UPDATE: Evaluation of Trace Element Leaching
MnROAD Field Investigation of Highway Base Material
Stabilized With High Carbon Fly Ash
Mn/DOT Partnership Agreement #90701-P

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Project Goal & Scope

This report concerns the current status of results of the ongoing environmental chemical analysis of leachate collected from test cells using off-classification HCFA as a stabilizer of road base materials under an asphalt wearing course. The test section consists of road base course constructed using recycled paving material (RPM) stabilized with 14% fly ash, by weight. Additionally there are two control sections with base courses composed of RPM without fly ash, and of crushed stone aggregate (CA).

The goal of this research project is to study a road base at the Minnesota Road Research Facility (MnROAD) constructed with fly ash aggregate for long term monitoring of engineering and environmental characteristics. This study will provide a controlled long term evaluation of pavement base materials stabilized with High Carbon Fly Ash (HCFA). Engineering laboratory testing has shown HCFA to be a viable stabilizing material. Field construction of road test segments is necessary to validate the structural and environmental performance of high carbon fly ash stabilized bases.

Leachate Sampling and Analysis

Leachate has been regularly pumped by submersible pump from the lysimeter tanks, and the volumes emptied have been recorded. Periodic sampling of leachate for chemical analysis has also been conducted. Leachate samples were collected using a submersible pump, which was decontaminated by pumping approximately four gallons of tap water through the apparatus before and after each individual sample. Samples were collected in HDPE bottles, and preserved with nitric acid when necessary.

Field samples were analyzed by the UW Soil & Plant Laboratory (SPL). These were analyzed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) for twenty-nine (29) elements including nutrient minerals as well as heavy metals. Also SPL analyzed these samples for six anions using Ion Chromatography. Samples for these elements were collected four times beginning September 11, 2007, and last sampled January 31, 2009. The results of the January 31 sampling event are still pending. Additional sampling is scheduled to occur quarterly, at least through 2009, with the next sampling event scheduled for April 2009.

It should be noted that the first two sampling events occurred prior to the final paving of the two control sections (RPM and CA base courses). The first event occurred after the RPM and CA base courses were originally compacted, and the second occurred after the base courses were excavated, dried, and re-compacted in early October 2008.

Samples are also collected for mercury (Hg) analysis approximately 4 times per year. Regulatory limits are very low for Hg, and background levels are high enough to make contamination likely and significant using traditional water sampling methods. A more stringent method (US EPA Method 1631, Revision E) for Hg was used to minimize the likelihood of contamination of samples. All sampling equipment that contacted the liquid samples was acid cleaned, dried, and double bagged by the Wisconsin State Laboratory of Hygiene (WSLH). Samples were collected by two persons using a "clean-hands, dirty hands" method (adapted from EPA 1669), where one person, "clean-hands", only touches the sample bottles. All other handling of equipment was conducted by the "dirty-hands" person. These samples were collected from March 19, 2008 to January 31, 2009. The results of the January 31 sampling event are still pending. Chemical analysis was conducted by WSLH according to US EPA Method 1631.

Analytical Results

Pore Volumes of flow (PVF) through base course layers were calculated from volumes of leachate collected and by calculating approximate pore volume of the layer using material properties, and construction compaction data. The CA base course has had the highest relative total flow volumes (9.1 PVF), followed by the fly ash stabilized RPM (4.2 PVF). The lowest flow is in the RPM base course (2.8 PVF).

