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Estimating the Housing Infill Capacity of the Bay Area

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INTRODUCTION

The nine-county San Francisco Bay Area, according to the California Department of Finance, will add nearly 1.5 million new residents between now and 2020. Depending on the density of new development, the region will need between 90,000 and 150,000 acres of developable land to accommodate this level of growth (California Department of Housing and Community Development 2000). If current trends continue, most new development will occur on previously undeveloped *greenfield* sites at the urban fringe. This will put substantial pressure on the region's natural environment and open space lands—particularly in Alameda, Contra Costa, and Santa Clara counties. One way to preserve open space and sensitive environmental lands is to accommodate more growth as *infill*.

Infill means different things. It has traditionally meant the development of vacant, cleared, or abandoned parcels. More recently, the term has expanded to include land reuse and recycling—that is, the redevelopment of developed parcels that are physically or economically underutilized. Land recycling is also known as *refill* to distinguish it from the infilling of previously undeveloped parcels. Whatever it is called, recycling is controversial, mostly because of its connection with federal urban renewal efforts of the 1950s and 1960s which cleared massive amounts of land without replacement uses.

Calls for increased infill activity have intensified throughout the Bay Area in recent years, whether among environmental groups, traffic-conscious suburbanites, transit and neighborhood advocates, business organizations advocating smart growth, or builders looking for new development opportunities. Once a concern only to planners and open space advocates, the infill issue assumed greater Bay Area prominence with the 1995 publication of *Beyond Sprawl: New Patterns of Growth to Fit the New California*, more commonly known by the name of its chief corporate sponsor, the Bank of America. Building on arguments long advanced by the Greenbelt Alliance, the Bank of America report argued first, that the Bay Area economy could no longer afford high-cost low-density suburban growth forms; second, that there was plenty of land available for more compact, infill development forms; and third, that such forms were not only less expensive and resource-consuming than suburban development, they were also more sustainable and desirable. The challenges posed by *Beyond Sprawl* have been picked up by a number of Bay Area advocacy and public policy organizations, including the Greenbelt Alliance,

the Sierra Club, Urban Ecology, the Regional Alliance for Transit (and various successor organizations), the District Council of the Urban Land Institute, the Bay Area Council, the Bay Area Alliance for Sustainability, the Center for Land Recycling, the Association of Bay Area Governments, and most recently, CalPERS, the California Public Employees Retirement System.

Infill is in nationwide, not just in the Bay Area. At the state level, California Treasurer Phil Angelides has made promoting infill development a key criteria for bond and tax credit allocations (California Treasurer's Office 1999). Expanded infill development is the cornerstone of the national smart growth movement. The U.S. Environmental Protection Agency has been actively promoting and subsidizing "brownfield" redevelopment since the early 1990s. The U.S. Department of Transportation has directed millions of dollars of Intermodal Surface Transportation Efficiency Act (ISTEA) Innovation grants to infill projects served by transit. Economic and community development specialists like infill because it offers a physical way to re-stitch together the broken economic and social fabric of poor neighborhoods. Urban designers like infill because it creates a richer urban fabric. Big city elected officials like infill because it improves land utilization and generates tax revenues. Although later dropped as a campaign issue, increased infill development was and is an important component of Vice President Gore's Livability Agenda.

The case for increased infill and refill development rests on four basic arguments:

- Reduced growth pressure on open space and resource lands. This is simply a matter of arithmetic: the more urban growth that can be accommodated as infill—within the current urban footprint—the less pressure there will be for development on resource lands and open space. The truth of this contention rests as much on the form and density of new development as on its location. It is possible to find examples of compact suburban development, just as it also is possible to find examples of low-density infill development. This argument was first advanced in the Bay Area in the 1950s during the initial planning for BART. It was re-introduced in 1983 by the People for Open Space in their report, *Room Enough: Housing and Open Space in the Bay Area.*

