

Annual Trend Analysis - 2009

Submitted by Constellation Power Source Generation, Inc. for the BBSS Site

Paragraph 51 of the Consent Decree effective October 31, 2007, between the Maryland Department of the Environment, Constellation Power Source Generation, Inc. (CPSG), and BBSS, Inc. requires that the April 30th quarterly report for each year shall include a long term trend analysis. This report addresses that requirement of Paragraph 51 with a narrative trend analysis followed by selected long term trend charts supporting the described observations. For those instances where the analytical results were found to be below the detection limit for the analyte, a concentration equal to one half the reporting limit is shown on the charts.

Description of Monitoring and Recovery Wells

Waugh Chapel Pit (WCP) - The WCP ash fill area is monitored by the following wells:

- Upgradient wells: MW-17, 25, and 18;
- Downgradient wells: MW-20, 21, 21b, 22, and 3. MW-21b monitors concentrations deeper in the surficial aquifer than the other monitoring wells. Monitoring wells MW-1, 2, 15 and 16 are located further downgradient of the WCP fill area and the Summerfield Road area. Well MW-19 is located at the northeastern corner of the fill and based on groundwater modeling appears to be more of a side-gradient well.
- Leachate well: MW-24 is located within the WC ash fill in an area where site investigation work identified wet ash present above the water table.

The leachate well, MW-24 is located within the WCP ash fill area and is screened within the wet ash; and therefore, can be used to analyze the characteristics of ash. This well generally shows the highest concentrations of sulfate, boron, chloride and lithium, calcium, sodium, total dissolved solids, magnesium and potassium. These particular parameters, as well as others, are useful in determining if other monitoring and off-site wells have been impacted by ash leachate. Because it does not reflect groundwater conditions moving away from the WCP, well MW-24 is not included in this trends analysis.

The WCP area is hydrogeologically upgradient of the Turner Pit (TP) area.

Turner Pit (TP) – The perimeter of the TP ash fill area is monitored by the following wells:

- Upgradient wells: MW-11, 12, 1, 2, and 15 (note that some of these wells are also downgradient of WCP);
- Downgradient wells: MW-7, 13 and 8; Side or cross-gradient wells consist of MW-9, 26, 10 and 16. MW-16 is located at the northeastern edge of the TP ash fill. It is directly downgradient of the mined but not completely reclaimed section of North Turner Pit. A significant quantity of black soil directly upgradient of this well was

encountered during mining. It is possible that this well may be affected by leachate from the black soil. Laboratory testing of the black soil indicated that the black soil can generate acidic leachate high in sulfate and other metals.

Leachate well MW-14 is located within the TP ash fill and is screened within the groundwater. It can be helpful in determining the characteristics of ash leachate similar to MW-24 but is also influenced by groundwater due to the depth of the well screen.

Recovery Wells - The existing TP groundwater recovery wells are located at the downgradient edge of TP, parallel to Route 3. They consist of wells RW-1, 2, 3, 4, and 5. These wells collect groundwater at the downgradient end of TP for treatment prior to discharge in accordance with the requirements of an MDE issued discharge permit. They function to draw impacted groundwater to them for extraction and treatment, and are not considered perimeter compliance wells. Recovery Well RW-11 is located near MW-21 on the downgradient edge of WCP. It was installed for a pumping test to determine aquifer properties and was built to be capable of eventual functioning as a groundwater recovery.

Summary of Trends Observed for Pertinent Ash Indicators – Sulfate (SO₄), Boron (B), Chloride (Cl), Lithium (Li)

Downgradient monitoring wells that have exhibited elevated concentrations of sulfate, chloride, boron and lithium are MW-3, MW-20, MW-21 and MW-22 in WCP; and MW-7, MW-13 in TP. Of these parameters, only sulfate and chloride have established groundwater quality standards; sulfate at 250 milligrams/liter (mg/l) as a primary drinking water standard, and chloride at 250 mg/l as a secondary drinking water standard. Boron and lithium do not have established groundwater quality standards. The attached time/concentration graphs show the concentration trends of these parameters since January 2000. Specifically, since the previous trend summary in April 2007:

- **Sulfate** remains elevated above the 250 mg/l primary drinking water standard in WCP downgradient wells MW-3, MW-20, MW-21 and MW-2 (Graph WCP-1); and in TP downgradient wells MW-7 and MW-13 (Graph TP-1). With the exception of a spike observed in several wells, the sulfate concentrations have shown a general decrease over the past year. Sulfate concentrations for samples collected from wells MW-3, MW-20 MW- 21, MW-22 (WCP) and MW-13 (TP) in late August 2008 were anomalously high, and have been excluded from the charts. Subsequent duplicate samples submitted to a third party laboratory confirmed that the original results stemmed from procedural difficulties encountered by the outside laboratory that Constellation was using at the time.
- **Chloride** exceeds the water quality standard in WCP downgradient wells MW-21 and MW-22 only (Graph WCP-2), and in TP downgradient well MW-13 (Graph TP-2). Over the past year, the chloride concentrations have generally decreased.
- **Boron and Lithium:** Similarly, the most elevated concentrations for boron and lithium observed in wells MW-20, MW-21 and MW-22 (WCP) and MW-13 (TP)

have been decreasing over the past year, as shown in Graphs WCP-3, WCP-4, TP-3 and TP-4.

Summary of Trends for pH

- **pH at WCP** – Most of the WCP monitoring well **pH** data roughly falls in the 3.2 – 5.2 pH range (Graph WCP-5). Exceptions are Well MW-3 which is typically around a pH of 2.5, and wells MW-1 and MW-2 which are typically around a pH of 6.5.
- **pH at TP** – Most of the TP monitoring well **pH** data fall in the 3.5 to 5.2 pH range (Graph TP-5). Wells MW-10 and MW-26 are typically higher at pH 5.5 to 6.0. Recently wells MW-10 and MW-13 have shown an increase to levels of 5.7 and 5.5, respectively, but still within the generally observed ranges.

Given the logarithmic nature of pH and the relative solubility of many metals at reduced pH, the observed differences in pH can be significant. The data indicates that the pH of the ash leachate is near neutral. These conditions reduce the likelihood of leaching of heavy metals from the ash in quantities that exceed primary drinking water standards.

Summary of Trends for Parameters that have Primary Drinking Water Standards

The following parameters with primary drinking water standards have remained below detection limits or are significantly below the drinking water standard in all site monitoring wells, and consequently are not included in this trend analysis: antimony (Sb), barium (Ba), chromium (Cr), mercury (Hg), cyanide, fluoride, and nitrite (NO₂).

- **Arsenic (As)** has exhibited generally decreasing trends in both WCP and TP downgradient monitoring wells, last exceeding the primary drinking water standard of 0.01 mg/l in March and June 2007, respectively (Graphs WCP-6 and TP-6).
- With the exception of several spikes in October and December 2008, which do not appear to be statistically valid, **beryllium (Be)** has remained below the primary drinking water limit of 0.004 mg/l, and generally below detection limits in the WCP and TP wells (Graphs WCP-7 and TP-7).
- **Cadmium (Cd)** concentrations have been somewhat erratic in the WCP downgradient monitoring wells over the past year, but have been within primary drinking water standards (0.005 mg/l) since July 2008 (Graph WCP-8). Cadmium concentrations have been generally below detection limits and within the primary drinking water standards in the TP downgradient monitoring wells, except for Well MW-13. Cd concentrations in well MW-13 have been erratic and currently exceed drinking water standards, but exhibit an overall decrease since higher concentrations were observed in 2003 and 2004.
- **Thallium (Tl)** is similarly erratic, with wells MW-21 and MW-22 at WCP and MW-MW-7 and MW-13 currently exceeding the drinking water standard of 0.002 mg/l. Although erratic, Graphs WCP-9 and TP-9 show generally depict improving Tl concentrations since 2006, with the exception of Turner Pit monitoring well MW-13.

- **Nitrate (NO₃)** concentrations in the WCP and TP monitoring wells have been within the primary drinking water standard of 10 mg/l since March of 2008 (Graphs WCP-10 and TP-10). It is possible that the previously observed nitrate concentrations in groundwater were from sources other than the ash, such as from fertilizers.

