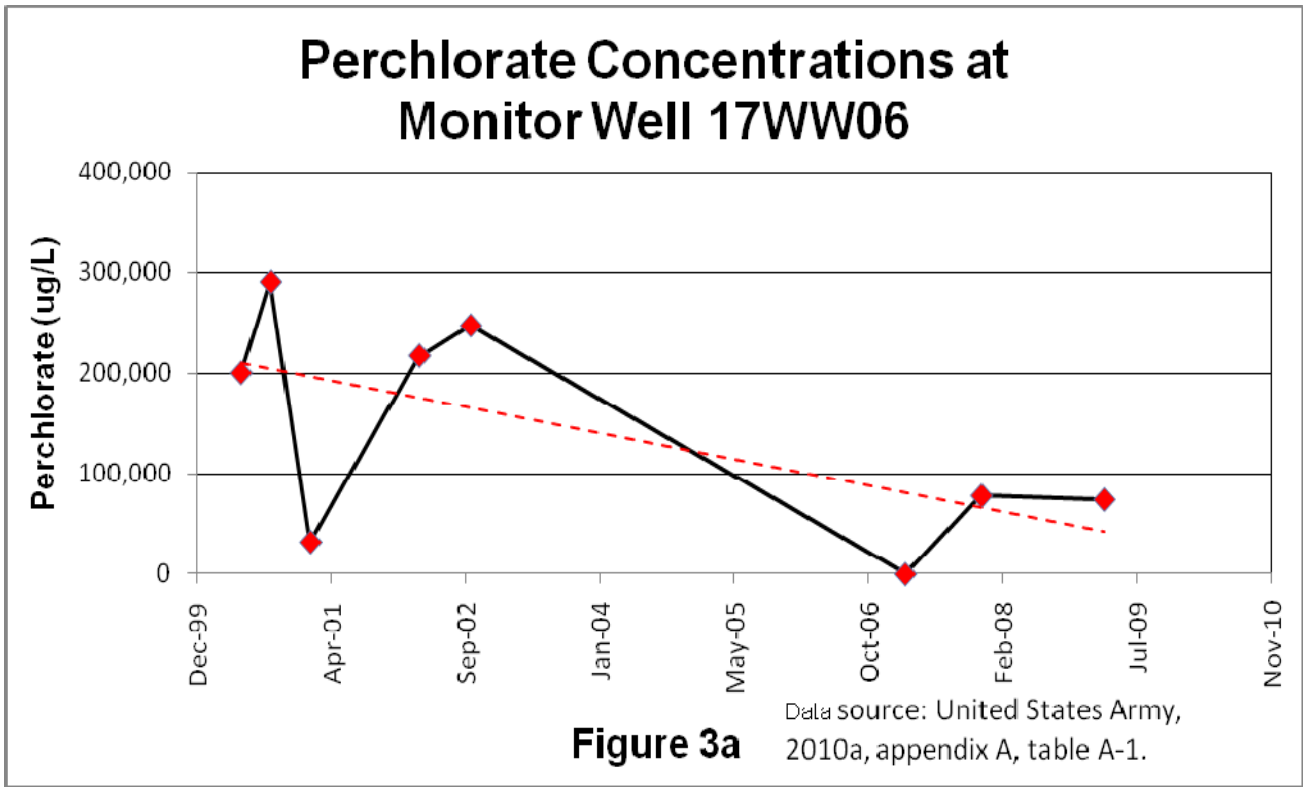



Figure 3a Data source: United States Army, 2010a, appendix A, table A-1.