- Increased utilization of existing capital infrastructure, particularly transit. This assumes that there are density-related economies of scale to the provision and financing of capital

infrastructure, and that there is excess infrastructure capacity within the existing urban footprint. If either of these conditions are true, then infill development will be more efficient, less expensive, and generate fewer externalities than greenfield development. Simply put, it costs less to use the infrastructure already in place than to build new facilities at the urban fringe. Considering how often this argument is made, it's amazing that it has not been the subject of more extensive empirical study. Indeed, we know of no comprehensive, constant-quality analysis of the differential costs of providing urban services to infill versus suburban development. The pros and cons of infill development versus greenfield development (sometimes called sprawl) are explored in Burchell et al. (1998) and debated in Gordon and Richardson (1997) and Ewing (1997).

A specific form of infill located near transit stations and stops—commonly termed transit oriented development—has been widely advocated as a way of boosting transit ridership and reducing auto use. Given the lack of residential and mode choices throughout the Bay Area, transit-oriented development is certainly a good idea for its own sake. Given current zoning and density limits, whether it can have a significant impact on region-wide auto use or land utilization is a matter of some debate.

- Reducing racial and income segregation. To the extent that past "white flight" has either caused or resulted in concentrated pockets of poverty within older urban cores, then redirecting growth back into urban cores should help revitalize and desegregate such areas (Downs 1994). While perhaps true in theory, this argument, like the previous one, has never been formally evaluated.

- Promoting the 24-hour city. This argument presumes that interesting and vital places—whether cities or suburbs—require an integrated mix of urban land uses, particularly housing, shopping, office buildings, and public and recreational spaces, all in close proximity to each other; and that the cities and regions that offer such a land use form will be the winners in the global economy. Recent evidence suggests that while this argument is generally true, getting to the right mix of land uses is harder than it looks.

Infill proponents don't have all the arguments on their side.[1] There are also arguments to be made *against* promoting greater infill development, also known as compact growth:

- Infill development is actually more expensive than suburban development. Infill development often requires completely replacing old and inadequate capital facilities with new, higher-capacity infrastructure. Because scale economies in service provision are more difficult to achieve than supposed, increased infill development thus results in greater congestion and decreased service quality—quite the opposite to what is promised. Again, given the lack of empirical study, this argument is difficult to evaluate.

- Per square foot of built space, infill development, whether housing or commercial space, is much more expensive to provide than suburban development. Land costs in urban cores are generally higher than in suburban areas, as are construction costs. Infill residents and commercial tenants thus get less space at a higher cost than their suburban counterparts. While generally true, this argument begs the larger question: there may indeed be many households and businesses willing to pay more money for less space precisely because they place greater value on urban amenities, built forms, or locations.

Whatever its theoretical merits, infill remains unpopular in practice, especially when it involves multi-family housing. Most frequently opposed are neighborhood groups and existing residents, who are legitimately concerned about traffic congestion and parking. Neighbors also complain about losses of urban open space, and when proposed developments are denser or physically out-of-scale with the existing neighborhood. Infill housing projects are frequently criticized as fiscally imprudent; that is, they are presumed to consume disproportionately more public service than they generate in revenues. Despite substantial and definitive results to the contrary, multi-family and affordable housing projects are regularly attacked as contributing to reduced property values and higher crime rates. Increased infill activity also heightens concerns over gentrification and displacement, especially when economic times are good. Lastly, because the residents of new infill projects are generally from outside the community, and are often socially or demographically different from existing residents, increased infill activity can trigger all sorts of worries about the character and impacts of change.

As interesting as all these issues may be to urban theorists, they are only of practical importance if two conditions can be met. First, there must be significant land available for infill development, and it must be of the appropriate size, type, and location. Second, infill development must be either currently or potentially economically feasible. It is easy to champion

development, infill or otherwise, when it is someone else's money at risk. It is considerably harder when resources are scarce.