Status of Treatment Systems

The trend analyses continue to indicate the success of the current treatment systems and remedial measures, and indicate the progress to date toward achieving the remediation goals of the Consent Decree. The “Quarterly Assessment of the Turner Pit Pump and Treat System Hydraulic Control – 1st Quarter 2009” confirms that capture is being maintained downgradient of the Turner Pit as demonstrated by the observed potentiometric surface in the vicinity of the five recovery wells. The groundwater extraction and treatment system continues to operate with few problems. A thorough discussion of how CPSG proposes to fulfill the remedial goals was included in the remedial alternatives report submitted in May, 2008.

Summary

The data developed since the trends summary report prepared last year show a continuing improvement in the groundwater quality in wells downgradient to the Waugh Chapel and Turner Pits for most analyzed parameters. This improvement corresponds to the continued efforts to eliminate potential sources of surface water infiltration into the ash. Furthermore, the successful operation of the groundwater extraction and treatment system has created a capture zone at the downgradient end of the WCP-TP hydrogeological system, reducing the potential for offsite migration of ash constituents.

Attached Trend Graphs

Most Pertinent Ash Indicators (Sulfate-SO₄, Boron-B, Chloride-Cl, Lithium-Li)

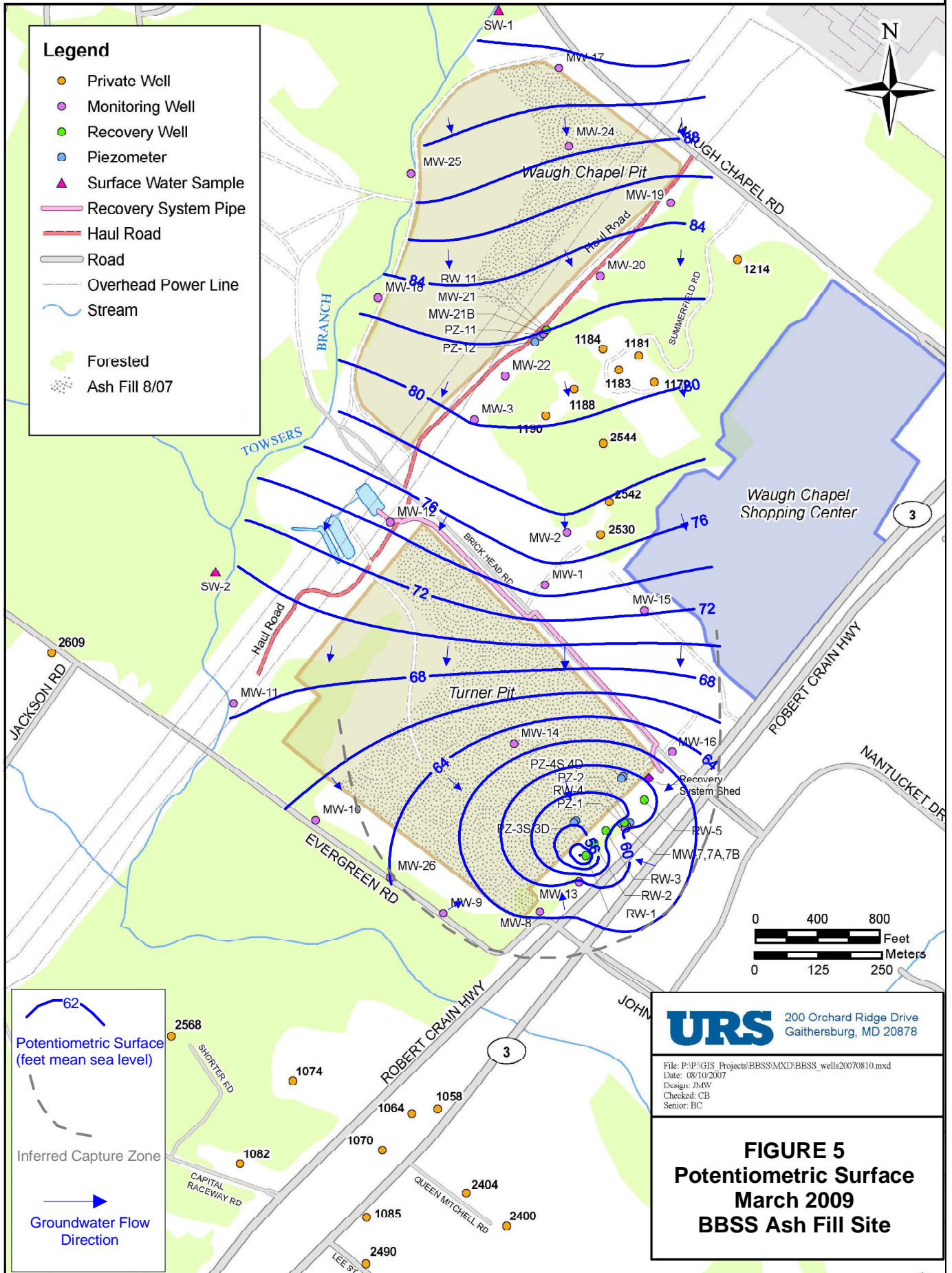
- Graphs WCP-1, 2, 3 and 4; WCP Monitoring Wells MW-1, 2, 3, 15, 16, 19, 20, 21, 21B, and 22.
- Graphs TP-1, 2, 3 and 4; TP Monitoring Wells MW-7, 8, 9, 10, 13, 16, and 26.

pH

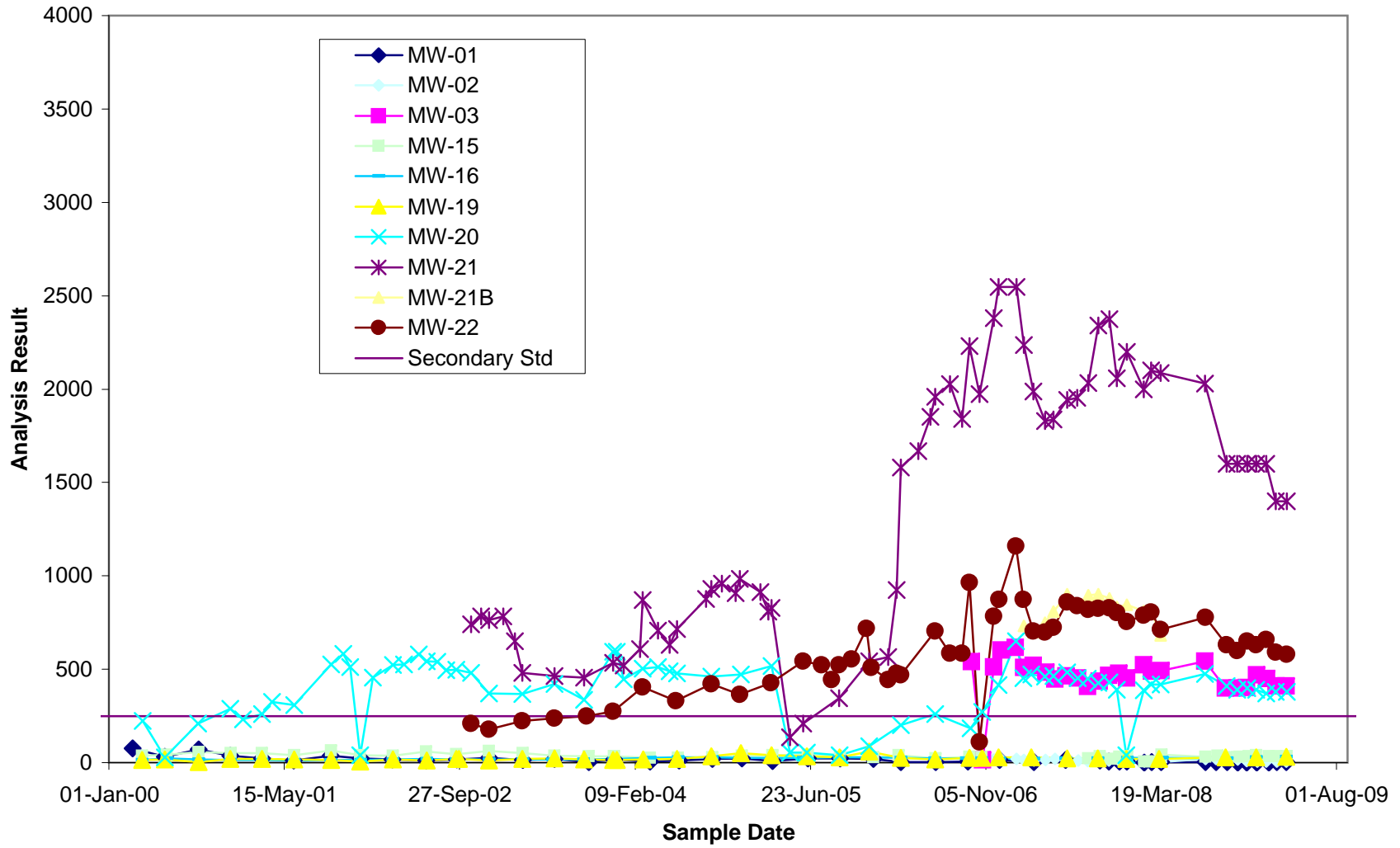
- Graph WCP-5; WCP Monitoring Wells MW-1, 2, 3, 15, 16, 19, 20, 21, 21B, and 22.
- Graph TP-5; TP Monitoring Wells MW-7, 8, 9, 10, 13, 16, and 26.

