Appendix K

Meat, Milk, and Egg Transfer Coefficients

K.1 Chemical Transfer Coefficient (Tco) Derivation Methodology

Meat, cow's milk and eggs can become contaminated when food-producing animals inhale or ingest contaminated materials that then transfer into these food products. The transfer coefficients (Tco) presented in Tables K.1 and K.2 were derived from published studies investigating chemical concentrations in food products resulting from animal intake of the chemical. In most studies, the chemicals were mixed into the animal's feed, although some studies investigated the bioaccumulation of chemicals from contaminated soil in poultry feed. The Tcos, expressed in day/kilogram (d/kg), represent the ratio of contaminant concentration in fresh weight animal product (in mg/kg, for example) to the daily intake of contaminant by the animal (in mg/day). Tcos were determined only for the main food-producing animal sources, including cow's milk, eggs, and meat from cattle, pigs and chickens.

The studies selected to estimate Tcos were usually of long enough duration to allow steady-state concentrations to be reached in milk-, meat- and egg-producing animals. Steady-state concentrations in the tissues are a function of the tissue elimination half-lives (MacLachlan and Bhula, 2008). Assuming a first-order process, an exposure duration that is five times greater than the tissue elimination half-life has been used to represent time to steady-state conditions (i.e., the ratio of the measured concentration at five half-lives to steady-state concentration is 0.968).

Realistically, fast-growing animals used for food may never attain a true tissue steady-state for persistent organic chemicals due to the competing factors of growth, fattening and lactation (Fries, 1996; Hoogenboom, 2005). A steady-state concentration in food-producing animals will likely be reached more quickly than in humans due to these factors and may even show declining levels in fat during the fattening phase of the animals' prior to slaughter (Fries, 1996). The most practical approach is to base the Tco on exposure studies that expose the animal for a majority of the animals' life span up to or near marketable weight. The studies that followed tissue and milk contaminant levels during exposures over most of the animals' productive lifespan have shown that a sufficient semblance of steady-state is reached during the productive life of lactating dairy cattle and laying hens, and in meat animals prior to slaughter.

Default consumption rates of contaminated feed were used for estimating Tcos if no consumption data were provided in the primary studies. Usually, the food-producing animals in biotransfer studies were caged or treated similar to commercial farming practices. However, this exposure assessment document is primarily concerned with small farm or family farm situations in which the food-producing animals may be allowed to roam more freely than in commercial operations. This is particularly relevant for pigs and chickens. Free-range and organic farming will result in greater feed intake, slower growth, and potentially greater contaminant exposure from range forage and soil ingestion (MacLachlan, 2010).

Specifically regarding poultry food products, the term “poultry” refers to a number of avian species that are food sources for humans. Due to the substantial human consumption of eggs and meat from chickens, the Tcos described here were exclusively based on data from chickens, laying hens (usually Leghorns) for the egg Tcos and usually meat chickens (broilers) for the meat Tcos. However, these values could also be reasonably applied to other home-raised avian species, such as turkeys and quail.

Compared to chickens and dairy cattle, fewer swine and beef cattle exposure studies could be found to estimate the biotransfer of ingested contaminants to muscle tissue. Rather than simply adopting the same cattle Tco values for swine when biotransfer data are lacking, contaminant transfer models are employed by OEHHA to estimate differences in chemical accumulation among livestock. For transfer of organic lipophilic chemicals, MacLachlan (2009) developed Physiologically Based Pharmacokinetic (PBPK) models to derive scaling factors that are used to assist the extrapolation of transfer studies, carried out most often on lactating dairy cows, to beef cattle and pigs. Given the estimated half-life (or extraction ratio for liver) of the chemical in the animal and the ratio of the chemical concentration in milk fat to body fat of dairy cows, the appropriate scaling factor can be selected and combined with the Tco derived from lactating dairy cattle to improve estimates of residues in beef cattle and pigs.

For metal Tcos, a metabolic weight adjustment can be made that accounts for differences in tissue transfer of chemicals in animals of different weight (i.e., a lower metabolic rate is expected in larger animals such as cattle compared to smaller animals such as swine, resulting in slower rates of transfer into tissues). A similar metabolic weight approach has been used to estimate the transfer of metals to dairy cattle from data in sheep (Crout et al., 2004). This adjustment is reasonable considering most of the metal compounds of interest have passive uptake and elimination processes and are subject to little or no metabolism.

The effect of metabolic weight is apparent when comparing the meat Tco values between chicken and cattle in Tables K-1 and K-2. Where published data were used to directly estimate individual chemical Tco values, the chicken Tcos were greater than cattle Tcos. For chemicals in which biotransfer could not be estimated from published reports in pigs, a default meat Tco was estimated with the following formula:

$$\text{Pig } Tco_i = (W^{0.75}_{cow}) / (W^{0.75}_{pig}) \times \text{cow } Tco_i \qquad \text{Eq. K-1}$$

Where:
$W^{0.75}_{cow}$ = live-weight in kg of a cow to the 0.75 power
$W^{0.75}_{pig}$ = live weight in kg of a pig to the 0.75 power
Pig Tco_i = pig meat Tco for chemical i
Cattle Tco_i = cow meat Tco for chemical i

Using average live weights of 500 kg for cattle and 60 kg for swine, the metabolic weight ratio adjustment is 4.8.

Table K.1 ~~Food Animal~~Meat, Milk and Egg Transfer Coefficients for Persistent Organic Chemicals

Organic Chemical	Tcos (d/kg)[a]				
	Cow's Milk	**Chicken Egg**	**Chicken Meat**	**Cattle Meat**	**Pig Meat**
Diethylhexylphthalate	9×10^{-5}	0.04	0.002	6×10^{-4}	5×10^{-4}
Hexachlorobenzene	0.02	20	10	0.2	0.08
Hexachlorocylcohexanes	0.01	7	5	0.2	0.09
PAH's	0.01	0.003	0.003	0.07	0.06
PCB Congeners					
77	0.001	6	4	0.07	0.4
81	0.004	10	7	0.2	0.4
105	0.01	10	7	0.6	0.7
114	0.02	10	7	0.9	0.7
118	0.03	10	7	1	0.7
123	0.004	10	7	0.2	0.7
126	0.04	10	7	2	0.7
156	0.02	10	8	0.9	2
157	0.01	10	8	0.5	2
167	0.02	10	8	1	2
169	0.04	10	8	2	2
189	0.005	10	8	0.2	1
Unspeciated	0.01	10	7	0.2	0.5
~~Unspeciated (TEQ)[b]~~	~~0.01~~	~~20~~	~~10~~	~~0.7~~	~~0.3~~
PCDD/F's Congeners					
2378-TCDD	0.02	10	9	0.7	0.1
12378-PeCDD	0.01	10	9	0.3	0.09
123478-HxCDD	0.009	10	6	0.3	0.2
123678-HxCDD	0.01	10	6	0.4	0.1
123789-HxCDD	0.007	7	3	0.06	0.02
1234678-HpCDD	0.001	5	2	0.05	0.2
OCDD	0.0006	3	1	0.02	0.1
2378-TCDF	0.004	10	6	0.1	0.02
12378-PeCDF	0.004	30	10	0.1	0.01
23478-PeCDF	0.02	10	8	0.7	0.09
123478-HxCDF	0.009	10	5	0.3	0.1
123678-HxCDF	0.009	10	6	0.3	0.09
234678-HxCDF	0.008	5	3	0.3	0.06
123789-HxCDF	0.009	3	3	0.3	0.03
1234678-HpCDF	0.002	3	1	0.07	0.06
1234789-HpCDF	0.003	3	1	0.1	0.02
OCDF	0.002	1	0.6	0.02	0.03
Unspeciated	0.001	6	5	0.03	0.09
~~Unspeciated (TEQ)[b]~~	~~0.005~~	~~10~~	~~7~~	~~0.2~~	~~0.09~~

[a] All Tco values were rounded to the nearest whole number
~~[b] TEQ-adjusted Tco values~~

Table K.2 ~~Food Animal~~Meat, Milk and Egg Transfer Coefficients for Inorganic ~~and Organic~~ Metals

Inorganic ~~and Organic~~ Metals	**Tcos (d/kg)[a]**				
	Cow's Milk	**Chicken Egg**	**Chicken Meat**	**Cattle Meat**	**Pig Meat**
Arsenic	5 x 10^{-5}	0.07	0.03	2 x 10^{-3}	0.01[b]
Beryllium	9 x 10^{-7}	0.09	0.2	3 x 10^{-4}	0.001
Cadmium	5 x 10^{-6}	0.01	0.5	2 x 10^{-4}	0.005
Chromium (VI)	9 x 10^{-6}	NA[c]	NA	NA	NA
Fluoride	3 x 10^{-4}	0.008	0.03	8 x 10^{-4}	0.004[b]
Lead	6 x 10^{-5}	0.04	0.4	3 x 10^{-4}	0.001[b]
Mercury	7 x 10^{-5}	0.8	0.1	4 x 10^{-4}	0.002[b]
~~Hg(II) only in diet:~~					
~~Inorganic mercury~~	~~7 x 10^{-5}~~	~~0.3~~	~~0.02~~	~~4 x 10^{-4}~~	~~0.002[b]~~
~~Methylmercury (MeHg)~~	~~NA~~	~~0.5~~	~~0.09~~	~~NA~~	~~NA~~
~~MeHg only in diet:~~					
~~Inorganic mercury~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
~~Methylmercury~~	~~7 x 10^{-4}~~	~~10~~	~~10~~	~~NA~~	~~NA~~
Nickel	3 x 10^{-5}	0.02	0.02	3 x 10^{-4}	0.001
Selenium	0.009	3	0.9	0.04	0.5

[a] All Tco values were rounded to the nearest whole number.
[b] The meat Tco was estimated using the metabolic weight adjustment ratio of 4.8 from cattle to pig
[c] NA – no data available or were not applicable

Speciated data existed that allowed the derivation of individual Tcos for polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and furans (PCDD/F), shown in Table K.1, that are a toxicological concern under the "Hot Spots" program. ~~TCos~~ Tcos for unspeciated mixtures of PCBs and PCDD/Fs have also been calculated by OEHHA from literature sources and are shown in Table K.1. In screening level risk assessments in which only the unspeciated mixture is determined, OEHHA recommends using the Tcos for PCB126 to represent the PCBs, and the Tcos for 2378-TCDD to represent the PCDD/F's. These compounds are one of the most persistent and toxic congeners within their respective classes. The unspeciated Tco~~s~~ values in K.1 are for only comparison to the other Tco values. Different emissions sources of these chemicals may result in different mixtures of PCBs and PCDD/Fs, and thus influence the unspeciated Tco value. ~~are the values used to estimate the impact of these two groups of compounds in risk assessments, unless chemical analysis was conducted to speciate these compounds. In addition, toxic equivalent (TEQ)-adjusted Tcos have been estimated for unspeciated mixtures, which adjust for the different toxic potencies of the congeners compared to a sentinel compound (TCDD for both PCDD/Fs and PCBs). Many of the TEQs originated from European studies and are referred to as WHO-TEQs or International-TEQs (I-TEQs). However, some more recent revisions of individual TEQ values have~~

been carried out and are discussed in detail in OEHHA's Air Toxics Guidelines (OEHHA, 2005). Nevertheless, the TEQ-adjusted TCos presented here probably would not vary greatly compared to recent OEHHA TEQ estimates, and provide a reasonable optional screening estimate of the overall potency of PCB and PCDD/F mixtures that are found in contaminated food products.

K.2 Tco Derivations for Milk, Meat and Eggs

K.2.1 Semi- and Non-Volatile Organic Chemicals

The exposure studies used to derive organic compound Tcos often normalized the muscle tissue, egg and cow's milk contaminant concentrations to their respective fat content. The Tcos presented here are based on fresh, whole meat, egg and milk concentrations of the contaminants. If necessary, the fat concentration of a chemical was adjusted to the average fresh weight concentration using fat content default factors derived from reference sources: 0.11 for egg, 0.07 for chicken meat, 0.19 for beef cattle meat, 0.23 for pig meat, and 0.04 for cow's milk (Malisch et al., 1996; Pirard and De Pauw, 2005; U.S. EPA, 2005). If only the fat concentration of the organic chemical in egg yolk was provided in the key study, the fresh weight whole egg concentration was derived based on a fat content default value of 0.30 for yolk, and a yolk volume of 0.32 for the whole egg. If the study determined the fat content in food products, these were used for adjustment to fresh weight concentration in lieu of the default values.

For chicken meat, organic chemical content in skin was usually not included by the studies, although skin has a higher fat content and is often consumed with the meat. This would suggest that the skin could have a higher contaminant content than the muscle tissue. Due to lack of skin chemical concentration data and potential loss or destruction of organic chemicals in skin when the meat is cooked, the concentration of chemical in skin was considered similar to the concentration of a chemical in muscle for Tco derivation.

In general, extensive bioaccumulation of persistent, organic chemicals is not as great in either beef or dairy cattle as might be expected, even though beef cattle have no major fat excretion pathway as dairy cattle do with milk production (McLachlan, 1996). This finding is a result of the short life spans and rapid growth dilution that is characteristic of modern animal husbandry. A beef cow develops 100-150 kg of fat in which to deposit the chemical that it absorbs over its 1.5-year life. While a milk cow might excrete its absorbed contaminant in 300 kg of milk fat over the same period, it consumes more feed (and contaminant) in this time. Hence, the chemical concentrations in milk fat were not always much lower compared to beef fat (McLachlan, 1996; RTI, 2005).

Interestingly, the lower-than-expected bioaccumulation of persistent, hydrophobic chemicals in cow's milk does not translate to human milk (McLachlan, 1996).

Persistent, organic chemicals tend to bioaccumulate in human milk by an order of magnitude greater than in cow's milk, presuming similar chemical concentrations in the diet on a mg/kg basis. This pronounced difference in bioaccumulation is due to a more limited capability of humans to excrete these chemicals. In addition, the extent of contaminant absorption from food in the human digestive tract may be greater. For example, nursing human infants absorb over 95% of PCBs and most PCDD/Fs while absorption in cows for these same compounds averages closer to 80%.

K.2.1.1 Diethylhexylphthalate (DEHP)

At high concentrations (1% DEHP in feed), Tcos for chicken eggs and breast muscle were estimated by OEHHA to be 0.04 and 0.002 d/kg (Ishida et al., 1981; Ishida, 1993). The low transfer values for DEHP relative to other organic chemicals are likely due to rapid metabolism and excretion of DEHP in the chicken.

In dairy cattle, DEHP was observed to be extensively metabolized prior to secretion into the milk (Bluthgen and Ruoff, 1998). OEHHA surmised that much of the metabolism begins in the rumen, where DEHP ester-bond cleavage would occur. Consequently, steady-state is reached in about 7 days and a low milk Tco of 9×10^{-5} d/kg was calculated by OEHHA. Cessation of DEHP administration resulted in nearly undetectable milk levels within 3 days post-exposure. No data could be found regarding residue levels of DEHP in cattle muscle, so a Tco of 4×10^{-4} d/kg was estimated after adjusting for the average fat content difference between cow's milk and cattle muscle. PBPK modeling by MacLachlan (2009) observed a ratio of about 1.5 for residues of highly metabolized lipophilic compounds, such as DEHP, in body fat of non-lactating cows and steers to the same compound in body fat of lactating dairy cows. Thus, the Tco of 4×10^{-4} d/kg was increased by a factor of 1.5 to arrive at a Tco of 6×10^{-4} d/kg for DEHP in meat of beef cattle.

Bioaccumulation data are lacking for DEHP in pigs. Thus, a scaling factor by MacLachlan (2009) was applied for the transfer of lipophilic xenobiotics from lactating cattle to other livestock species. For chemicals such as DEHP that are extensively metabolized in the animal and have a short half-life ($t_{1/2}$ <5.8 d in lactating cows), the ratio of simulated residues in the body fat of pigs to the body fat of lactating dairy cows was essentially equal to 1. Therefore, the dairy cattle muscle Tco determined above (4×10^{-4} d/kg) was only adjusted for the difference in muscle fat content in pig to beef cattle (ratio = 1.2) to arrive at a default Tco of 5×10^{-4} d/kg for pig meat.

K.2.1.2 Hexachlorobenzene (HCB)

HCB in the atmosphere is predicted to be predominantly in the vapor phase (Lane et al., 1992). However, due to the extreme persistence of HCB and other chlorinated organic compounds in the environment, deposition and accumulation of non-volatile forms of these organics onto crops, soil and sediment are significant pathways of exposure (Eisenreich et al., 1981; Kelly et al., 1991; Douben et al., 1997; Horstmann and McLachlan, 1998).

In dairy cattle, two studies recorded nearly identical cow's milk HCB Tcos of 0.015-0.016 d/kg with 60-70 days of exposure (Fries and Marrow, 1976; Firestone et al., 1979). The data suggested near steady-state levels in milk were attained with this duration of exposure. A higher Tco of 0.030 d/kg was recorded in pregnant dairy cattle after about 8 months of exposure (Vreman et al., 1980). Steady-state was reached in milk of the pregnant dairy cattle after about 5 months. The average HCB Tco from these three studies is 0.02 d/kg.

In his review, Kan (1978) provided bioaccumulation data from which to calculate Tcos for HCB. The Tco for egg and chicken muscle were estimated at 16 and 13 d/kg, respectively.

In beef cattle, steady-state levels of HCB were at or near attainment in subcutaneous fat following ten weeks of exposure in the feed (Dingle and Palmer, 1977; RTI, 2005). A muscle Tco estimated from this study was 0.090 d/kg. Exposure to HCB in dairy cattle provided similar Tco values. A muscle Tco of 0.070 d/kg was calculated from HCB concentrations in body fat of lactating dairy cattle following 60 day exposure in the feed (Fries and Marrow, 1976). An eight-month HCB exposure in dairy cattle resulted in a muscle Tco of 0.16 d/kg (Vreman et al., 1980). Because the Vreman study provided a considerably longer exposure overall for cattle, the Tco was based on this study. The PBPK-based scaling factor data by MacLachlan (2009) was applied to estimate the transfer of HCB from lactating cattle to body fat of steers. Using data supplied by Fries and Marrow (1976), a slow elimination half-life of HCB in lactating dairy cattle (average: 50 days) and a small ratio for milk fat concentration over body fat concentration at steady state (0.04) suggests that the PBPK-generated ratio of simulated HCB level in body fat of steers to body fat of lactating dairy cows would be about 1.5. The final default beef Tco is 0.24 d/kg (0.16 d/kg x 1.5)

No data for HCB accumulation in pig muscle tissue could be found. Therefore, a PBPK-based scaling factor was also applied to estimate the transfer of HCB from lactating cattle to pigs (MacLachlan, 2009). The PBPK model results generated a ratio of 0.5 for the simulated HCB level in body fat of pigs to body fat of lactating dairy cows. The final default pig Tco is 0.08 d/kg (0.16 d/kg x 0.5)

K.2.1.3 Hexachlorocyclohexanes (HCH)

HCH Tcos of 7.3 d/kg for egg and 5.1 d/kg for chicken meat were calculated from contaminated feed data provided by Kan (1978) and Szokolay et al. (1977). The beta-isomer tended to have roughly 10-fold greater bioaccumulation in poultry egg and muscle than the other major isomers (i.e., alpha and gamma isomers), but is generally found to a lesser extent in the environment. Hence, the Tcos represent a mean of the three major HCH isomers. MacLachlan (2008) developed a model that adequately reproduced the pattern of lindane (gamma-HCH) residue levels in fat and eggs of hens consuming contaminated feed. Utilizing the authors' data, the egg and muscle Tcos at steady-state were estimated to be 1.3 and 1.5 d/kg, respectively. These lindane Tcos were similar to those calculated from data by Kan (1978) and Szokolay et al. (1977) for eggs, 1.7 and 4.2 d/kg, respectively, and in muscle, 1.8 and 1.2 d/kg, respectively.

As in eggs and meat, the major isomers of HCH (alpha-, beta-, and gamma-HCH) had different patterns of accumulation in cow's milk. The beta isomer has the largest transfer factor, 0.025 d/kg, but generally is in the smallest proportion relative to the other 2 major isomers found in the environment (van den Hoek et al., 1975; Vreman et al., 1976; Vreman et al., 1980). Average Tco values for the alpha- and gamma- (Lindane) isomers were 0.0054 and 0.0014 d/kg, respectively (Williams and Mills, 1964; van den Hoek et al., 1975; Vreman et al., 1980; Surendra Nath et al., 2000). An average Tco for these three HCH isomers is 0.011 d/kg. Surendra Nath et al. (2000) provided data for the industrial grade HCH isomer mixture resulting in a Tco of 0.003 d/kg. The HCH mixture contained 21% gamma-HCH, but further speciation data were not included.

Vreman et al. (1980) fed dairy cows diets containing alpha- and beta-HCH for up to eight months. The calculated muscle Tcos were 0.045 and 0.19 d/kg for alpha- and beta-HCH, respectively. For lindane (gamma-HCH), a Tco of 0.027 d/kg was calculated from a different study following 12-week exposure in non-lactating dairy cattle (Claborn et al., 1960).

We applied a scaling factor by MacLachlan (2009) to estimate the transfer of HCHs from lactating cattle to beef cattle. Using data supplied by Vreman *et al.* (1980) that showed a cow's milk elimination half-life of 9-19 days for alpha- and beta-HCH, and the data by van den Hoek et al. (1975) that showed similar levels of HCH isomers in milk fat and body fat, the PBPK-generated ratio of simulated HCH levels in body fat of steers to body fat of lactating dairy cows is approximately 2. We multiplied the alpha- and beta-HCH Tcos of 0.045 and 0.19 d/kg, respectively, which were determined in dairy cattle by the scaling factor of 2. The gamma-HCH Tco remained unchanged since non-lactating cows and steers have similar steady state HCH levels in body fat. The average Tco for these three isomers is 0.17 d/kg and is the recommended Tco for beef cattle.

No data for HCH accumulation in pig muscle tissue could be found, so we used a scaling factor by MacLachlan (2009) to estimate the transfer of HCHs from lactating cattle to pigs. Based on the HCH half-lives and milk fat to body fat ratios in dairy cattle discussed above, the PBPK-generated ratio of simulated HCH levels in body fat of pigs to body fat of lactating dairy cows is very close, or slightly greater, than 1. Thus, Tcos of the three isomers in lactating and non-lactating dairy cows were averaged by us and used as the default for pig meat (0.045 + 0.19 + 0.027 d/kg / 3 = 0.087 d/kg).

K.2.1.4 Polycyclic Aromatic Hydrocarbons (PAH)

Although there are a considerable number of studies investigating PAH exposure in the environment, there are surprisingly few studies that provide reliable data for estimating Tcos in food-producing animals. Exposure of fish, poultry and dairy cattle to a mixture of PAHs results in the presence of mainly low molecular weight PAHs (i.e., three or four cyclic rings) in the fat of meat and milk (Meador et al., 1995; Grova et al., 2000; Grova et al., 2002; Schaum et al., 2003; Lutz et al., 2006). Many of the high molecular weight PAHs with five or more cyclic rings, such as benzo[a]pyrene (BaP), are known carcinogens or possible carcinogens. Bioaccumulation of PAHs declines with increasing number of aromatic rings and the associated increase in K_{ow}, likely due to both lower gut assimilation efficiency and increased metabolism rate. Another factor appears to be that lower levels of the larger carcinogenic PAHs contaminate pastures and feed compared to the smaller PAHs, often resulting in animal milk and tissue concentrations below the detection limits of analysis equipment (EC, 2002). For example, Muhlemann et al. (2006) found that the larger carcinogenic PAHs in contaminated feed comprised only 8.3% of total PAHs, while the smaller PAHs of four rings or less contributed most of the remaining fraction.

Broiler chickens fed a diet containing low levels of PAHs found in de-inking paper sludge did not exhibit increased PAH levels in abdominal fat for nearly all carcinogenic PAHs examined (Beauchamp et al., 2002). However, the low molecular weight PAHs fluoranthene and pyrene showed increasing levels in abdominal fat with increasing levels of PAHs from paper sludge in the diet of broilers. The carcinogenic potential of these PAHs are undetermined, due to inadequate evidence of carcinogenicity in animals. The calculated broiler muscle Tco for total PAHs was 0.003 d/kg (due mainly to accumulation of pyrene and fluoranthene), and the individual PAH Tcos for pyrene and fluoranthene were 0.1 and 0.04 d/kg, respectively. The total PAH Tco of 0.003 d/kg was chosen as a poultry muscle default value for PAHs, as Tcos for the larger carcinogenic PAHs would likely not surpass this value. No data could be found for PAH accumulation in eggs. Thus, the poultry muscle Tco was also applied to the egg Tco.

The presence of PAHs in milk and milk products suggests that these foods can represent a significant part of human intake of PAHs (Schaum et al., 2003). Among PAHs, the lightest and least lipophilic ones, such as naphthalene, phenanthrene, fluoranthene and pyrene, are detected in the greatest amounts in milk from farms exposed to airborne PAHs (Grova et al., 2000; Grova et al., 2002; Cavret et al., 2005; Lutz et al., 2006). Higher molecular weight PAHs with more than four rings, including possible carcinogens or known carcinogens such as BaP, chrysene and benz[a]anthracene, have been largely undetectable in cow's milk. Of the larger carcinogenic and possibly carcinogenic PAHs, only benz[a]anthracene was detected in tank milk (pooled milk from many cows) sampled near several potential contamination sources (Grova et al., 2002). Levels of this PAH in milk fat ranged from 1.9-2.2 ng/g in milk fat (approximately 0.08-0.09 ng/g in whole milk).

Based on the pasture grass concentrations and corresponding cow's milk concentrations of the three most abundant PAHs (phenanthrene, anthracene, and pyrene) from 10 rural and urban farms investigated by Grova et al. (2000), the range of PAH Tco values in milk were 0.02 to 0.002 d/kg. However, some assumptions were made to arrive at this estimate, including pasture grass as the only source of ingested PAHs, and intake of pasture grass ranged between 10 to 100% of the cow's diet.

A cow's milk Tco range of 0.002 to 2×10^{-5} d/kg for total PAHs was calculated by OEHHA from the risk assessment by Muhlemann et al. (2006), based on measurement of total PAHs (roughly 19 PAHs measured) in contaminated feed. Although BaP consisted of only 1.5% of total PAHs, the calculated Tco was within an expected range of 0.013-0.00013 d/kg for BaP. We chose a cow's milk Tco of 0.01 d/kg for total PAHs based primarily on the high-end accumulation of BaP in cow's milk from Muhlemann et al. The recommended Tco is also within the range of 0.02 to 0.002 d/kg estimated for PAHs from data published by Grova et al. (2000).

No data could be found regarding residue levels of PAHs in cattle muscle. The ratio of simulated PAH residues in body fat of steers to body fat of lactating dairy cows for extensively metabolized lipophilic compounds is about 1.4, based on PBPK modeling (MacLachlan, 2009). Assuming equal PAH concentrations in milk fat and body fat of dairy cattle, and application of a scaling factor of 1.4 for dairy cattle to steers, we calculated a default beef Tco for PAHs of 0.067 d/kg (0.01 d/kg x 0.19/0.04 x 1.4).

Accumulation data are also lacking for PAHs in pigs. Using the assumptions from MacLachlan (2009) for transfer of extensively metabolized lipophilic compounds to body fat in livestock, the ratio of PAHs in body fat of pigs to dairy cattle is close to 1. Based on a milk Tco of 0.01 d/kg, adjusting for fat content in pig meat and a scaling factor of 1, we calculate a default pig meat Tco of 0.058 d/kg (0.01 d/kg x 0.23/0.04 x 1).

K.2.1.5 Polychlorinated Biphenyls (PCB)

~~In dairy cattle, Willett et al. (1990) reviewed early studies that examined the transfer of Aroclor 1254 applied to feed to cow's milk. Tcos of 0.008 to 0.009 d/kg were obtained with doses ranging from 3.5-200 mg/d and exposures ranging from 60-107 days. A cow's milk Tco of 0.01 d/kg for unspeciated PCBs from~~

data by Thomas et al. (1999a) was calculated for the sum of 28 PCB congeners found both in feed and the milk.

TEQs have been determined for some PCBs and are generally added to PCDD/F TEQs for calculation of risk assessment values (OEHHA, 2005). Specific congener Tcos are recommended due to variation in absorption and metabolism of PCBs in dairy cattle, and also due to the degree of chlorination and the position of the chlorine atoms. Some PCBs are transferred effectively unchanged from grass to milk and dairy products (e.g. PCBs 118, 138, 153, 180), with the cow acting as an efficient conduit to humans, while others (e.g. PCBs 52, 101, 149) are largely removed from the environment and the human food chain if ingested by the dairy cow because they are readily metabolized by the cow (Thomas et al., 1999b). Tcos for individual PCB congeners were estimated from published data and are presented in Table RK-1 (Slob et al., 1995; Thomas et al., 1998; Thomas et al., 1999a; Kerst et al., 2004; Huwe and Smith, 2005). Kerst et al. (2004) provided TEQ-adjusted data from which a Tco (WHO-TEQ) of 0.014 d/kg was estimated for unspeciated PCBs.

In dairy cattle, Willett et al. (1990) reviewed early studies that examined the transfer of Aroclor 1254 applied to feed to cow's milk. Tcos of 0.008 to 0.009 d/kg were obtained with doses ranging from 3.5-200 mg/d and exposures ranging from 60-107 days. A cow's milk Tco of 0.01 d/kg for unspeciated PCBs from data by Thomas et al. (1999a) was calculated for the sum of 28 PCB congeners found both in feed and the milk.

Only one study could be found that allowed development of poultry meat Tcos for a limited number of individual PCB congeners. Pirard and De Pauw (2005) determined bioconcentration factors for coplanar-PCBs (PCBs 77, 81, 126, 169) in chicken breast muscle. Traag et al. (2006) provided bioconcentration data in abdominal chicken fat for all PCBs but exposure lasted only seven days. Because steady-state was not attained, Tcos could not be reliably determined. However, the data do indicate that based on the number of chlorines, the coplanar-PCBs are similarly, or more, bioaccumulative in fat compared to the other PCB congeners with the same number of chlorines. Thus, Tcos for the non-coplanar PCB congeners in Table K-1 were based on the co-planar PCBs with the same number of chlorines.

No reliable data could be found for developing individual congener Tcos for chicken eggs. Thus, the muscle Tcos for individual PCB congeners were also used for eggs, following adjustment for the higher fat content of eggs (11%) compared to muscle (7%).

A general PCB egg Tco of 6.7 d/kg was calculated from a laboratory study in which seven reference congeners (only one of which (#118) is listed in Table K-1) were spiked in the diet of hens (De Vos et al., 2005). Because none of the more bioaccumulative co-planar PCBs were investigated in this study, the coplanar PCB Tco of 10 d/kg was used for unspeciated PCBs. Numerous unspeciated PCB feed-to-muscle tissue studies have been published in chickens, resulting in a range of Tco values of 2.5 to 7.7 d/kg (Hansen et al., 1983; De Vos et al., 2003; Maervoet et al., 2004; De Vos et al., 2005; Pirard and De Pauw, 2005). A Tco of 7 d/kg for unspeciated PCBs was selected as the default value to reflect the median Tco of the individual congeners listed in Table K-1, and because this value is within the range of Tcos for unspeciated PCBs.

Toxic equivalent (TEQ)-adjusted Tcos could not be developed for poultry egg or muscle due to lack of steady-state conditions in the studies reviewed. However, a TEQ-adjusted egg Tco of 17 d/kg could be calculated from the bioaccumulation model developed for dioxins and dioxin-like PCBs by Van Eijkeren et al. (2006). Adjusting for the lower fat content in chicken muscle compared to eggs result in a TEQ-adjusted muscle Tco of 11 d/kg.

No reliable data could be found that estimated transfer of PCBs consumed in food to body fat of beef cattle. In dairy cattle, Willett et al. (1990) reviewed early experiments that examined the transfer of Aroclor 1254 from feed to adipose tissue. Fresh weight dairy beef Tcos of 0.013 to 0.027 d/kg were obtained for doses ranging from 10-200 mg/d with 60 day exposures. In another study, a beef Tco of 0.024 d/kg was calculated for dairy cattle following 14-week consumption of PCBs that naturally contaminated pastures (Thomas et al., 1999a).

On a fat weight basis, Thomas et al. (1999b) observed that not only are the PCB concentrations in body fat and milk fat similar, but that the congener patterns were similar as well. Thus, even though comprehensive congener-specific data are lacking for PCBs in muscle, congener-specific beef Tcos can be estimated from the cow's milk Tco data by adjusting for the greater fat content in muscle tissue (19%) compared to the milk fat content (4%).

We applied a PBPK-generated scaling factor developed by MacLachlan (2009) to estimate the transfer of PCBs from body fat of lactating cattle to body fat of beef cattle. Using data by Huwe and Smith (2005) that found a cow's milk half-life of 39-196 days for some co-planar PCBs, and the data by Thomas et al. (1999b) that showed similar levels of PCBs in milk fat and body fat, the ratio of simulated co-planar PCB levels in body fat of steers to body fat of lactating dairy cows is approximately 10. We multiplied the scaling factor of 10 by the PCB milk Tcos in Table K-1 following adjustment for differences in fat content between milk and beef to generate Tcos for beef. A similar calculation was also used to estimate the TEQ-adjusted beef Tco for PCBs.

In swine, Arochlor 1254 was added to feed for 6 months resulting in an unspeciated PCB Tco of 0.52 d/kg (Hansen et al., 1983). Speciated Tcos for 16 PCBs could be determined from the data, although only one PCB (#118) is currently listed in Table K-1. Thus, Tcos for individual PCBs in Table K-1 were based on the highest calculated PCB Tco with the same number of chlorines from the Hansen et al. study. ~~No information could be found for a TEQ-adjusted Tco for PCBs in swine, so the Tco was based on a Tco of 0.07 d/kg for meat of dairy cattle. The TEQ-adjusted value was then adjusted using a ratio of 3 for PCBs in body fat of pigs to body fat of lactating dairy cows from MacLachlan (2009), and then accounting for the higher average fat content in pig meat (23%) compared to cattle (19%). The default TEQ-adjusted pig Tco is 0.25 d/kg.~~

K.2.1.6 Polychlorinated Dibenzo-p-Dioxins and Furans (PCDD/F)

Numerous studies have investigated the feed-to-cow's milk transfer of PCDD/Fs. Several of these studies were conducted in the field near municipal solid waste incinerators, or estimated the mass balance of PCDD/F intake resulting from exposure to background or elevated levels of PCDD/Fs in pasture and soil (McLachlan et al., 1990; Slob et al., 1995; Schuler et al., 1997b; McLachlan and Richter, 1998; Lorber et al., 2000). These types of studies likely represent the best data for developing individual congener and overall unspeciated transfer factors of PCDD/Fs from "Hot Spots" facilities. Averaged congener Tco values were estimated from these data and are presented in Table K-1.

The milk Tco decreases by an order of magnitude or more for some of the higher chlorinated PCDD/Fs. This trend agrees with models showing that the percent transfer of chemical from feed to milk decreases for compounds with log Kow larger than about 6.5 (McLachlan, 1996). This reduced absorption is attributed to the presence of an aqueous resistance that limits diffusion of very hydrophobic compounds through the intestinal wall. Thus, a Tco for total PCDD/Fs (unspeciated PCDD/Fs) has not been pursued by researchers in their exposure studies. Nevertheless, a Tco for unspeciated dioxin-like PCDD/Fs of 0.001 d/kg can be calculated from the data by McLachlan et al. (1990). ~~In addition, an averaged TEQ-adjusted (I-TEQ) Tco value of 0.005 d/kg could also be calculated from the data of Slob et al. (1995) and McLachlan et al. (1990).~~

Several studies provided data from which Tcos could be estimated for individual PCDD/F congeners found in eggs and chicken meat. For eggs, transfer factor data were derived from three studies in which feed was mixed with soil environmentally contaminated with PCDD/Fs (Petreas et al., 1991; Stephens et al., 1995; Schuler et al., 1997a), and one study of feed contaminated with fly ash (Pirard and De Pauw, 2006). Individual congener Tcos among the studies were similar, often within a factor of five between values. An average Tco was calculated for each congener from the four studies and is shown in Table K-1.

Many of the same studies in chickens also estimated accumulation values for the sum of all PCDD/F congeners, or unspeciated PCDD/Fs, in eggs and meat. In egg, four studies in free-range and laboratory chickens exposed to contaminated soil provided an average Tco of 5.5 d/kg (range: 1.9 to 13.1 d/kg) for unspeciated PCDD/Fs (Petreas et al., 1991; Stephens et al., 1995; Malisch et al., 1996;

Schuler et al., 1997a). In chicken muscle, three contaminated feed or soil studies provided accumulation data from which an average Tco of 4.6 d/kg (range: 1.0 to 7.6 d/kg) was calculated (Stephens et al., 1995; Iben et al., 2003; Pirard and De Pauw, 2005).

~~However, unspeciated PCDD/F accumulation was most often expressed in toxic equivalents (TEQs). Three controlled laboratory studies in which 10% of the diet was PCDD/F-contaminated soil, the calculated TEQ-adjusted Tcos for eggs ranged from 2.4 to 4.1 d/kg with an average of 3.6 d/kg (Petreas et al., 1991; Stephens et al., 1995; Hoogenboom et al., 2006).~~ For the controlled laboratory feed-to-egg studies in which PCDD/Fs in fly ash or oil were added to feed (i.e., no contaminated soil was added to the diet), egg Tcos ranged from 8.5 to 17 d/kg with a mean of 12 d/kg (Pirard and De Pauw, 2005; 2006; Van Eijkeren et al., 2006).

For field studies, calculated egg Tcos of free-foraging chickens in various regions with PCDD/F-contaminated soil showed greater variation and was higher (Schuler et al., 1997a; Harnly et al., 2000; Hoogenboom et al., 2006). The Tcos ranged from 12 to 37 d/kg with an average of 23 d/kg. An assumption was made that the PDCC/F source for the free-foraging hens was contaminated soil, and that the soil ingestion rate was 10 g soil/day. There is general support among researchers for this soil ingestion rate by free-foraging chickens (De Vries et al., 2006). The larger egg Tco in field studies compared to controlled laboratory studies may be a result of free-foraging chickens consuming soil organisms and herbs and grass which may also be contaminated. However, greater bioavailability of soil PCDD/Fs in the field, or a higher soil ingestion rate than predicted may also play a role in a larger egg Tco under field conditions.