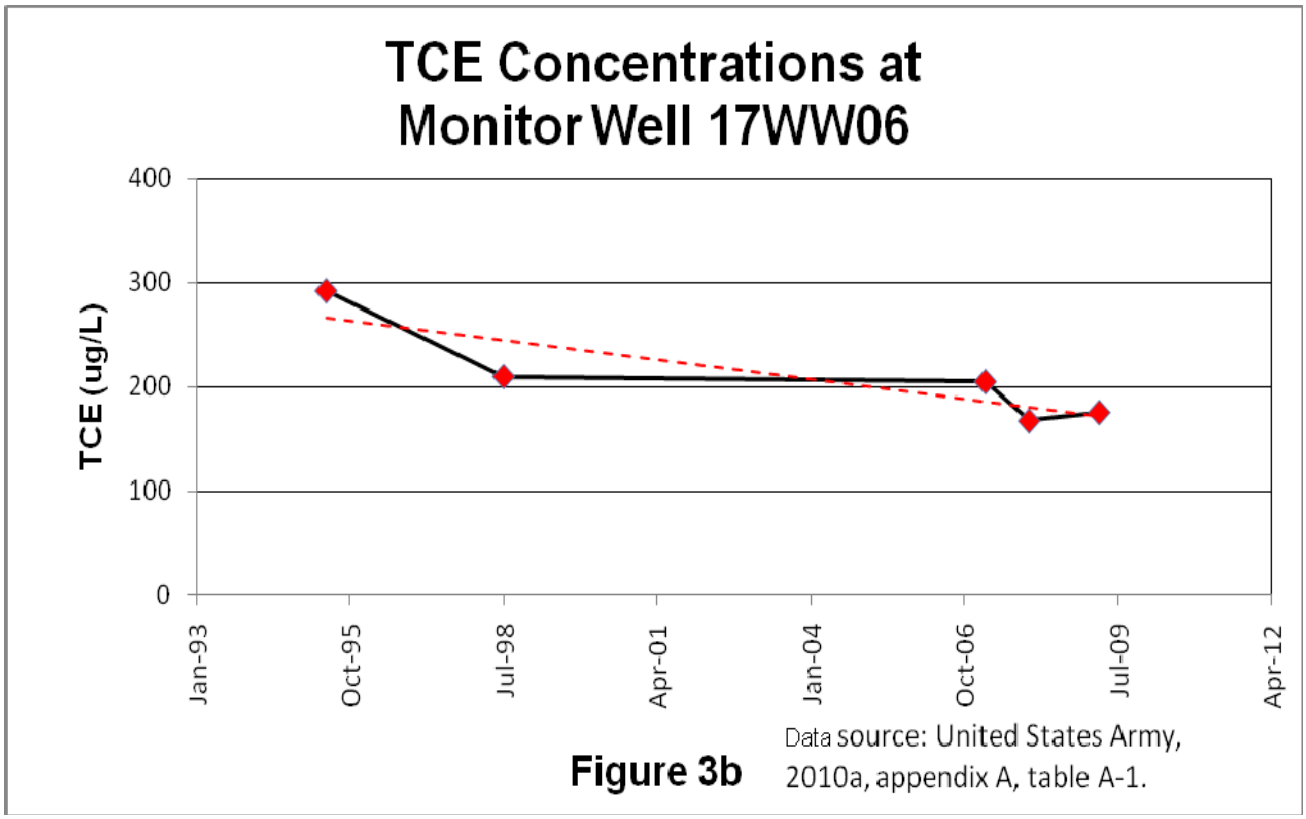



Figure 3b Data source: United States Army, 2010a, appendix A, table A-1.

