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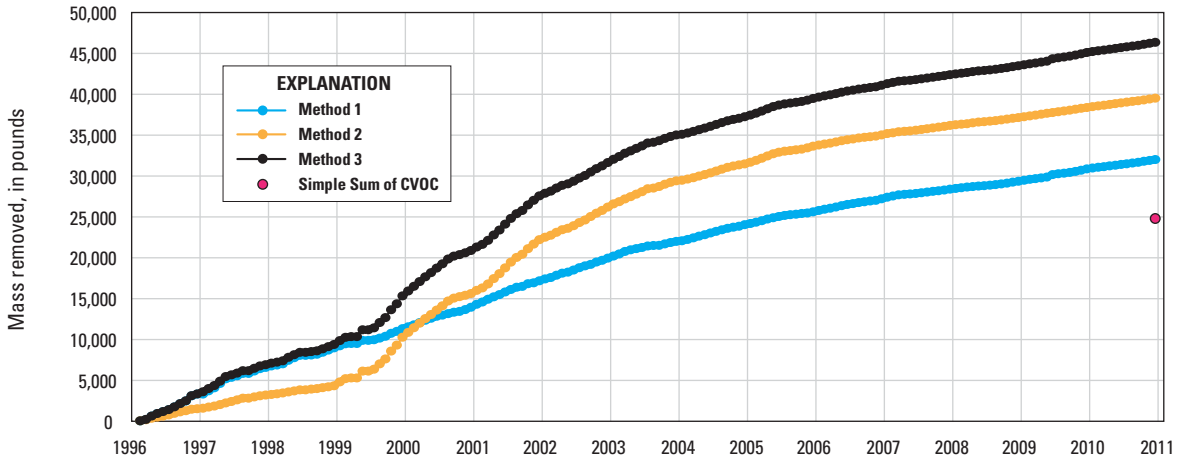
Mass of Chlorinated Volatile Organic Compounds Removed by Pump-and-Treat, Naval Air Warfare Center, West Trenton, New Jersey, 1996–2010



Scientific Investigations Report 2011–5003

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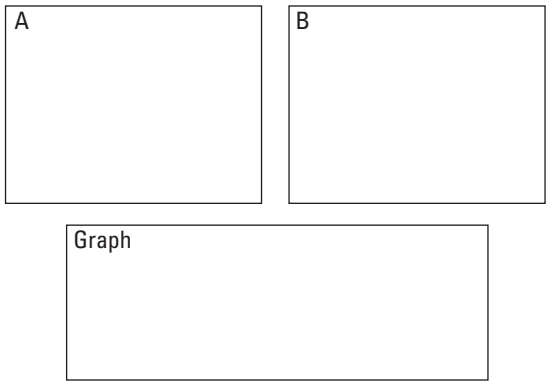

Cover. Photo A, Pump and Treat plant; Photo B, Pump and Treat recovery well; Graph, shows mass of original trichloroethylene recovered based on analysis of influent to Pump and Treat plant (Method 1), analysis of withdrawal from recovery wells (Method 2), maximum monthly recovery based on Methods 1 and 2, (Method 3) (Photographs by Pierre J. Lacombe, U.S. Geological Survey, March 29, 2011)

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Contents

Figures

Tables

Conversion factors

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Volume	
liter (l)	0.2642	gallon (gal)
	Mass	
gram (g)	0.002205	pound (lb)
	Flow rate	
liter per second (l/s)	0.2642	gallon per minute (gal/min)

Chlorinated Volatile Organic Compounds

	Trichloroethylene (TCE)	Dichloroethylene (cDCE and tDCE)	Vinyl chloride (VC)
Molecular weight (grams per mole)	131.39	96.95	62.498
(moles per gram)	0.007611	0.010315	0.016001
Density (grams per cubic centimeter)	1.46	1.28	0.91
(cubic centimeter per gram)	0.684932	0.78125	1.098901
Moles to pounds	0.289715	0.213775	0.13779
Pounds to moles	1.6782E-05	7.8507E-05	1.2178E-04
Gallons per pound	0.082	0.094	0.132
Pound per gallon	12.183	10.681	7.594

Mass of Chlorinated Volatile Organic Compounds Removed by Pump-and-Treat, Naval Air Warfare Center, West Trenton, New Jersey, 1996–2010

By Pierre J. Lacombe

Abstract

Pump and Treat (P&T) remediation is the primary technique used to contain and remove trichloroethylene (TCE) and its degradation products cis 1-2,dichloroethylene (cDCE) and vinyl chloride (VC) from groundwater at the Naval Air Warfare Center (NAWC), West Trenton, NJ. Three methods were used to determine the masses of TCE, cDCE, and VC removed from groundwater by the P&T system since it became fully operational in 1996. Method 1, is based on the flow volume and concentrations of TCE, cDCE, and VC in groundwater that entered the P&T building as influent. Method 2 is based on withdrawal volume from each active recovery well and the concentrations of TCE, cDCE, and VC in the water samples from each well. Method 3 compares the maximum monthly amount of TCE, cDCE, and VC from Method 1 and Method 2. The greater of the two values is selected to represent the masses of TCE, cDCE and VC removed from groundwater each month.

Previously published P&T monthly reports used Method 1 to determine the mass of TCE, cDCE, and VC removed. The reports state that 8,666 pounds (lbs) of TCE, 13,689 lbs of cDCE, and 2,455 lbs of VC were removed by the P&T system during 1996–2010. By using Method 2, the mass removed was determined to be 8,985 lbs of TCE, 17,801 lbs of cDCE, and 3,056 lbs of VC removed, and Method 3, resulted in 10,602 lbs of TCE, 21,029 lbs of cDCE, and 3,496 lbs of VC removed. To determine the mass of original TCE removed from groundwater, the individual masses of TCE, cDCE, and VC (determined using Methods 1, 2, and 3) were converted to numbers of moles, summed, and converted to pounds of original TCE. By using the molar conversion the mass of original TCE removed from groundwater by Methods 1, 2, and 3 was 32,381 lbs, 39,535 lbs, and 46,452 lbs, respectively, during 1996–2010.

P&T monthly reports state that 24,805 lbs of summed TCE, cDCE, and VC were removed from groundwater. The simple summing method underestimates the mass of original TCE removed by the P&T system.

Introduction

The U.S. Navy installed a pilot Pump-and-Treat (P&T) system (fig. 1) at the Naval Air Warfare Center (NAWC), West Trenton, NJ, on March 15, 1995. The P&T containment system was designed to create a cone of depression in the Site 1 and Site 3 Plumes that would (1) prevent flow of chlorinated volatile organic compounds (CVOCs) to the surrounding neighborhood where it might contaminate water-supply wells; and (2) prevent contaminated groundwater from discharging to nearby intermittent streams that flow in the West Ditch culvert and the Gold Run culvert. In addition, the P&T system was designed to remove trichloroethene (TCE) and its degradation products cis-1,2-dichloroethene (cDCE) and vinyl chloride (VC) from the subsurface.

The pilot P&T system in 1995 consisted of one recovery well, an underground transmission line, and the P&T building where the contaminated water was treated. The pilot P&T system was put into full operation in February 1996. By April 1998, upgrades to the P&T system were completed, and the expanded P&T system consisted of an expanded underground transmission line network and 14 recovery wells that could be pumped at the Navy's discretion. In 1998, wells 04BR, 08BR, 15BR, 16BR, 20BR, 22BR, 29BR, 31BR, 41BR, 45BR, 48BR, BRP-01, BRP-02, and West Ditch well (WDW) were available for use as recovery wells for the P&T system. In 2004, well 56BR was added to the recovery system. The P&T system operated continuously during 1996–2010, except for during short periods of maintenance and power outages.

The Navy used TCE as a heat transfer agent while performing tests on jet engines during 1953–95. The Navy had a 25,000-gallon (304,607 pounds (lbs)) capacity TCE piping system with associated valves, pumps, and heat exchanger, as well as three TCE tanks that held a total of 12,825 gallons (156,264 lbs). TCE occasionally would leak from valves, joints, pumps, tanks, and pipes. In addition, TCE was discarded at the NAWC if it was contaminated with water condensation. There is no concise estimate of how much TCE leaked or was discarded at the NAWC. Rogers, Golden, and Halpern, (1986) estimated that during 1951–55 the volume of

TCE that was disposed of (leaked to waste) was 5,000 gallons (60,915 lbs) and further estimated that during 1951–55 leakage was 10 percent of the waste (leakage) generated after 1955. Rogers, Golden, and Halpern, (RGH; 1986) estimated that 50,000 gallons (609,150 lbs) of TCE leaked during 1955–86. RGH estimated that only 1 percent or 500 gallons (6,092 lbs) of the leakage entered the ground and the rest evaporated. RGH report that tests of three condenser tubes were found to leak refrigerant (TCE) in 1980. RGH also estimated 500 gallons of TCE leaked from a test building at a rate of 20 gallons per year for 25 years. In total, RGH estimated that 55,500 gallons or 676,166 lbs of TCE leaked at NAWC.

On the basis of CVOC concentrations in groundwater, Lacombe (2007) estimated that 2,900 to 47,400 liters (9,334 to 152,600 lbs) of TCE were in the subsurface in 2006. The lesser estimate assumes that the CVOC is in the fracture system only, and the greater estimate assumes that the CVOC is in the fracture system, adsorbed to the rock matrix, and that pure TCE exists in some fractures.

Jet fuel, used during engine tests, also leaked from fuel storage tanks and transmission pipes. The jet fuel tanks and pipes were in the same location as most of the TCE storage tanks and transmission pipes. Because of the fuel spill and the local bedrock geology, much of the TCE in the shallow bedrock biodegraded to various CVOCs and ethane. Analysis of groundwater at NAWC showed that the major CVOCs present are TCE and the major degradation products, cDCE and VC. Minor CVOCs include trans-1,2-dichloroethene (tDCE), 1,1-dichloroethene, and tetrachloroethene (PCE). Most of the DCE found at the NAWC is cDCE. Only a small mass of tDCE has been removed (49 lbs). In this report, cDCE and tDCE are generally combined and are referred to cumulatively as cDCE.

The first monthly report that documents P&T operations was published for February 1996. During February 1996 through December 2010, the Navy produced 178 monthly P&T operation reports to document influent rates, CVOC concentrations, groundwater pumping rates, and monthly and cumulative TCE, cDCE, and VC removals. Reports for 2 months are not available (Sept. 1997 and July 1998.) The study discussed in this report was conducted, in cooperation with the U.S. Navy, to compile and reinterpret the data from the 178 months.

Purpose and Scope

This report documents the monthly and cumulative mass of TCE, cDCE, and VC, as well as the monthly and total mass of original TCE removed by the P&T containment system. Original TCE is the compound that leaked from the storage and piping system at the NAWC. Much of the original TCE degraded in the past 45 years to cDCE and VC. The mass of TCE, cDCE, and VC removed was determined using three methods. Method 1 uses flow rates and CVOC concentrations of influent entering the P&T building. Method 2 uses the pumping rates and CVOC concentrations in groundwater from the active recovery wells. Method 3 uses the maximum mass of TCE, cDCE, and VC that was removed monthly and is based on Methods 1 and 2.

Removal of the contaminants documented in this report began in February 1996 and ended in December 2010. Data were obtained from 176 monthly P&T operations reports for the 178 months and 50 water-quality reports for the groundwater withdrawn by the recovery wells. The reported data are tabulated, graphed, and discussed.

The masses of TCE, cDCE, and VC provided in this report vary from the masses stated in the monthly reports because of errors in adding or publication. The masses of TCE, cDCE, and VC vary from table to table in this report because of conversion factors and rounding errors.

Previous Investigations

Foster Wheeler Environmental Corporation (1995) and EA Engineering, Science, and Technology, Inc., (1995) describe start-up of the P&T operations during 1995. At that time, each component of the P&T system was tested and evaluated, and by February 1996, the system was operational.

From February 1996 through December 2010, 178 monthly P&T system reports were prepared by environmental contractors of the U.S. Navy. The first monthly P&T report was published for February 1996 (Foster Wheeler Environmental Corporation, 1996). Monthly P&T reports from February 1996 through December 1998 present total volume of P&T influent and a short description regarding maintenance of, and problems with, operations. Graphs show the concentrations of TCE, cDCE, and VC in influent samples that were collected four to eight times per month. These early P&T reports do not document the amount of CVOC removed; however, it was possible to calculate the mass of TCE, cDCE, and VC that was removed each month.

From January 1999 through December 2010 (Foster Wheeler Environmental Corporation, 1999–2003; ECOR Solutions, Inc., 2003–10; H&S Environmental Inc., 2010), monthly P&T reports contain expanded data and information compared to the 1996–99 P&T reports. Each report presents the volume of influent, average influent flow rate, hours of operation and downtime, reasons for downtime, and TCE, cDCE, and VC concentrations in the samples of the influent groundwater. The reports also include instantaneous pumping rates from each active recovery well. In many reports, tDCE concentrations also are included. On the basis of influent flow rates and CVOC concentrations, Foster Wheeler Environmental Corp., ECOR Solutions, Inc., and H&S Environmental, Inc., documented the monthly and cumulative mass of TCE, cDCE, and VC that was removed by the P&T system.

During February 1996 to December 1997, well 15BR was the only recovery well in operation. During January to March 1998, wells 15BR and WDW were being used as recovery wells though it is possible that additional wells were being

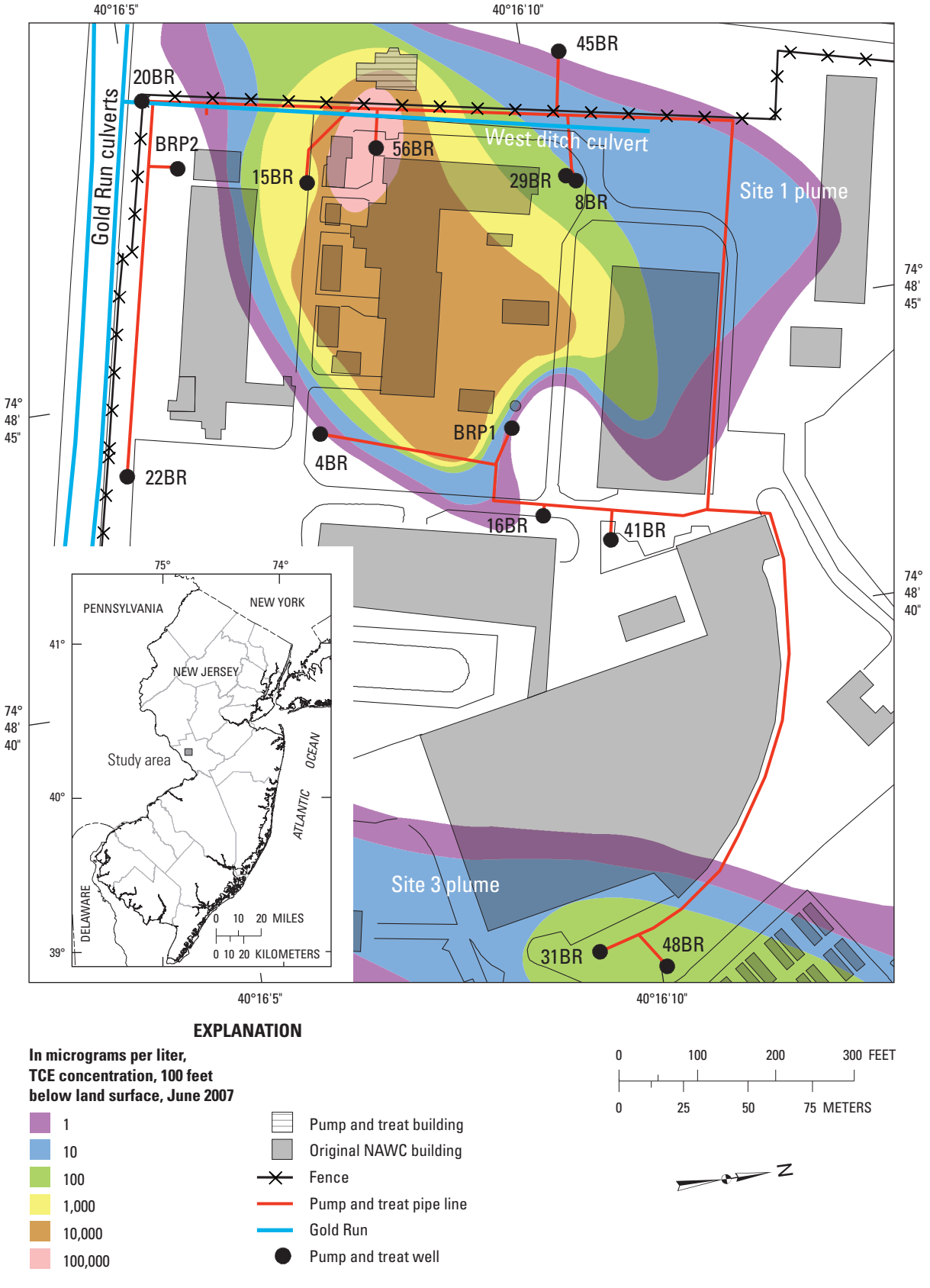

Figure 1. Locations of pump-and-treat wells, underground pipeline, and building, Naval Air Warfare Center, West Trenton, NJ, 2010.

used for recovery. During April 1998 to December 2000, recovery wells 15BR, 20BR, 41BR, 45BR, 48BR, and WDW were used. Pumping rates from these recovery wells during 1998 are shown in this report to be equal. In all likelihood, withdrawals were not equal. Pumping rates were likely similar to those published in later reports. Pumping rates in these recovery wells during 1999 to 2000 are the reported recovery rates. In January 2001, the P&T system was reconfigured to pump from seven wells—15BR, 20BR, 22BR, 45BR, 48BR, WDW, and BRP-02. In July 2004, recovery well 56BR was added to the P&T system. During September to December 1999, well 36BR was pumped as part of a second pilot test to evaluate an experimental nano-scale iron filing remediation method. Only a few hundred gallons of water were withdrawn during this test.

Monthly P&T reports from 1999 through 2010 include the average monthly influent flow rates that were calculated by using two methods. The most commonly used method consisted of dividing the monthly influent flow rate by the number of minutes in the month that the P&T system was operating properly. The second and less frequently used method consisted of dividing the monthly influent flow rate by the number of minutes in the month. Five laboratories were used consecutively to analyze the P&T influent water samples for TCE, cDCE, and VC.

Fifty quarterly and annual reports showing concentrations of TCE, cDCE, and VC in groundwater samples from recovery wells were published by EA Engineering, Science, and Technology, Inc., during 1997 to mid 2003; by ECOR Solutions, Inc., during mid 2003 to early 2010; and by H&S Environmental, Inc., during early to late 2010. There were four groundwater quality reports for most years. However, there is no groundwater quality report for 1996, one report in 1997 and 2002, and two reports in 1998 and 2003. The reports show that seven laboratories were used consecutively to analyze the groundwater samples for TCE, cDCE, and VC. During 1999 and 2004, each laboratory was used for 1 year or less.

Three Methods of Determining Mass of CVOC Removed

Three methods were used in this study to determine the monthly masses of TCE, cDCE, VC, and original TCE that were removed by the P&T system. Method 1 calculations are based on monthly flow rate measurements and monthly CVOC concentration measurements of groundwater influent to the P&T building. Method 2 calculations are based on monthly pumping rates and average annual CVOC concentration measurements made on groundwater from each recovery well. Method 3 calculations are based on the greater of the two values determined by Methods 1 and 2 for each month. Because of independent rounding, sums are not equal in some instances.

Method 1 was used to calculate the mass of TCE, cDCE, and VC that was removed from P&T influent each month; it is based on (1) the monthly influent volume to the P&T building and (2) average monthly concentrations of TCE, cDCE, and VC in influent to the building.

The mass of TCE, cDCE, and VC removed was calculated using

$$ {}^{i}M_{w} = (V_{inf})({}^{i}C)\,k \ , \qquad (1) $$

where

- ${}^{i}M_{w}$ is mass of individual CVOC, in pounds;
- V_{inf} is monthly volume of influent, in gallons;
- ${}^{i}C$ is concentration of each CVOC in influent, in micrograms per liter; and
- k is a constant to balance units.

The mass of original TCE removed each month was also calculated using Method 1.

The monthly mass was calculated by converting the mass of each CVOC compound to a number of moles of each compound. The number of moles were summed and converted to the mass of original TCE.

$$ {}^{Total}mM = ({}^{T}M_{w})({}^{T}mk) + ({}^{D}M_{w})({}^{D}mk) + ({}^{V}M_{w})({}^{V}mk) \ , \qquad (2) $$

where

- ${}^{Total}mM$ is the sum of the number of moles and
- ${}^{i}mk$ is a constant to convert mass in pounds to number of moles of individual CVOC.

The Navy used Method 1 to calculate the masses of TCE, cDCE, and VC removed each month, then summed the masses of TCE, cDCE, and VC that were removed each month to determine the total CVOCs removed. This summation does not adequately reflect the mass of original TCE that was removed.

Method 2 was used to calculate the masses of TCE, cDCE, and VC that were removed each month on the basis of (1) the monthly withdrawals from each recovery well and (2) the average annual concentrations of TCE, cDCE, and VC in water samples from each recovery well.

Monthly discharge from a well was calculated using

$$ V_{iw} = (Q_{i} / \sum Q)\,(V_{inf}) \ , \qquad (3) $$

where

- V_{iw} is the monthly volume of withdrawal from an individual recovery well, in gallons;
- Q_{i} is the instantaneous rate of withdrawal reported for an individual recovery well, in gallons; and
- Q is the instantaneous rate of withdrawal reported for all recovery wells, in gallons.

The masses of TCE, cDCE, and VC removed from each recovery well were calculated using

$$ {}^{i}M_{w} = (V_{iw})({}^{w}C)\,k \ , \qquad (4) $$

where

${}^{w}C$ is the average annual concentration of TCE, cDCE, and VC for water samples from a recovery well.

The mass of original TCE removed by Method 2 was calculated as described in Method 1.

The simple sum of the masses of TCE, cDCE, and VC that were removed as calculated by Method 2 is included in this report. The simple summation is included for comparison with the simple sum method that was used in Method 1.

Method 3 was used to calculate the masses of TCE, cDCE, and VC that were removed each month, based on the greater mass of Methods 1 or Method 2. The value determined using Method 1 was compared to the value from Method 2, and the greater of the two values was selected. This was done for each month during 1996–2010.

Method 1, in general, produced greater mass removal for 1996 to 1998, and Method 2, in general, produced greater mass removal for 2000 to 2004. The mass removed monthly during 2005 to 2010 using the two methods was similar.

Results of Method 1: Removal Based on Influent to the Pump and Treat Building

The results of Method 1 are that the P&T building has received 280,088,872 gallons of influent during 1996–2010 and removed 8,666 lbs of TCE, 13,689 lbs of cDCE, and 2,456 lbs of VC. The mass of original TCE removed as calculated by Method 1 is 32,381 lbs.

Mass of TCE, cDCE, and VC Removed

Monthly influent volume to the P&T building (fig. 2A; table 1, at end of report) was about 500,000 gal during 1996–97. Recovery well 15BR was the only well pumped during this time. Influent flow rate increased to about 1,500,000 gal/mon during 1998–99 after the Navy increased the number of recovery wells to six. During 2000–09, the P&T system generally pumped eight recovery wells, and influent flow rates fluctuated from 750,000 to 2,500,000 gal/mon. Average influent flow rate was about 1,815,000 gal/mon during 2000–10. The cumulative volume of influent to the P&T building during 1996–2010 was 280,088,872 gal (fig. 2B). The volume accumulated at a relatively constant rate during 1996–99, and increased by a factor of 4 during 2000–10.

Reported average monthly concentrations of TCE, cDCE, and VC in the influent to the P&T building are shown in figure 3 and table 1. During 1996–98, concentrations of the CVOCs are presented only on graphs in the monthly reports and were extrapolated for this report. During 1999–2004, three to five concentrations of each CVOC were given in each monthly report and the average monthly concentration for each CVOC typically was used for this report. However, for some months, the CVOC concentrations that are presented in this report are the values that were used in the monthly P&T reports to calculate the masses removed of TCE, cDCE, and VC. During 2005–09, only one concentration of each CVOC was reported monthly, and that concentration is included in this report (table 1).

Monthly concentrations of TCE in the influent ranged from about 2,000 to about 25,000 µg/L during 1996–98 (fig. 3). After 1999, average monthly concentrations of TCE rarely exceeded 5,000 µg/L, and generally declined from about 5,000 to 2,000 µg/L. Monthly concentrations of cDCE in the influent ranged from 10,000 to 62,000 µg/L during 1996–98. After 1999, average monthly concentrations of cDCE rarely exceeded 10,000 µg/L. Monthly concentrations of cDCE steadily declined from about 10,000 to about 2,500 µg/L during 2000–10. Monthly concentrations of VC in the influent ranged from 2,000 to 10,000 µg/L during 1996–98. After 1998, monthly concentrations rarely exceeded 2,000 µg/L. Monthly concentrations of VC declined from about 1,500 to less than 60 µg/L during 2000–10.

The mass of TCE removed each month, based on measurements of influent to the P&T building, ranged from 3.6 to 151 lbs with a mean of 49 lbs (fig. 4A; table 1). The general trend in the monthly mass of TCE removed was a slight decrease from a range of 60 to 80 pounds per month (lbs/mon) during 1996–2001 to a range of 30 to 40 lbs/mon during 2007–09.