The extent to which either or both of these conditions can be met is largely a matter of geography. The first condition is more easily met among cities in the Northeast, Midwest, and South Atlantic regions, where the capital stock is older and where successive rounds of disinvestment have hollowed out many urban cores. The issue in these regions is not land availability, but demand, and whether infill projects, once developed, will command sufficient prices and rents to make them economically feasible. The problem is the converse among cities in the Mountain and Pacific region: the economics of infill development are generally more favorable, but sites are in short supply. Not only is the capital stock in western cities newer and in better condition, but a rule, western metropolitan areas have developed more contiguously (albeit at lower densities) than their eastern counterparts, leaving fewer holes to be filled in.

This report considers the potential for and economic viability of infill/refill throughout the nine-county San Francisco Bay Area. Its purpose is three-fold:

1. To ascertain the physical and economic infill capacity of the Bay Region, using a realistic range of densities and economic conditions.

2. To identify the locations and pattern of infill opportunities within the Bay Region, keeping in mind the economic, physical, governmental, and social structure of the Bay Area.

3. To establish and test a procedure for identifying and analyzing infill development which can be reliably used elsewhere in the state and country.

This is not the first such initiative. Past studies of infill potential have been undertaken at the regional or sub-regional levels by the People for Open Space (1983), the Silicon Valley Manufacturing Group (1995, 1999), and the Association of Bay Area Governments (through its land monitoring program). In addition, most cities undertake parcel inventories as part of their normal plan-making activities.

As worthwhile as these efforts have been, they have all suffered one or more limitations. Because of a lack of data, they have mostly focused on vacant land and ignored or minimized the

infill potential associated with land recycling and re-use. Equally problematic, previous studies have generally ignored issues of economic feasibility. If the costs of redeveloping an infill site can't be recovered through market rents or prices, it will not be developed or redeveloped, regardless of any physical or planning factors that might make it appropriate for development. Many potential infill sites are located in neighborhoods that are regarded as less-than-desirable in the current marketplace, thereby depressing achievable rent or price levels. Squeezed by lower rents and higher development costs, most infill development—in the absence of subsidies or supportive land use policies—simply doesn't pencil-out.

A second issue is also worth mentioning. Proposed infill projects often involve a change of land use. To the extent that the proposed land use is deemed by the current landowner to be a lower-order use—that is, to generate a lower land price—than some other prospective use, however speculative, the landowner will keep his or her property off the market. This stickiness problem is not unique to infill, but it is more prevalent among infill parcels, particularly if the current landowner is willing to wait out the market.

Also absent from previous infill studies is the political dimension, particularly as it concerns density. Most infill studies presume that future infill development will occur at higher-than - prevailing densities. While this may make sense in terms of land utilization, it rarely makes sense politically. Most Bay Area residents don't want their communities to look or feel like Manhattan, or even San Francisco. Never mind higher densities, experienced infill developers use all their political and planning skills to gain approvals for projects that just match prevailing densities or the densities set forth in local planning documents. Infill projects typically require more extensive impact mitigation efforts on the part of the developer. Yet given the higher costs of developing infill, there are usually fewer resources available for meeting community demands and mitigating negative impacts.

The methodology used in this report addresses all these issues. In Phase I, we make use of county assessors' property files to comprehensively identify and evaluate the number of parcels and amount of acreage available for infill/refill development. We consider the issue of economic feasibility in Phase II, by applying a financial feasibility model to identify which of the parcels identified in Phase I could be profitably developed as market-rate rental housing. In Phase III, we examine the relationship between infill capacity and density, as well as consider the region-wide

infill potential for residential infill near transit stations, near job centers, and in neighborhoods of concentrated poverty. We conclude with a discussion of the opportunities and options available to landowners, developers, planners and policy-makers for promoting infill development.