Overall, the range of mean values for these three types of studies is not large (within a factor of 10), considering the different sources of PCDD/Fs that the poultry were exposed to. A grand mean from the three types of exposure studies (contaminated soil field study, controlled contaminated soil study and contaminated feed study) is 13 d/kg (3.6 + 23 + 12 d/kg / 3), which we recommend as the default egg Tco for PCDD/Fs.

For edible muscle tissue (usually thigh or breast tissue), TEQ-adjusted Tcos could be calculated from several studies that investigated PCDD/F concentrations in chickens given contaminated feed. In a controlled laboratory study in which 10% of the diet was PCDD/F-contaminated soil, a Tco of 7.4 d/kg was calculated (Stephens et al., 1995). In three contaminated feed studies where PCDD/Fs in oil or fly ash were added to diet, similar Tcos of 8.6, 9.0 and 4.1 d/kg were calculated (Iben et al., 2003; Pirard and De Pauw, 2005; 2006). ~~A mean of 7.3 d/kg is calculated from these data and represents the TEQ-adjusted poultry meat Tco for PCDD/Fs.~~

Congener-specific data for development of beef Tcos were not as comprehensive as that for development of cow's milk Tcos. Two long-term pentachlorophenol (PCP) feeding studies in dairy cattle determined body fat concentrations for several PCDD/F congeners (1, 2, 3, 6, 7, 8- and 1, 2, 3, 7, 8, 9-HxCDD, 1, 2, 3, 4, 6, 7, 8-HpCDD, OCDD, 1, 2, 3, 4, 6, 7, 8-HpCDF, and OCDF) that were contaminants in the PCP formulation (Firestone et al., 1979; Parker et al., 1980). Beef Tcos based on dairy cattle for the other congeners and unspeciated PCDD/Fs were estimated with the assumption that the fat concentration is similar in milk and beef, and were adjusted upward to account for the greater fat content in muscle tissue (19%) compared to the fat content in milk (4%). As noted above, the concentration of PCBs in milk fat and body fat have been shown to be similar in exposure studies (Thomas et al., 1999b). We then applied scaling factors by MacLachlan (2009) to estimate the transfer of PCDD/Fs from body fat of lactating cattle to body fat of beef cattle. Data by Huwe and Smith (2005) found that half-lives were mostly 30-50 days for the PCDD/Fs; the major exceptions were OCDF ($t_{1/2}$ = 14 days) and OCDD ($t_{1/2}$ = 72.6 days). A ratio of 7 is estimated for the simulated PCDD/F levels in body fat of steers to body fat of lactating dairy cows for most PCDD/Fs. A ratio of 4 was estimated for OCDF and a ratio of 10 was estimated for OCDD.

Pig Tcos for individual and unspeciated PCDD/Fs in Table K-1 were estimated from a comprehensive study in which PCDD/Fs were added to the diet in feed of pigs during the 12-week fattening period (Spitaler et al., 2005). This exposure period represents the last 12-weeks prior to slaughter in the typical 6-month life of a pig. Notably, the researchers did not observe a reduction of residues due to roasting of the meat.

K.2.2 Tcos for Inorganic ~~and Organic~~ Metals

The studies used to derive inorganic ~~and organic~~ metal Tcos listed in Table K-2 usually presented data as fresh weight concentrations in muscle, milk and eggs. Occasionally, dry weight concentrations were reported. Unless the study noted the water content of the food source, default factors of 0.87 for cow's milk, 0.35 for chicken egg, 0.25 for chicken meat, and 0.30 for beef and pork were used for adjusting to fresh weight concentration (USDA, 1975).

Biotransfer studies for pig muscle could not be found for most of the metals. As noted in the beginning of this appendix, biotransfer data in cattle were more abundant. Where specific metal biotransfer data were missing in pigs but present in cattle, the pig meat Tco was estimated using a simple metabolic weight adjustment from cattle to pig as shown in Eq. K-1.

In general, low concentrations of inorganic metals are transferred from contaminated feed to muscle tissue, cow's milk and eggs and are not as great a concern relative to other potential sources of heavy metals in multipathway exposures. However, many of the inorganic metals such as cadmium, lead and mercury tend to accumulate over time in organs, particularly kidney and liver. Thus, frequent consumption of organs from exposed food animals may present a much greater toxic hazard to humans than consumption of the meat. Cadmium is of particular concern due to its relatively high toxicity and high potential for accumulation in the kidney and liver. Kidney and liver-specific Tcos for cadmium and a few other metals are presented in the text below for some of these food-producing animals only for comparison purposes. Tcos for accumulation in bone for some of the metals (i.e., lead) are also noted or calculated for some of the food products.

Another toxicological concern is that chickens can convert some of the ingested inorganic mercury in controlled feeding studies to methyl mercury, which is then found primarily in the poultry meat and egg white (Kiwimae et al., 1969). The inorganic mercury Tcos for poultry meat and eggs in Table K-2 represents total mercury, although some will be present as organic methyl mercury. Because methyl mercury is not emitted from facilities (i.e., only inorganic or elemental mercury is emitted), it is not accounted for in health risk assessments. However, Tcos for methyl mercury were calculated by OEHHA and presented in Section K.2.2.7 only for comparison to the inorganic mercury Tcos.

K.2.2.1 Arsenic

Only one study could be located that recorded a measurable increase of arsenic in cow's milk following dairy cattle consumption of contaminated feed. We calculated a Tco of 5×10^{-5} d/kg from data in dairy cattle exposed to As(III) as arsenic trioxide for 15-28 months (Vreman et al., 1986).

In poultry, organic arsenic compounds are an approved dietary supplement that can result in increased levels of total arsenic in meat and eggs (Lasky et al., 2004). Both organic and inorganic forms of arsenic are found in poultry, with inorganic forms more toxic than organic forms. Analysis of poultry and meat samples indicates that about 65% of total arsenic is in the inorganic form.

We calculated a Tco of 0.07 d/kg for total arsenic in eggs from hens fed a diet containing arsenic trioxide (Holcman and Stibilj, 1997). In muscle, total arsenic Tcos of 0.06 and 0.02 d/kg were determined in chickens from two studies following addition of arsenic trioxide to feed (Overby and Frost, 1962; Vadnjal et al., 1997). The proportion of arsenic in the inorganic form was not determined. In drinking water, soluble As(V) was added to the water resulting in a total arsenic Tco of 0.2 d/kg in muscle of broiler chickens (Pizarro et al., 2004). However, only 10% of arsenic in muscle was in the inorganic form. Over 50% was present as dimethylarsinic acid, which is considered a methylation detoxification pathway for arsenic. Thus, the inorganic arsenic Tco was 0.02 d/kg. We calculated an average muscle Tco of 0.03 d/kg from the three studies for transfer of arsenic from diet to chicken meat.

In beef cattle, Vreman et al. (1988) administered arsenic trioxide in the feed for 143 days to 16 bulls at about 12.5 mg/d resulting in a muscle Tco of 2.4 x 10^{-3} d/kg. The same Tco was calculated from data by Ham et al. (1949) that dosed adult steers daily with 270 mg arsenic trioxide for 201 days. In another study in steers, Bruce et al. (2003) estimated the daily intake of arsenic from grazing pasture grass, ingesting dust adhering to pasture, and direct ingestion of soil in an area contaminated with arsenic-laced mine tailings. Based on the daily intake and muscle concentration of arsenic at sacrifice after 237 days of exposure, a Tco of 2.8 x 10^{-4} d/kg was derived. We calculated an average muscle Tco of 1.7 x 10^{-3} d/kg from these three studies, which we recommend as the default value for beef cattle. Long-term arsenic feeding studies have also been conducted in lactating dairy cows. A slightly lower muscle Tco of 7.1 x 10^{-4} d/kg was calculated from these studies (Peoples, 1964; Vreman et al., 1986).

Arsenic exposure in beef and dairy cattle has not shown tissue-specific sequestering in liver or kidney, unlike some of the inorganic metals (e.g., cadmium, lead, and mercury). Similar Tcos were estimated for muscle, liver and kidney (Ham et al., 1949; Peoples, 1964; Vreman et al., 1988).

K.2.2.2 Beryllium

No inorganic beryllium accumulation studies could be found in the literature for poultry. Thus, we calculated poultry egg and meat Tcos for beryllium based on the average Tco value of the other “Hot Spots” divalent, cationic metals in Table K-2 (i.e., cadmium, lead, inorganic mercury, and nickel) providing beryllium Tcos for egg and muscle of 0.09 and 0.2 d/kg, respectively.

No multiple day inorganic beryllium exposure studies have been conducted in cattle or swine. In a single bolus study, Ng (1982) estimated a cow’s milk Tco of 9.1 x 10^{-7} d/kg based on recovery of radiolabeled beryllium chloride given to dairy cattle. For beef, we determined a beryllium Tco of 3 x 10^{-4} d/kg based on the average Tco value of the divalent, cationic metals cadmium, lead, and inorganic mercury. Beef Tcos for these three metals were determined directly from published studies. A default pork Tco was determined by us by the same method as that used for beef, resulting in a pig meat Tco of 1 x 10^{-3} d/kg.

K.2.2.3 Cadmium

Very low accumulation of cadmium occurs in cow’s milk, and concentrations of cadmium in cow’s milk are often below the detection limit. In his review, Stevens (1991) estimated an average Tco of 1.3 x 10^{-6} d/kg in cow’s milk from two long-term cadmium exposure studies by Vreman et al. (1986). More recently, we estimated a milk Tco of 1.3 x 10^{-5} d/kg from exposure data in a single cow exposed to cadmium for 77 days (Mehennaoui et al., 1999). The average Tco from the three exposure studies is 5 x 10^{-6} d/kg, which we recommend as a default Tco.

Numerous cadmium accumulation studies have been conducted in poultry. Similar to cow's milk, very low accumulation of cadmium occurred in hen's eggs with exposure in feed; the levels of cadmium in eggs are sometimes below the detection limit. We calculated an average egg Tco of 0.01 d/kg from the best available data (Leach et al., 1979; Sharma et al., 1979; Hinesly et al., 1985). In muscle, we determined cadmium Tcos in exposed chickens ranging from 0.2 to 1 d/kg (Leach et al., 1979; Sharma et al., 1979; Hinesly et al., 1985; Pribilincova et al., 1995; Bokori et al., 1996). The average value from these studies was 0.5 d/kg, which we recommend as the Tco.

Similar cadmium Tcos in muscle of dairy and beef cattle have been observed in long-term feeding studies lasting 3.5 to 28 months. We calculated an average Tco of 2.0×10^{-4} d/kg with a range of $1.2 – 3.2 \times 10^{-4}$ d/kg (Johnson et al., 1981; Vreman et al., 1986; 1988). A muscle Tco of 6.5×10^{-5} d/kg was obtained from a feeding study by Lamphere et al. (1984) describing cadmium body burden in calves exposed for 60 days. However, the short exposure duration only during growth of the animal may result in an underestimation of the Tco compared to exposure to adulthood.

Cadmium accumulates to a much greater extent in some organs compared to muscle tissue. In poultry, exposure studies suggest that cadmium accumulation in the kidney and liver increases with increasing exposure duration and may not attain a steady-state concentration. Eighty-week exposure to cadmium in chickens resulted in a Tco of 800 d/kg in the kidney and 70 d/kg in the liver (Hinesly et al., 1985). In dairy and beef cattle, cadmium Tcos for liver and kidney did not vary greatly even though exposure durations varied. Average calculated Tcos were about 0.03 d/kg (range: 0.01 to 0.048 d/kg) for liver, and 0.1 d/kg (range: 0.09 to 0.19 d/kg) for kidney (Sharma et al., 1979; Sharma et al., 1982; Vreman et al., 1986; 1988).

Only one study could be found that measured cadmium muscle levels in pigs following exposure to cadmium in feed. Cousins et al. (1973) only found measurable cadmium levels in skeletal muscle at the highest of four doses tested (1350 ppm) following a six-week exposure, but this level caused severe toxicity. More accurate estimates of muscle uptake were found in heart tissue, which exhibited increased tissue concentration with increasing dose and may represent the upper end of the cadmium concentration found in skeletal muscle. The average Tco we calculated in heart muscle was 0.0051 d/kg. In the liver and kidneys of pigs, cadmium Tcos as high as 0.48 and 2.53 d/kg, respectively, were calculated from a study by Sharma et al. (1979).

K.2.2.4 Chromium (Hexavalent)

Only a portion of ingested hexavalent chromium (Cr(VI)), perhaps 1-2%, is expected to be systemically absorbed in the hexavalent form due to rapid reduction to the less soluble and less toxic trivalent chromium in the acidic environment of the stomach (Costa, 1997; NTP, 2008). Trivalent chromium (Cr(III)) is an essential micronutrient, but no cancer potency or noncancer reference exposure level is currently available for this form of chromium. Cr(VI) that is absorbed can then be actively transported into all cells and tissues of the body in place of anions, such as phosphates. Once inside the cell, the Cr(VI) is reduced to various unstable reactive intermediates and, finally, stable Cr(III) is ultimately formed inside the cell.

Current analytical procedures cannot differentiate between the oxidation states of chromium in biological tissues (NTP, 2008). However, it has been advocated that any Cr(VI) transported into meat and eggs would be converted to the more stable Cr(III) form and would presumably not pose a risk for human consumption (Chundawat and Sood, 2005). Based on these findings no Cr(VI) Tco is currently recommended by OEHHA for meat and eggs.

However, a similar situation may not be the case for cow's milk. Lameiras et al. (1998) found Cr(VI) in cow's milk, which was 25-50% of total chromium. In whole milk, the average total chromium concentration was 2.70 ug/L (range: 1.42-5.70 ug/L) and the average Cr(VI) concentration was 0.68 ug/L (range: 0.20-1.20 ug/L). No multiple day Cr(VI) exposure studies in dairy cattle could be found in the literature. Following a single oral dose of radiolabeled sodium chromate (Na_2CrO_4), Van Bruwaene et al. (1984) calculated a steady-state cow's milk Tco of 1.0×10^{-5} d/kg for total chromium. Stevens (1991) estimated a similar Tco of 1.4×10^{-5} d/kg from the same data based on a half-life of 26 days for total chromium in cow's milk. These studies did not attempt to estimate the proportion of total chromium that was secreted as Cr(VI) into milk.

Multiplying the Stevens total chromium Tco by the fraction of total chromium that is Cr(VI) in normal milk (1.4×10^{-5} d/kg x 0.68/2.70 ug/L) provided a modified Tco of 3.5×10^{-6} d/kg. Until valence-speciated cow's milk data are available from Cr(VI) exposure studies, we chose a midpoint Tco value between the Stevens Tco and this modified Tco adjusted for Cr(VI) content in normal milk (8.75×10^{-6} d/kg) as a health-protective cow's milk default value for Cr(VI).

K.2.2.5 Fluoride

In a series of long-term exposure studies on fluorides' effect on milk production, the fluoride concentration in the milk of dairy cows given fluoride in feed resulted in an estimated cow's milk Tco of 0.0003 d/kg (Stoddard et al., 1963; Harris et al., 1964).

Fluoride in the diet of hens resulted in very low accumulation of fluoride in muscle, and yolk and albumin of eggs (Hahn and Guenter, 1986). We calculated a Tco in whole eggs of 0.008 d/kg from the exposure data. Considerably greater accumulation occurs in egg shell. Muscle accumulation in the fluoride-exposed hens resulted in a Tco of 0.03 d/kg.

Specific data concerning accumulation of fluoride in the skeletal muscle tissue of exposed cattle could not be found. However, in cases of high fluoride intake, fluoride levels in the soft tissue (i.e., brain, liver, kidney, pancreas, intestines, etc.) are reported to increase only two or three times the normal value in meat producing animals. Fluoride does not accumulate in the edible portions of the animal (Suttie et al., 1958; Shupe et al., 1964). However, considerably greater accumulation of fluoride occurred in bone. In heart tissue, we calculated a fluoride Tco of 8.4×10^{-4} d/kg for Holstein cows fed fluoride-contaminated rations for 5.5 years, which we recommend as the default muscle Tco for range cattle (Suttie et al., 1958). It is assumed that similar pharmacokinetic properties, and similar Tcos, occur for fluoride in both skeletal and heart muscle tissue.

K.2.2.6 Lead

Only three contaminated feed studies observed measurable levels of lead in milk from both control and exposed dairy cows. Based on data from a 15-28 month lead exposure study of dairy cows kept indoors, a cow's milk Tco of 2.6×10^{-5} d/kg was calculated (Vreman et al., 1986). A three-month outdoor lead exposure study by the same researchers produced a Tco of 5.4×10^{-5} d/kg. Stating that the half-life of lead in dairy cows is about 45 days, Stevens (1991) adjusted the Tco of the three-month outdoor study to 7.1×10^{-5} d/kg. However, Willett et al. (1994) observed that steady-state was attained in cow's milk after only 14 days of a 49-day lead exposure study, generating a Tco of 7.9×10^{-5} d/kg. Using the steady-state-corrected Tco by Stevens (1991) for the outdoor Vreman study, we recommend an average Tco of 5.9×10^{-5} d/kg from these three studies.

An average Tco of 0.4 d/kg in muscle was calculated by OEHHA for lead in broiler chicks fed contaminated feed for 20 days (Stoddard et al., 1963; Harris et al., 1964; Latta and Donaldson, 1986a; 1986b). For comparison, a roughly 10-fold higher Tco was calculated for lead in kidney. However, lead tends to accumulate most in bone, generating a Tco of 70 d/kg. Lead in bone is not expected to be a problem, unless contaminated bone is ground into bone meal and fed to animals. Accumulation of lead in eggs was very low, generating a Tco of 0.04 d/kg (Meluzzi et al., 1996).

Vreman et al. (1988) administered lead acetate in feed to young bulls for 143 days during the fattening period. The resulting muscle Tco was 2.7×10^{-4} d/kg. A slightly lower muscle Tco of 6.7×10^{-5} d/kg in lactating dairy cows fed lead mixed with their feed (Vreman et al., 1986).

Roughly 10- to 100-fold greater accumulation of lead occurs in the kidney and liver of cattle compared to their muscle tissue. We calculated Tcos of 4.8×10^{-3} and 1.4×10^{-2} d/kg for liver and kidney, respectively, in the bulls from the Vreman et al. (1988) study. In addition to liver and kidney, lead was also found to accumulate in bone. In a three-month feeding study in dairy cattle, a bone Tco of

0.02 d/kg was calculated from the data by Sharma et al. (1982). In one of the few biotransfer studies conducted in pigs, a liver Tco of 1.4 x 10^{-2} d/kg was recorded in pigs fed diets containing either 5 or 25 ppm lead acetate for 90 days (Sharma and Street, 1980).

K.2.2.7 Inorganic Mercury (Inorganic and Methyl Mercury)

Addition of only inorganic mercury (Hg(II)) to the feed of hens for 140 days resulted in a muscle tissue Tco of 0.02 1 d/kg (Kiwimae et al., 1969). However, some Hg(II) was converted to methyl mercury (MeHg) in the chickens, resulting in a muscle Tco of 0.09 d/kg for MeHg. When only MeHg is added to the diet in prolonged feeding studies, an average Tco of 10 d/kg was calculated with virtually all the mercury in the muscle as MeHg (Kiwimae et al., 1969; Soares et al., 1973; Hilmy et al., 1978). Some Hg(II) added to feed is also endogenously methylated in the hens and transported to the eggs. Addition of Hg(II) to the feed of hens for 140 days resulted in a calculated egg Tco of 0.3 8 d/kg for total Hgmercury(II), and 0.5 d/kg for MeHg (Kiwimae et al., 1969). An average egg Tco of 11 d/kg was calculated when only MeHg was added to feed (Scott et al., 1975; Hilmy et al., 1978).

Vreman et al. (1986) observed a small, but statistically insignificant increase in mercury in cow's milk with exposure of dairy cattle to inorganic mercury in feed for 15-28 months. The Tco range was 7 to 40 x 10^{-5} d/kg with an average of 2 2 x 10^{-4} d/kg. Stevens (1991) calculated Tcos of 9.2 x 10^{-6} and 1.3 x 10^{-5} d/kg from oral single bolus studies of radiolabeled inorganic mercury by Mullen et al. (1975) and Potter et al. (1972). The steady-state Tcos were calculated by use of study-specific half-lives of 1.2 (Potter et al., 1972) or 5.5 days (Mullen et al., 1975) for mercury. We calculated an average Tco of 7 x 10^{-5} d/kg from the three studies, which we recommend for transfer of inorganic mercury to cow's milk.

Similar to cow's milk, only a small, but statistically insignificant increase in inorganic mercury could be measured in muscle tissue following long-term exposure of dairy and beef cattle to soluble mercury (Vreman et al., 1986; 1988). Calculated maximum muscle Tco values from these two studies were 6.7-18 x 10^{-4} d/kg, but we lack confidence in this value due to the detection limit of these studies. To calculate the biotransfer of ingested mercury to muscle, Stevens (1992) relied on three oral bolus dose studies that determined the half-life of inorganic mercury in blood of dairy cattle (Potter et al., 1972; Ansari et al., 1973; Mullen et al., 1975). Operating on a reasonable assumption that muscle is a well-perfused tissue and shares the same kinetic compartment as blood, Stevens calculated an average muscle Tco of 3.5 x 10^{-4} d/kg (range: 1.8-4.4 x 10^{-4} d/kg). This value is comparable with the Tcos estimated from the Vreman studies, and which we recommend as the point estimate Tco for inorganic mercury in beef.

Although it is not anticipated that human exposure to methyl mercury via cow's milk and beef would be a significant pathway (e.g., as compared to fish), biotransfer information is included here for completeness. There are few published data that investigated ruminant methylmercury uptake and accumulation. However, background exposure and accumulation of inorganic and methylmercury in meat products are reported to be very low (U.S. EPA, 1997). In their risk assessment guidelines, U.S. EPA (2005) suggests that only 13% of total mercury in ruminants is present as methylmercury, an indication that ruminants have little exposure to methylmercury.

In vitro, cow rumen microflora does not methylate added inorganic mercury (as $HgCl_2$) to methylmercury (Kozak and Forsberg, 1979). On the other hand, rumen microflora was found to demethylate up to 40% of added methylmercury to elemental, or metallic, mercury (Hg^0), which would then be presumably excreted with little or no absorption. This finding suggests that ruminants can detoxify some of the ingested methylmercury.

Stevens (1991) estimated that the Tco for methylmercury in cow's milk is roughly one order of magnitude greater than that for inorganic mercury (i.e., 7×10^{-4} d/kg). His finding was based on a study by Neathery et al. (1974), in which two dairy cows were given a bolus dose of radiolabeled methylmercuric chloride and followed for the appearance of label in milk for 14 days. A milk excretion half-life of 6 days was calculated from the data. It was suspected that the lipophilic nature of methyl mercury resulted in its accumulation in milk fat. Of the labeled methylmercury that was absorbed, 72% of the total body burden was found in muscle tissue 15 days after the single bolus dose. However, there are insufficient data to estimate the biotransfer of ingested methylmercury in cattle and pigs with chronic exposure.

K.2.2.8 Nickel

Only two studies were found in the literature that attempted to estimate the nickel concentration in cow's milk following 1.5 to 2 month exposure of the dairy cattle to inorganic nickel-contaminated feed (Archibald, 1949; O'Dell et al., 1970). Neither study used analysis methods that were sensitive enough to record measurable increases of nickel in the cow's milk. Stevens (1991) used the maximum value approach by dividing the detection limit (0.1 ppm) of the studies by two, arriving at an average cow's milk Tco of 2.7×10^{-5} d/kg. Until more sensitive studies are conducted, we recommend this Tco as the default value for inorganic nickel.

Limited data for nickel indicate low accumulation of this metal occurs in eggs and tissues of chickens (Ling and Leach, 1979; Meluzzi et al., 1996). We calculated Tcos of 0.02 d/kg for both eggs and muscle tissue of hens fed inorganic nickel mixed in their diet. As with other inorganic metals, greatest nickel accumulation occurred in the kidney (Tco = 0.68 d/kg), resulting in a Tco over 30-fold higher than that found in muscle or eggs.

No adequate studies investigating biotransfer of ingested inorganic nickel to beef or pork could be located. As with the approach used for beryllium, we determined a beef Tco based on an average of the three divalent cationic metal Tcos (i.e., cadmium, lead and inorganic mercury) that had sufficient biotransfer data available in the literature. The resulting beef Tco was 3 x 10^{-4} d/kg. We then developed a pig meat Tco of 0.001 d/kg based on the cow-to-pig metabolic weight ratio adjustment (Eq. K-1). OEHHA recognizes that these Tcos developed for beef and pork are more uncertain than would be desirable. However, the data available in other food-producing animals and similar Tcos developed for other cationic metal contaminants indicates the nickel muscle Tco is likely not underestimated in cattle and pigs.

K.2.2.9 Selenium

The selenium concentration in milk tends to increase as intake of selenium increases from about 2 to 6 mg/day (Fisher et al., 1980; Maus et al., 1980; Beale et al., 1990). Secretion of selenium into milk then appears to reach a temporary limit when selenium intake is about 6 to 12 mg/day. The mammary gland is either limited in the limited amount of selenium it can secrete into milk, or, more likely, the net absorption of selenium from the gut is controlled in the face of increased selenium intake. Only when selenium intake increases above 50-100 mg/day does the ability of the protection mechanism become exceeded, resulting in selenium toxicity and increased selenium concentration in milk. We calculated a Tco of 0.009 d/kg based on the average value for studies that supplemented feed with 6 mg/d selenium or less.

Optimum levels of selenium in the diet of poultry are about 0.1 to 0.2 ppm (Arnold et al., 1973; Moksnes and Norheim, 1982). Concentrations of selenium above 3 ppm may result in toxicity. At concentrations of 1 to 9 ppm selenite in the feed, we calculated an average egg Tco of 3 d/kg (Arnold et al., 1973; Ort and Latshaw, 1978; Moksnes and Norheim, 1982; Davis and Fear, 1996). In broiler chicks, an average Tco of 0.9 d/kg for muscle was calculated (Moksnes and Norheim, 1982; Echevarria et al., 1988a; 1988b). Laying hens had a lower Tco of 0.4 d/kg for muscle tissue, possibly due to eggs acting as an elimination pathway for selenium (Arnold et al., 1973; Ort and Latshaw, 1978; Moksnes and Norheim, 1982). Thus, the muscle Tco for selenium is based on the findings in meat (broiler) chickens.

In beef cattle, groups of calves were fed sodium selenite in a milk replacer at concentrations of 0.2 to 5 ppm for six weeks (Jenkins and Hidiroglou, 1986). We calculated an average muscle Tco of 6.6 x 10^{-2} d/kg from the exposure data. In another study, inorganic selenium was intraruminally administered in beef cows through two soluble-glass boluses to slowly release Se over approximately 11 months (Hidiroglou et al., 1987). We calculated a Tco of 7.1 x 10^{-3} d/kg in the muscle tissue. The average muscle Tco from the two studies is 0.037 d/kg, which we recommend as the default selenium transfer factor. Jenkins and

Hidiroglou (1986) also observed greater accumulation of selenium in the liver and kidney cattle compared to muscle, resulting in calculated Tcos of 2.7 and 0.25 d/kg, respectively.

In pigs, selenium muscle concentrations have been measured following unsupplemented intake or supplementation of selenium in diets. No studies could be located that estimated tissue levels of selenium following prolonged intake of toxic or near-toxic levels of selenium. Using a study by Ku et al. (1972), we calculated an average muscle Tco of 0.61 d/kg in groups of adult pigs that had been fed diets containing selenium at levels ranging from 0.027 to 0.493 ppm. A positive correlation between selenium level in the diet and muscle concentration was observed. Using another study, which exposed pigs to diets containing 0.78-0.88 ppm selenium during the growth phase, we calculated a muscle Tco of 0.35 d/kg in pigs at market weight (Jenkins and Winter, 1973).

Similar to the phenomena observed in dairy cattle, supplementation of pig diets with selenium (0.1 to 1.0 ppm) did not always result in an increase in tissue selenium levels. Tcos based on these studies are as much as 10-fold lower compared to Tcos calculated from baseline levels of selenium found in feed (Groce et al., 1971). However, it is not known if this protective mechanism also operates at higher selenium levels in feed that may produce toxic effects in pigs. Thus, we recommend a default pig Tco based on the average Tco (0.48 d/kg) determined using Ku et al. (1972) and Jenkins and Winter (1973), which covered a range of baseline selenium intakes in feed from 0.027 to 0.88 ppm.

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Appendix L

Activity Data Analysis Report

L.1 Introduction

The Office of Environmental Health Hazard Assessment (OEHHA) and the Air Resources Board (ARB) staff ~~are evaluating ways to update and improve~~have updated the exposure assessment methodologies and the data used for conducting Health Risk Assessments (HRA) as prescribed under the Air Toxics “Hot Spots” Information and Assessment Act (Assembly Bill 2588; Health and Safety Code Section 44300 et seq.). The ~~goals~~ mandates of the Air Toxics "Hot Spots" Act are to collect emission data, to identify facilities having localized impacts, to ascertain health risks, to notify nearby residents of significant risks, and to reduce those significant risks to acceptable levels. This report focuses on ~~the~~ two of the exposure variables (i.e. exposure duration and exposure frequency) used in estimating a person’s lifetime average daily dose by considering the time a person lives in ~~their~~ his or her primary residence and the time ~~they~~ a person spends daily at home.

Staff looked into various data sources to determine the residency duration at the household level and the daily activity pattern at the individual level. The data sources the staff examined include the National Human Activity Pattern Survey (NHAPS), the National Household Travel Surveys (NHTS), the National Longitudinal Surveys, the American Time Use Survey Data Extract Builder, the Integrated Public Use Microdata Series (IPUMS-USA) census data, the Southern California Association of Governments (SCAG) 2000 regional travel survey data, and the California Department of Transportation (Caltrans) 2000-2001 California Statewide Household Travel Survey (CHTS) data. The staff determined that IPUMS-USA, SCAG 2000 regional travel survey, and Caltrans 2000-2001 CHTS represent the most current and California-specific residence and activity data and therefore were used as the basis for the conclusions stated in this report.

Results show that, from 2006 to 2009, over 91% of California householders had lived at their current home address for less than 30 years, and over 63% of householders had lived at their current residence for 9 years or less. No data were available for householders who lived in their homes over a 70 year period.

The 2000-2001 CHTS data show that, on average, Californians spend approximately 73% of their time at home per day. When looking at the data by age group, the time increases to 85% for children under 2 years old. Individuals that are 2 years or older, but less than 16 years old, spend 72% of their time at home whereas Californians that are 16 years or older spend 73% of their time at home.

L.2 Data Sources Analyzed

L.2.1 IPUMS-USA data

IPUMS-USA consists of more than fifty samples of the American population drawn from fifteen federal censuses and from the American Community Surveys (ACS). ACS is a nationwide survey that collects and produces population and housing information every year from about three million selected housing unit addresses across every county in the nation (ACS). IPUMS-USA samples, which draw on every surviving census from 1850-2000 and the 2000-2009 ACS samples, collectively constitute the quantitative information on long-term changes in the American population. These records for the period since 1940 only identify geographic areas with equal or larger than 100,000 residents (250,000 in 1960 and 1970) (IPUMS-USA).

IPUMS-USA census data contain residency duration, travel to work data, residence and work location, age, household and personal income, and ethnicity data.

L.2.2 SCAG Year 2000 Post-Census Regional Household Travel Survey Data

The second set of data the staff evaluated was the Post-Census Regional Household Travel Survey sponsored by the Southern California Association of Governments (SCAG). SCAG is the federally designated metropolitan planning organization (MPO) for the Los Angeles region of California. The survey targeted households in the six counties of the SCAG region: Imperial, Los Angeles, Orange, San Bernardino, Riverside, and Ventura (SCAG, 2003).

SCAG survey has data of time spent at home, trip data, geo code for locations, home address, age, income, ethnicity, and limited residency duration (months lived at home location).

L.2.3 Caltrans 2000-2001 California Statewide Household Travel Survey Data

Caltrans maintains statewide household travel data to estimate, model, and forecast travel throughout the State. The information is used to help in transportation planning, project development, air quality analysis, and other programs. The CHTS obtained sample household socioeconomic and travel data at the regional and statewide levels.

In the raw survey database obtained from Caltrans, there are data about trip duration, activity duration, location type, geo code for destination, address, age, income, and ethnicity. There are no data about residency duration.

Caltrans is currently developing a new 2011-2012 CHTS, which is a joint effort among Caltrans, SCAG and other MPOs. ARB is part of the Steering Committee.

L.2.4 Data Sources Summary

Table L.1 summarizes the activity data sources the staff analyzed, which include IPUMS census data, SCAG 2000 regional travel survey data, and Caltrans 2000-2001 CHTS data. It shows the data availability based on the HRA related categories.

Table L.1 Activity Data Sources

Sources			
HRA related Categories	**IPUMS-USA Census Data 2000-2009**	**SCAG 2000 Travel Survey**	**Caltrans 2000-2001 CHTS**
Residency duration	Year moved in	Months lived at home location	N/A*
Time at home per day	N/A	At home activity duration	At home activity duration
Time away from home	Hours worked, Travel time to work	Trip duration, activity duration	Trip duration, activity duration
Trip distance	N/A	Geo code for origin and destination	Geo code for destination
Residence location	City. No zip code	Address	Address
Age	Yes	Yes	Yes
Income level	Income Variables	Household income	Household income
Seasonal trend	N/A	N/A	N/A
Ethnicity	Yes	Yes	Yes
Data Set	Federal censuses (1850-2000), American Community Surveys (2000-2009)	2000-2002 Six-county Los Angeles region of CA	2000-2001 CA Statewide weekday travel survey

* N/A: Data are not available.

L.3 Methodologies and Findings:

In this section, we outline the methodologies we used in each of the data sources to estimate a person's time period lived in his or her residence and the time spent in different activities each day. We also examined how different environmental factors such as socioeconomic status, age, and ethnicity affect residency duration and daily activity patterns. We conclude with a discussion of the findings of each of the data sources.

L.3.1 IPUMS-USA data

L.3.1.1 Methodology

The staff used IPUMS online analysis tool (IPUMS Tool) to analyze the residency duration data based on ACS 2006-2009 data. The results are compiled and discussed below.

There are IPMUS_USA ACS data from 2000 to 2005 as well. However, the IPMUS_USA ACS data from 2006 to 2009 are more recent and have the same sample size percentage (i.e. 1%) for each year. In addition, these data include persons in group quarters and the smallest identifiable geographic unit is the Public Use Microdata Area (PUMA) containing at least 100,000 persons (IPUMS Samples). Group quarters consist of both institutions and units housing either a primary family or a primary individual plus a given number of persons unrelated to the head (IPUMA GQ).

L.3.1.2 Findings and Discussions

L.3.1.2.1 California Statewide Residency Duration Distributions

Table L.2 presents California statewide time moved into residence distributions compiled from the analysis results of ACS 2006, 2007, 2008, 2009 single year samples and ACS 2006-2008 3-year sample using IPUMS-USA online data analyzing tool. The time moved into residence variable has 7 values in ACS data as listed in "Time Moved into Residence" column in Table L.2, including "5 to 9 years ago" and "30 years ago". The statistical data provided have the samples' household weight applied. Household weight indicates how many households in the U.S. population are represented by a given household in an IPUMS sample (IPUMS Weights). Each cell besides the row and column headers in Table L.2 contains a household percent and the number of householders presented by that percent.

In summary, IPUMS-USA ACS 2006 to 2009 data show that the percentage of the California householders with a residency period of 30 years or greater is less than 9%. In other words, over 91% of California householders had lived in their current residence location for less than 30 years. These data also show that over 63% California householders had lived at their current residence for 9 years or less.

