



2018 Groundwater Monitoring Report for the D-Area Groundwater Operable Unit (U)

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EXECUTIVE SUMMARY

This Annual Groundwater Monitoring Report has been prepared to support the regulatory reporting requirements for the D-Area Groundwater Operable Unit (DAG OU) at the Savannah River Site. The *Monitoring Work Plan for the D-Area Groundwater Operable Unit* specifies the reporting requirements. A groundwater letter report is submitted in even numbered years, and a groundwater report is submitted in odd number years. This groundwater report for data collected during 2017 and 2018 must be submitted on or before July 31, 2019.

The well network for the DAG OU monitors the Upper Three Runs Aquifer Unit, and the Gordon Aquifer Unit in the uppermost aquifer system beneath the facility. The current monitoring network is consistent with the intent of and conducted in accordance with the Monitoring Work Plan.

The scheduled sampling was completed for all planned wells with the following exceptions:

- During 2Q2017 sampling, DWP 1 and DWP 6 were dry;
- During 4Q2017 sampling, DWP 1, DWP 2, DWP 3, DWP 6, DWP 8, and DWP 9 were dry;
- During 2Q2018 sampling, DWP 6, DWP 7 DWP 8, and DWP 9 were dry and surface water stations DSWM-2, and DSWM-5 were dry; and
- During 4Q2018 sampling, DWP 1 and DWP 6 were dry.

There were no changes in groundwater flow direction from the previous years. Groundwater velocities during 2018 remained consistent with calculated velocities from previous years.

Surface water monitoring revealed that aluminum, beryllium, and cobalt exceeded maximum contaminant levels (MCL) or secondary drinking water standards. Groundwater monitoring revealed that volatile organic compounds (tetrachloroethylene and trichloroethylene), metals (aluminum, beryllium, cadmium, chromium, hexavalent chromium, cobalt, iron, lead, manganese, nickel, sulfate, and uranium), and tritium exceeded their respective regulatory MCLs, the secondary drinking water standards, or the regional screening levels in the groundwater. Two source wells (DCB 21B and DCB 21C) located immediately downgradient of the 484-17D D-Area

Coal Storage Area and the 489-D Coal Pile Runoff Basin exceeded well specific threshold values for chromium, selenium, cadmium, and/or beryllium in 2017 or 2018. The exceedances are not a new occurrence, many are below MCLs, and concentrations are less than other nearby source wells. As such, confirmation samples were not collected during 2017 and 2018.

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LIST OF ACRONYMS AND ABBREVIATIONS

~	approximate, approximately
1Q	first quarter
2Q	second quarter
3Q	third quarter
4Q	fourth quarter
cm	centimeter
cm/sec	centimeter per second
CPRB	Coal Pile Runoff Basin
DAB	D-Area Ash Basin
DAG OU	D-Area Groundwater Operable Unit
DCSA	D-Area Coal Storage Area
DAOU	D-Area Operable Unit
DEXOU	D-Area Expanded Operable Unit
DHWF	D-Area Heavy Water Facility
DHWRP	D-Area Heavy Water Rework Facility
DRP	D-Area Rubble Pit
FFA	Federal Facility Agreement
ft	foot/feet
ft/day	feet per day
gal	gallon
GA	Gordon Aquifer
GCU	Gordon Confining Unit
in.	inches
m	meter/meters
MCL	maximum contaminant level
msl	mean sea level
µg/L	micrograms per liter
mg/L	milligrams per liter
NSDWS	National Secondary Drinking Water Standards
NTCR	Non-time critical removal
PCE	tetrachloroethylene
pCi/mL	picocuries per milliliter
ROD	Record of Decision
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
SCDHEC	South Carolina Department of Health and Environmental Control
SEMS	Superfund Enterprise Management System
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
TAL	target analyte list
TCE	trichloroethylene
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UTRA	Upper Three Runs Aquifer
VOC	volatile organic compound
WSRC	Washington Savannah River Company, LLC
yr	year

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Annual Groundwater Monitoring Report has been prepared to support the regulatory reporting requirements for the D-Area Groundwater Operable Unit (DAG OU) at the Savannah River Site (SRS). The reporting requirements are specified in the *Monitoring Work Plan for the D-Area Groundwater Operable Unit (U)* (WSRC 2004a), dated June 2004. In accordance with the approved Monitoring Work Plan, a groundwater letter report is submitted in even number years, and a groundwater report is submitted in odd number years. This groundwater report for data collected during 2017 and 2018 must be submitted on or before July 31, 2019.

1.2 Unit History/Description

D Area is located on an alluvial terrace in the southwest quadrant of the SRS approximately (~) 915-meter (m [3,050-feet {ft}]) east of the Savannah River (Appendix D, Figure D-1) at an elevation ~37.5-m (125-ft) above mean sea level (msl). Local topography is relatively flat with a general slope from the northeast to southwest.

The DAG OU consists of the groundwater impacted by operations from the following:

- 488-D Ash Basin (488-DAB), D-Area Coal Storage Area (484-17D) (DCSA), D-Area Coal Pile Runoff Basin (489-D) (CPRB), and D-Area Rubble Pit (431-2D) (DRP);
- D-Area Heavy Water Facility (411-D, 412-D, 412-1D, 413-D) (DHWF);
- D-Area Heavy Water Rework Facility (DHWRF), also known as the 420-D Concentrator Building;
- Moderator Recovery Facility, also known as the 420-2D Rework Handling Facility;
- Drum Storage Facility (specifically, the 421-2D Moderator Handling and Storage Building);

- Gasoline Station (715-D).

The 488-DAB, 489-D CPRB, and the 431-D DRP surface units received waste from operation of the coal-fired 484-D Powerhouse. The 488-DAB and the 431-D DRP are no longer operational and remedial actions for these subunits are complete. The 484-D Powerhouse began operation in 1952, ceased operation in April 2012, and is currently used for military training exercises. Coal burned in the powerhouse was stored in the 484-17D DCSA. Exposure of coal to rainwater for up to 59 years has caused the dissolution of iron sulfide (pyrite; a mineral commonly found in coal), leading to the creation of sulfuric acid. As a result, the soils underneath the 484-17D DCSA, the associated storm water runoff to the 489-D CPRB, and groundwater underlying the area have been acidified. Since the shutdown of the 484-D Powerhouse, the coal pile was removed, and the area regraded and partially vegetated. A non-time critical removal (NTCR) action is planned at the 484-17D DCSA for fiscal year 2020 to neutralize the acidified soil in the upper vadose zone (SRNS 2019a). In addition, a treatability study for displacing and treating acidified groundwater beneath the 484-17D DCSA is planned to begin in 2020 (SRNS 2019b). The low-pH water is currently discharging into the D-Area Effluent Discharge Canal which later converges with Beaver Dam Creek and flows through the Savannah River floodplain to the Savannah River (Figure D-2). The 489-D CPRB is no longer an active facility, and a NTCR was completed for the northern 25% section of the basin in 2011. The remaining 75% section was addressed under a NTCR action in 2018 to remove coal fines and contaminated sediments from the basin. The southern 75% section will remain open as a storm water retention structure.

The DHWF and DHWRF were used in the production of heavy water for use in the SRS reactors. The DHWF consisted of six rows of bubble towers, which were used in series to progressively enrich water to 20% to 30% deuterium oxide. Operations of the bubble towers ceased in January 1982. The DHWRF was used to purify contaminated heavy water, and the 420-2D Rework Handling Facility was used to empty and fill contaminated heavy water drums. The Drum Storage Facility stored drums of degraded moderator water until 1988. The DHWF, the DHWRF, 420-2D Rework Handling Facility, and the Drum Storage Facility have been decommissioned and/or decontaminated and are no longer a source of contamination to groundwater.

The 715-D Gasoline Station Area, including an underground storage tank (UST) (5,000 gal capacity), was a former refueling station located just east of the 484-D Powerhouse. The UST was removed in 1983 along with about 96 liters (25 gallons) of pooled product beneath the tank. The fueling station was closed about the same time. With the removal of the UST and the pooled product beneath the tank, the 715-D Gas Station Area is no longer considered a source of contamination to groundwater.

1.3 Regulatory History

In March 2002, the United States Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and United States Department of Energy (USDOE) created the DAG OU to monitor groundwater quality until the operational facilities become inactive and a final remedial decision is reached for the DAG OU.

Monitoring conducted during 2003, prior to development and approval of the Monitoring Work Plan, included measurement of water levels from 123 wells and sample collection from 50 wells. The samples were analyzed for volatile organic compounds (VOCs), tritium, metals, and/or uranium.

Analytical data from groundwater investigations indicate the D Area groundwater plumes are relatively large, commingled, and dilute. The major contaminants of concern are tritium, trichloroethylene (TCE), and metals. The tritium and TCE are a result of historical releases with no continuing source to the vadose zone. The metals are sourced primarily from the 484-17D DCSA and the 489-D CPRB and underlying soils due to acidic conditions created from years of rainwater infiltration through the coal.

1.4 D-Area Comprehensive Environmental Response, Compensation and Liability Act Related Activities

D-Area Operable Unit (DAOU) consists of the following three main facility areas: the 484-D Powerhouse (Powerhouse Subunit), the D-Area Heavy Water Facility (Bubble Tower Subunit), and the Moderator Processing Facility (Moderator Processing Subunit). NTCR actions were completed for the facilities associated with the Bubble Tower Subunit and the Moderator Processing Subunit, and these facilities are no longer a source of tritium or TCE contamination to

groundwater. An Early Action Record of Decision Remedial Alternative Selection for the DAOU (SRNS 2011) integrates the results of these completed removal actions.

The Powerhouse Subunit consists of the Powerhouse building, the 484-17D DCSA, and the 489-D CPRB and associated ancillary facilities for coal and ash storage, runoff, and disposal. The 488-DAB and the 431-2D DRP are no longer operational and remedial actions for these surface units were completed under the D-Area Expanded Operable Unit (DEXOU) project. The *Record of Decision Remedial Alternative Selection for the D-Area Expanded Operable Unit* (WSRC 2004b) documents the selection of a low permeability geosynthetic cover system installed over the 488-DAB, and land use controls and groundwater monitoring for the 488-DAB and the 431-2D DRP.

The 489-D CPRB previously received runoff from the coal pile located at the 484-17D DCSA south of the Powerhouse. Rainwater created acidic leachate from the 484-17D DCSA to collect in the 489-D CPRB. The coal pile was removed following shutdown of the Powerhouse, and the southern 2-hectare (5-acre) section of the 484-17D DCSA was regraded and vegetated. A NTCR action was completed for the northern 25% section of the 489-D CPRB in 2011 (SRNS 2009c). The remaining 75% southern section of the 489-D CPRB was addressed under a NTCR action to remove coal fines and contaminated sediments from the basin and it will remain open as a storm water retention structure (SRNS, 2018a).

In 2013, the 488-1D Ash Basin, 488-2D Ash Basin, and the 488-4D Ash Landfill were included as subunits of the DAOU. A NTCR action was conducted for the 488-1D Ash Basin to consolidate ash in the eastern portion of the basin and install a geosynthetic cover and vegetative layer (SRNS 2018a).

A time critical removal action was conducted for the 488-2D Ash Basin to dewater and remove bulk ash from the basin and consolidate in the 488-4D Ash Landfill (SRNS 2017). A NTCR action was conducted for the 488-4D Ash Landfill to consolidate excavated ash from the 488-2D Ash Basin and install a geosynthetic cover and vegetative layer (SRNS 2017).

A second Early Action Record of Decision (ROD) for the DAOU to include the 488-1D Ash Basin, 488-2D Ash Basin, 488-4D Ash Landfill and the southern 75% section of the 489-D CPRB is

scheduled for issuance in November 2020. The final ROD for the DAOU to include the remaining Powerhouse Subunit waste units and facilities is currently scheduled for issuance in January 2046.

DAG OU Related Activities

A NTCR action to add soil neutralization amendments to reduce the acidity in the upper portion of the vadose zone beneath the 484-17D DCSA and subsequently reduce the amount of acidic leachate to groundwater is planned (SRNS 2019a). Addressing the acidic vadose zone soils will eventually improve groundwater conditions by mixing neutralization amendments (lime/calcium carbonate) into the vadose zone soils at the 484-17D DCSA to raise the pH of the vadose zone soils to natural background levels (approximate pH of 5.5). In addition, a treatability study is planned to inject potable water into the Upper Three Runs Aquifer (UTRA) upgradient of the low-pH, metals, and sulfate plume to create a hydraulic head and displace the low pH groundwater in the aquifer (SRNS 2019b). Both the treatability study and the NTCR action are scheduled to begin in 2020.

1.5 Site Geology and Hydrogeology

The SRS is underlain by Atlantic Coastal Plain sediments that thicken to the southeast. Sediments range in age from Late Cretaceous to recent and are ~270-m (900-ft) thick at SRS (Aadland et al., 1995; Fallaw and Price, 1995). The pertinent stratigraphy beneath D-Area, in ascending order, is the Snapp, Fourmile Branch, Congaree, Warley Hill, Tinker/Santee, and Clinchfield Formations. Quaternary Savannah River deposits exists at D-Area, with more extensive reworking of the shallow material west of 488-DAB near the current Savannah River (Appendix D, Figure D-3). The transition between Eocene sediment underlying D-Area and Quaternary fluvial deposits from the ancestral Savannah River is presented in cross sectional view in Appendix D, Figures D-3, D-5, and D-6. Additional details regarding the geology in D Area are included in the DEXOU Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation/Baseline Risk Assessment (WSRC 2003).

Two main aquifer systems are present beneath D-Area: a deep aquifer system and a shallow aquifer system. The deep aquifer system comprises a 135 m (450 ft) thick sequence of sands and clays confined beneath a thick sequence of interbedded silts and clays known as the Meyers Branch

Confining Unit. The shallow aquifer system lies above the Meyers Branch Confining Unit and includes a semi-confined and an unconfined aquifer system. The semi-confined Gordon Aquifer (GA) is a 15-m (50-ft) thick sequence of fine to medium-grained sand that is overlain by the Gordon Confining Unit (GCU), a 3-m (10-ft) thick clay layer. The GCU is overlain by the UTRA, which is an unconfined series of interbedded and laterally discontinuous sand, silt, and clay beds ranging in thickness from 12-m (40-ft) to 18-m (60-ft) beneath D-Area. A schematic of the lithostratigraphy and hydrostratigraphy generally observed at SRS is provided in Figure D-4. The water table is encountered at a depth of ~7.5-m (25-ft) below ground surface. West of 488-DAB the UTRA and GCU are incised by 13.7-m (45-ft) thick sequence of Quaternary deposits consisting of fluvial clay, silt, and sand.

The shallow groundwater system generally flows to the west-southwest near D-Area and discharges to the floodplain and wetlands as well as the Savannah River (Appendix D, Figure D-7). Groundwater flow in the GA is to the southwest (Appendix D, Figure D-8).

2.0 MONITORING NETWORK

The DAG OU annual groundwater and surface water monitoring requirements are specified in the Monitoring Work Plan. The well network for the DAG OU monitors both the UTRA and the GA with 82 wells. The well construction information for the wells are provided in Appendix A. Seven surface water stations are also monitored at streams throughout D-Area (Appendix D, Figure D-3).

Groundwater sample analyses include tritium, VOCs, uranium, sulfate, target analyte list (TAL) metals, and hexavalent chromium. Surface water samples are analyzed for TCE, tritium, and TAL metals. Field parameters are collected at all stations where samples are collected. Implementation of the Monitoring Work Plan includes annual monitoring of the groundwater and surface water monitoring network (during the first half of the year) and semiannual monitoring of selected wells (during the second half of the year). In order to maintain the integrity of the monitoring network and improve the groundwater monitoring program, periodic changes to the initial monitoring plan have been implemented. The current sampling frequency and analytes monitored are provided in Appendix B.

Four replacement monitoring wells (DCB077, DCB078, DCB079, and DCB080), replacing wells abandoned during ash remedial activities, were installed for the 488-4D Ash Landfill monitoring in December 2016. Monitoring for field parameters, and sample analysis for TAL metals, sulfate, tritium and VOCs began for the four replacement monitoring wells in 2Q2017. Following completion of the NTCR action at the 488-1D Ash Basin, wells DCB081 and DCB082 were installed and sampling began in 4Q2018 (Figure D-3). The proposed monitoring frequency and analytes for new wells DCB081 and DCB082 based on 4Q2018 data are provided in Appendix B.

3.0 MONITORING RESULTS

Locations monitored during 2017 and 2018 are shown on Figure D-3 (Appendix D). Specific sample stations, sample frequency, and analyses are included in Appendix B.

During 2Q and 4Q of 2017 and 2018, selected monitoring wells were sampled based on the schedule in Appendix B. The monitoring wells were selected to provide adequate coverage (vertically and laterally) in the study area. The following stations were not sampled:

- During 2Q2017 sampling, DWP 1 and DWP 6 were dry;
- During 4Q2017 sampling, DWP 1, DWP 2, DWP 3, DWP 6, DWP 8, and DWP 9 were dry;
- During 2Q2018 sampling, DWP 6, DWP 7 DWP 8, and DWP 9 were dry and surface water stations DSWM-2, and DSWM-5 were dry; and
- During 4Q2018 sampling, DWP 1 and DWP 6 were dry.

Groundwater monitoring results for 2017 and 2018 are compared to national primary drinking water standards (also referred to as maximum contaminant levels [MCLs]), national secondary drinking water standards (NSDWS), or regional screening levels (RSLs), if available, with preference in the order listed. Data tables are provided in Appendix C and include groundwater and surface water data where applicable.

The Appendix C data tables also include the well specific threshold limits for source and downgradient wells as prescribed in the Monitoring Work Plan (WSRC 2004a). Any threshold value exceedance (of an analyte with an MCL) in groundwater from a source well will be

considered indicative of additional loading from the vadose zone. Additionally, downgradient wells exceeding threshold limits may pose a threat to surface water of the Savannah River. Confirmatory sampling of the increasing trend will be initiated within 30 days of the verified/validated result. If the exceedance is verified, SCDHEC and USEPA will be notified regarding a decision for a path forward. Metals at source wells are compared to 200% (2 times) the maximum concentration from data prior to October 2003 for constituents with MCLs. Metals at downgradient wells are compared to the maximum concentration from data prior to October 2003 for constituents with MCLs. TCE is compared to 425 µg/L in downgradient wells, 187.5 µg/L at source well DRW 1, and 637.5 µg/L at source well DCB 62. Tritium source wells are compared to 2,250 pCi/mL at well DCB 26AR, 1,650 pCi/mL at well DCB 45A, 780 pCi/mL at well DCB 45C, 1,500 pCi/mL at well DCB 39A, and 780 pCi/mL at well DCB 39C. Tritium downgradient wells are compared to 1,500 pCi/mL.

Monitoring results exceeded MCLs, NSDWS, or RSLs for tritium, VOCs, and metals (Appendix C). Arsenic, beryllium, cadmium, chromium, lead, selenium, thallium, uranium, tetrachloroethylene (PCE), TCE, and tritium exceeded their respective MCLs. Aluminum, ferric iron, ferrous iron, manganese, and sulfate exceeded their respective NSDWS. Cobalt and nickel exceeded their respective RSLs. Plume maps for many of these constituents are provided in Appendix D. Well clusters on the planar plume maps are listed in descending order of the screen zone elevations for relative vertical concentration configuration. Cross sections of a subset of these plumes (beryllium, cobalt, sulfate, TCE, tritium, and also pH) are provided in Appendix D.

3.1 Metals (Low pH Coal Leachate) Plume

Groundwater monitoring results for 2017 and 2018 revealed that aluminum, arsenic, beryllium, cadmium, chromium, cobalt, ferric iron, ferrous iron, lead, manganese, nickel, sulfate, and uranium exceeded their respective MCL, NSDWS, or RSL.

A plume of sulfate, metals, and low pH is present beneath the 484-17D DCSA, 489-D CPRB, 488-DAB, and southwest of the 431-2D DRP (Appendix D, Figures D-9 through D-35). The distribution of coal leachate in groundwater is represented by sulfate, which is highly soluble and provides the highest resolution as an indicator parameter of plume migration (Appendix D, Figures D-26, D-27, and D-28). Data from upgradient well DCB 8 and previous data from

upgradient locations show background sulfate concentrations to be less than 10 mg/L and pH values greater than 4. The maximum concentrations of sulfate in groundwater are adjacent to the 484-17D DCSA and the 489-D CPRB. The maximum sulfate values observed in 2017 are as follows: 868 mg/L (2Q2017) was measured in well DCB 22B and 2,850 mg/L (4Q2017) was measured in well DCB 6. The maximum sulfate values observed in 2018 are as follows: 2,340 mg/L (2Q2018) and 1,850 mg/L (4Q2018), both measured in well DCB 22A. The western boundary of the sulfate plume extends into the D-Area Ash Basin Wetlands.

The pH data (Appendix D, Figure D-22) are consistent with sulfate since the lowest pH values are also observed near the 484-17D DCSA and the 489-D CPRB. The lowest pH values measured during the reporting period are as follows: 2.1 in 2Q2017, 3.1 in 4Q2017, and 2.4 in 2Q2018, all at well DCB 21A. The lowest pH value observed in 4Q2018 was 2.8 at well DCB 22A. At upgradient well DCB 8, pH values during 2017 and 2018 were 5.1 and 5.0, respectively.

Along with sulfate, the metals associated with the coal leachate plume in the UTRA include aluminum, beryllium, cadmium, chromium, hexavalent chromium, cobalt, iron, lead, manganese, nickel, and total uranium. Concentrations of these metals that exceed a MCL, NSDWS, or RSL are within the footprint of the sulfate plume or low pH area (Appendix D, Figures D-9 through D-35). Time series plots for beryllium, cobalt, and manganese are provided in Appendix E.

Elevated aluminum concentrations that exceed the NSDWS (200 µg/L) are mostly located near the 489-D CPRB but also extend down to the D-Area Ash Basin Wetlands. The most elevated concentrations are directly downgradient of the 489-D CPRB (Appendix D, Figure D-9).

Beryllium exceeding the MCL (4 µg/L) extends from the 431-2D DRP to the D-Area Ash Basin Wetlands and 489-D CPRB, under the 488-DAB and the 488-4D Ash Landfill into the D-Area Ash Basin Wetlands (Appendix D, Figures D-10, D-11, and D-12). A plume map comparing the beryllium plume with the low groundwater pH is shown in Figure D-25. Similarly, cobalt exceeding the RSL (6 µg/L) extends across the site from the 431-2D DRP and 489-D CPRB down to the D-Area Ash Basin Wetlands (Appendix D, Figures D-16, D-17, and D-18). Other metals such as cadmium, chromium, lead, nickel, and uranium that are exceeding MCLs, NSDWS, or

RSLs remain close to the 489-D CPRB and are not widespread across D Area. Plume maps are provided in Appendix D.

Analysis for hexavalent chromium was performed at all wells that are sampled for metals during 2Q2017 to obtain a complete data set. Following which, samples are analyzed for hexavalent chromium only if the total chromium concentrations from the previous sampling event are above the 100 µg/L MCL. In 4Q2017 and 4Q2018, hexavalent chromium was analyzed at well DCB 21B. No samples were analyzed for hexavalent chromium during 2Q2018. South Carolina certified laboratories that can analyze hexavalent chromium are currently limited. Method EPA7196A was available for analysis; however, the detection limit of 3 µg/L was not below the hexavalent chromium RSL of 0.035 µg/L, but is below the total chromium MCL (100 µg/L). The total chromium MCL assumes the form of chromium is the more toxic hexavalent chromium. In 2Q2017, hexavalent chromium was detected at 11 locations, with a maximum estimated (J-qualified) concentration of 20.9 µg/L at well DCB077. Hexavalent chromium concentrations at DCB 21B were 10.3 µg/L (J-qualified) in 4Q2017 and below detection in 4Q18.

Source wells are also compared to threshold limits defined in the Monitoring Work Plan (WSRC 2004a). These are calculated as 2 times the maximum concentration from data prior to October 2003 for constituents with MCLs. Downgradient wells are compared to the maximum concentration from data prior to October 2003 for constituents with MCLs. The well specific threshold limits for metals with MCLs are provided in the data tables in Appendix C. Two source wells (DCB 21B and DCB 21C) located immediately downgradient of the 489-D CPRB exceeded threshold values for beryllium, chromium, copper, and selenium in 2017 and/or 2018. The selenium exceedance was a single, new occurrence in 2Q2018, only slightly above the threshold limit, and below the MCL. Time series trends for the other constituents that exceeded threshold limits are provided in Figures D-36 and D-37. As seen in these graphs, the exceedances are not a new occurrence. Many of them are below MCLs, and concentrations are less than other nearby source wells. For these reasons, confirmation samples were not collected during 2017 and 2018.

Seven surface water locations were monitored during 2Q2017 and in 2Q2018 only 5 were sampled since DSWM-2 and DSWM-5 were dry (Appendix C, Table C-4) (Appendix D, Figure D-3). DSWM-2 and DSWM-5 were sampled in 4Q2018. Beryllium concentrations exceeded the MCL

(4 µg/L) at one surface water station in 2017 (DSWM-7) and two stations in 2018 (DSWM-6 and DSWM-7) (Appendix D, Figure D-10). Cobalt concentrations exceeded the RSL (6 µg/L) at one surface water station in 2017 (DSWM-7) and three locations in 2018 (DSWM-4, DSWM-6, and DSWM-7) (Appendix D, Figure D-16). Aluminum concentrations exceeded the NSDWS (200 µg/L) at all surface stations except DSWM-1 and DSWM-2 (Appendix D, Figure D-9). Manganese concentrations exceeded the NSDWS (50 µg/L) at all surface water locations.

3.2 Volatile Organic Compound Plume

The VOC plume is primarily the result of TCE concentrations that exceed the MCL, with some PCE detections above the MCL. During 2Q2017, measured TCE concentrations ranged from 0.38 µg/L (J-qualified) to 140 µg/L in the UTRA. Groundwater monitoring results for 2017 revealed no TCE above the MCL in wells in the GA. Measured TCE concentration data for 2Q2018 range from 0.5 (J-qualified) to 146 µg/L in the UTRA (Appendix D, Figures D-30, D-31, and D-32). Groundwater monitoring results for 2018 revealed no TCE above the MCL in wells in the GA. Both 2017 and 2018 TCE concentrations exceeded the MCL (5 µg/L) in groundwater, but there were no detections in surface water.

The TCE plume outlined by the 5 µg/L MCL is ~2,200-m (7,200-ft) long by 940-m (3,100-ft) wide, and confined to the UTRA (Appendix D, Figure D-30). The TCE plume extends from the DHWF in the northeast to the DAB Wetlands in the east.

Most source well concentrations of TCE in the UTRA are decreasing, which indicates depletion of the source and is consistent with degradation of the TCE plume. The highest TCE concentrations are from well DCB 62 (140 µg/L in 2Q2017 and 146 µg/L in 2Q2018), southwest of the DHWF, near the former 715-D Gasoline Station Area. These concentrations are distinctly lower than previous maximum concentrations and indicative of source depletion and dispersion throughout the plume. Increases displayed at well DCB 26AR (directly downgradient of the source zone) are most likely due to plume migration from the higher concentrations upgradient. Intermediate wells DCB 27C and DCB 28 show decreasing concentrations indicating the plume is not expanding. Downgradient wells, removed spatially from the source area, display steady or decreasing trends which also support that the plume is not expanding and is not posing an

immediate threat to surface water or the D-Area Ash Basin Wetlands. Additionally, TCE threshold limits set in the Monitoring Work Plan (WSRC 2004a) for source and downgradient wells were not exceeded. The well specific threshold limits for TCE are provided in the data tables in Appendix C. Time series plots for TCE are provided in Appendix E.

PCE is less prevalent in D Area. PCE was detected above the MCL at three wells in 2Q2017 with a maximum concentration of 9.47 µg/L at well DCB 45C, and at four wells in 2Q2018 with a maximum concentration of 11.1 µg/L at well DCB 45C.

PCE and TCE degradation products cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, chloroethene (vinyl chloride), and ethylene were either non-detect or did not exceeding their respective MCL.

3.3 Tritium Plume

Both the 2017 and 2018 sampling events had tritium concentrations exceeding the MCL (20 pCi/mL). Groundwater monitoring data from 2Q2017 revealed tritium concentrations ranging from 0.909 pCi/mL (J-qualified) to 329 pCi/mL at well DCB 26AR in the UTRA with no detection of tritium in the GA wells. Groundwater monitoring data from 2Q2018 revealed tritium concentrations ranging from 0.58 pCi/mL (J-qualified) to 298 pCi/mL at well DCB 26AR in the UTRA with no detection of tritium in the GA wells. Time series plots of tritium are provided in Appendix E.

Overall, concentrations of tritium in the UTRA are decreasing as displayed in Appendix E, which suggests depletion of the source and reductions due to the half-life (12.7 years) of tritium and advection. The tritium plume exceeding the MCL (20 pCi/mL) is ~1,650-m (5,500-ft) long and is ~560-m (1,900-ft) wide at its greatest extent to the southwest, and is confined to the UTRA (Appendix D, Figures D-33, D-34, and D-35). Core plume concentrations have drastically decreased over the last 17 to 19 years when core concentrations were above 1,000 pCi/mL. Correspondingly, source wells DCB 45A and DCB 45C show decreasing trends. Source well DCB 26AR, downgradient of DCB 45A and DCB 45C, shows an overall decreasing trend, but concentrations have increased slightly over recent years likely due to plume migration. The highest tritium activity detected during 2017 (329 pCi/mL) and 2018 (298 pCi/mL) was detected

in well DCB 26AR. Intermediate wells display slightly decreasing or steady trends. Downgradient wells (e.g., DWP 2) are generally steady with intermittent increasing trends due to plume movement towards discharge locations.

No source or downgradient well exceeded well specific threshold limits for tritium. The contaminant trends suggest the plume source is depleted and that the tritium plume is attenuating without causing a major threat to surface water of the Savannah River or associated DAB Wetlands.

Monitoring results from the surface water stations were below the MCL during 2Q2018. The 2Q2018 DSWM surface water sampling locations had five measured tritium values ranging from 1.37 pCi/mL (J-qualified) to 2.31 pCi/mL (Appendix D, Figure D-33).

4.0 MONITORING EVALUATION

4.1 Groundwater Flow Direction and Rate

4.1.1 *Water Elevation Measurements*

Water levels were attempted to be measured at 80 wells during 2017 and 82 wells during 2018. Wells DCB0081 and DCB082 were added in 2018.

Water table elevations during 2Q2018 in the UTRA ranged from ~42-m (140-ft) above msl in northeast D Area to an elevation of ~25-m (84-ft) above msl in the southwest area. Groundwater flow direction in the water table remains to the southwest (Appendix D, Figure D-7), which is consistent with characterization activities and groundwater modeling.

Potentiometric levels during 2Q2018 in the GA ranged from ~41-m (134-ft) msl in northeast D Area down to ~29-m (94-ft) msl west of the 488-DAB (Appendix D, Figure D-8). Although the spatial distribution of the potentiometric data for the GA is limited, this data indicates that groundwater continues to flow toward the southwest as demonstrated in the 2002 groundwater model report (WSRC 2002).

Hydrographs for the wells sampled through 4Q2018 are presented in Appendix F. The hydrographs demonstrate that most water elevations were steady over the past few years. All water elevations are within historical normal ranges.

4.1.2 Horizontal Gradient Flow Rate and Direction

Groundwater in the UTRA and the GA beneath D Area generally flows from northeast to southwest and eventually discharges to the floodplain/wetlands and the Savannah River. Overall, groundwater velocities during 2018 remained consistent with velocities from previous periods. Flow rate is calculated as follows:

$$\text{Velocity (ft/day)} = \frac{\text{Hydraulic Conductivity (ft/day)}}{\text{Porosity (unitless)}} \times \frac{dh(\text{ft})}{dl(\text{ft})}$$

The value dh is the difference in hydraulic head over a given length (dl) of the flow path. A porosity of 0.3 was assumed for the calculations.

The hydraulic conductivity values (from previous testing) for the UTRA can range from 1.01E-04 to 5.1E-02 cm/sec (0.287 to 144 ft/day). The average hydraulic conductivity of the UTRA used to calculate the flow was 3E-03 cm/sec (8.5 ft/day). The horizontal hydraulic head of the UTRA is ~0.0077.

The estimated hydraulic conductivity values for the Quaternary fluvial deposits west of the 488-DAB have a similar range as the UTRA. This reflects the presence of fluvial sands and river channel deposits. These sands beds, however, are laterally discontinuous and thought to have a limited local effect on diverting groundwater flow and the contaminated groundwater plumes emanating from D Area.

Estimated hydraulic conductivity values (from previous testing) for the GA range from 6.60E-04 to 2E-03 cm/sec (1.87 to 5.67 ft/day). A hydraulic conductivity of 1.4E-03 cm/sec (4.0 ft/day) was used to calculate the flow rate. The estimated hydraulic head of the GA is ~0.0072.

The calculated flow rates were based on measurements collected during 2018. The flow velocities for the UTRA and the GA were calculated to be 80.1 ft/yr and 35.2 ft/yr, respectively.

4.1.3 Vertical Gradient Flow Rate and Direction

A downward gradient typically exists between the UTRA and the GA as the hydraulic head in the UTRA is on average 0.3- to 0.6-m (1- to 2-ft) higher than in the GA. Based on the 2018 water elevation data, the hydraulic head difference between the UTRA and the GA was consistent with the historical range at well cluster DCB 51 (0.56 m [1.9 ft]) and high at well cluster DCB 37 (0.89 m [2.9 ft]). Well clusters DCB 33 and cluster DCB 48 displayed the low hydraulic difference with a 0.13-m (0.4-ft) and .08-m (0.3-ft) downward gradient, respectively. Well cluster DCB 23 has consistently displayed a strong upward gradient from the GA to the UTRA and did so in 2018 with an upward gradient of 0.47 m (1.6 ft). The vertical differences in hydraulic head are similar to previous observations. The vertical groundwater seepage rates for 2018 are estimated to be less than 1.3 m/yr (4 ft/yr). This seepage rate is an order of magnitude less than the calculated horizontal flow rates; therefore, the primary flow direction is horizontal.

4.1.4 Recharge and Precipitation

Daily precipitation measurements were made at a meteorological station located at D Area from January 1973 to present, though for a period from November 2012 to December 2013, the 100-C rain gauge was used for rainfall measurement data because of issues with the D-Area rain gauge. The measurements represent the total precipitation for a 24-hour period. Table 1 is a monthly summary for rainfall for the last 40 years. The total annual rainfall for 2018 was 140.7 centimeters (cm [55.4 inches {in.}]) (Table 1). Rainfall during 2018 was ~22.9-cm (9-in.) above average, and 25.4-cm (10-in.) higher than 2017 (Table 1). Based on an annual total precipitation recorded for the year 2018, the recharge to the water table aquifer would be ~46.5 cm/yr (18.3 in./yr) (i.e., 1/3 of the annual total precipitation), compared with an estimated recharge of 37.8 cm/yr (14.9 in/yr) for 2017.

4.2 Contaminant Migration

The acidic plume containing metals and sulfate emanates from the 484-17D DSCA and the 489-D CPRB. Sulfate and metals that are mobile at a low pH are widely distributed in D Area, extending to the Savannah River floodplain/wetlands. These mobile metals include aluminum, beryllium, cobalt, and manganese. The metals are likely sourced from the coal that has since been removed from the 484-17D DSCA, soils in the vadose zone below the 484-17D DCSA, and the 489-D

CPRB, and aquifer solids that interact with the low-pH plume. Concentrations of these mobile metals should dissipate over time but continue to affect a large area, which is consistent with the recent monitoring results. These metals will likely continue to migrate within low-pH groundwater.

Immobile metals that are still predominantly found near the 484-17D DCSA and the 489-D CPRB include cadmium, chromium, lead, nickel, and uranium. These metals are likely sourced from the coal previously stored at the 484-17D DCSA with some additional source from vadose zone soils. Concentrations of the immobile metals should dissipate more slowly than their mobile counterparts but will be mainly localized to the area adjacent to the 484-17D DCSA and the 489-D CPRB. Current monitoring results show a slight decrease in immobile metal concentrations still localized to the 484-17D DCSA and 489-D CPRB area.

The plumes of mobile TCE and tritium should behave similarly as the contaminants travel from the source zone towards the Savannah River. Consistent with monitoring results, the plume concentrations in the source zone are expected to decrease with hotspots shifting downgradient over time. With this, wells directly downgradient of the source are expected to increase slightly as the hot spots travel into the area. Locations further downgradient, where increased travel time leads to increased plume dispersion, should see slight decreases in concentrations. The current monitoring results are consistent with the expected migration.

4.3 Comparison to Model/Expectation for Long-Term Plume Behavior

Overall, the results from recent analytical monitoring are consistent with those predicted from the groundwater modeling for the DAG OU. Modeling assumed there were no continuing sources for TCE and tritium. Monitoring results show that overall the plumes are being depleted. A few increasing or steady trends are believed to be due to plume movement and possible diffusion from low permeability zones. Threshold limits for TCE and tritium have not been exceeded and concentrations remain well below those threshold limits.

Modeling identified that there is some uncertainty with respect to the mobility of metals in the UTRA at D Area. This uncertainty is a result of varying chemical conditions (e.g., pH and redox on the flow path from the source areas, 489-D CPRB, 431-2D DRP, and the 488-DAB, towards

the wetland area). Initial modeling predicted more metal contamination would be present downgradient sooner; however, contaminants were not present at levels expected. Currently, contaminants are not migrating through groundwater quickly causing increases downgradient within the DAB Wetlands. Continued monitoring will provide trend information to further define the DAG OU characterization.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 Summary

Groundwater flow in the UTRA and GA is from the northeast to southwest towards the Savannah River. Water-level elevations have been relatively stable, reflecting expected variations from precipitation events.

Groundwater monitoring results for 2017 and 2018 revealed that the MCLs, NSDWS, or RSLs were exceeded for tritium, VOCs, and metals (Appendix C). Tritium, PCE, TCE, uranium, lead, chromium, cadmium, beryllium, fluoride, and chloride exceeded their respective MCLs. Aluminum, ferric iron, ferrous iron, manganese, sulfate, and total dissolved solids exceeded their respective NSDWS. Cobalt, hexavalent chromium, and nickel exceeded their respective RSLs.

Surface water monitoring results during 2018 show surface water exceeded MCLs for beryllium and cobalt at locations downgradient of the 484-17D DCSA and 489-D CPRB. Aluminum exceeded the NSDWS at most surface water locations. Sulfate exceeded the NSDWS at surface water locations downgradient of the 484-17D DCSA and the 489-D CPRB. Manganese exceeded the NSDWS at all surface water stations.

5.1.1 *Metals (Low pH Coal Leachate) Plume*

Groundwater monitoring results for 2017 and 2018 indicated that aluminum, beryllium, cadmium, chromium, hexavalent chromium, cobalt, iron, lead, manganese, nickel, sulfate, and uranium exceeded their respective MCL, NSDWS, or RSL.

In general, the highest concentrations of metals in groundwater are adjacent to the former 484-17D DCSA and the 489-D CPRB where metals in coal and the vadose zone soils leached to groundwater

when exposed to low-pH stormwater runoff from the former D-Area coal pile. Metals such as cadmium, chromium, hexavalent chromium, lead, nickel, and uranium that are exceeding MCLs, NSDWS, or RSLs remain close to the 489-D CPRB, likely due to an affinity for soils and are not widespread across D Area. Metals plumes for sulfate, cobalt, beryllium, and manganese are widespread over D Area and show correspondence with the low-pH plume areas. The impacted groundwater discharges to surface water which also has a low pH and has exceeded the MCL for beryllium, NSDWS for sulfate, and the RSL for cobalt.

All ground water samples analyzed for metals were analyzed for hexavalent chromium during 2Q2017. Hexavalent chromium was detected above the RSL (0.035 µg/L) with a maximum concentration of 20.9 µg/L but is below the total chromium MCL (100 µg/L). The MCL assumes the form of chromium is the more toxic hexavalent chromium. In 4Q2017 and 4Q2018, only one well (DCB 21B) required analysis for hexavalent chromium with a concentration of 10.3 µg/L in 2017 and no detection in 2018.

Two source wells (DCB 21B and DCB 21C) located immediately downgradient of the 489-D CPRB exceeded threshold values for beryllium, chromium, copper, and selenium in 2017 and/or 2018. The majority of threshold exceedances remain below MCLs, with concentrations less than nearby source wells. For these reasons, confirmation samples were not collected during 2017 and 2018.

5.1.2 VOC Plume

Groundwater monitoring results revealed TCE and PCE concentrations in the UTRA exceeded MCLs (5 µg/L), though concentrations in the GA wells were below MCLs. PCE and TCE degradation products cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, chloroethene (vinyl chloride), and ethylene were either non-detect or did not exceed their respective MCLs. Monitoring results from the surface water stations were below MCLs during 2017 and 2018. Decreasing concentrations of VOCs suggest the decline to be a result of dilution and dispersion rather than degradation. As the plume moves through the system, the source, intermediate, and downgradient wells are generally decreasing in concentration with a few wells showing steady or increasing trends most likely due to plume hotspot movement.

5.1.3 Tritium Plume

Overall, tritium concentrations in the groundwater and source area are decreasing, likely the result of radioactive decay (i.e., half-life = 12.7 years), advection, and source depletion. Groundwater monitoring results revealed that tritium concentrations in the UTRA exceeded the MCL (20 pCi/mL) during 2017 and 2018. Tritium concentrations in the GA wells were below the MCL. Monitoring results from the surface water stations were below the MCL during 2017 and 2018. The maximum concentration in 2018 was 298 pCi/mL at DCB 26AR. Concentrations of tritium in the UTRA are decreasing as displayed in Appendix E, which suggests depletion of the source and reductions due to the radioactive decay. No increases were displayed in source wells except DCB 26AR where it is expected to be due to plume movement from higher concentrations upgradient. No well specific threshold values were exceeded in source and downgradient wells.

5.2 Recommendations

Continued monitoring ensures that any additional loading from the vadose zone will be detected; however, the tritium and TCE contaminants are a result of historical releases with no continuing source in the vadose zone. The metals were sourced primarily from the vadose zone beneath the 484-17D DCSA and 489-D CPRB and leached from the coal when exposed to low-pH stormwater runoff from the coal pile. In accordance with the Monitoring Work Plan, groundwater and surface water monitoring will continue until a final remedial decision is made for the DAG OU. The 484-17D DCSA removal action (SRNS 2019a) and DAG OU treatability study (SRNS 2019b) will begin to address this source area by raising the pH of vadose zone soils and displacing and treating the upper portion of the acidified groundwater. In support of the treatability study, five additional surface water wells were added in 2019 (SRNS 2019b). The groundwater and surface water monitoring data reported herein will be used to support the final remedial decision on the DAG OU.

During review of the DAG OU Letter Report for Calendar Year 2017 (SRNS 2018b), SCDHEC requested that wells DCB 34A and DCB 34C be monitored for chromium on a semi-annual basis. SRS agreed to add the metals analysis (including chromium) to the fourth quarter sampling event for wells DCB 34A and DCB 34C beginning with the 4Q2019 sampling event.

DAG OU FFA Schedule

The DAG OU Federal Facility Agreement (FFA) schedule has been aligned with the DAB/Landfill closure activities. The FFA Field Start for additional characterization for groundwater at the DAG OU is scheduled for June 2020. There are no current plans to address the tritium or TCE plumes until full characterization of groundwater is complete at the DAG OU.

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Table 1. Rainfall (inches), 1979 - 2018

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1979	3.48	9.49	3.06	4.54	7.45	1.37	5.57	7.14	6.13	0.82	6.38	2.35	57.78
1980	4.23	3.05	11.1	2.45	4.15	4.5	0.97	1.65	7.51	2.05	1.73	2.71	46.1
1981	0.72	3.8	4.16	2.64	3.7	4.96	4.56	6.18	0.06	3.04	0.66	8.86	43.34
1982	4.48	4.89	3.17	4.98	3.64	5.82	3.36	3.12	3.2	3.71	1.68	6.08	48.13
1983	4.09	7.12	5.36	5.43	2.4	3.44	1.63	5.32	2.54	2.42	4.35	4.03	48.13
1984	3.22	5.65	5.3	4.91	5.39	6.07	8.81	1.97	0.73	0.38	1.15	1.34	44.92
1985	2.64	5.71	1.01	1.53	1.79	6.25	8.9	4.15	0.2	5.53	7.16	2.7	47.57
1986	1.14	2.8	3.07	0.48	2.48	5.01	1.66	8.13	0.52	2.52	4.7	3.96	36.47
1987	6.49	6.65	3.85	0.28	1.39	4.69	2.45	1.73	4.64	0.19	2.34	1.27	35.97
1988	3.55	5.3	2.04	6.18	1.56	6.94	1.76	5.04	5.06	2.45	1.81	1.15	42.84
1989	1.78	3.17	4.56	4.72	2.42	5.73	7.39	0.23	5.11	4.57	2.61	2.37	44.66
1990	2.05	3.51	3.19	0.29	1.1	1.22	4.8	5.23	0.44	17.12	1.26	1.67	41.88
1991	7.49	2	7.15	4.9	3.09	2.58	9.11	8.59	1.52	0.53	1.01	3.34	51.31
1992	3.59	4.86	3.27	2.48	2.15	7.55	7.29	6.27	3.58	3.91	6.64	1.95	53.54
1993	7.92	2.55	9.7	1.3	2.24	8.65	1.85	3.06	6.42	0.87	1.84	2.25	48.65
1994	4.71	4.49	6.72	1.29	1.66	7.33	6.08	3.62	2.33	8.98	2.86	4.71	54.78
1995	5.28	6.06	2.47	0.17	2.28	7.24	4.2	6.86	3.95	2.11	2.49	4.47	47.58
1996	2.6	2.05	6.26	1.69	1.6	3.65	4.89	7.93	3.72	1.98	1.5	2.74	40.61
1997	4.14	5.1	1.98	3.42	1.69	6.82	6.54	1.37	5.41	4.74	4.29	7.93	53.43
1998	7.76	6.26	7.86	7.14	4.2	2.86	7.53	2.98	6.33	0.65	0.57	1.89	56.03
1999	6.9	2.26	2.98	2.12	2.59	7.37	6.36	5.46	3.45	2.18	0.65	0.91	43.23
2000	5.11	0.77	4.26	1.62	0.21	5.85	3.86	4.15	9.11	0.06	3.33	1.61	39.94
2001	2.69	3.05	7.28	1.43	3.24	6.54	2.19	3.14	3.31	0.18	1.12	0.57	34.74
2002	2.04	2.23	4	1.59	1.63	3.9	4.41	4.55	3.72	4.57	3.94	3.86	40.44
2003	2.07	5.31	8.07	8.64	6.81	9.18	10.14	3.96	2.63	3.39	1.19	2.26	63.65
2004	2.7	7.11	0.86	1.28	2.79	7.83	2.91	1.96	7.05	0.59	2.74	2.54	40.36
2005	2.35	4.43	6.07	1.26	4.12	9.57	5.19	4.64	2.07	2.95	2.53	6.4	51.58
2006	3.19	2.61	1.35	2.29	2.34	6	5.26	1.59	2.81	1.77	3.76	4.4	37.37
2007	3.18	2.87	1.7	2.48	1.23	5.42	4.97	3.04	0.91	1.47	0.14	9.67	37.08
2008	4	5.89	4.66	2.35	2.42	0.27	6.82	6.86	0.57	4.47	2.93	5.13	46.37
2009	2.03	0.8	4.25	5.86	8.21	1.72	4.47	7.67	5.74	2.89	4.56	9.75	57.95
2010	4.9	2.62	2.5	1.71	1.34	7.29	2.39	7.04	2.51	0.48	1.45	1.41	35.64
2011	2.2	4.95	5.67	3.53	1.17	2.81	2.5	2.54	2.38	1.86	2.68	1.91	34.2
2012*	1.91	1.59	3.07	1.43	6.96	3	5.27	9.85	1.55	0.54	1.51	5.1	41.78
2013*	0.92	9.89	3.65	5.17	3.17	10.87	11.44	7.39	1.06	0.51	1.58	4.94	60.59
2014	2.77	6	3.15	3.69	4.08	5.2	6.1	3.8	4.46	1.43	3.88	5.17	49.73
2015	3.47	5.09	4.12	7.08	0.35	6.03	4.33	2.81	4.64	1.27	7.25	5.36	51.8
2016	1.77	5.13	3.37	3.42	6.81	4.88	4.61	1.96	6.06	4.71	0.49	6.22	49.43
2017	4.54	1.43	1.57	7.23	3.41	6.53	3.26	3.27	6.12	1.27	1.58	4.9	45.11
2018	2.4	1.96	4.04	4.08	8.39	5.25	5.32	1.77	3.45	3.92	7.58	7.24	55.4
Average	3.56	4.26	4.30	3.23	3.19	5.45	5.03	4.45	3.58	2.73	2.80	3.93	46.50
Max	7.92	9.89	11.10	8.64	8.39	10.87	11.44	9.85	9.11	17.12	7.58	9.75	63.65
Min	0.72	0.77	0.86	0.17	0.21	0.27	0.97	0.23	0.06	0.06	0.14	0.57	34.20

* Beginning in November 2012, the 100-C rain gauge was for used for rainfall measurement data through Dec 2013 because of issues with the D-Area rain gauge.

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APPENDIX A

Well Construction Summary

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Table A-1. Well Construction Summary

Well ID	Well Type	Sample Media	Aquifer	Year Installed	Casing Material	Diameter	Ground Elevation	Top of Screen	Bottom of Screen	Base of Well	UTM East	UTM North
						(in.)	(ft msl)			(ft bgs)	(m)	(m)
DPB 1	Monitoring	GW	UTRA	1983	PVC	4	133.2	123.2	93.2	42	430364.81	3673925.84
DPB 2	Abandoned (2005)			1983	PVC	4	124.3	114.3	84.3	42	430340.35	3673827.67
DCB 1A	Monitoring	GW	UTRA	1984	PVC	4	125.1	120.1	90.1	37	431136.63	3673484.04
DCB 2A	Monitoring	GW	UTRA	1984	PVC	4	132.4	127.4	97.4	36.9	431498.81	3673524.41
DCB 3A	Monitoring	GW	UTRA	1984	PVC	4	131.2	126.2	96.2	36.8	431636.48	3673337.73
DCB 4A	Monitoring	GW	UTRA	1984	PVC	4	127.5	122.5	92.5	37	431535.73	3673265.86
DCB 5A	Monitoring	GW	UTRA	1984	PVC	4	120.9	115.9	85.9	37	431368.31	3673312.57
DCB 6	Monitoring	GW	UTRA	1987	PVC	4	131.5	129.5	109.5	23.7	431141.94	3673540.44
DCB 7	Monitoring	GW	UTRA	1987	PVC	4	130.9	128.9	108.9	23.9	431185.84	3673509.64
DCB 8	Monitoring	GW	UTRA	1987	PVC	4	134.8	130.3	110.3	26.5	431521.32	3673555.05
DCB 8C	Monitoring	GW	UTRA	1998	PVC	2	134.74	69.14	59.14	78	431524.86	3673558.71
DCB 9	Monitoring	GW	UTRA	1987	PVC	4	120.2	117.3	97.3	25	431095.52	3673515.20
DCB 10	Monitoring	GW	UTRA	1987	PVC	4	121.8	119.8	99.8	24.1	431176.07	3673427.79
DCB 11	Abandoned (2004)			1987	PVC	4	128.8	126.8	106.8	23.8	430877.57	3673525.28
DCB 12	Abandoned (2005)			1987	PVC	4	115	112	92	24.9	430608.74	3673522.23
DCB 13R	Abandoned (Sep 2016)	GW	UTRA	2002	PVC	2	127.67	97.67	87.67	40	431032.82	3673336.63
DCB 15	Abandoned (2005)			1988	PVC	4	125.4	119.9	99.8	27.8	430485.81	3673228.46
DCB 15R	Abandoned (2005)			1999	PVC	2	125.5	94.5	85.2	42	430479.70	3673236.26
DCB 16R	Abandoned (2014)			1997	PVC	2	125	97	87	39	430566.82	3673107.33
DCB 21A	Piezometer	GW	UTRA	1994	PVC	2	126.6	120.1	110.1	20	431156.63	3673455.74
DCB 21B	Piezometer	GW	UTRA	1994	PVC	2	126.7	104.7	102.2	27	431154.91	3673456.45
DCB 21C	Piezometer	GW	UTRA	1994	PVC	2	126.8	90.8	88.3	44	431153.39	3673457.34
DCB 22A	Piezometer	GW	UTRA	1994	PVC	2	125.3	119.8	109.8	18.5	431143.02	3673443.12
DCB 22B	Piezometer	GW	UTRA	1994	PVC	2	125.4	103.4	100.9	30	431141.17	3673443.85
DCB 22C	Piezometer	GW	UTRA	1994	PVC	2	125.6	90.6	88.1	41	431139.60	3673444.97
DCB 23A	Piezometer	GW	UTRA	1994	PVC	2	119.2	115.7	105.7	16	431103.89	3673400.62
DCB 23B	Piezometer	GW	UTRA	1994	PVC	2	119.1	96.6	94.1	27.5	431102.51	3673401.84
DCB 23C	Piezometer	GW	UTRA	1994	PVC	2	119.1	89.1	86.6	35	431101.08	3673403.13
DCB 23D	Piezometer	GW	UTRA	1994	PVC	2	119.1	51.6	49.1	47.1	431097.08	3673406.81

Table A-1. Well Construction Summary (Continued)

Well ID	Well Type	Sample Media	Aquifer	Year Installed	Casing Material	Diameter	Ground Elevation	Top of Screen	Bottom of Screen	Base of Well	UTM East	UTM North
						(in.)	(ft msl)			(ft bgs)	(m)	(m)
DCB 26AR	Monitoring	GW	UTRA	1999	PVC	2	122.7	111.7	97.4	26	430790.49	3673705.50
DCB 27	Monitoring	GW	UTRA	1998	PVC	2	111.9	101.8	91.8	26	430379.01	3673474.09
DCB 27C	Monitoring	GW	UTRA	2001	PVC	2	110.68	70.53	60.5	50.5	430373.22	3673468.61
DCB 27D	Monitoring	GW	GA	2005	PVC	2	110.1	34.9	24.9	87.5	430360.55	3673467.67
DCB 28	Monitoring	GW	UTRA	1998	PVC	2	100	92.1	82.09	18	430162.70	3673314.01
DCB 29C	Abandoned (2005)			2002	PVC	2	108.3	68.3	63.3	75	430421.51	3673097.93
DCB 29R	Abandoned (2005)			1999	PVC	2	108.1	90.1	80.74	28	430409.59	3673084.36
DCB 31	Abandoned (2005)			1998	PVC	2	116.6	96.67	87.34	30	430474.33	3673701.14
DCB 32A	Monitoring	GW	UTRA	1998	PVC	2	141.3	121.7	111.7	30	430490.56	3674027.44
DCB 33B	Monitoring	GW	UTRA	1998	PVC	2	140.5	114	104	37	431452.80	3673862.25
DCB 33C	Monitoring	GW	UTRA	1999	PVC	2	140.7	78.7	69.33	72	431451.66	3673859.57
DCB 33D	Monitoring	GW	GA	1999	PVC	2	140.5	52.5	42.5	102	431450.84	3673857.43
DCB 34A	Monitoring	GW	UTRA	1998	PVC	2	128	112	102	26	431473.05	3673255.46
DCB 34C	Monitoring	GW	UTRA	1998	PVC	2	127.6	80.8	70.8	59.3	431469.82	3673256.45
DCB 35A	Monitoring	GW	UTRA	1998	PVC	2	118.2	103.4	93.4	25	431332.98	3673237.04
DCB 35C	Monitoring	GW	UTRA	1998	PVC	2	118	84.2	74.2	44	431331.03	3673234.39
DCB 36A	Monitoring	GW	UTRA	1998	PVC	2	123.9	114.1	104.1	20	431236.59	3673348.17
DCB 36C	Monitoring	GW	UTRA	1998	PVC	2	123.8	97.3	87.3	37	431234.78	3673349.94
DCB 37A	Monitoring	GW	UTRA	1998	PVC	2	126.5	110.8	100.8	25.9	431055.20	3673579.31
DCB 37C	Monitoring	GW	UTRA	1998	PVC	2	126.5	92.4	82.4	44.3	431052.33	3673582.18
DCB 37D	Monitoring	GW	GA	2002	PVC	2	127.19	47.19	37.19	102	431052.62	3673592.55
DCB 38C	Abandoned (2005)			1998	PVC	2	131.1	90.3	80.3	51	431023.83	3673434.06
DCB 39A	Abandoned (2005)			1998	PVC	2	128.3	114.3	104.3	27	430940.02	3673606.85
DCB 39C	Abandoned (2005)			1998	PVC	2	128.4	92.3	82.3	46.3	430938.58	3673609.15
DCB 40A	Monitoring	GW	UTRA	1998	PVC	2	129.3	115.5	105.5	24	430726.31	3673786.61
DCB 44A	Monitoring	GW	UTRA	1999	PVC	2	134.6	123.3	108.3	26.5	431108.13	3673846.58
DCB 44C	Monitoring	GW	UTRA	1998	PVC	2	134.7	97.7	88.72	48	431105.41	3673844.68
DCB 45A	Monitoring	GW	UTRA	1998	PVC	2	134.9	125.2	110.2	25.2	431028.48	3673926.55
DCB 45C	Monitoring	GW	UTRA	1998	PVC	2	134.8	98.8	88.8	48	431030.14	3673924.04

Table A-1. Well Construction Summary (Continued)

Well ID	Well Type	Sample Media	Aquifer	Year Installed	Casing Material	Diameter	Ground Elevation	Top of Screen	Bottom of Screen	Base of Well	UTM East	UTM North
						(in.)	(ft msl)			(ft bgs)	(m)	(m)
DCB 46C	Abandoned (2005)			1999	PVC	2	128	96	86.7	48	430779.43	3673332.86
DCB 47C	Abandoned (2014)			1998	PVC	2	128.2	96.4	86.4	42	430872.77	3673192.65
DCB 48A	Monitoring	GW	UTRA	2001	PVC	2	107.28	81.28	76.24	43	430359.35	3673208.55
DCB 48D	Monitoring	GW	GA	1999	PVC	2	106.9	50.9	40.9	70	430355.09	3673213.92
DCB 49	Monitoring	GW	UTRA	1999	PVC	2	122	118.65	106.15	16.5	431282.81	3673364.86
DCB 50	Monitoring	GW	UTRA	1999	PVC	2	122	118.46	105.9	16.5	431281.04	3673362.29
DCB 51A	Monitoring	GW	UTRA	2001	PVC	2	157.69	138.32	128.28	29.7	431799.12	3674403.72
DCB 51D	Monitoring	GW	GA	2001	PVC	2	157.57	64.27	54.22	104.5	431800.46	3674407.69
DCB 52C	Monitoring	GW	UTRA	2002	PVC	2	97.28	72.28	62.28	60	429674.05	3673200.68
DCB 53	Monitoring	GW	UTRA	2001	PVC	2	113.58	87.58	77.48	41	431042.31	3672711.99
DCB 54	Monitoring	GW	UTRA	2001	PVC	2	111.13	76.63	66.53	45.5	430490.70	3672912.27
DCB 55	Monitoring	GW	UTRA	2001	PVC	2	96.68	72.68	62.64	34.4	429888.10	3673308.92
DCB 56	Monitoring	GW	UTRA	2001	PVC	2	130.78	107.78	97.74	33.5	430830.21	3673961.54
DCB 57A	Abandoned (2005)			2001	PVC	2	127.22	107.22	97.22	30	430539.29	3673887.23
DCB 59A	Monitoring	GW	UTRA	2001	PVC	2	133.95	113.95	103.95	31	430550.92	3674002.63
DCB 60	Monitoring	GW	UTRA	2002	PVC	2	148.61	120.61	110.61	47	431681.68	3674215.99
DCB 61	Monitoring	GW	UTRA	2001	PVC	2	136.14	118.34	108.3	28.5	430385.61	3674316.30
DCB 62	Monitoring	GW	UTRA	2002	PVC	2	141.56	111.56	101.56	40.5	431257.37	3674186.44
DCB 63	Monitoring	GW	UTRA	2001	PVC	2	140.54	132.54	117.44	26	431236.18	3674186.60
DCB 65A	Monitoring	GW	UTRA	2002	PVC	2	112.74	103.98	93.95	27	430211.35	3673688.89
DCB 65C	Monitoring	GW	UTRA	2001	PVC	2	112.74	75.39	70.37	57	430208.22	3673689.05
DCB 70A	Monitoring	GW	UTRA	2002	PVC	2	116.49	114.69	104.69	12.5	431125.88	3673428.49
DCB 70B	Monitoring	GW	UTRA	2002	PVC	2	116.2	95.6	90.57	27	431124.28	3673429.27
DCB 72C	Monitoring	GW	UTRA	2005	PVC	2	99.5	78.8	74.3	25.8	430085.46	3673499.57
DCB077	Monitoring	GW	UTRA	2016	PVC	2	127.7	118	98	31.7	430985.68	3673528.71
DCB078	Monitoring	GW	UTRA	2016	PVC	2	126.7	107	87	41.7	430852.27	3673189.19
DCB079	Monitoring	GW	UTRA	2016	PVC	2	127.8	104.1	84.1	45.7	430707.50	3673083.91
DCB080	Monitoring	GW	UTRA	2016	PVC	2	116.1	103	83	35.1	430585.51	3673019.20
DCB081	Monitoring	GW	UTRA	2018	PVC	2	113.11	98.41	78.41	36.7	430893.89	3672935.21
DCB082	Monitoring	GW	UTRA	2018	PVC	2	110.44	100.74	80.74	31.7	430968.84	3672831.31

Table A-1. Well Construction Summary (Continued/End)

Well ID	Well Type	Sample Media	Aquifer	Year Installed	Casing Material	Diameter	Ground Elevation	Top of Screen	Bottom of Screen	Base of Well	UTM East	UTM North
						(in.)	(ft msl)			(ft bgs)	(m)	(m)
DRW 1	Test	GW	UTRA	2000	Stainless Steel	6	144.7	115.06	85.06	65	431499.49	3674038.76
DWP 1	Piezometer	GW	UTRA	2001	PVC	2	98.17	93.27	88.27	10.21	429914.37	3673356.99
DWP 2	Piezometer	GW	UTRA	2001	PVC	2	95.99	90.99	85.99	10.31	429978.51	3673072.13
DWP 3	Piezometer	GW	UTRA	2001	PVC	2	95.98	93.08	88.08	8	429818.26	3673153.92
DWP 6	Piezometer	GW	UTRA	2001	PVC	2	97.17	91.67	89.17	8	430303.67	3672814.52
DWP 7	Piezometer	GW	UTRA	2001	PVC	2	97.29	92.98	88	9.5	430107.69	3673206.63
DWP 8	Piezometer	GW	UTRA	2001	PVC	2	96.14	92.14	87.15	10	430071.83	3672924.40
DWP 9	Piezometer	GW	UTRA	2001	PVC	2	95.83	91.85	86.86	9.5	429886.11	3672992.72
DWP 03A	Monitoring	GW	UTRA	2005	PVC	2	96.3	81.5	76.3	20.2	429819.87	3673152.93
DWP 09A	Monitoring	GW	UTRA	2005	PVC	2	95.6	80.6	76.1	20	429895.94	3672991.54

bgs = below ground surface
 ft = feet
 GA = Gordon Aquifer
 GW = Groundwater

msl = mean sea level;
 m = meter
 UTM = Universal Transverse Mercator
 UTRA = Upper Three Runs Aquifer

APPENDIX B

**Groundwater and Surface Water Samples Analyte List and Sample
Frequency**

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Table B-1. Groundwater Samples Analyte List and Sample Frequency

Well D	2Q	4Q	Well Type	Aquifer	Indicator Well	Applicable Threshold Limit
DBP 1	W	W	Monitoring	UTRA		
DCB 1A	W	W	Monitoring	UTRA		
DCB 2A	W	W	Monitoring	UTRA		
DCB 3A	Fp,M,Rd,S,V	W	Monitoring	UTRA		
DCB 4A	Fp,M,Rd,S,V	W	Monitoring	UTRA		
DCB 5A	W	W	Monitoring	UTRA		
DCB 6	Fp,U	W	Monitoring	UTRA		
DCB 7	Fp,U	W	Monitoring	UTRA		
DCB 8	Fp,M,S,T,U	W	Monitoring	UTRA		
DCB 8C	Fp,M,S,U,V	W	Monitoring	UTRA		
DCB 9	W	W	Monitoring	UTRA		
DCB 10	Fp,M,S,U	W	Monitoring	UTRA		
DCB 17A			Piezometer	UTRA		
DCB 17B			Piezometer	UTRA		
DCB 17C			Piezometer	UTRA		
DCB 18A			Piezometer	UTRA		
DCB 18B			Piezometer	UTRA		
DCB 18C			Piezometer	UTRA		
DCB 19A			Piezometer	UTRA		
DCB 19B			Piezometer	UTRA		
DCB 19C			Piezometer	UTRA		
DCB 20A			Piezometer	UTRA		
DCB 20B			Piezometer	UTRA		
DCB 20C			Piezometer	UTRA		
DCB 20D			Piezometer	GA		
DCB 21A	Fe,Fp,M,Rd,S,U	Fp,Fe,M,Rd,S,U	Piezometer	UTRA	Source	M,U
DCB 21B	Fe,Fp,M,Rd,S,U,V	Fp,Fe,M,Rd,S,U	Piezometer	UTRA	Source	M,U
DCB 21C	Fe,Fp,M,Rd,S,U,V	Fp,Fe,M,Rd,S,U	Piezometer	UTRA	Source	M,U
DCB 22A	Fe,Fp,M,Rd,S,U	Fp,Fe,M,Rd,S,U	Piezometer	UTRA		
DCB 22B	Fe,Fp,M,Rd,S,U	Fp,Fe,M,Rd,S,U	Piezometer	UTRA		
DCB 22C	Fe,Fp,M,Rd,S,U	Fp,Fe,M,Rd,S,U	Piezometer	UTRA		
DCB 23A	W	W	Piezometer	UTRA		
DCB 23B	Fp,M,S,U	W	Piezometer	UTRA		
DCB 23C	Fp,M,S,T,U	W	Piezometer	UTRA		
DCB 23D	W	W	Piezometer	GA		
DCB 24A			Piezometer	UTRA		
DCB 24B			Piezometer	UTRA		
DCB 24C			Piezometer	UTRA		
DCB 26AR	Fp,M, S, T,V	W	Monitoring	UTRA	Source	T
DCB 27	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB 27C	Fp,M,S,T,V	W	Monitoring	UTRA	Intermediate	V,T
DCB 27D	Fp,M,S,T,V	W	Monitoring	GA		
DCB 28	Fp,M,S,T,V	W	Monitoring	UTRA	Intermediate	V,T
DCB 32A	W	W	Monitoring	UTRA		
DCB 33B	Fp,V	W	Monitoring	UTRA		
DCB 33C	Fp,V	W	Monitoring	UTRA		

Table B-1. Groundwater Samples Analyte List and Sample Frequency (Continued)

Well D	2Q	4Q	Well Type	Aquifer	Indicator Well	Applicable Threshold Limit
DCB 33D	Fp,Rd,V	W	Monitoring	UTRA		
DCB 34A	Fp,M,Rd,S,U,V	W	Monitoring	UTRA	Source	M,U
DCB 34C	Fp,M,Rd,S,U,V	W	Monitoring	UTRA	Source	M,U
DCB 35A	Fp,M,S,U,V	W	Monitoring	UTRA		
DCB 35C	Fp,M,S,U,V	W	Monitoring	UTRA		
DCB 36A	Fp,M,Rd,S,V	W	Monitoring	UTRA	Source	M,U
DCB 36C	Fp,M,Rd,S,V	W	Monitoring	UTRA	Source	M,U
DCB 37A	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB 37C	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB 37D	Fp,T,V	W	Monitoring	GA		
DCB 40A	Fp,T,V	W	Monitoring	UTRA		
DCB 41A			Monitoring	UTRA		
DCB 41C			Monitoring	UTRA		
DCB 43A			Monitoring	UTRA		
DCB 43C			Monitoring	UTRA		
DCB 44A	Fp,Rd,T, V	W	Monitoring	UTRA		
DCB 44C	Fp,Rd,T,V	W	Monitoring	UTRA		
DCB 45A	Fp,T,V	W	Monitoring	UTRA	Source	T
DCB 45C	Fp,T,V	W	Monitoring	UTRA	Source	T
DCB 48A	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB 48D	Fp,M,S,T,V	W	Monitoring	GA		
DCB 49	W	W	Monitoring	UTRA		
DCB 50	W	W	Monitoring	UTRA		
DCB 51A	Fp,T,V	W	Monitoring	UTRA		
DCB 51D	Fp,T,V	W	Monitoring	GA		
DCB 52C	E,Fe,Fp,M,Rd,S,T,V	W	Monitoring	UTRA	Downgradient	V, T
DCB 53	Fp,M,Rd,S,T,V	W	Monitoring	UTRA		
DCB 54	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB 55	E,Fe,Fp,M,Rd,S,T,V	Fp,M,Rd,S	Monitoring	UTRA	Downgradient	V, T
DCB 56	Fp,M,S,V	W	Monitoring	UTRA		
DCB 59A	W	W	Monitoring	UTRA		
DCB 60	Fp,M,S,V	W	Monitoring	UTRA		
DCB 61	Fp, M, S	W	Monitoring	UTRA		
DCB 62	Fp,V	W	Monitoring	UTRA	Source	V
DCB 63	Fp, T	W	Monitoring	UTRA		
DCB 64			Monitoring	UTRA		
DCB 65A	Fp,M,S,T	W	Monitoring	UTRA		
DCB 65C	Fp,M,S,T	W	Monitoring	UTRA		
DCB 70A	Fe,Fp,M,Rd,S	Fp,Fe,M,Rd,S	Monitoring	UTRA		
DCB 70B	Fe,Fp,M,Rd,S	Fp,Fe,M,Rd,S	Monitoring	UTRA		
DCB 71A			Monitoring	UTRA		
DCB 71B			Monitoring	UTRA		
DCB072C	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB077	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB078	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB079	Fp,M,S,T,V	W	Monitoring	UTRA		

Table B-1. Groundwater Samples Analyte List and Sample Frequency (Continued/End)

Well ID	2Q	4Q	Well Type	Aquifer	Indicator Well	Applicable Threshold Limit
DCB080	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB081*	Fp,M,S,T,V	W	Monitoring	UTRA		
DCB082*	Fp,M,S,V	W	Monitoring	UTRA		
DRW 1	Fp,T,V	W	Test Well	UTRA	Source	V
DWP 1	Fp,M,Rd,S,T,V	W	Piezometer	UTRA	Downgradient	M,U,V,T
DWP 2	E,Fe,Fp,M,Rd,S,T,V	Fp,M,Rd,S	Piezometer	UTRA	Downgradient	M,U,V,T
DWP 3	W	W	Piezometer	UTRA	Downgradient	V,T
DWP003A	Fp,M,Rd,S,T,V	Fp,M,Rd,S	Monitoring	UTRA		
DWP 6	Fp,M,Rd,S,T,V	W	Piezometer	UTRA		
DWP 7	E,Fe,Fp,M,Rd,S,T,V	W	Piezometer	UTRA		
DWP 8	Fp,M,Rd,S,V	Fp,M,Rd,S	Piezometer	UTRA	Downgradient	M,U
DWP 9	Fp,M,Rd,S,T,V	W	Piezometer	UTRA	Downgradient	M,U
DWP009A	Fp,M,Rd,S,T,V	W	Monitoring	UTRA		

Notes:

- E = Ethene
 - Fe = ferric and ferrous iron
 - Fp = Field Parameters (collected during 2Q and 4Q sampling and included water-level, pH, turbidity, alkalinity)
 - GA = Gordon Aquifer
 - M = metals (if chromium exceeds 100 µg/L, chromium-6+ will be analyzed during the next sampling event)
 - Rd = REDOX/DO
 - S = sulfate
 - T = tritium
 - U = uranium
 - UTRA = Upper Three Runs Aquifer
 - V = volatile organic compounds (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride)
 - W = water-level measurement only
- * Analytes and parameters listed are the proposed for new monitoring wells

Table B-2. Surface Water Samples Analyte List and Sample Frequency

Surface Water Station	Frequency	Analytes	UTM East	UTM North
			(m)	
DSWM-1	1/yr	Tritium, TCE, TAL Metals	430638.0	3673869.0
DSWM-2	1/yr	Tritium, TCE, TAL Metals	430537.0	3673620.7
DSWM-3	1/yr	Tritium, TCE, TAL Metals	430371.0	3673534.9
DSWM-4	1/yr	Tritium, TCE, TAL Metals	431036.9	3673523.6
DSWM-5	1/yr	TCE, TAL Metals	431643.9	3673157.8
DSWM-6	1/yr	TCE, TAL Metals	431458.1	3672856.2
DSWM-7	1/yr	TCE, TAL Metals	431218.6	3672718.9

APPENDIX C

DAG Matrix Tables
(Under Separate Cover. See Inserted Charts)

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APPENDIX D

DAG Figures

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Figure D-37. Time Series Plots of Copper at DCB 21B and DCB 34C, Beryllium at DCB 21C, and Cadmium at DCB 21C77

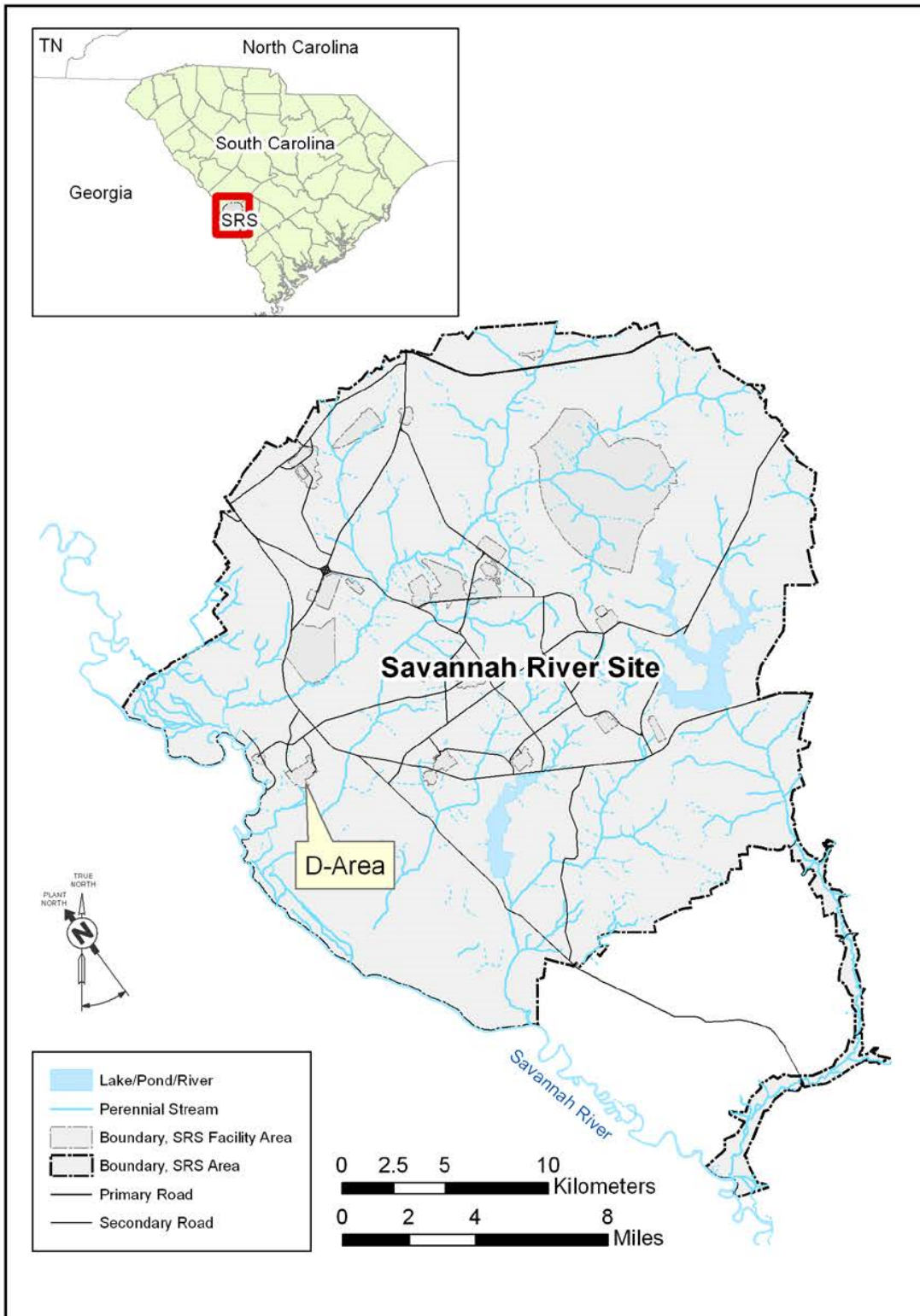


Figure D-1. D-area Location Map

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Figure D-2. D-area Facilities

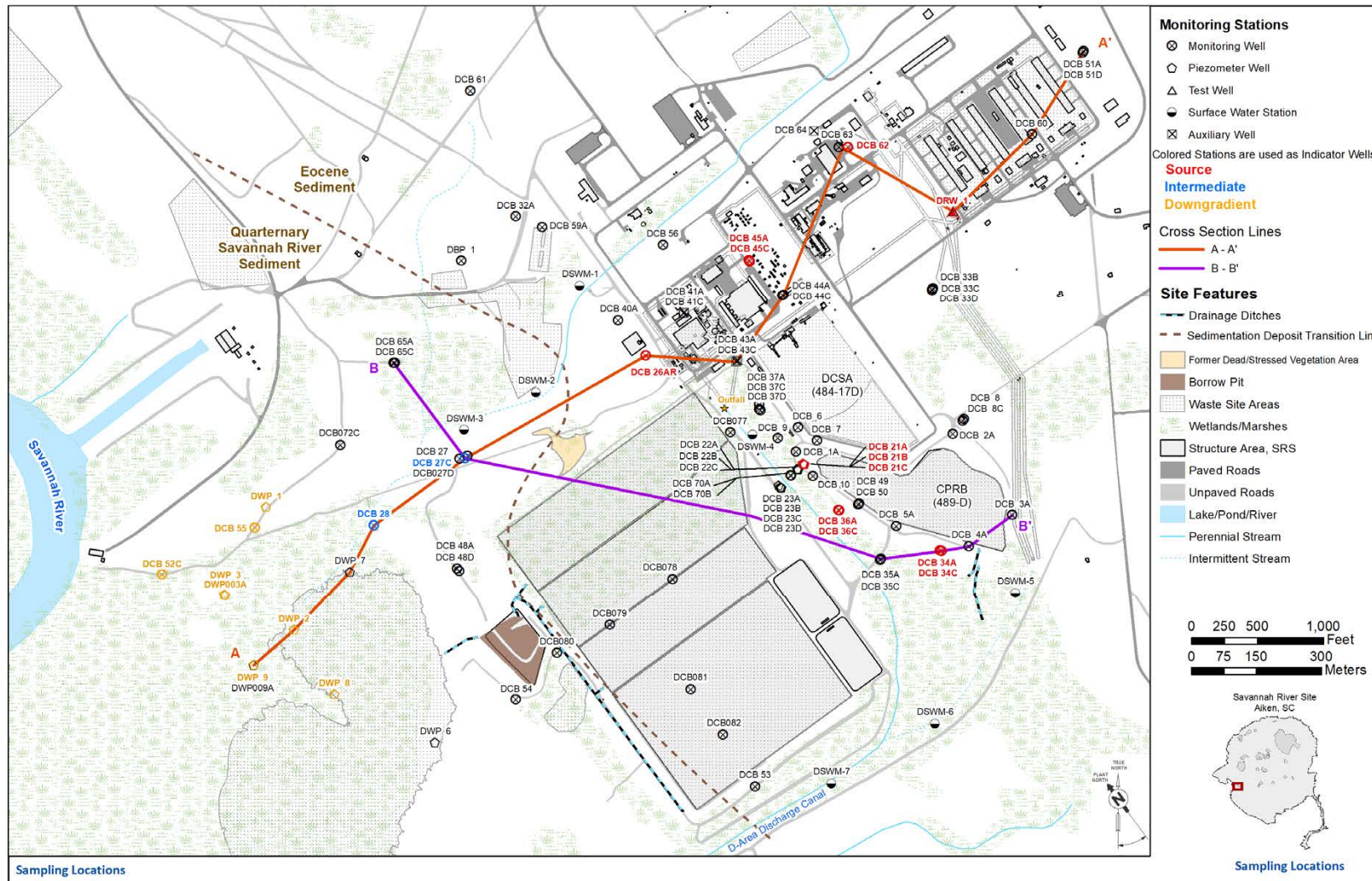


Figure D-3. D-Area Groundwater Sampling Locations

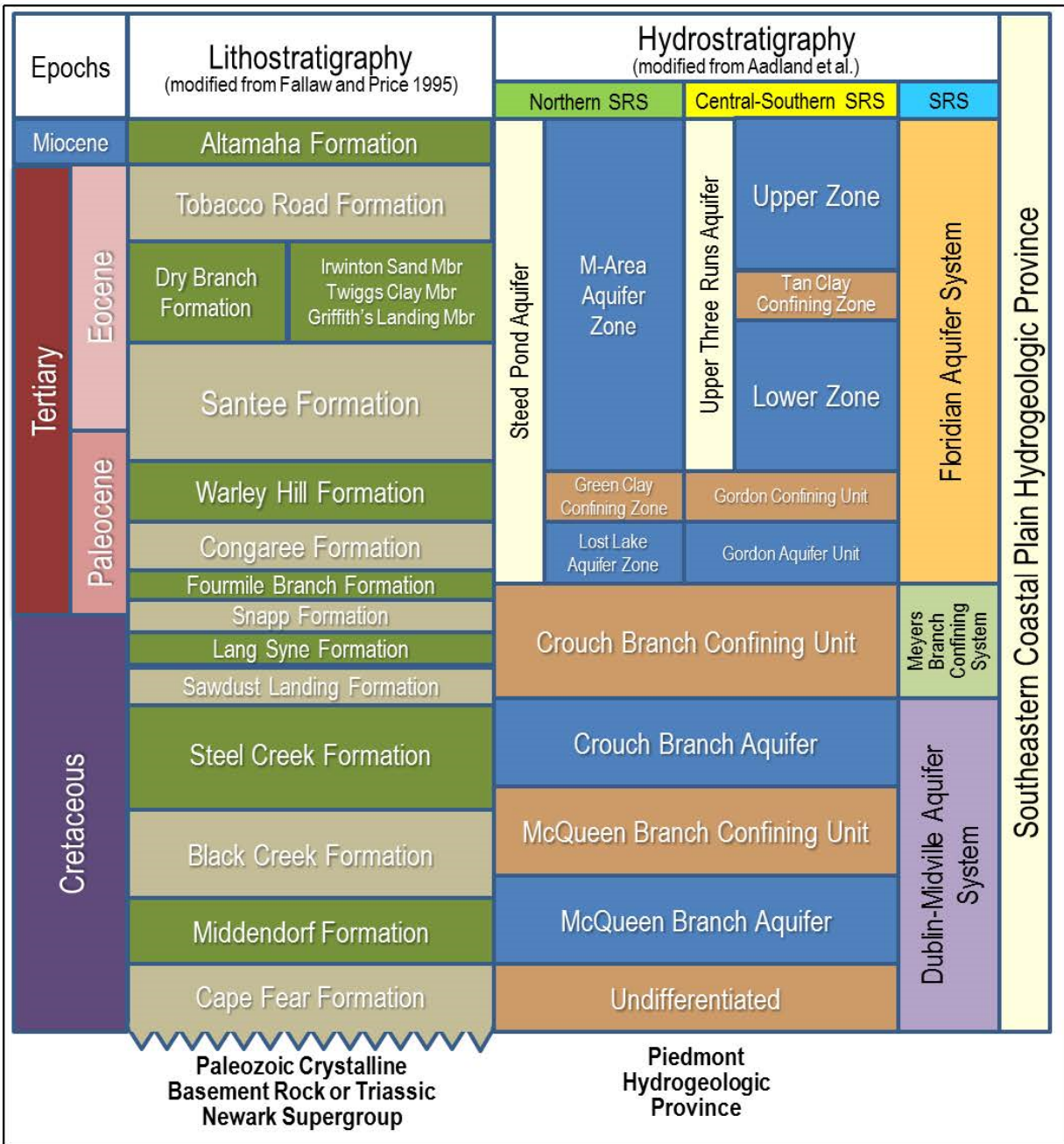


Figure D-4. Lithostratigraphic and Hydrostratigraphic Units at SRS

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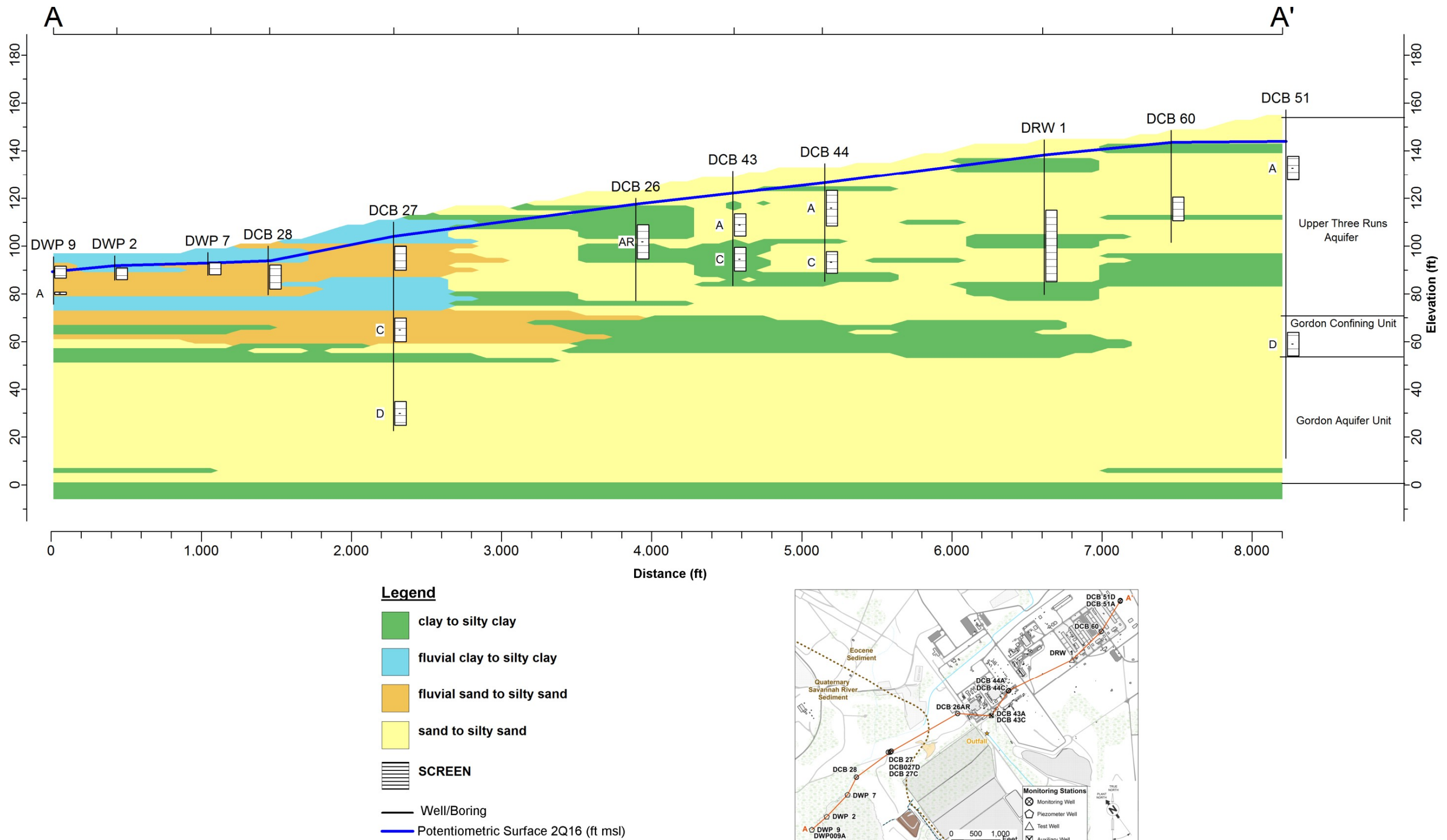
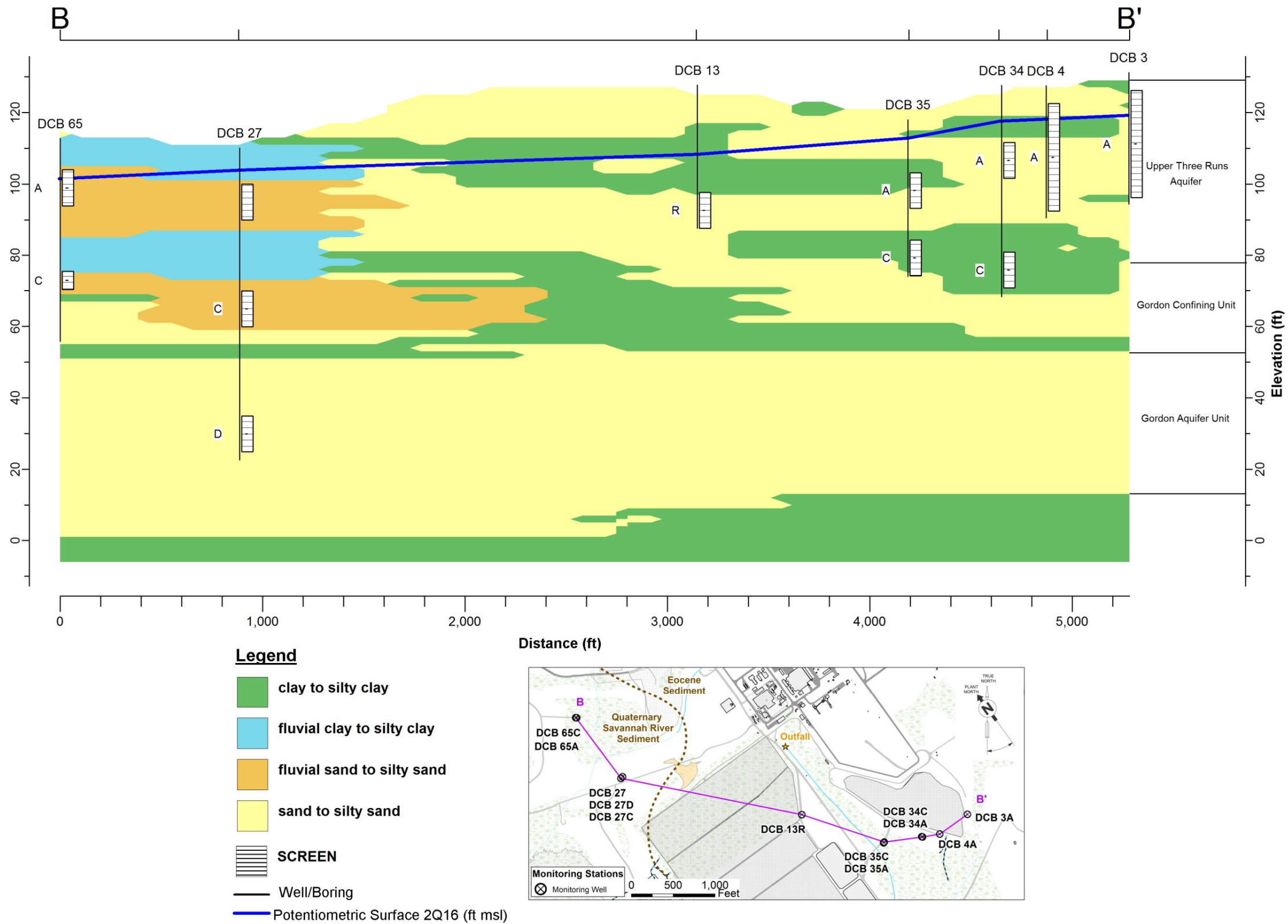


Figure D-5. D-area Cross Section A-A'

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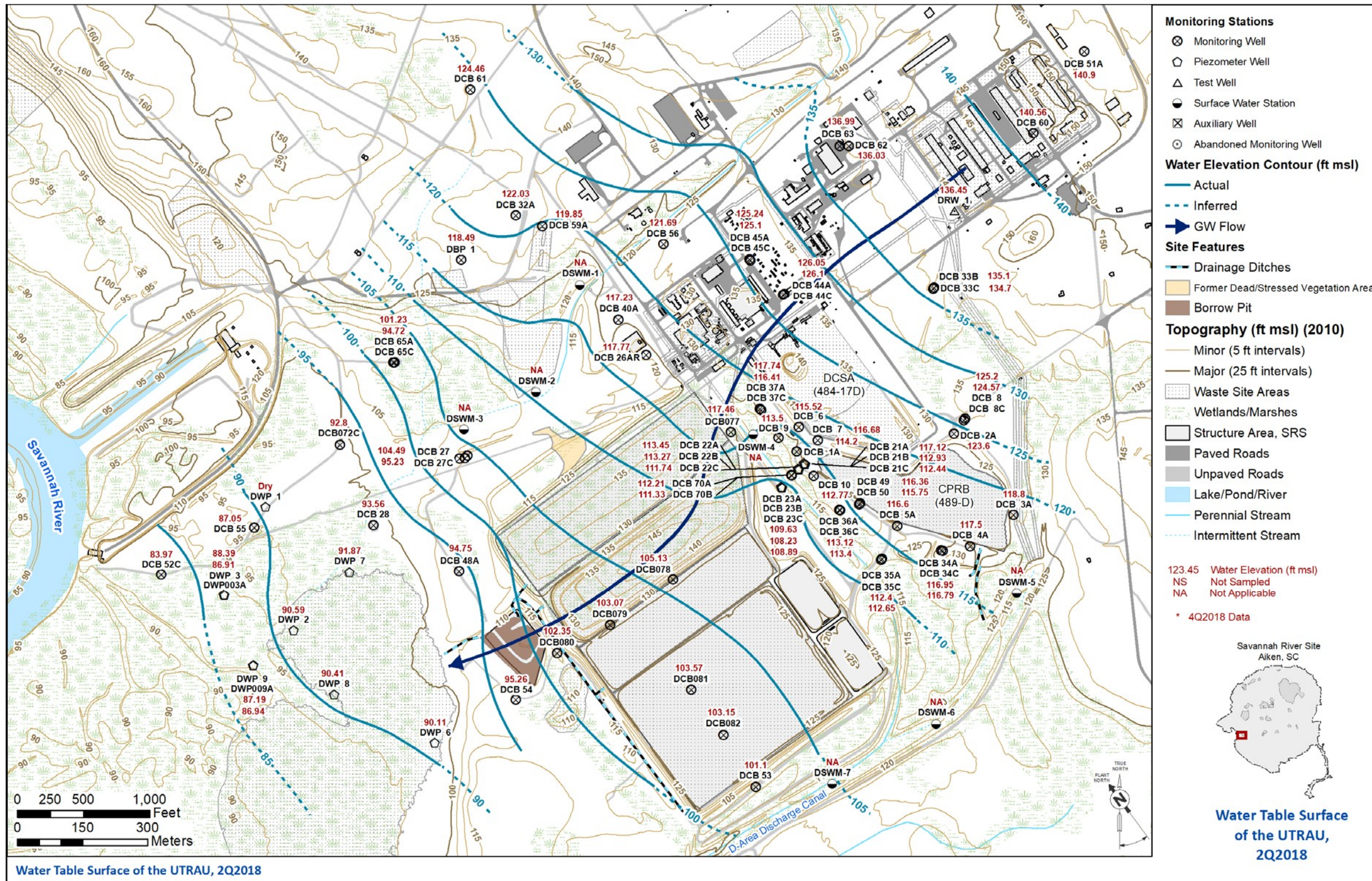


Figure D-7. Water Table Surface of the Upper Three Runs Aquifer Unit, 2Q2018

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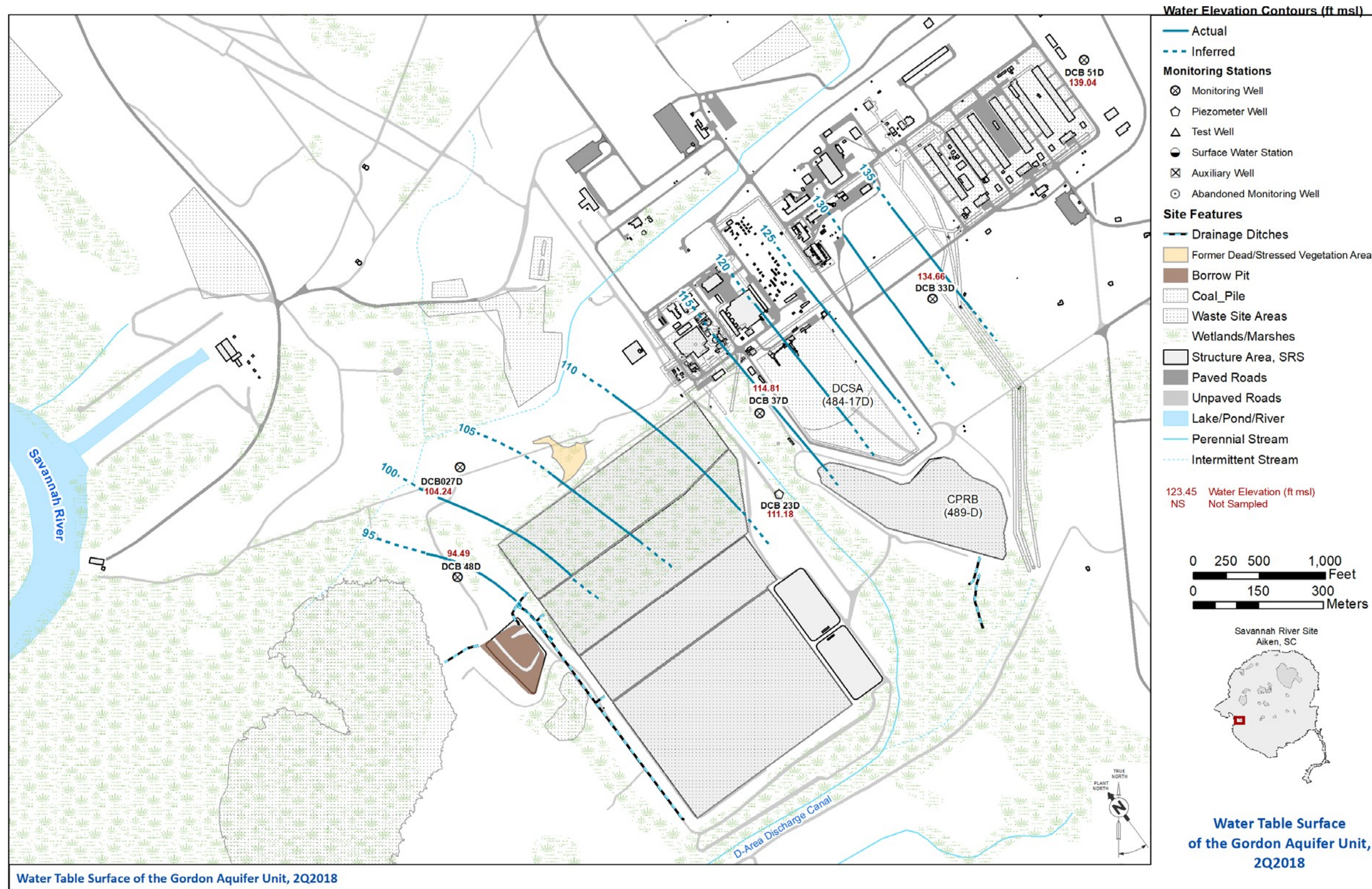


Figure D-8. Potentiometric Surface of the Gordon Aquifer Unit, 2Q2018

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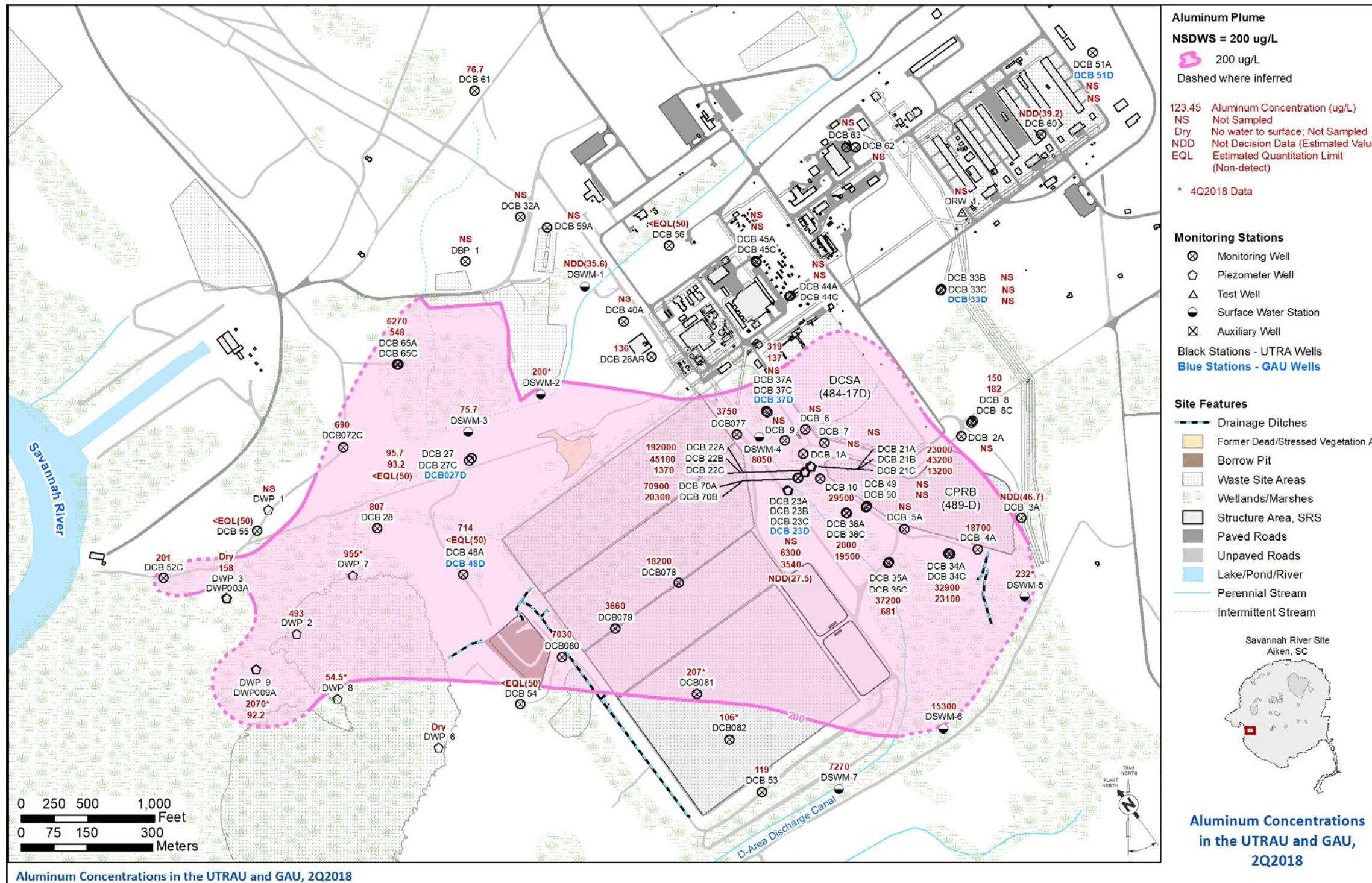


Figure D-9. Aluminum Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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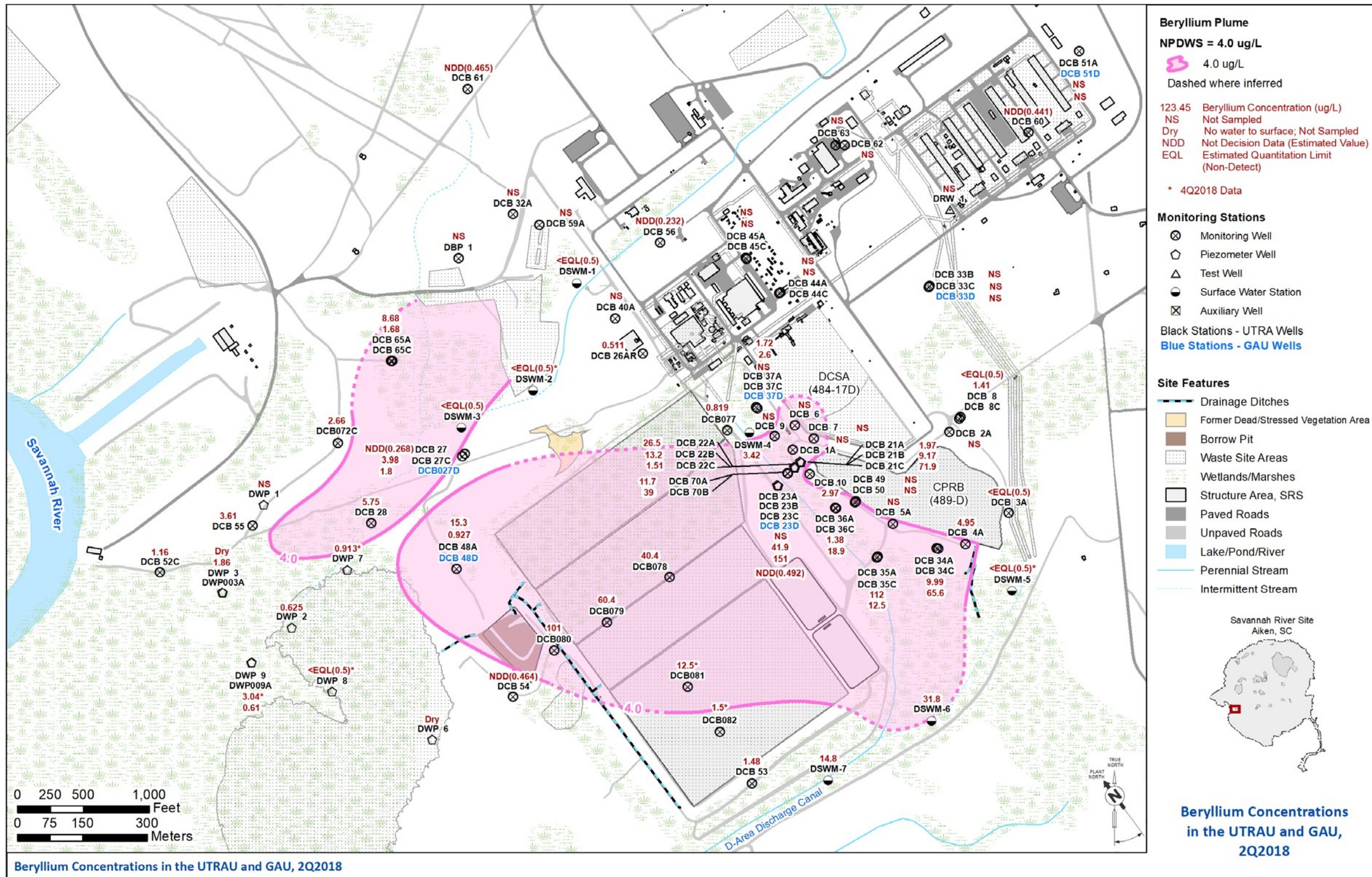


Figure D-10. Beryllium Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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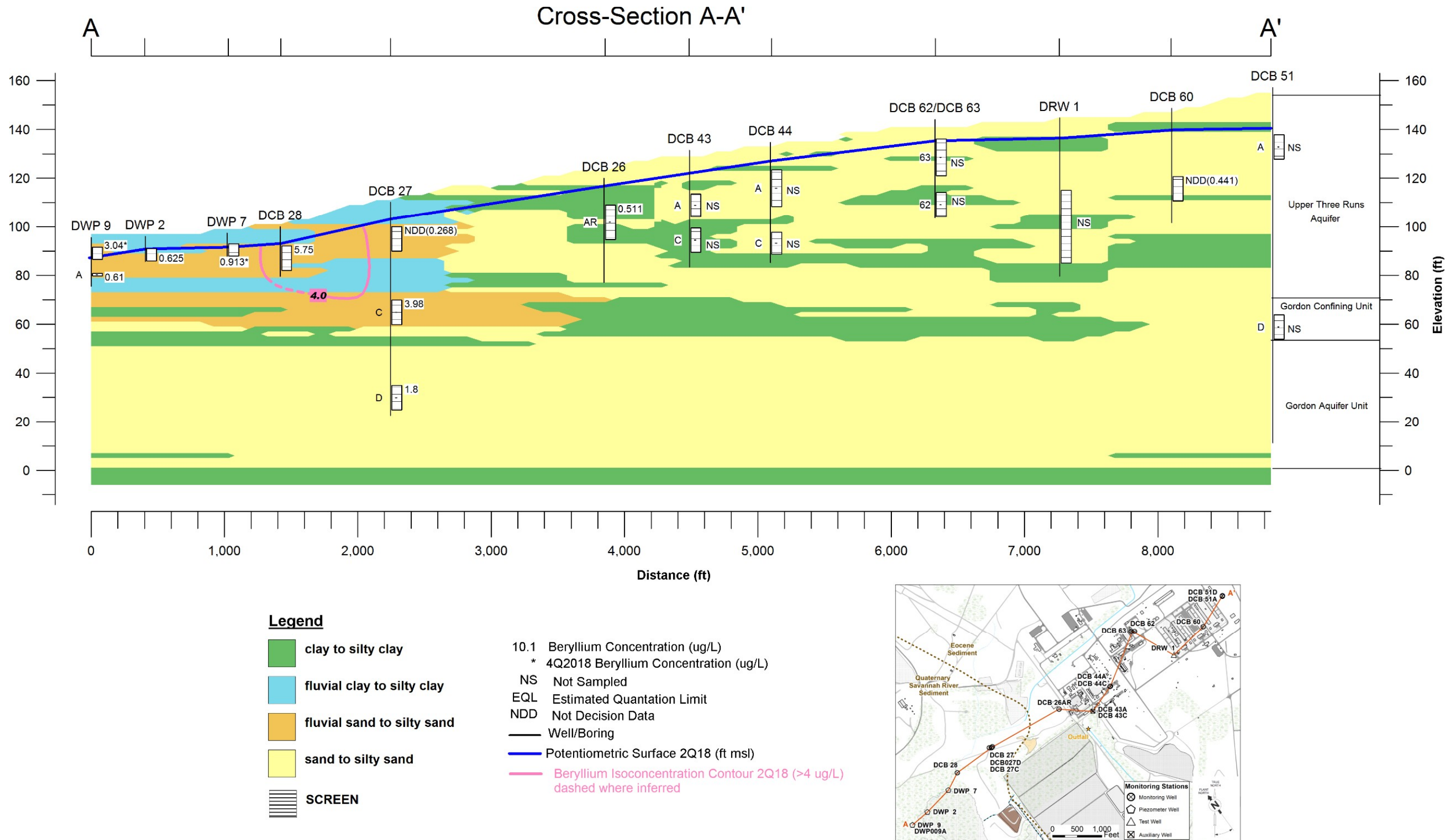


Figure D-11. D-Area Groundwater Cross-Section A-A' for Beryllium, 2Q2018

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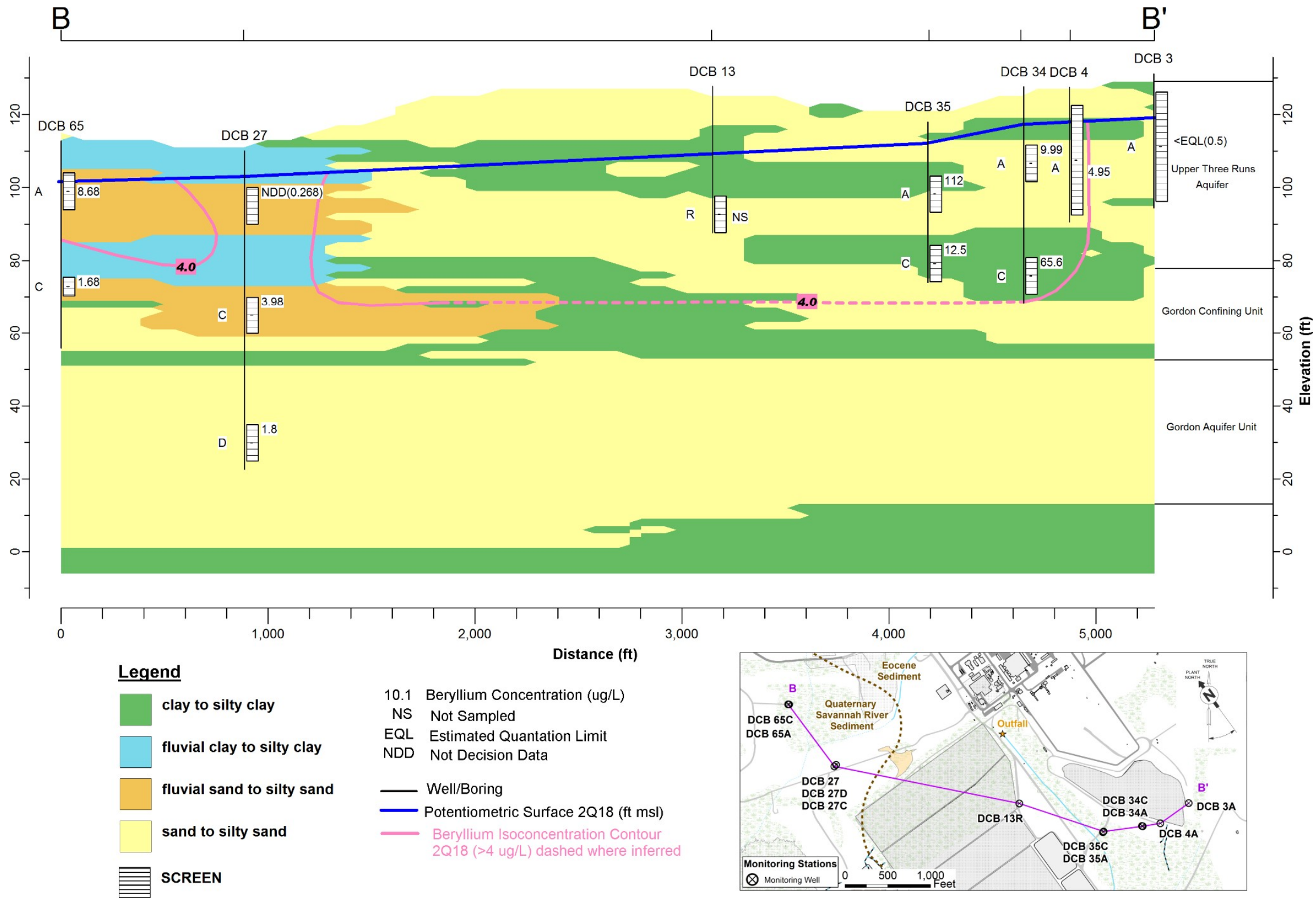


Figure D-12. D-Area Groundwater Cross-Section B-B' for Beryllium, 2Q2018

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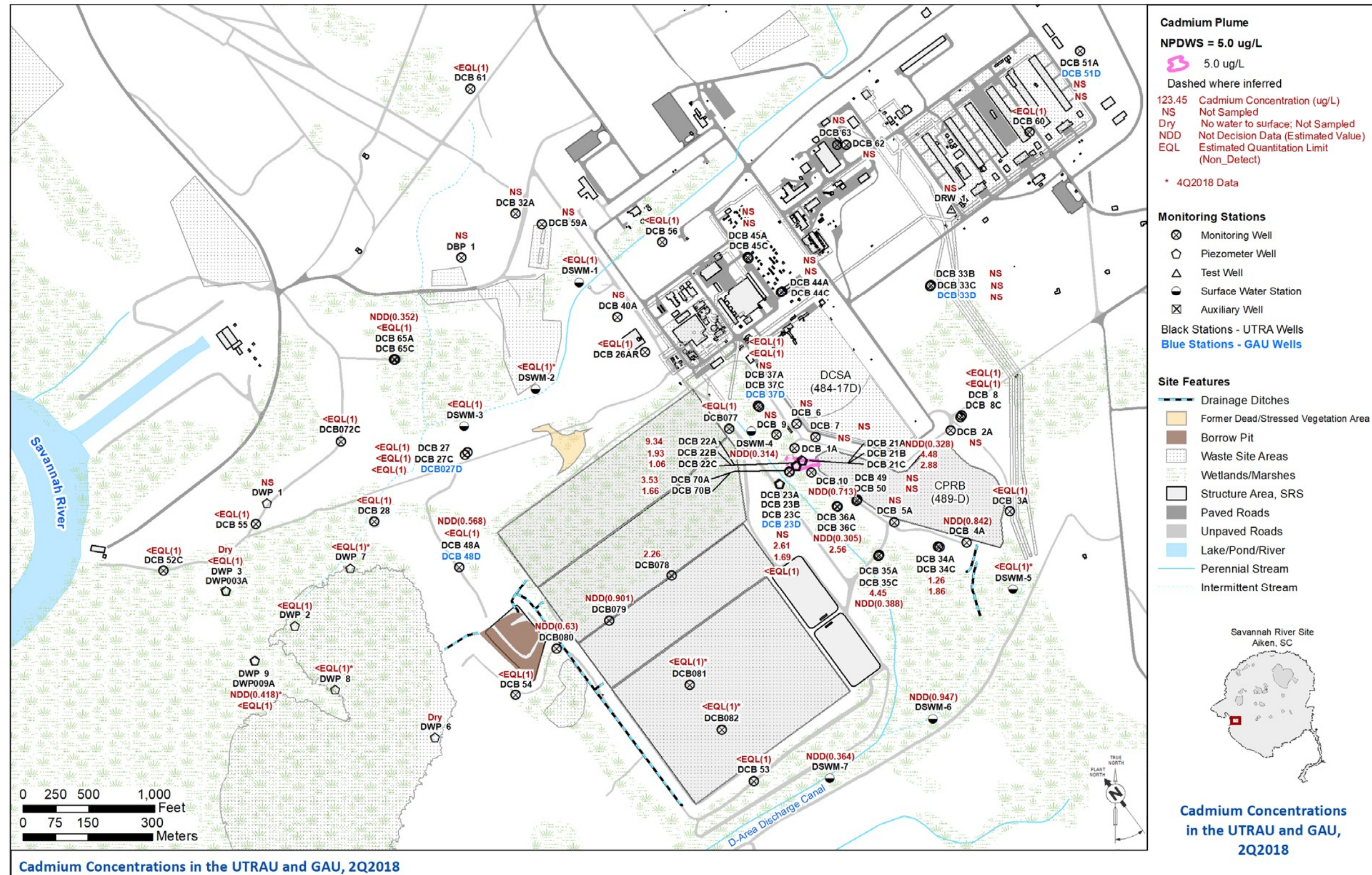