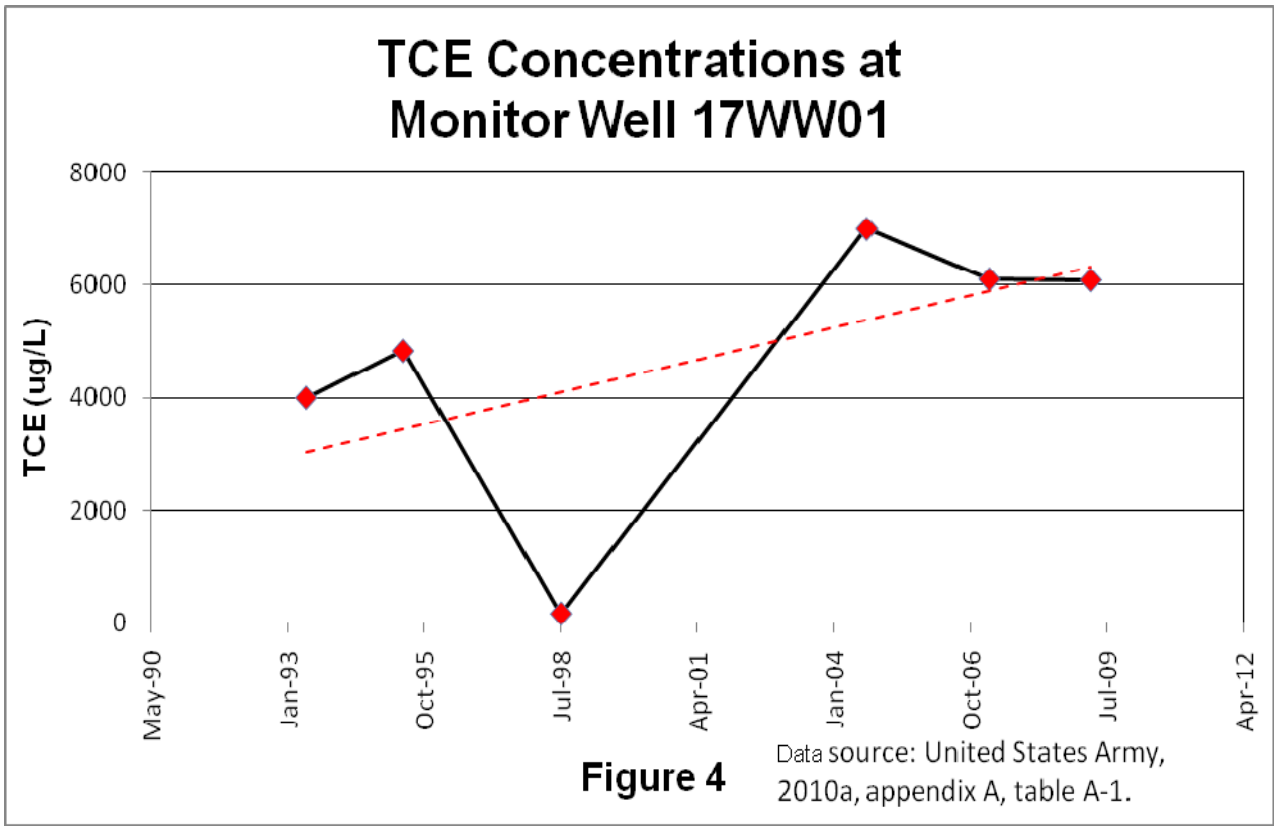



Figure 4 Data source: United States Army, 2010a, appendix A, table A-1.