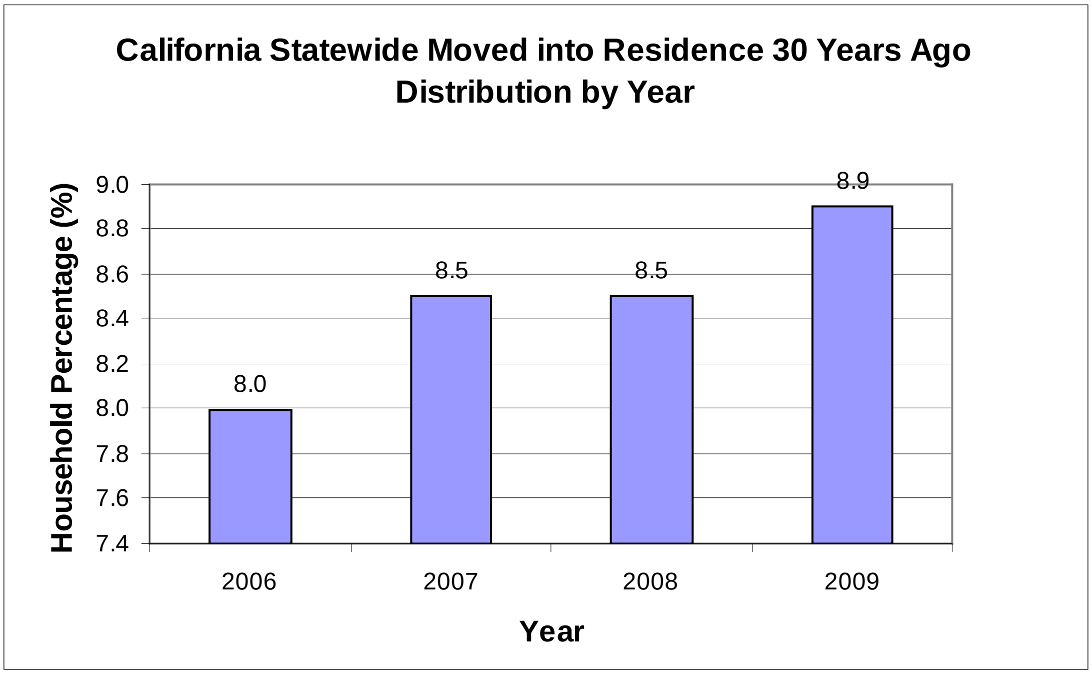
Table L.2* California Statewide Time Moved into Residence Distribution by Year (Weighted Household Percent and Number)

Time Moved into Residence	2006	2007	2008	2006-2008 3-year Sample	2009
12 months or less	**17.2** 2,084,533.0	**15.9** 1,939,774.0	**15.4** 1,871,049.0	**16.2** 1,968,717.0	**15.7** 1923501
13 to 23 months ago	**7.5** 910,536.0	**6.9** 838,322.0	**6.5** 796,030.0	**7** 848,579.0	**6.4** 783261
2 to 4 years ago	**21.9** 2,665,547.0	**22.9** 2,795,422.0	**23.3** 2,834,921.0	**22.7** 2,768,053.0	**20.3** 2482340
5 to 9 years ago	**19.8** 2,411,057.0	**20.1** 2,449,371.0	**20.1** 2,448,160.0	**20** 2,434,099.0	**20.9** 2554979
10 to 19 years ago	**17.6** 2,141,482.0	**17.7** 2,162,519.0	**18.1** 2,208,805.0	**17.8** 2,169,353.0	**18.9** 2311981
20 to 29 years ago	**7.9** 960,926.0	**8.1** 982,699.0	**8.0** 979,208.0	**8.0** 974,196.0	**8.7** 1067833
30 years ago	**8.0** 977,136.0	**8.5** 1,032,572.0	**8.5** 1,038,566.0	**8.3** 1,014,849.0	**8.9** 1090992
TOTAL	***100.0*** *12,151,217.0*	***100.0*** *12,200,679.0*	***100.0*** *12,176,739.0*	***100.0*** *12,177,846.0*	***100.0*** *12214887*

* IPUMS-USA ACS 2006 to 2009 data with household weight applied. As of March 2011, there is no IPUMS-USA multi-year sample with ACS 2009 sample included yet.

Figure L.1 graphically depicts the 2006 to 2009 statewide householder percentages of Californians that moved into their current home location 30 years ago. From 2006 to 2009, this figure shows an increase in the percentage of statewide householders that moved into residence 30 years ago.

Figure L.1*

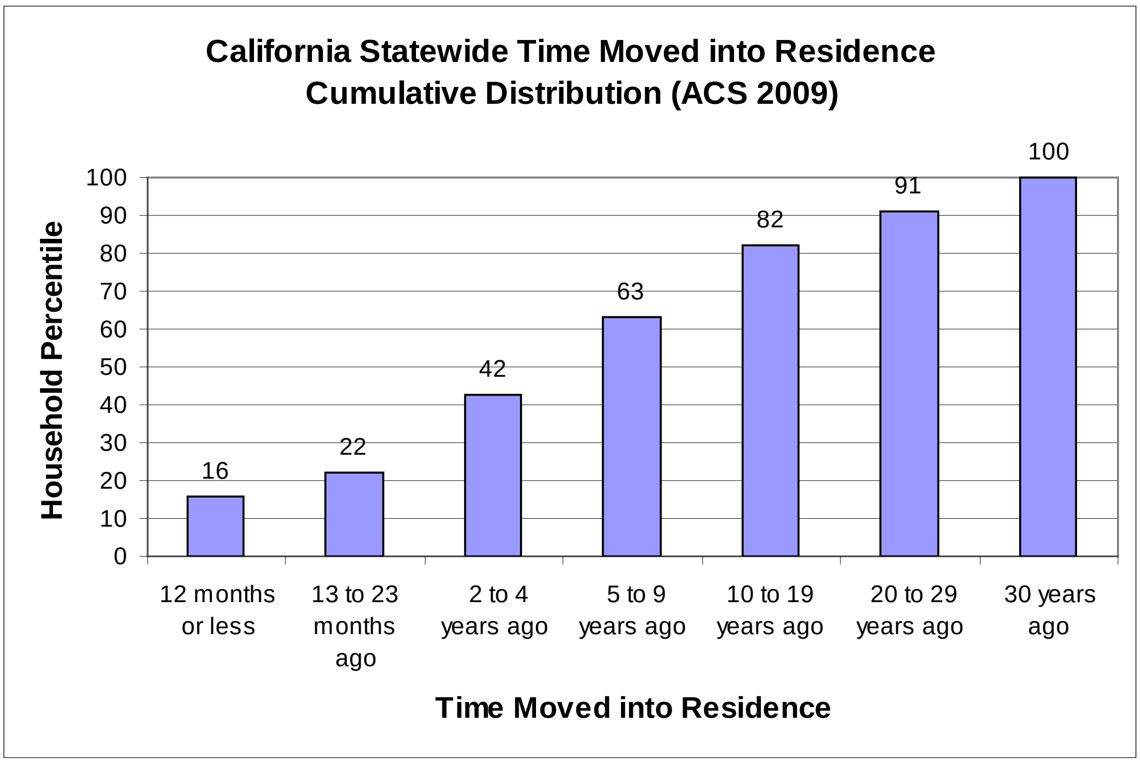


* IPUMS-USA ACS 2006, 2007, 2008, and 2009 single year samples with household weight applied.

Figure L.2 and Figure L.3, respectively, show the California statewide time moved into residence cumulative distributions using IPUMS-USA ACS 2009 sample and 2006-2008 3-year sample with household weight applied. Both of these figures show that over 90 percent of California householders had lived at their current home address for less than 30 years, and approximately 63 to 66 percent of the householders had lived at their current residency location for 9 years or less.

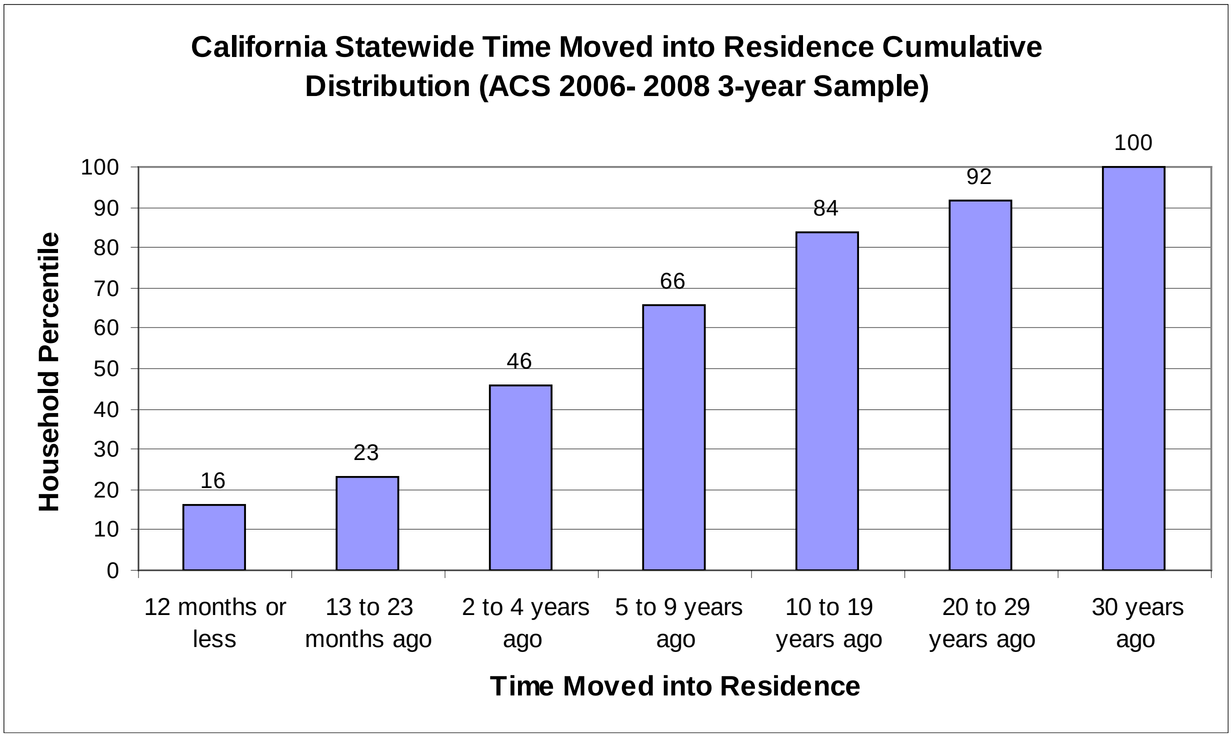
See Supplemental Information section (page 29) for additional information on time moved into residence distributions by California householder's ethnicity, age, and household income from IPUMS-USA ACS 2009 data.

Figure L.2*



* IPUMS-USA ACS 2009 data with household weight applied.

Figure L.3*



* IPUMS-USA ACS 2006-2008 3-year sample with household weight applied. As of March 2011, there is no IPUMS-USA multi-year sample with ACS 2009 sample included available yet.

L.3.1.2.2 Evaluation of Populations and Residency Duration Distributions for California Cities

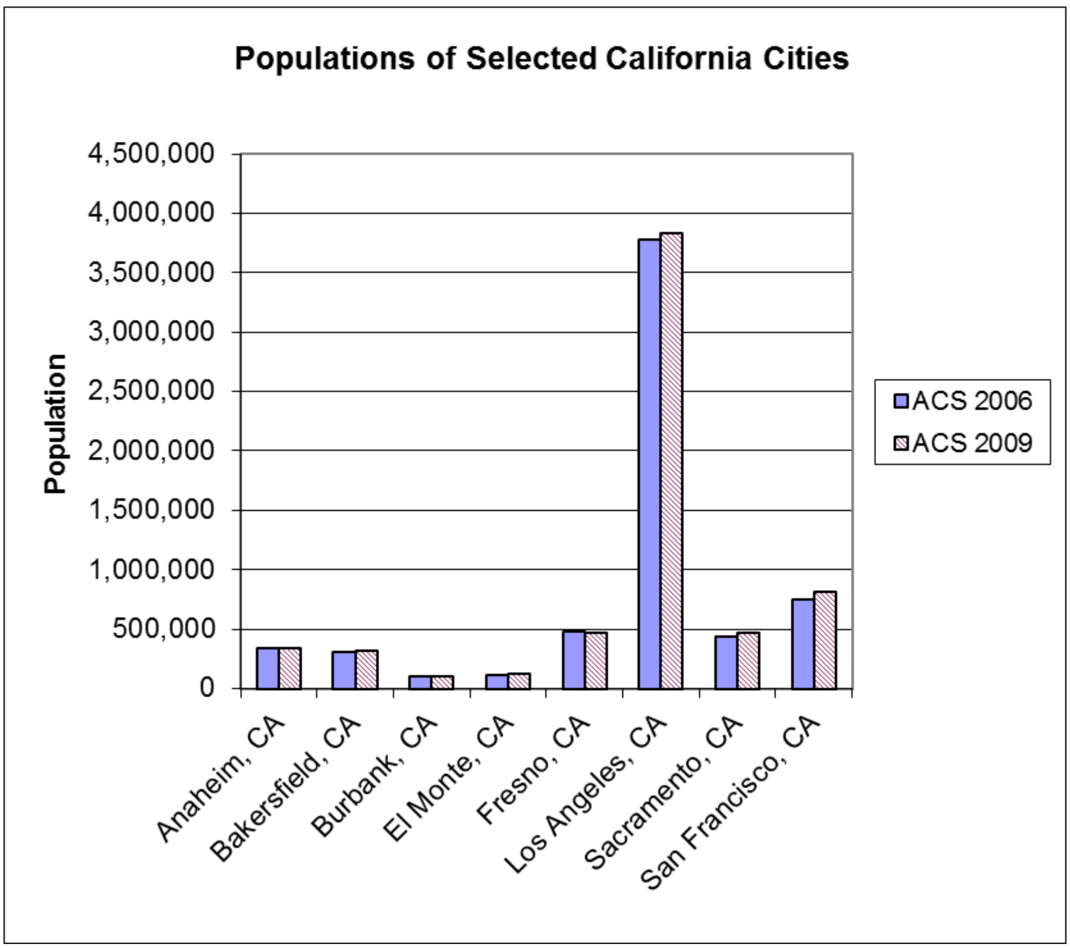
Table L.3 and Figure L.4 display the populations and population changes for 8 selected California cities from IPUMS-USA ACS 2006 and ACS 2009 data with person weight applied. Person weight indicates how many persons in the U.S. population are represented by a given person in an IPUMS sample (IPUMS Weights). These 8 cities have populations over 100,000 from IPUMS-USA ACS 2006 and 2009 data, and were selected to represent the regions of California and to include an Environmental Justice community (Fresno, CA). If an area consisted of less than 100,000 persons then it was combined with another area so that the total population would be greater than 100,000 persons. The exhaustive distribution data from IPUMS-USA ACS 2006 and 2009 samples contain 41 identifiable California cities.

Table L.3 ***Comparison of Populations of Selected California Cities (IPUMS-USA ACS 2006 and 2009)***

California City	Anaheim, CA	Bakersfield, CA	Burbank, CA	El Monte, CA	Fresno, CA	Los Angeles, CA	Sacramento, CA	San Francisco, CA
2006	343,120	304,813	107,540	113,644	474,466	3,775,106	438,385	744,389
2009	337,966	316,313	103,096	121,183	466,466	3,832,554	466,492	815,575
Population Change Percent	-1.5	3.8	-4.1	6.6	-1.7	1.5	6.4	9.6

* IPUMS-USA ACS 2006 and 2009 data with person weight applied.

Figure L.4*



* IPUMS-USA ACS 2006 and 2009 data with person weight applied.

Table L.4 and L.5 display the time moved into residence distributions for the 8 selected California cities from IPUMS-USA ACS 2006 and 2009 data, respectively, with household weight applied. Both tables show that 89% to 96% of householders had moved out of their residence within 30 years. In other words, about 4% to 11% householders had lived at their current residence for 30 years or longer. The residency duration data from IPUMS-USA ACS also indicate that, for all the 41 identifiable California cities, about 1% to 15% of householders had lived at their current residence for 30 years or longer in 2006, whereas 2% to 15% of householders had lived at their current residence for 30 years or longer in 2009.

Table L.4* Time Moved into Residence Distribution for Selected California Cities Weighted Household Percent and Samples (IPUMS-USA ACS 2006)

Time Moved into Residence	Anaheim, CA	Bakersfield, CA	Burbank, CA	El Monte, CA	Fresno, CA	Los Angeles, CA	Sacramento, CA	San Francisco, CA
12 months or less	**19.1** 18,845	**23.6** 23,729	**11.3** 4,847	**11** 3,083	**22** 33,457	**15.8** 200,769	**21.9** 37,111	**15.8** 50,869
13 to 23 months ago	**8.1** 8,021	**9.1** 9,194	**9.9** 4,236	**6.1** 1,715	**7.2** 10,896	**6.4** 81,792	**9.3** 15,778	**7.9** 25,535
2 to 4 years ago	**22.9** 22,542	**25.9** 26,028	**21.8** 9,314	**23** 6,456	**24.3** 36,928	**21.8** 278,034	**23.2** 39,271	**21** 67,837
5 to 9 years ago	**21.6** 21,324	**18.9** 19,038	**23.2** 9,924	**23.1** 6,469	**19.8** 30,086	**22.3** 284,354	**17.7** 30,006	**15.6** 50,166
10 to 19 years ago	**15.6** 15,341	**13.3** 13,427	**15.5** 6,649	**18.4** 5,177	**14.9** 22,728	**18.1** 231,199	**11.2** 18,986	**20.2** 65,170
20 to 29 years ago	**4.9** 4,838	**5.3** 5,373	**7.5** 3,194	**9.9** 2,768	**5.6** 8,512	**7.3** 93,569	**7.8** 13,134	**9** 28,989
30 years ago	**7.8** 7,654	**3.8** 3,857	**10.9** 4,651	**8.5** 2,397	**6.3** 9,554	**8.2** 104,450	**8.8** 14,939	**10.5** 33,980
TOTAL	***100*** *98,565*	***100*** *100,646*	***100*** *42,815*	***100*** *28,065*	***100*** *152,161*	***100*** *1,274,167*	***100*** *169,225*	***100*** *322,546*

* IPUMS-USA ACS 2006 data with household weight applied.

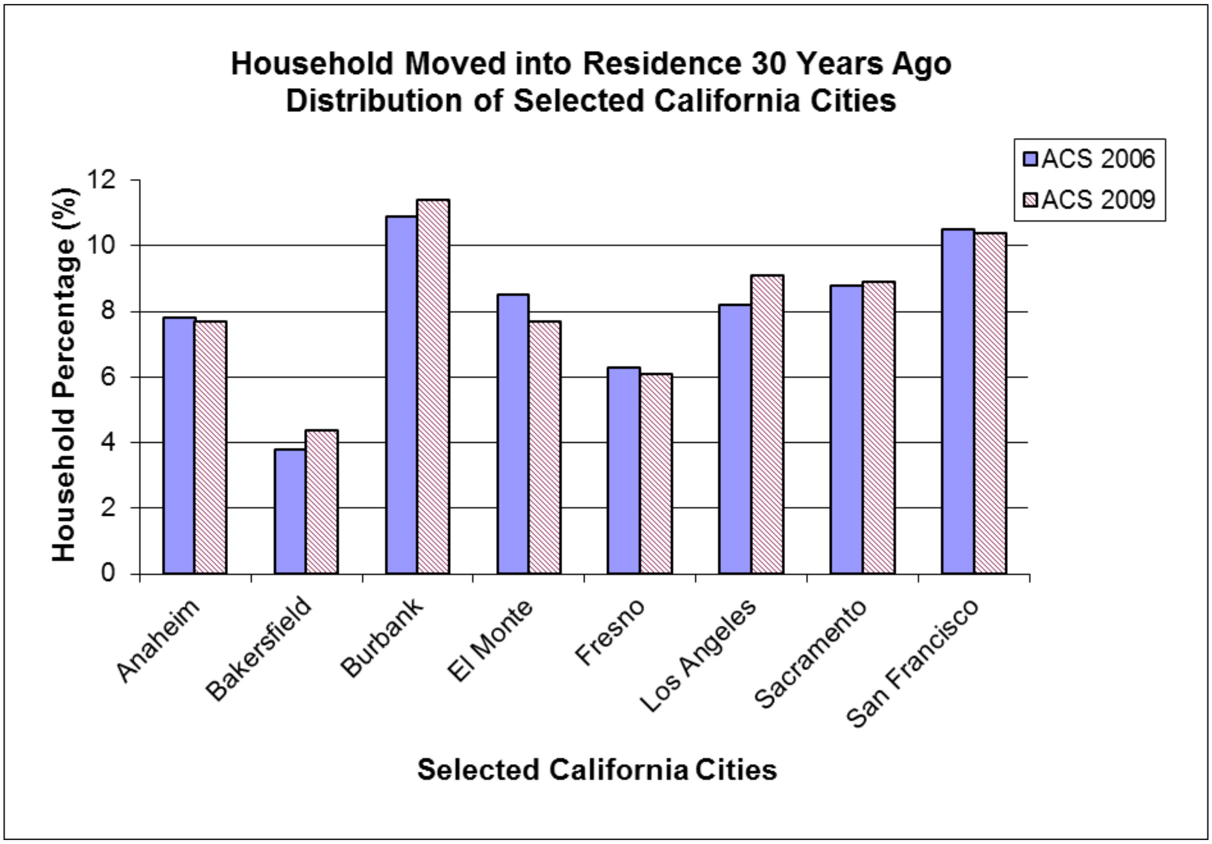
Table L.5* Time Moved into Residence Distribution for Selected California Cities Weighted Household Percent and Samples (IPUMS-USA ACS 2009)

Time Moved into Residence	Anaheim, CA	Bakersfield, CA	Burbank, CA	El Monte, CA	Fresno, CA	Los Angeles, CA	Sacramento, CA	San Francisco, CA
12 months or less	**15.8** 15,554	**21.3** 21,302	**17.5** 6,907	**11** 2,995	**21.3** 31,605	**15.5** 200,860	**23** 40,825	**14.8** 48,036
13 to 23 months ago	**6.5** 6,428	**7.9** 7,875	**6.3** 2,475	**6.9** 1,888	**8.8** 13,032	**5.7** 74,089	**8.4** 14,879	**7** 22,627
2 to 4 years ago	**22.7** 22,405	**27.1** 27,146	**19.2** 7,580	**19.7** 5,388	**19.8** 29,474	**20.3** 263,922	**22.3** 39,562	**21.9** 71,210
5 to 9 years ago	**21.1** 20,817	**20.4** 20,411	**21.5** 8,507	**26.8** 7,337	**20.2** 29,998	**21.6** 279,991	**17.4** 30,875	**18.7** 60,640
10 to 19 years ago	**19.2** 18,951	**14.6** 14,640	**18.7** 7,391	**17.2** 4,692	**16.9** 25,153	**20.2** 262,938	**13.2** 23,382	**18.6** 60,314
20 to 29 years ago	**7.1** 6,964	**4.2** 4,241	**5.5** 2,170	**10.7** 2,932	**6.9** 10,258	**7.6** 98,225	**6.7** 11,848	**8.7** 28,132
30 years ago	**7.7** 7,591	**4.4** 4,443	**11.4** 4,504	**7.7** 2,094	**6.1** 8,989	**9.1** 118,599	**8.9** 15,830	**10.4** 33,631
TOTAL	***100*** *98,710*	***100*** *100,058*	***100*** *39,534*	***100*** *27,326*	***100*** *148,509*	***100*** *1,298,624*	***100*** *177,201*	***100*** *324,590*

* IPUMS-USA ACS 2009 data with household weight applied.

Figure L.5 shows the distribution of householders with residency periods of 30 years or greater for the 8 selected California cities from IPUMS-USA ACS 2006 and ACS 2009 data with household weight applied.

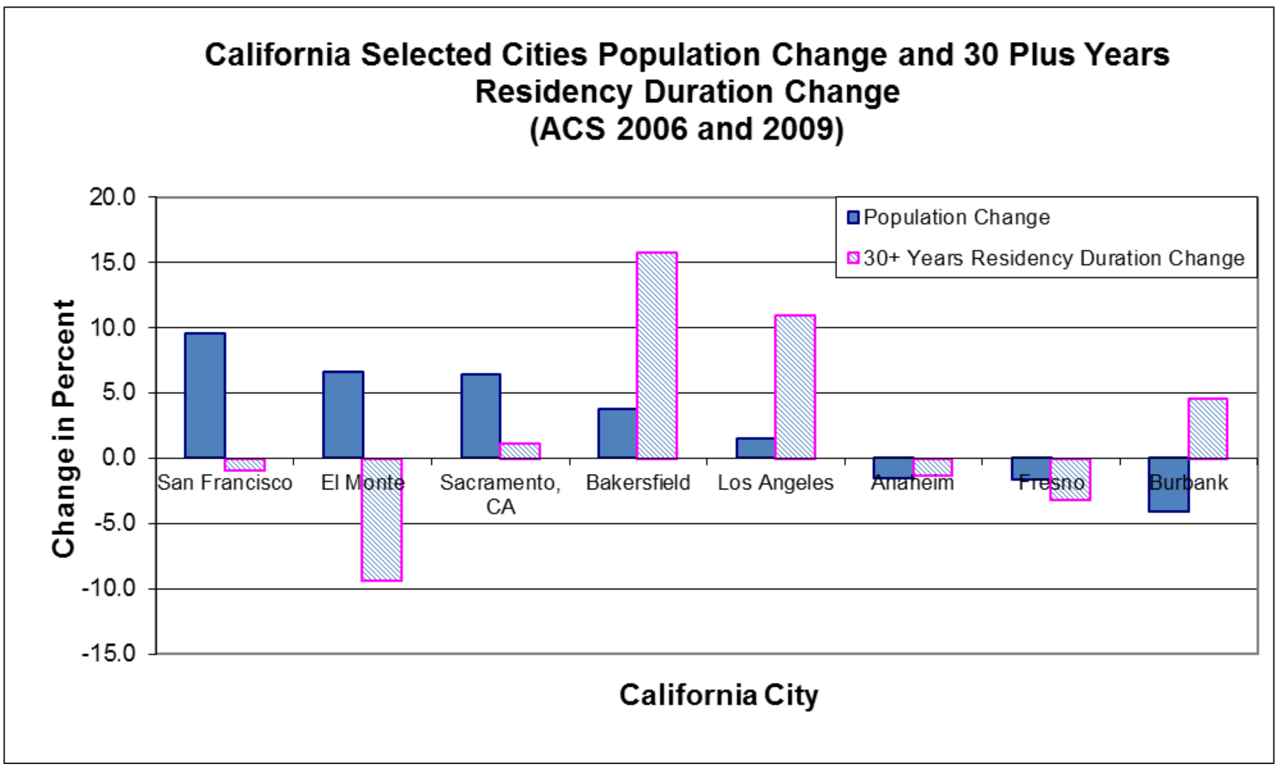
Figure L.5*



* IPUMS-USA ACS 2006 and 2009 data with household weight applied.

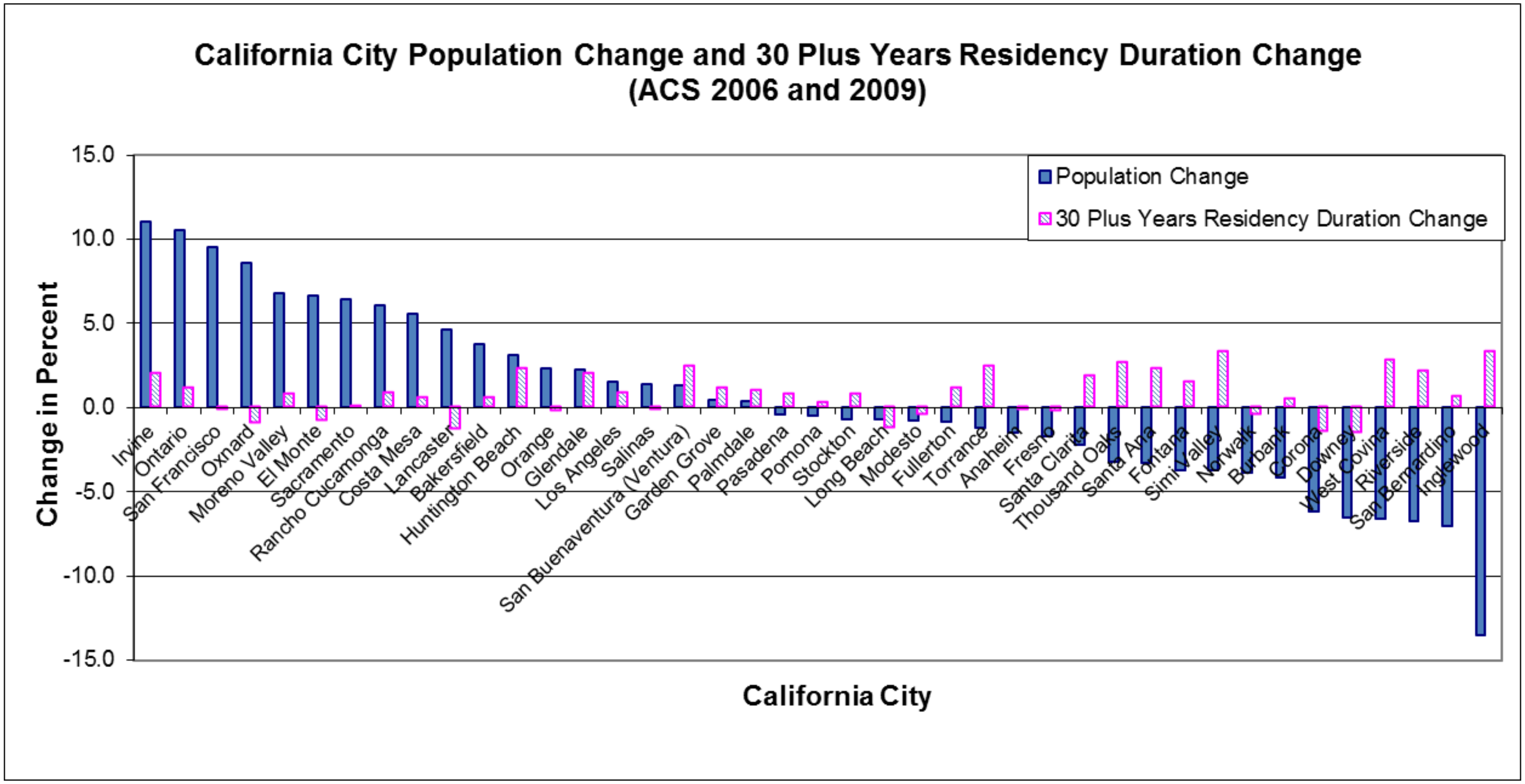
Staff also analyzed the population changes and the 30 years or greater residency duration changes for both the 8 selected cities and the 41 identifiable California cities using IPUMS-USA ACS 2006 to ACS 2009 data. The purpose of this analysis is to see if a rapidly growing city has a different pattern of residency durations. The results are illustrated in Figure L.6 and Figure L.7 respectively. There is no obvious correlation found between the population changes and the 30 years or greater residency duration changes. Figure L.7 shows that, when the population increased from 2006 and 2009, 13 cities showed an increase in 30 years or greater residency duration while 6 cities showed a decrease in 30 years or greater residency duration. And when the population decreased from 2006 to 2009, 15 cities showed an increase in 30 years or greater residency duration while 7 cities showed a decrease in 30 years or greater residency duration.

Figure L.6*



* IPUMS-USA ACS 2006 and 2009 data with household weight applied to the residency duration data, and person weight applied to population data.

Figure L.7*



* IPUMS-USA ACS 2006 and 2009 data with household weight applied to the residency duration data, and person weight applied to population data.

L.3.1.3 Limitations of the IPUMS-USA data for Our Purposes

The ideal data for our purposes would be longitudinal data on the duration of residence of individuals. The IPUMS collects information on how long the person has been in the current residence, but not previous residences. People may continue at the current residence for an indefinite period of time. Likewise people who report living in the current residence for a short period of time may have lived in the previous residence for an extended period time. This could be the case with older people who have recently moved to assisted living. Second, ~~D~~data on the amount of time that a person might have lived beyond thirty years were not collected. There is therefore no way of knowing the number of people who may have lived in the same residence for 40 or 50 years. Third, ~~G~~geographic areas with fewer than 100,000 inhabitants are not identifiable so the impact of living in a smaller community on residency time in California could not be determined. The data are binned into intervals that are as much 9 years at the longer residency times. These data are the only California specific data that we could locate however, and are generally supportive of the nationwide data.

L.3.2 SCAG Year 2000 Post-Census Regional Household Travel Survey Data

L.3.2.1 Methodology

The survey collected demographic information about persons and households. It also captured activity and travel information for household members during a 24-hour or 48-hour timeframe. The survey coincides with 2000-2001 CHTS. According to the 2000 Census, this region had 5,386,491 households. The total number of households that participated the survey and met the criteria for a completed record was 16,939 (SCAG, 2003). In the survey report, there are some trip time and age information.

Using the SCAG survey database, a statistical analysis for the regional average time spent at home per day was performed.

L.3.2.2 Findings and Discussions

The average time at home per person per day was determined to be 17.6 hours, which is about 73% of a day. This result is based on 44,344 person day records without any weight factor applied.

The residency duration data (months lived at home location) in the database are labeled as 1 to 12, 98-unknown, and 99-refused. Label 1 to 11 represents 1 to 11 months lived at home location, whereas label 12 represents 12 plus months lived at home location. No additional data were collected on residency duration. Therefore, the residency duration data from SCAG survey are limited for long-term health risk assessment evaluations.

L.3.2.3 Limitations on the Use of SCAG Household Travel Survey Data

The limitations of SCAG travel survey data include that the time spent at home analysis does not have weight factors applied due to in-sufficient user information on weights for personal level analysis (SCAG Manual) and the residency duration is not further categorized for a period that is 12 months or longer, which limits the data usage for long-term health risk assessment.

L.3.3 Caltrans 2000-2001 California Statewide Household Travel Survey Data

L.3.3.1 Methodology

The Survey was “activity” based and included in-home activities and any travel to activity locations. The Survey was conducted among households in each of the 58 counties throughout the State and grouped by region to provide a snapshot of both regional and interregional travel patterns. The participating households were asked to record travel information in their diaries for a specified 24-hour or 48-hour period. The Survey produced a sample size of 17,040 randomly selected households with an overall standard error of 0.8% at the 95% confidence level with respect to household level attributes at the statewide level of analysis (CHTS, 2003).

There are statistical survey reports about income, region, trip purpose, and trip time (home-work travel time percent by five minutes intervals by region). However, no report is based on travel distance, activity duration, season, or weekend.

A statistical analysis was performed by the staff using the CHTS database for the statewide average time spent at home per person per day. The result is based on 40,696 person day respondents’ records without any population weight factor applied.

Further statistical analysis gave us the statewide time at home average by age group, income level, and ethnicity. Time at home by age group and ethnicity results are based on 40,653 person day records. Time at home by income level result is based on 40,696 person day records. These results don’t have any weight factors applied. And five percent of the person day records are weekend records.

L.3.3.2 Findings and Discussions

L.3.3.2.1 California Statewide Average Time Spent at Home and Distributions by Age, Income, and Ethnicity

The statewide average time spent at home per person per day was determined to be 17.5 hours (including weekend samples), which is 73% of a day. This statewide average time at home percentage is about the same as the SCAG's regional average time at home percentage based on its 2000 regional travel survey data.

Table L.6 and Figure L.8 demonstrate California statewide time spent at home distribution by age group. The results show that children less than 2 years old spend 85% of their time at home, which is 12% more than the statewide average of 73%. Children in the age group 2 to <16 spend 72% of their time at home, which is a little less than the statewide average time at home.

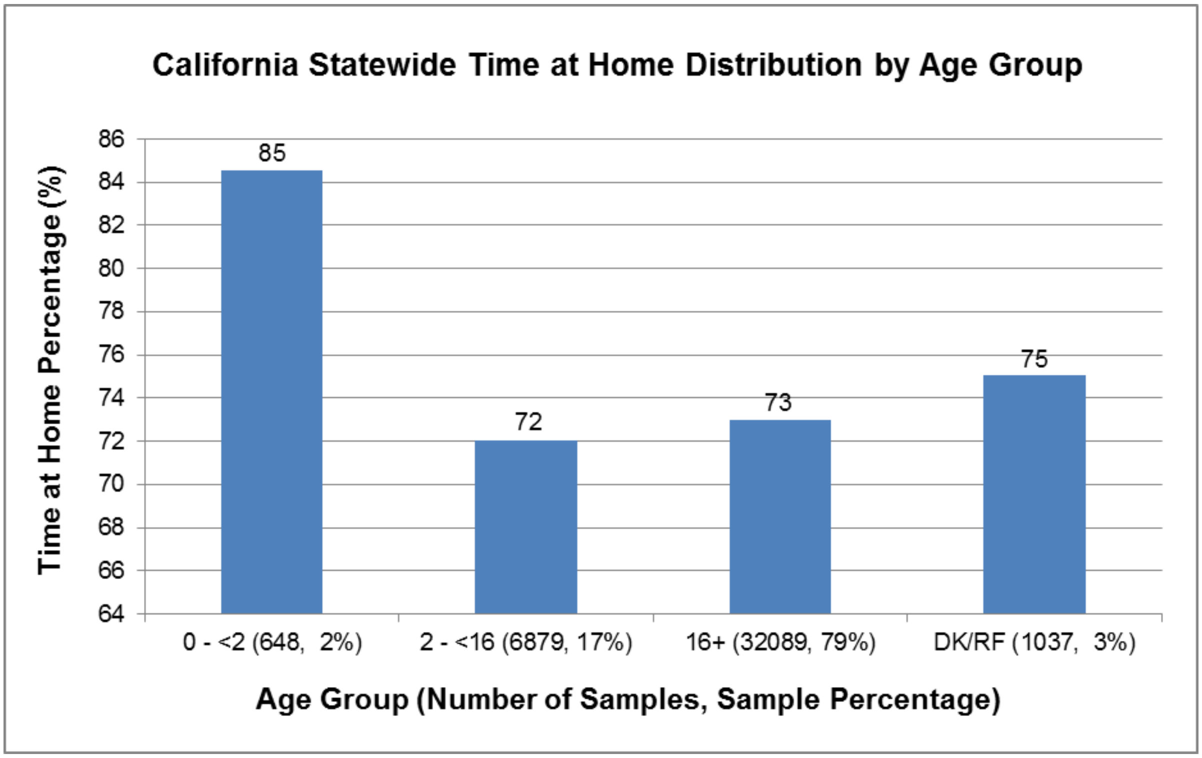
Age groups listed in Table L.6 match those used for the application of Age Specific Sensitivity Factors that are listed in OEHHA's Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing or available values, and adjustments to allow for early life stage exposures (May 2009).

Table L.6 California Statewide Time at Home Distribution by Age Group

Age Group	Time at Home in Minute	Time at Home in Hour	Time at Home Percentage	Number of Samples	Sample Percentage
0 - <2	1218	20.3	85	648	2%
2 - <16	1037	17.3	72	6879	17%
16+	1051	17.5	73	32089	79%
DK/RF	1081	18.0	75	1037	3%
State Avg.	1052	17.5	73	40653	100%

Notes:
1. Caltrans 2000-2001 CHTS Data.
2. DK/RF means Don't Know/Refused.
3. Results don't have any weight factors applied.

Figure L.8



Notes:
1. Caltrans 2000-2001 CHTS Data.
2. DK/RF means Don't Know/Refused.
3. California statewide time at home average is 73%.
4. Total number of samples: 40,653.
5. Results don't have any weight factors applied.

Table L.7 and Figure L.9 demonstrate California statewide time spent at home distribution by household income level. They show a trend: the higher the household income is, the less time people spend at their home. The households with income level less than $10k spend most of their time at home as 81% (19.5 hr.) whereas the households with income level more than $100k but less than $150k spend the least time at home as 68% (16.2hr). The households with income level more than $35k but less than $50k spend the state average time 73% (17.5 hr) at home.

