APPENDIX C Hazard Impact Calculations

The hazard assessment modeling was based on equations from the EPA document *Risk Management Program Guidance for Off-Site Consequence Analysis* (EPA-550-B-99-009, April 1999) for estimating impact distances for vapor explosions and pool fires. The EPA equations for these events were programmed into an EXCEL[™] spreadsheet and used to determine the size of the impact zone. The equations are summarized below.

Vapor Cloud Explosions

For vapor cloud explosion, the total quantity of flammable substance is assumed to form a vapor cloud. The entire cloud is assumed to be within the flammability limits, and the cloud is assumed to explode. Ten percent of the flammable vapor in the cloud is assumed to participate in the explosion. The distance to the one pound per square inch overpressure level is determined using RMP guidance document equation C-1:

$$X = 17 \left(0.1 \ W_{f} \ \frac{H_{cf}}{H_{CTNT}} \right)^{\frac{1}{3}}$$

Where:

X = distance to overpressure of 1 pound per square inch (psi) [meters]

W_f = weight of flammable substance [kilograms (kg)]

H_{Cf} = heat of combustion of flammable substance [joules/kg]

 H_{CTNT} = heat of combustion of trinitrotoluene [4.68 x 10⁶ joules/kg]

Pool Fires

The EPA equation is based on factors for estimating the distance to a heat radiation level that could cause second degree burns from a 40-second exposure. This heat radiation level was calculated to be 5,000 watts per square meter. The equation for estimating the distance from pool fires of flammable liquids with boiling points above ambient temperature is determined using RMP guidance document equation D-25:

$$X = H_{c} \sqrt{\frac{0.0001 \text{ A}}{5000 \text{ }\Pi (H_{v} + C_{p} (T_{B} - T_{A}))}}$$

Where:

X = distance to the 5 kilowatt per square meter endpoint [m]

H_c = heat of combustion of the flammable liquid [joules/kg]

 H_V = heat of vaporization of the flammable liquid [joules/kg]

A = pool area $[m^2]$ C_P = liquid heat capacity [joules/kg-°K] T_B = boiling temperature of the liquid [°K] T_A = ambient temperature [°K]

The off-site consequence for pool fires and vapor explosions for the proposed project were estimated using the above equations. The spreadsheet performing the computations is in Attachment C.1. The physical parameters for the substances reviewed in this consequence analysis are given in Table C-1 in Attachment C.1. The specific release scenarios analyzed are documented in Table C-22. The liquid spill areas analyzed for the pool fire scenarios are documented in Table C-3. The pool fire impact distances for the liquid pool fire hazard scenarios are computed in Table C-4, based on the pool fire equation (D-25) from the EPA RMP consequence analysis document, and documented above. The vapor explosion distances to impact threshold for the vapor release hazard scenarios are computed in Table C-1) from the EPA RMP consequence analysis document, and documented above.