Development of a Watering Regiment for *Quercus engelmannii* (Engelmann oak)
Using Edaphic Factors
Research Agreement Number 09-000067-04
Summary Report
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The following statement from the executive summary of the grant proposal summarizes the scope of the project: "Proposed acquisition and installation of equipment, and analyses of edaphic factors will be accomplished in the first year; field observations and collection of data will begin in the first year and continue for several more, but transcription of the data into a useful watering regiment reference document in both print and electronic format will be on-going for at least two to three years, none of which will rely on current funding or future funding from Saratoga Horticultural Research Endowment."

The three project goals with summary statements are:

Goal I: Gather soil characteristics, soil moisture and climate data.

- Assess soil properties with "bulk density, water holding capacity, volume percentage airspace at capacity with percolation rate" test—which will provide valuable information to guide frequency and duration of supplemental irrigation.
  - *The comprehensive soil analysis package conducted on 13 samples included: half saturated %, saturated extract pH, salinity, potassium, calcium, magnesium, boron, sodium, sulfate, SAR, pH, organic content and particle sizes. The originally proposed test is applied only to artificial media. Results were interesting. Observation led me to believe the site contains different soil classifications but all returned as sandy loam. One has a significantly reduced organic content, making it appear to have a different classification. 10 of 13 samples are deficient in nitrite and nitrate nitrogen. Phosphate phosphorus is normal in all samples. Potassium is excessive in all samples and zinc is excessive in 10 of 13 samples. The balance of the nutrient analyses showed a mixture of normal, excess and below optimum results. pH ranges from 5.3 to 7.5. All of these data are useful for understanding health and vigor of the trees.*
- Acquire and install tensiometers throughout the 6-acre site on 100-foot centers to provide valuable soil water capacity that will aid the decision-making process for supplemental irrigation; this density is required because the soil on the side is highly variable.
  - *13 tensiometers were purchased, 7-12" (to measure available upper root-zone moisture) and 6-24 inch (to measure available lower root-zone moisture). The units were acquired too late in the season to be of use. And, rainfall was well below normal, providing only 2 significant accumulations which would have provided only minimal data for analysis.*
- Acquire and install a weather station that will provide site-specific climate data that will guide supplemental irrigation.
  - *A more simplistic weather station model than was specified in the grant proposal was purchased that captures only the essential data required: temperature, rainfall, wind speed and wind direction. It is solar powered and transmits data via 4G connection. I downsized the weather station model because I was concerned about security of an expensive unit in the remote location containing the Engelmann oak grove.*

Goal II: Improve health and vigor of trees.

- Use data from soil analyses, tensiometers and weather station to inform decisions about watering regiments to improve tree health and vigor.
  - *This is a longer term goal that can be realized only after several years of data accumulation and analyses.*

Goal II: Develop a watering regiment based on measurement of edaphic factors for Arboretum use and to educate the public about appropriate water needs of Engelmann oak.

- Gather field data from aforementioned protocols and translate into a watering regiment that becomes the best management watering practice for Arboretum use and for the public who currently either ignore Engelmann oaks entirely because they are perceived to be completely "drought tolerant" or water regularly as part of their overall landscape irrigation cycle(s). This will be done with on-site sign, publications, tours, talks and our web site.
  - *All media programs that emphasize recommendation based on new site data are longer term objectives because they, like the general recommendation of Goal II, require several years of data. General tours and talks continue as they have for the past several years. The Arboretum web site has a section dedicated to Engelmann oaks and will continue to be the repository of information pertaining to our Engelmann oak grove. The on-site sign is in fabrication and will be installed in September. It describes the plight of Engelmann oaks, IUCN Red List's vulnerable status designation and a brief summary of the conservation management program at the Arboretum. And, it is the Arboretum's first interpretive sign to focus on conservation.*

Year of acquisition of equipment and analyses of soil
Tensiometers, weather station acquired and set for installation this fall
Sign designed and in fabrication for installation shortly
Soil samples taken for composition and nutrient content

As noted in grant proposal, the components from this grant will be part of a long-term assessment program to collect data from the tensiometers and weather station to determine optimal guidelines for supplemental irrigation of the Engelmann oak grove