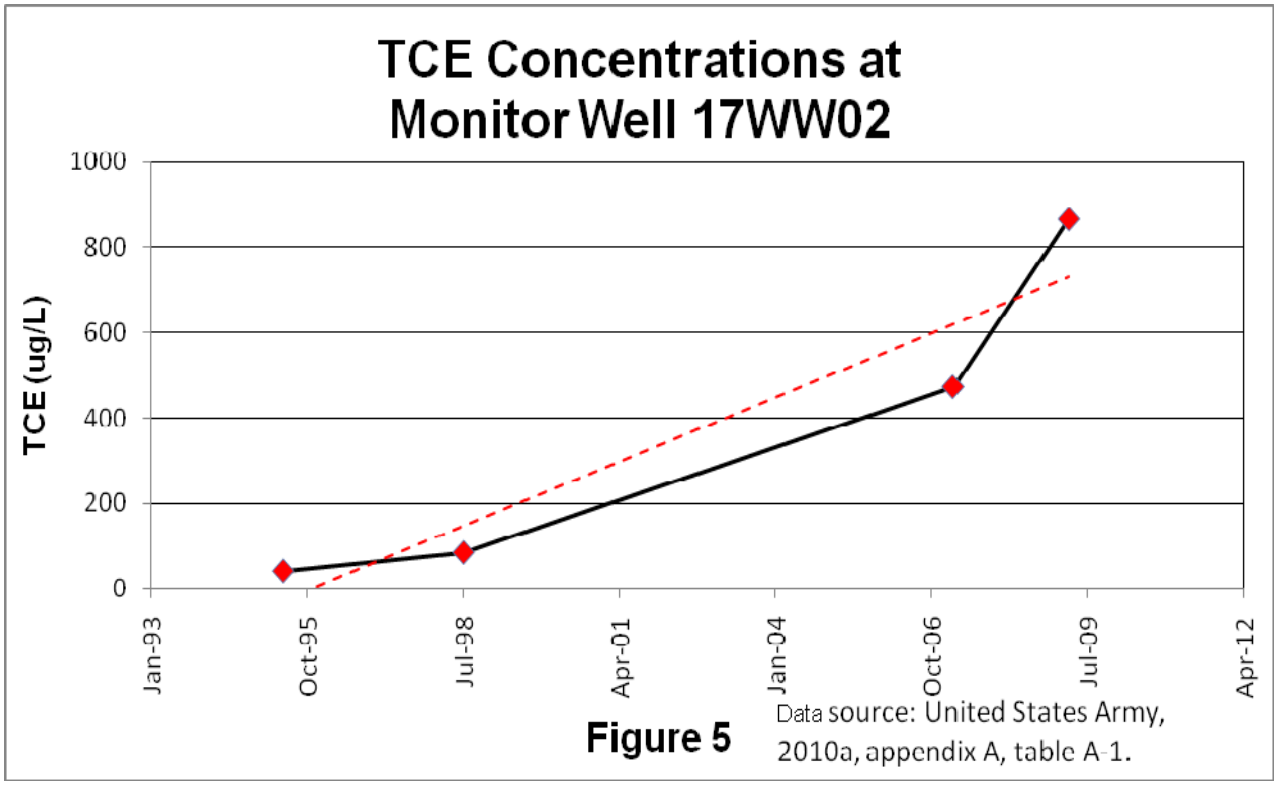



Figure 5 Data source: United States Army, 2010a, appendix A, table A-1.

