EXHIBIT NO. 33

Detention/Retention Basin Computation Sheet

Project: _____ By: _____ Date: _____

Storm Water Detention/Retention Basin Design

Refer to Sections ST 701, 702, 711 and/or 712 for design criteria. This computation sheet may be used for drainage areas, off-site and on-site, totaling not more than 200 acres. Design criteria for all detention and retention basins that have contributing drainage areas totaling more than 200 acres must be established on a case-by-case basis.

Required Storage

The required storage is the volume of runoff obtained by using the formulas in this EXHIBIT. It shall be the difference between the post-development Q_{100}, based on an adjusted post-development runoff coefficient C_6 as indicated below, and the pre-development Q_{10}, based on an adjusted pre-development runoff coefficient C_3 as indicated below.

The detention of storm water shall occur in two (2) stages. Stage One (1) shall provide for a pre-development one (1) year storm and Stage Two (2) shall provide for a pre-development ten (10) year storm. Refer to Section ST 711(i) and Section ST 711(l).

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a_1 = On-site pre-development drainage area (acres), See Section ST 711(d)(1)	=	
a_2 = Off-site drainage area (acres) See Section ST711(d)(1)	=	
a_3 = Total pre-development drainage area (acres) = $a_1 + a_2$	=	
a_4 = On-site post development drainage area to release structure	=	
a_5 = Total post development drainage area to release structure $a_2 + a_4$	=	
c_1 = On-site pre-development runoff coefficient, See Section ST 711(f)	=	
c_2 = Off-site pre-development runoff coefficient, See Section ST 711(f)	=	
c_3 = Adjusted pre-development runoff coefficient = $\frac{c_1 a_1 + c_2 a_2}{a_1+a_2}$	=	
c_4 = On-site post-development runoff coefficient, See Section ST 702(c) & ST 711(g)	=	
c_5 = Off-site post-development runoff coefficient See Section ST 711(g)	=	
c_6 = Adjusted post-development runoff coefficient = $\frac{c_4 a_4 + c_5 a_2}{a_4+a_2}$	=	
tc_{10} = Time of concentration to release structure (pre-development condition) using the adjusted pre-development runoff coefficient (c_3) and EXHIBIT NO. 5	=	
tc_{100} = Time of concentration to release structure (post-development condition) using the adjusted post-development runoff coefficient (c_6) and EXHIBIT NO. 5 =	=	

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Pre-Development Ten (10) Year Storm

$$I_{10} = \frac{170}{tc_{10} + 23} = \frac{170}{(\quad) + 23} = (\quad) \text{ in/hr}$$

Pre $Q_{10} = c_3\, a_3\, I_{10} = (\quad)(\quad)(\quad) = (\quad)$ c.f.s.

NOTE: $c_3 = c_1$ and $a_3 = a_1$ when off-site runoff does not exist

q_0 = Pre Q_{10} = Maximum Release Rate = ( ) c.f.s.

Orifice Controlled Outflow Condition:

Storm Duration Producing Maximum Detention Storage

$$Tc = \left[(290 \times 31\, c_6\, a_5) \div [(2q_0 \div 3) - [(q_0^{\,2}\, tc100) \div (290 \div 6 \div c_6 \div a_5)]]\right]^{½} - 31$$

$$Tc = \left[(\_\_\_\_\_) \div [(\_\_\_\_\_) - [(\_\_\_\_\_) \div (\_\_\_ \div \_\_\_ \div \_\_\_ \div \_\_\_)]]\right]^{½} - 31$$

Tc = _____ minutes

Rainfall Intensity

$$I_{100} = \frac{290}{T_c + 31} = \frac{290}{(\quad) + 31} = (\,) \text{ in/hr}$$

Peak Rate of Flow Post-Development Q_{100}

$Q_0 = c_6\, a_5\, I_{100} = (\quad)(\quad)(\quad) = (\quad)$ c.f.s.

Detention Storage Volume

$$V = 60\, Q_0\, T_c - \frac{2\, q_0\, (T_c + tc_{100})\, (60)}{3} + \frac{(q_0)^2\, (tc_{100})\, (60)}{6\, Q_0}$$

$$V = 60\,(\quad)(\quad) - \frac{2\,(\quad)\,[(\quad) + (\quad)]\,(60)}{3} + \frac{(\quad)^2\,(\quad)60}{6(\quad)}$$

V = ( ) - ( ) + ( ) = ( ) cu. ft.

V = ( ) ¸ 43560 = ( ) Acre-Ft

NOTE: $c_6 = c_4$ and $a_3 = a_1$ when off-site runoff does not exist.