Soil characterization is one of the many issues addressed using forensic chemistry techniques. In this study, soil pH, settling rate, and gas chromatography using a flame ionization detector (GC-FID) are examined to investigate what effects on-site weathering and soil sample storage conditions have on the results of subsequent chemical analyses in the laboratory. Samples from several simulated “crime scene” sites in West-Central Illinois are tested to see if soil chemistry results change over the course of several weeks, as new aliquots are taken and tested from each individual (storage and on-site) environment. This study assesses whether soil characterizations based upon pH, settling rate, and GC-FID data may be substantially affected by the timing of collection or storage conditions of soil samples submitted for comparative testing in forensic cases.