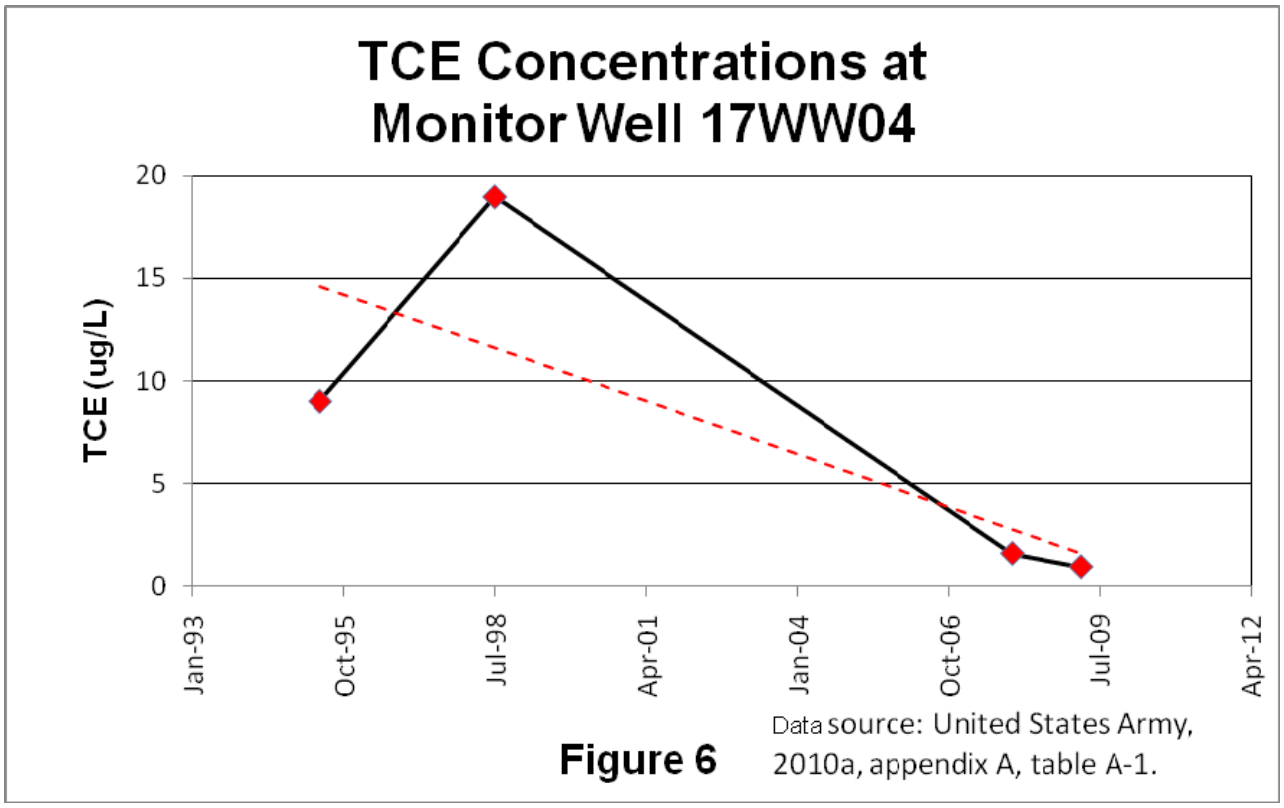



Figure 6 Data source: United States Army, 2010a, appendix A, table A-1.

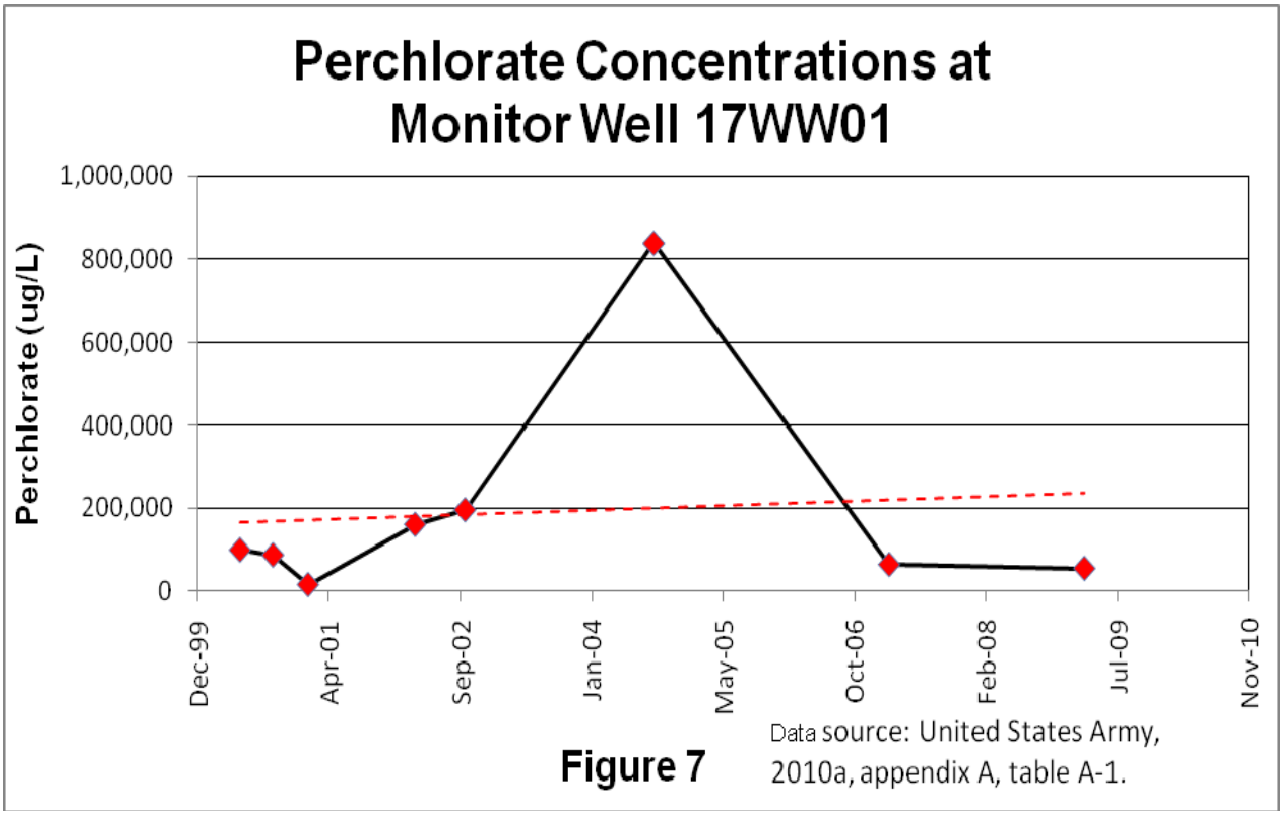



Figure 7 Data source: United States Army, 2010a, appendix A, table A-1.

