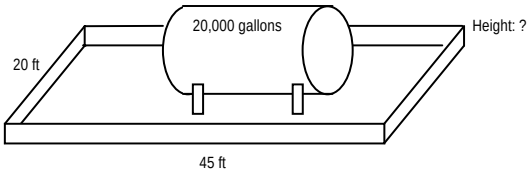
Figure 4-5. Sample calculation of containment size, using two design criteria.

The following example compares two different design criteria: one based on the volume of the tank and one based on precipitation.

Scenario:
A 20,000-gallon horizontal tank is placed within an engineered secondary containment structure, such as a concrete dike. The tank is 35 feet long by 10 feet in diameter. The secondary containment area provides a 5-foot buffer on all sides (i.e., dike dimensions are 45 feet x 20 feet).



Given the dike footprint, we want to determine the wall height necessary to provide sufficient freeboard for precipitation, based on (1) the tank storage capacity; (2) actual precipitation data. Several storm events in the recent past caused precipitation in amounts between 3.6 and 4.0 inches at this location, although greater amounts have also been reported in the past.
Note: The factor for converting cubic feet to gallons is 7.48 gallons/ft^3.

1. Calculation of secondary containment capacity, based on a design criterion of 110% of tank storage capacity:

Containment surface area = 45 ft x 20 ft = 900 ft^2
Tank volume, based on 100% of tank capacity = 20,000 gallons
Tank volume, in cubic feet = 20,000 gallons / 7.48 gallons/ft^3 = 2,674 ft^3
Wall height that would contain the tank's volume = 2,674 ft^3 / 900 ft^2 = 2.97 ft

Containment capacity with freeboard, based on 110% of tank capacity = 22,000 gallons
Containment capacity, in cubic feet = 22,000 gallons / 7.48 gallons/ft^3 = 2,941 ft^3
Wall height equivalent to 110% of storage capacity = 2,941 ft^3 / 900 ft^2 = 3.27 feet
Height of freeboard = 3.27 ft - 2.97 ft = 0.3 ft = 3.6 inches

Therefore, a dike design based on a criterion of 110% of tank capacity provides a dike wall height of 3.27 feet.

2. Calculation of secondary containment capacity, based on rainfall criterion:

After a review of historical precipitation data for the vicinity of the facility, the PE determined that a 4.5 inch rain event is the most reasonable design criterion for this diked area.

Containment surface area = 45 ft x 20 ft = 900 ft^2
Tank volume, based on 100% of tank capacity = 20,000 gallons
Tank volume, in cubic feet = 20,000 gallons / 7.48 gallons/ft^3 = 2,674 ft^3
Wall height that would contain the tank's volume = 2,674 ft^3 / 900 ft^2 = 2.97 ft

The height of the dike would need to be 3.35 feet (2.97 ft + 4.5 in).

4.5 inches / 12 inches = .375 ft + 2.97 ft = 3.35 ft

Therefore, a dike design based on a 4.5 inch rain event provides a dike wall height of 3.35, or 0.9 inch higher than calculated using the 110% criterion.

Conclusion: As noted from the comparison of the two design criteria illustrated above, the dike heights are similar. The adequacy of the secondary containment freeboard is ultimately an engineering determination made by the PE and certified in the Plan.