The mass of cDCE removed each month ranged from 5.6 to 309 lbs with a mean of 77 lbs (fig. 4B; table 1). Monthly mass removal of cDCE steadily decreased from about 150 lbs/mon in the late 1990s to less than 50 lbs/mon in 2010. The mass of VC removed each month ranged from 0.5 to 46 lbs with a mean of 14 lbs (fig. 4C). Monthly mass removal of VC decreased step wise from about 25 lbs/mon during 1996–2003 to less than 5 lbs/mon during 2003–09. The maximum cumulative mass of each CVOC that had been removed (fig. 5) during 1996–2010 for TCE was 8,666 lbs, for cDCE was 13,689 lbs, and for VC was 2,456 lbs.

Mass of Original TCE Removed

The mass of original TCE removed each month was calculated by converting the mass of TCE, cDCE, and VC from pounds to the number of moles (fig. 6A, table 1). The numbers of moles were summed (fig. 6A) to show the monthly and cumulative number of moles removed from influent to the P&T building (fig. 6B). The cumulative number of moles removed was converted to a mass of original TCE (fig. 6C) to show the mass of original TCE that was removed.

The monthly number of moles of TCE removed ranged from 12 to 520 with a mean of 166. The monthly number of moles of cDCE removed ranged from 26 to 1,445 with a mean

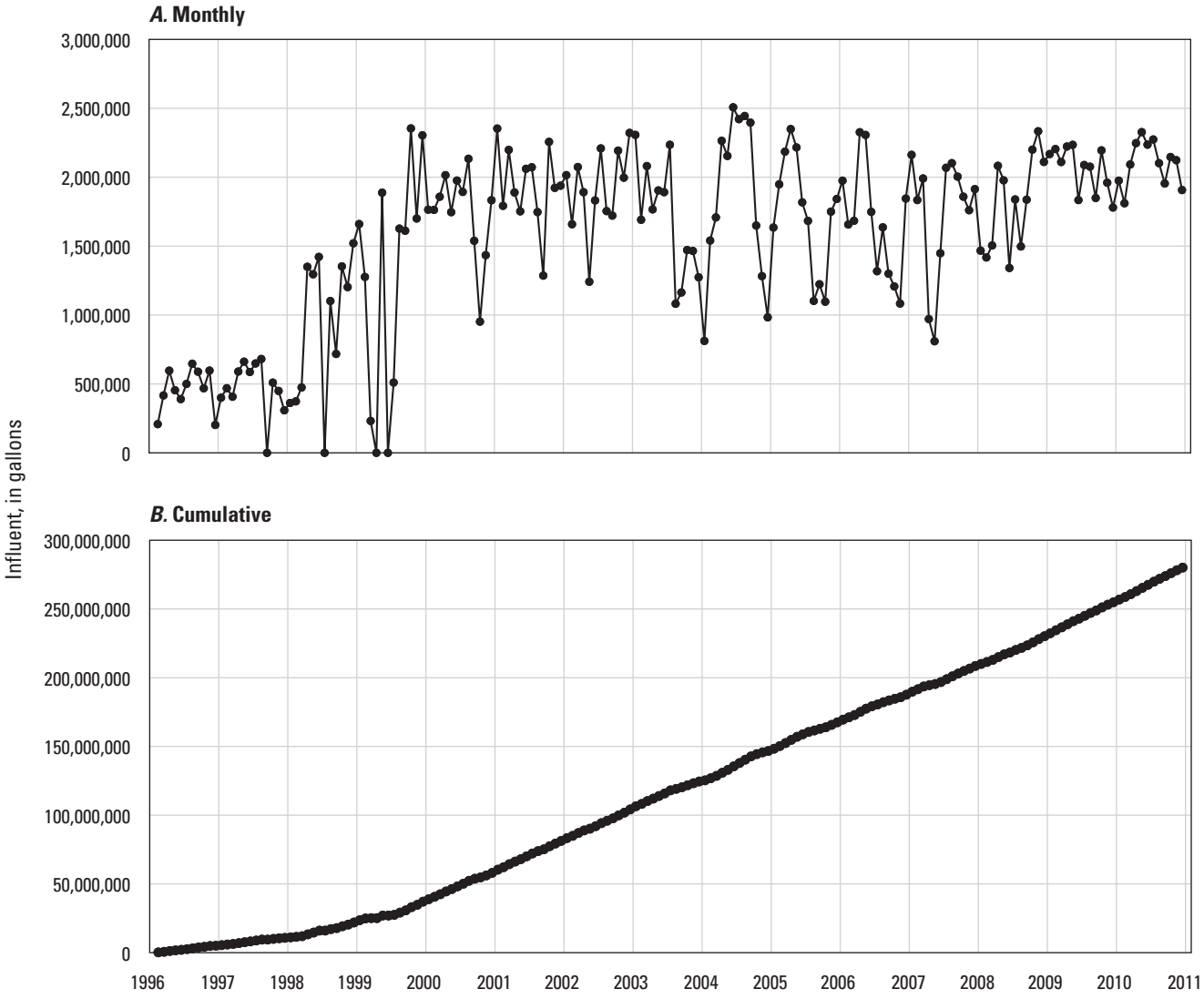

Figure 2. Influent volume to the Pump-and-Treat building (*A*) monthly and (*B*) cumulatively, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

of 358. The monthly number of moles of VC removed ranged from 7 to 337 with a mean of 99. The total monthly number of moles of original TCE removed ranged from 60 to 2,165 with an average of 618.

The cumulative number of moles removed during the period of operation for TCE is 29,911; for cDCE, 64,033; and for VC, 17,823. The cumulative number of moles of the original TCE removed is 111,767. The cumulative mass of original TCE removed from influent to the P&T building is 32,375 lbs.

The Navy summed the masses of TCE, cDCE, and VC to report the total mass of CVOCs removed each month, as well as the cumulative mass of CVOC removed (fig. 7). As stated previously, the results of this summing are included for illustration purposes. The summed total cumulative mass of CVOC removed is 24,806 lbs.

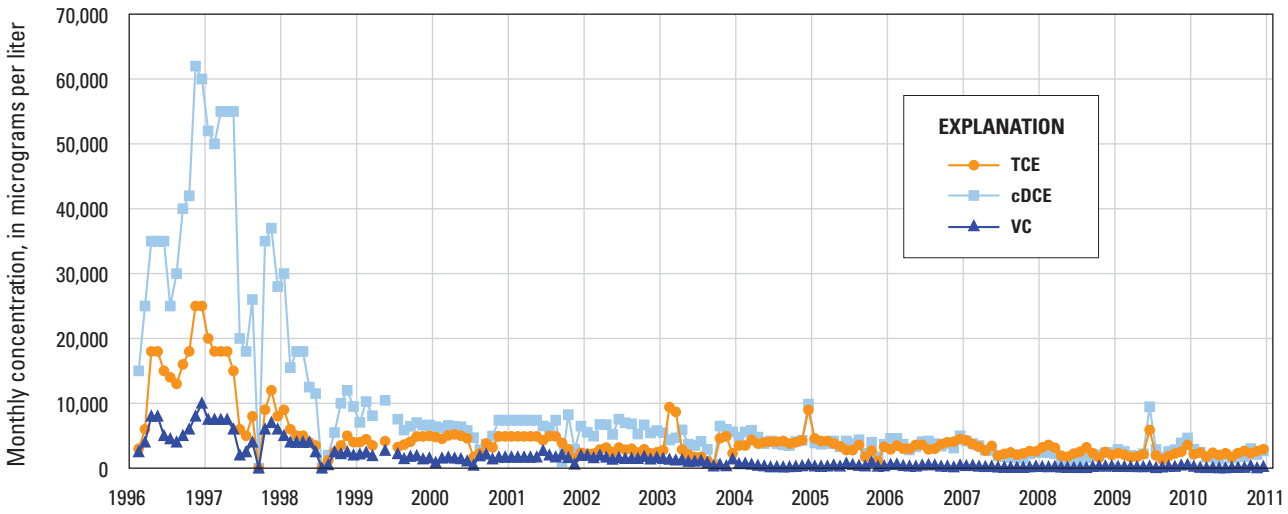

Figure 3. Monthly concentrations of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) in influent to the Pump and Treat building, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

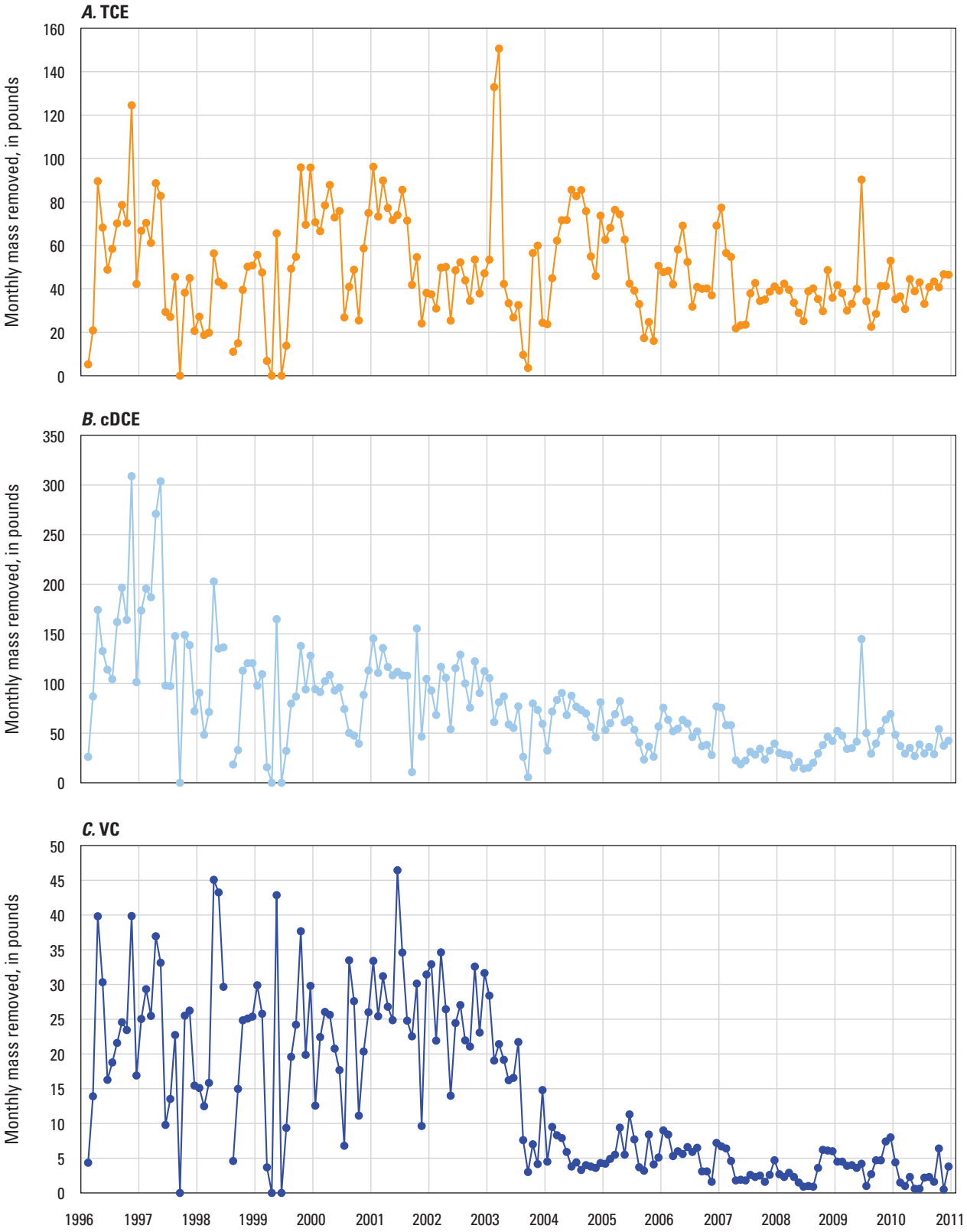

Figure 4. Monthly mass of (*A*) trichloroethylene (TCE), (*B*) cis-dichloroethylene (cDCE), and (*C*) vinyl chloride (VC) removed from influent to the Pump and Treat building, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

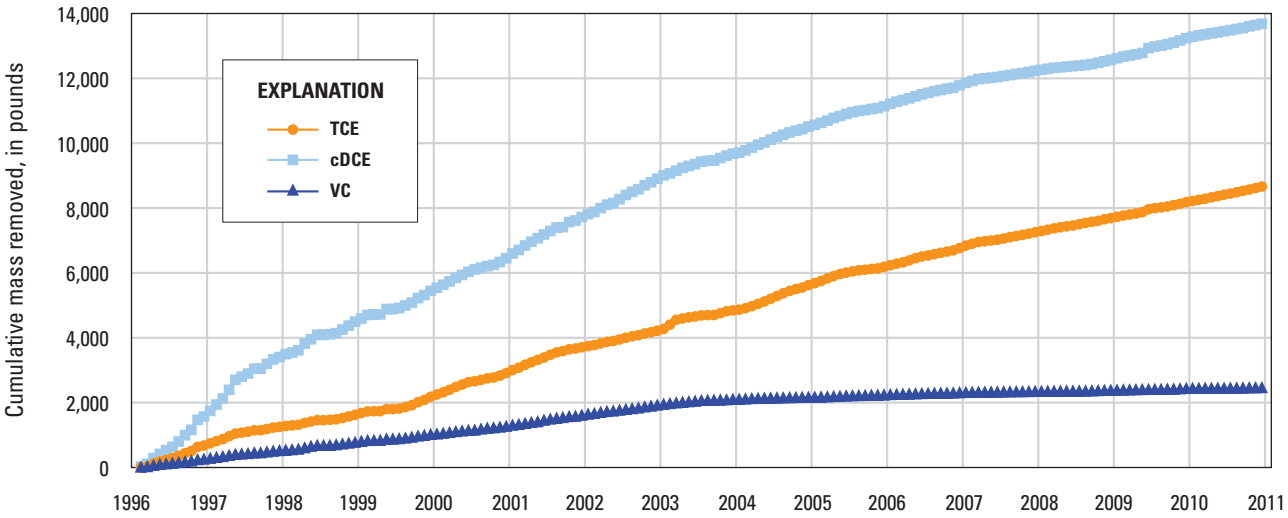

Figure 5. Cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) removed from influent to the Pump and Treat building, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

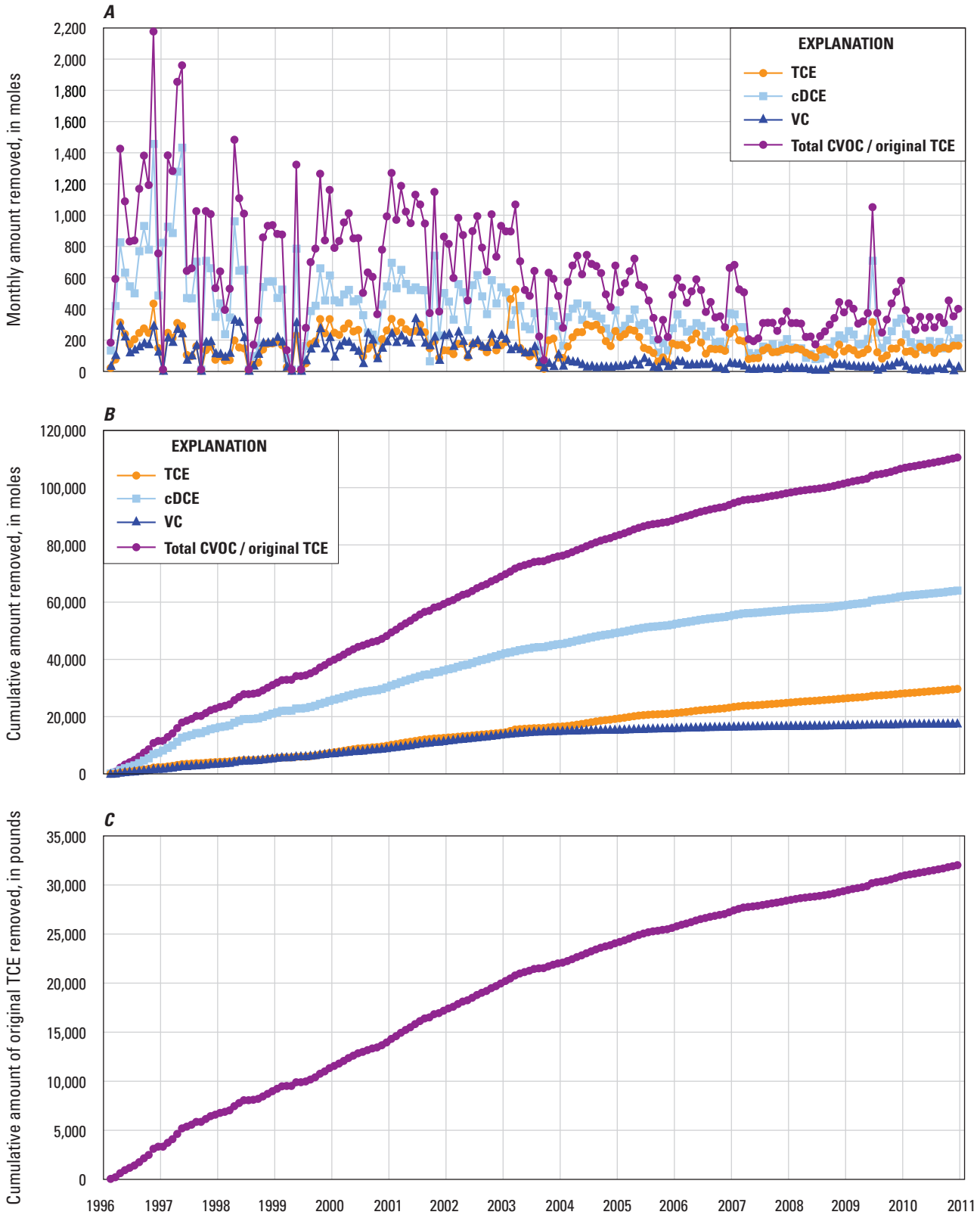

Figure 6. Amount of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) and total chlorinated volatile organic compounds (CVOC) / original TCE removed (*A*) monthly, (*B*) cumulatively, and (*C*) mass in pounds of original TCE removed cumulatively from influent to the Pump and Treat building, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

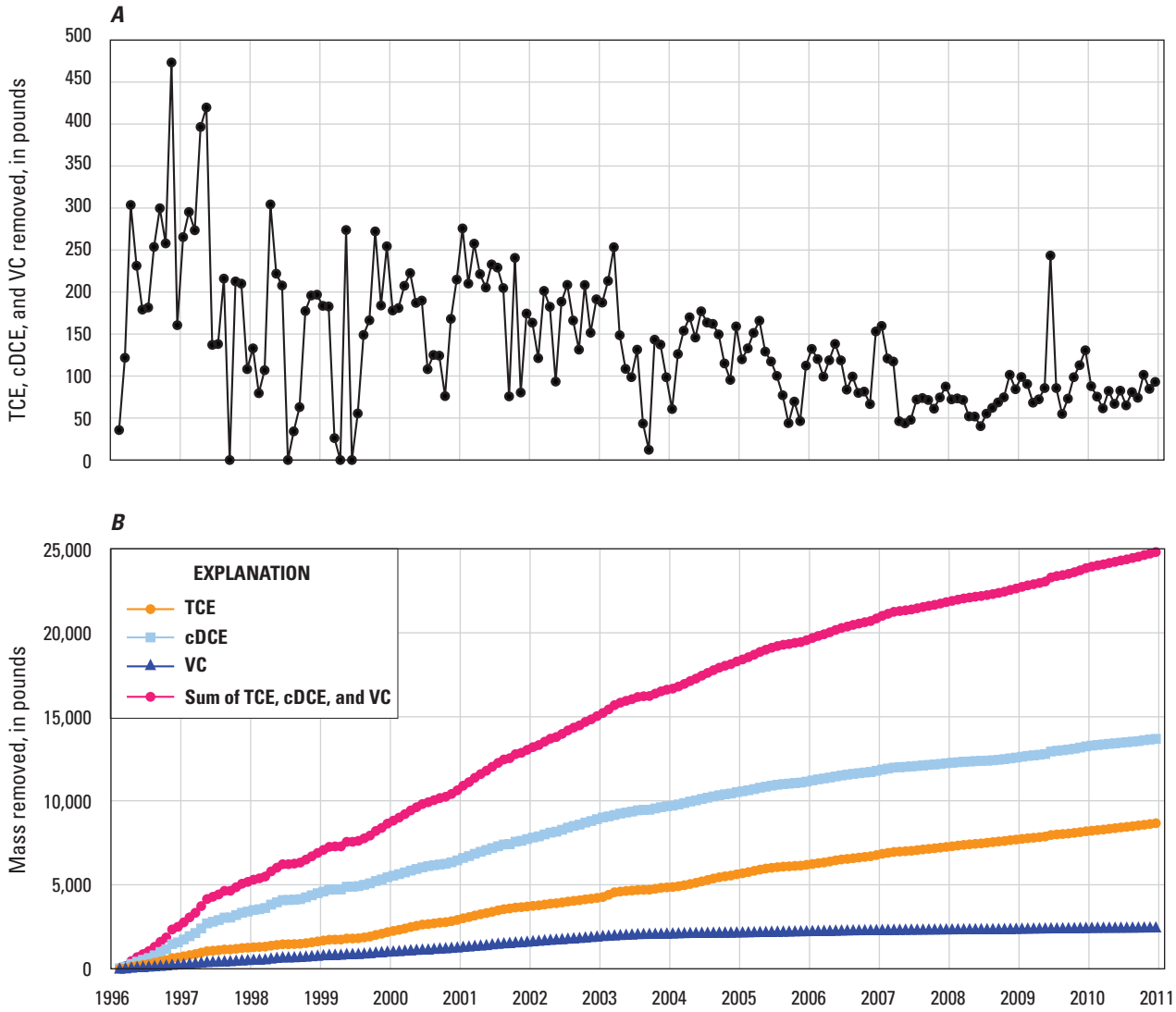

Figure 7. Mass of (*A*) monthly simple sum of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) and (*B*) cumulative simple sum of the above and total chlorinated volatile organic compounds (CVOCs) removed from influent to the Pump and Treat building, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

Results of Method 2: Removal Based on Withdrawals from the Recovery Wells

Eleven recovery wells were used to withdraw contaminated groundwater for the P&T system (15BR, 20BR, 41BR, 45BR, 48BR, WDW, BRP-02, 22BR, 56BR, 8BR, and 29BR). Well 15BR was used for containment and recovery of contaminated water for 14 years (1996 through 2010). The other recovery wells were used for less than 1 to 12 years (table 2, separate file at *http://pubs.usgs.gov/sir/2011/5003/*). The masses of TCE, cDCE, and VC that were removed each month from each recovery well were calculated by using (1) the volume of water withdrawn from each well, based on the reported instantaneous pumping rate, influent flow rate to the P&T building, and time of operation of the P&T system and (2) the concentrations of TCE, cDCE, and VC in water samples from each recovery well.

Pumping and Withdrawals Rates for Nine Recovery Wells

The monthly instantaneous pumping rates for each of eleven recovery wells (figs. 8A to 16A; table 2) were obtained from data presented in the monthly P&T operations reports. The sum of the monthly instantaneous pumping rates of the operating recovery wells rarely equaled the monthly flow rate

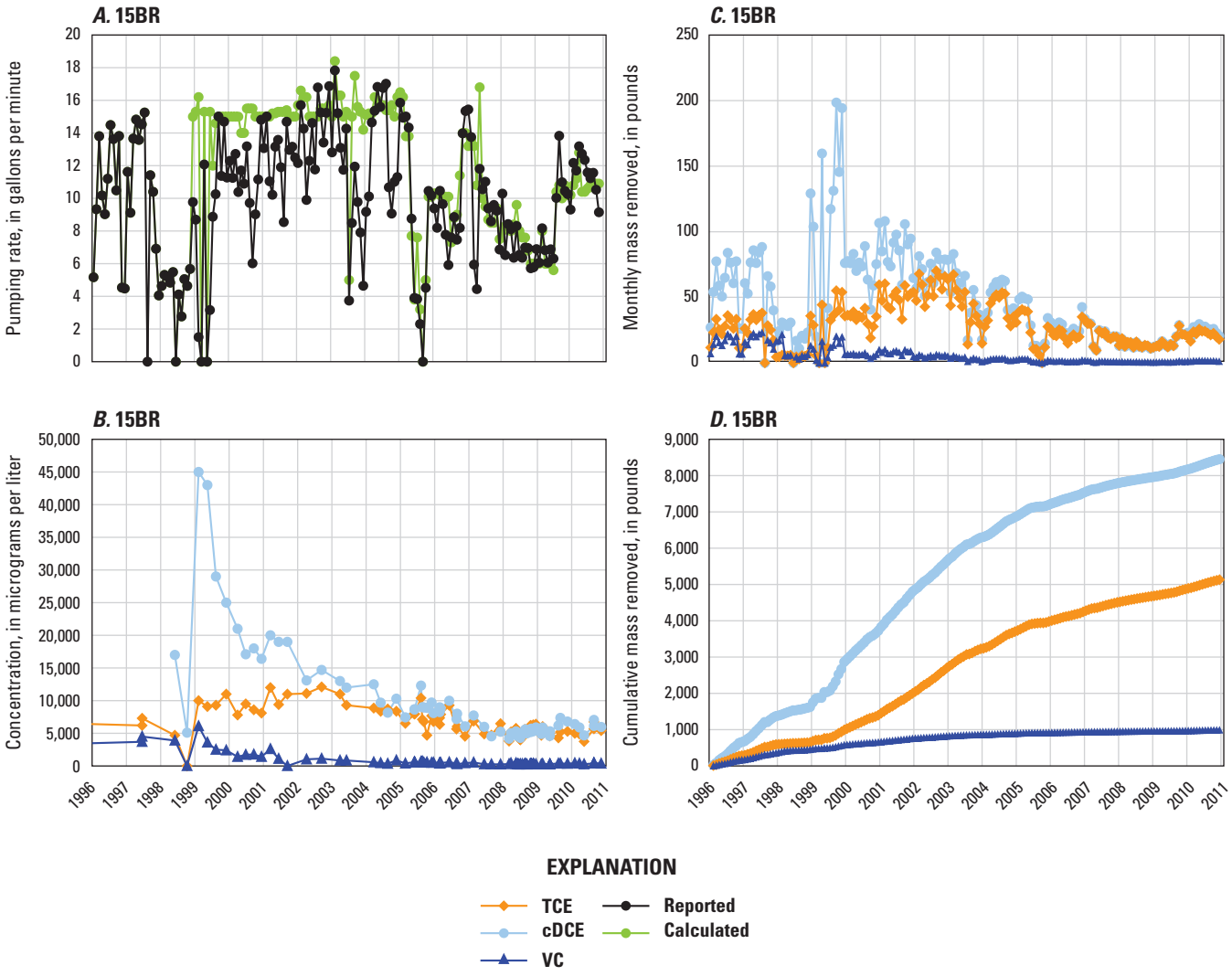

Figure 8. (*A*) Pumping rate, (*B*) concentrations of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) in groundwater samples, (*C*) monthly mass removed, and (*D*) cumulative mass removed of TCE, cDCE, and VC from recovery well 15BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

that was reported for the influent into the P&T building. The monthly average pumping rate for each recovery well was calculated by prorating the monthly instantaneous flow rate for each well on the basis of the monthly flow rate of influent to the P&T building (fig. 8A to 16A). The volume of water that was removed each month from each well was calculated on the basis of the monthly average pumping rate and the length of time that the P&T system was operating that month. (table 2).