Figure D-13. Cadmium Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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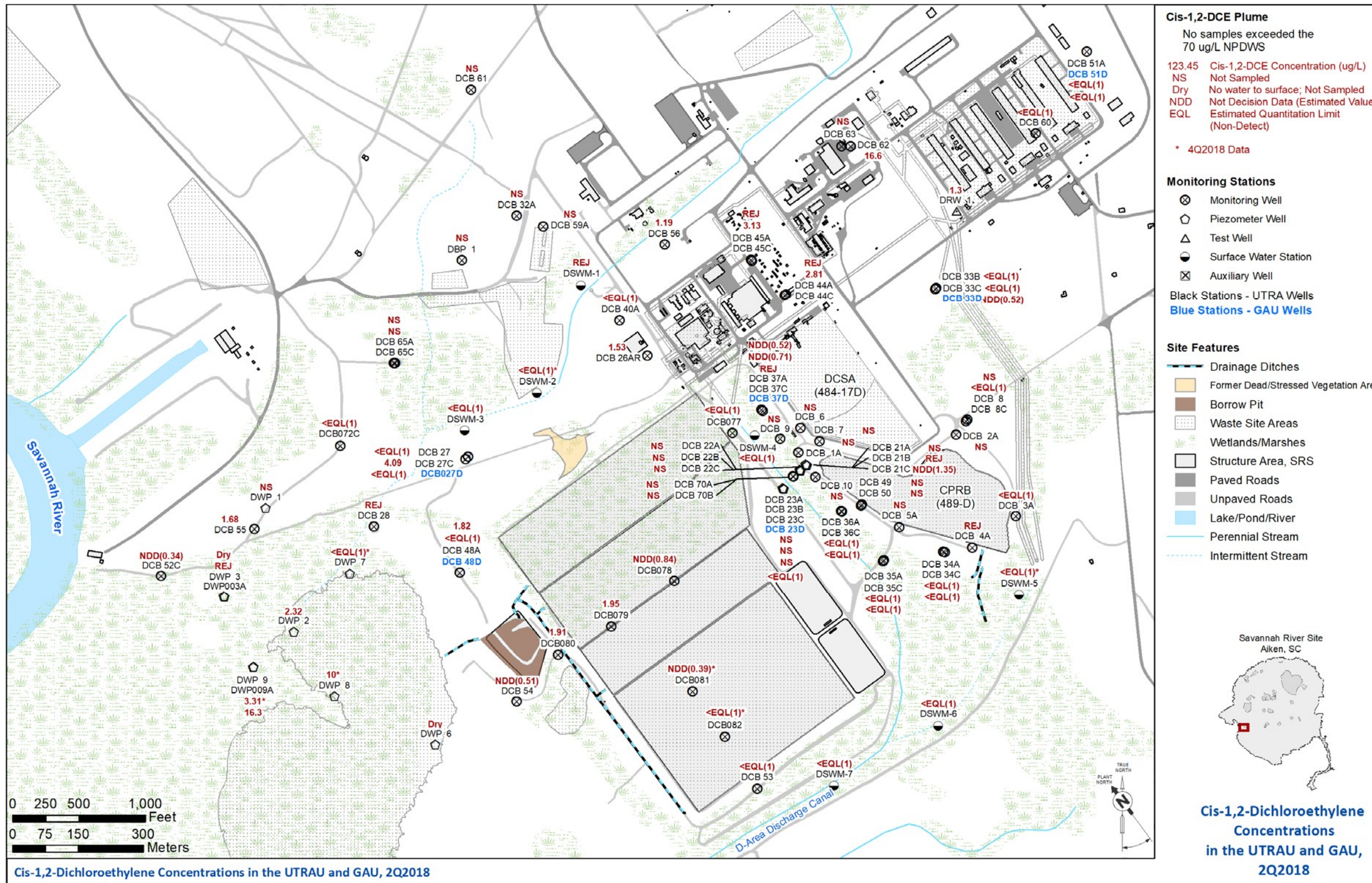


Figure D-14. cis-1,2-Dichloroethylene Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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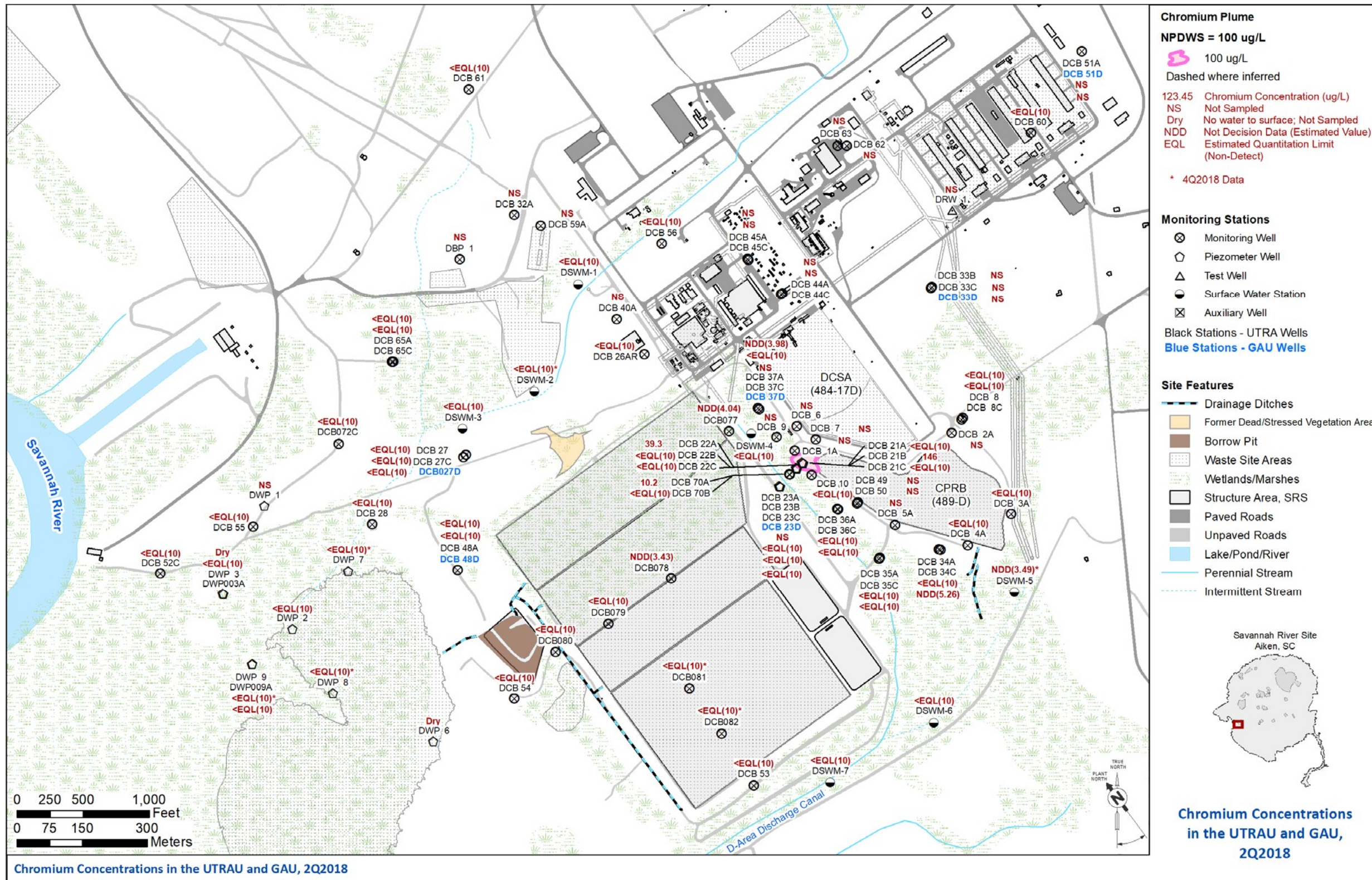


Figure D-15. Chromium Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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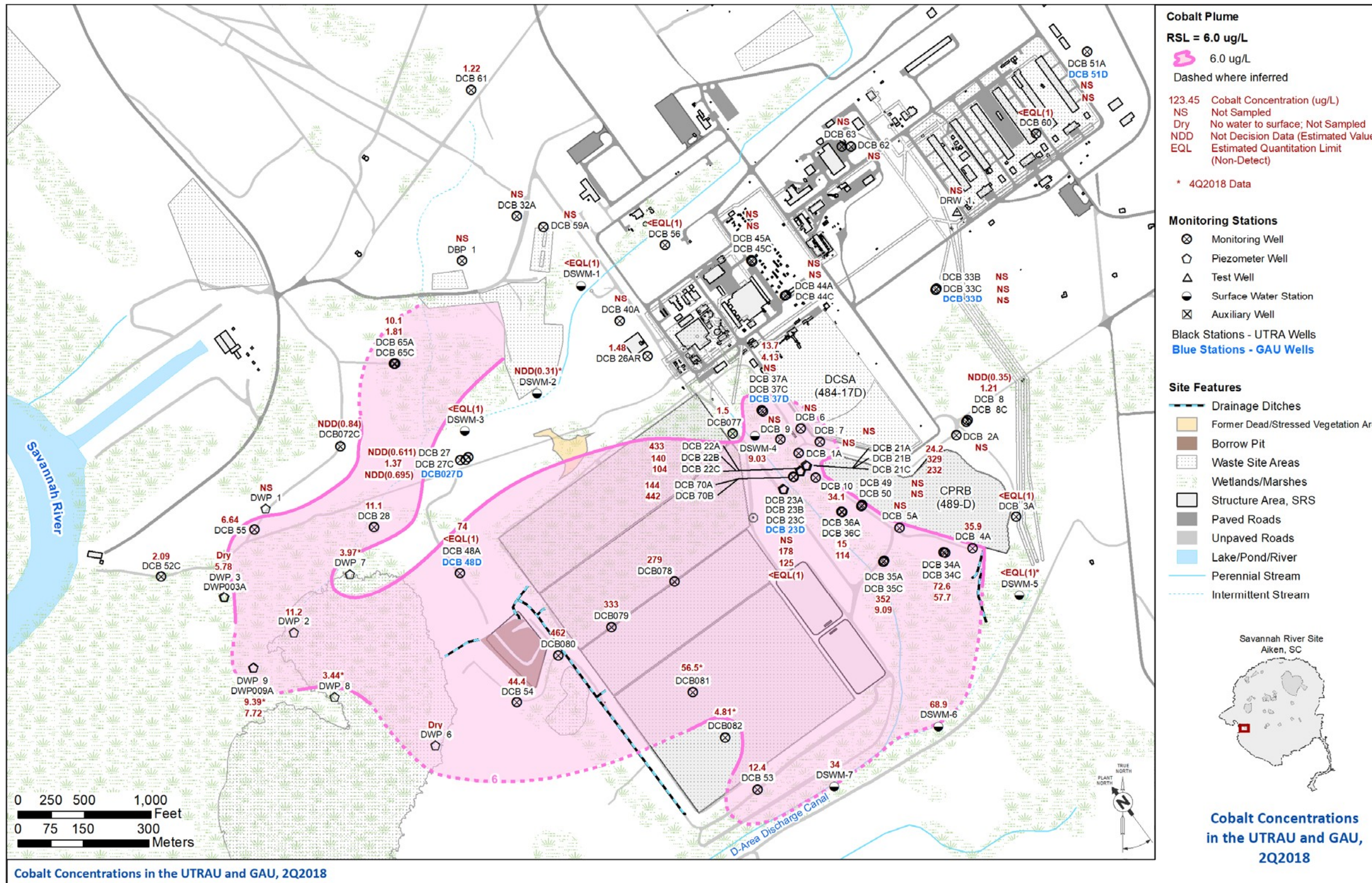


Figure D-16. Cobalt Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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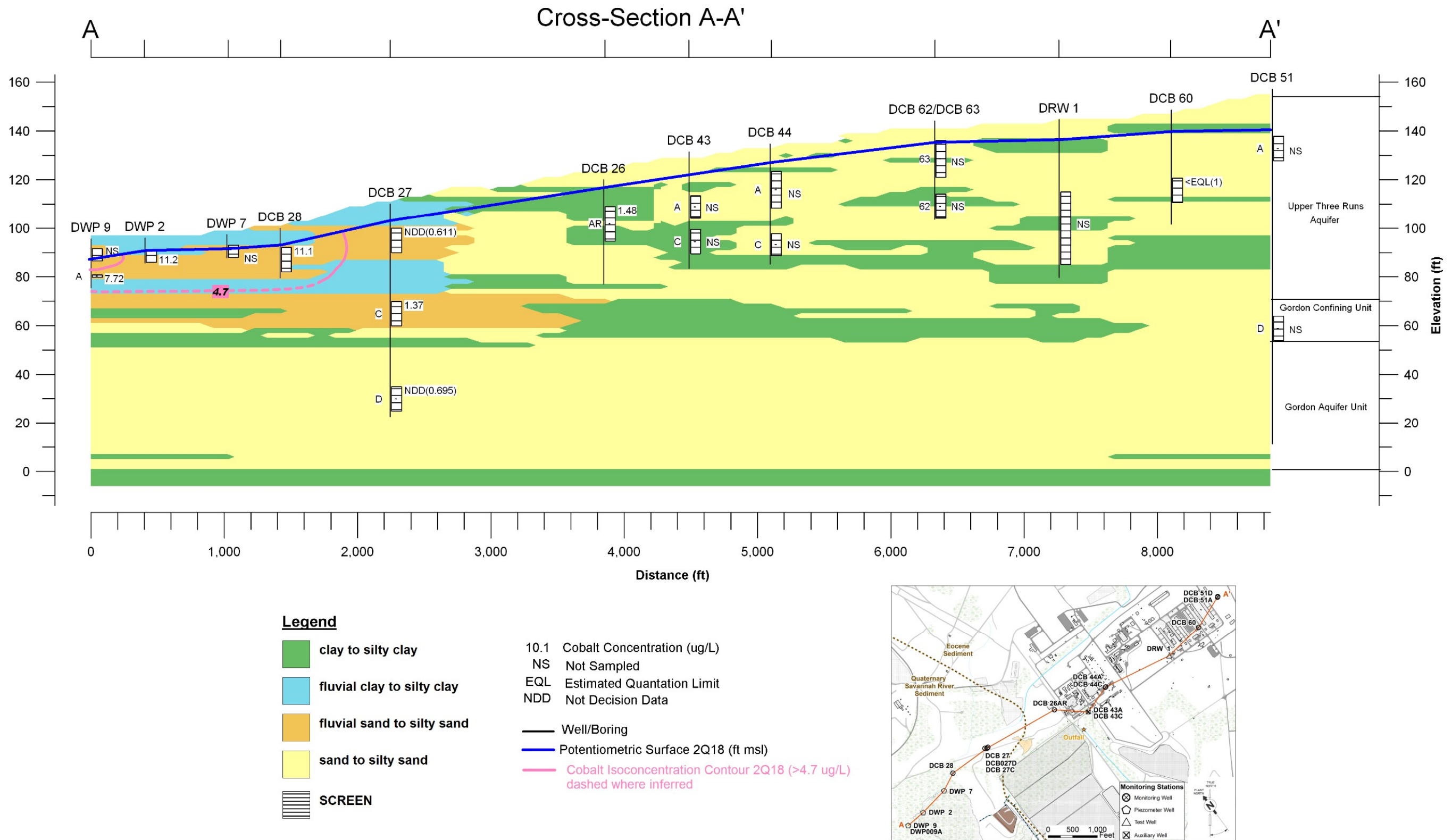


Figure D-17. D-Area Groundwater Cross-Section A-A' for Cobalt, 2Q2018

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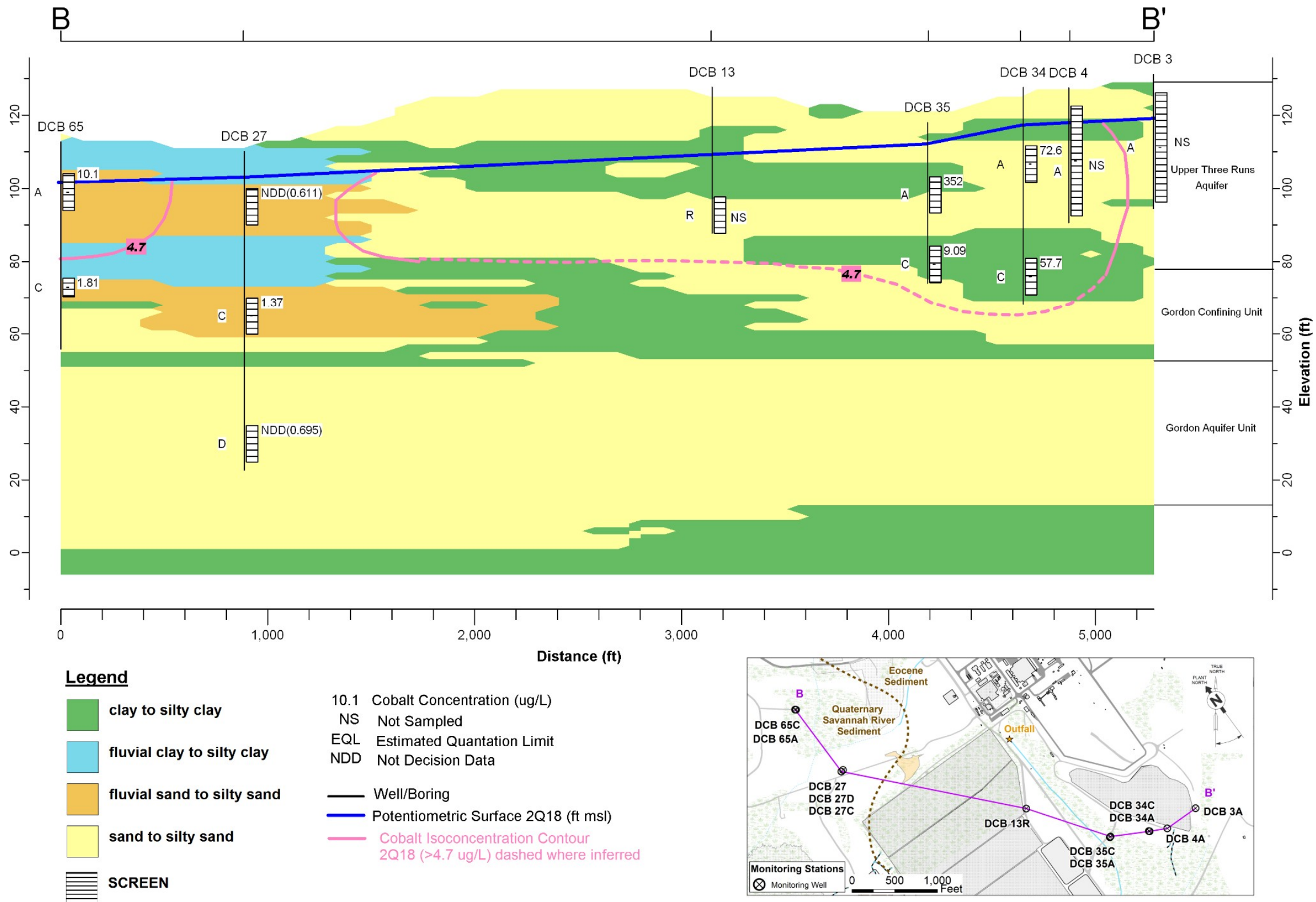


Figure D-18. D-Area Groundwater Cross-Section B-B' for Cobalt, 2Q2018

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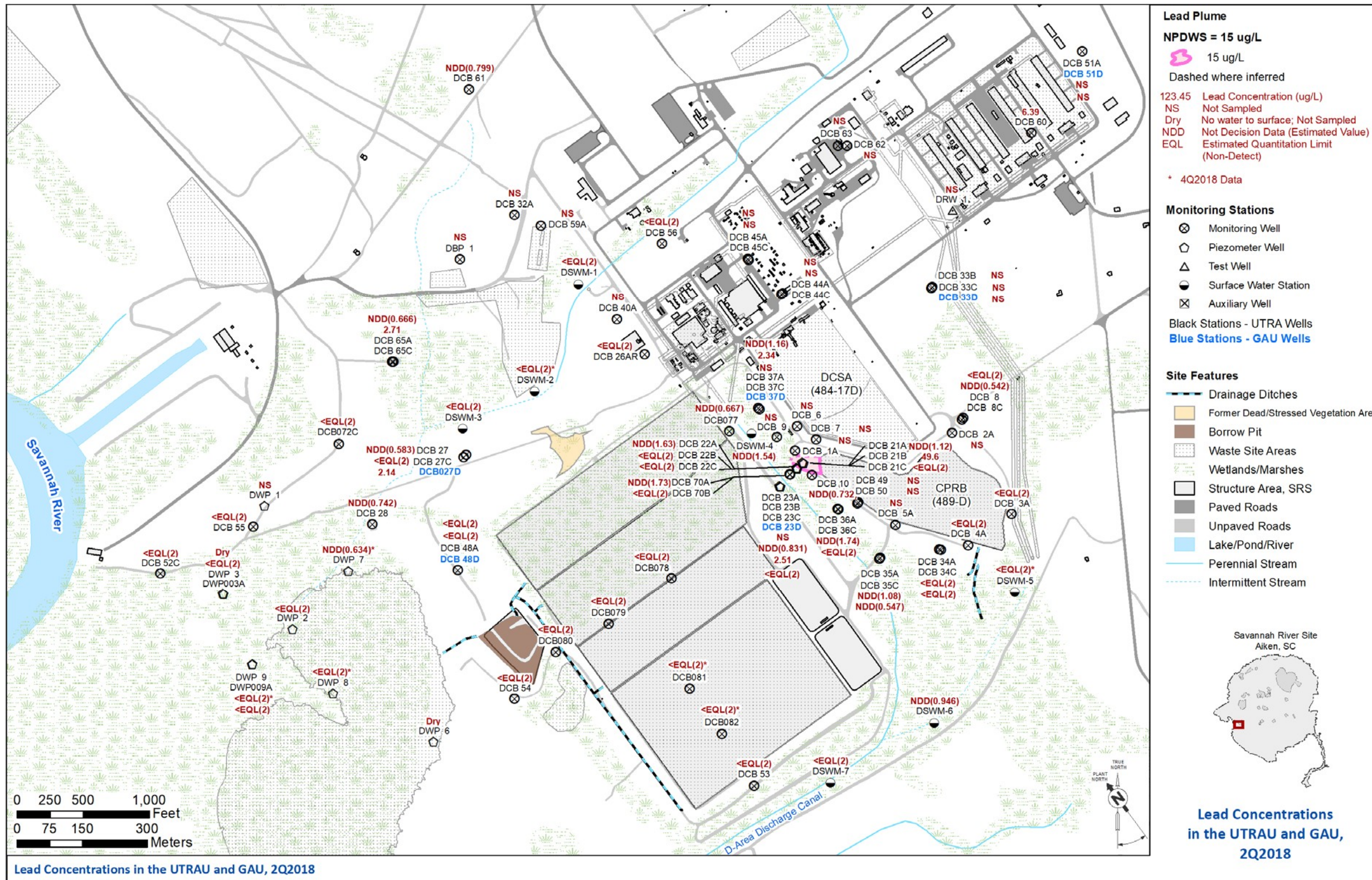


Figure D-19. Lead Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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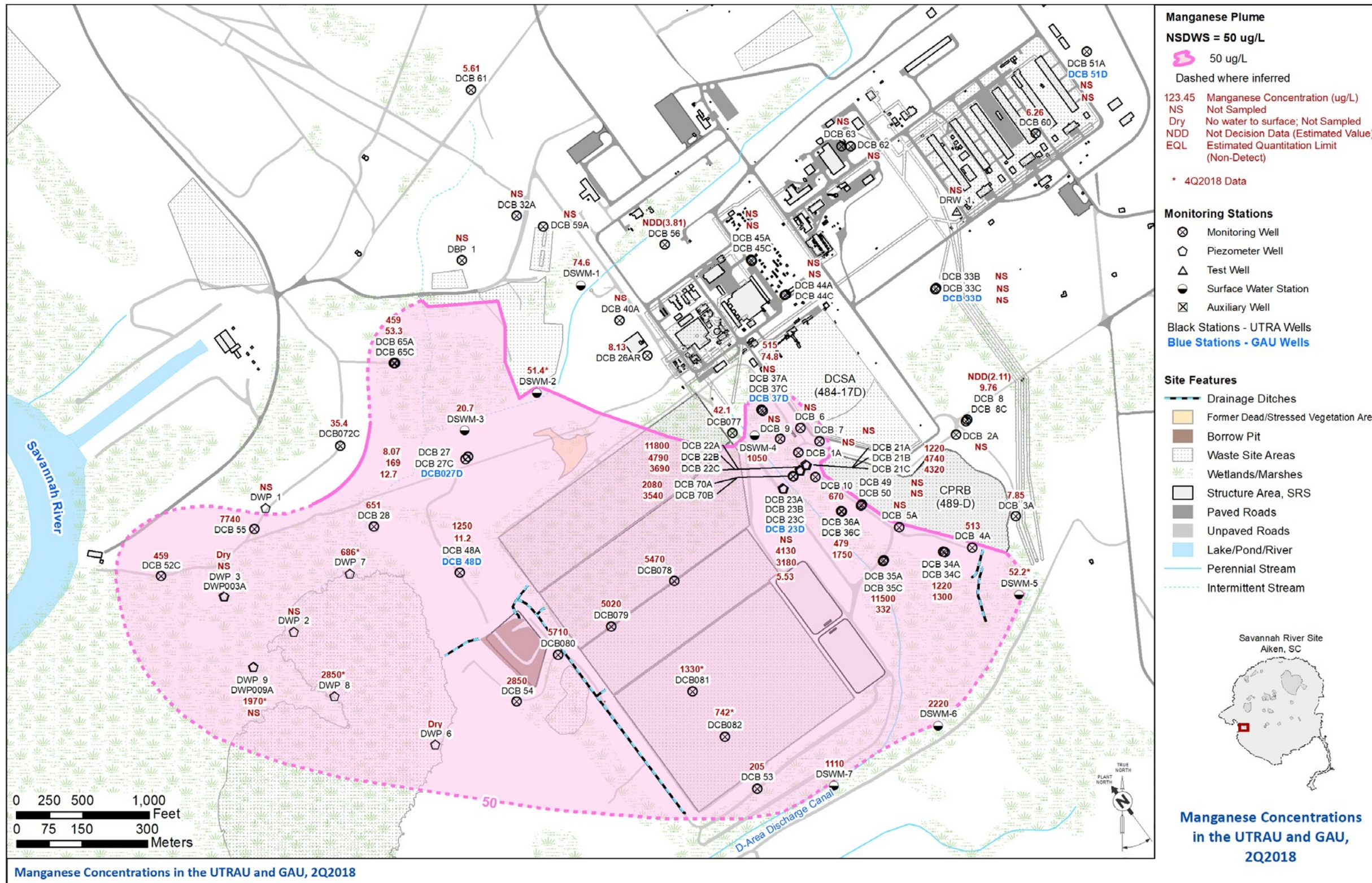


Figure D-20. Manganese Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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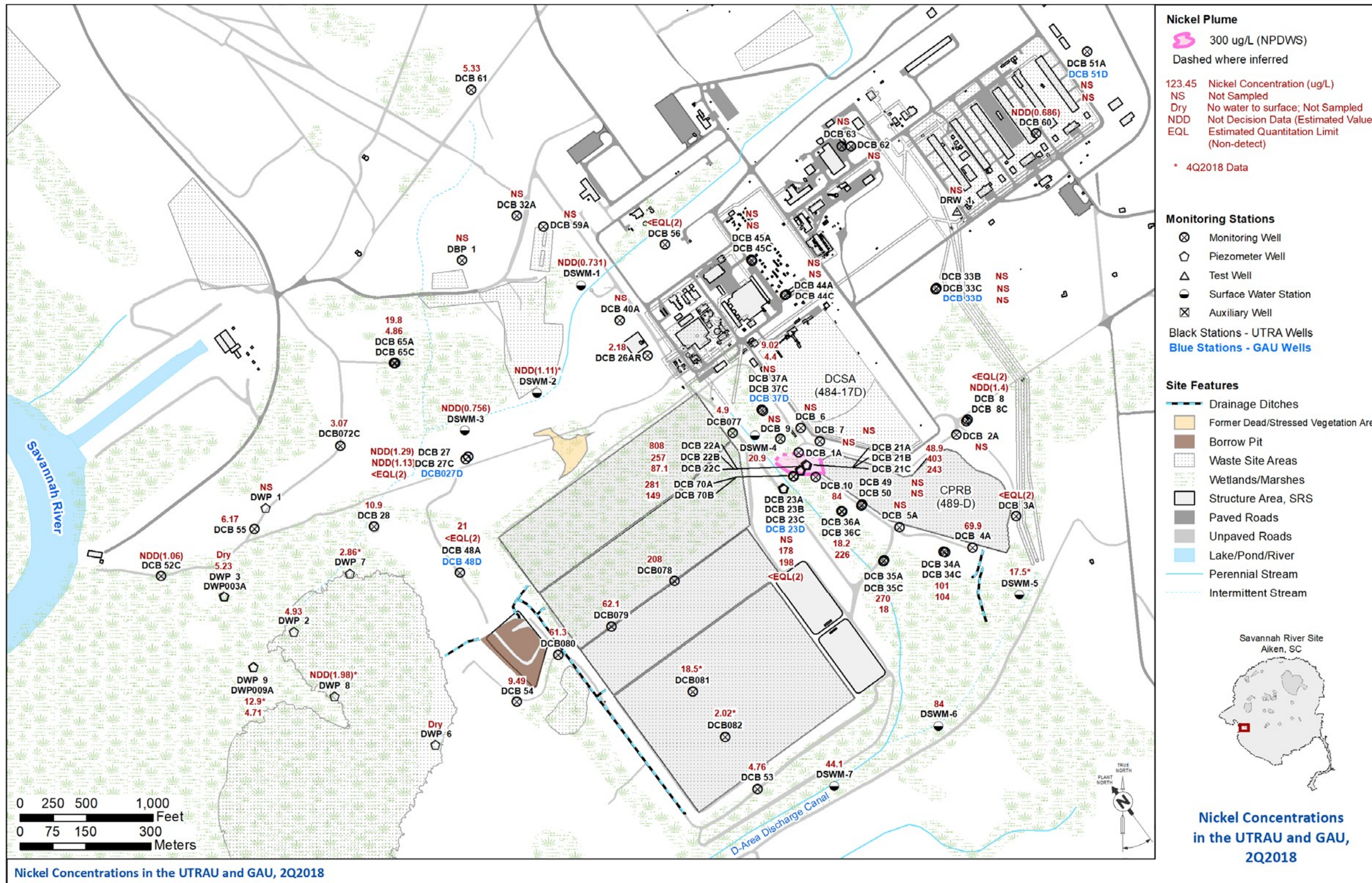


Figure D-21. Nickel Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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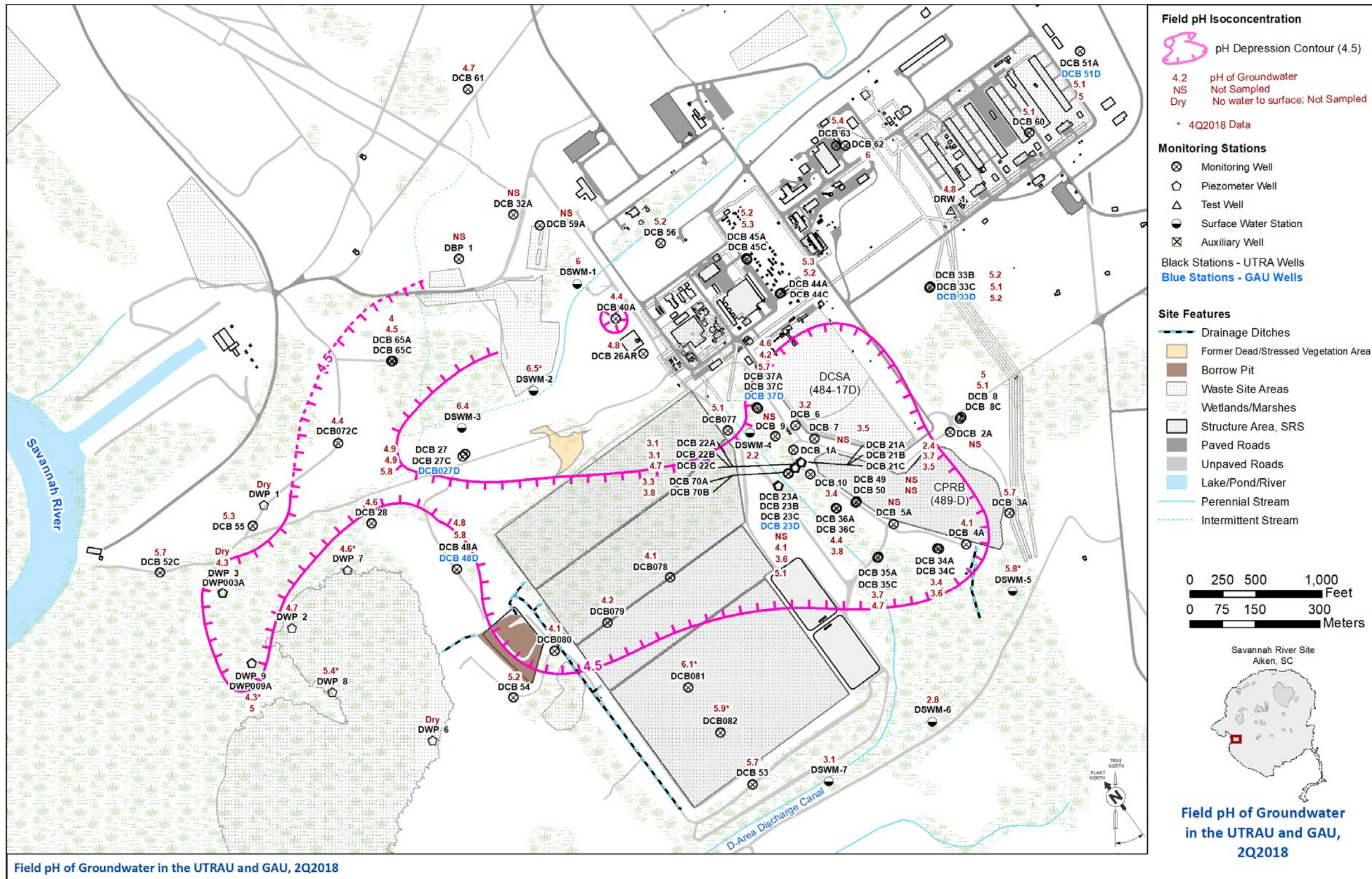
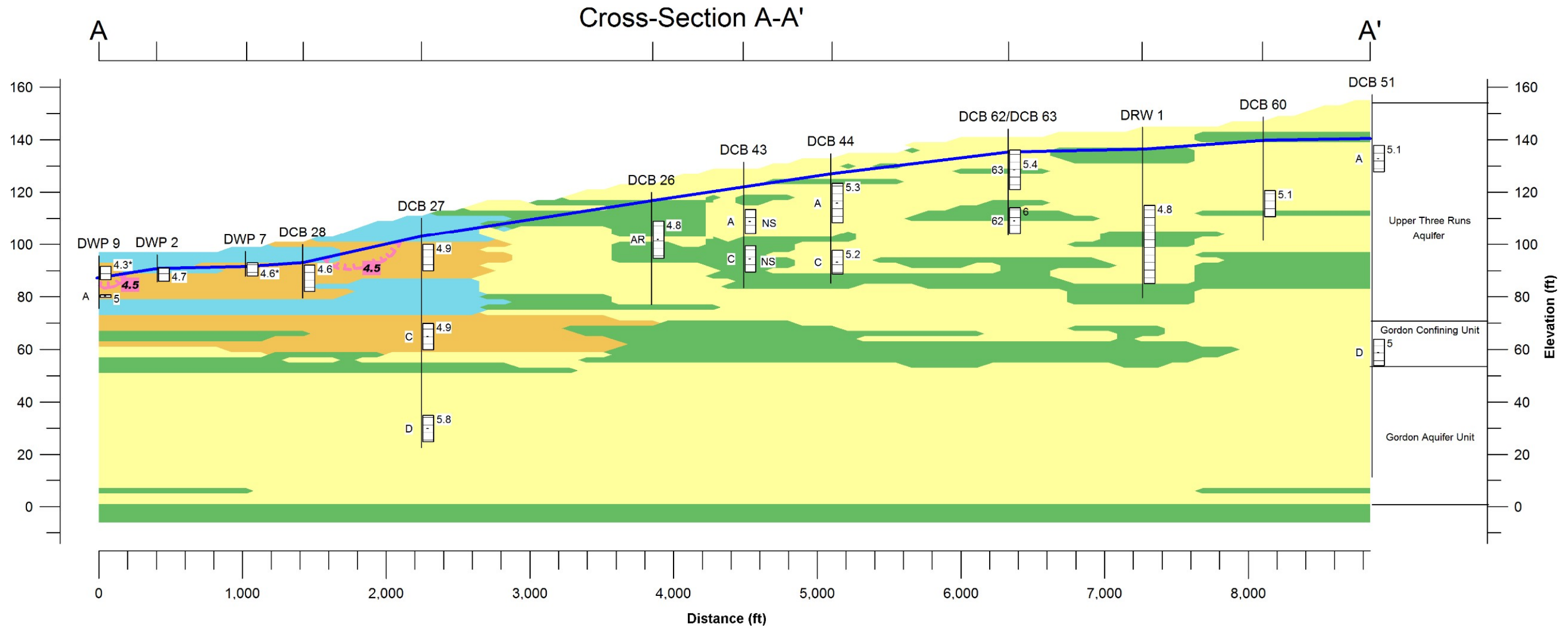


Figure D-22. Field pH of Groundwater in the Upper Three Runs Aquifer Unit, 2Q2018

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Legend

- clay to silty clay
- fluvial clay to silty clay
- fluvial sand to silty sand
- sand to silty sand
- SCREEN

- 10.1 Field pH Measurement
- * 4Q2018 Field pH Measurement
- NS Not Sampled
- EQL Estimated Quantitation Limit
- NDD Not Decision Data
- Well/Boring
- Potentiometric Surface 2Q18 (ft msl)
- Field pH Isoconcentration Contour 2Q18 (<4.5) dashed where inferred

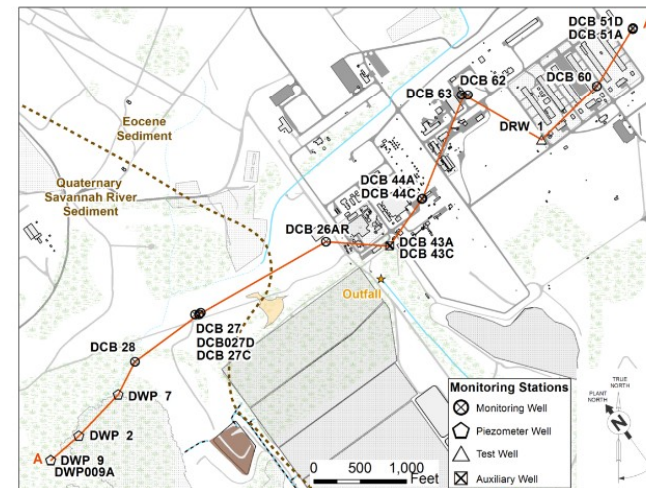


Figure D-23. D-Area Groundwater Cross-Section A-A' for pH, 2Q2018

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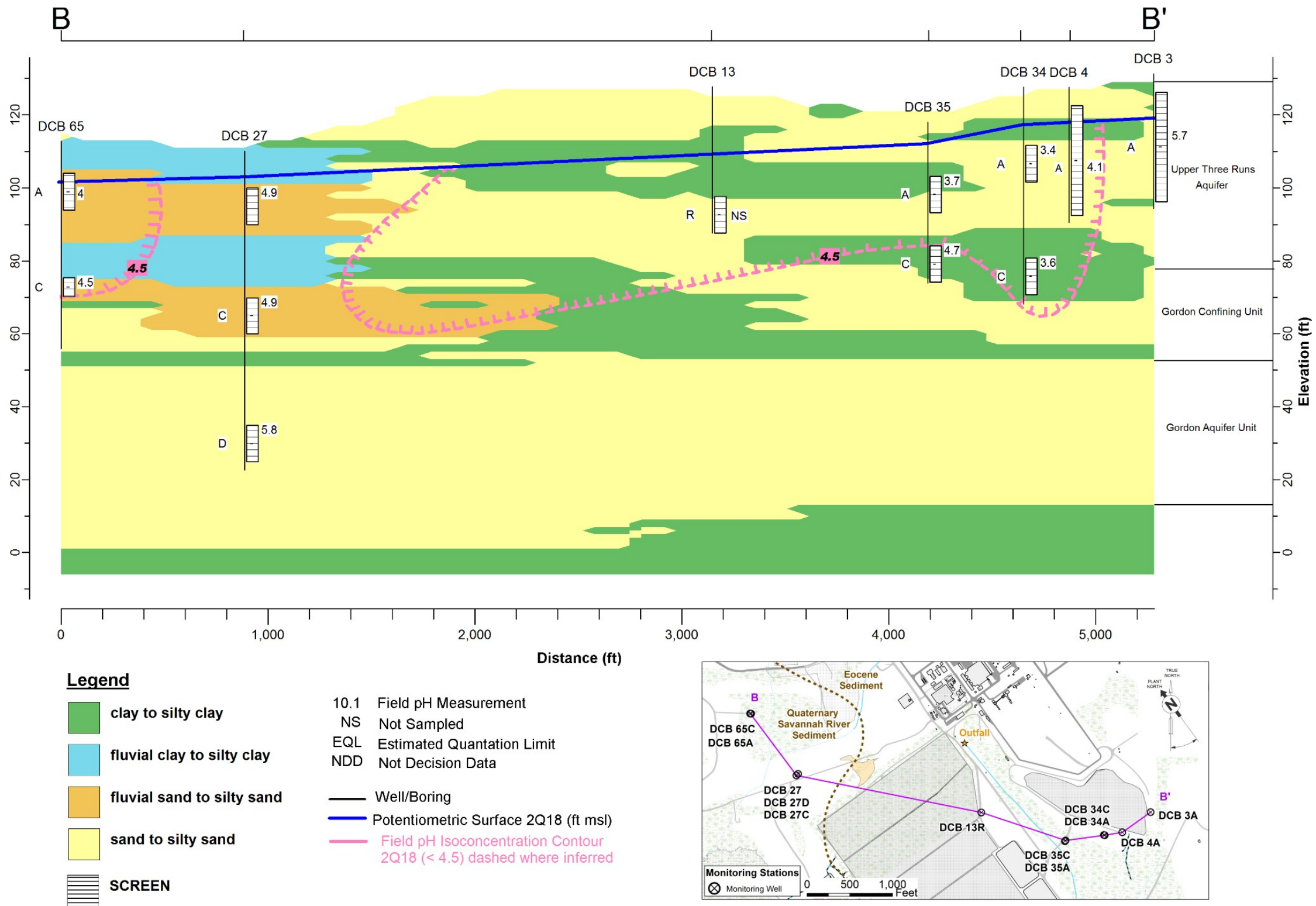


Figure D-24. D-Area Groundwater Cross-Section B-B' for pH, 2Q2018

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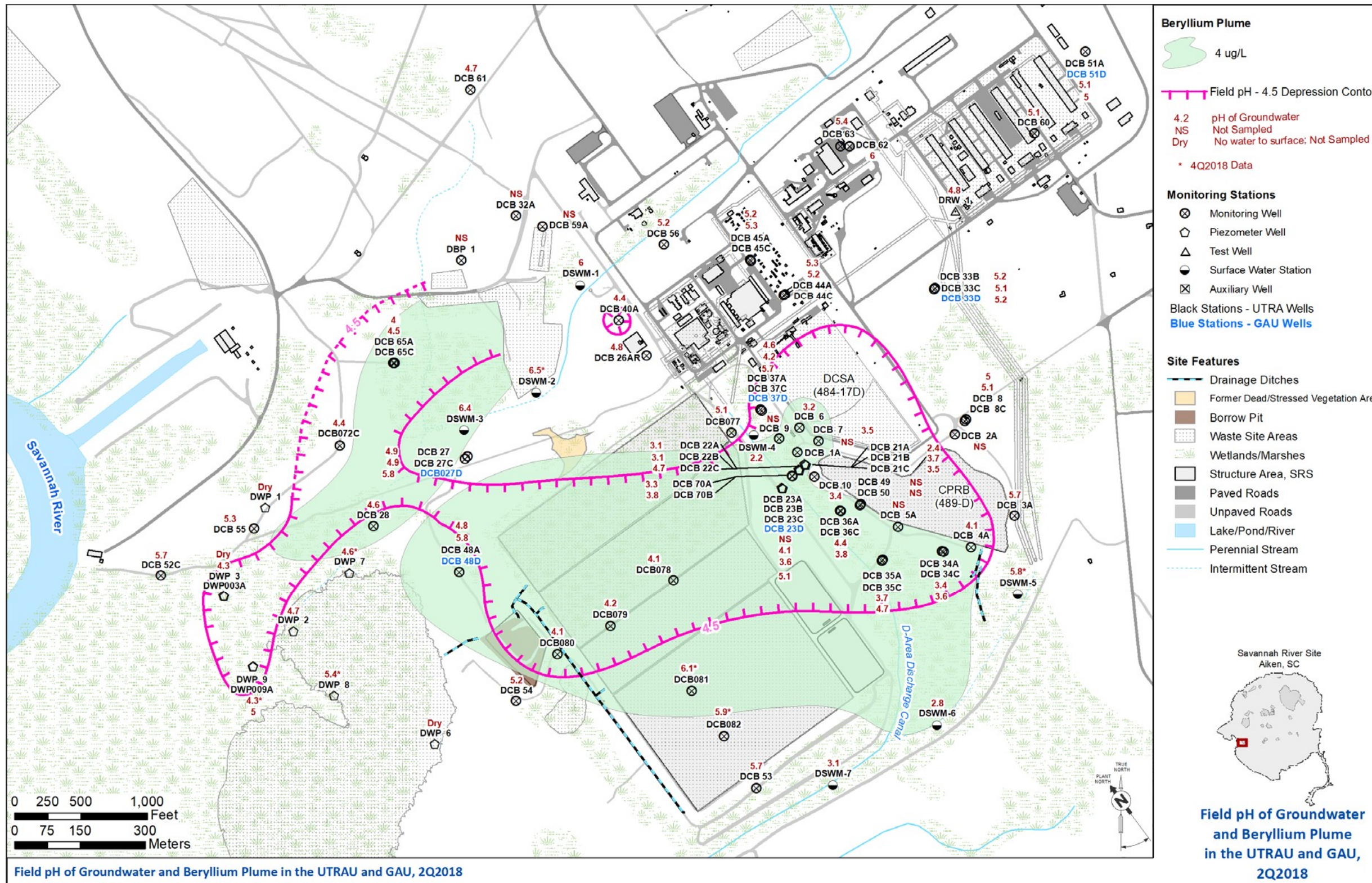


Figure D-25. Field pH of Groundwater and Beryllium Plume in the Upper Three Runs Aquifer Unit, 2Q2018

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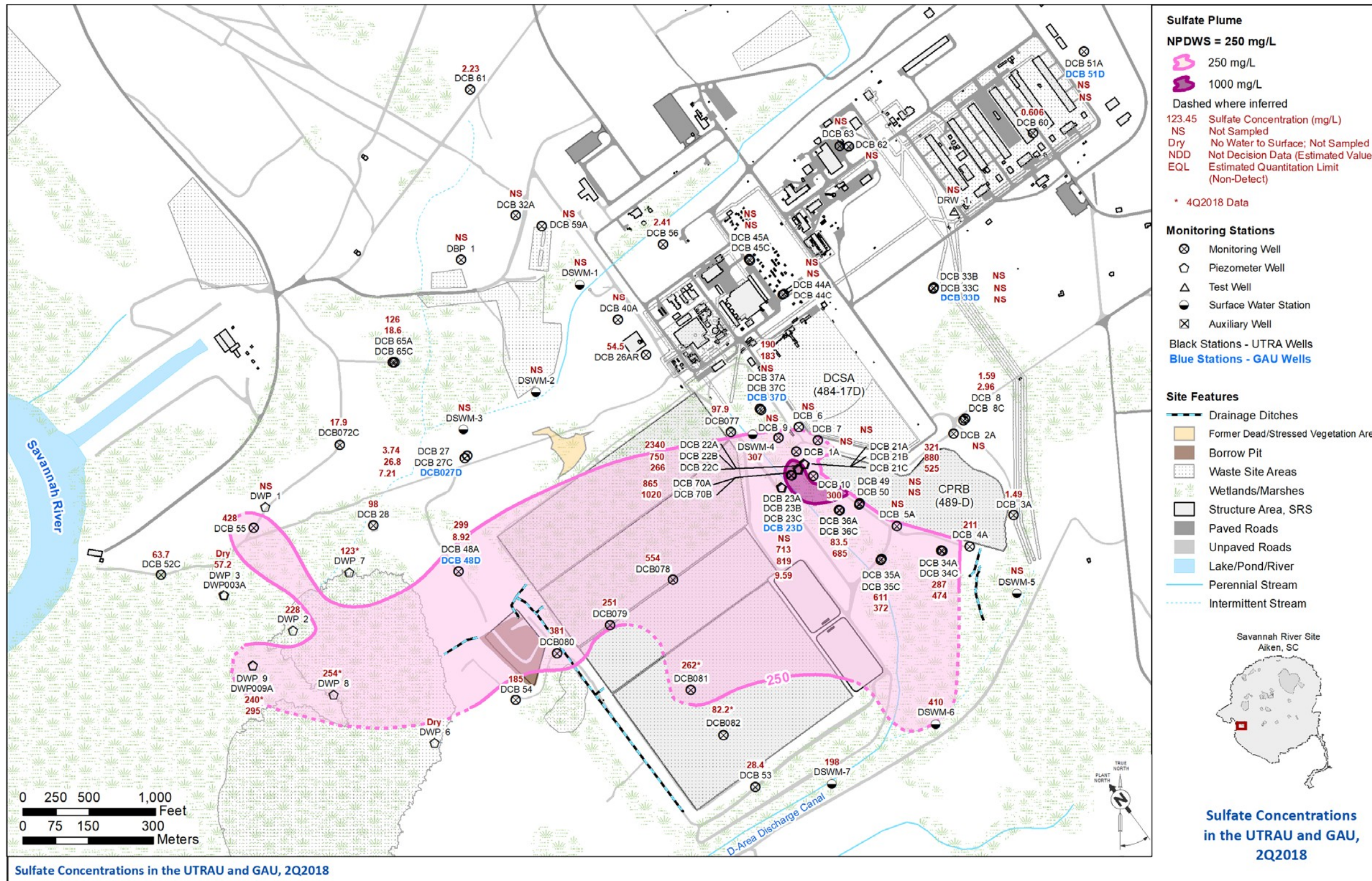
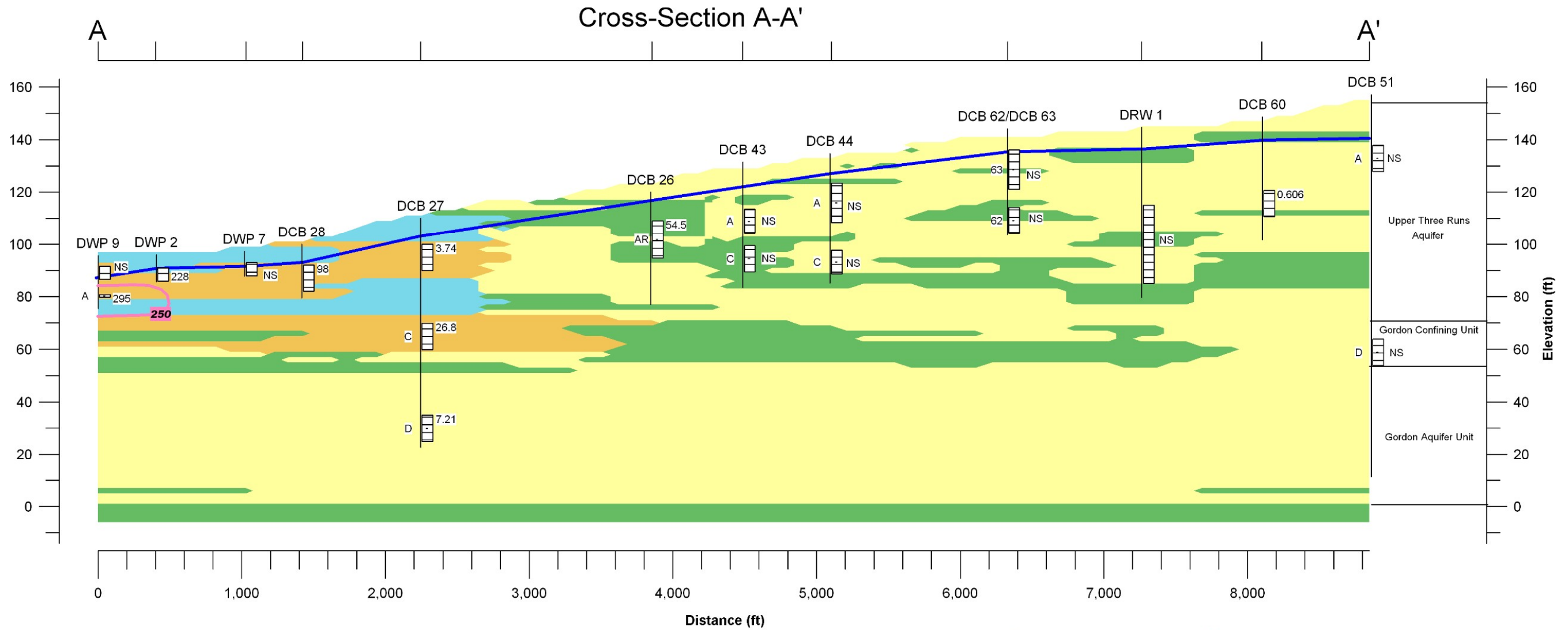


Figure D-26. Sulfate Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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Legend

- | | |
|--|---|
| <ul style="list-style-type: none"> clay to silty clay fluvial clay to silty clay fluvial sand to silty sand sand to silty sand SCREEN | <ul style="list-style-type: none"> 10.1 Sulfate Concentration (mg/L) NS Not Sampled EQL Estimated Quantation Limit NDD Not Decision Data — Well/Boring — Potentiometric Surface 2Q18 (ft msl) — Sulfate Isoconcentration Contour 2Q18 (>250 mg/L)
dashed where inferred |
|--|---|

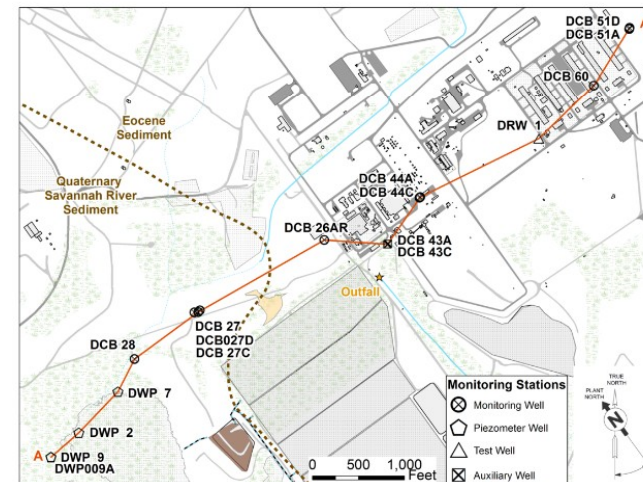


Figure D-27. D-Area Groundwater Cross-Section A-A' for Sulfate, 2Q2018

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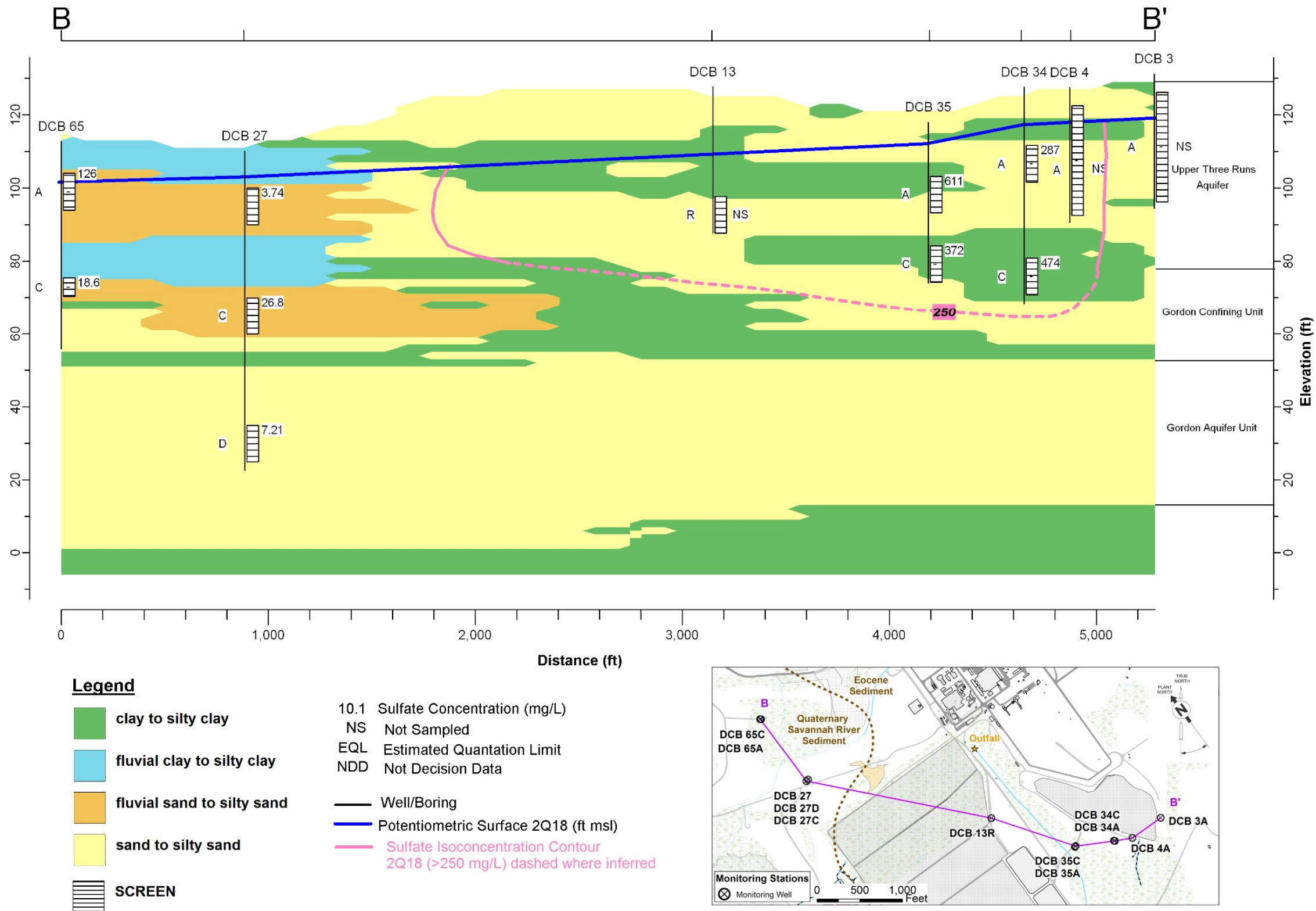


Figure D-28. D-Area Groundwater Cross-Section B-B' for Sulfate, 2Q2018

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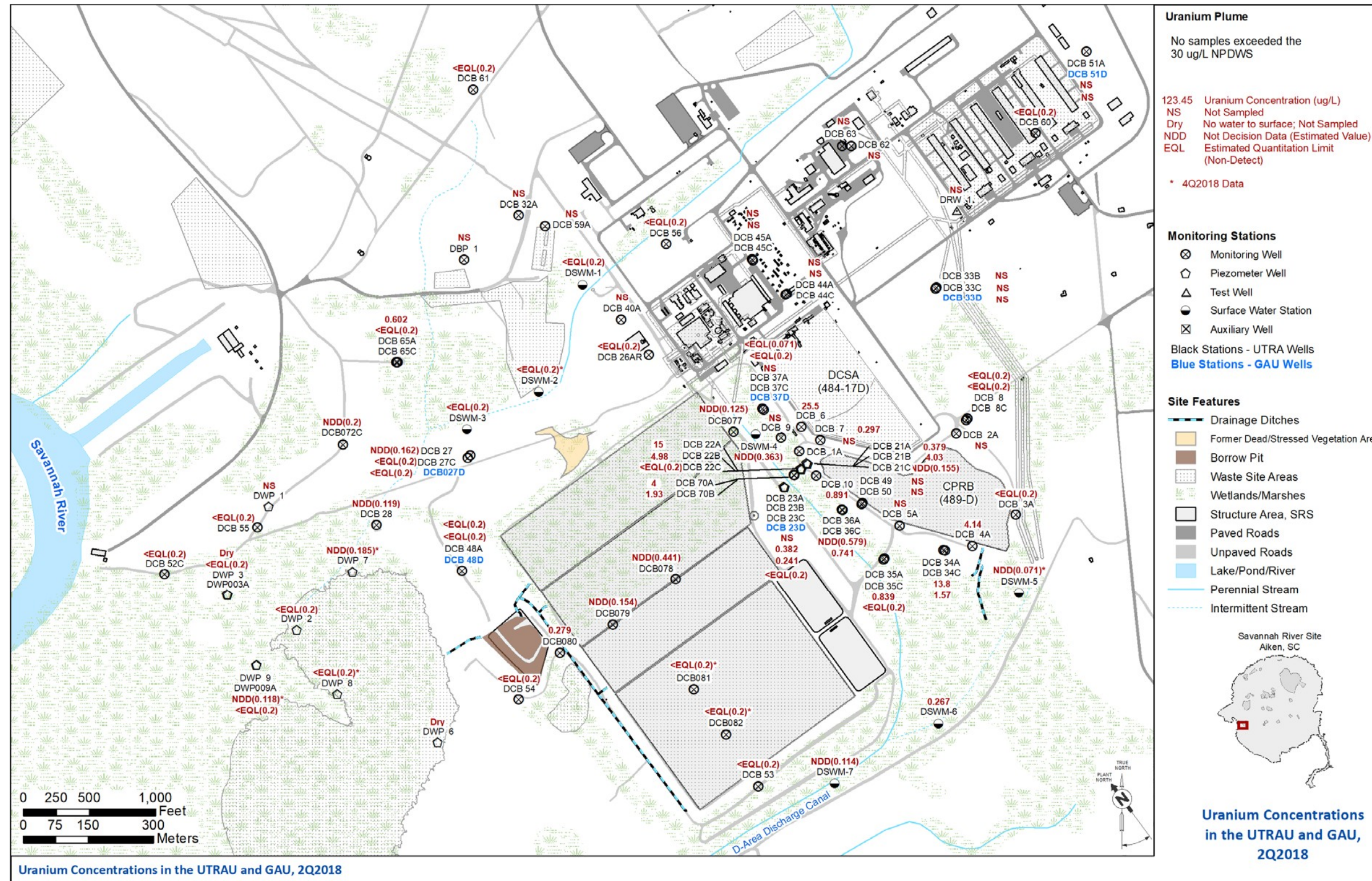


Figure D-29. Uranium Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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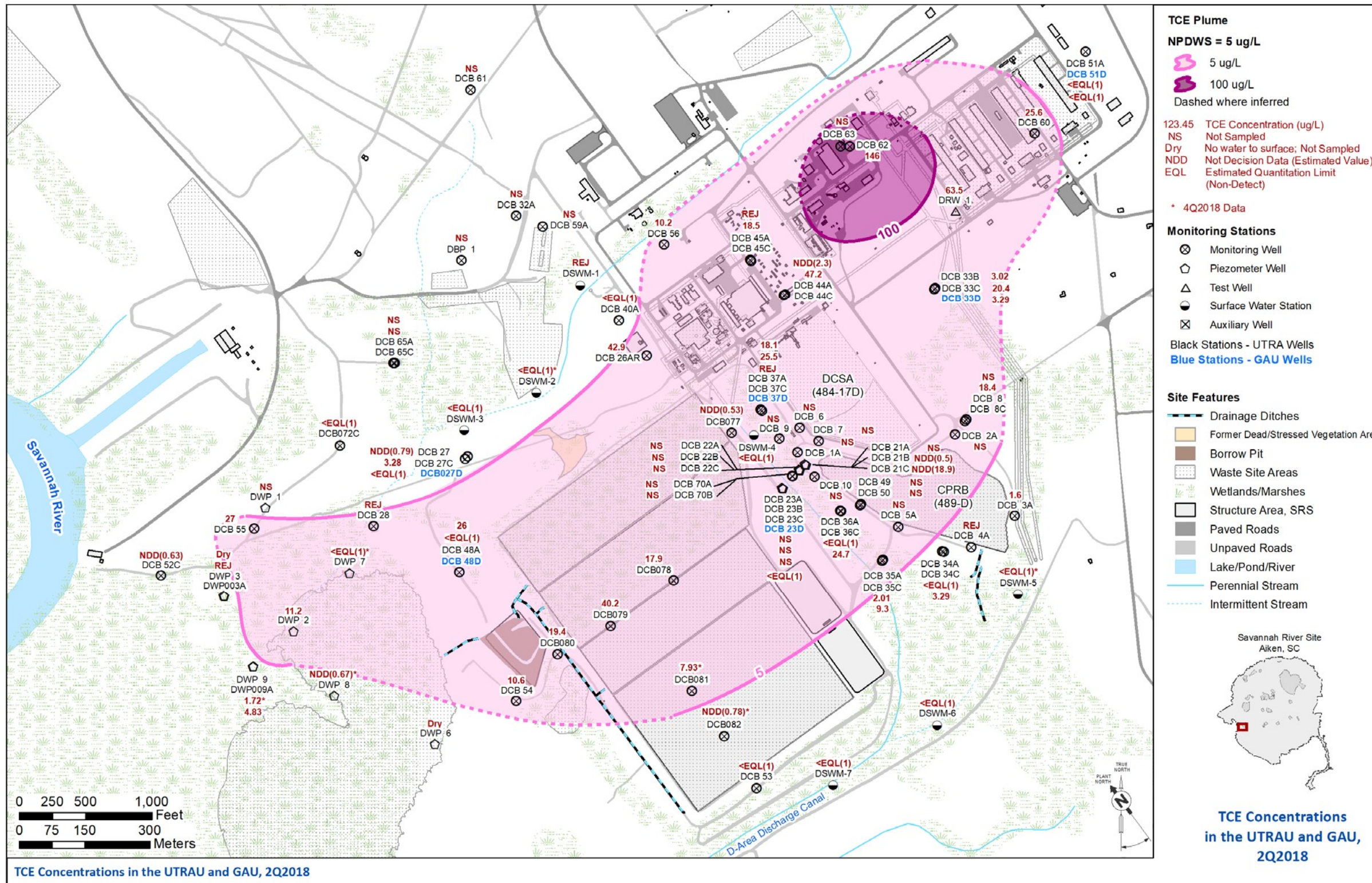


Figure D-30. Trichloroethylene (TCE) Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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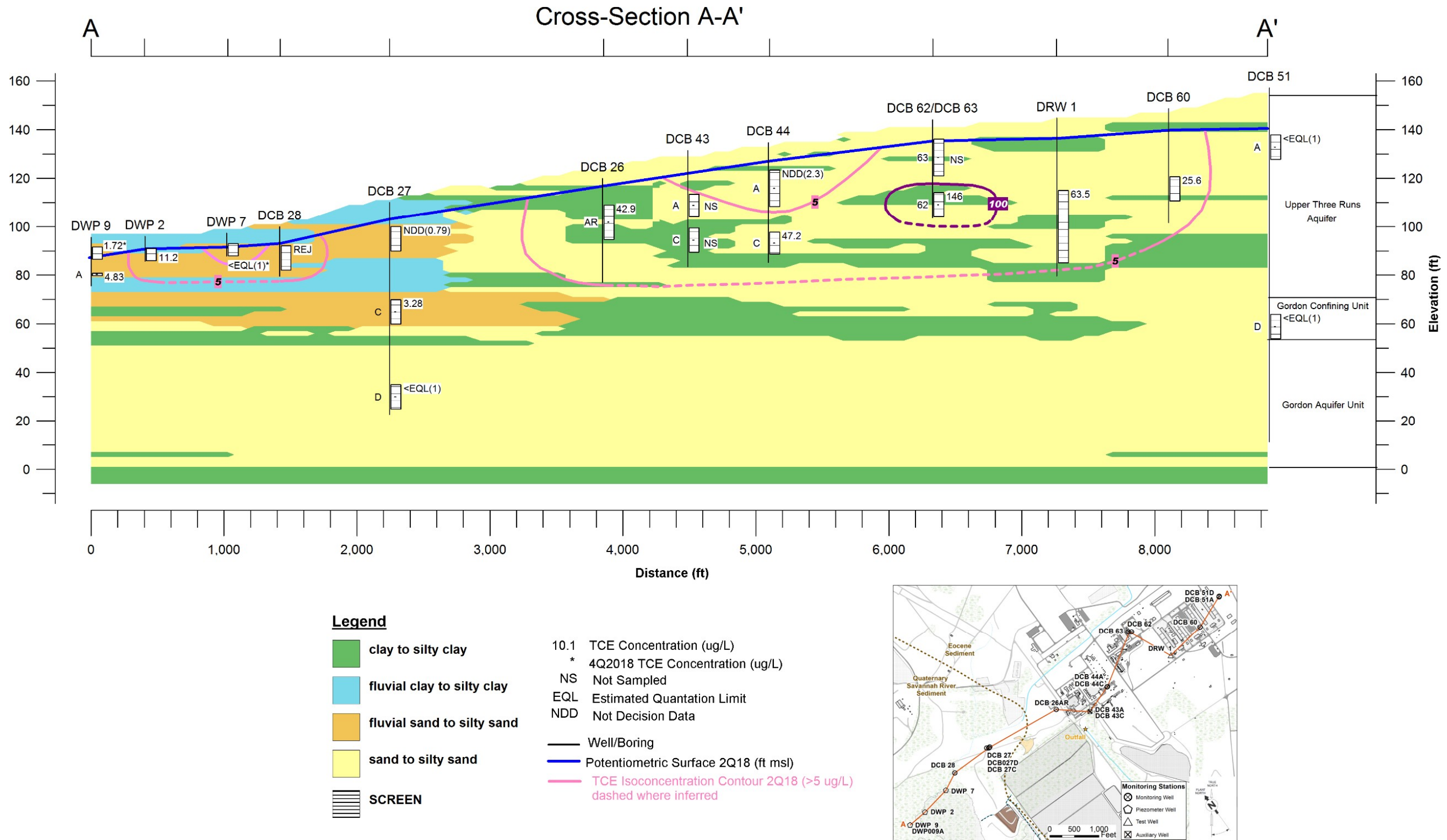


Figure D-31. D-Area Groundwater Cross-Section A-A' for Trichloroethylene (TCE), 2Q2018

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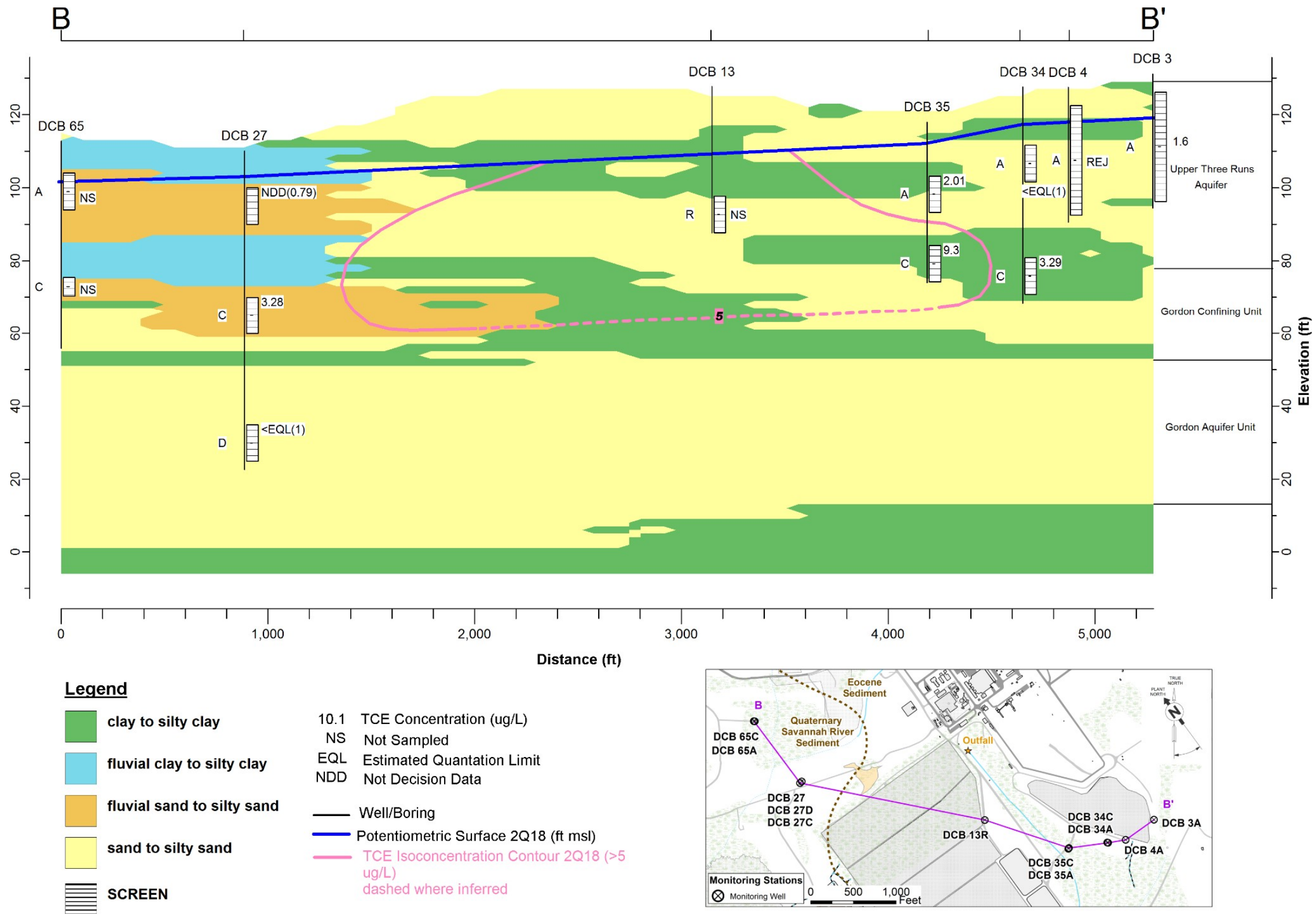


Figure D-32. D-Area Groundwater Cross-Section B-B' for Trichloroethylene (TCE), 2Q2018

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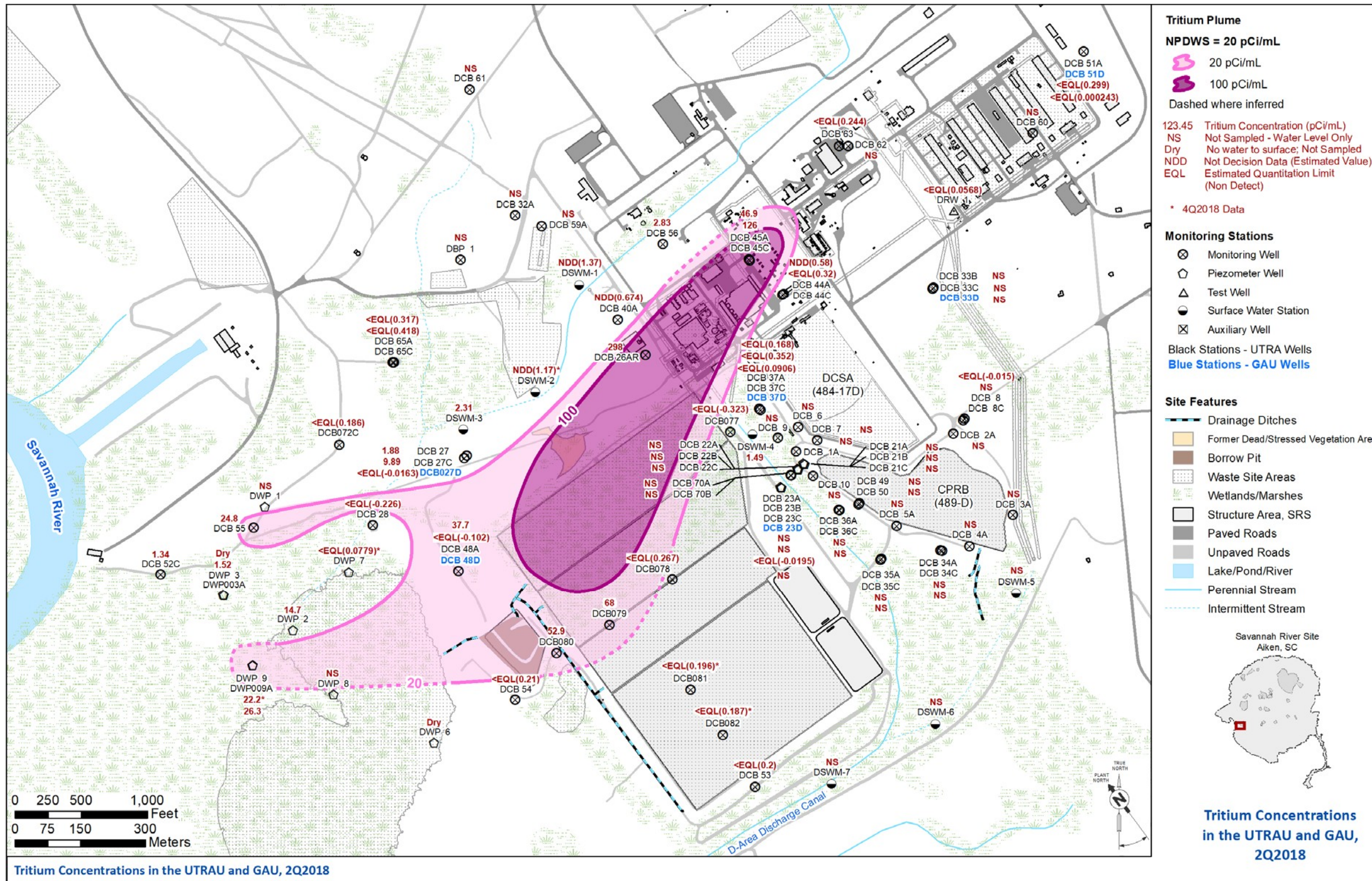


Figure D-33. Tritium Concentrations in the Upper Three Runs Aquifer Unit, 2Q2018

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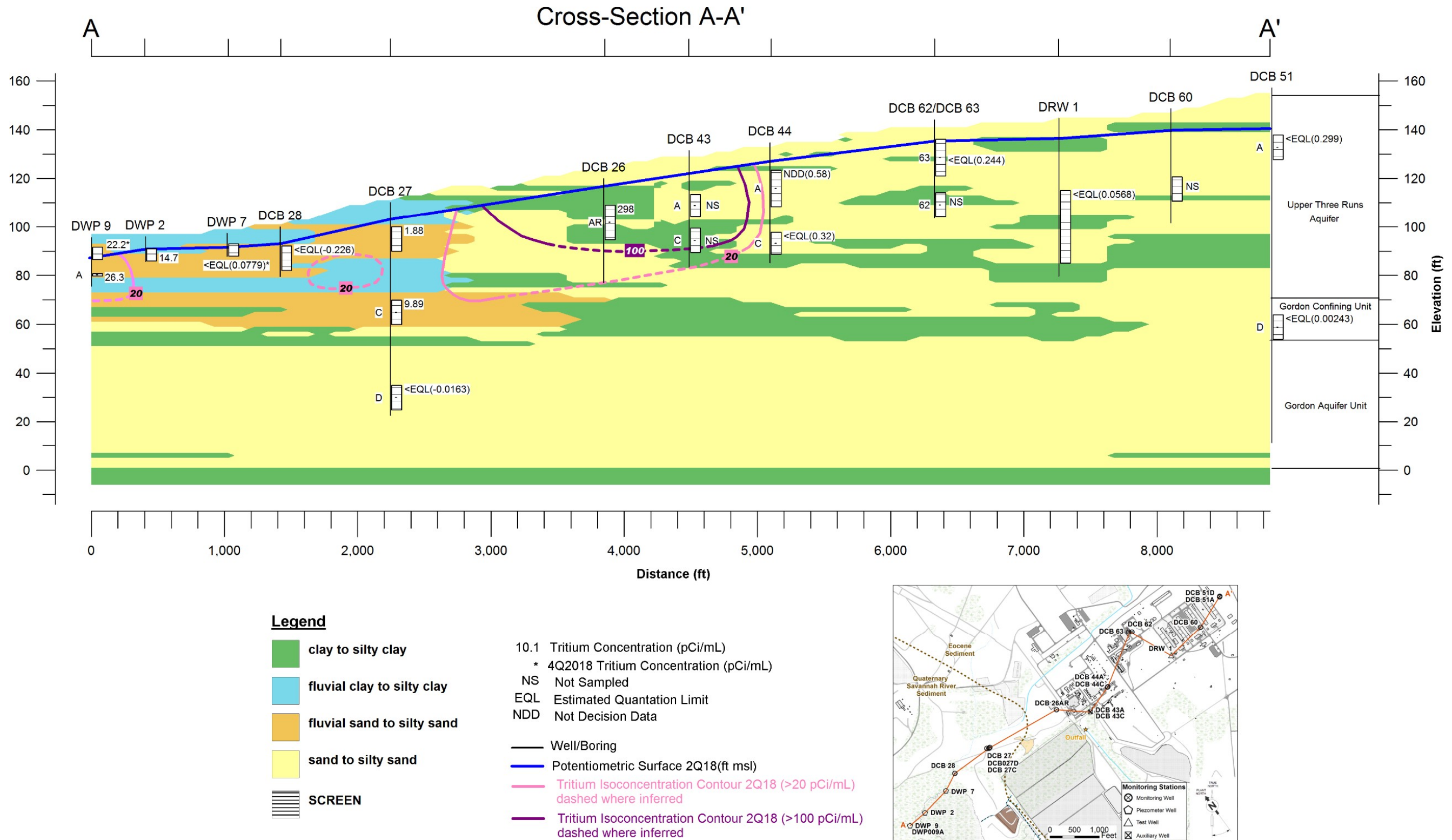


Figure D-34. D-Area Groundwater Cross-Section A-A' for Tritium, 2Q2018

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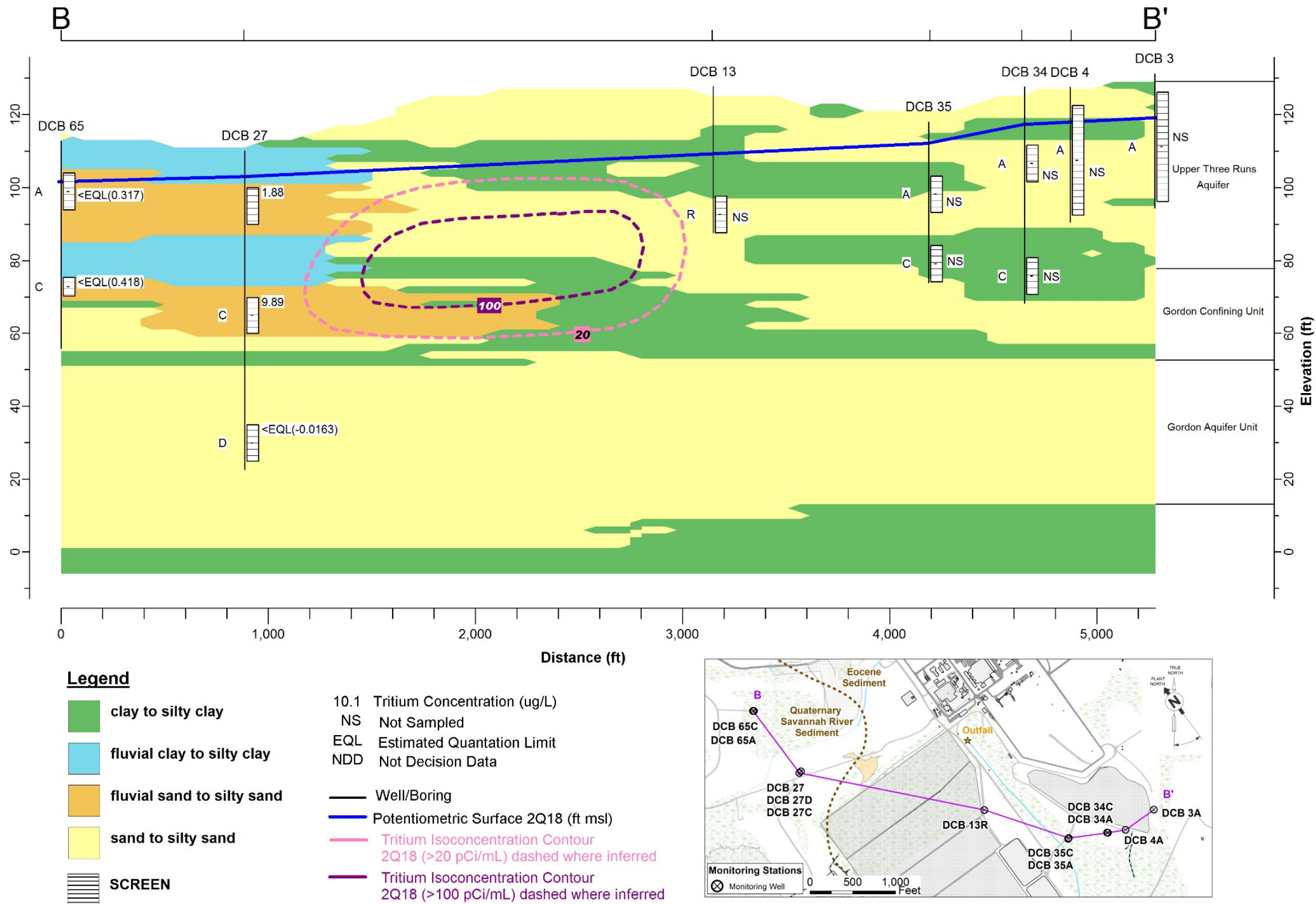


Figure D-35. D-Area Groundwater Cross-Section B-B' for Tritium, 2Q2018

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Figure D-36. Time Series Plots of Chromium at DCB 21B, DCB 34C, and DCB 36C

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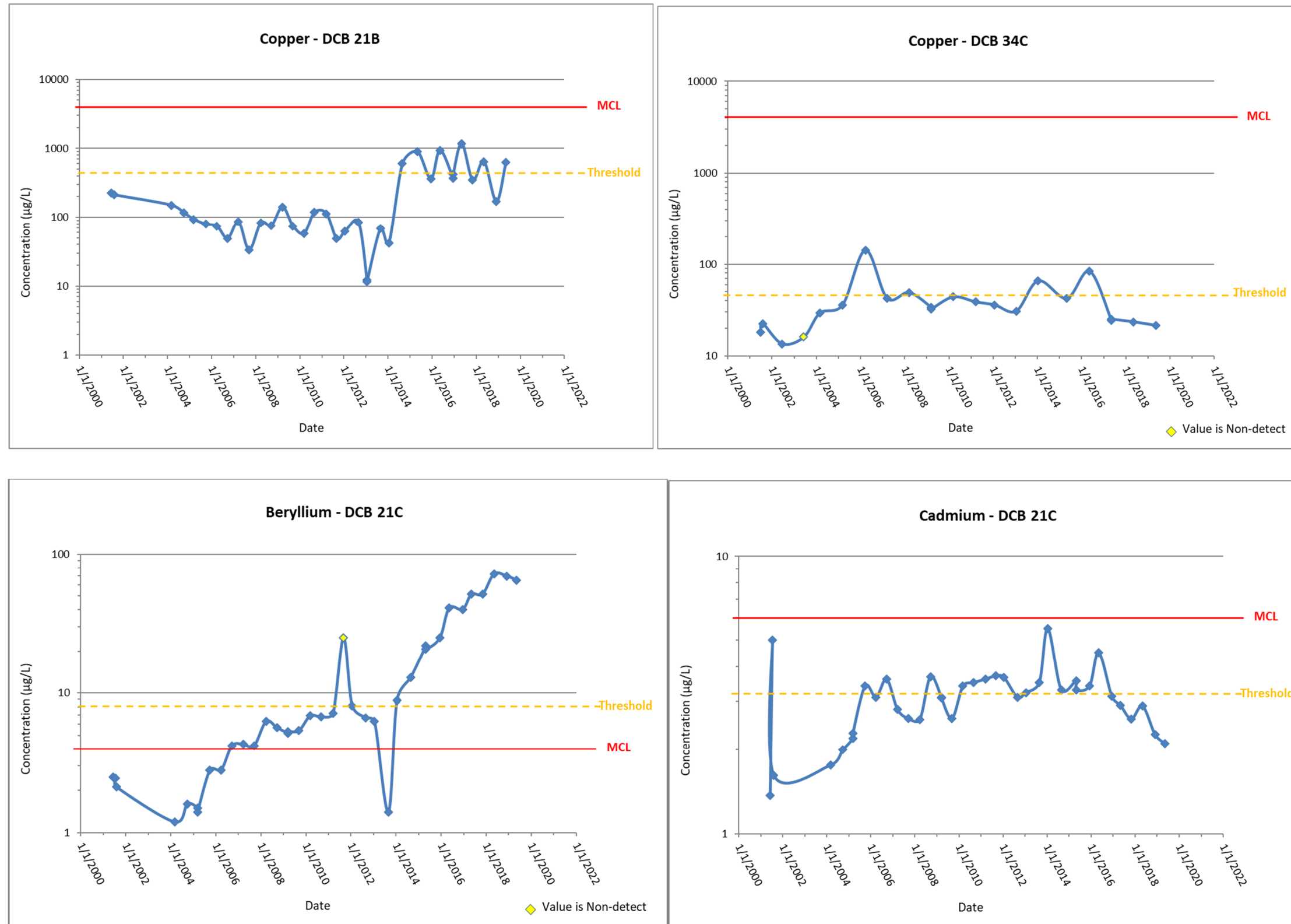


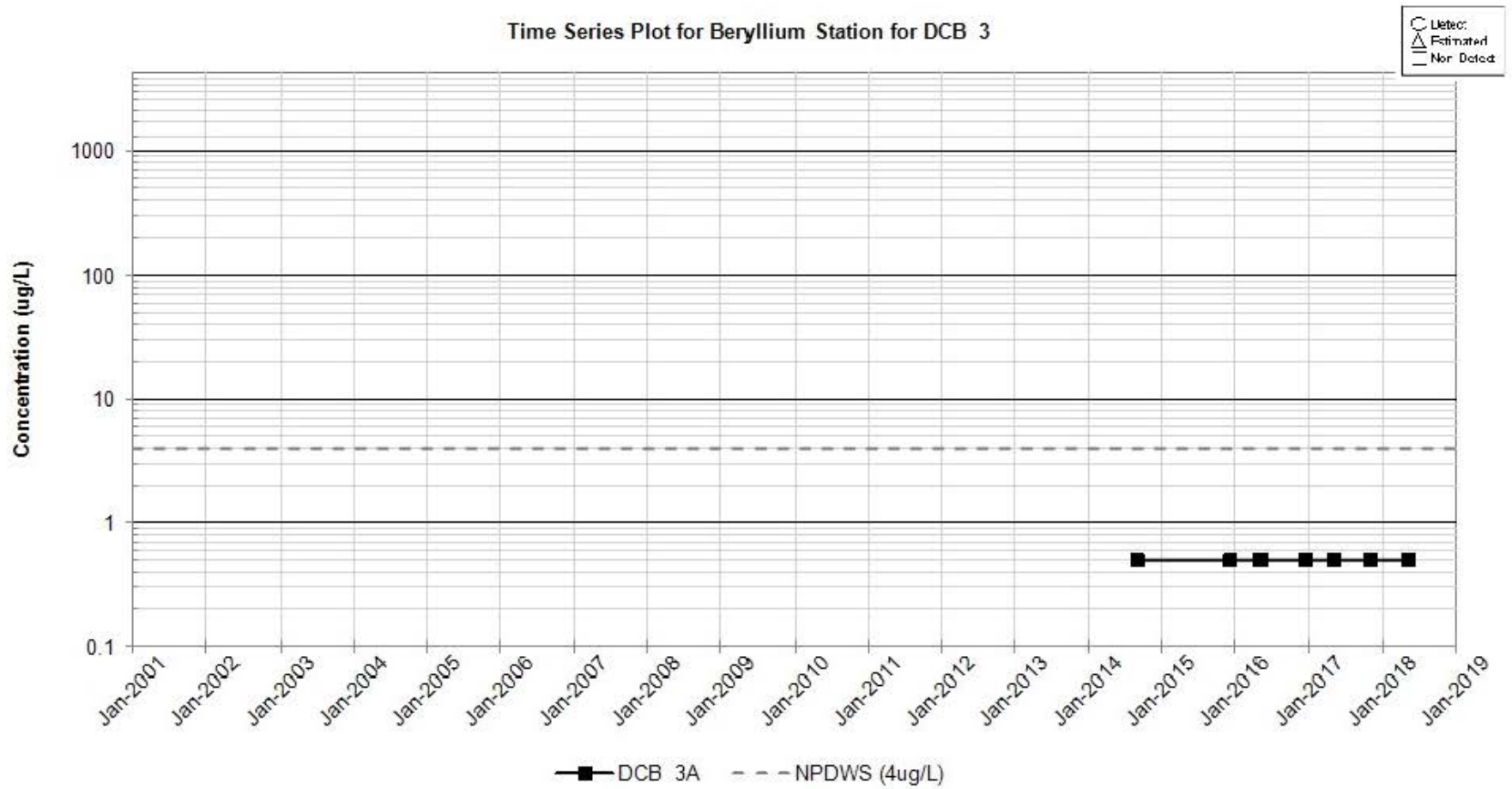
Figure D-37. Time Series Plots of Copper at DCB 21B and DCB 34C, Beryllium at DCB 21C, and Cadmium at DCB 21C

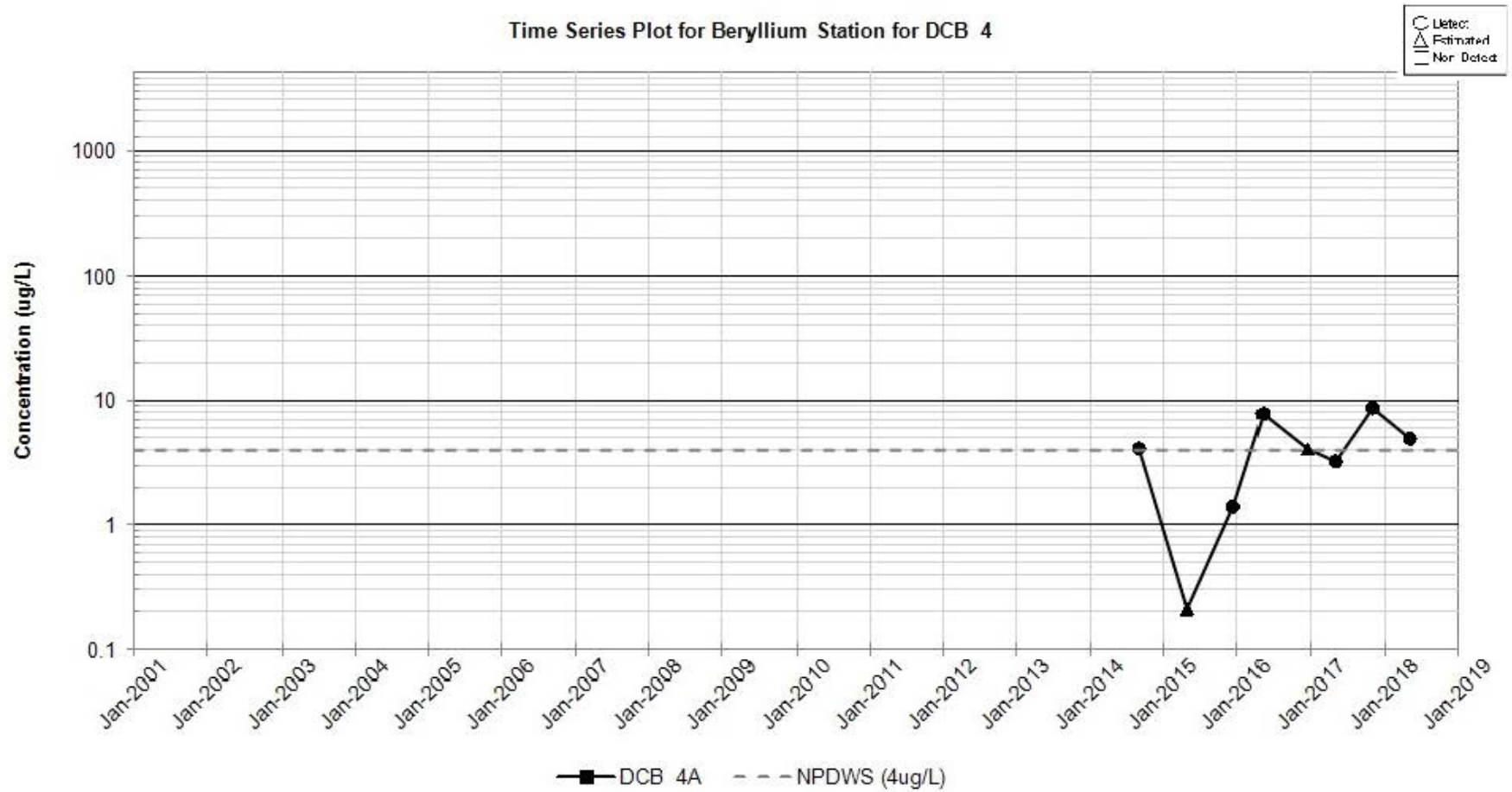
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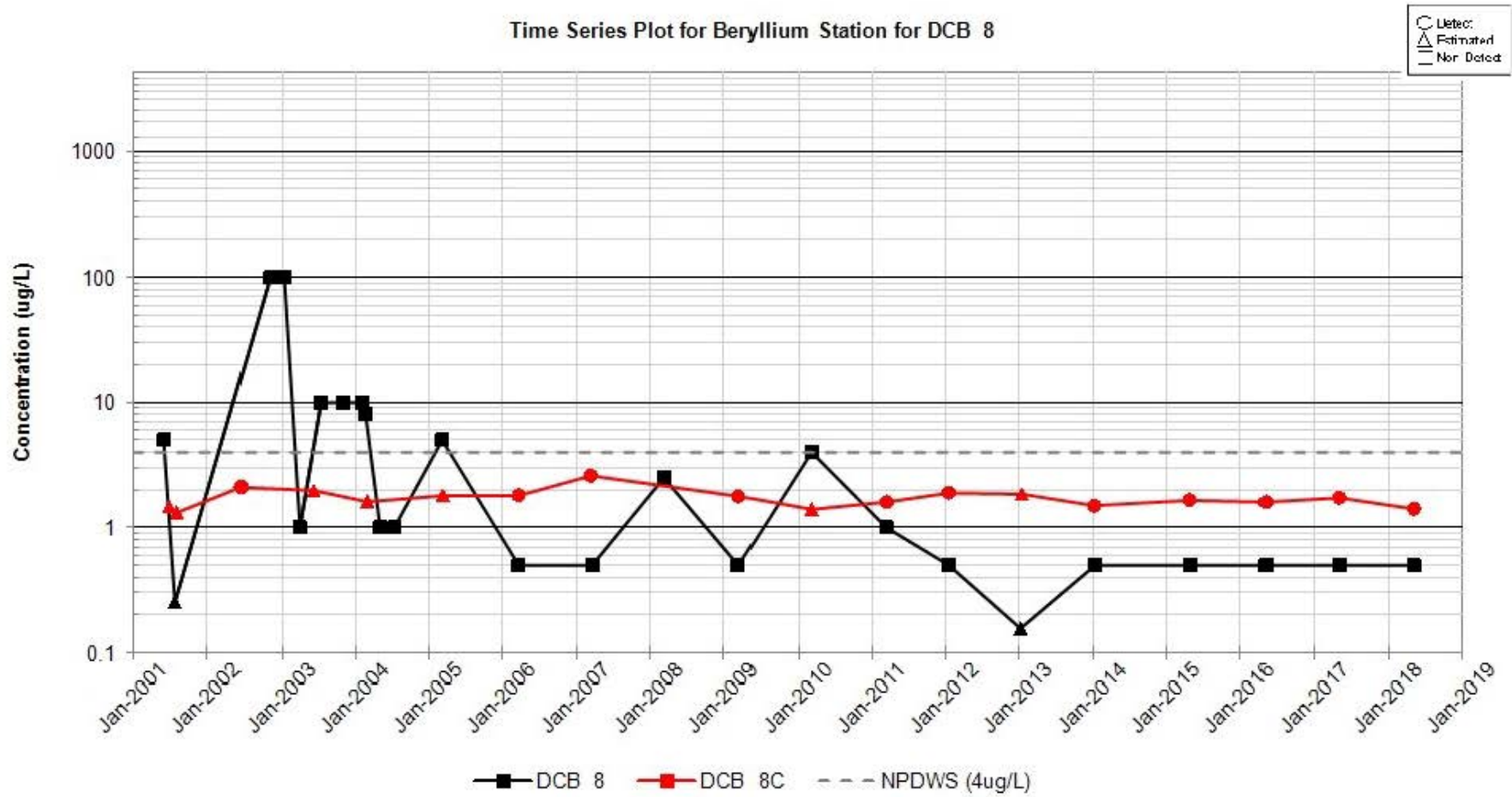
APPENDIX E

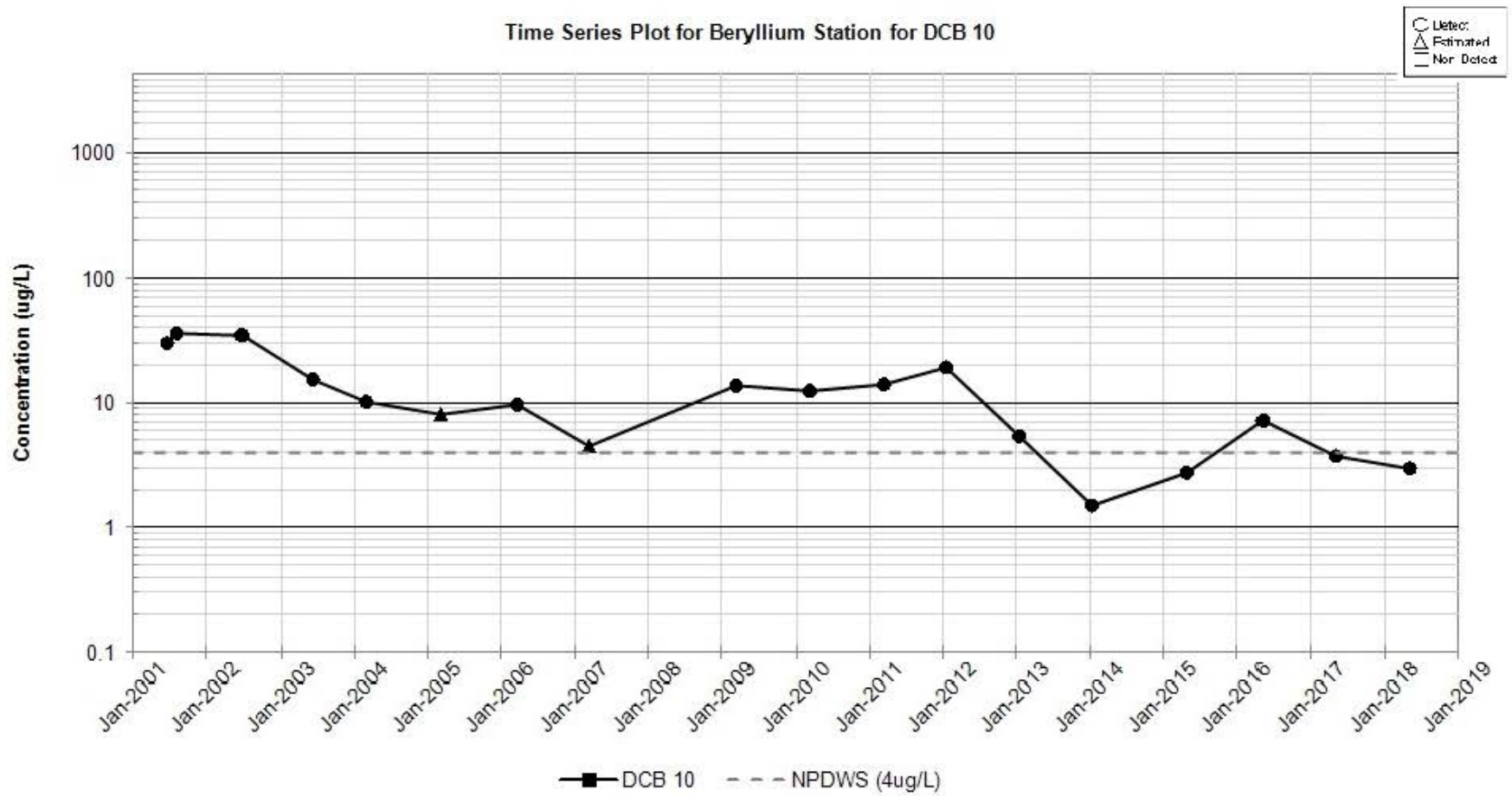
Time Series Plots

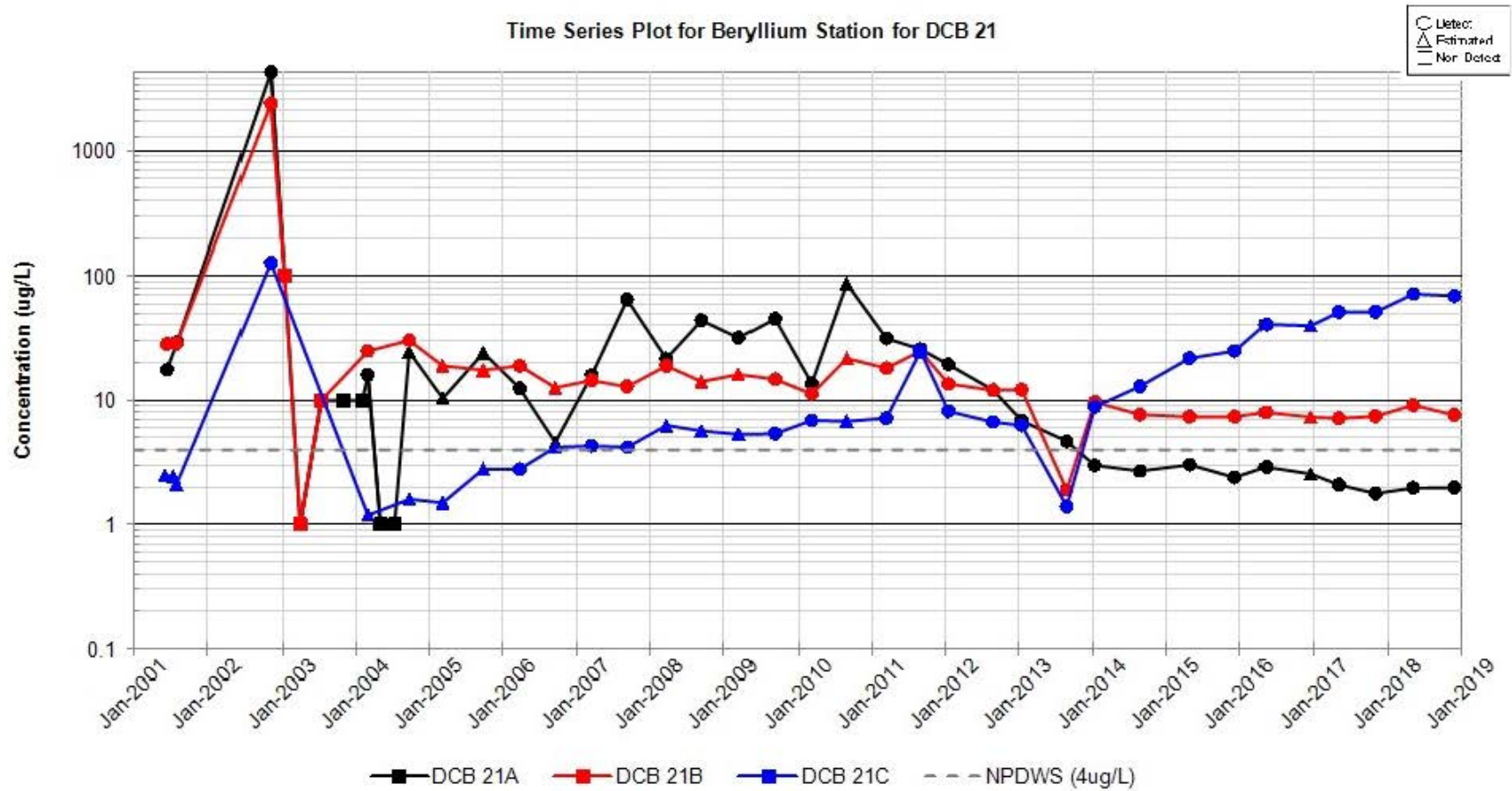
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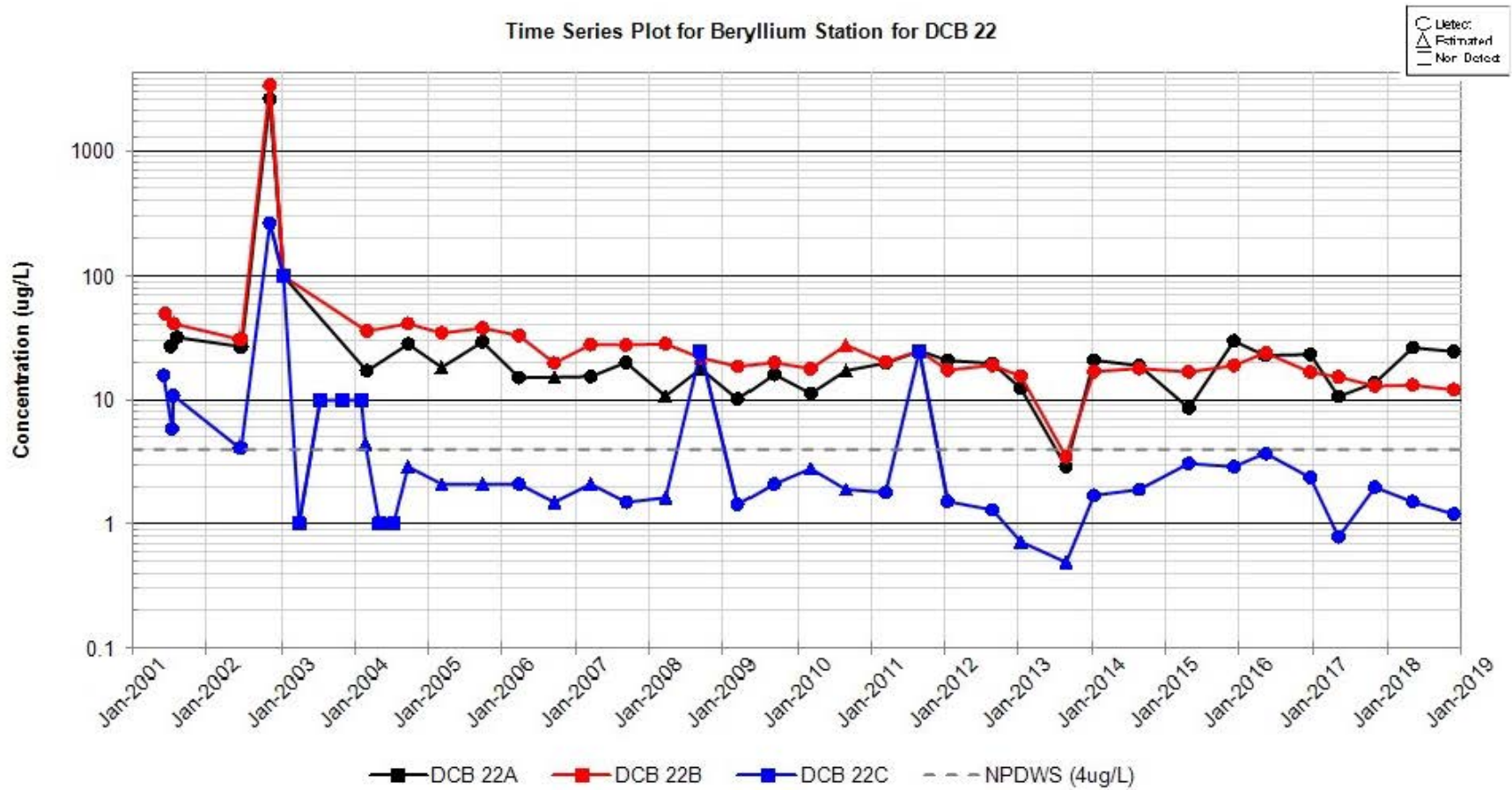