The Analytical results of chemical concentration vs. pore volume of flow for the thirty-six (36) elements or anions that were tested are presented as Figures 1.01 to 1.36, with method detection limit and the Minnesota Department of Health (MDH) Drinking Water Maximum Contaminant Level (MCL) or Health Risk Limit (HRL), if one exists and whichever is lowest. Concentration levels that are below method detection limits are graphed as being at the detection limit.
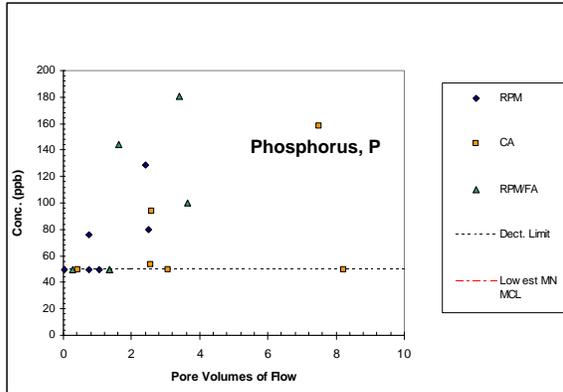
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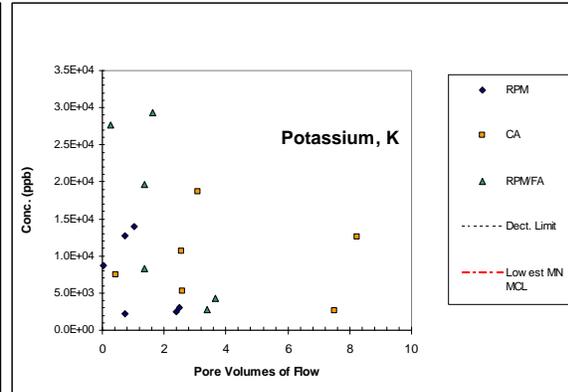
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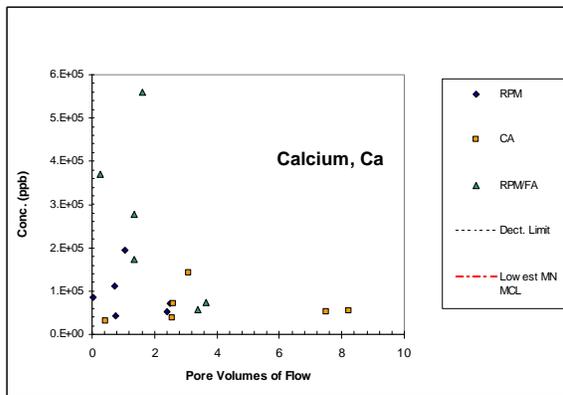
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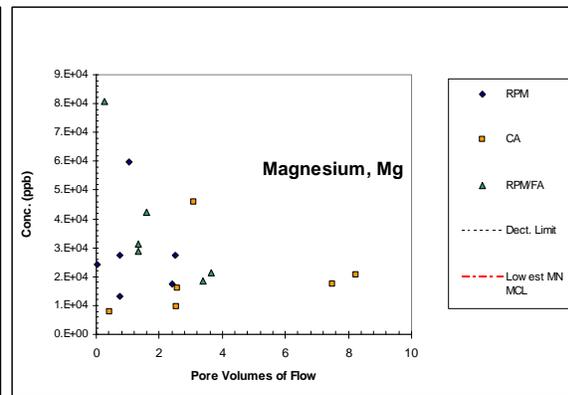
