

Bench Scale Biochemical Reactor Treatment of Uranium, Radium, and Selenium

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Presentation Overview

- Site Location / Background / Goals
- Biological Reactor (BCR) Overview
- Bench Testing Set-up
- Bench Testing Results
- Bench Testing Observations
- Path Forward



Site Location / Background / Goals

- Former vanadium mine
- Two adits
 - Adit 1 – Typically static (lower water quality)
 - Adit 2 – Typically discharging (higher water quality)
- Goals
 - Bulk removal (Uranium, Radium, and Selenium)
 - Low operations cost



Google earth V 7.1.2.2041. (October 7, 2013). Colorado USA
38° 17'39.46"N, 117° 38' 22.28"W, Eye alt 1184 mi.
DigitalGlobe 2013. <http://www.earth.google.com> [February 15, 2014].



Bench Test Set-Up

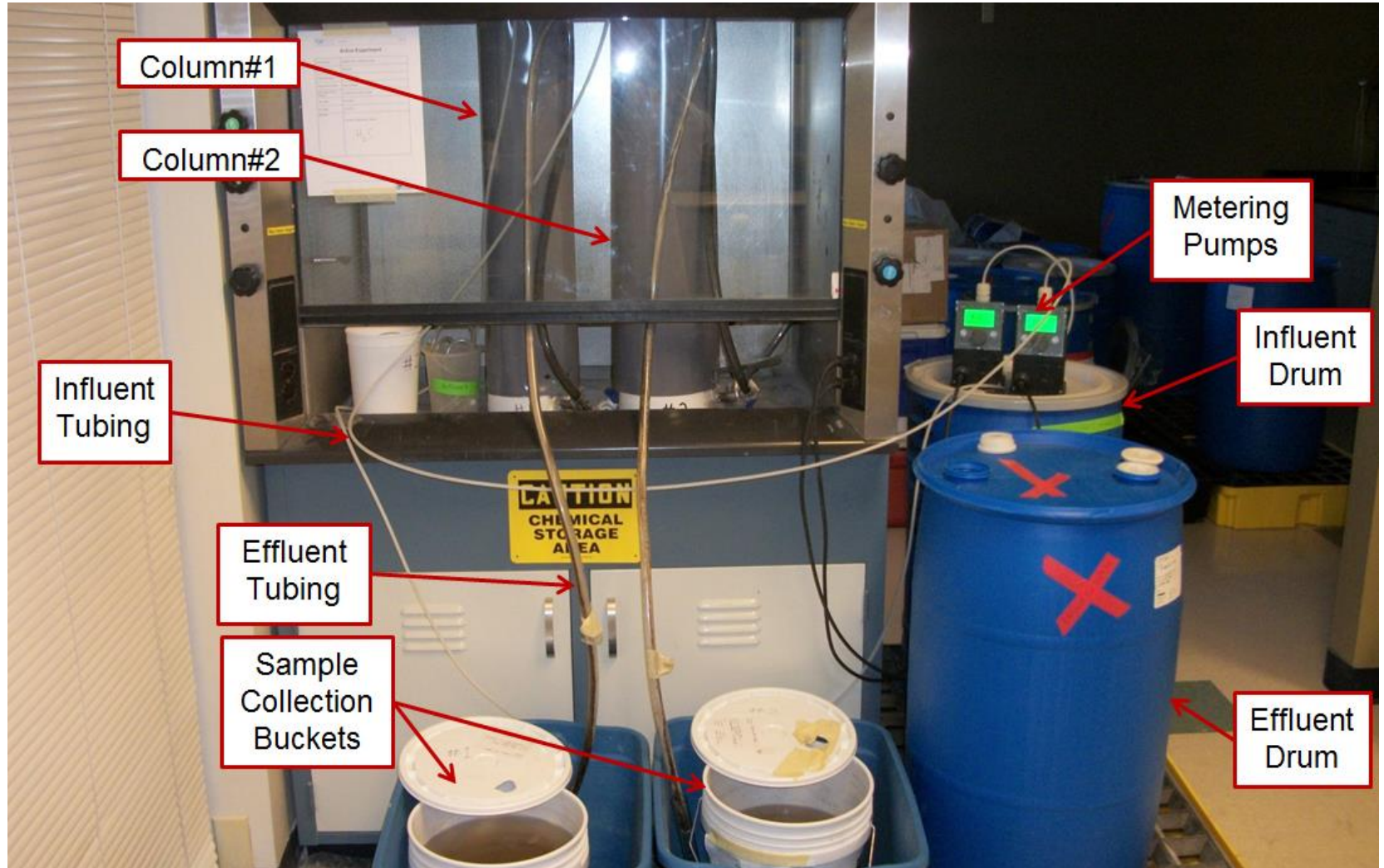
- Influent Feed Drum
- BCR Substrate

Substrate	BCR Column #1	BCR Column #2
Woodchips	79.5%	59.5%
Sawdust	0.0%	20.0%
Hay/Straw	10.0%	10.0%
Crushed Limestone	10.0%	10.0%
Sheep Manure (Inoculum)	0.5%	0.5%