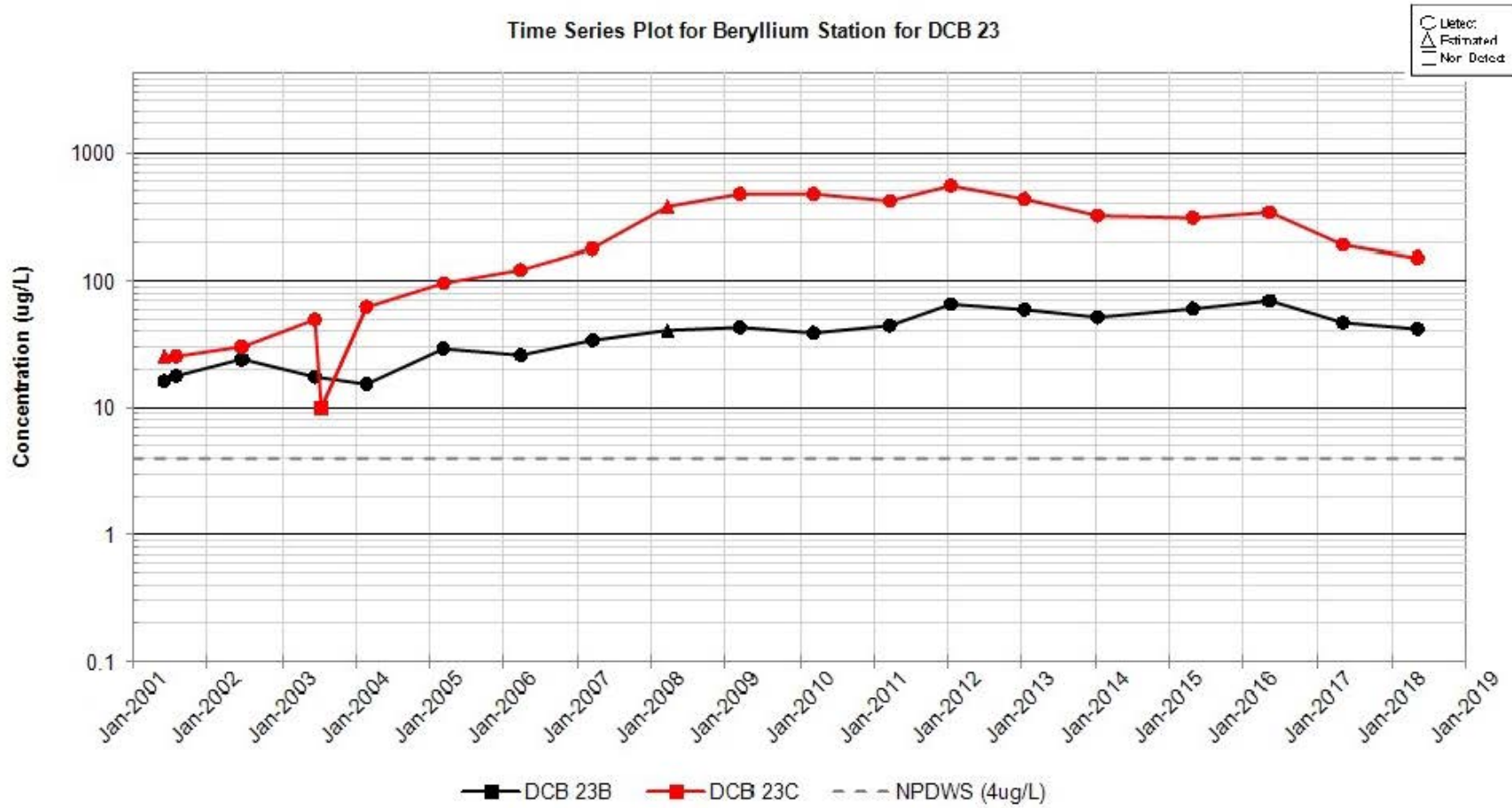


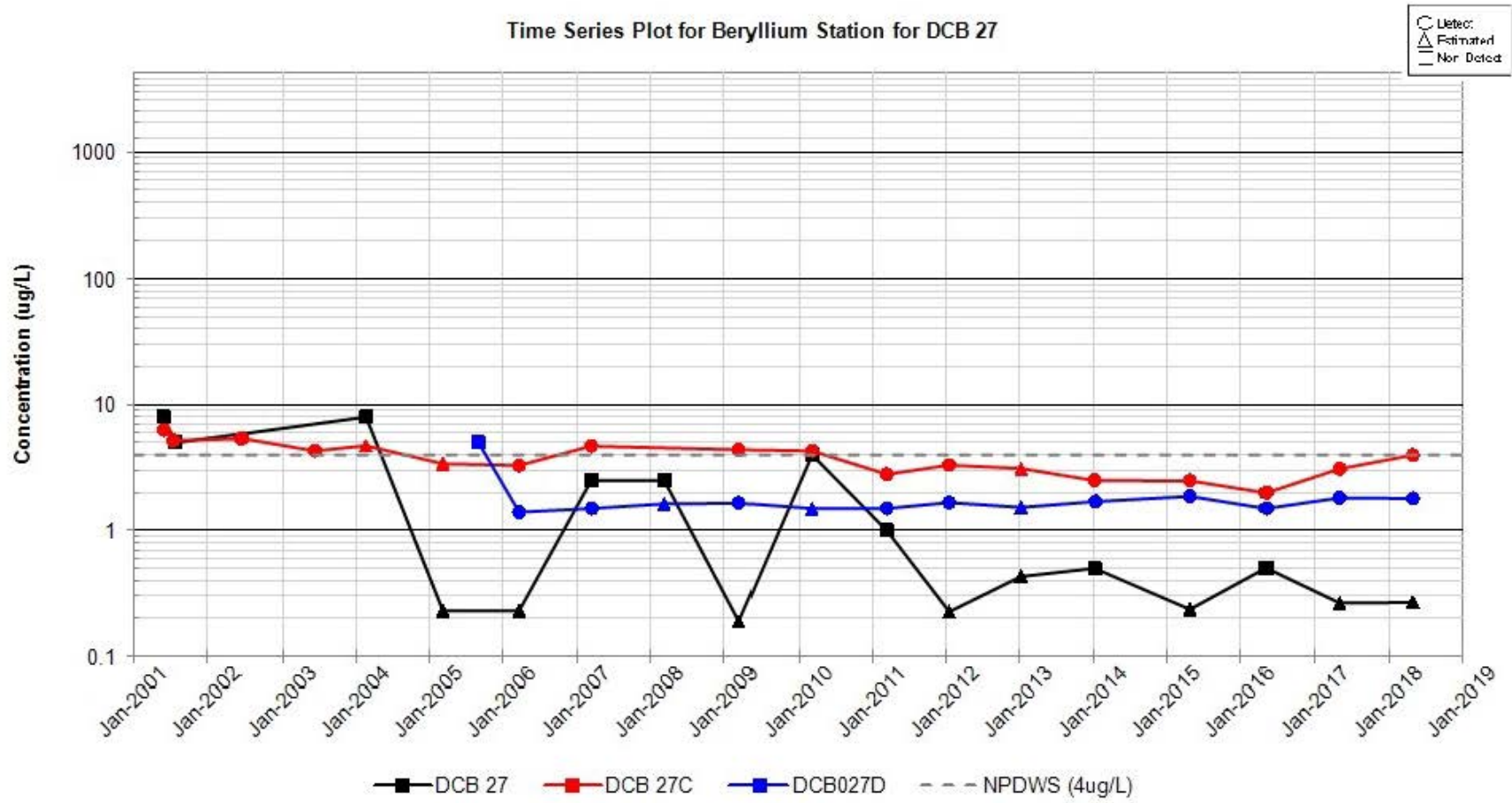


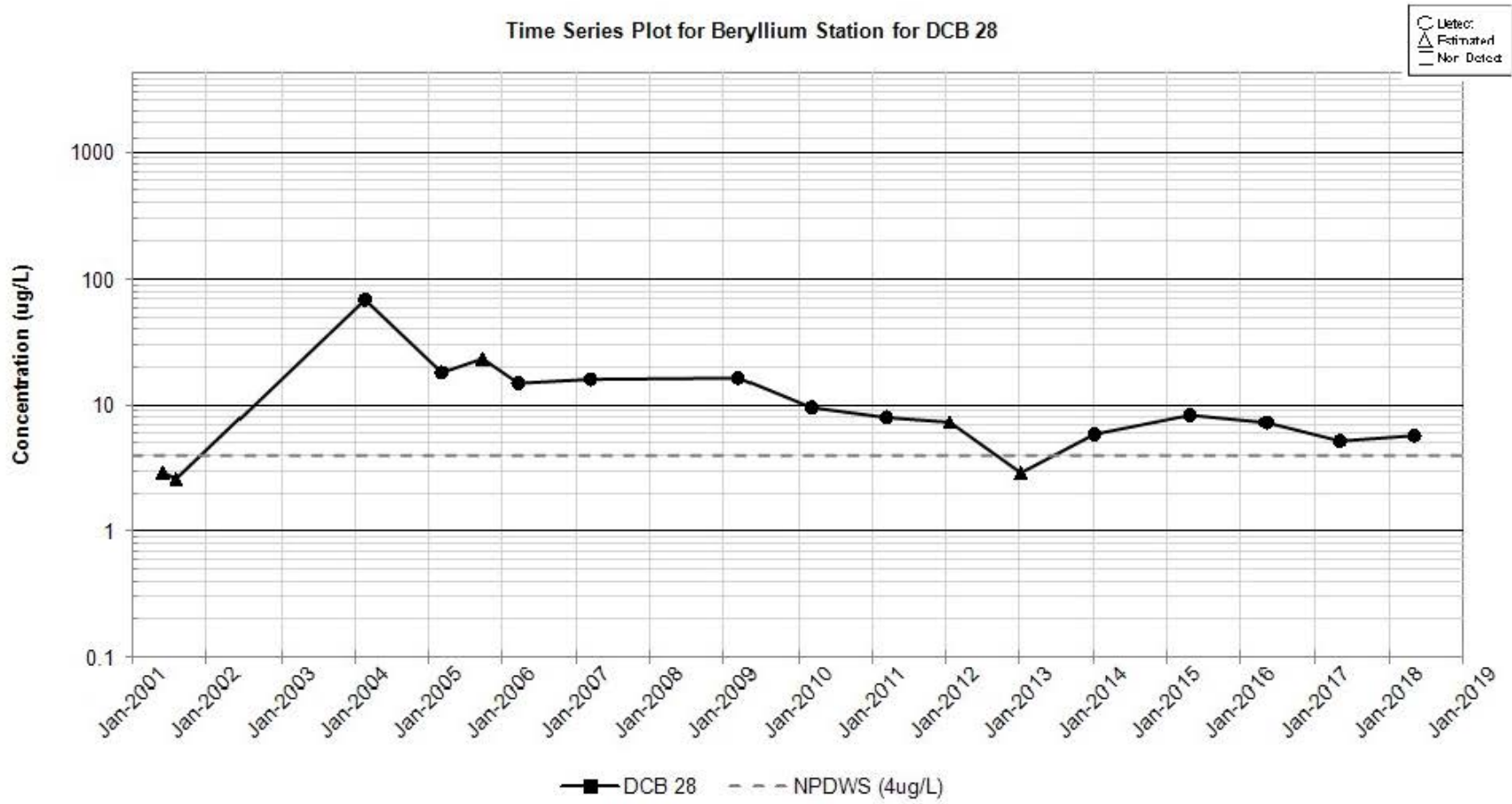


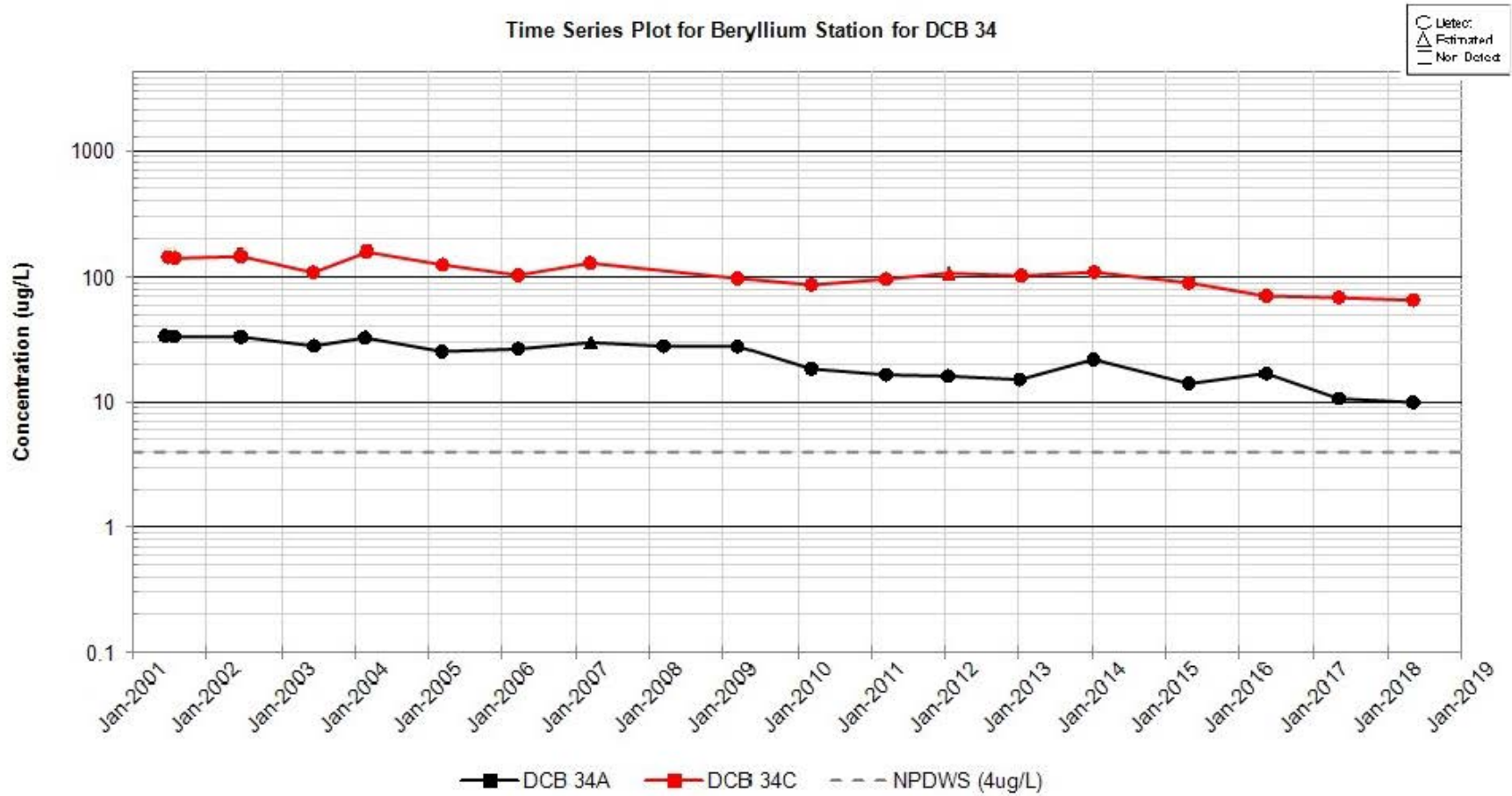


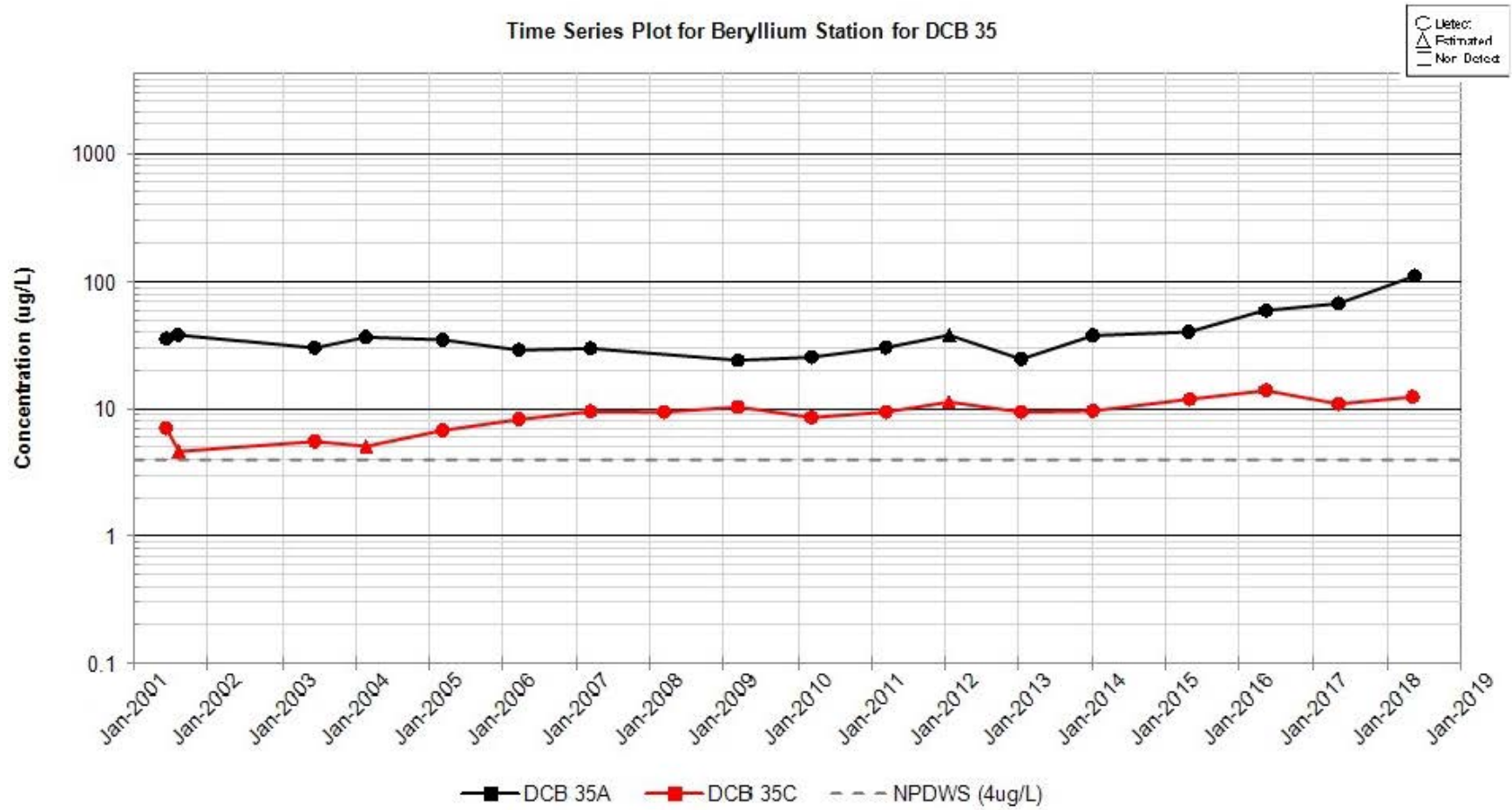


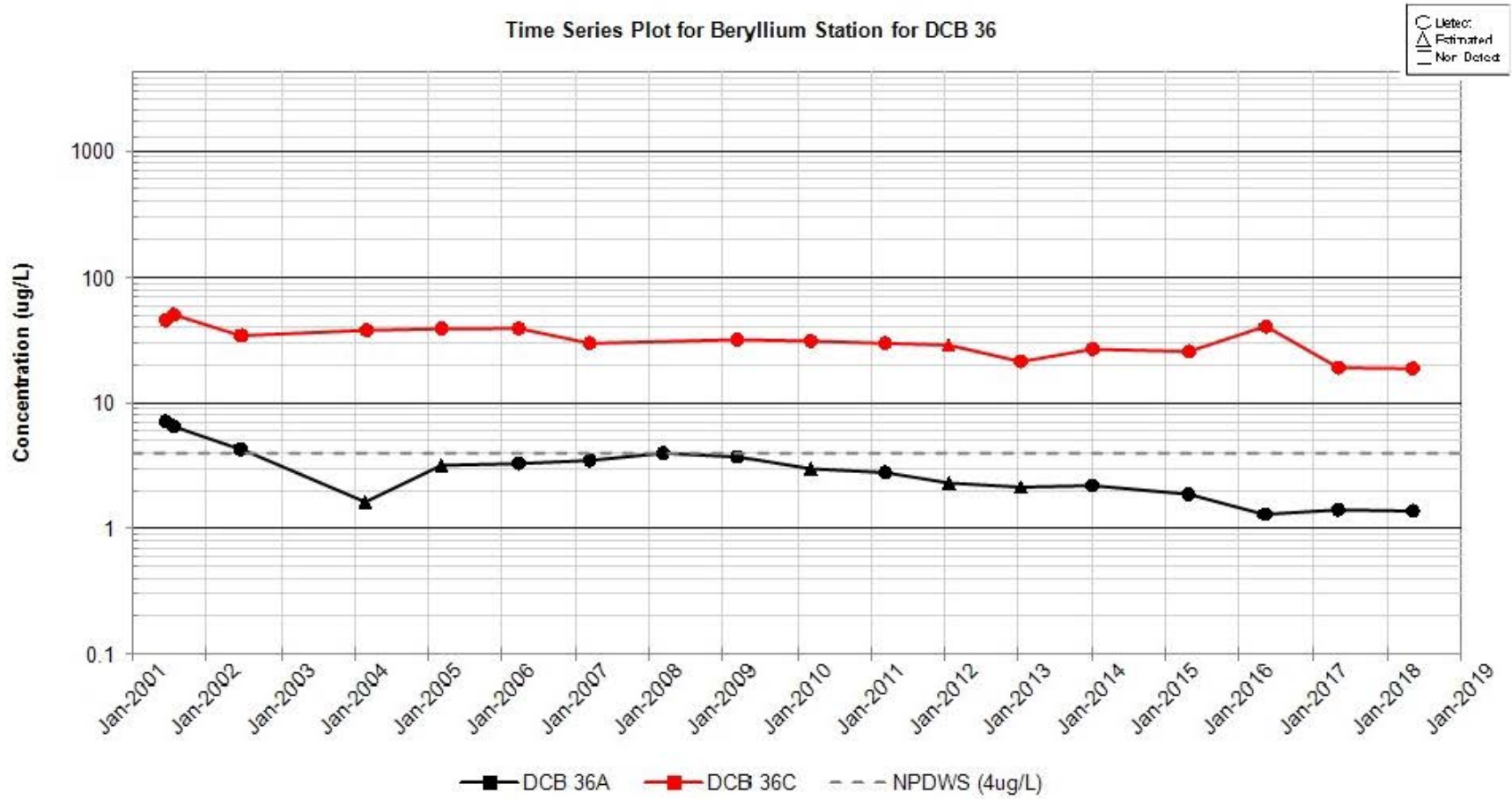


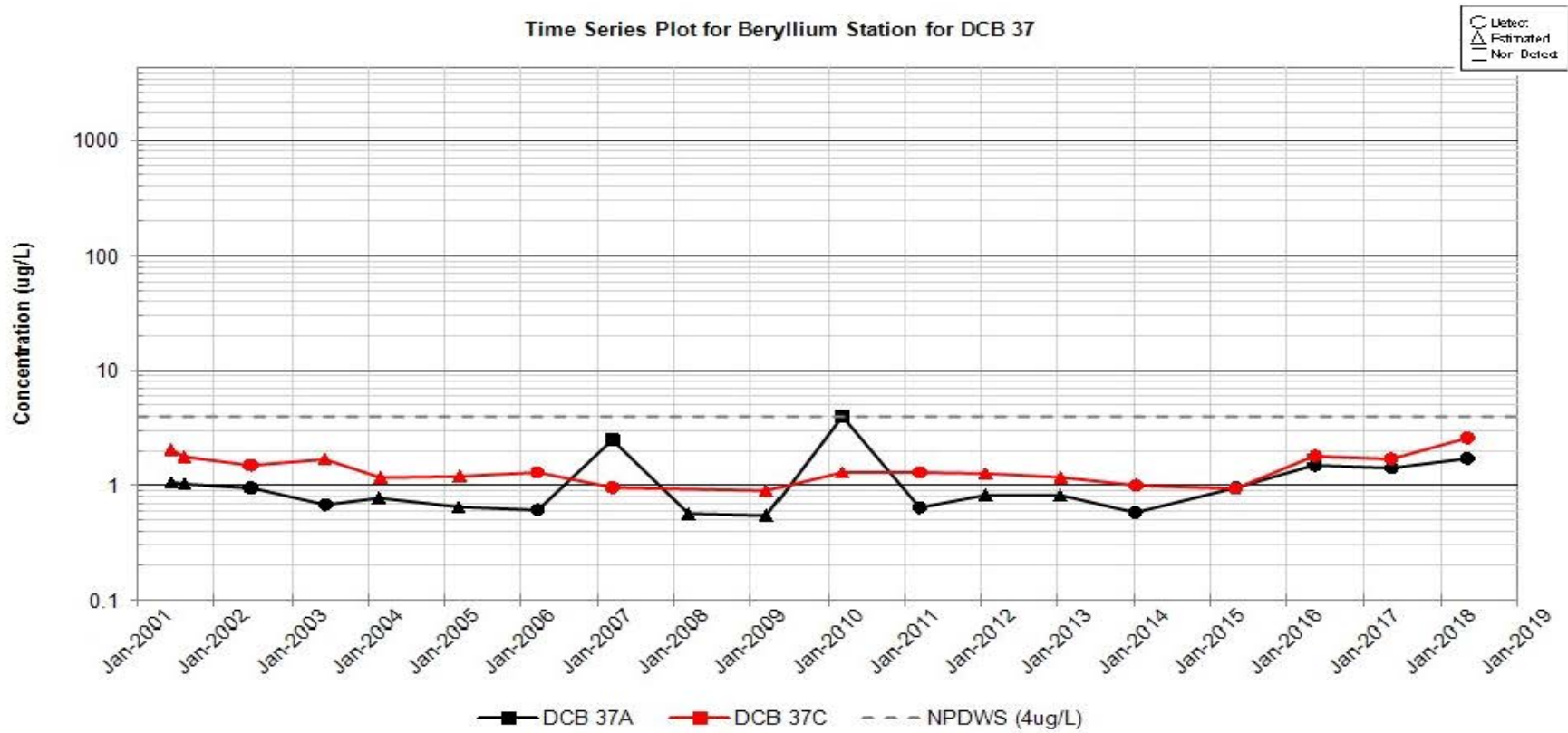


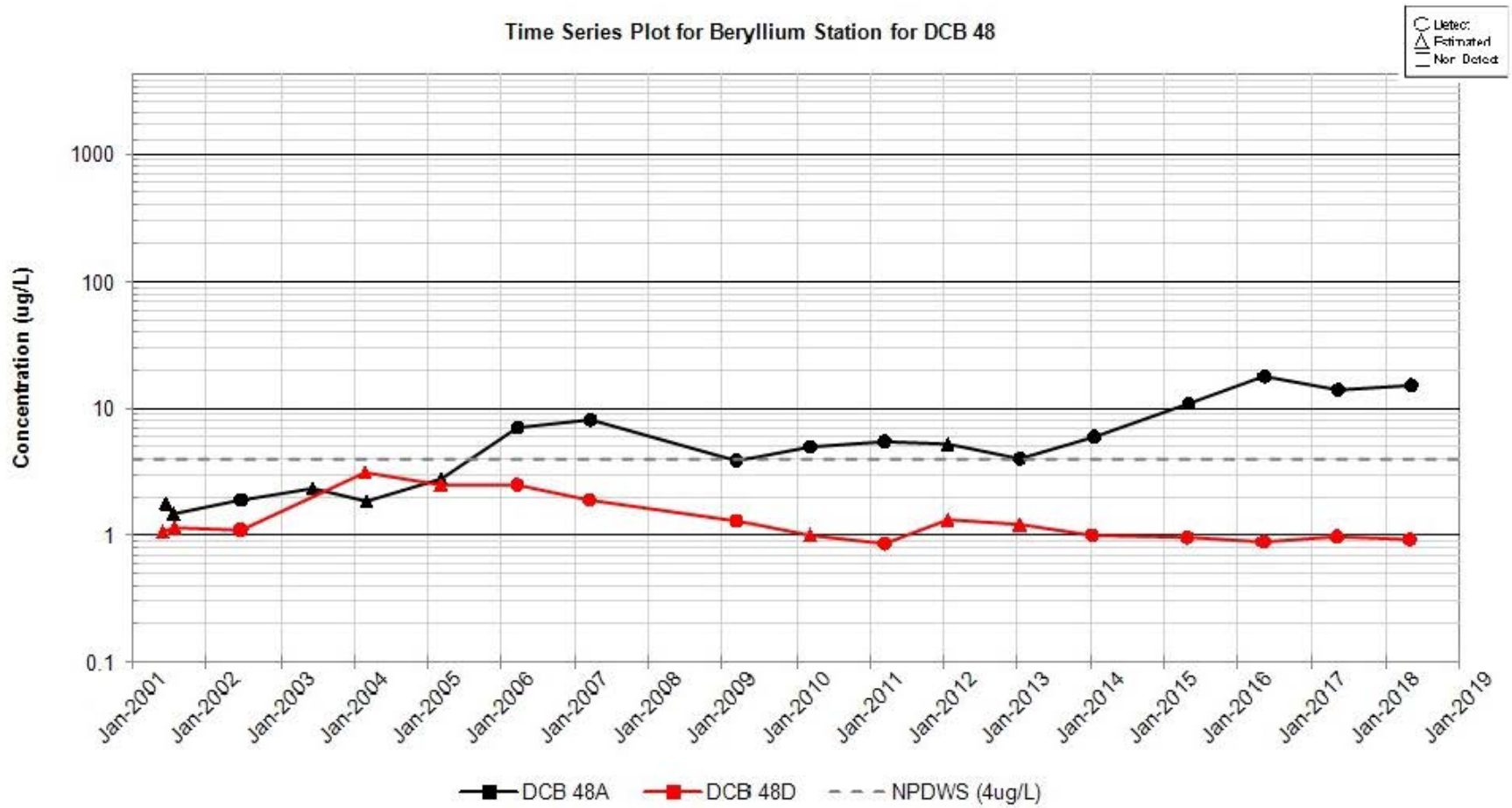


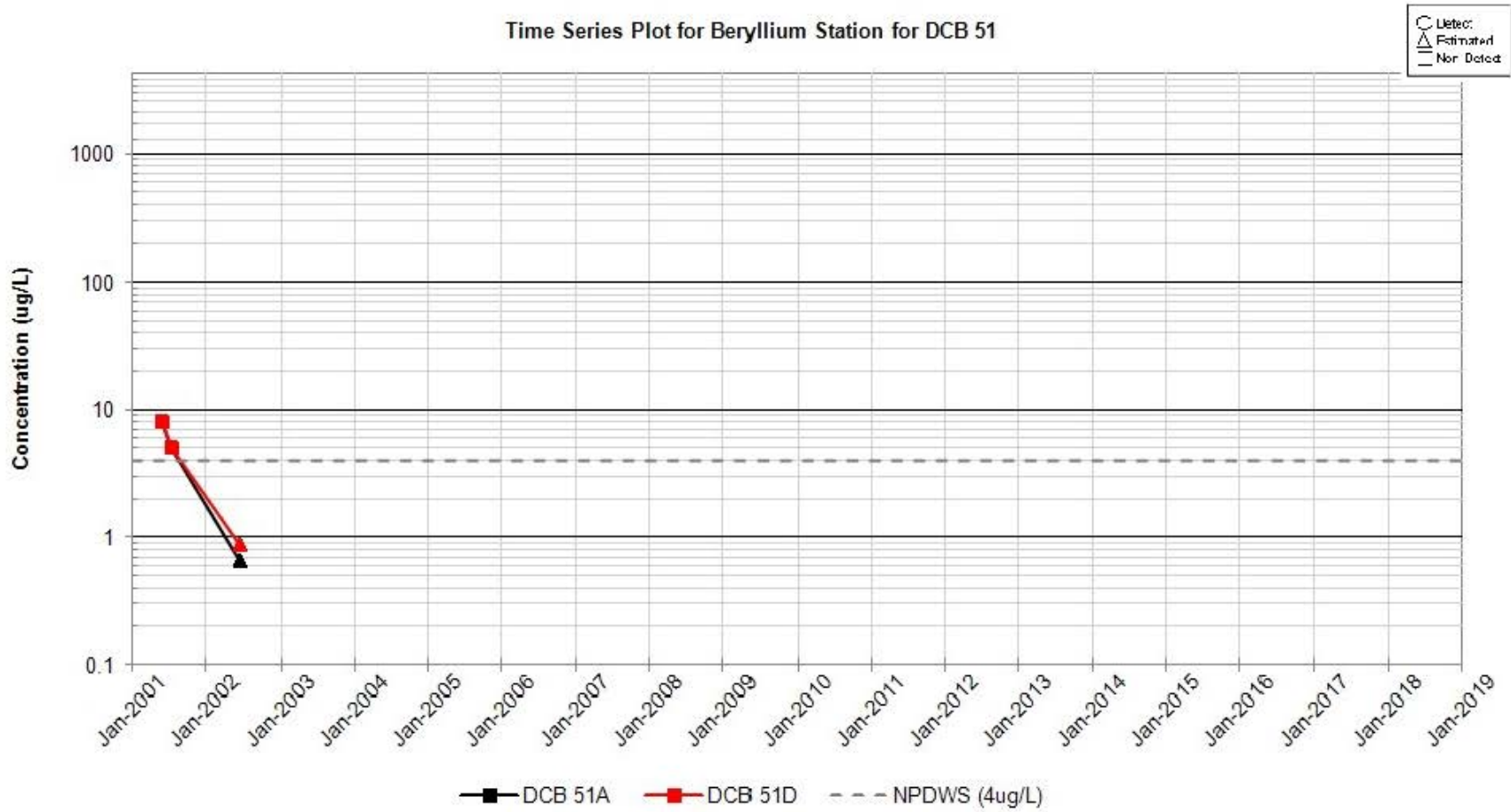


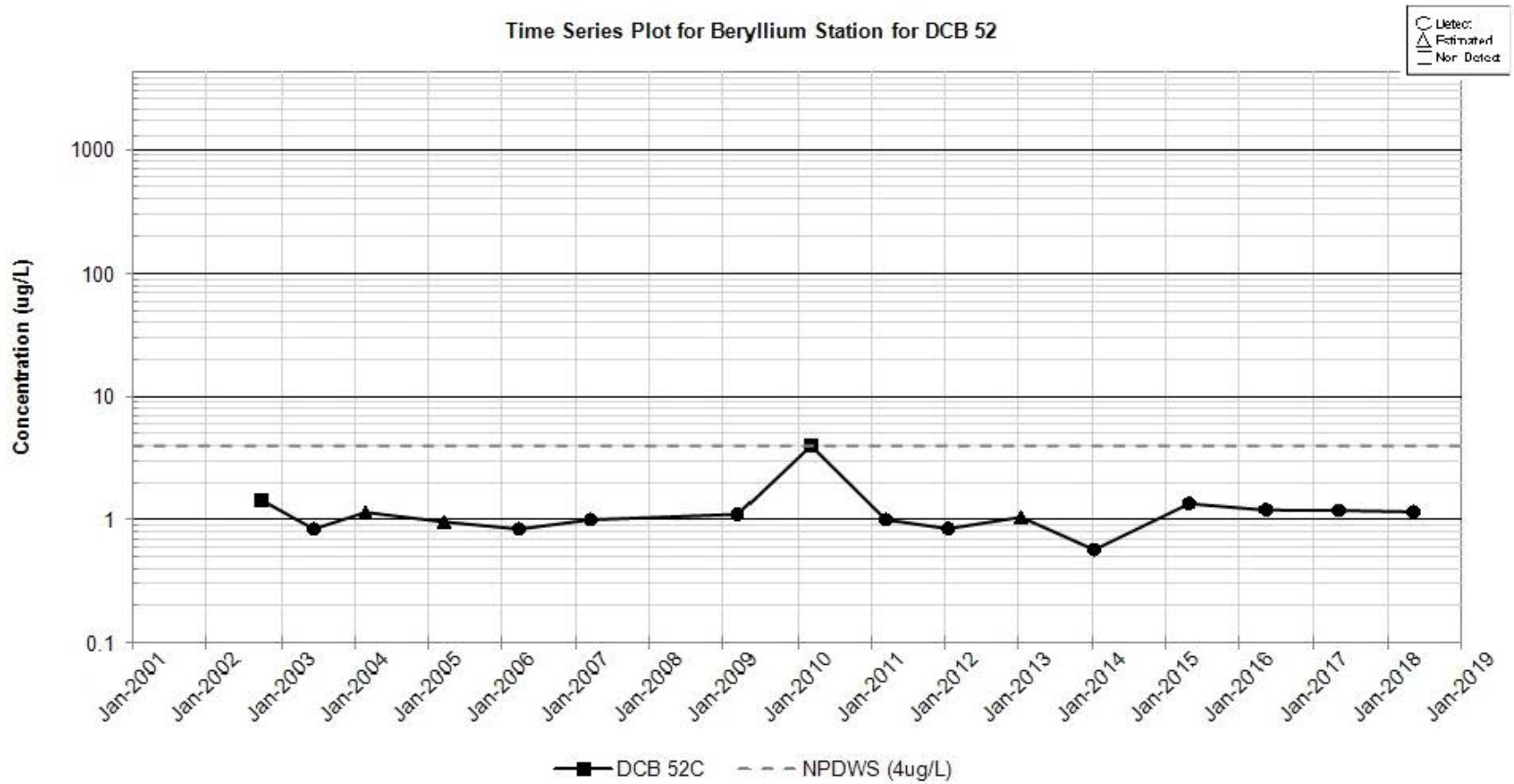


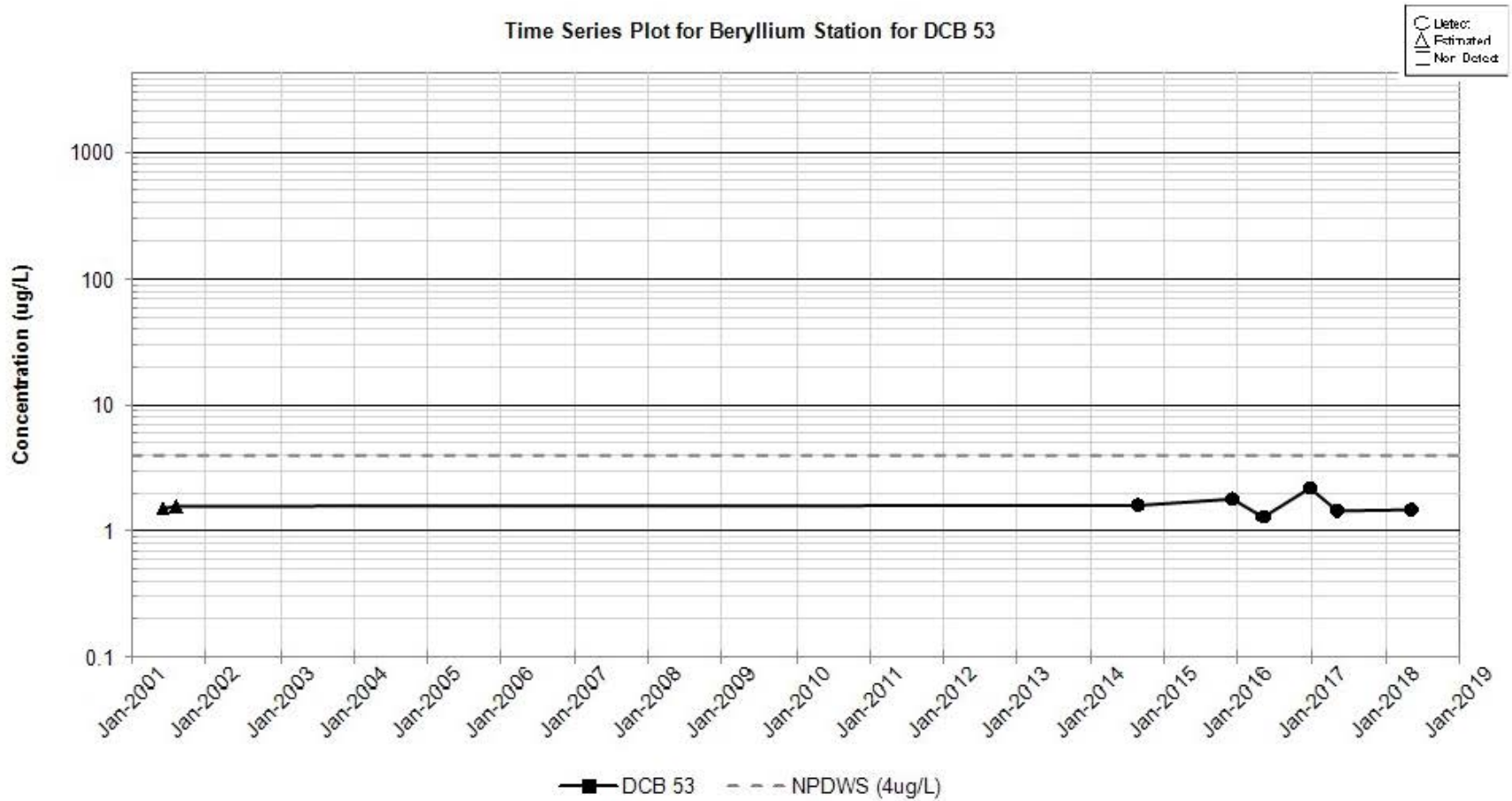


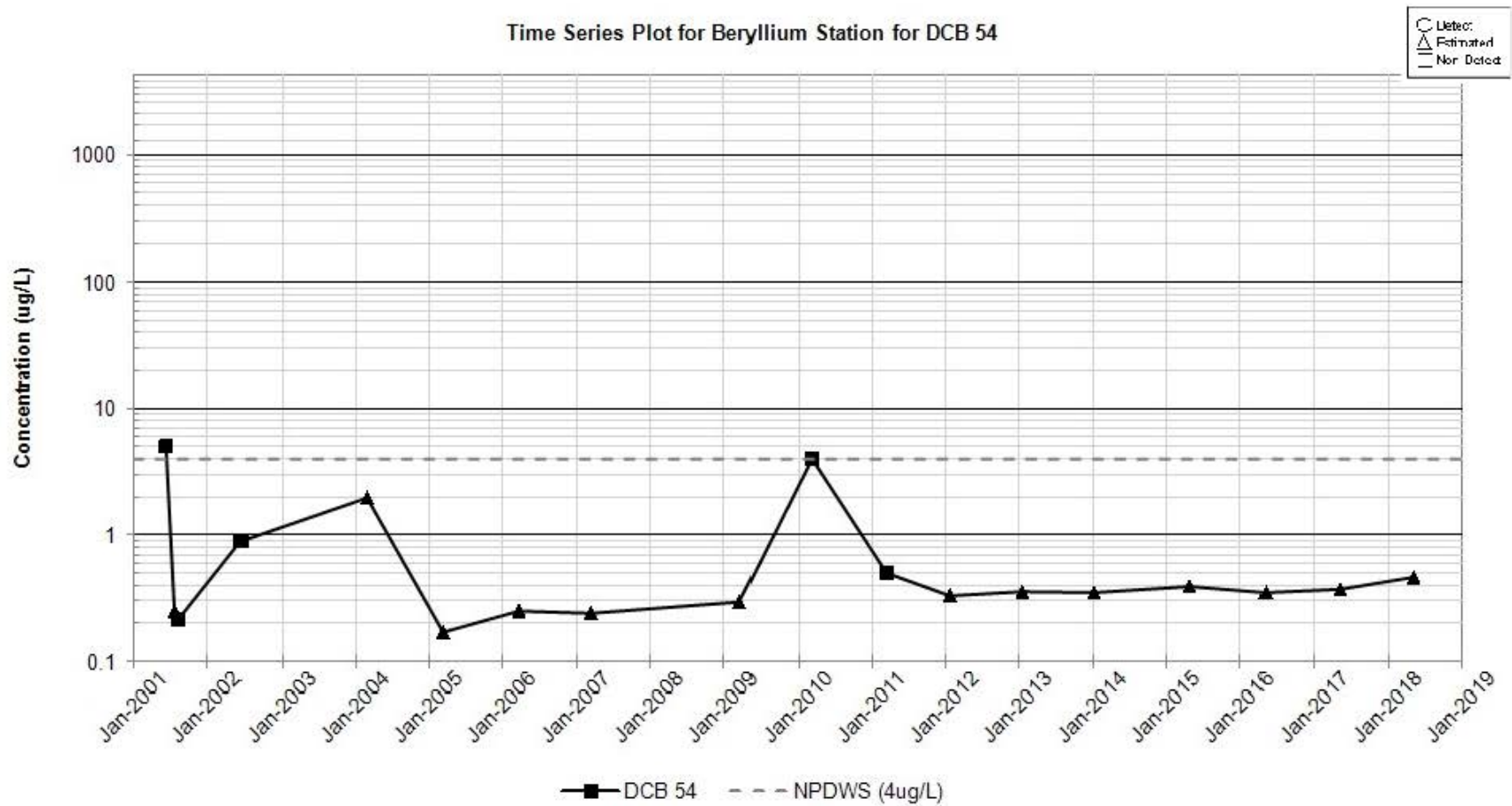


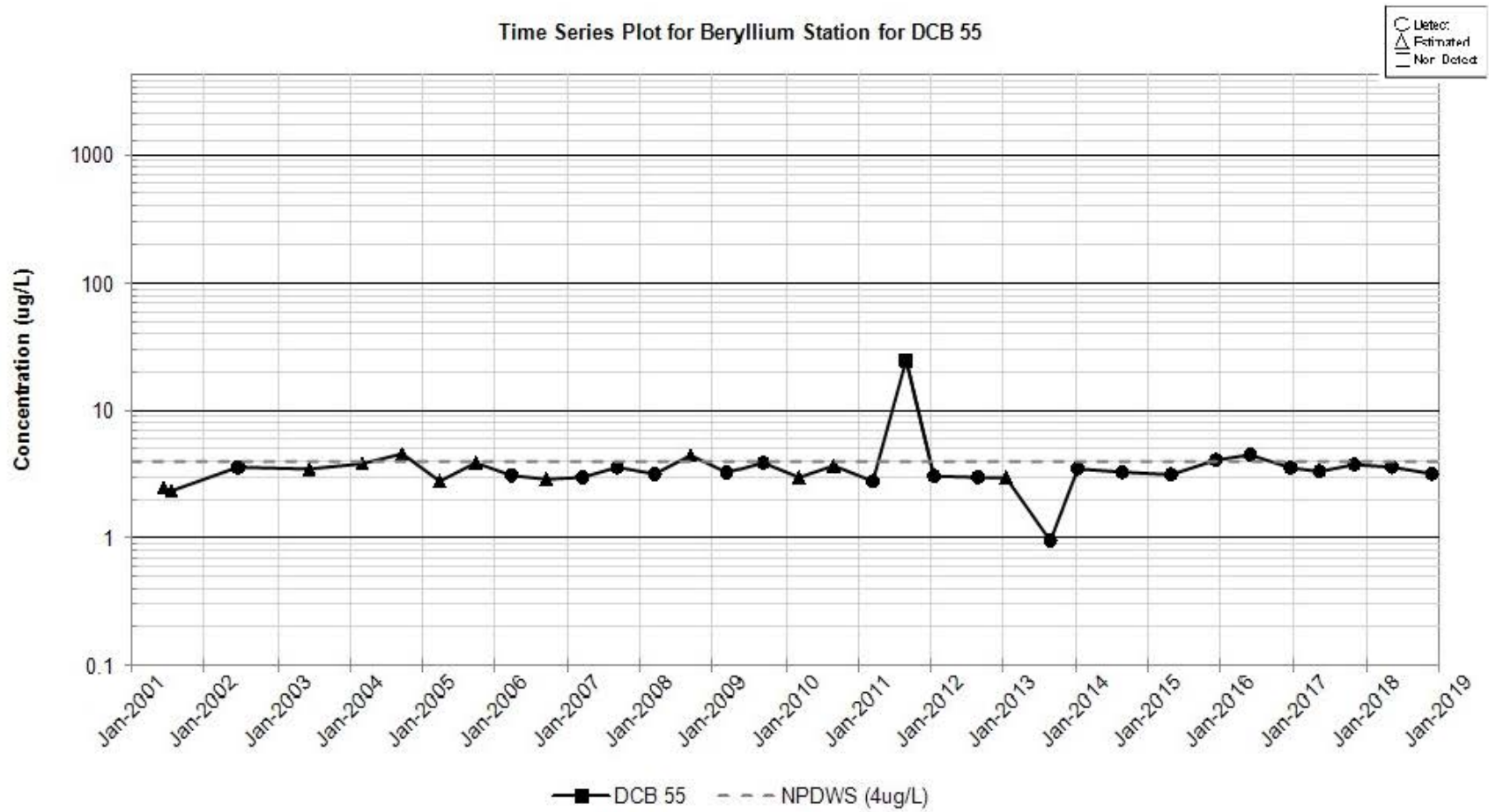


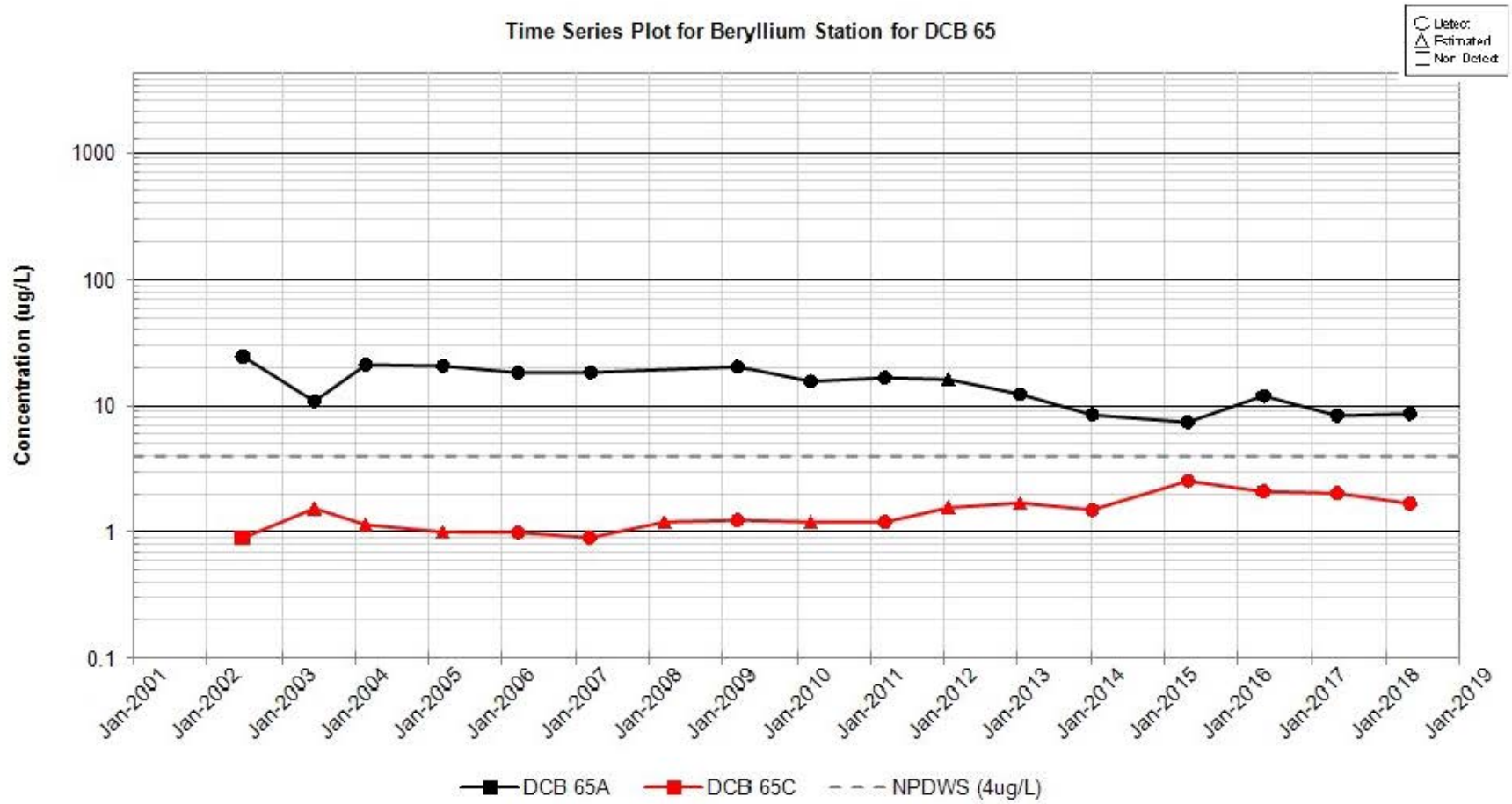


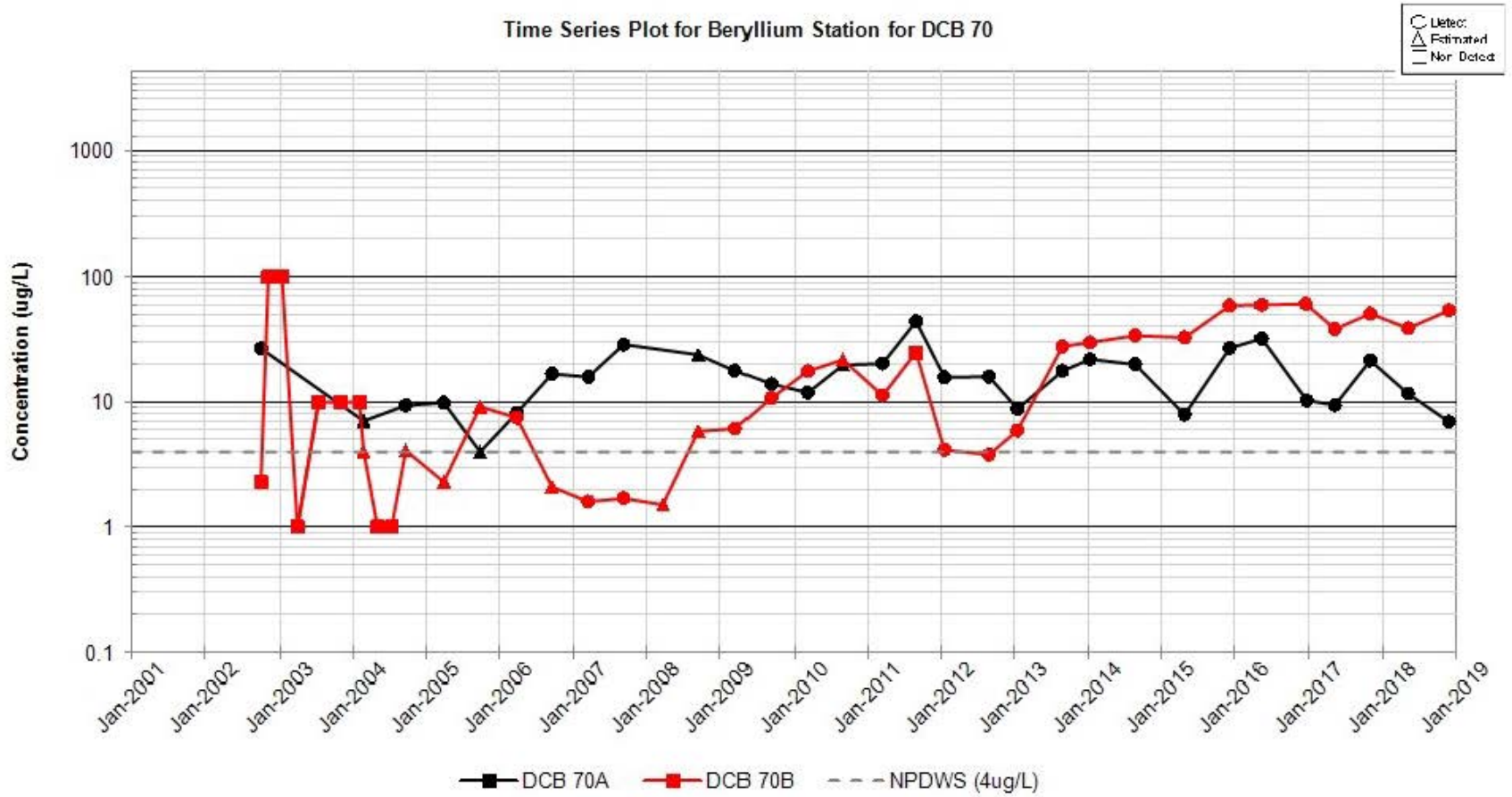


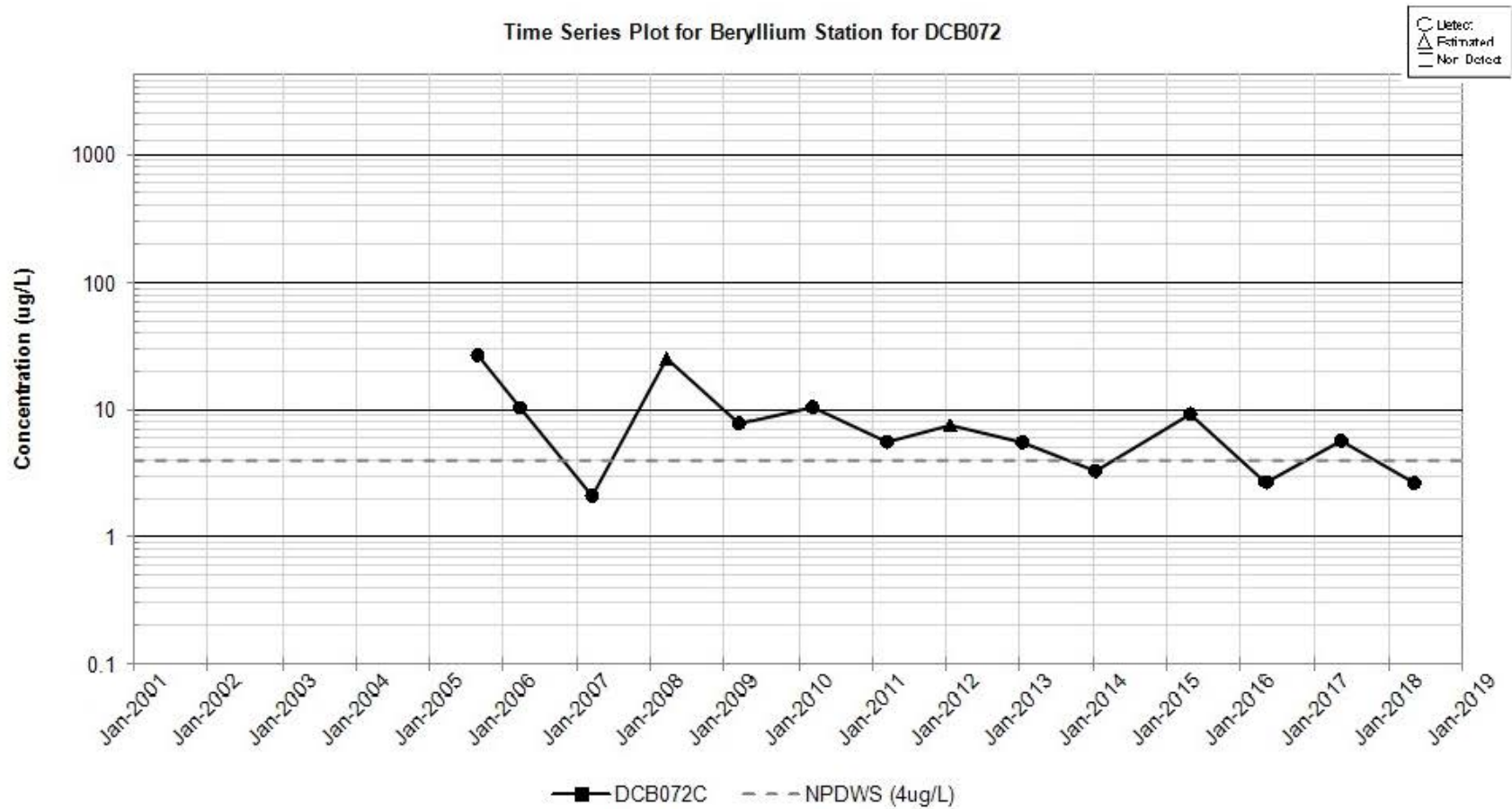


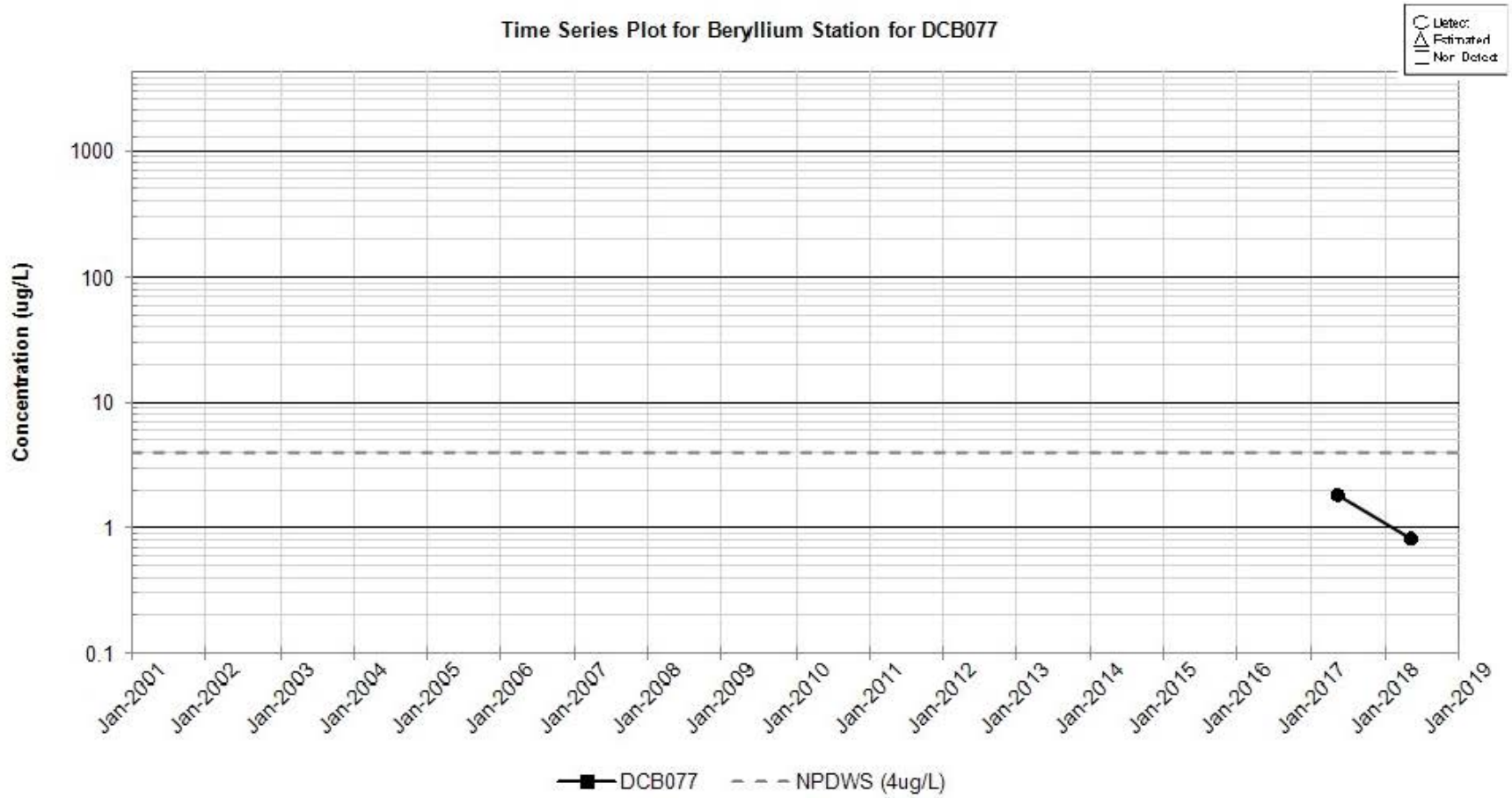


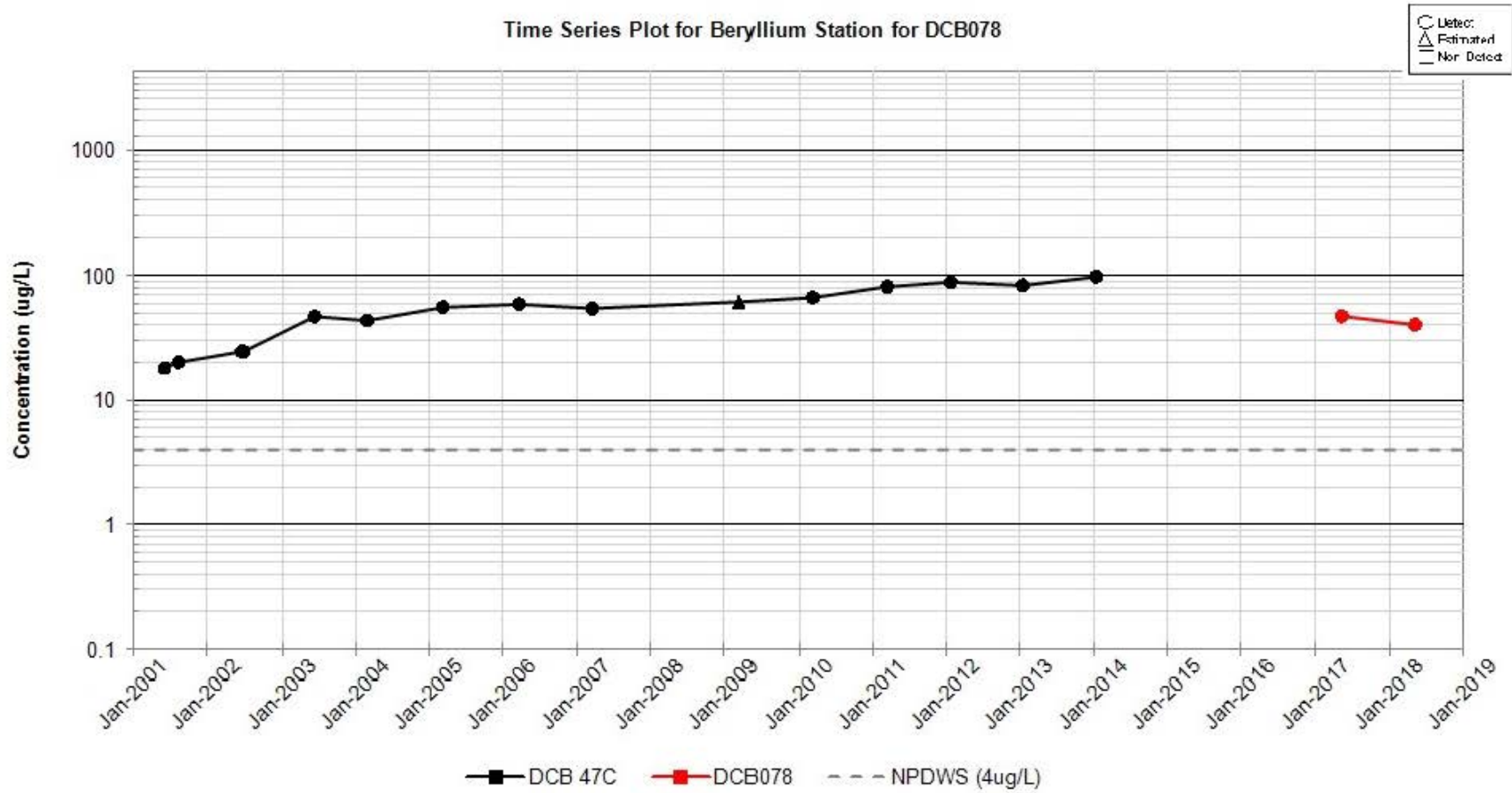


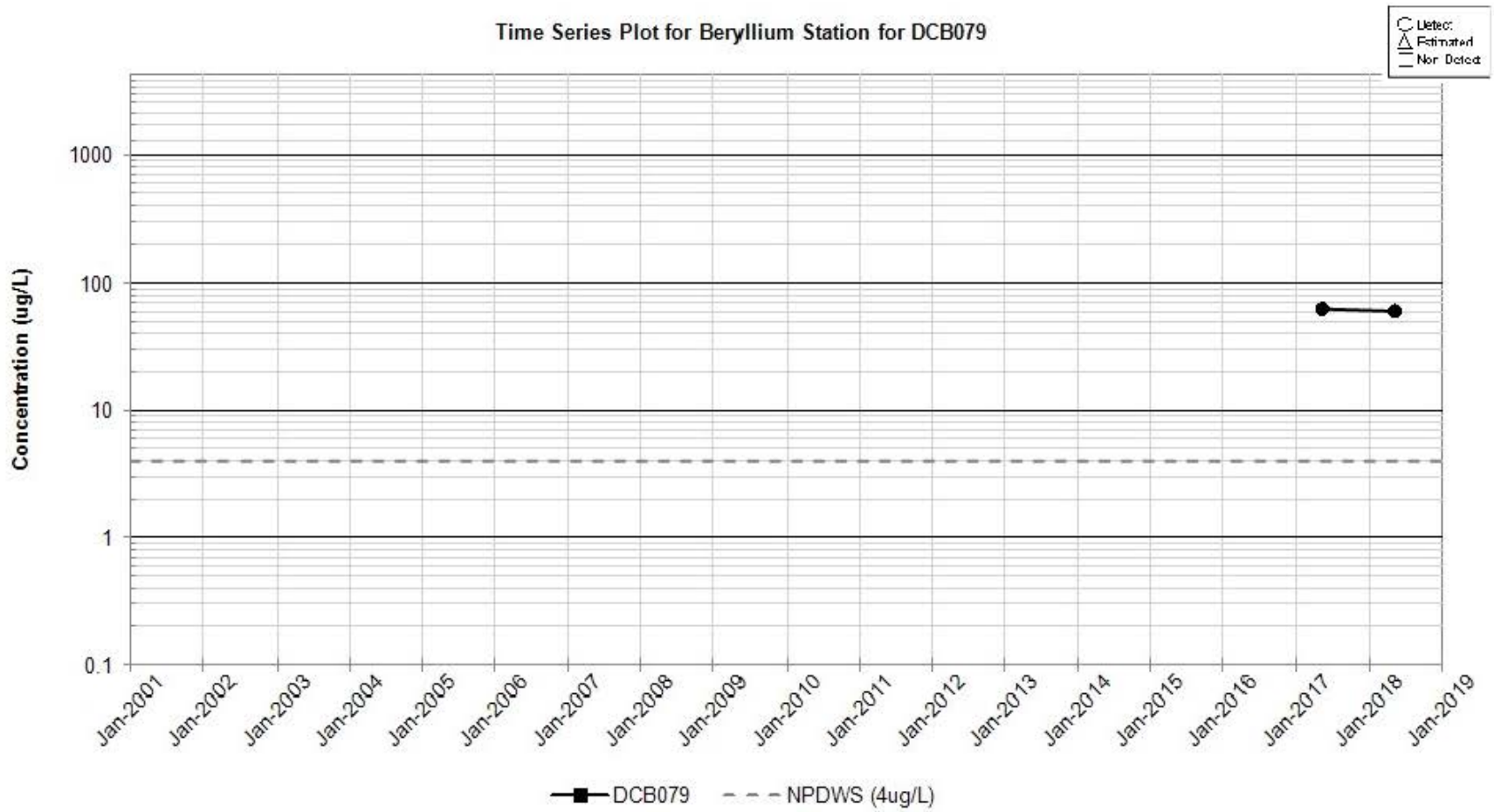


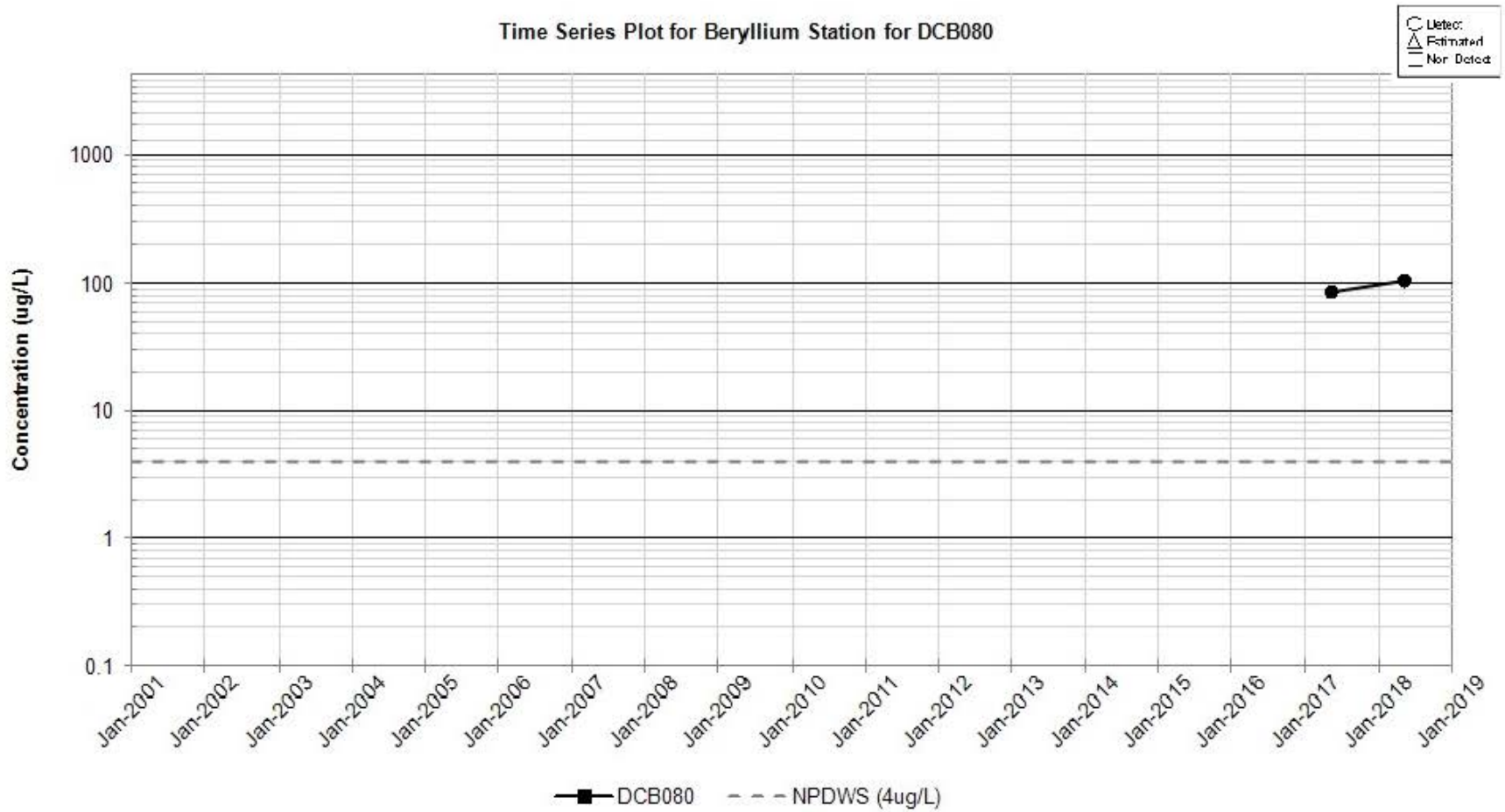


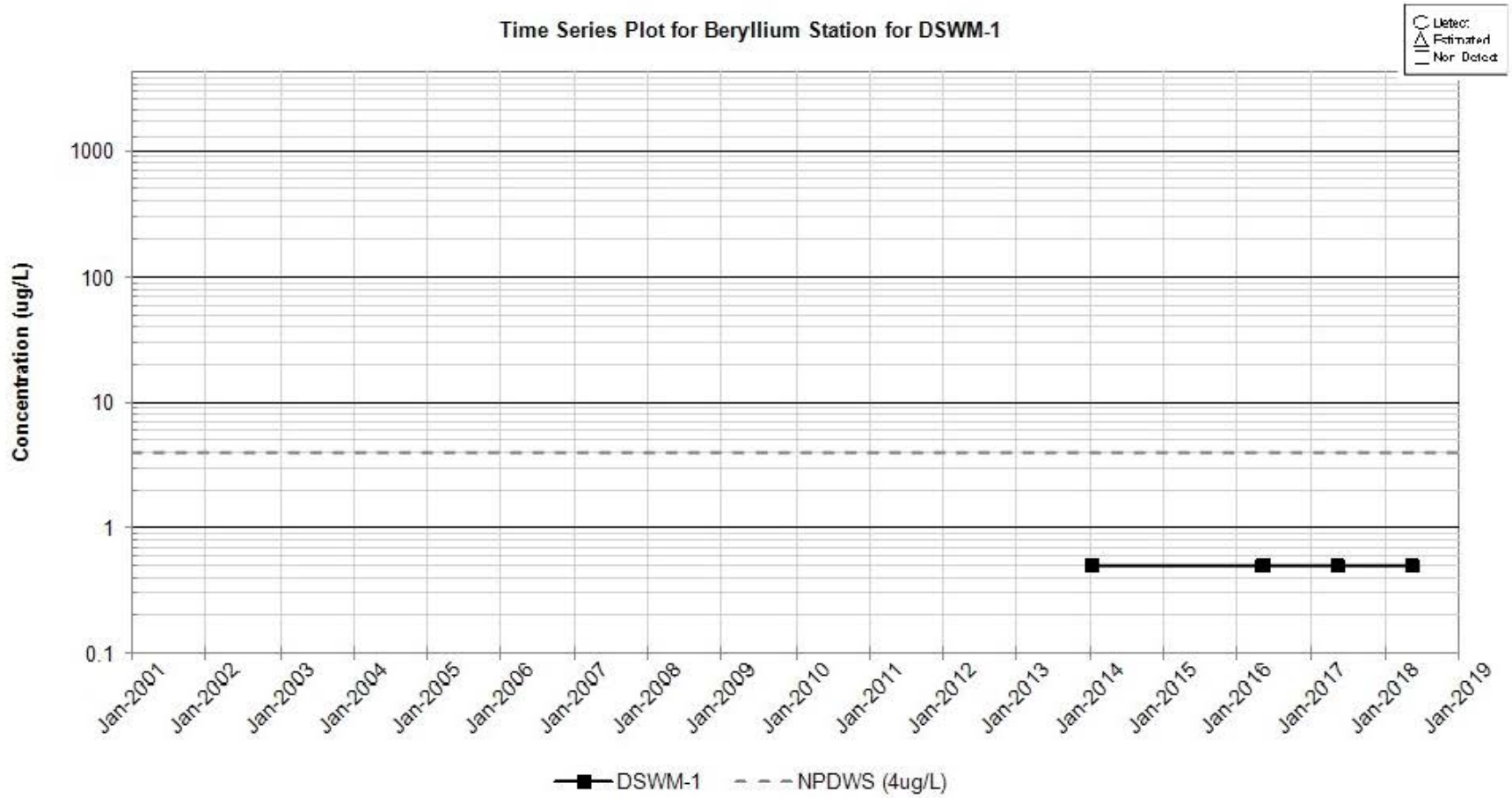


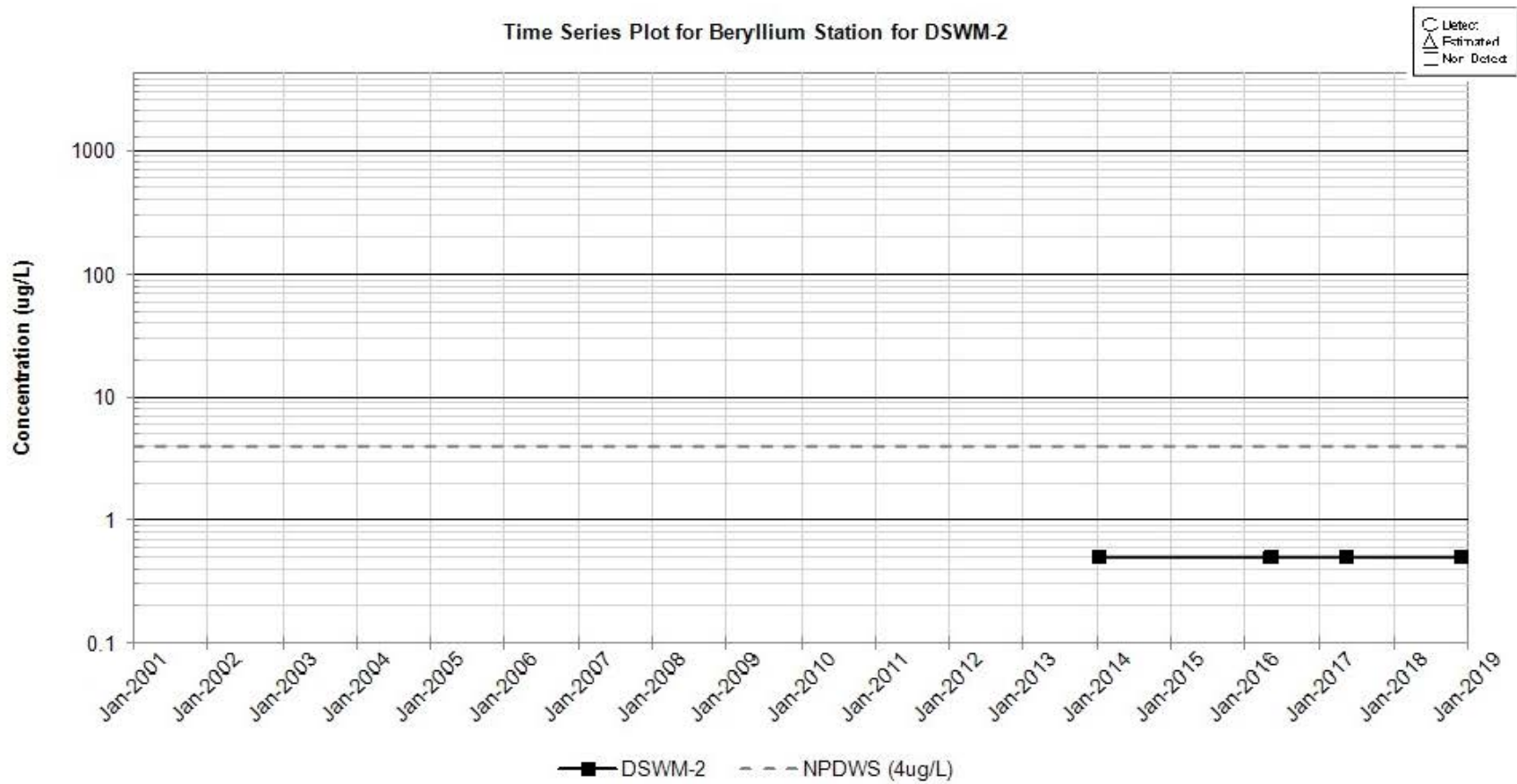


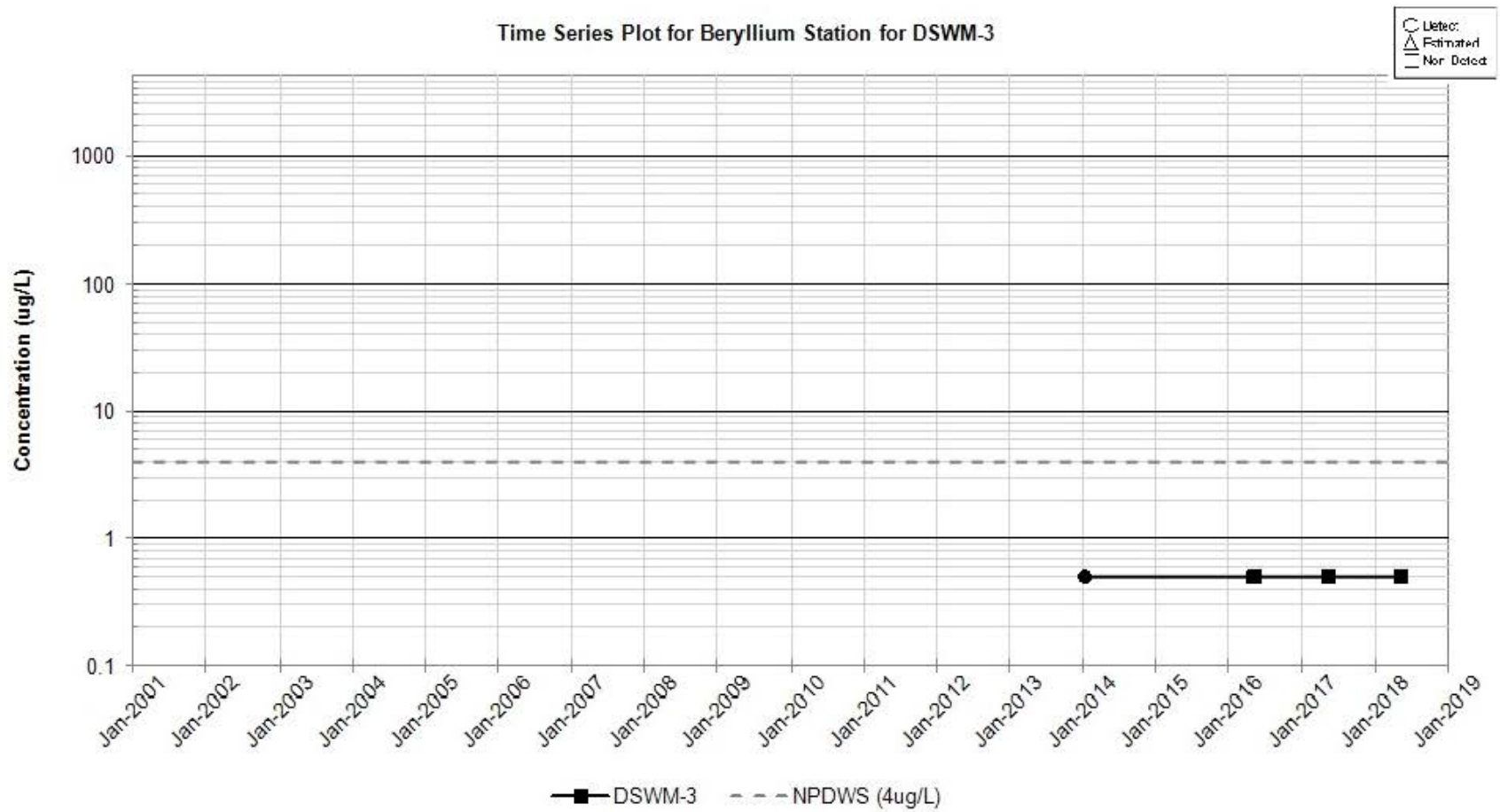


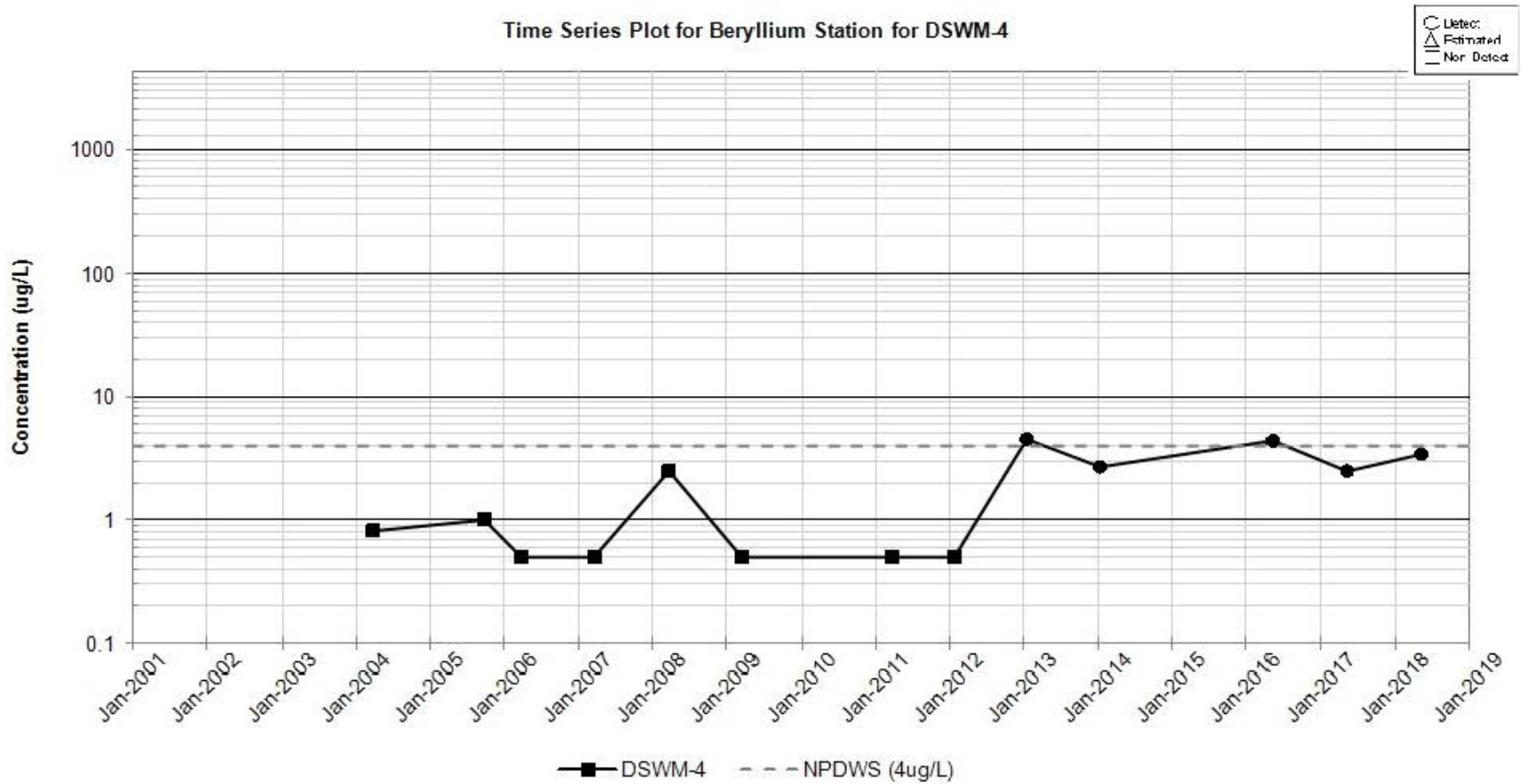


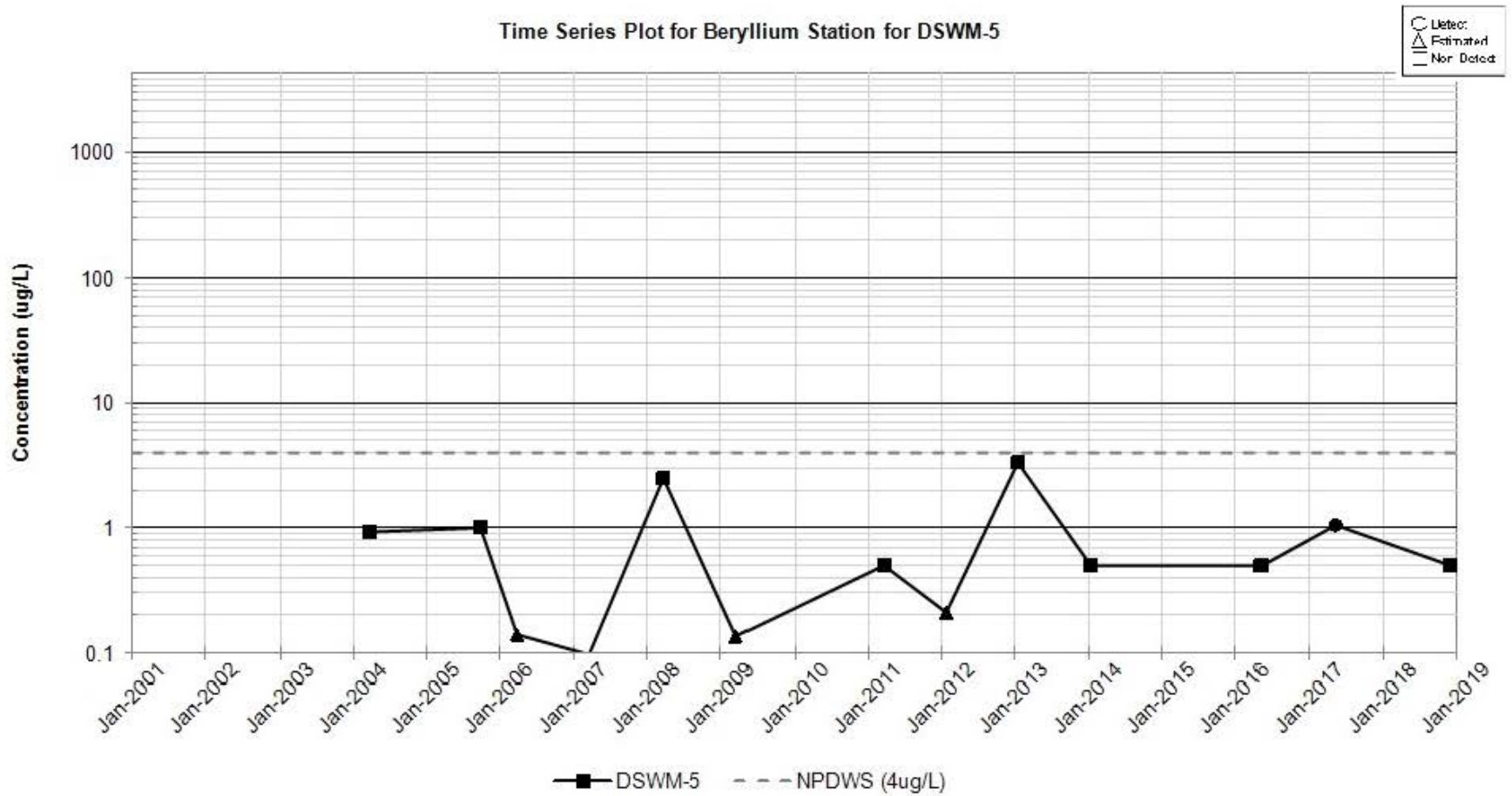


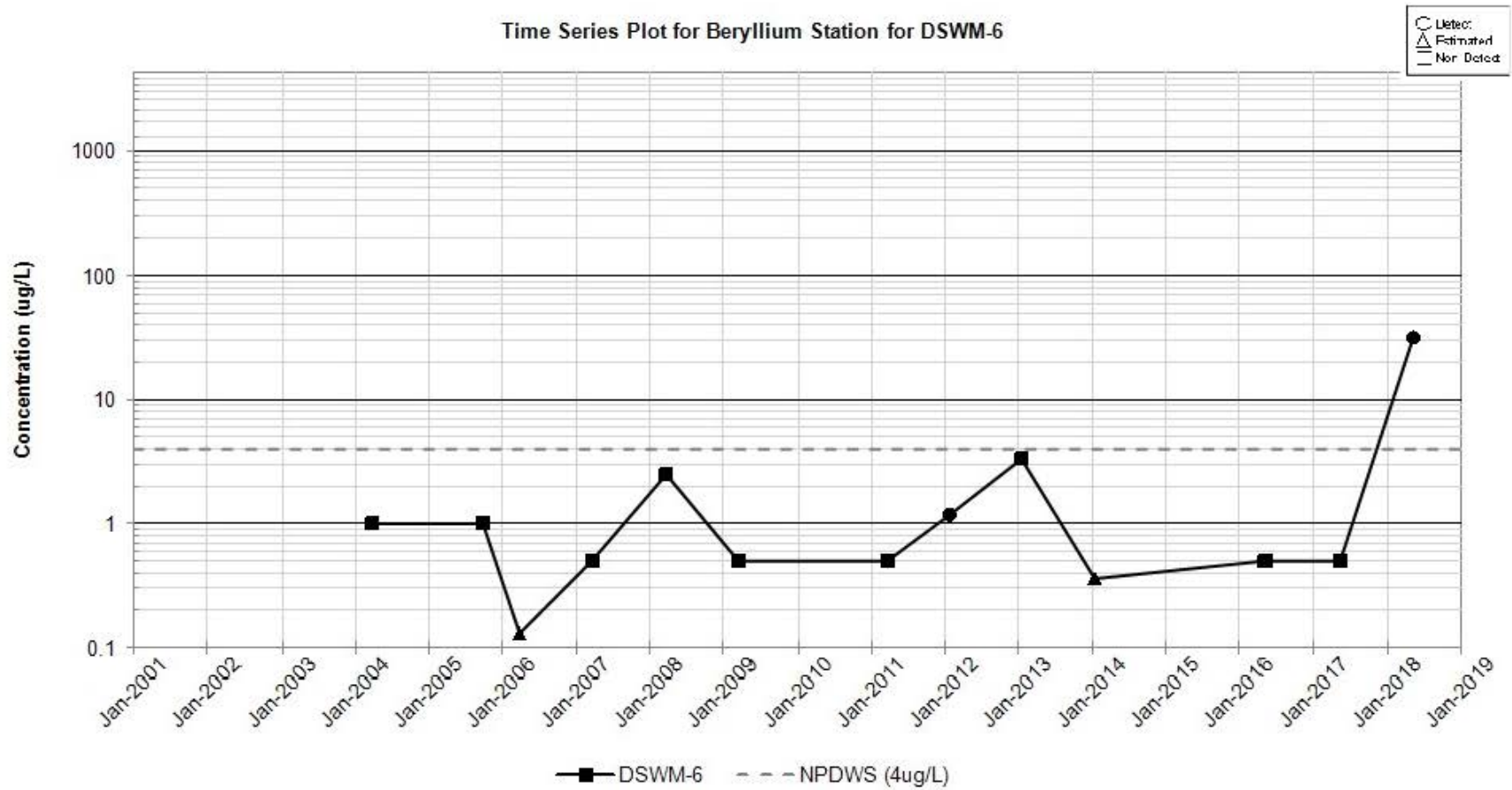


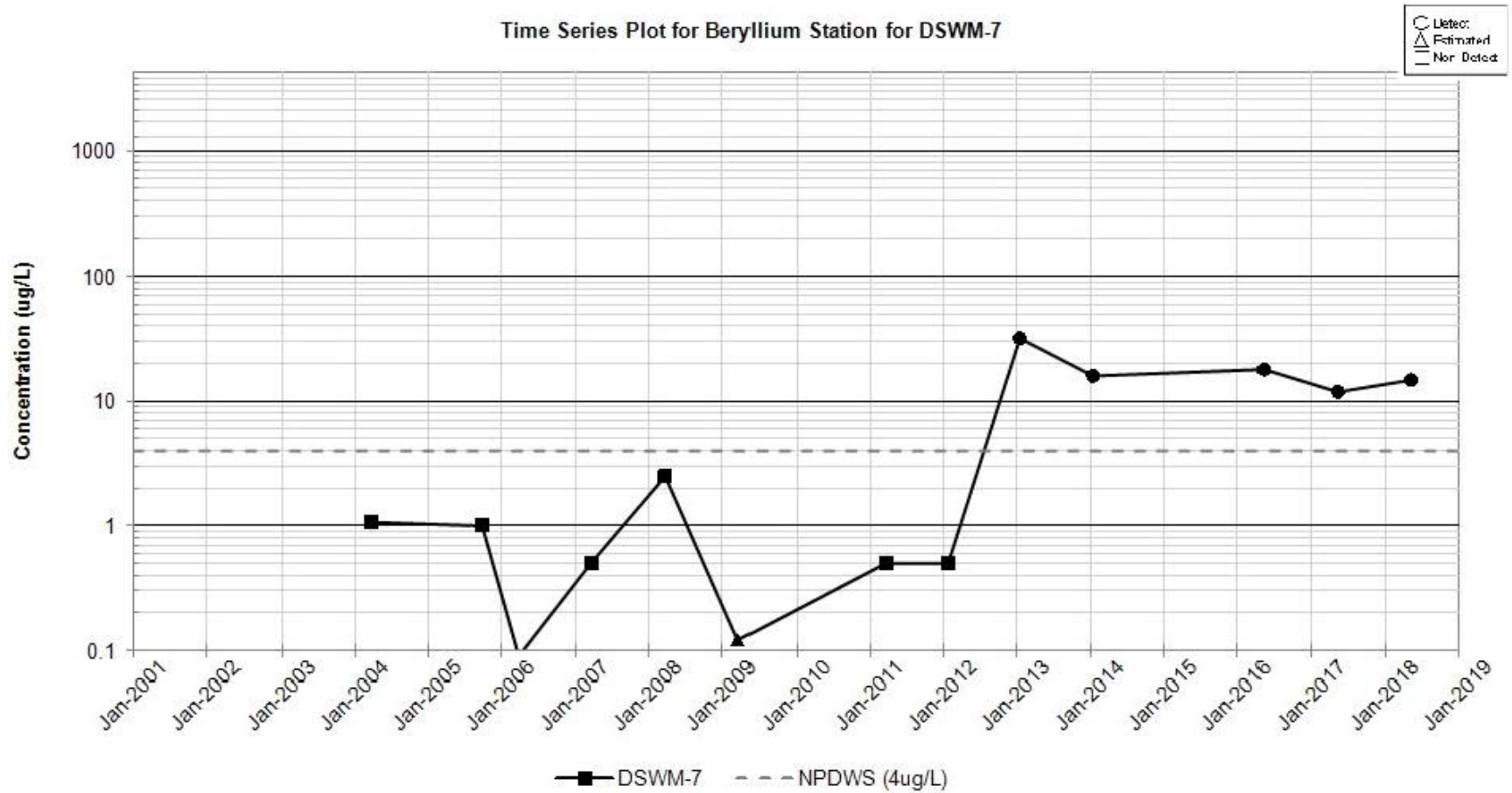


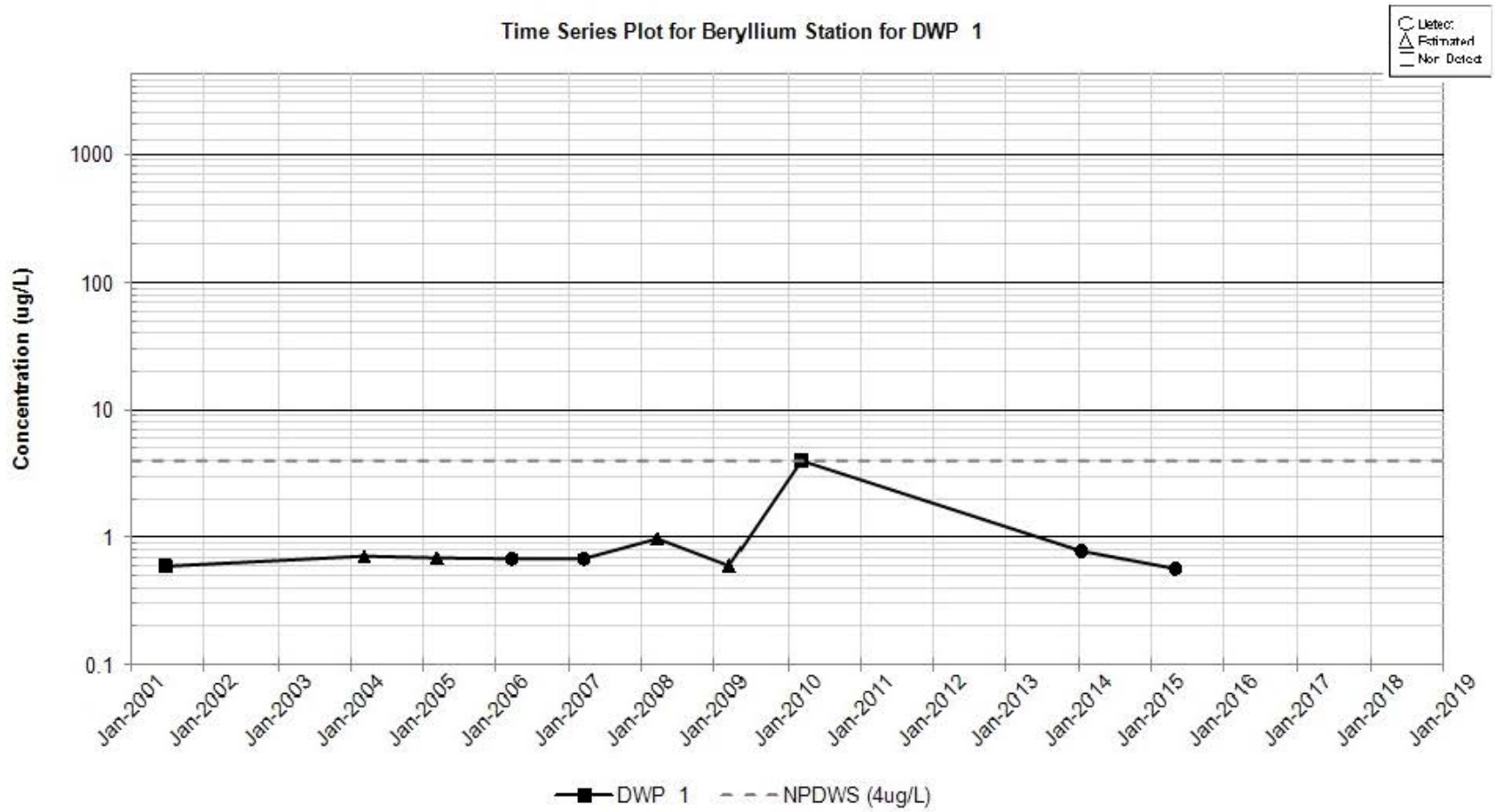


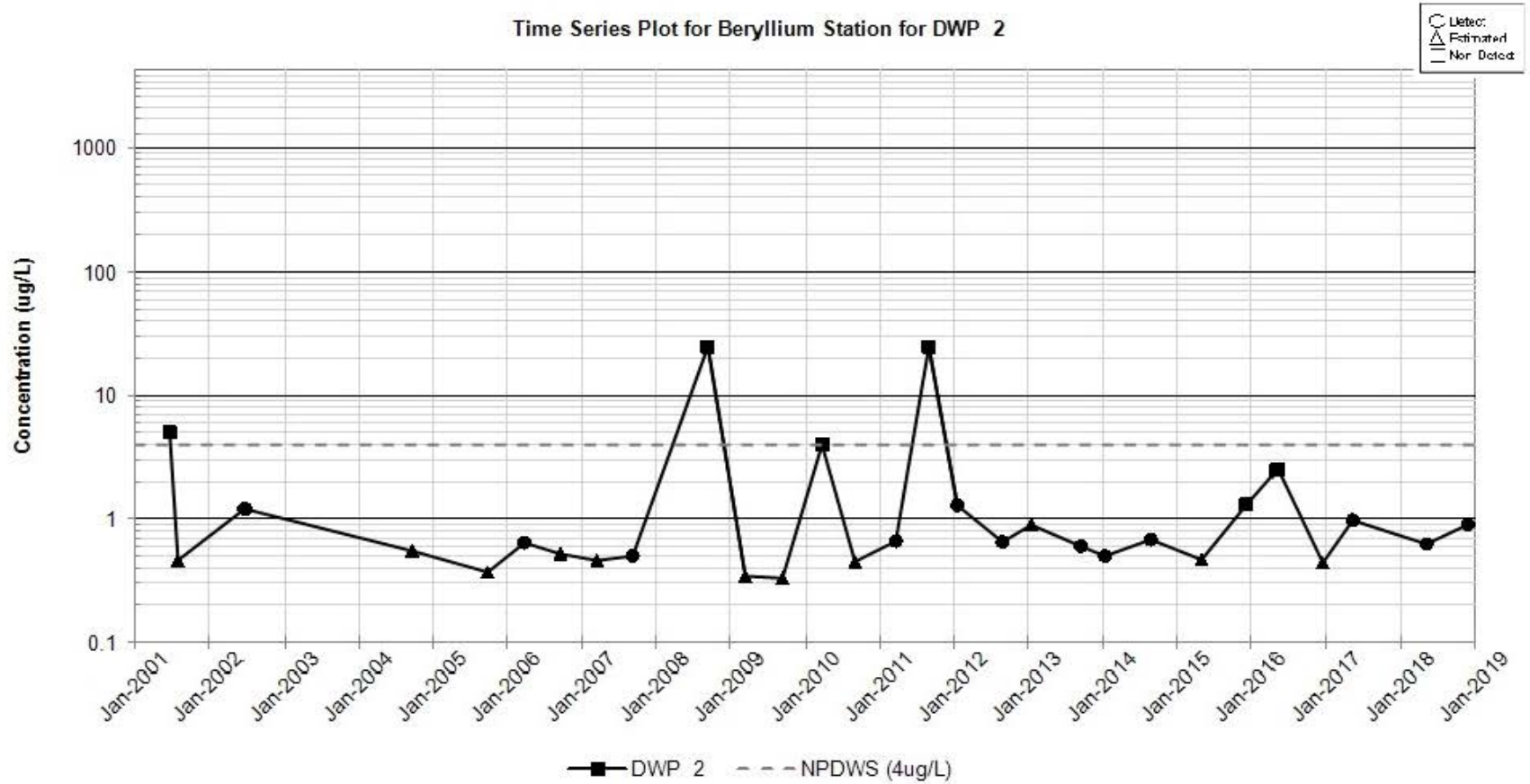


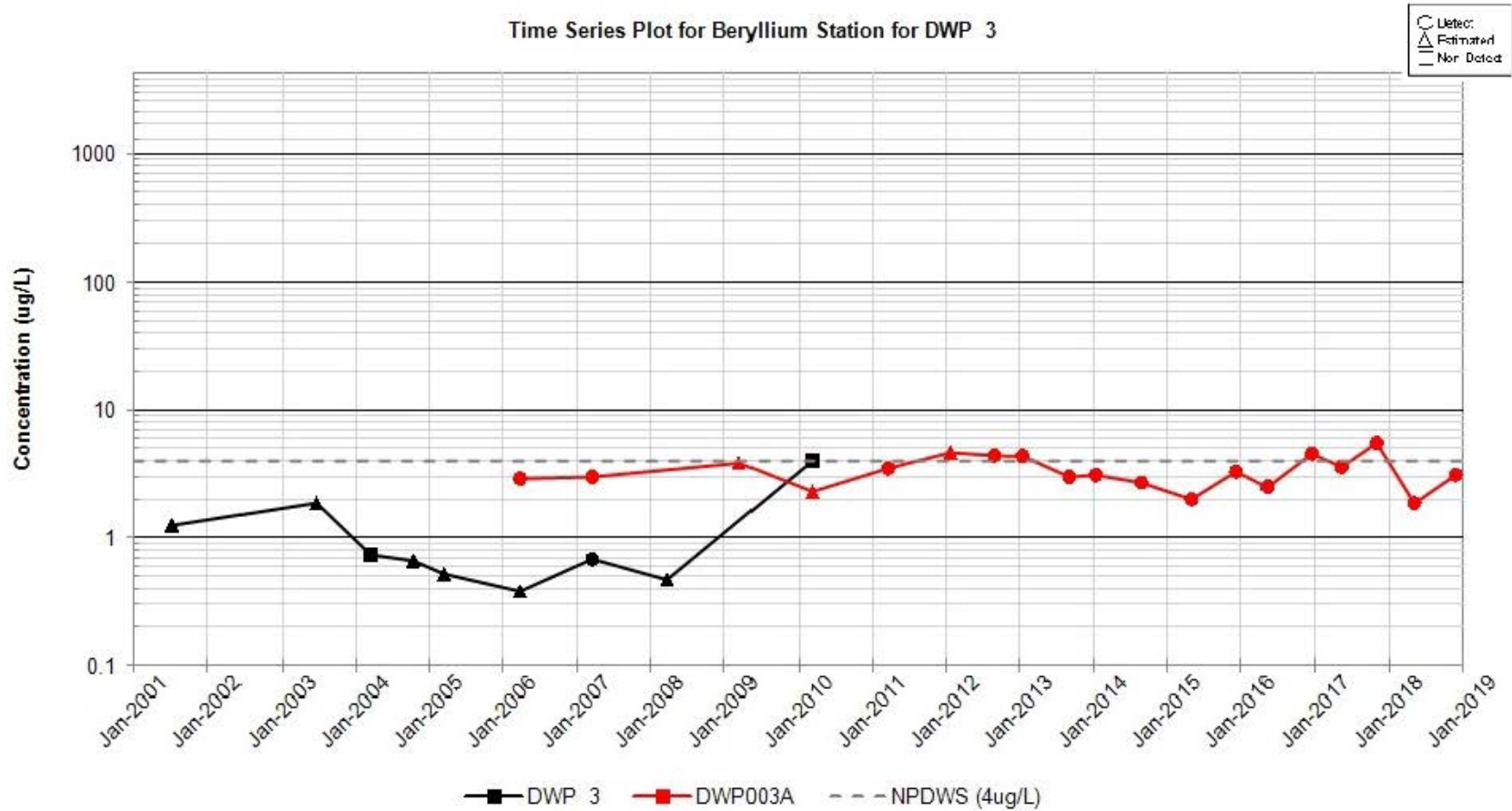


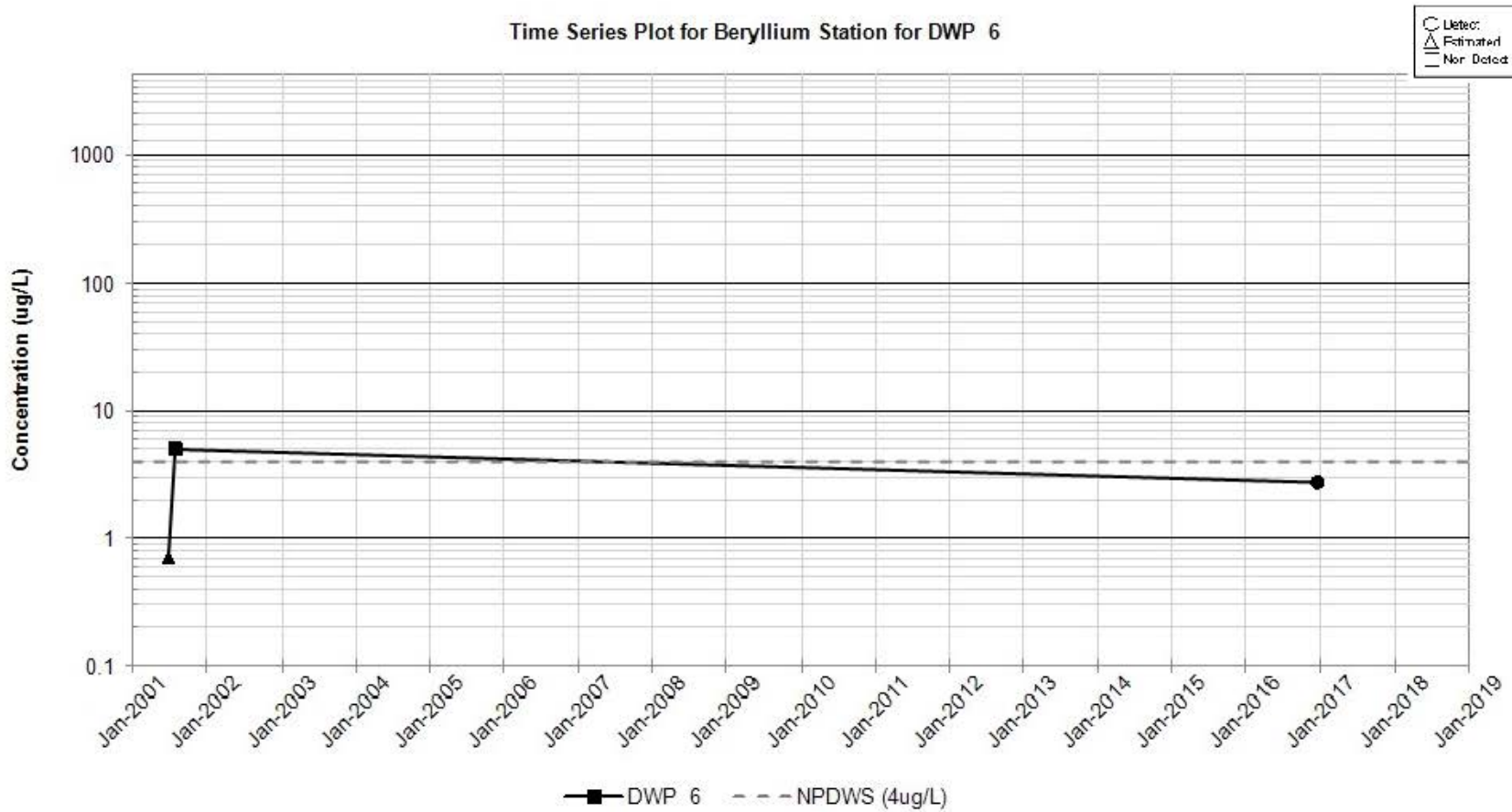


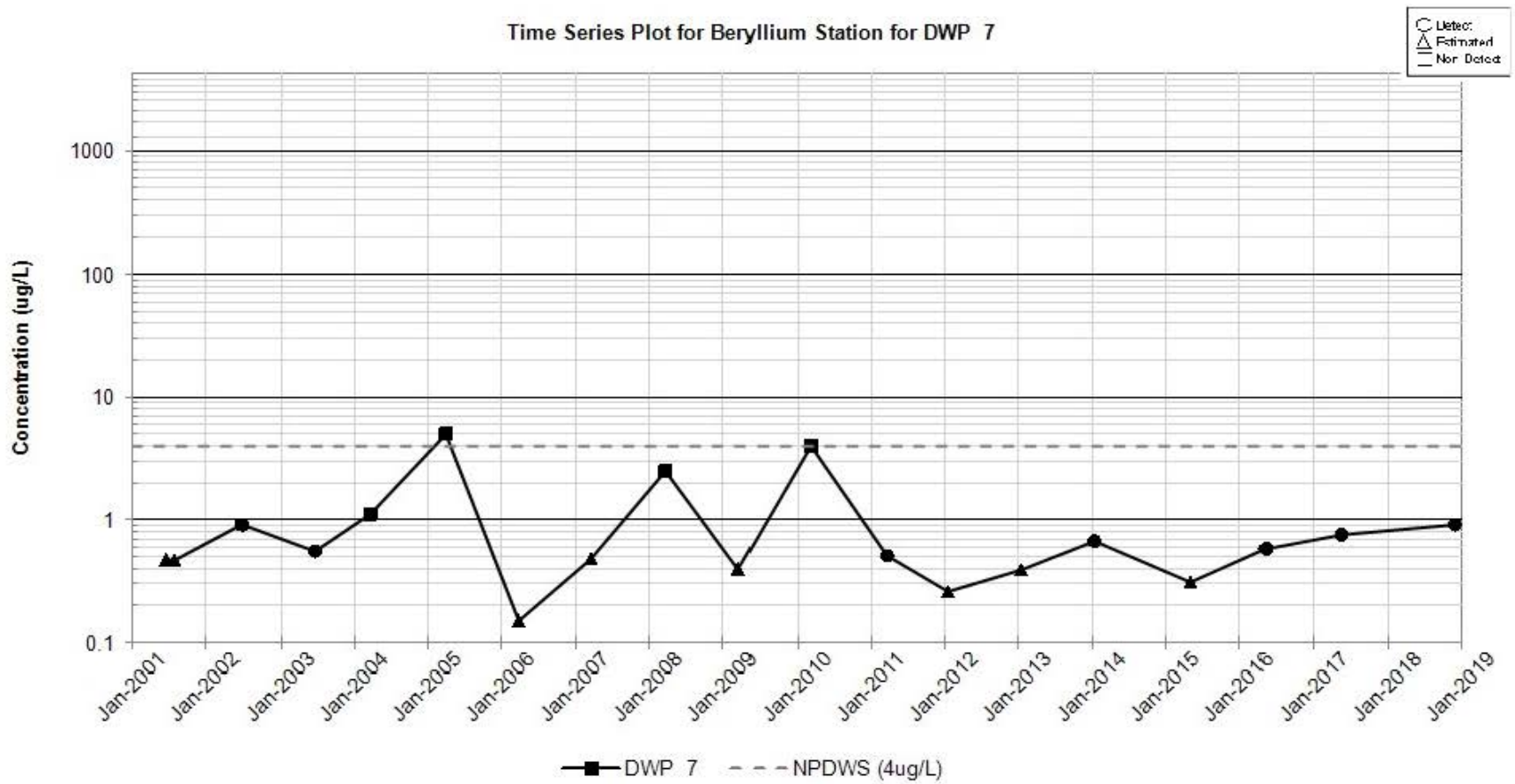


