SECTION VIII ELEVATION OF SEASONAL HIGH GROUND WATER TABLE

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A. Introduction

Predicting the elevation of the seasonal high water table (SHWT) is necessary in order to ensure that an adequate depth of unsaturated soil will exist below an SWAS. There are basically two methods for making such predictions: measuring the depth of ground water in a monitoring well during the annual period of seasonally high ground water, and by evaluating redoximorphic features (RMF) in the soil. Neither of these methods is foolproof, and thus prediction of the SHWT is not an exact science.

B. Measurement of Depth to SHWT

Ideally, installing ground water monitoring wells at a proposed SWAS site and determining the depth to the water in such wells during the period of maximum seasonal high ground water would be the method of choice for determining the SHWT. However, this can only be done during a short period of each year, and the likelihood that the maximum SHWT will be encountered at the site being investigated during the period of such investigation is problematic, due to annual variations in the SHWT**.** One method that may resolve this problem in a reasonable manner is discussed below.

Frimpter (1983) developed a method for the estimation of maximum ground water levels at any time of the year in Massachusetts based on statistical analyses of ground water observation well records for different hydrogeologic situations common in Massachusetts. He stated that an estimate of the probable high ground water level at a site could be made on the basis of the assumption that water level fluctuations at the site are directly correlated with water-level fluctuations at a selected observation well. The method developed involves adding an estimated potential rise to the water level currently measured at a site. However, the method developed by Frimpter cannot be currently used in Connecticut because similar statistical analyses of observation well records in Connecticut are not available. The Department may consider an adjustment for on-site water table measurements made using the following relationship:

Depth to SHWT on-site = Current depth to WT on site x (minimum depth to SHWT of record at the Index Well Site / current depth to WT at the Index Well Site).

The data for the Index Well(s) SHWT can be obtained from U.S. Geological Survey (U.S.G.S.) records. The U.S.G.S has maintained and published ground water level records for 71 wells in Connecticut. Records for selected locations in Connecticut were published monthly, beginning in 1967, in “Water-Resources Conditions in Connecticut” until September 1999, after which the data were made available on the Internet (http://waterdata.usgs.gov/ct/nwis/gw). In addition, ground water level data for the period 1935 - 1974 were published as Water-Supply Papers under the title “Ground-water Levels in the United States”. Ground water level data are given in feet below land surface.

The published data on ground water levels includes: current month water level and date measured, the water level in the same month of the previous year, the previous month water level, the maximum and minimum water levels in the period of record for the current month, and the median water level for current month. Graphs are given for selected wells depicting the highest, lowest and monthly median water levels of record and the water levels in the current and previous year. Information is also provided on precipitation records maintained for the primary and several secondary weather stations in the State.

More complete ground water data, for all of the USGS ground water monitoring well sites, are available in the annual USGS Water-Data Report publication "Water Resources Data-Connecticut" (U.S.G.S.-Annual Publication). This data includes descriptions of well location, descriptions of the aquifer soil, well characteristics, datum, period of record and extremes for period of record and may prove helpful in evaluating the suitability of using a particular USGS ground water monitoring well as an index well.

The current number of monitoring wells in each county of the State, and the aquifer types represented are shown in the following table.

TABLE 1

U.S. GEOLOGICAL SURVEY GROUND WATER MONITORING WELLS IN CT

AQUIFER TYPE

COUNTY	STRATIFIED DRIFT	TILL	BEDROCK
Fairfield	3	1	3
Hartford	7	6	0
Litchfield	4	1	0
Middlesex	4	5	0
New Haven	8	4	2
New London	3	2	0
Tolland	8	4	0
Windham	5	1	0
Totals:	42	24	5

The index well sites should be carefully chosen so as to be representative of the climate, soil and topographic conditions at the project site. The current SHWT at the project site should be determined from water level measurements made in the on-site water table monitoring wells during the wettest season of the year, which usually occurs from late February through the end of April of each year.

A review of precipitation data should also be made, to determine if the preceding annual total precipitation was at, below, or above the mean annual precipitation for the locality in which the SWAS is proposed to be located. The same determination should be made for the location of the Index Wells. If the preceding annual total precipitation data at the site of the proposed SWAS are not similar to the data at the Index well, the results of the calculation of SHWT at the project site will be suspect.

C. Predicting SHWT Using Redoximorphic Features (RMF)

Predicting the SHWT using RMF, although often used, is not a foolproof method, as is indicated by the following review of published articles.