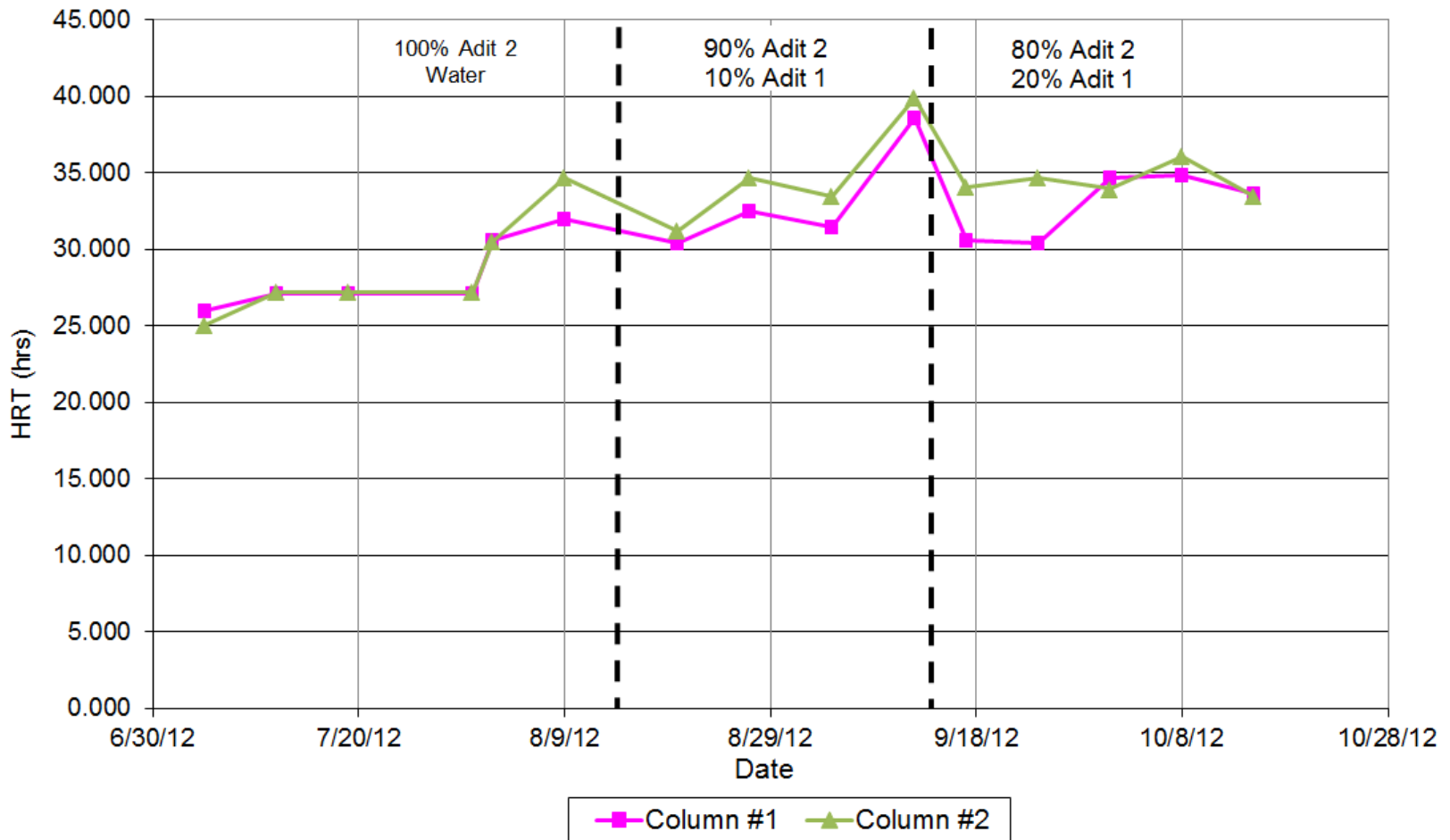
- Two 6-inch PVC columns to house the BCRs
 - Top-bottom flow
 - Diaphragm metering pump feed
- Effluent and sample collection containers



