APPENDIX G. Estimation of the fraction of the watershed area which receives application on impervious surfaces in residential watersheds.

As will be described below, this appendix describes the method used for calculating the fraction of the watershed that is impervious surface and that receives an application of a pesticide applied to lawns or ornamental plants in a representative urban/suburban watershed in California. Three parameters describing the watershed, the average lot size, the average basal size or 'footprint' of the houses in the watershed and the fraction of impervious surface in the watershed are necessary to make this calculation. These three values are then combined, along with an assumption about the width of the bands of treated impervious surface from the edge of the lawn, or treated area, to estimate the fraction of the residential watershed that is treated impervious surface.

The procedure for estimating this fraction is 1) Estimate the fraction of the watershed that is impervious; and that which is lawn, 2) estimate the average lot size, 3) estimate the dwelling footprint, 4) construct a standard lot with an impervious surface consisting of the house, sidewalks, and driveway, 5) estimate the area of treated impervious surface associated with each lot 6) estimate the number of lots in a standard 10 ha watershed, 7) and finally, estimate the fraction of the total watershed that is treated impervious surface.

1) Estimate the fraction of the watershed that is impervious surface

In general, the majority of occupied areas including core areas and critical habitat (as defined by FWS) and occurrence data from CNDDB are located in areas where the percentage of impervious surface is less than 20%. However, a few selected areas with higher percentages of impervious surface (*e.g*. San Francisco Bay region) were evaluated to determine a representative value for residential settings. The conceptual model for the ROW scenario assumes that the watershed is represented by equal portions of impervious and pervious surface (50%). Based on geospatial data, it is evident that the areas with the highest percentage of impervious cover are urban areas outside the occupied areas, and, in general, the occupied areas have impervious surface of less than 50% (Figure G-1). Therefore, for purposes of modeling, it is assumed that a representative percentage of impervious cover is 50%. In general, as the percentage of impervious surface increases, the overall exposure resulting from applications to the pervious surface decreases because less mass is applied within the watershed. Additional information on the impact of this assumption has been previously characterized in the Barton Springs salamander endangered species risk assessment for atrazine (U.S. EPA, 2006).