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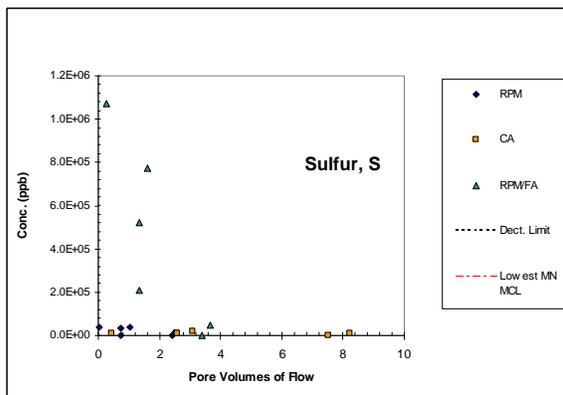
Figure 1.05 – S Concentration
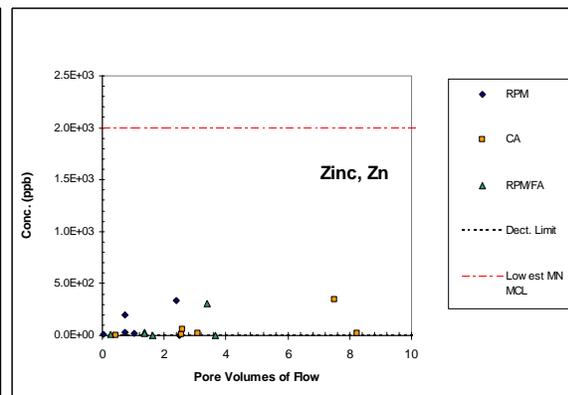
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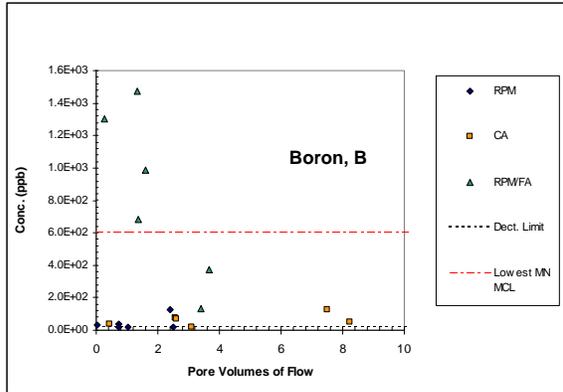
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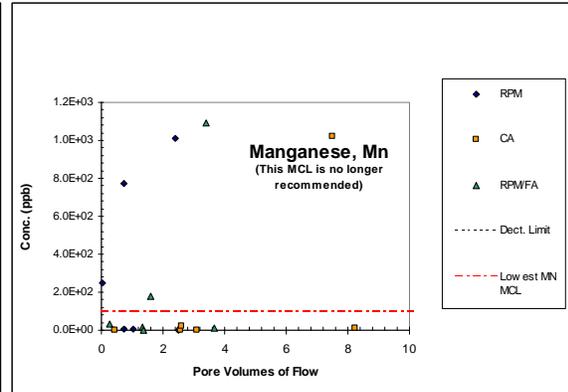
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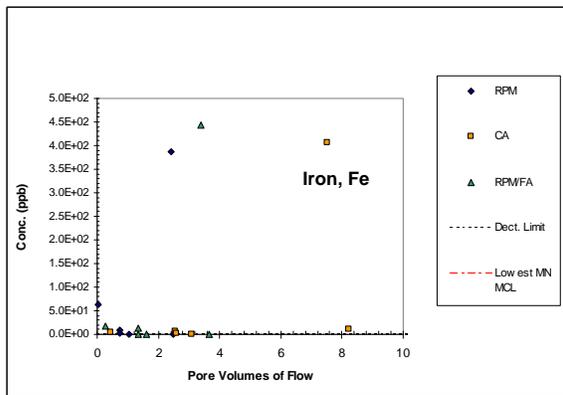
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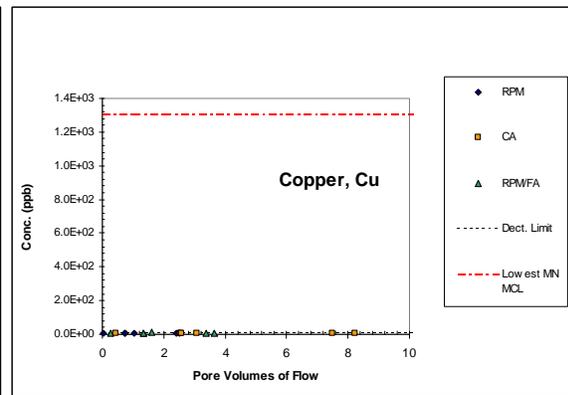
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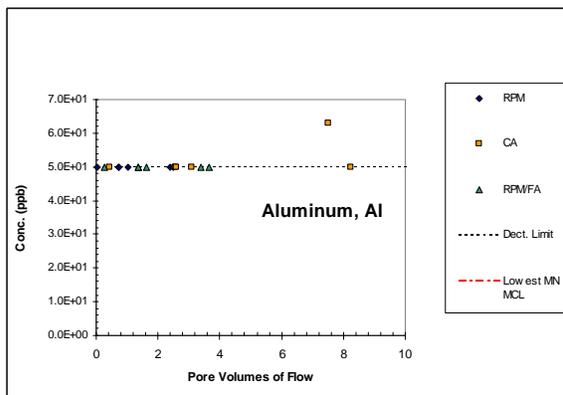
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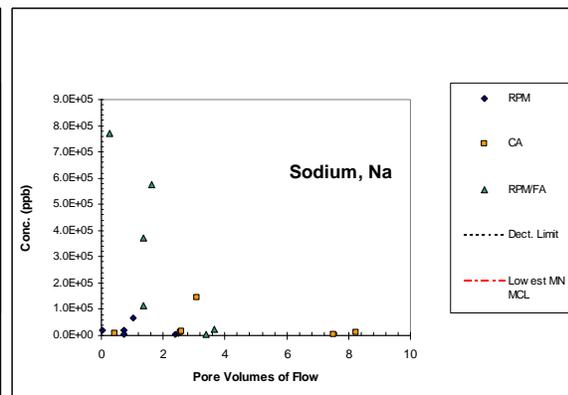
Figure 1.12 – Na Concentration