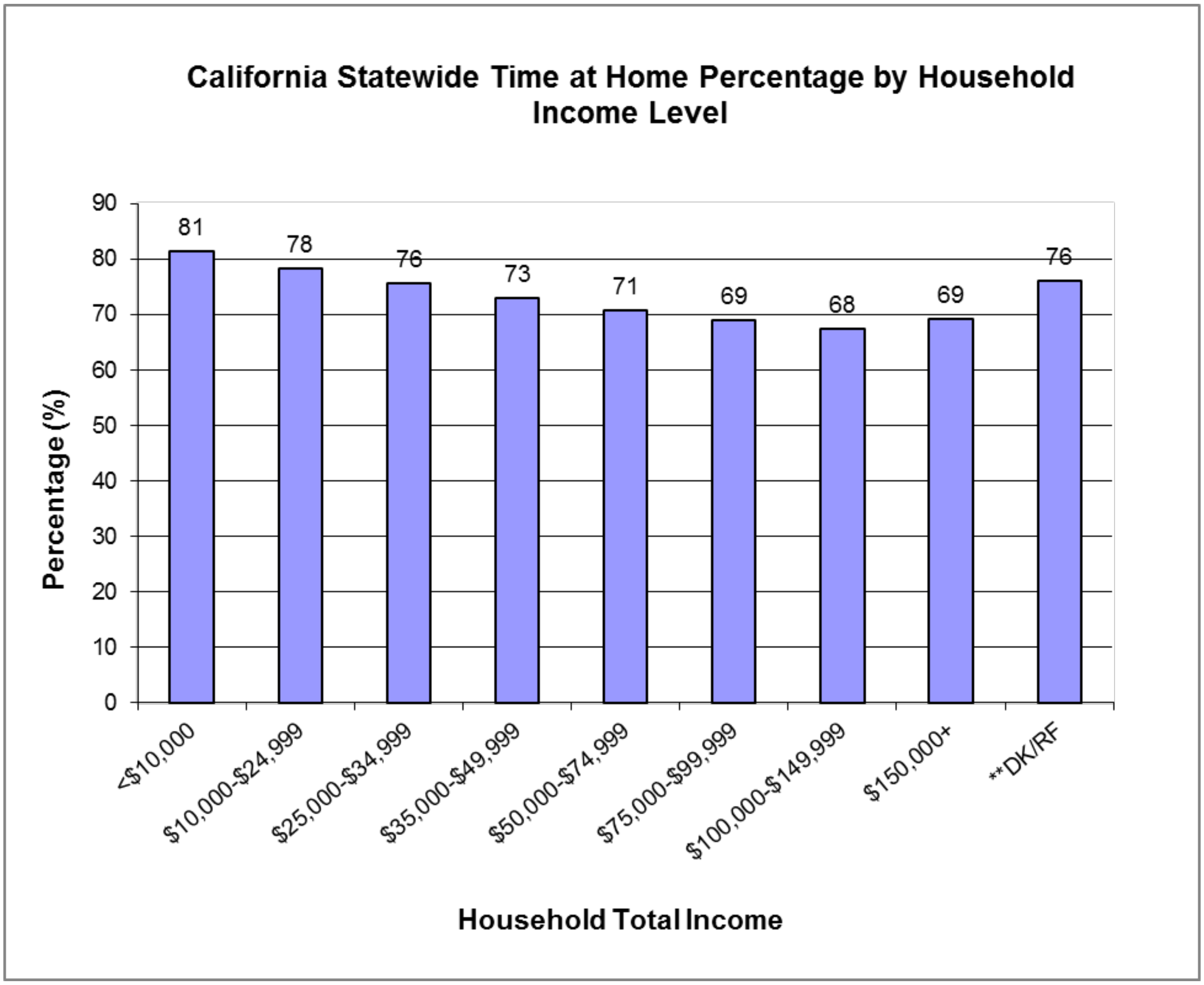
Table L.7 California Statewide Time at Home Distribution by Household Income Level

Household Total Income	Time at Home In Minute	Time at Home In Hour	Time at Home Percentage	Number of Samples	Sample Percentage
<$10,000	1172	19.5	81	1312	3%
$10,000-$24,999	1128	18.8	78	5189	13%
$25,000-$34,999	1089	18.2	76	5265	13%
$35,000-$49,999	1051	17.5	73	5568	14%
$50,000-$74,999	1019	17.0	71	8677	21%
$75,000-$99,999	994	16.6	69	5077	12%
$100,000-$149,999	973	16.2	68	3332	8%
$150,000+	998	16.6	69	1525	4%
DK/RF	1095	18.3	76	4751	12%
Total				**40696**	**100%**

Notes:

1. Caltrans 2000-2001 CHTS Data.
2. California statewide time at home average is 73%.
3. DK/RF means Don't Know/Refused.
4. Results don't have any weight factors applied.

Figure L.9



Notes:
1. Caltrans 2000-2001 CHTS Data.
2. California statewide time at home average is 73%.
3. DK/RF means Don't Know/Refused.
4. Total number of samples: 40,696.
5. Results don't have any weight factors applied.

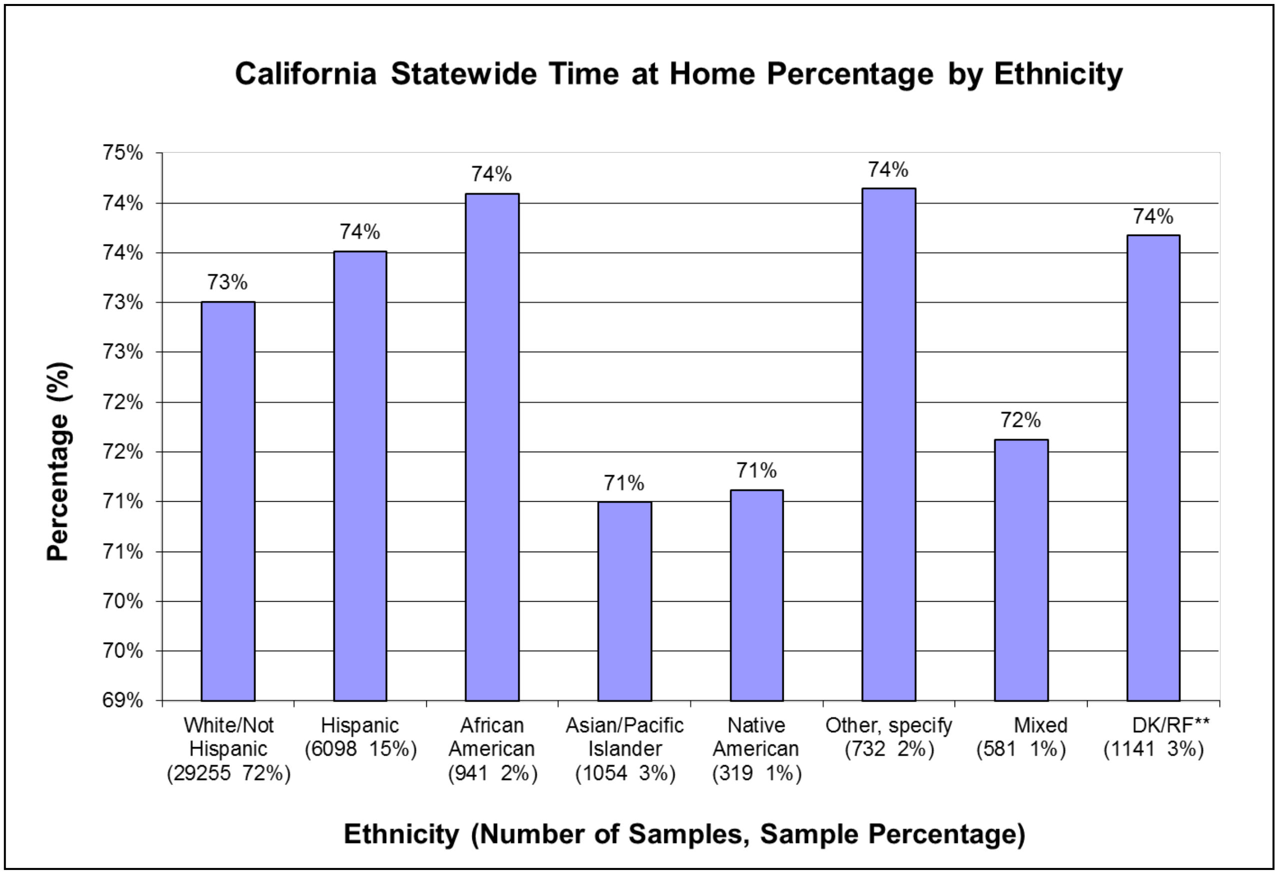
Table L.8 and Figure L.10 show California statewide time spent at home distribution by ethnicity. They depict that all the ethnic groups spend 71% to 74% time at home per day. The N/A in the ethnicity group in Table L.8 means the description of the ethnicity code 6 in the database is not available. The Caltrans survey data contact person believes that the code 6 should not have existed. This was a mistake in survey reporting. The 532 person day records (1% of the total person day records) with ethnicity code 6 may exist in error.

Table L.8 California Statewide Time at Home Average by Ethnicity

Ethnicity	Ethnicity Code	Time at Home In Minute	Time at Home In Hour	Time at Home Percentage	Number of Samples	Sample Percentage
White/Not Hispanic	1	1051	17.5	73%	29255	72%
Hispanic	2	1059	17.6	74%	6098	15%
African American	3	1067	17.8	74%	941	2%
Asian/Pacific Islander	4	1022	17.0	71%	1054	3%
Native American	5	1024	17.1	71%	319	1%
N/A	6	1077	17.9	75%	532	1%
Other, specify	7	1068	17.8	74%	732	2%
Mixed	8	1031	17.2	72%	581	1%
DK/RF	9	1061	17.7	74%	1141	3%
Total					**40653**	**100%**

Notes:
1. Caltrans 2000-2001 CHTS Data.
2. California statewide time at home average is 73%.
3. DK/RF means Don't Know/Refused.
4. N/A means the description of ethnicity code 6 is not available.
5. Results don't have any weight factors applied.

Figure L.10



Notes:

1. Caltrans 2000-2001 CHTS Data.
2. California statewide time at home average is 73%.
3. DK/RF means Don't Know/Refused.
4. Total number of samples: 40,653.
5. Results don't have any weight factors applied.

L.3.3.2.2 Comparison of Time at Home Results from CHTS Data with Time inside Home Results from ARB Activity Pattern Studies

Staff compared the time at home by age group statistical results from Caltrans 2000-2001 CHTS data and the time inside home results from 1987-1990 ARB activity pattern studies (ARB, 2005). Table L.9 and Figure L.11 show that, compared to the time spent inside home in 1987-1990, children under age of 12 spent similar amount of time at home in 2000-2001. However, teens (age 12 to17) spent 6% more time at home in 2000-2001, and adults spent 11% more time at home in 2000-2001.

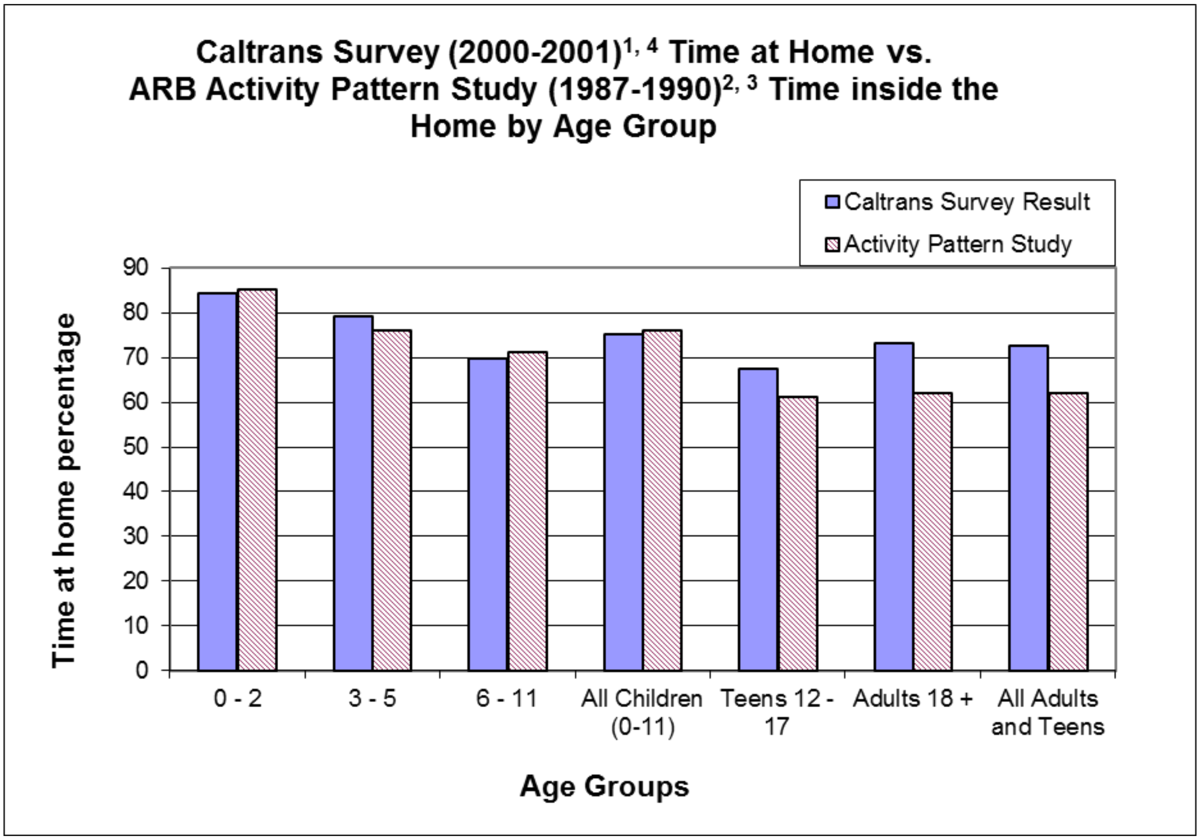
Table L.9 Caltrans Survey (2000-2001) Time at Home vs. ARB Activity Pattern Study (1987-1990) Time inside the Home by Age Group

Age Group	Caltrans[1, 4]			ARB[2, 3]	
	Number of Samples	Time at Home In Hour	Time at Home (%)	Number of Samples	Time Inside Home (%)
0 - 2	1086	20.3	84	313	85
3 - 5	1328	19.0	79	302	76
6 - 11	2985	16.8	70	585	71
All Children (0-11)	5399	18.0	75	1200	76
Teens 12 - 17	3180	16.2	67	183	61
Adults 18 +	31937	17.6	73	1579	62
All Adults and Teens	34217	17.4	73	1762	62

Notes:

1. The 2000 - 2001 California Statewide Household Travel Survey was conducted among households in each of the 58 counties throughout the State and grouped by region. Total person day records are 40,653.
2. The 1989 -1990 Children's Activity Pattern Study's samples are selected from households among three major areas: Southern Coast, S.F. Bay Area, and the rest of state. Total samples are 1,200 (ARB, 1991).
3. The 1987 – 1988 California Residents Activity Pattern Study's samples are selected from the same three major areas as for Children's Activity Pattern Study, with 1579 adult samples and 183 youth samples (ARB, 1992).
4. Results from Caltrans survey data don't have any weight factors applied, whereas the results from the activity pattern studies have the weight factors applied.

Figure L.11



Notes:

1. The 2000 - 2001 California Statewide Household Travel Survey was conducted among households in each of the 58 counties throughout the State and grouped by region. Total person day records are 40,653.
2. The 1989 -1990 Children's Activity Pattern Study's samples are selected from households among three major areas: Southern Coast, S.F. Bay Area, and the rest of state. Total samples are 1,200 (ARB, 1991).
3. The 1987 – 1988 California Residents Activity Pattern Study's samples are selected from the same three major areas as for Children's Activity Pattern Study, with 1579 adult samples and 183 youth samples (ARB, 1992).
4. Results from Caltrans survey data don't have any weight factors applied, whereas the results from the activity pattern studies have the weight factors applied.

L.3.3.3 Limitations on the Use of 2000-2001 CHTS data

The limitations of the use of the 2000-2001 CHTS data are that the analysis results do not have weight factors applied due to in-sufficient user information on weights for personal level analysis (CHTS Guide). And 2000-2001 CHTS does not have residence duration data.

L.4 Other Data Sources Not Used in This Report

L.4.1 The 2009 National Household Travel Survey

The 2009 NHTS updates information gathered in the 2001 NHTS and in prior Nationwide Personal Transportation Surveys. The data are collected on daily trips taken in a 24-hour period (NHTS, 2009). Although we may be able to analyze the 2009 NHTS data to get the time at home statistical results for Californians, the staff didn't use the data because the user manual was not ready at the time the staff was preparing this report.

L.4.2 National Human Activity Pattern Survey

NHAPS was sponsored by the U.S. Environmental Protection Agency. It was conducted between late September 1992 and September 1994, collected 24-hour activity diaries and answers of personal and exposure questions. The survey interviewed 9386 participants across the 48 contiguous states (Klepeis et al., 1995).

NHAPS has time in a residence data from California respondents. However, the staff didn't further analyze these data because the 2000-2001 CHTS provides much larger sample size and more recent California-specific data.

L.5 Conclusion

The staff has evaluated several data sources to identify the California statewide exposure duration and exposure frequency characteristics. Estimates on residence duration and time spent at home have been determined from available data on the California population. The data on residency time are similar to the available national data as discussed in Chapter 11. There is some variability in the residence duration and time spent at home by ethnicity, age, and income.

The IPUMS-USA census data show that, from 2006 to 2009, over 90% of California householders had lived at their current home address for less than 30 years, and over 63% householders had lived at their current residence for 9 years or less.

The 2000-2001 CHTS data show that, on average, Californians spend approximately 73% of their time at home per day. When looking at the data by age group, the time increases to 85% for children under 2 years old. Children that are 2 years or older but less than 16 years old spend 72% of their time at home; whereas Californians that are16 years or older spend 73% of their time at home. In addition, all ethnicity groups spend 71%-74% of their time at home. The data also demonstrate a trend where the higher the total household income is, the less time the residents spend at their home.

These data are the best available on the California population for helping to establish default recommendations for the Hot Spots program.

L.6 References

1. (ACS) American Community Survey: http://factfinder2.census.gov/faces/nav/jsf/pages/wc_acs.xhtml. Last visited: April, 2011.

2. (IPUMS-USA) Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database]. Minneapolis: University of Minnesota, 2010. http://usa.ipums.org/usa/index.shtml. Last visited: January, 2011.

3. (IPUMS Tool) IPUMS Online Data Analysis System: http://usa.ipums.org/usa/sda/. Last visited: January, 2011.

4. (IPUMS Weights) IPUMS-USA Sample Weights: http://usa.ipums.org/usa/intro.shtml#weights. Last visited: January, 2011.

5. (IPUMS Samples) Descriptions of IPUMS Samples: http://usa.ipums.org/usa/sampdesc.shtml. Last visited: January, 2011.

6. (IPUMS GQ) IPUMS-USA Group Quarters: http://usa.ipums.org/usa-action/variables/GQ. Last visited: April, 2011.

7. (SCAG, 2003) Year 2000 Post-Census Regional Travel Survey Final Report of Survey Results. SCAG, Fall 2003. http://www.scag.ca.gov/travelsurvey/pdf/MainSurveyResults.pdf

8. (SCAG Manual) Post Census Regional Household Travel Survey Data User's Manual. SCAG, June 2003.

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10. (CHTS Guide) 2000-2001 California Statewide Household Travel Survey Data Users Guide. Caltrans, May 2002.

11. (ARB, 2005) Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant. ARB, 2005. http://www.arb.ca.gov/regact/ets2006/app3parta.pdf

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14. (NHTS, 2009) The 2009 National Household Travel Survey: http://nhts.ornl.gov/introduction.shtml. Last visited: January, 2011.

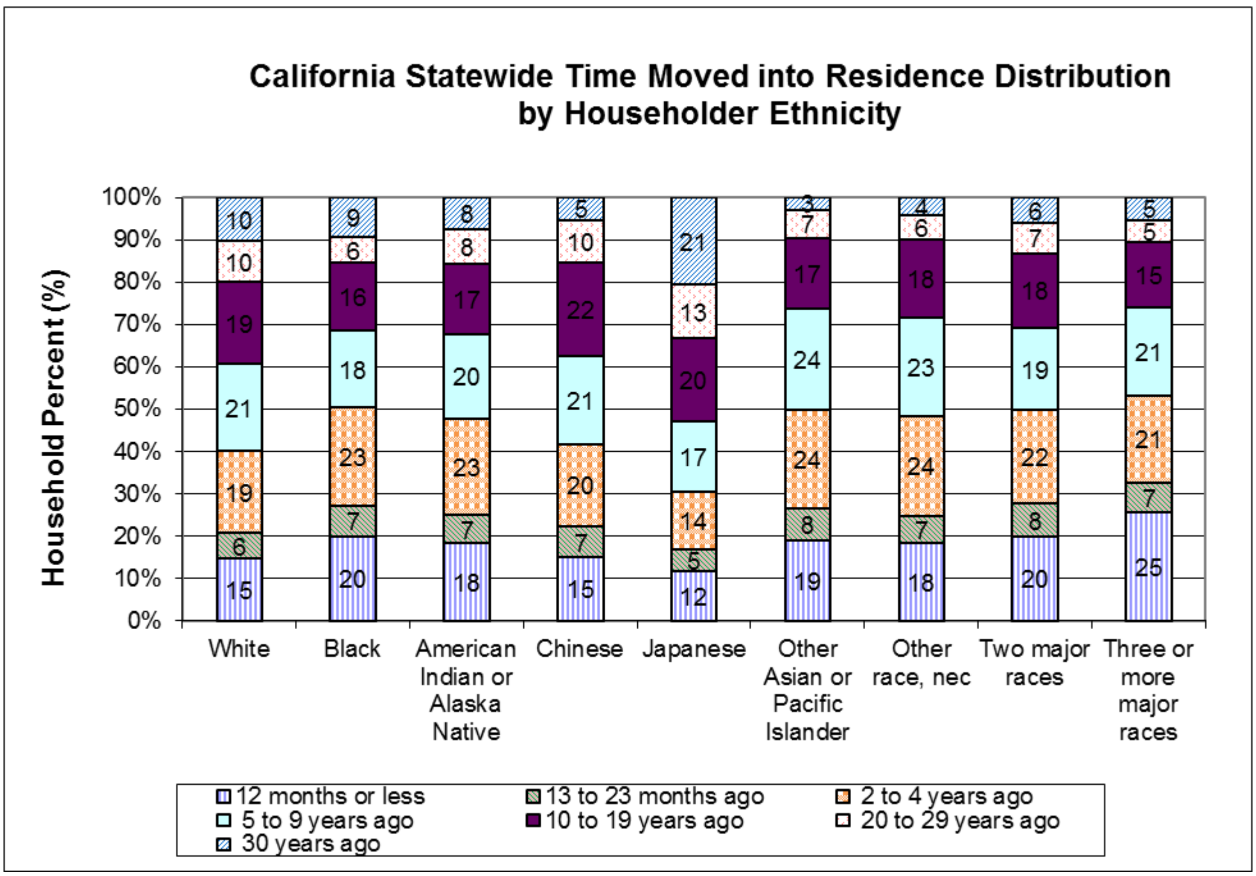
15. (Klepeis NE, Nelson W C, Ott W R, Robinson, J-Pm Tsang A M, Switzer P, Bhar J, Hem S C, Engelmann W H. (1995) National Human Activity Pattern Survey. Klepeis et al., 1995. http://eetd.lbl.gov/ie/viaq/pubs/LBNL-47713.pdf

A. Supplemental Information

The following figures graphically present the analysis results of California statewide time moved into residence distribution by householders' ethnicity, age, and household income respectively from IPUMS-USA ACS 2009 data (IPUMS-USA). The data are obtained by using IPUMS online analysis tool (IPUMS Tool). These data may be useful to the risk manager in considering population risk in different communities.

Figure A.1 shows California statewide time moved into residence distribution by householders' ethnicity. In general, the percentages of householders that moved into their residence 12 months or less ago, 2 to 4 years ago, 5 to 9 years ago, and 10 to 19 years ago are larger than the percentages of 13 to 23 months ago, 20 to 29 years ago, and 30 years ago.

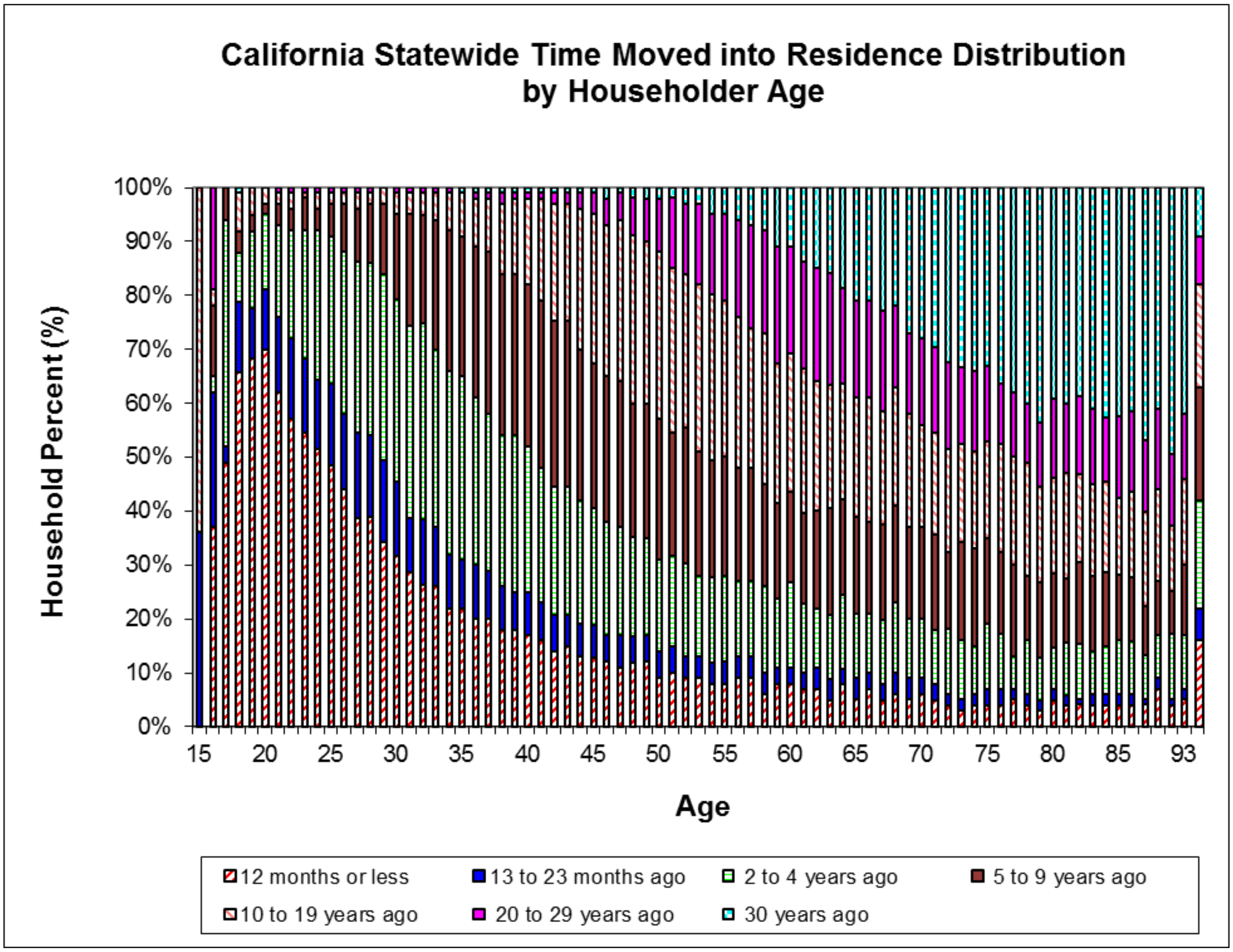
Figure A.1*



* IPUMS-USA ACS 2009 data with household weight applied (IPUMS Weights) (IPUMS Ethnicity).

Figure A.2 presents California statewide time moved into residence distribution by householders' age. It shows a general trend that the younger the householders are, the more householders moved into their residence within the last 12 months. And the older the householders are, the more householders moved into their residence 30 years ago. There are some exceptions at the both ends of the age range.

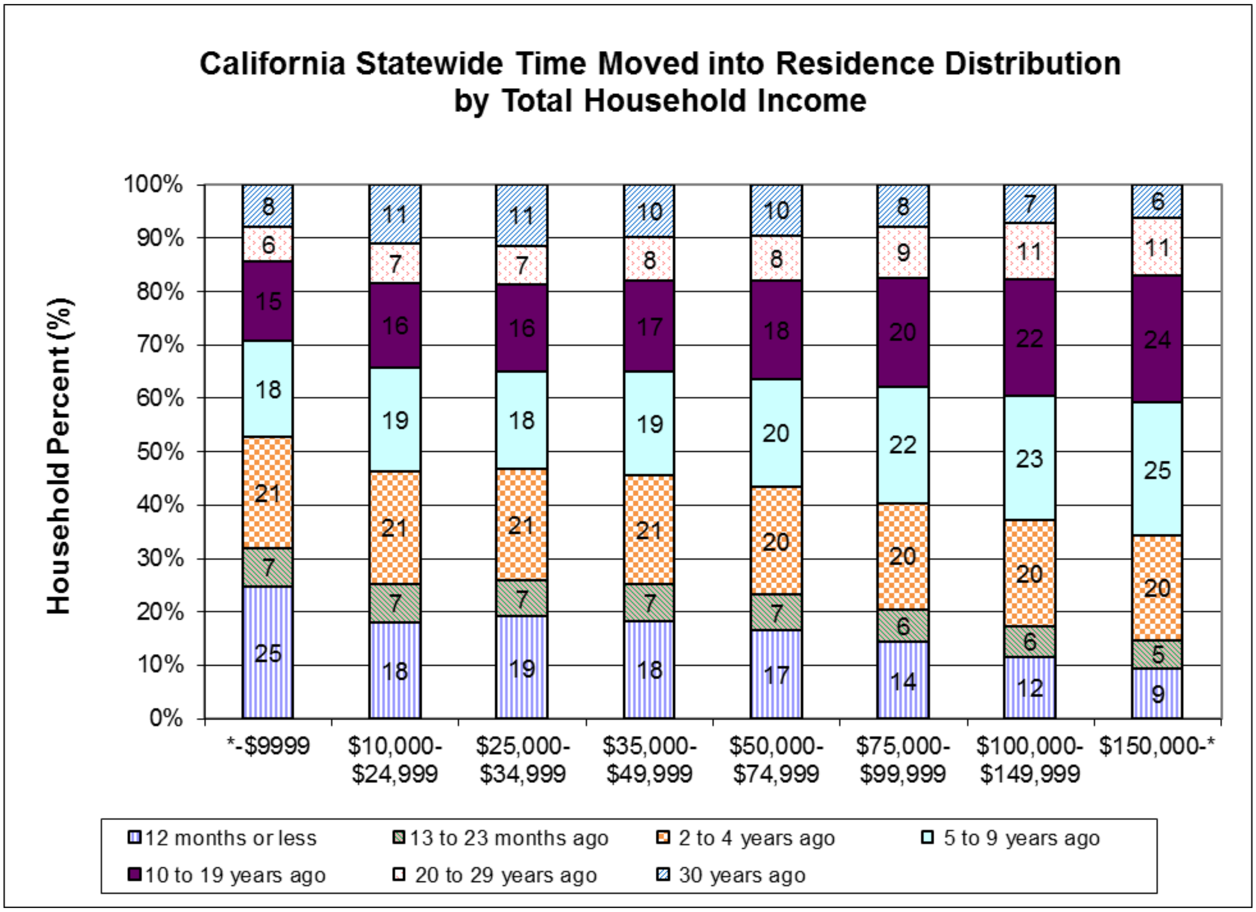
Figure A.2*



* IPUMS-USA ACS 2009 data with household weight applied (IPUMS Weights). The age categories are 15-89 and 93.

Figure A.3 shows California statewide time moved into residence distribution by total household income. It reveals a general trend that the higher the household income is, the smaller percentage of the householders moved into their residence within last the 12 months. And the households with household income of $150,000 or above not only have the smallest percentage of householders moved into their residence within the last 12 months, but also have the smallest percentage of householders moved into their residence 30 years ago.

Figure A.3*



* IPUMS-USA ACS 2009 data with household weight applied (IPUMS Weights).

A. References

1. (IPUMS-USA) Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database]. Minneapolis: University of Minnesota, 2010. http://usa.ipums.org/usa/index.shtml. Last visited: January, 2011.

2. (IPUMS Tool) IPUMS Online Data Analysis System: http://usa.ipums.org/usa/sda/. Last visited: January, 2011.

3. (IPUMS Ethnicity) IPUMS-USA Ethnicity Code: http://usa.ipums.org/usa-action/codes.do?mnemonic=RACE. Last visited: January, 2011.

4. (IPUMS Weights) IPUMS-USA Sample Weights: http://usa.ipums.org/usa/intro.shtml#weights. Last visited: January, 2011.

Appendix M.

How to Post-Process Offsite Worker Concentrations using the Hourly Raw Results from AERMOD

Appendix M

How to Post-Process Offsite Worker Concentrations using the Hourly Raw Results from AERMOD

The offsite worker health risk analysis begins with estimating the pollutant concentration at a receptor location. To estimate this concentration, the typical approach is to use the residential annual concentration that is modeled based on the adjacent facility's emission schedule. However, if the facility emissions are non-continuous (i.e., the facility does not emit for 24 hours a day and 7 days a week), the residential concentration may not represent what the offsite worker breathes during their work shift. In lieu of conducting additional special case modeling which can be time-consuming, the residential annual concentration is adjusted upwards using a worker adjustment factor based on the facility's emission schedule with respect to the worker's schedule. For an 8-hour work shift that coincides with an adjacent facility that emits eight hours per day, a worker adjustment factor of 4.2 (24 hours / 8 hours * 7 days / 5 days) is typically used for cancer risk assessment.

A possible problem with using this approach is that wind direction, wind speed, and atmospheric stability can vary throughout the day and night and straight scaling as above may skew the results. As observed in the sensitivity study of the worker adjustment factor (Appendix N), using the 4.2 worker adjustment factor can underestimate the offsite worker's inhalation exposure during nighttime hours. In these cases, it is recommended that the worker adjustment factor be increased to 4.8 (Appendix N) or a more representative offsite worker concentration be processed using the hourly raw results from the air dispersion analysis.

This appendix describes how to calculate refined offsite worker concentrations for a single receptor location using the hourly raw results from the AERMOD air dispersion model. The calculations described in this appendix can be used for assessing acute, 8-hour non-cancer chronic, and inhalation cancer health impacts. In some cases, a better representation of what the offsite worker breathes during their work shiftis needed for the health risk analysis. To obtain a better representation, the hourly raw results contain enough information to allow the risk assessor to evaluate the concentrations that occurs during the offsite worker's shift. However, since the hourlyraw results include all the concentrationsfor every hour of meteorological data at each receptor for each source in the air dispersion analysis, the results must be filtered and processed to obtain the refined offsite worker concentrations. The basic steps include: 1) determining the averaging periods needed for the offsite worker analysis; 2) outputting the hourly raw results from the AERMOD air dispersion model; 3) extracting the hourly concentrations based on when the receptor is present; and 4) calculating the required averaging periods. identifying or calculating the required concentration. The calculation methods described in this appendix can be used for assessing acute, 8-hour non-cancer chronic, and inhalation cancer health impacts.

1.0. Determine the Averaging Periods Required for the Offsite Worker Health Risk Analysis

Before any refined offsite worker concentrations can be calculated, the first step is to determine which type of refined concentrations or ~~refined~~ averaging periods are needed for the health risk analysis. The refined averaging periods needed for the analysis are based on the pollutant-specific health values ~~that are associated with the pollutants~~ emitted by the ~~facility.~~source or sources. Specifically, ~~only~~refined offsite worker concentrations can only be used forpollutants that have inhalation cancer potency factors, 8-~~-~~hour RELs, and/or acute RELs~~ can use refined offsite worker concentrations.~~. This section describes the refined averaging periods~~needed~~required for assessing acute RELs, 8-hour RELs, and inhalation cancer potency factors~~, 8-hour RELs, and acute RELs. Table M.1 describes the averaging period needed for assessing inhalation cancer potency factors, 8-hour RELs, and acute RELs~~.

~~However, calm hours should be disregarded when calculating refined short-term averages (1-hour and 8-hour). This process is described further in the subsequent steps of this appendix.~~

~~Table M.1. Description of the Refined Averaging Period by Health Value Category~~

~~Health Value Category~~	~~Description of the Refined Averaging Period~~
~~Acute REL~~	~~The maximum 1-hour concentration that occurs during an offsite worker's schedule.~~
~~8-Hour REL~~	~~The maximum 8-hour running average that occurs during the offsite worker's schedule.~~ ~~For short-term averaging periods, calm hours should be disregarded when calculating the refined maximum 8-hour averaging period. In addition, the total number of valid hours (not calm or not missing) should be 75% of the maximum 8-hour average. If the total number of valid hours in an 8-hour average is less than six (6), the 8-hour total concentration should be divided by (6).~~
~~Inhalation Cancer Potency Factor~~	~~The sum of the hourly concentrations for when the offsite worker is present divided by the number of processed hours for the entire meteorological dataset.~~ ~~If calm hour processing was used in the original air dispersion analysis, then calm and missing hours must also be considered when calculating the refined period concentration.~~

1.1. Averaging Period Required for Acute RELs

The maximum 1-hour concentration is typically required for the acute health hazard index calculation. AERMOD can determine and output the maximum 1-hour concentration at each receptor location for each source in the air dispersion analysis. However, if more refined concentrations for the offsite worker are needed,the maximum1-hour concentration that occurs during the offsite worker's shiftmay be used. This type of refinement can be processed using the hourly raw results from the air dispersion analysis.