Bench Test Set-Up

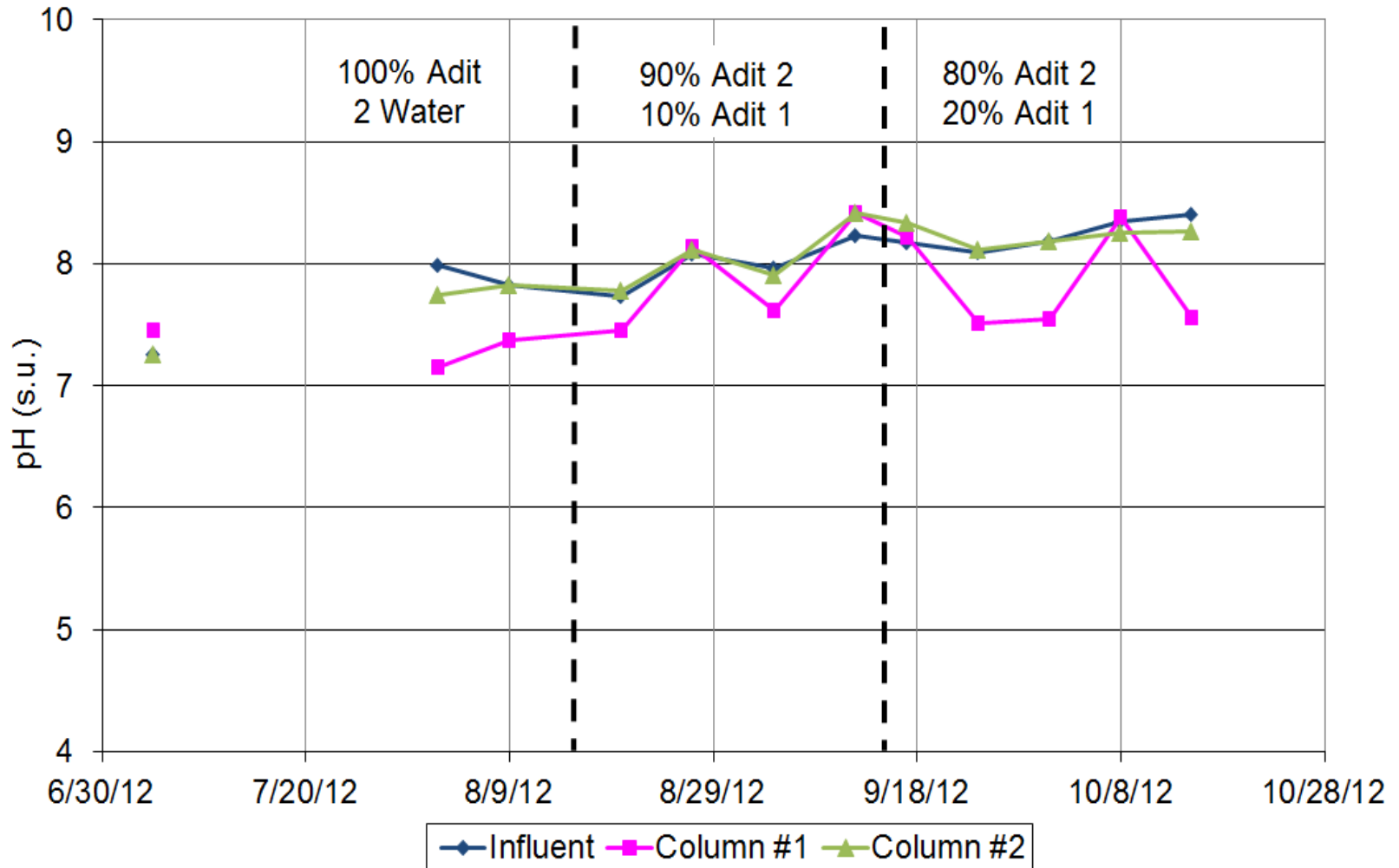


Bench Test Results - HRT



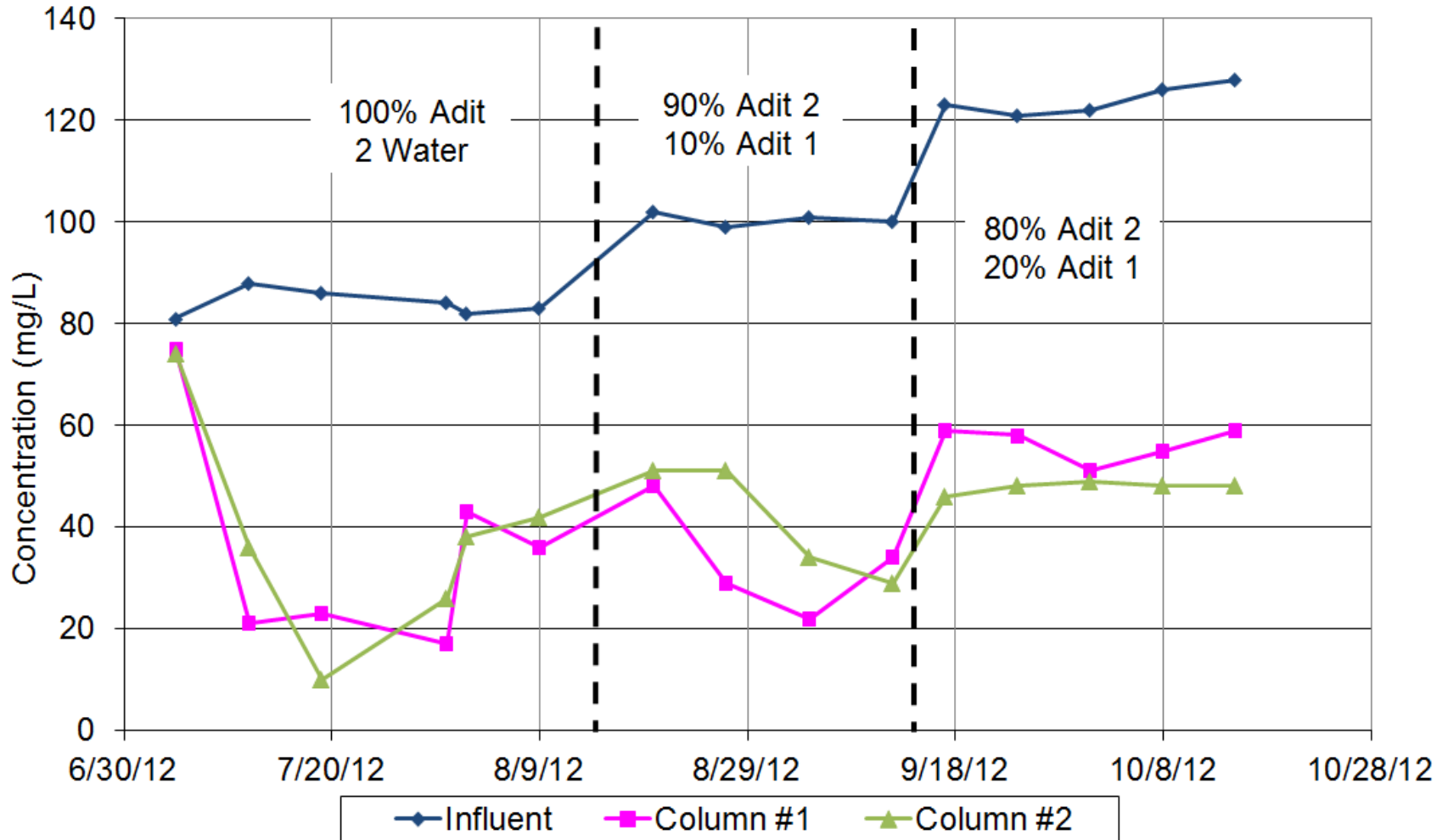


Bench Test Results - pH



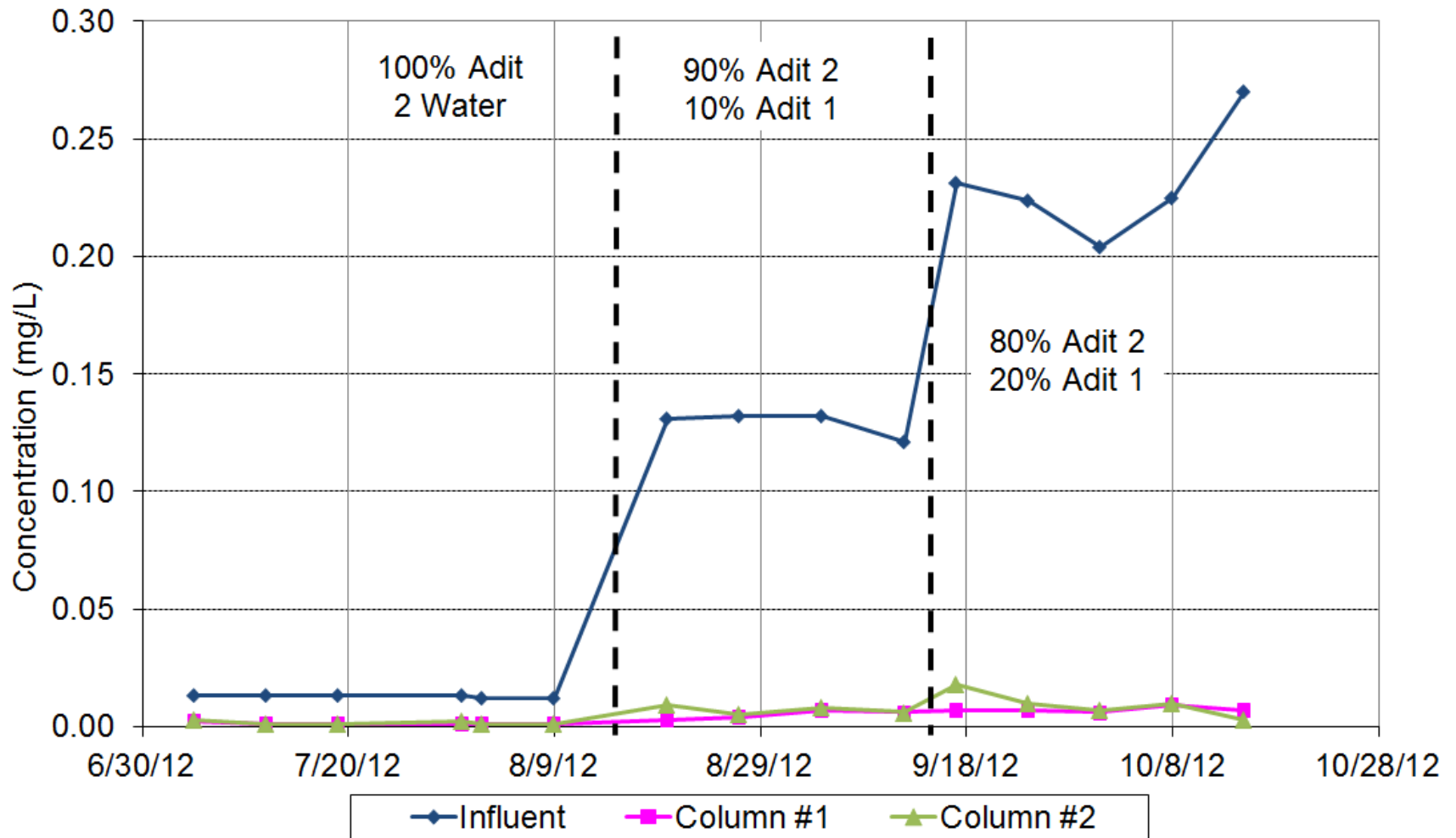


Bench Test Results - Sulfate