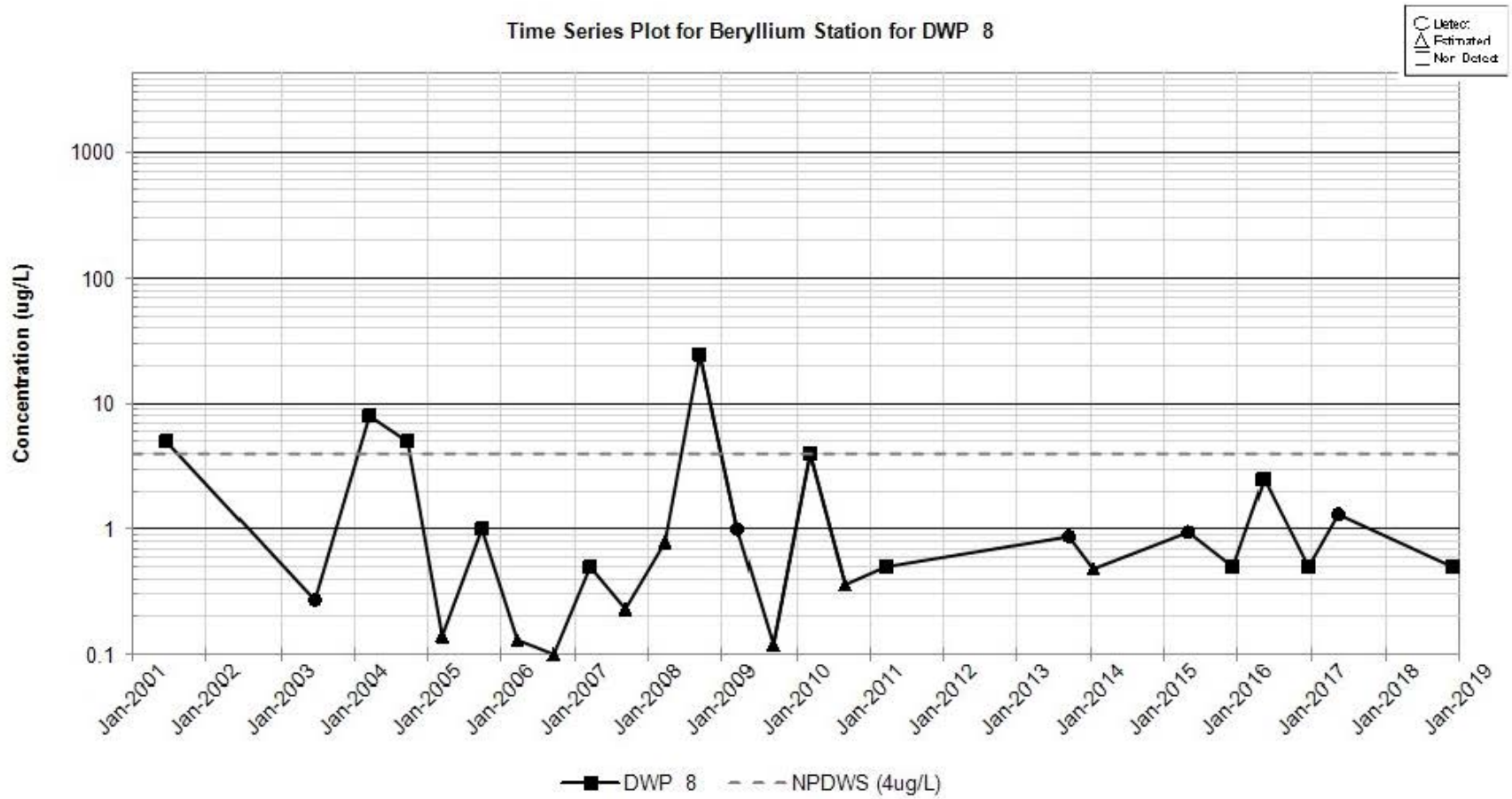


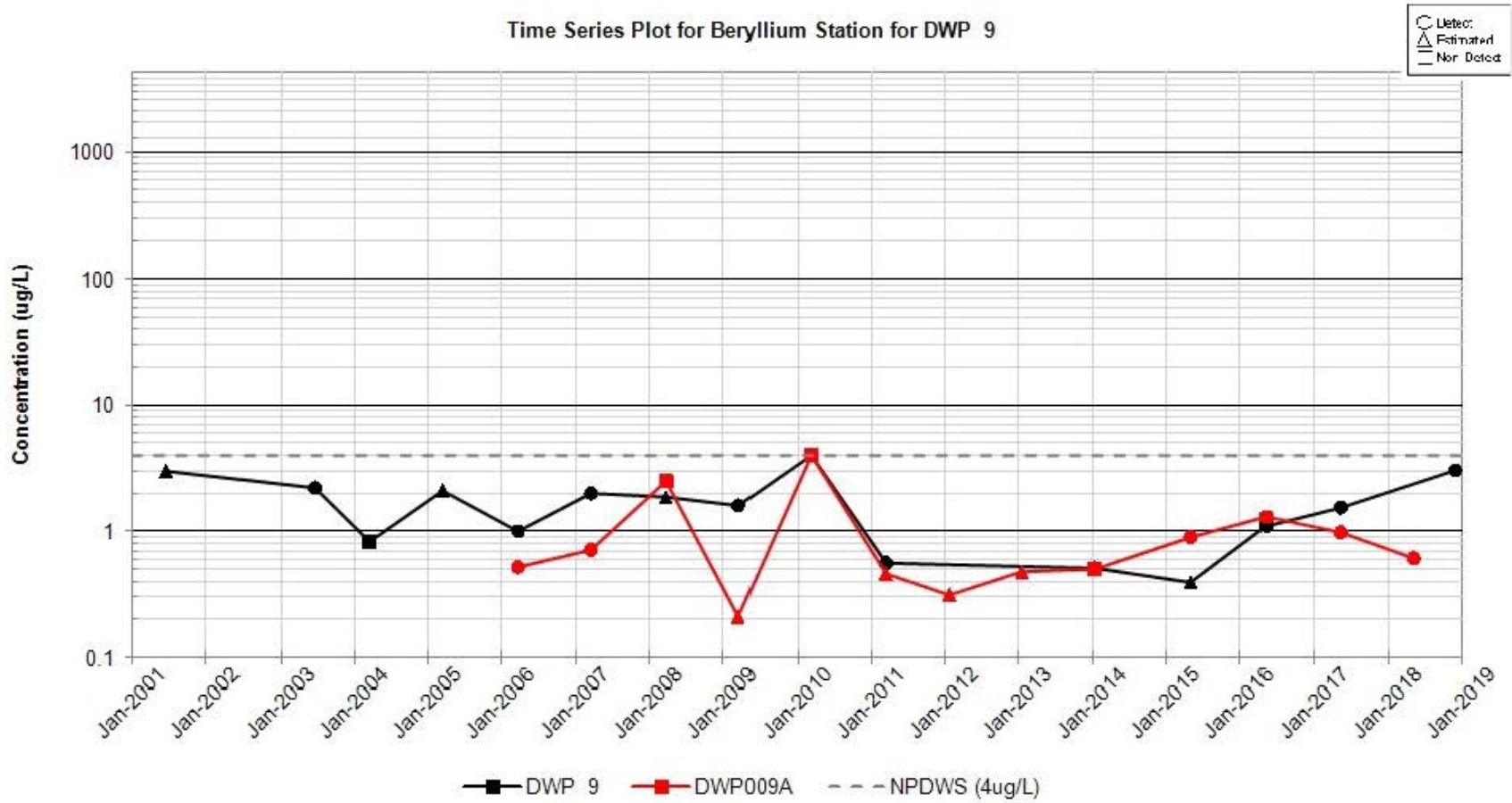


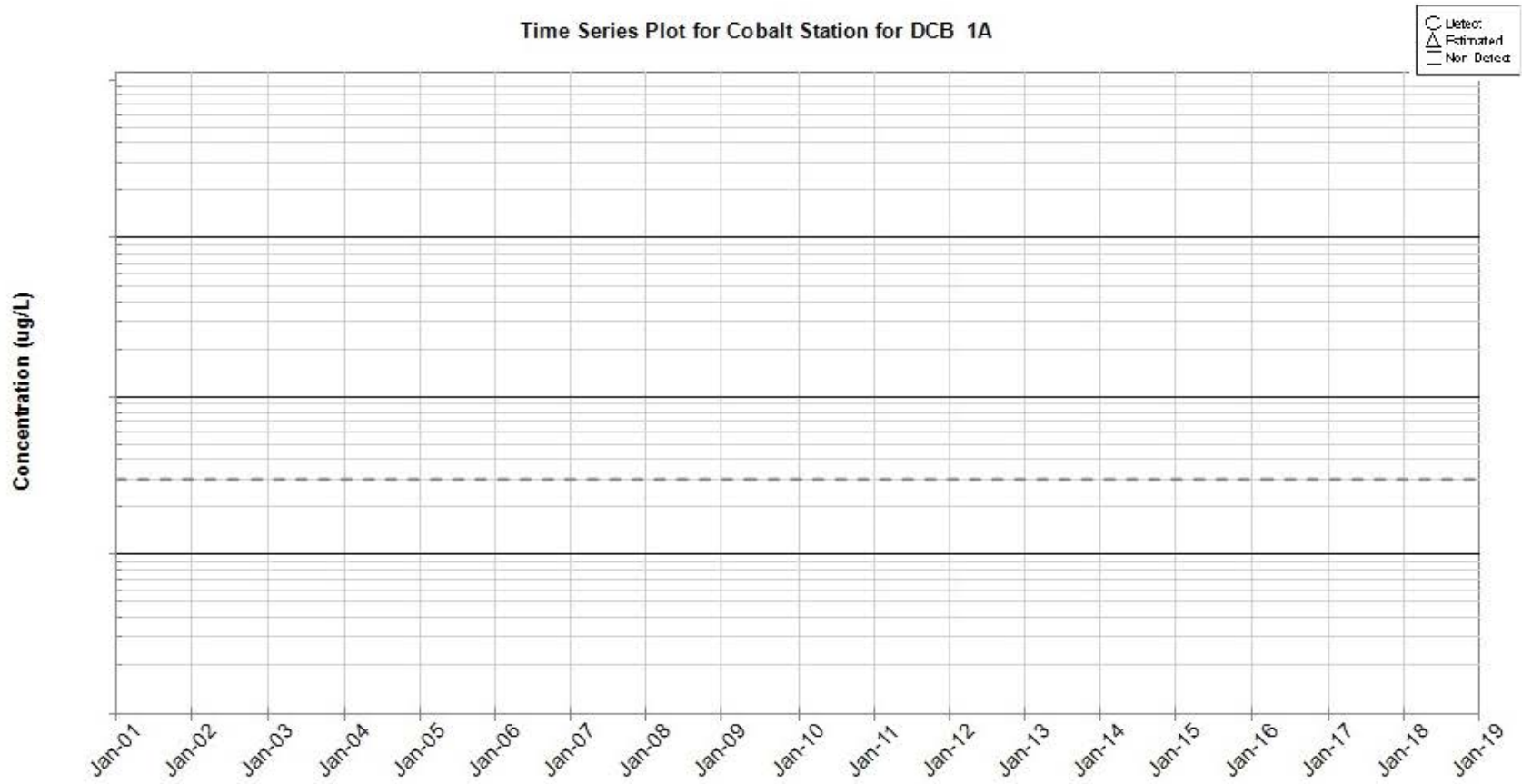


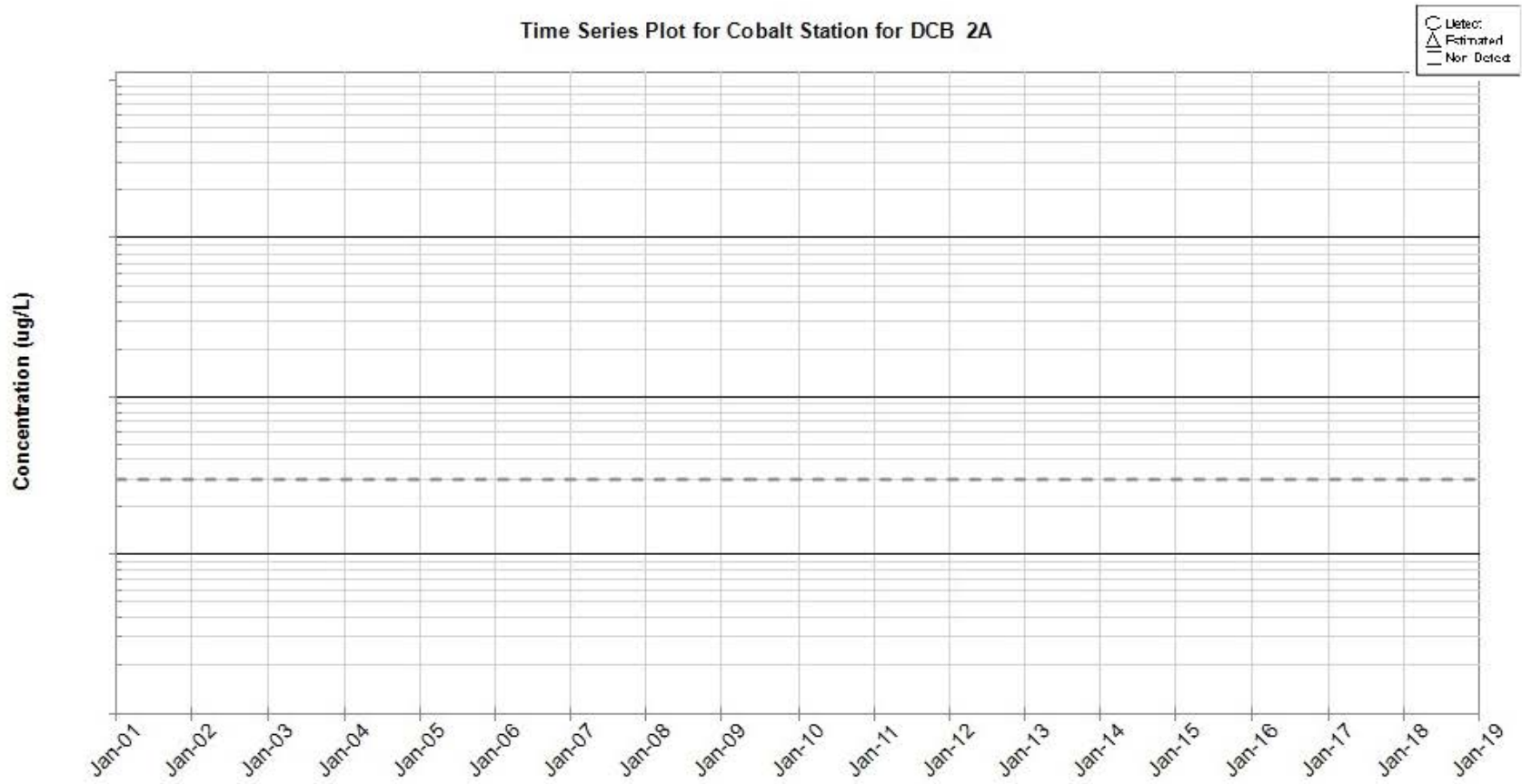


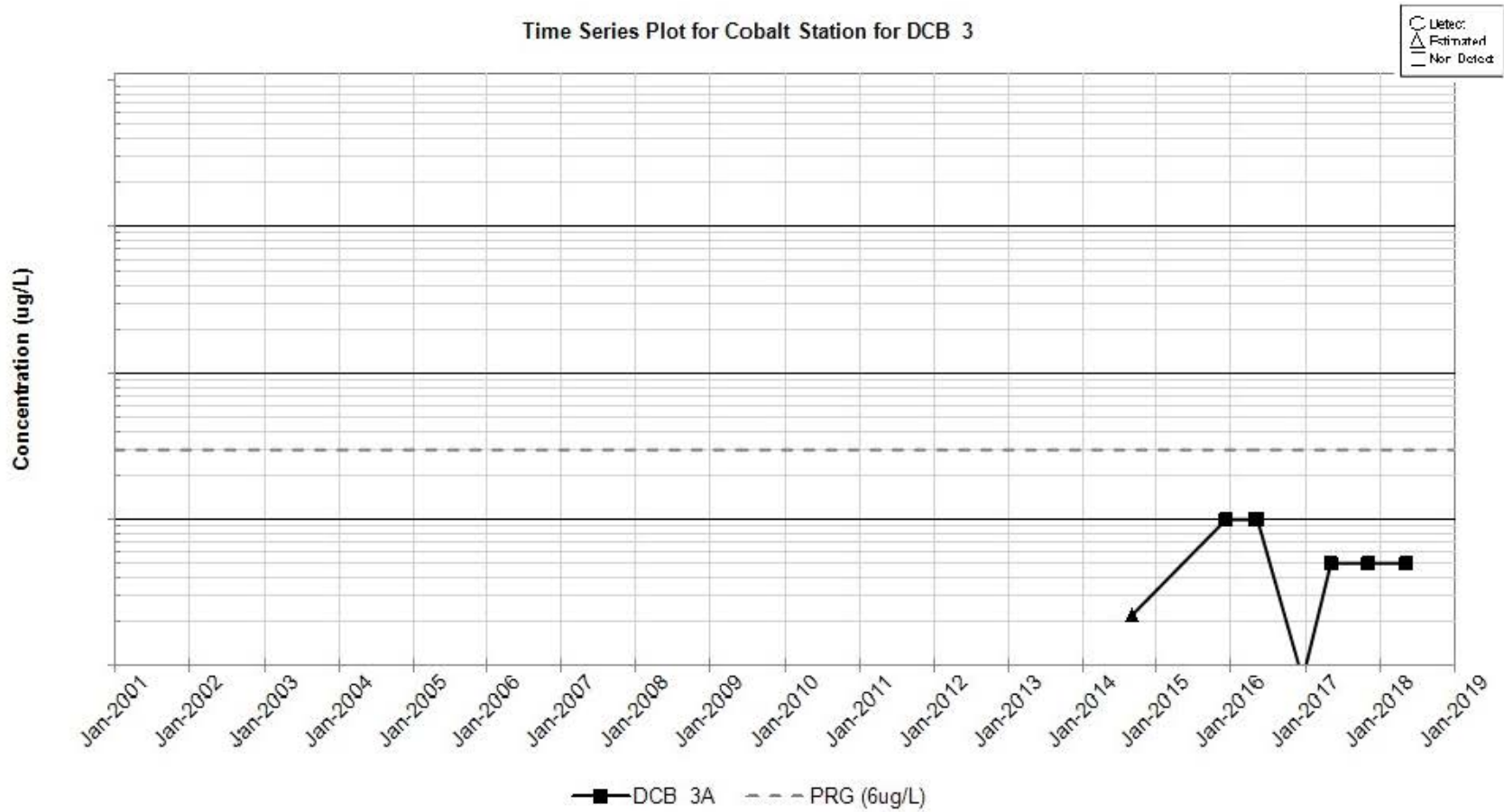


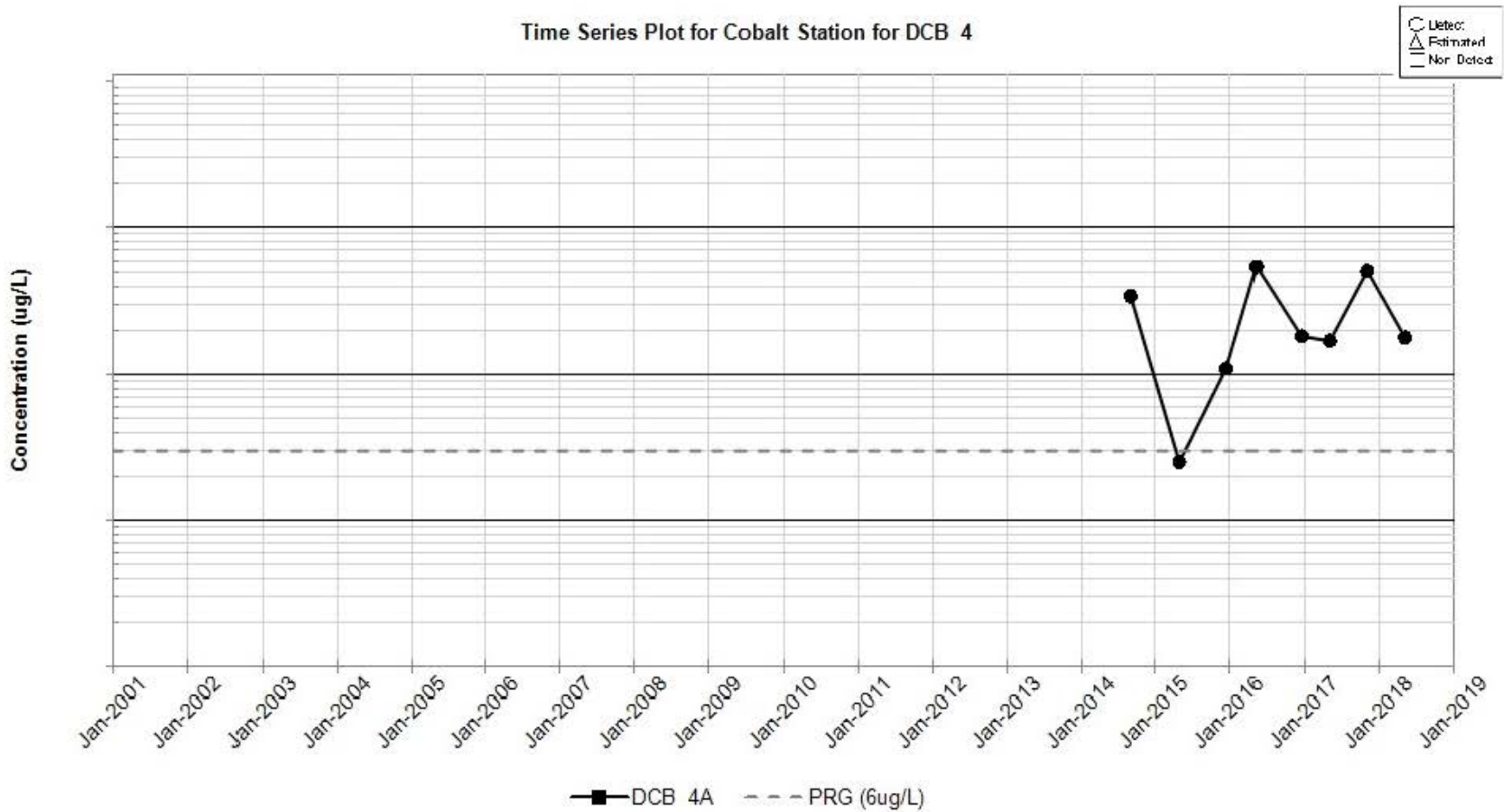


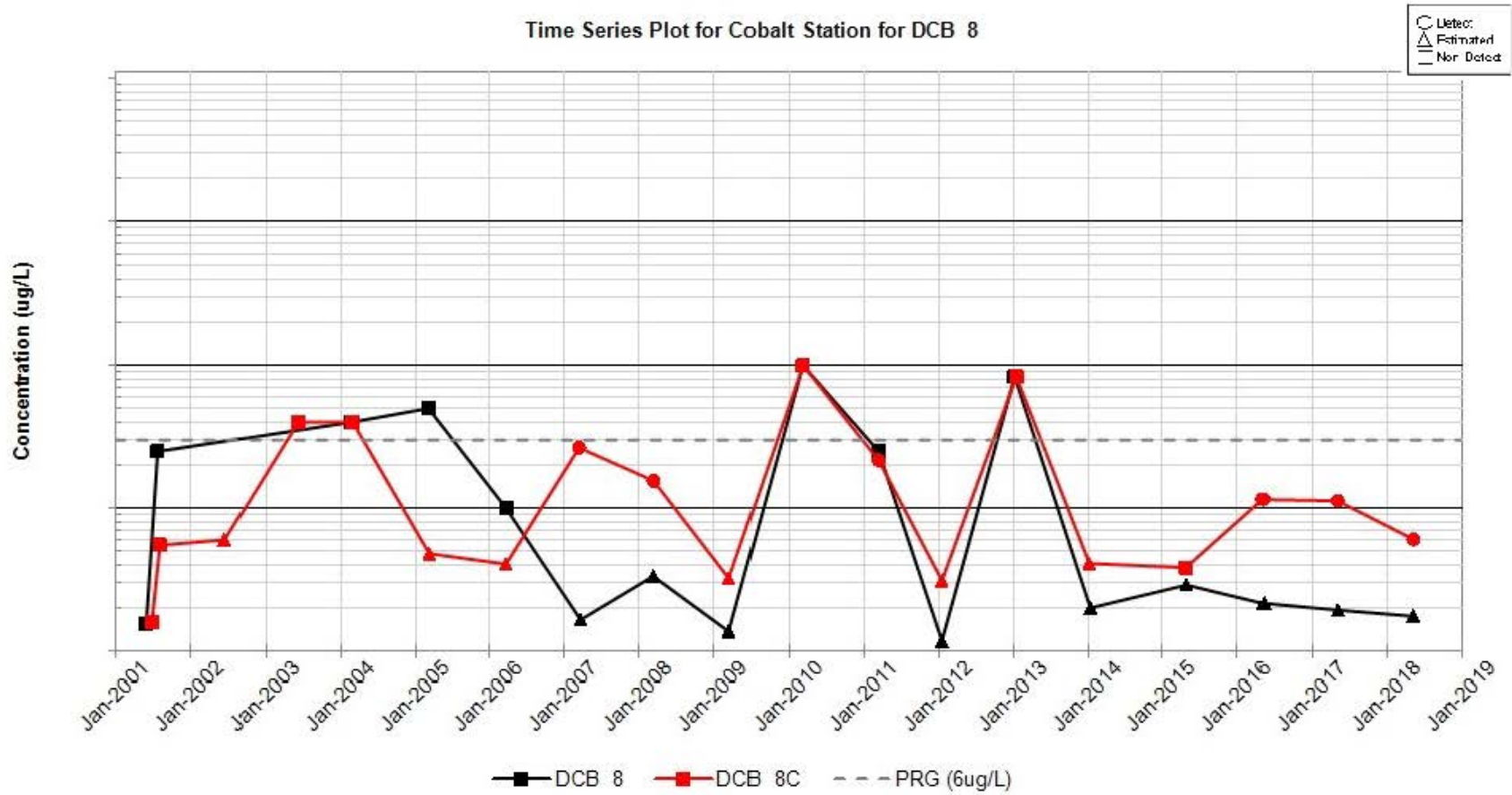


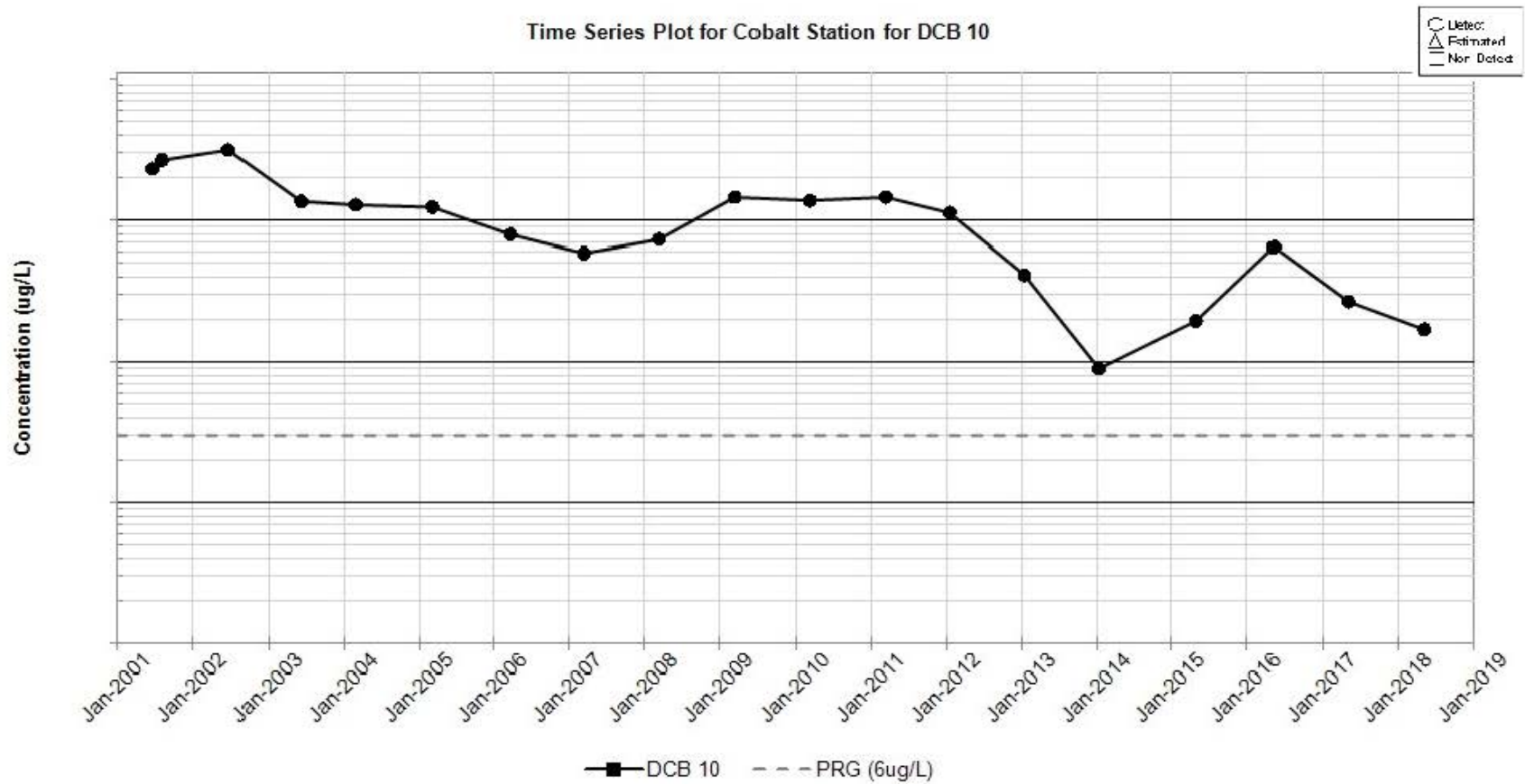


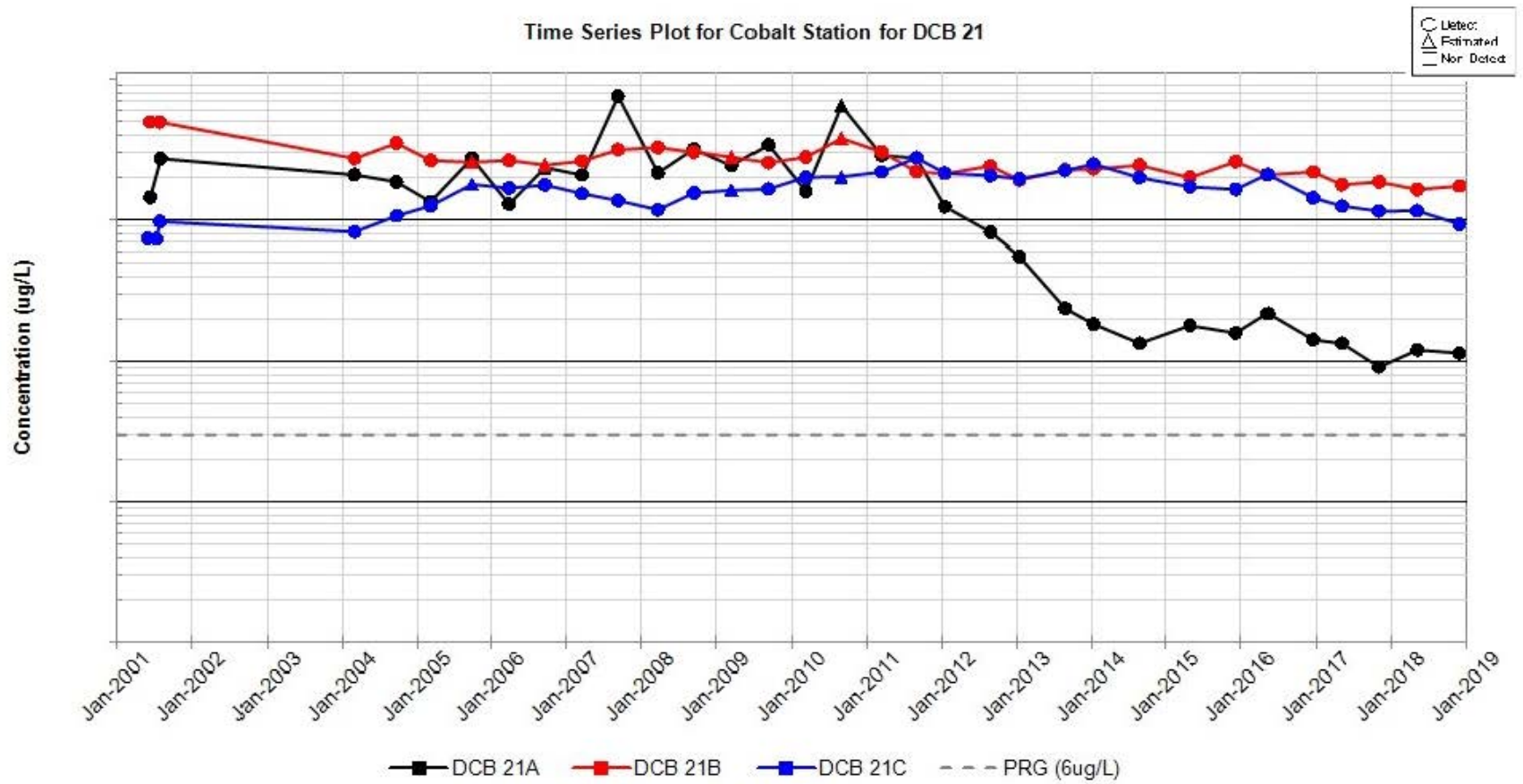


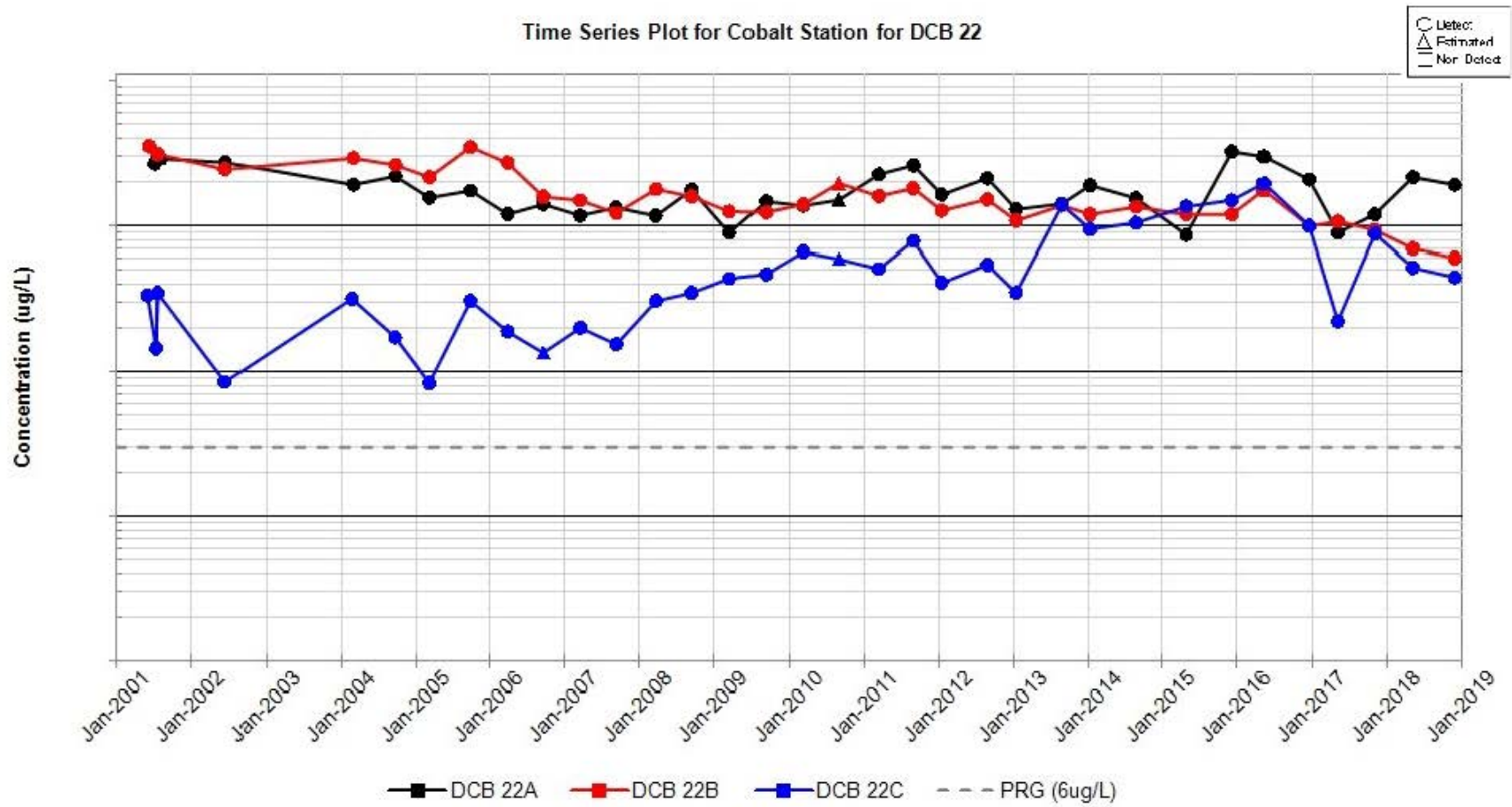


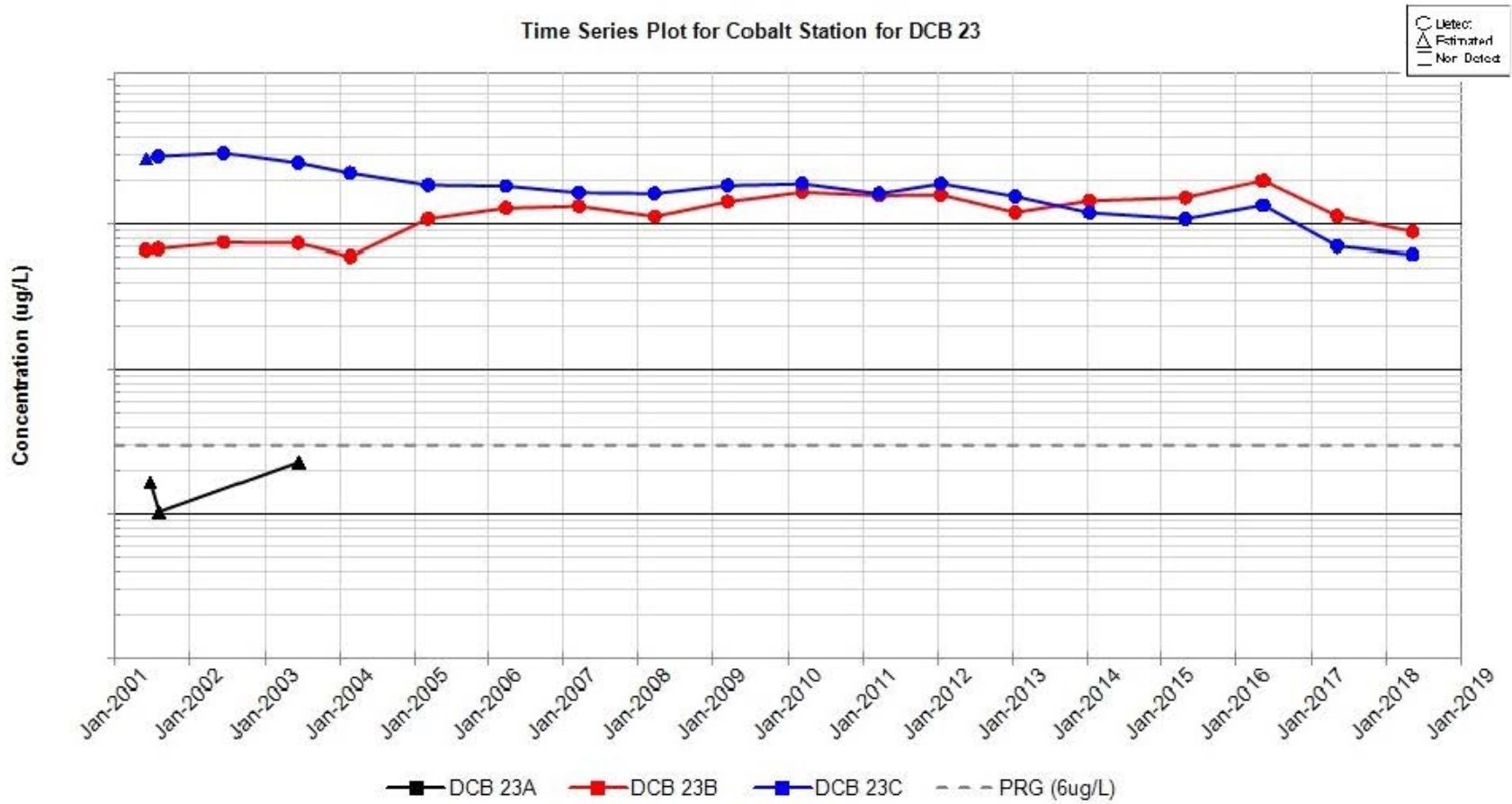


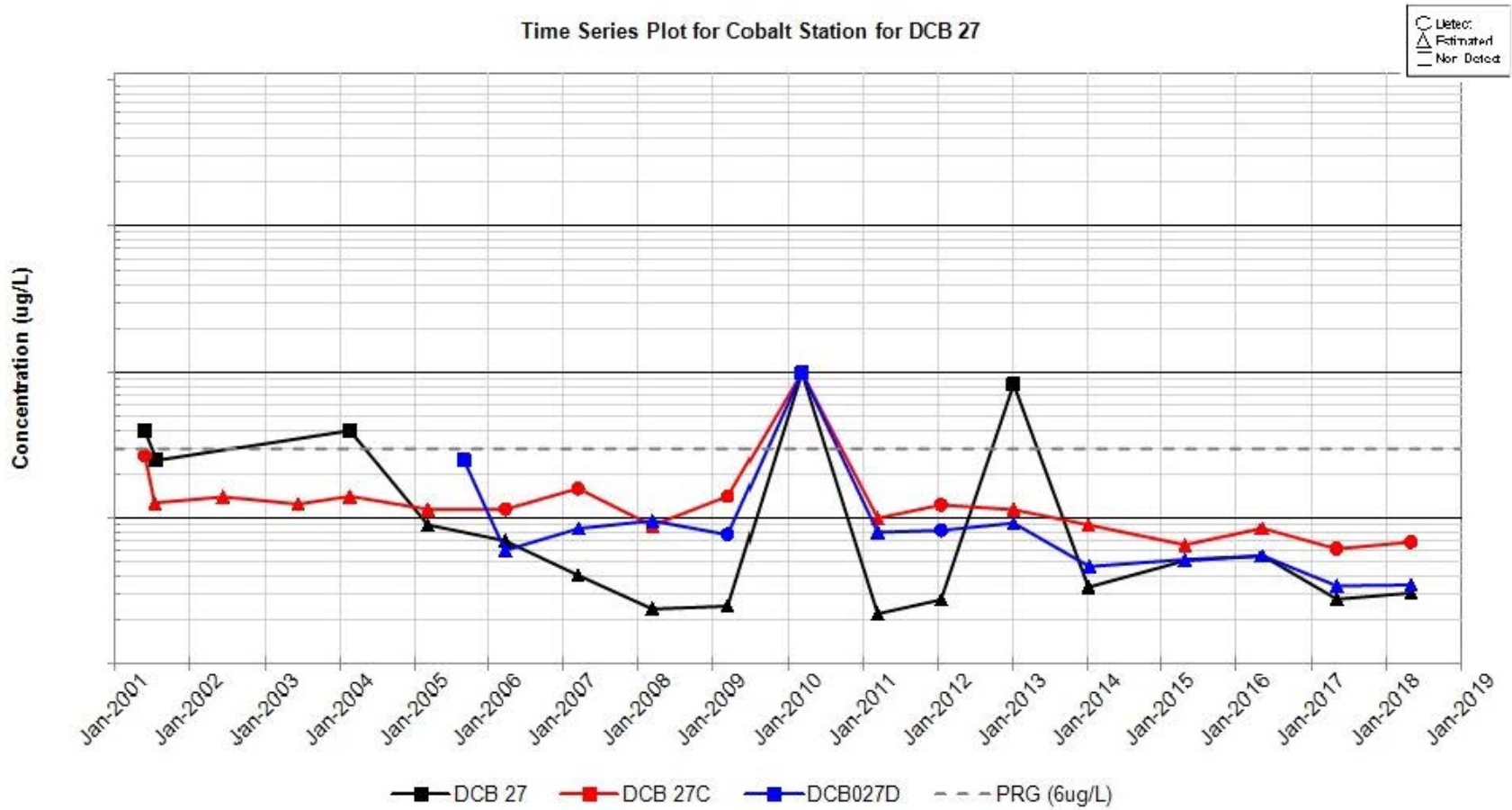


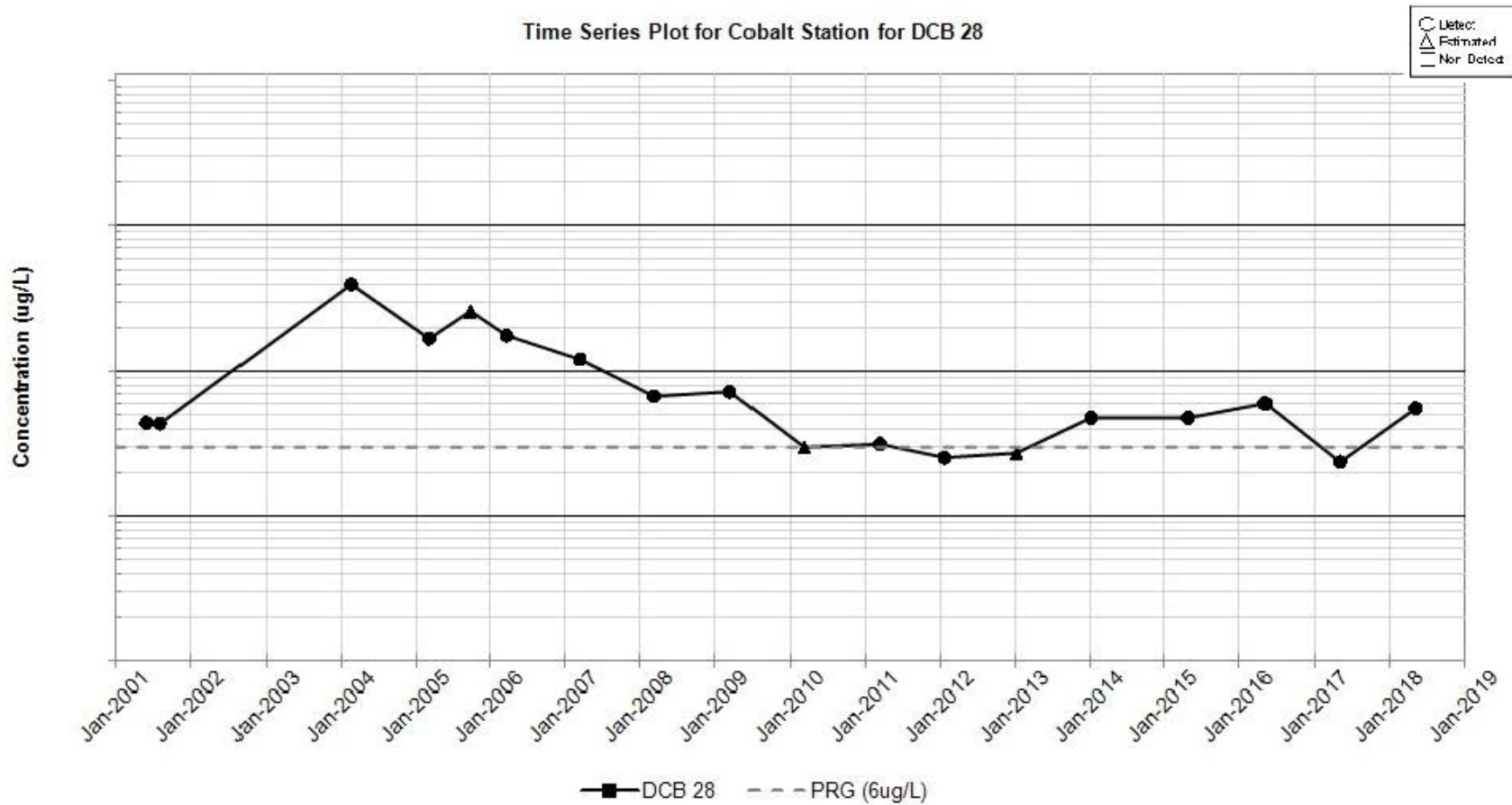


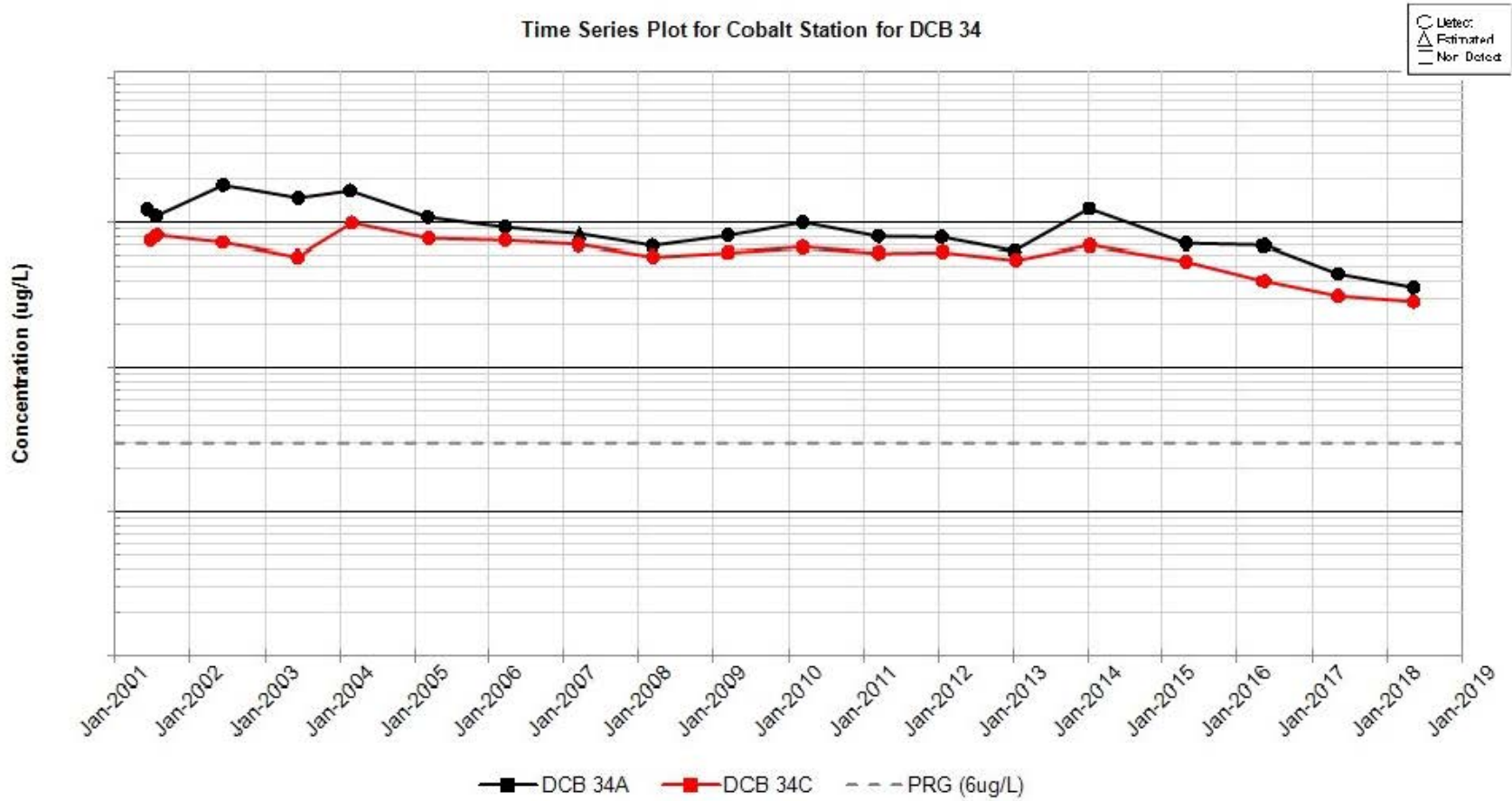


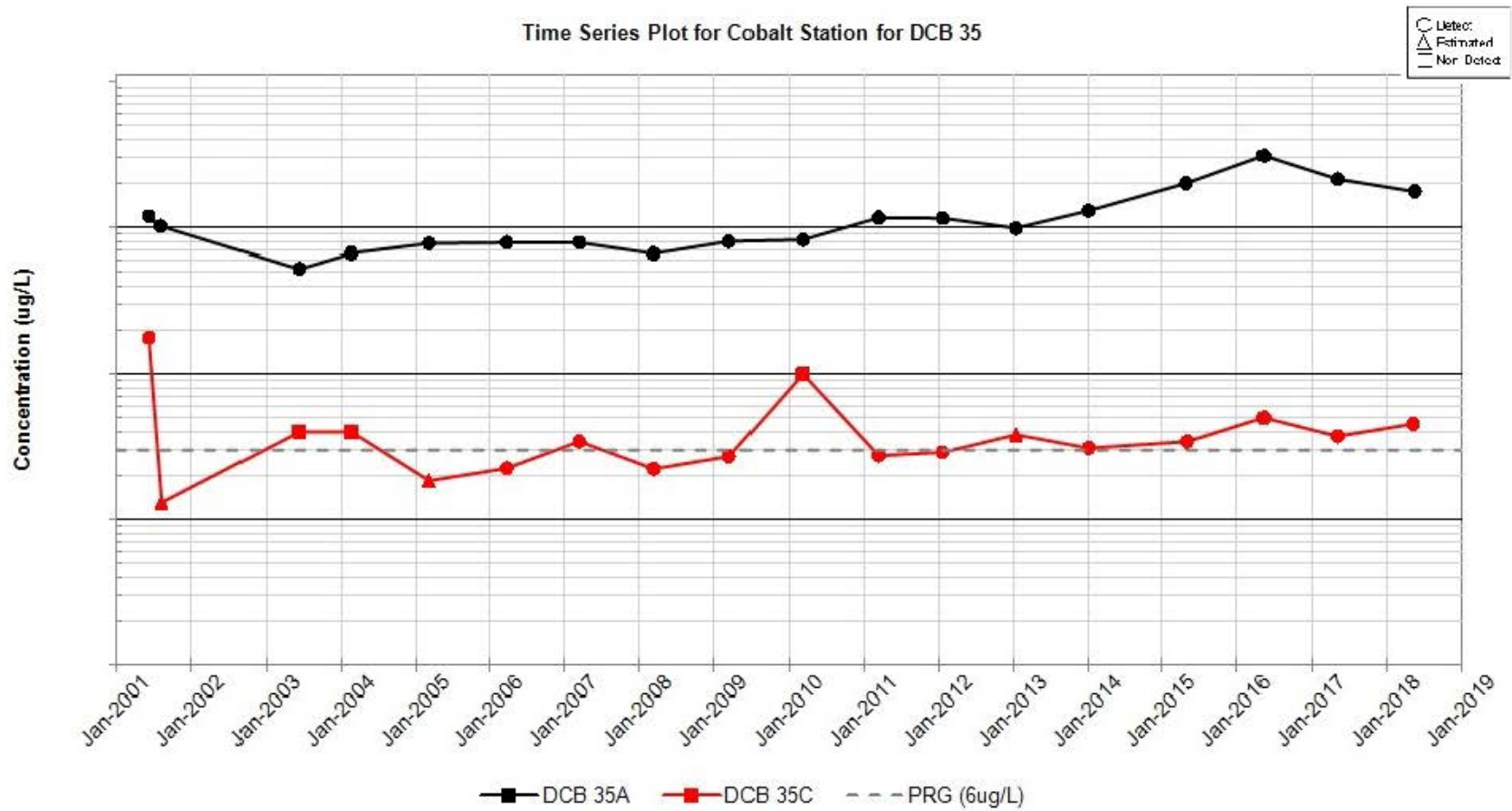


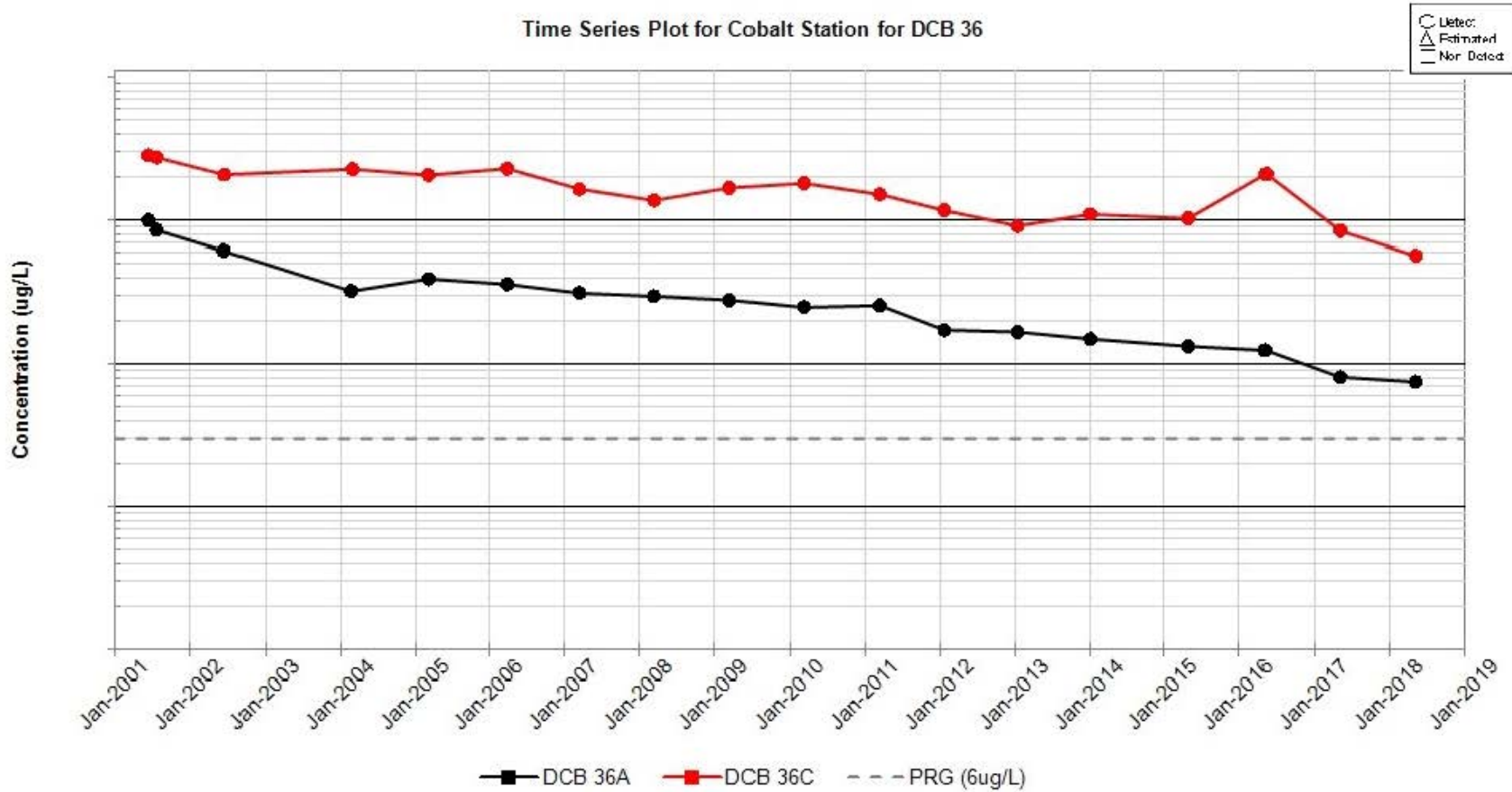


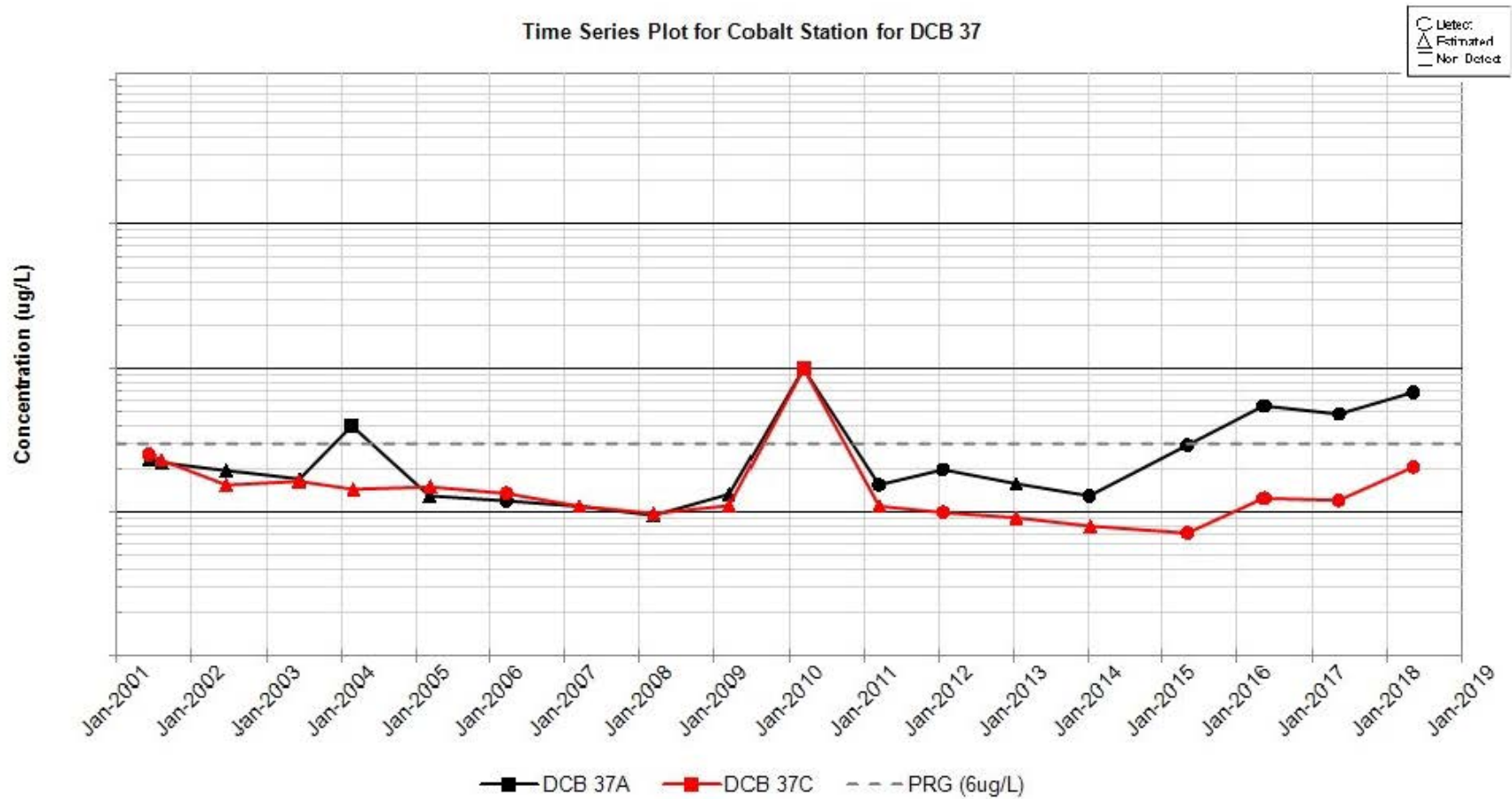


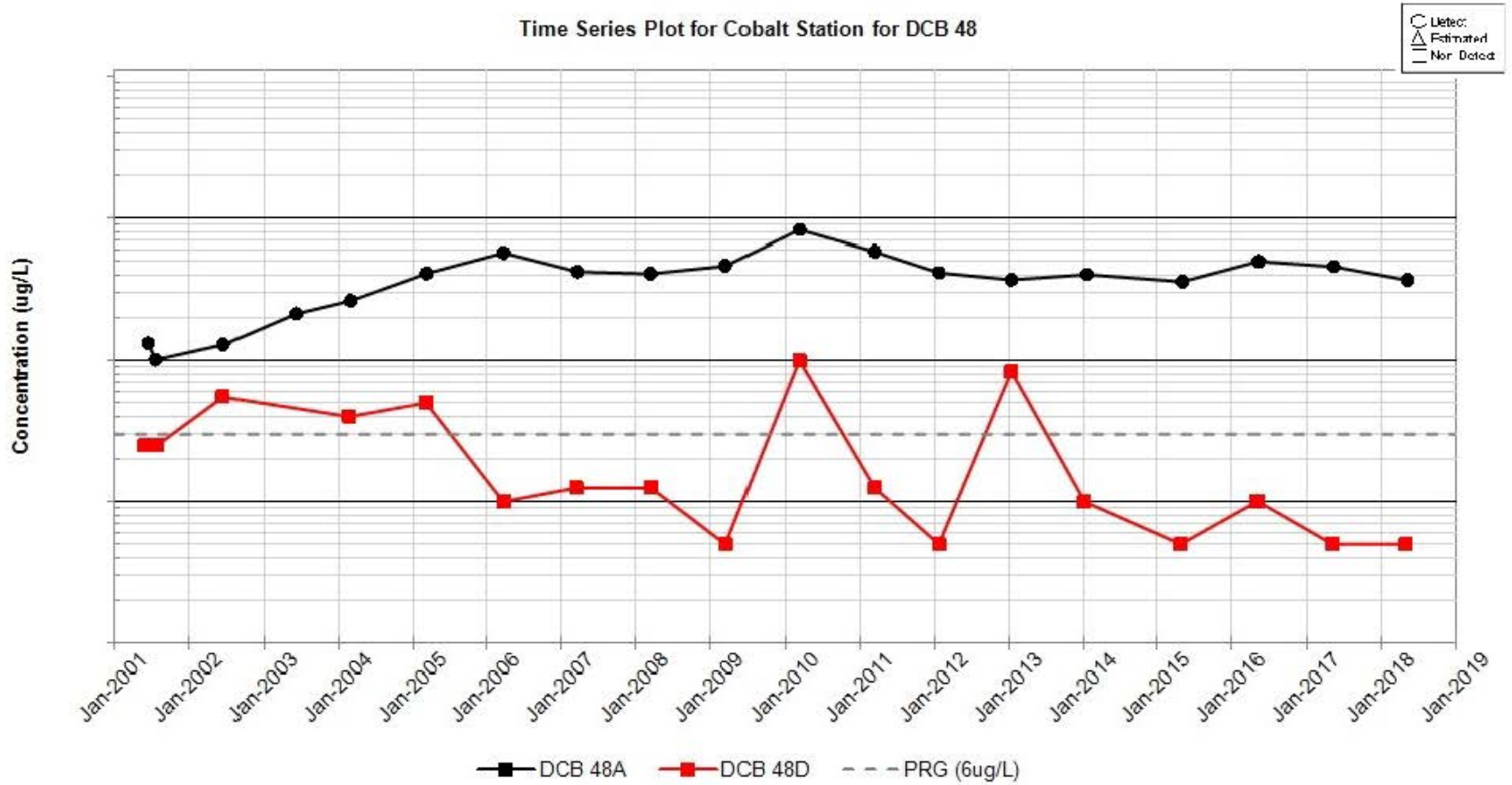


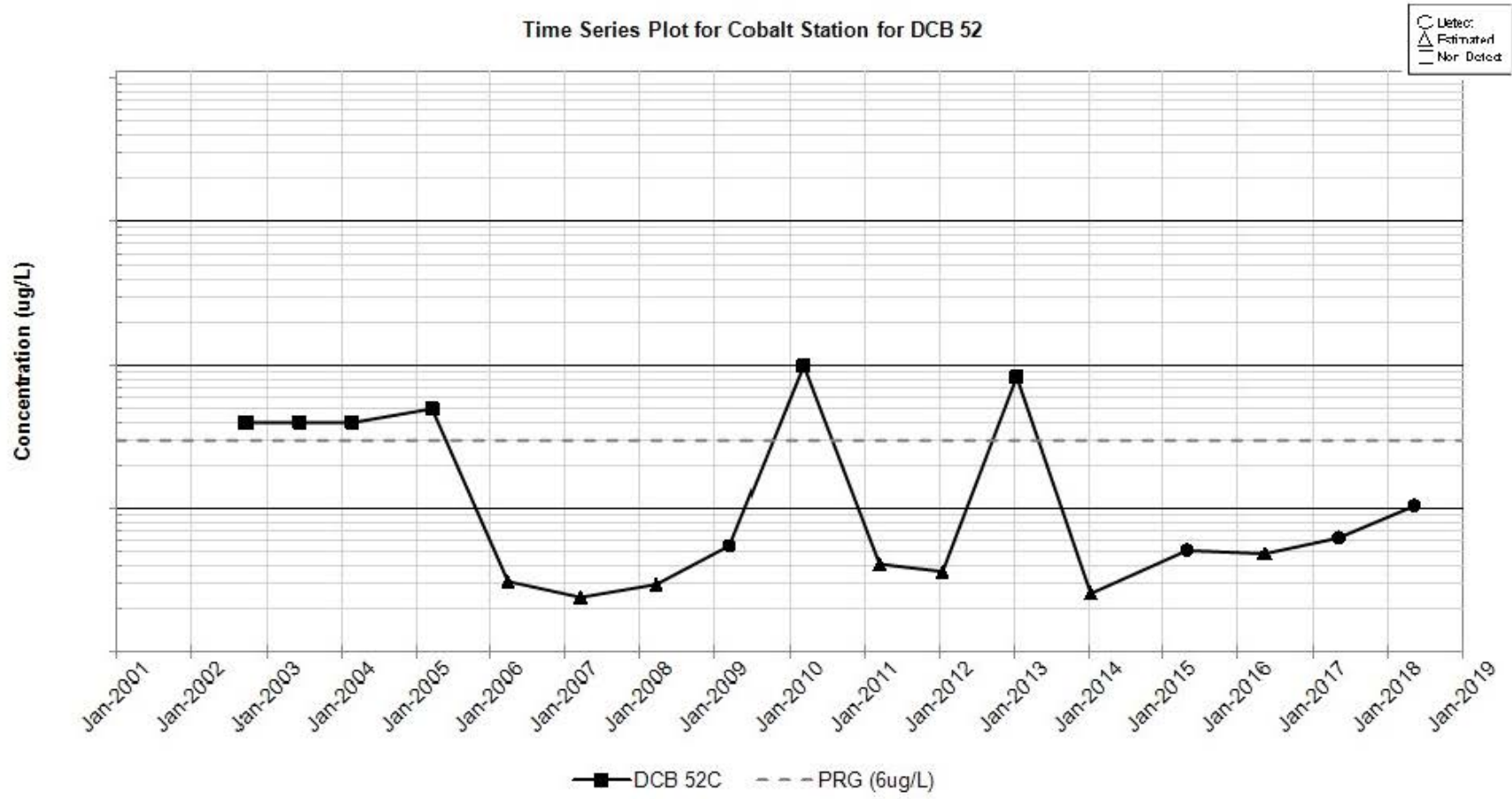


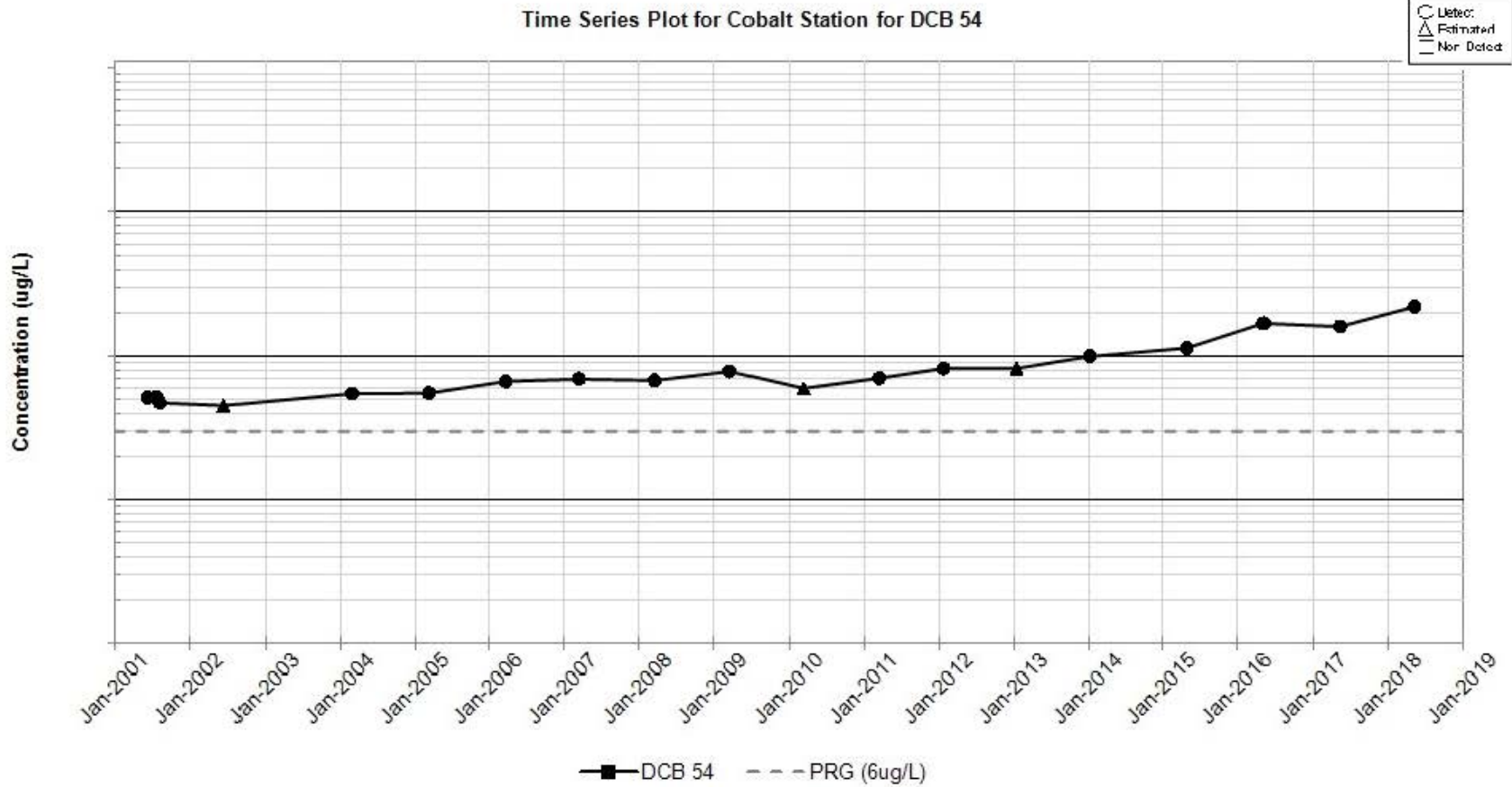


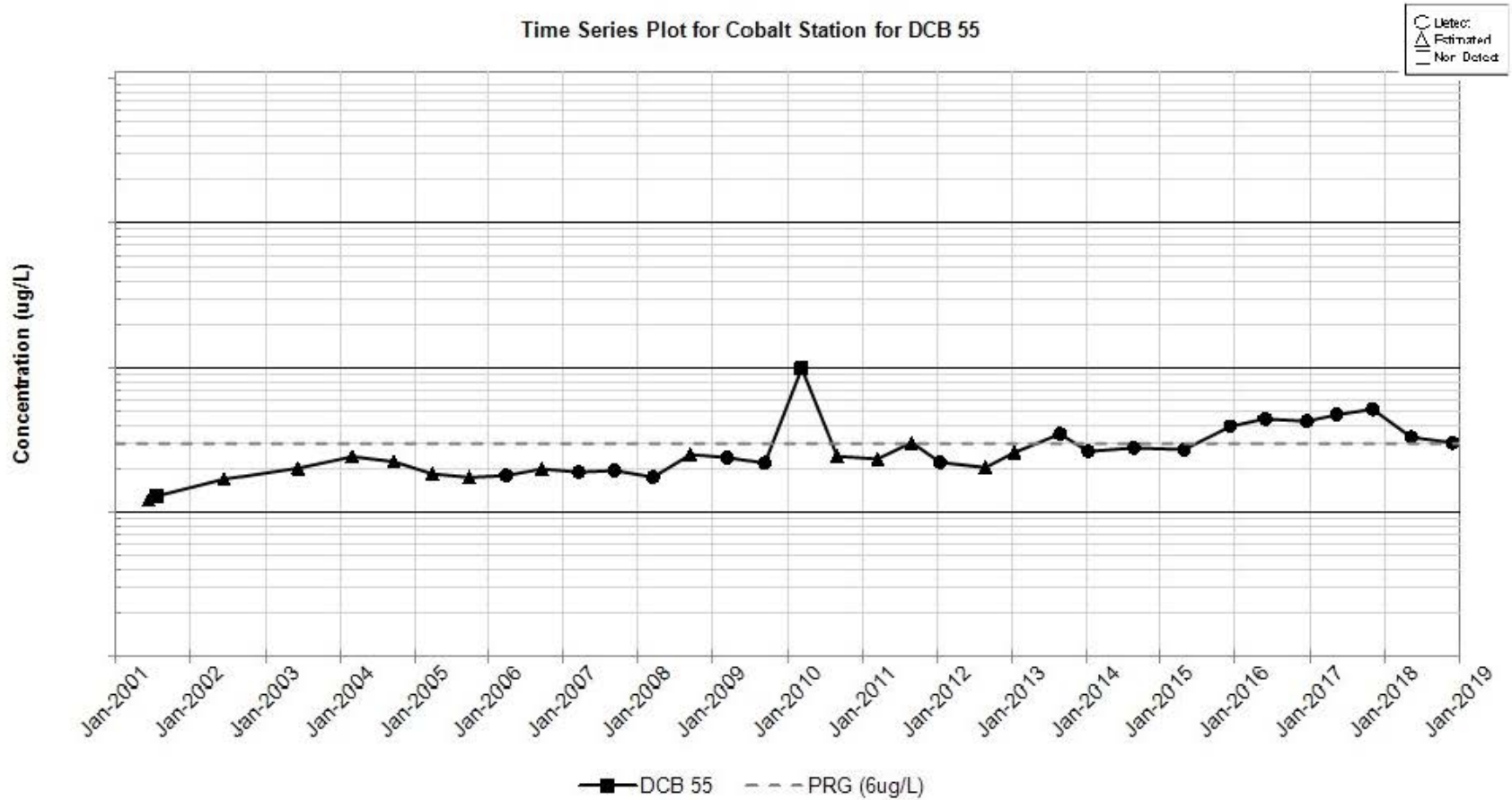


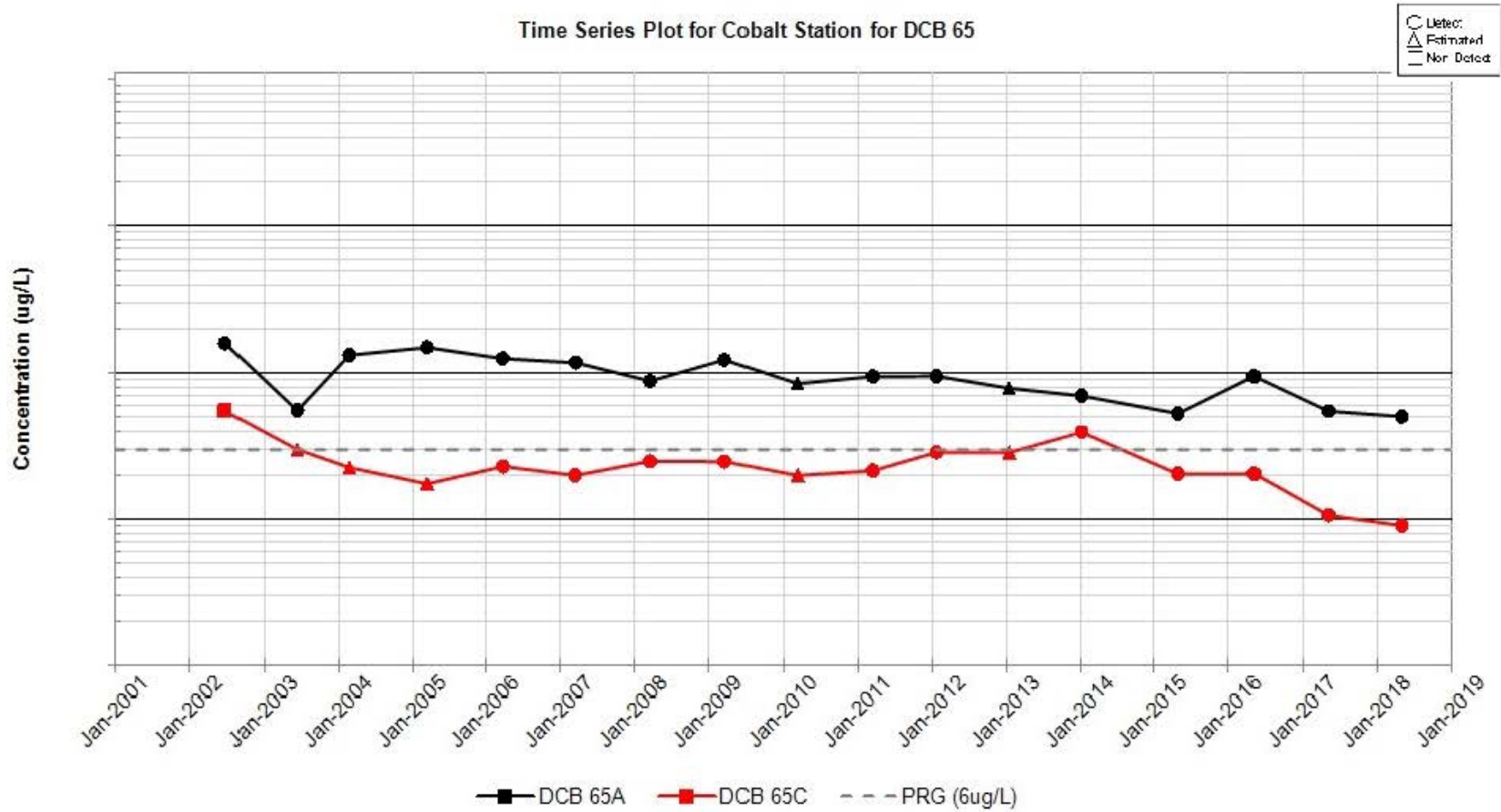


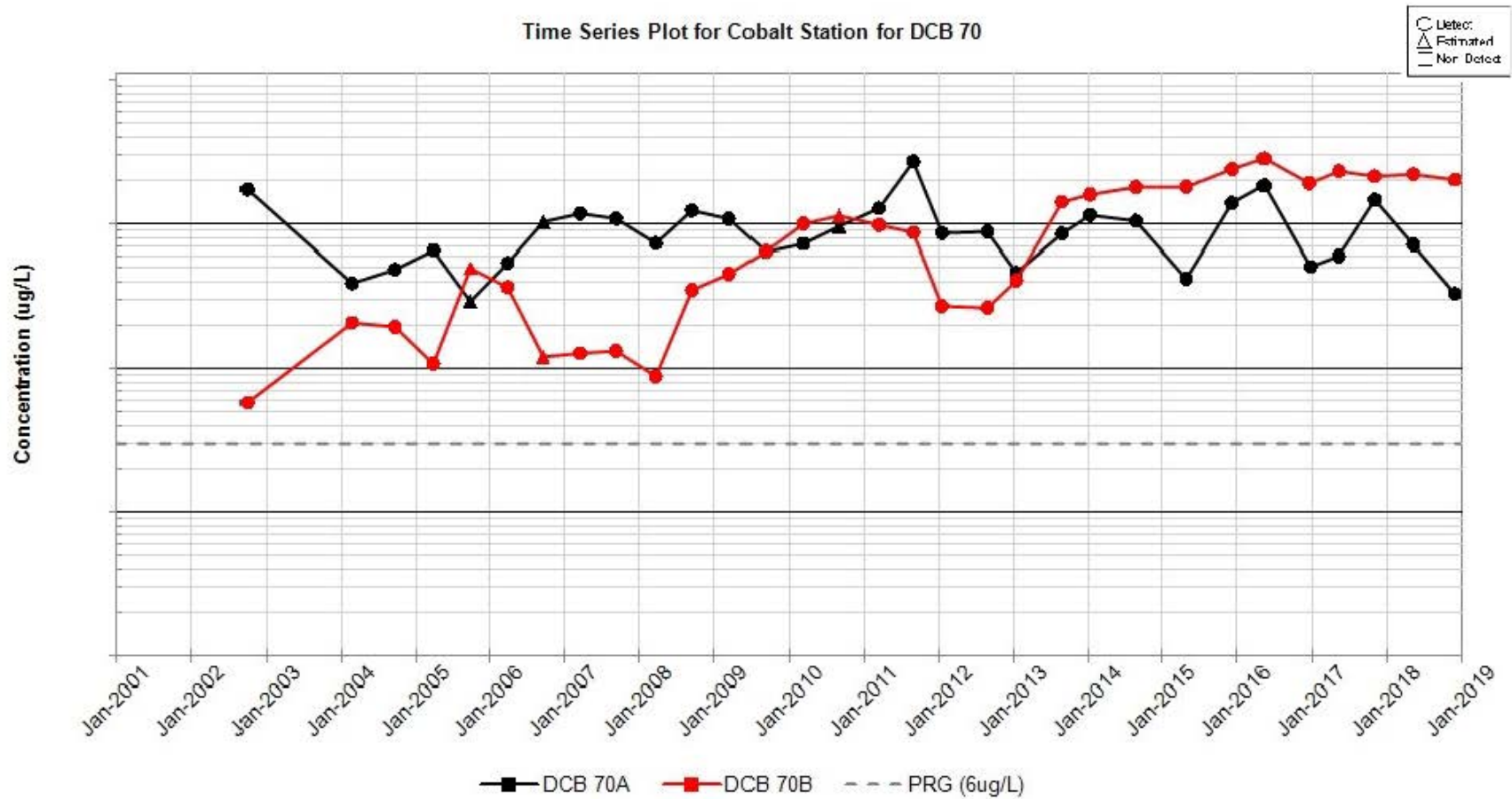


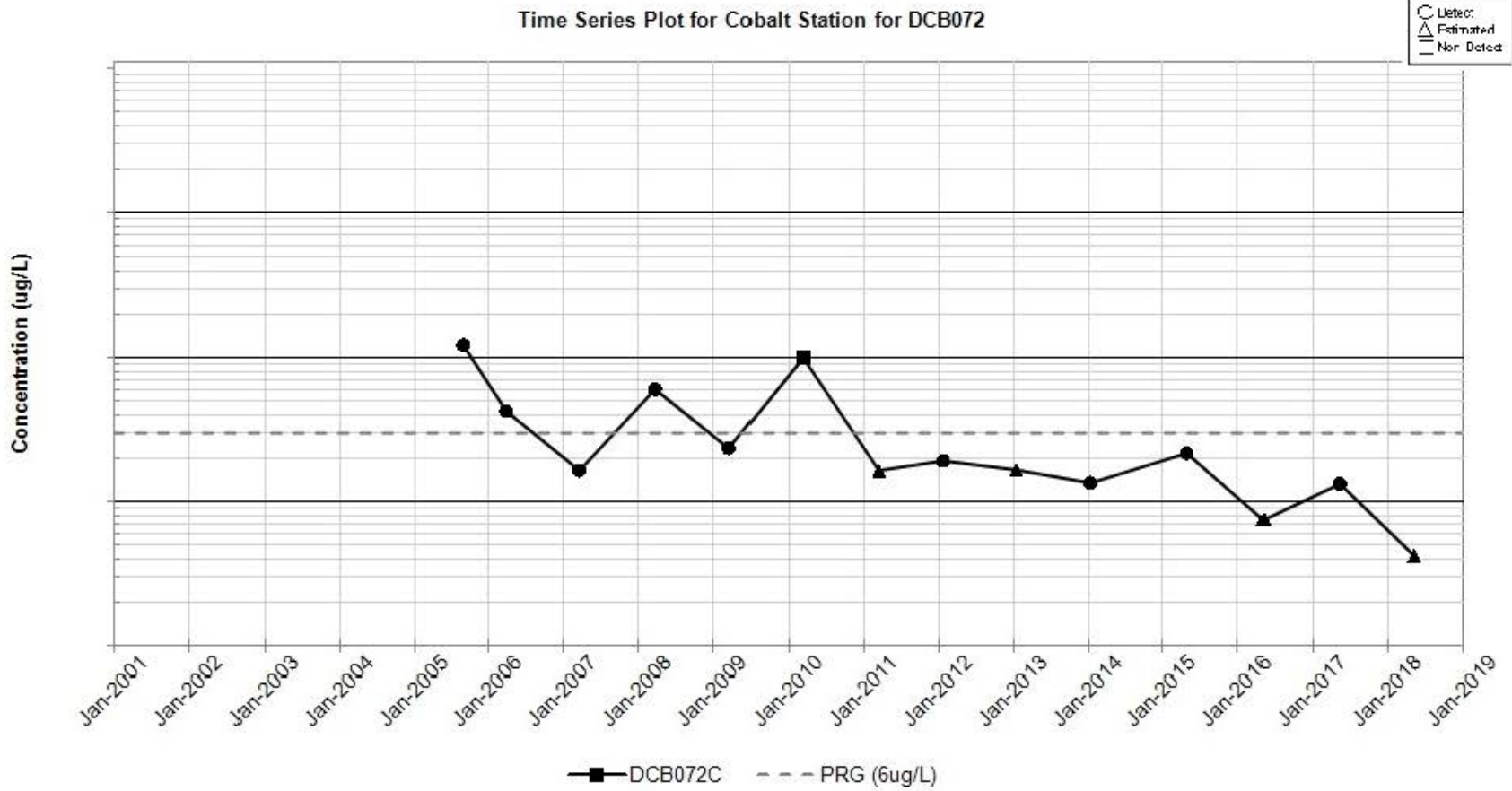


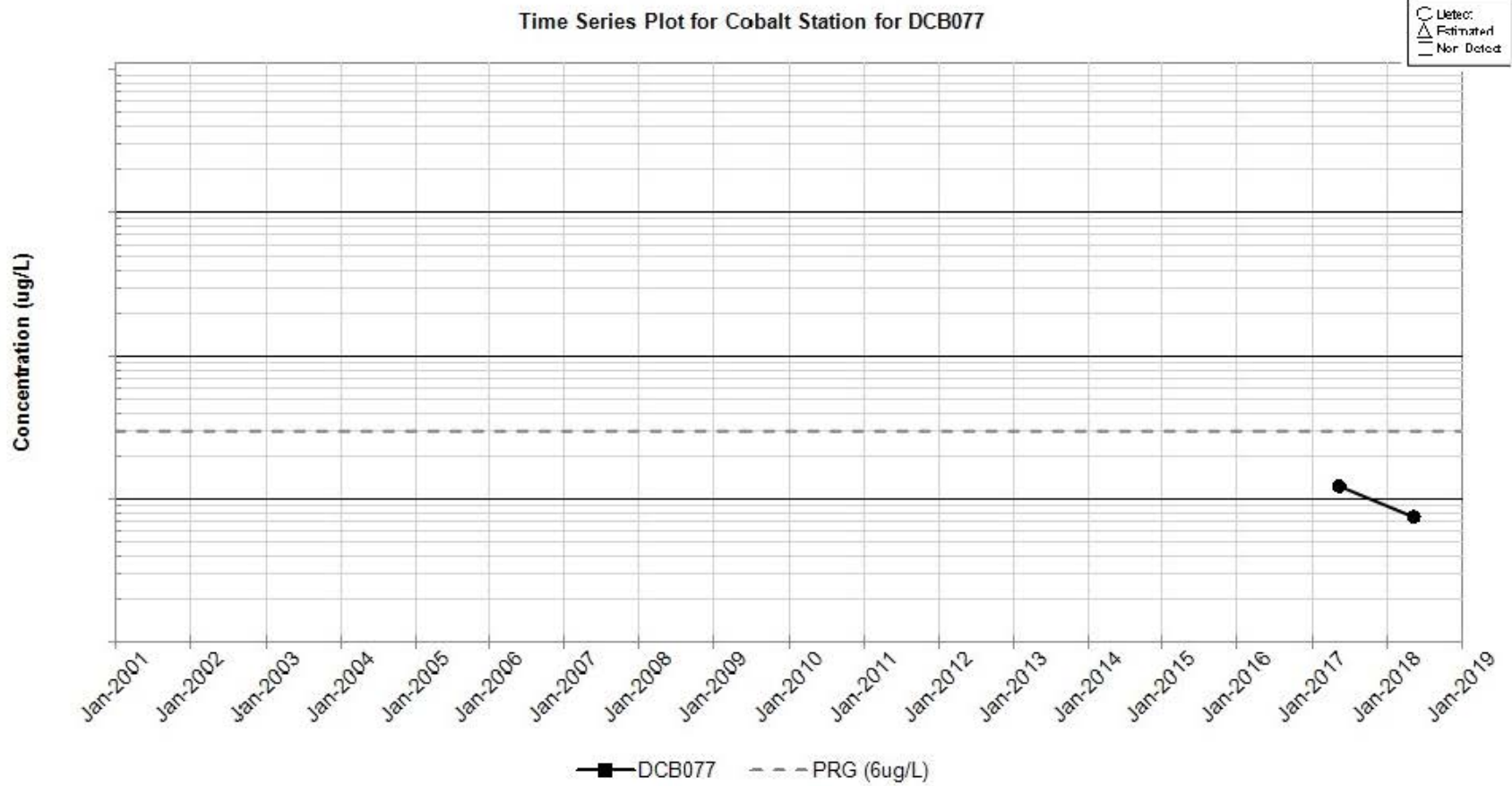


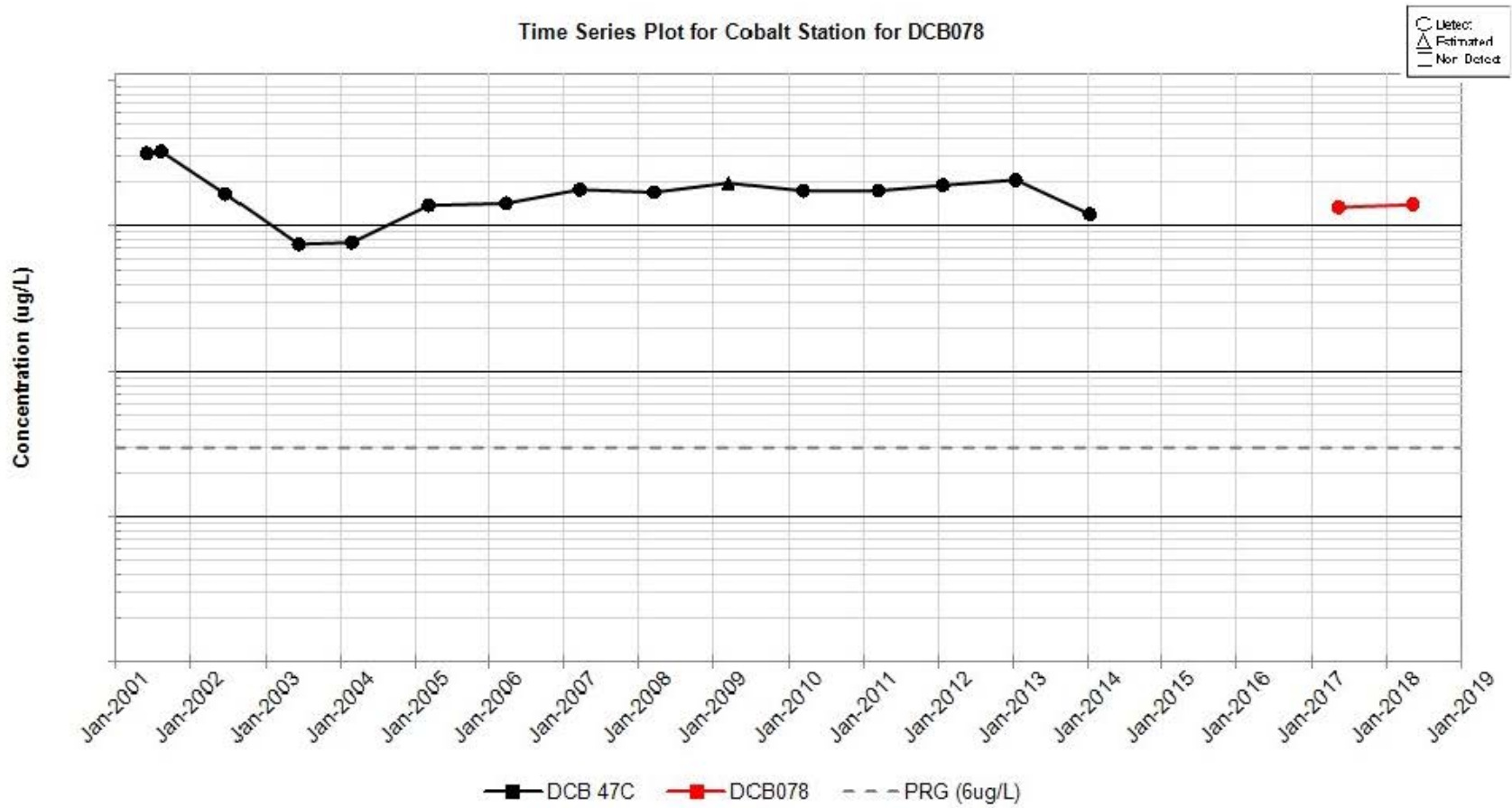


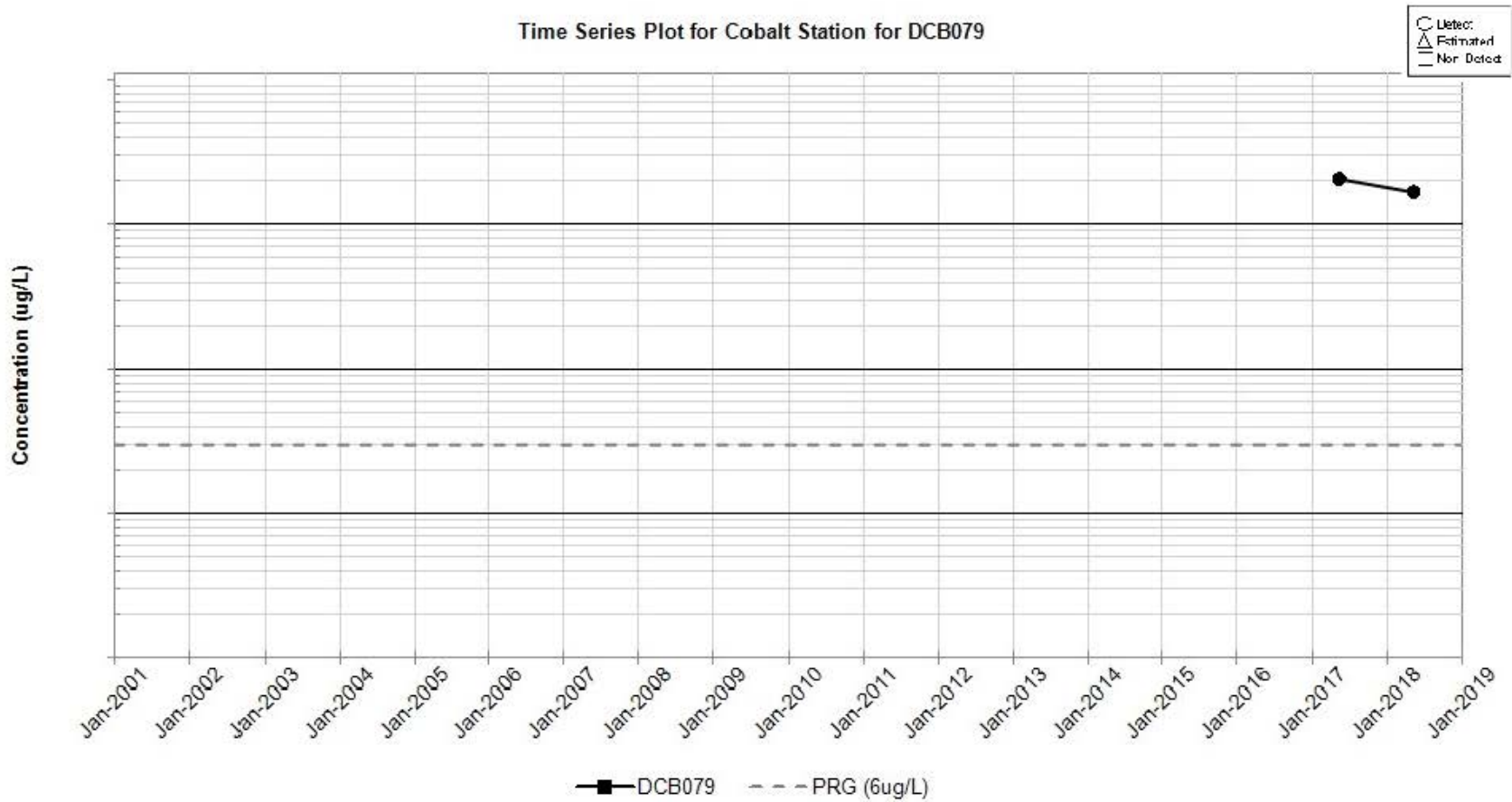


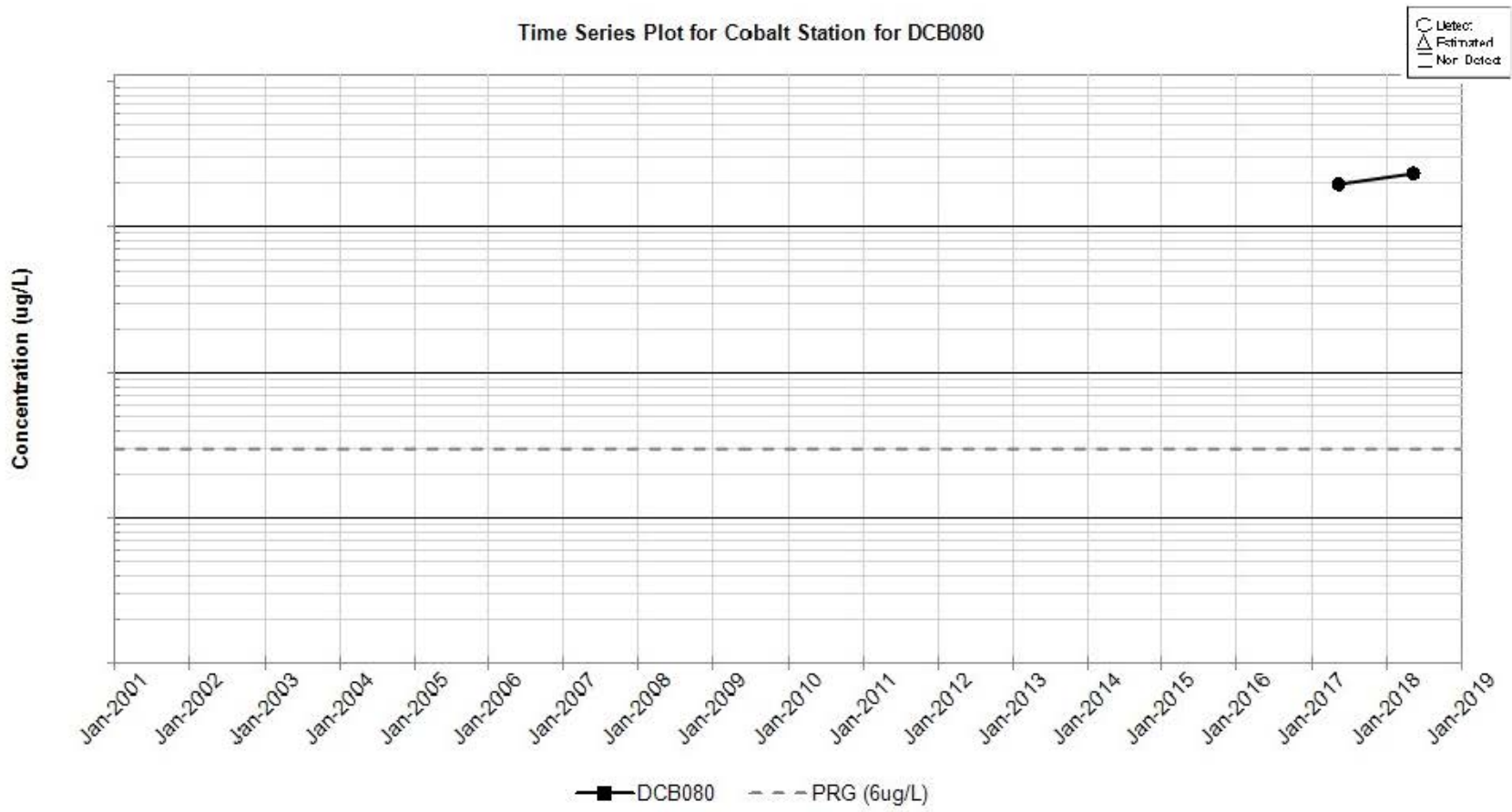


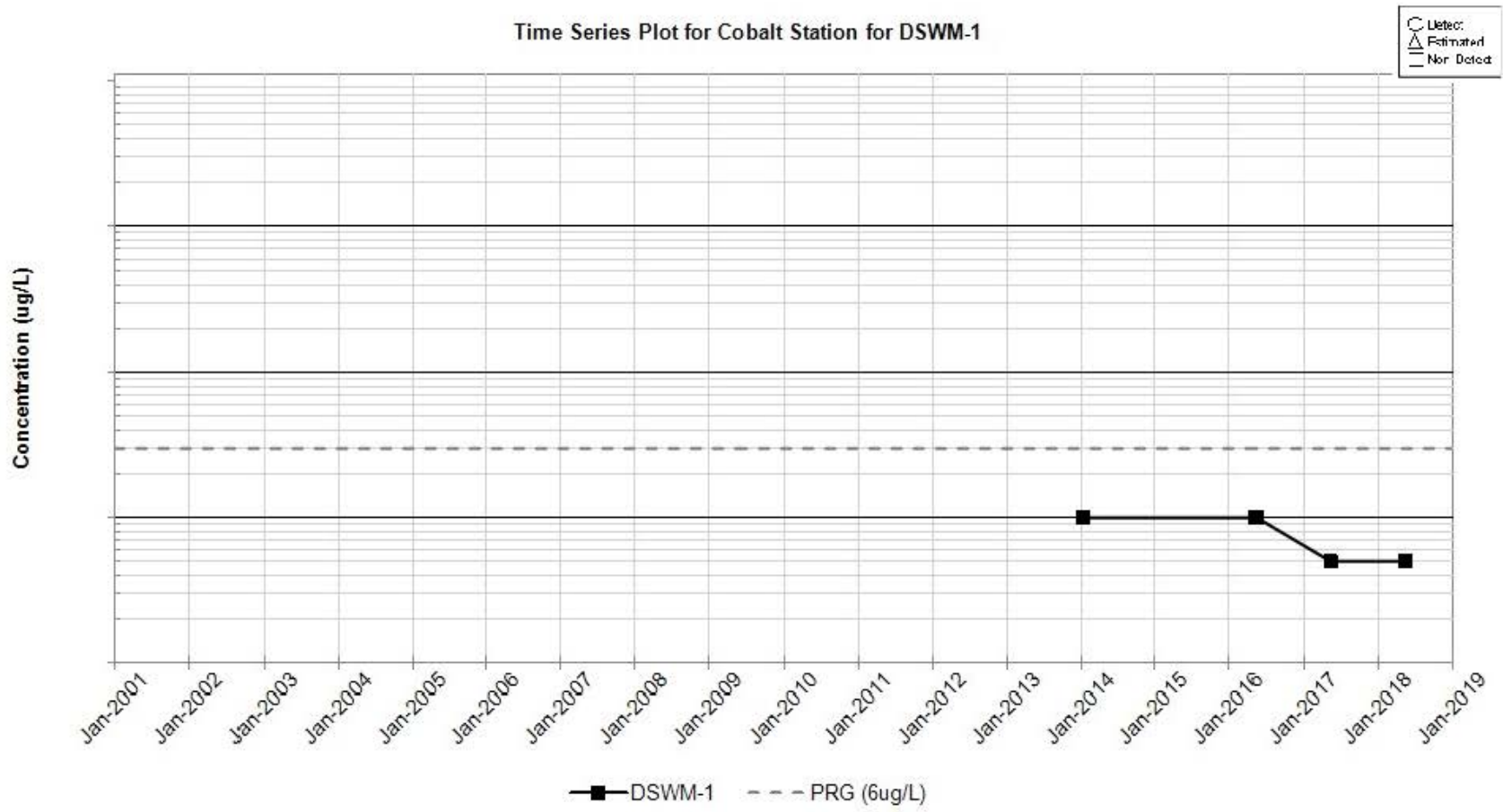


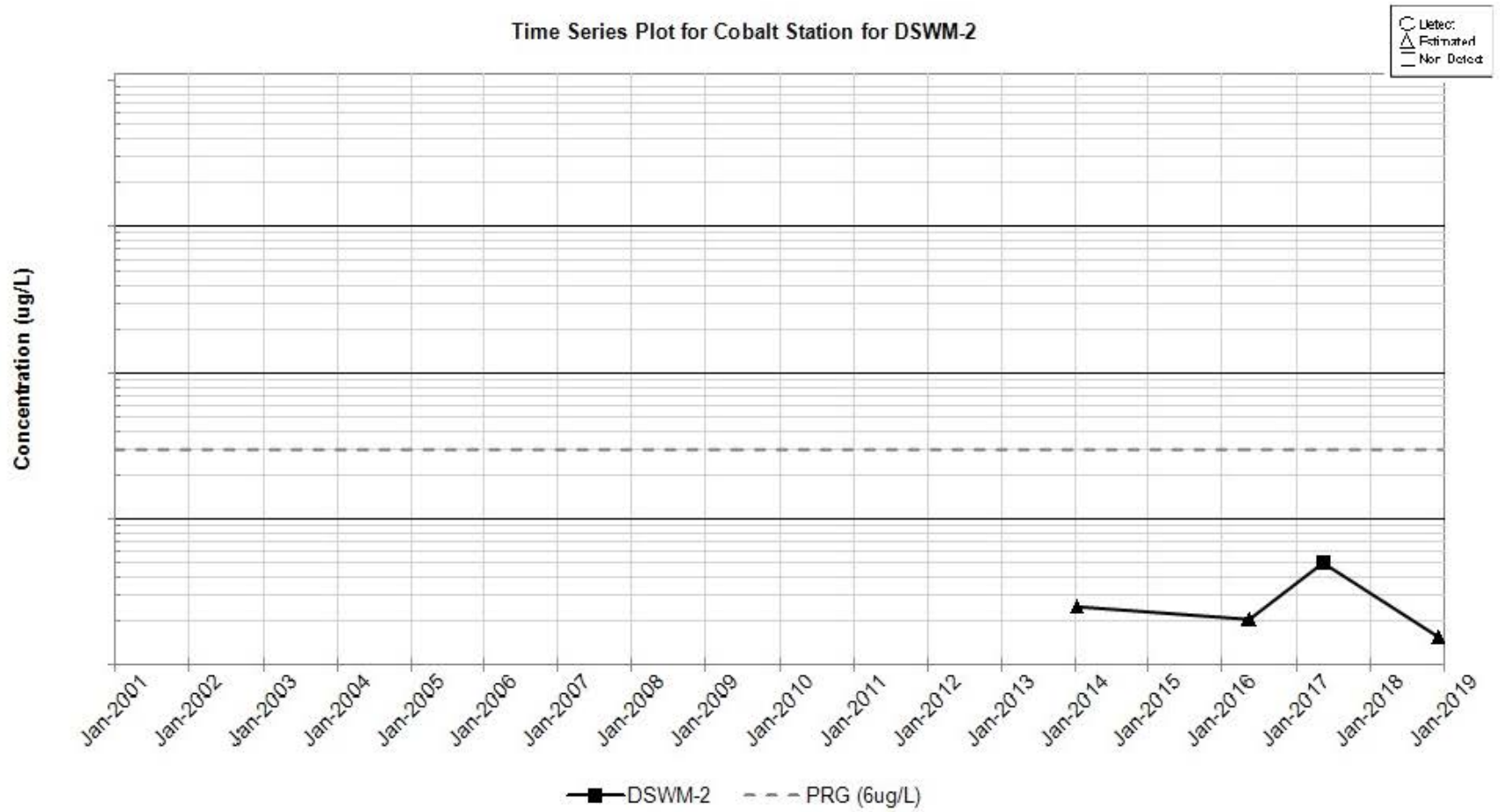


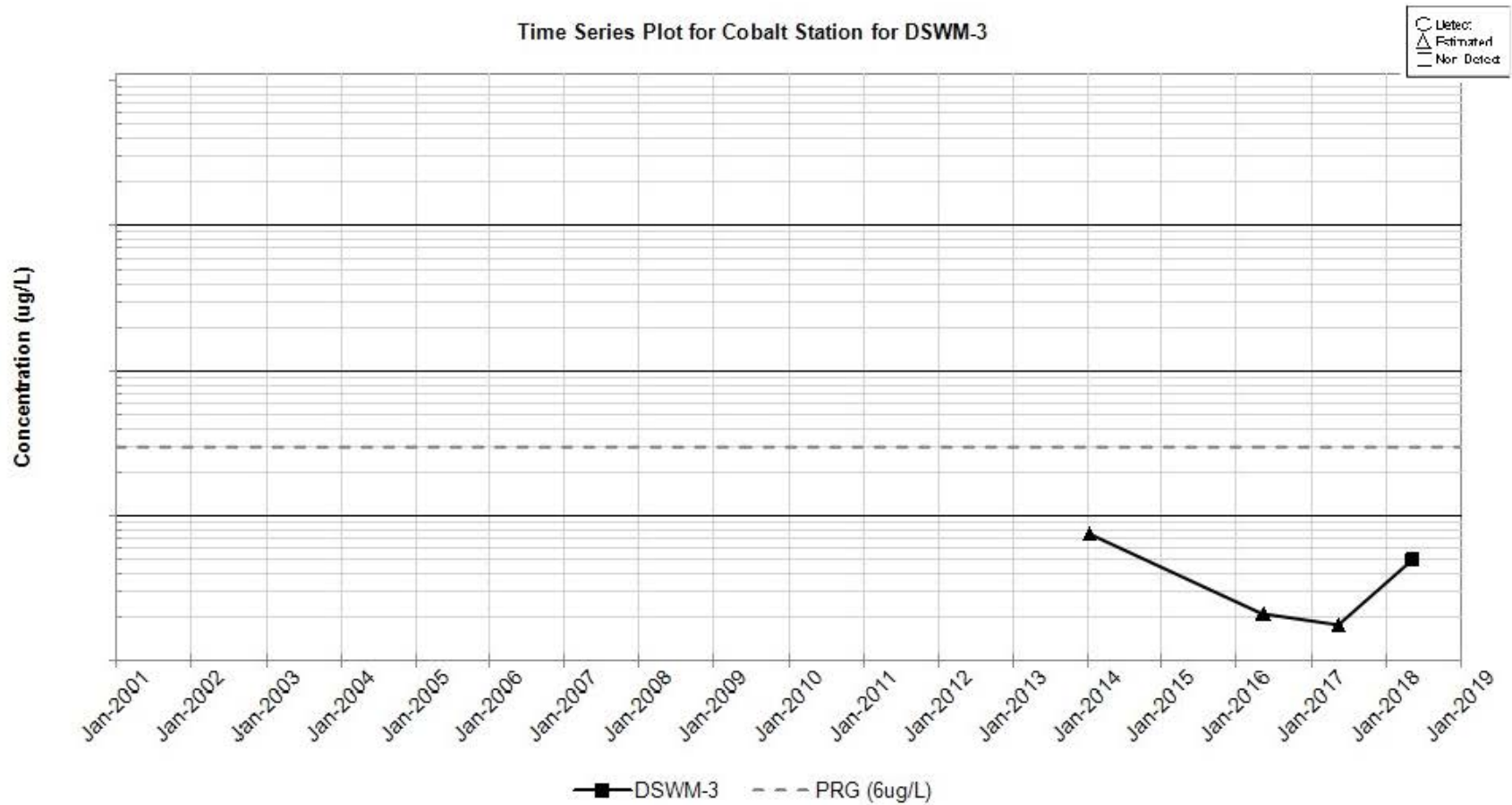


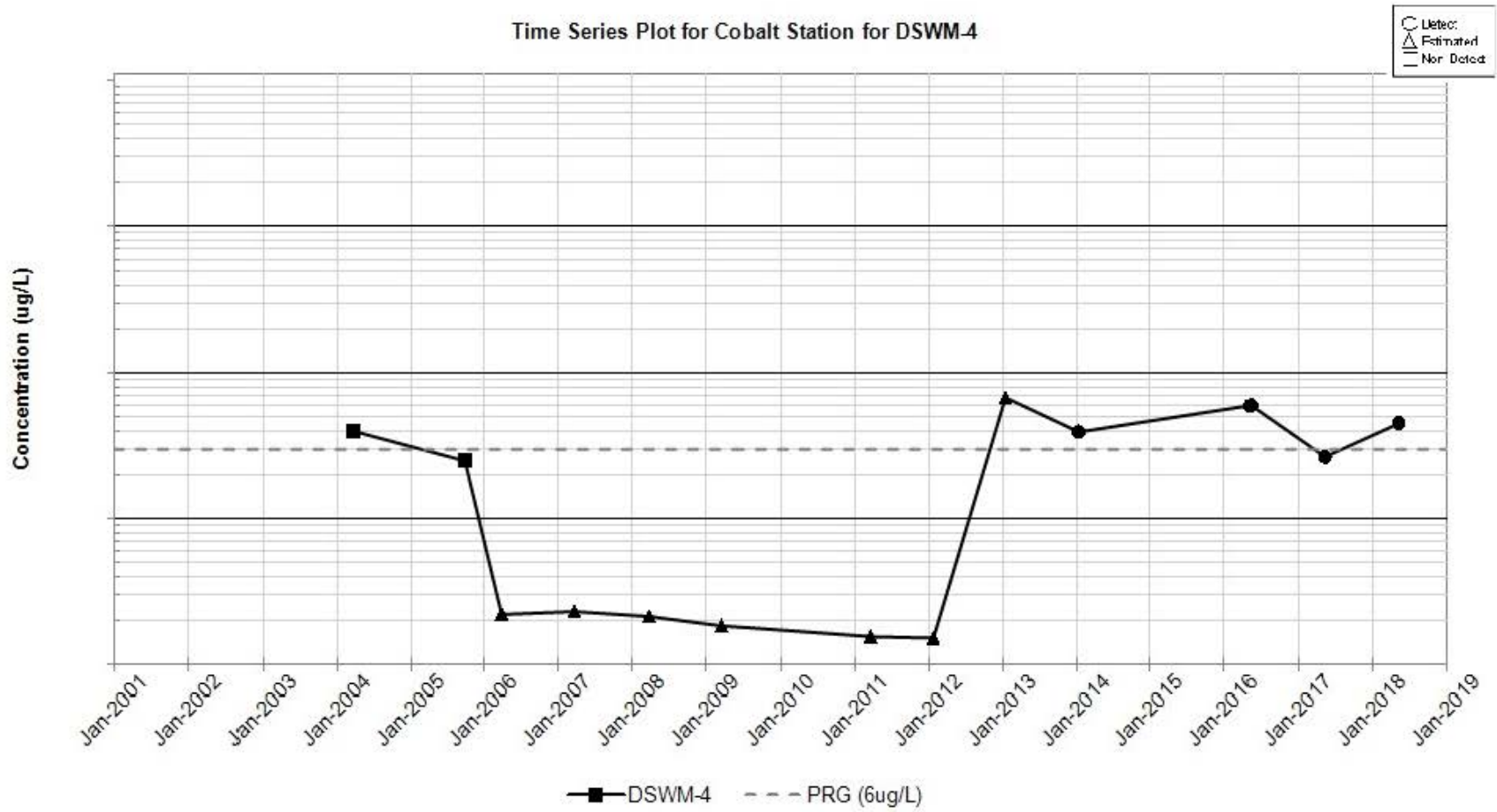