Parameters that have Primary Drinking Water Standards (Arsenic-As, Beryllium-Be, Cadmium-Cd, Thallium-Tl, Nitrate-NO₃)

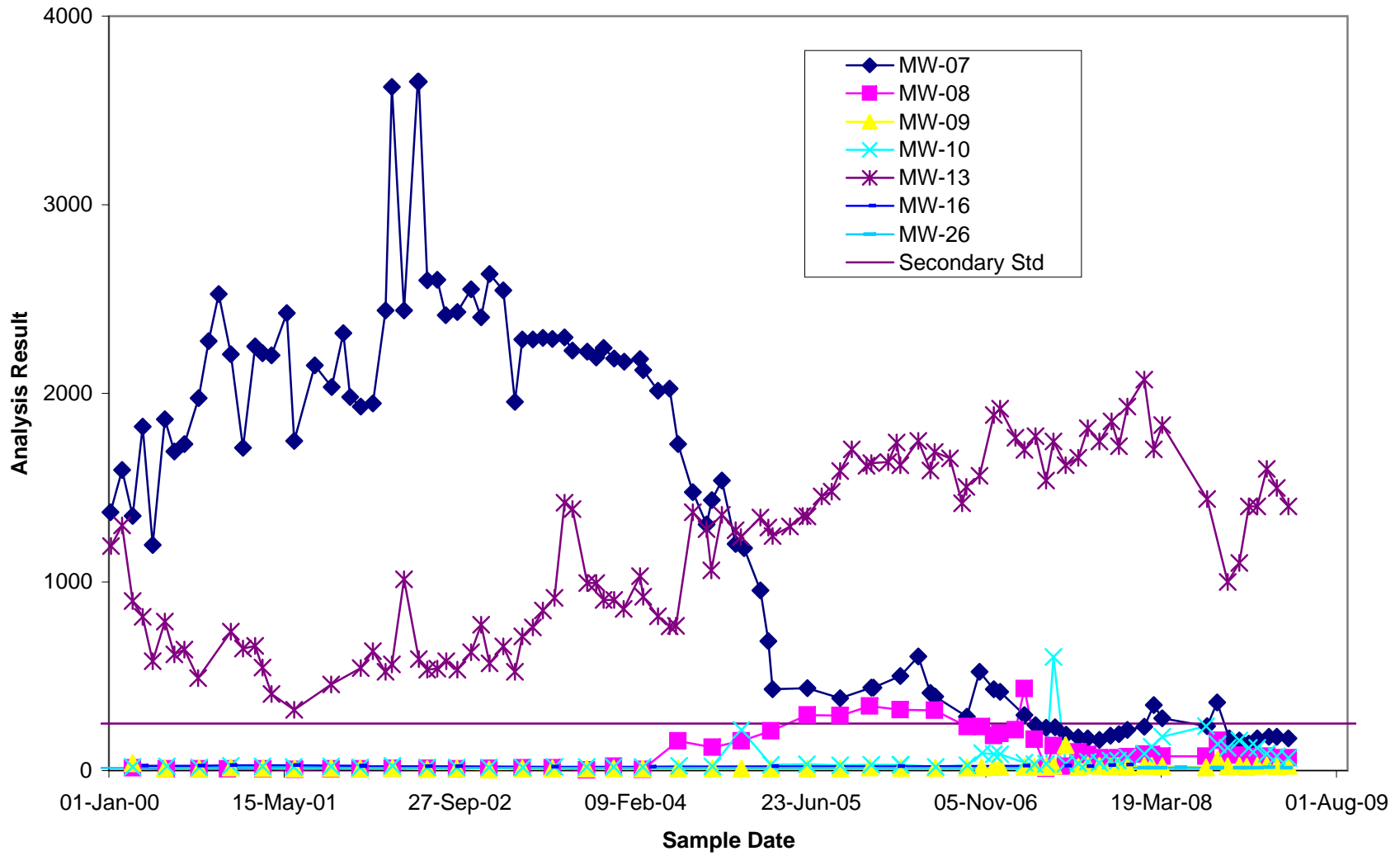
- Graphs WCP-6, 7, 8, 9, 10; WCP Monitoring Wells MW-1, 2, 3, 15, 16, 19, 20, 21, 21B, and 22.
- Graphs TP-6, 7, 8, 9, 10; TP Monitoring Wells MW-7, 8, 9, 10, 13, 16, 26.



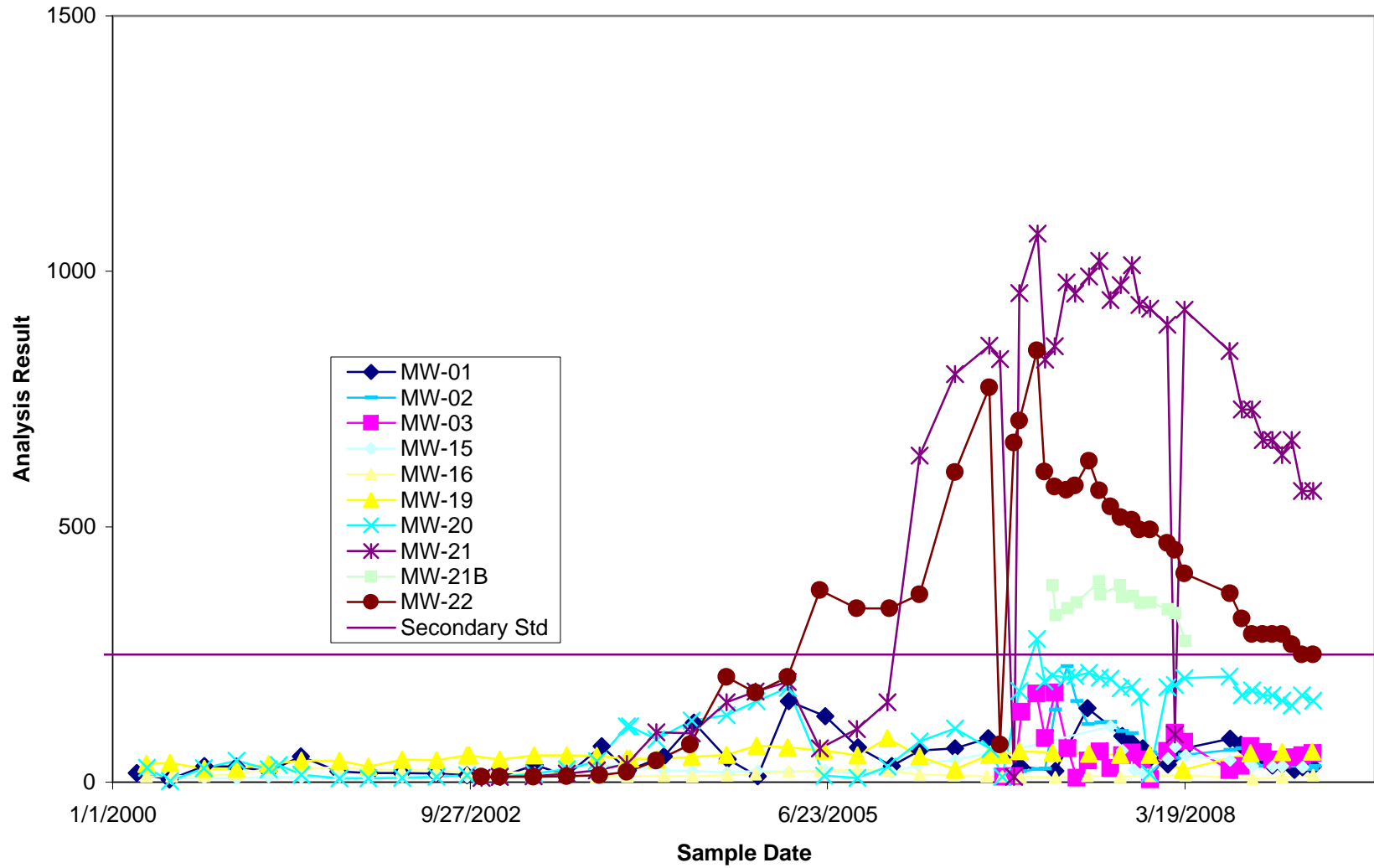
**Graph WCP1, Sulfate in mg/L
BBSS Site, Waugh Chapel Pit**