TCE, cDCE, and VC Concentrations in Water Samples from Nine Recovery Wells

The concentrations of TCE, cDCE, and VC in water samples from nine recovery wells (fig. 8B to 16B; table 3) are from quarterly and annual water-quality reports. The average annual concentrations of TCE, cDCE, and VC were used to calculate the amount of each CVOC removed from each recovery well. TCE, cDCE, and VC concentrations in water samples decreased in most recovery wells during 1998–2010. The decrease in concentration is a result of CVOC removal by the P&T system, monitored natural attenuation, enhanced biodegradation, thermal conductive heating, and removal of contaminated soil.

Mass of TCE, cDCE, and VC Removed

The masses of TCE, cDCE, and VC removed each month by pumping each recovery wells were calculated, based on the volume of water pumped each month and the average annual

Table 3. Average annual concentrations of chlorinated volatile organic compounds in water samples from recovery wells, for the Pump and Treat plant, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

[TCE, trichloroethylene; cDCE, cis-dichloroethylene; VC, vinyl chloride; µg/L, micrograms per liter; --, well not used for recovery; value in red, estimate, data not collected]

Date	Well 15BR			Well 20BR			Well 41BR			Well 45BR			Well 48BR			Well WDW		
	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC
	(µg/L)			(µg/L)			(µg/L)			(µg/L)			(µg/L)			(µg/L)		
1996	6,700	15,555	4,100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1997	6,700	15,555	4,100	34	15,000	9,200	450	400	10	825	400	1	11	10	1	--	--	--
1998	3,000	11,000	3,000	185	11,450	4,500	300	390	19	3,567	1,023	3	539	15	1	172	2,025	1,040
1999	9,850	35,500	3,650	8,590	78,000	26,700	430	440	36	3,529	470	3	988	24	3	227	741	112
2000	8,500	18,125	1,570	5,806	76,300	21,740	717	587	33	3,924	478	5	1,073	35	3	221	487	4
2001	10,800	19,333	1,850	1,0430	71,700	7,000	720	520	12	3,667	537	5	757	63	4	700	1,040	11
2002	11,600	13,900	1,070	5,710	19,970	4,590	523	290	4	4,010	367	1	1,000	30	3	9	9	1
2003	10,150	12,500	840	5,800	26,800	5,300	890	530	5	3,700	520	1	860	39	4	1,095	1,320	170
2004	8,583	10,163	556	753	5,825	731	567	398	4	4,078	465	2	826	36	3	781	361	3
2005	7,329	9,081	561	830	6,813	1,068	--	--	--	4,095	434	3	850	33	2	1,081	404	3
2006	6,739	8,180	430	372	4,520	638	--	--	--	3,708	415	2	845	41	2	1,622	476	5
2007	5,743	5,875	326	677	6,367	908	--	--	--	4,293	446	2	825	34	1	809	224	1
2008	5,201	5,077	310	595	5,340	846	--	--	--	3,703	437	3	837	61	8	307	87	1
2009	5,510	5,600	312	1,787	8,203	1,208	--	--	--	4,045	405	2	743	31	5	3,200	93	1
2010	5,253	6,023	386	797	4,756	737	--	--	--	3,820	421	2	693	29	2	573	180	5

Table 3. Average annual concentrations of chlorinated volatile organic compounds in water samples from recovery wells, for the Pump and Treat Plant, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.—Continued

[TCE, trichloroethylene; cDCE, cis-dichloroethylene; VC, vinyl chloride; µg/L, micrograms per liter; --, well not used for recovery; value in red, estimate, data not collected]

Date	Well BRP-02			Well 22BR			Well 56BR			Well 8BR			Well 29BR		
	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC	TCE	cDCE	VC
	(µg/L)			(µg/L)			(µg/L)			(µg/L)			(µg/L)		
1996	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1997	1	20,000	21,000	31	50	1	--	--	--	--	--	--	--	--	--
1998	57	12,850	9,150	18	72	3	--	--	--	--	--	--	--	--	--
1999	247	22,667	15,000	12	32	1	--	--	--	--	--	--	--	--	--
2000	628	27,300	10,377	51	171	2	93,600	2,348	157	--	--	--	--	--	--
2001	3,693	18,033	3,520	50	200	1	175,000	7,950	292	--	--	--	--	--	--
2002	3,015	12,800	4,345	37	95	1	167,500	6,735	50	--	--	--	--	--	--
2003	1,755	8,880	2,375	33	298	1	190,000	7,800	50	--	--	--	--	--	--
2004	1,597	12,356	2,295	38	93	1	82,100	4,466	57	--	--	--	--	--	--
2005	1,685	16,300	4,090	39	90	0	17,525	840	29	--	--	--	--	--	--
2006	1,794	8,715	1,864	36	74	1	13,543	959	18	--	--	--	--	--	--
2007	1,397	18,067	4,010	42	80	1	13,055	1,100	27	--	--	--	--	--	--
2008	999	12,217	3,220	27	68	1	9,127	2,500	172	--	--	--	--	--	--
2009	1,365	1,915	169	21	52	1	14,900	2,265	71	--	--	--	--	--	--
2010	533	8,820	2,422	19	53	1	12,375	1,523	65	230	4	0	1,234	101	2

Table 4. Mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) recovered by each Pump-and-Treat recovery well, Naval Air Warfare Center, West Trenton, NJ, February 1996–December 2010.

	15BR	20BR	41BR	45BR	48BR	WDW	BRP2	22BR	56BR	8BR	29BR	Total
	In pounds											
TCE	5,133	1,063	37	1,059	450	138	231	8	848	3	12	8,983
cDCE	8,452	7,587	35	129	20	85	1,422	24	43	0	1	17,798
VC	997	1,693	2	1	2	22	338	0	2	0	0	3,056

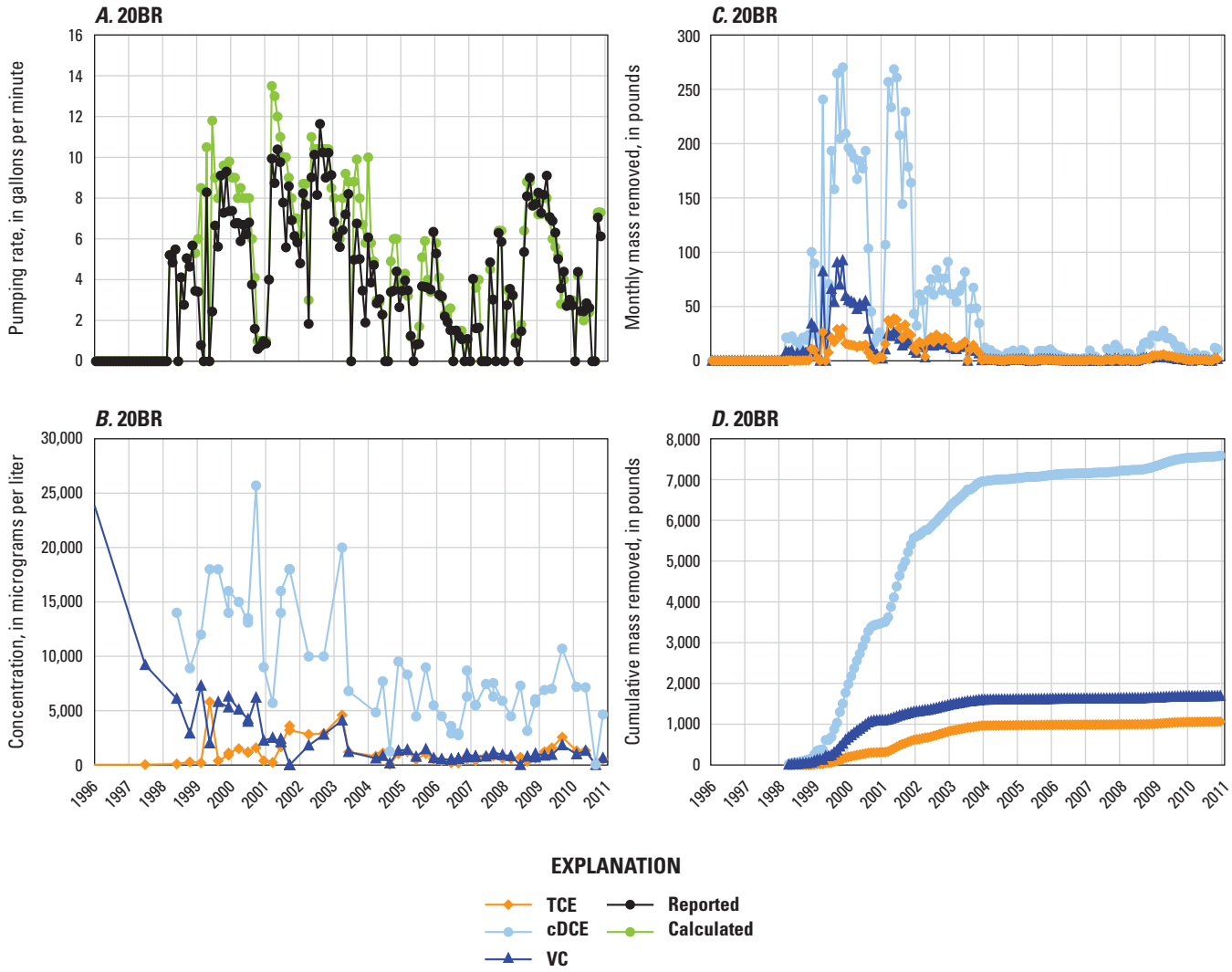

Figure 9. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 20BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

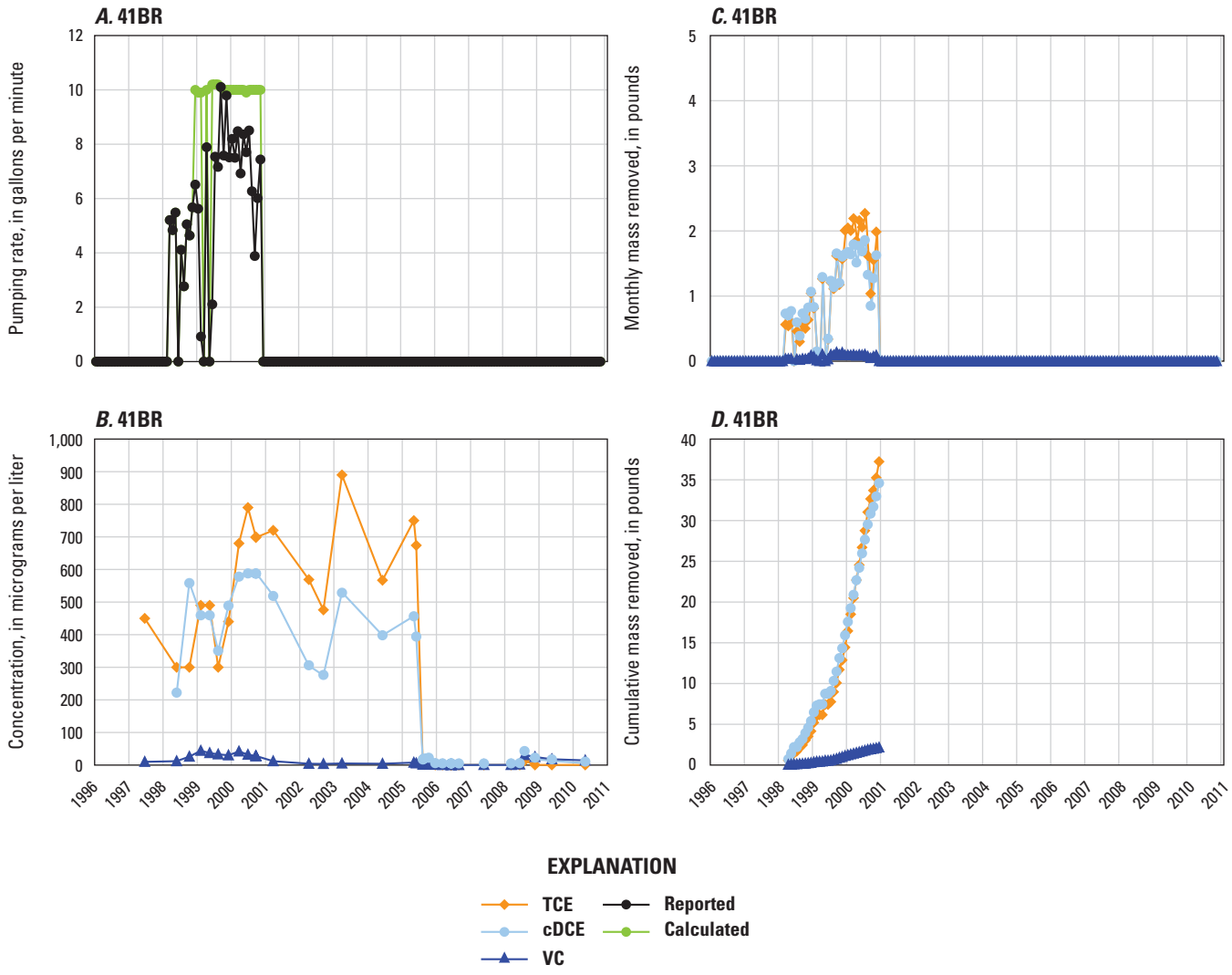

Figure 10. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 41BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

concentration of TCE, cDCE, and VC in the water for that year (fig. 8C; table 2). The total mass of TCE, cDCE, and VC removed by each recovery wells is summarized in table 4.

Individual Recovery Wells

Well 15BR was the only recovery well used during 1996–98 (fig. 8). In late 1998, withdrawals began in the other recovery wells, and concentrations of TCE and cDCE increased in water withdrawn from well 15BR. About half the TCE and cDCE and a third of the VC removed by the P&T system was in groundwater from recovery well 15BR (table 4).

Removal of CVOCs from recovery well 20BR began in 1998 (fig. 9). Concentrations of cDCE increased soon after withdrawals began but declined sharply in 2002 and again in 2004. About half the cDCE and VC removed by the recovery wells was removed from water from well 20BR.

Recovery well 41BR was used for removal of CVOCs for less than 3 years (fig. 10). The Navy stopped using the well because it caused increased CVOC concentrations in an area that the Navy decided was not part of the long-term objective of the remediation plan.

Recovery from well 45BR began in 1998 (fig. 11). Concentrations of each CVOC stayed constant for the period of record. In 2004, pumping rates increased, and with that, CVOC removal rates increased. About 10 percent of the total TCE removed from the recovery wells was from well 45BR.

Well 48BR is the only recovery well within the Site 3 Plume (fig. 12). Withdrawals from the well began in 1998. The pumping rates and TCE concentrations have decreased over the recovery period.

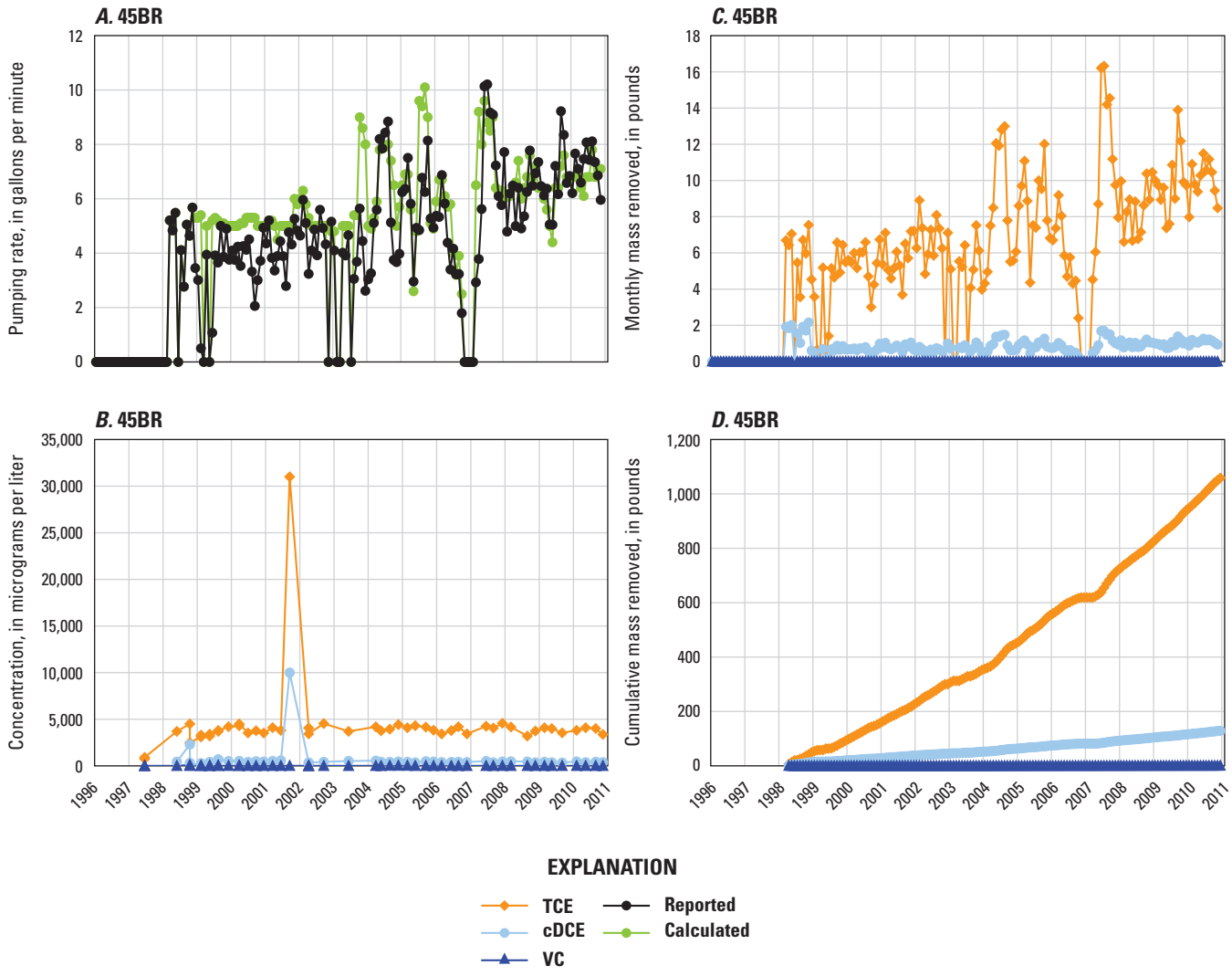

Figure 11. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 41BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

Well WDW is the shallowest recovery well (fig. 13). The pump and riser pipe frequently became plugged with deposits likely generated by iron fixing bacteria. The Navy frequently had the pump and riser pipe cleaned. After each cleaning, the pumping rate increased, and CVOC recovery increased. Because of plugging and cleaning, recovery of CVOCs from the well fluctuated between cleanings.

Recovery well BRP-02 was put into service in 2001 (fig. 14). Concentrations of cDCE and VC in water samples from this well were greater than the concentration of TCE, and concentrations of cDCE and VC decreased over time. More VC was removed than TCE by this recovery well (table 3).

Recovery well 22BR began withdrawing groundwater in 2000 (fig. 15) in order to reduce contaminated groundwater discharges into the Gold Run culvert (fig. 1) at the south side of the NAWC. Pumping rates increased during 2000–10. This well has removed the least CVOCs of the P&T system, but it is essential in reducing contaminated groundwater discharge to the lower reach of Gold Run.

Recovery well 56BR began withdrawals in 2004 (fig. 16). The well was put into operation because TCE concentrations were in excess of 200,000 µg/L, which can indicate the presence of pure phase TCE nearby. Soon after pumping began, TCE concentrations decreased to about 20,000 µg/L. The high recovery rate of 2004–05 decreased substantially during 2006–09. Nearly 10 percent of the TCE removed by the P&T system was in water from this recovery well.

Recovery wells 8BR and 29BR began operation February 18, 2010; the purpose was to intercept contaminated groundwater that would otherwise discharge to the reach of the West Ditch between recovery wells 8BR and 56BR (fig. 1). With only 10.5 months of data, it is too soon to assess the data.

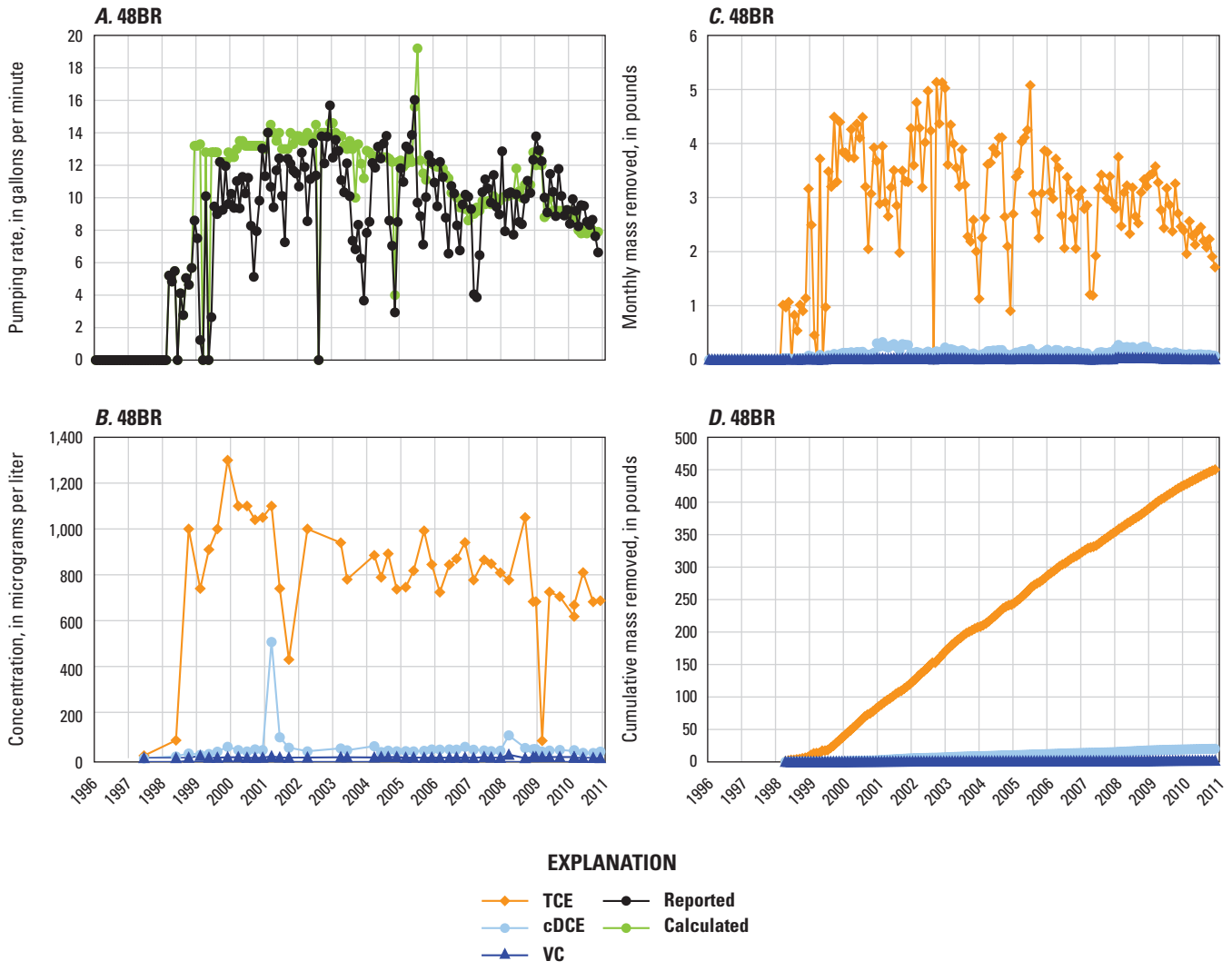

Figure 12. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 41BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

All Recovery Wells

A comparison of the mass of TCE, cDCE, and VC removed from the active recovery wells (fig. 17) shows that most TCE (57 percent) was removed by well 15BR and most cDCE and VC (90 and 88 percent, respectively) were recovered by pumping wells 15BR and 20BR. More CVOCs were removed by pumping these two wells than by pumping the other seven wells.