If there are multiple sources in the analysis, an additional refinementstep is to examinethe coincident acute health impacts at each receptor from all sources at each hour during the offsite worker's shift and identify the total maximum acute health impacts from all sources.For example, if there are two sources that emit a single pollutant for ten hours per day and the offsite worker's shift is from hour three to hour seven, the risk assessor may evaluate the total acute risk from all sources during the offsite worker's shift. Assuming the acute REL is 50 µg/m^3, the highest acute health impact occurs at hour threewith a Health Hazard Index of 0.3 (see Table M.1). Thisapproach is also known as a refined acute analysis.

Table M.1. Example of a Refined Acute Calculation

Hour	1	2	3	4	5	6	7	8	9	10
Source 1 Concentration (µg/m^3)	5	7	8	0	9	11	5	1	12	3
Source 2 Concentration(µg/m^3)	4	6	7	0	2	1	3	4	5	2
Total Acute Health Hazard Index from All Sources	0.18	0.26	**0.3**	0	0.22	0.24	0.16	0.1	0.34	0.1

1.2. Averaging Period Required for Inhalation Cancer Potency Values

The period average is typically required for cancer risk assessments. AERMOD calculates this average by summing all the hourly concentrations and dividing it by the number of processed hours over the entire time period of the air dispersion analysis. However, theperiod averages calculated from AERMOD typically represent exposures for receptors (i.e., residential receptors) that are present 24 hours a day and seven days per week. For the offsite worker, the period average should represent what the worker breathes during their work shift when assessing the cancer inhalation pathway.

To estimate the offsite worker's concentration, there are two approaches. The simple approach is to obtain the period average concentration as calculated by AERMOD and approximate the worker's inhalation exposure using an adjustment factor (See Chapter 2.8.1.1. for more information). For a more representative concentration, the second approach is to calculate a refined period average using the hourly raw results from the air dispersion analysis. This refined period average should reflect only the concentrations that occur during the offsite worker's shift. It is calculated by summingall of the hourly concentrations that occurs during the offsite worker's shift and dividing it by the number of hours that occurs during the offsite worker's shift. The equation for calculating the refined offsite worker concentration is shown in Section 4.3.

1.3. Averaging Period Required for 8-Hour RELs

For 8-hour noncancer health impacts, we evaluate if the worker is exposed to a daily (e.g., 8-hour) average concentration that exceeds the 8 hour REL. The daily average concentration is intended to represent the long term average concentration the worker is breathing during their work shift. ~~T~~The long-term ~~average of~~ 8-~~-~~hour daily average concentration is~~typically~~ required for 8-~~-~~hour health hazard index calculations. Specifically, this concentration represents the long-term average of repeated 8-hour daily averages that occur when the source's emission schedule and offsite worker's schedule overlap. For example, the 8-hour averages are first calculated for each day in the air dispersion analysis. The 8-hour averages should represent the eight hour sequential concentration for ~~based on~~ when the source's emission schedule and offsite worker's schedule overlap. All the 8-hour averages are then averaged over the entire time period of the air dispersion analysis.

There are two approaches for calculating the average 8-hour daily concentration. The simple approach is to obtain the long-term concentration (i.e., period average) as calculated by AERMOD and approximate the average 8-hour daily concentration using an adjustment factor (See Chapter 2.8.1.2 for more information). For a more representative concentration, the second approach is to calculate the offsite worker concentration using the hourly raw results from the air dispersion analysis.

Please note that although the duration of work shifts or period of overlap with the source's emission schedule can vary from eight hours, the calculated ~~average~~long-term daily average concentrations~~s~~ can still be applied to the 8-hour RELs. However, ~~However, t~~the risk assessor may wish to calculate the 8-hour hazard index using the ~~first approach~~adjustment factor approachas a screening assessment before proceeding with the ~~secon~~post-processing~~d~~ approach. Based on the~~ose~~ results of the screening assessment, the risk assessor can contact OEHHA for assistance in determining whether further evaluation may be necessary.

2.0. Output the Hourly Raw Results from AERMOD

The hourly raw results from the air dispersion analysis are needed to calculate the refined offsite worker concentrations as described above. AERMOD can output the hourly raw results to a file for post-processing. In order to output a file suitable for post-processing, the AERMOD input file must be modified. The AERMOD input file contains the modeling options, source location and parameter data, receptor locations, meteorological data file specifications, and output options. It is organized into five main sections that include the Control (CO), Source (SO), Receptor (RE), Meteorology (ME), and Output (OU) pathways(U.S. EPA, 2004). In orderThis section describes how to output a file suitable for post-processing (i.e., the hourly raw results), the CO, SO, RE, and OU modify the pathways in the AERMOD input file mustto allow the hourly raw results to be modified using a text editor (e.g., Notepad) or third party modeling softwaresaved to a file.

2.1. Modify the Control (CO) Pathway to IdentifyCalm and Missing Hours

~~Based on how~~By default, AERMOD ~~calculates long-term averages (i.e., period average), if calm hour processing is used in the air dispersion analysis,~~disregards calm and missing hours ~~that occur during~~when calculating the long-term and short-term averages. When calculating the ~~worker's shift~~refined offsite worker concentrations, the calm and missing hours must also be ~~accounted. Since~~disregarded. However,the hourly raw results from AERMOD do not identify which hours are calm or missing~~, the Detailed Error Listing File will need to be outputted~~. Since this is the case, an additional file from ~~the air dispersion analysis. The~~AERMOD must also be saved in order to post-process the hourly raw results correctly. The AERMODDetailed Error Listing File will report all calm and missing hours ~~in~~from the air dispersion analysis. The syntax for creating a Detailed Error Listing File in the CO pathway is shown below. ~~The ERRORFIL keyword is followed by a user-defined filename for the output file. An explanation about how this file will be used is~~This modification in the CO pathway will create a file which will be used assist with calculating the refined offsite worker concentrations.This process is described in the subsequent sections of this appendix.

Syntax for Creating the Detailed Error Listing File

```
CO ERRORFIL [Filename]
```

2.2. Modify the Source (SO) Pathway if Unit Emission Rates are used

In an air dispersion analysis, it is typical to use non-substance specific unit emission rates (e.g., 1 g/s)for evaluating multiple pollutants. This precludes modelersfrom having to run the air dispersion model for each individual pollutant that is emitted from a source. Unit emission rates allow the air dispersion modeling results to be expressed as dilution factors in (µg/m^3)/(g/s). When these dilution factors are combined with the pollutant specific emission rate (g/s), it will yield the ~~actual~~ ground level concentrations (µg/m^3) for eachpollutant in the analysis.~~However, when~~Whenthere are multiple sources in the air dispersion analysis and unit emission rates are used~~ in the air dispersion analysis~~, the individual source contributionsmust be providedin the modeling resultsso the ground level concentrations can be correctly scaled for each pollutant. To do this, the air dispersion input file must be modified to create individual source groups for each source. The example below shows how individual source groups for two sources (S001 and S002) are specified in the SO pathway of an AERMOD input file. This modification in the SO pathway will allow the individual source contributions to be saved in the hourly raw results.

```
SO STARTING

**S001 and S002 location and source parameters are not shown.**
```

~~This parameter identifies the sources tied to the source group. Use only one source ID per source group.~~

SRCGROUP SRCGP1 S001
SRCGROUP SRCGP2 S002

This parameter identifies the sources tied to the source group. Use only one source ID per source group.

SO FINSHED

This section specifies the name of your source group. The source group name is what is specified when you output the required concentrations files.

name is what is specified when you output the required concentrations files.

Please note that a separate input file is needed for evaluating acute health impacts when**unit emission rates are used and the source has a variable emission schedule (e.g., emissions vary by hour-of-day and day-of-week).** Acute health impacts are based on maximum hourly emissions whereas **long-term**cancer and chronichealthimpacts are based on average hourly emissions. To correctly simulate unit emissions for the acute impacts, a **second**duplicate source with a variable emission rate of “on” (1) or “off” (0) should be used so the maximum hourly inventory is not incorrectly adjusted bycorrectly calculated separately from the emission factors placed in the annual file. The example below shows how the variable emission rates should be modified. Alternatively, a source can be duplicated in the same input file instead of rerunning the source using a separate input file.

First Run with Unmodified Emission Rate Factors for Long-Term

```
EMISFACT S002  HROFDY     0.000     0.000     0.000     0.000     0.000
         S002  HROFDY     0.000     2.667     2.667     2.667     2.667
         S002  HROFDY     2.667     2.667     1.333     1.333     1.333
         S002  HROFDY     1.333     1.333     1.333     0.000     0.000
         S002  HROFDY     0.000     0.000     0.000     0.000
```

Second Run with Modified Emission Rates Factors for Acute

```
EMISFACT S002  HROFDY     0.000     0.000     0.000     0.000     0.000
         S002  HROFDY     0.000     1.000     1.000     1.000     1.000
         S002  HROFDY     1.000     1.000     1.000     1.000     1.000
         S002  HROFDY     1.000     1.000     1.000     0.000     0.000
         S002  HROFDY     0.000     0.000     0.000     0.000
```

2.3. Modify the Receptor (RE) Pathway to Reduce the Processing Time

The POSTFILE option in AERMOD is capable of producing outputting the hourly raw results from the air dispersion analysis suitable for post-processing the exposure estimates for the off-site worker.. However, without taking appropriate precautions in the parameters of the input file, this option, outputting the hourly raw results can produce extremely large file sizes especially when evaluating multiple years of meteorological data, a large number of receptors, and short-term averaging periods (e.g., 1-hour). To minimize the amount of processing time and hard disk space, it is recommended to use only a single discrete receptor representing the off-site worker location. Multiple off-site worker locations with the same work shift can also be added as well. The proper syntax for specifying a discrete receptor is shown below. The next section will discuss how to setup the POSTFILE.

Sample Syntax for Creating a Single Discrete Receptor

RE DISCCART XcoordYcoord (ZelevZhill) (Zflag)

Please note that depending on how many receptors are specified, a database may be required to sort the hourly results. For example 12 receptors and five years of meteorological data can result in 525,600 records (12 receptors x 5 years x 8760 hours/year).

2.4. Modify the Output (OU) Pathway to Output the Hourly Raw Results

To create a file containing the hourly raw results, modify the ~~output~~OU pathway to include the POSTFILE keyword and parameters. The sample below shows the syntax for outputting the hourly raw results for a single source. ~~The file generated by this option is suitable for post-processing the acute, inhalation chronic, and inhalation cancer scenarios.~~The POSTFILE will list in order the concentration for each receptor and for each hour of meteorological data regardless of the source's emission schedule. Use Table M.2 to help construct the proper syntax for the POSTFILE option. This step must be repeated for each source in the analysis which will result in additional files.

Please note that if the data are outputted as binary file~~,~~ (UNFORM), aseparatecomputer program will be needed to read and parse the data.

Sample Syntax for Outputting the
Hourly Concentrations for a Single Source

OU POSTFILE 1 ~~S001~~SRCGP1PLOT PSTS001.TXT

Table M.2. Descriptions of the POSTFILE Parameters

Keyword	**Parameters**	
POSTFILE	AveperGrpid Format Filnam (Funit)	
where:	Aveper	Specifies averaging period to be output to file. Set this value to 1 to output 1-hour raw results.
	Grpid	Specifies source group to be output to file. If there ~~a~~are multiple sources, you will need to repeat the POSTFILE option for each source. You can combine the different outputs to a single file using the Funit parameter.
	Format	Specifies format of file, either UNFORM for binary files or PLOT for formatted files. Unformatted files offer a smaller file size; however, this file requires programming expertise in order to view and parse the data. Selecting the PLOT option will allow you to view the file in any text editor.
	Filnam	Specifies filename for output file
	Funit (optional)	The file unit is an optional parameter. If the filename and the file unit number are the same, the results for different source groups can be combined into a single file.

3.0. Extract the Hourly Concentrations when the Offsite Worker is Present

To calculate the averaging periods for the refined offsite worker concentrations, it is necessary to extract the hourly concentrations based on the offsite worker's schedule. This section provides information on how to extract the hourly concentrations for the offsite worker including the calm and missing hours that may occur during the offsite worker's shift.

At this point, it is recommended the hourly raw results be imported into a spreadsheet or database to assist with the extraction process. **The steps that are described below will require additional information for each hourly concentration record.** Spreadsheets and database contain preprogrammed functions **or allows the use of Structured Query Language** to assist with deciphering data. **Use the information in Section 3.1 as a guide to help import the hourly raw results into a database or spreadsheet.**

Please note that if the hourly raw results are imported into a database, familiarity with Structured Query Language and database design is assumed. The steps below will only provide examples for spreadsheets.

3.1. Description of thePOSTFILE File Format

AERMOD was compiled created using FORTRAN, a type of programming language. When the AERMOD output files are created, it is based on a specified FORTRAN format. The FORTRAN syntax for the POSTFILE format is shown below. The variables provided on each data record in the POSTFILE include the X and Y coordinates of the receptor location, the concentration value for that location, receptor terrain elevation, hill height scale, flagpole receptor height, the averaging period, the source group ID, and the date for the end of the averaging period (in the form of YYMMDDHH)(U.S. EPA, 2004). Table M.3 shows the equivalent data types based on the POSTFILE format. The equivalent data types shown in Table M.3 can be used as a guide for importing the results into a database or spreadsheet for extracting the offsite worker concentrations. The POSTFILE will list in order the concentration for each receptor and for each hour of meteorological data regardless of the source's emission schedule (see Figure M.1). 3.1). Use the information in this section as a guide to help import the hourly raw results into a database or spreadsheet.

FORTRAN syntax for the POSTFILE Format

(3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)

Table M.3. POSTFILE Variables and Equivalent Data Types

Column Name	Fortran Format	Equivalent Data Type
X	F13.5	Number/Double Precision
Y	F13.5	Number/Double Precision
AVERAGE_CONC	F13.5	Number/Double Precision
ZELEV	F8.2	Number/Double Precision
ZHILL	F8.2	Number/Double Precision
ZFLAG	F8.2	Number/Double Precision
AVE	A6	6-Character String/Text
GRP	A8	8-Character String/Text
NUM_HRS OR DATE	I8.8	8-Character String/Text
NET_ID	A8	8-Character String/Text

Figure M.3.1. Sample of an AERMOD POSTFILE

```
AERMOD (09292): LARGE PS                                                                        08/24/10
MODELING OPTIONS USED:                                                                          07:39:24
NonDFAULT CONC                                     FLAT                  FLGPOL
        POST/PLOT FILE OF CONCURRENT  1-HR VALUES FOR SOURCE GROUP: S010
        FOR A TOTAL OF     1 RECEPTORS.
        FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)
        X             Y      AVERAGE CONC    ZELEV    ZHILL    ZFLAG    AVE     GRP       DATE      NET ID
 ____________  ____________  ____________  ______  ______  ______  ______  ________  ________  ________
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010101
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010102
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010103
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010104
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010105
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010106
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010107
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010108
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010109
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010110
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010111
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010112
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010113
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010114
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010115
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010116
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010117
```

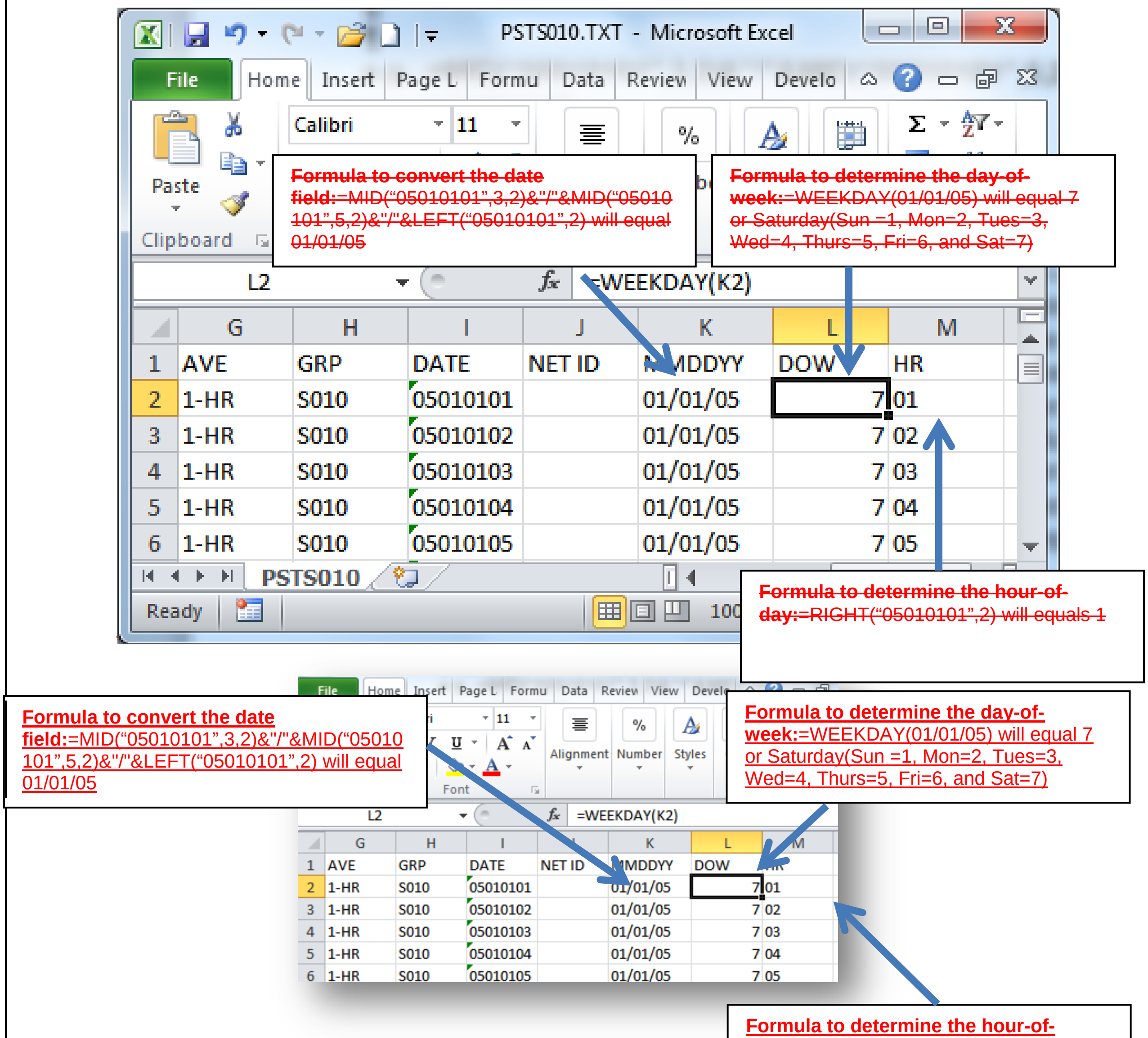

```
AERMOD (09292): LARGE PS                                                                        08/24/10
MODELING OPTIONS USED:                                                                          07:39:24
NonDFAULT CONC                                     FLAT                  FLGPOL
        POST/PLOT FILE OF CONCURRENT  1-HR VALUES FOR SOURCE GROUP: S010
        FOR A TOTAL OF     1 RECEPTORS.
        FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)
        X             Y      AVERAGE CONC    ZELEV    ZHILL    ZFLAG    AVE     GRP       DATE      NET ID
 ____________  ____________  ____________  ______  ______  ______  ______  ________  ________  ________
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010101
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010102
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010103
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010104
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010105
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010106
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010107
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010108
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010109
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010110
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010111
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010112
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010113
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010114
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010115
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010116
    100.00000       0.00000       0.00000    10.00    10.00     1.20   1-HR   S010     05010117
```

3.2. Determine the Day-of-Week and Hour-of-Day

In order to extract only the hourly concentrations that occur when an offsite worker is present, the risk assessor must first determine the day-of-week and hour-of-day for each hourly concentration record. For this step, it is recommended to import the data into a spreadsheet or database. This will allow the addition of columns for using the date field. Since the date outputted by AERMOD cannot be directly interpreted by the day-of-weekand hour-of-day. The purpose of this step is to determine which hourly concentration records are associated with the offsite worker's schedule. This step must be repeated for each source.function ofin a database or determine the day-of-week and hour-of-day for each record use the datefield in the POSTFILE (see Figure M.1). The date field is in the format of YYMMDDHH (e.g., 05010124equalsthe data period ending at hour 24 on January 1, 2005). If the data were imported usinga spreadsheet, the preprogrammed functionscan be used to determine the day-of-week.date must be first converted. For example, the date field can be first converted using the LEFT and MID functions in Microsoft Excel (See Column K in Figure M.3.2). After which, the WEEKDAY function in Microsoft Excel can be used to determine the day--of--week (See Column L in Figure M.3.1.2). The hour-of-day can simply be extracted using the RIGHT function (See Column M in Figure M.3.12).

Please note that in order to use the WEEKDAY function in Microsoft Excel, the date must be first converted into a format that Microsoft Excel can understand.The date field can be converted using the LEFT and MID functions (See Figure M.3).

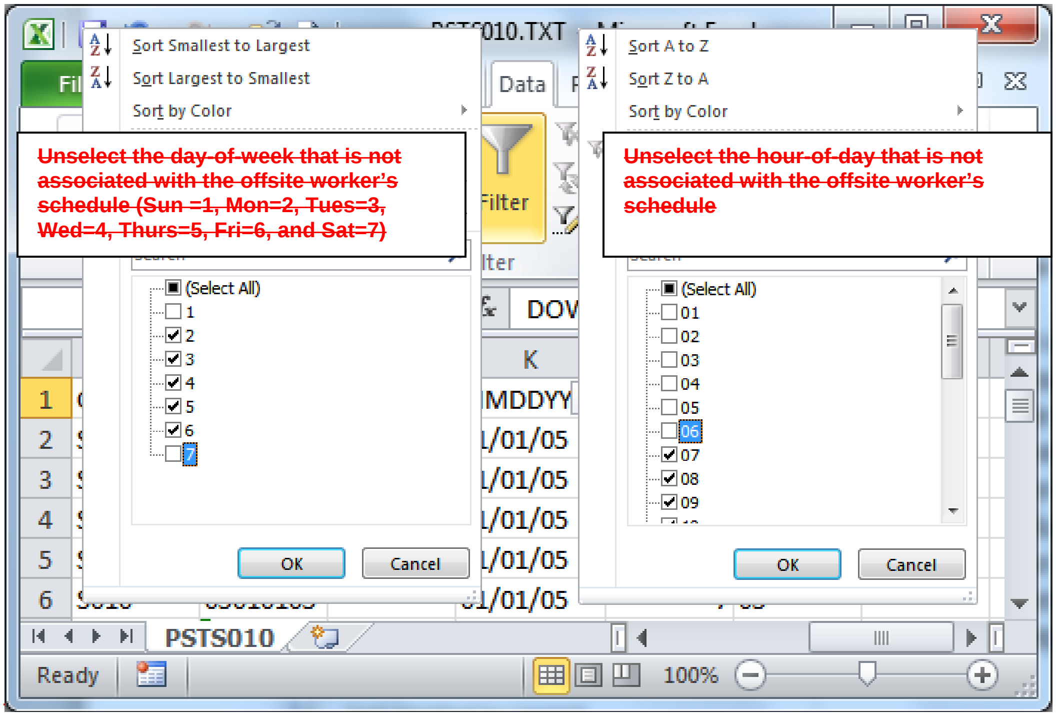
Figure M.3.~~1~~2. How to Determine the Day-of-Week and Hour-of-Day in Microsoft Excel

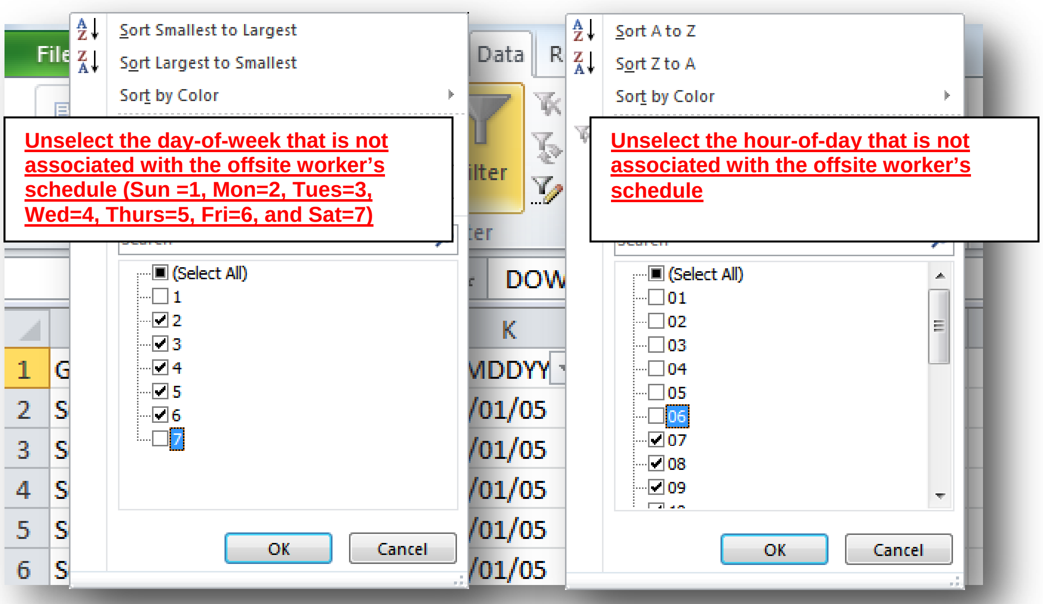


3.3. Extract the Hourly Concentrations Based on

After the day-of-week and hour-of-day have been determined, the concentrations can now be extracted or filtered. Based on the offsite worker's schedule, filter or query the hourly concentrations using a spreadsheet or database. For example, in Microsoft Excel, you can filter the data by selecting the data filter option (see Figure M.3.~~2~~3). Then unselect the records that are not associated with the offsite worker's schedule using the day-of-week and hour-of-day fields that were created in previous section.~~Since~~If the ~~imported~~ data ~~may contain~~contains information for multiple receptors, ~~also~~ filter the X and Y coordinates to get the concentrations that are specific to each receptor. The ~~result~~results from the filter will now only show hourly concentrations for times when the offsite worker is present. Please note that the day-of-week field may also be filtered for cancer assessment only.

Figure M.3.23. How to Filter the Data in Microsoft Excel





3.4. Count the Number of Calm and Missing Hours that OccurDuring the Offsite Worker's Schedule

If calm hour processing iswas used in the air dispersion analysis, then calm and missing hours must also be considered when post-processing the long-term average concentrationsand short-term averages for the offsite worker. To assist in this calculation, the Detailed Error Listing File that was created from the air dispersion analysis (Section 2.1) can be used to count the number of calm and missing hours that occurred during the worker's shift.

To identify the calm and missing hours, it is recommended to import the Detailed Error Listing File into a spreadsheet or database. Then follow the instructions from Sections 3.2 and 3.3 to determine the number of calm and missing hours that occur during the offsite worker's schedule. This information is needed to calculate the averaging periods for the offsite worker.

4.0. How to Identify or Calculate the Refined Averaging PeriodsConcentrations for the Offsite Worker Analysis

Depending on which averaging periods are needed (as determined by Section 1.0), use the sectionsSections 4.1 through 4.53 below to identify or calculate refined concentrations for estimating the acute, 8-hour non-cancer chronic, and cancer health impacts. The equations are based on how the maximum 1-hourlong-term and period concentrationsshort-term averages are calculated in AERMOD. These equations also account for how calm and missing hours are handled by AERMOD (U.S. EPA, 2005). After calculating the appropriate averaging periods, the refined concentrations can be used to assess the health impacts for the offsite worker's inhalation pathway only.

Please note that if unit emission rates were used in the air dispersion analysis, each averaging period calculated using the methods below must be combined with the pollutant specific emission rate (g/s) to yield the actual ground level concentrations (μg/m^3) for each pollutant in the analysis before the health impacts can be assessed.

4.1. How to Determine theMaximum 1-Hour Average for a Simple Acute Assessment

The maximum 1-hour average concentration ~~used to assessthe acute health impact~~ represents the highest concentration that occurs during the offsite worker's schedule. To determine the maximum 1-hour average, ~~Sort~~sort the extracted hourly concentrations in descending order using a spreadsheet or a database. The maximum hourly concentration will be at the top of the list (Figure M.4.1). This process must be repeated ~~for~~at each~~source~~receptor for all sources of interest.

~~Equation for Calculating~~Figure M.4.1. Identifying the ~~Average~~ Maximum 1-Hour Concentration ~~for the~~

X	Y	AVERAGE CONC	ZELEV	ZHILL	ZFLAG	AVE	GRP	DATE	NET ID	MMDD	DOW
100	0	110.2656	10	10	1.2	1-HR	S010	05082610		08/26/05	
100	0	105.365	10	10	1.2	1-HR	S010	05082315		08/23/05	
100	0	105.1168	10	10	1.2	1-HR	S010	05080512		08/05/05	
100	0	103.7613	10	10	1.2	1-HR	S010	05071310		07/13/05	
100	0	103.6595	10	10	1.2	1-HR	S010	05082314		08/23/05	
100	0	103.6498	10	10	1.2	1-HR	S010	05071113		07/11/05	
100	0	103.2635	10	10	1.2	1-HR	S010	05082413		08/24/05	
100	0	103.0836	10	10	1.2	1-HR	S010	05012012		01/20/05	
100	0	102.8738	10	10	1.2	1-HR	S010	05052310		05/23/05	

4.2. How to Determine the Long-Term Average of 8-Hour ~~Non-Cancer Chronic from a Non-Continuous Emitting Source~~Daily Concentrations for an 8-Hour Assessment

~~Below is~~To calculate the ~~equation for calculating the~~ long-term ~~average of~~ 8-hour daily average concentration ~~for~~, the 8-hour ~~chronic assessments. This calculation must be repeated~~averages are first calculated for each ~~source.~~

$$C_{worker\_period\_average} = \frac{\sum C_{hourly}}{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}}$$

~~Where:~~

~~C_{hourly}~~ =day in the air dispersion analysis. All the ~~concentration that occurs during~~ 8-hour averages are then averaged over the ~~worker's daily shift. This also includes every day~~ entire time period of the ~~week regardless if~~air dispersion analysis. However, since the ~~worker is present.~~

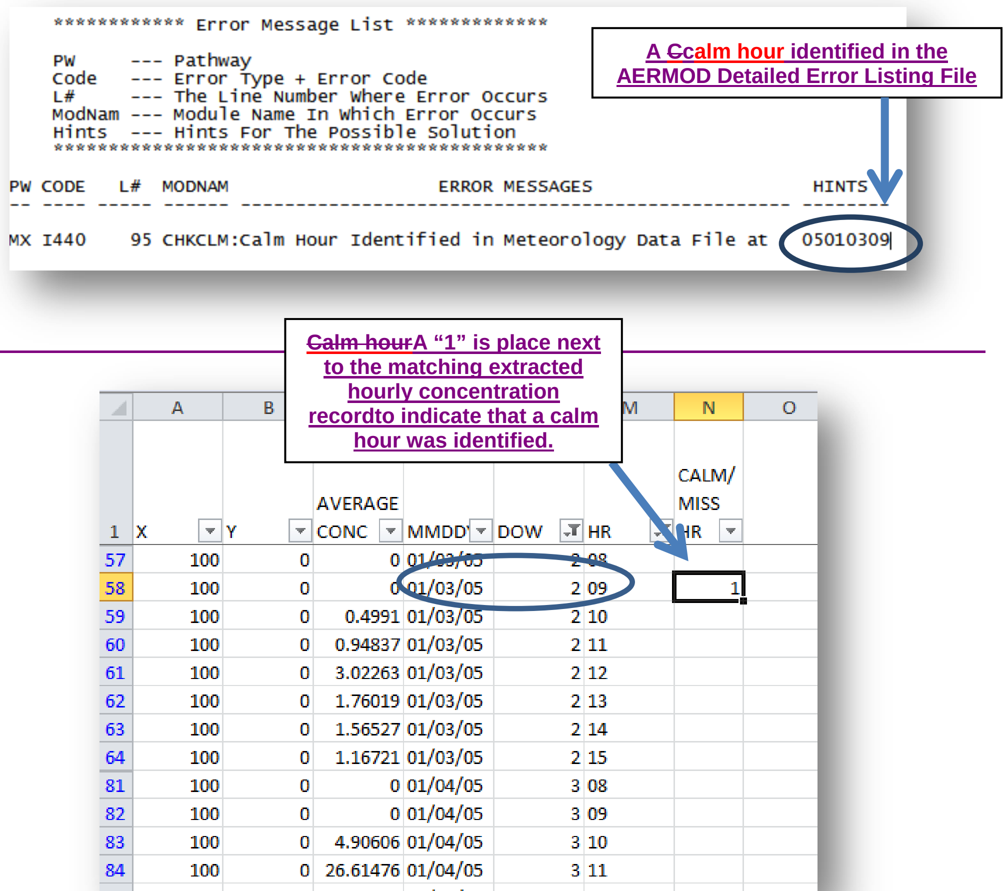
N 8-hour daily average is considered a short-term average, the total_hrs = the number of processedvalid hours that occur during the worker's shift. This includes every day of the week regardless if the worker is present.

N(i.e., not calm_hrs = the or not missing) must be considered. The total number of calmvalid hours that occur that occurs during the worker's shift. This includes every dayshould be 75% of the week regardless if8-hour average. Ifthe worker is present

N missing_hrs = thetotal number of valid hours in an 8--hour average is less than six (6), the 8-hour total concentration should be divided by six (6)(U.S. EPA, 2005). The following steps below are an example that shows how the average of 8-hourdaily concentration is calculated.

- ~~In a spreadsheet~~Using the extracted hourlyconcentrations based on the steps from Section 3.0, identify any calm and missing hours ~~that occur during~~ with a "1". To do this,using~~e~~ the Detailed Error Listing File that was created from the air dispersion analysis (See Section 2.1 for more information).The Detailed Error Listing File will list the calm and missing hours by date. Place a "1" where the dates match up with the extracted hourly concentrations (See Column N in Figure M.4.2.1). Please note that some of the columns are hidden in Figure M.4.2.1 for presentation purposes.

Figure M.4.2.1. Identify Calm and Missing Hours

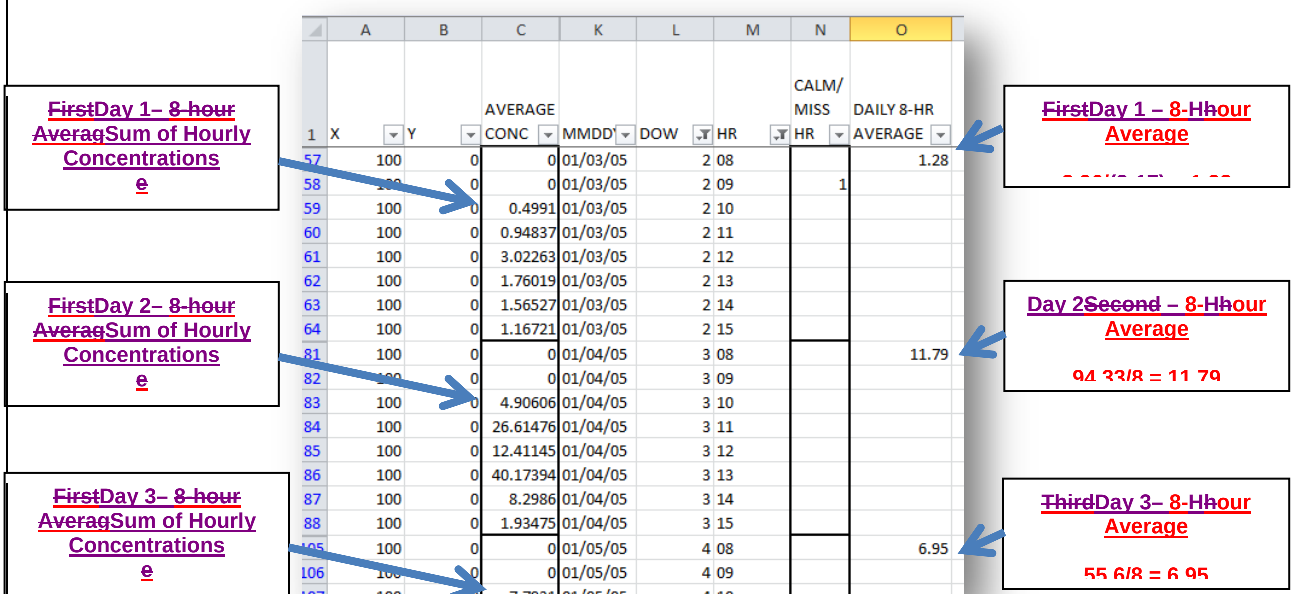



```
************ Error Message List *************

PW      --- Pathway
Code    --- Error Type + Error Code
L#      --- The Line Number Where Error Occurs
ModNam  --- Module Name In Which Error Occurs
Hints   --- Hints For The Possible Solution
*********************************************

PW CODE    L#  MODNAM                   ERROR MESSAGES                     HINTS
-- ---- ----- ------ ------------------------------------------------ --------

MX I440    95 CHKCLM:Calm Hour Identified in Meteorology Data File at  05010309
```

1	X (A)	Y (B)	AVERAGE CONC	MMDD	DOW	HR	CALM/ MISS HR (N)	(O)
57	100	0	0	01/03/05	2	08		
58	100	0	0	01/03/05	2	09	1	
59	100	0	0.4991	01/03/05	2	10		
60	100	0	0.94837	01/03/05	2	11		
61	100	0	3.02263	01/03/05	2	12		
62	100	0	1.76019	01/03/05	2	13		
63	100	0	1.56527	01/03/05	2	14		
64	100	0	1.16721	01/03/05	2	15		
81	100	0	0	01/04/05	3	08		
82	100	0	0	01/04/05	3	09		
83	100	0	4.90606	01/04/05	3	10		
84	100	0	26.61476	01/04/05	3	11		

- Then calculate the 8-hour average for each day throughout the file. The 8-hour average is the ~~worker's shift. This includes every day~~sum of the ~~week regardless if~~hourly concentrations in a day ~~(concentrations outlined in blue in Figure M.4.2.2)~~ divided by eight (s~~S~~ee Figure M.4.2.2~~3~~). However, if there are any calm or missing hours in the time period, the sum of hourly concentrations should be divided by total number of valid hours. The total number of valid hours is ~~The formula in Figure M.4.2.2 accounts for any calm or missing hour occurring during an eight hour period~~eight minus the total number of calm and missing hours~~.~~. If the total number of valid hours is less than six, then the sum of hourly concentrations should be divided by six.