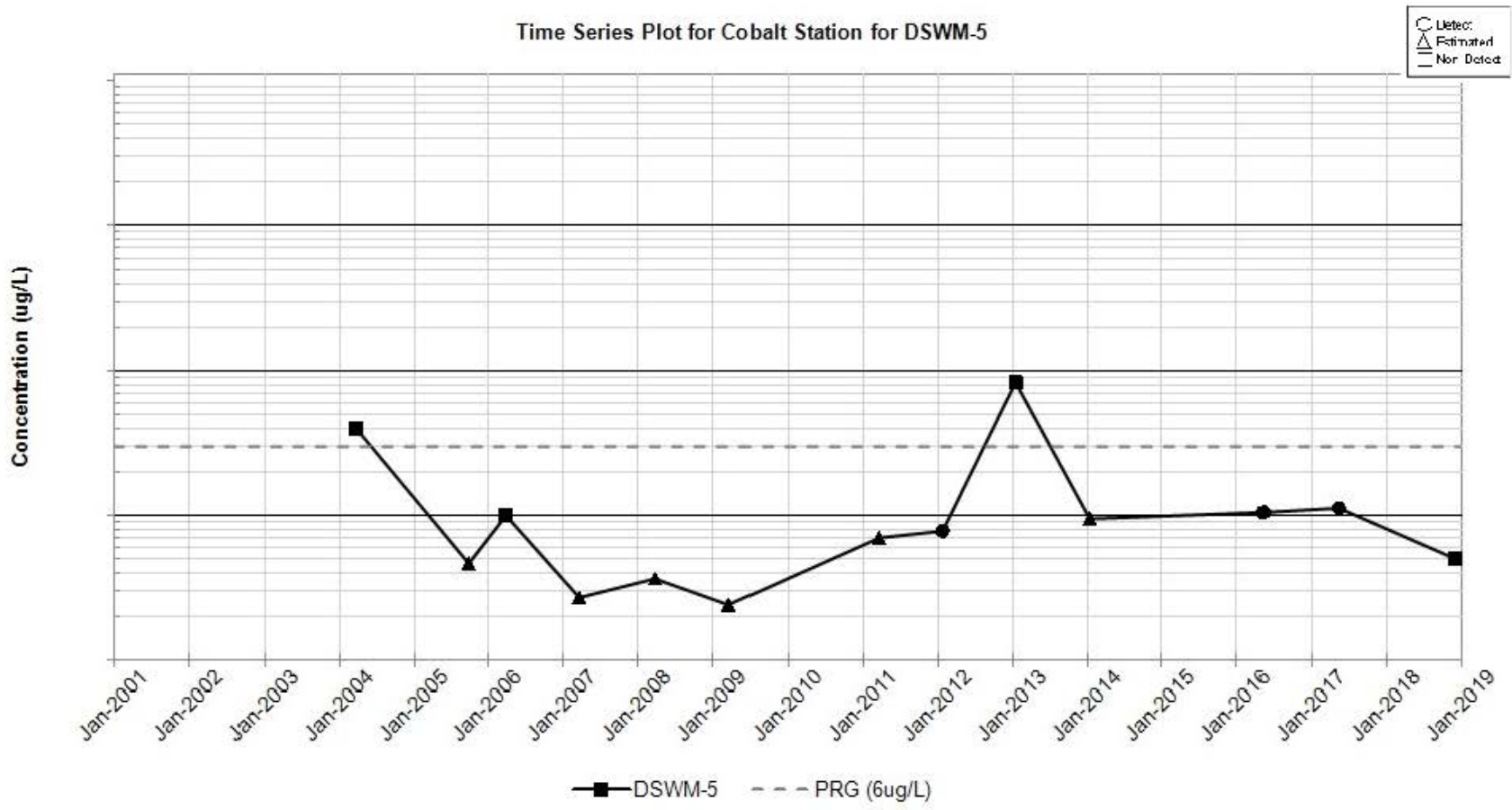


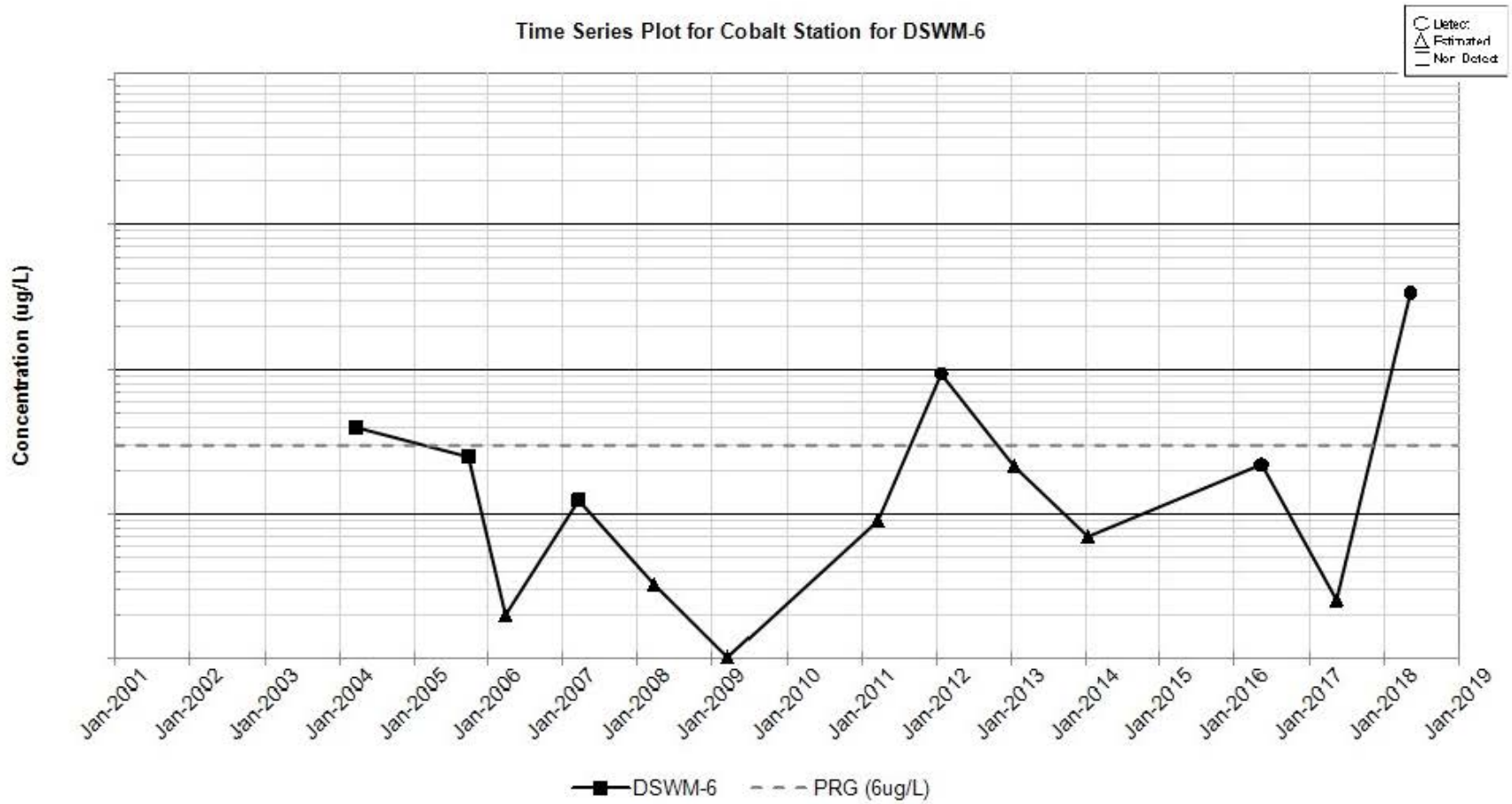


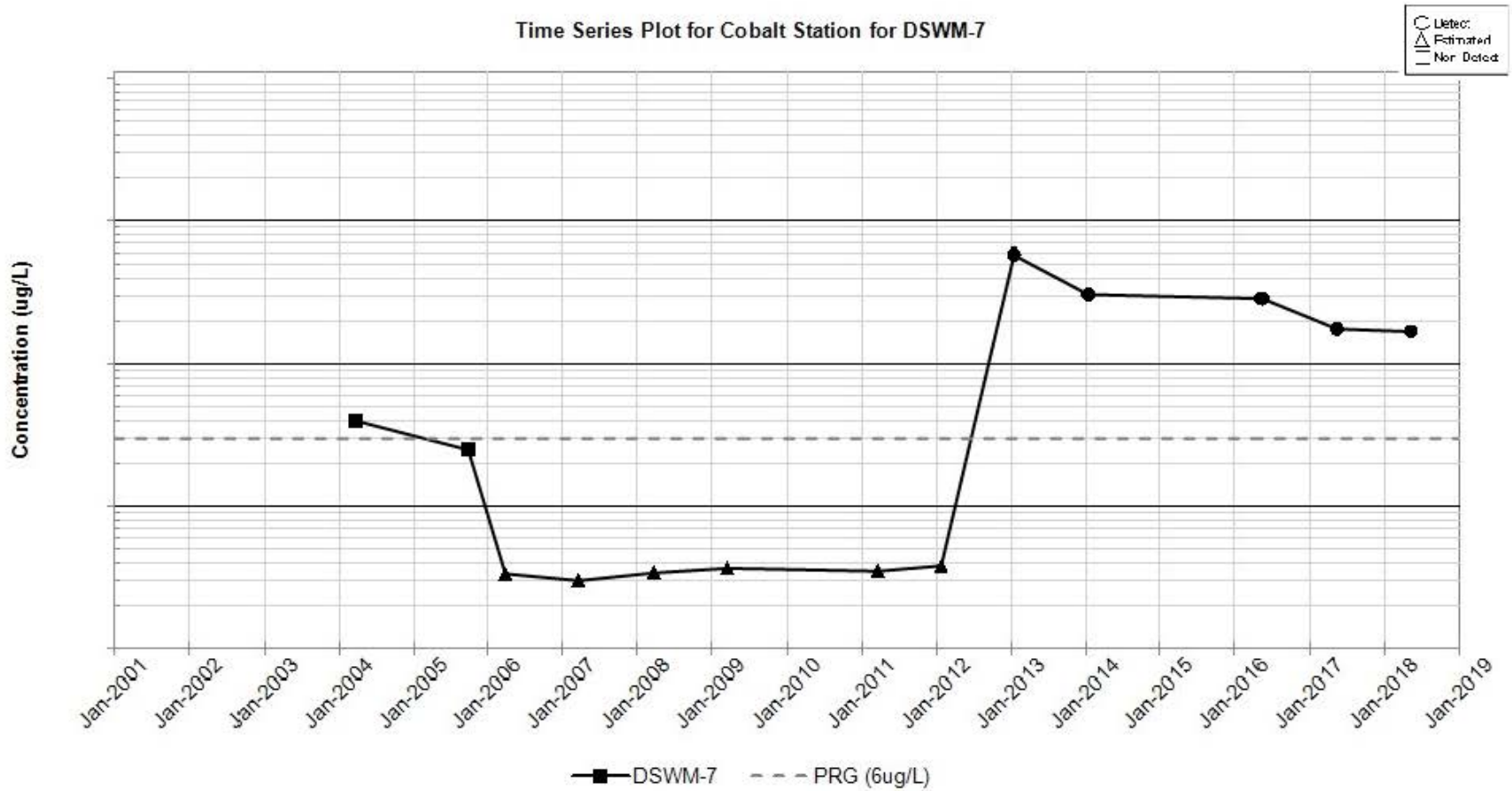


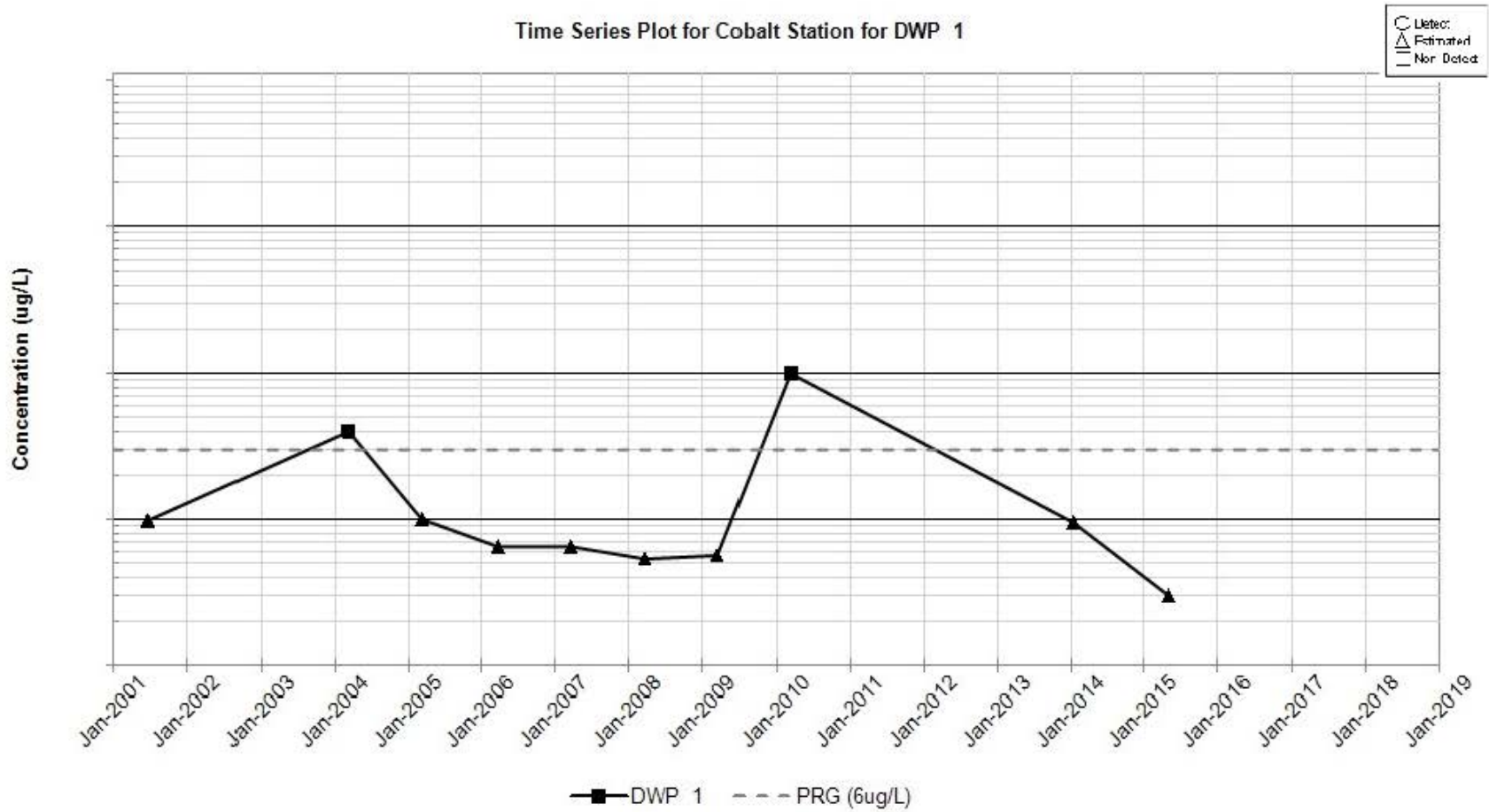


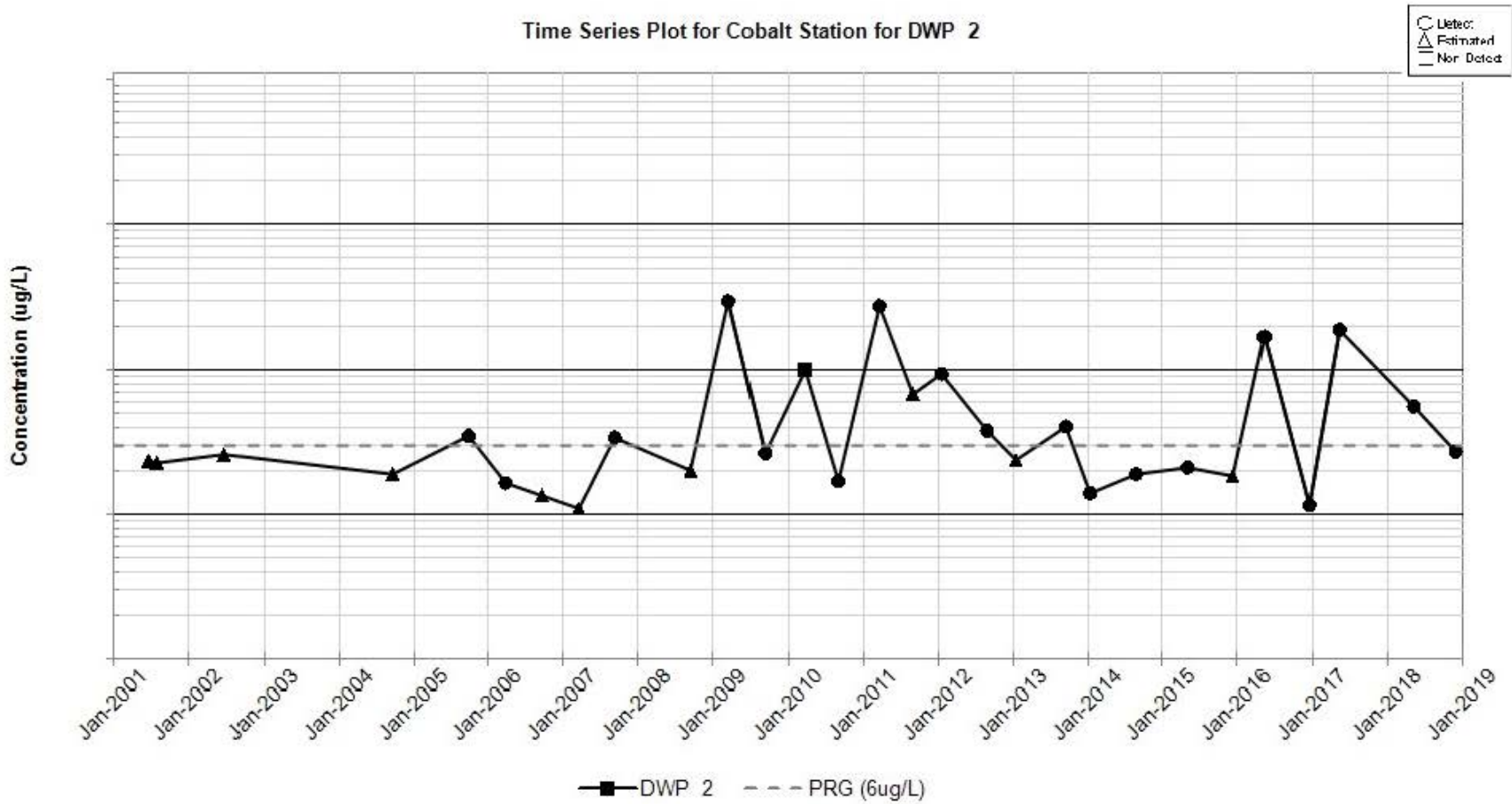


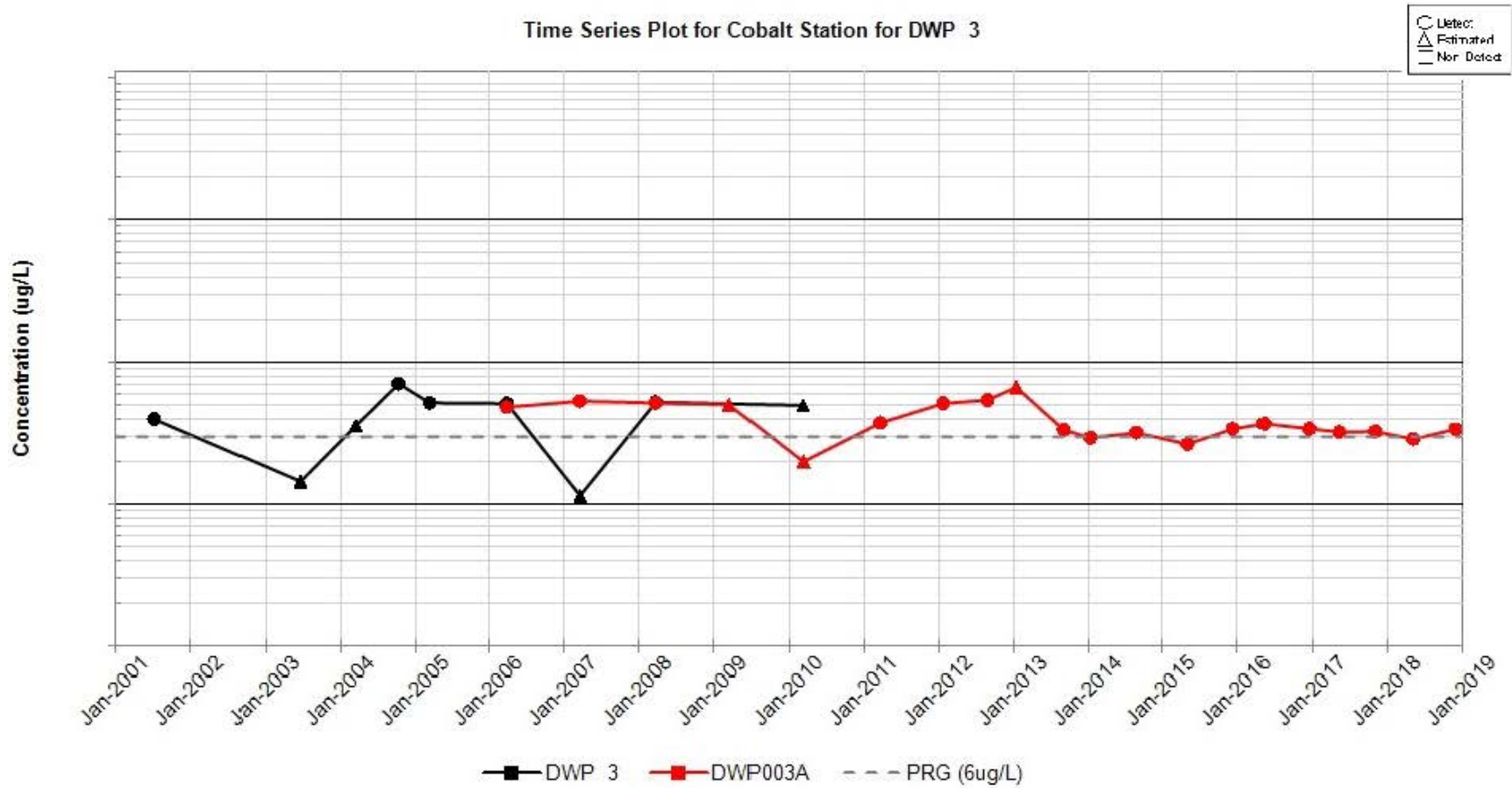


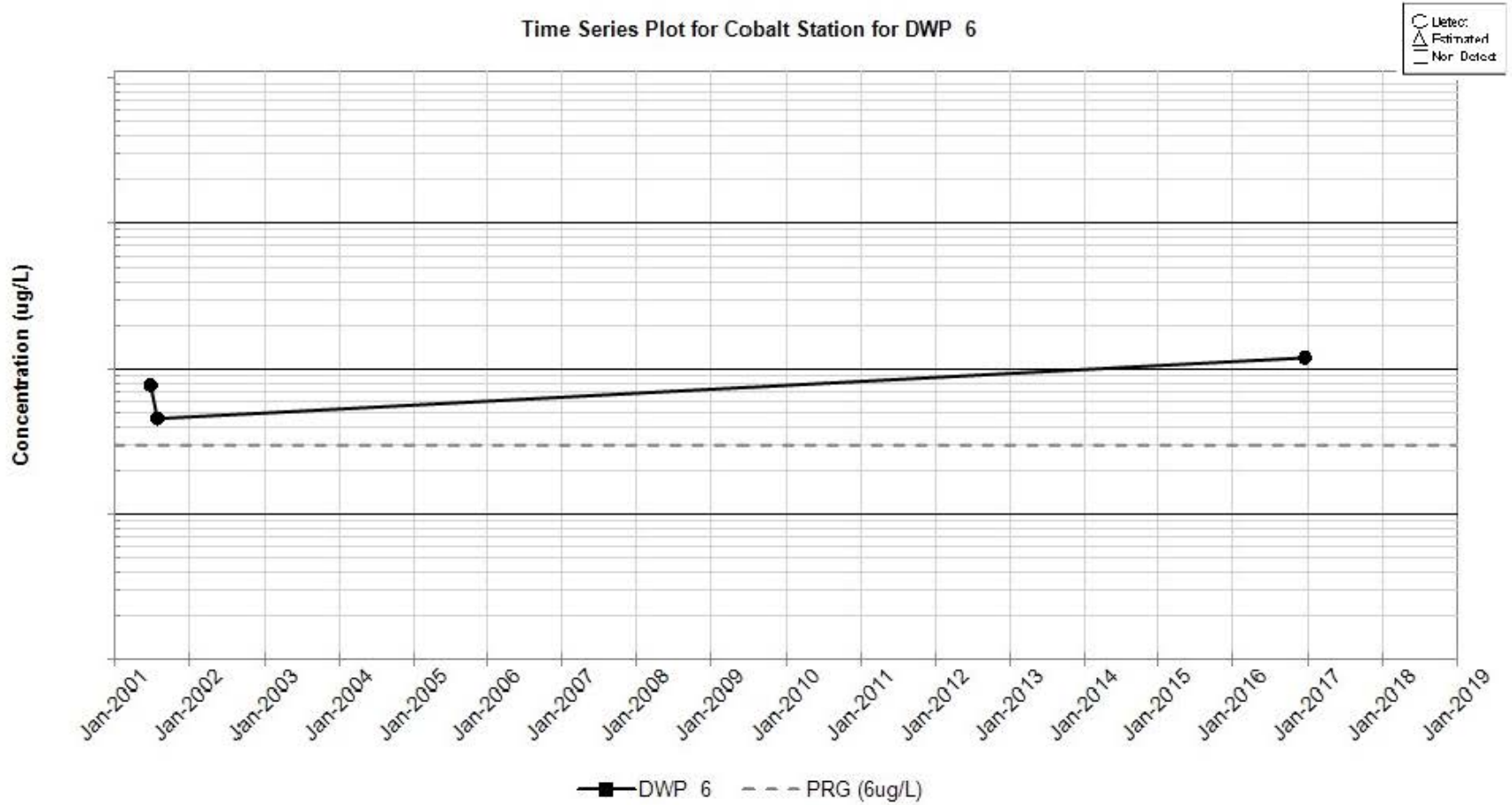


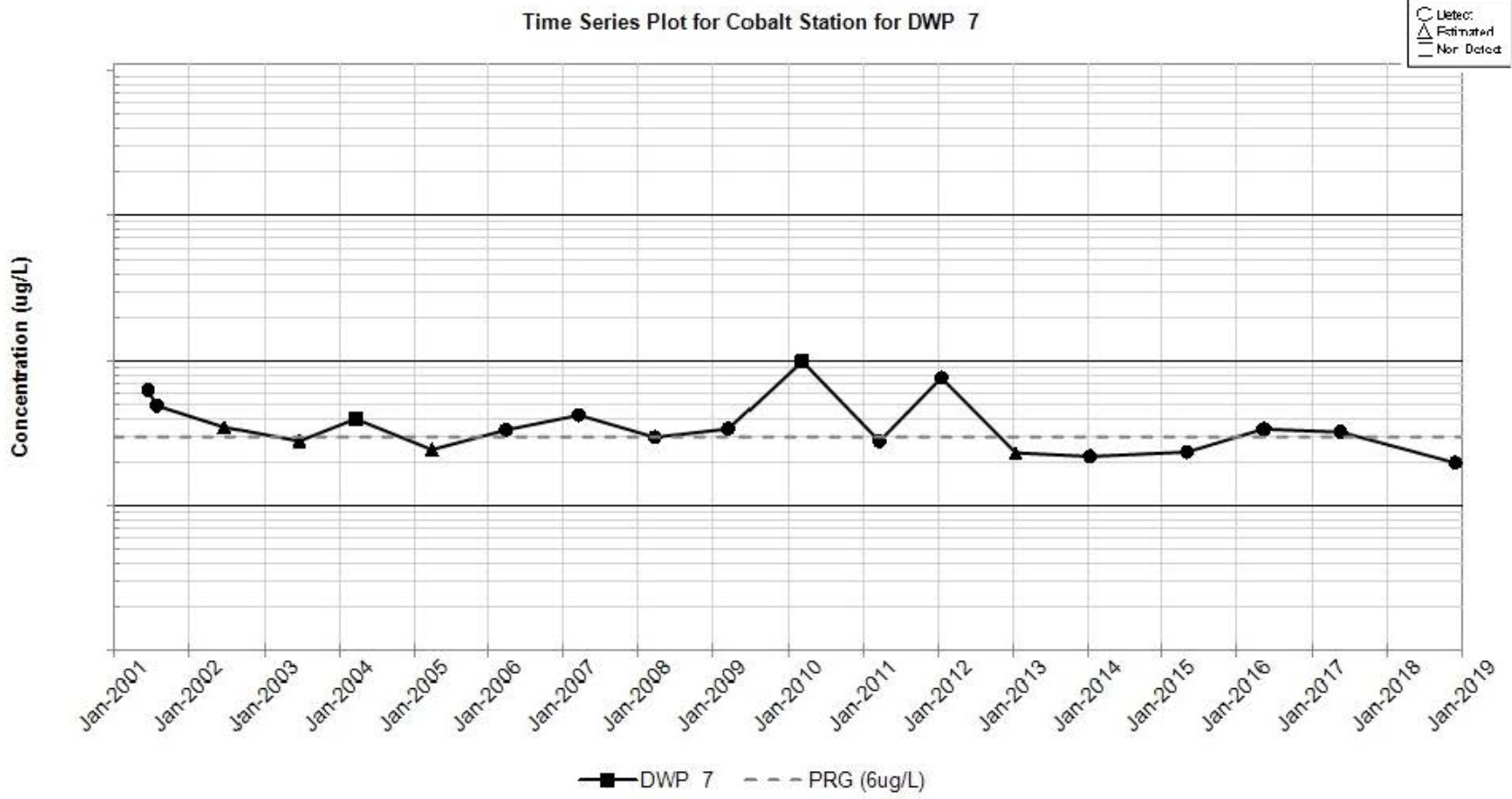


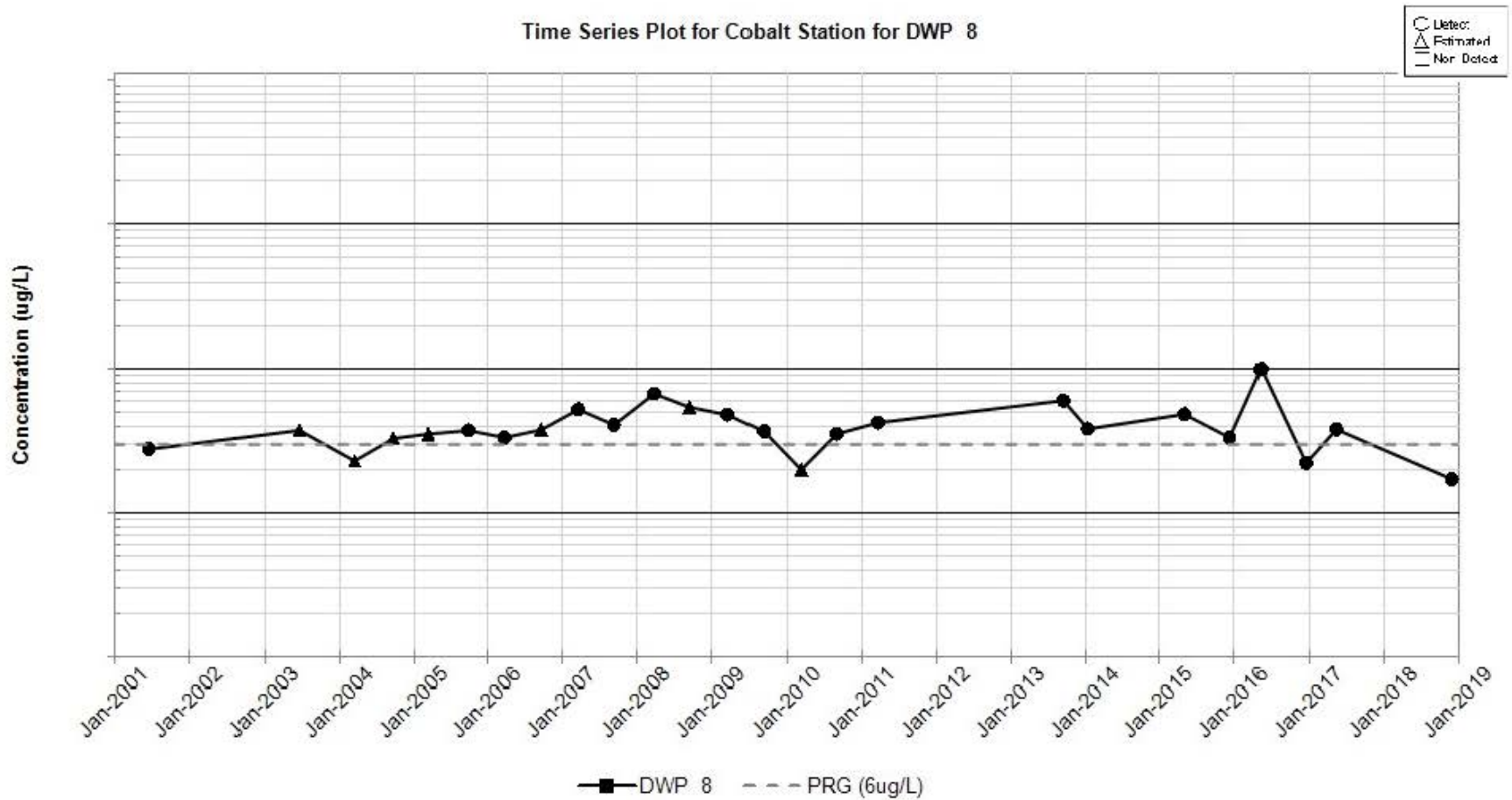


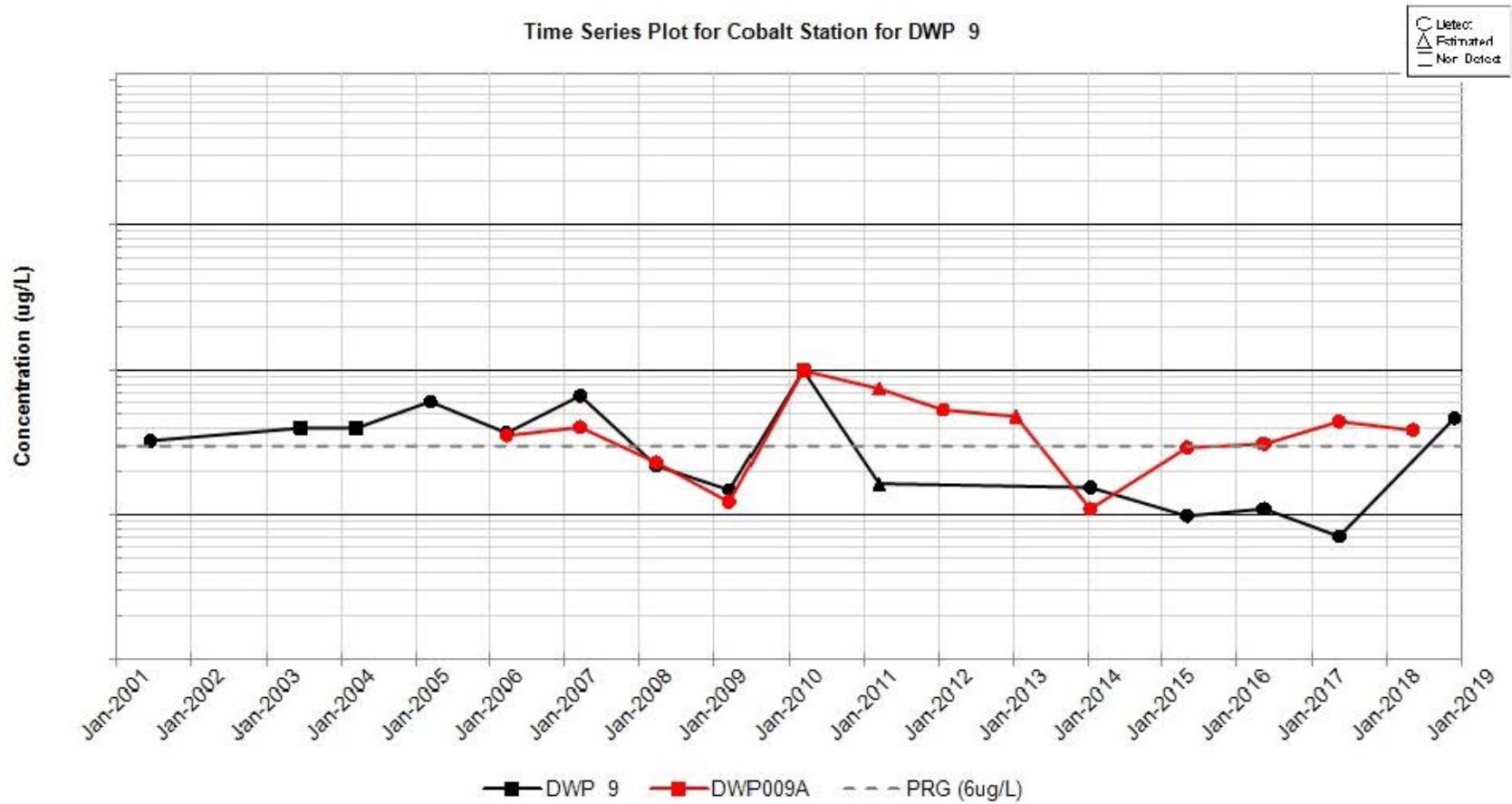


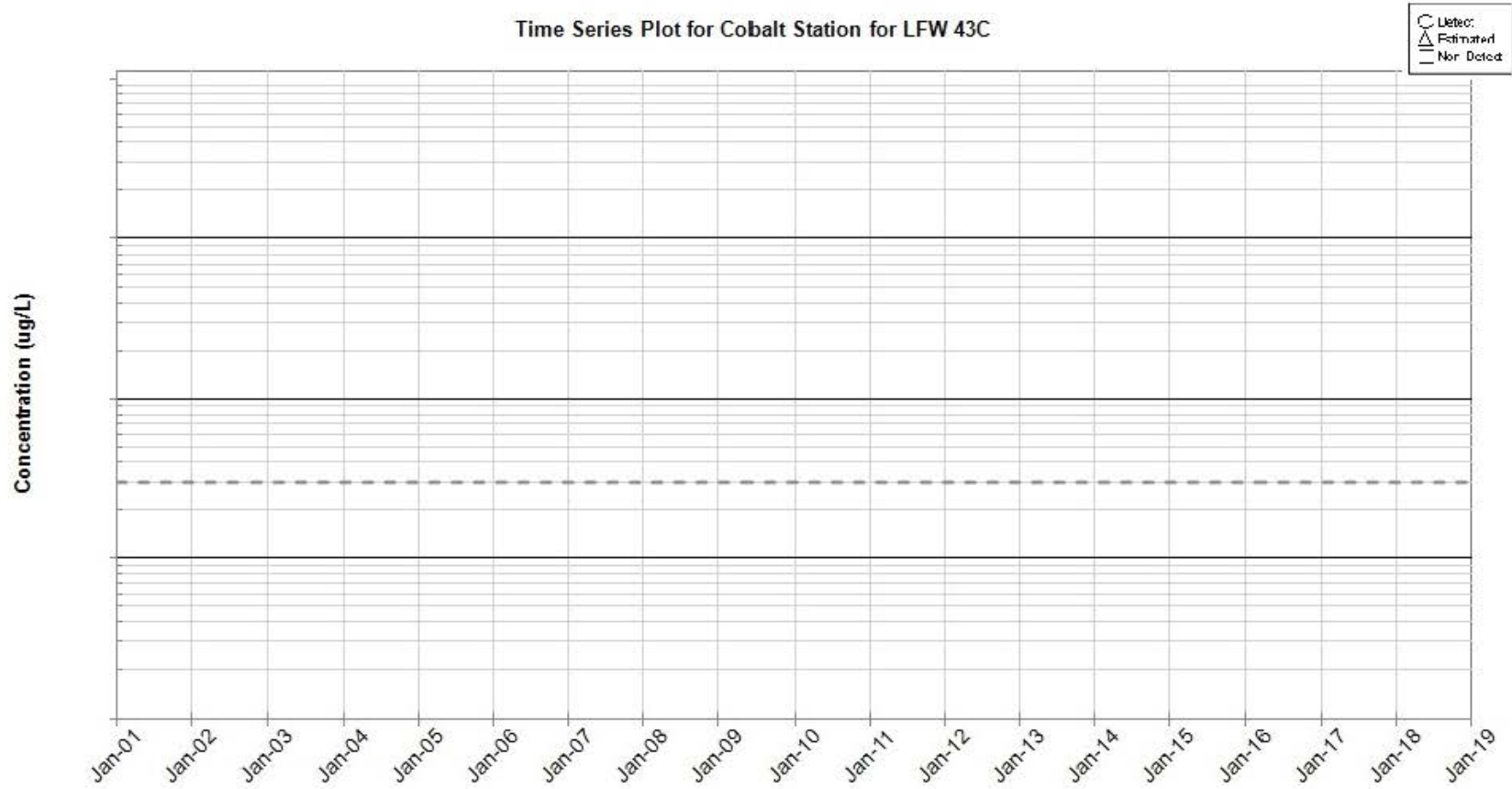


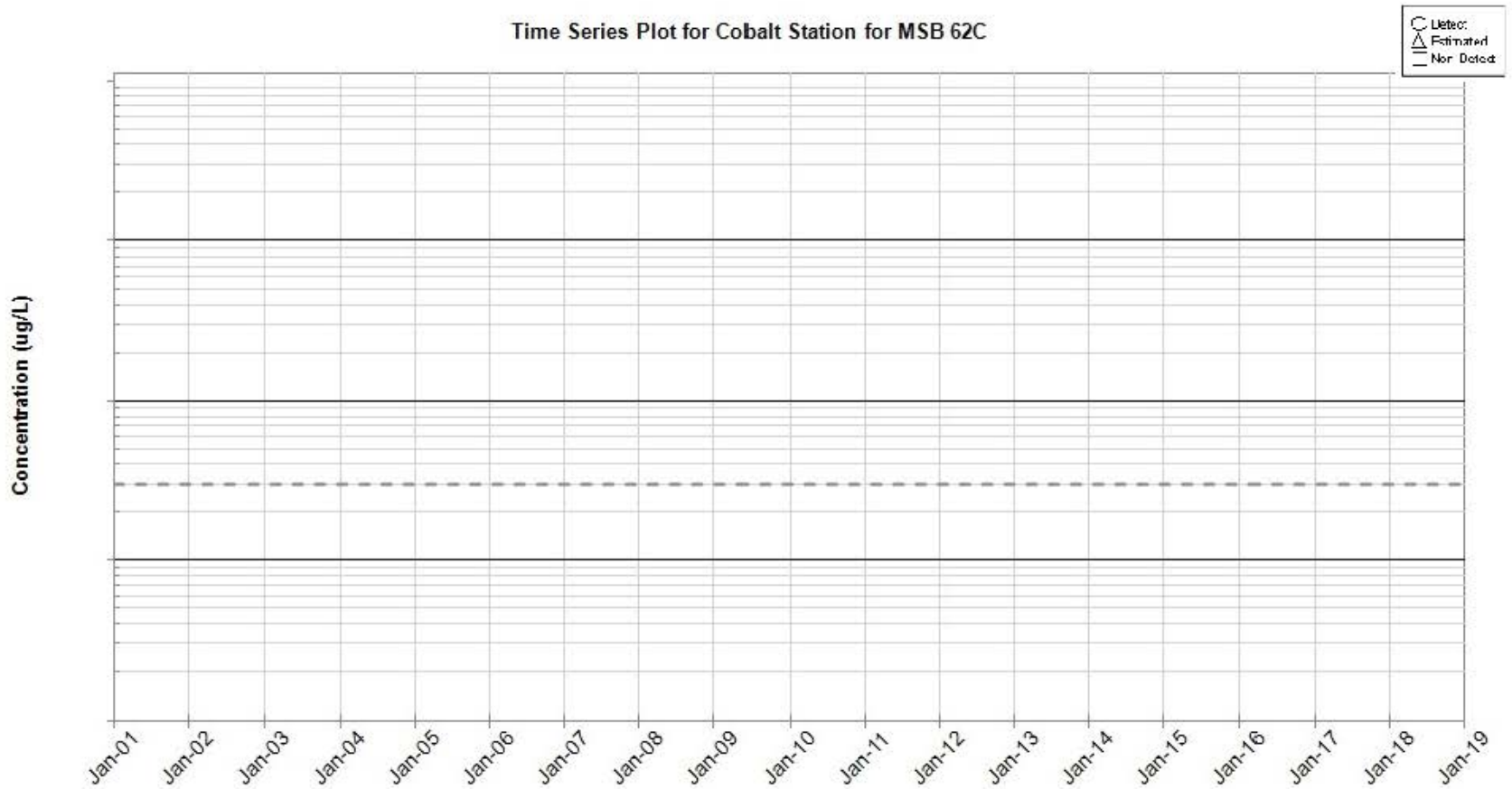


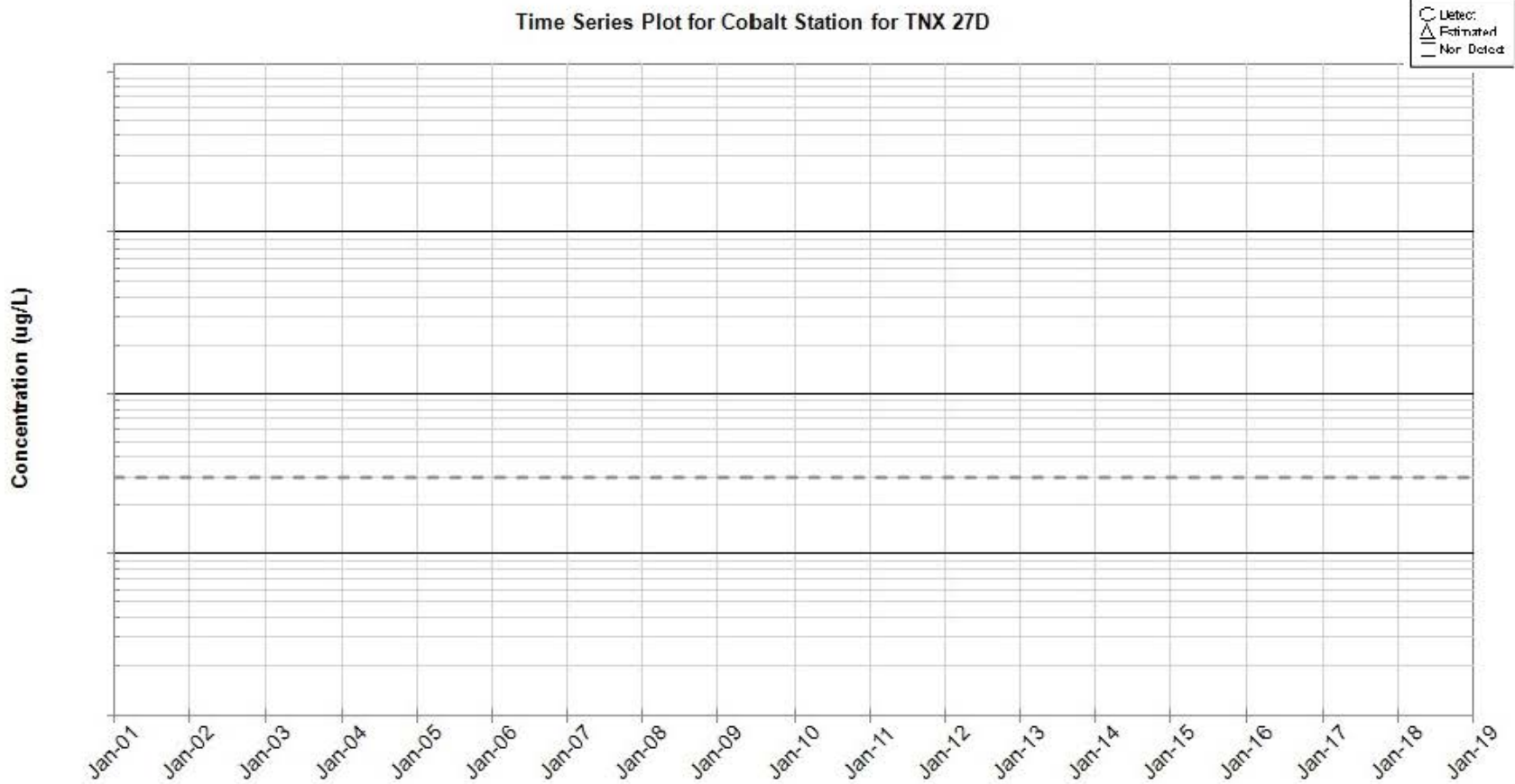


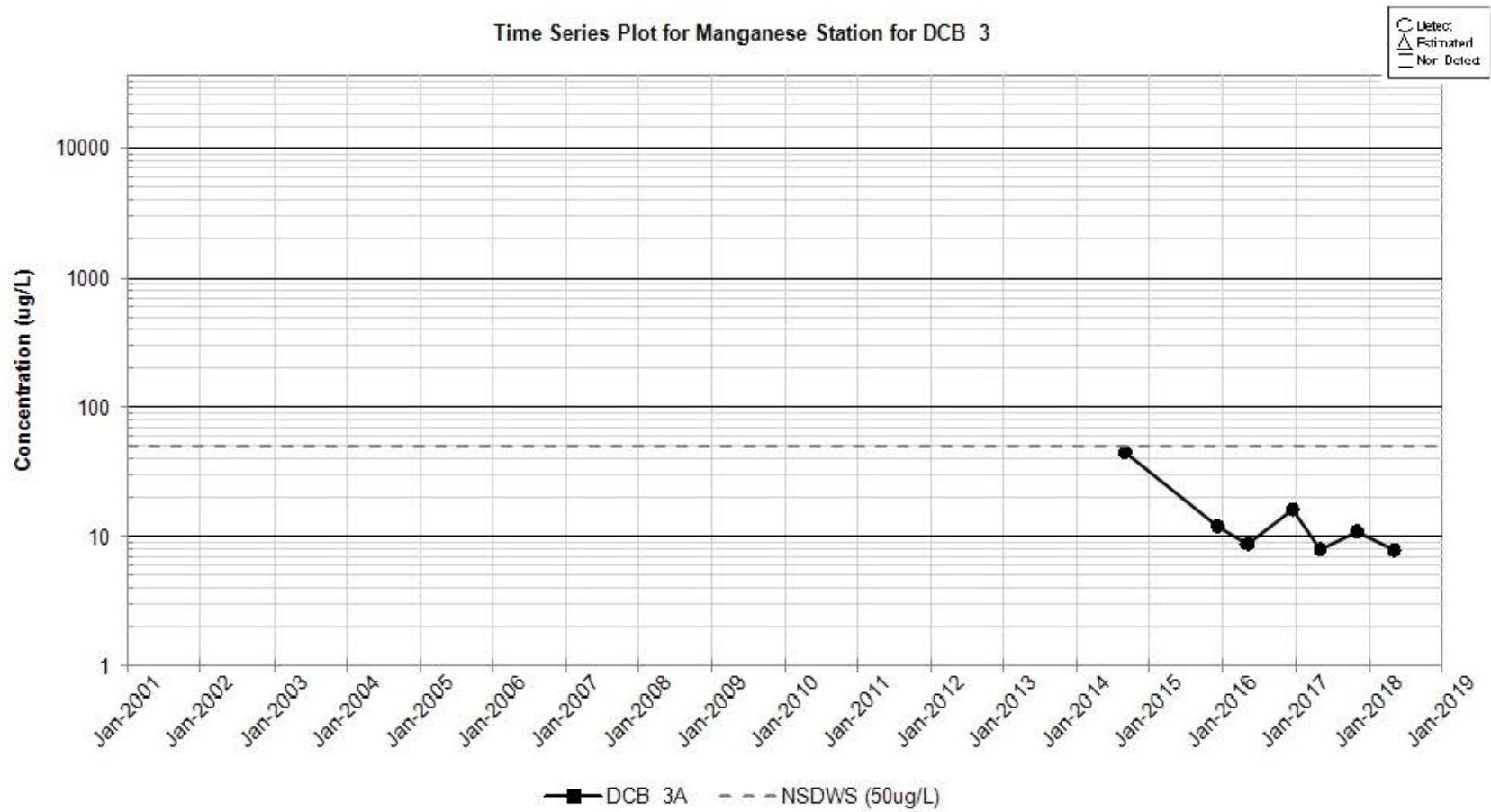


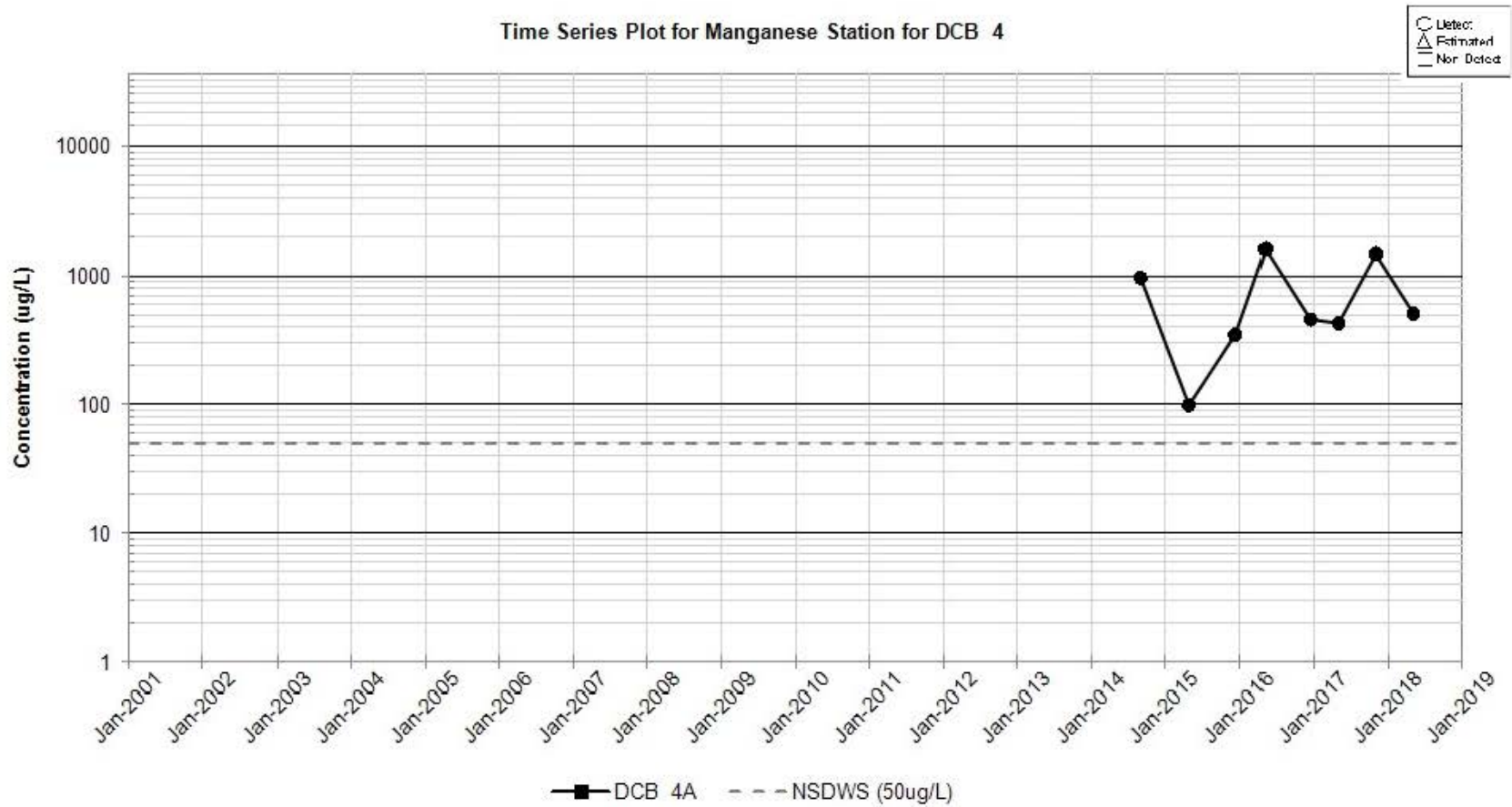


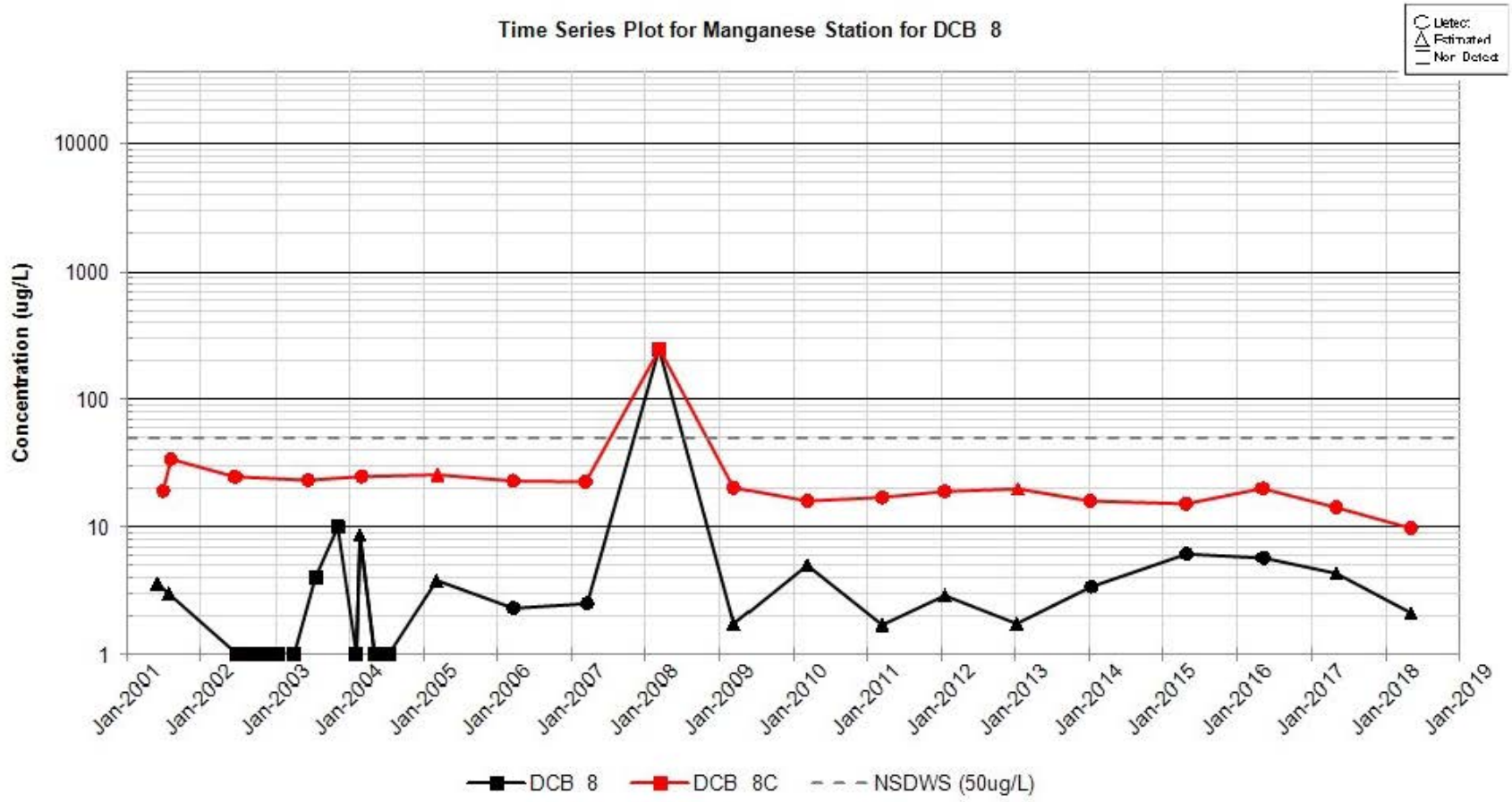


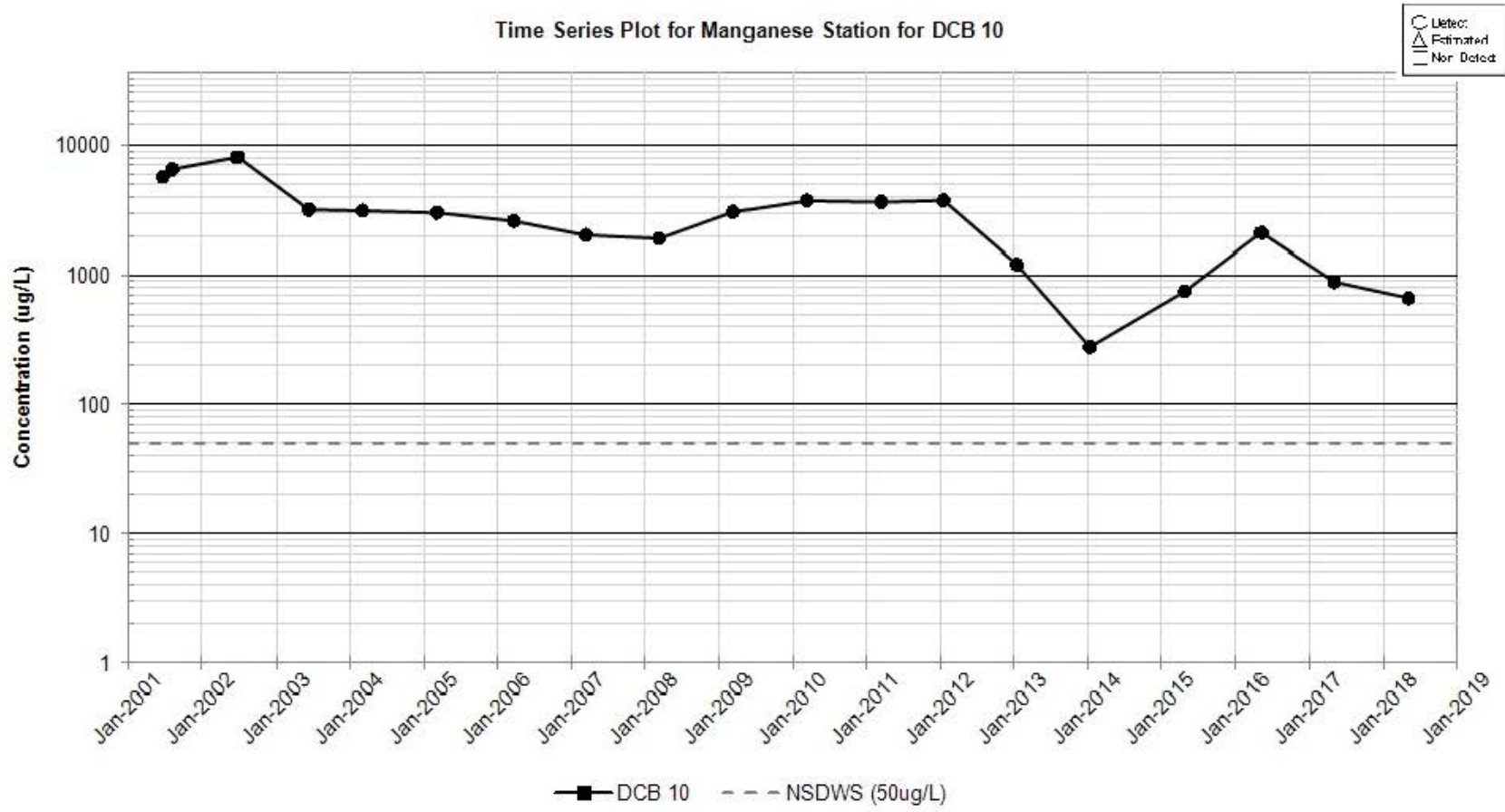


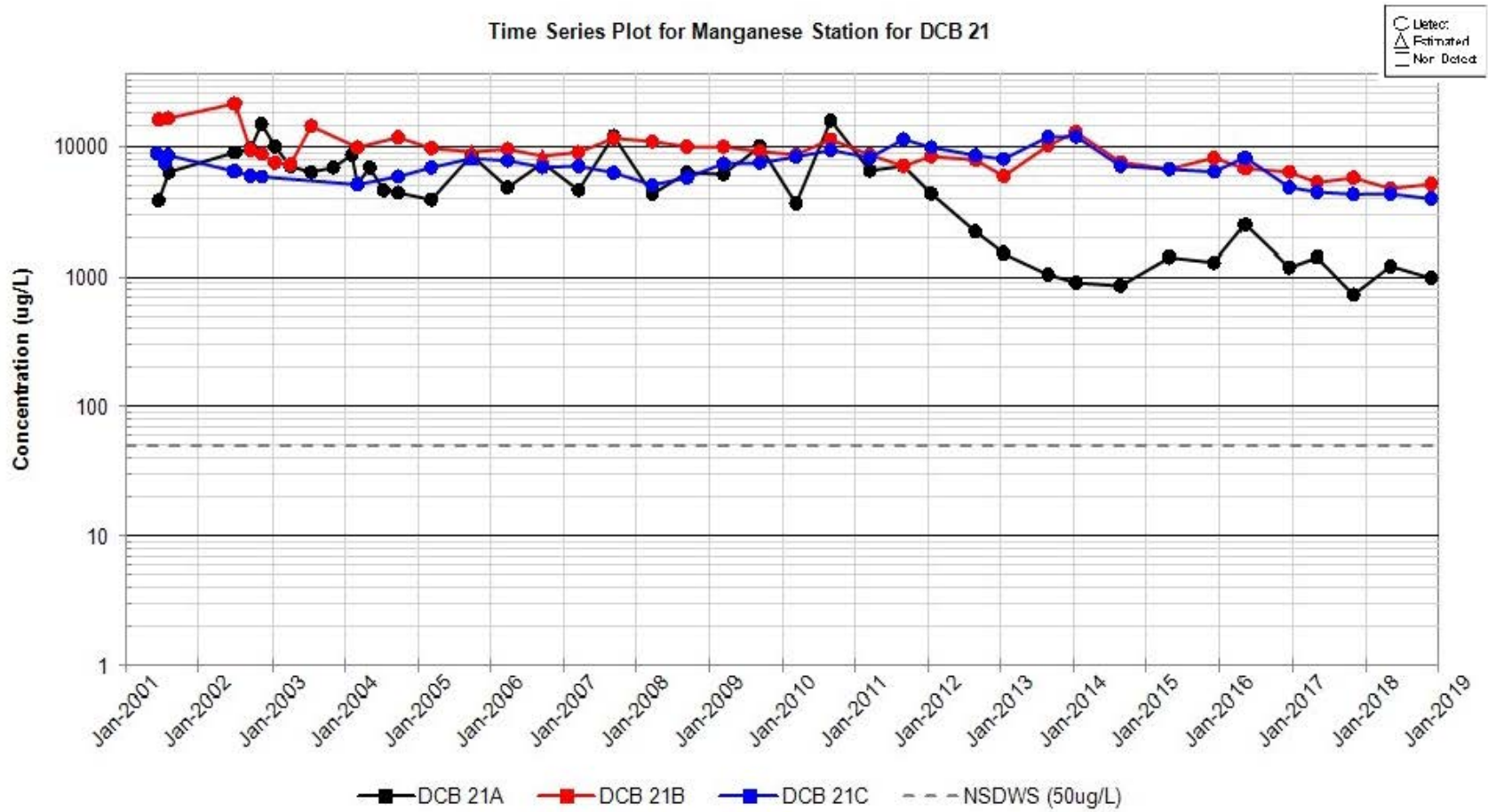


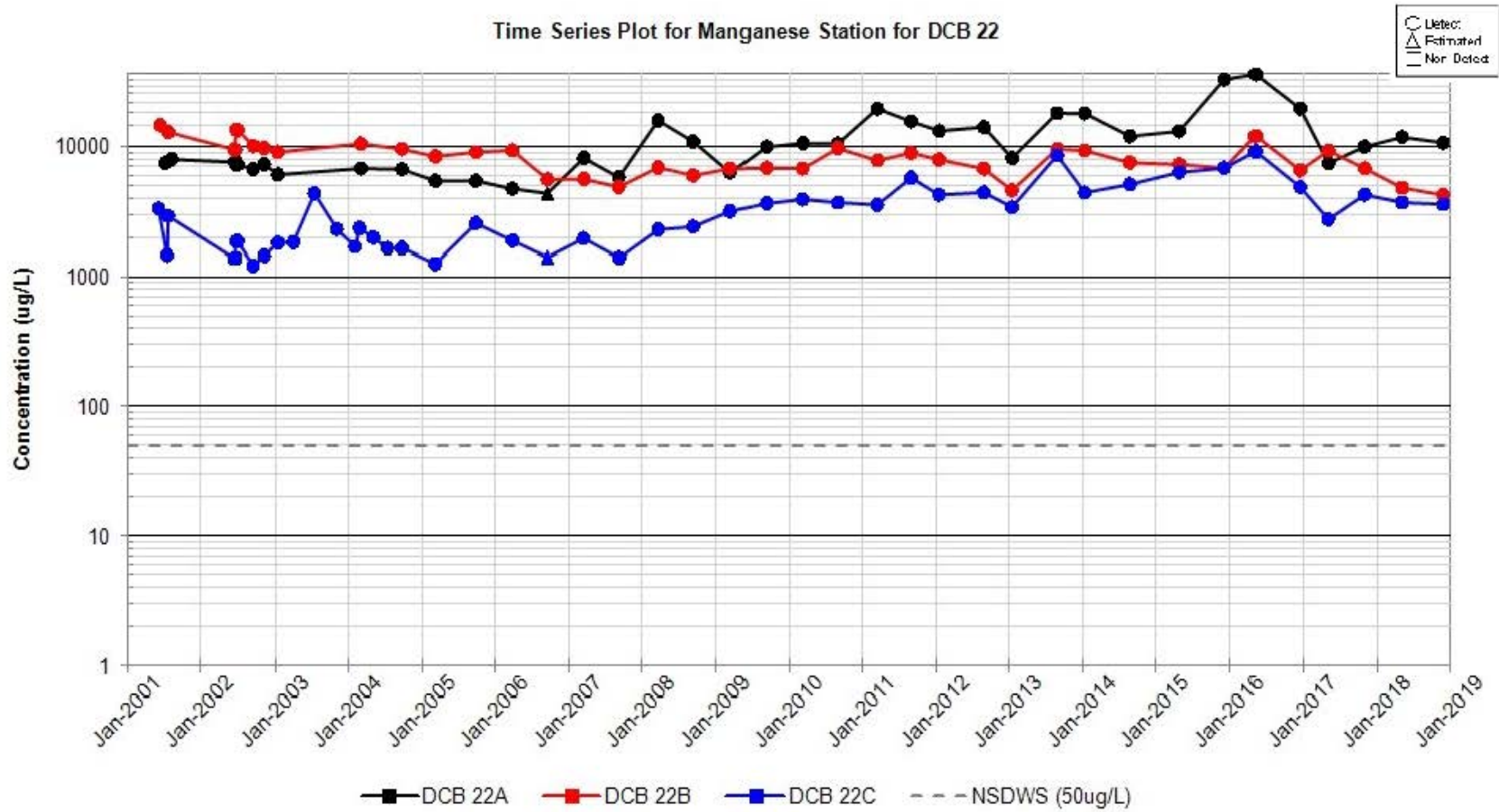


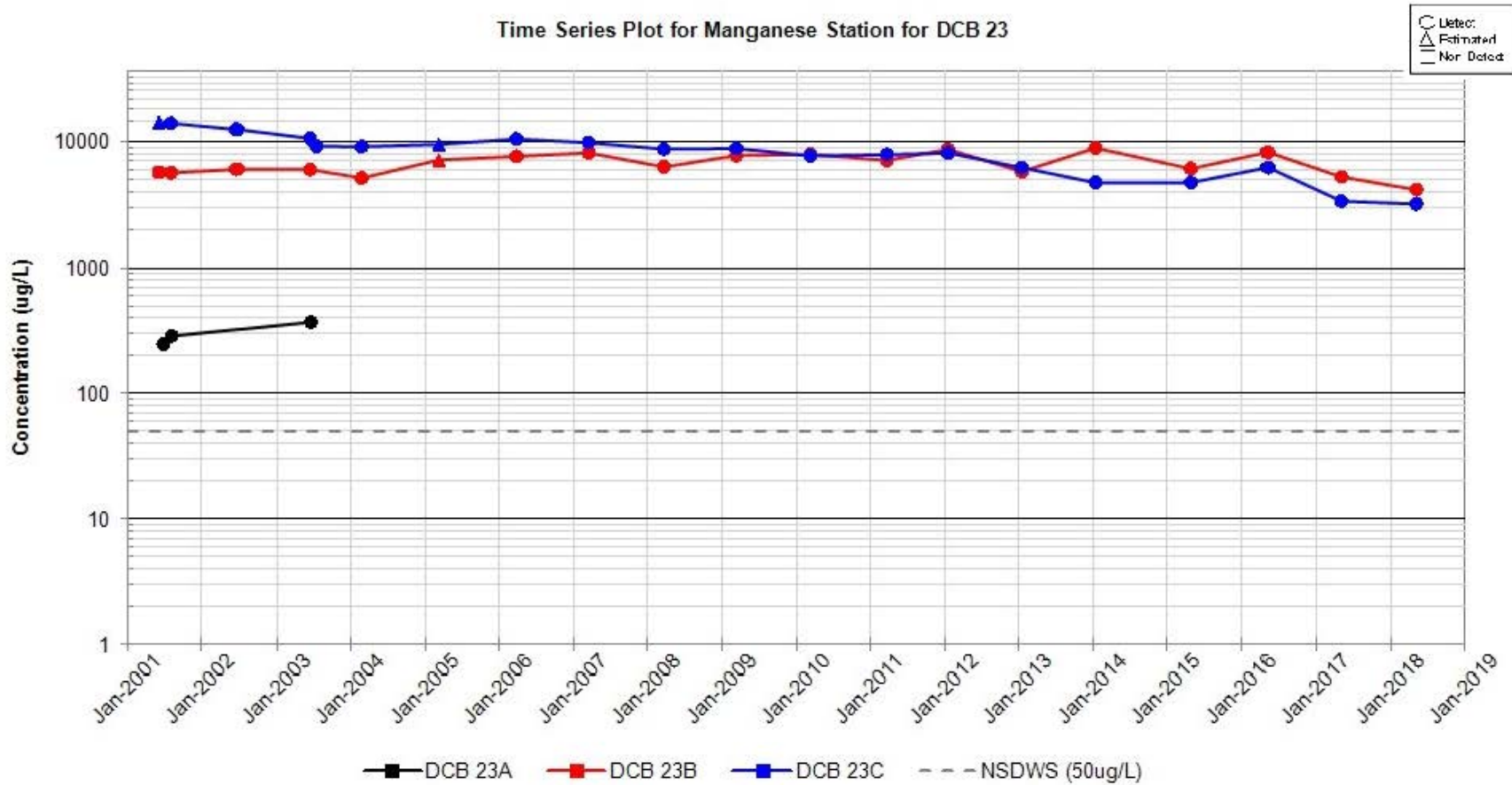


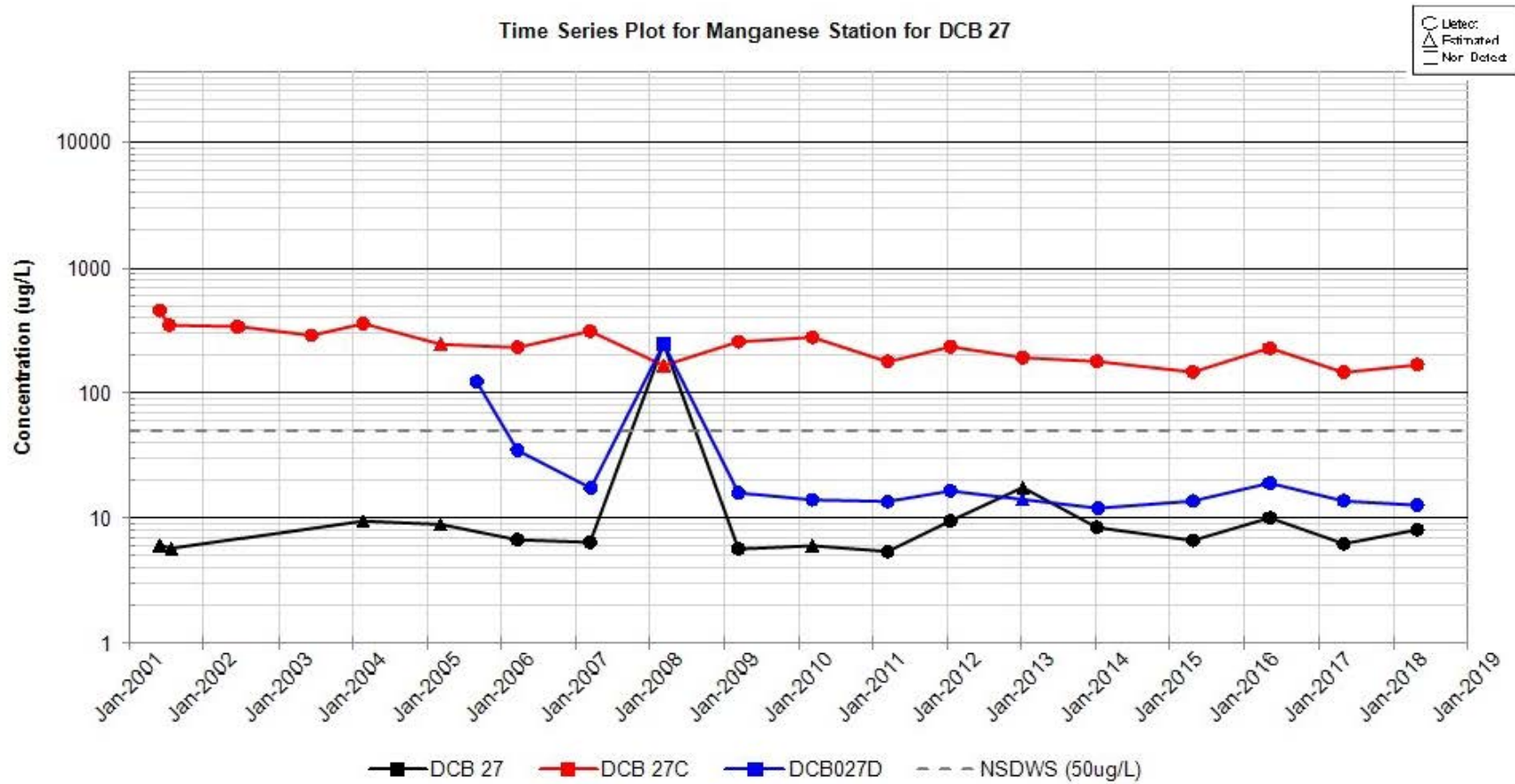


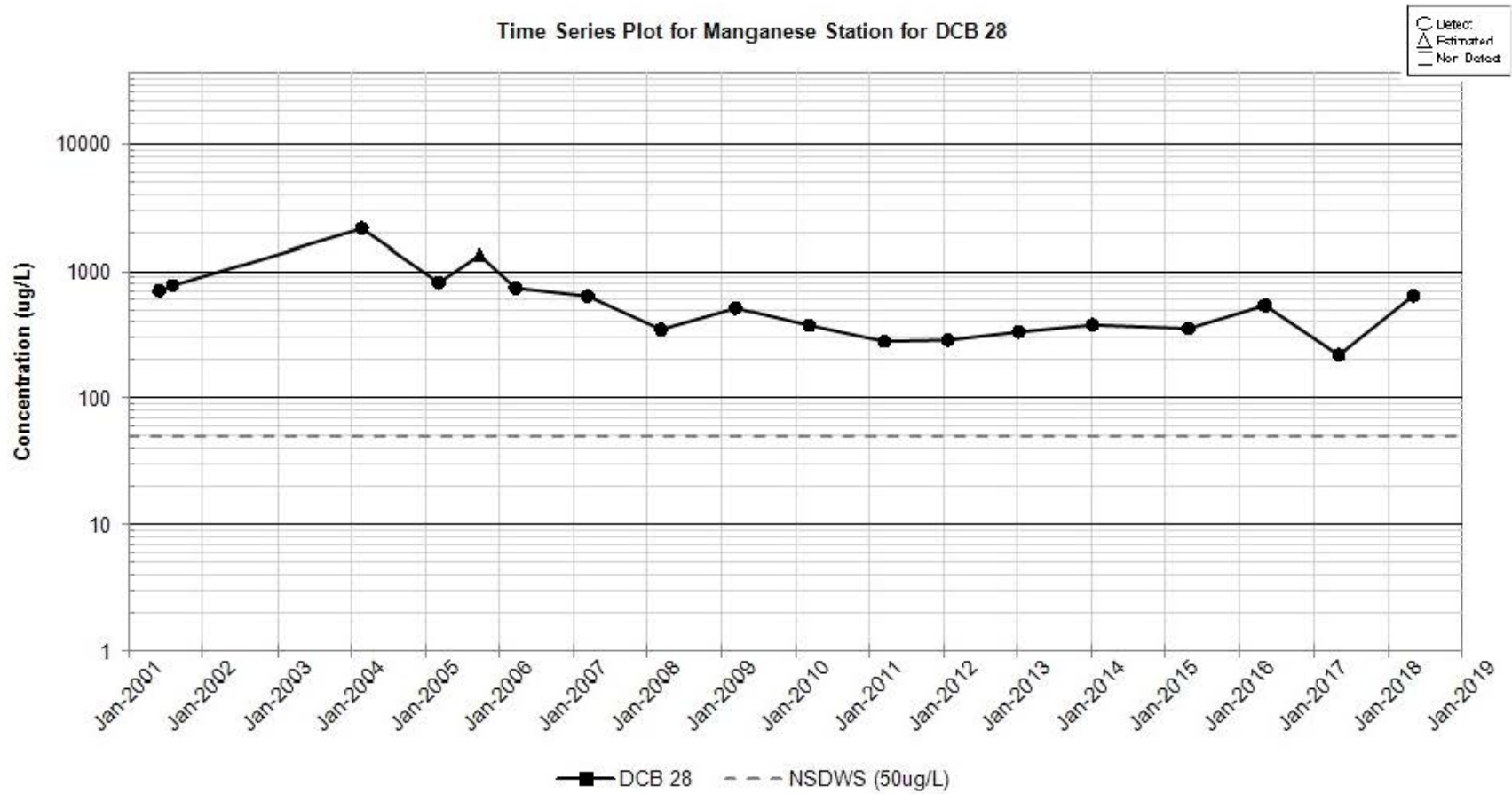


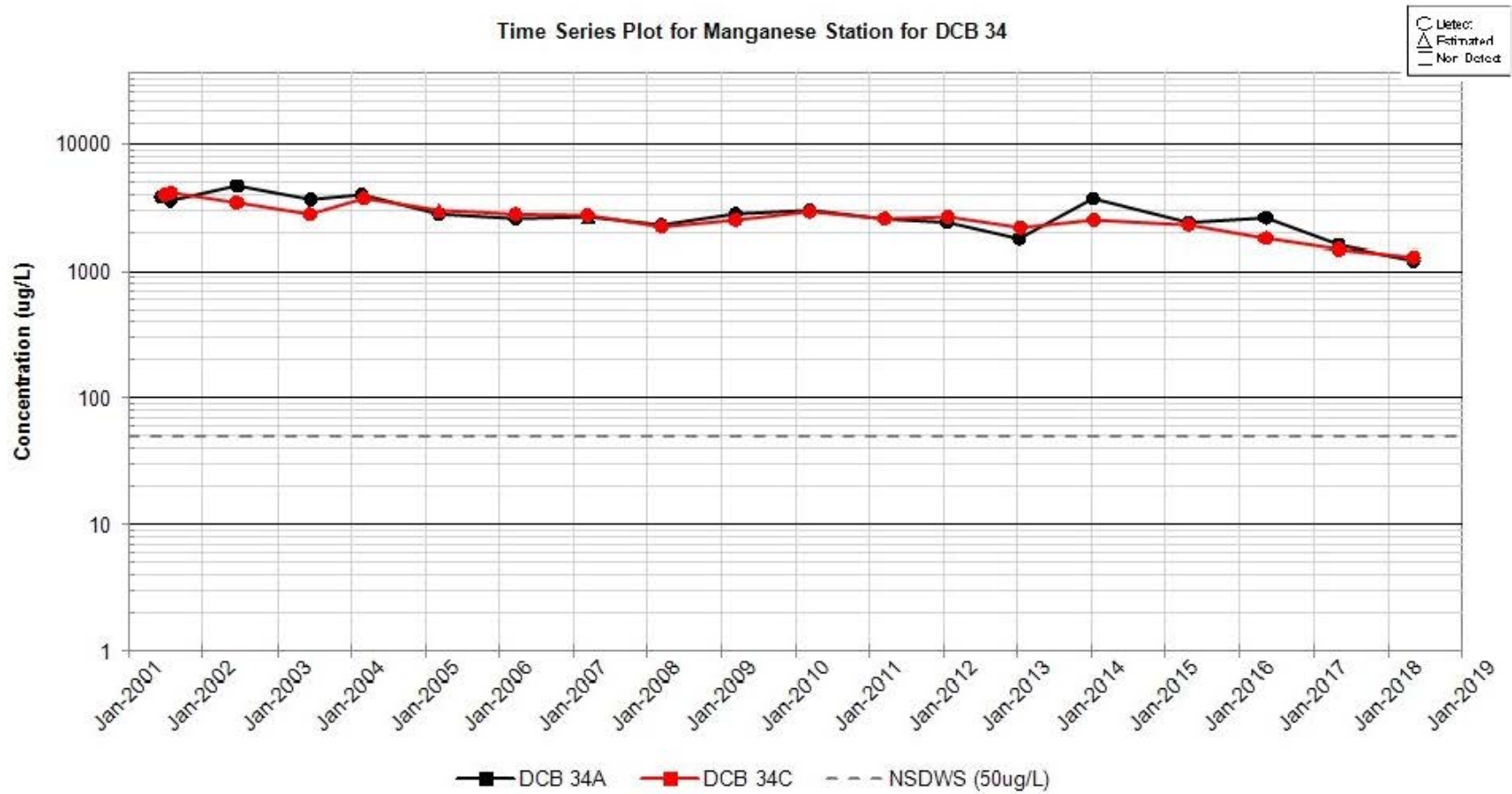


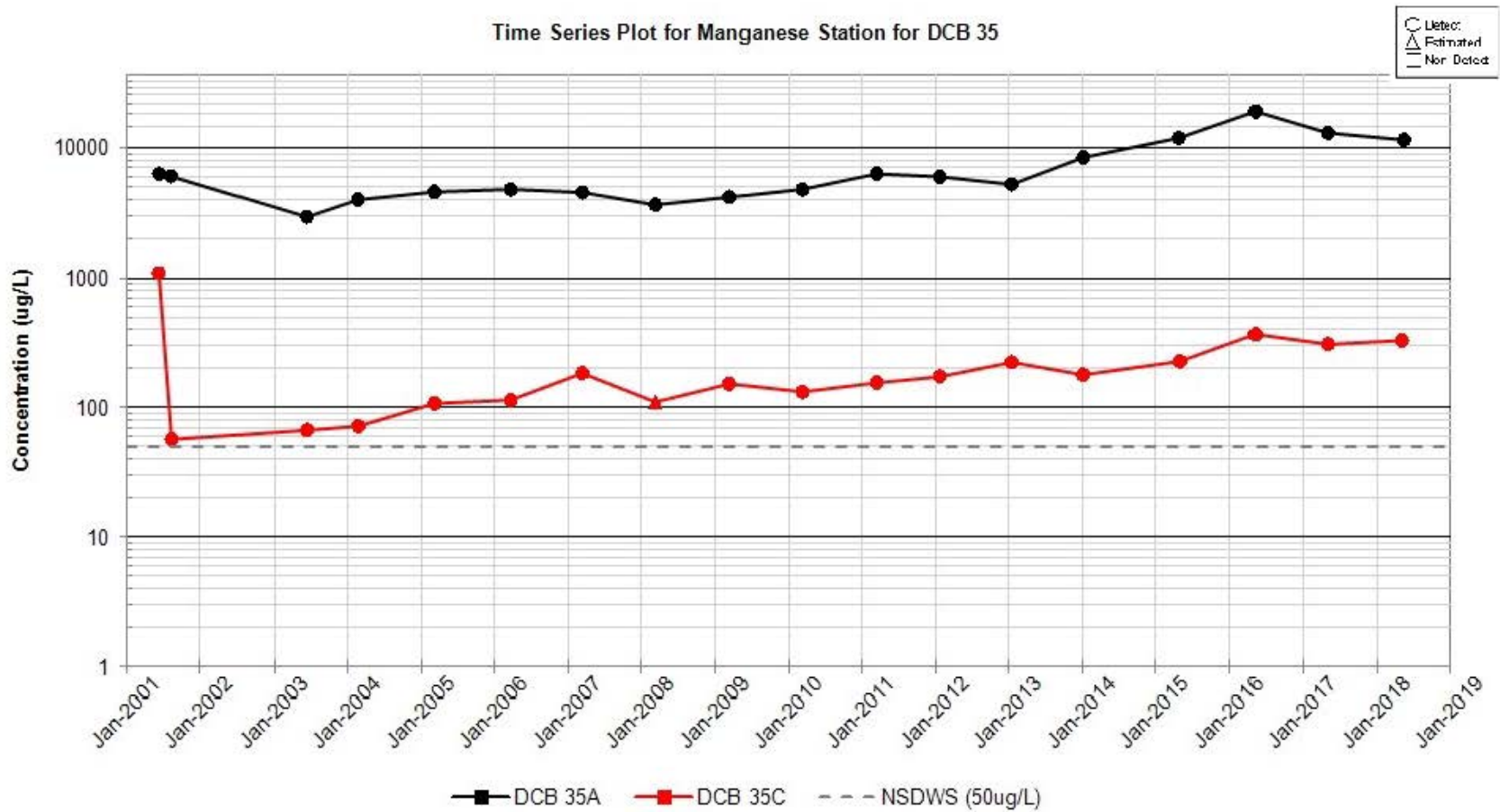


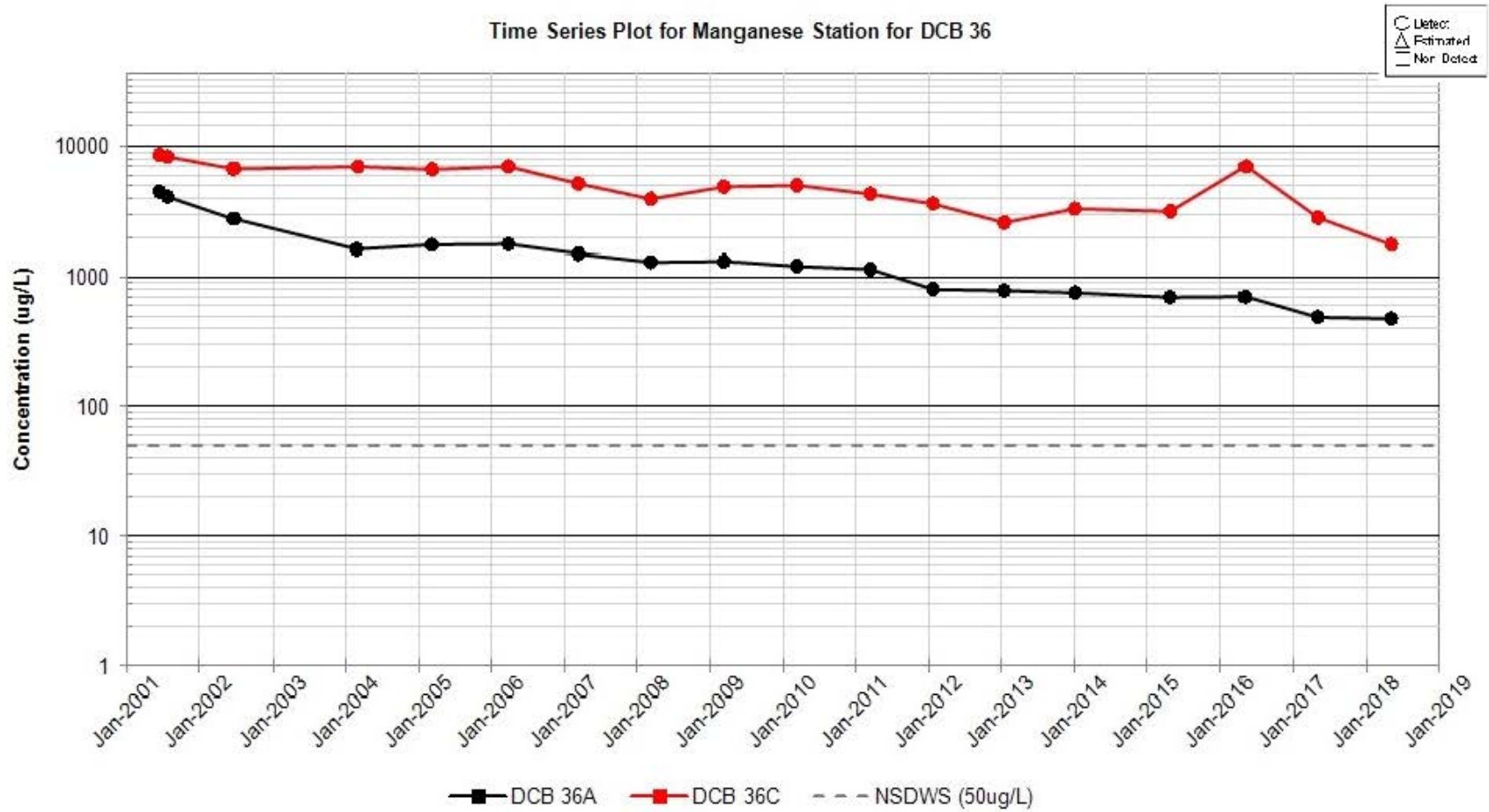


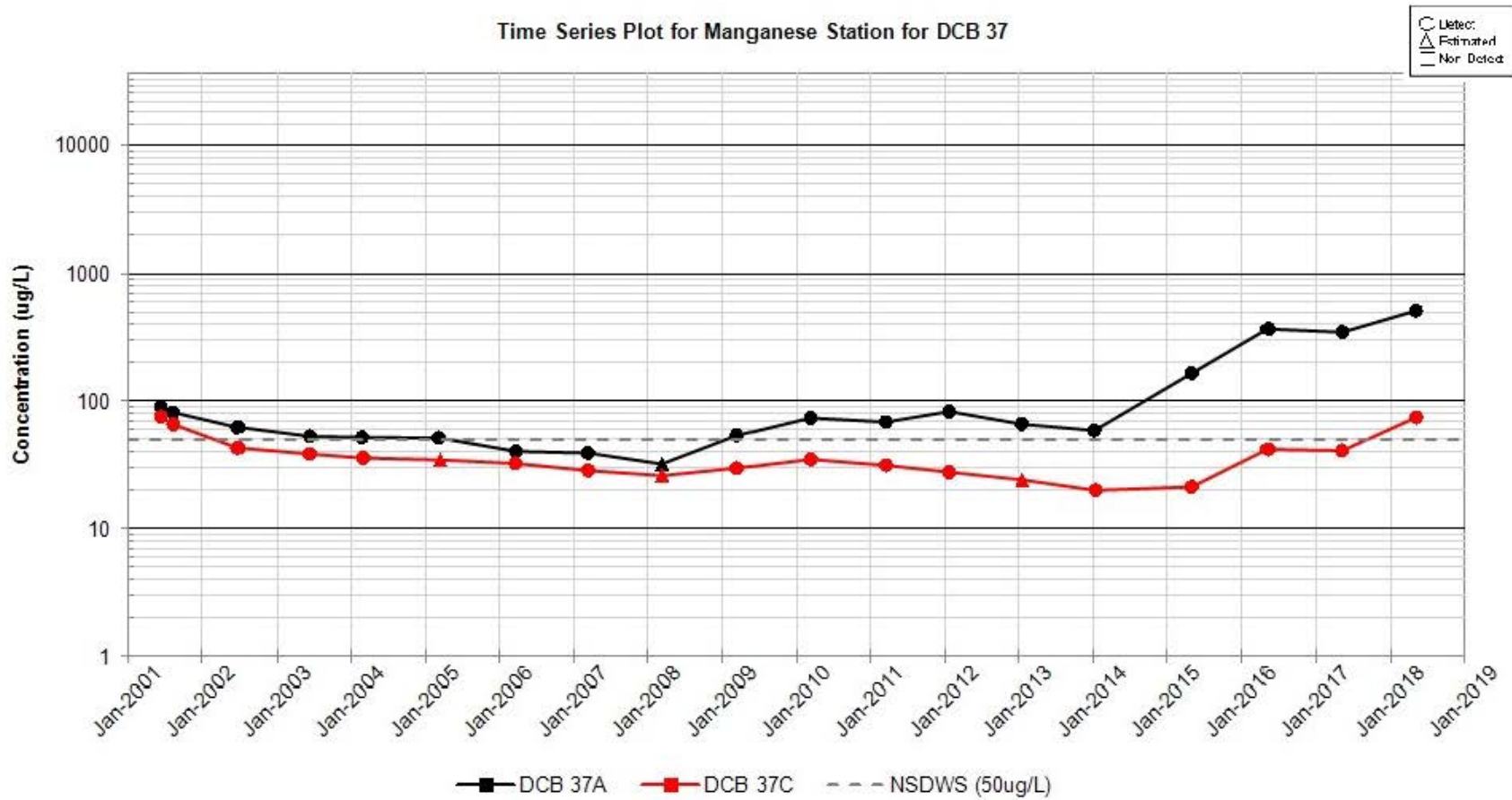


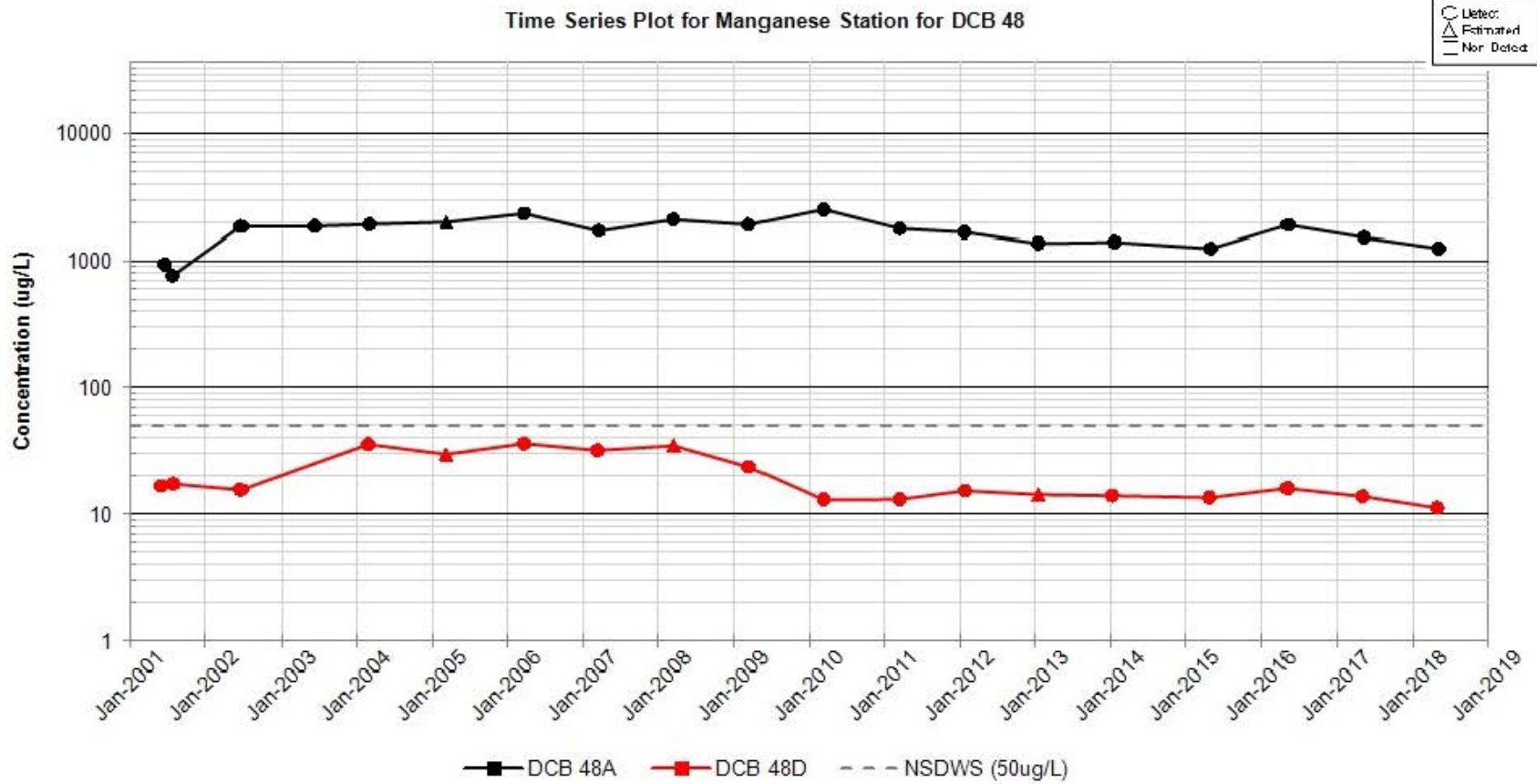


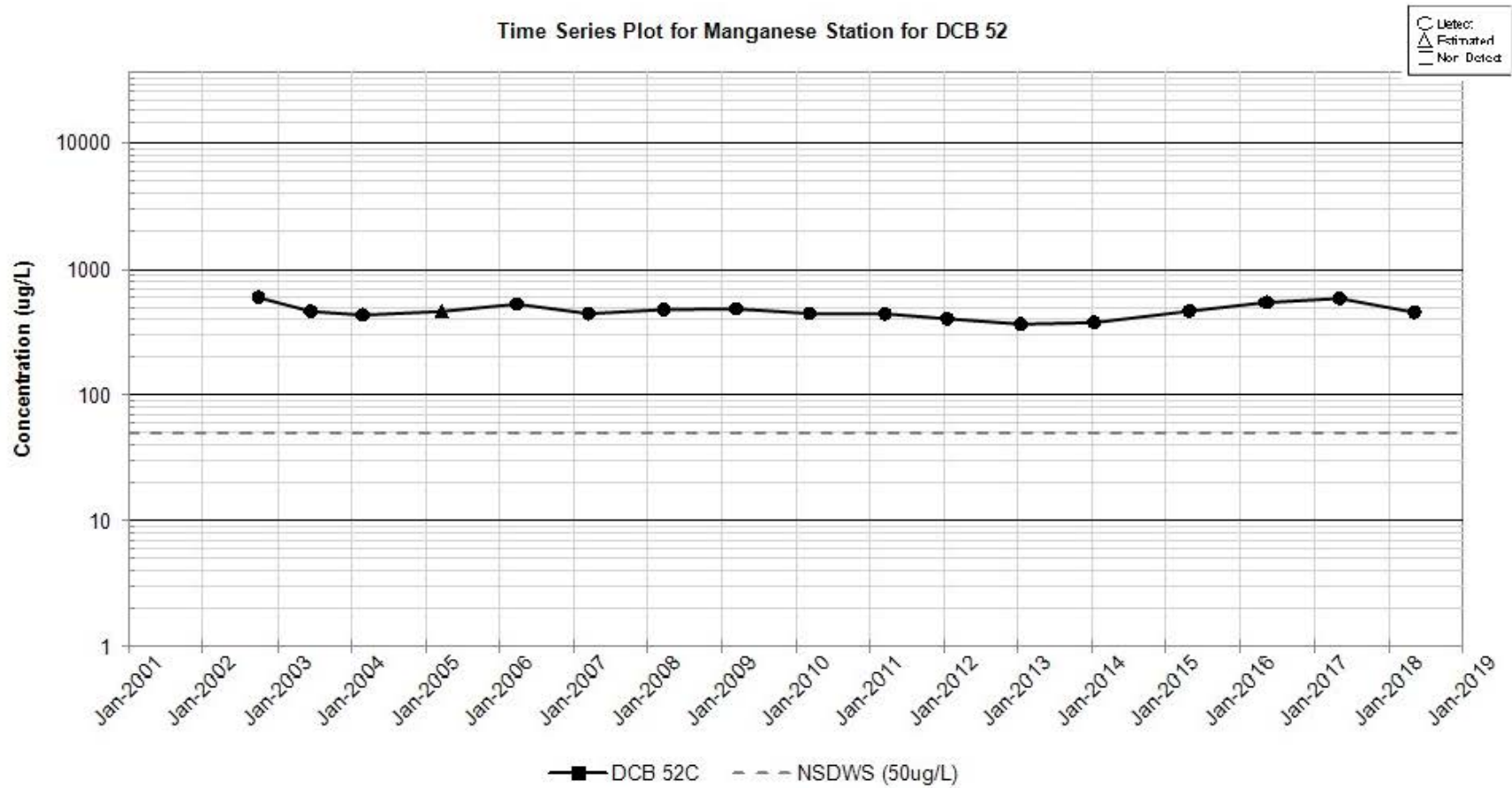


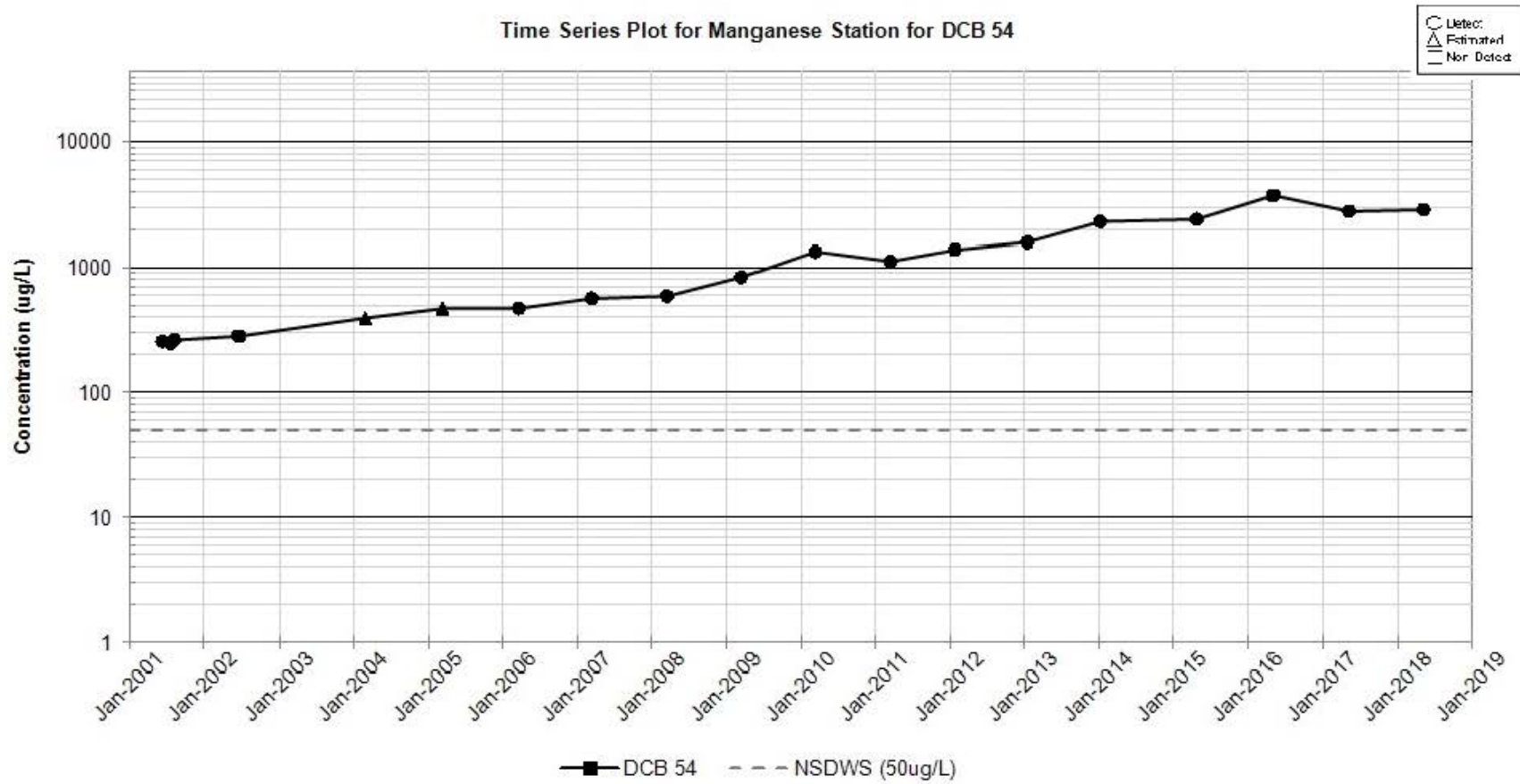


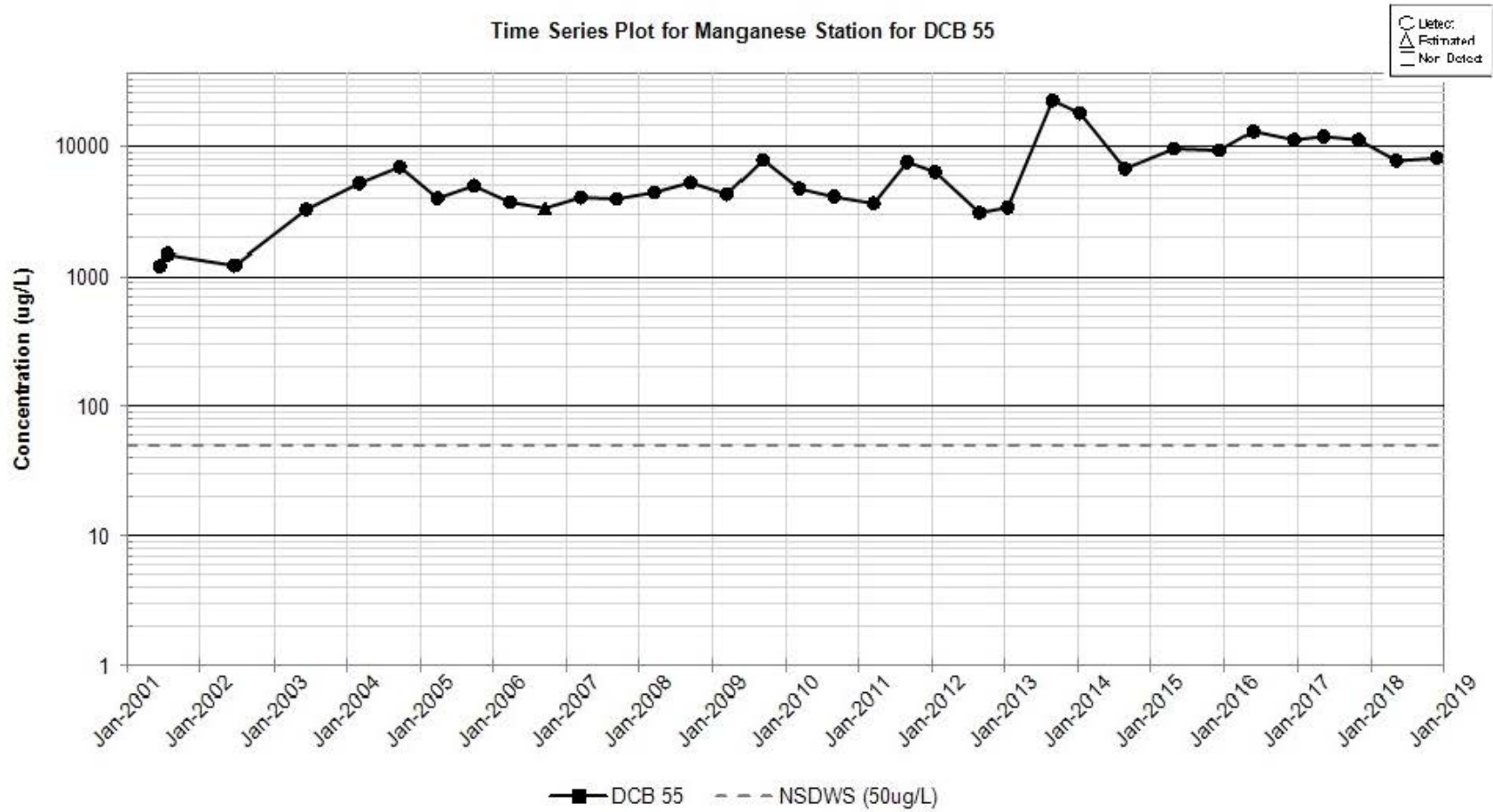


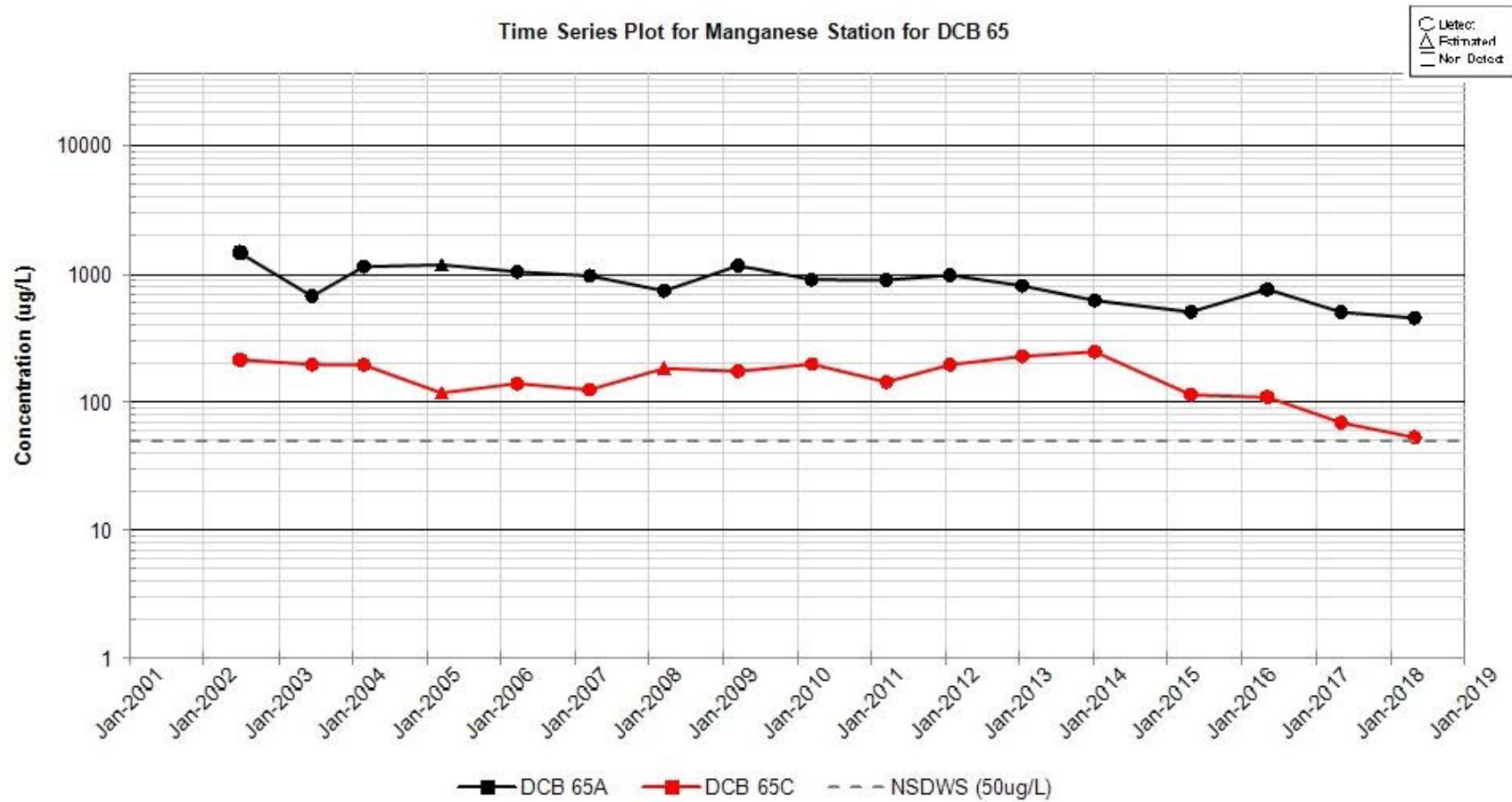


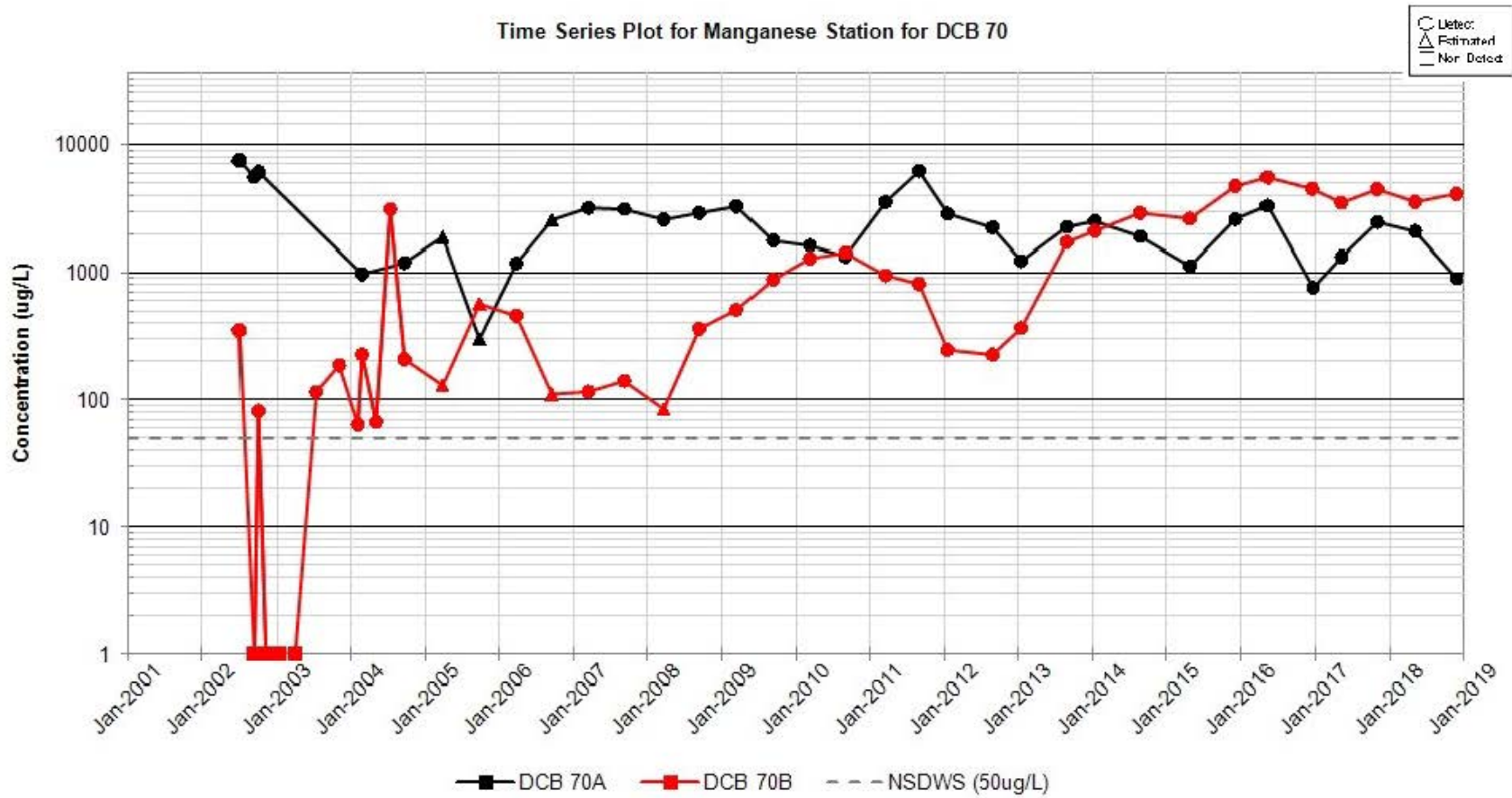