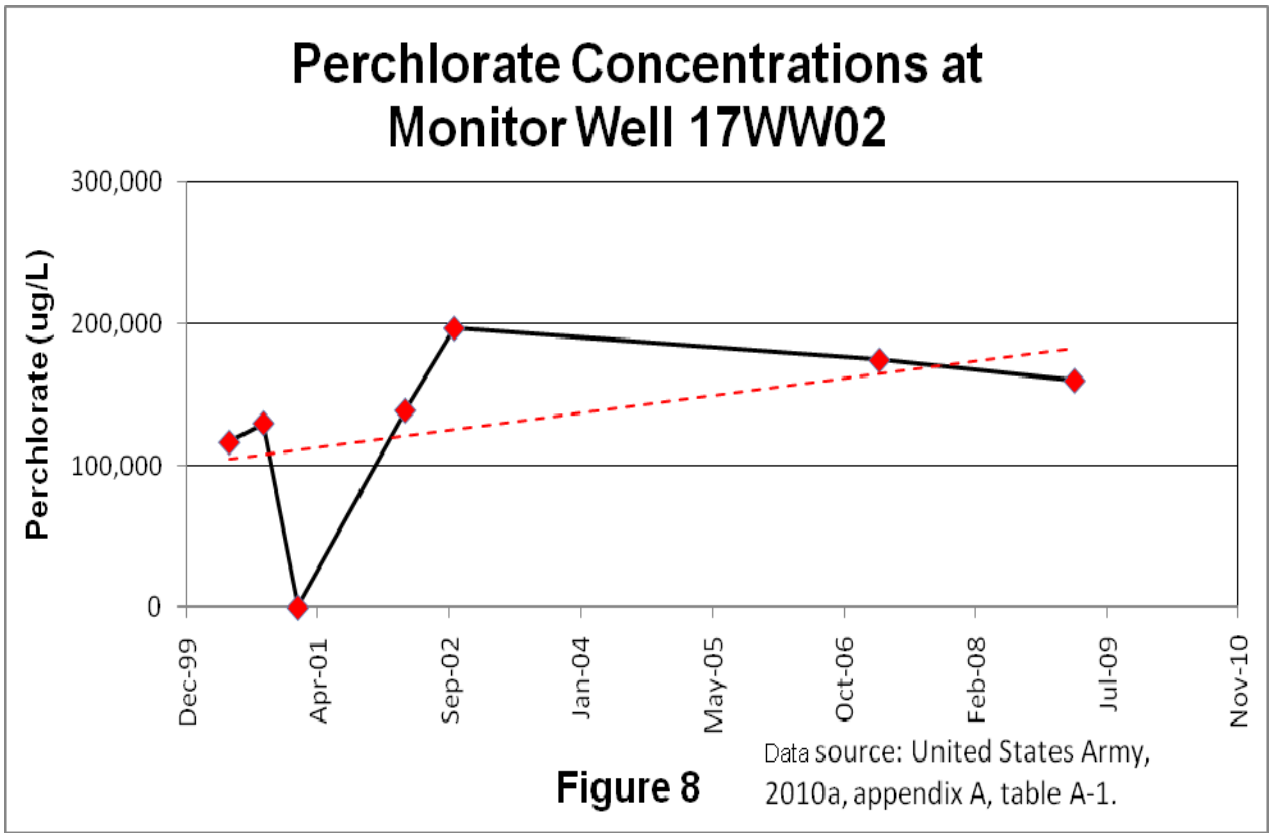



Figure 8

Data source: United States Army, 2010a, appendix A, table A-1.