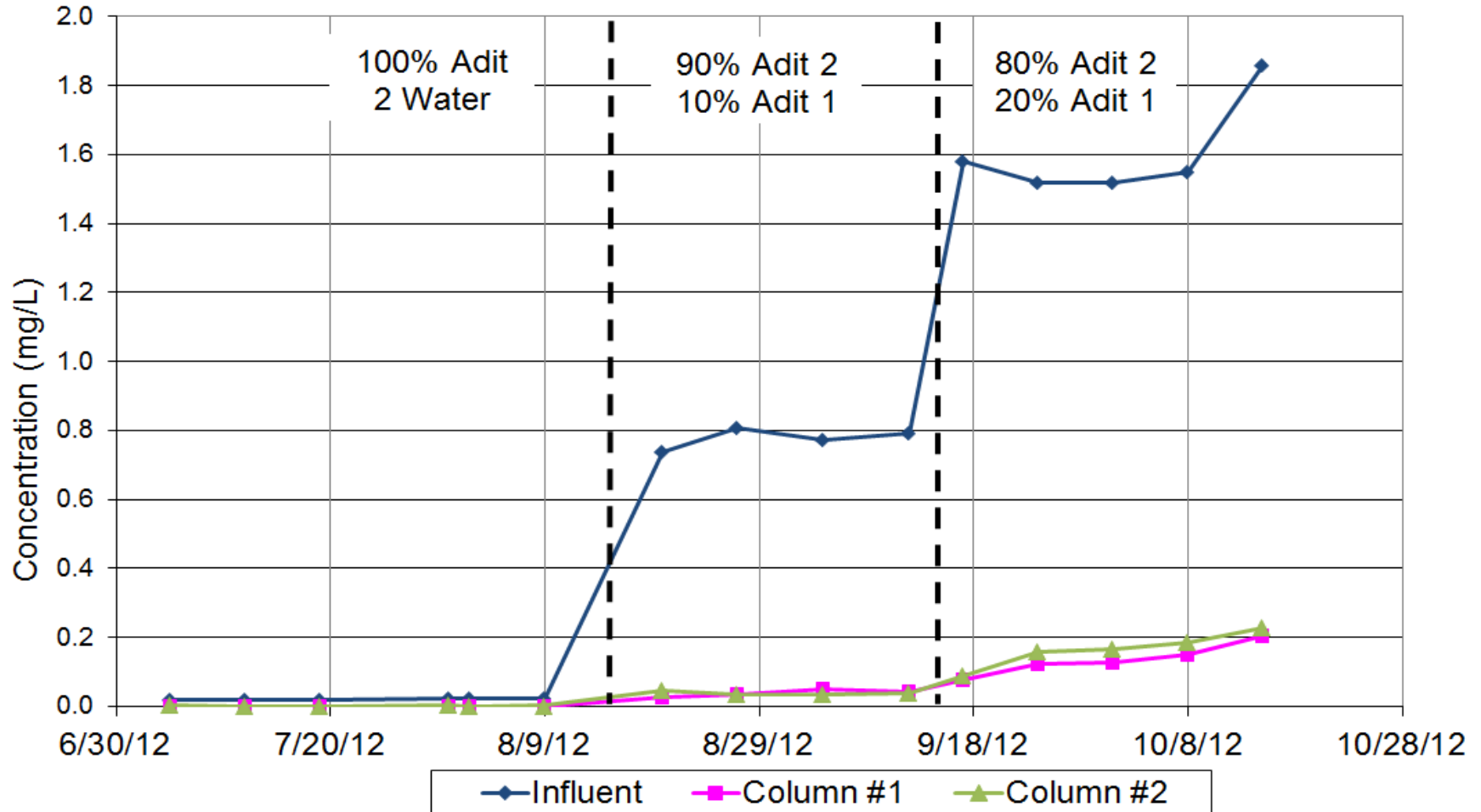


Bench Test Results – Diss Selenium



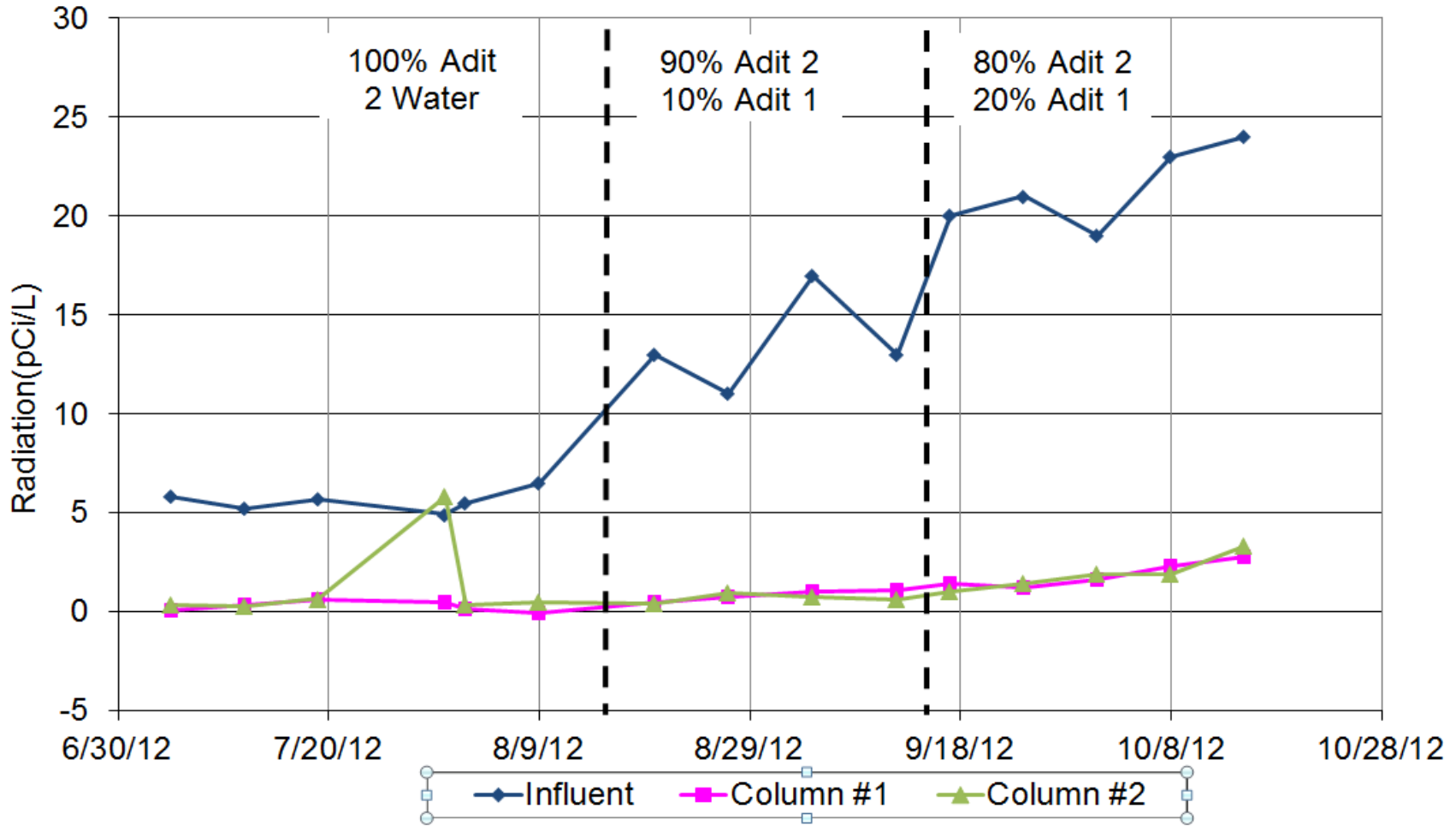


Bench Test Results – Diss Uranium



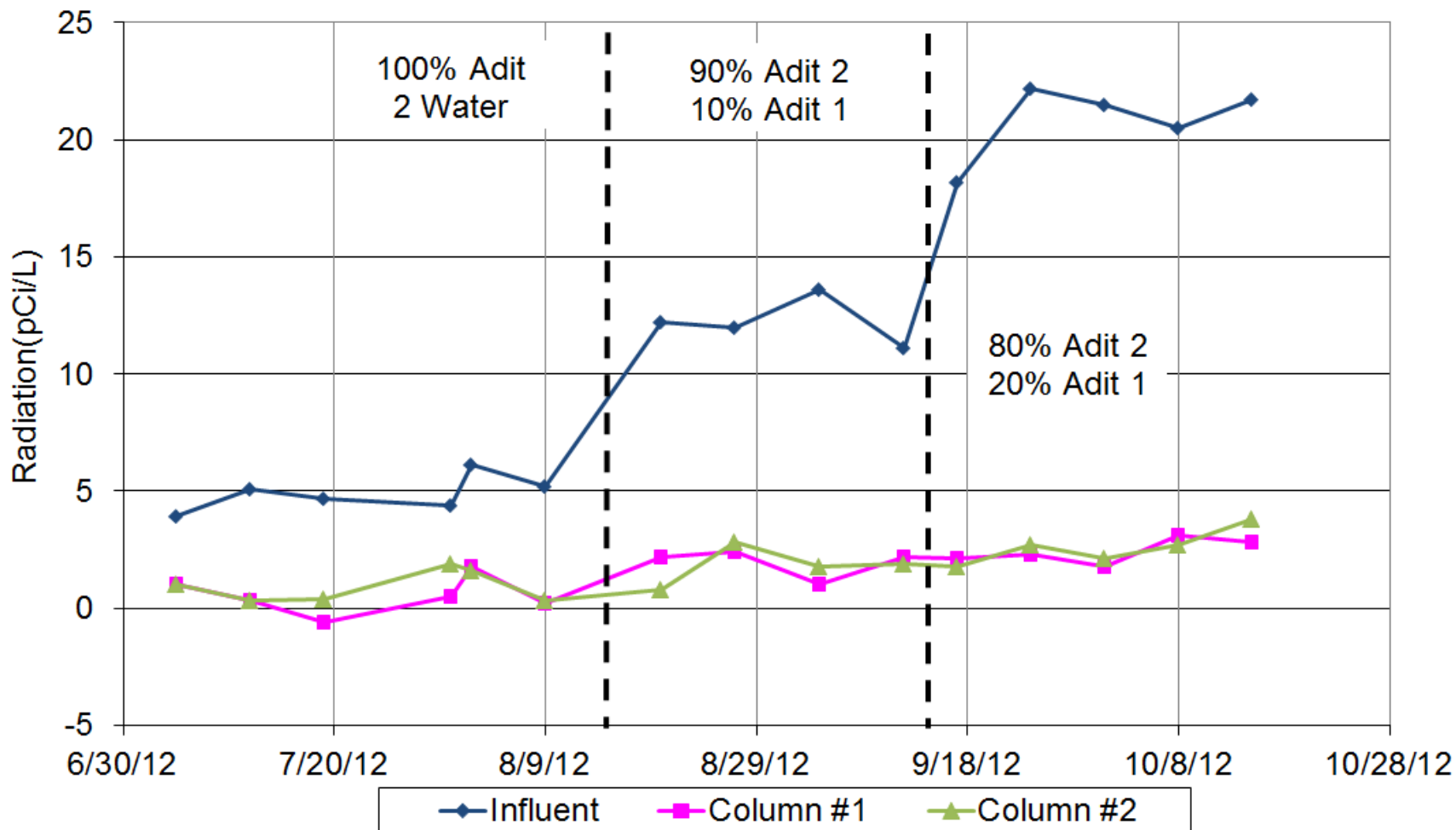