Figure M.4.2.2~~3~~. 8-Hour Daily Average Calculation



	A	B	C	K	L	M	N	O
1	X	Y	AVERAGE CONC	MMDD	DOW	HR	CALM/ MISS HR	DAILY 8-HR AVERAGE
57	100	0	0	01/03/05	2	08		1.28
58	100	0	0	01/03/05	2	09	1	
59	100	0	0.4991	01/03/05	2	10		
60	100	0	0.94837	01/03/05	2	11		
61	100	0	3.02263	01/03/05	2	12		
62	100	0	1.76019	01/03/05	2	13		
63	100	0	1.56527	01/03/05	2	14		
64	100	0	1.16721	01/03/05	2	15		
81	100	0	0	01/04/05	3	08		11.79
82	100	0	0	01/04/05	3	09		
83	100	0	4.90606	01/04/05	3	10		
84	100	0	26.61476	01/04/05	3	11		
85	100	0	12.41145	01/04/05	3	12		
86	100	0	40.17394	01/04/05	3	13		
87	100	0	8.2986	01/04/05	3	14		
88	100	0	1.93475	01/04/05	3	15		
105	100	0	0	01/05/05	4	08		6.95
106	100	0	0	01/05/05	4	09		
107	100		[illegible]	01/05/05	4	10		

- Assuming that there were only three days~~8-hour averages~~ in the entire time period of the ~~worker~~air dispersion analysis, the average of 8-hour daily concentrations is ~~present~~
(1.28 + 11.79 + 6.95) /3 = 6.78.

4.3. Equation for Calculating the Average Concentration for the 8-Hour Non-Cancer Chronic from a Continuous Emitting Source

Below is the equation for calculating the average concentration for the 8-hour chronic assessments. This calculation must be repeated for each source.

$$C_{worker\_period\_average} = \frac{\sum C_{hourly}}{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}}$$

Where:

C_{hourly} = the concentration that occurs during the worker's daily shift. This includes every day of the week regardless if the worker is present.

N_{total_hrs} = the number of processed hours that occur during the worker's shift. This includes every day of the week regardless if the worker is present. However, if the offsite worker's shift is less than eight hours a day, then the number of processed hours should still be based on an 8-hour work shift. For example, if a worker's shift only last six hours a day, the number of processed hours should be eight (8) multiplied by the number of days in the meteorological dataset.

N_{calm_hrs} = the number of calm hours that occurs that occur during the worker's shift. This includes every day of the week regardless if the worker is present

$N_{missing\_hrs}$ = the number of missing hours that occur during the worker's shift. This includes every day of the week regardless if the worker is present

4.4.4.3. Equation for Calculating the Period Average for the Inhalation Cancer Pathway from a Non-Continuous Emitting Source

Below is the equation for calculating the period average for the inhalation cancer pathway. This calculation must be repeated at each receptor for each source of interest.

$$C_{worker\_period\_average} = \frac{\sum C_{hourly}}{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}}$$

Where:

C_{hourly} = the concentration that occurs during the worker's shift. To obtain the sum of the hourly concentrations for the offsite worker, sum the extracted worker concentrations from Section 3.0.

N_{total_hrs} = the number of processed hours that occur during worker's shift. To obtain the number of processed hours, use the COUNT function to return the total number of extracted worker concentrations from Section 3.0.

N_{calm_hrs} = the number of calm hours that occur during the worker's shift. To obtain the number of calm and missing hours, use the COUNT function to return the total number of missing and calm hours from Section 3.0. Since the total will include missing hours, it is not necessary to repeat this step for the variable below.

$N_{missing\_hrs}$ = the number of missing hours that occur during worker's shift.

~~4.5. Equation for Calculating the Period Average for the Inhalation Cancer Pathway from a Continuous Emitting Source~~

~~Below is the equation for calculating the period average for the inhalation cancer pathway. This calculation must be repeated for each source.~~

$$C_{worker\_period\_average} = \frac{\sum C_{hourly}}{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}}$$

~~Where:~~

~~C_{hourly} = the concentration that occur during the worker's shift~~
~~N_{total_hrs} = the number of processed hours for the entire meteorological dataset~~
~~N_{calm_hrs} = the number of calm hours for the entire meteorological dataset~~
~~$N_{missing\_hrs}$ = the number of missing hours for the entire meteorological dataset~~

REFERENCES

U.S. EPA (2004). User's Guide for the AMS/EPA Regulatory Model – AERMOD. EPA-454/B-03-001.U.S. Environmental Protection Agency, Research Triangle Park, NC.

U.S. EPA (2005). Guideline on Air Quality Models (Revised). 40 CFR 51, Appendix W.

Appendix N.

Sensitivity Study of the Worker Adjustment Factor using AERMOD

N.1. Introduction

The offsite worker health risk analysis begins with estimating the pollutant concentration at a receptor location. To estimate this concentration, the typical approach is to use the residential annual concentration that is modeled based on the adjacent facility's emission schedule. However, if the facility emissions are non-continuous, the residential concentration may not represent what the worker breathes during their work shift. In lieu of conducting additional special case modeling which can be time-consuming, the residential annual concentration is adjusted upwards using a worker adjustment factor based on the facility's emission schedule with respect to the worker's schedule. For an 8-hour work shift that coincides with an adjacent facility that emits eight hours per day, a worker adjustment factor of 4.2 (24 hours / 8 hours * 7 days / 5 days) is typically used for cancer risk assessment.

A possible problem with using this approach is that wind direction, wind speed, and atmospheric stability can vary throughout the day and night and straight scaling as above may skew the results. If the diurnal variation is considerable, the 4.2 adjustment could be an under- or overestimate depending on the time of day that the offsite worker shift begins and ends. The goal of this study is to test the validity of the 4.2 adjustment using five meteorological data sets from five different locations in California and with three different size point sources. The modeling is performed with 8-hour emissions coinciding with the offsite workers' schedule. The 8-hour shifts are modeled as starting every hour around the clock.

To perform this study, the AERMOD air dispersion model, meteorological data from five locations (i.e., Kearny Mesa, Palomar, Pomona, Redlands, and San Bernardino), and three different size point sources (small, medium, and large) are used. The AERMOD-ready meteorological datasets are selected to represent a range of meteorological conditions around the state. To mirror the assumptions used in the 4.2 worker adjustment factor, the emission rate of each source is simulated for eight continuous hours with 24 different start times for five days a week (Monday through Friday). This will simulate the conditions that result during an 8-hour work schedule starting any hour of the day. In addition, the emitting source and offsite worker are assumed to have coincident schedules.

Using the AERMOD air dispersion modeling results, the Point of Maximum Impact (PMI) is identified and the hourly raw concentrations are post-processed to calculate the long-term offsite worker concentration for each scenario. To test the validity of the worker adjustment factor, the calculated long-term offsite worker concentration is divided by the long term residential average to obtain a quotient that is unique to each meteorological data location. The quotient is then compared to the 4.2 worker adjustment factor to see which is higher or more health protective.

Although this study is primarily based on an 8-hour work schedule, the actual duration that an offsite worker is present near the emitting source may vary when considering a lunch break or a longer work shift. Thus, 10-hour scenarios are also evaluated. The worker adjustment factor for ten hours is 3.4 (24 hours / 10 hours * 7 days / 5 days).

N.2. Background on the Worker Adjustment Factor for Inhalation Cancer Assessments

There are basically two approaches that can be used to calculate the offsite worker inhalation exposure for cancer assessments. One approach is to post-process the hourly dispersion modeling results and examine the coincident hours between the source's emission schedule and the worker's schedule. The second, and more commonly used approach, is to apply a worker adjustment factor to the modeled long-term residential concentration. While post-processing the hourly modeling output will offer a more representative worker concentration, it is very time consuming and requires the management of large amounts of data. Thus, the simplistic approach of applying a worker adjustment factor to estimate the worker inhalation exposure is typically used.

The worker adjustment factor is used together with the long-term residential concentration to estimate the offsite worker's inhalation exposure. This calculation is summarized below.

a. Obtain the long-term concentrations from air dispersion modeling as is typical for residential receptors (all hours of a year or multi-year analysis are used).

b. Determine the coincident hours per day and days per week between the source's emission schedule and the offsite worker's schedule.

c. Calculate the worker adjustment factor using Equation N.1. When assessing inhalation cancer health impacts, a discount factor (*DF*) may also be applied if the offsite worker's schedule partially overlaps with the source's emission schedule. The discount factor is based on the number of coincident hours per day and days per week between the source's emission schedule and the offsite worker's schedule (see Equation N.2).

Please note that worker adjustment factor does not apply if the source's emission schedule and the offsite worker's schedule do not overlap. Since the worker is not around during the time that the source is emitting, the worker is not exposed to the source's emission (i.e., the DF in Equation N.2 becomes 0).

$$WAF = \frac{H_{residential}}{H_{source}} \times \frac{D_{residential}}{D_{source}} \times DF \qquad \text{Eq. N.1}$$

Where:

WAF = the worker adjustment factor
$H_{residential}$= the number of hours per day the long-term residential concentration is based on (24)
H_{source} = the number of hours the source operates per day
$D_{residential}$ = the number of days per week the long-term residential concentration is based on (7).
D_{source}= the number of days the source operates per week.
DF = a discount factor for when the offsite worker's schedule partially overlaps the source's emission schedule. Use 1 if the offsite worker's schedule occurs within the source's emission schedule. If the offsite worker's schedule partially overlaps with the source's emission schedule, then calculate the discount factor using Equation N.2 below.

$$DF = \frac{H_{coincident}}{H_{worker}} \times \frac{D_{coincident}}{D_{worker}} \qquad \text{Eq. N.2}$$

Where:

DF = the discount factor for assessing cancer impacts
$H_{coincident}$ = the number of hours per day the offsite worker's schedule and the source's emission schedule overlap
$D_{coincident}$= the number of days per week the offsite worker's schedule and the source's emission schedule overlap.
H_{worker} = the number of hours the offsite worker works per day
D_{worker}= the number of days the offsite worker works per week.

d. The final step is to estimate the offsite worker inhalation exposure by multiplying the worker adjustment factor with the long-term residential concentration.

N.3. Method and Modeling Parameters

For this study, all scenarios are simulated using the AERMOD (Version 09292) air dispersion model. The modeling parameters input to AERMOD and methods used to process the model outputs are discussed below.

N.3.1. Point Source Release Parameters

This study uses three different size point sources representing small, medium, and large. The point source release parameters are shown in Table N.1.

Table N.1. Point Source Modeling Parameters

Source Size	Emission Rate (g/s)	Release Ht (m)	Diameter (m)	Exit Temp (K)	Exit Vel (m/s)	Building Dimensions L (m) x W (m) x H (m)	XBADJ YBADJ[1]
Large	1	30	3	400	10	15 x 15 x 6	7.5
Medium	1	10	1	400	10	12 x 12 x 6	6
Small	1	2.15	0.1	400	10	6 x 6 x 2	3

1 – The XBADJ and YBADJ are keywords defining the along-flow and across-flow distances from the stack to the center of the upwind face of the projected building, respectively (U.S. EPA, 2004).

N.3.2. Temporal Emission Rate

Each point source (i.e., small, medium, and large) is simulated with continuous emissions for eight hours a day from Monday through Friday. In addition, all starting hour combinations (24 scenarios) are evaluated by duplicating each source 24 times with unique start times. Table N.2 shows the 8-hour operating schedule for each scenario. All emissions for Saturday and Sunday are set at zero. This process will also be repeated for the 10-hour evaluation. Table N.3 shows the 10-hour operating schedule for each scenario.

Table N.2. 8-Hour Operating Schedule

Time	Scenario																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12:00 AM	ON																	ON	ON	ON	ON	ON	ON	ON
1:00 AM	ON	ON																	ON	ON	ON	ON	ON	ON
2:00 AM	ON	ON	ON																	ON	ON	ON	ON	ON
3:00 AM	ON	ON	ON	ON																	ON	ON	ON	ON
4:00 AM	ON	ON	ON	ON	ON																	ON	ON	ON
5:00 AM	ON	ON	ON	ON	ON	ON																	ON	ON
6:00 AM	ON	ON	ON	ON	ON	ON	ON																	ON
7:00 AM	ON	ON	ON	ON	ON	ON	ON	ON																
8:00 AM		ON	ON	ON	ON	ON	ON	ON	ON															
9:00 AM			ON	ON	ON	ON	ON	ON	ON	ON														
10:00 AM				ON	ON	ON	ON	ON	ON	ON	ON													
11:00 AM					ON	ON	ON	ON	ON	ON	ON	ON												
12:00 PM						ON	ON	ON	ON	ON	ON	ON	ON											
1:00 PM							ON	ON	ON	ON	ON	ON	ON	ON										
2:00 PM								ON	ON	ON	ON	ON	ON	ON	ON									
3:00 PM									ON	ON	ON	ON	ON	ON	ON	ON								
4:00 PM										ON	ON	ON	ON	ON	ON	ON	ON							
5:00 PM											ON	ON	ON	ON	ON	ON	ON	ON						
6:00 PM												ON	ON	ON	ON	ON	ON	ON	ON					
7:00 PM													ON	ON	ON	ON	ON	ON	ON	ON				
8:00 PM														ON	ON	ON	ON	ON	ON	ON	ON			
9:00 PM															ON	ON	ON	ON	ON	ON	ON	ON		
10:00 PM																ON	ON	ON	ON	ON	ON	ON	ON	
11:00 PM																	ON	ON	ON	ON	ON	ON	ON	ON

Table N.3. 10-Hour Operating Schedule

Time	Scenario																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12:00 AM	ON															ON	ON	ON	ON	ON	ON	ON	ON	ON
1:00 AM	ON	ON															ON	ON	ON	ON	ON	ON	ON	ON
2:00 AM	ON	ON	ON															ON	ON	ON	ON	ON	ON	ON
3:00 AM	ON	ON	ON	ON															ON	ON	ON	ON	ON	ON
4:00 AM	ON	ON	ON	ON	ON															ON	ON	ON	ON	ON
5:00 AM	ON	ON	ON	ON	ON	ON															ON	ON	ON	ON
6:00 AM	ON	ON	ON	ON	ON	ON	ON															ON	ON	ON
7:00 AM	ON	ON	ON	ON	ON	ON	ON	ON															ON	ON
8:00 AM	ON	ON	ON	ON	ON	ON	ON	ON	ON															ON
9:00 AM	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON														
10:00 AM		ON	ON	ON	ON	ON	ON	ON	ON	ON	ON													
11:00 AM			ON	ON	ON	ON	ON	ON	ON	ON	ON	ON												
12:00 PM				ON	ON	ON	ON	ON	ON	ON	ON	ON	ON											
1:00 PM					ON	ON	ON	ON	ON	ON	ON	ON	ON	ON										
2:00 PM						ON	ON	ON	ON	ON	ON	ON	ON	ON	ON									
3:00 PM							ON	ON	ON	ON	ON	ON	ON	ON	ON	ON								
4:00 PM								ON	ON	ON	ON	ON	ON	ON	ON	ON	ON							
5:00 PM									ON	ON	ON	ON	ON	ON	ON	ON	ON	ON						
6:00 PM										ON	ON	ON	ON	ON	ON	ON	ON	ON	ON					
7:00 PM											ON	ON	ON	ON	ON	ON	ON	ON	ON	ON				
8:00 PM												ON	ON	ON	ON	ON	ON	ON	ON	ON	ON			
9:00 PM													ON	ON	ON	ON	ON	ON	ON	ON	ON	ON		
10:00 PM														ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	
11:00 PM															ON	ON	ON	ON	ON	ON	ON	ON	ON	ON

N.3.3. Receptor Grid Parameters

A 1000 meter by 1000 meter receptor grid is centered over each source. The receptors are spaced in 50 meter increments resulting in 441 receptor points. All receptor flagpole heights are set at 1.2 meters above ground.

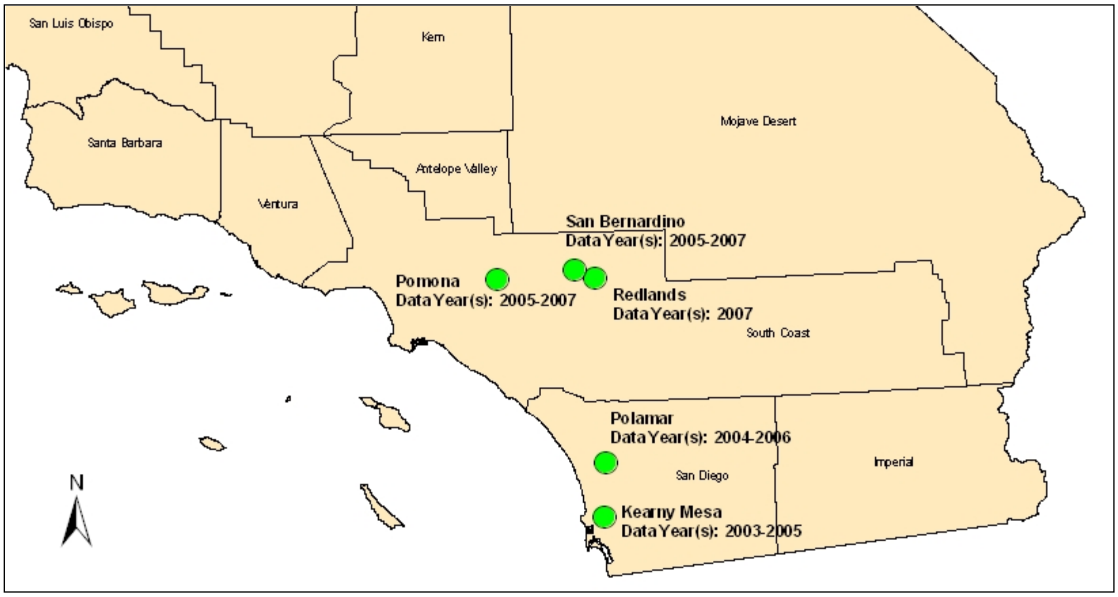
N.3.4. Meteorological Data

The meteorological data input to AERMOD were requested from two local air districts in California (ARB 2009a and ARB 2009b). The meteorological data that were provided by the Districts are, based on the Districts' observations and expertise, datasets that were likely to result in higher than average long-term impacts. The data includes four multi-year files and one single year file. Table N.4 shows the meteorological datasets used in this study. Figure N.1 shows the location of the meteorological station. The AERMOD profile base is defaulted to 10 meters above mean sea level for each meteorological file.

Table N.4. Meteorological Datasets

Data Provider	Area	Data Year(s)	Total Hours	Percent of Calm and Missing Hours	Avg. Wind Speed (m/s)
San Diego Air Pollution Control District	Kearny Mesa	2003-2005	26304	6.9	1.36
	Palomar	2004-2006	26304	8.7	1.36
South Coast Air Quality Management District	Pomona	2005-2007	26280	1.6	1.18
	Redlands	2007	8760	5.5	0.94
	San Bernardino	2005-2007	26280	4.9	1.44

Figure N.1. Meteorological Data Set Locations



N.3.5. Post-Processing the Period Average Concentrations for the Offsite Worker

The period average concentration represents the average concentration of all hours processed within the meteorological set. Equation N.3 shows how the period average is calculated in AERMOD including how calm and missing hours are processed (U.S. EPA, 2005).

$$C_{period\_average} = \frac{\sum C_{hourly}}{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}} \qquad \text{Eq. N.3}$$

Where:

C_{hourly} = the concentration that occurs at a given hour
N_{total_hrs} = the number of processed hours reported by AERMOD (e.g., 1 yr = 8760 hours)
N_{calm_hrs} = the number of calm hours reported by AERMOD
$N_{missing\_hrs}$ = the number of missing hours reported by AERMOD

Normally to post-process hourly data, the off-site worker hours are extracted from the hourly model output files and then averaged. However, this sensitivity study assumes the hourly emissions are coincident with the off-site worker schedule. Since this is the case, the 8-hour period average for the offsite worker can simply be scaled from the period average reported by AERMOD (see Equation N.4). To make sure this calculation is accurate, a check was performed by processing the hourly concentrations for one receptor with the Pomona data. If the emission schedule was not 100% coincident with the offsite worker, then all post-processing would have to be completed on an hourly basis. See Appendix M for more information on how to post-process worker concentrations using hourly raw results.

$$C_{worker\_period\_average} = C_{period\_average} \times \frac{N_{total\_hrs} - N_{calm\_hrs} - N_{missing\_hrs}}{N_{worker\_hrs} - N_{worker\_calm\_hrs} - N_{worker\_missing\_hrs}} \qquad \text{Eq. N.4}$$

Where:

$C_{period\_average}$ = the period concentration reported by AERMOD
N_{total_hrs} = the total number of processed hours reported by AERMOD
N_{calm_hrs} = the total number of calm hours reported by AERMOD
$N_{missing\_hrs}$ = the total number of missing hours reported by AERMOD
N_{worker_hrs}[a] = the total number of hours that occurred during the worker's shift
$N_{worker\_calm\_\_hrs}$[b] = the number of calm hours that occurs during the worker's shit
$N_{worker\_missing\_hrs}$[b]= the number of missing hours that occurred during the worker's shit

a – The worker hours are determined by multiplying the number of weekdays (Monday through Friday) that occurs in the meteorological data set by the work shift duration (8 hours). For example, a meteorological data set ranging from 1/1/2003 to 12/31/2005 contains 783 weekdays. If you multiply the number weekdays by the work shift duration (8 hour/day), this will equal 6264 worker hours. The number of weekdays varies depending on the day of the week January 1st starts on.

b – Calm and missing hours are reported in the AERMOD Detailed Message Listing File. To determine the number of worker calm and missing hours, the calm and missing hours that occur during the worker shift are isolated and summed.

N.4. Results

To test the validity of the worker adjustment factor, the post-processed period average concentration for the offsite worker was divided by the modeled period residential average to obtain a quotient. This calculation was performed at the PMI of each scenario. If the quotient is smaller or equal to the worker adjustment factor, the worker adjustment factor is considered a suitable health protective approximation. If the quotient is greater, the worker adjustment factor will underestimate the long-term average concentration and would not be the most conservative estimation of what the worker breathes. For these scenarios, the 8-hour and 10-hour worker adjustment factors are 4.2 and 3.4, respectively. The results for this study are summarized in the figures and tables below. To view the details for every scenario, see Appendix N-1.

Figure N.2 shows how the post-processed period averages changes over 8-hour rolling work shifts. The value at each 8-hour work shift represents the quotient average across the five meteorological data sets. Values that fall on or below the thick dashed line (i.e., the 4.2 worker adjustment factor) indicate that the worker adjustment factor would be a health protective value. Based on the five metrological data sets, the worker adjustment factor is health protective for work shifts that start approximately between 8 am and 3 pm (i.e., 8-hour work shifts starting at 8 am and ending by 11 pm).

Figure N.2. Summary of the 8-Hour Scenarios

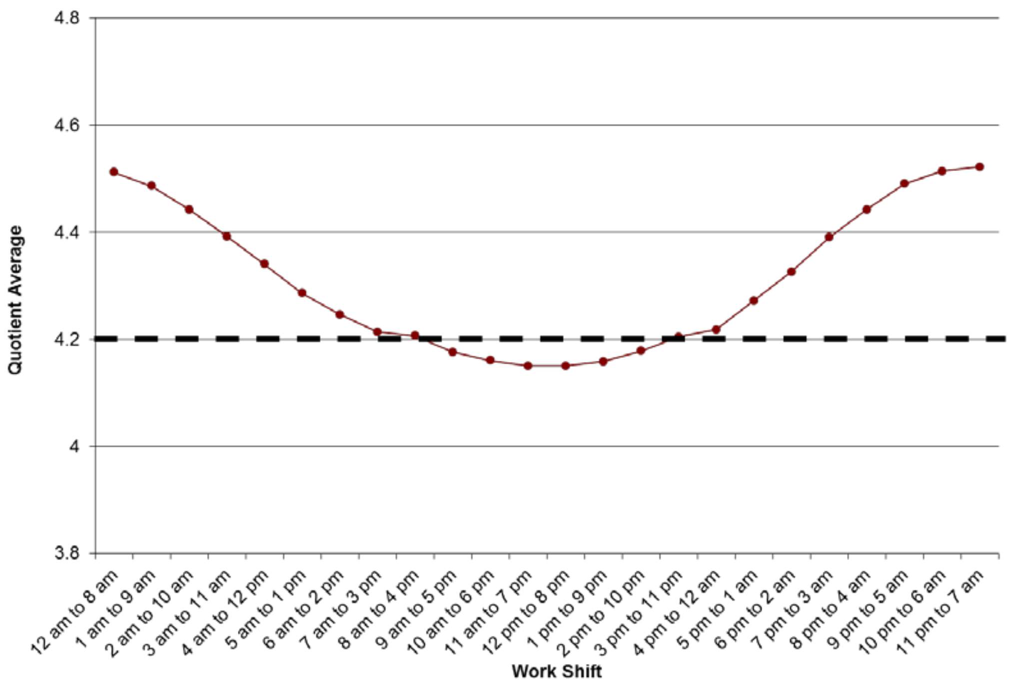


Figure N.3 shows relationship between the worker schedule and the percent of calm and missing hours that occurred during 8-hr work shifts. The figure shows the percent of calm and missing hours are higher during the early morning and evening hour start hours.

Figure N.3. Average Percent of Calm and Missing Hours for 8-Hour Work Shifts

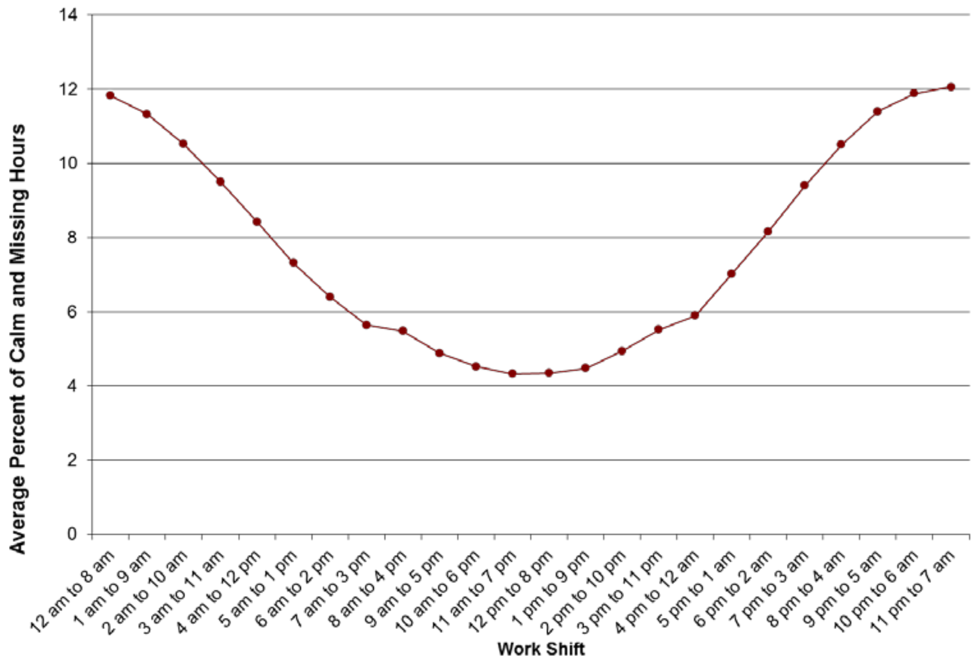


Figure N.4 shows how the post-processed period averages change over 10-hour rolling work shifts. The value at each 10-hour work shift represents the quotient average across the five meteorological data sets. Values that fall on or below the thick dashed line (i.e., the 3.4 worker adjustment factor) indicate that the worker adjustment factor would be a health protective value. Based on the five metrological data sets, the worker adjustment factor is health protective for work shifts that start approximately between 5 am and 4 pm (i.e., 10-hour work shifts starting at 5 am and ending by 2 am).

Figure N.4. Summary of the 10-Hour Scenarios

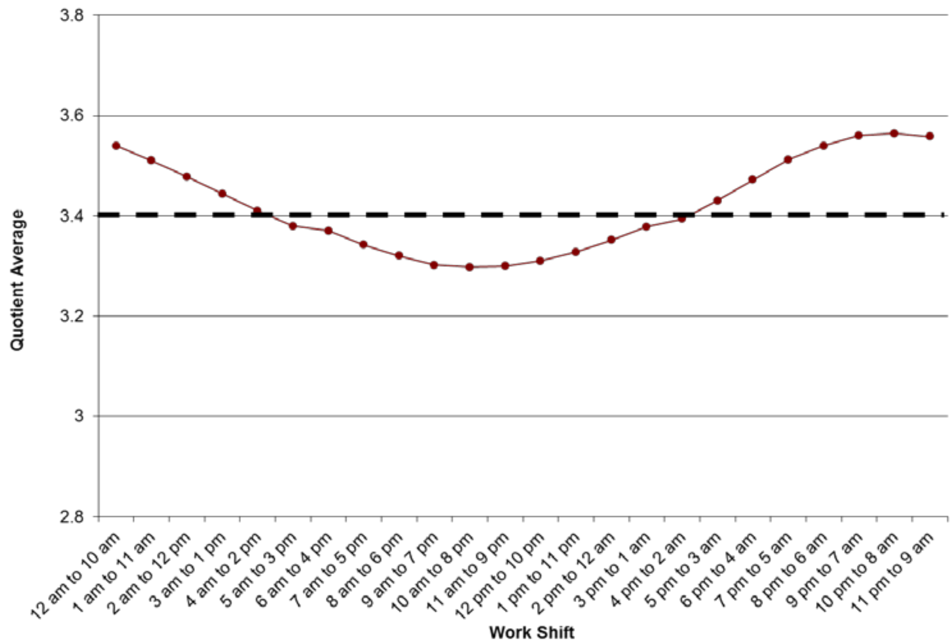


Figure N.5 shows relationship between the worker schedule and the percent of calm and missing hours that occurred during 10-hr work shifts. The figure shows the percent of calm and missing hours are higher during the early morning and evening hour start hours.

Figure N.5. Average Percent of Calm and Missing Hours for 10-Hour Work Shifts

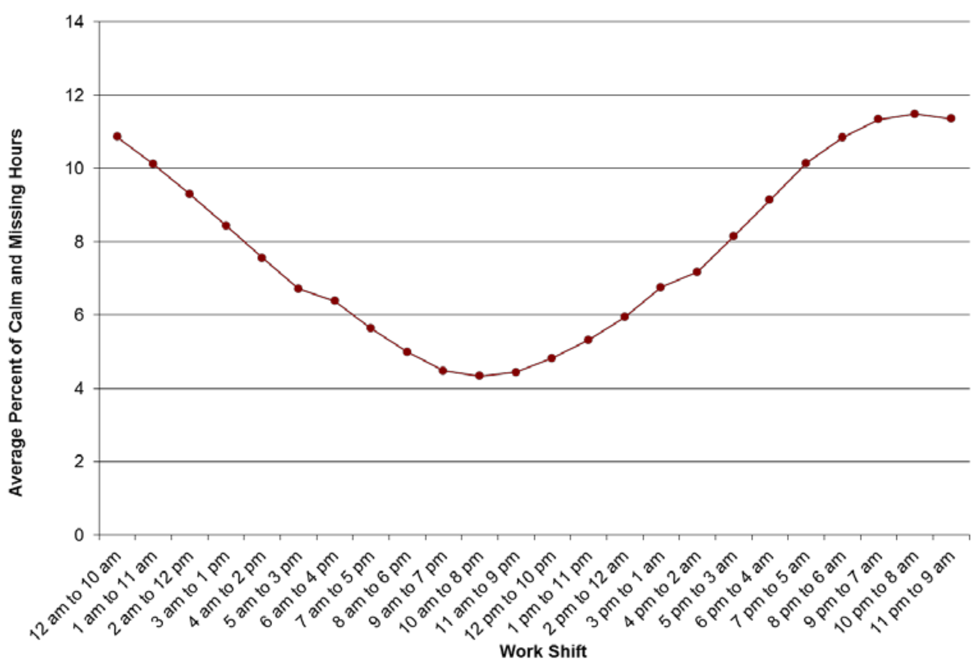


Table N.5 shows the average, minimum, and maximum quotients across all 24 8-hour work shifts for each point source size (i.e., small, medium, and large). The values in the parentheses are the range across the 24 work shifts for each meteorological data set.

Table N.5. Summary of the Average 8-Hour Scenarios by Point Source Size

Meteorological Set	Point Source Size			% Calm/Missing Hours During the Worker's Shift
	Small	Medium	Large	
Kearny Mesa	4.33 (4.19 to 4.43)	4.33 (4.19 to 4.43)	4.33 (4.19 to 4.43)	9.6 (6.8 to 11.8)
Palomar	4.38 (4.18 to 4.65)	4.38 (4.18 to 4.65)	4.38 (4.18 to 4.65)	12.2 (8.2 to 17.5)
Pomona	4.24 (4.23 to 4.25)	4.24 (4.23 to 4.25)	4.24 (4.23 to 4.25)	2.3 (2.1 to 2.5)
Redlands	4.31 (4.00 to 4.75)	4.31 (4.00 to 4.75)	4.31 (4.00 to 4.75)	7.6 (1.0 to 16.5)
San Bernardino	4.31 (4.06 to 4.65)	4.31 (4.06 to 4.65)	4.31 (4.06 to 4.65)	6.9 (1.4 to 14.1)

Table N.6 shows the average, minimum, and maximum quotients across all 24 10-hour work shifts for each point source size (i.e., small, medium, and large). The values in the parentheses are the range across the 24 work shifts for each meteorological data set.

Table N.6. Summary of the Average 10-Hour Scenarios by Point Source Size

Meteorological Set	Point Source Size			% Calm/Missing Hours During the Worker's Shift
	Small	Medium	Large	
Kearny Mesa	3.46 (3.38 to 3.54)	3.46 (3.38 to 3.54)	3.46 (3.38 to 3.54)	9.6 (7.5 to 11.6)
Palomar	3.50 (3.34 to 3.70)	3.50 (3.34 to 3.70)	3.50 (3.34 to 3.70)	12.2 (8.0 to 17.1)
Pomona	3.39 (3.38 to 3.39)	3.39 (3.38 to 3.39)	3.39 (3.38 to 3.39)	2.3 (2.2 to 2.5)
Redlands	3.45 (3.21 to 3.74)	3.45 (3.21 to 3.74)	3.45 (3.21 to 3.74)	7.6 (1.1 to 15.2)
San Bernardino	3.31 (3.12 to 3.54)	3.31 (3.12 to 3.54)	3.31 (3.12 to 3.54)	6.9 (1.5 to 13.1)

N.5. Conclusions

The goal of this study was to determine if the worker adjustment factor of 4.2 (8 hours/day, 5 days/week) or 3.4 (10 hours/day, 5 days/week) would always yield a more conservative or health protective approximation using five meteorological data sets. This study demonstrated that the worker adjustment factor does not always represent the most health protective approximation of long-term hourly model predictions. This is primarily observed during night conditions. Air Districts may wish to evaluate their meteorological data to determine an appropriate worker adjustment factor for their area using the methods described in this appendix.

Although the meteorological data used in this study are site-specific, several general conclusions and recommendations can be made. These conclusions and recommendations are summarized below.

- ***The worker adjustment factor is generally a suitable health protective approximation for daytime work shifts.***

  For the meteorological data used in this study, the results show that the worker adjustment factor is a suitable health protective approximation for work shifts that occur during the daytime hours. When comparing the 8-hour and 10-hour scenarios, the results show yhat the range of work shifts that were considered a more health protective approximation increased with the longer work shift duration.

- ***The size of the emitting source did not affect the long-term concentration approximated with the worker adjustment factor.***

  The size of the source was inconsequential in determining whether the worker adjustment factor is health protective. This is because the worker adjustment factor is applied to the modeling results after the air dispersion analysis has been completed. However, it should be noted that the size of the source does affect the location of the PMI during a specific time of day. This is shown in the scenario details in Appendix N-1.

- ***The worker adjustment factor may not represent the most conservative estimation of the worker's inhalation exposure for nighttime work shifts.***

  In most cases, the worker adjustment factor will represent a health protective approximation for work shifts that occur during the daytime. However, the worker adjustment factor may not represent the most conservative estimation when the source's emission schedule and offsite worker's schedules are 100% coincident at night. It is recommended that the offsite worker long-term average concentrations be post-processed using the hourly dispersion modeling results when examining work shifts occurring at night. Alternatively, a more conservative worker adjustment factor can be used to account for the calm hours (see the next bullet point below).

- ***Recommended worker adjustment factor for 8 and 10-hour work shifts***

  Based on the five meteorological data sets used in this study, the range of worker adjustment factors (WAF) was between 4.2 and 4.8. We recommend using the 4.2 WAF for most cases. In the event of predominant night time emissions and worker schedule or if only one year of meteorological data are available, then we recommend using 4.8 for the 8-hour WAF.