The monthly mass of TCE removed by all recovery wells ranged from 0 to 137 lbs with an average of about 50 lbs (fig. 18A). The monthly mass of cDCE removed ranged from 0 to 467 lbs with an average of 99 lbs (fig. 18B). The monthly mass of VC removed ranged from 0 to 113 lbs with an average of 17 lbs (fig. 18C). The low recovery rate during 1996 to 1998 was because only well 15BR was operating. Starting in 1999, TCE, cDCE, and VC monthly removal rates increased dramatically because of the increased number of recovery wells. The suite of recovery wells removed TCE, cDCE, and VC that was located in the highly transmissive fractures and TCE that was adsorbed to the walls of the fractures. For 7 years during 1999–2005, the monthly removal of TCE was the greatest for the period of record. For 3 years during 1999 to 2001, the monthly removal of cDCE was greatest for the period of record. While for only 2 years during 1999–2000, the monthly removal of VC was greatest for the period of record. These data show that VC in the high transmissive fractures was removed more quickly than cDCE, and cDCE was removed more quickly than TCE.

Since 2005, recovery of the three CVOCs has decreased. This long-recognized “tailing” phenomenon is characteristic of most P&T systems (U.S. Environmental Protection Agency,

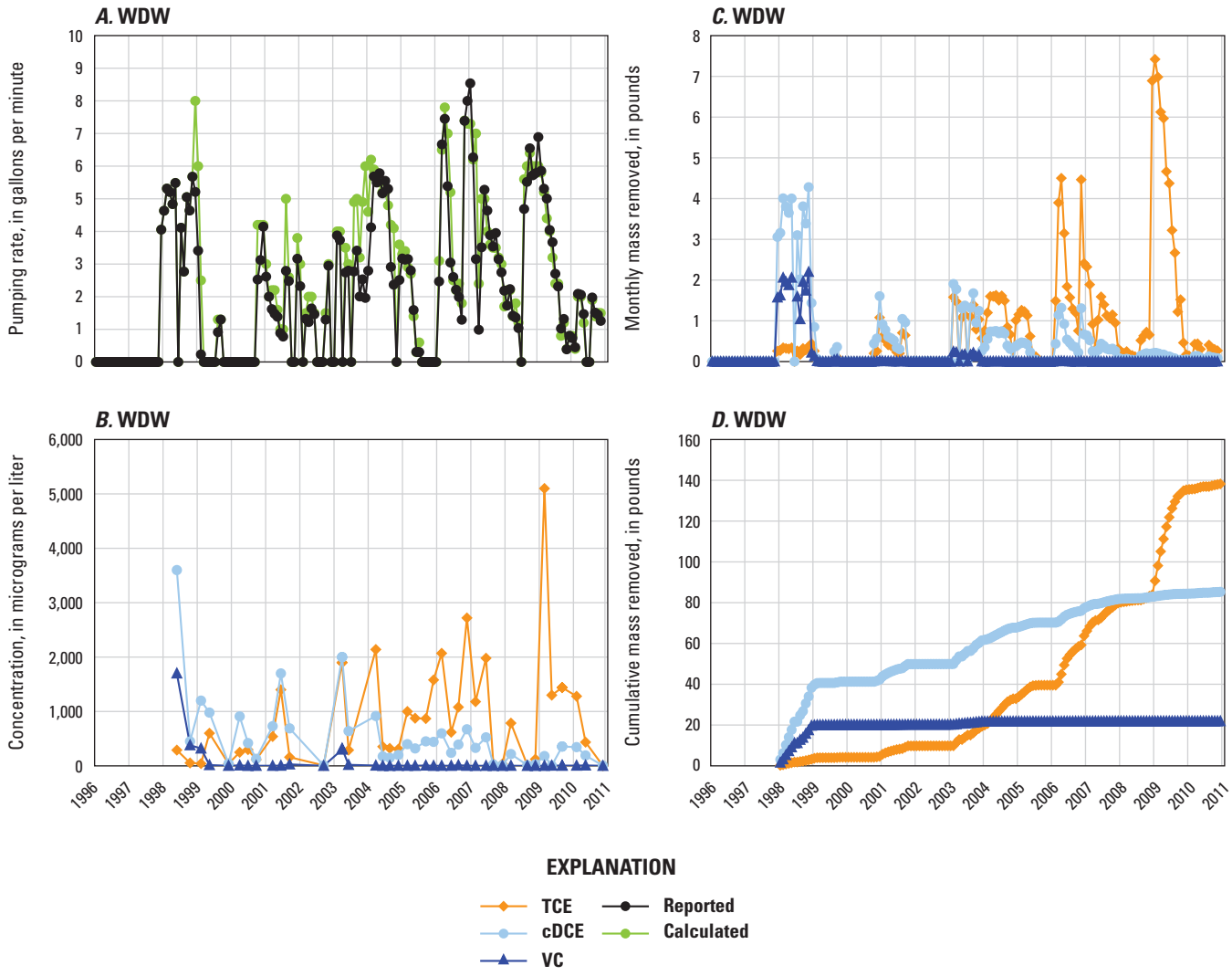

Figure 13. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well WDW, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

1996). The tailing is interpreted to mean that the TCE, cDCE, and VC that has been recovered during 2005–09 has migrated from the low transmissive fractures and from rock matrix that is more removed from the high transmissivity fracture into the high transmissivity fractures.

The sums of the masses of CVOCs removed by pumping the recovery wells are TCE, 8,983 lbs; cDCE, 17,798 lbs; and VC, 3,056 lbs (table 2, fig. 19).

Mass of Original TCE Removed

The mass of original TCE that was removed each month was calculated by converting the masses of TCE, cDCE, and VC from pounds to the number of moles of each compound (table 2). The number of moles was summed to show the monthly (fig. 20A) and cumulative number of moles (fig. 20B) removed from groundwater withdrawn from recovery wells. The cumulative number of moles removed was converted to show the pounds of original TCE that was removed (fig. 20C).

The monthly number of moles of TCE removed ranged from 0 to 473 with a mean of 173. The monthly number of moles of cDCE removed ranged from 0 to 2,186 with a mean of 465. The monthly number of moles of VC removed ranged from 0 to 818 with a mean of 124. The sum of the monthly number of moles of CVOC removed ranged from 0 to 3,335 with an average of 762.

The cumulative number of moles of TCE removed during the period of operation was 31,012; cDCE was 83,269; and VC was 22,180. The cumulative number of moles of original TCE removed was 136,461 (table 2, fig. 20B). The cumulative

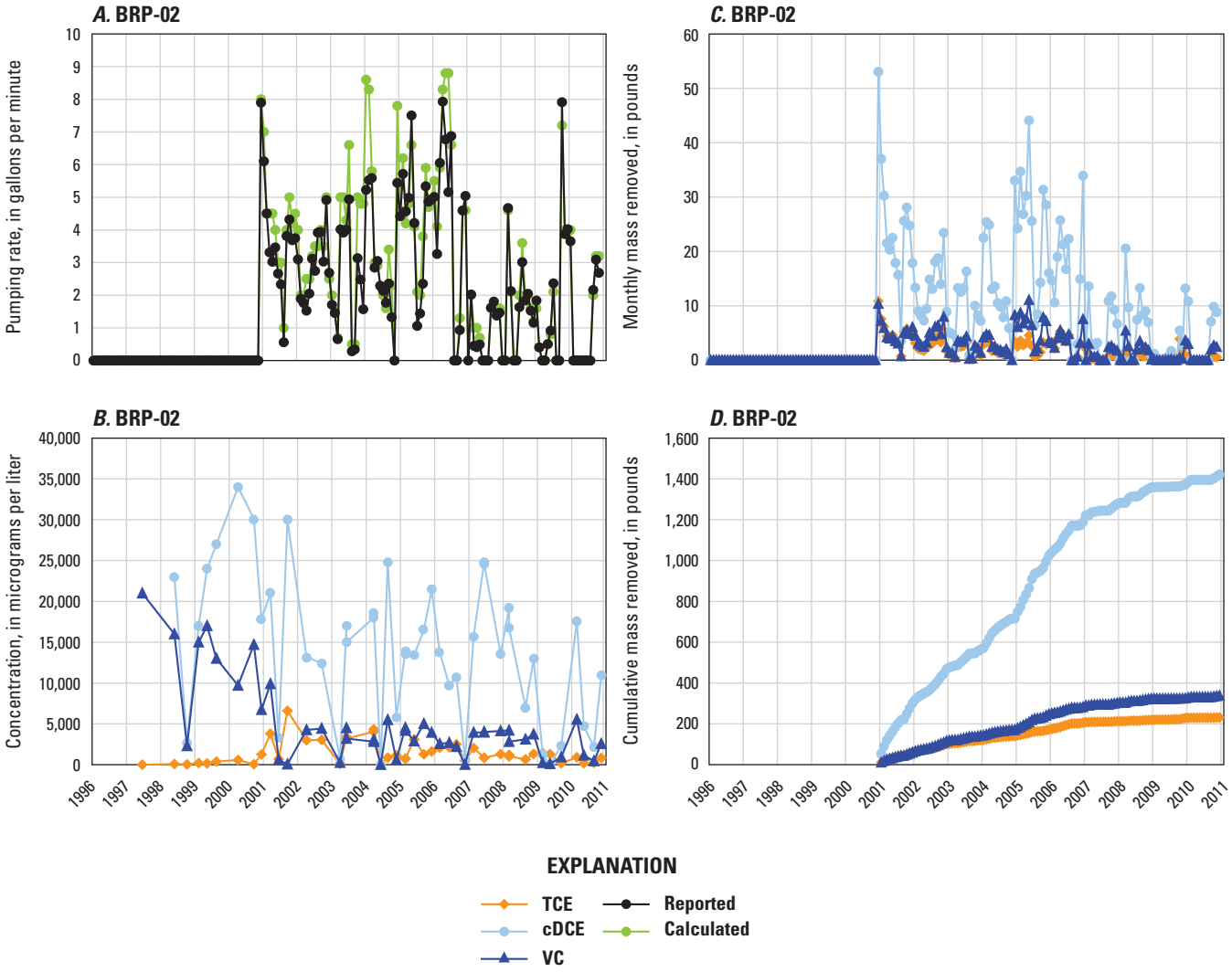

Figure 14.*ABCD*

number of moles of original TCE was converted to obtain the mass of original TCE removed by the P&T recovery system; 39,528 lbs of original TCE has been removed by using Method 2.

The Navy simply summed the masses of TCE, cDCE, and VC determined using Method 1 to report the total mass of CVOCs removed each month, as well as the cumulative mass of CVOCs removed. As stated previously the result of this simple addition is included for illustration purposes. The total cumulative mass of CVOCs removed calculated by using simple addition and based on Method 2 is 29,837 lbs.

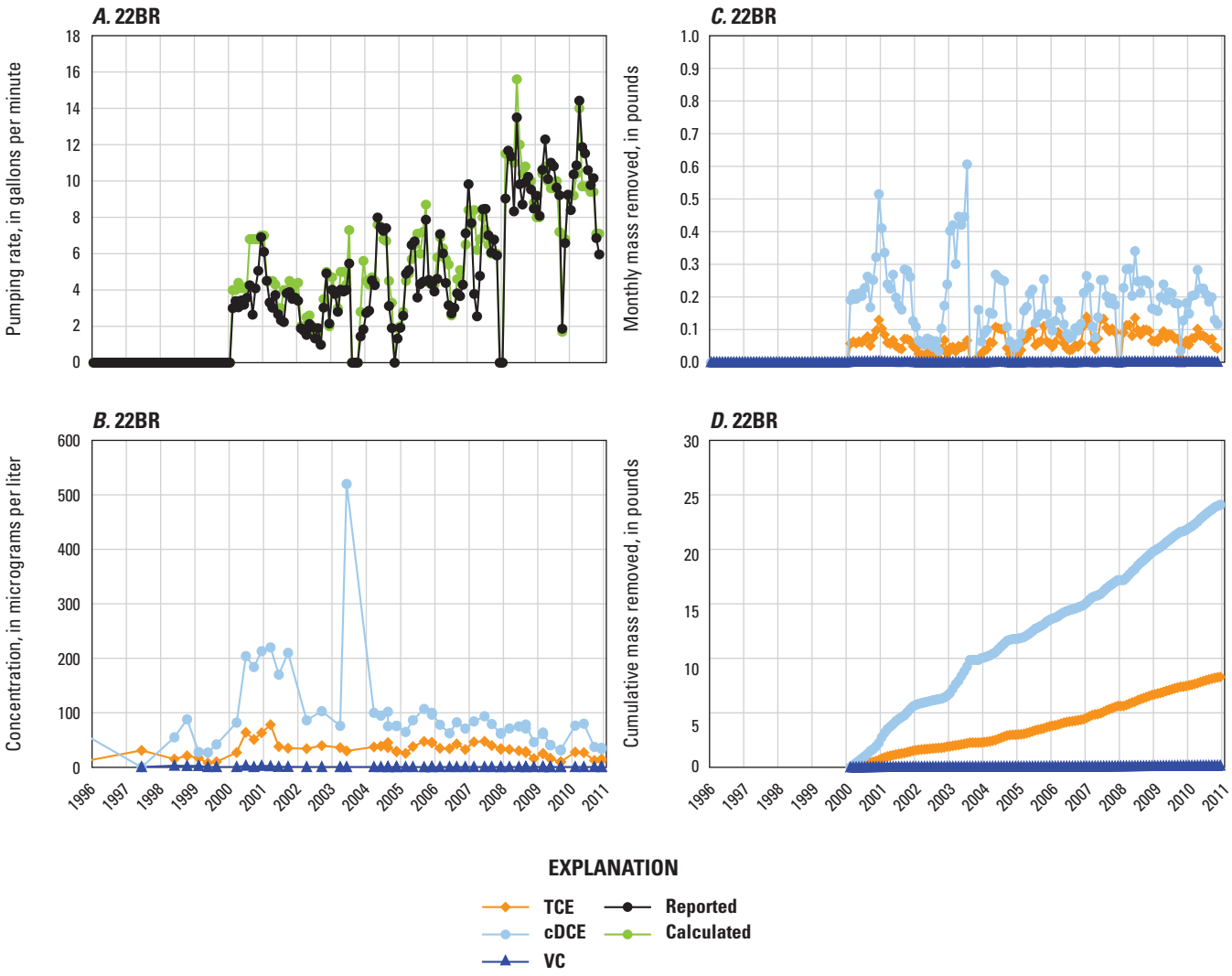

Figure 15. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 41BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

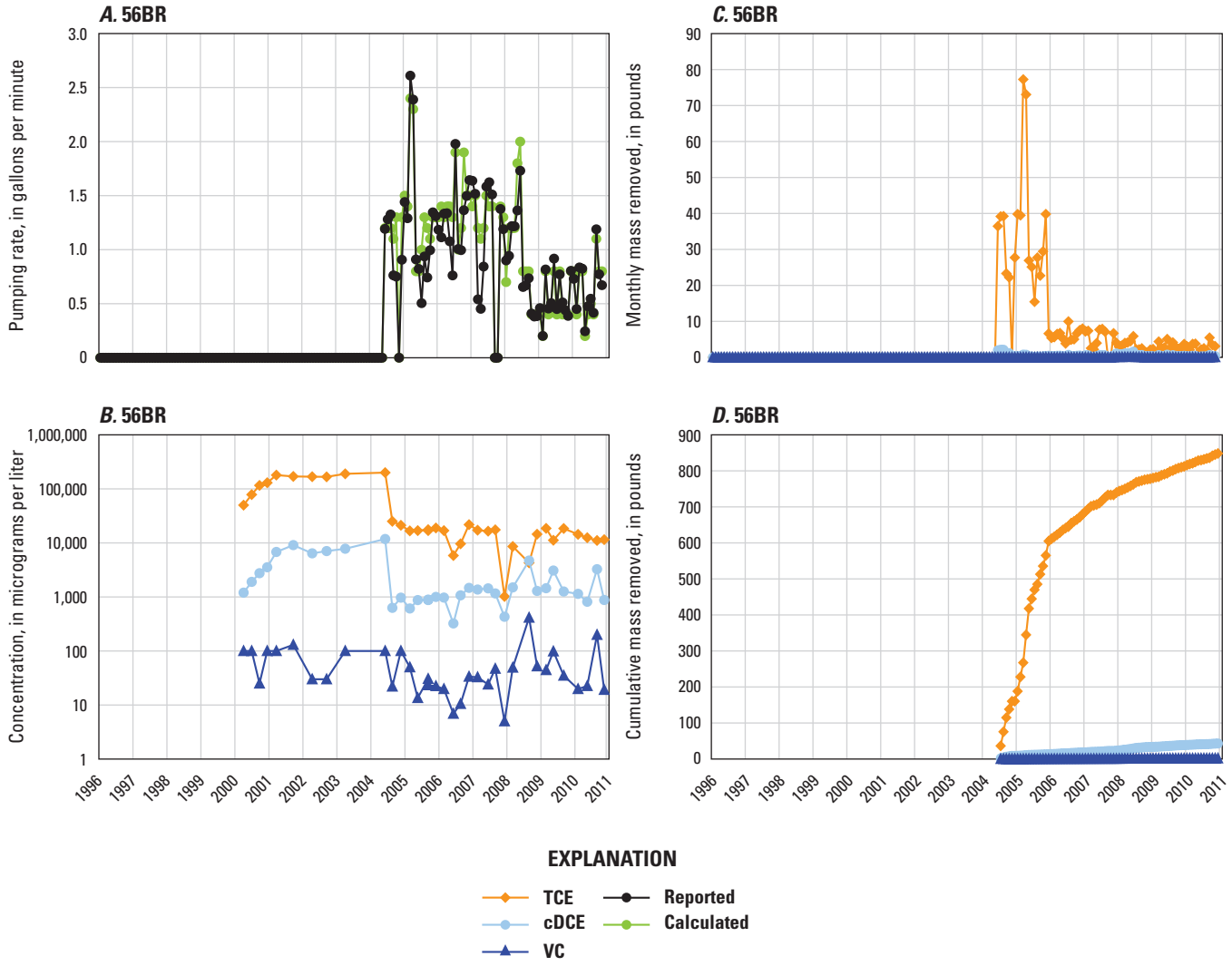

Figure 16. (*A*) Pumpage rate, (*B*) chlorinated volatile organic compound (CVOC) concentrations in groundwater samples, (*C*) monthly recovery of CVOC, and (*D*) cumulative recovery of CVOCs from recovery well 41BR, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

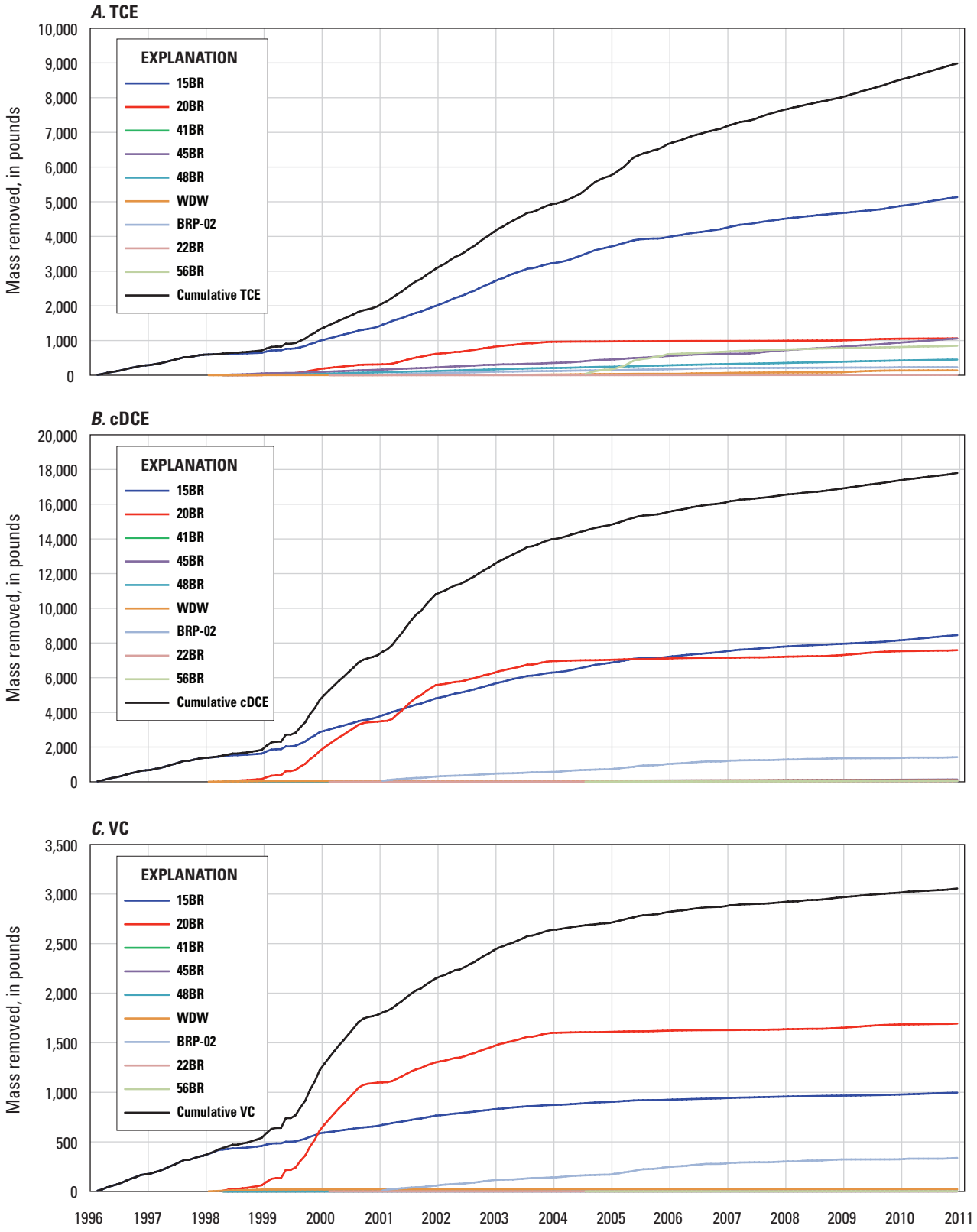

Figure 17. Mass of (*A*) trichloroethylene (TCE), (*B*) cis-dichloroethylene (cDCE), and (*C*) vinyl chloride (VC) removed from each recovery well, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

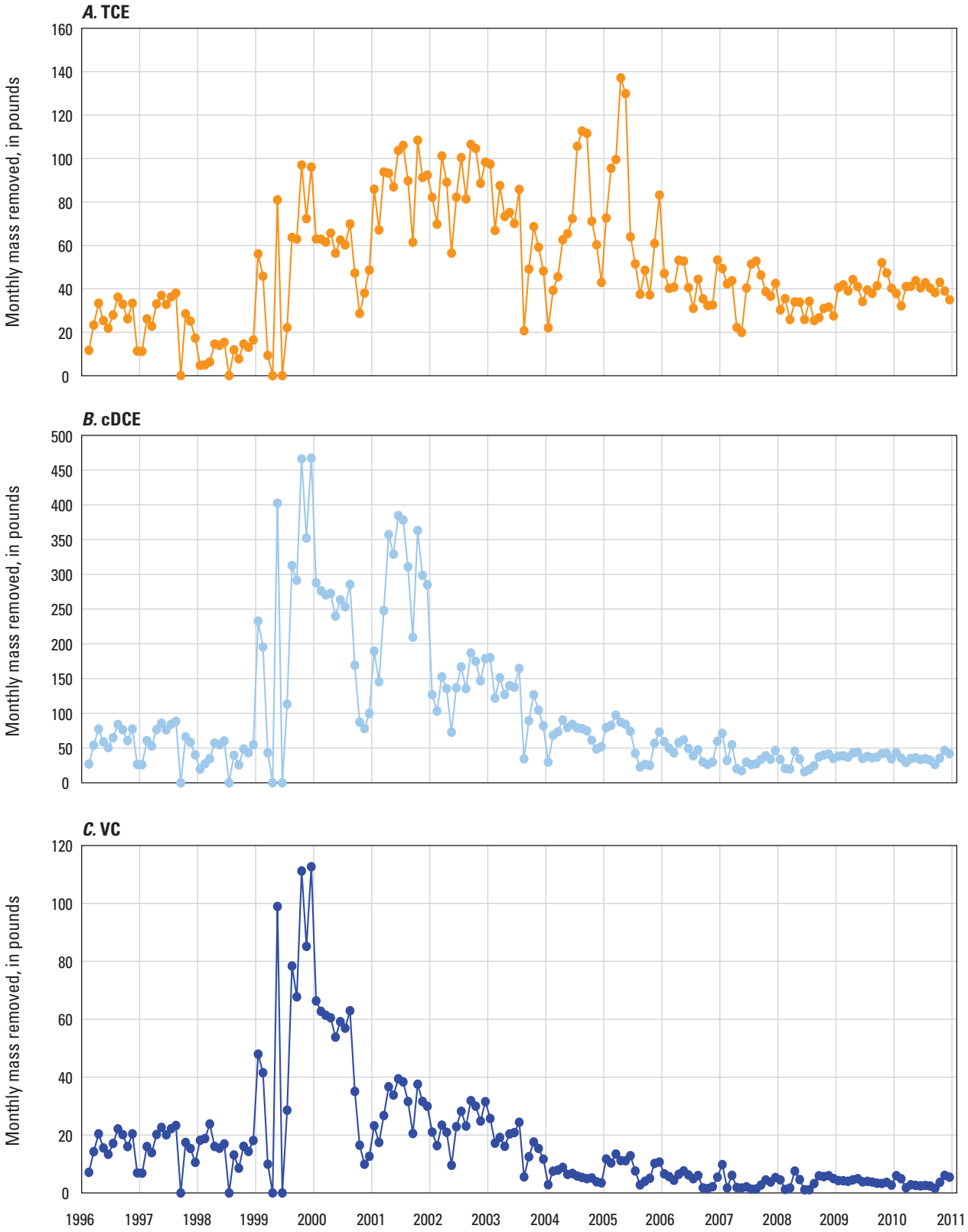

Figure 18. Monthly mass of (*A*) trichloroethylene (TCE), (*B*) cis-dichloroethylene (cDCE), and (*C*) vinyl chloride (VC) removed based on withdrawals from the recovery wells, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