PHASE I: IDENTIFYING VACANT AND RECYCLABLE PARCELS

Approach

Phase I involved obtaining a comprehensive list of all land parcels in the nine-county San Francisco Bay Area and then sequentially eliminating parcels which were either: (i) incomplete; (ii) could not be physically geo-coded to street addresses; (iii) were outside the region's 1996 urban footprint[2]; (iv) were too small to be feasibly developed as housing; (v) were not economically under-utilized; (vi) were environmentally inappropriate for development; (vii) were publicly-owned or currently developed in a heavy industrial use; and (viii) were adjacent to designated superfund sites. Each of the above steps is explained in greater detail below. Parcel and acreage totals and percentages are presented by county in Exhibit 1A and Exhibit 1B.

First, with the assistance of the Association of Bay Area Governments (ABAG) and Metroscan (a private company), a complete list of all legal parcels in the Bay Area was obtained from each county assessor's office. A geographic information system (GIS) was then used to geo-code, or *address-match,* as many parcels as possible to a 1995 digital street map. The percentage of successfully addressed-matched locations ranged from a high of 93% in San Francisco, to a low of 79% in Napa County. Region-wide, 88% of the properties listed in county assessor files were successfully address-matched.

Infill parcels were identified as those located inside the Bay Area's 1996 *urban footprint*. The urban footprint was identified using digital maps obtained from the California Farmland Mapping and Monitoring Project (CFMMP). The CFMMP defines urban lands as those at least ten acres in size, and occupied by structures with a minimum building density of at least one unit per 1.5 acres, or six structures per ten-acre parcel. Because it includes areas that are developed but outside incorporated city limits, as well as areas that are within city limits but are not developed, the urban footprint provides a better measure of urban development than simple city boundaries. Region-wide, 76% of parcels, but only 15% of lot area, fell within the 1996 urban footprint.

Exhibit 1A: Identifying Infillable and Recyclable Parcels

	Item & Exclusion Condition	Alameda Parcels		Contra Costa Parcels		Marin Parcels		Napa Parcels		San Mateo Parcels		San Francisco Parcels		Santa Clara Parcels		Sonoma Parcels		Solano Parcels		Total Parcels	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1	Total parcels & acreage from assessor's file	404,985	100%	318,605	100%	95,478	100%	45,579	100%	198,413	100%	112,419	100%	433,360	100%	168,274	100%	123,205	100%	1,900,318	100%
2	Successfully geocoded	368,441	91%	264,423	83%	80,310	84%	36,116	79%	185,337	93%	104,564	93%	385,845	89%	140,072	83%	105,103	85%	1,670,211	88%
3	Have valid lot data	319,538	79%	242,337	76%	72,391	76%	31,721	70%	148,545	75%	98,367	88%	377,969	87%	139,497	83%	104,229	85%	1,534,594	81%
4	Inside urban footprint	312,498	77%	231,939	73%	64,078	67%	18,149	40%	141,165	71%	98,367	88%	367,350	85%	105,217	63%	96,859	79%	1,435,622	76%
5	Minimum Lot Size >= 2000	301,722	75%	224,362	70%	58,080	61%	17,512	38%	137,369	69%	97,851	87%	325,534	75%	95,501	57%	90,565	74%	1,348,496	71%
6	Improved and unimproved lands	68,558	17%	41,876	13%	8,405	9%	3,496	8%	7,878	4%	33,083	29%	52,609	12%	13,348	8%	4,643	4%	233,896	12%
6a.	Improvement/Land Ratio <=0.9	62,567	15%	38,195	12%	7,484	8%	2,697	6%	7,196	4%	30,900	27%	50,795	12%	6,527	4%	3,184	3%	209,545	11%
6b.	Vacant (No Improvement)	5,991	1%	3,681	1%	921	1%	799	2%	682	0%	2,183	2%	1,814	0%	6,821	4%	1,459	1%	24,351	1%
7	Environmentally suitable (not in floodplain/wetlands/slope)	60,151	15%	38,850	12%	7,297	8%	3,171	7%	6,943	3%	32,712	29%	48,029	11%	10,773	6%	3,622	3%	211,548	11%
8	Not within 100m of on Superfund site	60,151	15%	38,762	12%	7,297	8%	3,169	7%	6,943	3%	32,689	29%	47,994	11%	10,714	6%	3,622	3%	211,341	11%
9	Not a public institution /condominium /heavy industrial land use	59,347	15%	37,274	12%	7,112	7%	3,097	7%	6,855	3%	32,494	29%	46,577	11%	10,354	6%	3,026	2%	206,136	11%