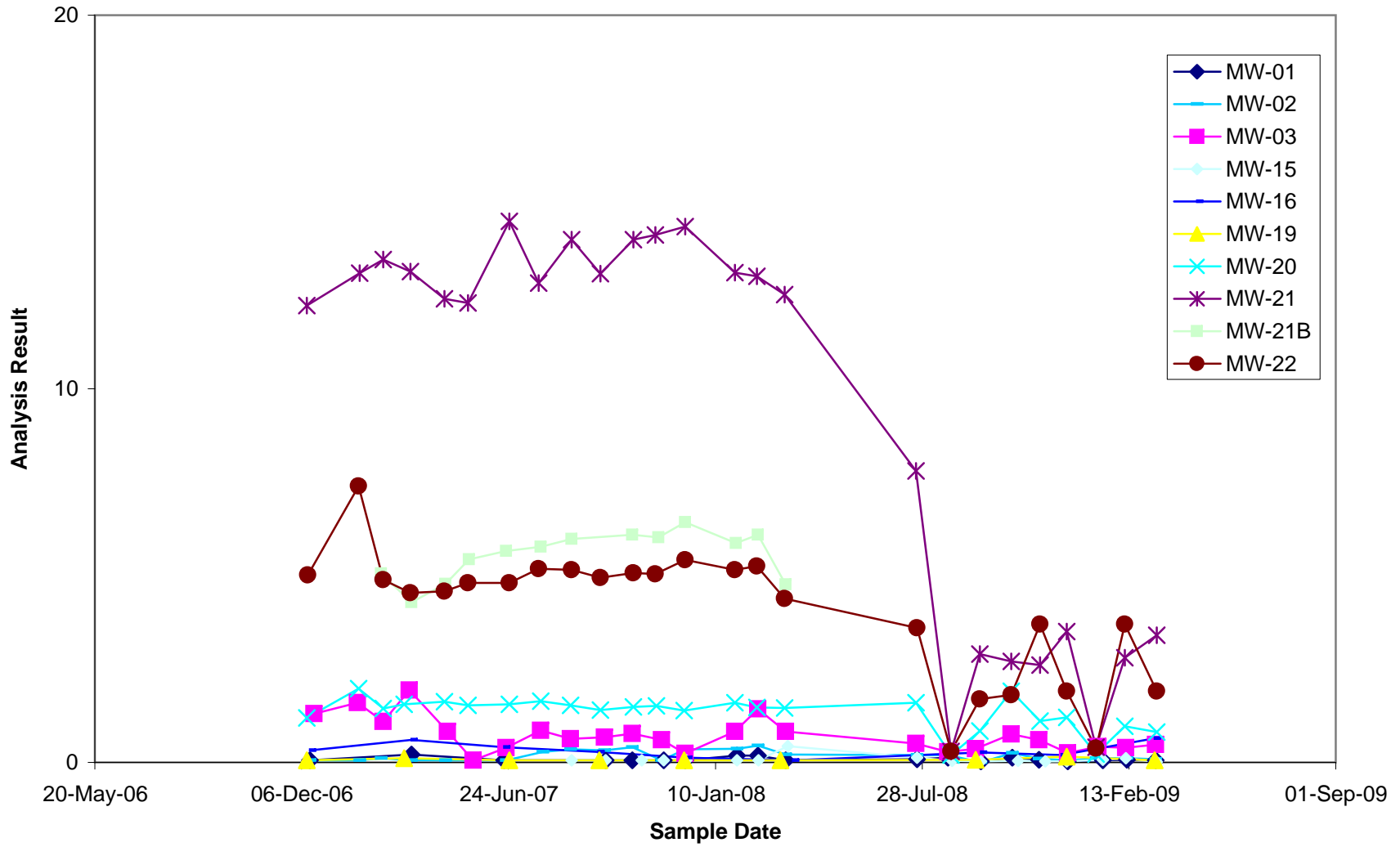
Graph TP-1, Sulfate in mg/L
BBSS Site, Turner Pit



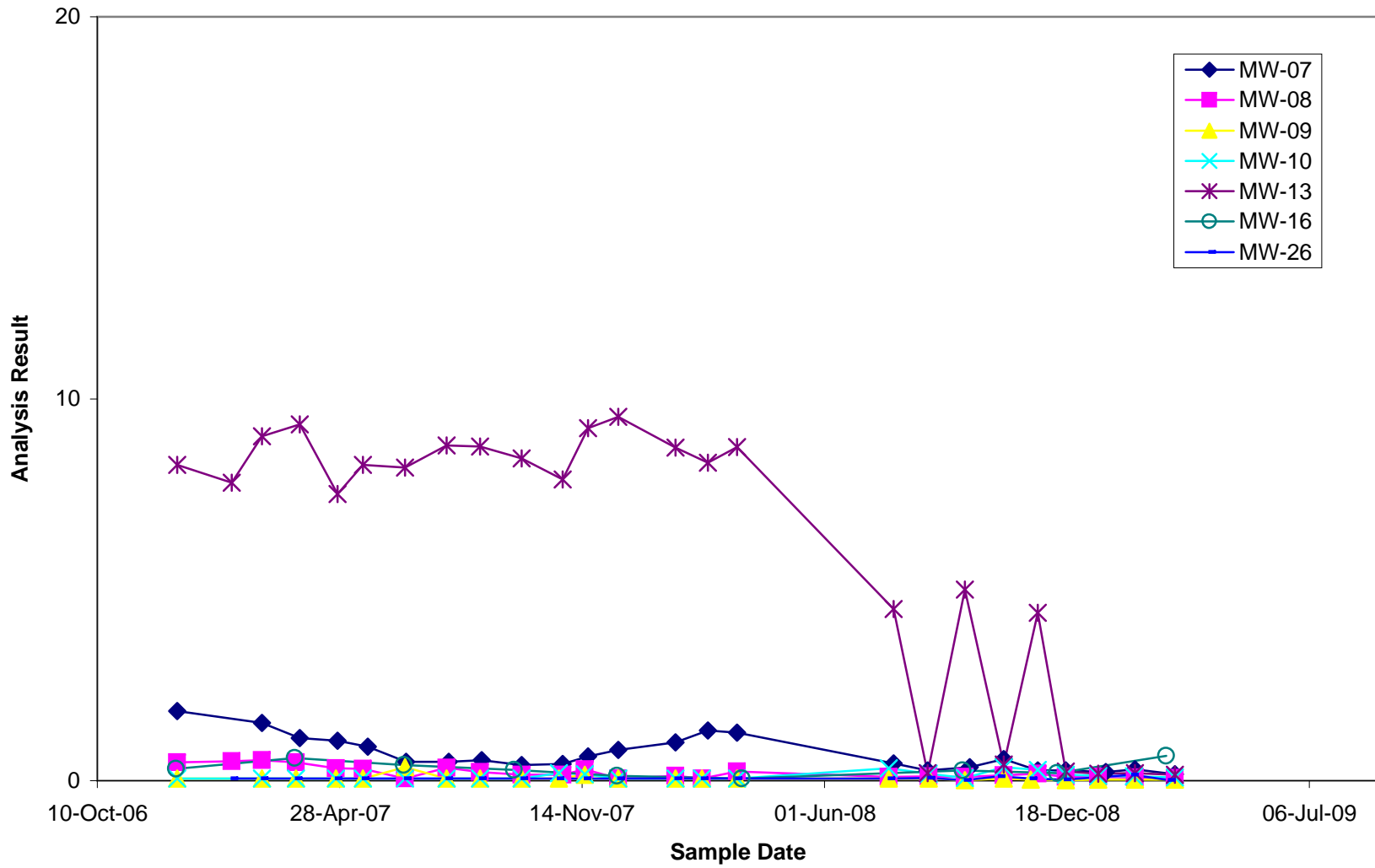
**Graph WCP-2, Chloride in mg/L
BBSS Site, Waugh Chapel Pit**



