A research project was conducted by UCF on behalf of the United States Navy with regards to the water supply on the island of Guam with the Marianas Islands and included three components of work. In the first and primary component of the research, surface water from Fena Lake located within the Naval Magazine in proximity of Santa Rita, Guam was collected at different lake depths and initially analyzed for iron and manganese using inductively coupled plasma (ICP). The samples collected were transferred to jars then dosed with varying amounts of KMnO4 after which iron and manganese content was determined. The jars were covered to simulate actual lake to plant transfer conditions experienced at the Navy’s facilities. The water samples were then coagulated with aluminum sulfate prior to filtration to remove the oxidized manganese and iron formed from the addition of the KMnO4. Coagulated aliquots were filtered and collected to evaluate residual dissolved iron and manganese content. Based on the results of the jar tests it was determined that manganese was reduced by 95% or greater and that iron was completely removed to below the analytical detection limit (0.001 mg/L). It was determined that the dose required for oxidation of iron was 0.94 mg/mg iron and for manganese was 1.92 mg/mg manganese. If the water was overdosed with KMnO4 the water may turn pink. The pink water is an undesired characteristic and could result in customer complaints when distributed to the system.

The second component of research focused on the NWTP. Water samples were collected after each key unit operation within the NWTP and analyzed for iron and manganese. This was to create an iron and manganese profile throughout the plant as well as to verify if pre-chlorination at Fena Lake was effective at removing iron and manganese that could be present in the source water. Analysis was conducted where pre-chlorination at Fena Lake was practiced as well as when no pretreatment was practiced prior to the NWTP. It was determined that the iron and manganese were not detected downstream of the coagulation unit operation within the NWTP.

A third study was also implemented to confirm that 0.1-micron filters are appropriate for use in preparing samples for analytical determination of iron and manganese analysis at various points of the NWTP. Standard Methods 3120B recommends the use of 0.45-micron filters, although based on literature it has been shown that oxidized manganese particles may be smaller than a 0.45-micron pore size. Unless a coagulant was used, the oxidized manganese may not be fully removed via the 0.45-micron filter. A jar test was conducted to compare the use of a 0.1-micron filter, a 0.45-micron filter, and a 0.45-micron filter after the sample has been coagulated. It was found that the use of a 0.1-micron filter was superior to the use of 0.45-micron filters when directly comparing between dissolved and suspended iron and manganese forms. It is recommended that 0.1-microns be utilized instead of historically recommended 0.45-micron filters for sample preparation procedures.

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Approved for distribution by Steven Duranceau, Committee Chair, on February 24, 2014.
The public is welcome to attend.