N.6. REFERENCES

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APPENDIX N-1 – SCENARIO DATA DETAILS

KEARNY MESA - 8-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	500	0.02584	26304	1813	632.84744	6264	723	11.5	0.11421	**4.42**
2	0	300	0.05638	26304	1813	1380.80258	6264	739	11.8	0.24992	**4.43**
3	150	-150	0.10366	26304	1813	2538.73706	6264	729	11.6	0.45867	**4.42**
4	150	-100	0.19993	26304	1813	4896.48563	6264	718	11.5	0.88289	**4.42**
5	200	-100	0.33363	26304	1813	8170.93233	6264	700	11.2	1.46854	**4.40**
6	200	-100	0.48136	26304	1813	11788.98776	6264	688	11.0	2.11424	**4.39**
7	200	-100	0.62685	26304	1813	15352.18335	6264	684	10.9	2.75129	**4.39**
8	200	-100	0.76245	26304	1813	18673.16295	6264	681	10.9	3.34465	**4.39**
9	200	-100	0.85443	26304	1813	20925.84513	6264	665	10.6	3.73743	**4.37**
10	250	-100	0.89012	26304	1813	21799.92892	6264	618	9.9	3.86113	**4.34**
11	250	-100	0.85448	26304	1813	20927.06968	6264	568	9.1	3.67399	**4.30**
12	250	-100	0.76187	26304	1813	18658.95817	6264	517	8.3	3.24673	**4.26**
13	250	-100	0.63409	26304	1813	15529.49819	6264	488	7.8	2.68863	**4.24**
14	250	-100	0.48738	26304	1813	11936.42358	6264	467	7.5	2.05907	**4.22**
15	300	-150	0.34902	26304	1813	8547.84882	6264	454	7.2	1.47123	**4.22**
16	300	-150	0.20978	26304	1813	5137.72198	6264	433	6.9	0.88110	**4.20**
17	300	-150	0.09739	26304	1813	2385.17849	6264	425	6.8	0.40849	**4.19**
18	350	-200	0.02843	26304	1813	696.27913	6264	456	7.3	0.11988	**4.22**
19	0	500	0.00479	26304	1813	117.31189	6264	516	8.2	0.02041	**4.26**
20	-50	500	0.00491	26304	1813	120.25081	6264	578	9.2	0.02115	**4.31**
21	0	500	0.00512	26304	1813	125.39392	6264	625	10.0	0.02224	**4.34**
22	0	500	0.00513	26304	1813	125.63883	6264	658	10.5	0.02241	**4.37**
23	0	500	0.00528	26304	1813	129.31248	6264	675	10.8	0.02314	**4.38**
24	0	500	0.01002	26304	1813	245.39982	6264	699	11.2	0.04410	**4.40**

KEARNY MESA - 8-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	0	100	0.48213	26304	1813	11807.84583	6264	723	11.5	2.13100	**4.42**
2	0	100	0.99949	26304	1813	24478.50959	6264	739	11.8	4.43050	**4.43**
3	50	50	1.69544	26304	1813	41523.02104	6264	729	11.6	7.50190	**4.42**
4	50	50	2.6458	26304	1813	64798.28780	6264	718	11.5	11.68379	**4.42**
5	50	50	3.51528	26304	1813	86092.72248	6264	700	11.2	15.47317	**4.40**
6	50	50	4.24949	26304	1813	104074.25959	6264	688	11.0	18.66468	**4.39**
7	100	-50	5.33685	26304	1813	130704.79335	6264	684	10.9	23.42380	**4.39**
8	100	-50	6.51541	26304	1813	159568.90631	6264	681	10.9	28.58121	**4.39**
9	100	-50	7.325	26304	1813	179396.57500	6264	665	10.6	32.04082	**4.37**
10	100	-50	7.60514	26304	1813	186257.48374	6264	618	9.9	32.98928	**4.34**
11	100	-50	7.28086	26304	1813	178315.54226	6264	568	9.1	31.30540	**4.30**
12	100	-50	6.51093	26304	1813	159459.18663	6264	517	8.3	27.74651	**4.26**
13	100	-50	5.53256	26304	1813	135497.92696	6264	488	7.8	23.45878	**4.24**
14	100	-50	4.37499	26304	1813	107147.88009	6264	467	7.5	18.48333	**4.22**
15	100	-50	3.13098	26304	1813	76680.83118	6264	454	7.2	13.19808	**4.22**
16	100	-50	1.92339	26304	1813	47105.74449	6264	433	6.9	8.07850	**4.20**
17	150	-50	0.97341	26304	1813	23839.78431	6264	425	6.8	4.08285	**4.19**
18	200	-100	0.37344	26304	1813	9145.91904	6264	456	7.3	1.57471	**4.22**
19	0	150	0.19509	26304	1813	4777.94919	6264	516	8.2	0.83124	**4.26**
20	0	150	0.18348	26304	1813	4493.60868	6264	578	9.2	0.79029	**4.31**
21	0	150	0.17623	26304	1813	4316.04893	6264	625	10.0	0.76539	**4.34**
22	0	150	0.16448	26304	1813	4028.27968	6264	658	10.5	0.71857	**4.37**
23	0	150	0.16295	26304	1813	3990.80845	6264	675	10.8	0.71405	**4.38**
24	0	150	0.22443	26304	1813	5496.51513	6264	699	11.2	0.98769	**4.40**

KEARNY MESA - 8-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	0	50	56.94704	26304	1813	1394689.95664	6264	723	11.5	251.70366	**4.42**
2	0	50	63.90855	26304	1813	1565184.29805	6264	739	11.8	283.29128	**4.43**
3	0	50	72.78622	26304	1813	1782607.31402	6264	729	11.6	322.06094	**4.42**
4	0	50	80.59339	26304	1813	1973812.71449	6264	718	11.5	355.89843	**4.42**
5	0	50	86.44869	26304	1813	2117214.86679	6264	700	11.2	380.52029	**4.40**
6	50	0	96.25147	26304	1813	2357294.75177	6264	688	11.0	422.75731	**4.39**
7	50	0	117.66867	26304	1813	2881823.39697	6264	684	10.9	516.45581	**4.39**
8	50	0	138.64904	26304	1813	3395653.63864	6264	681	10.9	608.21308	**4.39**
9	50	0	156.76654	26304	1813	3839369.33114	6264	665	10.6	685.72412	**4.37**
10	50	0	172.75048	26304	1813	4230832.00568	6264	618	9.9	749.35034	**4.34**
11	50	0	184.10847	26304	1813	4509000.53877	6264	568	9.1	791.60824	**4.30**
12	50	0	190.80885	26304	1813	4673099.54535	6264	517	8.3	813.13721	**4.26**
13	50	0	183.97723	26304	1813	4505786.33993	6264	488	7.8	780.08766	**4.24**
14	50	0	168.91026	26304	1813	4136781.17766	6264	467	7.5	713.60724	**4.22**
15	50	0	150.42213	26304	1813	3683988.38583	6264	454	7.2	634.07717	**4.22**
16	50	-50	146.48297	26304	1813	3587514.41827	6264	433	6.9	615.24857	**4.20**
17	50	-50	144.08415	26304	1813	3528764.91765	6264	425	6.8	604.34405	**4.19**
18	50	-50	130.6006	26304	1813	3198539.29460	6264	456	7.3	550.71269	**4.22**
19	50	-50	111.9118	26304	1813	2740831.89380	6264	516	8.2	476.83227	**4.26**
20	50	-50	86.25428	26304	1813	2112453.57148	6264	578	9.2	371.51839	**4.31**
21	50	-50	65.37008	26304	1813	1600978.62928	6264	625	10.0	283.91180	**4.34**
22	0	50	56.60048	26304	1813	1386202.35568	6264	658	10.5	247.27120	**4.37**
23	0	50	53.20196	26304	1813	1302969.20236	6264	675	10.8	233.13101	**4.38**
24	-100	-100	54.24037	26304	1813	1328400.90167	6264	699	11.2	238.70636	**4.40**

PALOMAR - 8-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	250	0.02363	26304	2291	567.42719	6256	1096	17.5	0.10997	**4.65**
2	100	150	0.0631	26304	2291	1515.22030	6256	1090	17.4	0.29331	**4.65**
3	150	50	0.14317	26304	2291	3437.94121	6256	1050	16.8	0.66038	**4.61**
4	150	50	0.27432	26304	2291	6587.24616	6256	971	15.5	1.24640	**4.54**
5	200	50	0.42859	26304	2291	10291.73167	6256	879	14.1	1.91403	**4.47**
6	200	50	0.58751	26304	2291	14107.87763	6256	788	12.6	2.58008	**4.39**
7	200	0	0.73867	26304	2291	17737.68271	6256	701	11.2	3.19310	**4.32**
8	200	0	0.87304	26304	2291	20964.30952	6256	628	10.0	3.72500	**4.27**
9	250	0	0.96493	26304	2291	23170.86409	6256	679	10.9	4.15472	**4.31**
10	250	0	0.99791	26304	2291	23962.81283	6256	589	9.4	4.22848	**4.24**
11	250	0	0.9484	26304	2291	22773.92920	6256	540	8.6	3.98424	**4.20**
12	250	0	0.83614	26304	2291	20078.22982	6256	518	8.3	3.49917	**4.18**
13	250	0	0.68595	26304	2291	16471.71735	6256	517	8.3	2.87014	**4.18**
14	250	0	0.51501	26304	2291	12366.93513	6256	523	8.4	2.15715	**4.19**
15	300	0	0.34888	26304	2291	8377.65544	6256	550	8.8	1.46822	**4.21**
16	300	-50	0.20229	26304	2291	4857.58977	6256	596	9.5	0.85823	**4.24**
17	300	-100	0.10109	26304	2291	2427.47417	6256	516	8.2	0.42290	**4.18**
18	300	-150	0.0311	26304	2291	746.80430	6256	612	9.8	0.13232	**4.25**
19	-450	-200	0.00583	26304	2291	139.99579	6256	701	11.2	0.02520	**4.32**
20	-400	-150	0.00576	26304	2291	138.31488	6256	802	12.8	0.02536	**4.40**
21	-400	-200	0.00503	26304	2291	120.78539	6256	895	14.3	0.02253	**4.48**
22	-400	-200	0.00427	26304	2291	102.53551	6256	980	15.7	0.01943	**4.55**
23	-400	-200	0.00323	26304	2291	77.56199	6256	1040	16.6	0.01487	**4.60**
24	-500	-500	0.0081	26304	2291	194.50530	6256	1067	17.1	0.03748	**4.63**

PALOMAR - 8-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	50	0.39916	26304	2291	9585.02908	6256	1096	17.5	1.85756	**4.65**
2	50	50	1.1355	26304	2291	27266.76150	6256	1090	17.4	5.27812	**4.65**
3	50	50	2.23922	26304	2291	53770.38986	6256	1050	16.8	10.32854	**4.61**
4	50	50	3.46481	26304	2291	83200.48253	6256	971	15.5	15.74276	**4.54**
5	100	0	5.01511	26304	2291	120427.83643	6256	879	14.1	22.39685	**4.47**
6	100	0	7.1387	26304	2291	171421.60310	6256	788	12.6	31.34996	**4.39**
7	100	0	9.3361	26304	2291	224187.76930	6256	701	11.2	40.35783	**4.32**
8	100	0	11.30065	26304	2291	271362.50845	6256	628	10.0	48.21651	**4.27**
9	100	0	12.55274	26304	2291	301428.94562	6256	679	10.9	54.04858	**4.31**
10	100	0	12.9907	26304	2291	311945.67910	6256	589	9.4	55.04600	**4.24**
11	100	0	12.32253	26304	2291	295900.91289	6256	540	8.6	51.76713	**4.20**
12	100	0	10.99232	26304	2291	263958.58016	6256	518	8.3	46.00184	**4.18**
13	100	0	9.16435	26304	2291	220063.53655	6256	517	8.3	38.34528	**4.18**
14	100	0	7.04288	26304	2291	169120.67744	6256	523	8.4	29.49951	**4.19**
15	100	0	4.85232	26304	2291	116518.76016	6256	550	8.8	20.42039	**4.21**
16	100	0	2.83666	26304	2291	68116.71658	6256	596	9.5	12.03476	**4.24**
17	150	0	1.4789	26304	2291	35512.82570	6256	516	8.2	6.18690	**4.18**
18	150	0	0.51952	26304	2291	12475.23376	6256	612	9.8	2.21035	**4.25**
19	500	100	0.16252	26304	2291	3902.59276	6256	701	11.2	0.70254	**4.32**
20	-100	-50	0.13578	26304	2291	3260.48514	6256	802	12.8	0.59782	**4.40**
21	-100	-50	0.12284	26304	2291	2949.75692	6256	895	14.3	0.55023	**4.48**
22	-100	-50	0.10491	26304	2291	2519.20383	6256	980	15.7	0.47748	**4.55**
23	-150	-50	0.08895	26304	2291	2135.95635	6256	1040	16.6	0.40950	**4.60**
24	-100	0	0.15313	26304	2291	3677.11069	6256	1067	17.1	0.70864	**4.63**

PALOMAR - 8-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	0	62.23758	26304	2291	1494511.00854	6256	1096	17.5	289.63392	**4.65**
2	-50	0	67.07392	26304	2291	1610646.04096	6256	1090	17.4	311.77817	**4.65**
3	-50	0	69.58692	26304	2291	1670990.70996	6256	1050	16.8	320.97401	**4.61**
4	50	0	76.6273	26304	2291	1840051.35490	6256	971	15.5	348.16487	**4.54**
5	50	0	101.35151	26304	2291	2433753.80963	6256	879	14.1	452.62299	**4.47**
6	50	0	132.881	26304	2291	3190871.45300	6256	788	12.6	583.55367	**4.39**
7	50	0	166.85749	26304	2291	4006748.90737	6256	701	11.2	721.28693	**4.32**
8	50	0	199.35655	26304	2291	4787148.83515	6256	628	10.0	850.59503	**4.27**
9	50	0	227.0465	26304	2291	5452067.60450	6256	679	10.9	977.59864	**4.31**
10	50	0	258.20597	26304	2291	6200299.95761	6256	589	9.4	1094.10622	**4.24**
11	50	0	284.95975	26304	2291	6842738.47675	6256	540	8.6	1197.12010	**4.20**
12	50	0	306.84919	26304	2291	7368369.59947	6256	518	8.3	1284.13552	**4.18**
13	50	0	305.48615	26304	2291	7335638.91995	6256	517	8.3	1278.20856	**4.18**
14	50	0	284.9321	26304	2291	6842074.51730	6256	523	8.4	1193.45448	**4.19**
15	50	0	255.29701	26304	2291	6130447.10113	6256	550	8.8	1074.38610	**4.21**
16	50	0	222.46841	26304	2291	5342133.92933	6256	596	9.5	943.83992	**4.24**
17	50	0	190.65477	26304	2291	4578192.99201	6256	516	8.2	797.59460	**4.18**
18	50	0	149.99496	26304	2291	3601828.97448	6256	612	9.8	638.16956	**4.25**
19	50	0	109.43689	26304	2291	2627908.03957	6256	701	11.2	473.07075	**4.32**
20	50	0	71.34752	26304	2291	1713267.99776	6256	802	12.8	314.13055	**4.40**
21	50	0	47.98635	26304	2291	1152296.22255	6256	895	14.3	214.94054	**4.48**
22	-50	50	46.33971	26304	2291	1112755.45623	6256	980	15.7	210.90892	**4.55**
23	-50	0	48.61618	26304	2291	1167420.33034	6256	1040	16.6	223.81525	**4.60**
24	-50	0	55.01306	26304	2291	1321028.60978	6256	1067	17.1	254.58250	**4.63**

POMONA - 8-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	300	-100	0.0378	26280	432	977.05440	6248	138	2.2	0.15991	**4.23**
2	200	-50	0.08941	26280	432	2311.06968	6248	140	2.2	0.37837	**4.23**
3	200	-50	0.18145	26280	432	4690.11960	6248	142	2.3	0.76812	**4.23**
4	200	-50	0.30538	26280	432	7893.46224	6248	145	2.3	1.29337	**4.24**
5	200	-50	0.4489	26280	432	11603.16720	6248	147	2.4	1.90185	**4.24**
6	200	0	0.59344	26280	432	15339.23712	6248	152	2.4	2.51628	**4.24**
7	200	0	0.72765	26280	432	18808.29720	6248	154	2.5	3.08636	**4.24**
8	250	0	0.84968	26280	432	21962.52864	6248	157	2.5	3.60573	**4.24**
9	250	0	0.93127	26280	432	24071.46696	6248	159	2.5	3.95327	**4.25**
10	250	0	0.9478	26280	432	24498.73440	6248	158	2.5	4.02278	**4.24**
11	250	0	0.89255	26280	432	23070.63240	6248	157	2.5	3.78766	**4.24**
12	250	0	0.7753	26280	432	20039.95440	6248	154	2.5	3.28847	**4.24**
13	300	0	0.63398	26280	432	16387.11504	6248	149	2.4	2.68685	**4.24**
14	300	0	0.49462	26280	432	12784.93776	6248	145	2.3	2.09486	**4.24**
15	300	50	0.35974	26280	432	9298.55952	6248	142	2.3	1.52286	**4.23**
16	350	50	0.22753	26280	432	5881.19544	6248	139	2.2	0.96271	**4.23**
17	350	50	0.11619	26280	432	3003.27912	6248	135	2.2	0.49129	**4.23**
18	400	0	0.03912	26280	432	1011.17376	6248	134	2.1	0.16539	**4.23**
19	0	-50	0.0042	26280	432	108.56160	6248	133	2.1	0.01775	**4.23**
20	0	-50	0.00468	26280	432	120.96864	6248	133	2.1	0.01978	**4.23**
21	0	-50	0.0052	26280	432	134.40960	6248	136	2.2	0.02199	**4.23**
22	0	-50	0.00567	26280	432	146.55816	6248	135	2.2	0.02397	**4.23**
23	0	-50	0.00623	26280	432	161.03304	6248	136	2.2	0.02635	**4.23**
24	500	-250	0.01616	26280	432	417.70368	6248	136	2.2	0.06834	**4.23**

POMONA - 8-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	100	-50	0.59146	26280	432	15288.05808	6248	138	2.2	2.50214	**4.23**
2	100	0	1.20437	26280	432	31130.55576	6248	140	2.2	5.09669	**4.23**
3	100	0	2.08811	26280	432	53973.46728	6248	142	2.3	8.83941	**4.23**
4	100	0	3.14746	26280	432	81355.54608	6248	145	2.3	13.33042	**4.24**
5	100	0	4.34608	26280	432	112337.47584	6248	147	2.4	18.41296	**4.24**
6	100	0	5.57952	26280	432	144219.43296	6248	152	2.4	23.65804	**4.24**
7	100	0	6.79151	26280	432	175546.95048	6248	154	2.5	28.80652	**4.24**
8	100	0	7.82163	26280	432	202173.49224	6248	157	2.5	33.19217	**4.24**
9	100	0	8.41525	26280	432	217517.38200	6248	159	2.5	35.72301	**4.25**
10	100	0	8.44758	26280	432	218353.04784	6248	158	2.5	35.85436	**4.24**
11	100	0	7.8987	26280	432	204165.59760	6248	157	2.5	33.51922	**4.24**
12	100	0	6.84909	26280	432	177035.27832	6248	154	2.5	29.05075	**4.24**
13	100	0	5.65066	26280	432	146058.25968	6248	149	2.4	23.94790	**4.24**
14	100	0	4.41875	26280	432	114215.85000	6248	145	2.3	18.71471	**4.24**
15	100	0	3.20379	26280	432	82811.56392	6248	142	2.3	13.56233	**4.23**
16	150	0	2.10868	26280	432	54505.16064	6248	139	2.2	8.92211	**4.23**
17	150	0	1.168	26280	432	30190.46400	6248	135	2.2	4.93873	**4.23**
18	200	0	0.48016	26280	432	12411.17568	6248	134	2.1	2.02996	**4.23**
19	500	-200	0.19471	26280	432	5032.86408	6248	133	2.1	0.82304	**4.23**
20	500	0	0.07366	26280	432	1903.96368	6248	133	2.1	0.31136	**4.23**
21	0	-50	0.04644	26280	432	1200.38112	6248	136	2.2	0.19640	**4.23**
22	0	-50	0.05041	26280	432	1302.99768	6248	135	2.2	0.21315	**4.23**
23	0	-50	0.05369	26280	432	1387.77912	6248	136	2.2	0.22706	**4.23**
24	100	-50	0.21115	26280	432	5457.80520	6248	136	2.2	0.89297	**4.23**

POMONA - 8-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	100	-50	65.9476	26280	432	1704613.56480	6248	138	2.2	278.98749	**4.23**
2	50	0	58.23568	26280	432	1505275.85664	6248	140	2.2	246.44333	**4.23**
3	50	0	70.24739	26280	432	1815754.53672	6248	142	2.3	297.37218	**4.23**
4	50	0	88.80241	26280	432	2295364.69368	6248	145	2.3	376.10432	**4.24**
5	50	0	111.03137	26280	432	2869938.85176	6248	147	2.4	470.40466	**4.24**
6	50	0	135.13711	26280	432	3493024.01928	6248	152	2.4	573.00263	**4.24**
7	50	0	158.47651	26280	432	4096300.83048	6248	154	2.5	672.18589	**4.24**
8	50	0	179.27428	26280	432	4633881.58944	6248	157	2.5	760.77517	**4.24**
9	50	0	197.23857	26280	432	5098222.55736	6248	159	2.5	837.28405	**4.25**
10	50	0	218.81575	26280	432	5655949.50600	6248	158	2.5	928.72734	**4.24**
11	50	0	244.03622	26280	432	6307848.21456	6248	157	2.5	1035.60141	**4.24**
12	50	0	270.93265	26280	432	7003067.13720	6248	154	2.5	1149.17413	**4.24**
13	50	0	285.34864	26280	432	7375691.64672	6248	149	2.4	1209.32803	**4.24**
14	50	0	285.77704	26280	432	7386764.92992	6248	145	2.3	1210.34982	**4.24**
15	50	0	275.07823	26280	432	7110222.08904	6248	142	2.3	1164.46480	**4.23**
16	50	0	256.69684	26280	432	6635099.92032	6248	139	2.2	1086.11883	**4.23**
17	50	0	236.76058	26280	432	6119787.47184	6248	135	2.2	1001.11033	**4.23**
18	50	0	207.98698	26280	432	5376047.45904	6248	134	2.1	879.30119	**4.23**
19	50	0	170.7548	26280	432	4413670.07040	6248	133	2.1	721.77761	**4.23**
20	100	-50	154.35448	26280	432	3989754.59904	6248	133	2.1	652.45374	**4.23**
21	100	-50	130.80712	26280	432	3381102.43776	6248	136	2.2	553.19084	**4.23**
22	100	-50	109.58201	26280	432	2832475.79448	6248	135	2.2	463.35282	**4.23**
23	100	-50	93.63298	26280	432	2420225.26704	6248	136	2.2	395.97926	**4.23**
24	100	-50	78.6095	26280	432	2031898.35600	6248	136	2.2	332.44410	**4.23**

REDLANDS - 8-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-500	0	0.04181	8760	478	346.27042	2088	291	13.9	0.19269	**4.61**
2	150	-100	0.08511	8760	478	704.88102	2088	250	12.0	0.38350	**4.51**
3	150	-100	0.18241	8760	478	1510.71962	2088	209	10.0	0.80400	**4.41**
4	150	-100	0.31173	8760	478	2581.74786	2088	167	8.0	1.34396	**4.31**
5	150	-100	0.45602	8760	478	3776.75764	2088	125	6.0	1.92397	**4.22**
6	200	-100	0.60555	8760	478	5015.16510	2088	84	4.0	2.50258	**4.13**
7	200	-50	0.75634	8760	478	6264.00788	2088	51	2.4	3.07511	**4.07**
8	200	-100	0.88379	8760	478	7319.54878	2088	31	1.5	3.55836	**4.03**
9	200	-50	0.9679	8760	478	8016.14780	2088	25	1.2	3.88568	**4.01**
10	250	-50	0.99231	8760	478	8218.31142	2088	20	1.0	3.97404	**4.00**
11	250	-50	0.94769	8760	478	7848.76858	2088	20	1.0	3.79534	**4.00**
12	250	-50	0.83365	8760	478	6904.28930	2088	21	1.0	3.34025	**4.01**
13	250	-50	0.69935	8760	478	5792.01670	2088	35	1.7	2.82125	**4.03**
14	300	-50	0.54905	8760	478	4547.23210	2088	53	2.5	2.23451	**4.07**
15	300	-50	0.40803	8760	478	3379.30446	2088	83	4.0	1.68544	**4.13**
16	300	-50	0.27569	8760	478	2283.26458	2088	120	5.7	1.16020	**4.21**
17	350	-50	0.15386	8760	478	1274.26852	2088	162	7.8	0.66161	**4.30**
18	400	-50	0.05645	8760	478	467.51890	2088	208	10.0	0.24868	**4.41**
19	-50	0	0.00342	8760	478	28.32444	2088	249	11.9	0.01540	**4.50**
20	-50	0	0.00391	8760	478	32.38262	2088	290	13.9	0.01801	**4.61**
21	-50	0	0.0043	8760	478	35.61260	2088	318	15.2	0.02012	**4.68**
22	-50	0	0.0046	8760	478	38.09720	2088	341	16.3	0.02181	**4.74**
23	-50	0	0.00521	8760	478	43.14922	2088	344	16.5	0.02474	**4.75**
24	-500	50	0.01975	8760	478	163.56950	2088	327	15.7	0.09288	**4.70**

REDLANDS - 8-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	WORKER PERIOD AVE CONC	% WORKER CALM & MISSING HRS	QUOTIENT (FACTOR)
1	-50	0	0.52894	8760	478	4380.68108	2088	291	2.43777	13.9	**4.61**
2	50	-50	1.22841	8760	478	10173.69162	2088	250	5.53520	12.0	**4.51**
3	50	-50	2.14057	8760	478	17728.20074	2088	209	9.43491	10.0	**4.41**
4	50	-50	3.12441	8760	478	25876.36362	2088	167	13.47026	8.0	**4.31**
5	100	-50	4.19282	8760	478	34724.93524	2088	125	17.68973	6.0	**4.22**
6	100	-50	5.31036	8760	478	43980.40152	2088	84	21.94631	4.0	**4.13**
7	100	-50	6.45196	8760	478	53435.13272	2088	51	26.23227	2.4	**4.07**
8	100	-50	7.43242	8760	478	61555.30244	2088	31	29.92479	1.5	**4.03**
9	100	-50	7.96745	8760	478	65986.42090	2088	25	31.98566	1.2	**4.01**
10	100	-50	7.90056	8760	478	65432.43792	2088	20	31.64044	1.0	**4.00**
11	100	-50	7.20298	8760	478	59655.08036	2088	20	28.84675	1.0	**4.00**
12	100	-50	6.14084	8760	478	50858.43688	2088	21	24.60495	1.0	**4.01**
13	100	0	5.07104	8760	478	41998.35328	2088	35	20.45706	1.7	**4.03**
14	150	-50	4.07763	8760	478	33770.93166	2088	53	16.59505	2.5	**4.07**
15	150	0	3.14168	8760	478	26019.39376	2088	83	12.97725	4.0	**4.13**
16	150	0	2.23696	8760	478	18526.50272	2088	120	9.41387	5.7	**4.21**
17	150	0	1.32077	8760	478	10938.61714	2088	162	5.67945	7.8	**4.30**
18	150	0	0.517	8760	478	4281.79400	2088	208	2.27755	10.0	**4.41**
19	500	-100	0.07352	8760	478	608.89264	2088	249	0.33110	11.9	**4.50**
20	-50	0	0.04779	8760	478	395.79678	2088	290	0.22013	13.9	**4.61**
21	-50	0	0.05202	8760	478	430.82964	2088	318	0.24341	15.2	**4.68**
22	-50	0	0.05512	8760	478	456.50384	2088	341	0.26131	16.3	**4.74**
23	-50	0	0.05897	8760	478	488.38954	2088	344	0.28004	16.5	**4.75**
24	-50	0	0.18742	8760	478	1552.21244	2088	327	0.88144	15.7	**4.70**

REDLANDS - 8-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-300	50	45.47894	8760	478	376656.58108	2088	291	13.9	209.60299	**4.61**
2	-50	0	45.80464	8760	478	379354.02848	2088	250	12.0	206.39501	**4.51**
3	-50	0	53.94402	8760	478	446764.37364	2088	209	10.0	237.76710	**4.41**
4	50	0	74.29323	8760	478	615296.53086	2088	167	8.0	320.30012	**4.31**
5	50	0	96.44381	8760	478	798747.63442	2088	125	6.0	406.90149	**4.22**
6	50	0	123.94464	8760	478	1026509.50848	2088	84	4.0	512.23029	**4.13**
7	50	0	151.19332	8760	478	1252183.07624	2088	51	2.4	614.71923	**4.07**
8	50	0	175.86202	8760	478	1456489.24964	2088	31	1.5	708.06478	**4.03**
9	50	0	200.54185	8760	478	1660887.60170	2088	25	1.2	805.08367	**4.01**
10	50	0	230.43001	8760	478	1908421.34282	2088	20	1.0	922.83431	**4.00**
11	50	0	263.81094	8760	478	2184882.20508	2088	20	1.0	1056.51944	**4.00**
12	50	0	299.22627	8760	478	2478191.96814	2088	21	1.0	1198.93177	**4.01**
13	50	0	298.91289	8760	478	2475596.55498	2088	35	1.7	1205.84343	**4.03**
14	50	0	277.77399	8760	478	2300524.18518	2088	53	2.5	1130.47872	**4.07**
15	50	0	252.24911	8760	478	2089127.12902	2088	83	4.0	1041.95867	**4.13**
16	50	0	224.21967	8760	478	1856987.30694	2088	120	5.7	943.59111	**4.21**
17	50	0	190.84881	8760	478	1580609.84442	2088	162	7.8	820.66970	**4.30**
18	50	0	147.20039	8760	478	1219113.62998	2088	208	10.0	648.46470	**4.41**
19	50	0	96.70574	8760	478	800916.93868	2088	249	11.9	435.51764	**4.50**
20	100	-50	65.67926	8760	478	543955.63132	2088	290	13.9	302.53372	**4.61**
21	100	-50	44.74535	8760	478	370580.98870	2088	318	15.2	209.36779	**4.68**
22	-300	50	46.41385	8760	478	384399.50570	2088	341	16.3	220.03406	**4.74**
23	-300	50	48.26296	8760	478	399713.83472	2088	344	16.5	229.19371	**4.75**
24	-300	50	48.06504	8760	478	398074.66128	2088	327	15.7	226.05035	**4.70**

SAN BERNARDINO - 8-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	200	350	0.04085	26280	1292	1020.75980	6248	872	14.0	0.18987	**4.65**
2	100	200	0.09946	26280	1292	2485.30648	6248	823	13.2	0.45812	**4.61**
3	100	150	0.20057	26280	1292	5011.84316	6248	744	11.9	0.91058	**4.54**
4	100	150	0.33332	26280	1292	8329.00016	6248	636	10.2	1.48414	**4.45**
5	150	150	0.48464	26280	1292	12110.18432	6248	526	8.4	2.11643	**4.37**
6	150	150	0.64456	26280	1292	16106.26528	6248	414	6.6	2.76076	**4.28**
7	150	150	0.79252	26280	1292	19803.48976	6248	312	5.0	3.33617	**4.21**
8	150	150	0.92034	26280	1292	22997.45592	6248	206	3.3	3.80627	**4.14**
9	200	200	1.02323	26280	1292	25568.47124	6248	138	2.2	4.18469	**4.09**
10	200	200	1.0794	26280	1292	26972.04720	6248	99	1.6	4.38641	**4.06**
11	200	200	1.04725	26280	1292	26168.68300	6248	87	1.4	4.24747	**4.06**
12	200	200	0.92541	26280	1292	23124.14508	6248	91	1.5	3.75575	**4.06**
13	200	200	0.78218	26280	1292	19545.11384	6248	92	1.5	3.17497	**4.06**
14	250	250	0.6348	26280	1292	15862.38240	6248	109	1.7	2.58387	**4.07**
15	250	250	0.49254	26280	1292	12307.58952	6248	150	2.4	2.01830	**4.10**
16	250	250	0.34312	26280	1292	8573.88256	6248	208	3.3	1.41952	**4.14**
17	300	300	0.19921	26280	1292	4977.85948	6248	282	4.5	0.83437	**4.19**
18	300	300	0.08024	26280	1292	2005.03712	6248	370	5.9	0.34111	**4.25**
19	500	500	0.0042	26280	1292	104.94960	6248	461	7.4	0.01814	**4.32**
20	500	-400	0.00275	26280	1292	68.71700	6248	565	9.0	0.01209	**4.40**
21	-50	0	0.00279	26280	1292	69.71652	6248	674	10.8	0.01251	**4.48**
22	-50	0	0.00305	26280	1292	76.21340	6248	769	12.3	0.01391	**4.56**
23	500	-450	0.00363	26280	1292	90.70644	6248	830	13.3	0.01674	**4.61**
24	500	-400	0.01549	26280	1292	387.06412	6248	878	14.1	0.07208	**4.65**

SAN BERNARDINO - 8-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	100	0.61923	26280	1292	15473.31924	6248	872	14.0	2.87822	**4.65**
2	50	50	1.30694	26280	1292	32657.81672	6248	823	13.2	6.01987	**4.61**
3	50	50	2.2765	26280	1292	56885.18200	6248	744	11.9	10.33524	**4.54**
4	50	50	3.33493	26280	1292	83333.23084	6248	636	10.2	14.84911	**4.45**
5	50	50	4.37187	26280	1292	109244.28756	6248	526	8.4	19.09198	**4.37**
6	50	50	5.37512	26280	1292	134313.49856	6248	414	6.6	23.02254	**4.28**
7	50	100	6.31892	26280	1292	157897.17296	6248	312	5.0	26.59993	**4.21**
8	100	100	7.24372	26280	1292	181006.07536	6248	206	3.3	29.95797	**4.14**
9	100	100	8.1813	26280	1292	204434.32440	6248	138	2.2	33.45897	**4.09**
10	100	100	8.82249	26280	1292	220456.38012	6248	99	1.6	35.85240	**4.06**
11	100	100	8.99277	26280	1292	224711.33676	6248	87	1.4	36.47319	**4.06**
12	100	100	8.30546	26280	1292	207536.83448	6248	91	1.5	33.70746	**4.06**
13	100	100	7.26975	26280	1292	181656.51300	6248	92	1.5	29.50886	**4.06**
14	100	100	6.13035	26280	1292	153185.18580	6248	109	1.7	24.95279	**4.07**
15	100	100	4.96832	26280	1292	124148.38016	6248	150	2.4	20.35887	**4.10**
16	100	100	3.72613	26280	1292	93108.53644	6248	208	3.3	15.41532	**4.14**
17	100	100	2.45722	26280	1292	61401.01336	6248	282	4.5	10.29182	**4.19**
18	150	150	1.45646	26280	1292	36394.02248	6248	370	5.9	6.19157	**4.25**
19	250	300	0.78676	26280	1292	19659.55888	6248	461	7.4	3.39719	**4.32**
20	400	500	0.34453	26280	1292	8609.11564	6248	565	9.0	1.51489	**4.40**
21	400	500	0.1543	26280	1292	3855.64840	6248	674	10.8	0.69172	**4.48**
22	150	-100	0.09964	26280	1292	2489.80432	6248	769	12.3	0.45443	**4.56**
23	150	-100	0.1332	26280	1292	3328.40160	6248	830	13.3	0.61432	**4.61**
24	150	-100	0.22779	26280	1292	5692.01652	6248	878	14.1	1.05997	**4.65**

SAN BERNARDINO - 8-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	100	63.46595	26280	1292	1585887.15860	6248	872	14.0	294.99389	**4.65**
2	0	50	55.96467	26280	1292	1398445.17396	6248	823	13.2	257.77791	**4.61**
3	0	50	65.81835	26280	1292	1644668.92980	6248	744	11.9	298.81340	**4.54**
4	0	50	76.94855	26280	1292	1922790.36740	6248	636	10.2	342.62123	**4.45**
5	0	50	88.11255	26280	1292	2201756.39940	6248	526	8.4	384.78791	**4.37**
6	0	50	98.59945	26280	1292	2463803.05660	6248	414	6.6	422.31797	**4.28**
7	0	50	107.32754	26280	1292	2681900.56952	6248	312	5.0	451.80266	**4.21**
8	0	50	112.73519	26280	1292	2817026.92772	6248	206	3.3	466.24080	**4.14**
9	50	50	120.54293	26280	1292	3012126.73484	6248	138	2.2	492.98310	**4.09**
10	50	50	141.77071	26280	1292	3542566.50148	6248	99	1.6	576.12075	**4.06**
11	50	50	169.40463	26280	1292	4233082.89444	6248	87	1.4	687.07724	**4.06**
12	50	50	207.02118	26280	1292	5173045.24584	6248	91	1.5	840.18926	**4.06**
13	50	50	237.14305	26280	1292	5925730.53340	6248	92	1.5	962.59430	**4.06**
14	50	50	260.28953	26280	1292	6504114.77564	6248	109	1.7	1059.47463	**4.07**
15	50	50	274.82077	26280	1292	6867221.40076	6248	150	2.4	1126.14323	**4.10**
16	50	50	274.32052	26280	1292	6854721.15376	6248	208	3.3	1134.88761	**4.14**
17	50	50	267.24594	26280	1292	6677941.54872	6248	282	4.5	1119.33315	**4.19**
18	50	50	247.00929	26280	1292	6172268.13852	6248	370	5.9	1050.06263	**4.25**
19	50	50	216.76584	26280	1292	5416544.80992	6248	461	7.4	935.98493	**4.32**
20	50	100	173.1904	26280	1292	4327681.71520	6248	565	9.0	761.51359	**4.40**
21	50	100	149.39248	26280	1292	3733019.29024	6248	674	10.8	669.72000	**4.48**
22	50	100	121.76981	26280	1292	3042784.01228	6248	769	12.3	555.35390	**4.56**
23	50	100	100.07427	26280	1292	2500655.85876	6248	830	13.3	461.54593	**4.61**
24	50	100	79.55709	26280	1292	1987972.56492	6248	878	14.1	370.19973	**4.65**