Bench Test Results – Radium 226



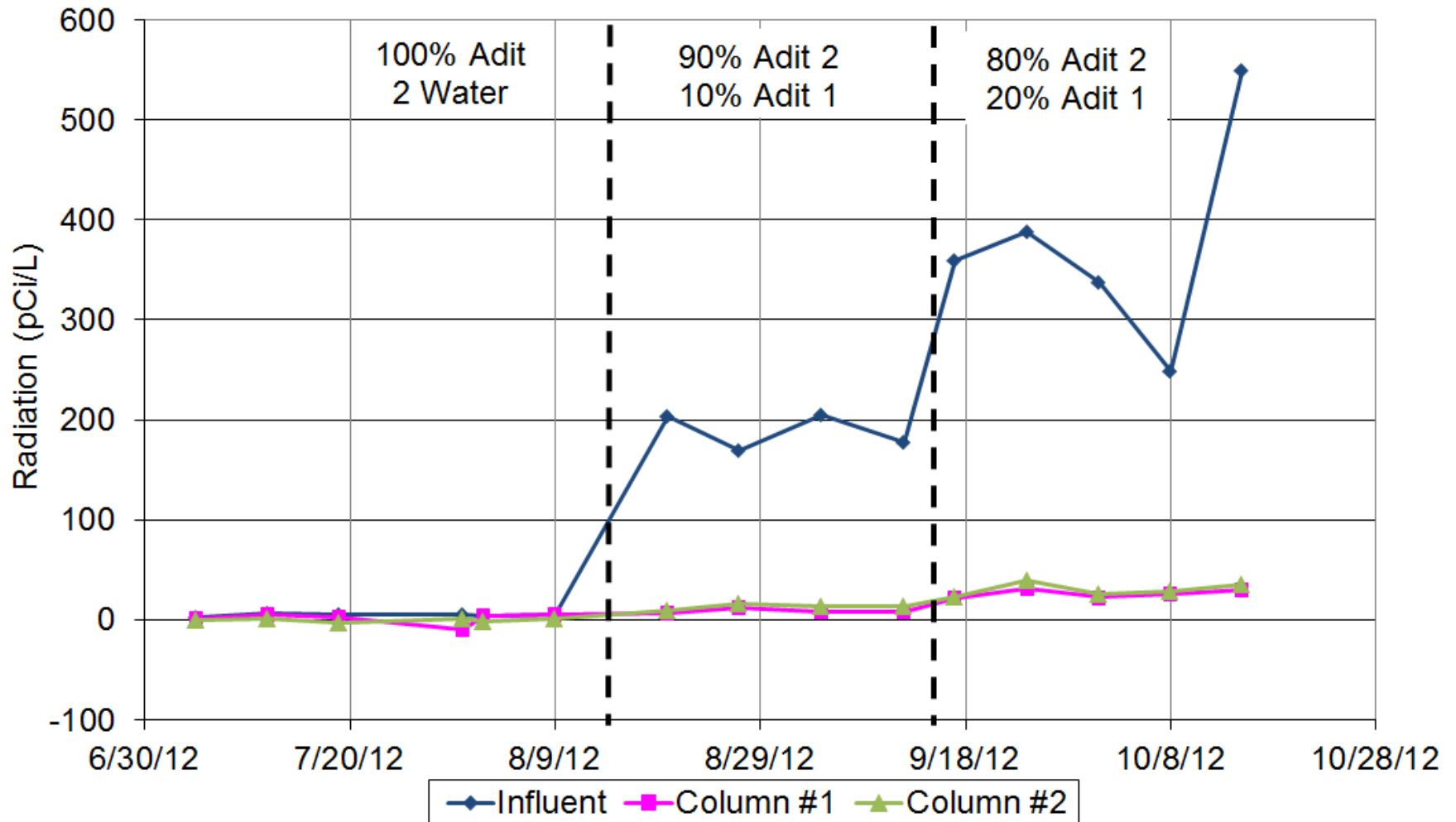


Bench Test Results – Gross Alpha





Bench Test Results – Gross Beta





Bench Test Observations

- Uranium
 - Average removal 93.6%
 - Maximum removal 98.5%
 - Removal to <0.3 ppb achieved during testing
- Selenium
 - Average removal 93.3%
 - Maximum removal 98.9%
 - Removal to <1 ppb during testing
- Radium
 - Average removal 89.5%
 - Maximum removal 100%
 - Removal to 0.07 pCi/L achieved during testing
- Substrate longevity estimated around 15 years (based on sulfate reduction rates)



Path Forward

- **Pilot or Full Scale Design**
- **Pilot or Full Scale Construction**



THANK YOU!