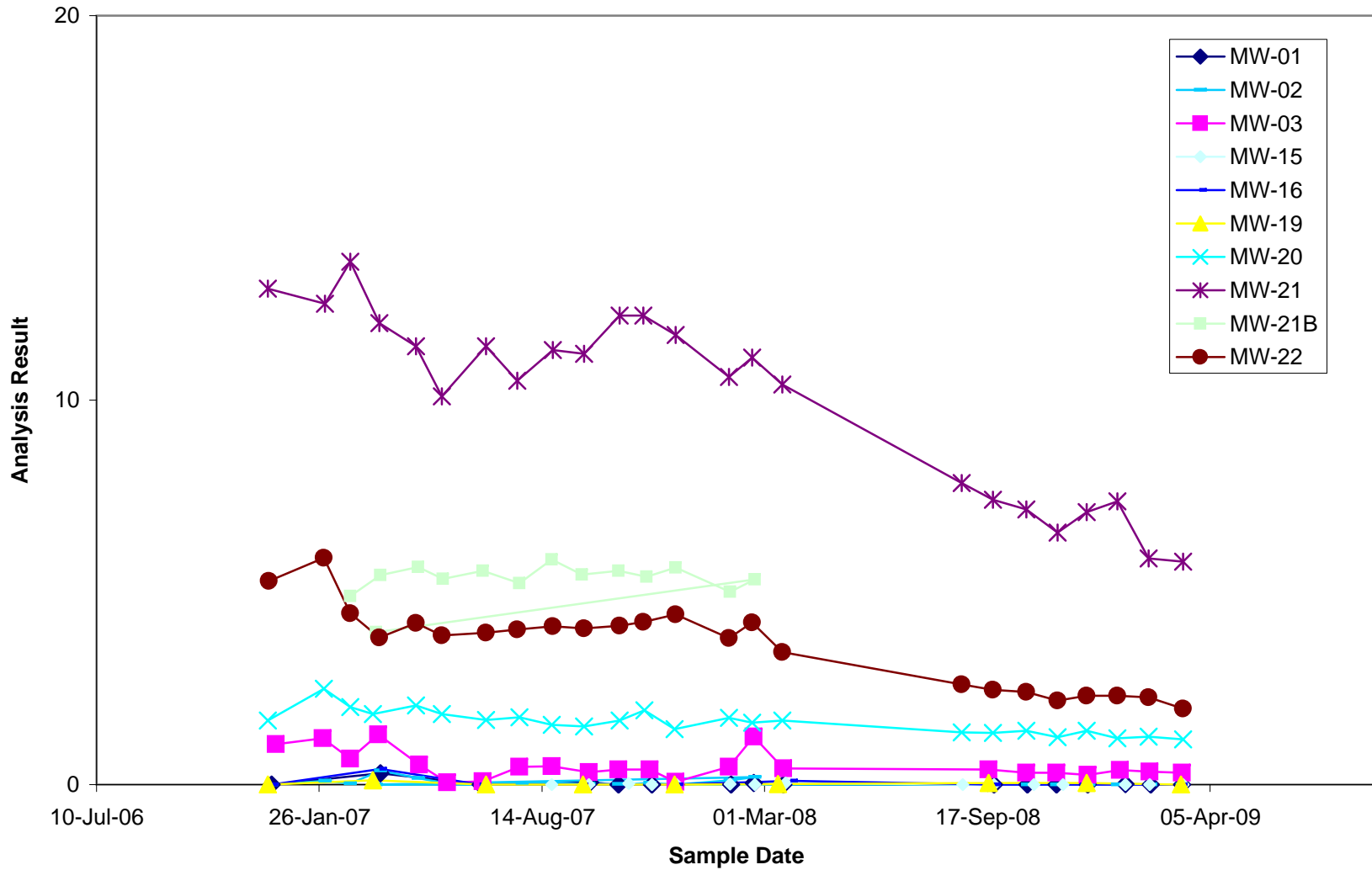
Graph WCP-3, Dissolved Boron in mg/L
BBSS Site, Waugh Chapel Pit



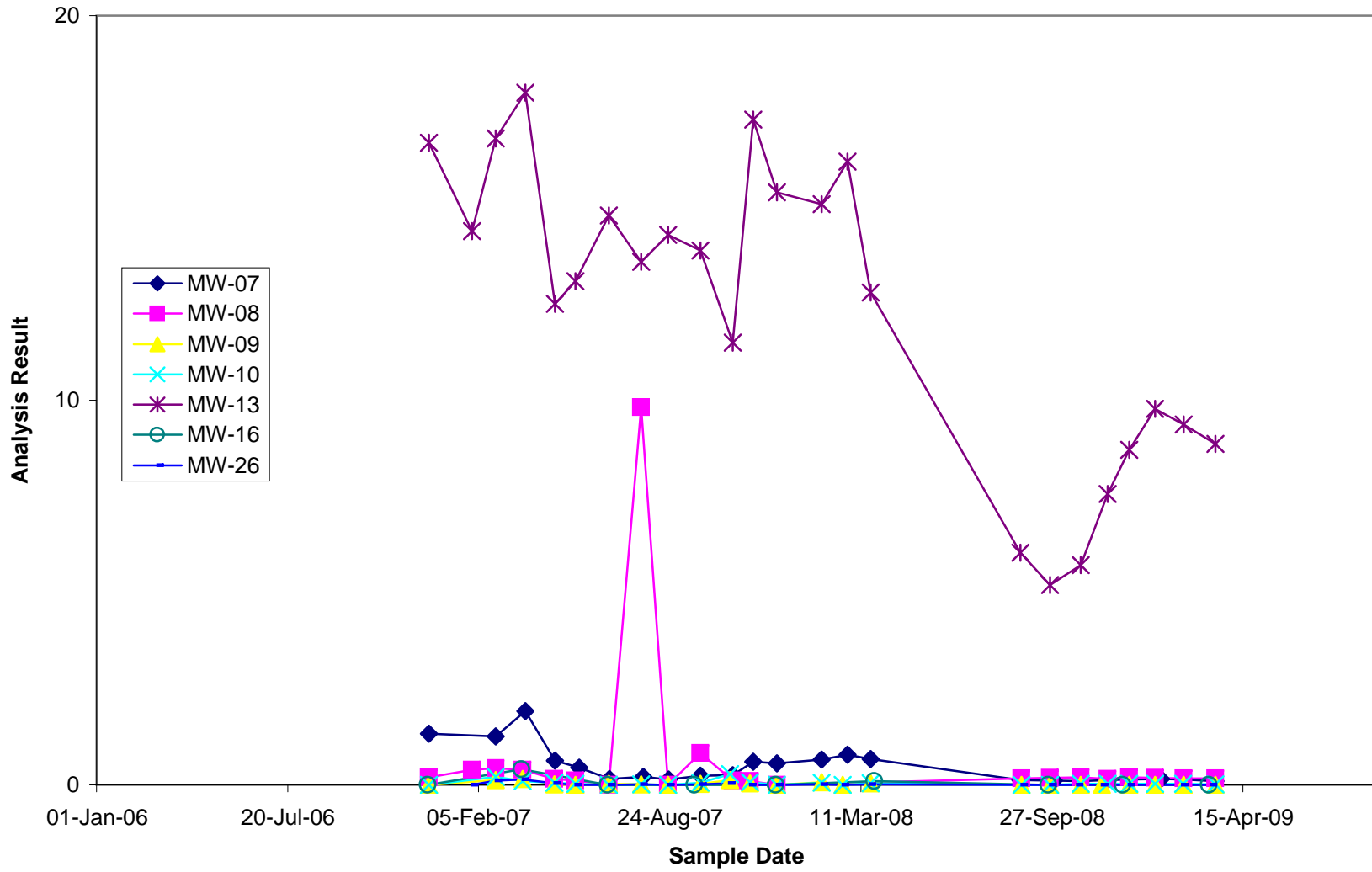
Graph TP-3, Dissolved Boron in mg/L
BBSS Site, Turner Pit