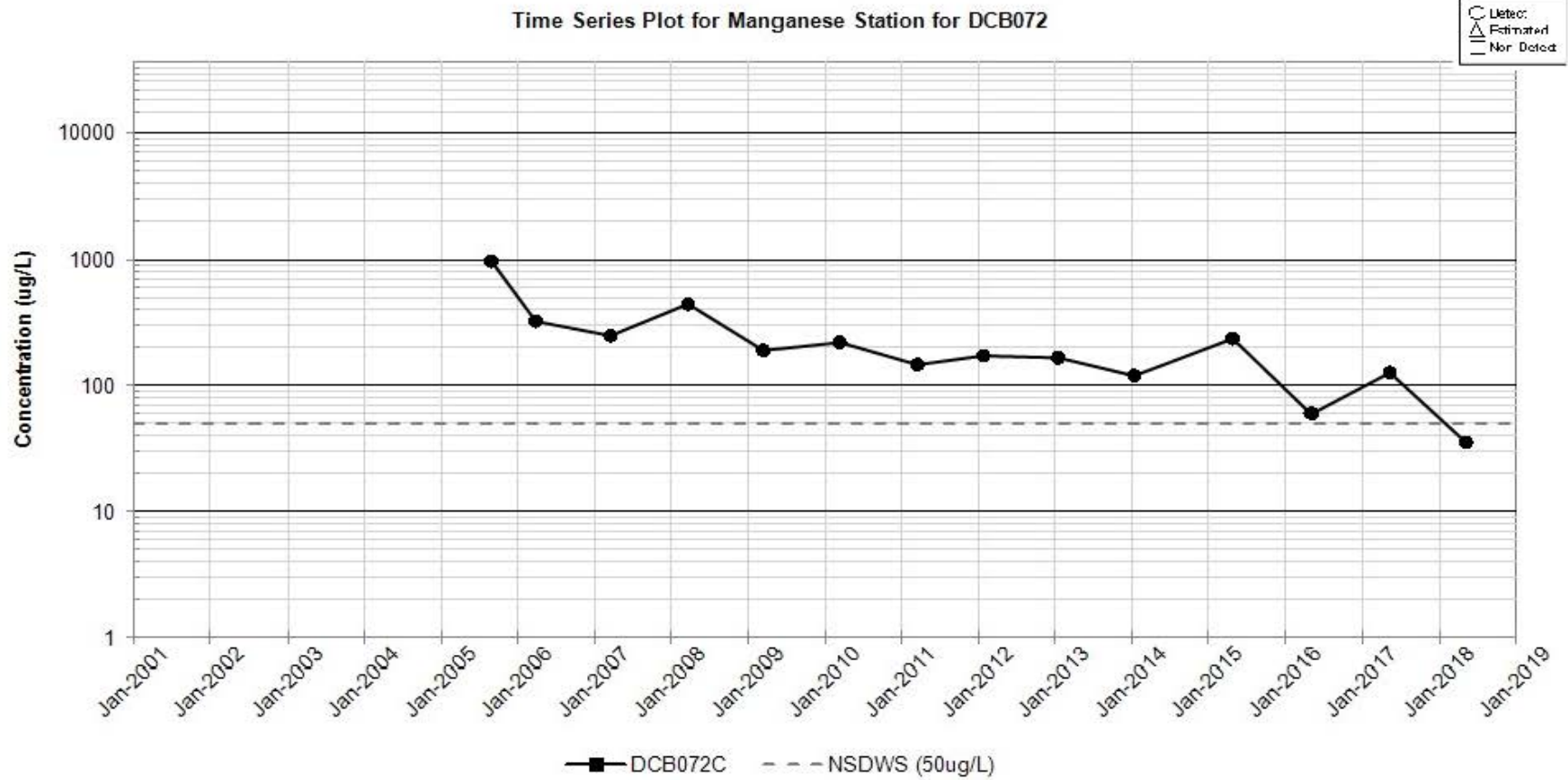


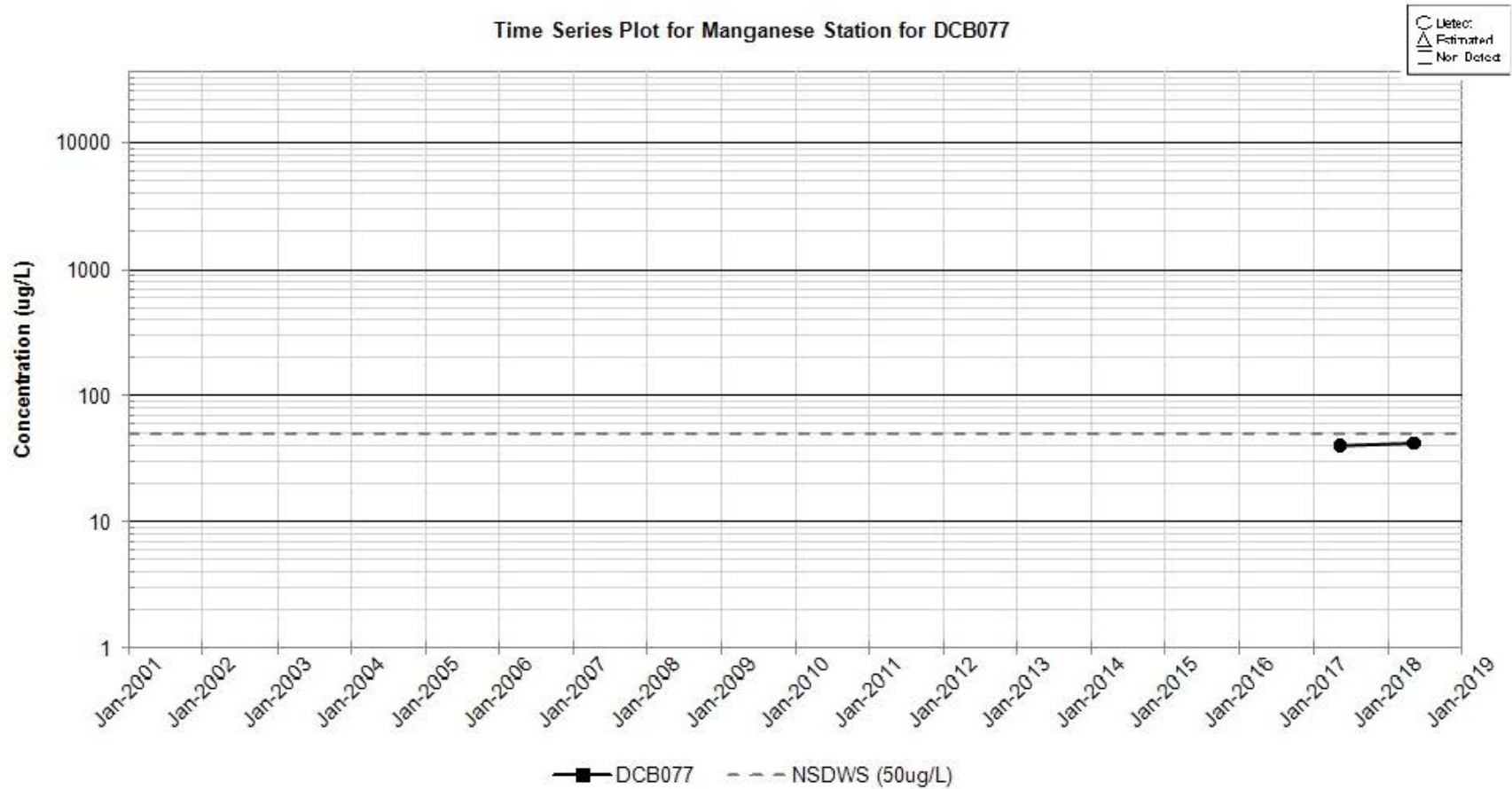


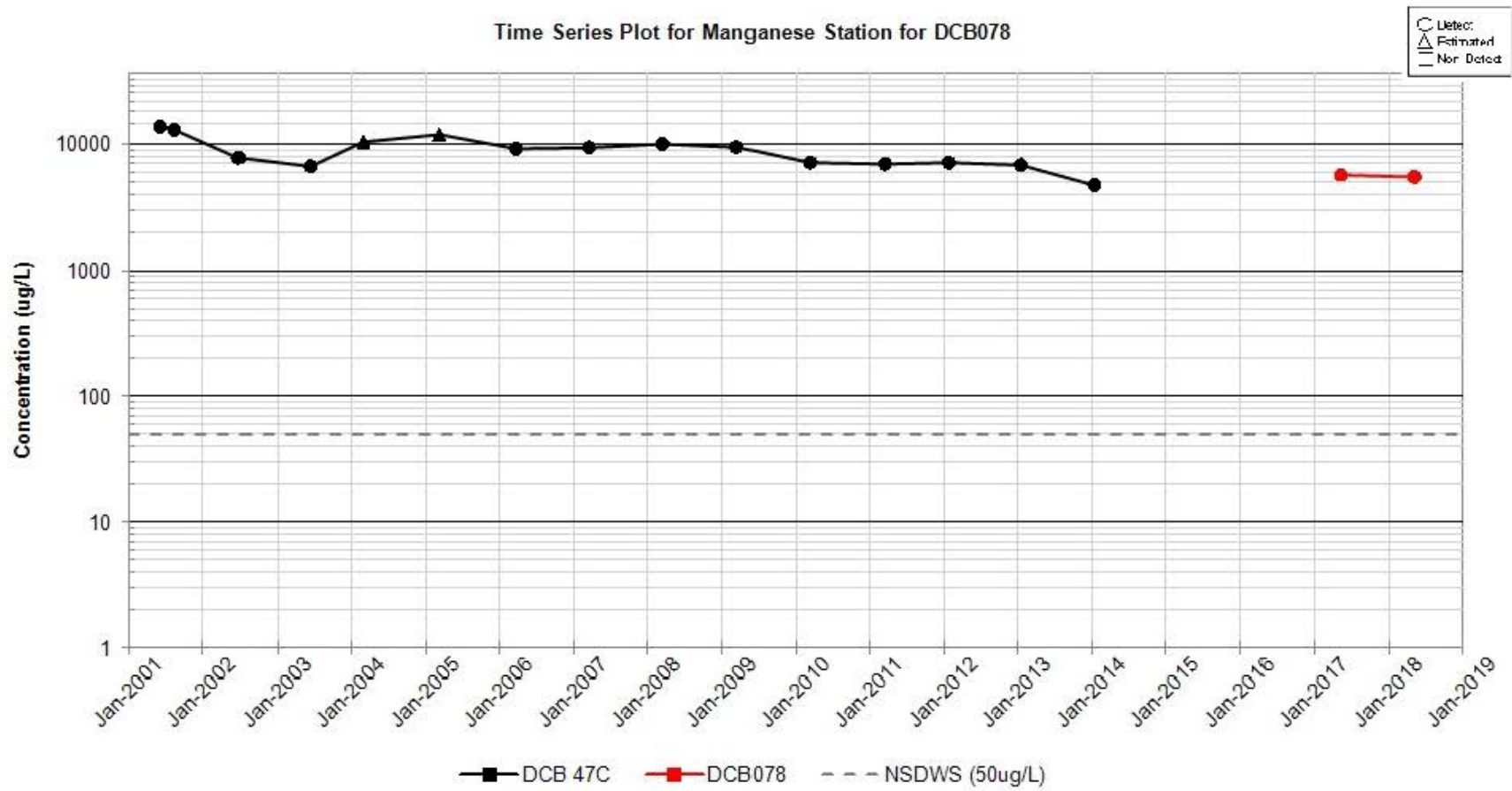


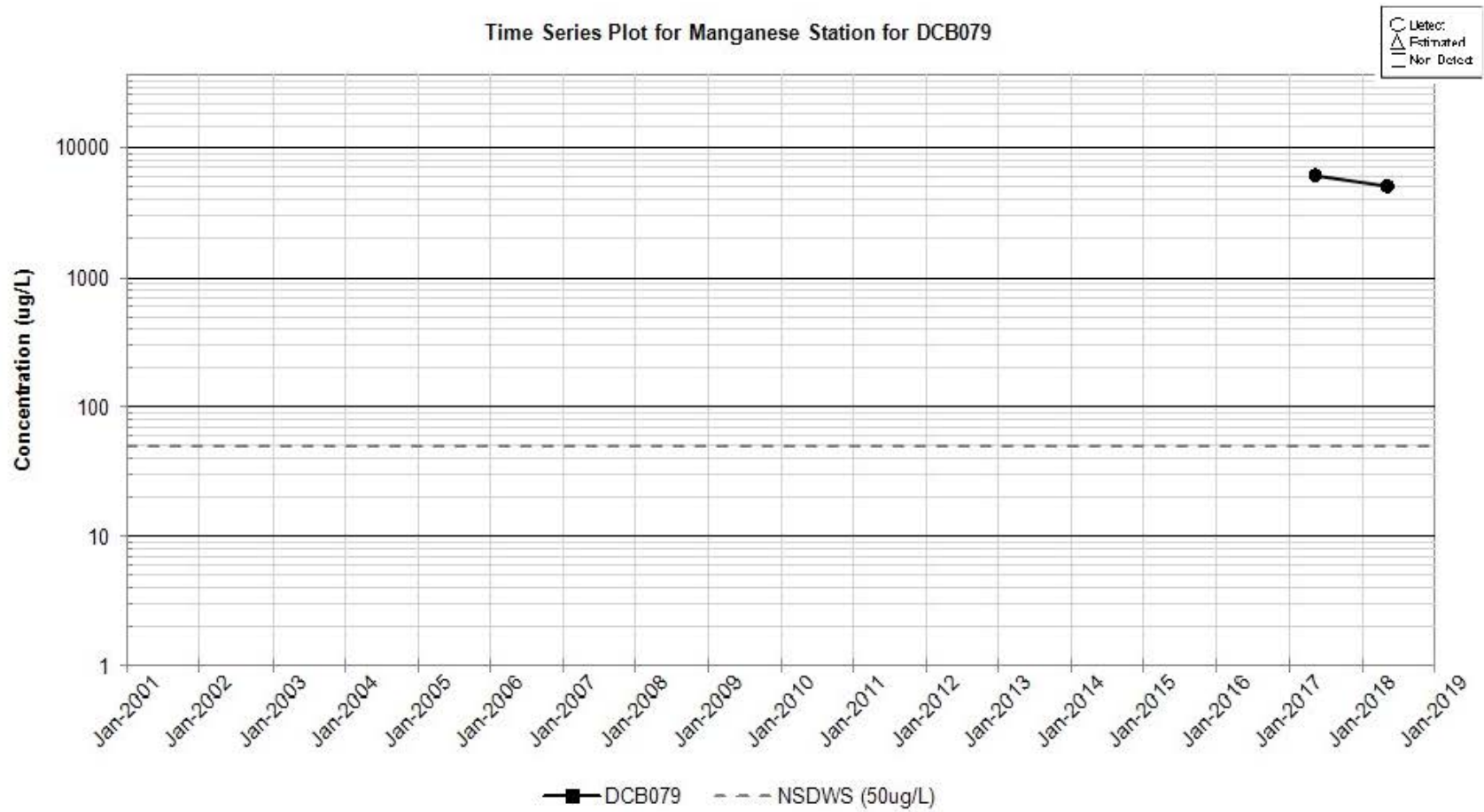


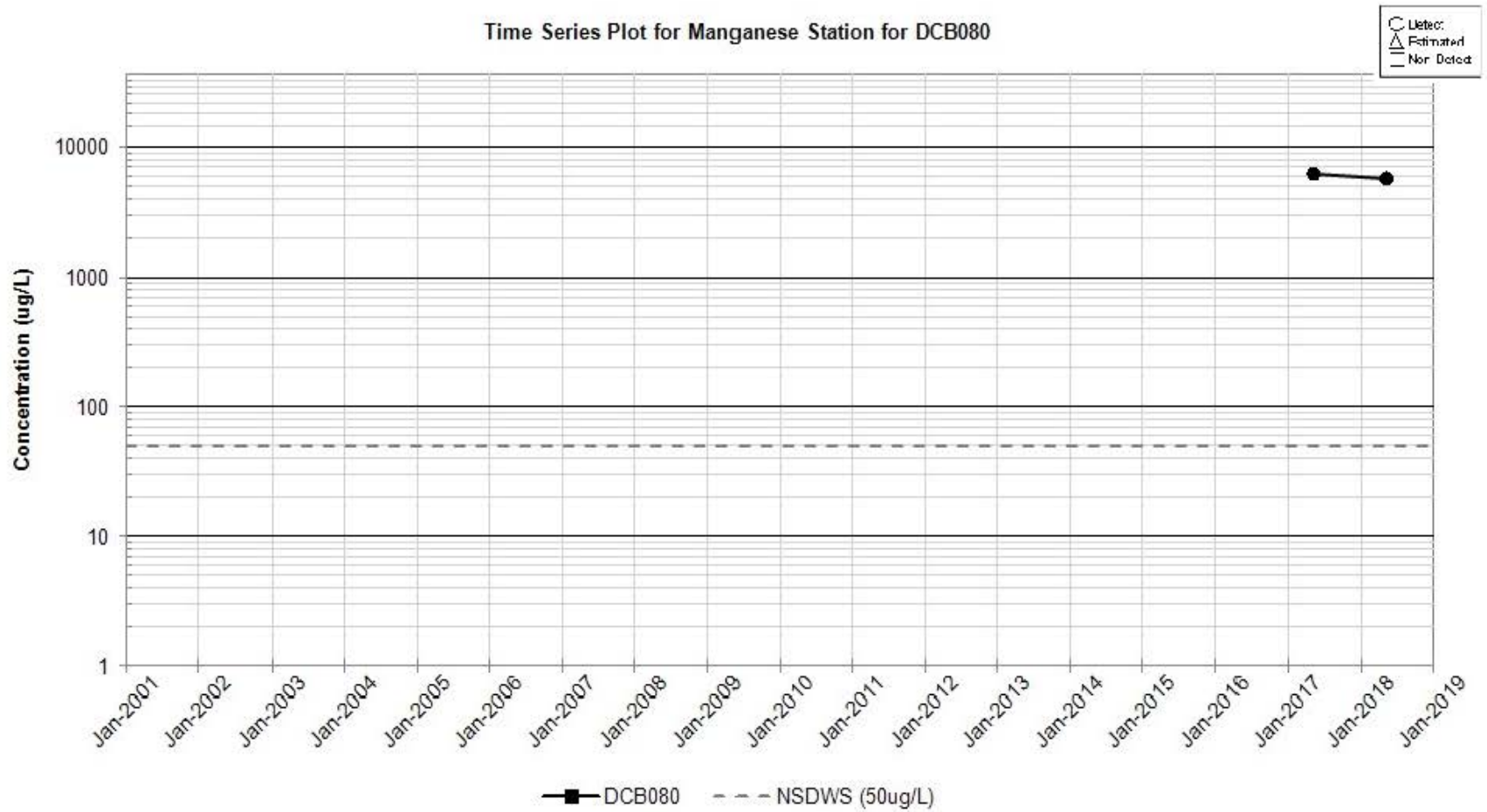


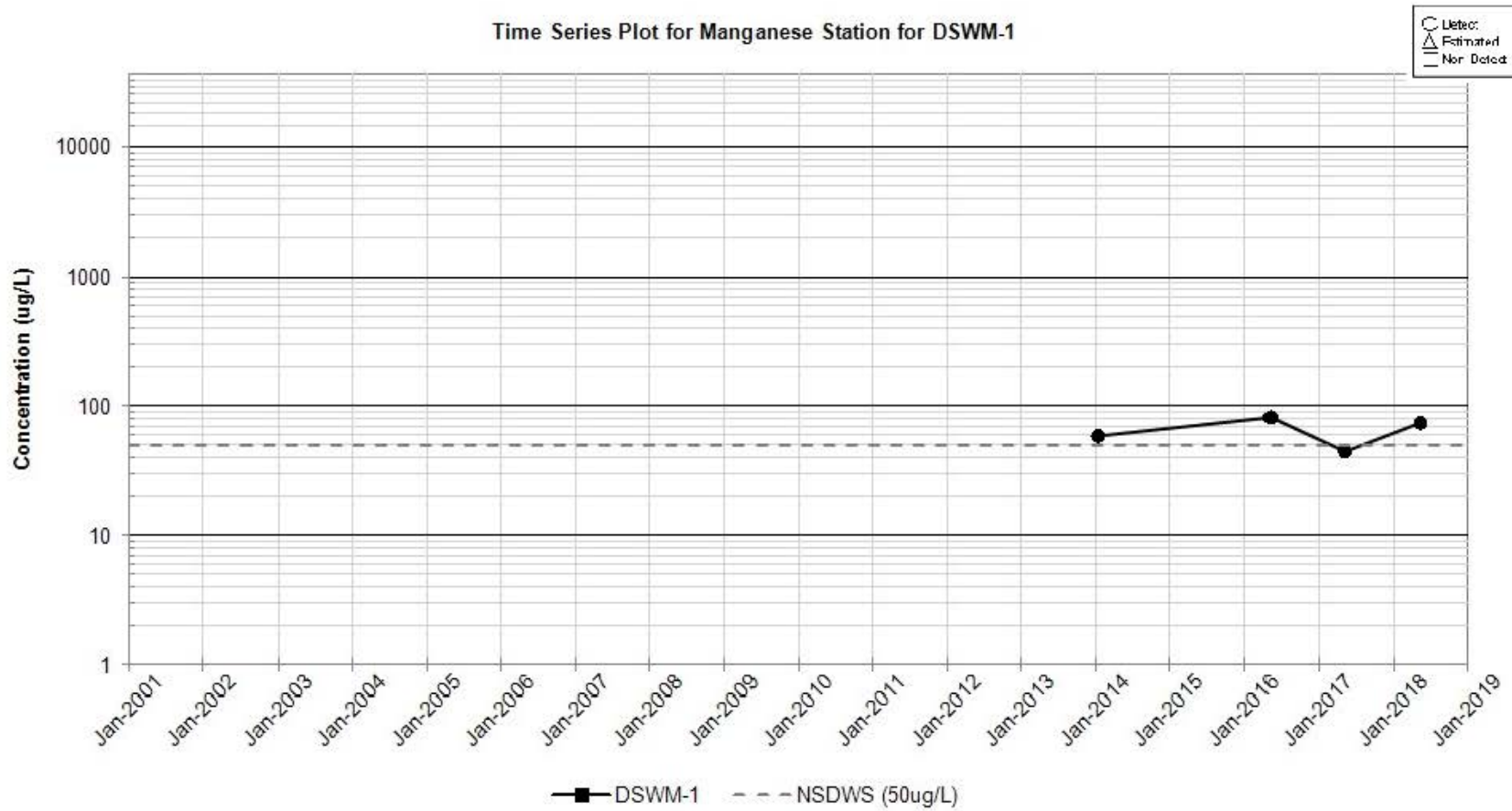


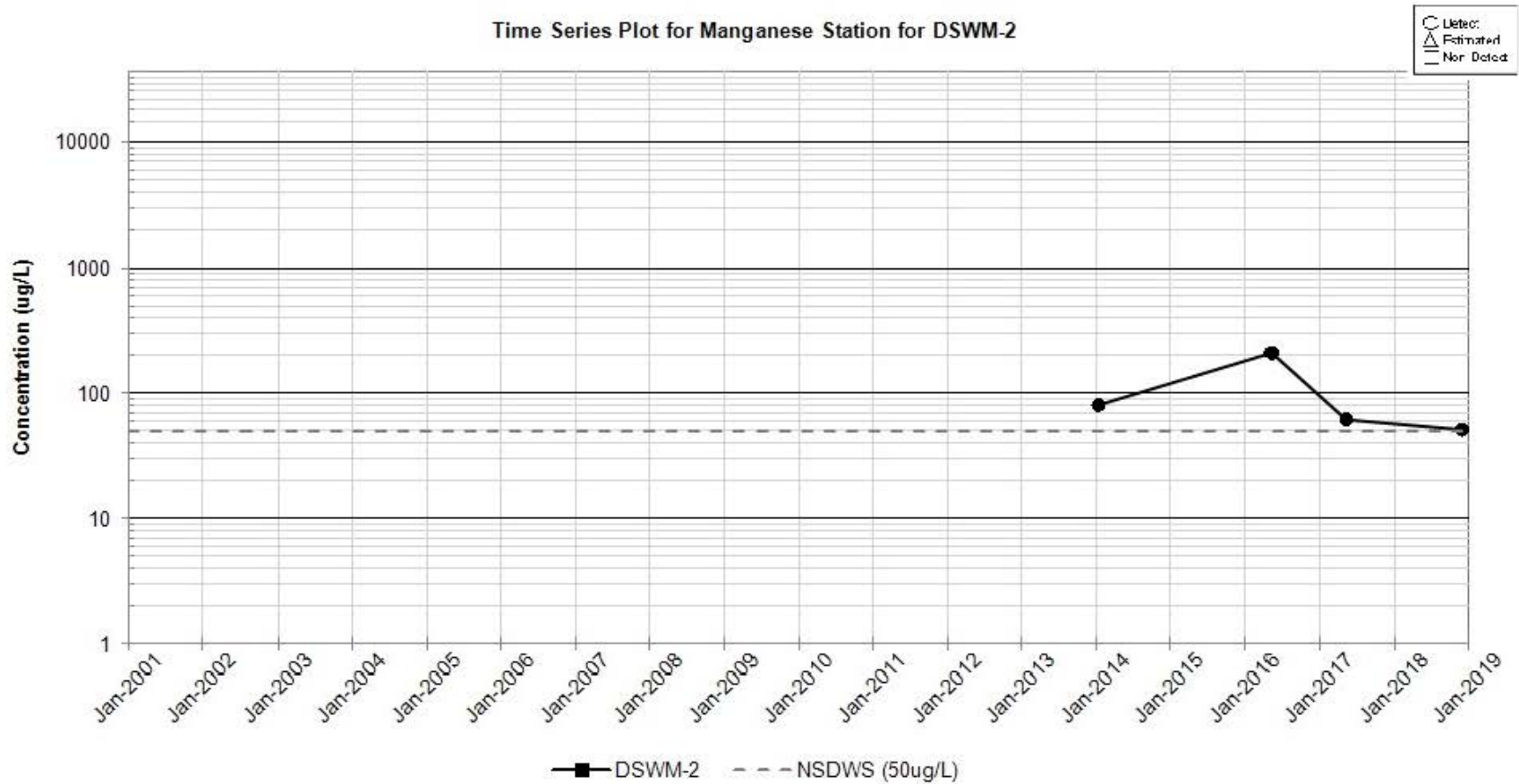


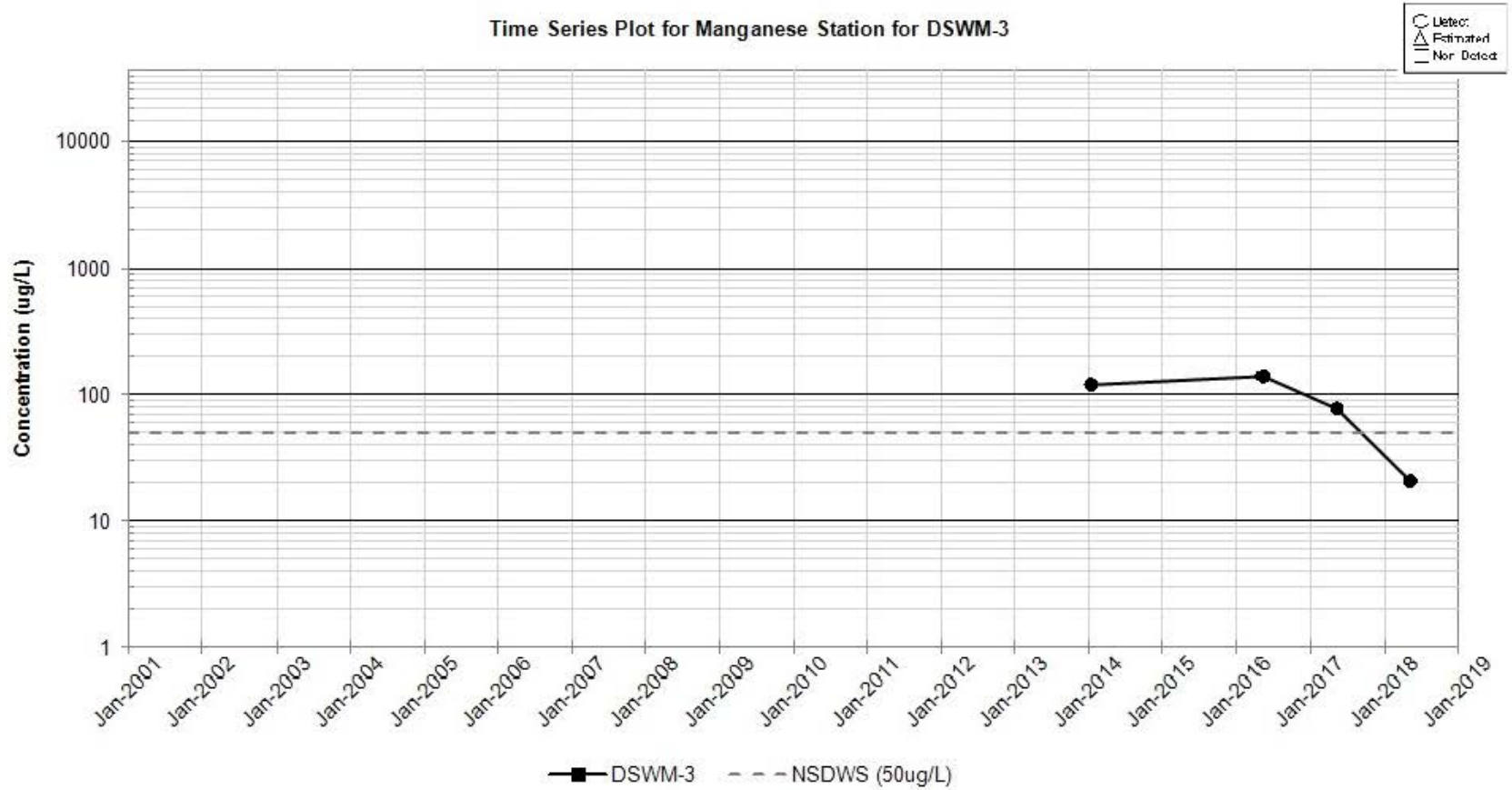


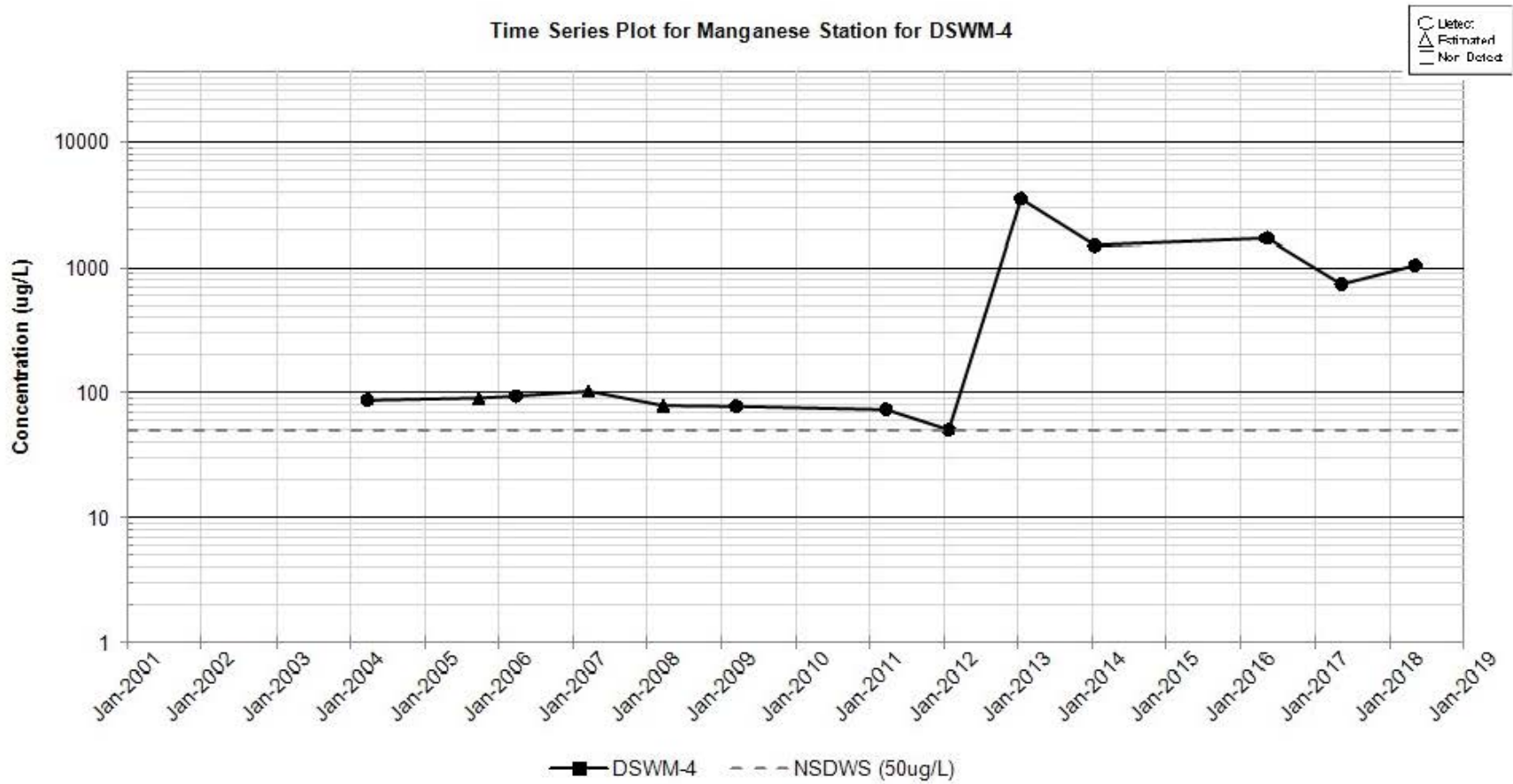


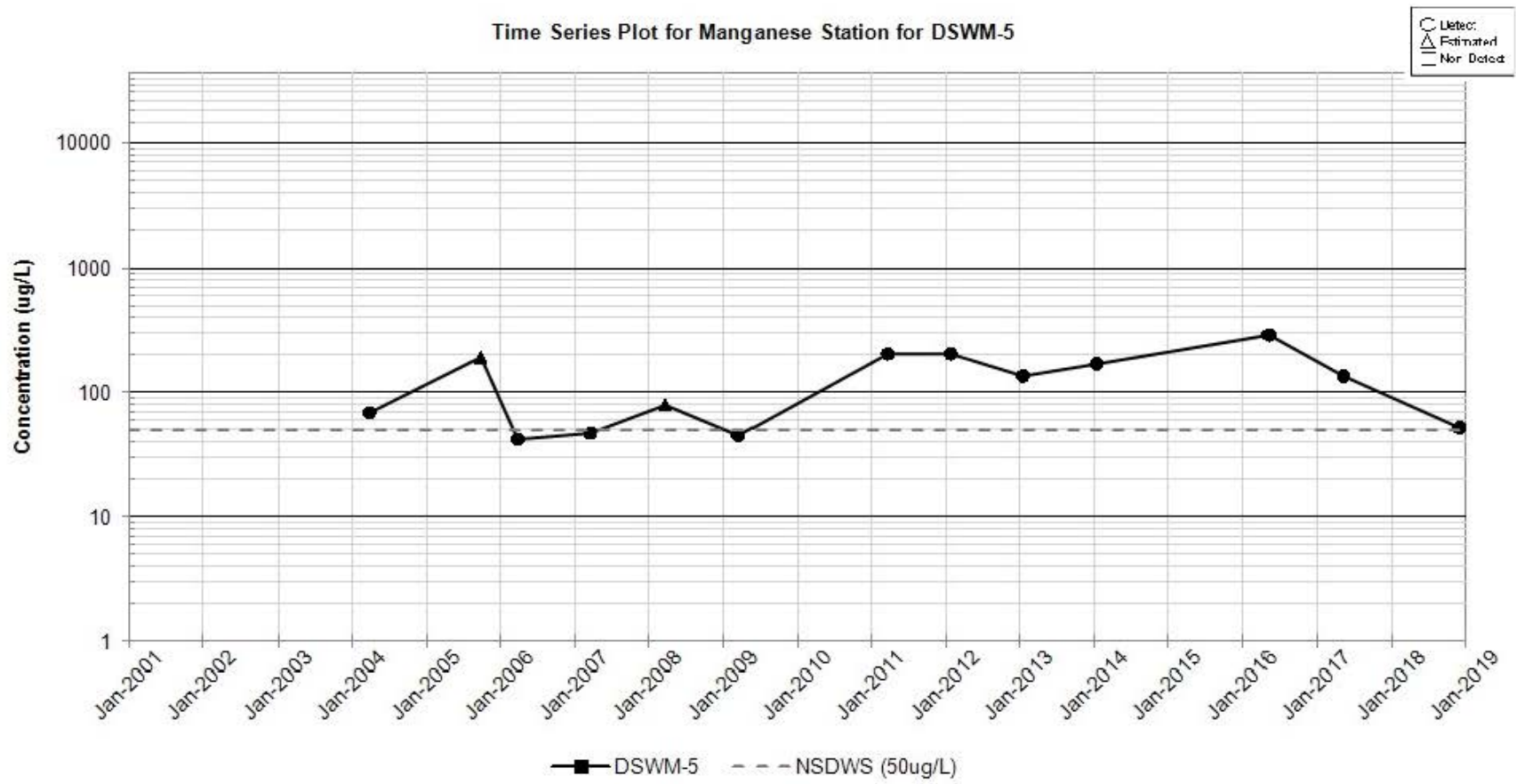


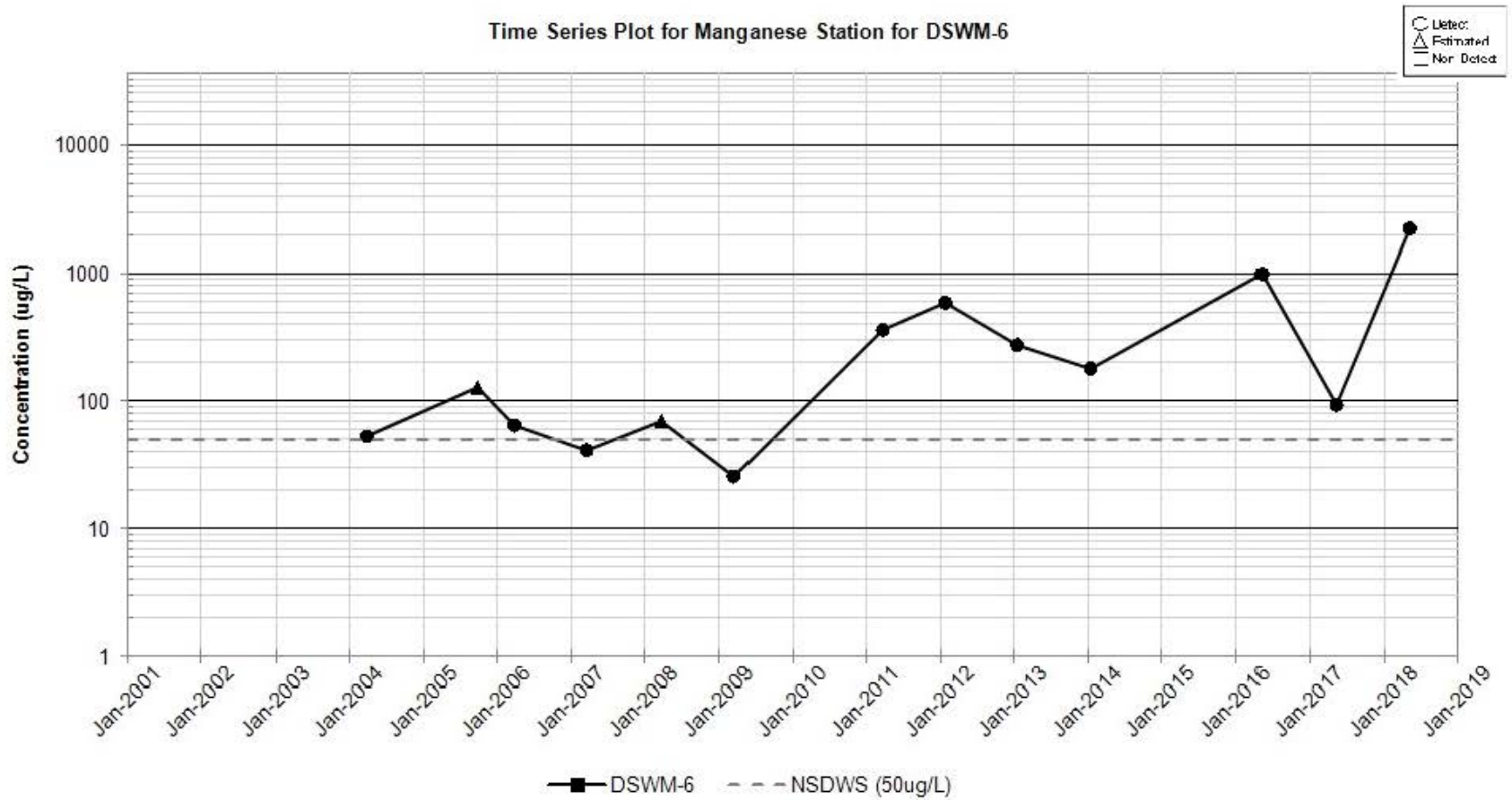


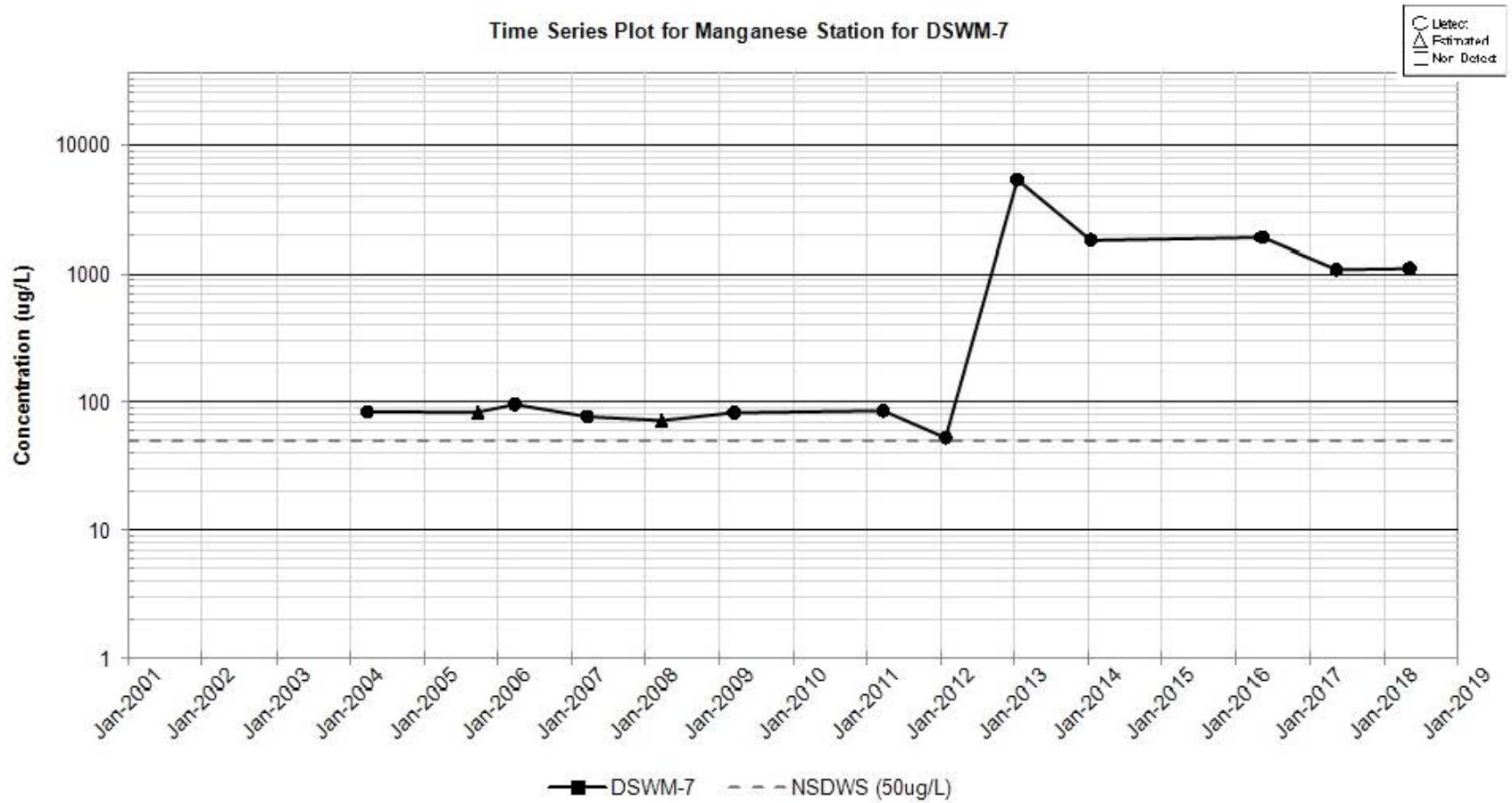


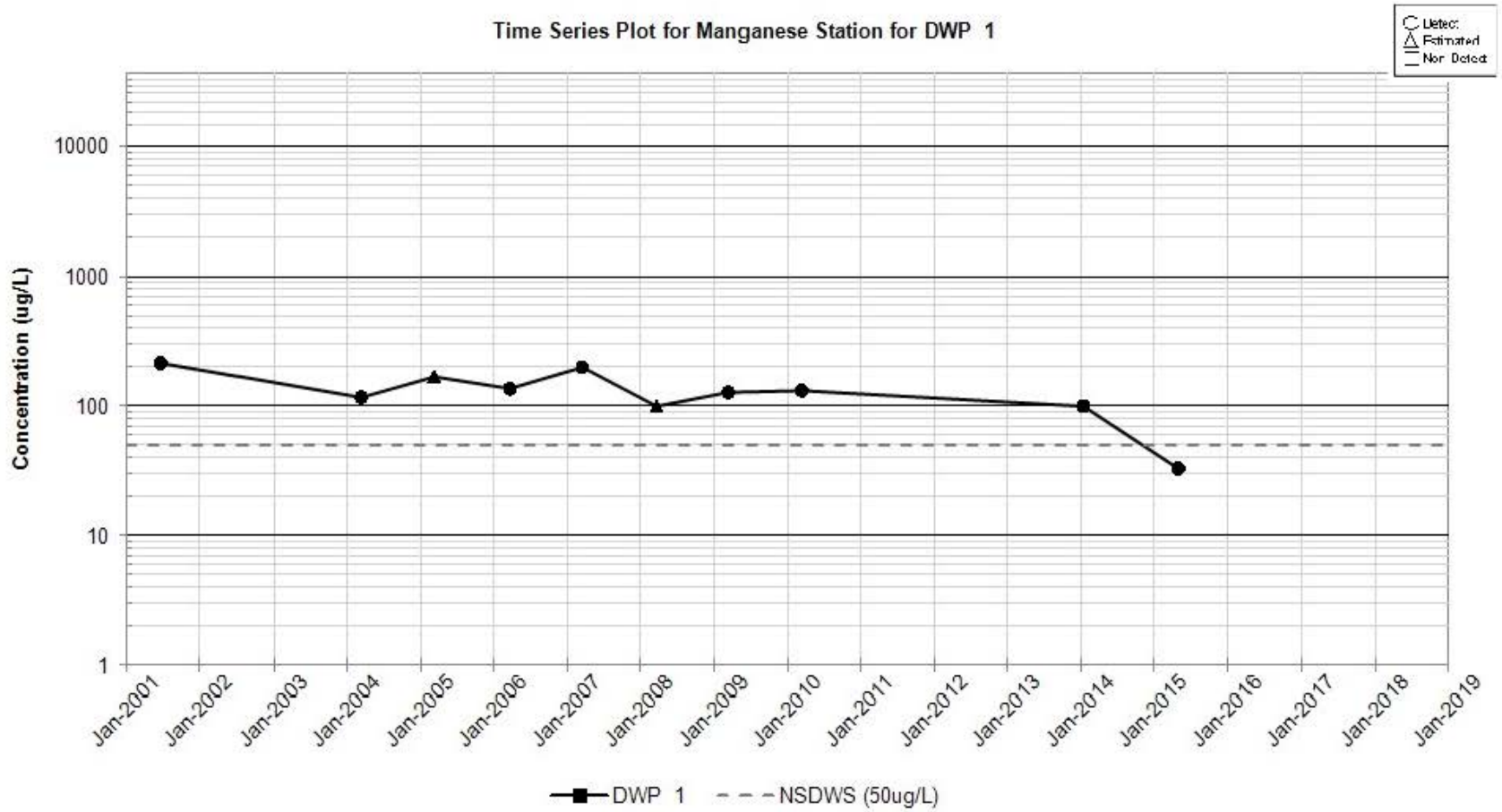


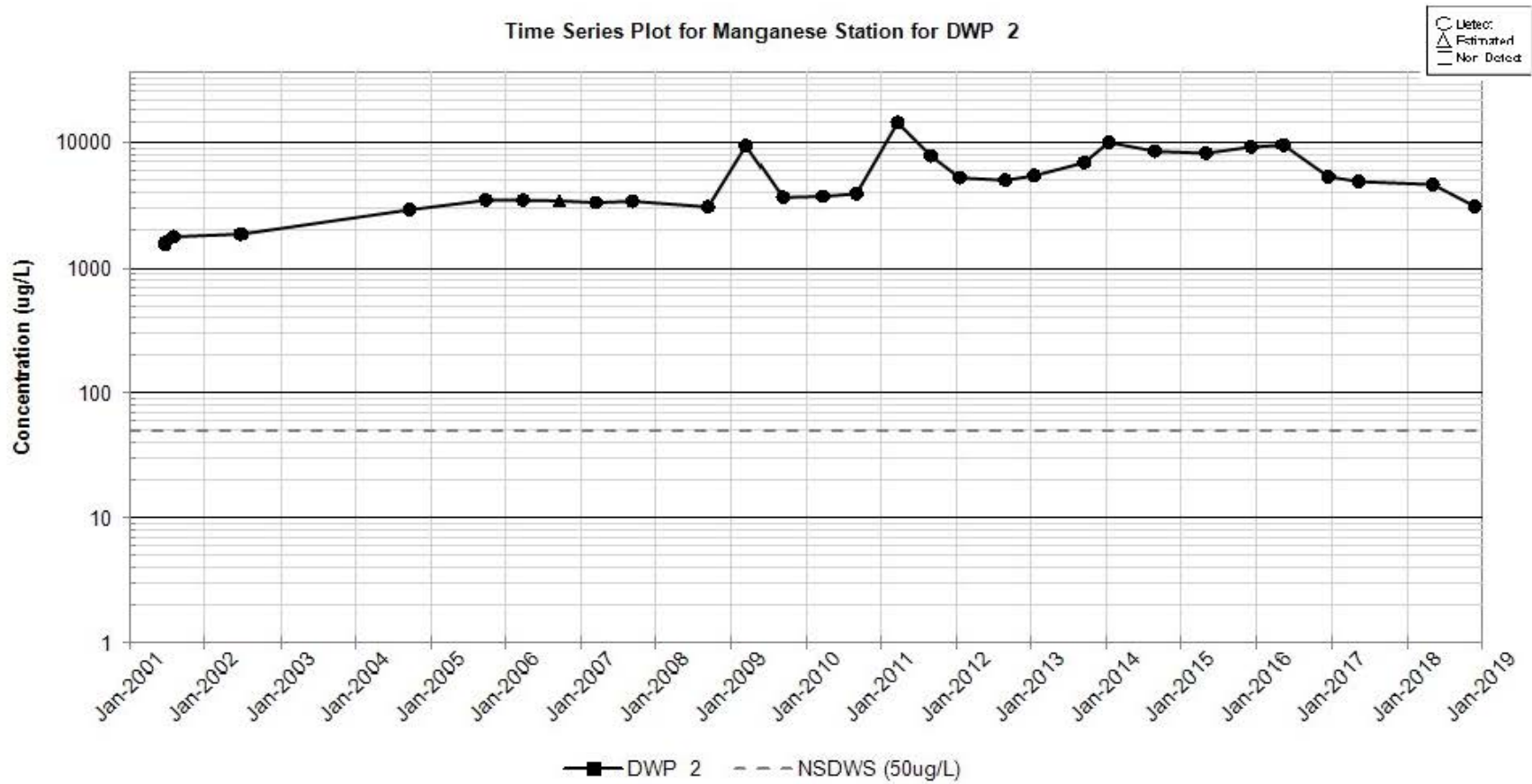


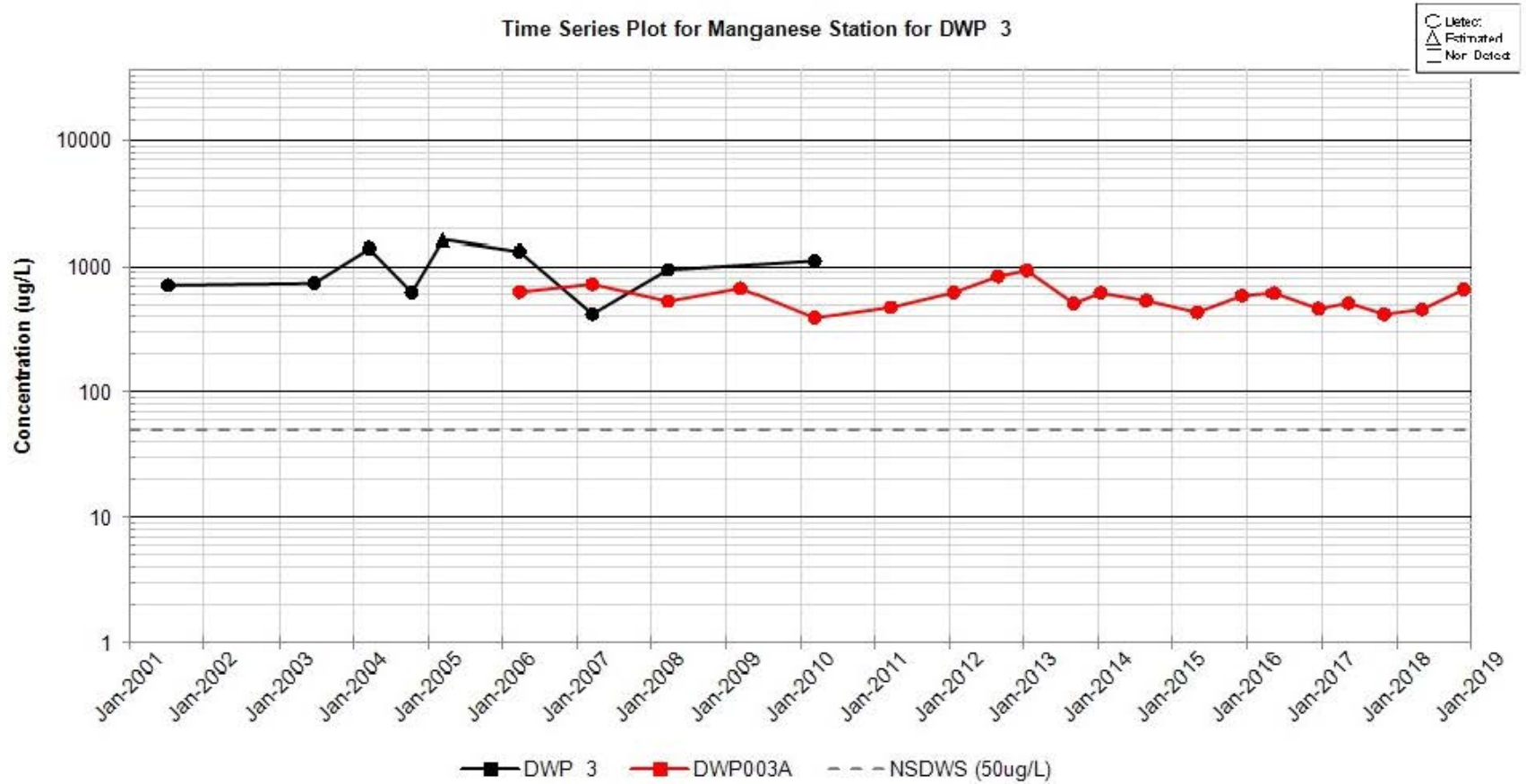


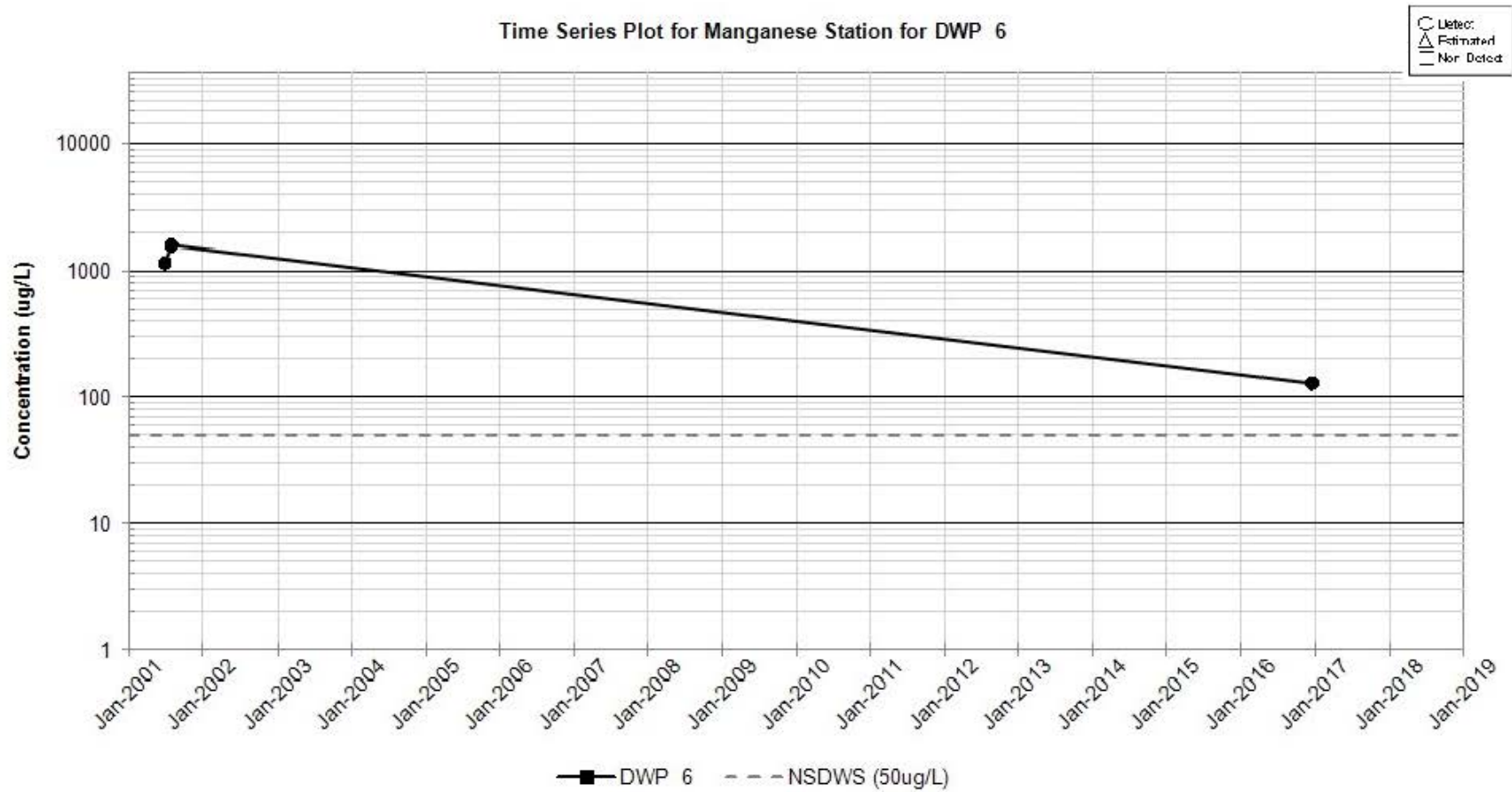


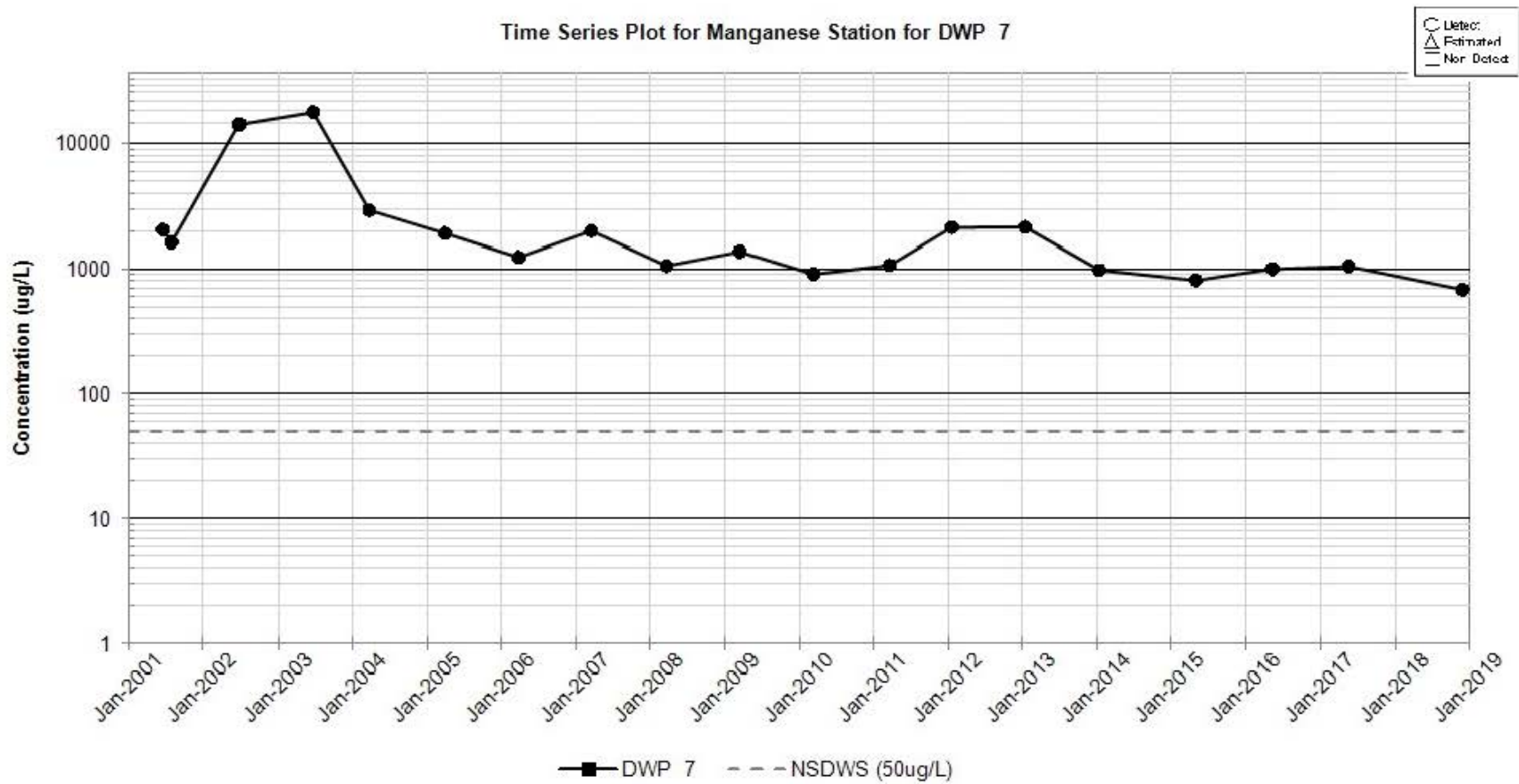


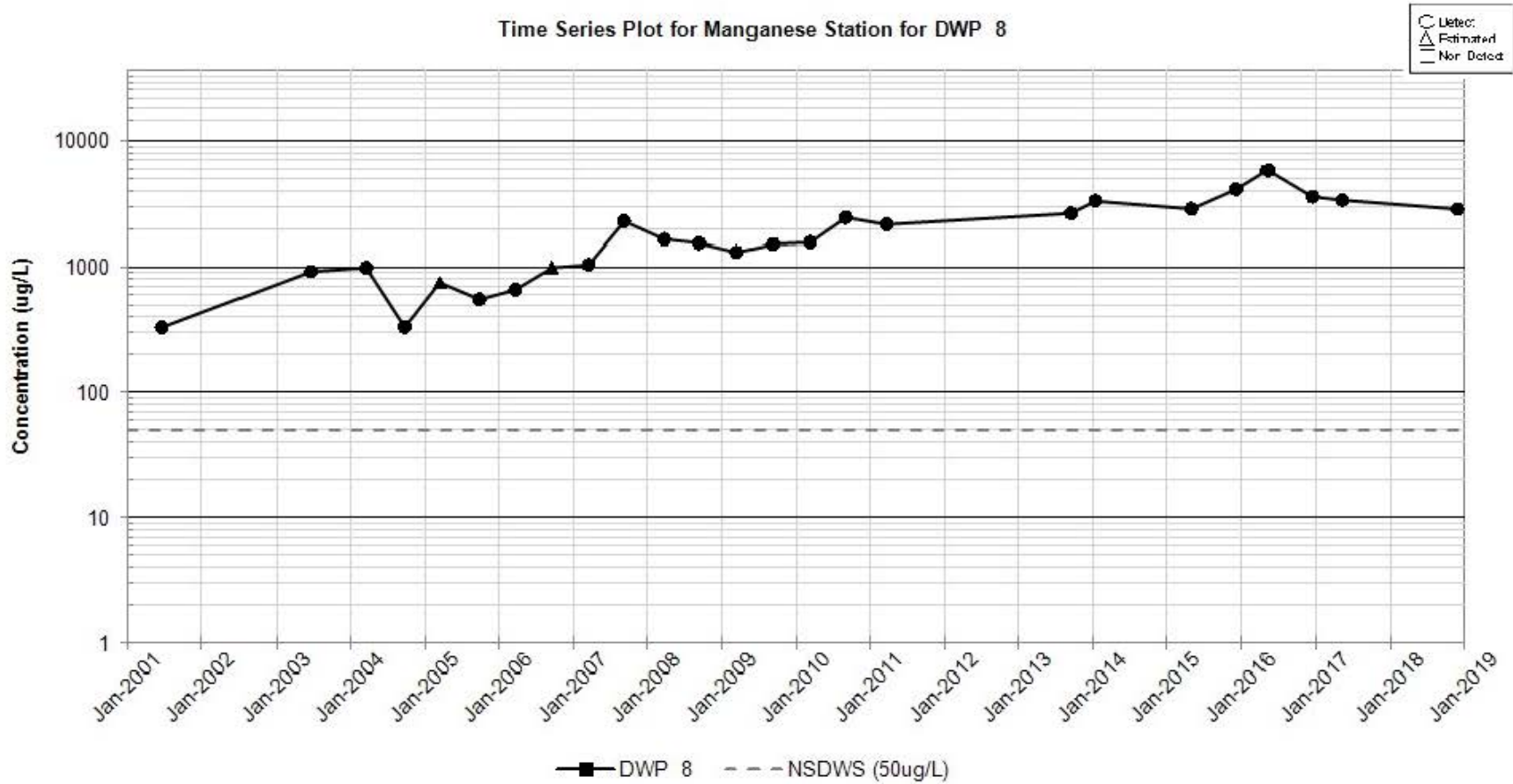


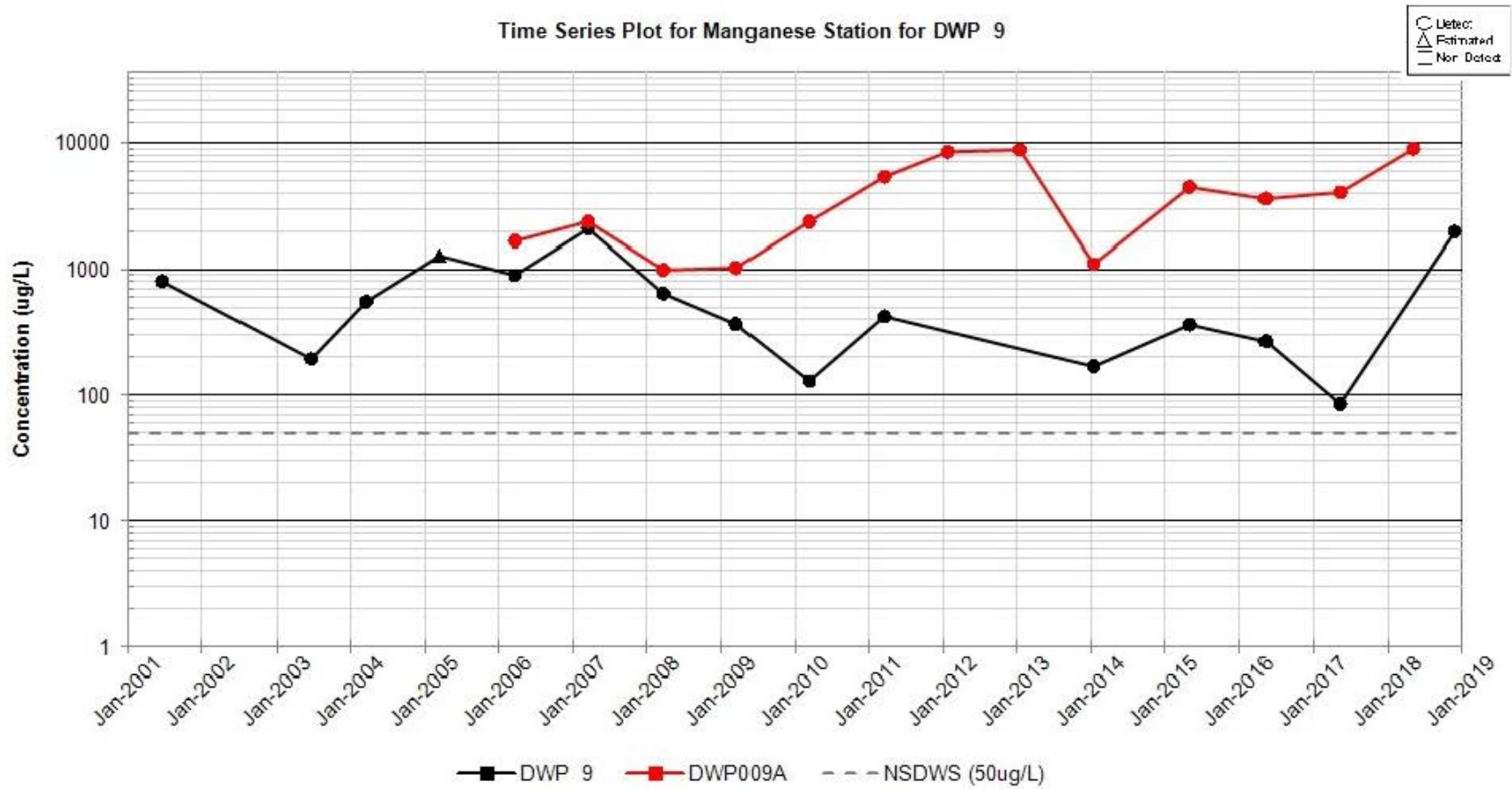


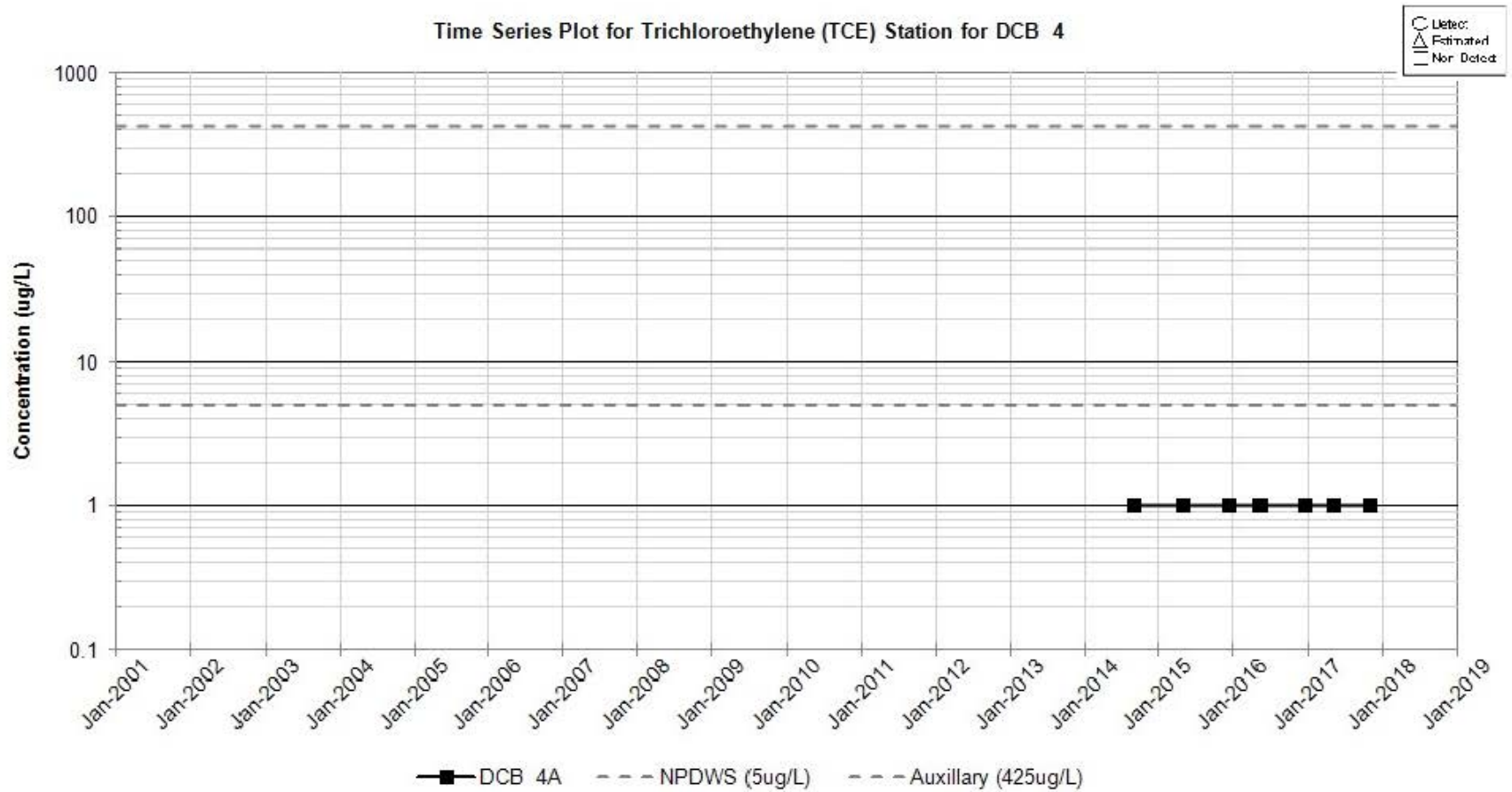


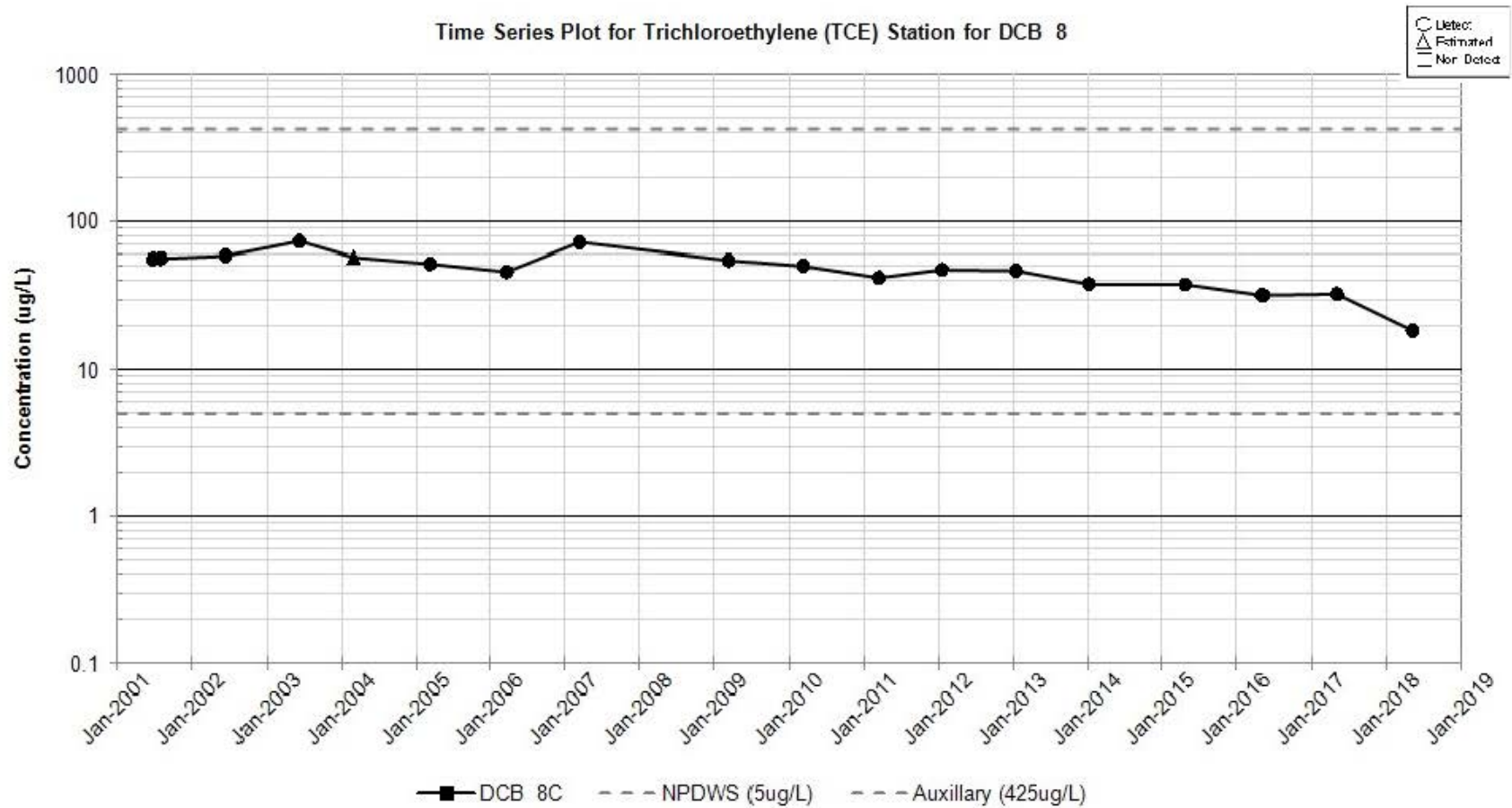


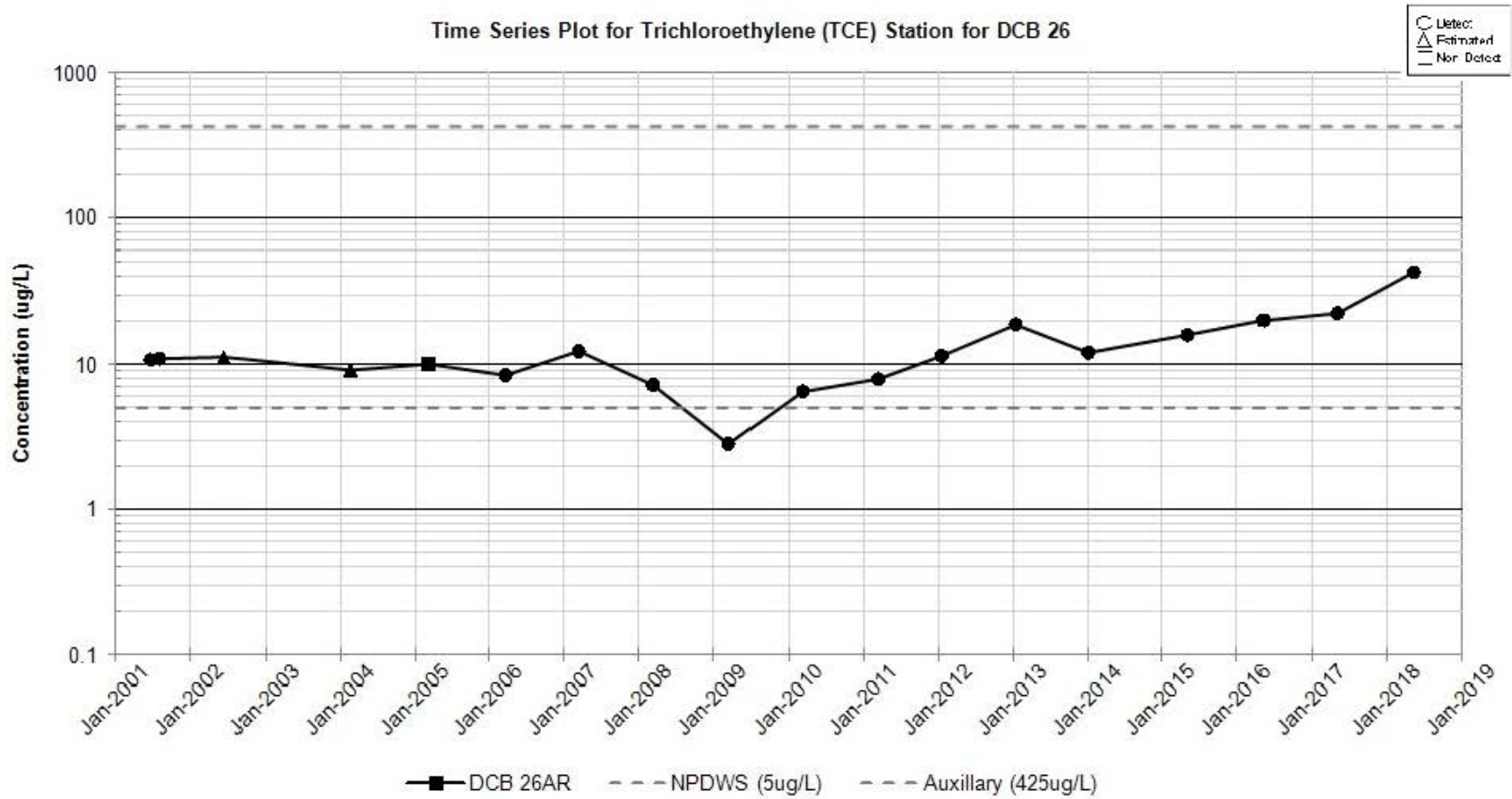


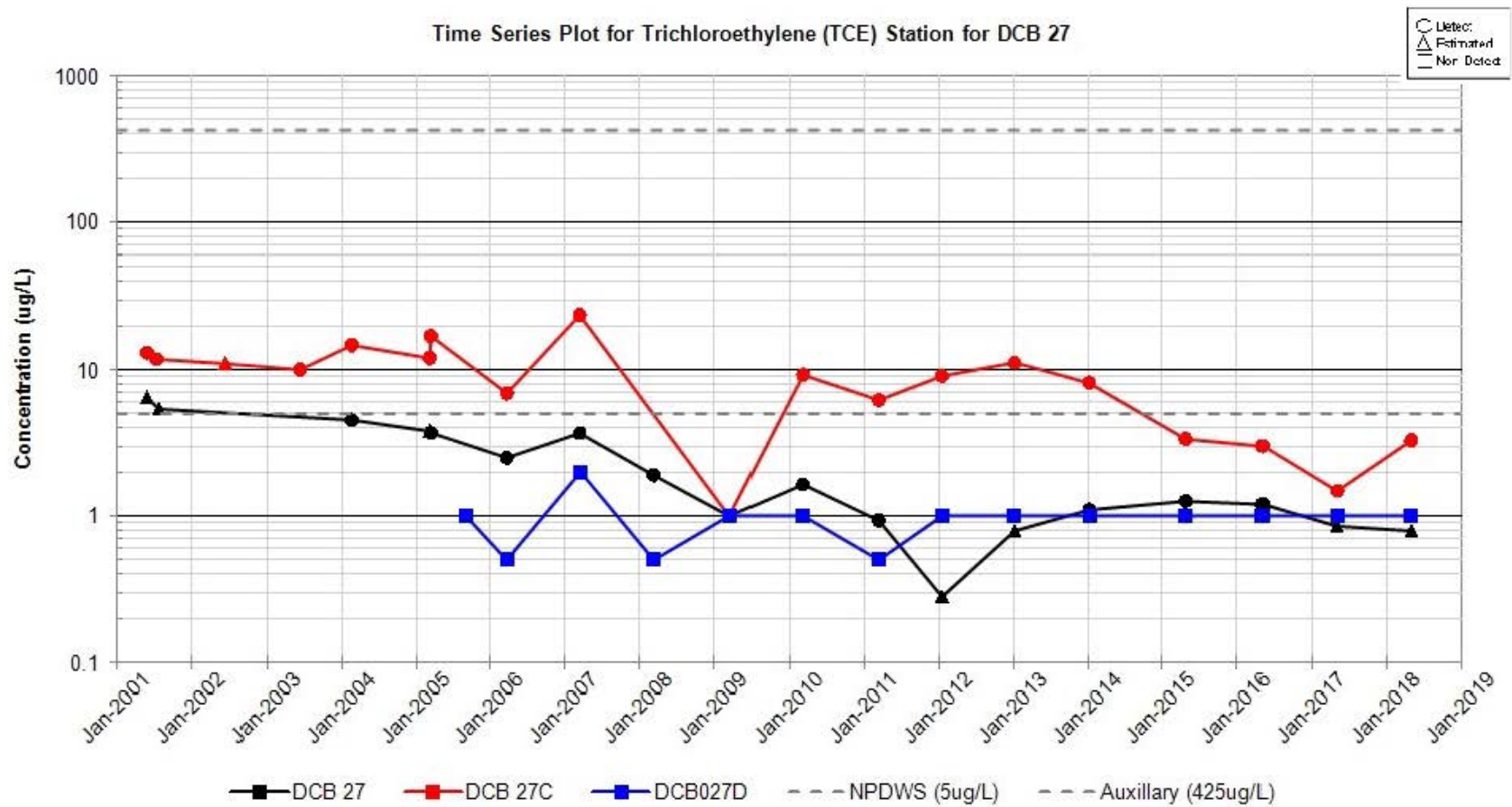


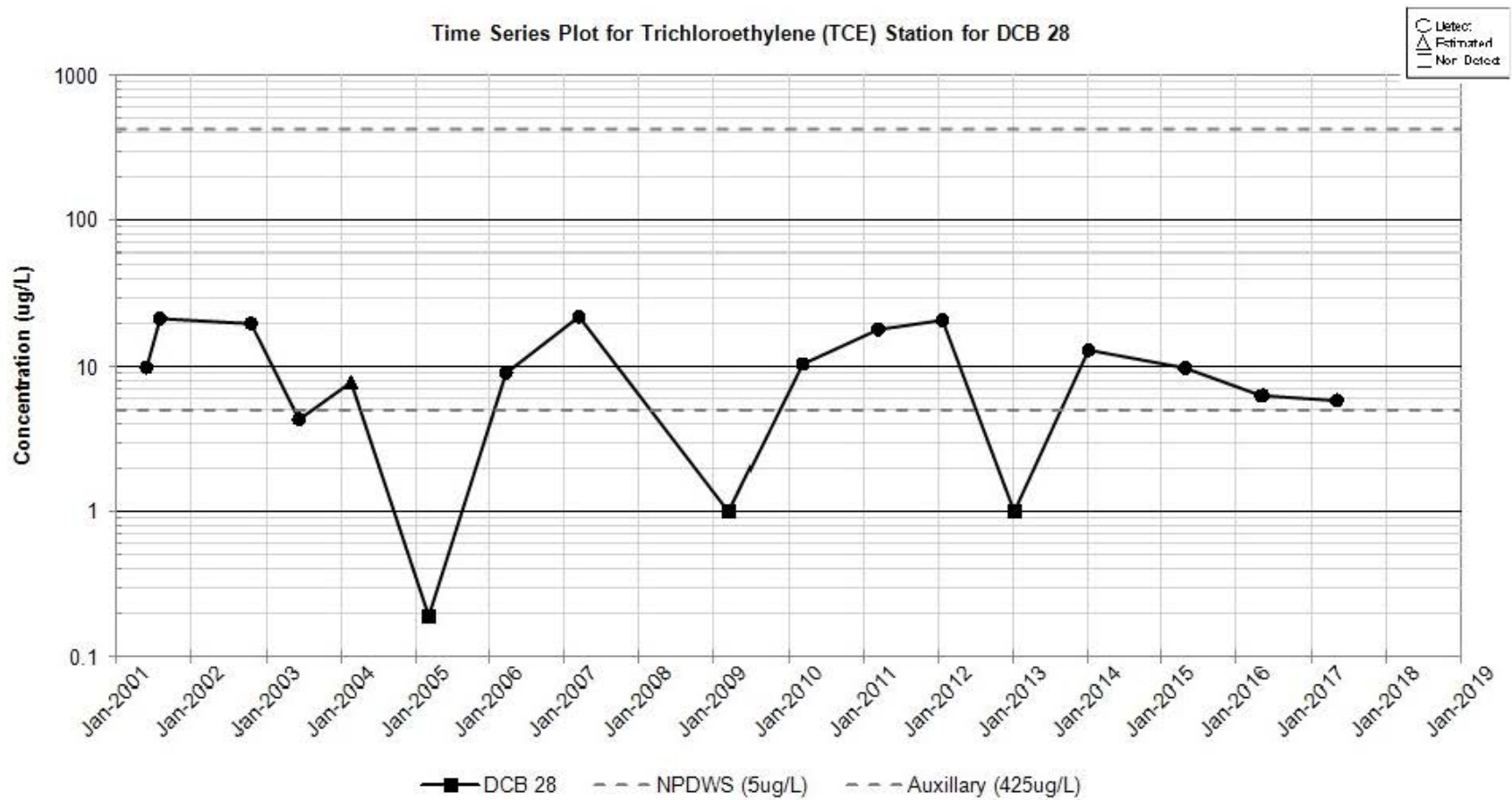


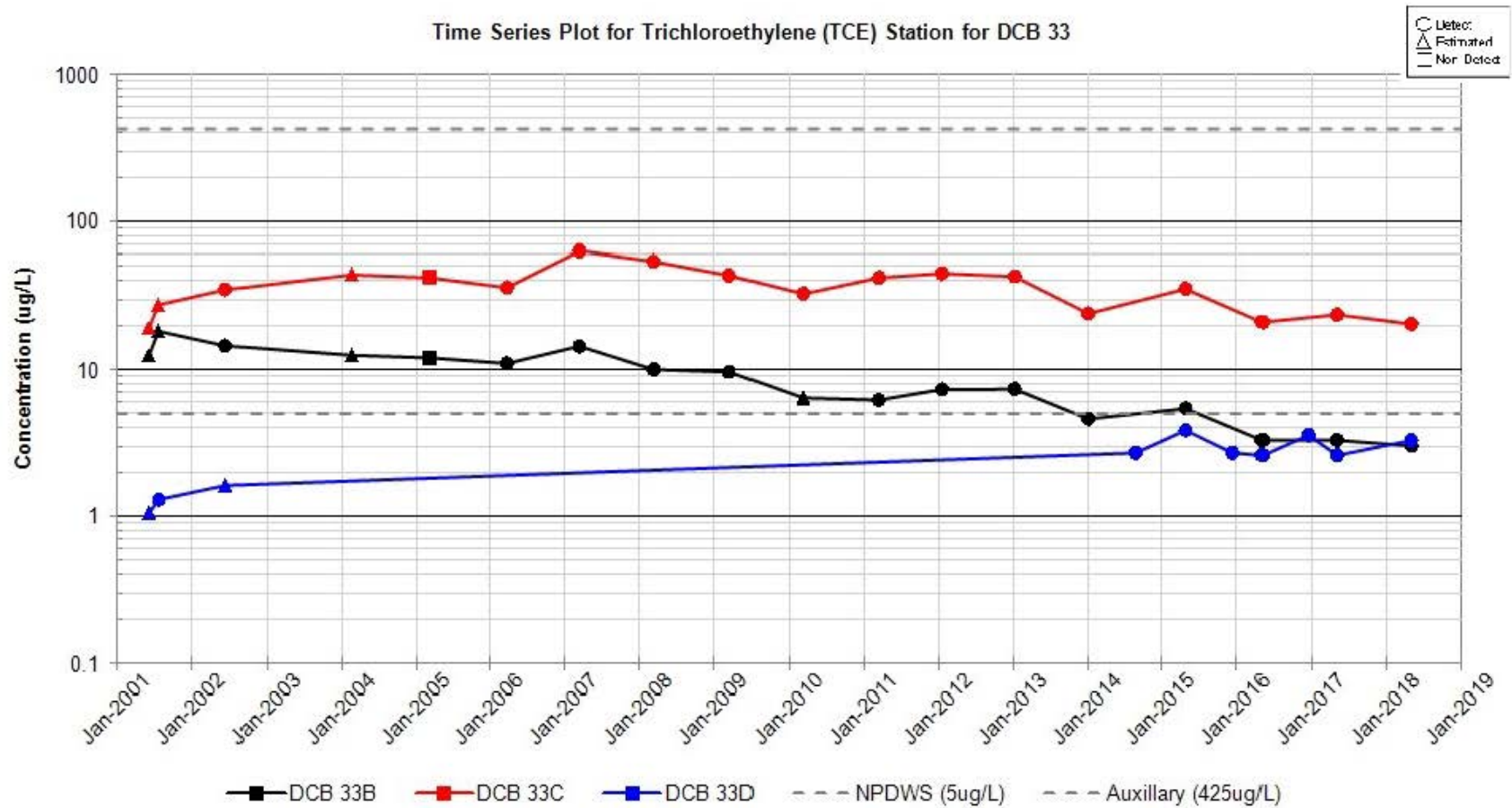


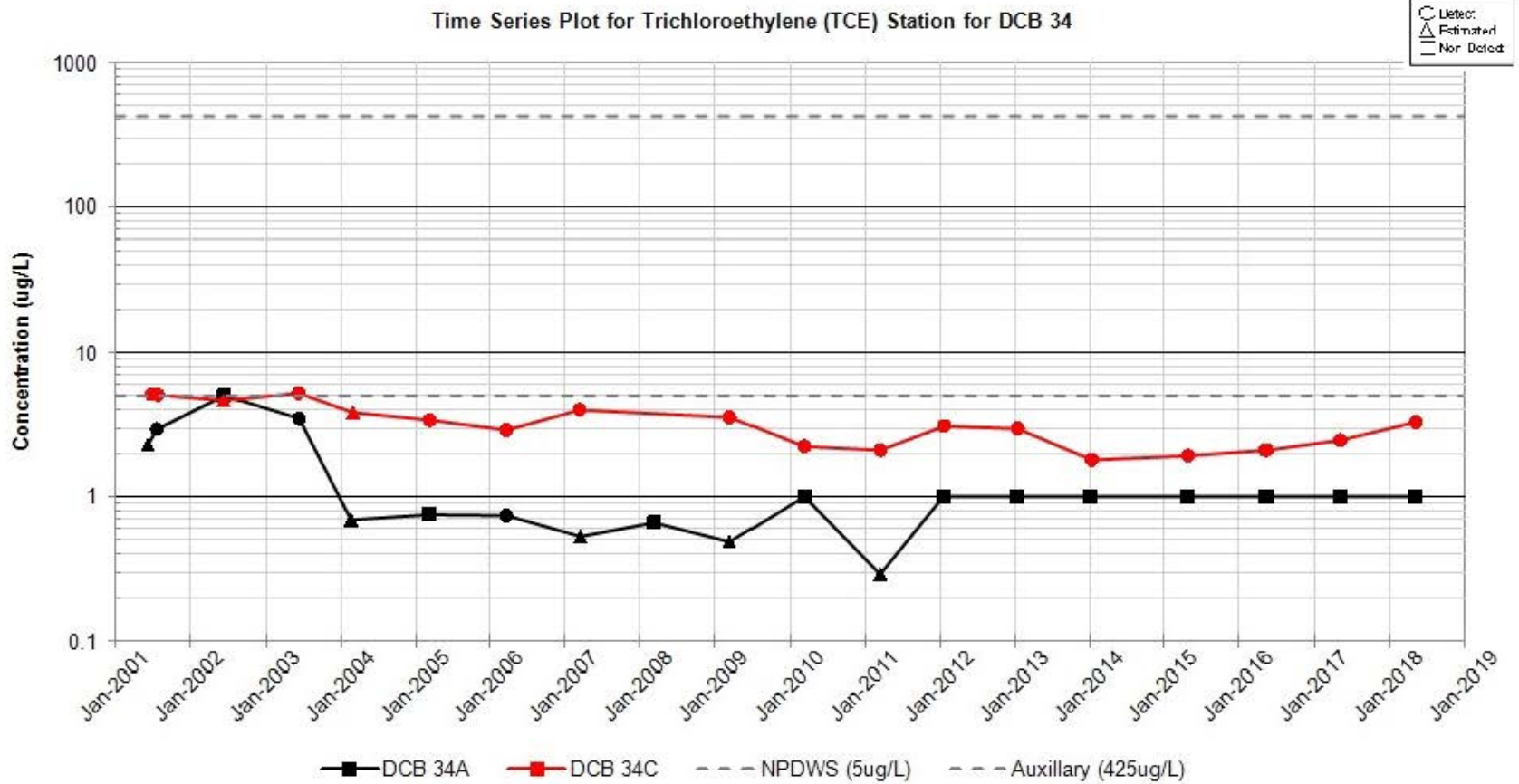


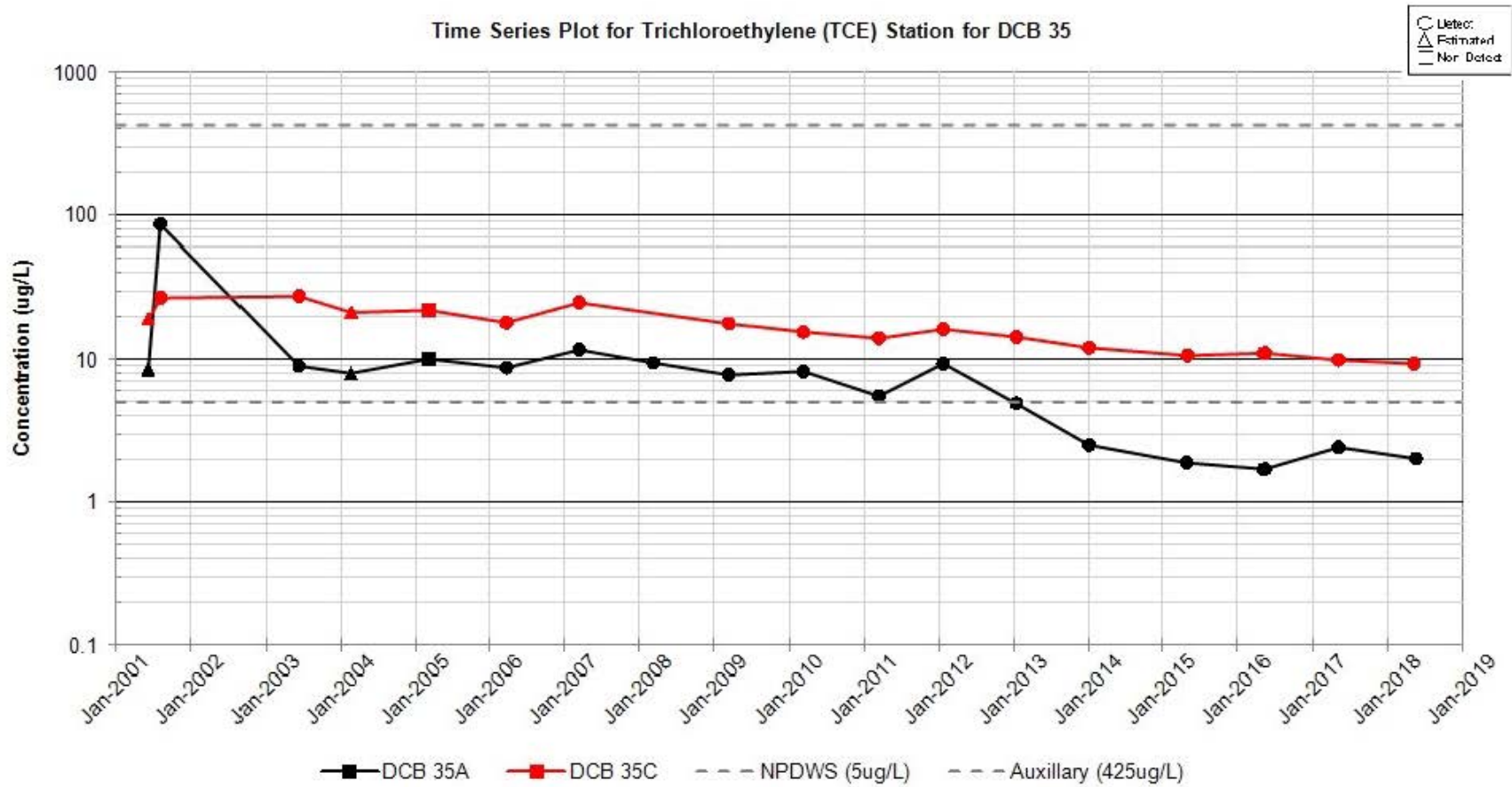


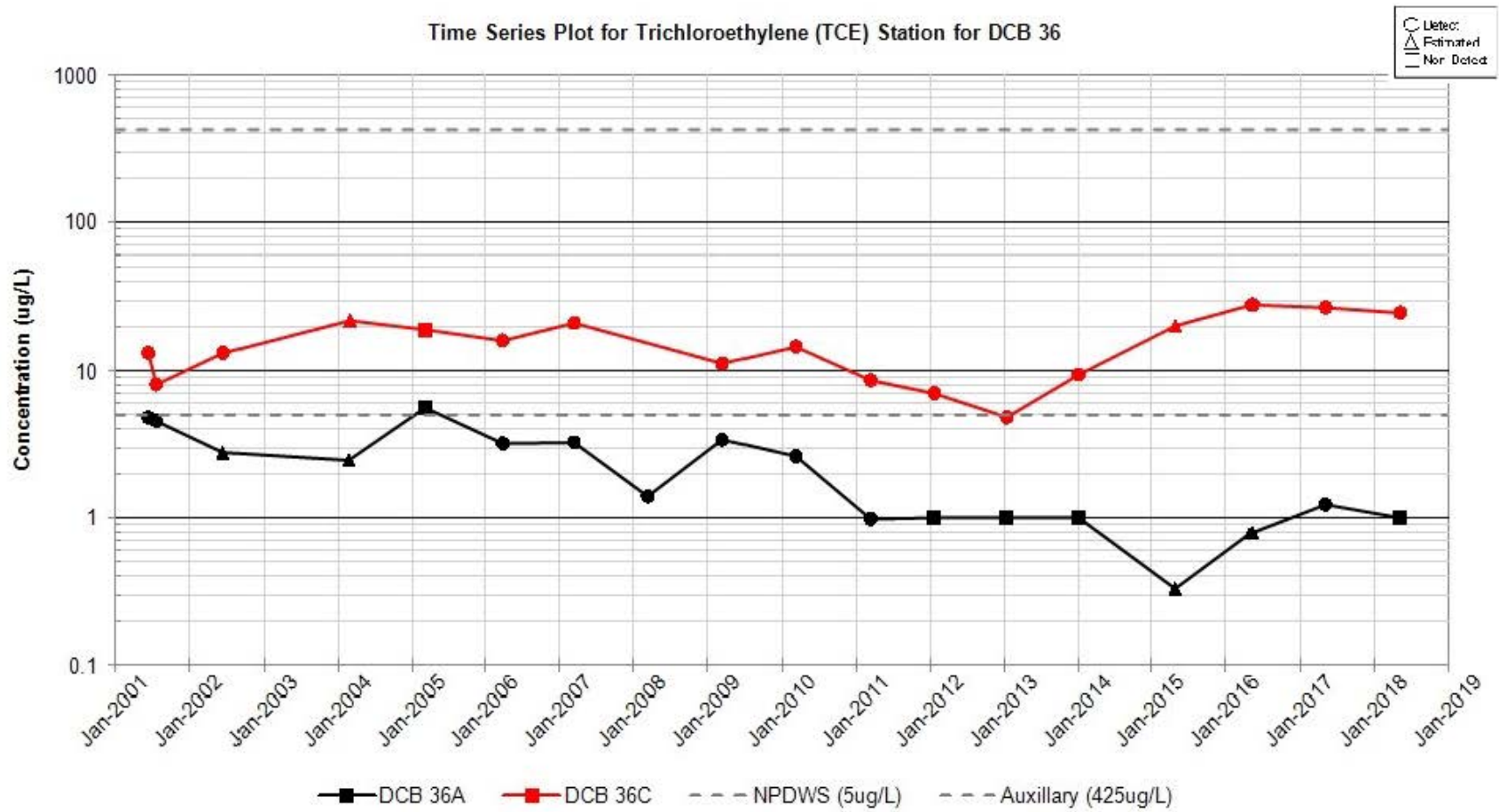


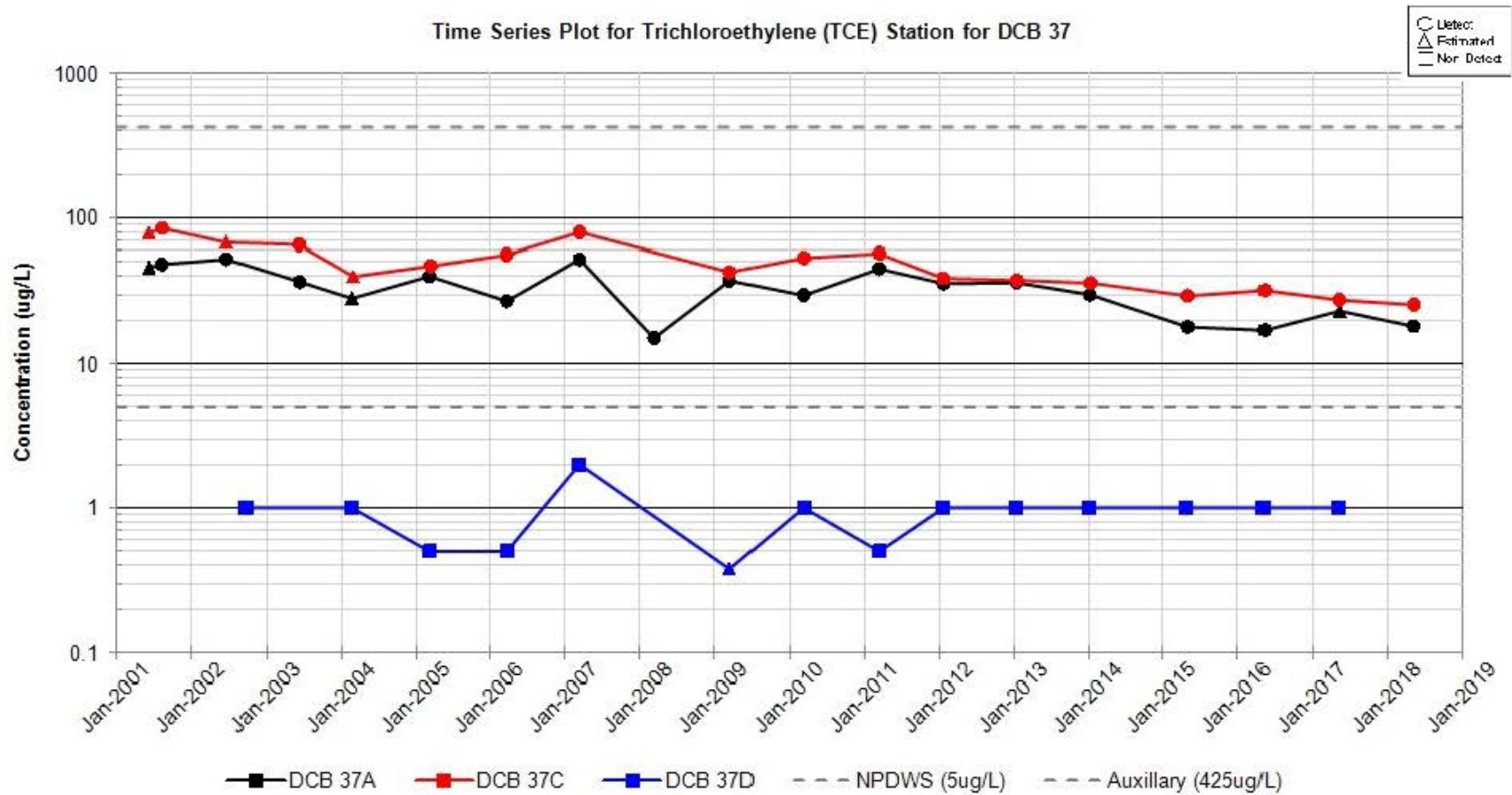


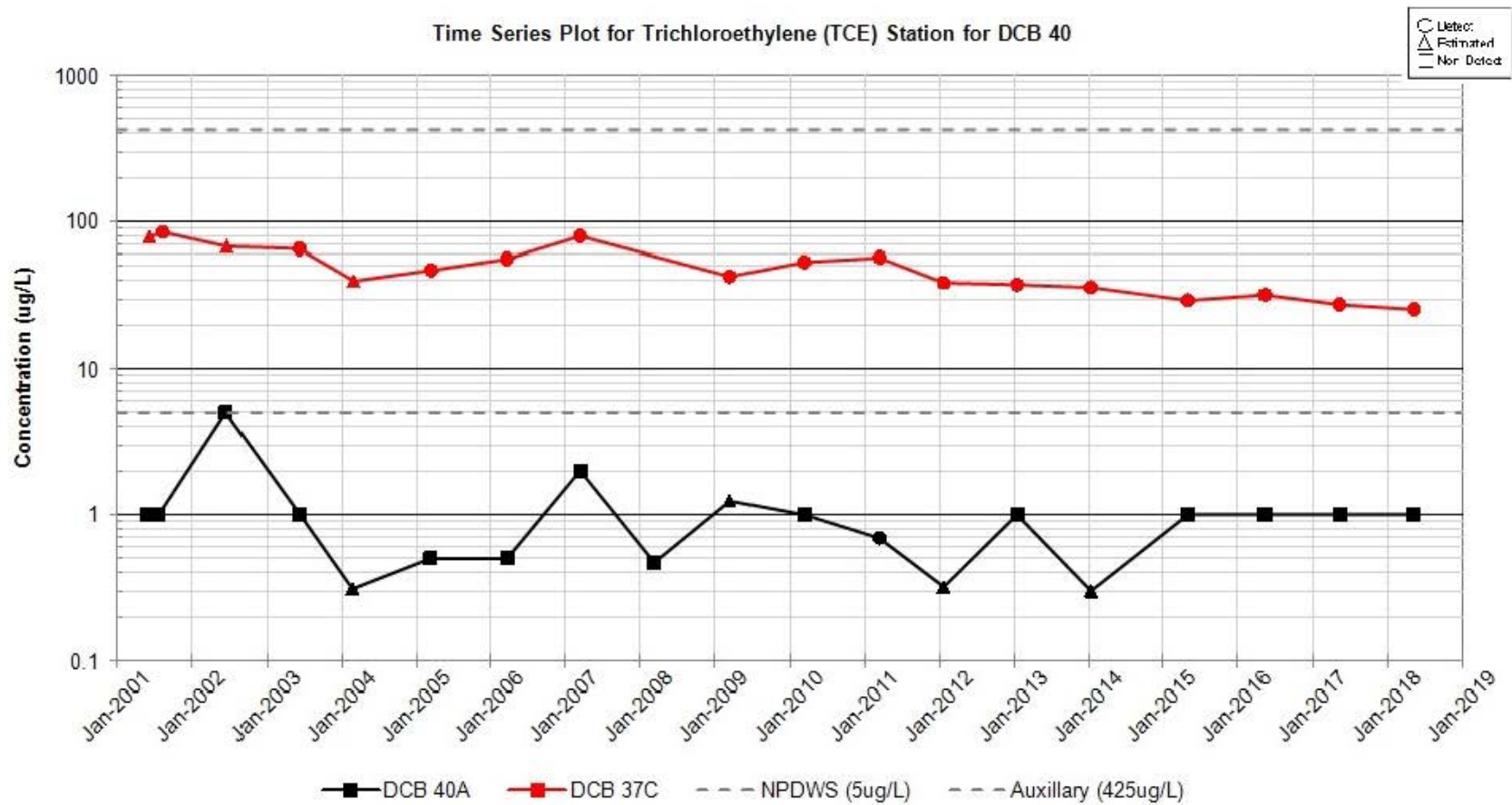


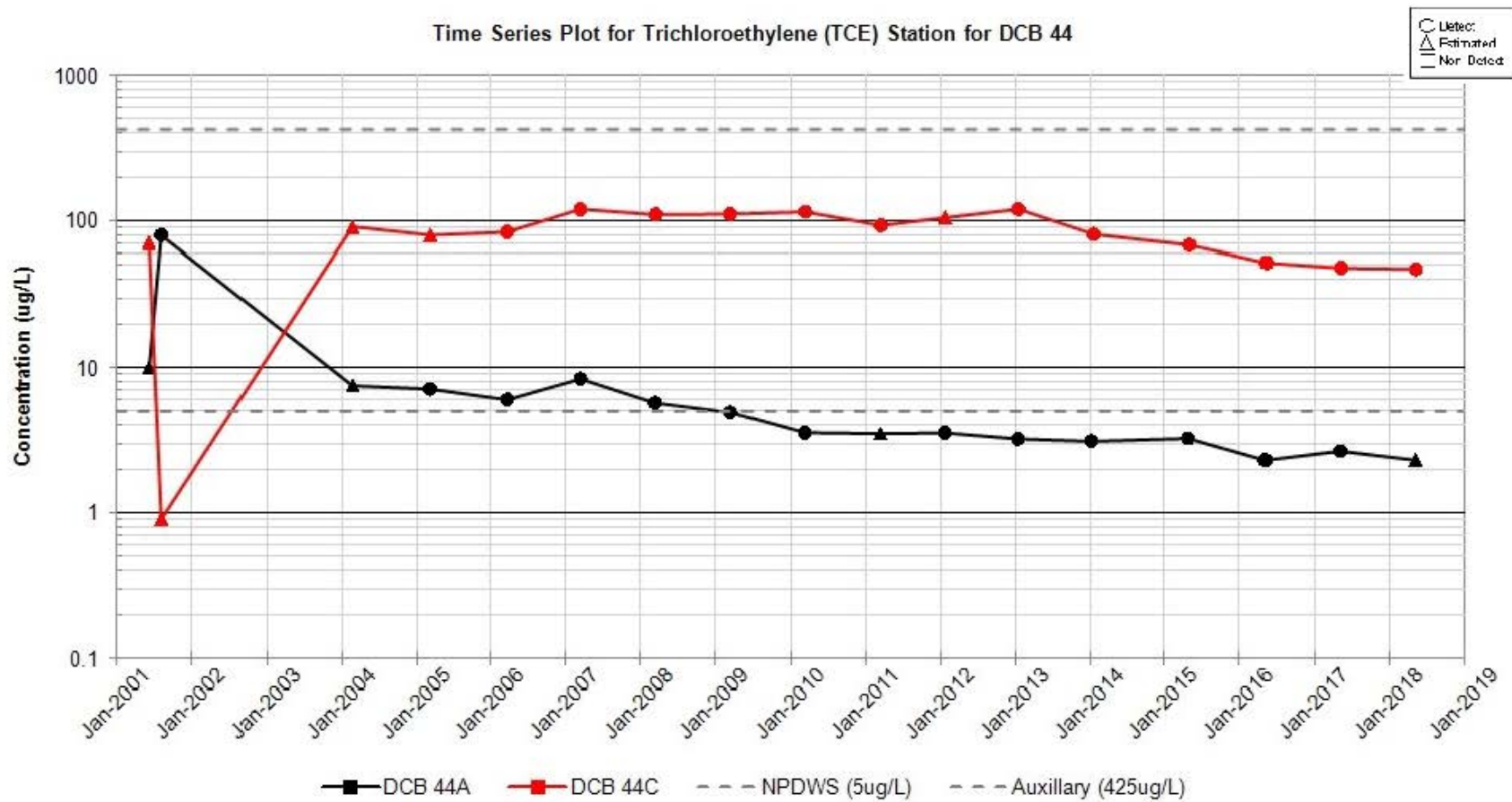


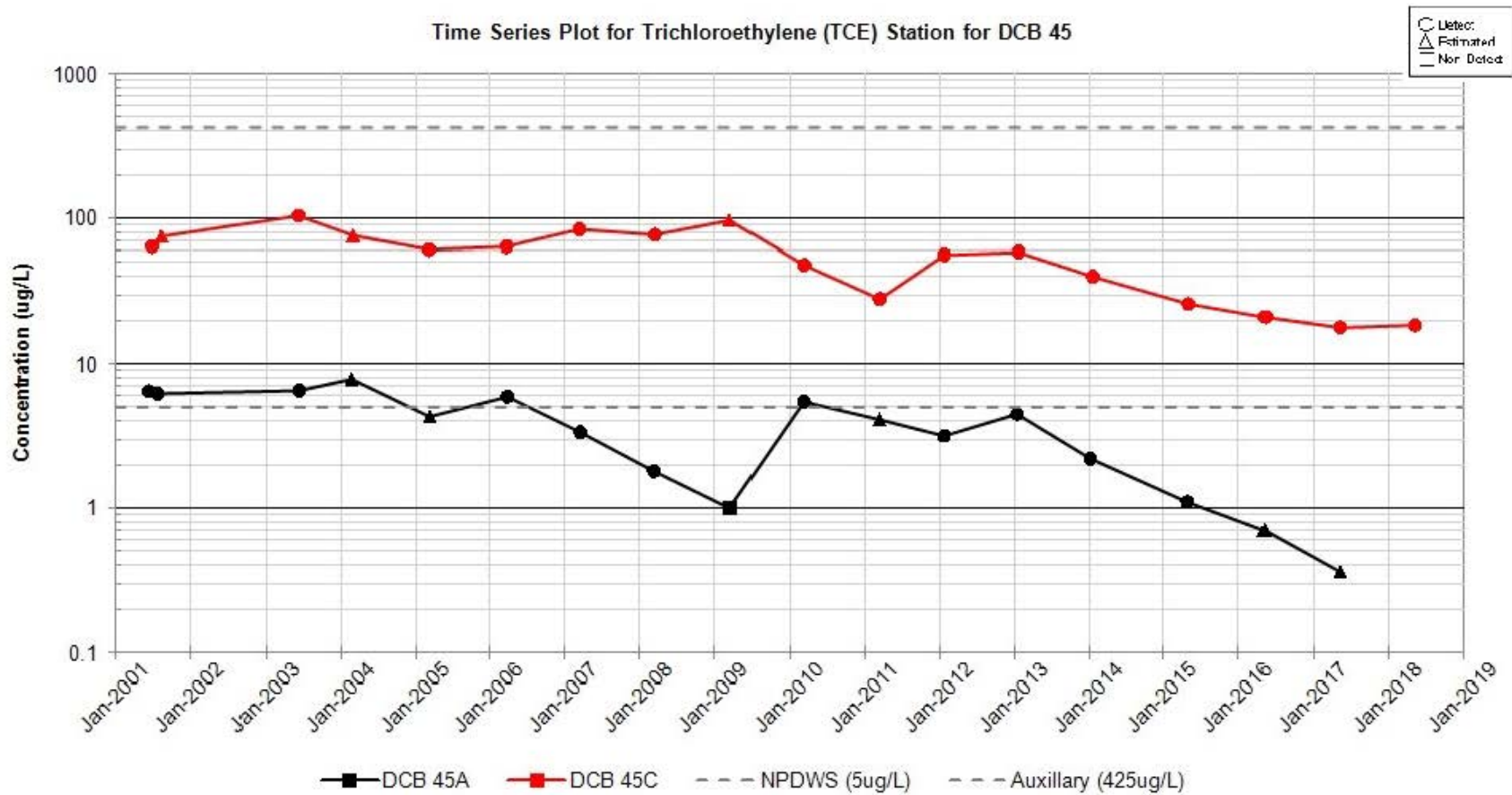