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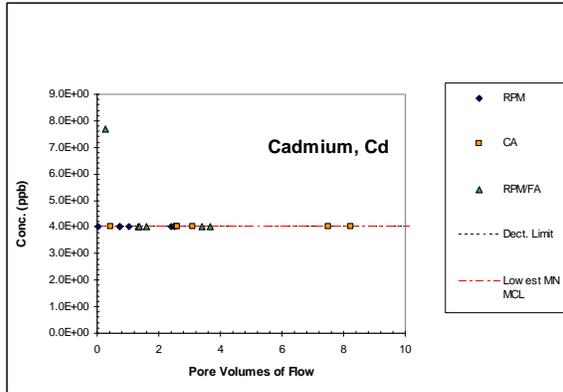
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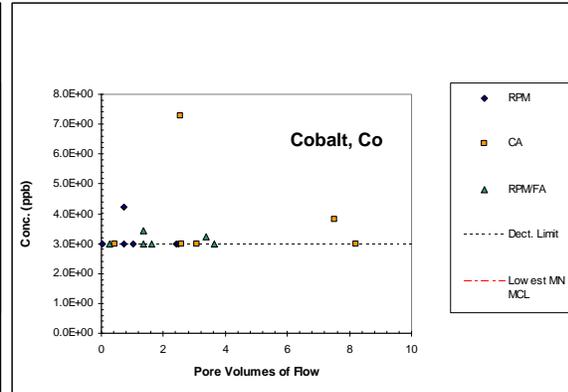
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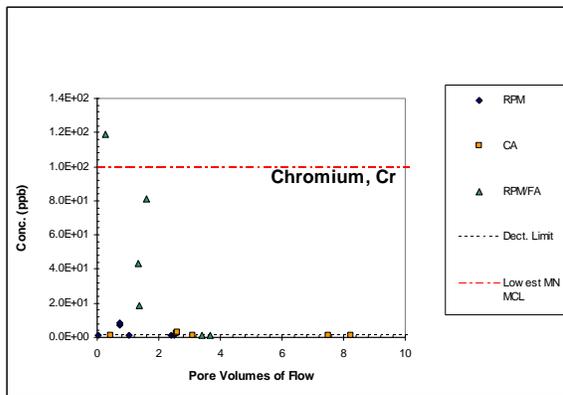
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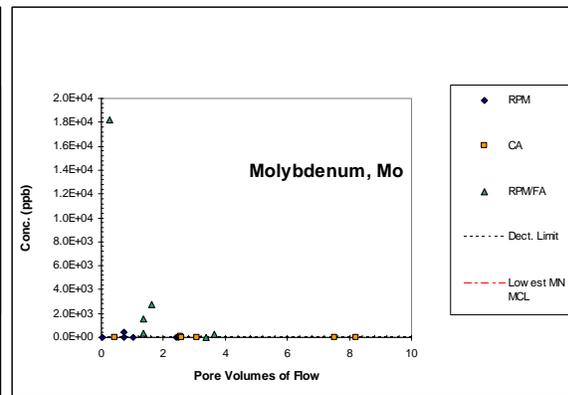
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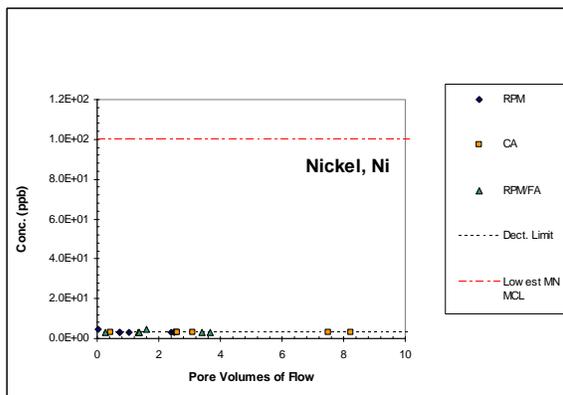
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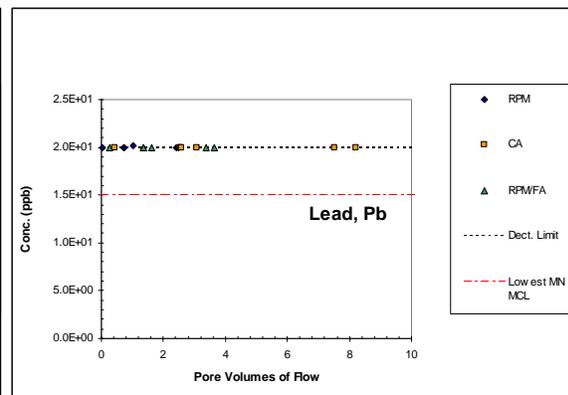
Figure 1.18 – Pb Concentration