Exhibit 1B: Identifying Infill and Recyclable Acreage

	Item & Exclusion Condition	Alameda Acreage		Contra Costa Acreage		Marin Acreage		Napa Acreage		San Mateo Acreage		San Francisco Acreage		Santa Clara Acreage		Sonoma Acreage		Solano Acreage		Total Acreage	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1	Total parcels & acreage from assessor's file	348,563	100%	539,109	100%	151,822	100%	499,880	100%	72,335	100%	13,059	100%	476,748	100%	1,038,644	100%	527,983	100%	3,668,143	100%
2	Successfully geocoded	147,015	42%	107,219	20%	62,834	41%	112,071	22%	47,383	66%	8,632	66%	155,488	33%	470,544	45%	133,254	25%	1,244,440	34%
3	Have valid lot data	147,015	42%	107,219	20%	62,834	41%	112,071	22%	47,380	66%	7,342	56%	155,488	33%	470,544	45%	133,254	25%	1,243,146	34%
4	Inside urban footprint	91,830	26%	79,156	15%	23,891	16%	65,827	13%	34,076	47%	7,342	56%	103,161	22%	96,403	9%	37,189	7%	538,875	15%
5	Minimum Lot Size >= 2000	91,506	26%	78,941	15%	23,729	16%	65,696	13%	33,954	47%	7,335	56%	102,086	21%	96,293	9%	37,189	7%	536,730	15%
6	Improved and unimproved lands	24,021	7%	18,920	4%	5,349	4%	36,921	7%	5,075	7%	2,864	22%	26,662	6%	44,869	4%	15,061	3%	179,740	5%
6a.	*Improvement/Land Ratio <=0.9*	*15,590*	*4%*	*13,710*	*3%*	*4,042*	*3%*	*27,399*	*5%*	*3,228*	*4%*	*2,388*	*18%*	*23,135*	*5%*	*23,522*	*2%*	*6,505*	*1%*	*119,519*	*3%*
6b.	*Vacant (No Improvement)*	*8,431*	*2%*	*5,209*	*1%*	*1,307*	*1%*	*9,522*	*2%*	*1,846*	*3%*	*476*	*4%*	*3,527*	*1%*	*21,347*	*2%*	*8,557*	*2%*	*60,221*	*2%*
7	Environmentally suitable (not in floodplain/wetlands/slope)	18,524	5%	16,786	3%	4,506	3%	33,212	7%	3,845	5%	2,591	20%	22,365	5%	34,153	3%	9,854	2%	145,836	4%
8	Not within 100m of on Superfund site	18,524	5%	16,747	3%	4,506	3%	33,132	7%	3,845	5%	2,590	20%	22,316	5%	34,083	3%	9,854	2%	145,596	4%
9	Not a public institution /condominium /heavy industrial land use	17,234	5%	13,986	3%	4,410	3%	33,059	7%	3,698	5%	2,564	20%	21,028	4%	33,929	3%	8,666	2%	138,573	4%

Some parcels, usually termed *remainder lots*, are too small to be economically developed. Based on empirical analysis of current residential parcel sizes, we set 2,000 square feet as the minimum developable residential parcel size. Region-wide, fewer than 90,000 parcels (out of 1.9 million) and 2,200 acres were excluded as remainder lots. Approximately 24,000 lots and 60,000 acres of land were identified as lacking structural improvements, which is to say they were classified as vacant.