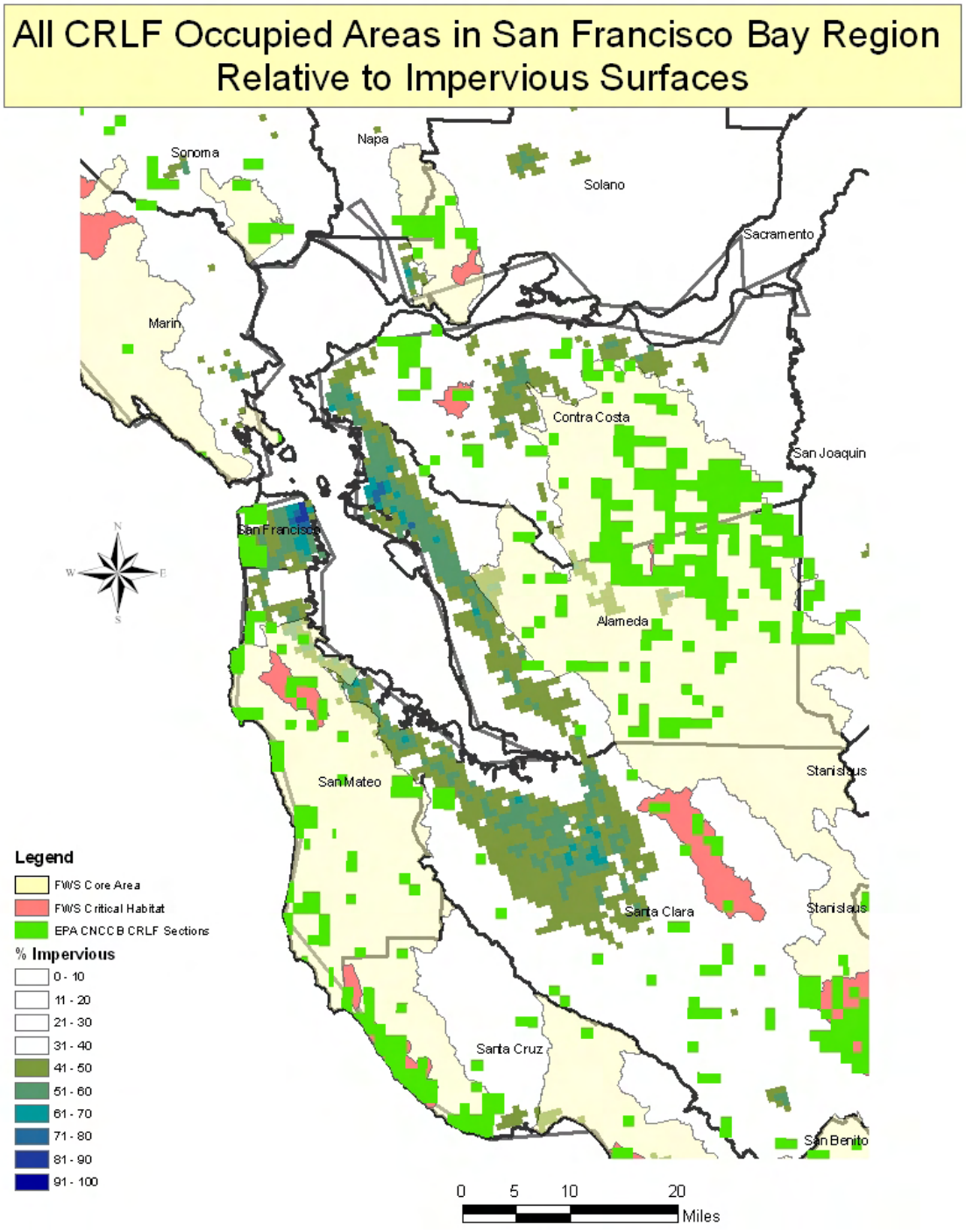

Figure G-1. California red-legged frog habitat relative to urban areas in Central California with their impervious surface fractions.

2) Estimate for the typical lot size

In order to justify the assumption of ¼ acre lot as a typical exposure scenario, publicly available data from the United States Census (Census) 2003 American Housing Survey (AHS) was reviewed on July 10, 2006 and is available at the following website.

http://www.census.gov/hhes/www/housing/ahs/ahs03/ahs03.html

Data for all suburban homes available nationally was considered. It is assumed that most residential pesticide applications will occur in suburban settings. In order to test the assumption of the ¼ acre lot as the best representation, the AHS data for suburban homes that list total number of houses by lot size and by square footage of house (see Table 1C-3 at the AHS website above) was evaluated. With a total of 45,552,000 total units reported nationally for all suburban areas, 12,368,000 units (the largest class at 27%) were on lots between 1/8 acre and ¼ acre, while 9,339,000 units (the second largest class at 21%) were on lots between ¼ acre and ½ acre. Overall, the median lot size was 0.37 acre. This analysis suggests that the ¼ acre lot is a reasonable approximation of suburban pesticide use.

3) Size of House Footprint

The AHS survey data reports that of a total of 43,328,000 reported single detached homes in suburban areas, 10,124,000 (the largest group at 23%) were between 1,500 and 2,000 square feet, while 7,255,000 (the third largest group at 17%) were between 2,000 and 2,500 square feet, and 9,513,000 (the second largest group at 22%) were between 1,000 and 1,500 square feet. From these data, it was assumed that a typical home is 2,000 square feet with a 1,000 square foot footprint. The lower sized houses less than 1,500 square feet are more likely to represent single floor structures; thus, the 1,000 square foot estimate for a house footprint is reasonable.

4) Development of a standard lot

Using a quarter acre lot and a house with a 1000 ft^2 footprint, a standard lot was developed (Figure G-2). Both the lot and house were assumed to be square, resulting in the side of the lot being 104.4 ft in length and the side of the house being 31.6 ft. If the house is placed in the center of the lot, the driveway will be 36.4 ft long. If the driveway is assumed to be 15 ft wide, then the driveway is 546 ft^2. For sidewalks, it necessary to consider whether it is a corner or mid-block lot. If we assume that the driveway is 3 ft wide, the area of the sidewalk is the width of the yard minus the width of driveway time three, or 268.1 ft^2 for the mid-block lot and 572 ft^2 for the corner lot (268.1 + 104.4x3 – 9), the 9 ft^2 are subtracted to account for the overlap where the sidewalks meet. Therefore, the total impervious surface, (house + driveway + sidewalk) for the mid-block lot is 1814.5 ft^2 and 2218 ft^2 for the corner lot. This leaves 9,075 ft^2 and 8,672 ft^2 of lawn for the two lot types respectively.

