Resilient Environment Department
ENVIRONMENTAL PERMITTING DIVISION
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EXHIBIT III

CALCULATION METHODS FOR RADIUS OF INFLUENCE AND DEWATERING FLOW RATE FROM AQUIFER TEST DATA

Radius of Influence

The most accurate method of estimating Radius of Influence (R_o) is to perform an aquifer test at the same flow rate at which dewatering will occur; however, an aquifer test conducted at such a high flow rate may itself cause a contaminant plume to migrate. Therefore, the dewatering flow rate required to achieve the necessary drawdown and the associated value of R_o must be estimated from an empirical relationship developed by Sichardt (Powers, 1992). Using values of hydraulic conductivity calculated directly from a site-specific aquifer test or from the EAR aquifer test database (see SOP Section II.C.1.), the R_o for an unconfined aquifer can be readily calculated using the following equation:

$$R_o = 3000(H - h)\sqrt{K}$$

where R_o and (H - h) are in meters and K is in meters per second (m/s). Note that in calculating hydraulic conductivity (K) from aquifer test data, the Division utilizes the base of the Biscayne Aquifer as depicted in Figure A-11 of SFWMD's *A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida* (1992), as the saturated thickness (H). When R_o from Sichardt's equation is added to the effective radius of the wellpoint configuration, and if the resulting value is less than the distance of the dewatering perimeter to the edge of the nearest contaminant plume, then it is reasonable to assume that the proposed dewatering will not cause the contaminant plume to migrate. If the resulting value is greater than the distance to the nearest contaminant plume, then further information is required for approval. The Dewatering Plan may be modified to include further hydraulic control, and analysis may be performed using a three-dimensional computer model.

Dewatering Flow Rate

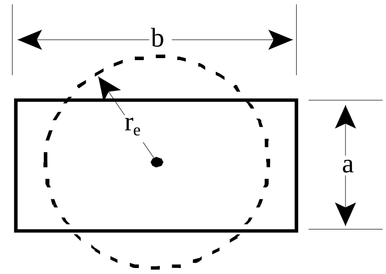
A direct calculation of flow rate may be derived from the following equation:

$$H^2 - h^2 = \frac{n \cdot q}{\pi \cdot k}(\ln R_o - \ln r_e)$$

where n = the number of wellpoints,
q = flow rate per wellpoint in m^3/sec,
r_e = effective radius of dewatering in m,
H = the total head of the water table aquifer in m,
h = the total head of the dewatered aquifer in m,
R_o = radius of influence in m, calculated via Sichardt's equation, and
k = hydraulic conductivity, in m/s

This equation is particularly useful to determine not only the total flow rate from all points (the value nq) but also the flow rate from each point (q). To correctly calculate R_o, equations generally assume that water is withdrawn from a circular area. Most dewatering activities, however, are from rectangular areas. Therefore, an equivalent radius of influence (r_e) must be calculated to make rectangular projects applicable:

$$r_e = \sqrt{\frac{ab}{\pi}}$$



Example:

Dewatering is required at a site in Broward County where Figure A-11 of SFWMD's report indicates a total saturated aquifer thickness of 150ft (45.7m). The closest contaminant plume is identified at 1000ft (304.8m) away. It is proposed to depress the water table 15ft (4.6m) to excavate an area 100 feet (30.5m) long by 50 feet (15.2m) wide. The groundwater table is to be lowered to the base of the excavation using a pattern of wells along the rectangular perimeter. A total of 26 wells, each connected to the pumping system, are to be used. The hydraulic conductivity of the aquifer is 100ft/day (3.528 x 10^{-4}m/s).

From Sichardt's equation, the resulting radius of influence would be:

$$h = 45.7\text{m} - 4.6\text{m} = 41.1m$$

$$R = 3000(45.7m - 41.1m)\sqrt{3.528x10^{-4}\, m/s}$$

$$R_o = 259m = 850\,ft$$

To calculate the effective radius of the dewatering wellpoint configuration:

$$r_e = \sqrt{\frac{(30.5m)(15.2m)}{\pi}}$$

$r_e = 12.1m = 40\,ft$. When added to R_o, the total radius of influence is 890ft from the center of the dewatered area. Because the radius of influence is less than 1000ft (the distance to the nearest contaminant plume), the dewatering plan may be submitted to the Division for approval. And using

$$H^2 - h^2 = \frac{nq}{\pi k}(\ln R_o - \ln r_e) \;,$$

$$(45.7m)^2 - (41.1m)^2 = \frac{nq}{\pi(3.528x10^{-4}\, m/s)}((\ln(259m) - \ln(12.1m)))$$

$$nq = 0.144\frac{m^3}{s} = 439{,}313\frac{ft^3}{d} = 2{,}282\frac{gal}{\min}$$

For n = 26 (i.e., 26 wells), the pump rate per well must be:

$$q = \frac{439{,}313\frac{ft^3}{d}}{26} = 16{,}397\frac{ft^3}{d} = 87.8\frac{gal}{\min}$$