Levees are the primary element of self-formed channels, are faithful recorders of channel history, and connect channels to their overbank surface yet little is known about their morphodynamics. We present results from a seismic geomorphology study, laboratory experiments, and simple numerical models that examine the growth of levees constructed by depositional turbidity currents. Using an industry-grade 3D seismic survey we have studied a submarine network of channels located offshore Brunei Darussalam. This network contains 13 channels, is positioned directly down slope from the Champion Delta shelf-edge, and encompasses an area approximately 6 km by 24 km in the strike and dip directions. We have mapped the seafloor and a shallow regional surface beneath the network of interest. The subsurface horizon defines the geometry of a scarp and slide plane associated with a mass-failure event that reset the margin to an unchannelized state. A map of deposit thickness created by differencing the seafloor and subsurface horizons was used to create plots of deposit thickness as a function of distance from a channel thalweg for channels of varying relief. Levee steepness increased from 0.01 m/m to 0.05 m/m as channel depth increased from 5 to 50 m, but this trend rolled over to a near constant steepness value of 0.05 m/m for channels greater than 50m in depth. A similar trend of levee steepness vs. local channel depth was observed in a reduced scale laboratory experiment. This experiment also revealed that deposition rates on levee crests decreased as the channel depths increased and the currents became more confined. We model levee growth using a simple advection settling model for currents with multiple grain sizes and a vertical sediment concentration profile defined by the Rouse equation. This model reproduces the field and laboratory observations of levee growth and suggests that the most important parameters controlling levee deposition rates and steepness are the degree of channel confinement and the vertical structure of the suspended-sediment concentration profile.