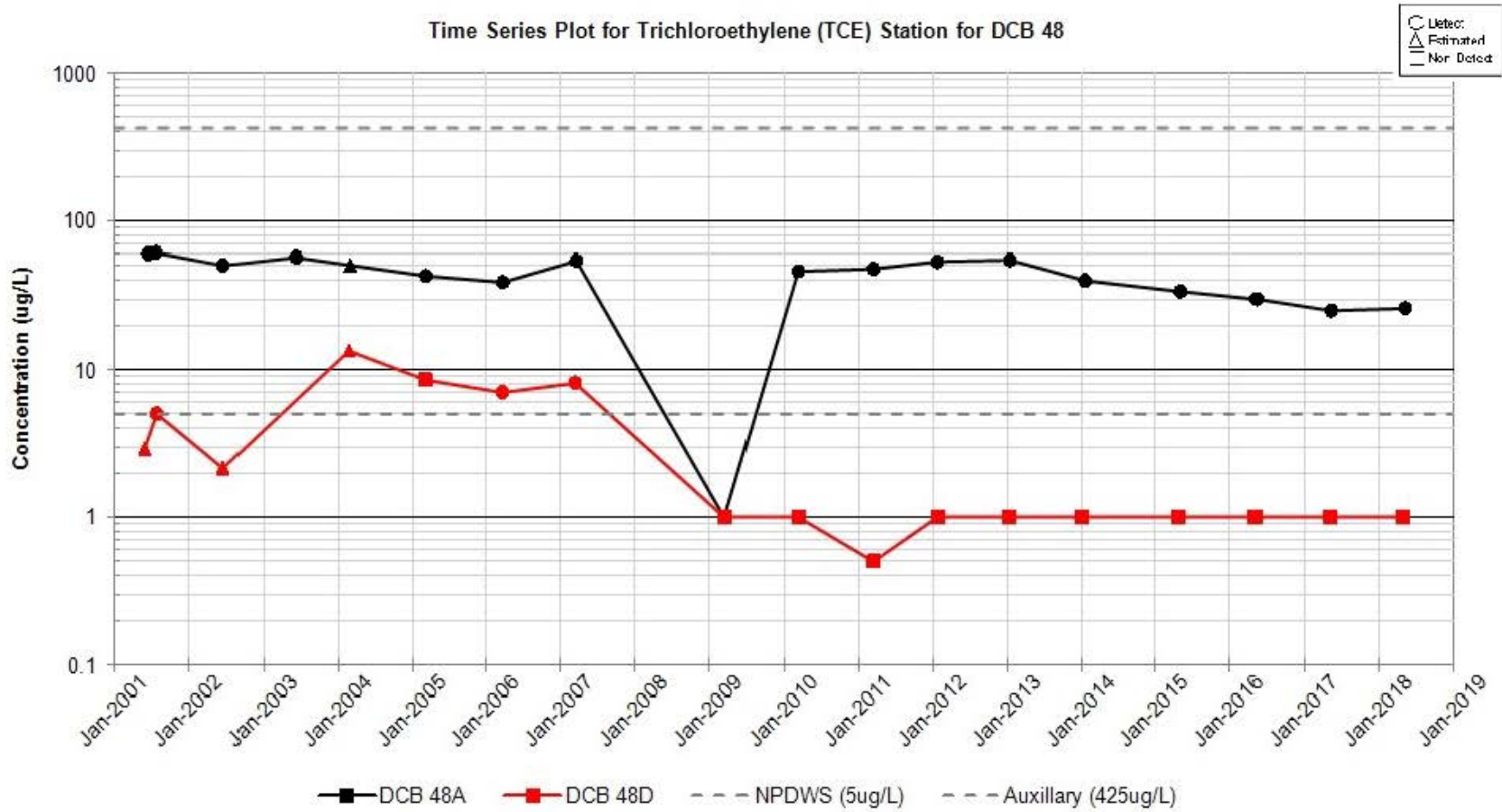


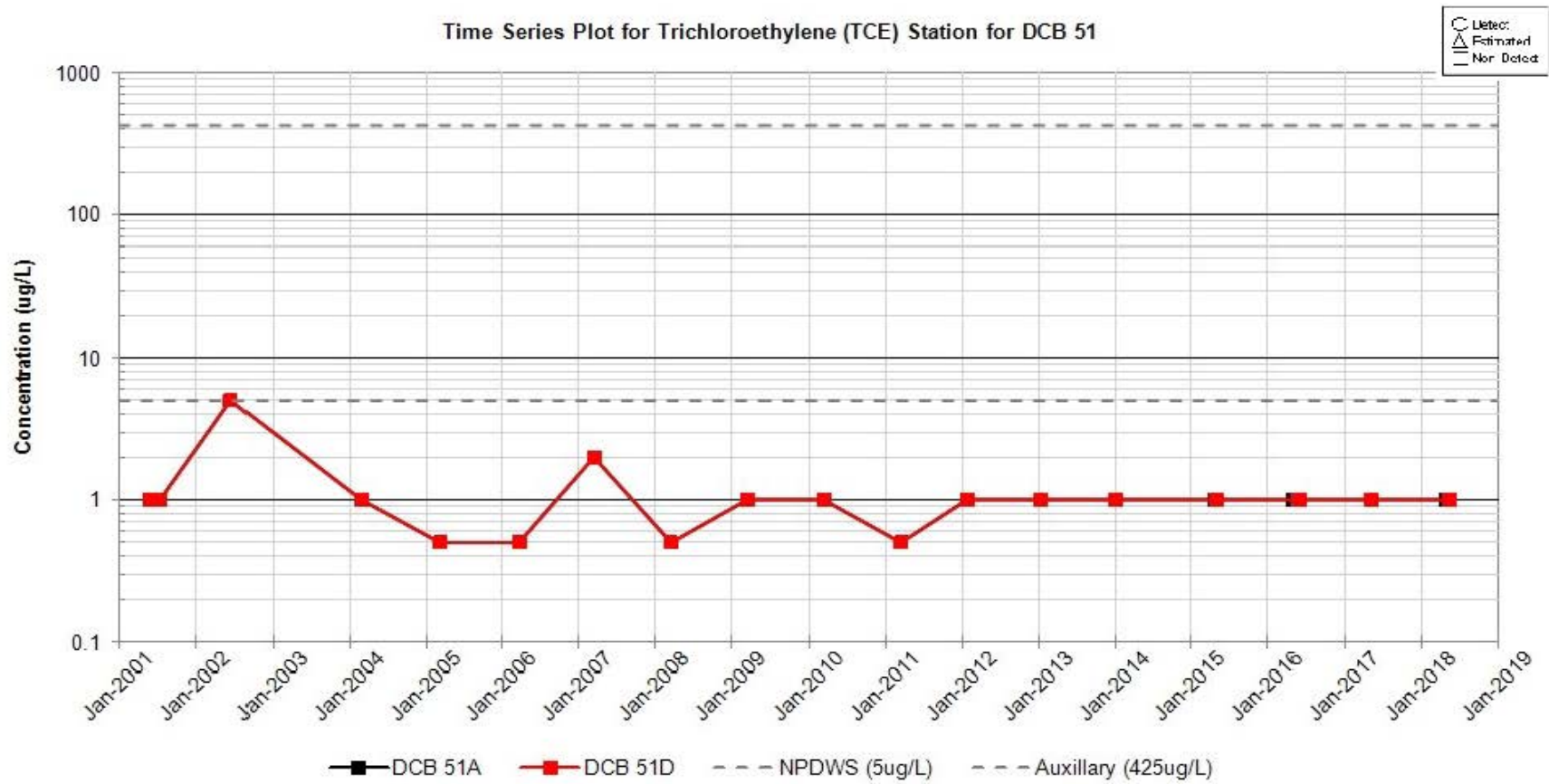


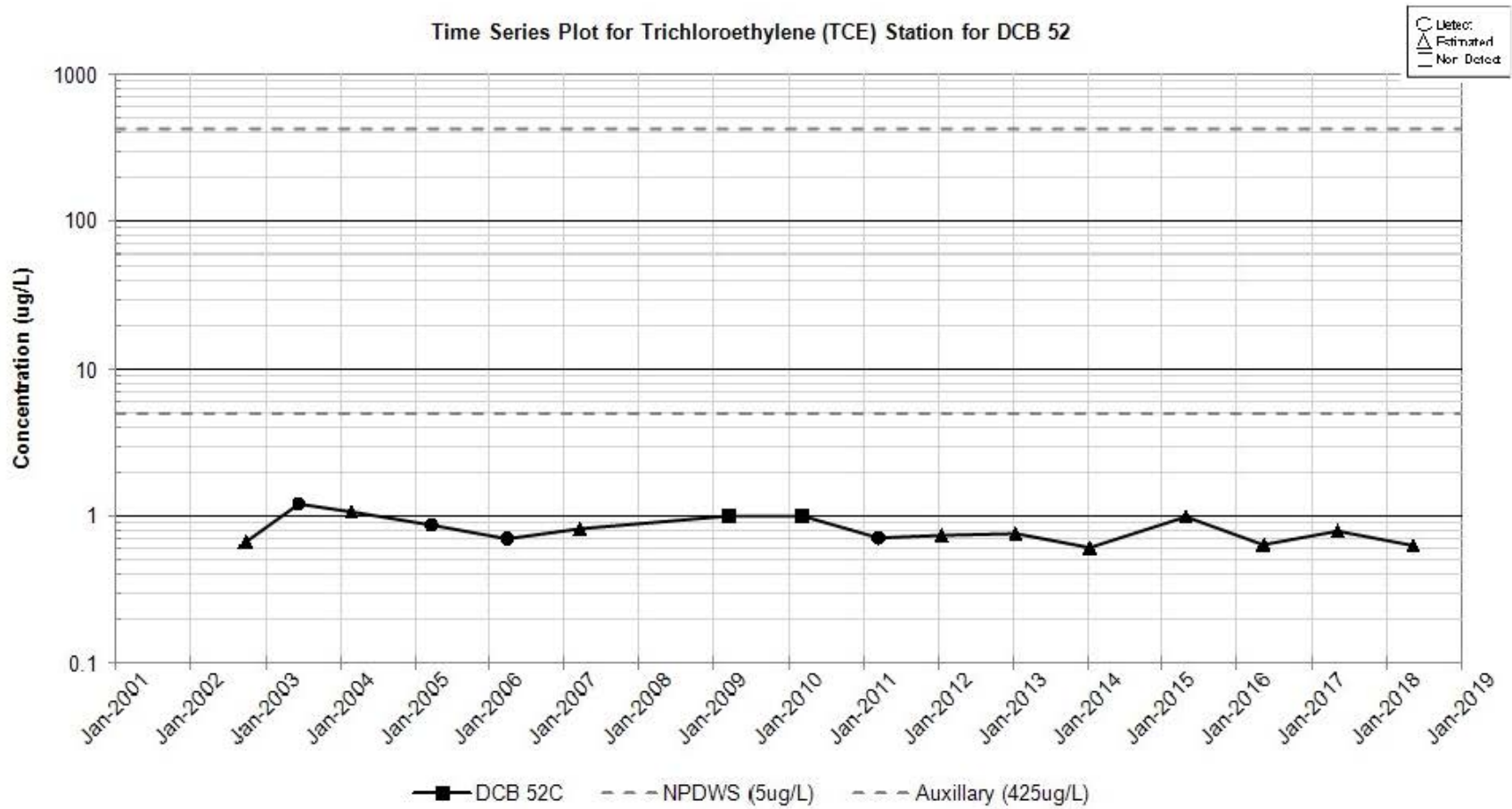


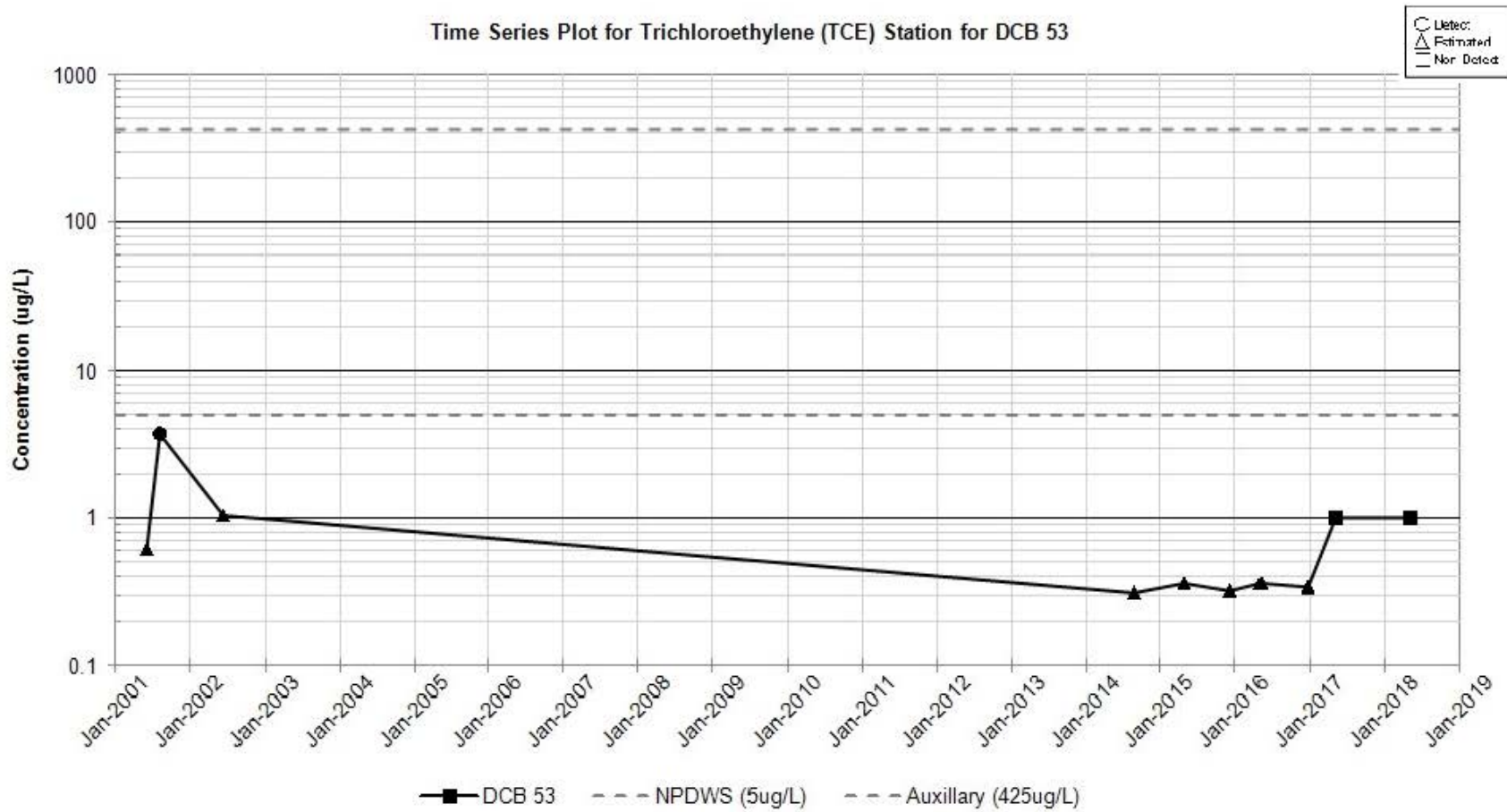


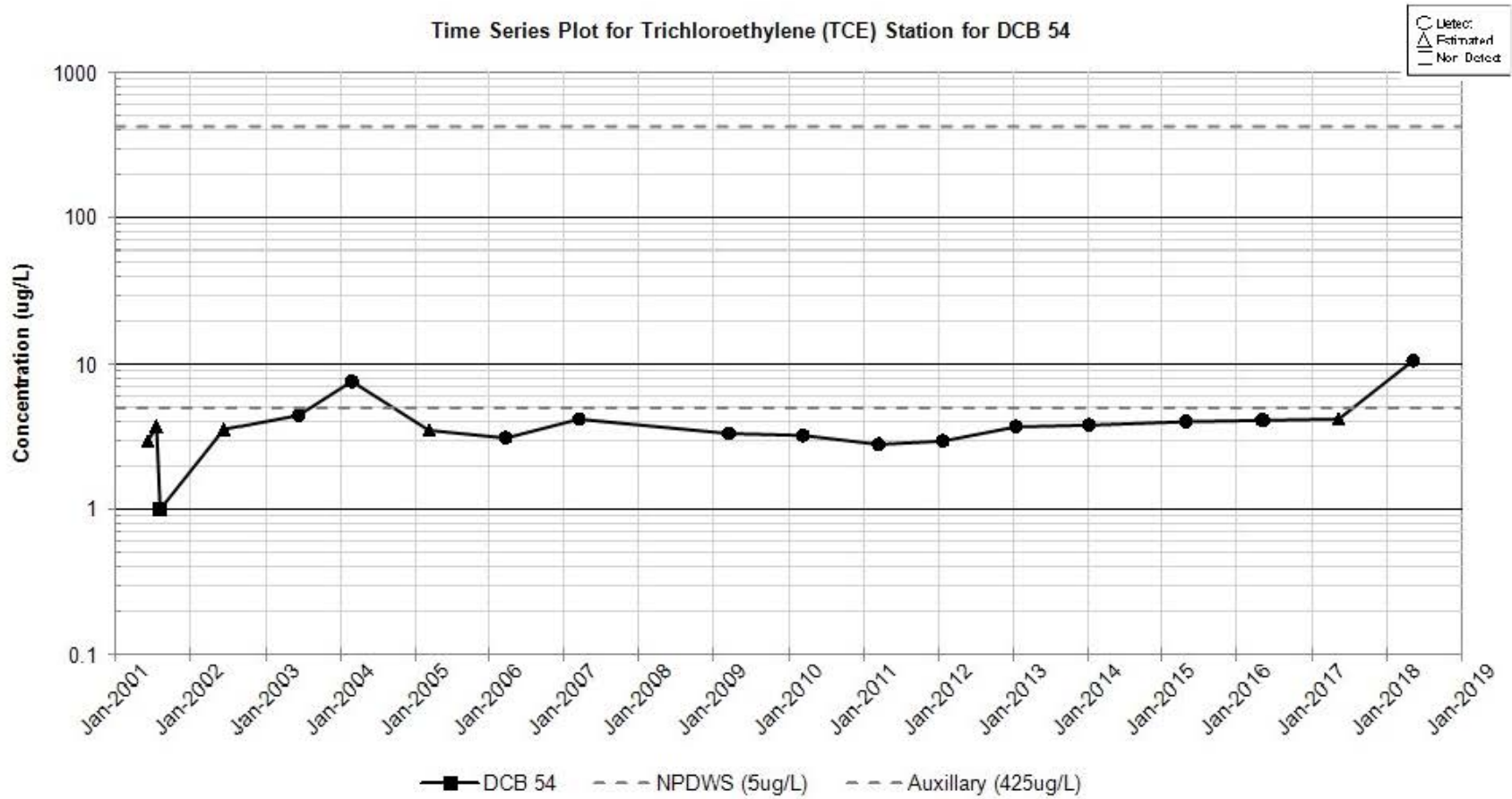


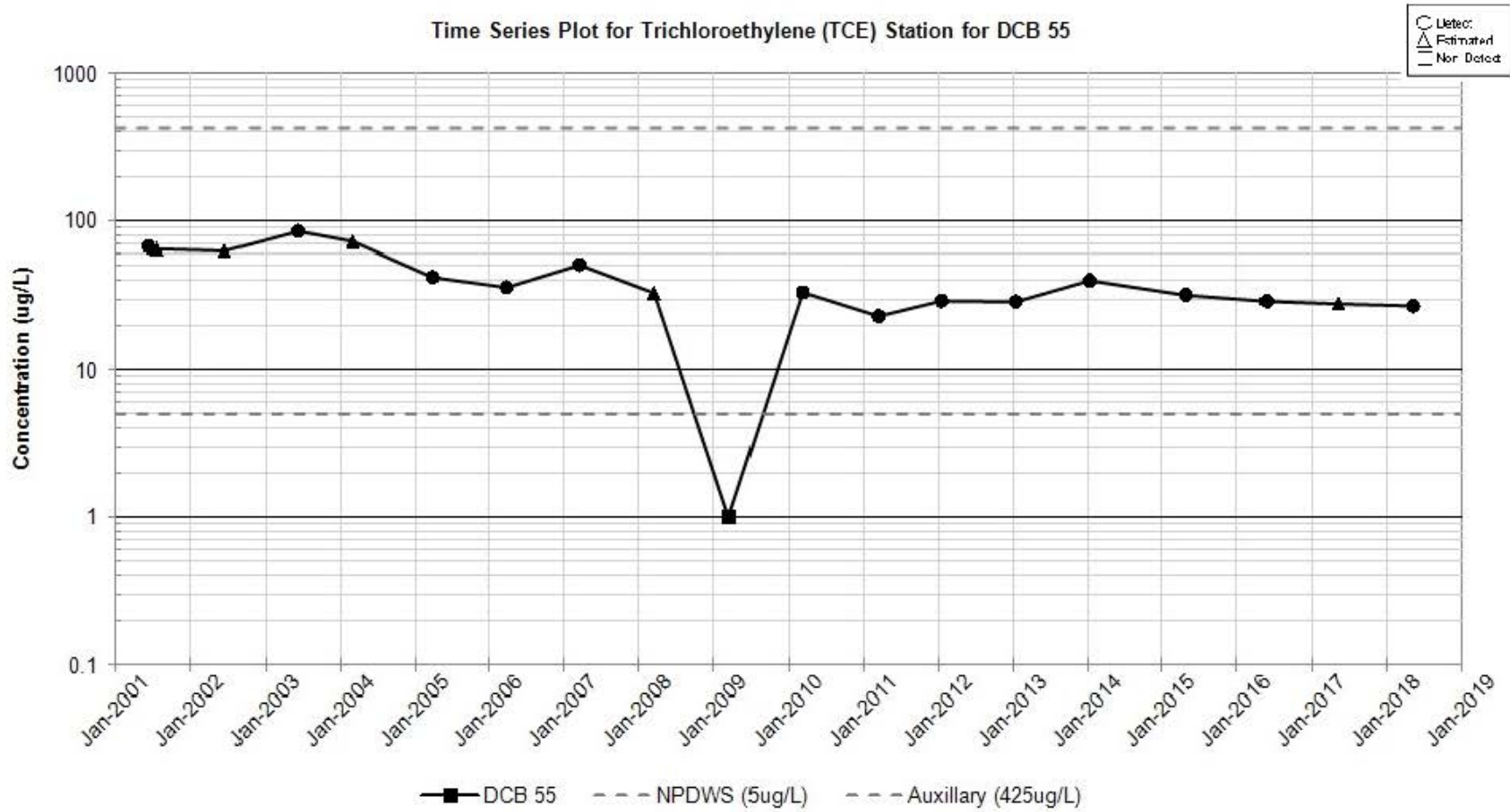


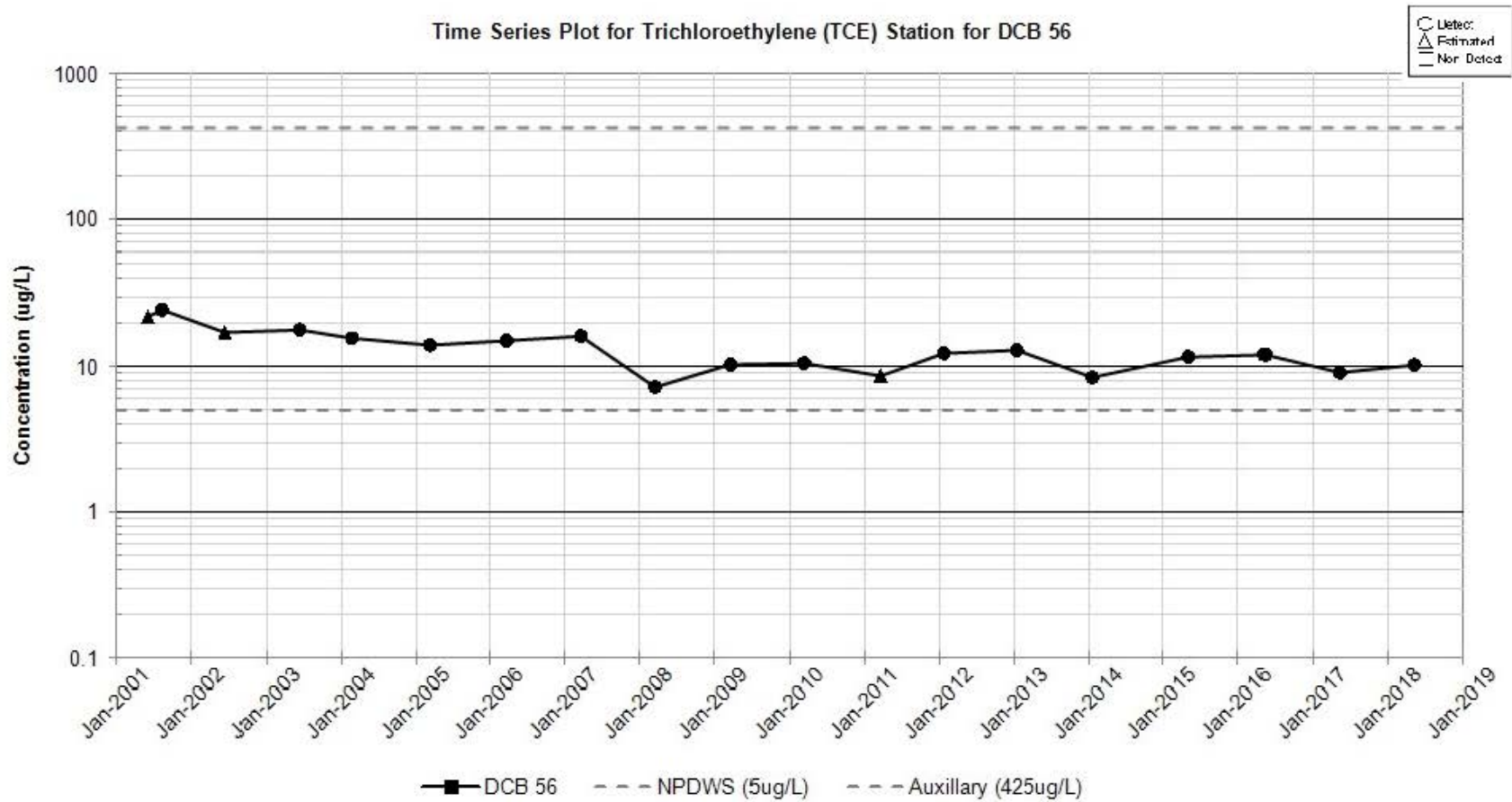


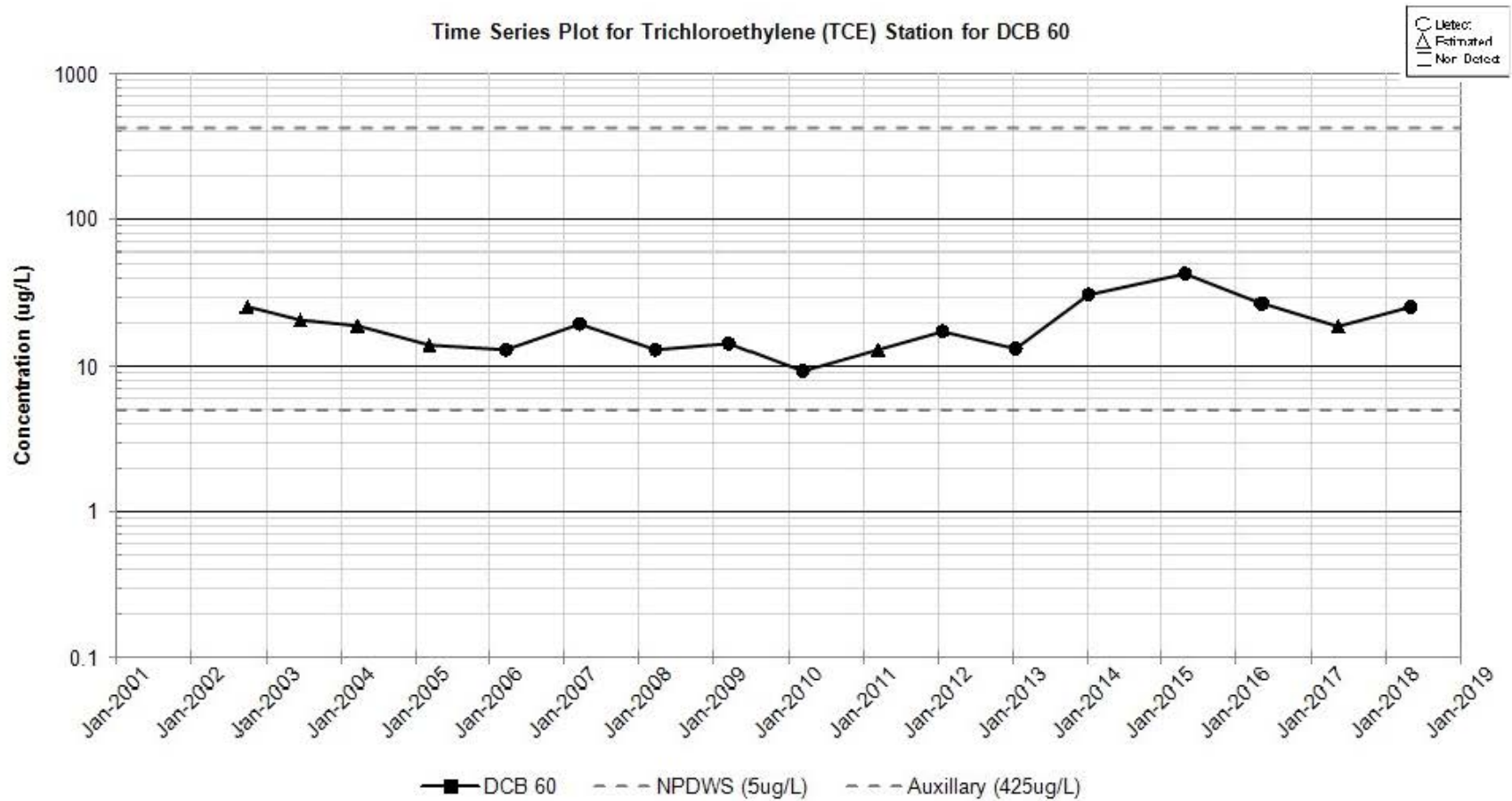


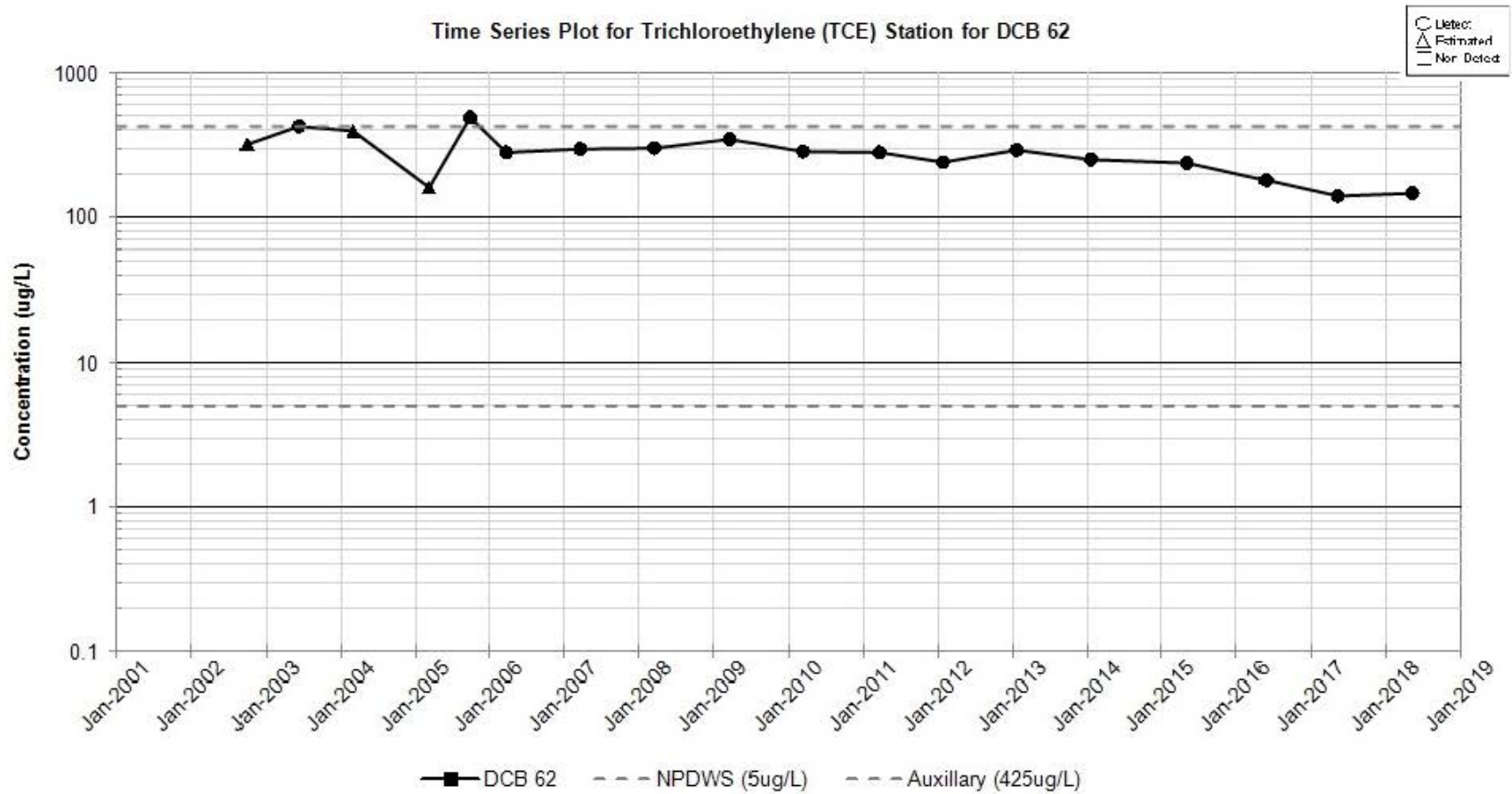


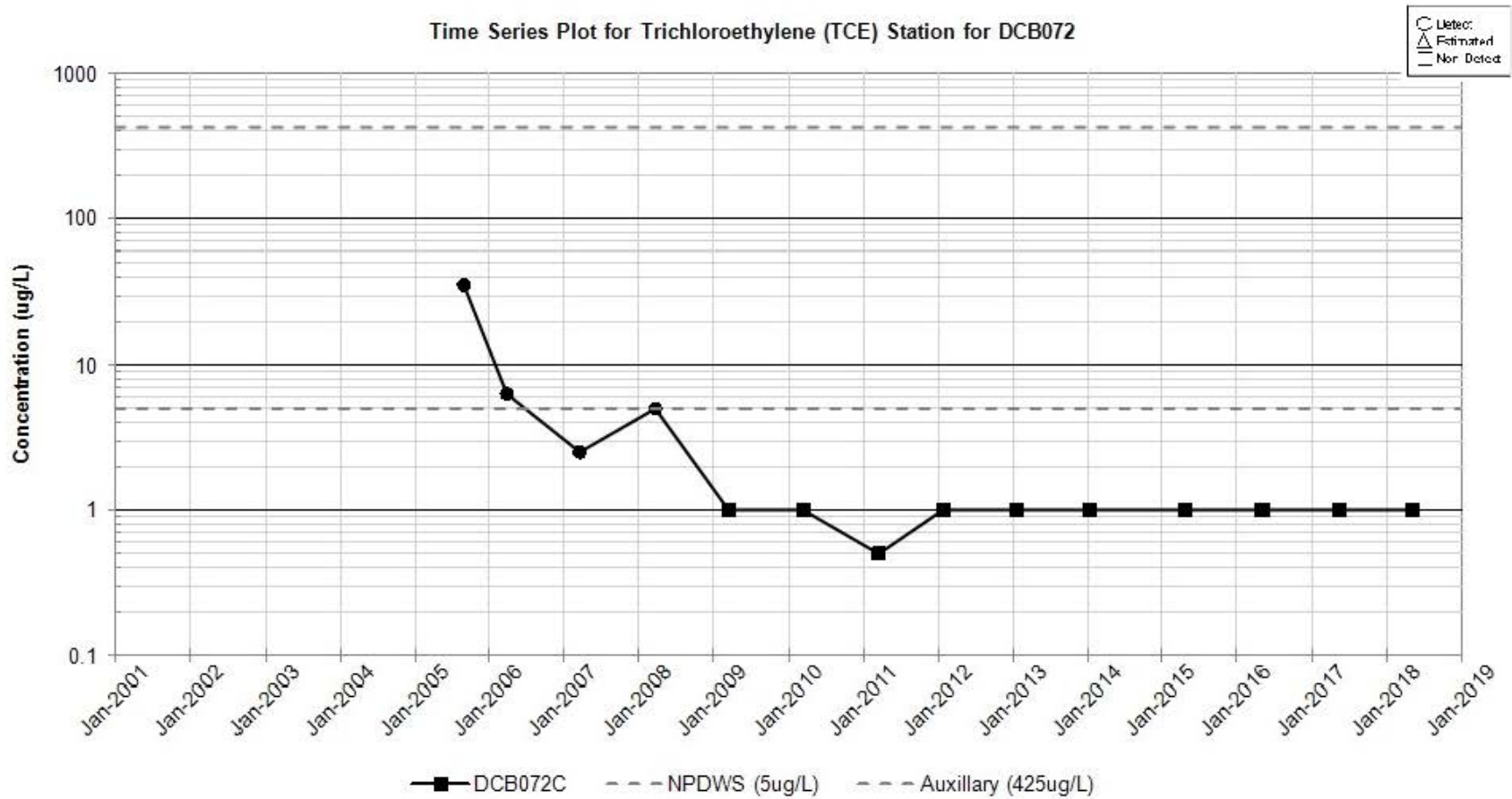


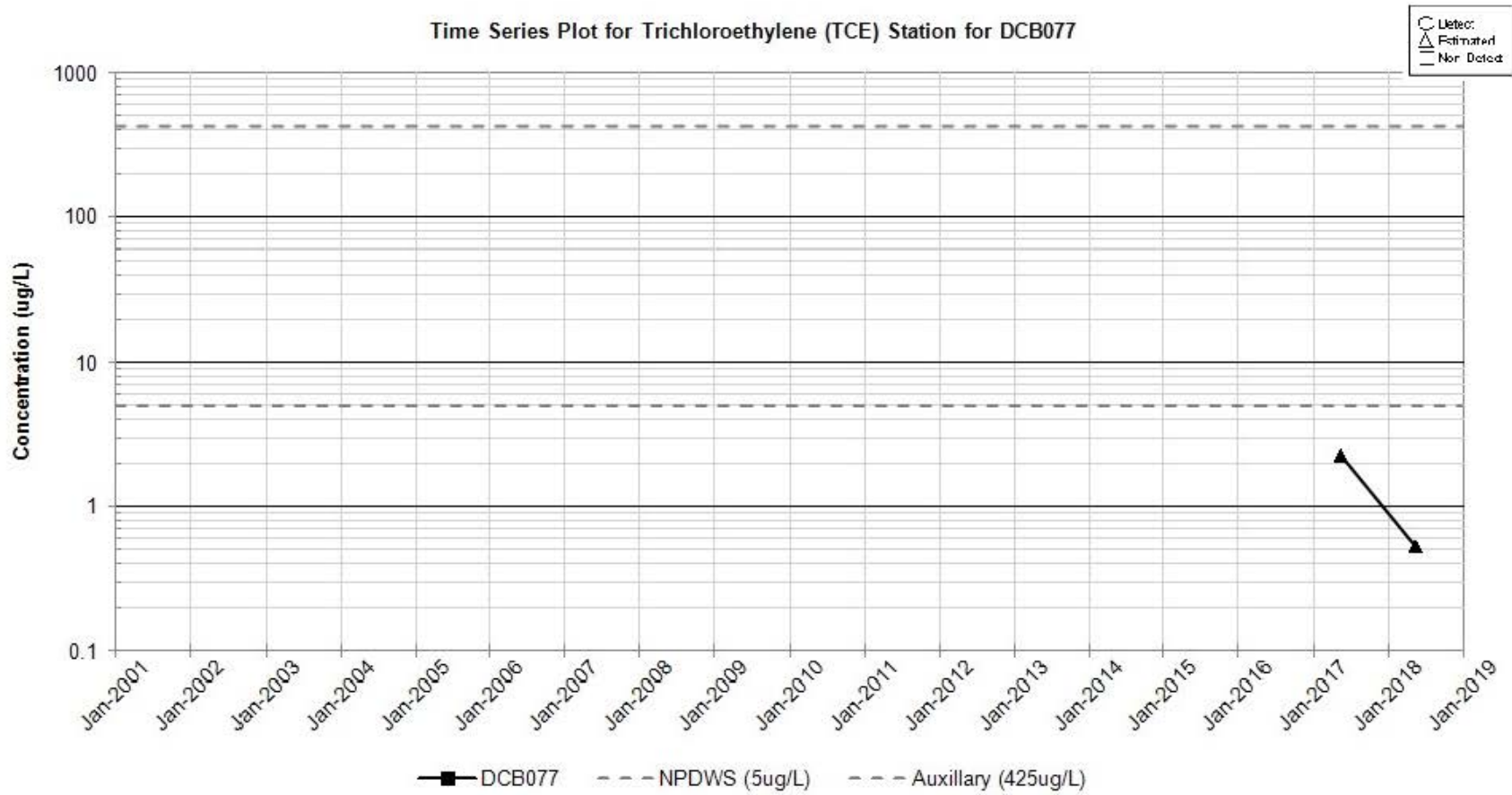


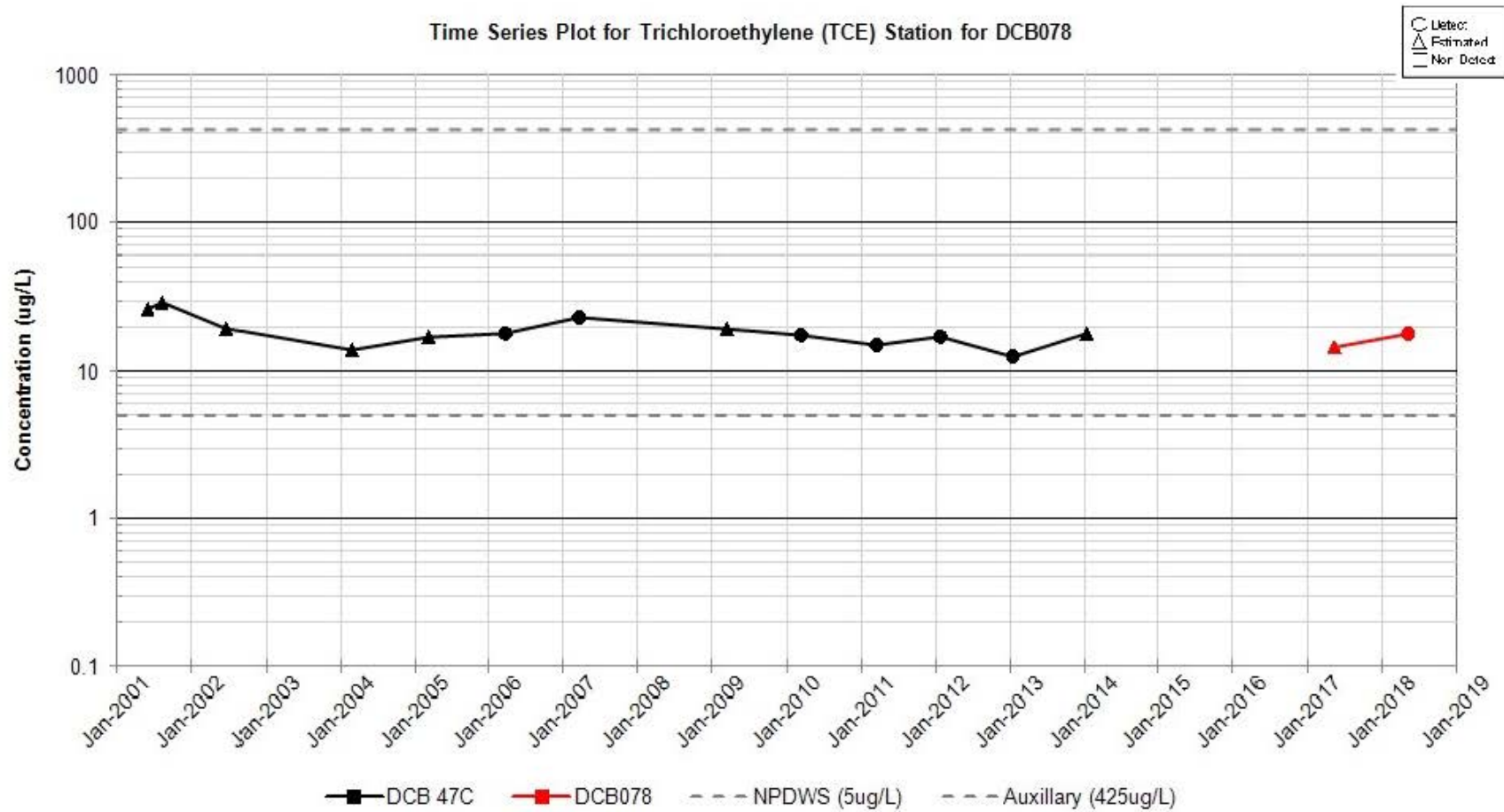


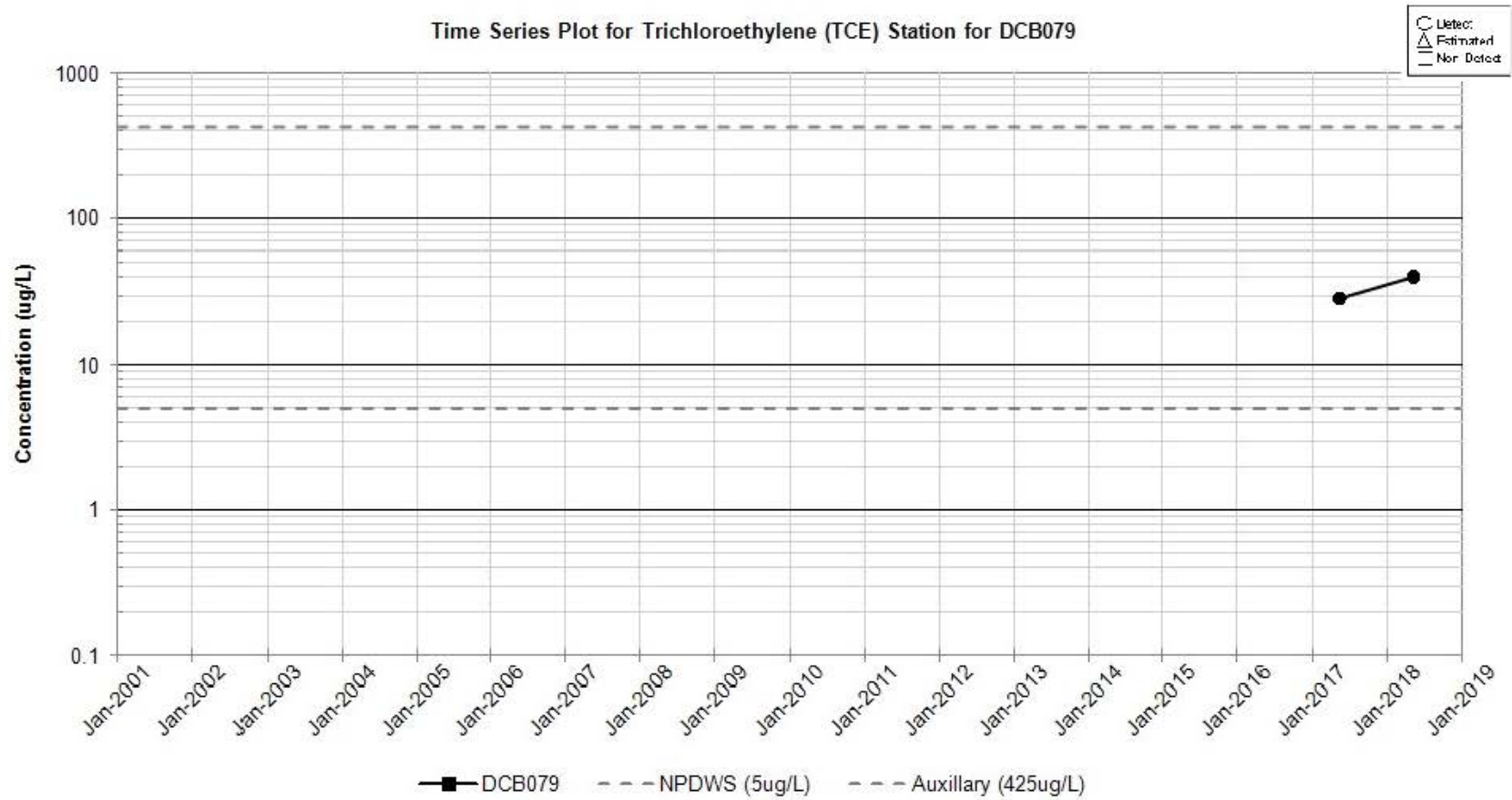


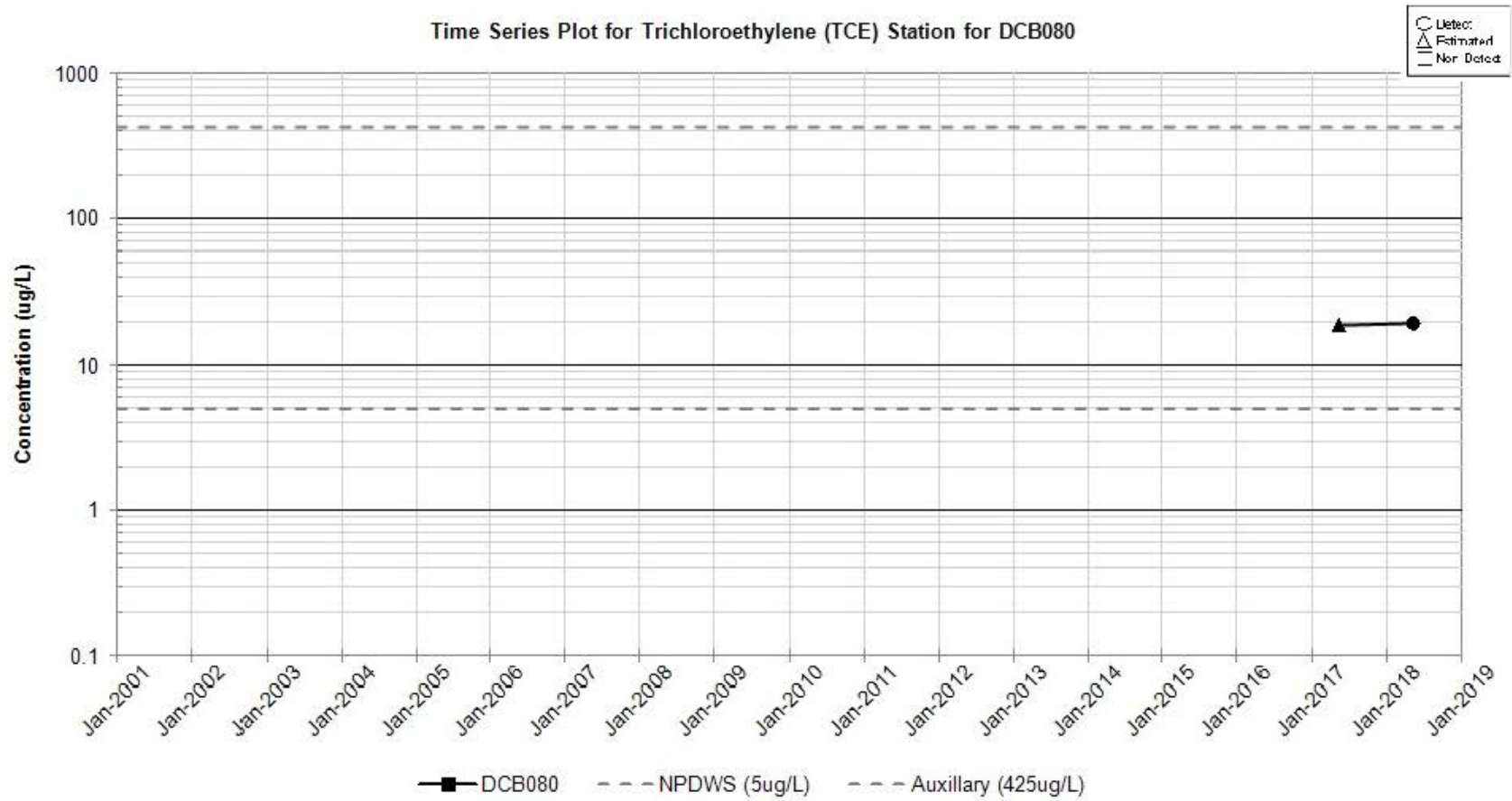


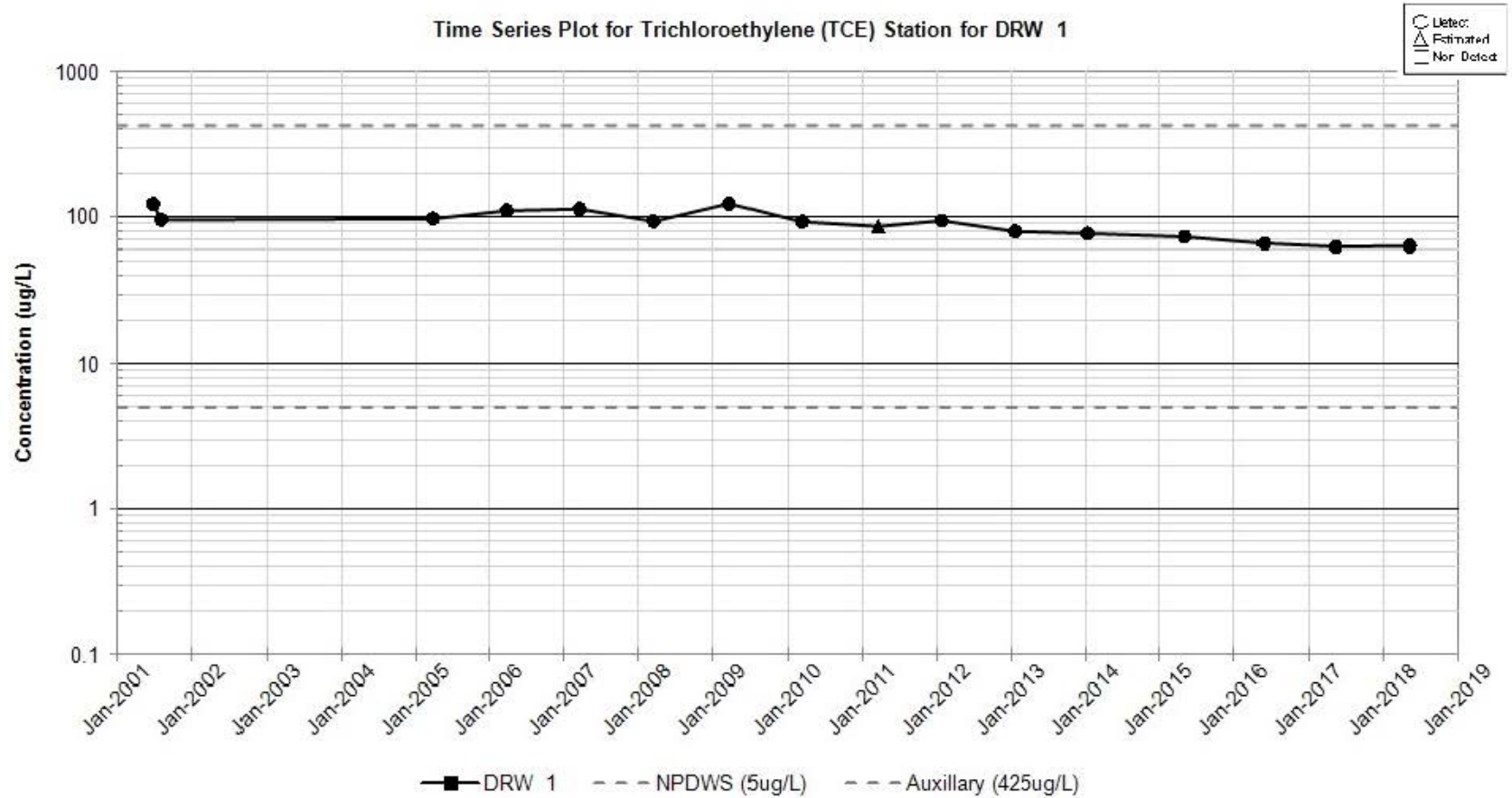


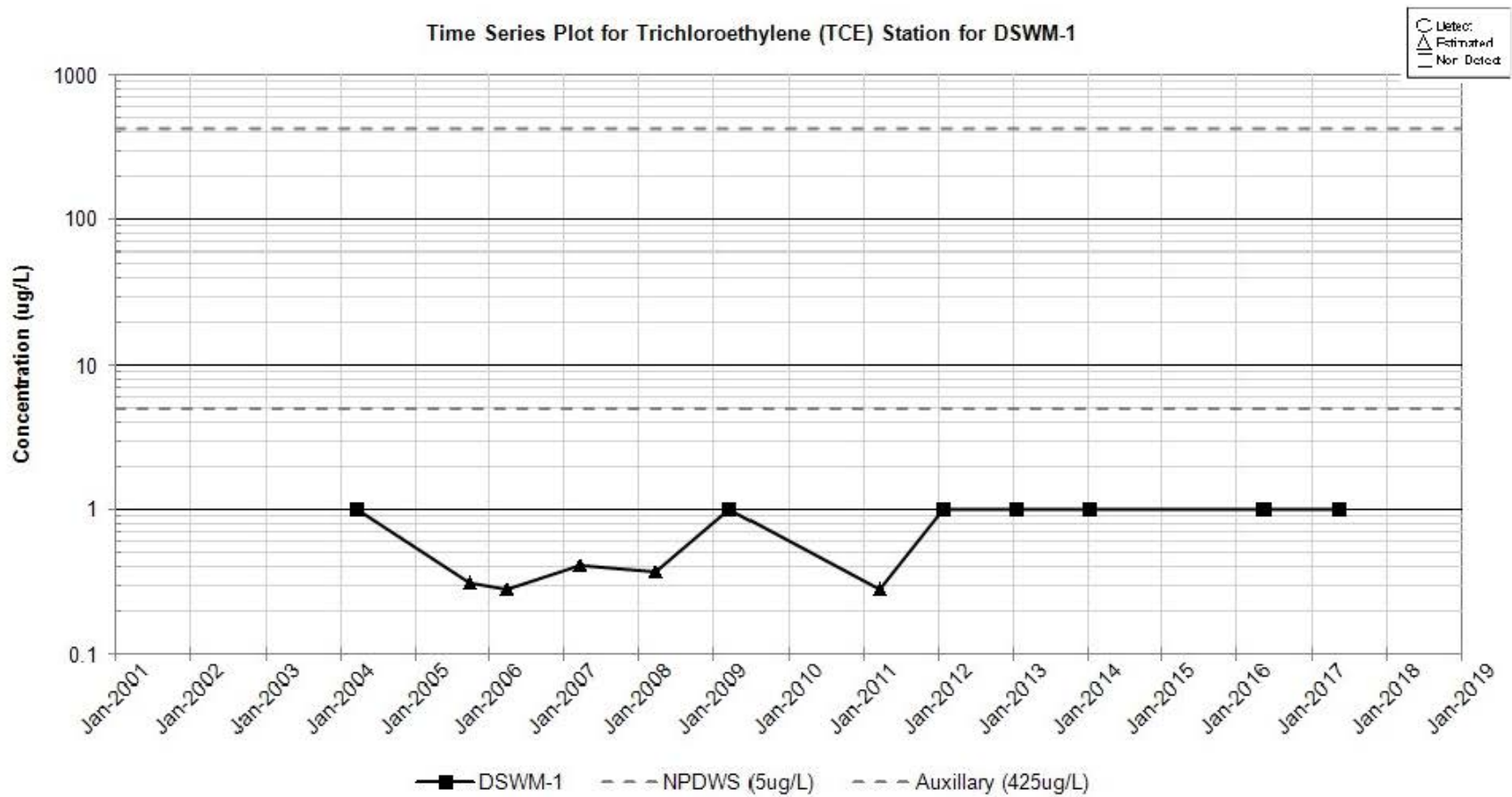


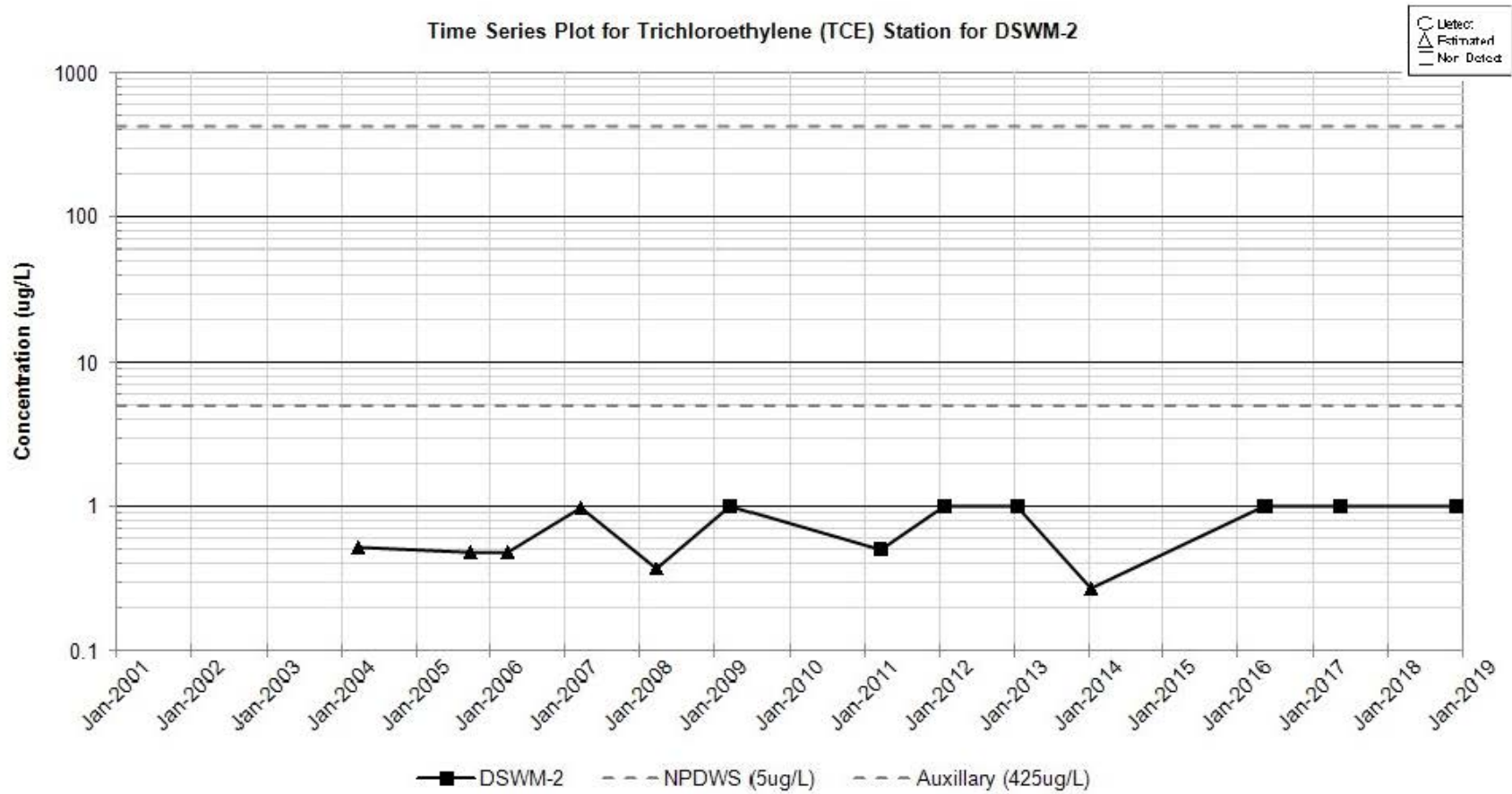


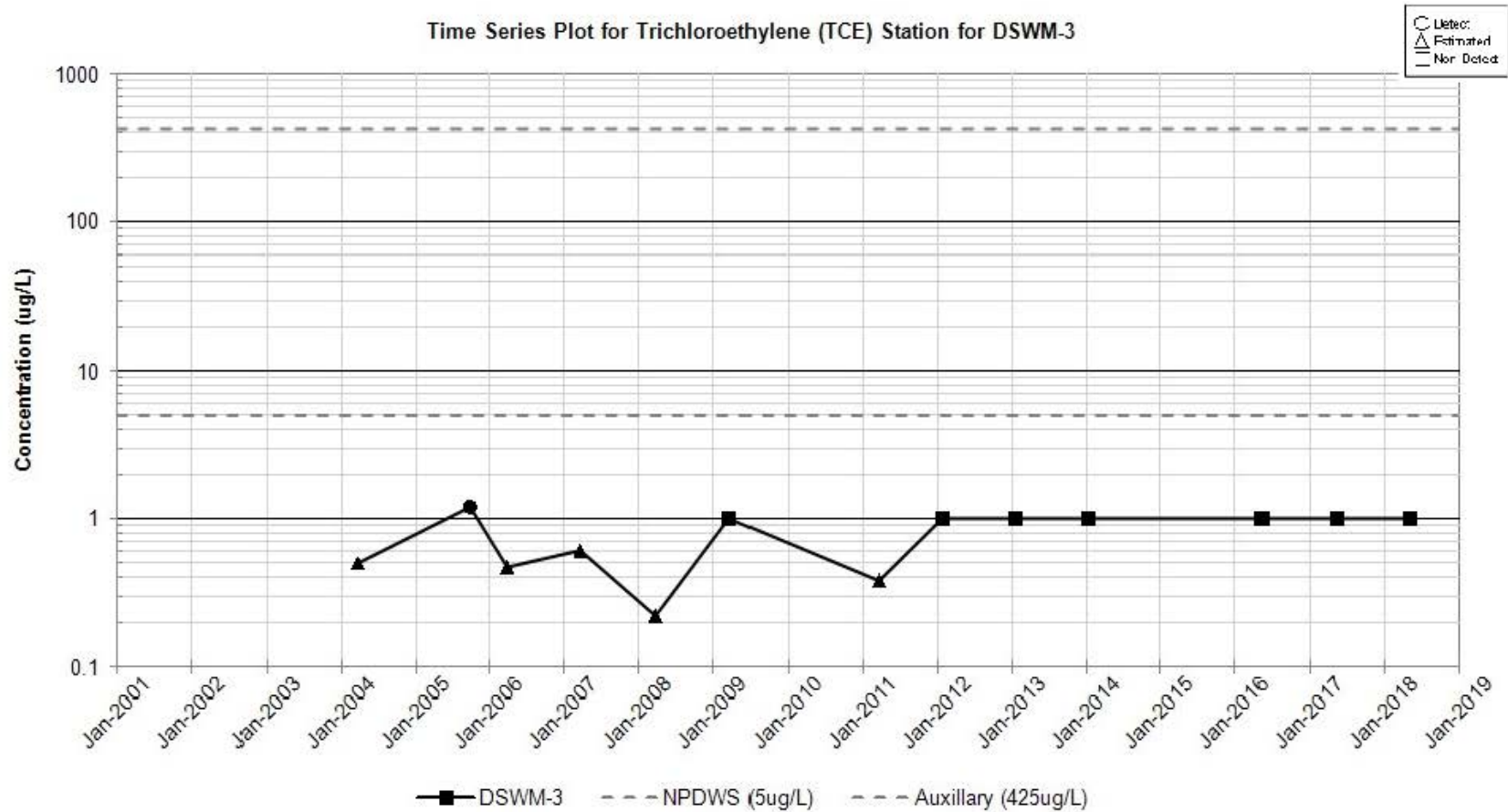


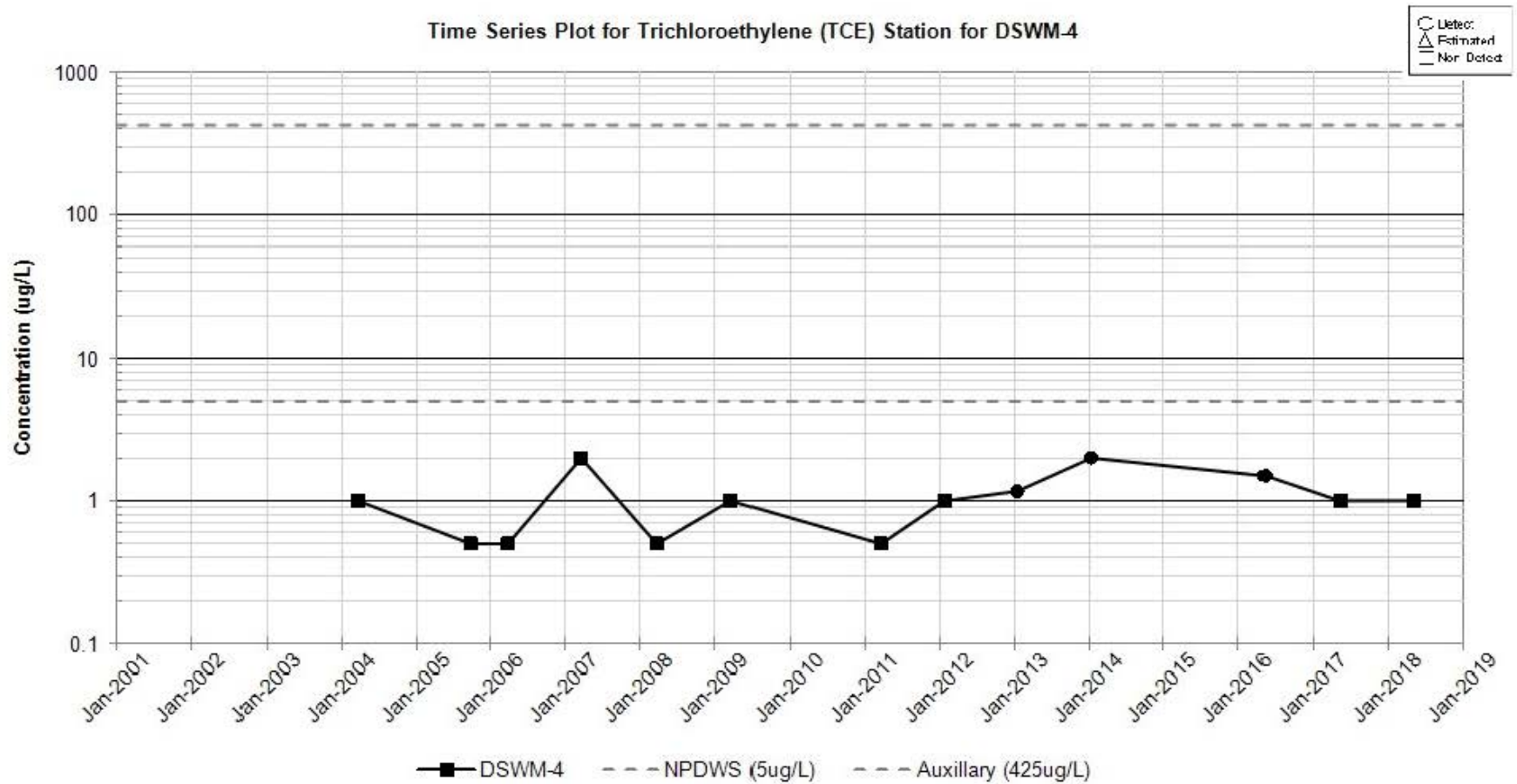


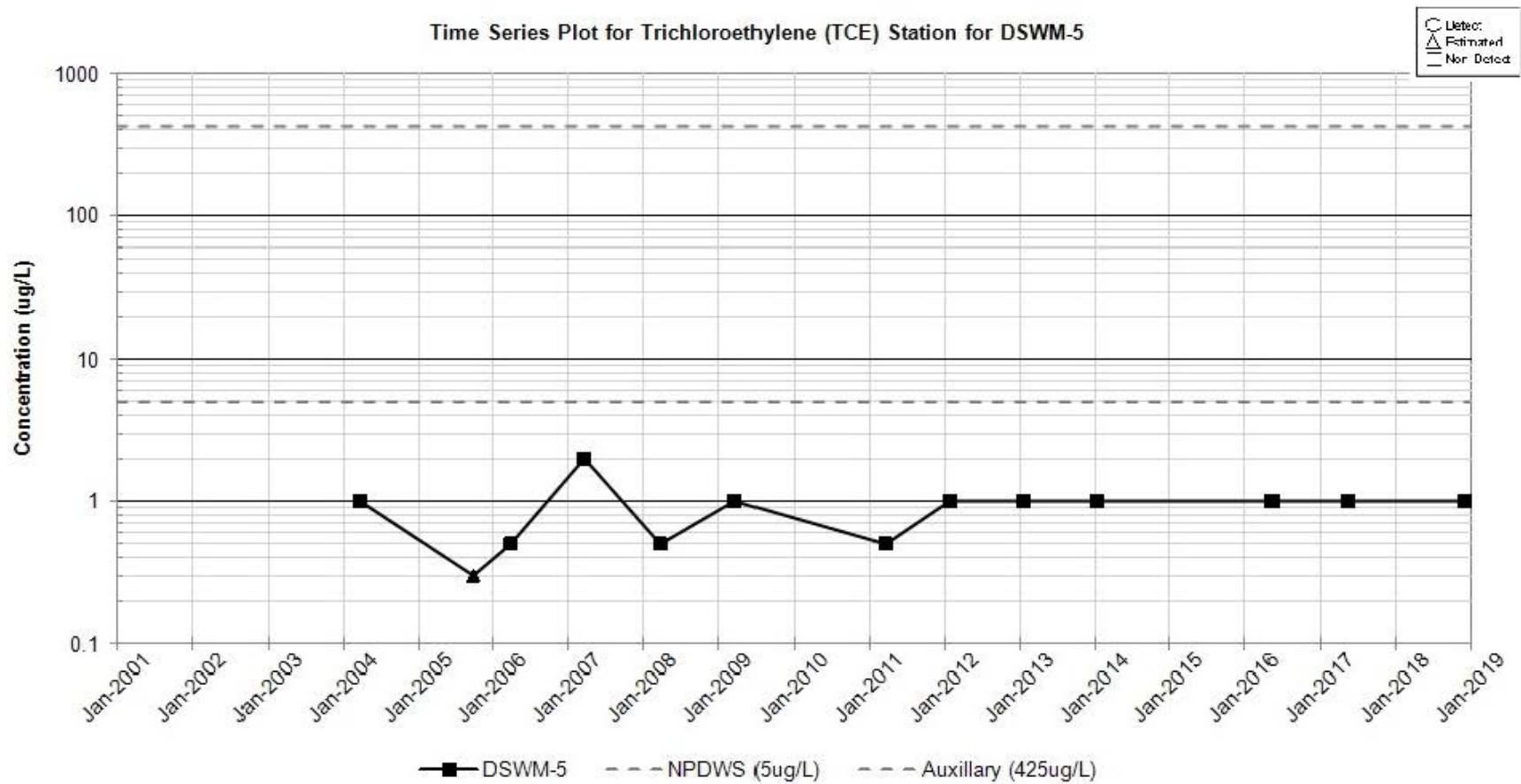


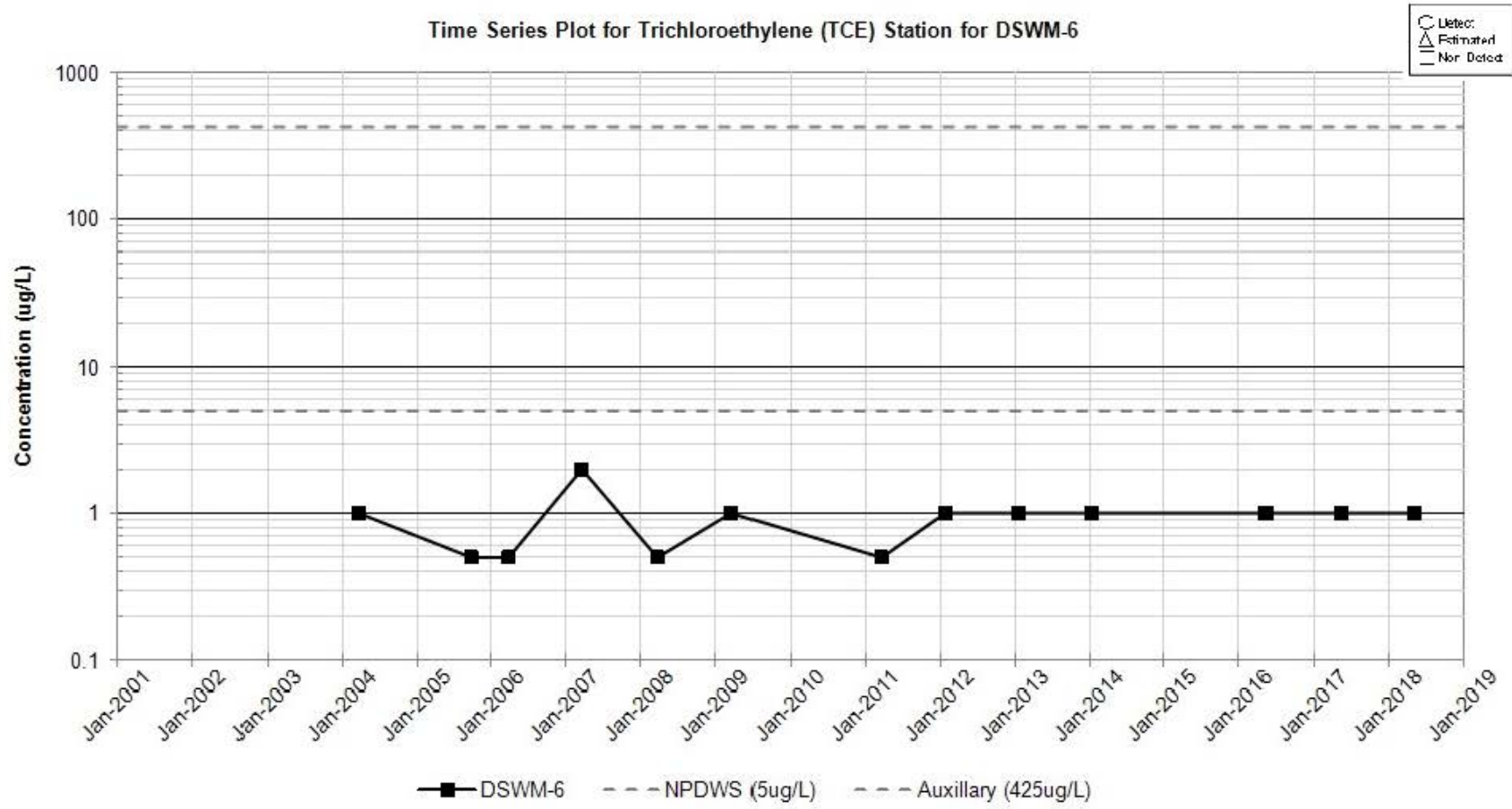


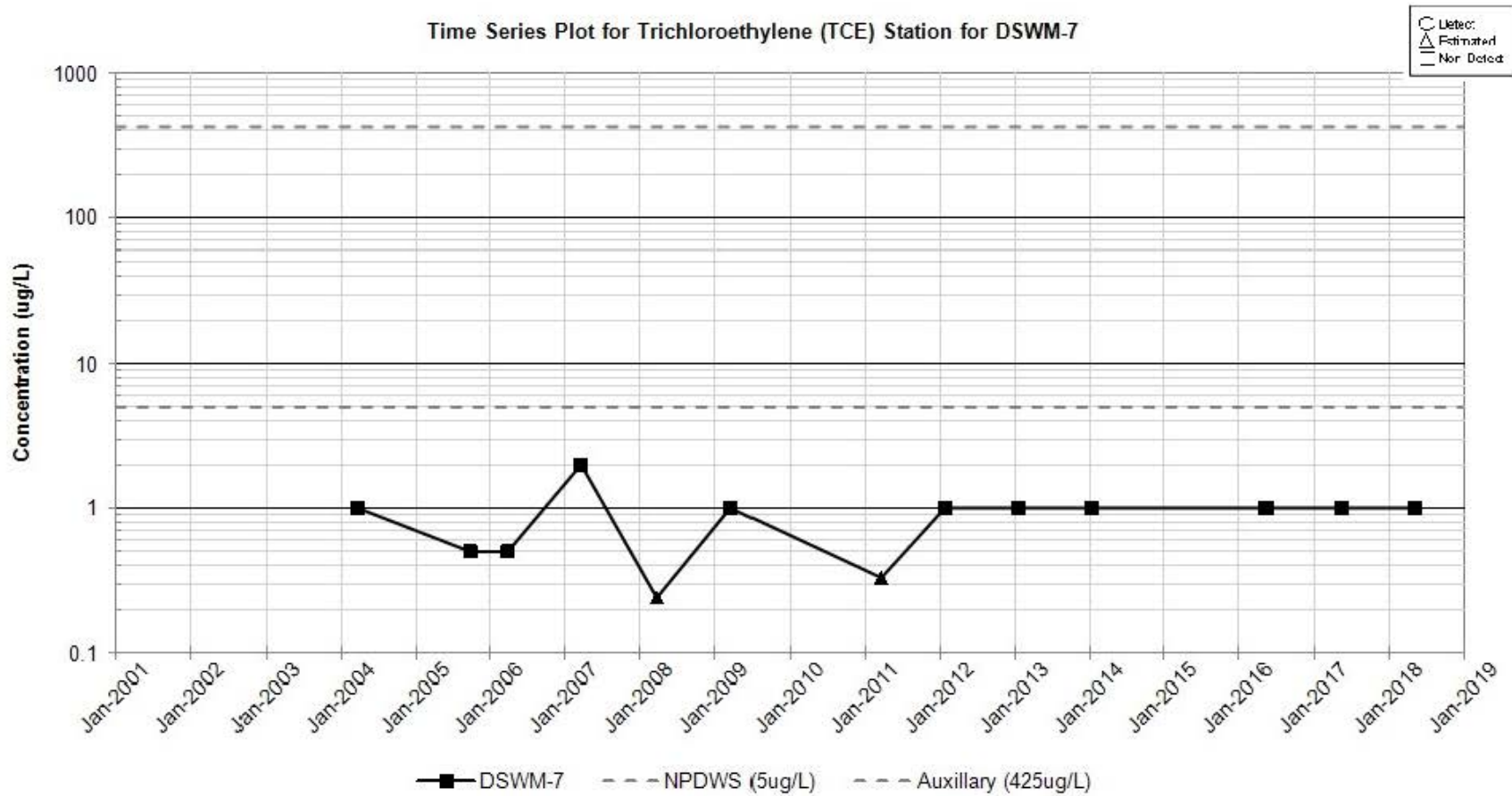


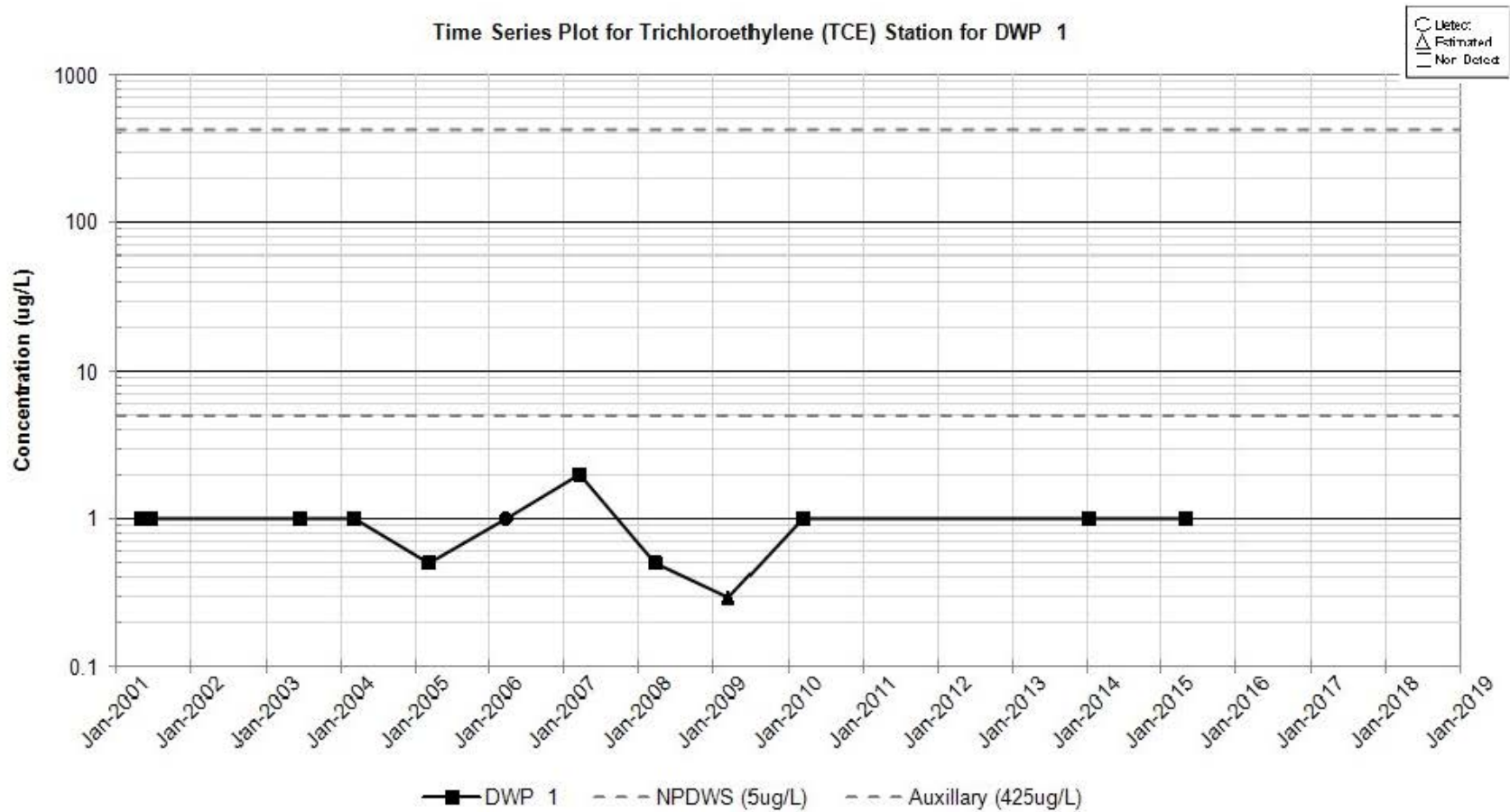


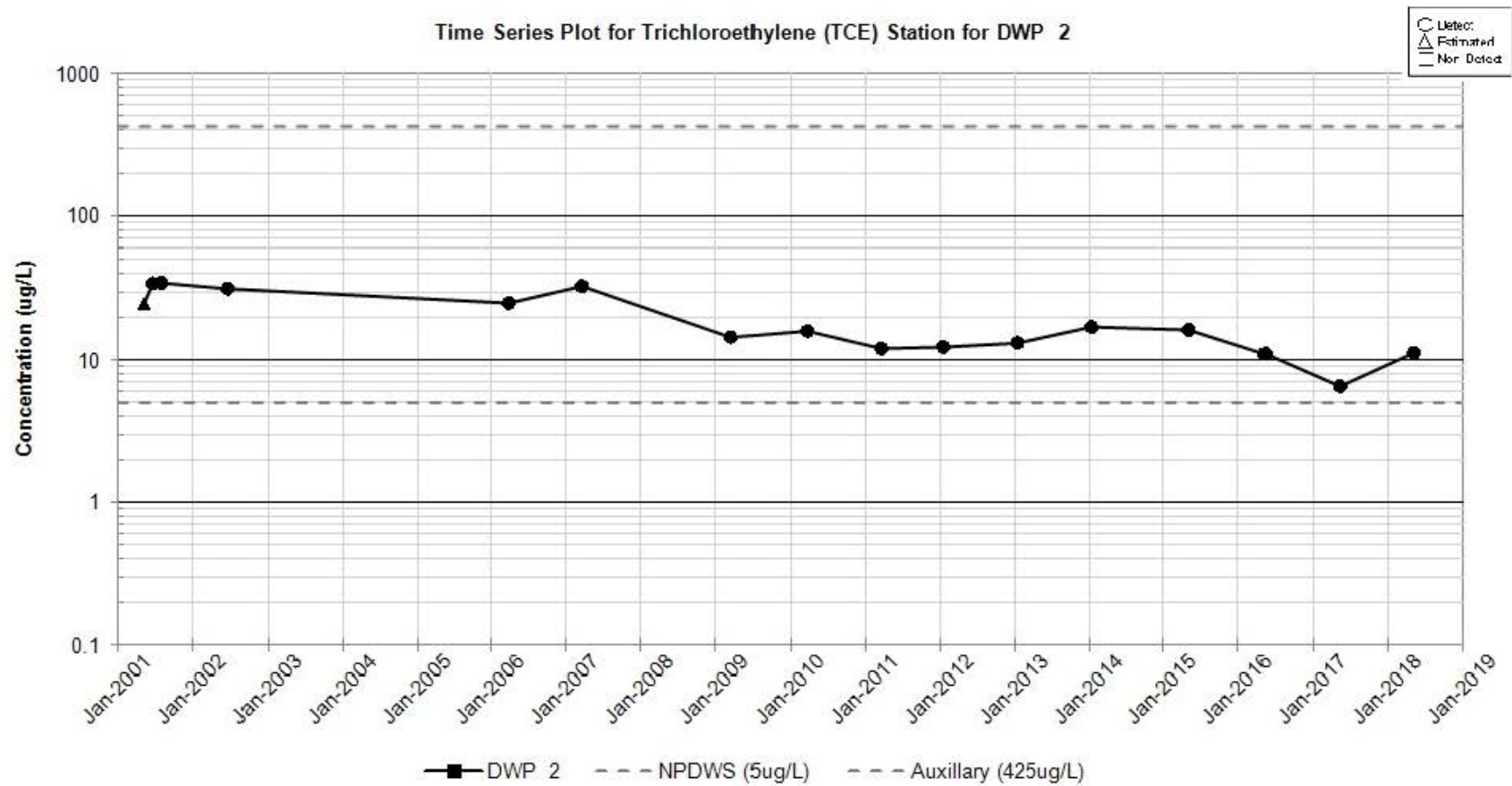


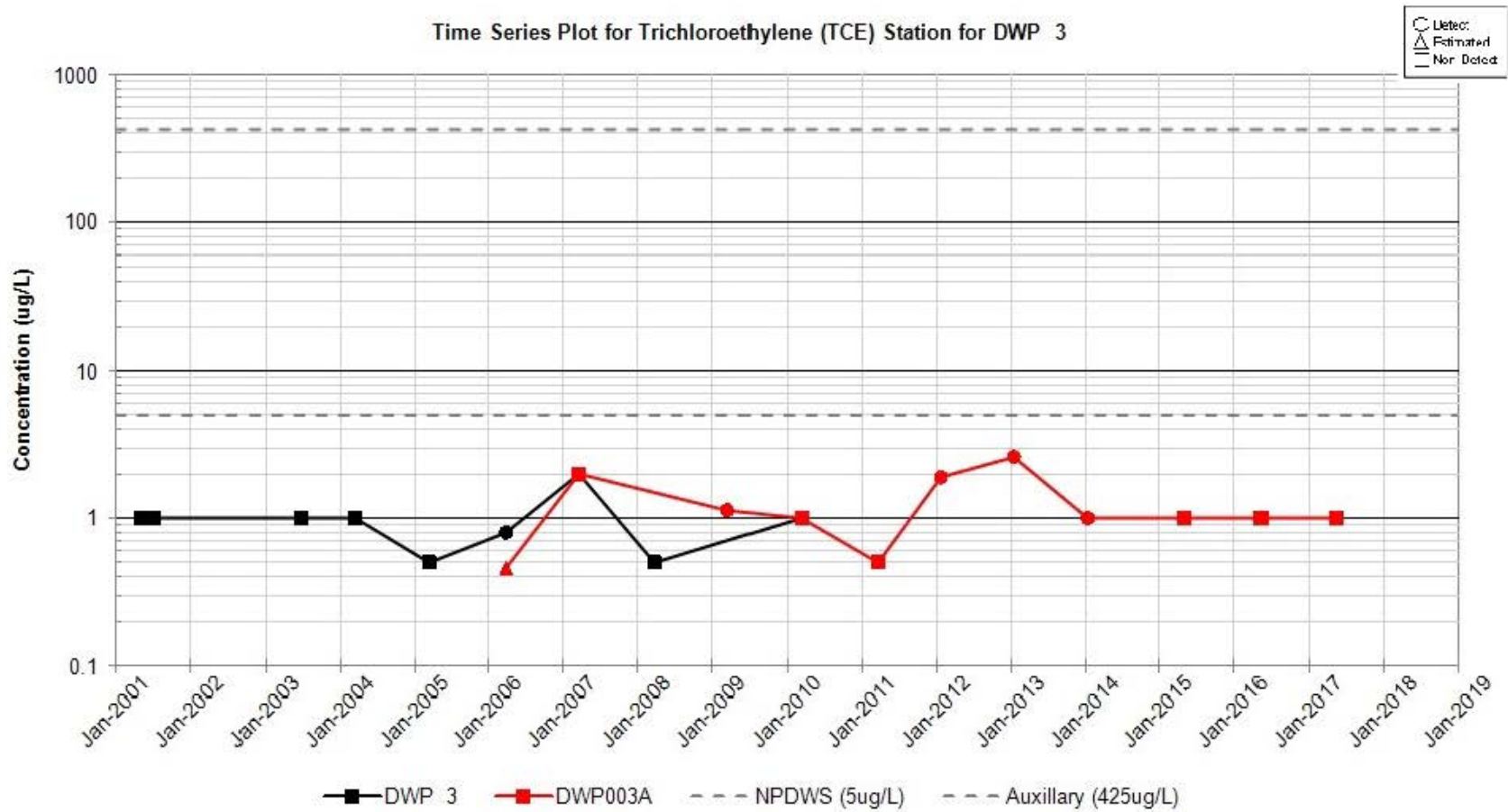


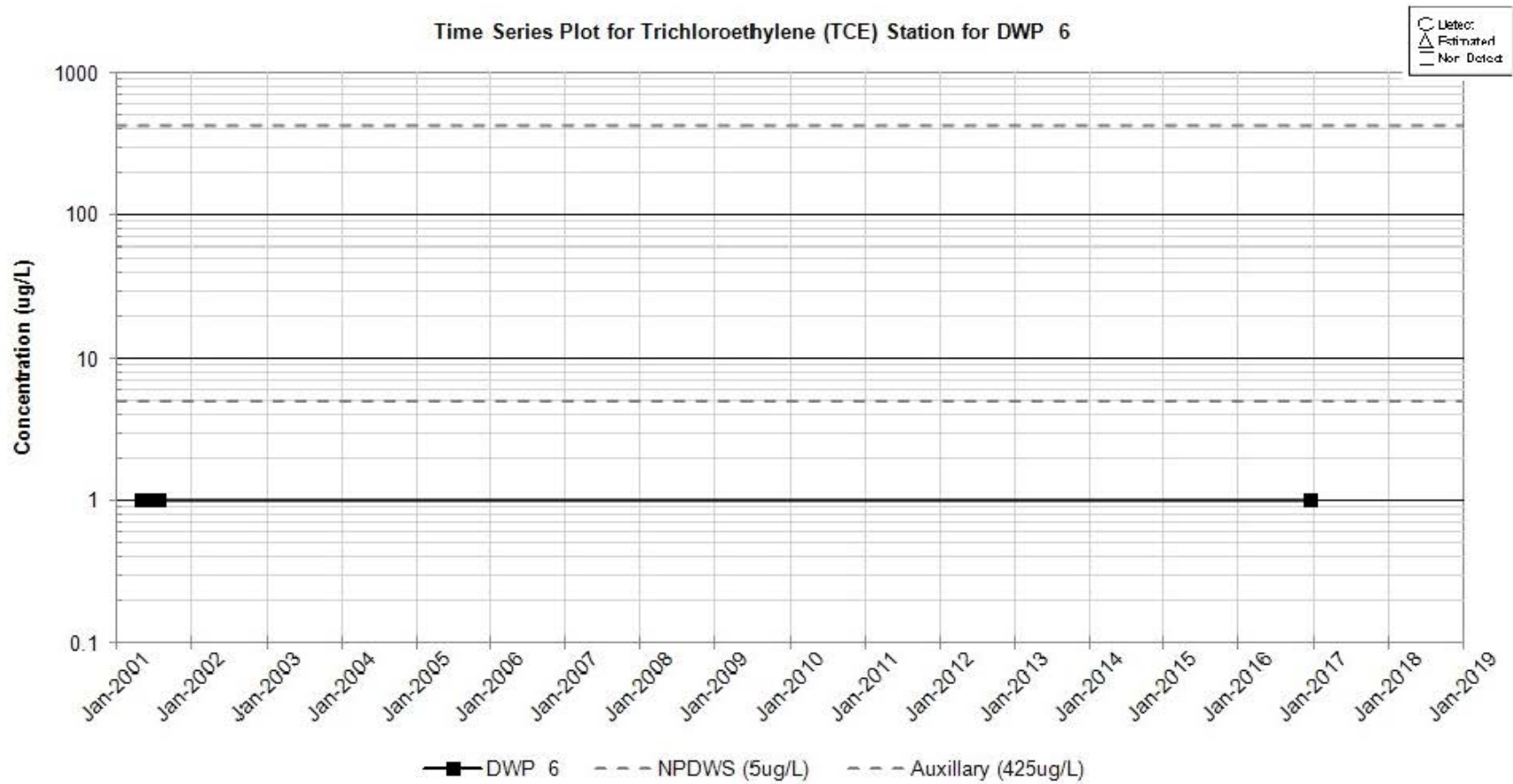


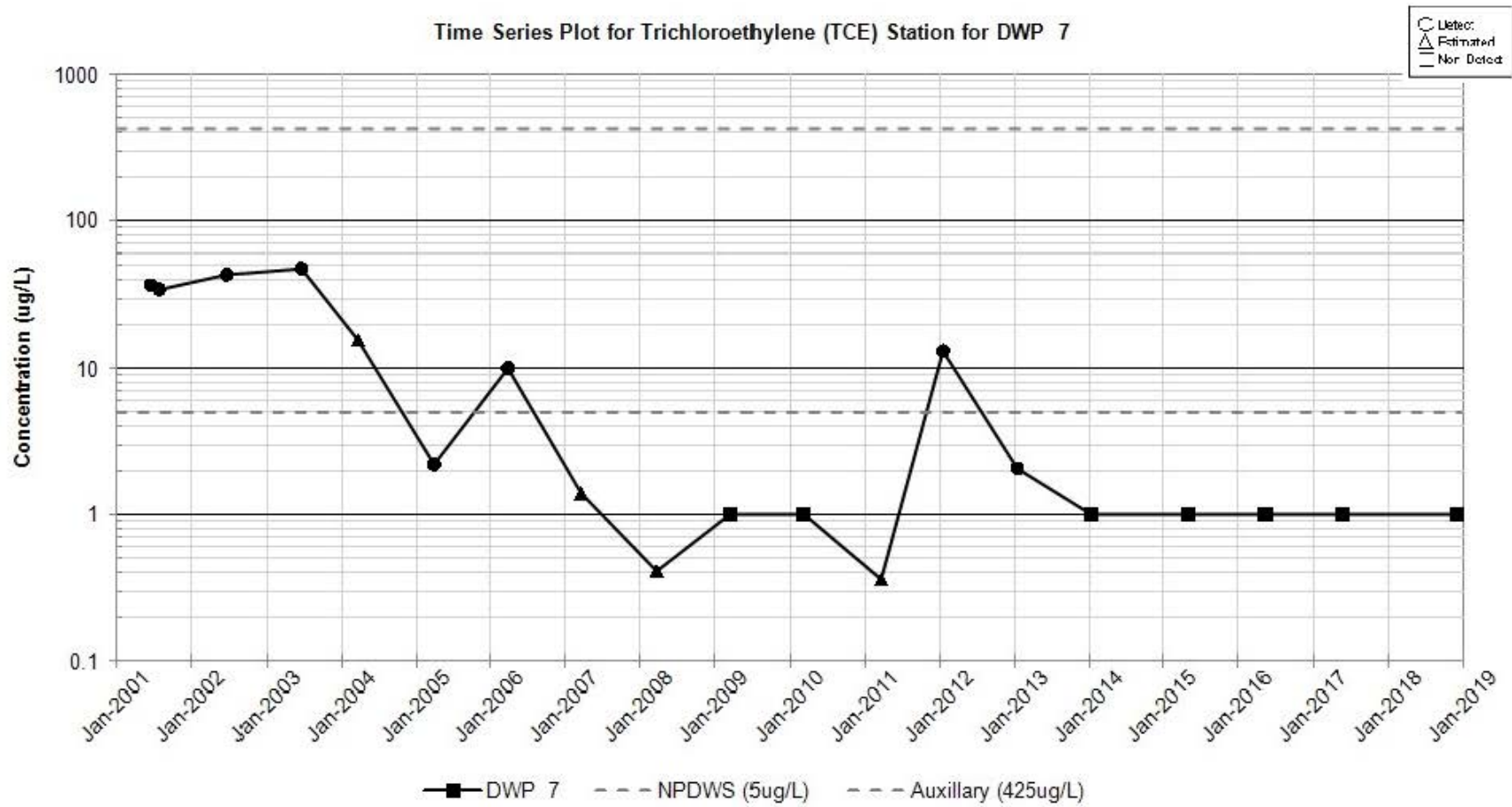


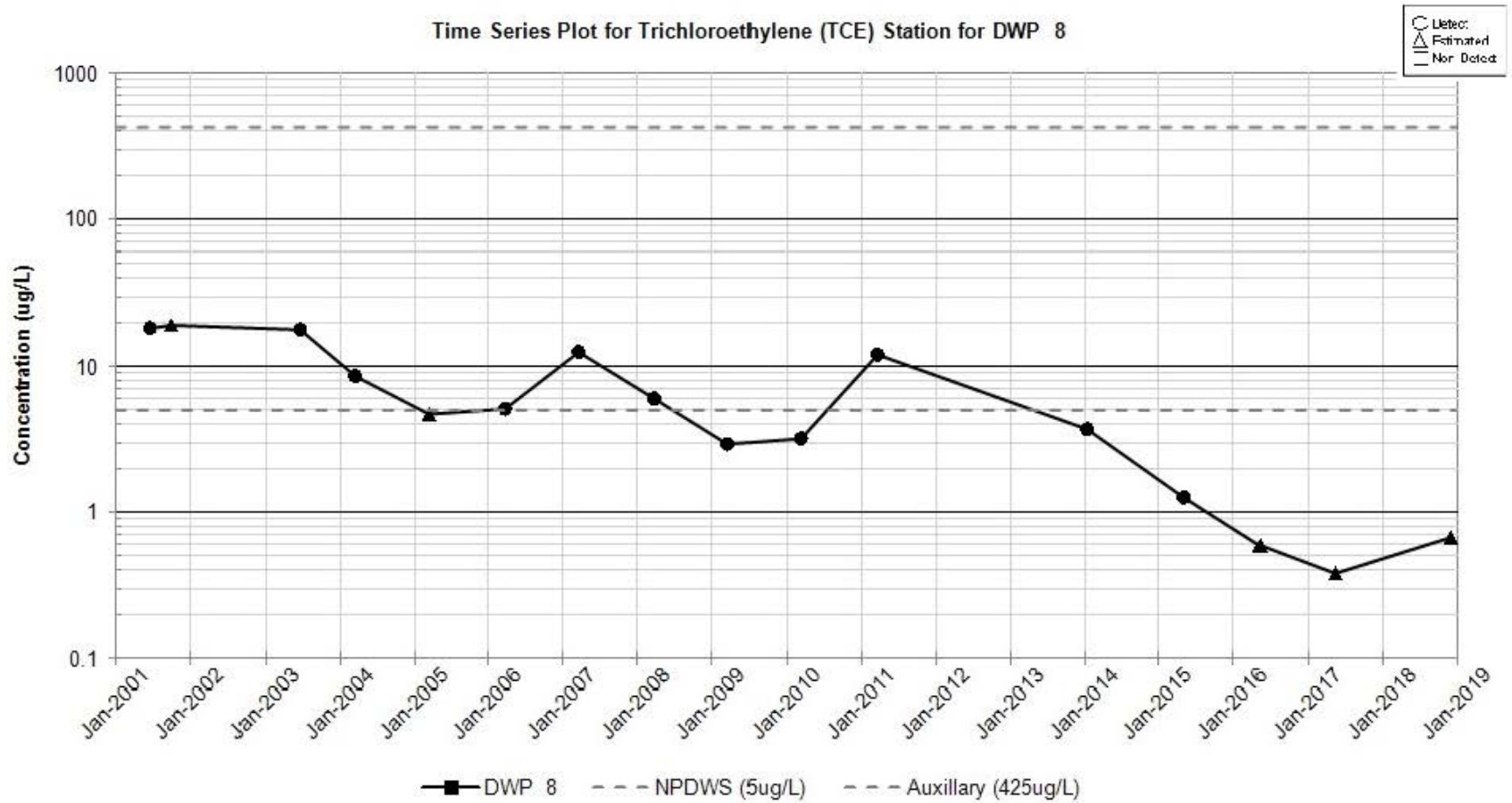


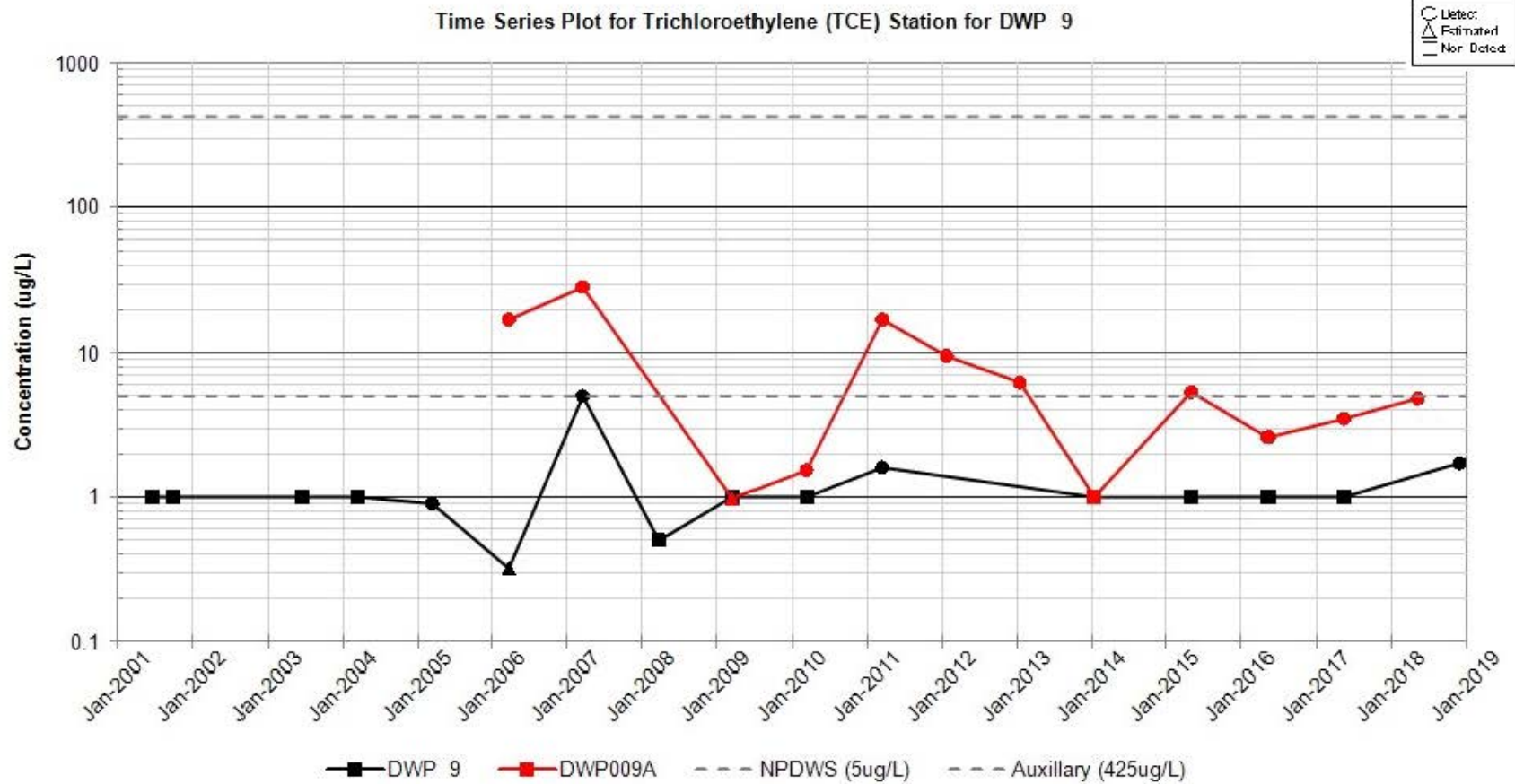


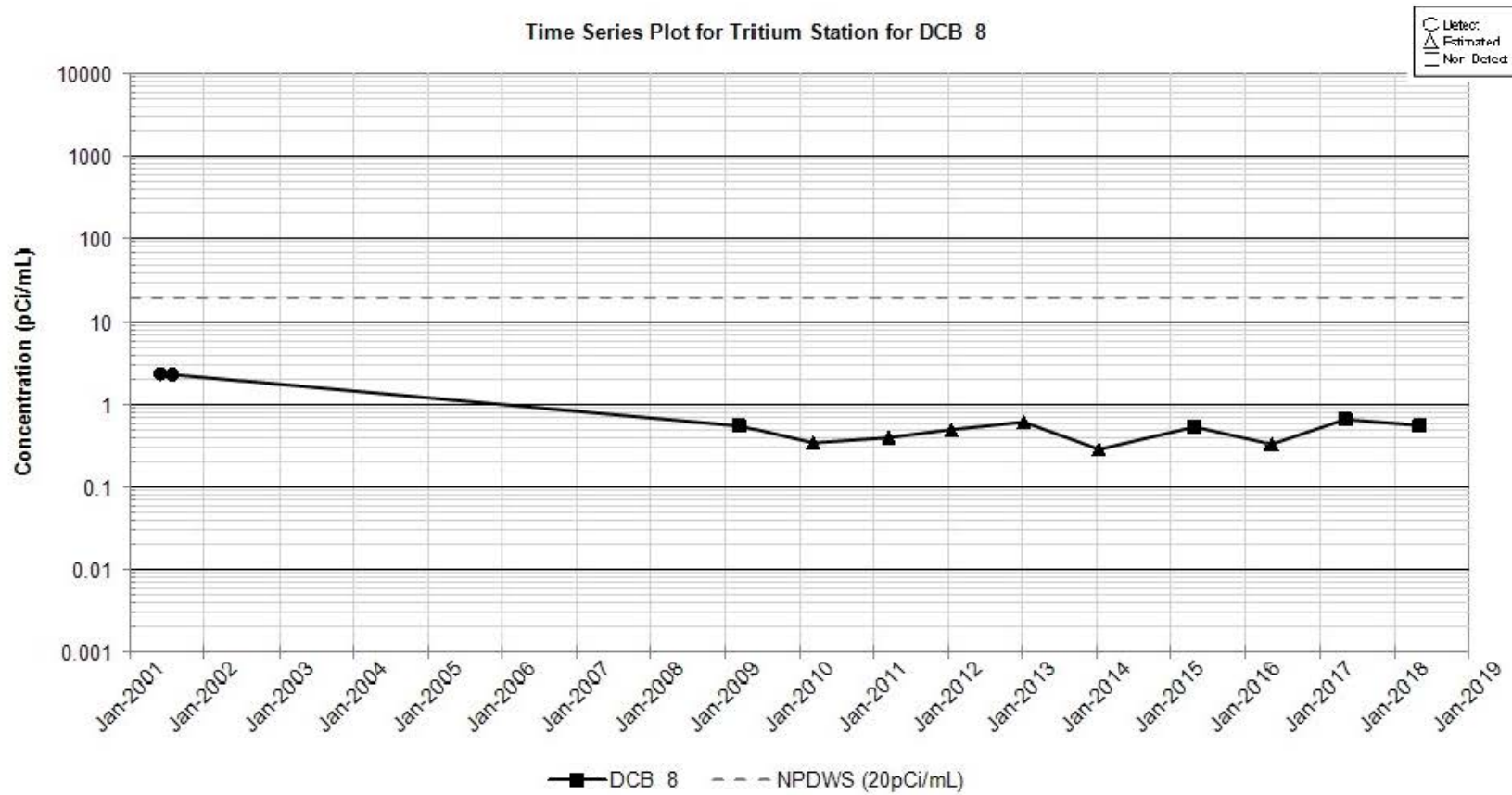


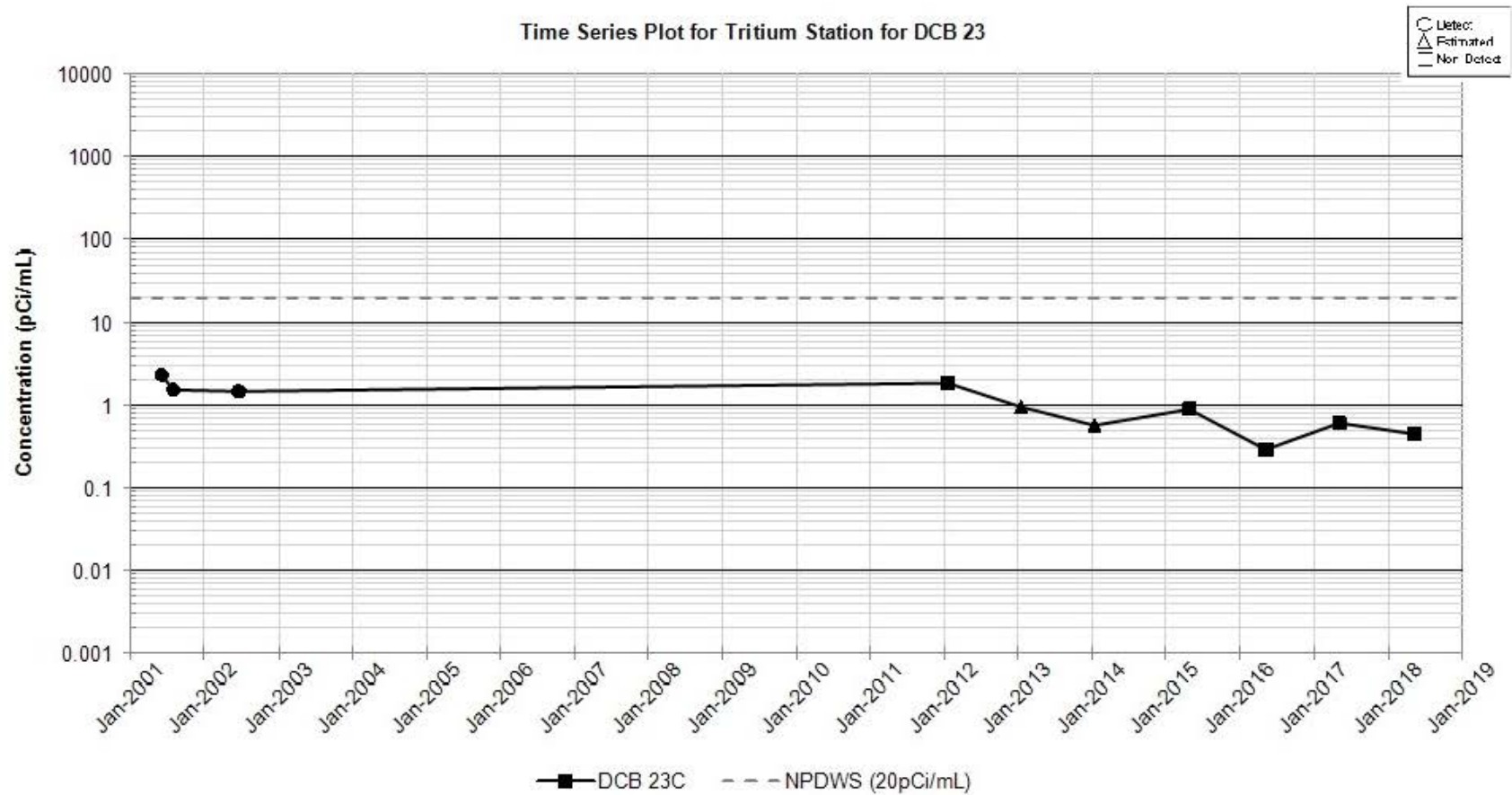


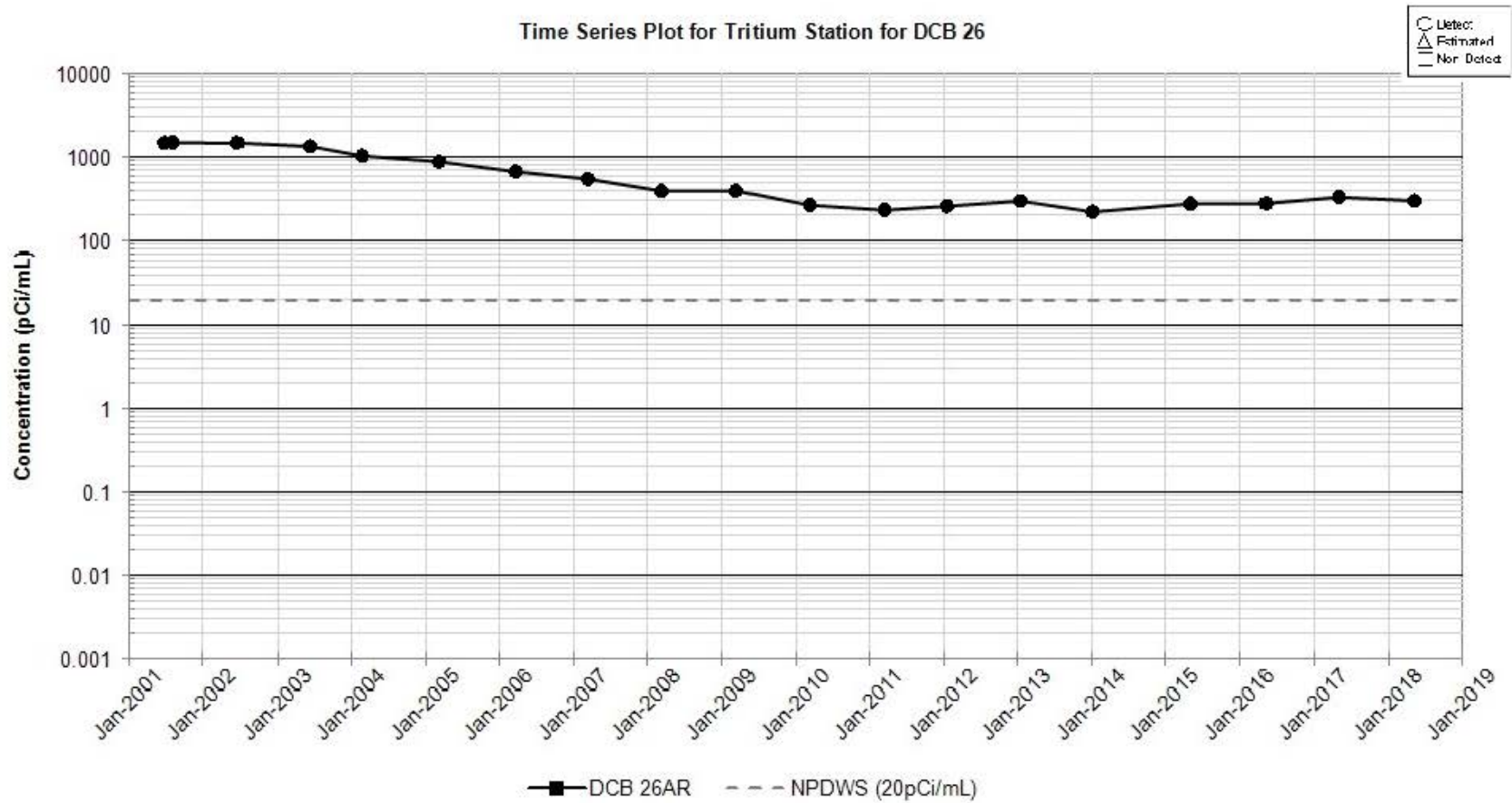