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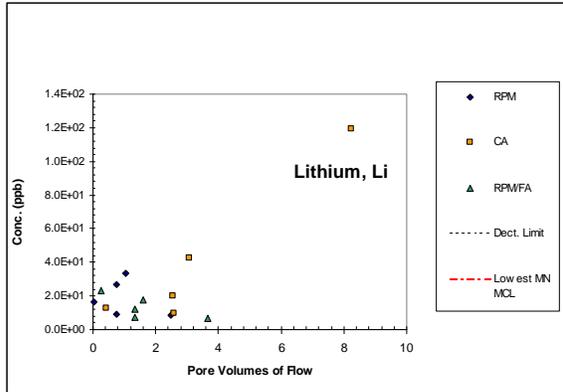
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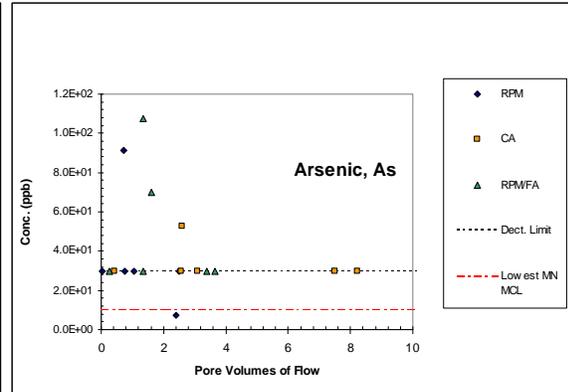
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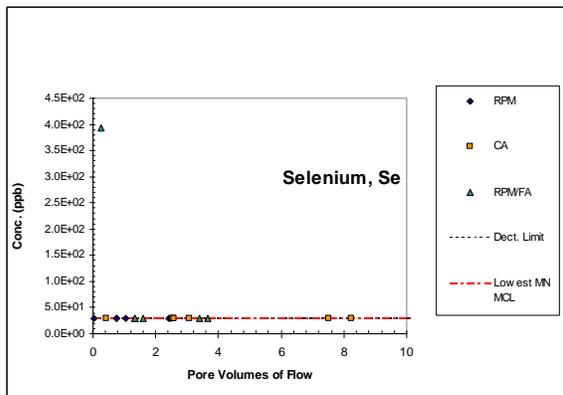
Figure 1.21 – Se Concentration
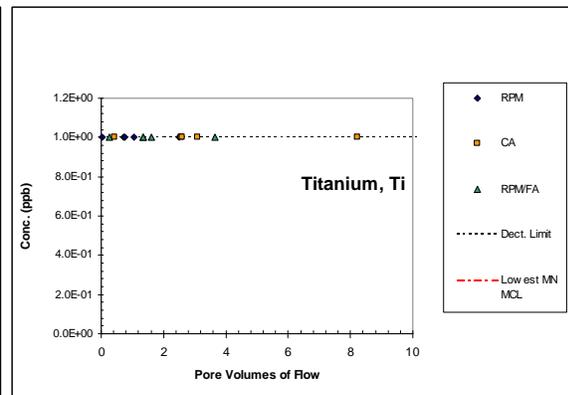