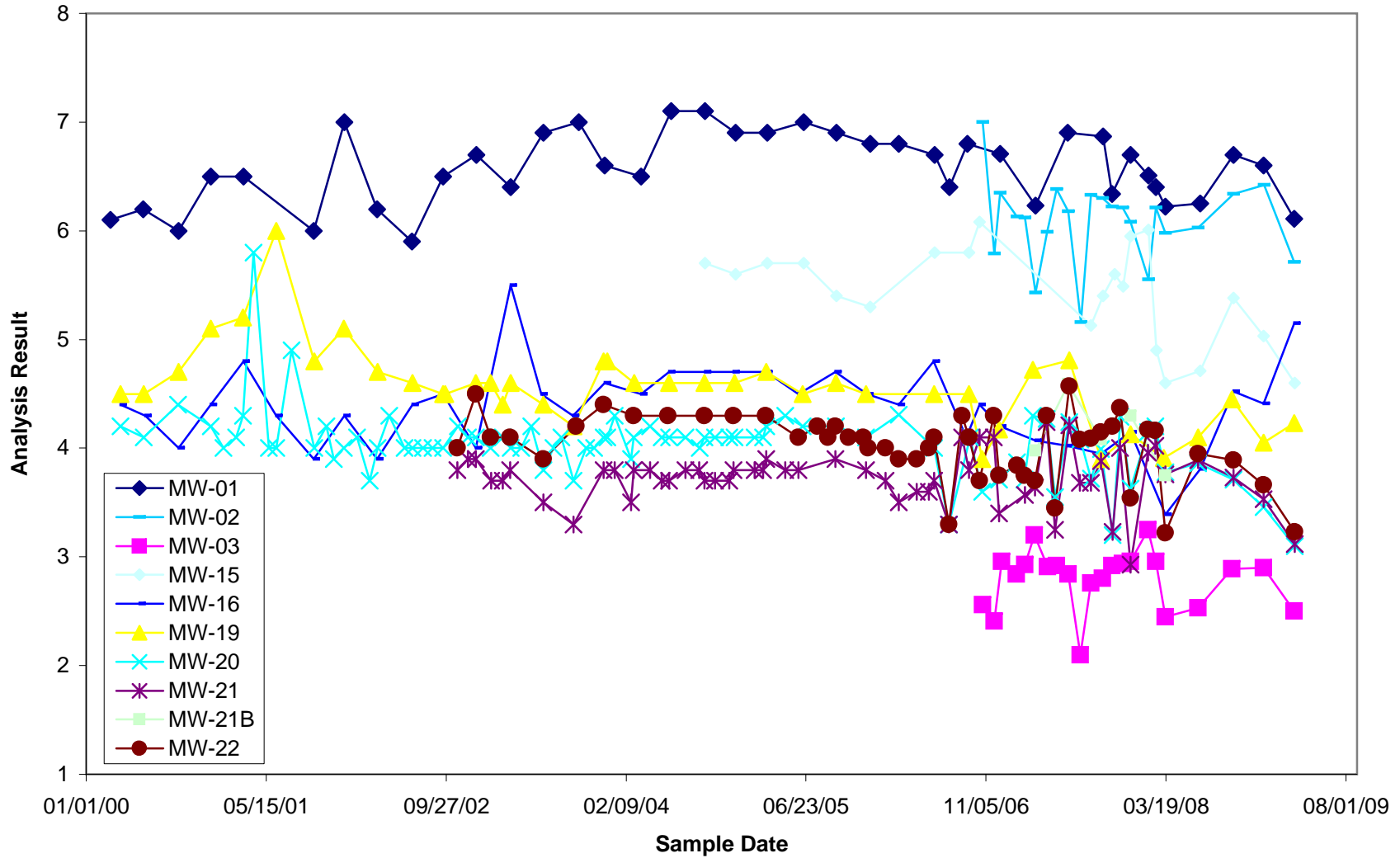
Graph WCP-4, Dissolved Lithium in mg/L
BBSS Site, Waugh Chapel Pit



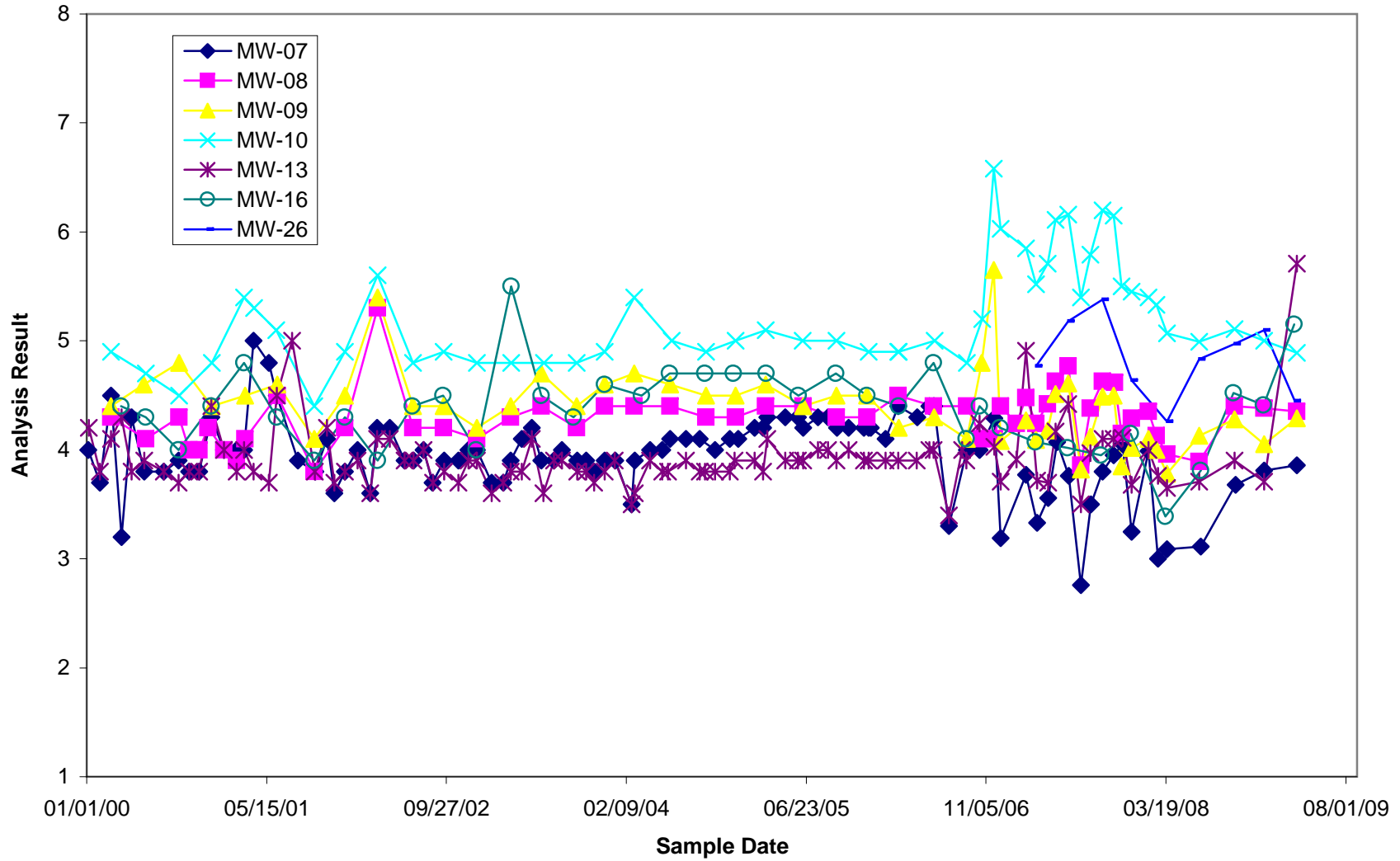
Graph TP-4, Dissolved Lithium in mg/L
BBSS Site, Turner Pit