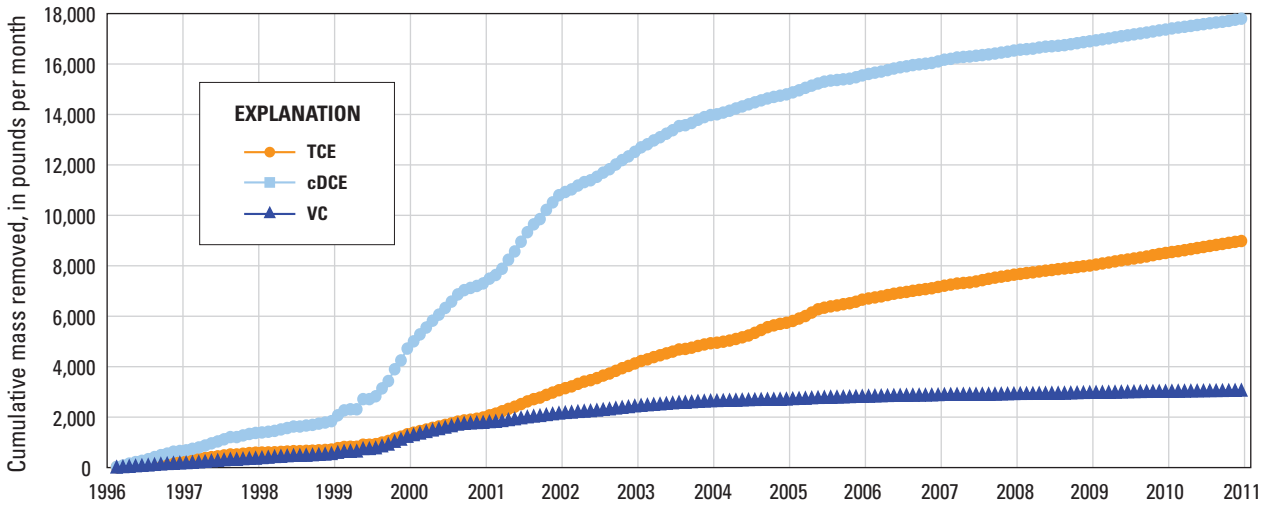

Figure 19. Cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) removed based on withdrawals from the recovery wells, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

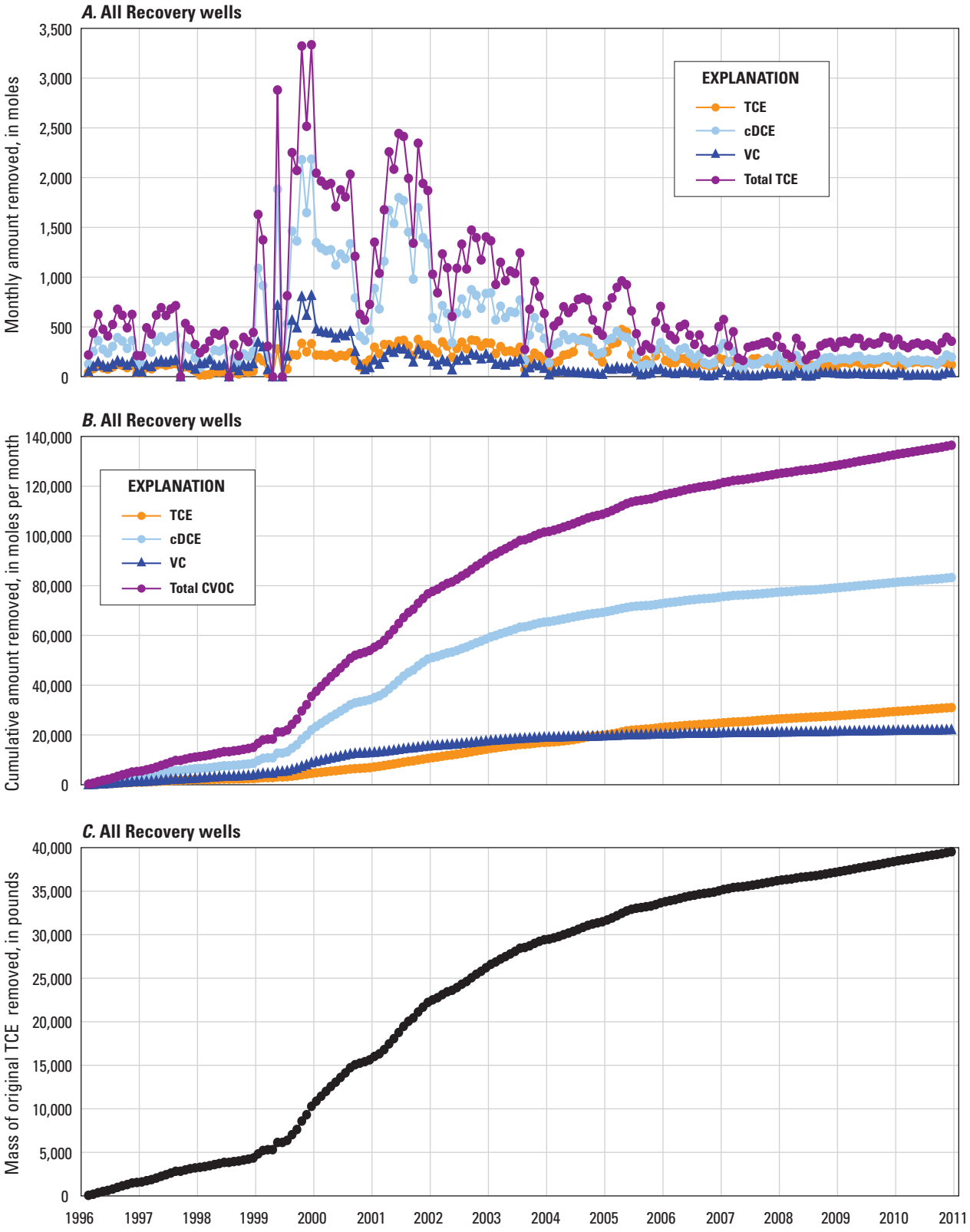

Figure 20. Amount of trichloroethylene (TCE), cis-dichloroethylene (cDCE), and vinyl chloride (VC) and total original TCE removed (*A*) monthly, (*B*) cumulatively, and (*C*) mass of original TCE removed from groundwater by pumping the recovery wells, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

Results of Method 3: Removal Based on Maximum of Methods 1 and 2

For Method 3, the greater value of the monthly number of moles for TCE, cDCE, and VC removed was selected from Methods 1 or Method 2 (fig. 21; table 5, at end of report). Method 1, in general, resulted in the greater monthly number of moles removed during 1996–98, and Method 2, in general, resulted in the greater monthly number of moles removed during 1999–2003. The monthly numbers of moles removed during 2004–10 were similar for both calculation methods.

The summed monthly mass of original TCE ranged from 52 to about 966 lbs with a mean of 259 lbs (table 5; fig. 22A). The cumulative mass of original TCE removed, using Method 3, during 1996–2010 was 46,452 lbs (fig. 22B).

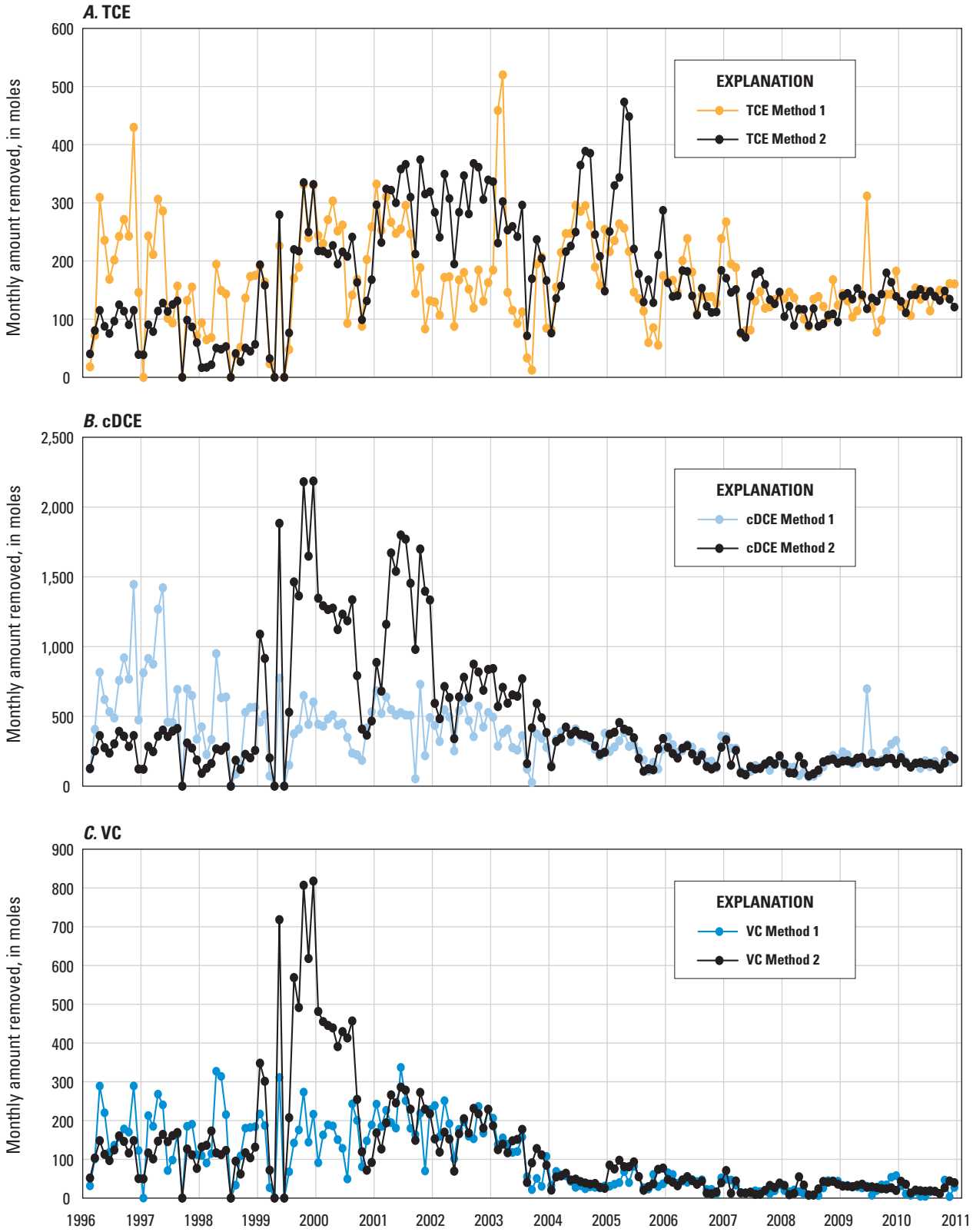

Figure 21. Amount of (*A*) trichloroethylene (TCE), (*B*) cis-dichloroethylene (cDCE), and (*C*) vinyl chloride (VC) removed monthly from groundwater using Method 1 from influent to the Pump and Treat building and using Method 2 from groundwater pumped from the recovery wells, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

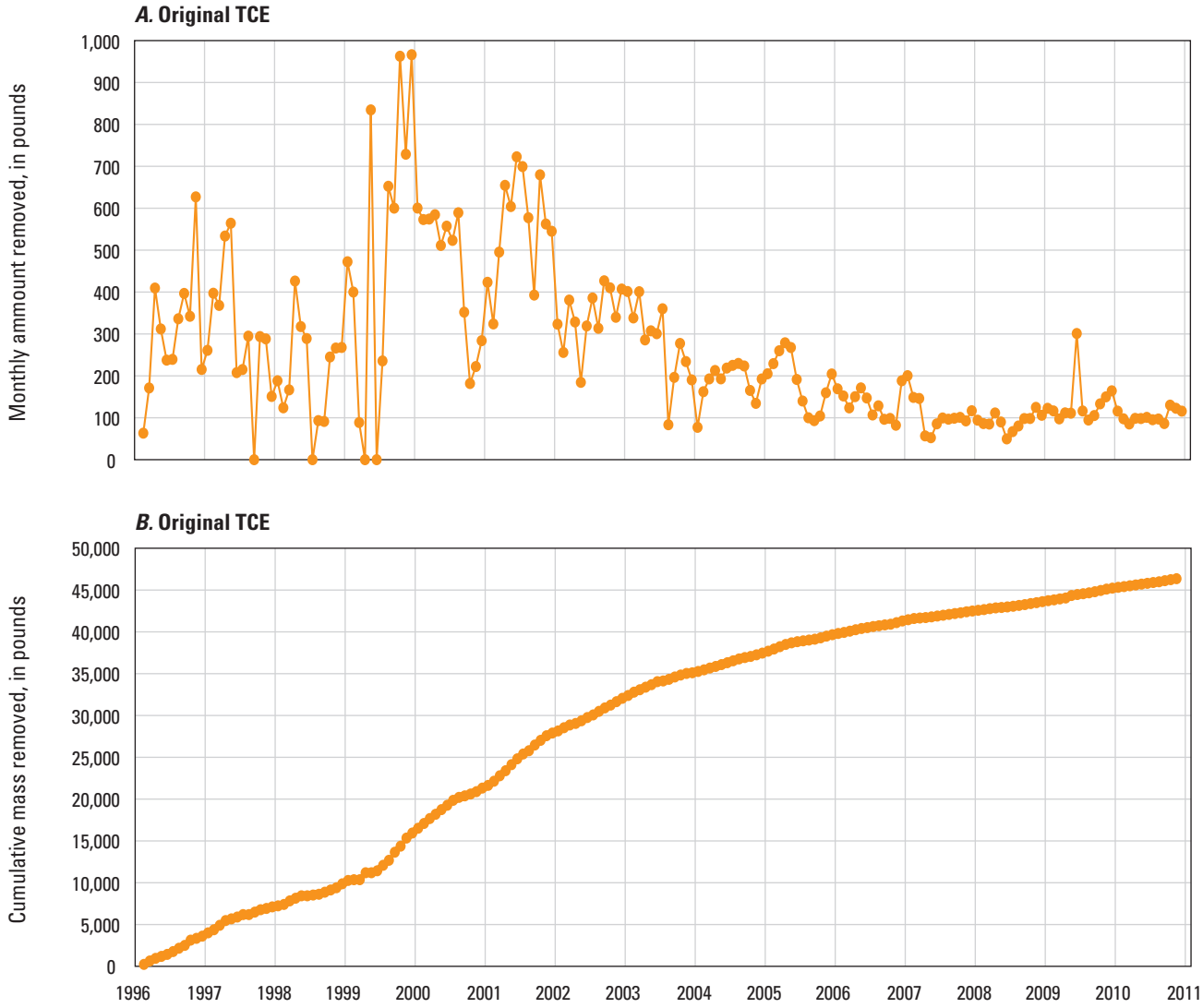

Figure 22. Number of pounds of original trichloroethylene (TCE) removed (*A*) monthly and (*B*) cumulatively using Method 3, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

Discussion of Difference in Masses Based on Methods

Masses of TCE, cDCE, and VC or origin TCE removed from groundwater by the P&T system should be the same whether using Method 1 or Method 2. The calculated masses removed are not similar. During 1996–98, the masses removed as calculated by Method 1 were greater than the masses calculated by Method 2 (fig. 21). During 1999–2004, the masses removed by Method 1 were sometimes much greater, sometimes equal, and sometimes much less than the masses removed by Method 2. During 2005–10, the masses removed by Method 1 and Method 2 were nearly identical. Plausible reasons for why the masses are different include (1) changes in concentrations of TCE, cDCE, and VC in the transmission pipe between the water sample collection locations at the recovery wells and in the P&T building; (2) changes in the volume of water between the two water sampling locations; or (3) differences in the laboratory analyses of water samples from the two sampling locations. It is unlikely that changes occurred in concentrations of the three compounds or volume of water between the two sampling locations because the changes would likely be constant over time and the changes are not constant with time.

It is likely that the difference in the monthly masses removed is a result of differences in the analytical results from the multiple laboratories that analyzed the water samples. During 1996–98 the influent water samples were analyzed by one laboratory, and the recovery well water samples were analyzed by another laboratory. The laboratory that analyzed influent water samples reported higher concentrations than the laboratory that analyzed water samples from the one active recovery well. During 1999–2004, influent water samples from the P&T building were analyzed by two laboratories, and CVOC concentrations remained relatively constant from one year to the next. During the same time, recovery well water samples were analyzed by five laboratories. Each laboratory analyzed the water samples for about 1 year. Some analytical results from the five laboratories showed wide fluctuations in TCE, cDCE, and VC concentrations from year to year. The fluctuations from year to year during 1999–2004 may be correct, but the fluctuations may also be a function of changes in analytical, calibration, and procedural methods between the laboratories. During 2005–10, two laboratories were used to analyze the influent, and one of those laboratories was used to analyze the recovery wells' water samples. Masses removed are nearly identical.

One might ask, are the results from Method 1 or Method 2 more accurate? Method 1 shows high rates of removal of TCE and cDCE during the first few years of operation with lesser removal rates as time passes (fig. 21). This characteristic is normal for P&T systems. Method 2 shows a high rate of removal of TCE, cDCE, and VC when the P&T system was expanded from one recovery well to seven recovery wells in 1999 and then shows lesser removal of each compound as time passes (fig. 21). This too is normal for a P&T system. During 1999–2002, at the time the P&T system expanded, Method 1 showed an increase in masses removed of cDCE or VC as well as an increase in masses removed of TCE. It is believed that Method 2 better reflects the increase in removal of TCE, cDCE, and VC with the startup of the additional seven recovery wells.

Calculations of the mass of original TCE removed, using Methods 1, 2, and 3, resulted in 32,381 lbs, 39,535 lbs, and 46,452 lbs, respectively (table 6; fig. 23). Historically, the Navy used Method 1 to obtain monthly masses of TCE, cDCE, and VC, then summed the masses to obtain the total mass of CVOCs that was removed, 24,805 lbs. Summing of the masses of three CVOCs is not a preferred manner of obtaining a value for original TCE; it is used for comparison purposes. With Methods 3, it is possible to show that the P&T system removed 21,647 lbs more (186 percent) of original TCE than was stated in the monthly reports.

Lacombe (2007) estimated that from 9,334 to 152,600 lbs of original TCE were in the subsurface in 2006. During 2006–10, the P&T system removed an average of about 1,200 lbs per year (fig. 21). The rate of removal of the CVOC by P&T will continue to decrease in the future. The P&T system as designed has controlled the off-site movement of contaminated groundwater toward the nearby neighborhood and the few supply wells in the neighborhood. The Navy annually monitors water quality in observation wells between the NAWC and the neighborhood to verify that no contaminant is migrating into the neighborhood. The P&T system also has reduced, but not eliminated, the discharge of contaminated groundwater to the West Ditch and the west branch of Gold Run, both intermittent streams. This problem has been addressed by increasing groundwater withdrawals from recovery wells near the intermittent stream, adding new recovery wells, and conducting research to determine the exact section of the intermittent stream where contaminated groundwater discharges.

Table 6. Mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed by the Pump and Treat system, determined using Methods 1, 2, and 3, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

	Method 1 (pounds)	Method 2 (pounds)	Method 3 (pounds)
TCE	8,666	8,985	10,602
cDCE	13,689	17,801	21,029
VC	2,456	3,056	3,496
Original TCE	32,381	39,535	46,452
Simple sum	24,805	29,837	35,053

reported simple sum of the mass of

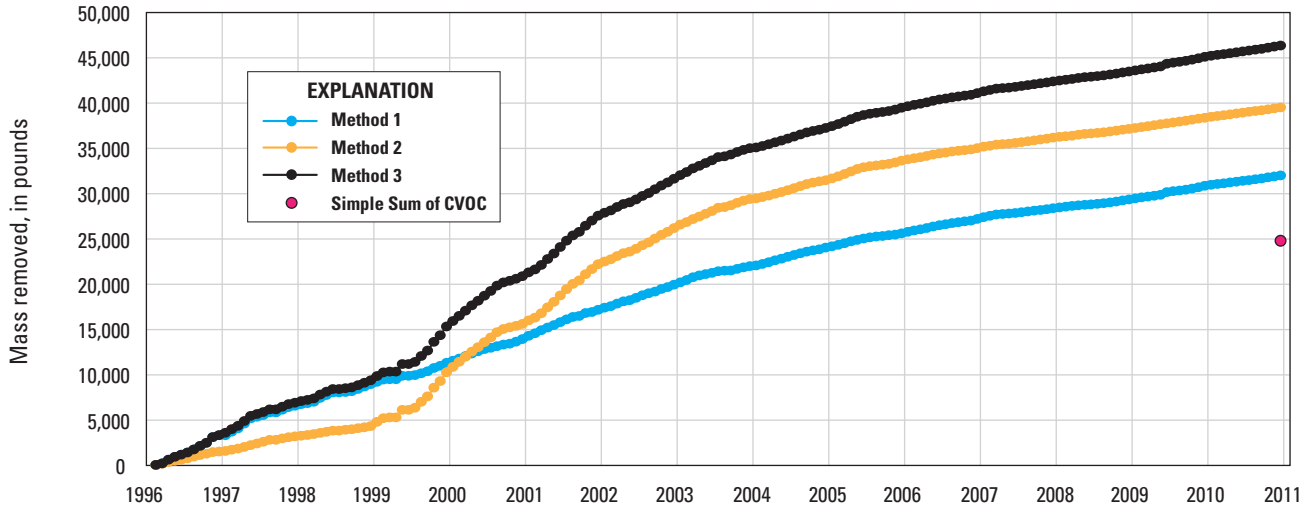

Figure 23. Mass removed of original trichloroethylene (TCE) using Methods 1, 2, and 3 and reported simple sum of the mass of TCE, cis-dichloroethylene (cDCE), and vinyl chloride (VC) removed, Naval Air Warfare Center, West Trenton, NJ, 1996–2010.

Summary and Conclusions

A P&T system was designed in the early 1990s to remove and contain CVOCs in the aquifer that underlies the former NAWC property in West Trenton, NJ. The system was designed to create a cone of depression that would prevent movement of CVOC contaminated groundwater to the surrounding neighborhood where CVOCs might contaminate domestic supply wells. The P&T system was also designed to prevent contaminated groundwater from discharging to surface water, thus contaminating the ecological water supply. Lastly, the system was designed to remove TCE and its degradation products cDCE and VC from the subsurface. The P&T system consists of 14 recovery wells, underground transmission lines from the recovery wells to the P&T stripper building, and the P&T air stripper building.

The Navy used TCE at NAWC as a heat transfer agent during tests of jet engines during 1953–95. TCE storage tanks, transmission lines, heat transfer units, and other related plumbing held 25,000 gallons (304,607 lbs) of TCE. TCE occasionally leaked from the plumbing system or was disposed if it became contaminated with water from condensation. The mass of TCE that leaked or was disposed of at the former NAWC is unknown. Estimates indicate that the amount of TCE that leaked or was disposed of ranged from 6,092 to 676,166 lbs.

Reducing conditions exist in the bedrock aquifer at the NAWC. The conditions result, in part, from the carbon-rich mudstone rocks of the region and, in part, from the jet fuel that leaked or spilled at the NAWC. The reducing environment enabled much of the TCE to biodegrade to cDCE, VC, and ethane. Concentrations of TCE, cDCE, and VC in water samples have decreased in most recovery wells similar to decreases in most monitoring wells. The decrease is in part a result of contaminant removal by the P&T system as well as other activities at NAWC, including monitored natural attenuation, enhanced biodegradation, thermal conductive heating, and removal of contaminated soil. As much as 152,600 lbs of original TCE was previously estimated to be present in the bedrock at NAWC.

About 250,000,000 gallons of contaminated groundwater was pumped and treated at NAWC during 1996–2010. Three methods were used to calculate the masses of TCE, cDCE, and VC, as well as the mass of original TCE, removed by the P&T system. Method 1 is based on the volume of influent to the P&T building and the concentration of each CVOC in influent to the P&T building. Method 2 is based on the volume of groundwater removed from each recovery well and the concentration of each CVOC in water samples from each recovery well. Method 3 consists of choosing the greater value from Method 1 or 2. The mass of original TCE removed by Methods 1, 2, and 3 are about 31,000 lbs, 38,000 lbs, and 45,000 lbs, respectively.

In theory, by using Methods 1 and 2, the calculated masses of TCE, cDCE, VC, and original TCE that were removed each month should be nearly identical. However, comparison of the two methods reveals that Method 1 resulted in more original TCE removed during 1996–98 than Method 2, and Method 2 resulted in more original TCE removed during 1999–2004 than Method 1. The two methods resulted in about the same amount of original TCE removed during 2005–10. The variations in calculated masses are believed to be the result of using multiple laboratories to analyze the water samples.