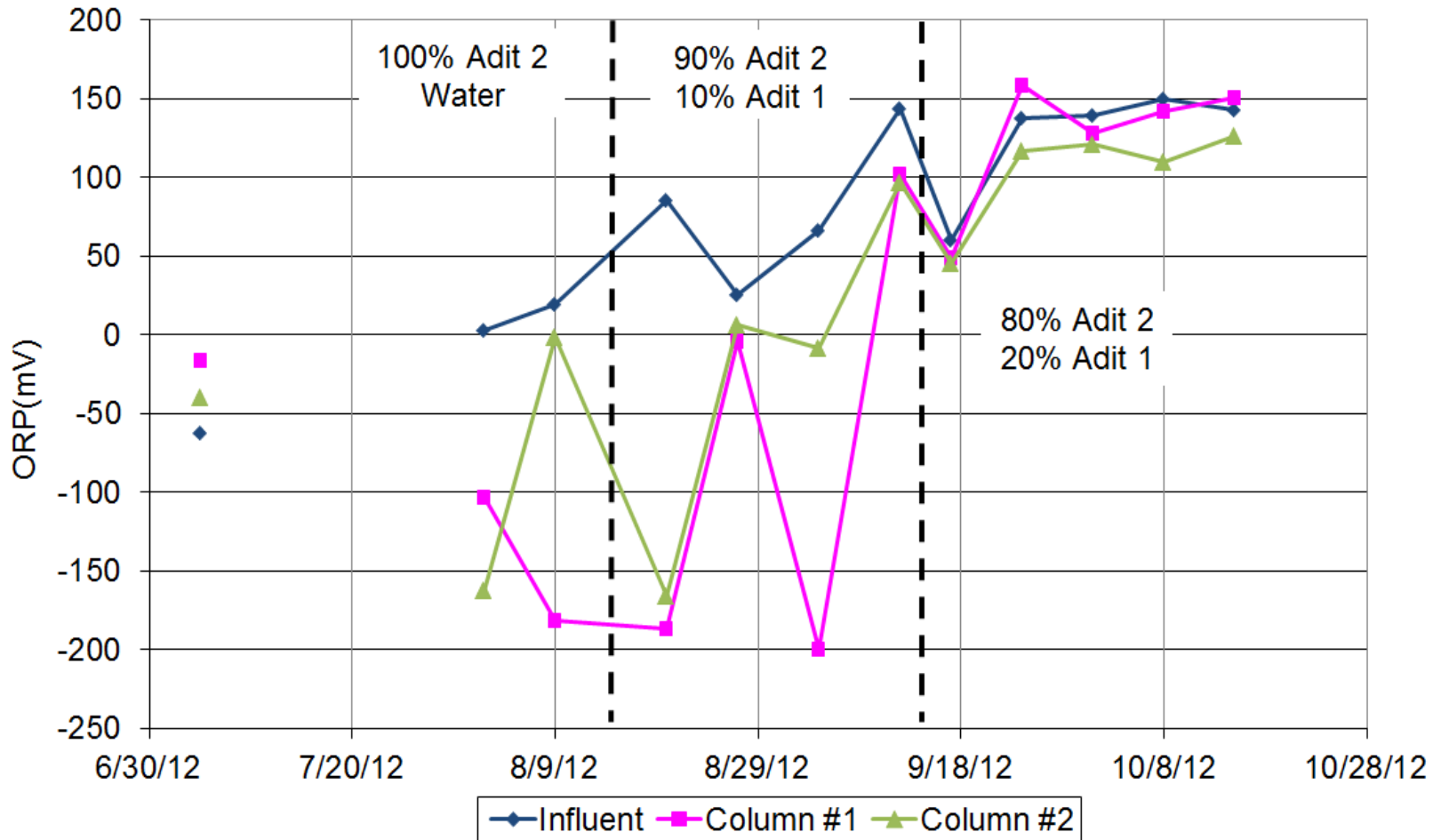
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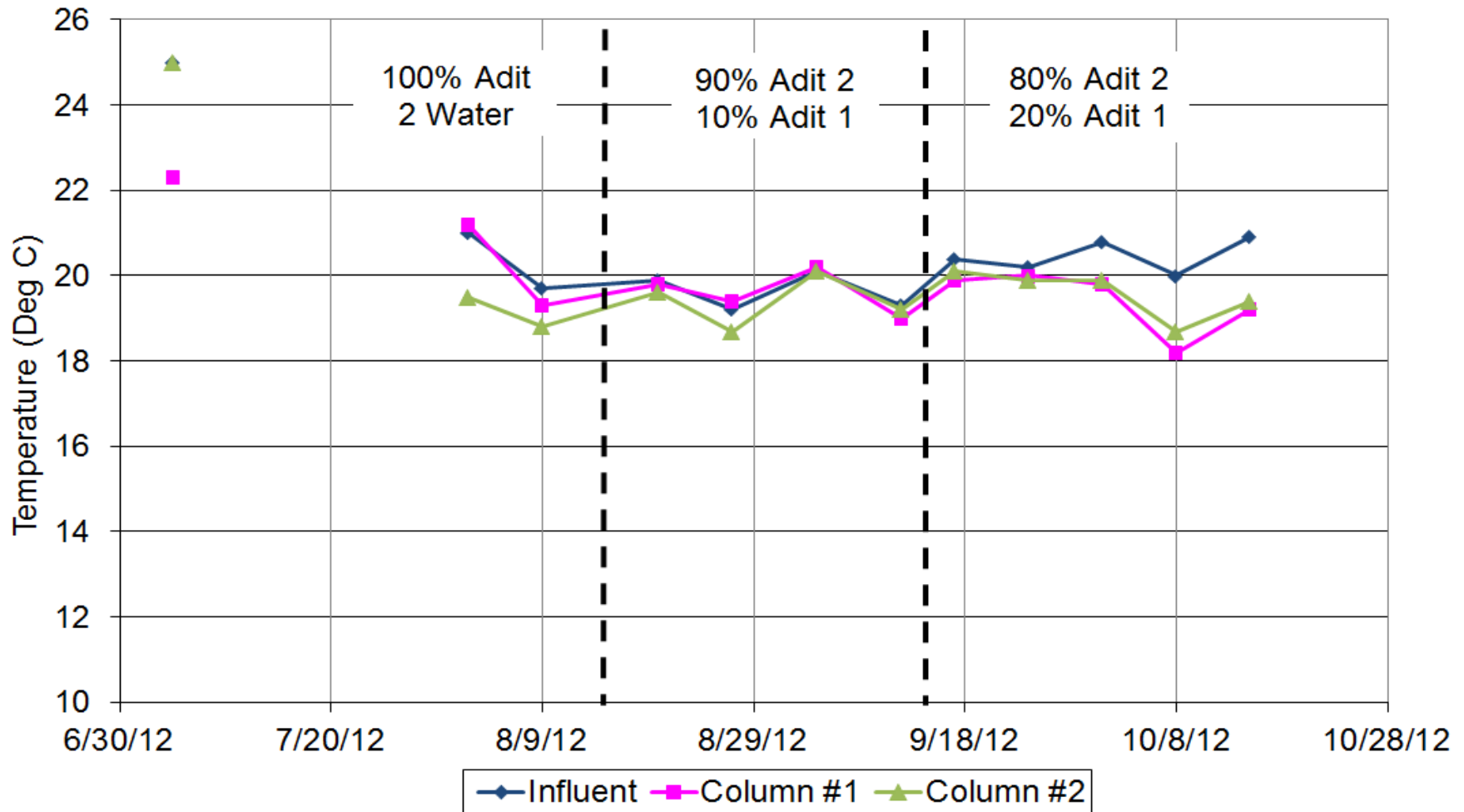


Bench Test Results - ORP





Bench Test Results - Temperature





Bench Test Results - Conductivity

