Problem: Eccentricity Greater than One

Let $F$ be a fixed point in the plane, and let $l$ be a fixed line in the plane with $F \notin l$ and $\text{dist}(F,l) = k$. Let $e > 1$. The set of points

$$\{Q \text{ in the plane with the property } \frac{QF}{\text{dist}(Q,l)} = e\}$$

is called a hyperbola with focus $F$, directrix $l$, and eccentricity $e$. Find an equation for the hyperbola.