Large masses of CVOC were removed when the P&T system was first started in 1996 and again when the P&T system was expanded in 1999. During the past 5 years, the monthly removal rates have decreased substantially. The large masses initially removed were TCE, cDCE and VC held in the voids and adsorbed to the walls of higher transmissive fractures. During the past 5 years, the masses of CVOC removed are likely from voids and walls of low transmissive fractures and from deeper within the rock matrix. Continuing P&T activities will maintain the cone of depression to prevent movement of contaminated groundwater to surrounding residential communities and to surface-water ecological supplies, but lesser amounts of CVOC will be removed each month.

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Table 1. Reported monthly data and cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed based on volume of influent and concentrations of CVOCs in influent to the Pump-and-Treat plant (Method 1), Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010.

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride; tDCE, trans-dichloroethylene; gal/mon, gallons per month; µg/L, micrograms per liter; lb/mon pounds per month; lb pounds; moles/mon, moles per month, **Bold**, published values; blue cells, data estimated from a published graph; orange cells, data calculated from published data; purple cells, data calculated from reported mass removed; --, no data; *, estimated data; purple numbers March–April 1998 combined report]

Date	Days	Influent volume		CVOC concentrations in influent				Monthly CVOC mass removed from influent				Cumulative CVOC mass removed from influent		
		Monthly (gal/mon)	Cumulative (gallons)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	tDCE (µg/L)	TCE (lb/mon)	cDCE (lb/mon)	VC (lb/mon)	tDCE (lb/mon)	TCE (lb)	cDCE (lb)	VC (lb)
Jan-1996	31	not started	--	--	--	--	--	--	--	--	--			
Feb-1996	28	**208,413**	208,413	3,000	15,000	2,500	15*	5.2	26.1	4.3	0.0	5	26	4
Mar-1996	31	**416,600**	625,013	6,000	25,000	4,000	15*	20.9	86.9	13.9	0.1	26	113	18
Apr-1996	30	**596,400**	1,221,413	18,000	35,000	8,000	15*	89.6	174.2	39.8	0.1	116	287	58
May-1996	31	**454,240**	1,675,653	18,000	35,000	8,000	15*	68.2	132.7	30.3	0.1	184	420	88
Jun-1996	30	**390,050**	2,065,703	15,000	35,000	5,000	15*	48.8	113.9	16.3	0.0	233	534	105
Jul-1996	31	**500,000**	2,565,703	14,000	25,000	4,500	15*	58.4	104.3	18.8	0.1	291	638	123
Aug-1996	31	**646,700**	3,212,403	13,000	30,000	4,000	15*	70.2	161.9	21.6	0.1	361	800	145
Sep-1996	30	**588,700**	3,801,103	16,000	40,000	5,000	15*	78.6	196.5	24.6	0.1	440	997	170
Oct-1996	31	**468,200**	4,269,303	18,000	42,000	6,000	15*	70.3	164.1	23.4	0.1	510	1,161	193
Nov-1996	30	**596,900**	4,866,203	25,000	62,000	8,000	15*	124.5	308.8	39.9	0.1	635	1,470	233
Dec-1996	31	**202,500**	5,068,703	25,000	60,000	10,000	15*	42.2	101.4	16.9	0.0	677	1,572	250
Jan-1997	31	**400,000**	5,468,703	20,000	52,000	7,500	15*	66.8	173.6	25.0	0.1	744	1,745	275
Feb-1997	28	**468,600**	5,937,303	18,000	50,000	7,500	15*	70.4	195.5	29.3	0.1	814	1,941	304
Mar-1997	31	**407,100**	6,344,403	18,000	55,000	7,500	15*	61.2	186.9	25.5	0.1	875	2,128	330
Apr-1997	30	**590,200**	6,934,603	18,000	55,000	7,500	15*	88.7	270.9	36.9	0.1	964	2,399	367
May-1997	31	**661,657**	7,596,260	15,000	55,000	6,000	15*	82.8	303.7	33.1	0.1	1,047	2,702	400
Jun-1997	30	**586,500**	8,182,760	6,000	20,000	2,000	15*	29.4	97.9	9.8	0.1	1,076	2,800	410
Jul-1997	31	**648,600**	8,831,360	5,000	18,000	2,500	15*	27.1	97.4	13.5	0.1	1,103	2,898	423
Aug-1997	31	**680,900**	9,512,260	8,000	26,000	4,000	15*	45.5	147.7	22.7	0.1	1,149	3,046	446
Sep-1997	30	no report	9,512,260	--	--	--	--	0	0	0	0	1,149	3,046	446
Oct-1997	31	**509,600**	10,021,860	9,000	35,000	6,000	15*	38.3	148.8	25.5	0.1	1,187	3,195	471
Nov-1997	30	**449,200**	10,471,060	12,000	37,000	7,000	15*	45.0	138.7	26.2	0.1	1,232	3,333	498
Dec-1997	31	**308,600**	10,779,660	8,000	28,000	6,000	15*	20.6	72.1	15.5	0.0	1,253	3,406	513
Jan-1998	31	**362,000**	11,141,660	9,000	30,000	5,000	15*	27.2	90.6	15.1	0.0	1,280	3,496	528
Feb-1998	28	**373,700**	11,515,360	6,000	15,500	4,000	15*	18.7	48.3	12.5	0.0	1,298	3,545	541
Mar-1998	31	474,344	11,989,704	5,000	18,000	4,000	15*	19.8	71.3	15.8	0.1	1,318	3,616	556
Apr-1998	30	1,350,056	13,339,760	5,000	18,000	4,000	15*	56.3	202.8	45.1	0.2	1,375	3,819	601
May-1998	31	**1,295,600**	14,635,360	4,000	12,500	4,000	15*	43.2	135.2	43.2	0.2	1,418	3,954	645
Jun-1998	30	**1,421,700**	16,057,060	3,500	11,500	2,500	15*	41.5	136.4	29.7	0.2	1,459	4,091	674
Jul-1998	31	no report	16,057,060	--	--	--	--					1,459	4,091	674
Aug-1998	31	**1,101,700**	17,158,760	1,200	2,000	500	10*	11.0	18.4	4.6	0.1	1,470	4,109	679
Sep-1998	30	**717,700**	17,876,460	2,500	5,500	2,500	10*	15.0	32.9	15.0	0.1	1,485	4,142	694
Oct-1998	31	**1,353,100**	19,229,560	3,500	10,000	2,200	10*	39.5	112.9	24.8	0.2	1,525	4,255	719
Nov-1998	30	**1,202,800**	20,432,360	5,000	12,000	2,500	10*	50.2	120.5	25.1	0.2	1,575	4,376	744
Dec-1998	31	**1,520,500**	21,952,860	4,000	9,500	2,000	10*	50.8	120.5	25.4	0.2	1,626	4,497	769
Jan-1999	31	**1,660,200**	23,613,060	4,014	7,063	2,157	10*	**55.6**	**97.9**	**29.9**	0.2	1,681	4,595	799

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Date	Days	Influent volume		CVOC concentrations in influent				Monthly CVOC mass removed from influent				Cumulative CVOC mass removed from influent		
		Monthly (gal/mon)	Cumulative (gallons)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	tDCE (µg/L)	TCE (lb/mon)	cDCE (lb/mon)	VC (lb/mon)	tDCE (lb/mon)	TCE (lb)	cDCE (lb)	VC (lb)
Feb-1999	**28**	**1,276,400**	24,889,460	4,460	10,269	2,420	10*	**47.5**	**109.4**	**25.8**	0.2	1,729	4,704	825
Mar-1999	**31**	**231,400**	25,120,860	3,515	8,092	1,907	10*	7	16	4	0	1,736	4,720	829
Apr-1999	**X30**	0	25,120,860	--	--	--	--	0	0	0	0	1,736	4,720	829
May-1999	**31**	**1,888,100**	27,008,960	4,160	10,460	2,720	41	**65.6**	**164.8**	**42.9**	**0.7**	1,801	4,886	871
Jun-1999	**X30**	0	27,008,960	--	--	--	--	0	0	0	0	1,801	4,886	871
Jul-1999	**31**	**510,000**	27,518,960	3,249	7,549	2,199	26	**13.8**	**32.1**	**9.4**	**0.1**	1,815	4,918	881
Aug-1999	**31**	**1,627,300**	29,146,260	3,629	5,872	1,443	27	**49.3**	**79.7**	**19.6**	**0.4**	1,864	4,998	900
Sep-1999	**30**	**1,611,400**	30,757,660	4,071	6,457	1,800	42	**54.8**	**86.8**	**24.2**	**0.6**	1,919	5,085	925
Oct-1999	**31**	**2,354,200**	33,111,860	4,883	7,016	1,917	39	**95.9**	**137.9**	**37.7**	**0.8**	2,015	5,224	962
Nov-1999	**30**	**1,700,300**	34,812,160	4,900	6,625	1,400	40	**69.5**	**94.0**	**19.9**	**0.6**	2,085	5,319	982
Dec-1999	**31**	**2,304,100**	37,116,260	4,986	6,657	1,550	42	**95.9**	**128.0**	**29.8**	**0.8**	2,181	5,447	1,012
Jan-2000	**31**	**1,764,300**	38,880,560	4,800	6,400	853	37	**70.7**	**94.2**	**12.6**	**0.5**	2,251	5,542	1,025
Feb-2000	**29**	**1,762,800**	40,643,360	4,525	6,212	1,525	37	**66.6**	**91.4**	**22.4**	**0.6**	2,318	5,634	1,047
Mar-2000	**31**	**1,858,300**	42,501,660	5,060	6,600	1,680	37	**78.5**	**102.4**	**26.1**	**0.6**	2,396	5,737	1,073
Apr-2000	**30**	**2,014,800**	44,516,460	5,225	6,450	1,525	39	**87.9**	**108.5**	**25.6**	**0.7**	2,484	5,846	1,099
May-2000	**31**	**1,746,300**	46,262,760	5,000	6,375	1,425	36	**72.9**	**92.9**	**20.8**	**0.5**	2,557	5,940	1,119
Jun-2000	**30**	**1,975,800**	48,238,560	4,600	5,817	1,072	28	**75.9**	**95.9**	**17.7**	**0.5**	2,633	6,036	1,137
Jul-2000	**31**	**1,893,500**	50,132,060	1,700	4,700	430	13	**26.9**	**74.3**	**6.8**	0.2	2,660	6,110	1,144
Aug-2000	**31**	**2,134,000**	52,266,060	2,300	2,820	1,880	22	**41.0**	**50.2**	**33.5**	**0.4**	2,701	6,161	1,177
Sep-2000	**30**	**1,538,500**	53,804,560	3,800	3,703	2,150	29	**48.8**	**47.5**	**27.6**	**0.4**	2,749	6,209	1,205
Oct-2000	**31**	**952,000**	54,756,560	3,200	4,950	1,400	29	**25.4**	**39.3**	**11.1**	**0.2**	2,775	6,248	1,216
Nov-2000	**30**	**1,434,300**	56,190,860	4,900	7,400	1,700	43	**58.7**	**88.6**	**20.4**	**0.5**	2,833	6,338	1,236
Dec-2000	**31**	**1,833,000**	58,023,860	4,900	7,400	1,700	43	**75.0**	**113.2**	**26.0**	**0.7**	2,908	6,451	1,262
Jan-2001	**31**	**2,353,300**	60,377,160	4,900	7,400	1,700	43	**96.2**	**145.3**	**33.4**	**0.8**	3,005	6,598	1,296
Feb-2001	**28**	**1,792,200**	62,169,360	4,900	7,400	1,700	43	**73.3**	**110.7**	**25.4**	**0.6**	3,078	6,709	1,321
Mar-2001	**31**	**2,198,200**	64,367,560	4,900	7,400	1,700	43	**89.9**	**135.8**	**31.2**	**0.8**	3,168	6,845	1,352
Apr-2001	**30**	**1,889,100**	66,256,660	4,900	7,400	1,700	43	**77.3**	**116.7**	**26.8**	**0.7**	3,245	6,963	1,379
May-2001	**31**	**1,752,400**	68,009,060	4,900	7,400	1,700	43	**71.7**	**108.2**	**24.9**	**0.6**	3,317	7,072	1,404
Jun-2001	**30**	**2,061,100**	70,070,160	4,300	6,500	2,700	43	**74.0**	**111.8**	**46.4**	**0.7**	3,391	7,184	1,451
Jul-2001	**31**	**2,072,300**	72,142,460	4,950	6,250	2,000	49	**85.6**	**108.1**	**34.6**	**0.9**	3,476	7,293	1,485
Aug-2001	**31**	**1,747,000**	73,889,460	4,900	7,400	1,700	43	**71.4**	**107.9**	**24.8**	**0.6**	3,548	7,402	1,510
Sep-2001	**30**	**1,286,000**	75,175,460	3,900	1,000	2,100	59	**41.9**	**10.7**	**22.5**	**0.6**	3,590	7,413	1,532
Oct-2001	**31**	**2,256,700**	77,432,160	2,900	8,250	1,600	32	**54.6**	**155.4**	**30.1**	**0.6**	3,644	7,569	1,563
Nov-2001	**30**	**1,922,500**	79,354,660	1,500	2,900	600	6	**24.1**	**46.5**	**9.6**	**0.1**	3,668	7,616	1,572
Dec-2001	**31**	**1,938,500**	81,293,160	2,357	6,471	1,943	11	**38.1**	**104.7**	**31.4**	**0.2**	3,706	7,720	1,604
Jan-2002	**31**	**2,015,000**	83,308,160	2,229	5,529	1,957	9	**37.5**	**93.0**	**32.9**	**0.2**	3,744	7,814	1,637
Feb-2002	**28**	**1,658,600**	84,966,760	2,233	4,933	1,583	9	**30.9**	**68.3**	**21.9**	**0.1**	3,775	7,882	1,658

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Date	Days	Influent volume		CVOC concentrations in influent				Monthly CVOC mass removed from influent				Cumulative CVOC mass removed from influent		
		Monthly (gal/mon)	Cumulative (gallons)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	tDCE (µg/L)	TCE (lb/mon)	cDCE (lb/mon)	VC (lb/mon)	tDCE (lb/mon)	TCE (lb)	cDCE (lb)	VC (lb)
Mar-2002	31	**2,074,000**	87,040,760	2,875	6,750	2,000	11	**49.8**	**116.8**	**34.6**	**0.2**	3,825	7,999	1,693
Apr-2002	30	**1,891,300**	88,932,060	3,175	6,700	1,675	13	**50.1**	**105.8**	**26.4**	**0.2**	3,875	8,105	1,720
May-2002	31	**1,241,400**	90,173,460	2,450	5,200	1,350	16	**25.4**	**53.9**	**14.0**	**0.2**	3,900	8,159	1,734
Jun-2002	30	**1,831,400**	92,004,860	3,175	7,550	1,600	12	**48.5**	**115.4**	**24.5**	**0.2**	3,949	8,275	1,758
Jul-2002	31	**2,209,100**	94,213,960	2,833	7,000	1,467	12	**52.2**	**129.1**	**27.0**	**0.2**	4,001	8,404	1,785
Aug-2002	31	**1,754,300**	95,968,260	3,000	6,833	1,500	14	**43.9**	**100.0**	**22.0**	**0.2**	4,045	8,504	1,807
Sep-2002	30	**1,721,400**	97,689,660	2,400	5,267	1,467	15	**34.5**	**75.7**	**21.1**	**0.2**	4,079	8,580	1,828
Oct-2002	31	**2,193,000**	99,882,660	2,920	6,680	1,780	8	**53.4**	**122.3**	**32.6**	**0.2**	4,133	8,702	1,861
Nov-2002	30	**1,996,500**	101,879,160	2,275	5,425	1,385	10	**37.9**	**90.4**	**23.1**	**0.2**	4,171	8,793	1,884
Dec-2002	31	**2,321,700**	104,200,860	2,433	5,800	1,634	12	**47.2**	**112.4**	**31.7**	**0.2**	4,218	8,905	1,915
Jan-2003	31	**2,307,200**	106,508,060	2,775	5,475	1,475	9	**53.4**	**105.4**	**28.4**	**0.2**	4,271	9,011	1,944
Feb-2003	28	**1,691,100**	108,199,160	9,417	4,334	1,350	10	**132.9**	**61.2**	**19.1**	**0.1**	4,404	9,072	1,963
Mar-2003	31	**2,080,800**	110,279,960	8,675	4,675	1,234	10	**150.6**	**81.2**	**21.4**	**0.2**	4,555	9,154	1,984
Apr-2003	30	**1,766,500**	112,046,460	2,867	5,900	1,300	13	**42.3**	**87.0**	**19.2**	**0.2**	4,597	9,241	2,003
May-2003	31	**1,904,300**	113,950,760	2,100	3,700	1,021	10	**33.4**	**58.8**	**16.2**	**0.2**	4,630	9,300	2,020
Jun-2003	30	**1,891,400**	115,842,160	1,700	3,500	1,050	0	**26.8**	**55.3**	**16.6**	**0.0**	4,657	9,355	2,036
Jul-2003	31	**2,235,400**	118,077,560	1,744	4,125	1,164	11	**32.5**	**77.0**	**21.7**	**0.2**	4,690	9,432	2,058
Aug-2003	31	**1,081,700**	119,159,260	1,067	2,900	842	0	**9.6**	**26.2**	**7.6**	**0.0**	4,699	9,458	2,066
Sep-2003	30	**1,163,500**	120,322,760	368	575	310	0	**3.6**	**5.6**	**3.0**	**0.0**	4,703	9,464	2,069
Oct-2003	31	**1,471,500**	121,794,260	4,600	6,500	570	0	**56.5**	**79.8**	**7.0**	**0.0**	4,759	9,544	2,076
Nov-2003	30	**1,465,100**	123,259,360	4,900	6,000	340	0	**59.9**	**73.4**	**4.2**	**0.0**	4,819	9,617	2,080
Dec-2003	31	**1,273,900**	124,533,260	2,295	5,587	1,392	0	**24.4**	**59.4**	**14.8**	**0.0**	4,844	9,677	2,094
Jan-2004	31	**812,100**	125,345,360	3,497	4,795	664	0	**23.7**	**32.5**	**4.5**	**0.0**	4,867	9,709	2,099
Feb-2004	29	**1,540,230**	126,885,590	3,493	5,586	739	0	**44.9**	**71.8**	**9.5**	**0.0**	4,912	9,781	2,108
Mar-2004	31	**1,708,399**	128,593,989	4,363	5,850	582	0	**62.2**	**83.4**	**8.3**	**0.0**	4,975	9,864	2,117
Apr-2004	30	**2,264,424**	130,858,413	3,789	4,789	418	0	**71.6**	**90.5**	**7.9**	**0.0**	5,046	9,955	2,125
May-2004	31	**2,154,300**	133,012,713	3,988	3,793	328	0	**71.7**	**68.2**	**5.9**	**0.0**	5,118	10,023	2,131
Jun-2004	30	**2,507,400**	135,520,113	4,091	4,191	182	0	**85.6**	**87.7**	**3.8**	**0.0**	5,203	10,111	2,134
Jul-2004	31	**2,421,300**	137,941,413	4,093	3,791	218	0	**82.7**	**76.6**	**4.4**	**0.0**	5,286	10,187	2,139
Aug-2004	31	**2,444,200**	140,385,613	4,192	3,594	162	0	**85.5**	**73.3**	**3.3**	**0.0**	5,372	10,261	2,142
Sep-2004	30	**2,396,300**	142,781,913	3,790	3,490	200	0	**75.8**	**69.8**	**4.0**	**0.0**	5,447	10,330	2,146
Oct-2004	31	**1,649,300**	144,431,213	3,989	4,090	276	0	**54.9**	**56.3**	**3.8**	**0.0**	5,502	10,387	2,150
Nov-2004	30	**1,282,200**	145,713,413	4,290	4,290	336	0	**45.9**	**45.9**	**3.6**	**0.0**	5,548	10,433	2,153
Dec-2004	31	**983,300**	146,696,713	8,981	9,883	524	0	**73.7**	**81.1**	**4.3**	**0.0**	5,622	10,514	2,158
Jan-2005	31	**1,634,900**	148,331,613	4,588	3,892	308	0	**62.6**	**53.1**	**4.2**	**0.0**	5,685	10,567	2,162
Feb-2005	28	**1,948,400**	150,280,013	4,188	3,690	301	0	**68.1**	**60.0**	**4.9**	**0.0**	5,753	10,627	2,167
Mar-2005	31	**2,185,460**	152,465,473	4,189	3,789	302	16	**76.4**	**69.1**	**5.5**	**0.3**	5,829	10,696	2,172

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Date	Days	Influent volume		CVOC concentrations in influent				Monthly CVOC mass removed from influent				Cumulative CVOC mass removed from influent		
		Monthly (gal/mon)	Cumulative (gallons)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	tDCE (µg/L)	TCE (lb/mon)	cDCE (lb/mon)	VC (lb/mon)	tDCE (lb/mon)	TCE (lb)	cDCE (lb)	VC (lb)
Apr-2005	30	**2,349,400**	154,814,873	3,790	4,192	479	0	**74.3**	**82.2**	**9.4**	**0.0**	5,903	10,778	2,182
May-2005	31	**2,216,200**	157,031,073	3,390	3,293	297	0	**62.7**	**60.9**	**5.5**	**0.0**	5,966	10,839	2,187
Jun-2005	30	**1,817,600**	158,848,673	2,795	4,193	745	0	**42.4**	**63.6**	**11.3**	**0.0**	6,008	10,903	2,199
Jul-2005	31	**1,683,200**	160,531,873	2,791	3,794	548	0	**39.2**	**53.3**	**7.7**	**0.0**	6,048	10,956	2,206
Aug-2005	31	**1,102,300**	161,634,173	3,587	4,392	402	0	**33.0**	**40.4**	**3.7**	**0.0**	6,081	10,997	2,210
Sep-2005	30	**1,223,400**	162,857,573	1,694	2,292	313	0	**17.3**	**23.4**	**3.2**	**0.0**	6,098	11,020	2,213
Oct-2005	31	**1,096,600**	163,954,173	2,699	3,988	918	0	**24.7**	**36.5**	**8.4**	**0.0**	6,123	11,057	2,222
Nov-2005	30	**1,750,400**	165,704,573	1,095	1,794	281	0	**16.0**	**26.2**	**4.1**	**0.0**	6,139	11,083	2,226
Dec-2005	30	**1,842,100**	167,546,673	3,291	3,688	332	0	**50.6**	**56.7**	**5.1**	**0.0**	6,189	11,139	2,231
Jan-2006	31	**1,975,000**	169,521,673	2,894	4,587	546	0	**47.7**	**75.6**	**9.0**	**0.0**	6,237	11,215	2,240
Feb-2006	28	**1,656,900**	171,178,573	3,493	4,592	607	0	**48.3**	**63.5**	**8.4**	**0.0**	6,285	11,279	2,248
Mar-2006	31	**1,683,900**	172,862,473	2,996	3,693	377	0	**42.1**	**51.9**	**5.3**	**0.0**	6,327	11,330	2,253
Apr-2006	30	**2,326,400**	175,188,873	2,993	2,807	309	10	**58.1**	**54.5**	**6.0**	**0.2**	6,385	11,385	2,259
May-2006	31	**2,306,700**	177,495,573	3,590	3,293	291	10	**69.1**	**63.4**	**5.6**	**0.2**	6,455	11,449	2,265
Jun-2006	30	**1,748,500**	179,244,073	3,591	4,091	452	0	**52.4**	**59.7**	**6.6**	**0.0**	6,507	11,508	2,272
Jul-2006	31	**1,318,000**	180,562,073	2,891	4,191	536	0	**31.8**	**46.1**	**5.9**	**0.0**	6,539	11,555	2,278
Aug-2006	31	**1,636,500**	182,198,573	2,995	3,793	476	15	**40.9**	**51.8**	**6.5**	**0.2**	6,580	11,607	2,284
Sep-2006	30	**1,299,800**	183,498,373	3,688	3,393	286	0	**40.0**	**36.8**	**3.1**	**0.0**	6,620	11,643	2,287
Oct-2006	31	**1,207,400**	184,705,773	3,990	3,791	308	0	**40.2**	**38.2**	**3.1**	**0.0**	6,660	11,682	2,290
Nov-2006	30	**1,083,200**	185,788,973	4,093	3,097	177	0	**37.0**	**28.0**	**1.6**	**0.0**	6,697	11,710	2,292
Dec-2006	31	**1,845,100**	187,634,073	4,488	4,988	468	0	**69.1**	**76.8**	**7.2**	**0.0**	6,766	11,786	2,299
Jan-2007	31	**2,162,400**	189,796,473	4,289	4,189	371	0	**77.4**	**75.6**	**6.7**	**0.0**	6,843	11,862	2,306
Feb-2007	28	**1,834,500**	191,630,973	3,690	3,788	418	0	**56.5**	**58.0**	**6.4**	**0.0**	6,900	11,920	2,312
Mar-2007	31	**1,991,000**	193,621,973	3,292	3,491	277	0	**54.7**	**58.0**	**4.6**	**0.0**	6,955	11,978	2,317
Apr-2007	30	**970,700**	194,592,673	2,691	2,790	222	0	**21.8**	**22.6**	**1.8**	**0.0**	6,976	12,001	2,319
May-2007	31	**809,800**	195,402,473	3,433	2,752	281	0	**23.2**	**18.6**	**1.9**	**0.0**	7,000	12,019	2,320
Jun-2007	30	**1,448,300**	196,850,773	1,944	1,853	149	8	**23.5**	**22.4**	**1.8**	**0.1**	7,023	12,042	2,322
Jul-2007	31	**2,068,500**	198,919,273	2,196	1,813	151	12	**37.9**	**31.3**	**2.6**	**0.2**	7,061	12,073	2,325
Aug-2007	31	**2,102,100**	201,021,373	2,434	1,613	131	29	**42.7**	**28.3**	**2.3**	**0.5**	7,104	12,102	2,327
Sep-2007	30	**2,004,300**	203,025,673	2,057	2,051	149	18	**34.4**	**34.3**	**2.5**	**0.3**	7,138	12,137	2,330
Oct-2007	31	**1,858,900**	204,884,573	2,263	1,508	103	64	**35.1**	**23.4**	**1.6**	**1.0**	7,173	12,161	2,331
Nov-2007	30	**1,760,500**	206,645,073	2,634	2,205	177	54	**38.7**	**32.4**	**2.6**	**0.8**	7,212	12,194	2,334
Dec-2007	31	**1,913,700**	208,558,773	2,573	2,473	294	138	**41.1**	**39.5**	**4.7**	**2.2**	7,253	12,236	2,339
Jan-2008	31	**1,467,099**	210,025,872	3,202	2,458	221	16	**39.2**	**30.1**	**2.7**	**0.2**	7,292	12,266	2,341
Feb-2008	29	**1,417,900**	211,443,772	3,583	2,409	194	17	**42.4**	**28.5**	**2.3**	**0.2**	7,335	12,295	2,344
Mar-2008	31	**1,504,700**	212,948,472	3,154	2,222	231	88	**39.6**	**27.9**	**2.9**	**1.1**	7,374	12,324	2,346
Apr-2008	30	**2,082,900**	215,031,372	1,933	874	132	52	**33.6**	**15.2**	**2.3**	**0.9**	7,408	12,340	2,349