Soil color criteria (reflecting redoximorphic features) developed by the NCRS can be used to predict the level of the maximum SHWT. Redoximorphic features, (a gray or bluish-gray colored soil matrix), and mottles are formed by the process of reduction, translocation and/or oxidation of iron and manganese oxides. They can be categorized as redox (oxidation/reduction) depletions and redox concentrations (low and high chroma mottles, respectively) and a gleyed (grayish or bluish-gray colored) matrix. When the soil becomes saturated, oxygen is depleted, and organisms reduce soil iron from the ferric form which is red-orange and insoluble to the ferrous form that is soluble. The ferrous iron can leach away leaving a duller colored area behind. Intermittent wet and dry periods lead to mottled duller and brighter areas, and the upper limit of these mottles has been used to predict the seasonal high water table. Soils with black surfaces and no bright colors at all in the profile usually have a very high water table.

The NRCS recognizes soil matrix or mottle colors of chroma 2 or lower, (gray colors), as indicating horizons that are saturated for at least part of the year. However, using this method to determine the SHWT may sometimes lead to serious overestimation or under-estimation of the SHWT (Cogger-1985). Two problems arise when estimating seasonal high water tables from redoximorphic features (RMF). First, it has been shown that color criteria are not always a good indicator of seasonal high water tables, and second, it is not clear what duration of high water tables will lead to inadequate treatment of wastewater (Cogger 1989).

Warkentin and Harward (1978) stated that depth to mottling is a useful tool but not an infallible one, and we need to understand its limitations. Depth to mottling tends to underestimate the maximum height of the water table. Barton (1980), on the other hand, concluded that soil mottling is a highly reliable indication of soil water saturation, and the duration of water saturation can normally be correlated with soil mottling intensity.

Carlile, et al. (1981) stated that soil color proved to be a valuable predictor of seasonal high water table at all sites studied, except where the water table was lowered by large-scale agricultural drainage. In their study, they measured the water tables in the monitoring wells and the seasonal highs (persisting for one month or more) and event highs (short duration after heavy precipitation events) were noted. Using the highest month as a basis, the water table predictions based on mottling were found to be somewhat conservative, with 8 of 16 being accurate and 7 of 16 being high. Using the highest event as a basis, 8 of 14 predictions were too low because these events would be of too short a duration to significantly alter the chemistry of the soil. Similarly, short-term events could not be expected to affect the treatment ability of a drainfield. Although the soil properties failed as predictors of the event highs, these are not as important as the seasonal high water tables in determining septic system operation.

Cogger (1985) also indicated that brief high water tables usually do not have a great effect on septic system operation although occasional temporary effects have been noted. Thus, these infrequent, short-lived high water tables can usually be discounted. Owens, et al. (2001) found their research indicated that any redoximorphic feature (Chroma $\leq$ 2, Chroma $\geq$ 2, and Fe-Mn nodules) should be considered to be an indicator of a seasonal water table, and the frequency and duration of the water table will be related to the intensity of the RMF that is expressed.

Statistical analysis by Williams, et al. (2001.) of daily water table data collected at several wells in eastern North Carolina over a three year period showed that redox depletions (>2%) were significantly correlated to periods of > 21 days saturation (R^2=0.93). In their study, the overall agreement was fair between the estimated water table depth based on morphology and that of the 21-day method for the seven soils investigated, ranging from 2 cm deeper to 28 cm shallower. Veneman (1997) stated that, in Massachusetts, the presence of 5% redoximorphic features is used as an indicator of the mean seasonal high ground water elevation and that this will predict the seasonal high ground water elevation for about 8 out of 10 years.

D. Establishing Depth to Seasonal High Water Table.

It is recommended that water table elevations determined from both on-site water table monitoring wells and redoximorphic features (soil coloration and mottles) be used to estimate the Seasonal High Water Table (SHWT). Where water table elevations from monitoring wells are used, a review of the references listed herein indicates that the SHWT could be defined as the maximum level at which the water table remains over a 21-day period during the wet season in a representative year. It is standard practice to refer to USGS monitoring well data to determine an appropriate ground water monitoring period. When redoximorphic features are used, the Department defines the SHWT as being located at the elevation where the sidewall area of an exposed soil horizon is mottled. The highest water table elevation that is determined through these methods should be used for design of a SWAS.

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