ESTABLISHMENT OF BASELINE SOIL SALINITY TRENDS FOR THE DEVILS LAKE WATER UTILIZATION TEST PROJECT

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ABSTRACT

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The water level of Devils Lake, a closed basin situated in northeastern North Dakota, is highly influenced by climatic variability. During the present wet cycle, which began in 1993, the water level of the lake has risen 7.8 m. This extraordinary increase has resulted in substantial flooding that has locally devastated agriculture, homes, businesses, roads, etc.

The goals of the Devils Lake Water Utilization Test Project are to evaluate the benefits and sustainability of the use of extensive irrigation to utilize excess surface waters in the basin. The use of irrigation as prescribed in the test project has potential implications for the areal and temporal distribution of soluble salts in the soils of the 10 research sites. As water is applied in excess of crop uptake, salts may dissolve and translocate within the soil profile or landscape. Assessment of irrigation-induced spatio-temporal change in soil salinity is critical to reliably evaluate the edaphic sustainability of the practice.

A combination of field-scale and site-specific techniques was used to assess soil salinity conditions for each of the test sites prior to irrigation. A Veris 3100 Soil EC Mapping System was used to quantify field-scale spatial patterns in salinity. The Veris system functions by introducing an electrical current into the soil and collecting georeferenced apparent electrical conductivity (EC_a) data at one-second intervals. Results from the EC_a surveys conducted between spring 2005 and spring 2006 indicate that the mean deep values exceeded the mean shallow values for most surveys. Among the soil

properties that were strongly correlated to EC_a ($R^2 \geq 0.60$) were EC_e, $EC_{1:1}$, SAR, TDS, SO_4^{2-}, Mg^{2+}, and Na^{+}.

Data from the initial EC_a surveys were used to identify gradient transects and broader zones for site-specific soil sampling. The soil salinity transects were originally sampled in 2005; a limited resampling of transect points occurred in spring 2006. Data from this sampling revealed a discernible increase in mean EC_e with depth. The shallow sample depth yielded the fewest mean EC_e values in the saline class (≥ 4 dS m^{-1}) while the deep sample depth provided the most. A similar trend was also observed among the 15 soil salinity zones that were sampled in spring 2006.

This study proposes a multi-faceted approach to assess temporal change in soil salinity that utilizes both EC_a surveys and EC_a directed soil sampling data. At the conclusion of the test project, determination of temporal change between EC_a surveys will be accomplished through the use of a non-interpolated grid system and application of a percent matching scheme. A similar scheme will also be employed for the soil salinity transects. Temporal differences between mean salinity zone values will be determined through a simple t-test of means. By utilizing several techniques, it is expected that the probability of capturing irrigation-induced changes in soil salinity will be substantially increased.