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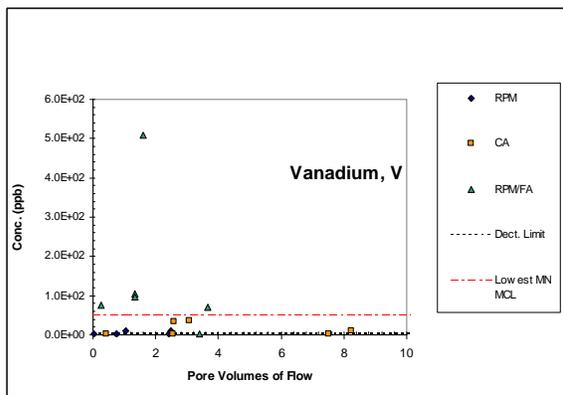
Figure 1.23 – V Concentration
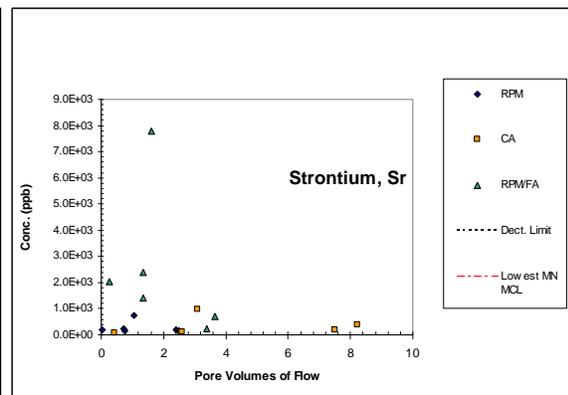
Figure 1.24 – Sr Concentration
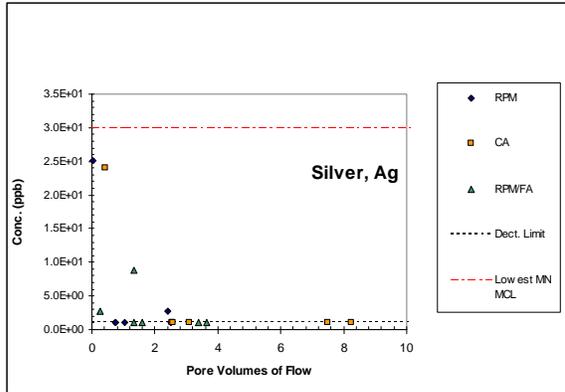
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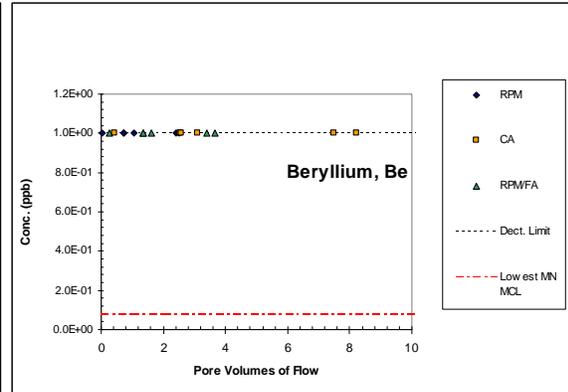