KEARNY MESA - 10-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	150	-150	0.08297	26304	1813	2032.01827	7830	910	11.6	0.29364	**3.54**
2	150	-100	0.15998	26304	1813	3918.07018	7830	907	11.6	0.56595	**3.54**
3	200	-100	0.26694	26304	1813	6537.62754	7830	886	11.3	0.94148	**3.53**
4	200	-100	0.38512	26304	1813	9431.97392	7830	872	11.1	1.35556	**3.52**
5	200	-100	0.50152	26304	1813	12282.72632	7830	856	10.9	1.76122	**3.51**
6	200	-100	0.61064	26304	1813	14955.18424	7830	848	10.8	2.14196	**3.51**
7	200	-100	0.69021	26304	1813	16903.93311	7830	849	10.8	2.42142	**3.51**
8	250	-100	0.73932	26304	1813	18106.68612	7830	817	10.4	2.58187	**3.49**
9	250	-100	0.75042	26304	1813	18378.53622	7830	755	9.6	2.59767	**3.46**
10	250	-100	0.72932	26304	1813	17861.77612	7830	685	8.7	2.49990	**3.43**
11	250	-100	0.68371	26304	1813	16744.74161	7830	645	8.2	2.33051	**3.41**
12	250	-100	0.60961	26304	1813	14929.95851	7830	621	7.9	2.07102	**3.40**
13	250	-100	0.50731	26304	1813	12424.52921	7830	610	7.8	1.72085	**3.39**
14	250	-100	0.38994	26304	1813	9550.02054	7830	593	7.6	1.31961	**3.38**
15	300	-150	0.27924	26304	1813	6838.86684	7830	590	7.5	0.94459	**3.38**
16	300	-150	0.16786	26304	1813	4111.05926	7830	592	7.6	0.56798	**3.38**
17	300	-150	0.07795	26304	1813	1909.07345	7830	606	7.7	0.26427	**3.39**
18	350	-200	0.02278	26304	1813	557.90498	7830	645	8.2	0.07765	**3.41**
19	0	500	0.00482	26304	1813	118.04662	7830	702	9.0	0.01656	**3.44**
20	0	500	0.00483	26304	1813	118.29153	7830	762	9.7	0.01674	**3.47**
21	0	500	0.00496	26304	1813	121.47536	7830	797	10.2	0.01727	**3.48**
22	-50	500	0.00874	26304	1813	214.05134	7830	825	10.5	0.03056	**3.50**
23	-50	500	0.02154	26304	1813	527.53614	7830	859	11.0	0.07568	**3.51**
24	0	300	0.04544	26304	1813	1112.87104	7830	898	11.5	0.16054	**3.53**

KEARNY MESA - 10-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	50	1.35817	26304	1813	33262.94147	7830	910	11.6	4.80678	**3.54**
2	50	50	2.11813	26304	1813	51875.12183	7830	907	11.6	7.49316	**3.54**
3	50	50	2.81323	26304	1813	68898.81593	7830	886	11.3	9.92206	**3.53**
4	50	50	3.40099	26304	1813	83293.64609	7830	872	11.1	11.97092	**3.52**
5	100	-50	4.27704	26304	1813	104748.98664	7830	856	10.9	15.01993	**3.51**
6	100	-50	5.2404	26304	1813	128342.63640	7830	848	10.8	18.38193	**3.51**
7	100	-50	6.03015	26304	1813	147684.40365	7830	849	10.8	21.15519	**3.51**
8	100	-50	6.5101	26304	1813	159438.85910	7830	817	10.4	22.73476	**3.49**
9	100	-50	6.57622	26304	1813	161058.20402	7830	755	9.6	22.76441	**3.46**
10	100	-50	6.3076	26304	1813	154479.43160	7830	685	8.7	21.62063	**3.43**
11	100	-50	5.84464	26304	1813	143141.07824	7830	645	8.2	19.92221	**3.41**
12	100	-50	5.22149	26304	1813	127879.51159	7830	621	7.9	17.73887	**3.40**
13	100	-50	4.43399	26304	1813	108592.84909	7830	610	7.8	15.04056	**3.39**
14	100	-50	3.50471	26304	1813	85833.85261	7830	593	7.6	11.86042	**3.38**
15	100	-50	2.50936	26304	1813	61456.73576	7830	590	7.5	8.48850	**3.38**
16	100	-50	1.54547	26304	1813	37850.10577	7830	592	7.6	5.22936	**3.38**
17	150	-50	0.78926	26304	1813	19329.76666	7830	606	7.7	2.67577	**3.39**
18	200	-100	0.30774	26304	1813	7536.86034	7830	645	8.2	1.04897	**3.41**
19	0	150	0.18342	26304	1813	4492.13922	7830	702	9.0	0.63021	**3.44**
20	0	150	0.16993	26304	1813	4161.75563	7830	762	9.7	0.58882	**3.47**
21	0	150	0.16545	26304	1813	4052.03595	7830	797	10.2	0.57615	**3.48**
22	0	150	0.21125	26304	1813	5173.72375	7830	825	10.5	0.73858	**3.50**
23	0	100	0.41536	26304	1813	10172.58176	7830	859	11.0	1.45927	**3.51**
24	0	100	0.83705	26304	1813	20500.19155	7830	898	11.5	2.95733	**3.53**

KEARNY MESA - 10-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	0	50	68.76835	26304	1813	1684205.65985	7830	910	11.6	243.38232	**3.54**
2	0	50	74.07187	26304	1813	1814094.16817	7830	907	11.6	262.03874	**3.54**
3	0	50	78.4778	26304	1813	1921999.79980	7830	886	11.3	276.78569	**3.53**
4	50	0	81.98311	26304	1813	2007848.34701	7830	872	11.1	288.56688	**3.52**
5	50	0	99.45639	26304	1813	2435786.44749	7830	856	10.9	349.26677	**3.51**
6	50	0	117.63254	26304	1813	2880938.53714	7830	848	10.8	412.62368	**3.51**
7	50	0	134.71148	26304	1813	3299218.85668	7830	849	10.8	472.59975	**3.51**
8	50	0	151.26253	26304	1813	3704570.62223	7830	817	10.4	528.24335	**3.49**
9	50	0	164.57775	26304	1813	4030673.67525	7830	755	9.6	569.70653	**3.46**
10	50	0	175.05832	26304	1813	4287353.31512	7830	685	8.7	600.04945	**3.43**
11	50	0	176.15086	26304	1813	4314110.71226	7830	645	8.2	600.43295	**3.41**
12	50	0	169.94269	26304	1813	4162066.42079	7830	621	7.9	577.34310	**3.40**
13	50	0	158.91434	26304	1813	3891971.10094	7830	610	7.8	539.05417	**3.39**
14	50	0	144.4592	26304	1813	3537950.26720	7830	593	7.6	488.86973	**3.38**
15	50	-50	129.79889	26304	1813	3178904.61499	7830	590	7.5	439.07522	**3.38**
16	50	-50	127.14583	26304	1813	3113928.52253	7830	592	7.6	430.21947	**3.38**
17	50	-50	122.72119	26304	1813	3005564.66429	7830	606	7.7	416.05269	**3.39**
18	50	-50	111.89165	26304	1813	2740338.40015	7830	645	8.2	381.39713	**3.41**
19	50	-50	97.37192	26304	1813	2384735.69272	7830	702	9.0	334.55888	**3.44**
20	50	-50	76.25987	26304	1813	1867680.47617	7830	762	9.7	264.24455	**3.47**
21	0	50	59.92054	26304	1813	1467513.94514	7830	797	10.2	208.66116	**3.48**
22	0	50	56.81233	26304	1813	1391390.77403	7830	825	10.5	198.62823	**3.50**
23	0	50	58.33987	26304	1813	1428801.75617	7830	859	11.0	204.96367	**3.51**
24	0	50	63.14546	26304	1813	1546495.46086	7830	898	11.5	223.09513	**3.53**

PALOMAR - 10-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	150	50	0.11461	26304	2291	2752.12993	7820	1313	16.8	0.42295	**3.69**
2	150	50	0.21952	26304	2291	5271.33376	7820	1235	15.8	0.80051	**3.65**
3	200	50	0.34291	26304	2291	8234.29783	7820	1156	14.8	1.23564	**3.60**
4	200	50	0.47006	26304	2291	11287.55078	7820	1071	13.7	1.67248	**3.56**
5	200	0	0.59099	26304	2291	14191.44287	7820	985	12.6	2.07629	**3.51**
6	200	0	0.70014	26304	2291	16812.46182	7820	902	11.5	2.43025	**3.47**
7	250	0	0.78328	26304	2291	18808.90264	7820	951	12.2	2.73823	**3.50**
8	250	0	0.83593	26304	2291	20073.18709	7820	858	11.0	2.88325	**3.45**
9	250	0	0.84409	26304	2291	20269.13317	7820	757	9.7	2.86976	**3.40**
10	250	0	0.8161	26304	2291	19597.00930	7820	663	8.5	2.73816	**3.36**
11	250	0	0.75885	26304	2291	18222.26505	7820	623	8.0	2.53193	**3.34**
12	250	0	0.66899	26304	2291	16064.45687	7820	623	8.0	2.23210	**3.34**
13	250	0	0.54882	26304	2291	13178.81466	7820	656	8.4	1.83959	**3.35**
14	250	0	0.41206	26304	2291	9894.79678	7820	710	9.1	1.39167	**3.38**
15	300	0	0.27978	26304	2291	6718.35714	7820	766	9.8	0.95242	**3.40**
16	300	-50	0.16245	26304	2291	3900.91185	7820	842	10.8	0.55903	**3.44**
17	300	-100	0.08094	26304	2291	1943.61222	7820	779	10.0	0.27604	**3.41**
18	300	-150	0.02496	26304	2291	599.36448	7820	876	11.2	0.08631	**3.46**
19	-450	-200	0.00494	26304	2291	118.62422	7820	978	12.5	0.01734	**3.51**
20	-400	-150	0.00466	26304	2291	111.90058	7820	1085	13.9	0.01661	**3.57**
21	-400	-200	0.00408	26304	2291	97.97304	7820	1179	15.1	0.01475	**3.62**
22	-500	-250	0.00734	26304	2291	176.25542	7820	1254	16.0	0.02684	**3.66**
23	-50	250	0.01896	26304	2291	455.28648	7820	1312	16.8	0.06996	**3.69**
24	100	150	0.05053	26304	2291	1213.37689	7820	1336	17.1	0.18713	**3.70**

PALOMAR - 10-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	50	1.79401	26304	2291	43079.56213	7820	1313	16.8	6.62050	**3.69**
2	50	50	2.7745	26304	2291	66624.06850	7820	1235	15.8	10.11755	**3.65**
3	100	0	4.02097	26304	2291	96555.55261	7820	1156	14.8	14.48913	**3.60**
4	100	0	5.71297	26304	2291	137185.54861	7820	1071	13.7	20.32680	**3.56**
5	100	0	7.47105	26304	2291	179402.32365	7820	985	12.6	26.24760	**3.51**
6	100	0	9.08402	26304	2291	218134.57226	7820	902	11.5	31.53145	**3.47**
7	100	0	10.25315	26304	2291	246208.89095	7820	951	12.2	35.84348	**3.50**
8	100	0	10.98429	26304	2291	263765.75577	7820	858	11.0	37.88649	**3.45**
9	100	0	11.11226	26304	2291	266838.69938	7820	757	9.7	37.77980	**3.40**
10	100	0	10.70486	26304	2291	257055.80318	7820	663	8.5	35.91670	**3.36**
11	100	0	9.8762	26304	2291	237157.19060	7820	623	8.0	32.95223	**3.34**
12	100	0	8.79903	26304	2291	211291.10739	7820	623	8.0	29.35822	**3.34**
13	100	0	7.34081	26304	2291	176274.87053	7820	656	8.4	24.60565	**3.35**
14	100	0	5.64239	26304	2291	135490.71107	7820	710	9.1	19.05636	**3.38**
15	100	0	3.89019	26304	2291	93415.13247	7820	766	9.8	13.24286	**3.40**
16	100	0	2.28302	26304	2291	54822.15926	7820	842	10.8	7.85643	**3.44**
17	150	0	1.19218	26304	2291	28627.81834	7820	779	10.0	4.06587	**3.41**
18	150	0	0.42743	26304	2291	10263.87659	7820	876	11.2	1.47809	**3.46**
19	500	100	0.13519	26304	2291	3246.31747	7820	978	12.5	0.47447	**3.51**
20	-100	-50	0.11603	26304	2291	2786.22839	7820	1085	13.9	0.41369	**3.57**
21	-100	-50	0.1019	26304	2291	2446.92470	7820	1179	15.1	0.36846	**3.62**
22	-100	0	0.13253	26304	2291	3182.44289	7820	1254	16.0	0.48469	**3.66**
23	-50	50	0.32155	26304	2291	7721.38015	7820	1312	16.8	1.18644	**3.69**
24	50	50	0.91054	26304	2291	21864.79702	7820	1336	17.1	3.37212	**3.70**

PALOMAR - 10-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	0	64.60191	26304	2291	1551285.66483	7820	1313	16.8	238.40259	**3.69**
2	50	0	67.16566	26304	2291	1612848.99358	7820	1235	15.8	244.92771	**3.65**
3	50	0	86.7754	26304	2291	2083737.68020	7820	1156	14.8	312.68573	**3.60**
4	50	0	111.35187	26304	2291	2673892.45431	7820	1071	13.7	396.19091	**3.56**
5	50	0	139.09175	26304	2291	3340010.19275	7820	985	12.6	488.66279	**3.51**
6	50	0	167.58523	26304	2291	4024224.12799	7820	902	11.5	581.70340	**3.47**
7	50	0	194.22411	26304	2291	4663903.55343	7820	951	12.2	678.97853	**3.50**
8	50	0	224.85236	26304	2291	5399379.72068	7820	858	11.0	775.55009	**3.45**
9	50	0	252.42285	26304	2291	6061429.89705	7820	757	9.7	858.19480	**3.40**
10	50	0	275.34655	26304	2291	6611896.70515	7820	663	8.5	923.83634	**3.36**
11	50	0	282.82242	26304	2291	6791414.77146	7820	623	8.0	943.64524	**3.34**
12	50	0	277.9957	26304	2291	6675510.74410	7820	623	8.0	927.54075	**3.34**
13	50	0	262.24815	26304	2291	6297364.82595	7820	656	8.4	879.02915	**3.35**
14	50	0	239.25516	26304	2291	5745234.15708	7820	710	9.1	808.04981	**3.38**
15	50	0	213.26193	26304	2291	5121058.72509	7820	766	9.8	725.97941	**3.40**
16	50	0	185.3631	26304	2291	4451124.12030	7820	842	10.8	637.87964	**3.44**
17	50	0	158.33517	26304	2291	3802102.43721	7820	779	10.0	539.99467	**3.41**
18	50	0	125.85979	26304	2291	3022271.13727	7820	876	11.2	435.23490	**3.46**
19	50	0	93.2437	26304	2291	2239060.96810	7820	978	12.5	327.25241	**3.51**
20	50	0	62.12509	26304	2291	1491809.78617	7820	1085	13.9	221.50108	**3.57**
21	-50	0	47.17899	26304	2291	1132909.08687	7820	1179	15.1	170.59315	**3.62**
22	-50	0	51.9114	26304	2291	1246548.44820	7820	1254	16.0	189.84899	**3.66**
23	-50	0	57.95502	26304	2291	1391673.89526	7820	1312	16.8	213.84049	**3.69**
24	-50	0	62.2143	26304	2291	1493951.98590	7820	1336	17.1	230.40592	**3.70**

POMONA - 10-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	100	0	1.67498	26280	432	43294.88304	7810	175	2.2	5.67058	**3.39**
2	100	0	2.52254	26280	432	65202.61392	7810	179	2.3	8.54444	**3.39**
3	100	0	3.48087	26280	432	89973.52776	7810	183	2.3	11.79671	**3.39**
4	100	0	4.46874	26280	432	115507.99152	7810	188	2.4	15.15455	**3.39**
5	100	0	5.44049	26280	432	140625.78552	7810	189	2.4	18.45241	**3.39**
6	100	0	6.37933	26280	432	164892.92184	7810	192	2.5	21.64517	**3.39**
7	100	0	7.16963	26280	432	185320.59624	7810	193	2.5	24.32987	**3.39**
8	100	0	7.58985	26280	432	196182.44280	7810	193	2.5	25.75587	**3.39**
9	100	0	7.54073	26280	432	194912.78904	7810	194	2.5	25.59254	**3.39**
10	100	0	7.03831	26280	432	181926.23688	7810	193	2.5	23.88424	**3.39**
11	100	0	6.33091	26280	432	163641.36168	7810	190	2.4	21.47524	**3.39**
12	100	0	5.48577	26280	432	141796.18296	7810	188	2.4	18.60354	**3.39**
13	100	0	4.52666	26280	432	117005.10768	7810	184	2.4	15.34292	**3.39**
14	100	0	3.53869	26280	432	91468.05912	7810	179	2.3	11.98638	**3.39**
15	100	0	2.56683	26280	432	66347.42184	7810	174	2.2	8.68877	**3.39**
16	150	0	1.68973	26280	432	43676.14104	7810	170	2.2	5.71677	**3.38**
17	150	0	0.93943	26280	432	24282.38664	7810	168	2.2	3.17749	**3.38**
18	200	0	0.38972	26280	432	10073.48256	7810	168	2.2	1.31817	**3.38**
19	500	-200	0.15933	26280	432	4118.36184	7810	169	2.2	0.53898	**3.38**
20	500	0	0.06427	26280	432	1661.25096	7810	169	2.2	0.21741	**3.38**
21	0	-50	0.04922	26280	432	1272.23856	7810	171	2.2	0.16655	**3.38**
22	100	-50	0.17372	26280	432	4490.31456	7810	170	2.2	0.58774	**3.38**
23	100	-50	0.47768	26280	432	12347.07264	7810	170	2.2	1.61611	**3.38**
24	100	0	0.96732	26280	432	25003.28736	7810	171	2.2	3.27311	**3.38**

POMONA - 10-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	200	-50	0.14539	26280	432	3758.04072	7810	175	2.2	0.49221	**3.39**
2	200	-50	0.24454	26280	432	6320.86992	7810	179	2.3	0.82831	**3.39**
3	200	-50	0.35936	26280	432	9288.73728	7810	183	2.3	1.21788	**3.39**
4	200	0	0.475	26280	432	12277.80000	7810	188	2.4	1.61084	**3.39**
5	200	0	0.58245	26280	432	15055.16760	7810	189	2.4	1.97548	**3.39**
6	250	0	0.68649	26280	432	17744.39352	7810	192	2.5	2.32927	**3.39**
7	250	0	0.77125	26280	432	19935.27000	7810	193	2.5	2.61721	**3.39**
8	250	0	0.81936	26280	432	21178.81728	7810	193	2.5	2.78047	**3.39**
9	250	0	0.82376	26280	432	21292.54848	7810	194	2.5	2.79577	**3.39**
10	250	0	0.78241	26280	432	20223.73368	7810	193	2.5	2.65508	**3.39**
11	250	0	0.7142	26280	432	18460.64160	7810	190	2.4	2.42266	**3.39**
12	250	0	0.62035	26280	432	16034.80680	7810	188	2.4	2.10375	**3.39**
13	300	0	0.50729	26280	432	13112.43192	7810	184	2.4	1.71944	**3.39**
14	300	0	0.39583	26280	432	10231.41384	7810	179	2.3	1.34077	**3.39**
15	300	50	0.28793	26280	432	7442.41464	7810	174	2.2	0.97465	**3.39**
16	350	50	0.18215	26280	432	4708.21320	7810	170	2.2	0.61626	**3.38**
17	350	50	0.09308	26280	432	2405.93184	7810	168	2.2	0.31483	**3.38**
18	400	0	0.03142	26280	432	812.14416	7810	168	2.2	0.10627	**3.38**
19	0	-50	0.00464	26280	432	119.93472	7810	169	2.2	0.01570	**3.38**
20	0	-50	0.00508	26280	432	131.30784	7810	169	2.2	0.01718	**3.38**
21	0	-50	0.00569	26280	432	147.07512	7810	171	2.2	0.01925	**3.38**
22	500	-250	0.01302	26280	432	336.54096	7810	170	2.2	0.04405	**3.38**
23	300	-100	0.0304	26280	432	785.77920	7810	170	2.2	0.10285	**3.38**
24	200	-50	0.07176	26280	432	1854.85248	7810	171	2.2	0.24281	**3.38**

POMONA - 10-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKE HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	0	66.88293	26280	432	1728789.97464	7810	175	2.2	226.42960	**3.39**
2	50	0	78.93616	26280	432	2040341.86368	7810	179	2.3	267.37542	**3.39**
3	50	0	94.94525	26280	432	2454144.82200	7810	183	2.3	321.77066	**3.39**
4	50	0	113.62804	26280	432	2937057.57792	7810	188	2.4	385.33949	**3.39**
5	50	0	133.76259	26280	432	3457495.42632	7810	189	2.4	453.68002	**3.39**
6	50	0	155.21512	26280	432	4012000.42176	7810	192	2.5	526.64747	**3.39**
7	50	0	174.83572	26280	432	4519153.69056	7810	193	2.5	593.29837	**3.39**
8	50	0	196.43289	26280	432	5077397.34072	7810	193	2.5	666.58755	**3.39**
9	50	0	221.2805	26280	432	5719658.36400	7810	194	2.5	751.00556	**3.39**
10	50	0	249.09373	26280	432	6438574.73304	7810	193	2.5	845.29011	**3.39**
11	50	0	267.02625	26280	432	6902094.51000	7810	190	2.4	905.78668	**3.39**
12	50	0	271.20773	26280	432	7010177.40504	7810	188	2.4	919.72939	**3.39**
13	50	0	265.00007	26280	432	6849721.80936	7810	184	2.4	898.20637	**3.39**
14	50	0	252.4629	26280	432	6525661.03920	7810	179	2.3	855.15149	**3.39**
15	50	0	237.46298	26280	432	6137943.10704	7810	174	2.2	803.81654	**3.39**
16	50	0	219.40304	26280	432	5671129.77792	7810	170	2.2	742.29447	**3.38**
17	50	0	200.09348	26280	432	5172016.27104	7810	168	2.2	676.78831	**3.38**
18	50	0	174.28381	26280	432	4504887.92088	7810	168	2.2	589.49070	**3.38**
19	100	-50	148.72624	26280	432	3844275.85152	7810	169	2.2	503.11162	**3.38**
20	100	-50	136.06151	26280	432	3516917.91048	7810	169	2.2	460.26932	**3.38**
21	100	-50	116.42089	26280	432	3009247.16472	7810	171	2.2	393.93208	**3.38**
22	100	-50	95.89973	26280	432	2478816.22104	7810	170	2.2	324.45238	**3.38**
23	100	-50	79.98215	26280	432	2067378.61320	7810	170	2.2	270.59929	**3.38**
24	100	-50	67.81091	26280	432	1752776.40168	7810	171	2.2	229.45103	**3.38**

REDLANDS - 10-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	150	-100	0.14613	8760	478	1210.24866	2610	303	11.6	0.52460	**3.59**
2	150	-100	0.24958	8760	478	2067.02156	2610	258	9.9	0.87884	**3.52**
3	150	-100	0.36502	8760	478	3023.09564	2610	216	8.3	1.26278	**3.46**
4	200	-100	0.4846	8760	478	4013.45720	2610	172	6.6	1.64621	**3.40**
5	200	-50	0.6053	8760	478	5013.09460	2610	128	4.9	2.01978	**3.34**
6	200	-100	0.71152	8760	478	5892.80864	2610	86	3.3	2.33471	**3.28**
7	200	-50	0.79696	8760	478	6600.42272	2610	54	2.1	2.58233	**3.24**
8	250	-50	0.85358	8760	478	7069.34956	2610	36	1.4	2.74645	**3.22**
9	250	-50	0.87022	8760	478	7207.16204	2610	32	1.2	2.79564	**3.21**
10	250	-50	0.82892	8760	478	6865.11544	2610	29	1.1	2.65987	**3.21**
11	250	-50	0.75826	8760	478	6279.90932	2610	42	1.6	2.44545	**3.23**
12	250	-50	0.66701	8760	478	5524.17682	2610	58	2.2	2.16465	**3.25**
13	250	-50	0.55959	8760	478	4634.52438	2610	86	3.3	1.83618	**3.28**
14	300	-50	0.43933	8760	478	3638.53106	2610	122	4.7	1.46243	**3.33**
15	300	-50	0.32652	8760	478	2704.23864	2610	165	6.3	1.10603	**3.39**
16	300	-50	0.22066	8760	478	1827.50612	2610	213	8.2	0.76241	**3.46**
17	350	-50	0.12319	8760	478	1020.25958	2610	256	9.8	0.43342	**3.52**
18	400	-50	0.04524	8760	478	374.67768	2610	299	11.5	0.16213	**3.58**
19	-50	0	0.0038	8760	478	31.47160	2610	340	13.0	0.01386	**3.65**
20	-50	0	0.00417	8760	478	34.53594	2610	378	14.5	0.01547	**3.71**
21	-50	0	0.00479	8760	478	39.67078	2610	395	15.1	0.01791	**3.74**
22	-500	50	0.01591	8760	478	131.76662	2610	396	15.2	0.05952	**3.74**
23	-500	0	0.03356	8760	478	277.94392	2610	373	14.3	0.12425	**3.70**
24	150	-100	0.06827	8760	478	565.41214	2610	343	13.1	0.24941	**3.65**

REDLANDS - 10-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	-50	1.71658	8760	478	14216.71556	2610	303	11.6	6.16243	**3.59**
2	50	-50	2.50366	8760	478	20735.31212	2610	258	9.9	8.81603	**3.52**
3	100	-50	3.35706	8760	478	27803.17092	2610	216	8.3	11.61369	**3.46**
4	100	-50	4.25095	8760	478	35206.36790	2610	172	6.6	14.44068	**3.40**
5	100	-50	5.1653	8760	478	42779.01460	2610	128	4.9	17.23570	**3.34**
6	100	-50	6.01292	8760	478	49799.00344	2610	86	3.3	19.73019	**3.28**
7	100	-50	6.72041	8760	478	55658.43562	2610	54	2.1	21.77560	**3.24**
8	100	-50	7.11772	8760	478	58948.95704	2610	36	1.4	22.90169	**3.22**
9	100	-50	7.01506	8760	478	58098.72692	2610	32	1.2	22.53636	**3.21**
10	100	-50	6.50262	8760	478	53854.69884	2610	29	1.1	20.86583	**3.21**
11	100	-50	5.76643	8760	478	47757.57326	2610	42	1.6	18.59719	**3.23**
12	100	-50	4.91534	8760	478	40708.84588	2610	58	2.2	15.95174	**3.25**
13	100	0	4.05934	8760	478	33619.45388	2610	86	3.3	13.31991	**3.28**
14	150	-50	3.26436	8760	478	27035.42952	2610	122	4.7	10.86633	**3.33**
15	150	0	2.51516	8760	478	20830.55512	2610	165	6.3	8.51965	**3.39**
16	150	0	1.79145	8760	478	14836.78890	2610	213	8.2	6.18973	**3.46**
17	150	0	1.05852	8760	478	8766.66264	2610	256	9.8	3.72416	**3.52**
18	150	0	0.41545	8760	478	3440.75690	2610	299	11.5	1.48886	**3.58**
19	500	-100	0.05953	8760	478	493.02746	2610	340	13.0	0.21719	**3.65**
20	-50	0	0.05022	8760	478	415.92204	2610	378	14.5	0.18635	**3.71**
21	-50	0	0.05482	8760	478	454.01924	2610	395	15.1	0.20497	**3.74**
22	-50	0	0.15882	8760	478	1315.34724	2610	396	15.2	0.59410	**3.74**
23	-50	0	0.43321	8760	478	3587.84522	2610	373	14.3	1.60386	**3.70**
24	50	-50	0.98664	8760	478	8171.35248	2610	343	13.1	3.60448	**3.65**

REDLANDS - 10-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	-50	0	45.3508	8760	478	375595.32560	2610	303	11.6	162.80682	**3.59**
2	50	0	60.52773	8760	478	501290.65986	2610	258	9.9	213.13378	**3.52**
3	50	0	78.2791	8760	478	648307.50620	2610	216	8.3	270.80514	**3.46**
4	50	0	100.35242	8760	478	831118.74244	2610	172	6.6	340.90186	**3.40**
5	50	0	123.30279	8760	478	1021193.70678	2610	128	4.9	411.43985	**3.34**
6	50	0	147.25117	8760	478	1219534.18994	2610	86	3.3	483.17519	**3.28**
7	50	0	173.53484	8760	478	1437215.54488	2610	54	2.1	562.29090	**3.24**
8	50	0	204.41071	8760	478	1692929.50022	2610	36	1.4	657.70377	**3.22**
9	50	0	237.08429	8760	478	1963532.08978	2610	32	1.2	761.64938	**3.21**
10	50	0	270.99063	8760	478	2244344.39766	2610	29	1.1	869.56389	**3.21**
11	50	0	274.80034	8760	478	2275896.41588	2610	42	1.6	886.25250	**3.23**
12	50	0	263.13703	8760	478	2179300.88246	2610	58	2.2	853.95803	**3.25**
13	50	0	247.94703	8760	478	2053497.30246	2610	86	3.3	813.58847	**3.28**
14	50	0	227.47119	8760	478	1883916.39558	2610	122	4.7	757.20112	**3.33**
15	50	0	205.25923	8760	478	1699956.94286	2610	165	6.3	695.27891	**3.39**
16	50	0	181.48141	8760	478	1503029.03762	2610	213	8.2	627.04591	**3.46**
17	50	0	154.0154	8760	478	1275555.54280	2610	256	9.8	541.86727	**3.52**
18	50	0	118.85346	8760	478	984344.35572	2610	299	11.5	425.93871	**3.58**
19	50	0	78.48865	8760	478	650042.99930	2610	340	13.0	286.36255	**3.65**
20	100	-50	55.02469	8760	478	455714.48258	2610	378	14.5	204.17316	**3.71**
21	-300	50	46.19985	8760	478	382627.15770	2610	395	15.1	172.74364	**3.74**
22	-300	50	45.56241	8760	478	377347.87962	2610	396	15.2	170.43716	**3.74**
23	-300	50	43.32203	8760	478	358793.05246	2610	373	14.3	160.39028	**3.70**
24	-300	50	40.49639	8760	478	335391.10198	2610	343	13.1	147.94491	**3.65**

SAN BERNARDINO - 10-HOUR ANALYSIS - LARGE POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	100	150	0.16062	26280	2291	3853.11318	7810	945	12.1	0.56127	**3.49**
2	100	150	0.26681	26280	2291	6400.50509	7810	857	11.0	0.92054	**3.45**
3	150	150	0.38784	26280	2291	9303.89376	7810	768	9.8	1.32120	**3.41**
4	150	150	0.51578	26280	2291	12373.04642	7810	659	8.4	1.73025	**3.35**
5	150	150	0.63431	26280	2291	15216.46259	7810	547	7.0	2.09507	**3.30**
6	150	150	0.74255	26280	2291	17813.03195	7810	433	5.5	2.41467	**3.25**
7	200	200	0.84805	26280	2291	20343.87145	7810	332	4.3	2.72050	**3.21**
8	200	200	0.92818	26280	2291	22266.11002	7810	229	2.9	2.93709	**3.16**
9	200	200	0.95389	26280	2291	22882.86721	7810	160	2.0	2.99122	**3.14**
10	200	200	0.91165	26280	2291	21869.57185	7810	125	1.6	2.84575	**3.12**
11	200	200	0.83833	26280	2291	20110.69837	7810	116	1.5	2.61382	**3.12**
12	200	200	0.74042	26280	2291	17761.93538	7810	132	1.7	2.31335	**3.12**
13	200	200	0.6259	26280	2291	15014.71510	7810	171	2.2	1.96553	**3.14**
14	250	250	0.50812	26280	2291	12189.29068	7810	227	2.9	1.60745	**3.16**
15	250	250	0.39411	26280	2291	9454.30479	7810	302	3.9	1.25923	**3.20**
16	250	250	0.27457	26280	2291	6586.65973	7810	393	5.0	0.88805	**3.23**
17	300	300	0.15944	26280	2291	3824.80616	7810	483	6.2	0.52202	**3.27**
18	300	300	0.06426	26280	2291	1541.53314	7810	591	7.6	0.21354	**3.32**
19	500	500	0.00341	26280	2291	81.80249	7810	703	9.0	0.01151	**3.38**
20	-50	0	0.00273	26280	2291	65.48997	7810	810	10.4	0.00936	**3.43**
21	500	-400	0.00355	26280	2291	85.16095	7810	909	11.6	0.01234	**3.48**
22	500	-400	0.01276	26280	2291	306.09964	7810	996	12.8	0.04492	**3.52**
23	200	350	0.03276	26280	2291	785.87964	7810	1024	13.1	0.11581	**3.54**
24	100	200	0.07971	26280	2291	1912.16319	7810	1008	12.9	0.28112	**3.53**

SAN BERNARDINO - 10-HOUR ANALYSIS - MEDIUM POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	50	50	1.82487	26280	2291	43776.80643	7810	945	12.1	6.37681	**3.49**
2	50	50	2.67182	26280	2291	64094.28998	7810	857	11.0	9.21822	**3.45**
3	50	50	3.50148	26280	2291	83997.00372	7810	768	9.8	11.92800	**3.41**
4	50	50	4.30472	26280	2291	103265.92808	7810	659	8.4	14.44077	**3.35**
5	50	100	5.06866	26280	2291	121592.08474	7810	547	7.0	16.74130	**3.30**
6	100	100	5.91978	26280	2291	142009.60242	7810	433	5.5	19.25032	**3.25**
7	100	100	6.91876	26280	2291	165974.13364	7810	332	4.3	22.19499	**3.21**
8	100	100	7.75458	26280	2291	186024.61962	7810	229	2.9	24.53827	**3.16**
9	100	100	8.257	26280	2291	198077.17300	7810	160	2.0	25.89244	**3.14**
10	100	100	8.0456	26280	2291	193005.89840	7810	125	1.6	25.11463	**3.12**
11	100	100	7.431	26280	2291	178262.25900	7810	116	1.5	23.16900	**3.12**
12	100	100	6.66787	26280	2291	159955.53343	7810	132	1.7	20.83297	**3.12**
13	100	100	5.82847	26280	2291	139819.16683	7810	171	2.2	18.30333	**3.14**
14	100	100	4.91446	26280	2291	117892.98094	7810	227	2.9	15.54701	**3.16**
15	100	100	3.97902	26280	2291	95452.71078	7810	302	3.9	12.71347	**3.20**
16	100	100	2.9845	26280	2291	71595.17050	7810	393	5.0	9.65285	**3.23**
17	100	100	1.96987	26280	2291	47255.21143	7810	483	6.2	6.44946	**3.27**
18	150	150	1.16932	26280	2291	28050.81748	7810	591	7.6	3.88569	**3.32**
19	250	300	0.63256	26280	2291	15174.48184	7810	703	9.0	2.13515	**3.38**
20	400	500	0.28079	26280	2291	6735.87131	7810	810	10.4	0.96227	**3.43**
21	400	500	0.14007	26280	2291	3360.13923	7810	909	11.6	0.48691	**3.48**
22	150	-100	0.19283	26280	2291	4625.79887	7810	996	12.8	0.67887	**3.52**
23	50	100	0.50387	26280	2291	12087.33743	7810	1024	13.1	1.78122	**3.54**
24	50	50	1.0492	26280	2291	25169.25880	7810	1008	12.9	3.70027	**3.53**

SAN BERNARDINO - 10-HOUR ANALYSIS - SMALL POINT SOURCE

SCENARIO	X	Y	MODELED PERIOD AVE CONC	TOTAL HRS PROCESSED REPORTED BY AERMOD	NO. CALM & MISSING HRS REPORTED BY AERMOD	SUM HRLY CONC	TOTAL WORKER HRS PROCESSED	WORKER NO. CALM & MISSING HRS	% WORKER CALM & MISSING HRS	WORKER PERIOD AVE CONC	QUOTIENT (FACTOR)
1	0	50	60.43292	26280	2291	1449725.31788	7810	945	12.1	211.17630	**3.49**
2	0	50	69.41259	26280	2291	1665138.62151	7810	857	11.0	239.48492	**3.45**
3	0	50	77.69048	26280	2291	1863716.92472	7810	768	9.8	264.65733	**3.41**
4	0	50	85.534	26280	2291	2051875.12600	7810	659	8.4	286.93541	**3.35**
5	0	50	93.35436	26280	2291	2239477.74204	7810	547	7.0	308.34060	**3.30**
6	0	50	100.18756	26280	2291	2403399.37684	7810	433	5.5	325.79631	**3.25**
7	50	50	106.42361	26280	2291	2552995.98029	7810	332	4.3	341.40091	**3.21**
8	50	50	125.22838	26280	2291	3004103.60782	7810	229	2.9	396.26746	**3.16**
9	50	50	150.67387	26280	2291	3614515.46743	7810	160	2.0	472.48568	**3.14**
10	50	50	184.43774	26280	2291	4424476.94486	7810	125	1.6	575.72895	**3.12**
11	50	50	211.62126	26280	2291	5076582.40614	7810	116	1.5	659.81055	**3.12**
12	50	50	232.56731	26280	2291	5579057.19959	7810	132	1.7	726.62897	**3.12**
13	50	50	246.19103	26280	2291	5905876.61867	7810	171	2.2	773.12169	**3.14**
14	50	50	248.55743	26280	2291	5962644.18827	7810	227	2.9	786.31731	**3.16**
15	50	50	246.83969	26280	2291	5921437.32341	7810	302	3.9	788.68371	**3.20**
16	50	50	238.7665	26280	2291	5727769.56850	7810	393	5.0	772.24883	**3.23**
17	50	50	227.65219	26280	2291	5461148.38591	7810	483	6.2	745.34576	**3.27**
18	50	50	209.04015	26280	2291	5014664.15835	7810	591	7.6	694.64803	**3.32**
19	50	50	182.12183	26280	2291	4368920.57987	7810	703	9.0	614.73485	**3.38**
20	50	100	150.39433	26280	2291	3607809.58237	7810	810	10.4	515.40137	**3.43**
21	50	100	130.14718	26280	2291	3122100.70102	7810	909	11.6	452.41280	**3.48**
22	50	100	105.33813	26280	2291	2526956.40057	7810	996	12.8	370.84773	**3.52**
23	50	100	85.36188	26280	2291	2047746.13932	7810	1024	13.1	301.76041	**3.54**
24	50	100	68.96638	26280	2291	1654434.48982	7810	1008	12.9	243.22765	**3.53**