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Date	Days	Influent volume		CVOC concentrations in influent				Monthly CVOC mass removed from influent				Cumulative CVOC mass removed from influent		
		Monthly (gal/mon)	Cumulative (gallons)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	tDCE (µg/L)	TCE (lb/mon)	cDCE (lb/mon)	VC (lb/mon)	tDCE (lb/mon)	TCE (lb)	cDCE (lb)	VC (lb)
May-2008	31	**1,977,400**	217,008,772	1,757	1,266	91	24	**29.0**	**20.9**	**1.5**	**0.4**	7,437	12,361	2,350
Jun-2008	30	**1,341,400**	218,350,172	2,242	1,268	80	9	**25.1**	**14.2**	**0.9**	**0.1**	7,462	12,376	2,351
Jul-2008	31	**1,838,900**	220,189,072	2,535	984	65	13	**38.9**	**15.1**	**1.0**	**0.2**	7,501	12,391	2,352
Aug-2008	31	**1,497,600**	221,686,672	3,216	1,608	72	72	**40.2**	**20.1**	**0.9**	**0.9**	7,541	12,412	2,353
Sep-2008	30	**1,837,100**	223,523,772	2,302	1,924	235	13	**35.3**	**29.5**	**3.6**	**0.2**	7,576	12,442	2,357
Oct-2008	31	**2,200,200**	225,723,972	1,618	2,070	338	44	**29.7**	**38.0**	**6.2**	**0.8**	7,606	12,480	2,363
Nov-2008	30	**2,333,500**	228,057,472	2,496	2,383	313	21	**48.6**	**46.4**	**6.1**	**0.4**	7,655	12,527	2,369
Dec-2008	31	**2,110,700**	230,168,172	2,038	2,390	341	17	**35.9**	**42.1**	**6.0**	**0.3**	7,690	12,570	2,375
Jan-2009	31	**2,168,100**	232,336,272	2,305	2,885	249	28	**41.7**	**52.2**	**4.5**	**0.5**	7,732	12,622	2,379
Feb-2009	28	**2,204,400**	234,540,672	2,066	2,577	245	33	**38.0**	**47.4**	**4.5**	**0.6**	7,770	12,670	2,384
Mar-2009	31	**2,110,200**	236,650,872	1,704	1,936	221	17	**30.0**	**34.1**	**3.9**	**0.3**	7,800	12,705	2,388
Apr-2009	30	**2,222,800**	238,873,672	1,784	1,881	216	16	**33.1**	**34.9**	**4.0**	**0.3**	7,833	12,740	2,392
May-2009	31	**2,235,100**	241,108,772	2,144	2,220	193	38	**40.0**	**41.4**	**3.6**	**0.7**	7,873	12,782	2,395
Jun-2009	30	**1,834,200**	242,942,972	5,899	9,460	274	274	**90.3**	**144.8**	**4.2**	**4.2**	7,964	12,931	2,400
Jul-2009	31	**2,088,600**	245,031,572	1,968	2,874	57	17	**34.3**	**50.1**	**1.0**	**0.3**	7,998	12,981	2,401
Aug-2009	31	**2,076,500**	247,108,072	1,298	1,697	156	17	**22.5**	**29.4**	**2.7**	**0.3**	8,020	13,011	2,403
Sep-2009	30	**1,849,100**	248,957,172	1,847	2,566	305	19	**28.5**	**39.6**	**4.7**	**0.3**	8,049	13,051	2,408
Oct-2009	30	**2,194,900**	251,152,072	2,255	2,844	257	27	**41.3**	**52.1**	**4.7**	**0.5**	8,090	13,104	2,413
Nov-2009	30	**1,960,300**	253,112,372	2,525	3,894	452	31	**41.3**	**63.7**	**7.4**	**0.5**	8,131	13,168	2,420
Dec-2009	30	**1,780,000**	254,892,372	3,561	4,658	539	40	**52.9**	**69.2**	**8.0**	**0.6**	8,184	13,238	2,428
Jan-2010	31	**1,975,100**	256,867,472	2,136	2,930	267	0	**35.2**	**48.3**	**4.4**	**0.0**	8,220	13,286	2,433
Feb-2010	28	**1,810,900**	258,678,372	2,415	2,455	99	26	**36.5**	**37.1**	**1.5**	**0.4**	8,256	13,323	2,434
Mar-2010	31	**2,092,500**	260,770,872	1,758	1,684	57	23	**30.7**	**29.4**	**1.0**	**0.4**	8,287	13,353	2,435
Apr-2010	30	**2,247,200**	263,018,072	2,373	1,877	123	16	**44.5**	**35.2**	**2.3**	**0.3**	8,331	13,389	2,437
May-2010	31	**2,327,300**	265,345,372	2,003	1,385	31	26	**38.9**	**26.9**	**0.6**	**0.5**	8,370	13,416	2,438
Jun-2010	30	**2,236,200**	267,581,572	2,304	2,074	32	16	**43**	**38.7**	**0.6**	**0.3**	8,413	13,455	2,439
Jul-2010	31	**2,273,900**	269,855,472	1,744	1,555	116	16	**33.1**	**29.5**	**2.2**	**0.3**	8,446	13,485	2,441
Aug-2010	31	**2,101,900**	271,957,372	2,326	2,058	131	97	**40.8**	**36.1**	**2.3**	**1.7**	8,487	13,523	2,443
Sep-2010	30	**1,954,400**	273,911,772	2,661	1,766	98	18	**43.4**	**28.8**	**1.6**	**0.3**	8,530	13,552	2,445
Oct-2010	31	**2,146,600**	276,058,372	2,272	3,014	357	22	**40.7**	**54.0**	**6.4**	**0.4**	8,571	13,606	2,451
Nov-2010	30	**2,123,600**	278,181,972	2,635	2,105	28	11	**46.7**	**37.3**	**0.5**	**0.2**	8,618	13,644	2,452
Dec-2010	31	**1,906,900**	280,088,872	2,922	2,664	239	19	**46.5**	**42.4**	**3.8**	**0.3**	8,664	13,686	2,455
Minimum≠0		202,500		368	575	28	4.0	3.6	5.6	0.5	0.1			
Mean		1,544,802		4,716	9,097	1,575	21	49	77	14	0			
Maximum		2,507,400		25,000	62,000	10,000	274	151	309	46	4			

Table 1. Reported monthly data and cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed based on volume of influent and concentrations of CVOCs in influent to the Pump-and-Treat plant (Method 1), Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010.—Continued

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Date	Days	Monthly CVOC number of moles removed from influent				Cumulative CVOC number of moles removed from influent				Original TCE removed from influent		Navy reported, simple sum	
		TCE (moles/mon)	cDCE (moles/mon)	VC (moles/mon)	Summed CVOCs (moles/mon)	TCE (mole)	cDCE (mole)	VC (mole)	Summed CVOCs (mole)	Original TCE removed (lb/mon)	Original TCE removed (lb)	Monthly total CVOC (lb/mon)	Cumulative total CVOCs (lb)
Jan-1996	**31**											--	--
Feb-1996	**28**	18	122	32	172	18	122	32	172	50	50	36	36
Mar-1996	**31**	72	407	101	580	90	529	133	752	168	218	122	157
Apr-1996	**30**	309	815	289	1,414	399	1,344	422	2,165	409	627	304	461
May-1996	**31**	236	621	220	1,077	635	1,965	642	3,242	312	939	231	692
Jun-1996	**30**	169	533	118	820	803	2,499	760	4,062	238	1,177	179	871
Jul-1996	**31**	202	488	136	826	1,005	2,987	896	4,888	239	1,416	182	1,053
Aug-1996	**31**	242	758	157	1,157	1,247	3,745	1,053	6,045	335	1,751	254	1,307
Sep-1996	**30**	271	920	178	1,369	1,519	4,665	1,231	7,415	397	2,148	300	1,607
Oct-1996	**31**	243	768	170	1,181	1,762	5,433	1,401	8,596	342	2,490	258	1,864
Nov-1996	**30**	430	1,445	289	2,165	2,191	6,878	1,691	10,760	627	3,117	473	2,338
Dec-1996	**31**	146	475	123	743	2,337	7,353	1,813	11,503	215	3,332	161	2,498
Jan-1997	**31**	230	812	182	1,225	2,568	8,165	1,995	12,728	355	3,687	265	2,764
Feb-1997	**28**	243	915	213	1,371	2,811	9,080	2,208	14,099	397	4,084	295	3,059
Mar-1997	**31**	211	874	185	1,271	3,022	9,955	2,393	15,369	368	4,452	274	3,333
Apr-1997	**30**	306	1,268	268	1,842	3,328	11,222	2,661	17,211	534	4,986	397	3,729
May-1997	**31**	286	1,421	240	1,948	3,614	12,644	2,901	19,159	564	5,550	420	4,149
Jun-1997	**30**	101	458	71	631	3,715	13,102	2,973	19,790	183	5,732	137	4,286
Jul-1997	**31**	93	456	98	648	3,809	13,558	3,071	20,438	188	5,920	138	4,424
Aug-1997	**31**	157	692	165	1,014	3,966	14,250	3,236	21,451	294	6,214	216	4,640
Sep-1997	**30**	-	-	-	-	3,966	14,250	3,236	21,451	-	6,214	-	4,640
Oct-1997	**31**	132	697	185	1,014	4,098	14,947	3,421	22,465	294	6,507	213	4,853
Nov-1997	**30**	155	649	190	995	4,253	15,596	3,611	23,460	288	6,796	210	5,063
Dec-1997	**31**	71	338	112	521	4,324	15,933	3,724	23,981	151	6,947	108	5,171
Jan-1998	**31**	94	424	110	628	4,418	16,358	3,833	24,609	182	7,128	133	5,304
Feb-1998	**28**	65	226	91	382	4,483	16,584	3,924	24,990	111	7,239	80	5,384
Mar-1998	**31**	68	334	115	517	4,551	16,918	4,039	25,507	150	7,389	107	5,491
Apr-1998	**30**	194	950	327	1,471	4,745	17,867	4,366	26,979	426	7,815	304	5,795
May-1998	**31**	149	633	314	1,096	4,895	18,500	4,680	28,075	318	8,132	222	6,017
Jun-1998	**30**	143	639	215	998	5,038	19,140	4,895	29,073	289	8,421	208	6,225
Jul-1998	**31**	-	-	-	-	5,038	19,140	4,895	29,073	-	8,421	-	6,225
Aug-1998	**31**	38	87	33	158	5,076	19,226	4,928	29,231	46	8,467	34	6,259
Sep-1998	**30**	52	155	109	315	5,128	19,381	5,037	29,546	91	8,558	63	6,322
Oct-1998	**31**	136	529	180	846	5,264	19,910	5,217	30,392	245	8,803	177	6,499
Nov-1998	**30**	173	564	182	920	5,438	20,474	5,400	31,311	266	9,070	196	6,695
Dec-1998	**31**	175	565	184	924	5,613	21,039	5,584	32,236	268	9,338	197	6,892
Jan-1999	**31**	192	459	217	868	5,805	21,498	5,801	33,103	251	9,589	184	7,076

Table 1. Reported monthly data and cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed based on volume of influent and concentrations of CVOCs in influent to the Pump-and-Treat plant (Method 1), Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010.—Continued

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Date	Days	Monthly CVOC number of moles removed from influent				Cumulative CVOC number of moles removed from influent				Original TCE removed from influent		Navy reported, simple sum	
		TCE (moles/mon)	cDCE (moles/mon)	VC (moles/mon)	Summed CVOCs (moles/mon)	TCE (mole)	cDCE (mole)	VC (mole)	Summed CVOCs (mole)	Original TCE removed (lb/mon)	Original TCE removed (lb)	Monthly total CVOC (lb/mon)	Cumulative total CVOCs (lb)
Feb-1999	**28**	164	513	187	864	5,969	22,010	5,988	33,967	250	9,839	183	7,258
Mar-1999	**31**	23	73	27	123	5,992	22,084	6,015	34,091	36	9,875	26	7,284
Apr-1999	**X30**	0	0	0	0	5,992	22,084	6,015	34,091	0	9,875	0	7,284
May-1999	**31**	226	774	311	1,312	6,219	22,858	6,326	35,402	380	10,255	274	7,558
Jun-1999	**X30**	0	0	0	0	6,219	22,858	6,326	35,402	0	10,255	0	7,558
Jul-1999	**31**	48	151	68	267	6,266	23,009	6,394	35,669	77	10,332	55	7,614
Aug-1999	**31**	170	375	142	687	6,436	23,383	6,536	36,356	199	10,531	149	7,763
Sep-1999	**30**	189	409	176	774	6,625	23,792	6,712	37,129	224	10,755	166	7,929
Oct-1999	**31**	331	649	273	1,253	6,957	24,441	6,985	38,383	363	11,118	272	8,201
Nov-1999	**30**	240	443	144	827	7,197	24,883	7,129	39,209	239	11,358	184	8,385
Dec-1999	**31**	331	603	216	1,150	7,528	25,486	7,346	40,359	333	11,691	254	8,640
Jan-2000	**31**	244	443	91	779	7,772	25,929	7,437	41,138	226	11,916	178	8,818
Feb-2000	**29**	230	430	163	823	8,001	26,360	7,600	41,961	238	12,155	181	8,999
Mar-2000	**31**	271	482	189	942	8,272	26,841	7,789	42,902	273	12,427	207	9,206
Apr-2000	**30**	303	510	186	1,000	8,576	27,352	7,975	43,902	290	12,717	223	9,429
May-2000	**31**	252	437	151	840	8,827	27,789	8,126	44,741	243	12,960	187	9,616
Jun-2000	**30**	262	451	128	841	9,089	28,240	8,254	45,583	244	13,204	190	9,806
Jul-2000	**31**	93	348	49	490	9,182	28,588	8,303	46,073	142	13,346	108	9,914
Aug-2000	**31**	141	237	243	621	9,323	28,825	8,546	46,694	180	13,526	125	10,039
Sep-2000	**30**	168	224	200	593	9,492	29,049	8,747	47,287	172	13,697	124	10,163
Oct-2000	**31**	88	185	81	354	9,579	29,234	8,827	47,641	102	13,800	76	10,239
Nov-2000	**30**	202	417	148	767	9,782	29,651	8,975	48,408	222	14,022	168	10,407
Dec-2000	**31**	259	533	189	980	10,041	30,184	9,164	49,388	284	14,306	215	10,622
Jan-2001	**31**	332	684	242	1,258	10,373	30,867	9,406	50,646	365	14,671	276	10,898
Feb-2001	**28**	253	521	185	958	10,626	31,388	9,591	51,605	278	14,948	210	11,108
Mar-2001	**31**	310	639	226	1,176	10,936	32,027	9,817	52,780	341	15,289	258	11,366
Apr-2001	**30**	267	549	195	1,010	11,203	32,576	10,012	53,791	293	15,581	221	11,587
May-2001	**31**	247	509	180	937	11,450	33,085	10,192	54,728	271	15,853	205	11,792
Jun-2001	**30**	255	527	337	1,119	11,706	33,612	10,529	55,847	324	16,177	233	12,025
Jul-2001	**31**	296	510	251	1,056	12,001	34,122	10,780	56,903	306	16,483	229	12,255
Aug-2001	**31**	247	508	180	934	12,248	34,629	10,960	57,837	271	16,753	205	12,459
Sep-2001	**30**	145	53	164	361	12,392	34,682	11,124	58,199	105	16,858	76	12,535
Oct-2001	**31**	189	730	219	1,137	12,581	35,412	11,343	59,336	329	17,187	241	12,776
Nov-2001	**30**	83	218	70	371	12,664	35,630	11,412	59,707	108	17,295	80	12,856
Dec-2001	**31**	132	491	228	850	12,796	36,121	11,641	60,557	246	17,541	174	13,031
Jan-2002	**31**	129	436	239	804	12,925	36,557	11,879	61,361	233	17,774	164	13,194
Feb-2002	**28**	107	320	159	586	13,032	36,877	12,039	61,947	170	17,944	121	13,315

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Date	Days	Monthly CVOC number of moles removed from influent				Cumulative CVOC number of moles removed from influent				Original TCE removed from influent		Navy reported, simple sum	
		TCE (moles/mon)	cDCE (moles/mon)	VC (moles/mon)	Summed CVOCs (moles/mon)	TCE (mole)	cDCE (mole)	VC (mole)	Summed CVOCs (mole)	Original TCE removed (lb/mon)	Original TCE removed (lb)	Monthly total CVOC (lb/mon)	Cumulative total CVOCs (lb)
Mar-2002	**31**	172	547	251	971	13,203	37,424	12,290	62,917	281	18,225	201	13,517
Apr-2002	**30**	173	496	192	861	13,376	37,920	12,482	63,778	249	18,474	183	13,699
May-2002	**31**	88	253	102	442	13,464	38,173	12,583	64,220	128	18,602	93	13,793
Jun-2002	**30**	168	541	177	886	13,632	38,713	12,761	65,106	257	18,859	189	13,981
Jul-2002	**31**	180	605	196	981	13,812	39,318	12,957	66,087	284	19,143	209	14,190
Aug-2002	**31**	152	469	159	780	13,964	39,787	13,116	66,867	226	19,369	166	14,356
Sep-2002	**30**	119	355	153	627	14,083	40,142	13,269	67,494	182	19,551	131	14,487
Oct-2002	**31**	184	573	236	994	14,267	40,715	13,506	68,488	288	19,839	208	14,696
Nov-2002	**30**	131	424	168	722	14,398	41,139	13,673	69,210	209	20,048	152	14,847
Dec-2002	**31**	163	527	230	919	14,561	41,665	13,903	70,129	266	20,314	191	15,039
Jan-2003	**31**	184	494	206	885	14,745	42,159	14,109	71,014	256	20,570	187	15,226
Feb-2003	**28**	459	287	138	884	15,204	42,446	14,248	71,898	256	20,826	213	15,439
Mar-2003	**31**	520	381	155	1,056	15,724	42,827	14,403	72,954	306	21,132	253	15,693
Apr-2003	**30**	146	408	139	693	15,870	43,235	14,542	73,647	201	21,333	149	15,841
May-2003	**31**	115	276	118	509	15,985	43,511	14,660	74,156	147	21,480	109	15,950
Jun-2003	**30**	93	258	120	471	16,078	43,769	14,780	74,627	137	21,617	99	16,048
Jul-2003	**31**	112	361	158	631	16,190	44,130	14,938	75,258	183	21,800	131	16,180
Aug-2003	**31**	33	122	55	211	16,223	44,253	14,993	75,469	61	21,861	43	16,223
Sep-2003	**30**	12	26	22	60	16,236	44,279	15,015	75,529	17	21,878	12	16,235
Oct-2003	**31**	195	373	51	619	16,431	44,652	15,066	76,148	179	22,058	143	16,379
Nov-2003	**30**	207	343	30	580	16,637	44,995	15,096	76,729	168	22,226	137	16,516
Dec-2003	**31**	84	278	107	470	16,722	45,273	15,203	77,198	136	22,362	99	16,615
Jan-2004	**31**	82	152	33	267	16,804	45,425	15,236	77,465	77	22,439	61	16,675
Feb-2004	**29**	155	336	69	560	16,959	45,761	15,305	78,025	162	22,601	126	16,802
Mar-2004	**31**	215	390	60	665	17,173	46,151	15,365	78,690	193	22,794	154	16,956
Apr-2004	**30**	247	423	57	728	17,420	46,575	15,422	79,418	211	23,005	170	17,126
May-2004	**31**	248	319	43	609	17,668	46,894	15,465	80,027	177	23,181	146	17,271
Jun-2004	**30**	296	410	28	733	17,963	47,304	15,493	80,761	212	23,394	177	17,448
Jul-2004	**31**	286	358	32	676	18,249	47,663	15,525	81,436	196	23,589	164	17,612
Aug-2004	**31**	295	343	24	662	18,544	48,006	15,549	82,098	192	23,781	162	17,774
Sep-2004	**30**	262	327	29	617	18,806	48,332	15,578	82,716	179	23,960	150	17,924
Oct-2004	**31**	190	263	28	481	18,995	48,595	15,605	83,196	139	24,099	115	18,039
Nov-2004	**30**	158	215	26	399	19,154	48,810	15,632	83,596	116	24,215	95	18,134
Dec-2004	**31**	254	379	31	665	19,408	49,190	15,663	84,261	193	24,407	159	18,293
Jan-2005	**31**	216	248	30	495	19,624	49,438	15,693	84,756	143	24,551	120	18,413
Feb-2005	**28**	235	281	36	551	19,859	49,719	15,729	85,307	160	24,711	133	18,546
Mar-2005	**31**	264	325	40	628	20,123	50,044	15,769	85,935	182	24,893	151	18,698

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Date	Days	Monthly CVOC number of moles removed from influent				Cumulative CVOC number of moles removed from influent				Original TCE removed from influent		Navy reported, simple sum	
		TCE (moles/mon)	cDCE (moles/mon)	VC (moles/mon)	Summed CVOCs (moles/mon)	TCE (mole)	cDCE (mole)	VC (mole)	Summed CVOCs (mole)	Original TCE removed (lb/mon)	Original TCE removed (lb)	Monthly total CVOC (lb/mon)	Cumulative total CVOCs (lb)
Apr-2005	**30**	257	385	68	709	20,380	50,428	15,837	86,645	205	25,098	166	18,863
May-2005	**31**	216	285	40	541	20,596	50,713	15,877	87,186	157	25,255	129	18,993
Jun-2005	**30**	146	298	82	526	20,743	51,011	15,959	87,712	152	25,407	117	19,110
Jul-2005	**31**	135	249	56	441	20,878	51,260	16,015	88,153	128	25,535	100	19,210
Aug-2005	**31**	114	189	27	330	20,992	51,449	16,042	88,482	96	25,630	77	19,287
Sep-2005	**30**	60	109	23	192	21,052	51,558	16,065	88,675	56	25,686	44	19,331
Oct-2005	**31**	85	171	61	317	21,137	51,729	16,126	88,992	92	25,778	70	19,401
Nov-2005	**30**	55	123	30	208	21,192	51,852	16,156	89,199	60	25,838	46	19,447
Dec-2005	**30**	175	265	37	477	21,367	52,117	16,193	89,676	138	25,976	112	19,559
Jan-2006	**31**	165	354	65	584	21,531	52,471	16,258	90,260	169	26,145	132	19,692
Feb-2006	**28**	167	297	61	525	21,698	52,768	16,319	90,785	152	26,297	120	19,812
Mar-2006	**31**	145	243	38	427	21,843	53,011	16,357	91,212	124	26,421	99	19,911
Apr-2006	**30**	201	256	44	500	22,044	53,267	16,401	91,712	145	26,566	119	20,030
May-2006	**31**	239	298	41	577	22,283	53,564	16,442	92,288	167	26,733	138	20,168
Jun-2006	**30**	181	279	48	508	22,464	53,843	16,490	92,797	147	26,880	119	20,287
Jul-2006	**31**	110	216	43	368	22,573	54,059	16,532	93,165	107	26,987	84	20,371
Aug-2006	**31**	141	243	47	432	22,714	54,302	16,580	93,597	125	27,112	99	20,470
Sep-2006	**30**	138	172	23	333	22,853	54,475	16,602	93,929	96	27,208	80	20,550
Oct-2006	**31**	139	179	23	340	22,991	54,653	16,625	94,269	98	27,307	82	20,632
Nov-2006	**30**	128	131	12	270	23,119	54,784	16,636	94,540	78	27,385	67	20,698
Dec-2006	**31**	239	359	52	650	23,358	55,144	16,688	95,190	188	27,573	153	20,851
Jan-2007	**31**	267	354	49	670	23,625	55,497	16,737	95,859	194	27,767	160	21,011
Feb-2007	**28**	195	271	46	513	23,820	55,769	16,784	96,372	149	27,916	121	21,132
Mar-2007	**31**	189	271	33	494	24,009	56,040	16,817	96,866	143	28,059	117	21,249
Apr-2007	**30**	75	106	13	194	24,084	56,146	16,830	97,060	56	28,115	46	21,295
May-2007	**31**	80	87	14	181	24,164	56,233	16,844	97,241	52	28,167	44	21,339
Jun-2007	**30**	81	105	13	199	24,245	56,338	16,857	97,440	58	28,225	48	21,387
Jul-2007	**31**	131	147	19	297	24,376	56,486	16,876	97,737	86	28,311	72	21,459
Aug-2007	**31**	147	135	17	299	24,523	56,620	16,892	98,036	87	28,398	74	21,533
Sep-2007	**30**	119	162	18	299	24,642	56,782	16,911	98,335	87	28,484	72	21,604
Oct-2007	**31**	121	114	12	247	24,763	56,896	16,922	98,582	72	28,556	61	21,665
Nov-2007	**30**	134	155	19	308	24,897	57,052	16,941	98,890	89	28,645	75	21,740
Dec-2007	**31**	142	195	34	371	25,039	57,247	16,975	99,261	107	28,752	88	21,827
Jan-2008	**31**	135	142	20	297	25,174	57,388	16,995	99,557	86	28,838	72	21,899
Feb-2008	**29**	146	134	17	297	25,321	57,523	17,011	99,855	86	28,924	73	21,973
Mar-2008	**31**	137	136	21	293	25,457	57,658	17,032	100,148	85	29,009	72	22,044
Apr-2008	**30**	116	75	17	208	25,573	57,734	17,049	100,356	60	29,070	52	22,096