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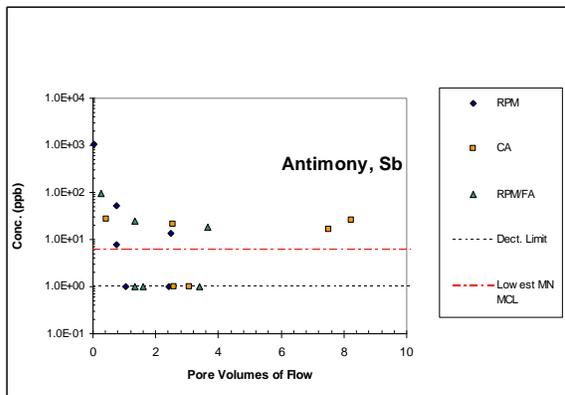
Figure 1.27 – Sb Concentration
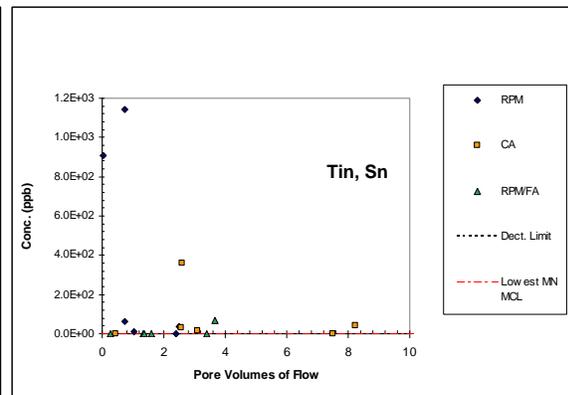
Figure 1.28 – Sn Concentration
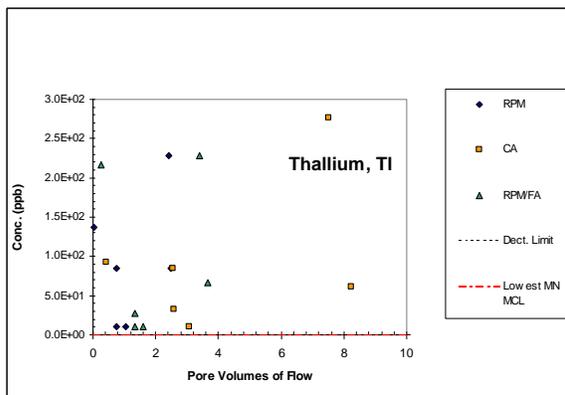
Figure 1.29 – Tl Concentration
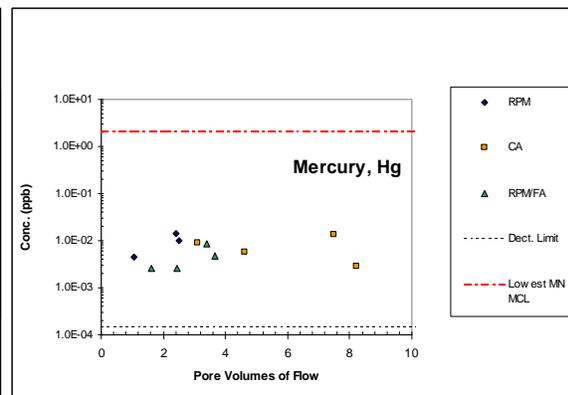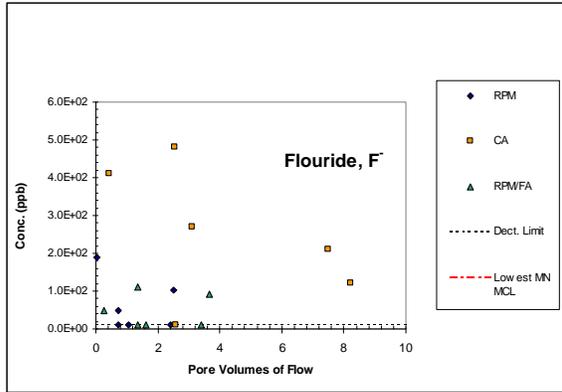