8672 - lawn
1000 - house
572 - sidewalk
+ 546- driveway
10,890 sq ft = ¼ acre

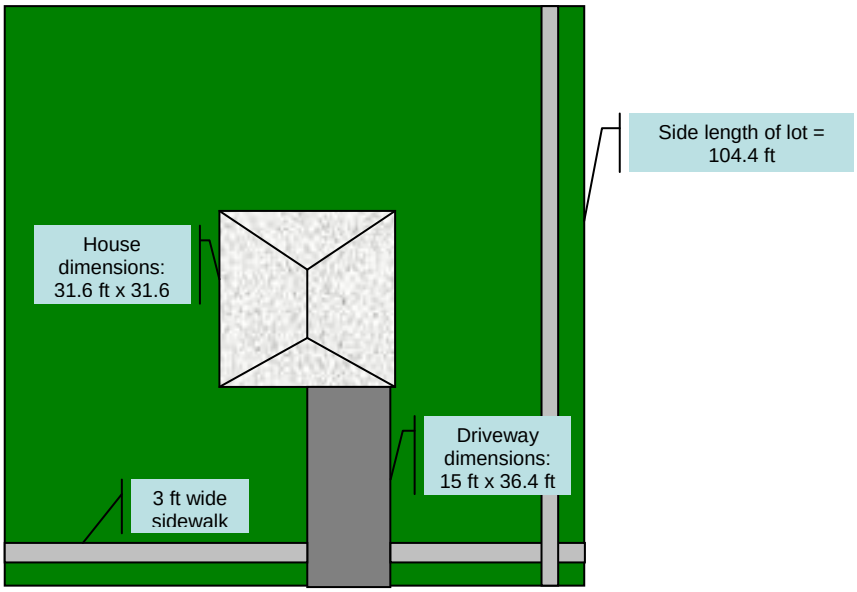

Figure G-2. Standard lot for assessment of aquatic exposure from applications of pesticide to residential settings in California for the California Red Legged Frog Assessment. The schematic represents a corner lot. Mid-block lots have side walk only along the front of the lot and the area of the sidewalk is 268.1 ft^2 rather than 572 ft^2 with a resulting increase in lawn area to 9,075 ft^2.

5) Area of treated impervious surface per lot

The area of treated impervious surface is estimated by assuming the whole sidewalk, and 3 ft of the driveway and street along the road get treated. This represents what might occur if the homeowner is using a broadcast spreader and makes no effort to avoid applying pesticide to hard surfaces bordering the lawn. In this scenario, 268.2 ft^2 of side walk is treated during an application for the mid-block lot, and 581.4 ft^2 for the corner lot. This is derived from the assumption that the perimeter of the property is planted with ornamental plants which are located on the property side of the sidewalk. An alternative scenario for home lawn treatments this results in 799.7 ft^2 treated surface on a mid-block lot (218.4 +313.2 + 268.1) and 1416 ft^2 for a corner lot (See Figure G-3). Figure G-3 was developed for home lawn applications, however the logic is similar except the amount of impervious area that receives treatment is much less.

Overspray Zones on Impervious Surfaces

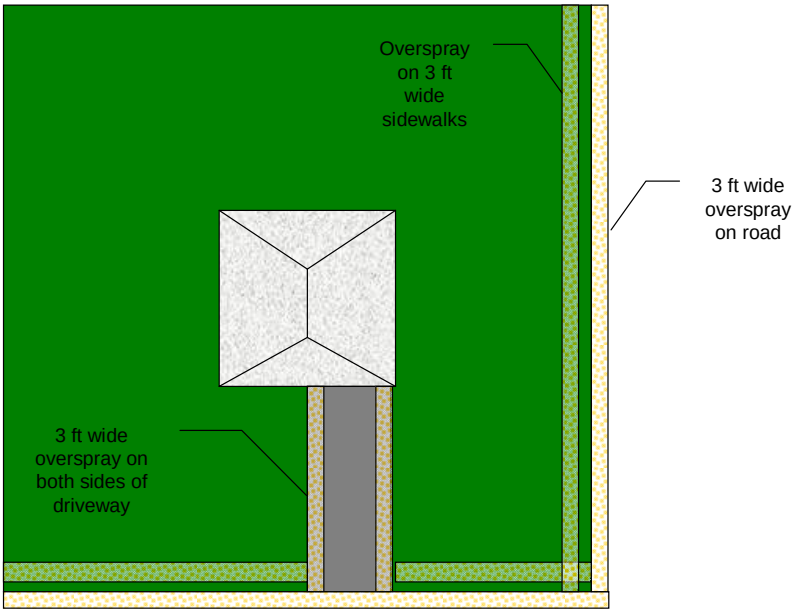

Figure G-3. Impervious surface treated during a broadcast application of a pesticide to residential lawns. Note, for alachlor, the treated impervious surface is probably only the sidewalks (based on an assumption of perimeter planting).