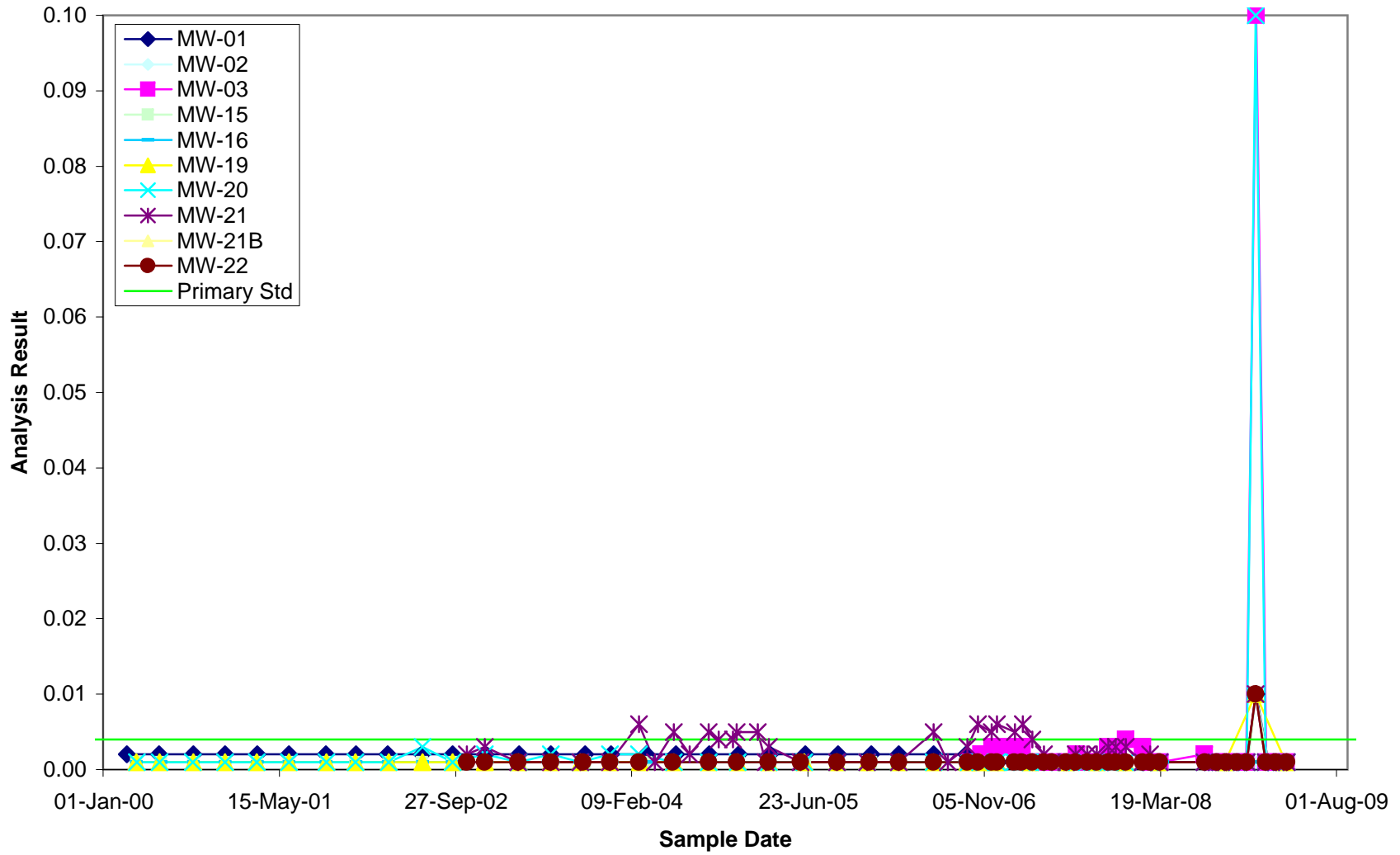
Graph WCP-5, pH (S.U.)
BBSS Site, Waugh Chapel Pit



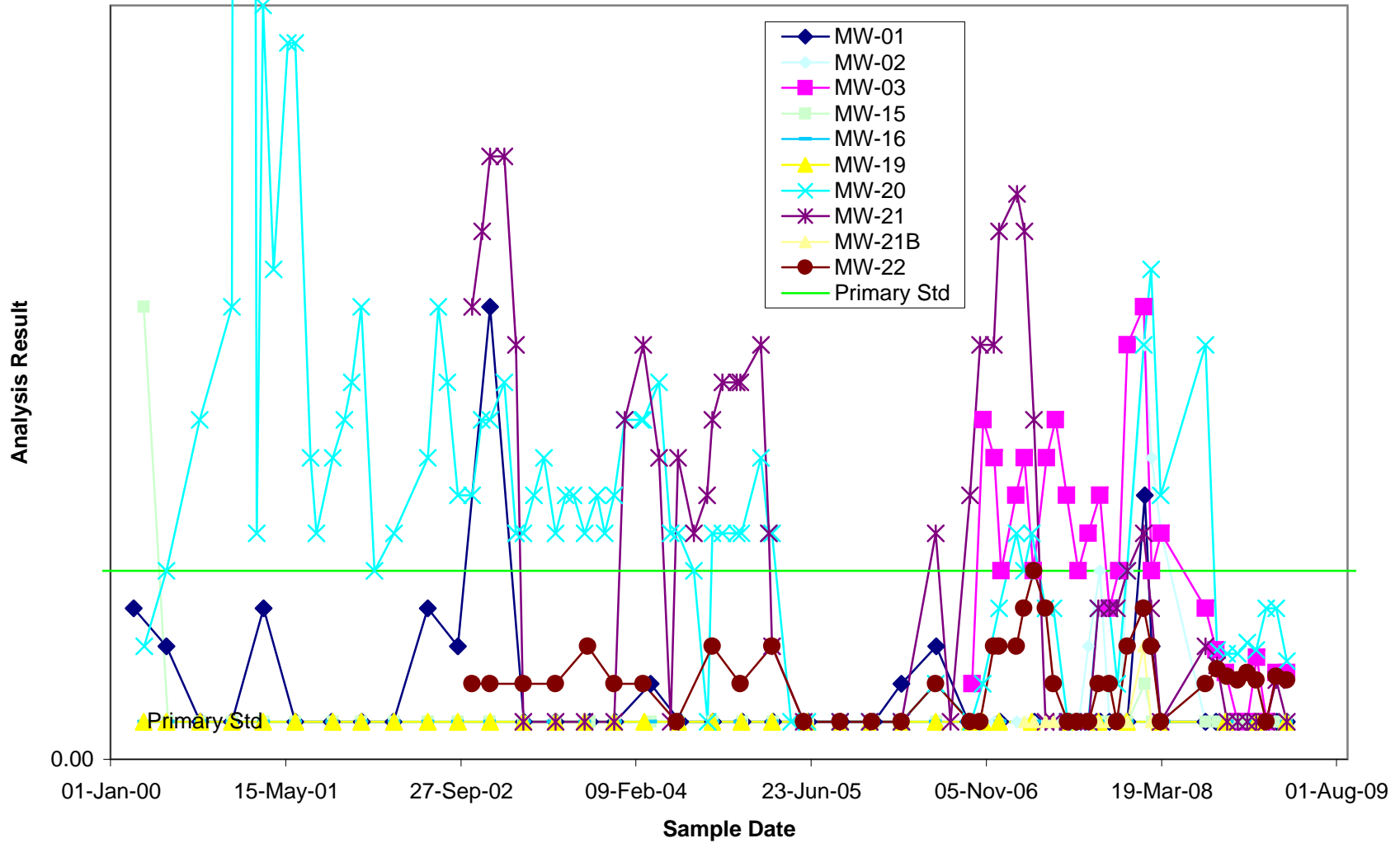
**Graph TP-5, pH (S.U.)
BBSS Site, Turner Pit**