Table 1. Reported monthly data and cumulative mass of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed based on volume of influent and concentrations of CVOCs in influent to the Pump-and-Treat plant (Method 1), Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010.—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride; tDCE, trans-dichloroethylene; gal/mon, gallons per month; µg/L, micrograms per liter; lb/mon pounds per month; lb pounds; moles/mon, moles per month, **Bold**, published values; blue cells, data estimated from a published graph; orange cells, data calculated from published data; purple cells, data calculated from reported mass removed; --, no data; *, estimated data; purple numbers March–April 1998 combined report]

Date	Days	Monthly CVOC number of moles removed from influent				Cumulative CVOC number of moles removed from influent				Original TCE removed from influent		Navy reported, simple sum	
		TCE (moles/mon)	cDCE (moles/mon)	VC (moles/mon)	Summed CVOCs (moles/mon)	TCE (mole)	cDCE (mole)	VC (mole)	Summed CVOCs (mole)	Original TCE removed (lb/mon)	Original TCE removed (lb)	Monthly total CVOC (lb/mon)	Cumulative total CVOCs (lb)
May-2008	**31**	100	100	11	211	25,673	57,833	17,060	100,567	61	29,131	52	22,148
Jun-2008	**30**	87	67	7	160	25,760	57,900	17,067	100,727	46	29,177	40	22,188
Jul-2008	**31**	134	72	7	213	25,894	57,972	17,074	100,940	62	29,239	55	22,244
Aug-2008	**31**	139	98	7	244	26,033	58,070	17,080	101,184	71	29,309	62	22,306
Sep-2008	**30**	122	139	26	287	26,155	58,209	17,107	101,471	83	29,393	69	22,374
Oct-2008	**31**	103	182	45	329	26,258	58,391	17,152	101,800	95	29,488	75	22,449
Nov-2008	**30**	168	219	44	431	26,425	58,610	17,196	102,231	125	29,613	102	22,551
Dec-2008	**31**	124	198	44	366	26,549	58,808	17,239	102,597	106	29,719	84	22,635
Jan-2009	**31**	144	247	33	423	26,693	59,055	17,272	103,020	123	29,841	99	22,734
Feb-2009	**28**	131	225	33	388	26,824	59,279	17,305	103,408	113	29,954	91	22,824
Mar-2009	**31**	104	161	28	293	26,928	59,440	17,333	103,701	85	30,039	68	22,893
Apr-2009	**30**	114	165	29	308	27,042	59,605	17,362	104,009	89	30,128	72	22,965
May-2009	**31**	138	197	26	361	27,180	59,802	17,388	104,370	105	30,232	86	23,051
Jun-2009	**30**	312	697	30	1,039	27,492	60,499	17,419	105,410	301	30,533	244	23,294
Jul-2009	**31**	118	236	7	361	27,610	60,735	17,426	105,771	105	30,638	86	23,380
Aug-2009	**31**	78	139	20	236	27,688	60,874	17,446	106,007	68	30,707	55	23,435
Sep-2009	**30**	98	187	34	319	27,787	61,060	17,480	106,326	92	30,799	73	23,508
Oct-2009	**30**	143	246	34	423	27,929	61,306	17,514	106,749	122	30,922	99	23,606
Nov-2009	**30**	143	300	54	497	28,072	61,607	17,567	107,246	144	31,065	113	23,719
Dec-2009	**30**	183	327	58	567	28,254	61,933	17,626	107,813	164	31,230	131	23,850
Jan-2010	**31**	122	226	32	379	28,376	62,159	17,657	108,193	110	31,340	88	23,938
Feb-2010	**28**	126	175	11	312	28,502	62,335	17,668	108,505	90	31,430	76	24,013
Mar-2010	**31**	106	139	7	253	28,608	62,474	17,676	108,758	73	31,503	62	24,075
Apr-2010	**30**	154	166	17	336	28,761	62,640	17,692	109,094	97	31,601	82	24,157
May-2010	**31**	134	128	4	267	28,896	62,768	17,697	109,361	77	31,678	67	24,224
Jun-2010	**30**	148	182	4	335	29,044	62,951	17,701	109,696	97	31,775	83	24,307
Jul-2010	**31**	114	139	16	270	29,158	63,090	17,717	109,966	78	31,853	65	24,372
Aug-2010	**31**	141	177	17	334	29,299	63,267	17,734	110,300	97	31,950	81	24,453
Sep-2010	**30**	150	136	12	298	29,449	63,403	17,745	110,598	86	32,036	74	24,527
Oct-2010	**31**	141	255	46	441	29,590	63,658	17,792	111,039	128	32,164	102	24,628
Nov-2010	**30**	161	175	4	340	29,751	63,833	17,795	111,380	99	32,263	85	24,713
Dec-2010	**31**	161	200	28	388	29,911	64,033	17,823	111,767	112	32,375	93	24,806
Minimum≠0		12	26	7	60					17		12	
Mean		166	358	99	618					185		143	
Maximum		520	1,445	337	2,165					627		473	

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/ month)	cDCE (moles/ month)	VC (moles/ month)	TCE (moles/ month)	cDCE (moles/ month)	VC (moles/ month)	TCE (moles/ month)	cDCE (moles/ month)	VC (moles/ month)	Summed original TCE (moles/ month)	Cumulative original TCE (moles/ month)	Summed original TCE (pound)	Cumulative original TCE (pound)
Jan-1996	no report												
Feb-1996	18	122	32	40	127	52	40	127	52	219	219	63	63
Mar-1996	72	407	101	80	253	103	80	407	103	591	809	171	234
Apr-1996	309	815	289	115	362	148	309	815	289	1,414	2,223	410	644
May-1996	236	621	220	88	276	113	236	621	220	1,077	3,300	312	956
Jun-1996	169	533	118	75	237	97	169	533	118	820	4,120	238	1,194
Jul-1996	202	488	136	97	304	124	202	488	136	826	4,946	239	1,433
Aug-1996	242	758	157	125	393	161	242	758	161	1,161	6,107	336	1,769
Sep-1996	271	920	178	114	358	146	271	920	178	1,369	7,476	397	2,166
Oct-1996	243	768	170	90	284	116	243	768	170	1,181	8,657	342	2,508
Nov-1996	430	1,445	289	115	363	148	430	1,445	289	2,165	10,822	627	3,135
Dec-1996	146	475	123	39	123	50	146	475	123	743	11,565	215	3,350
Jan-1997	230	812	182	39	121	50	39	812	50	901	12,465	261	3,611
Feb-1997	243	915	213	90	285	116	243	915	213	1,371	13,836	397	4,009
Mar-1997	211	874	185	79	247	101	211	874	185	1,271	15,107	368	4,377
Apr-1997	306	1,268	268	114	358	147	306	1,268	268	1,842	16,949	534	4,910
May-1997	286	1,421	240	128	402	164	286	1,421	240	1,948	18,897	564	5,475
Jun-1997	101	458	71	113	356	146	113	458	146	717	19,614	208	5,682
Jul-1997	93	456	98	125	394	161	125	456	161	742	20,356	215	5,898
Aug-1997	157	692	165	131	414	169	157	692	169	1,018	21,374	295	6,192
Sep-1997	0	0	0	0	0	0	0	0	0	0	21,374	0	6,192
Oct-1997	132	697	185	98	310	127	132	697	185	1,014	22,388	294	6,486
Nov-1997	155	649	190	87	273	112	155	649	190	995	23,383	288	6,774
Dec-1997	71	338	112	60	187	77	71	338	112	521	23,904	151	6,925
Jan-1998	94	424	110	17	92	132	94	424	132	650	24,554	188	7,114
Feb-1998	65	226	91	17	128	136	65	226	136	427	24,981	124	7,237
Mar-1998	68	334	115	22	163	173	68	334	173	575	25,556	167	7,404
Apr-1998	194	950	327	50	268	117	194	950	327	1,471	27,027	426	7,830
May-1998	149	633	314	48	257	112	149	633	314	1,096	28,124	318	8,148
Jun-1998	143	639	215	53	282	123	143	639	215	998	29,122	289	8,437
Jul-1998	0	0	0	0	0	0	0	0	0	0	29,122	0	8,437
Aug-1998	38	87	33	41	186	95	41	186	95	322	29,444	93	8,530
Sep-1998	52	155	109	27	121	62	52	155	109	315	29,759	91	8,622
Oct-1998	136	529	180	50	228	117	136	529	180	846	30,604	245	8,867

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	Summed original TCE (moles/month)	Cumulative original TCE (moles/month)	Summed original TCE (pound)	Cumulative original TCE (pound)
Nov-1998	173	564	182	45	203	104	173	564	182	920	31,524	266	9,133
Dec-1998	175	565	184	57	256	131	175	565	184	924	32,448	268	9,401
Jan-1999	192	459	217	194	1,089	348	194	1,089	348	1,630	34,079	472	9,873
Feb-1999	164	513	187	158	915	301	164	915	301	1,380	35,459	400	10,273
Mar-1999	23	73	27	32	202	72	32	202	72	306	35,765	89	10,362
Apr-1999	0	0	0	0	0	0	0	0	0	0	35,765	0	10,362
May-1999	226	774	311	280	1,883	718	280	1,883	718	2,881	38,646	835	11,196
Jun-1999	0	0	0	0	0	0	0	0	0	0	38,646	0	11,196
Jul-1999	48	151	68	76	530	207	76	530	207	813	39,460	236	11,432
Aug-1999	170	375	142	220	1,463	569	220	1,463	569	2,252	41,712	652	12,084
Sep-1999	189	409	176	217	1,363	492	217	1,363	492	2,072	43,783	600	12,685
Oct-1999	331	649	273	335	2,181	807	335	2,181	807	3,323	47,106	963	13,647
Nov-1999	240	443	144	250	1,648	618	250	1,648	618	2,516	49,622	729	14,376
Dec-1999	331	603	216	332	2,186	818	332	2,186	818	3,335	52,958	966	15,343
Jan-2000	244	443	91	217	1,347	481	244	1,347	481	2,072	55,030	600	15,943
Feb-2000	230	430	163	217	1,293	455	230	1,293	455	1,978	57,008	573	16,516
Mar-2000	271	482	189	212	1,265	445	271	1,265	445	1,982	58,989	574	17,090
Apr-2000	303	510	186	227	1,275	439	303	1,275	439	2,018	61,007	585	17,675
May-2000	252	437	151	195	1,122	391	252	1,122	391	1,765	62,772	511	18,186
Jun-2000	262	451	128	216	1,232	429	262	1,232	429	1,923	64,695	557	18,743
Jul-2000	93	348	49	208	1,185	413	208	1,185	413	1,806	66,501	523	19,266
Aug-2000	141	237	243	241	1,336	457	241	1,336	457	2,034	68,535	589	19,856
Sep-2000	168	224	200	163	792	255	168	792	255	1,215	69,750	352	20,208
Oct-2000	88	185	81	99	409	120	99	409	120	627	70,377	182	20,389
Nov-2000	202	417	148	131	365	72	202	417	148	767	71,144	222	20,612
Dec-2000	259	533	189	168	467	92	259	533	189	980	72,124	284	20,896
Jan-2001	332	684	242	297	887	168	332	887	242	1,461	73,586	423	21,319
Feb-2001	253	521	185	232	680	127	253	680	185	1,118	74,704	324	21,643
Mar-2001	310	639	226	324	1,159	194	324	1,159	226	1,710	76,413	495	22,138
Apr-2001	267	549	195	322	1,671	266	322	1,671	266	2,259	78,673	655	22,793
May-2001	247	509	180	300	1,539	245	300	1,539	245	2,085	80,758	604	23,397
Jun-2001	255	527	337	358	1,800	286	358	1,800	337	2,495	83,252	723	24,119
Jul-2001	296	510	251	366	1,770	278	366	1,770	278	2,414	85,666	699	24,819
Aug-2001	247	508	180	310	1,454	229	310	1,454	229	1,993	87,659	577	25,396

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	Summed original TCE (moles/month)	Cumulative original TCE (moles/month)	Summed original TCE (pound)	Cumulative original TCE (pound)
Sep-2001	145	53	164	212	980	149	212	980	164	1,356	89,015	393	25,789
Oct-2001	189	730	219	374	1,699	273	374	1,699	273	2,346	91,361	680	26,469
Nov-2001	83	218	70	315	1,397	229	315	1,397	229	1,941	93,303	562	27,031
Dec-2001	132	491	228	319	1,334	217	319	1,334	228	1,881	95,184	545	27,576
Jan-2002	129	436	239	284	594	153	284	594	239	1,116	96,300	323	27,900
Feb-2002	107	320	159	241	483	119	241	483	159	883	97,183	256	28,155
Mar-2002	172	547	251	349	714	170	349	714	251	1,315	98,498	381	28,536
Apr-2002	173	496	192	307	635	152	307	635	192	1,134	99,632	329	28,865
May-2002	88	253	102	195	341	69	195	341	102	637	100,269	185	29,050
Jun-2002	168	541	177	284	640	166	284	640	177	1,101	101,371	319	29,369
Jul-2002	180	605	196	347	780	205	347	780	205	1,332	102,703	386	29,754
Aug-2002	152	469	159	281	634	168	281	634	168	1,082	103,785	314	30,068
Sep-2002	119	355	153	368	874	231	368	874	231	1,473	105,258	427	30,495
Oct-2002	184	573	236	361	818	218	361	818	236	1,416	106,674	410	30,905
Nov-2002	131	424	168	306	687	180	306	687	180	1,173	107,847	340	31,245
Dec-2002	163	527	230	339	836	229	339	836	230	1,406	109,252	407	31,652
Jan-2003	184	494	206	336	843	187	336	843	206	1,385	110,637	401	32,053
Feb-2003	459	287	138	231	570	125	459	570	138	1,167	111,805	338	32,392
Mar-2003	520	381	155	302	708	139	520	708	155	1,384	113,188	401	32,792
Apr-2003	146	408	139	253	594	117	253	594	139	987	114,175	286	33,078
May-2003	115	276	118	259	654	148	259	654	148	1,061	115,236	308	33,386
Jun-2003	93	258	120	242	644	151	242	644	151	1,038	116,274	301	33,686
Jul-2003	112	361	158	296	770	177	296	770	177	1,243	117,517	360	34,047
Aug-2003	33	122	55	71	161	40	71	161	55	288	117,805	83	34,130
Sep-2003	12	26	22	170	418	91	170	418	91	678	118,483	196	34,326
Oct-2003	195	373	51	237	593	128	237	593	128	958	119,441	277	34,604
Nov-2003	207	343	30	204	490	112	207	490	112	808	120,249	234	34,838
Dec-2003	84	278	107	166	384	85	166	384	107	657	120,906	190	35,028
Jan-2004	82	152	33	76	139	21	82	152	33	267	121,173	77	35,106
Feb-2004	155	336	69	136	320	55	155	336	69	560	121,733	162	35,268
Mar-2004	215	390	60	157	344	57	215	390	60	665	122,398	193	35,460
Apr-2004	247	423	57	216	423	64	247	423	64	735	123,132	213	35,673
May-2004	248	319	43	226	372	47	248	372	47	666	123,798	193	35,866
Jun-2004	296	410	28	250	394	49	296	410	49	755	124,553	219	36,085

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	Summed original TCE (moles/month)	Cumulative original TCE (moles/month)	Summed original TCE (pound)	Cumulative original TCE (pound)
Jul-2004	286	358	32	365	370	43	365	370	43	777	125,330	225	36,310
Aug-2004	295	343	24	389	365	39	389	365	39	793	126,123	230	36,540
Sep-2004	262	327	29	385	351	36	385	351	36	772	126,894	224	36,763
Oct-2004	190	263	28	246	287	38	246	287	38	571	127,465	165	36,928
Nov-2004	158	215	26	208	228	28	208	228	28	464	127,929	134	37,063
Dec-2004	254	379	31	148	243	25	254	379	31	665	128,594	193	37,256
Jan-2005	216	248	30	251	372	85	251	372	85	708	129,302	205	37,461
Feb-2005	235	281	36	330	386	75	330	386	75	791	130,093	229	37,690
Mar-2005	264	325	40	344	456	98	344	456	98	897	130,990	260	37,950
Apr-2005	257	385	68	473	408	81	473	408	81	963	131,953	279	38,229
May-2005	216	285	40	448	395	81	448	395	81	924	132,877	268	38,496
Jun-2005	146	298	82	221	347	93	221	347	93	661	133,538	191	38,688
Jul-2005	135	249	56	178	198	55	178	249	56	483	134,021	140	38,828
Aug-2005	114	189	27	129	107	20	129	189	27	345	134,366	100	38,928
Sep-2005	60	109	23	168	125	29	168	125	29	322	134,688	93	39,021
Oct-2005	85	171	61	128	117	37	128	171	61	360	135,048	104	39,125
Nov-2005	55	123	30	210	267	74	210	267	74	551	135,599	160	39,285
Dec-2005	175	265	37	287	341	77	287	341	77	706	136,305	205	39,490
Jan-2006	165	354	65	162	277	48	165	354	65	584	136,888	169	39,659
Feb-2006	167	297	61	139	234	41	167	297	61	525	137,413	152	39,811
Mar-2006	145	243	38	141	201	32	145	243	38	427	137,840	124	39,934
Apr-2006	201	256	44	184	272	47	201	272	47	519	138,359	150	40,085
May-2006	239	298	41	182	289	55	239	298	55	591	138,950	171	40,256
Jun-2006	181	279	48	140	232	45	181	279	48	508	139,458	147	40,403
Jul-2006	110	216	43	107	182	36	110	216	43	368	139,827	107	40,510
Aug-2006	141	243	47	153	222	44	153	243	47	444	140,270	129	40,638
Sep-2006	138	172	23	122	140	13	138	172	23	333	140,603	96	40,735
Oct-2006	139	179	23	111	123	11	139	179	23	340	140,943	99	40,833
Nov-2006	128	131	12	112	140	16	128	140	16	284	141,227	82	40,916
Dec-2006	239	359	52	184	279	40	239	359	52	650	141,877	188	41,104
Jan-2007	267	354	49	170	333	71	267	354	71	692	142,569	200	41,304
Feb-2007	195	271	46	146	150	12	195	271	46	513	143,082	149	41,453
Mar-2007	189	271	33	151	256	44	189	271	44	504	143,586	146	41,599
Apr-2007	75	106	13	77	95	14	77	106	14	196	143,782	57	41,656

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	Summed original TCE (moles/month)	Cumulative original TCE (moles/month)	Summed original TCE (pound)	Cumulative original TCE (pound)
May-2007	80	87	14	69	81	12	80	87	14	181	143,963	52	41,708
Jun-2007	81	105	13	139	140	15	139	140	15	295	144,258	85	41,794
Jul-2007	131	147	19	177	123	10	177	147	19	344	144,602	100	41,893
Aug-2007	147	135	17	182	128	10	182	135	17	334	144,935	97	41,990
Sep-2007	119	162	18	160	158	20	160	162	20	342	145,277	99	42,089
Oct-2007	121	114	12	134	182	33	134	182	33	349	145,626	101	42,190
Nov-2007	134	155	19	126	159	27	134	159	27	319	145,945	93	42,282
Dec-2007	142	195	34	147	218	39	147	218	39	403	146,348	117	42,399
Jan-2008	135	142	20	104	157	33	135	157	33	325	146,674	94	42,494
Feb-2008	146	134	17	122	96	9	146	134	17	297	146,971	86	42,580
Mar-2008	137	136	21	89	93	12	137	136	21	293	147,264	85	42,665
Apr-2008	116	75	17	117	213	55	117	213	55	385	147,649	112	42,776
May-2008	100	100	11	117	160	34	117	160	34	311	147,960	90	42,866
Jun-2008	87	67	7	89	74	8	89	74	8	171	148,131	50	42,916
Jul-2008	134	72	7	118	89	8	134	89	8	231	148,362	67	42,983
Aug-2008	139	98	7	88	115	24	139	115	24	278	148,640	80	43,063
Sep-2008	122	139	26	92	174	43	122	174	43	339	148,979	98	43,161
Oct-2008	103	182	45	107	187	41	107	187	45	339	149,318	98	43,260
Nov-2008	168	219	44	109	194	43	168	219	44	431	149,749	125	43,385
Dec-2008	124	198	44	95	164	36	124	198	44	366	150,115	106	43,491
Jan-2009	144	247	33	140	179	31	144	247	33	423	150,538	123	43,613
Feb-2009	131	225	33	144	182	31	144	225	33	402	150,940	116	43,730
Mar-2009	104	161	28	135	172	29	135	172	29	336	151,276	97	43,827
Apr-2009	114	165	29	153	200	33	153	200	33	386	151,662	112	43,939
May-2009	138	197	26	142	206	36	142	206	36	383	152,045	111	44,050
Jun-2009	312	697	30	118	164	28	312	697	30	1,039	153,084	301	44,351
Jul-2009	118	236	7	136	178	29	136	236	29	401	153,485	116	44,467
Aug-2009	78	139	20	131	168	27	131	168	27	327	153,812	95	44,562
Sep-2009	98	187	34	143	173	24	143	187	34	364	154,175	105	44,667
Oct-2009	143	246	34	180	196	24	180	246	34	460	154,635	133	44,800
Nov-2009	143	300	54	163	198	27	163	300	54	517	155,153	150	44,950
Dec-2009	183	327	58	139	161	20	183	327	58	567	155,720	164	45,114
Jan-2010	122	226	32	131	203	43	131	226	43	400	156,120	116	45,230
Feb-2010	126	175	11	111	167	36	126	175	36	337	156,457	98	45,328

Table 5. Monthly and cumulative number of moles of trichloroethylene (TCE), cis-dichloroethylene (cDCE), vinyl chloride (VC), and original TCE removed determined by using the maximum of Methods 1 and 2, Naval Air Warfare Center, West Trenton, NJ, February 1996 through December 2010 (Method 3).—Continued

[CVOC, chlorinated volatile organic compound; TCE, trichloroethylene, cDCE, cis-dichloroethylene; VC, vinyl chloride]

Date	Method 1 (CVOC removal based on influent to Pump and Treat plant)			Method 2 (CVOC removal based on withdrawals from recovery wells)			Method 3 (Greater of Method 1 and 2)						
	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	TCE (moles/month)	cDCE (moles/month)	VC (moles/month)	Summed original TCE (moles/month)	Cumulative original TCE (moles/month)	Summed original TCE (pound)	Cumulative original TCE (pound)
Mar-2010	106	139	7	142	137	13	142	139	13	294	156,751	85	45,413
Apr-2010	154	166	17	142	164	21	154	166	21	340	157,091	99	45,512
May-2010	134	128	4	151	169	19	151	169	19	339	157,430	98	45,610
Jun-2010	148	182	4	140	157	18	148	182	18	349	157,779	101	45,711
Jul-2010	114	139	16	148	163	19	148	163	19	329	158,108	95	45,806
Aug-2010	141	177	17	139	152	18	141	177	18	335	158,443	97	45,903
Sep-2010	150	136	12	132	123	12	150	136	12	298	158,741	86	45,990
Oct-2010	141	255	46	149	165	27	149	255	46	449	159,190	130	46,120
Nov-2010	161	175	4	134	218	44	161	218	44	423	159,614	123	46,242
Dec-2010	161	200	28	121	196	40	161	200	40	400	160,014	116	46,358
Minimum ≠ 0	12	26	7	17	74	8	32	74	8	181		52	
Average	166	358	99	173	465	124	203	550	141	894		259	
Maximum	520	1,445	337	473	2,186	818	520	2,186	818	3,335		966	
Total moles	29,911	64,033	17,826	31,012	83,269	22,180	36,594	98,369	25,375	160,338			
Total pounds	8,666	13,689	2,456	8,985	17,801	3,056	10,602	21,029	3,496	46,452	45,208		

	Method 1	Method 2	Method 3
Cumulative moles	111,762	136,461	160,338
Cumulative Pounds	32,381	39,535	46,452

For additional information, write to:
Director
U.S. Geological Survey
New Jersey Water Science Center
Mountain View Office Park
810 Bear Tavern Rd., Suite 206
West Trenton, NJ 08628

or visit our Web site at:
http://nj.usgs.gov/