Methods of optimizing the coagulation, flocculation, sedimentation, and filtration (CSF) process at a conventional surface water treatment plant (WTP) were conducted to investigate opportunities for the reduction of disinfection by-product (DBP) precursor material. The research had two primary components: (1) optimize coagulant dosage and associated operating pH and (2) investigate pretreatment oxidation with chlorine dioxide (ClO2) and potassium permanganate (KMnO4). To accomplish the first component, jar tests were conducted at various pH and aluminum sulfate (alum) dosages to model current and potential treatment conditions during the CSF process at a WTP. Isopleths were developed to examine the removal efficiencies of turbidity and natural organic matter (NOM). NOM is a DBP precursor material and was represented by non-purgeable dissolved organic carbon (DOC) throughout the research. Isopleths indicated that at pH 6.2 and a corresponding alum dosage of 20 mg/L (control condition), turbidity and DOC were reduced by 90 and 35 percent, respectively. However, at pH 5.5 and 30 mg/L alum dosage, turbidity removal decreased to 80 percent whereas, DOC removal improved to 50 percent. Jar testing was conducted to evaluate differences in the use of KMnO4 and ClO2 as a pretreatment chemical to observe the reduction of DBP precursor material (i.e., NOM), dissolved iron, and dissolved manganese. Addition of ClO2 was able to reduce total trihalomethanes and haloacetic acid formation potentials (168-hours) up to 40 percent and 15 percent, respectively, and was dependent on chlorine dioxide generation method, dosage, and raw water characteristics. Chlorine dioxide also was shown to remove iron and manganese at levels greater than 99 percent.