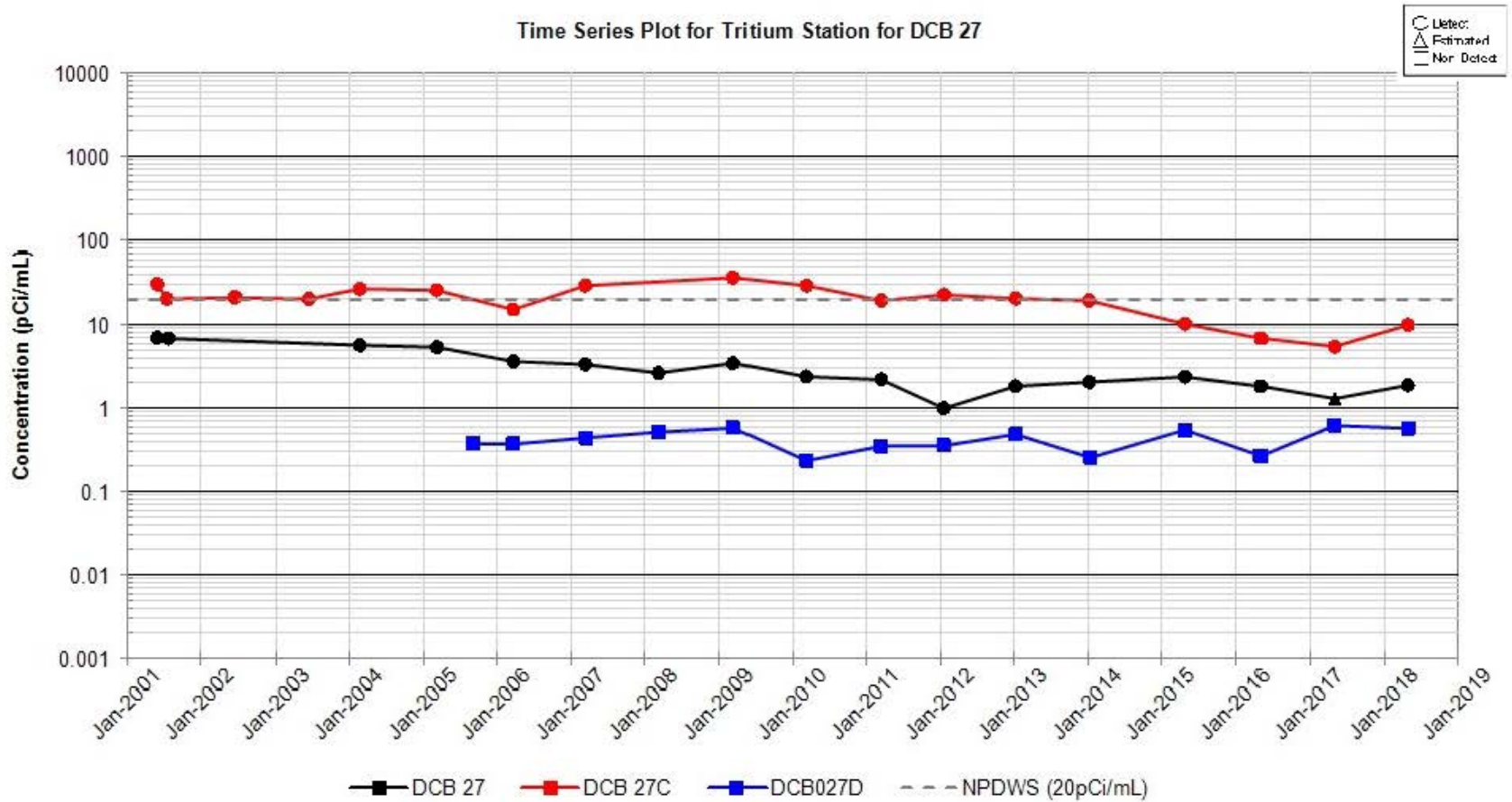


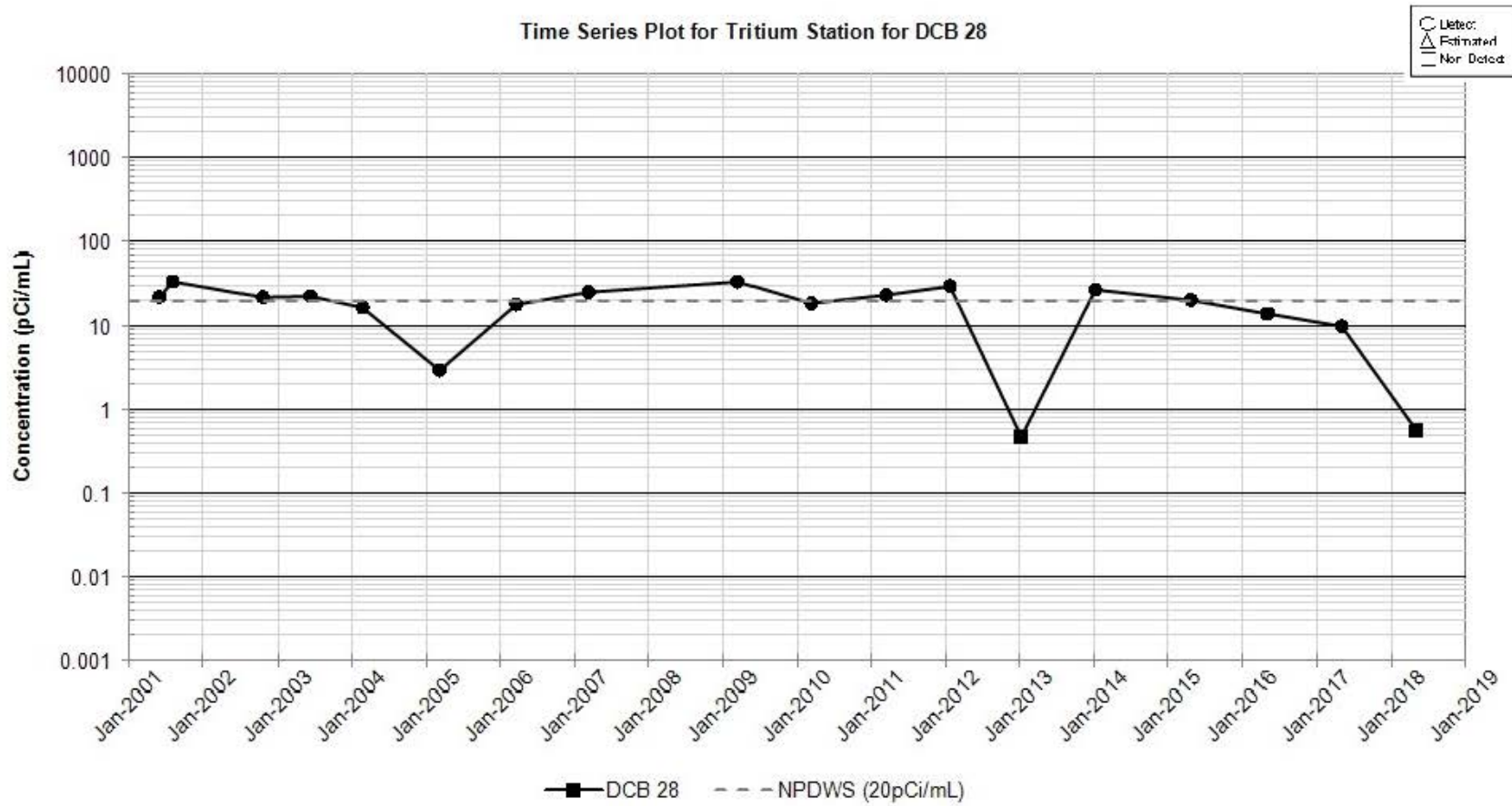


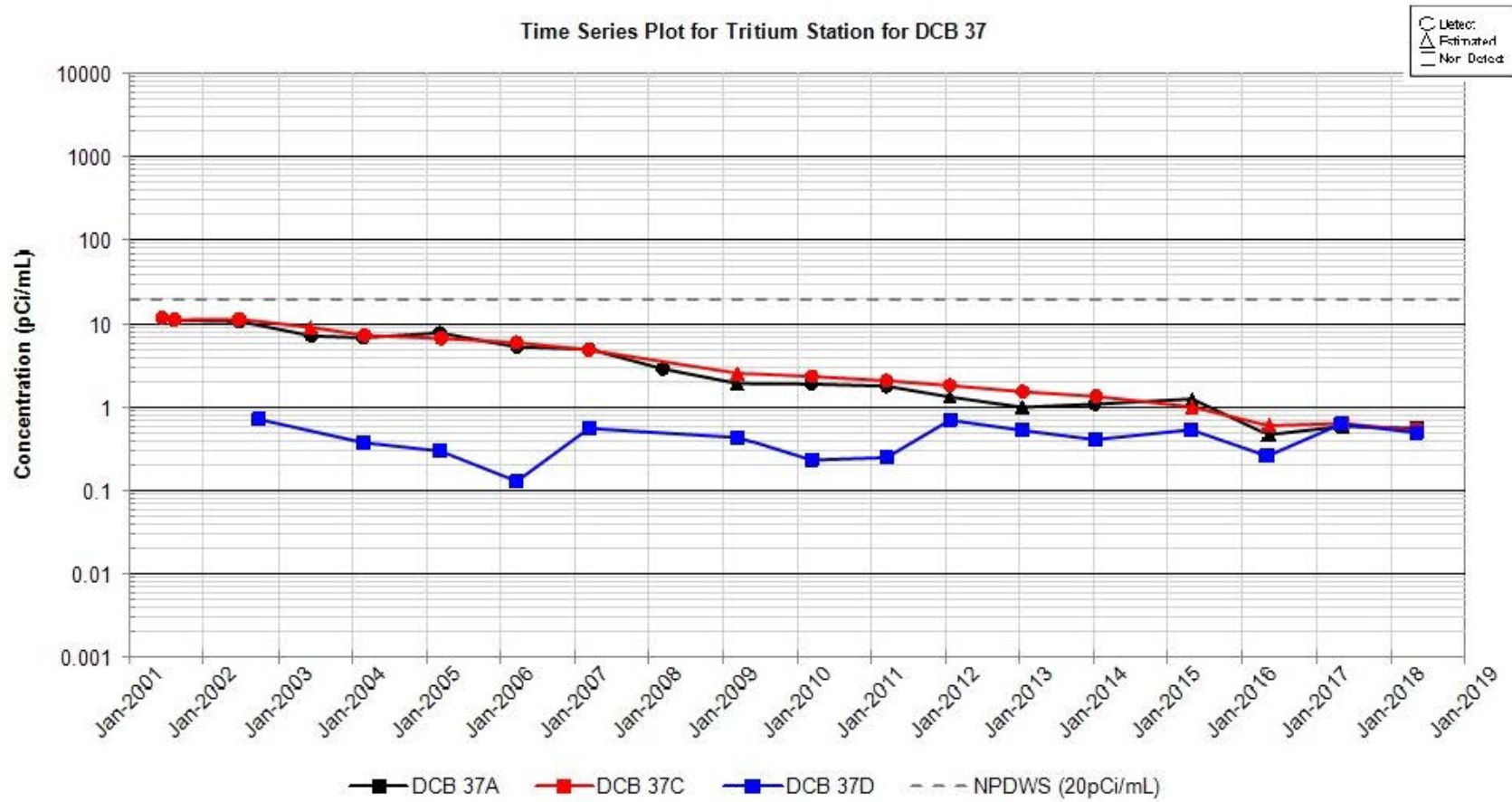


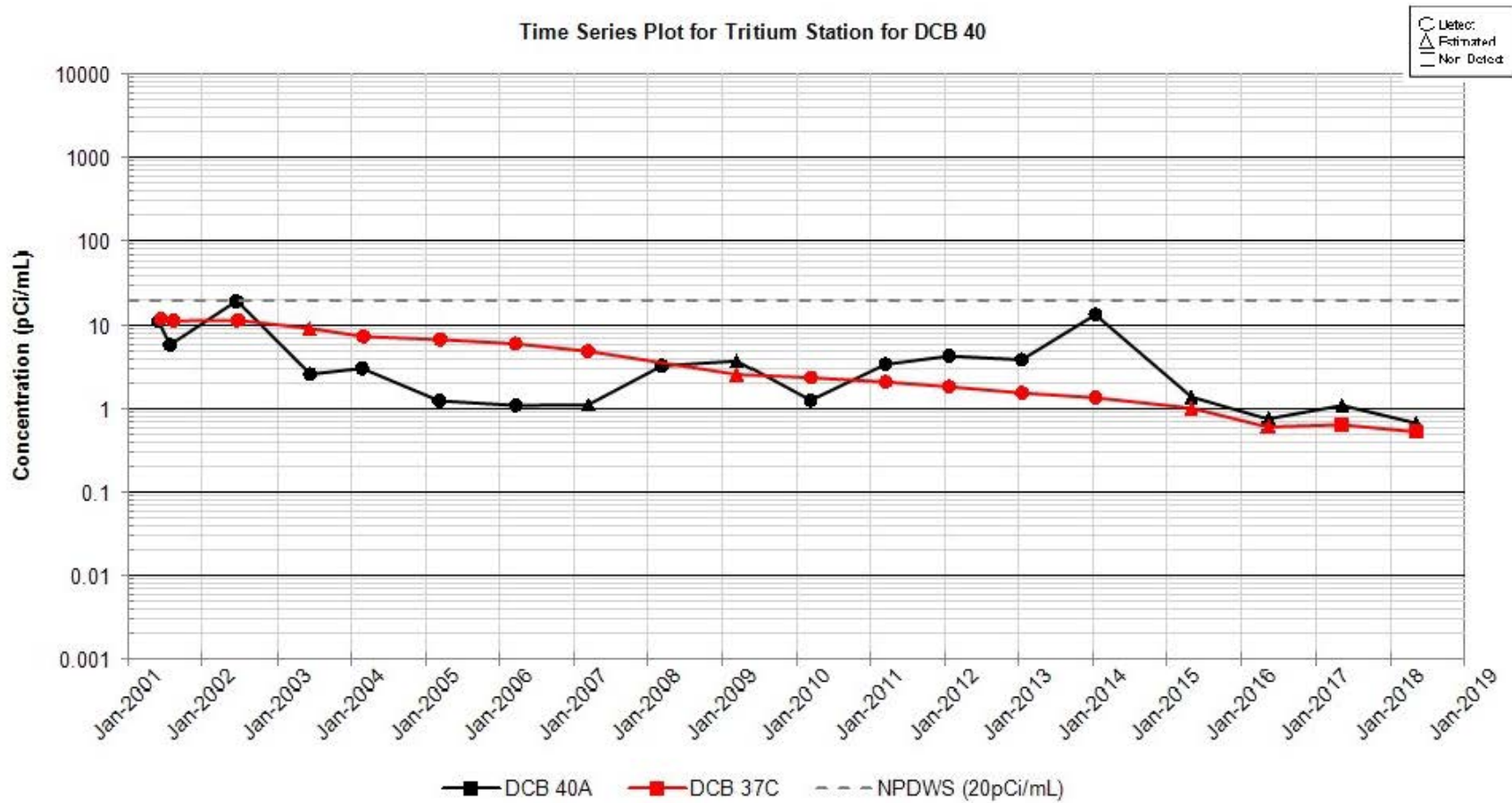


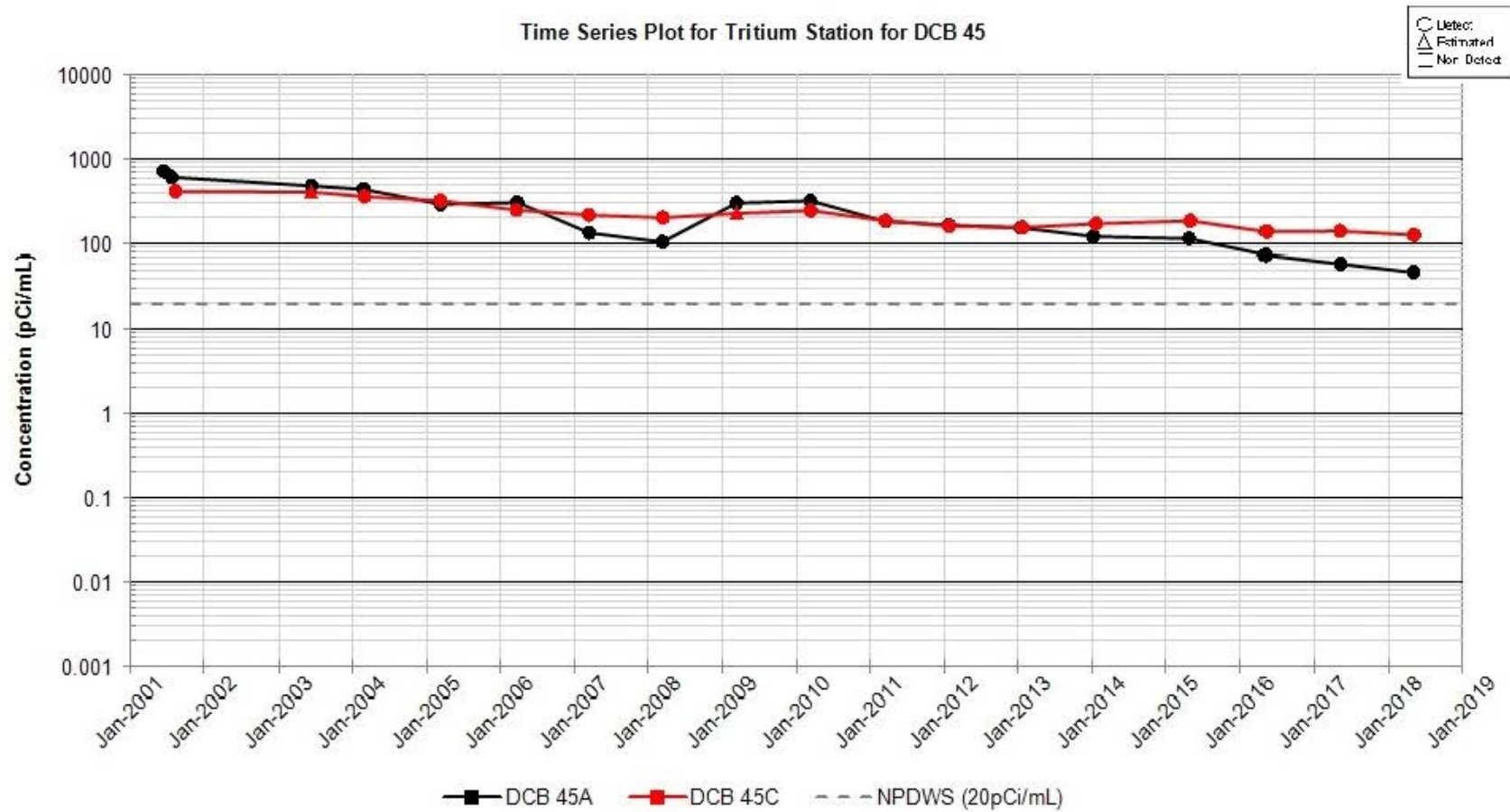


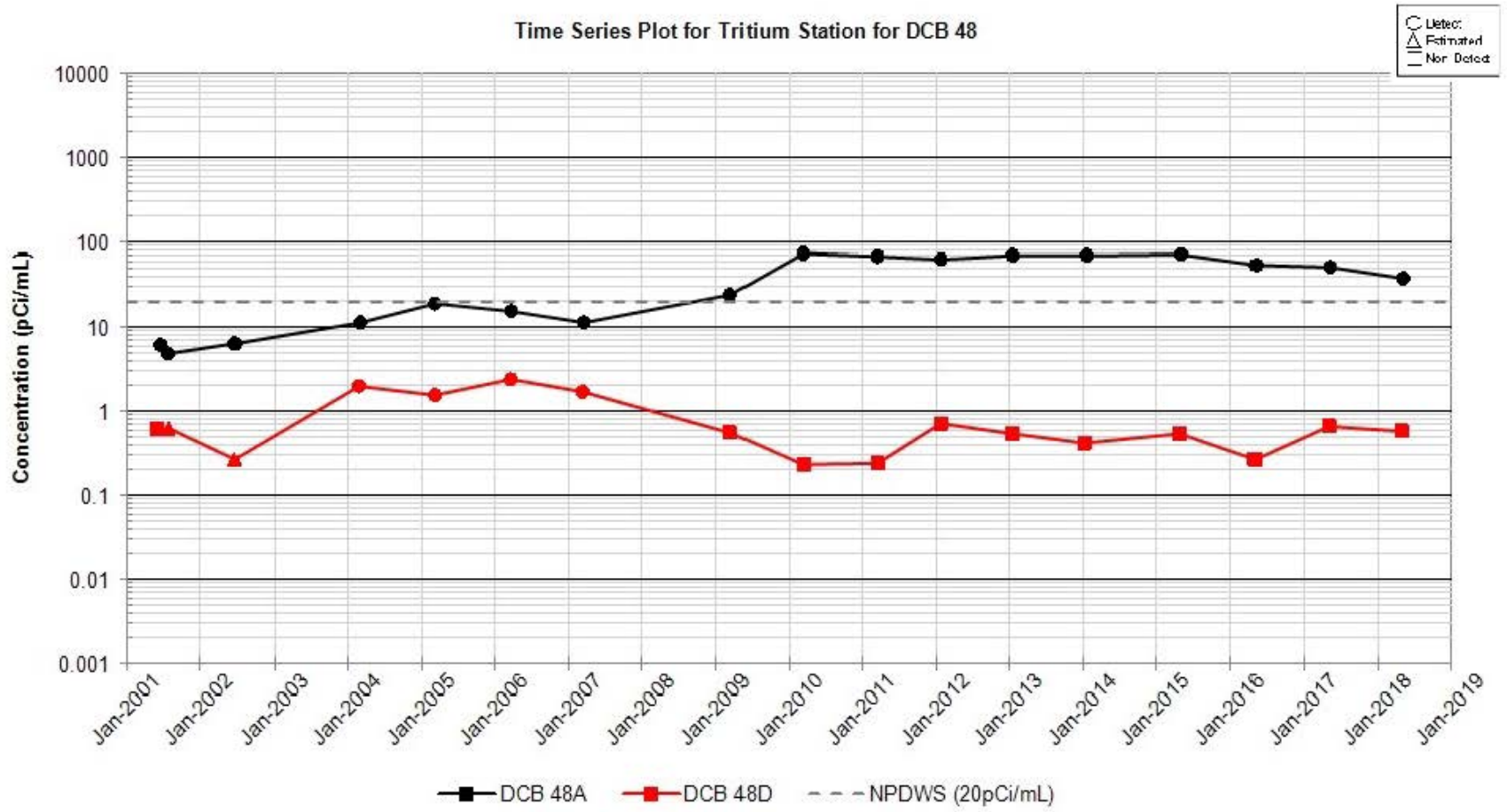


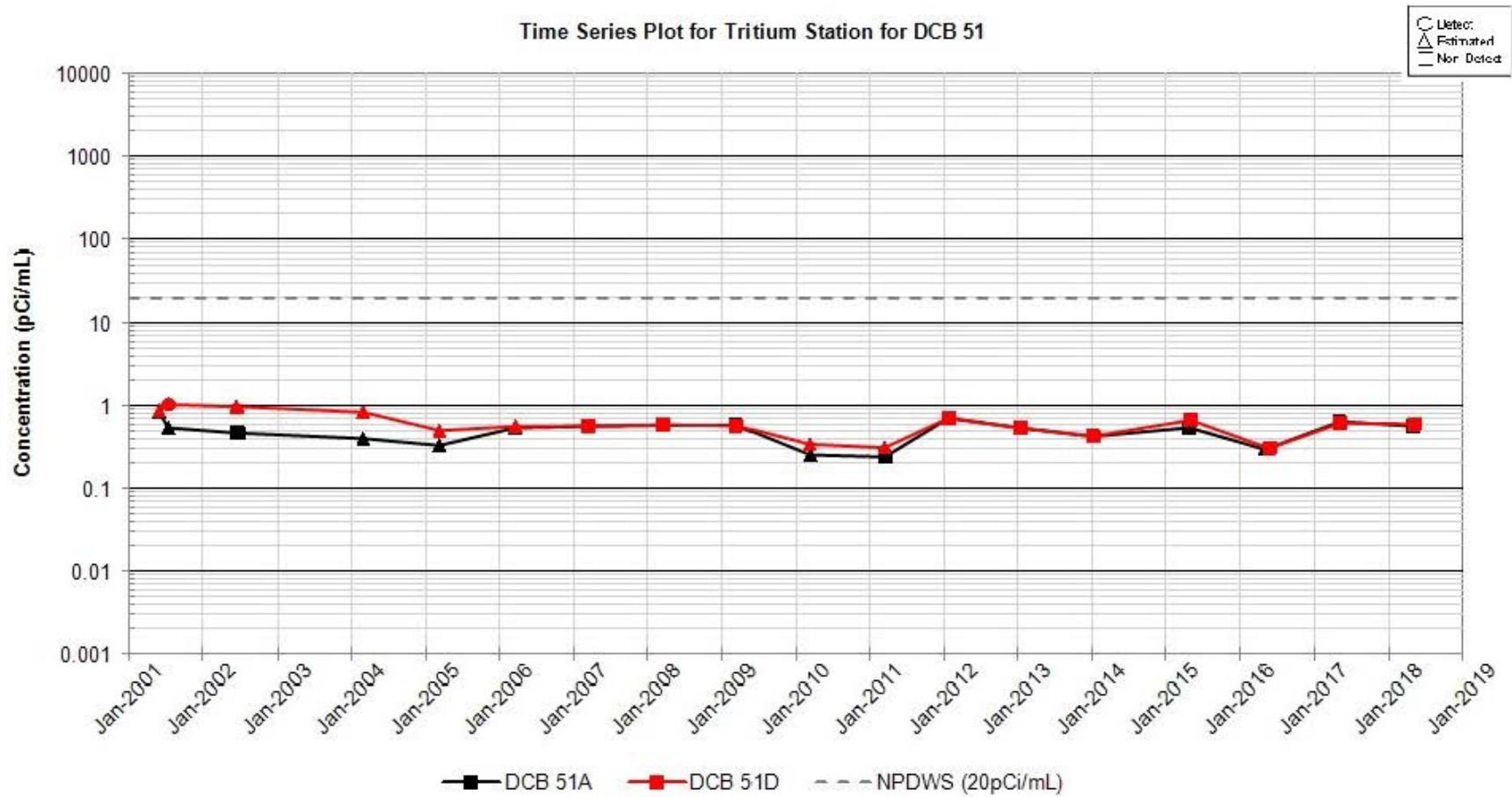


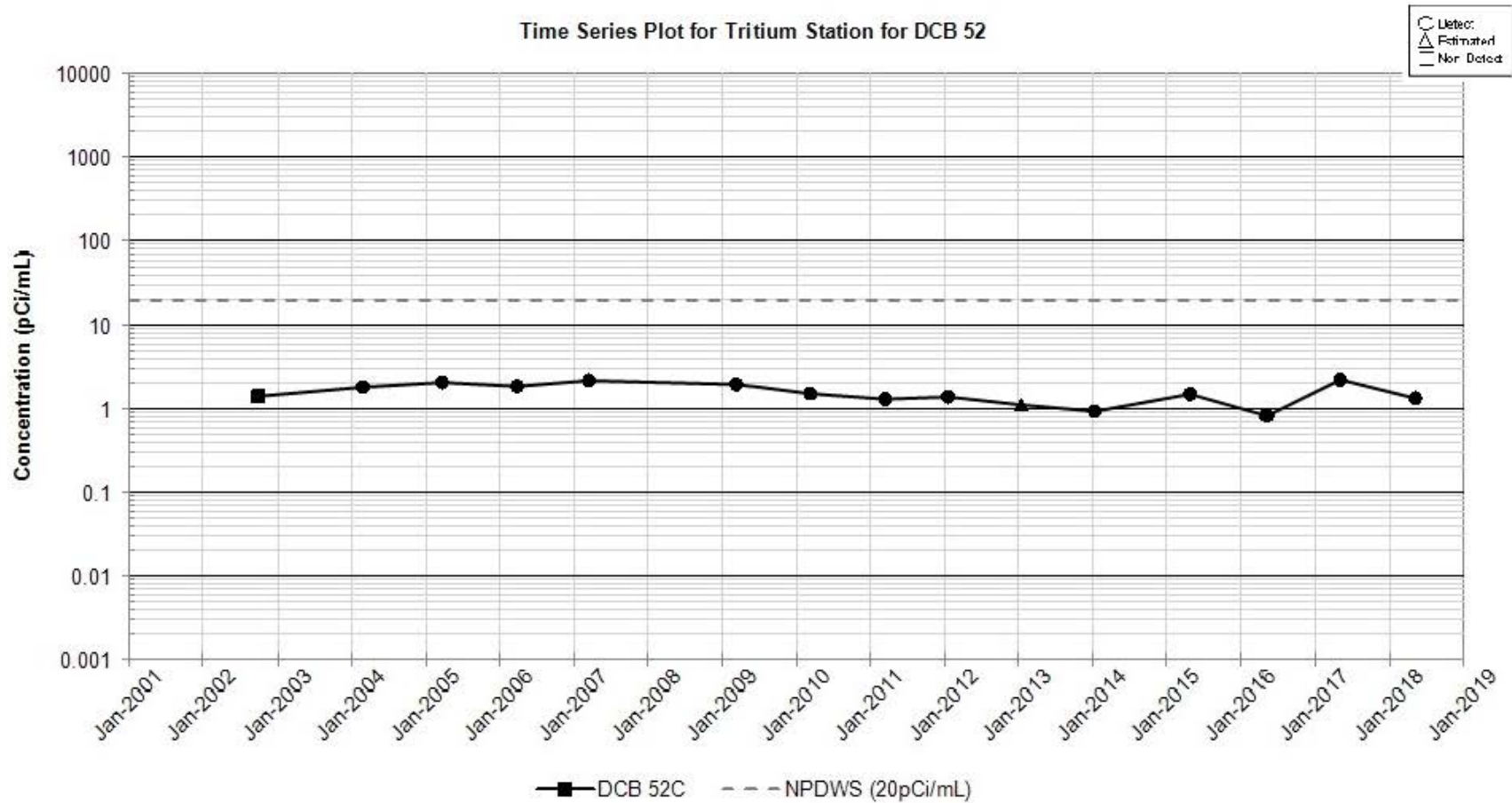


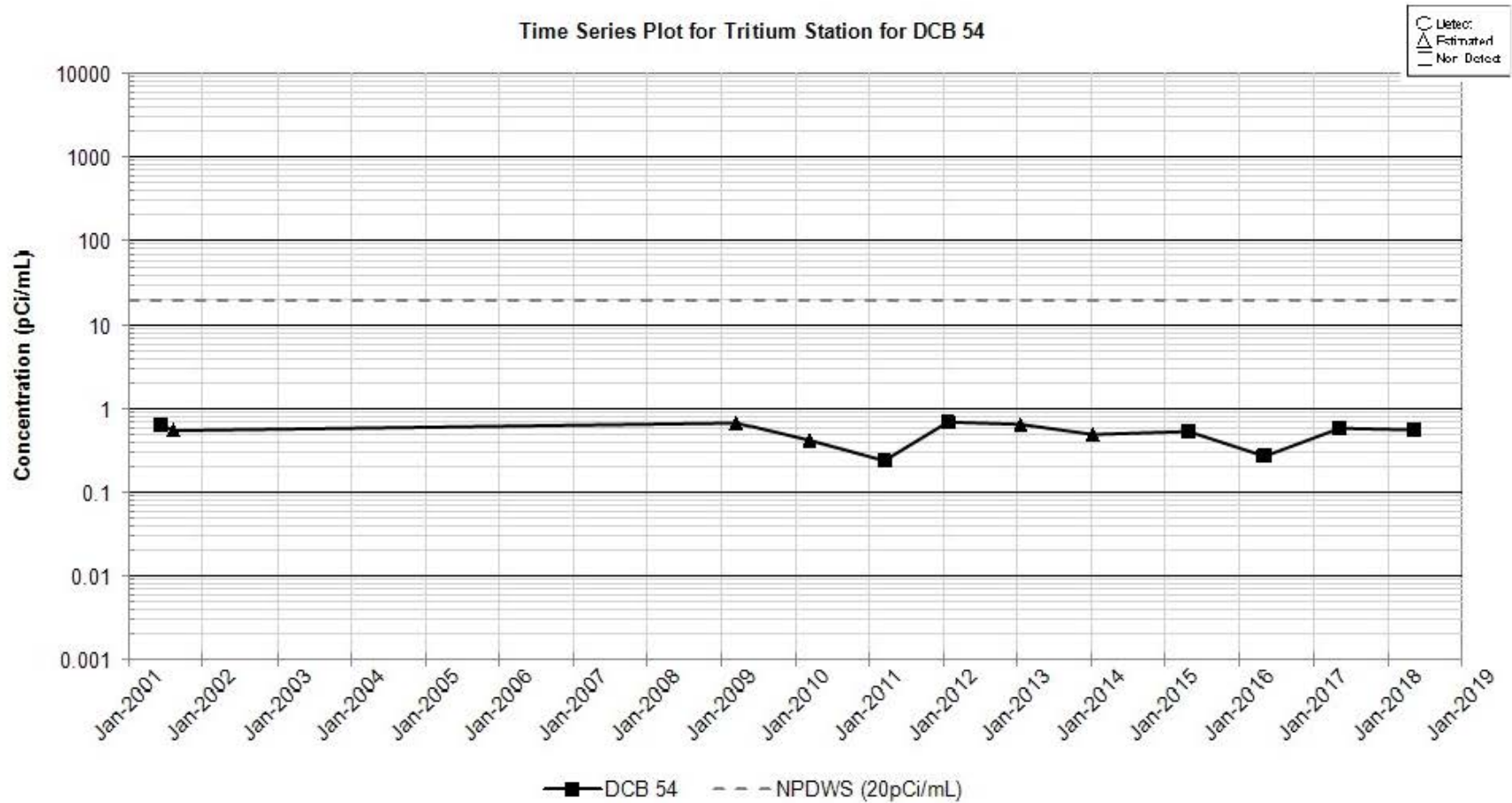


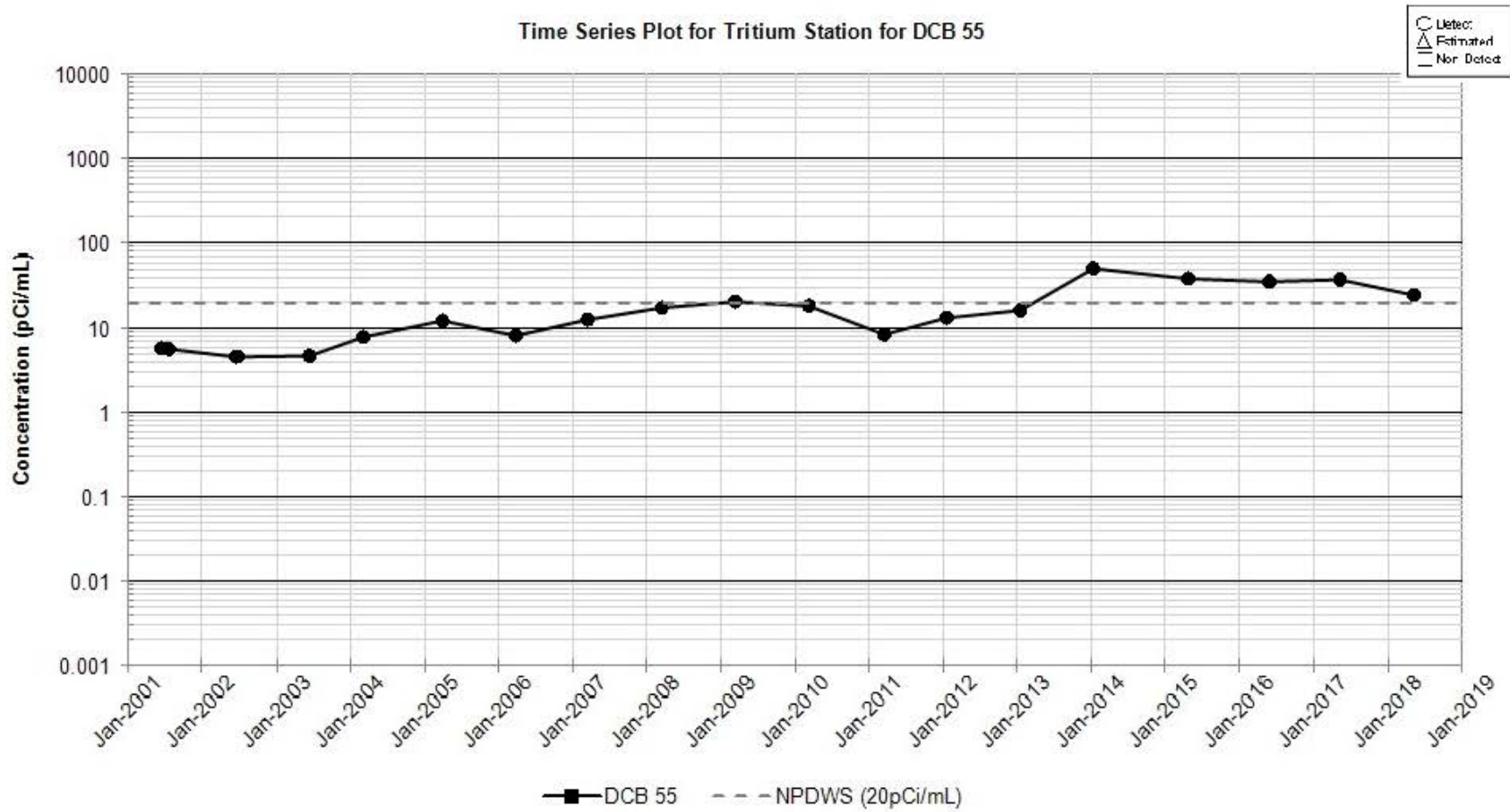


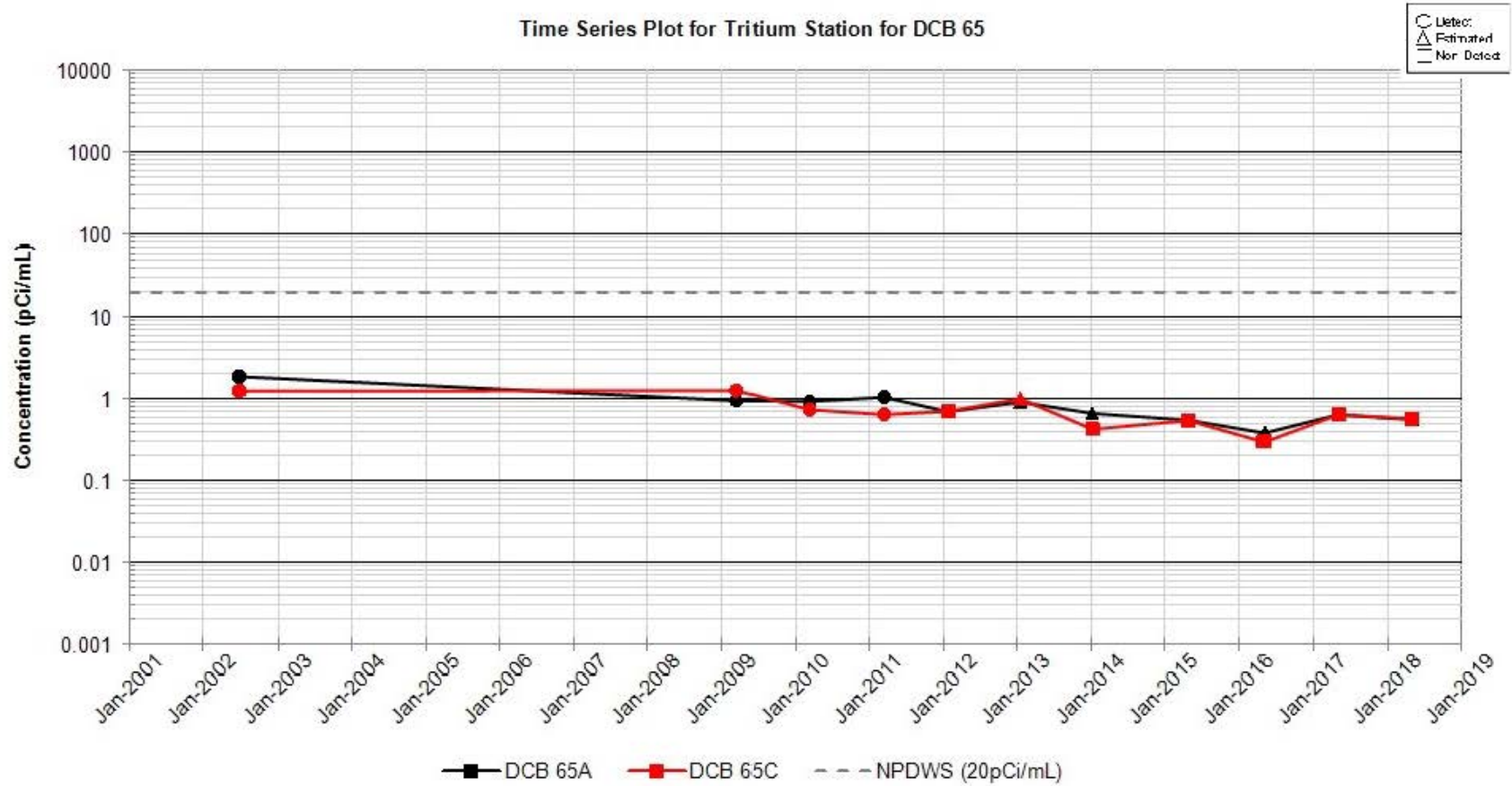


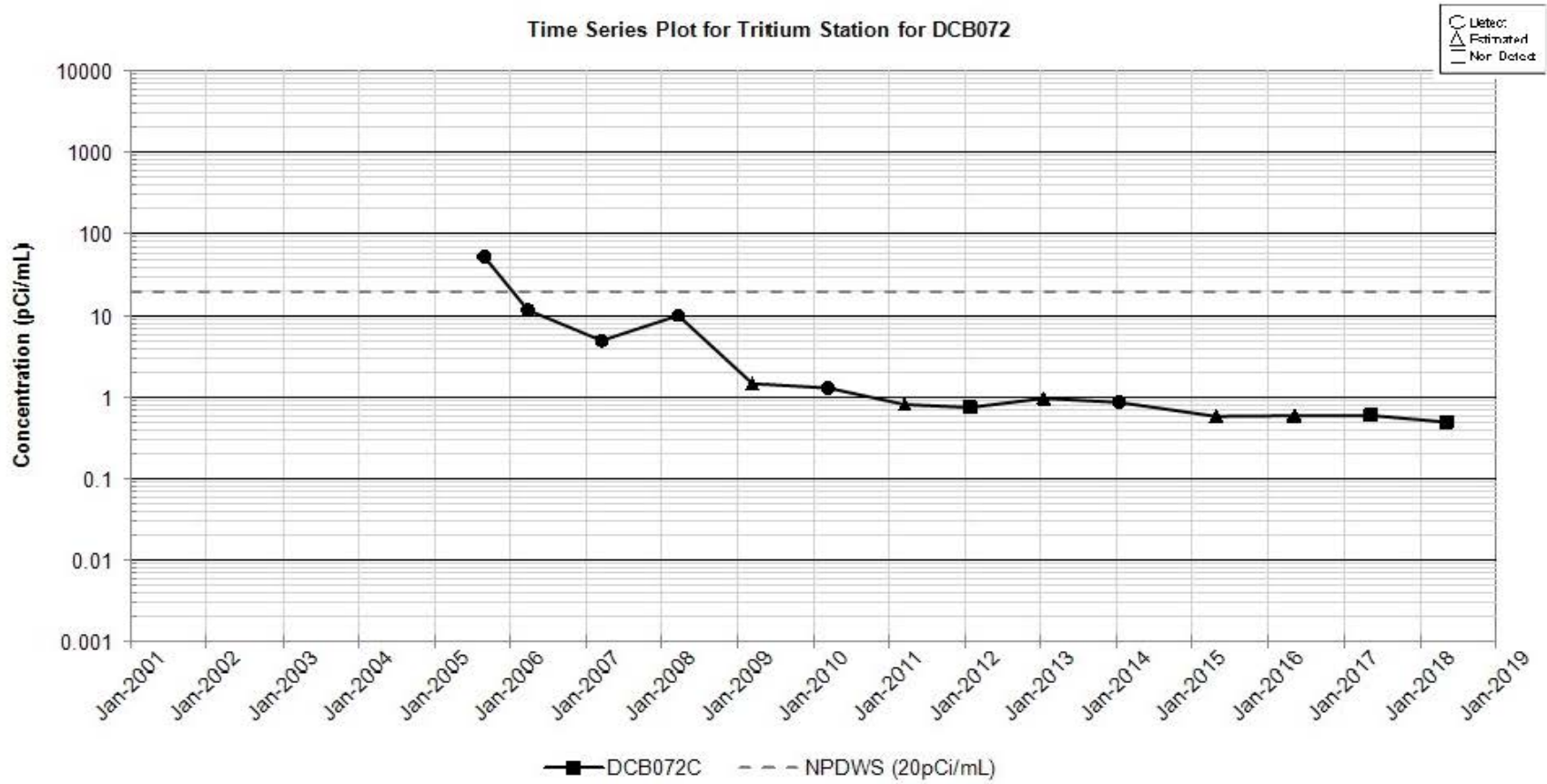


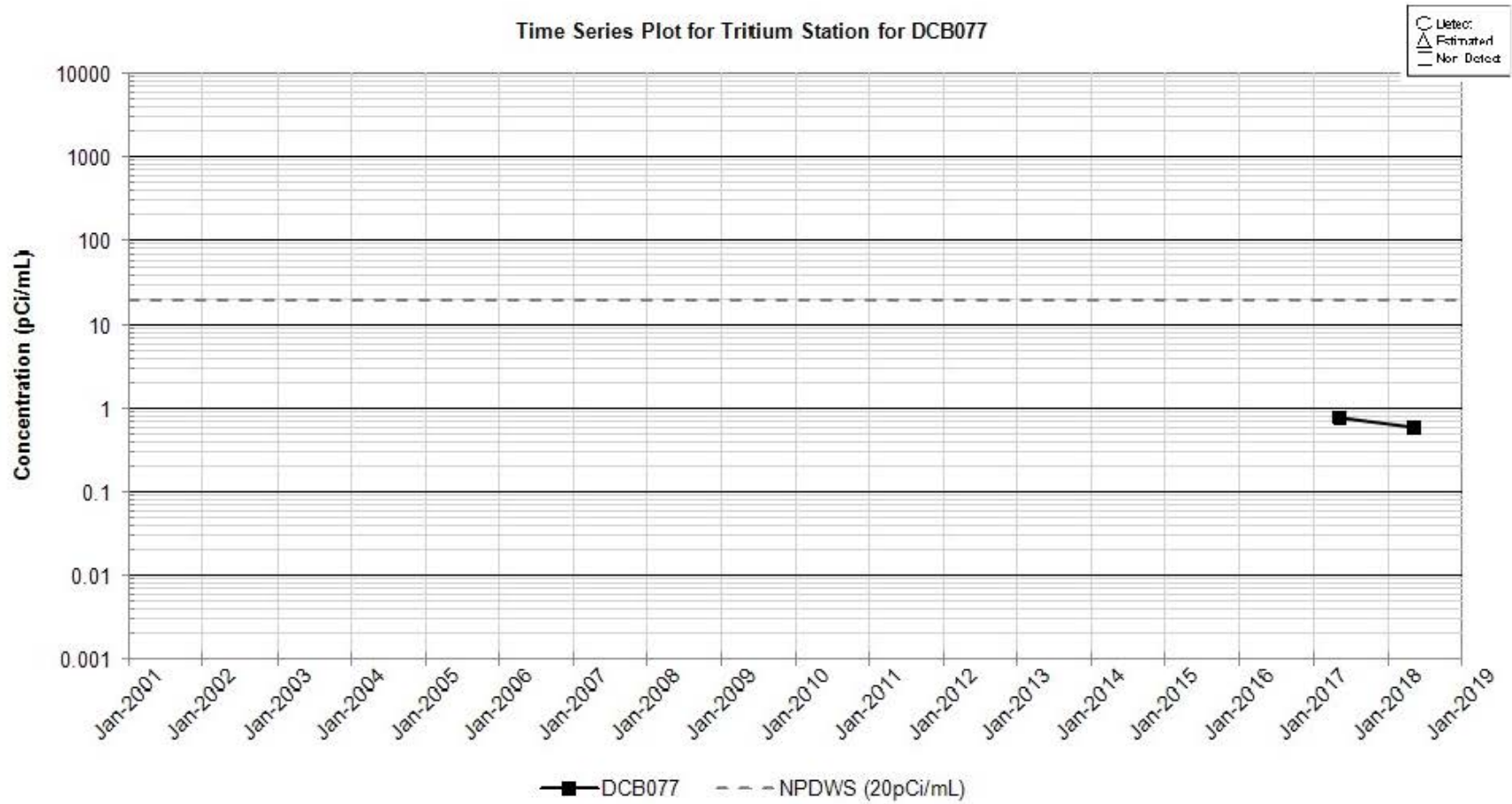


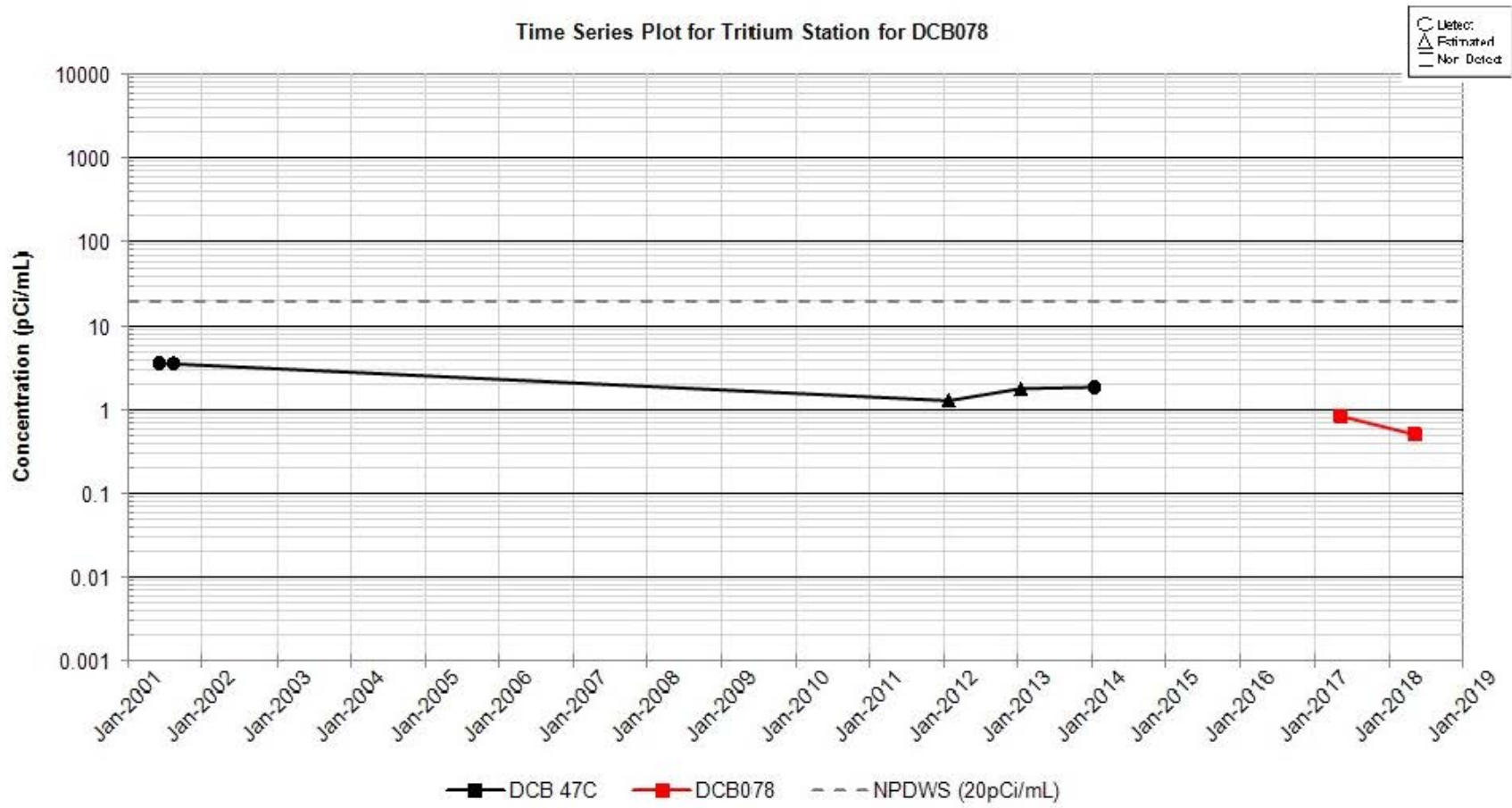


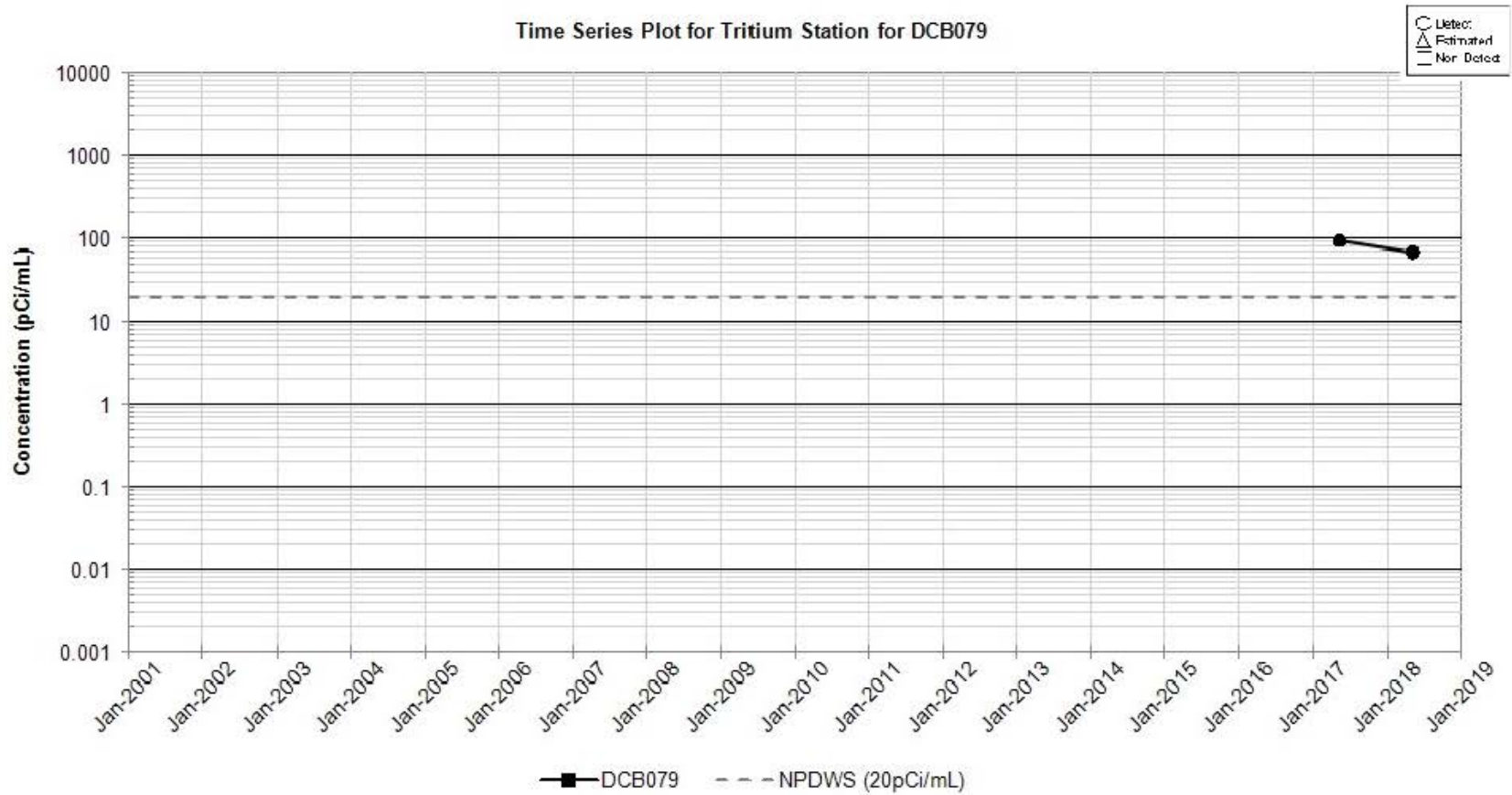


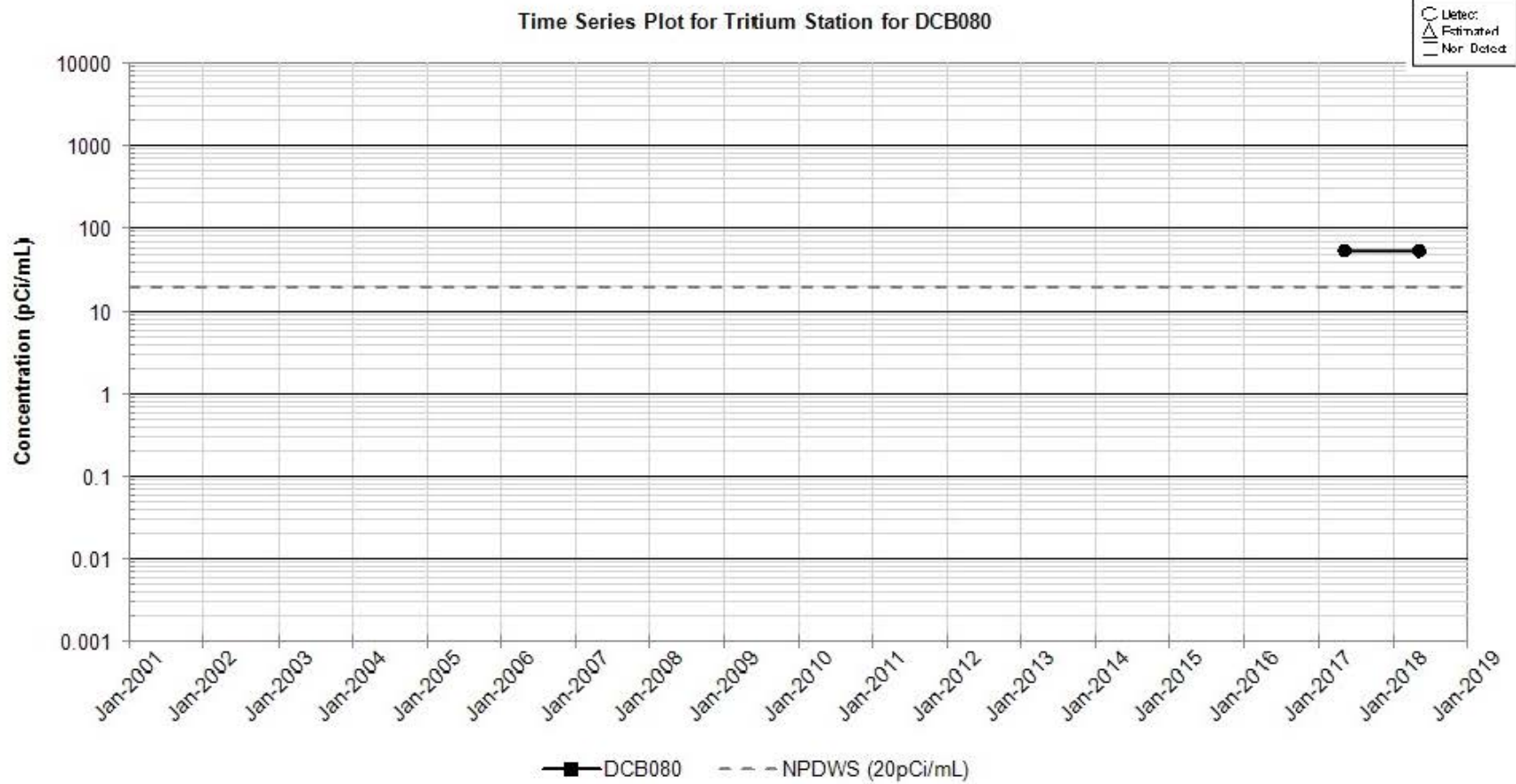


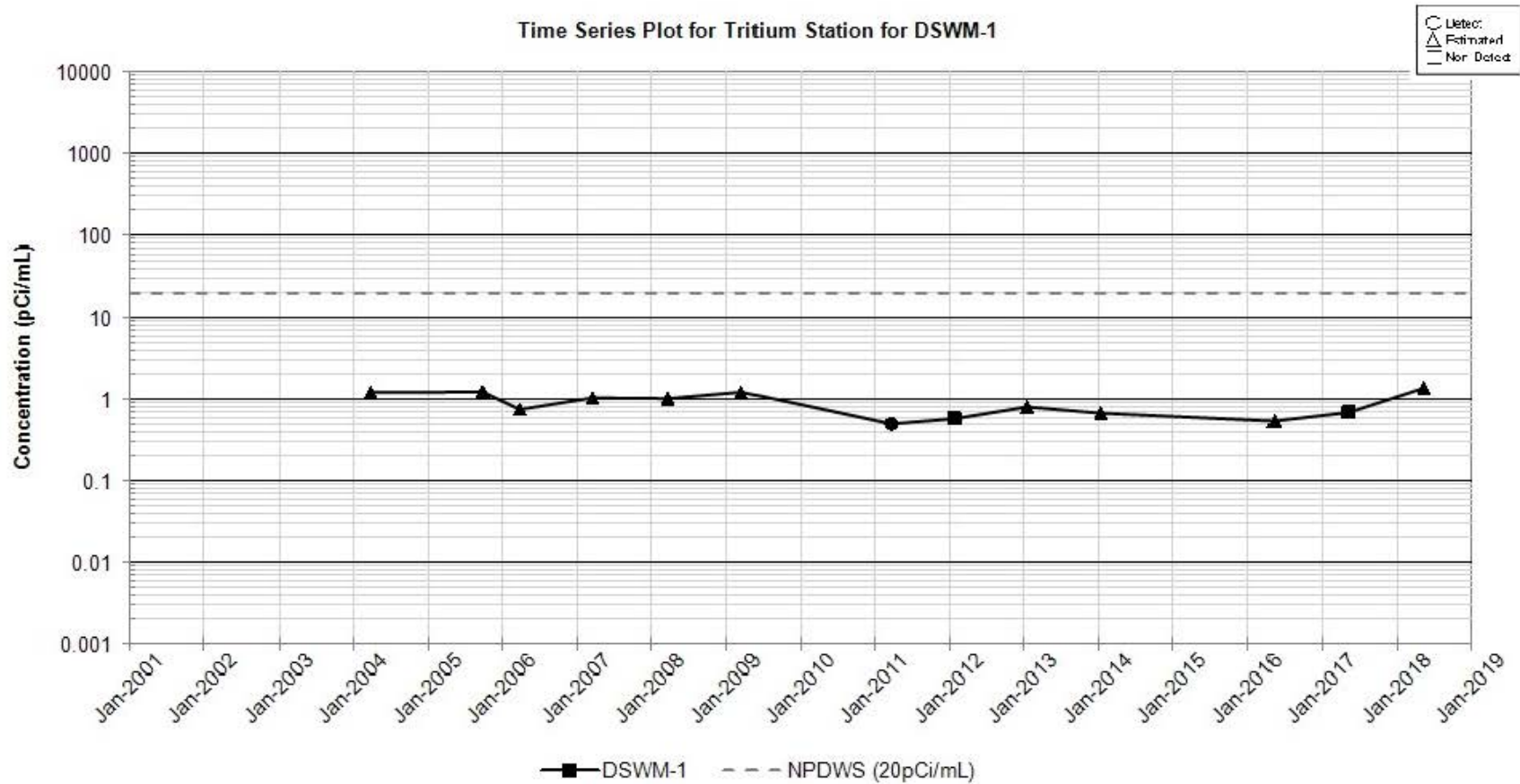


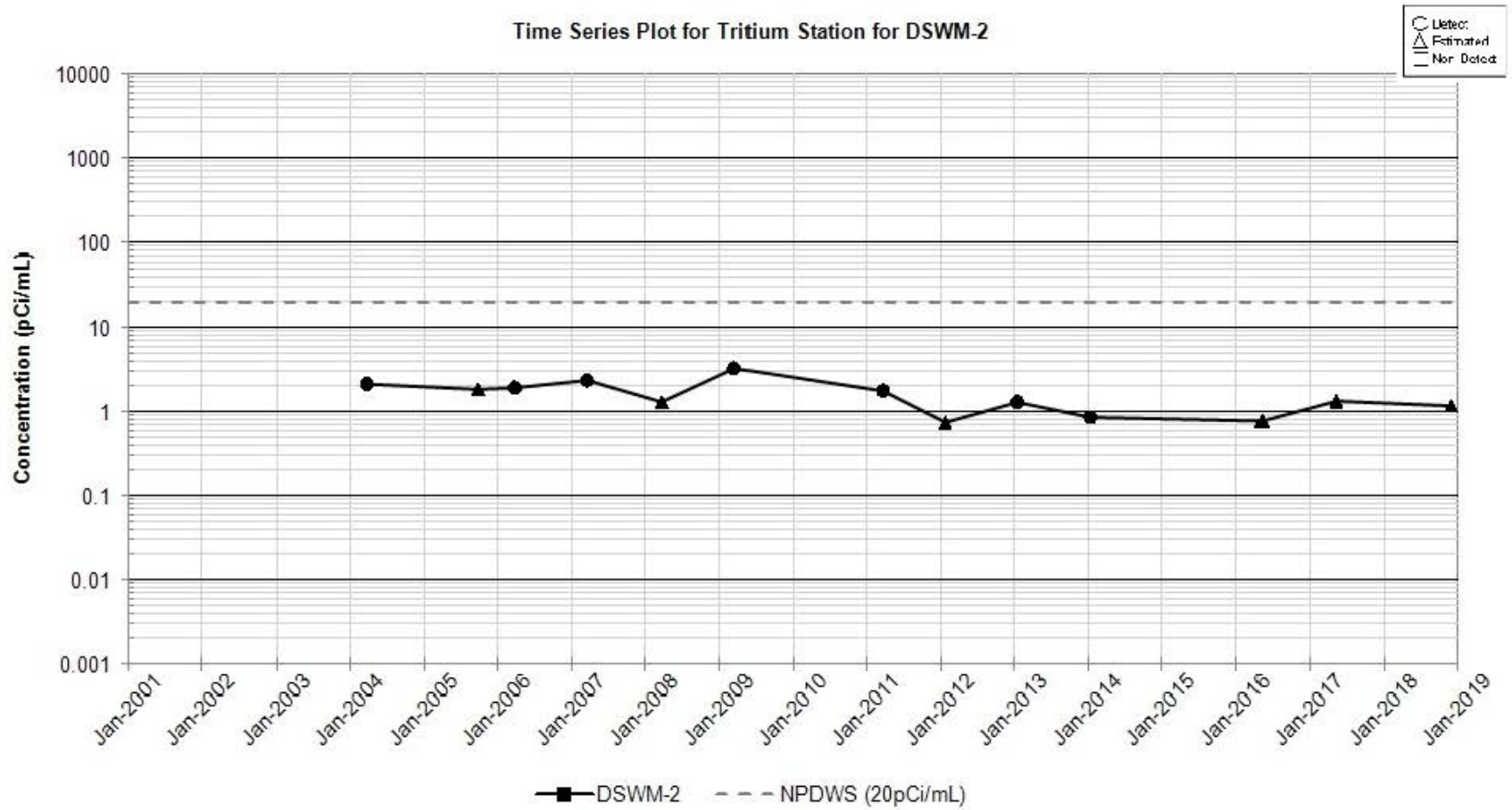


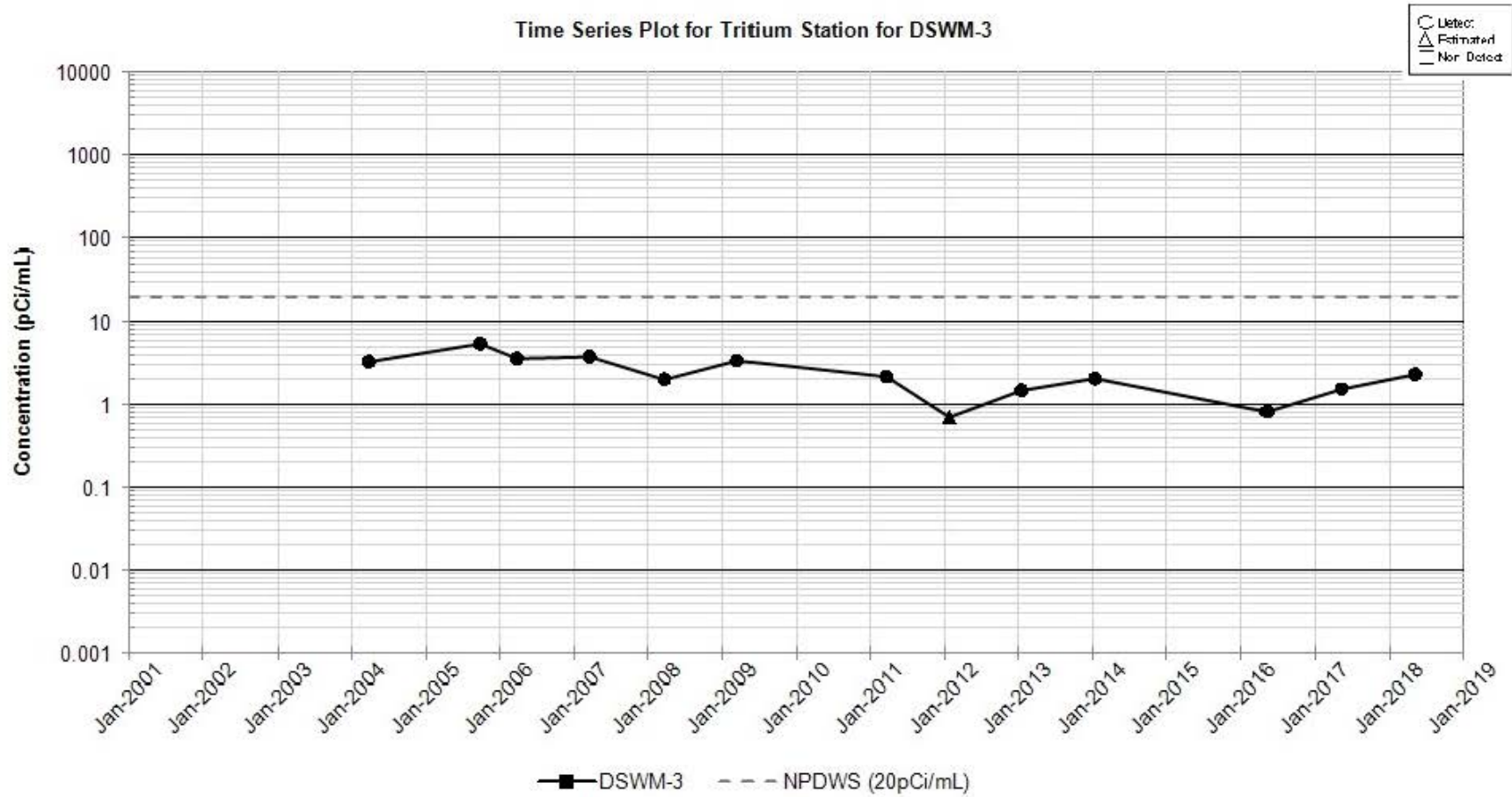


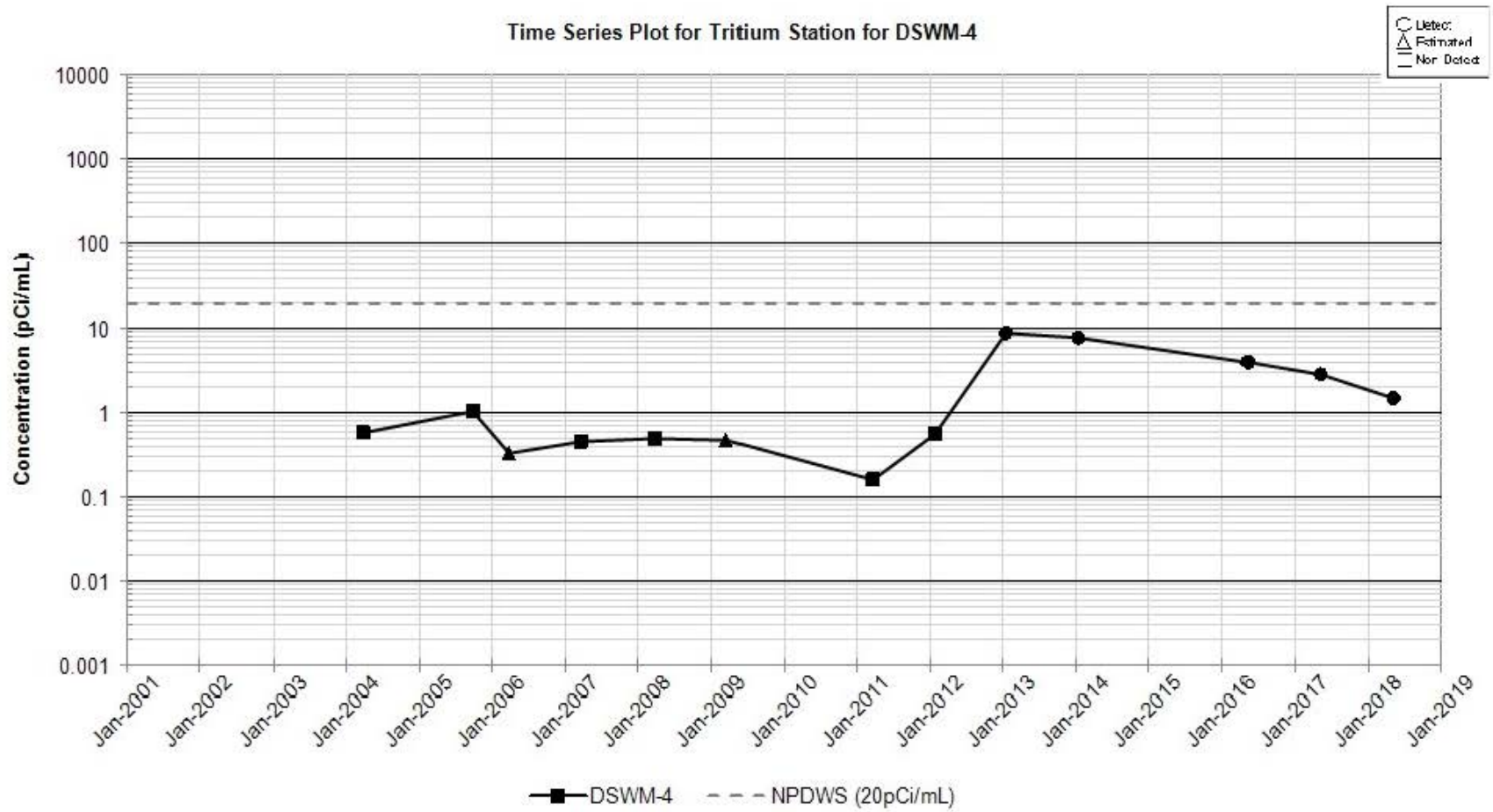


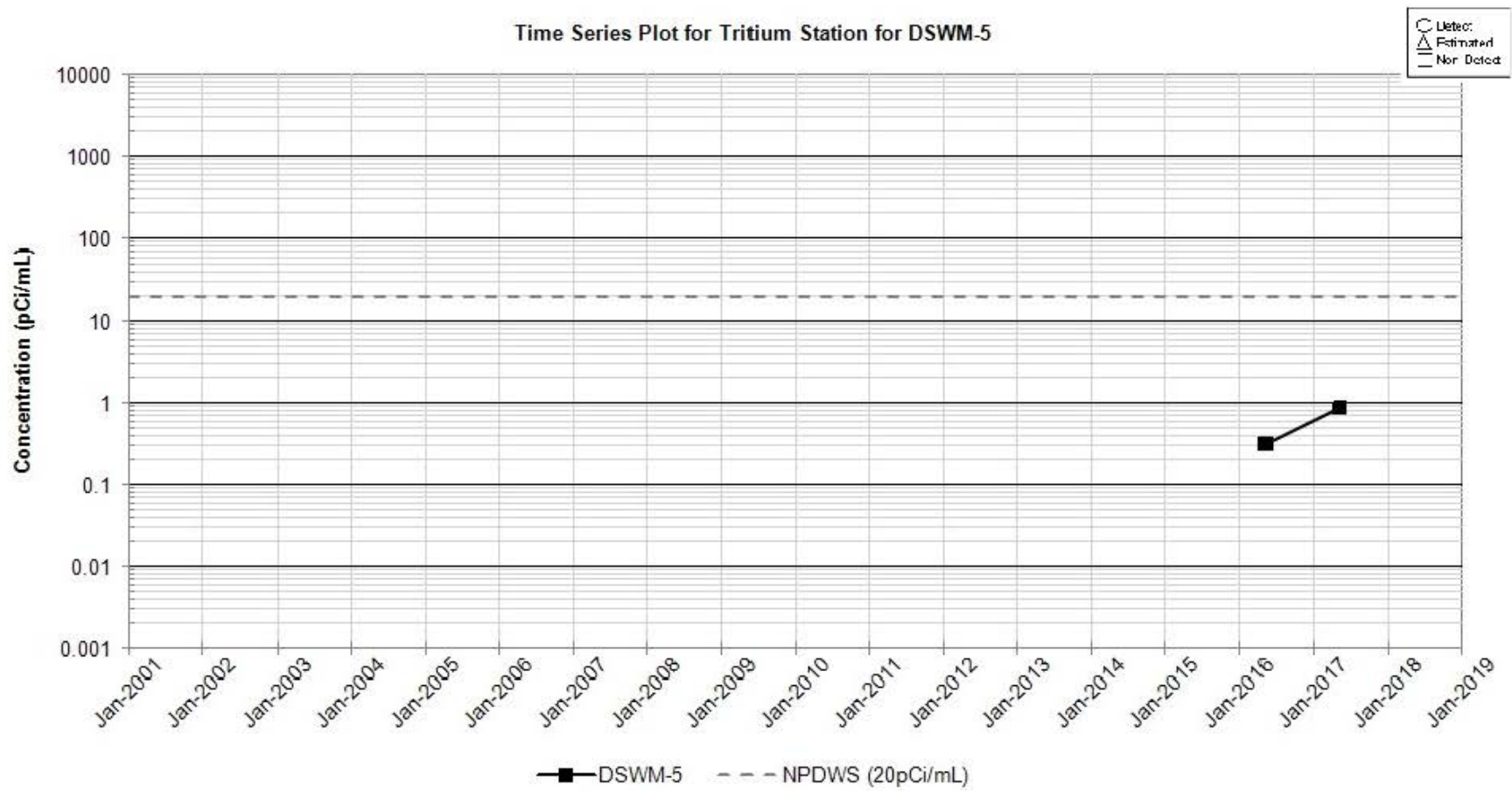


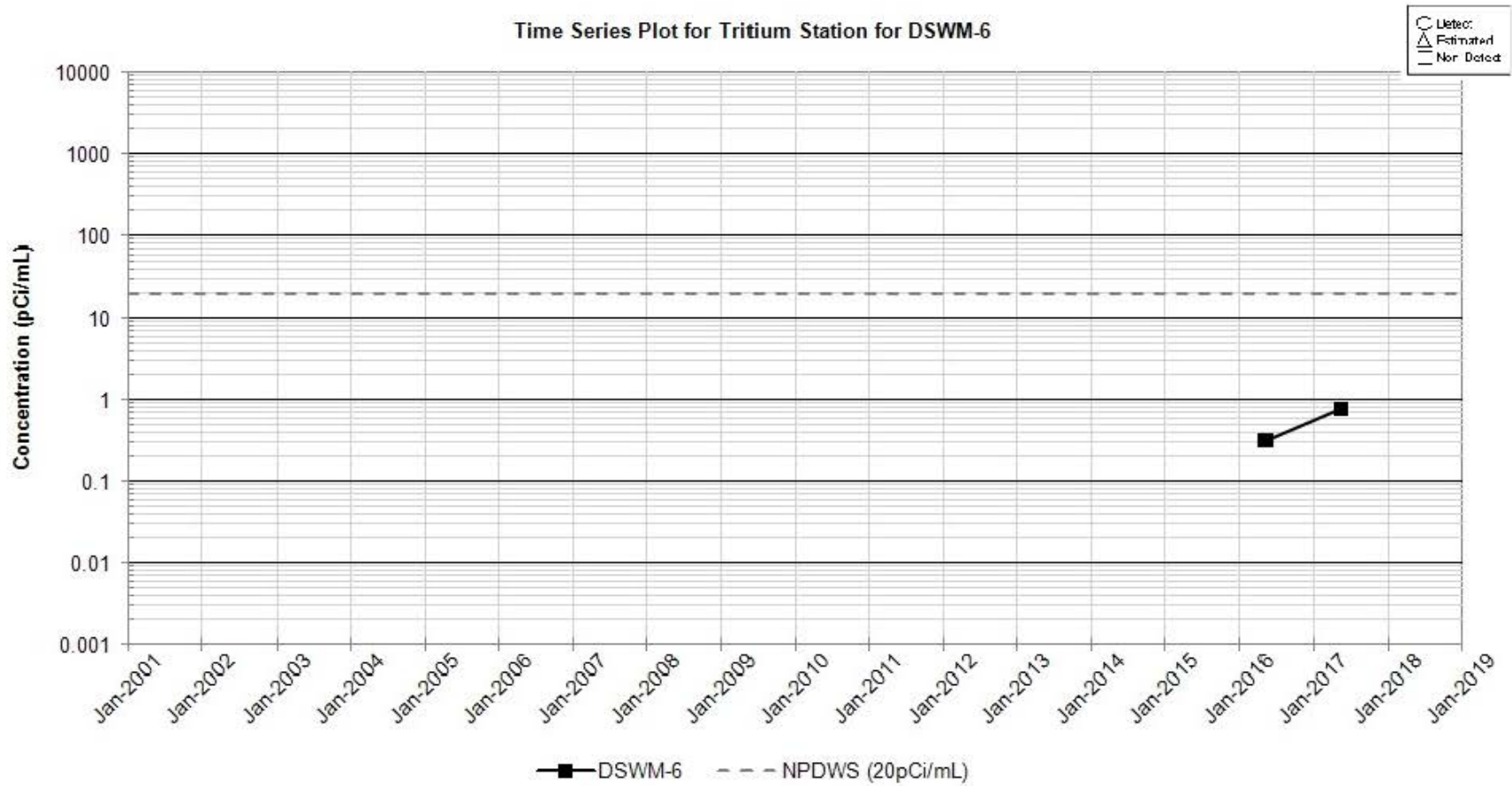


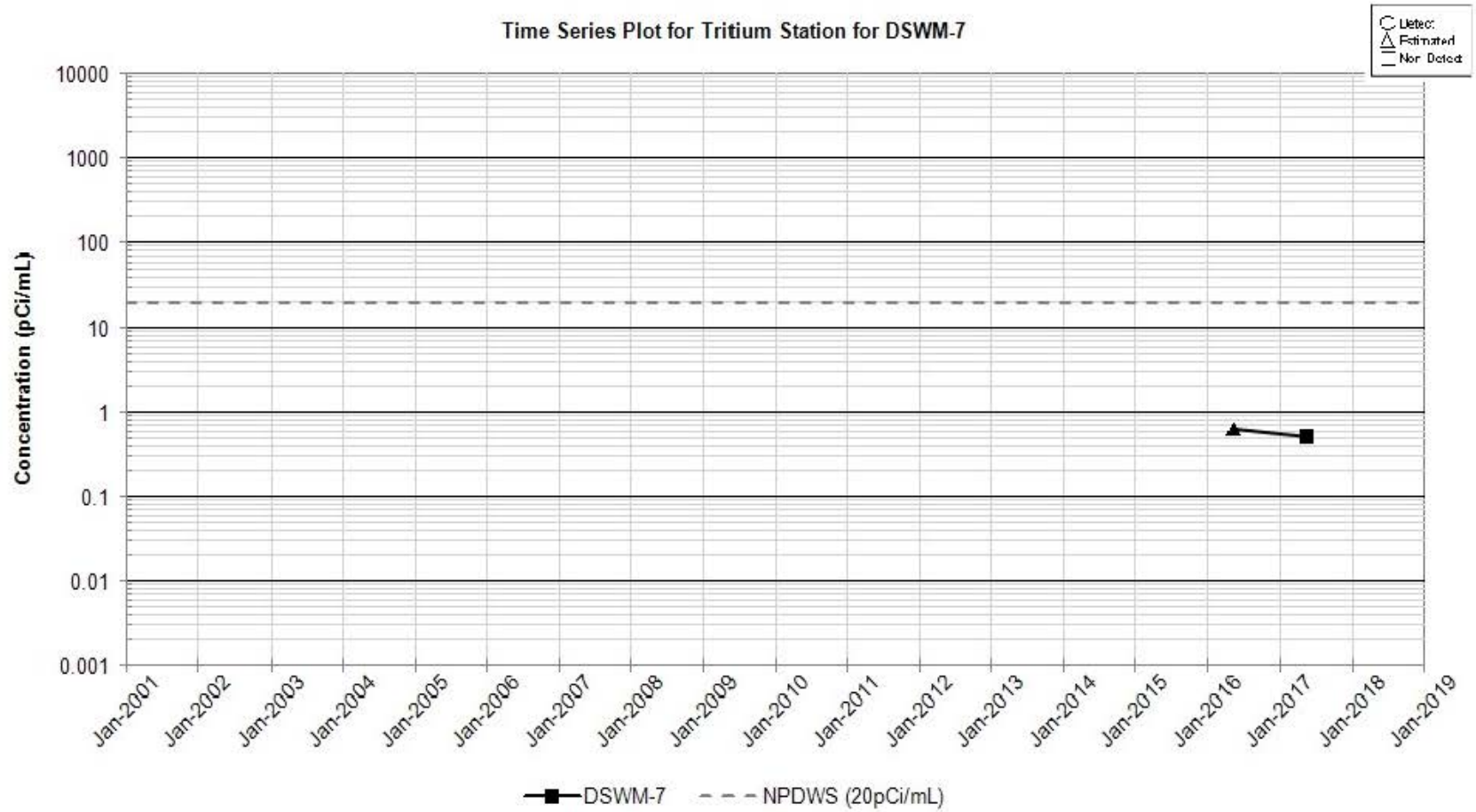


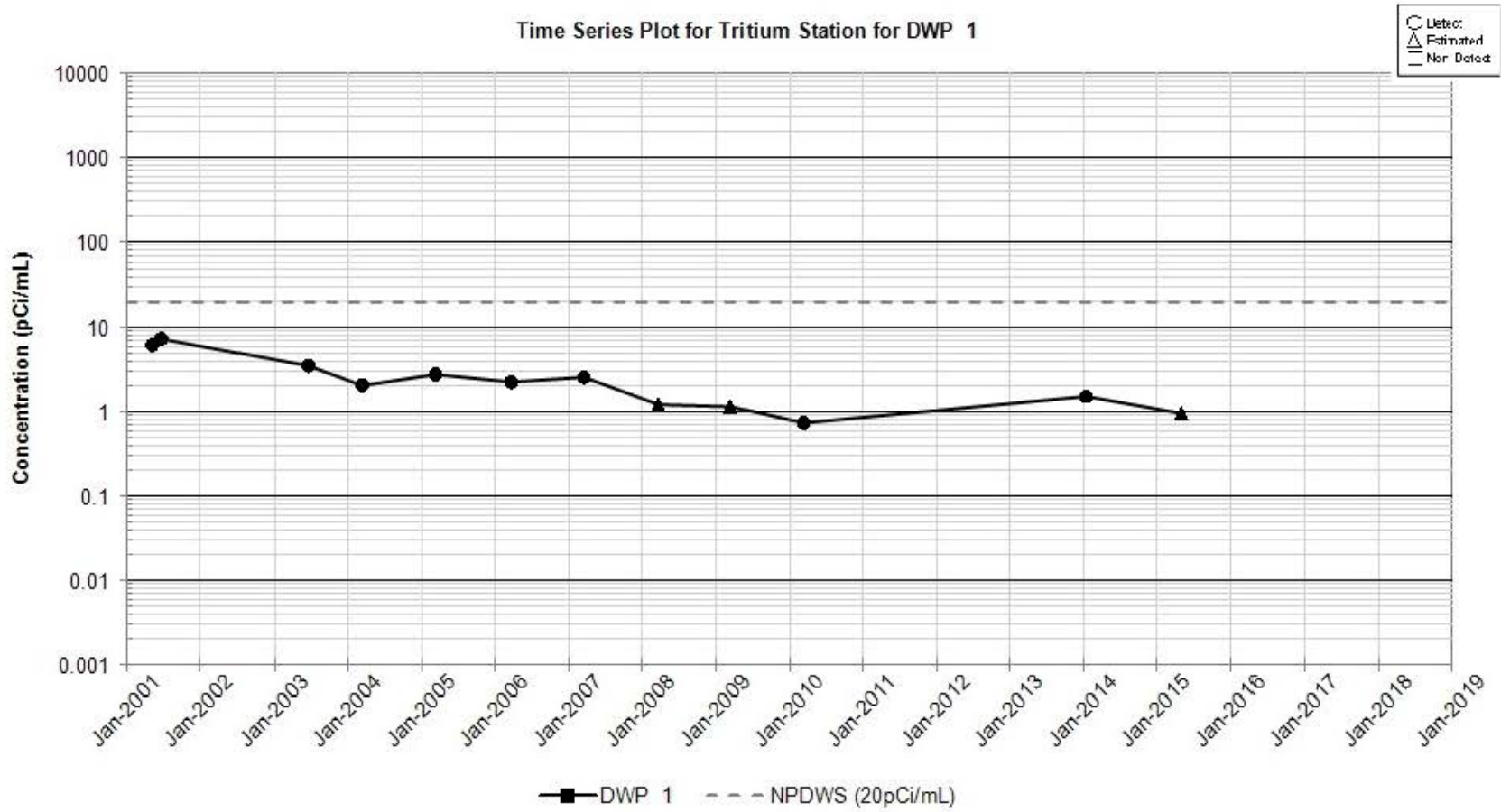


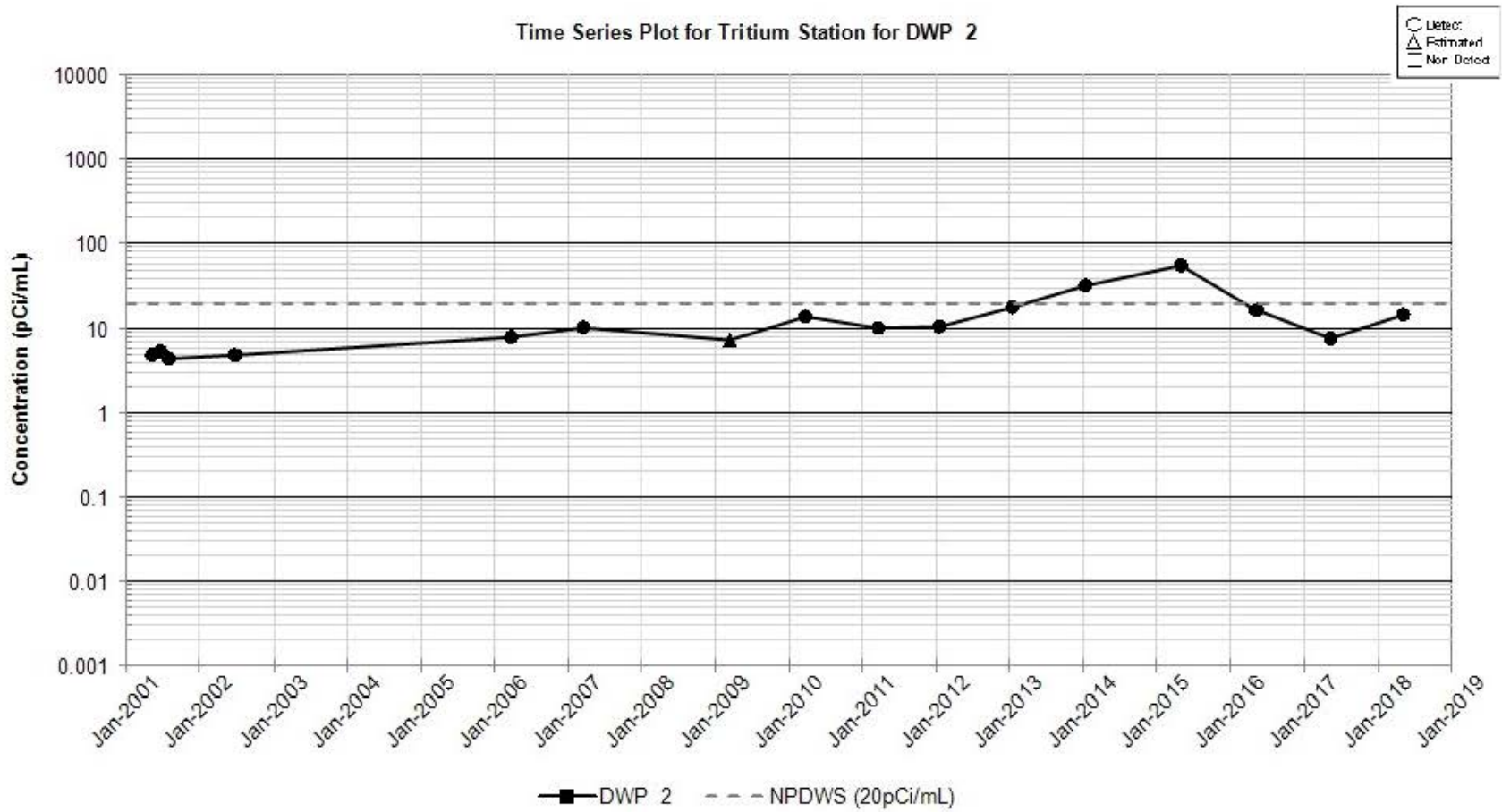


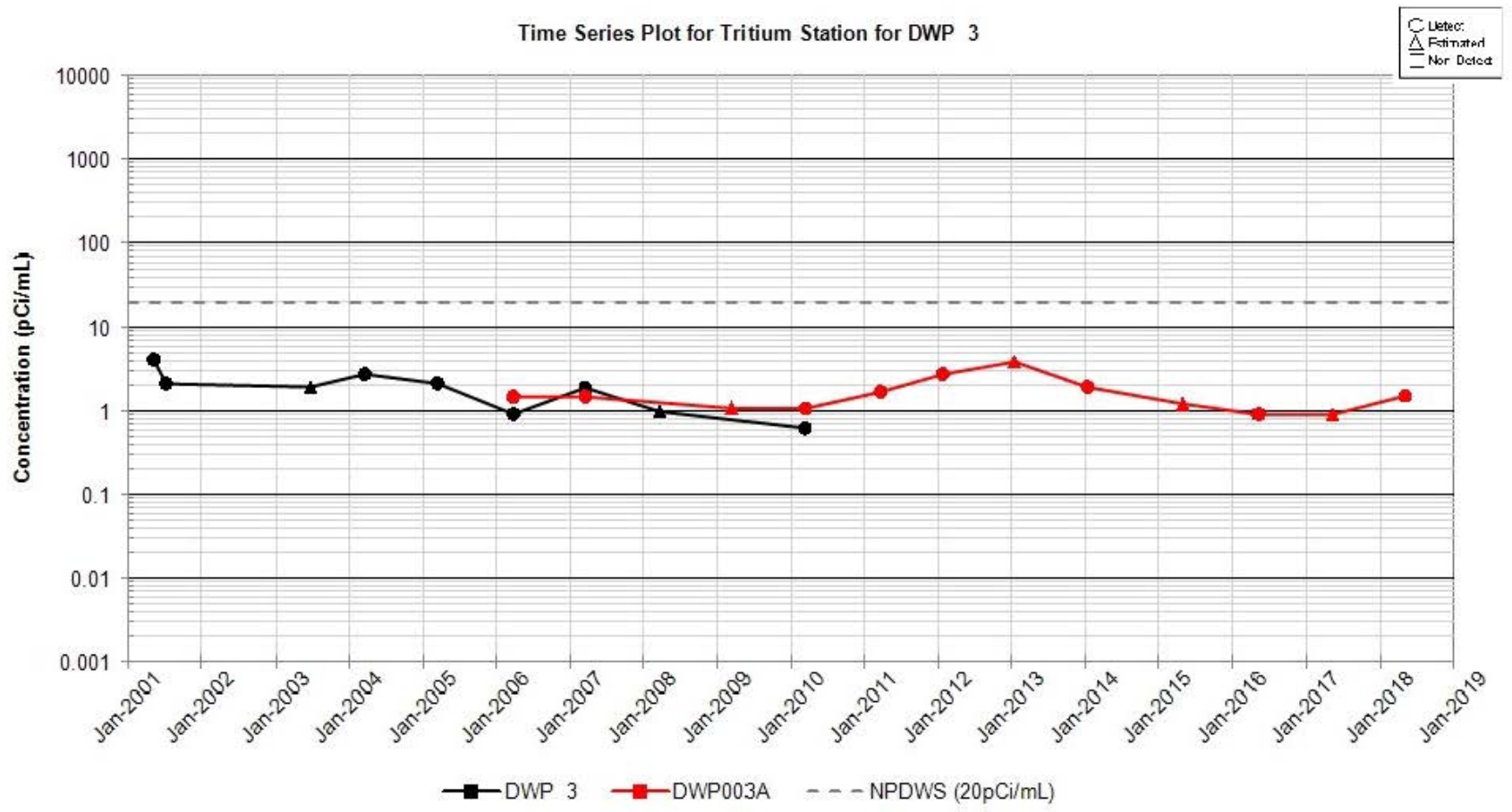


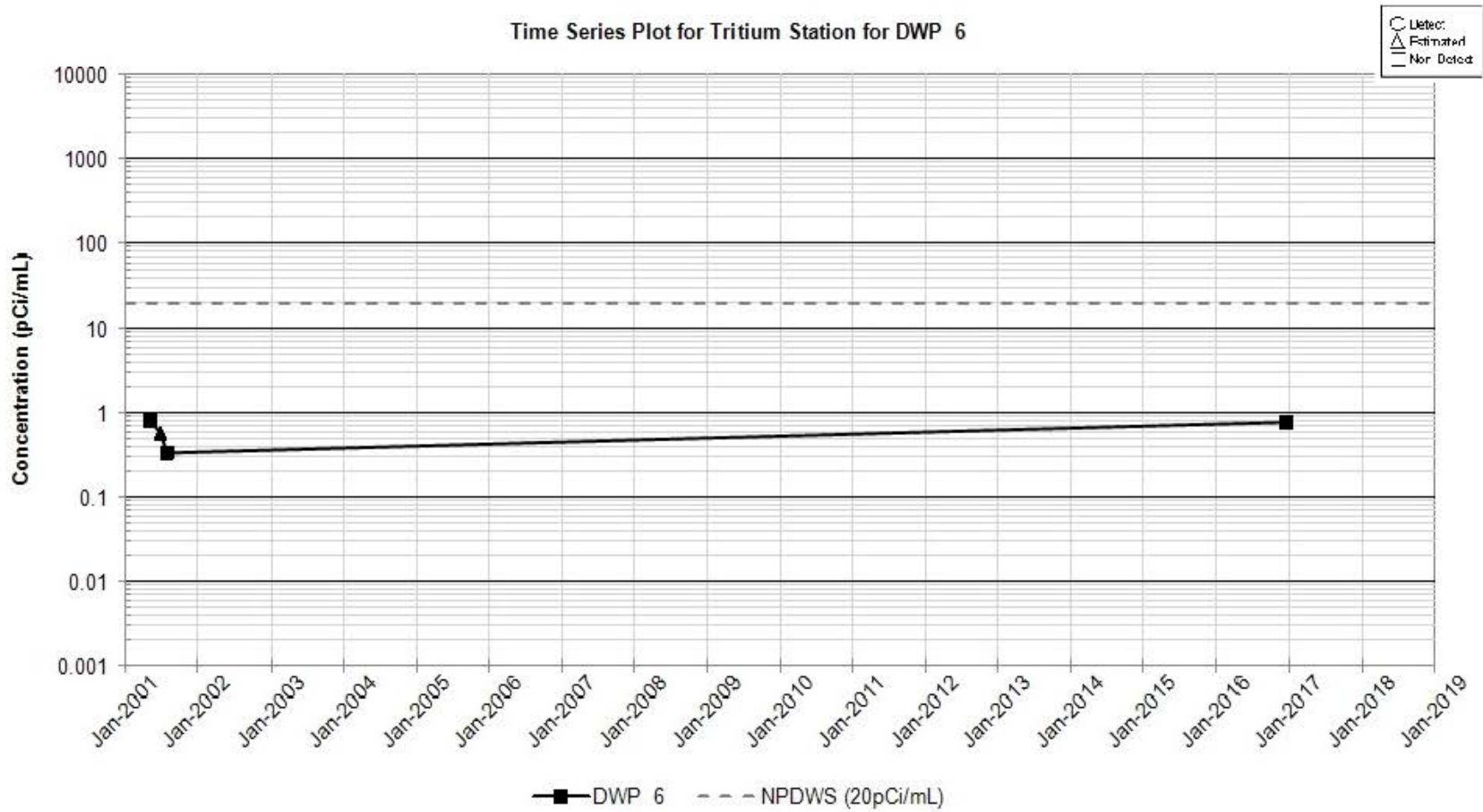


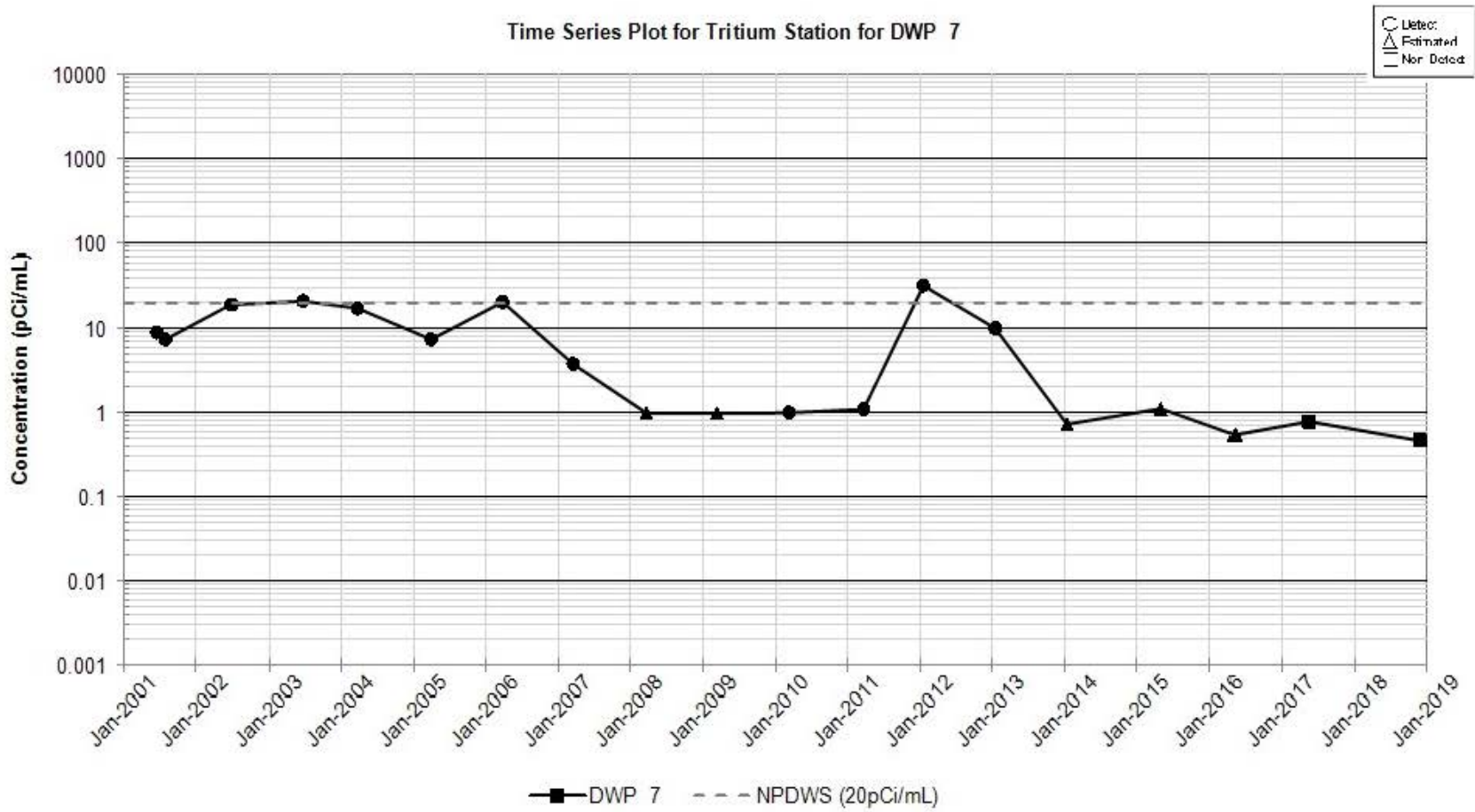


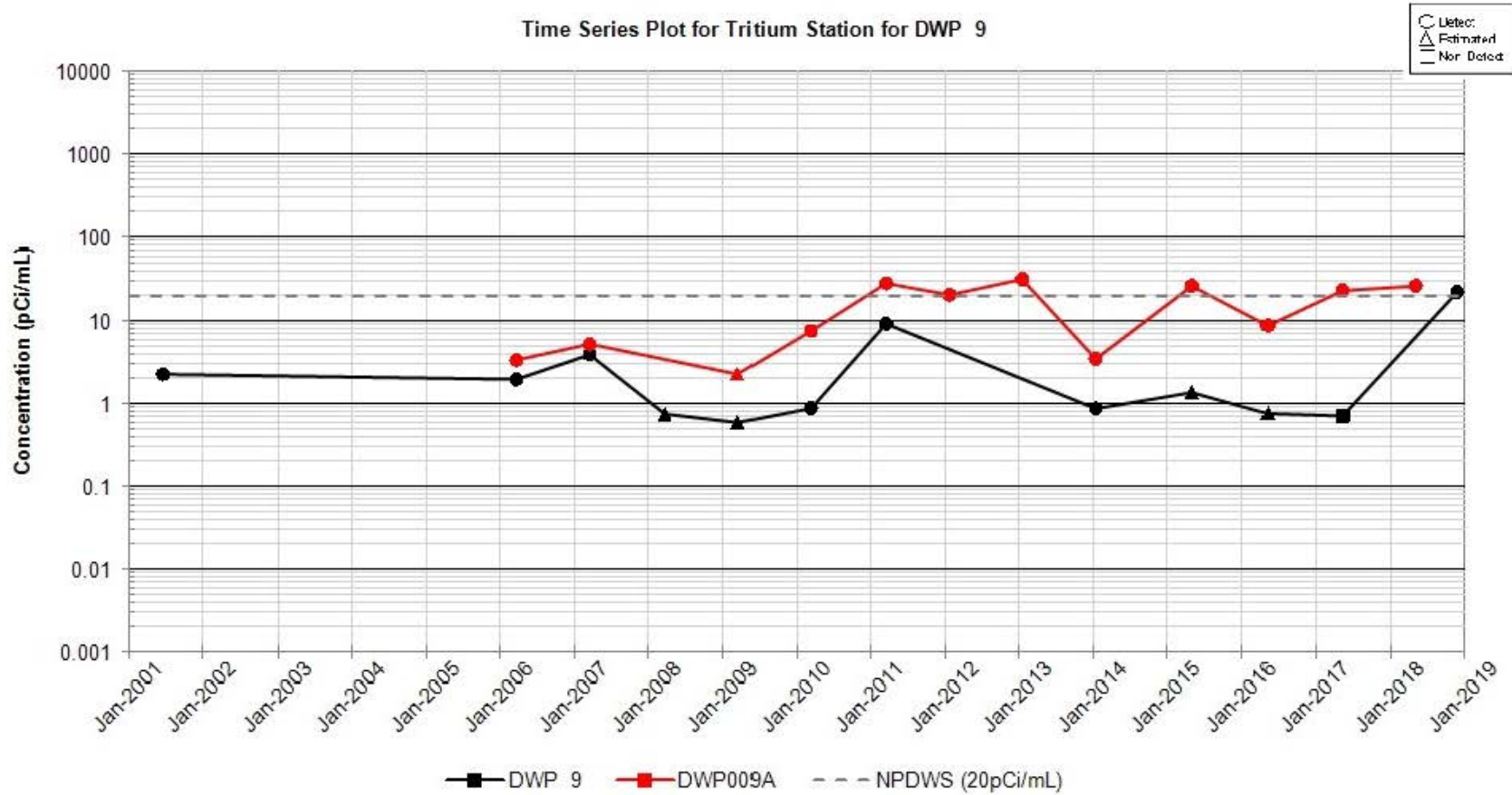












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APPENDIX F

Hydrographs

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