6) Number of lots in a 10 ha watershed.

In step 1 above, the fraction of the watershed that is in lawn was estimated to be 50%, with the balance being impervious surface, which includes, dwellings, sidewalks, driveways and streets. Since we now have an estimate of the treated impervious area associated with each lot, in order to estimate the total treated impervious surface, we need an estimate of the number of lots in the watershed. Current ecological risk assessments assume a standard watershed size of 10 ha, or 1,076,391 ft^2. If we assume that the lots are arranged in blocks of ten (Figure G-4), then 2/5 of the houses will be corner lots and 3/5 will be mid-block. Using these fractions, and the lawn areas calculated in step 4, we can estimate the number of houses as 2/5x 9,100 x N + 3/5 x 9,404xN = 1,076,391. Solving this equation for N, the number of lots gives a value of 57.98 ≈ 58 lots in the watershed

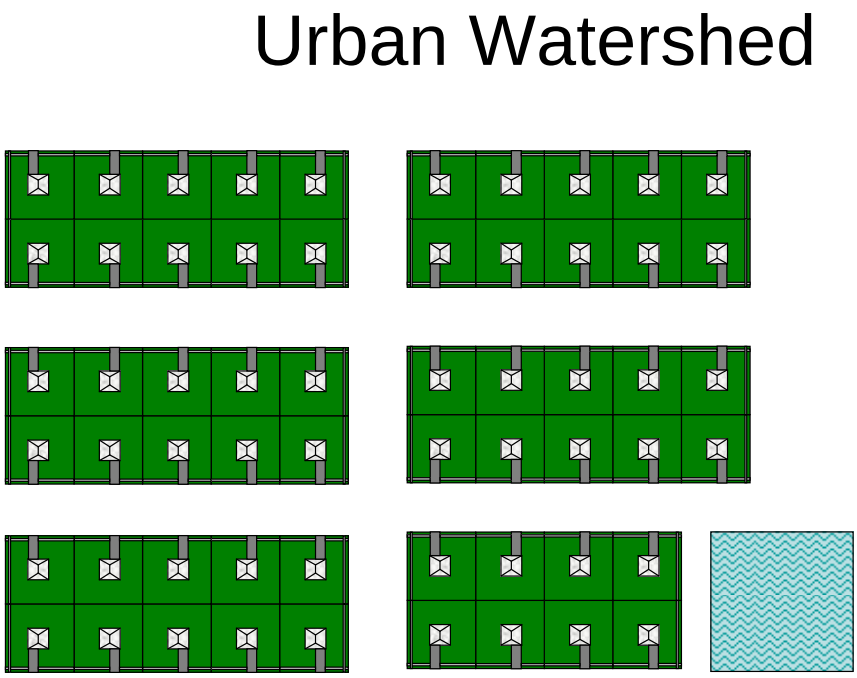

Figure G-4. Schematic for a representative California suburban watershed for use in assessing risks to the California Red Legged Frog.

7) Fraction of treated impervious surface in the watershed.

If there are 58 houses in the watershed, as in Figure 4, then 24 are corner lots and 34 are mid-block lots. Using the treated areas estimated in step 5, the treated area in the watershed is 581.4 ft^2 x 24 = 13,953.6 ft^2 for the corner lots and 268.2 ft^2 x 34 = 9,118.8 ft^2 for the mid-block lots, for a total of 23,072.4 ft^2. Since the total watershed area of 10 ha is equivalent to 1,107,391 ft^2, the percent of the watershed that is treated impervious surface is 2.08%. The modeled fraction was 1.68%, which may be an underestimation of treated impervious surface, which was derived from an application to non-turf crops (e.g., gardens) bordering the house. For home lawn treatments, the percent overspray is closer to 5.68% based on the same logic in the preceding steps but a larger amount of impervious surface receives treatment (e.g., road, driveway, and sidewalk vs just sidewalk).