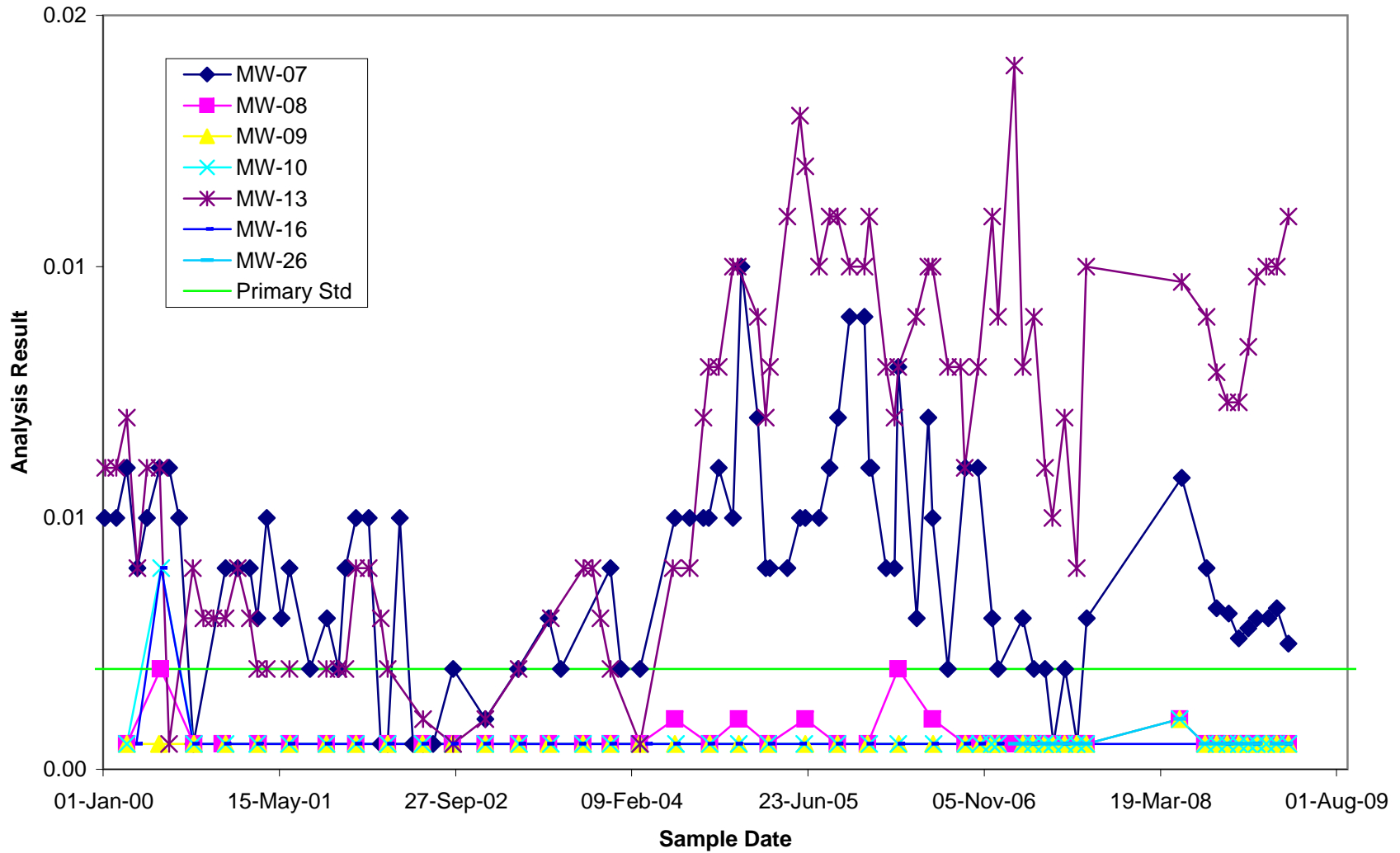
Graph WCP-7, Dissolved Beryllium in mg/L
BBSS Site, Waugh Chapel Pit



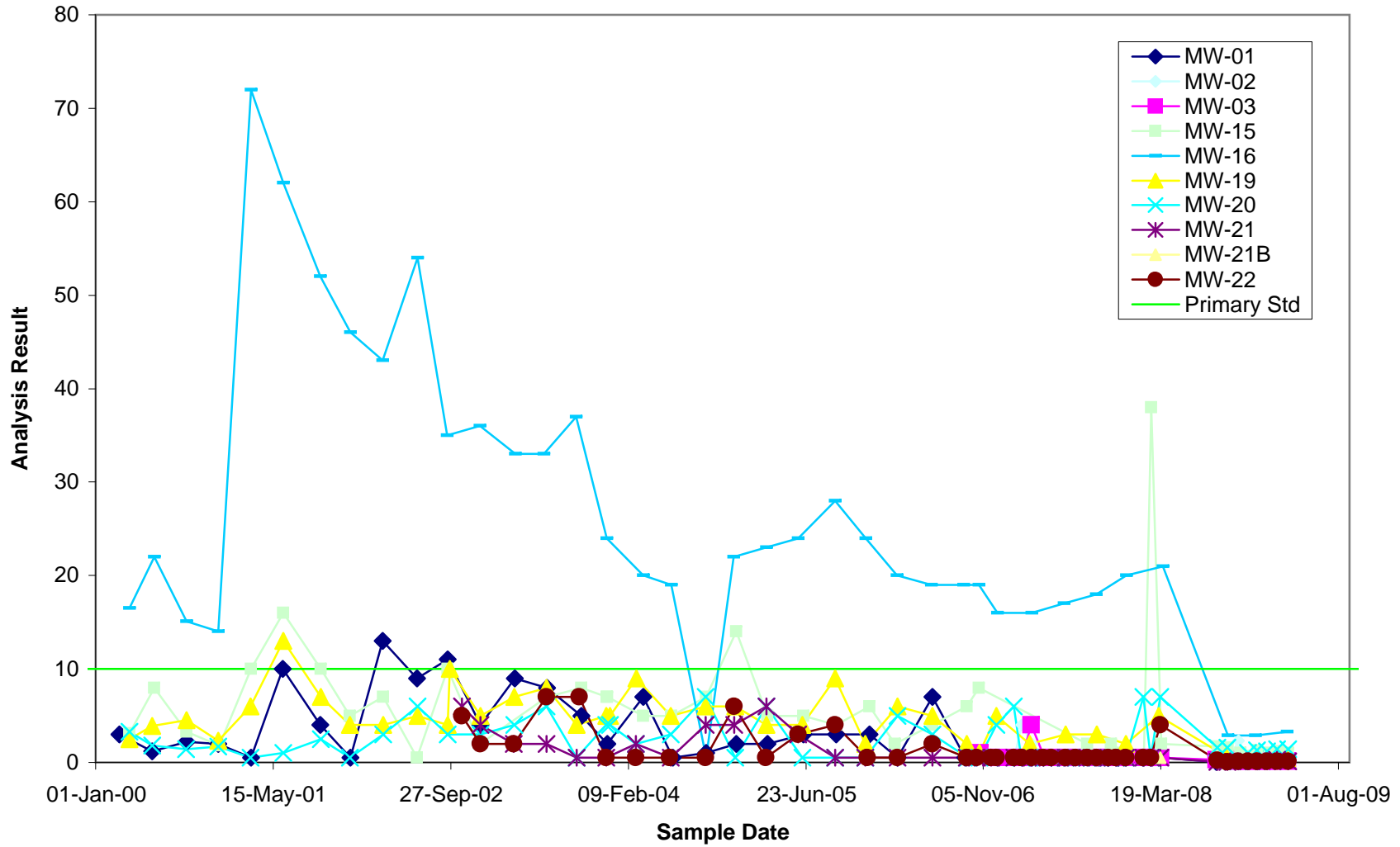
Graph WCP-8, Dissolved Cadmium in mg/L
BBSS Site, Waugh Chapel Pit



Graph TP-9, Dissolved Thallium in mg/L
BBSS Site, Turner Pit



Graph WCP-10, Nitrate in mg/L
BBSS Site, Waugh Chapel Pit



Graph TP-10, Nitrate in mg/L
BBSS Site, Turner Pit

