APPENDIX P. AIR QUALITY TECHNICAL INFORMATION

Carbon Monoxide Modeling

Dispersion Modeling

Predicting the ambient air quality impacts of pollutant emissions requires an assessment of the transport, dispersion, chemical transformation, and removal processes that affect pollutant emissions after their release from a source. Gaussian dispersion models are frequently used for such analyses. The term *Gaussian dispersion* refers to a general type of mathematical equation used to describe the horizontal and vertical distribution of pollutants downwind from an emission source.

Gaussian dispersion models treat pollutant emissions as being carried downwind in a defined plume, subject to horizontal and vertical mixing with the surrounding atmosphere. The plume spreads horizontally and vertically with a reduction in pollutant concentrations as it travels downwind. Mixing with the surrounding atmosphere is greatest at the edge of the plume, resulting in lower pollutant concentrations outward (horizontally and vertically) from the center of the plume. This decrease in concentration outward from the center of the plume is treated as following a Gaussian ("normal") statistical distribution. Horizontal and vertical mixing generally occur at different rates. Because turbulent motions in the atmosphere occur on a variety of spatial and time scales, vertical and horizontal mixing also vary with distance downwind from the emission source.

The CALINE4 Model

The ambient air quality effects of traffic emissions were evaluated using the CALINE4 dispersion model (Benson 1989). CALINE4 is a Gaussian dispersion model specifically designed to evaluate air quality impacts of roadway projects. Each roadway link analyzed in the model is treated as a sequence of short segments. Each segment of a roadway link is treated as a separate emission source producing a plume of pollutants which disperses downwind. Pollutant concentrations at any specific location are calculated using the total contribution from overlapping pollution plumes originating from the sequence of roadway segments.

When winds are essentially parallel to a roadway link, pollution plumes from all roadway segments overlap. This produces high concentrations near the roadway (near the center of the overlapping pollution plumes), and low concentrations well away from the roadway (at the edges of the overlapping pollution plumes). When winds are at an angle to the roadway link, pollution plumes from distant roadway segments make essentially no contribution to the pollution concentration observed at a receptor location. Under such cross-wind situations, pollutant concentrations near the highway are lower than under parallel wind conditions (fewer overlapping plume contributions), while pollutant concentrations away from the highway may be greater than would occur with parallel winds (near the center of at least some pollution plumes).

The CALINE4 model employs a "mixing cell" approach to estimating pollutant concentrations over the roadway itself. The size of the mixing cell over each roadway segment is based on the width of the traffic lanes of the highway (generally 12 feet per lane) plus an additional turbulence zone on either side (generally 10 feet on each side). Parking lanes and roadway shoulders are not counted as traffic lanes. The height of the mixing cell is calculated by the model.

Pollutants emitted along a highway link are treated as being well mixed within the mixing cell volume due to mechanical turbulence from moving vehicles and convective mixing due to the temperature of vehicle exhaust gases. Pollutant concentrations downwind from the mixing cell are calculated using horizontal and vertical dispersion rates, which are a function of various meteorological and ground surface conditions.

Modeling Procedures

Roadway and Traffic Conditions. Traffic volumes and operating conditions used in the modeling were obtained from the traffic analysis prepared for this project (DKS Associates 2002). Free-flow traffic speeds were adjusted to reflect congested speeds using methodology from the Highway Capacity Manual (Transportation Research Board 2000). Carbon monoxide (CO) modeling was conducted for the following intersections: Osgood Road/Durham Road/Auto Mall Parkway, Osgood Road/Warm Springs Boulevard/South Grimmer Boulevard, Warm Springs Boulevard/Mission Boulevard, and Warm Springs Boulevard/Northern Warm Springs Station Entrance.

CO modeling was performed for the following conditions:

- Existing conditions.
- 2010 p.m. peak project conditions.
- 2025 p.m. peak project conditions.

Vehicle Emission Rates. Vehicle emission rates were determined using the California Air Resources Board's EMFAC7F (version 1.1) emission rate program. A cold start percentage of 25% was assumed along with a hot start percentage of 50%.

Receptor Locations. CO concentrations were estimated at four receptor locations at each of the proposed intersections. The receptors were located 100 feet away from the center of each roadway. For the Warm Springs Boulevard/Northern Warm Springs Station Entrance intersection, receptors were located 50 feet away from the center of the roadway. Receptor heights were set at 5.9 feet.

Meteorological Conditions. Meteorological inputs to the CALINE4 model were determined using methodology recommended in *Air Quality Technical Analysis Notes* (California Department of Transportation 1988). The meteorological conditions used in the modeling represent a calm winter period. Worst-case wind angles were modeled to determine a worst-case concentration for each receptor. The meteorological inputs include: 1 meter-per-second wind speed, ground-level temperature inversion (atmospheric stability class G), wind direction standard deviation equal to 5 degrees, and a mixing height of 1000 meters.

Background Concentrations and 8-Hour Values. Background concentrations of 4.2 and 3.5 parts per million (ppm) were added to the modeled existing and future 1-hour values respectively to account for sources of CO not included in the modeling. Eight-hour modeled values were calculated from the 1-hour values using a persistence factor of 0.7. Background concentrations of 2.9 and 2.4 ppm were added to the modeled existing and future 8-hour values respectively. All background concentration data were taken from the Bay Area Air Quality Management District's (BAAQMD's) CEQA Guidelines. Actual 2025 background concentrations would likely be lower than those used in the CO modeling analysis because 2010 value was applied as background concentration for both future conditions.

References Cited

Benson, P. E. 1989. CALINE4 – a dispersion model for predicting air pollution concentrations near roadways. California Department of Transportation. Sacramento, CA.

California Department of Transportation. 1998. *Air Quality Technical Analysis Notes*. Sacramento, CA.

DKS Associates. 2002. BART WSX ADSEIR Technical Report Transportation. Draft. Prepared for Jones & Stokes. Oakland, CA.

Transportation Research Board. 2000. *Highway Capacity Manual*. Washington, D.C.