Figure 1.Hg – Cd Concentration

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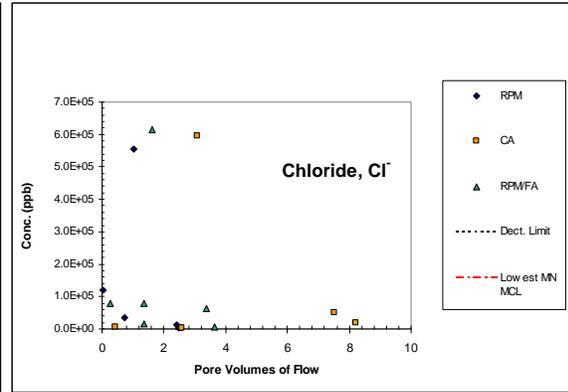**Figure 1.31 – Fluoride Concentration**

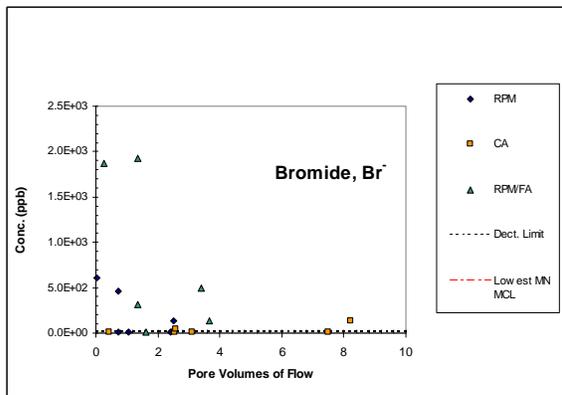**Figure 1.32 – Chloride Concentration**

Figure 1.33 – Bromide Concentration

Figure 1.34 – Nitrate Concentration

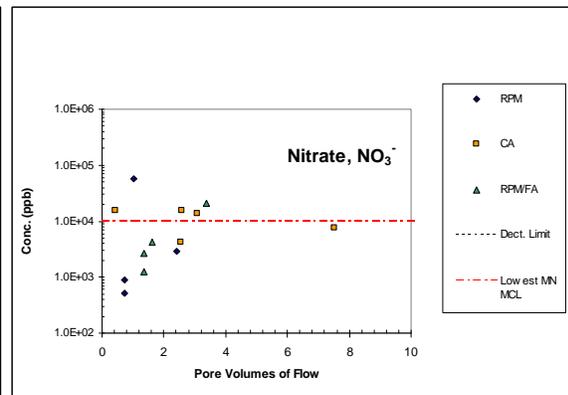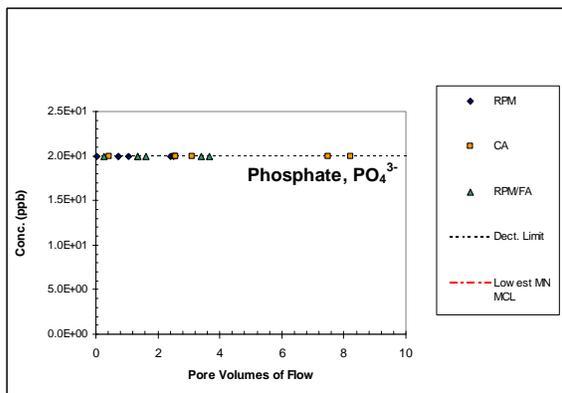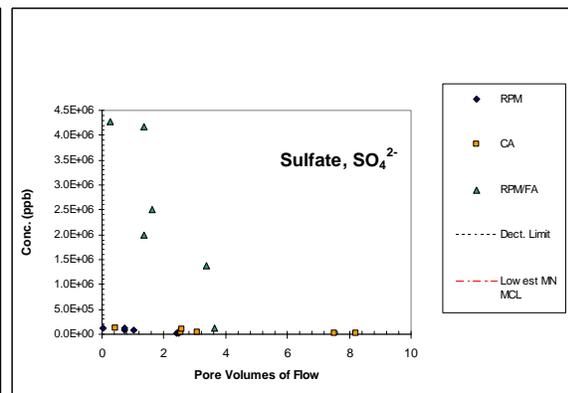**Figure 1.35 – Phosphate Concentration**

Figure 1.36 – Sulfate Concentration

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