To identify developed-but-economically-underutilized sites, we compared assessed land and improvement (i.e., structure) values.[3] After numerous sensitivity tests, the decision was made to use an assessed improvement-to-land ratio cutoff of .9. Parcels with ratios less than this amount, meaning that the assessed value of the improvements was 90% or less of the assessed value of the land, were deemed to be economically-underutilized, and therefore potential candidates for redevelopment or refill. Parcels with improvement-to-land ratios in excess of .9 were deemed not to be under-utilized, and therefore not candidates for redevelopment.

A note of caution. We do not assume, and readers should not assume that all developed parcels with improvement-to-land ratios less than .9 *should* be redeveloped. Such decisions are necessarily made on a case-by-case basis. There are many parcels throughout the Bay Area that are being appropriately used despite being economically-underutilized. Likewise, there are many underutilized parcels in which the value of the improvements exceeds the land value. Region-wide, this last screen yielded 211,548 under-utilized parcels comprising 119,519 acres.

Not all vacant or under-utilized parcels are environmentally suitable for development or redevelopment. Region-wide, approximately 22,000 parcels and 34,000 acres were eliminated because they were in located in a floodplain or on wetlands, or on hillsides with a slope in excess of 15%. Another 200 parcels and 250 acres were eliminated from consideration because they were either adjacent to, or listed as federal Superfund sites. The last set of sites to be eliminated were those previously used by heavy industry (and thus likely to have toxics present); those in public or institutional use (and thus not likely to be available for private development), and those double-counted by virtue of their condominium ownership form. Slightly more than 5,200 parcels comprising 7,000 acres fell into this last category.

At the end of this elimination process, a grand total of 206,136 parcels comprising 138,573 acres were found to be located inside the existing urban footprint and deemed appropriate for infill development. The supply of recyclable-infillable land accounts for 10 percent of the region's parcels and three percent of its buildable land area. Appendix A, available on CD-ROM for order at http://www-iurd.ced.berkeley.edu/ contains detailed listings of all 206,136 potential infill parcels.

The Geographic Distribution of Vacant Sites

Less than ten percent of infillable parcels and twenty-five percent of infillable acreage are currently vacant. Altogether, some 37,000 acres of vacant land lie within the urban footprint of the San Francisco Bay Area. Infillable vacant parcels account for only one percent of the region's parcels and developable land area.

Nearly two-thirds of the Bay Area's infillable vacant land supply is located in just three counties: Solano, Sonoma, and Napa Counties (Exhibit 2A). The region's three most populous counties: Alameda, Contra Costa, and Santa Clara Counties, include just under a quarter of its supply of vacant-infillable land. Only two percent of the region's vacant land supplies are located in San Francisco and San Mateo Counties. These differences reflect the fact that San Francisco and San Mateo's urban footprints are denser, more built-out, and more clearly defined than those of Solano, Sonoma, and Napa. Except in the North Bay, most vacant acreage is at the suburban inner edge of the urban footprint, not the urban center (see Map 1). The majority of the vacant acreage in the East Bay, for example, is census tracts that line I-680 and I-580, not I-880.

With smaller average lot sizes, the urban counties of the Bay Area include proportionately more vacant lots but less acreage. San Francisco County, for example, includes 10% of the region's vacant-infillable parcels, but only 1% percent of its vacant acreage. At the opposite extreme, Sonoma County includes 23% of the region's vacant-infillable lots but 37% of its vacant acreage. Except in the North Bay, the majority of vacant parcels are in or adjacent to older commercial and industrial areas. This is particularly true for San Francisco and Oakland (see Map 2). Indeed, what is most striking about the Bay Area, especially the Peninsula, East Bay, and South Bay sub-regions, is how few vacant parcels and how little vacant land there really is.

Exhibit 2A: Distribution of Vacant Lots and Acreage by County

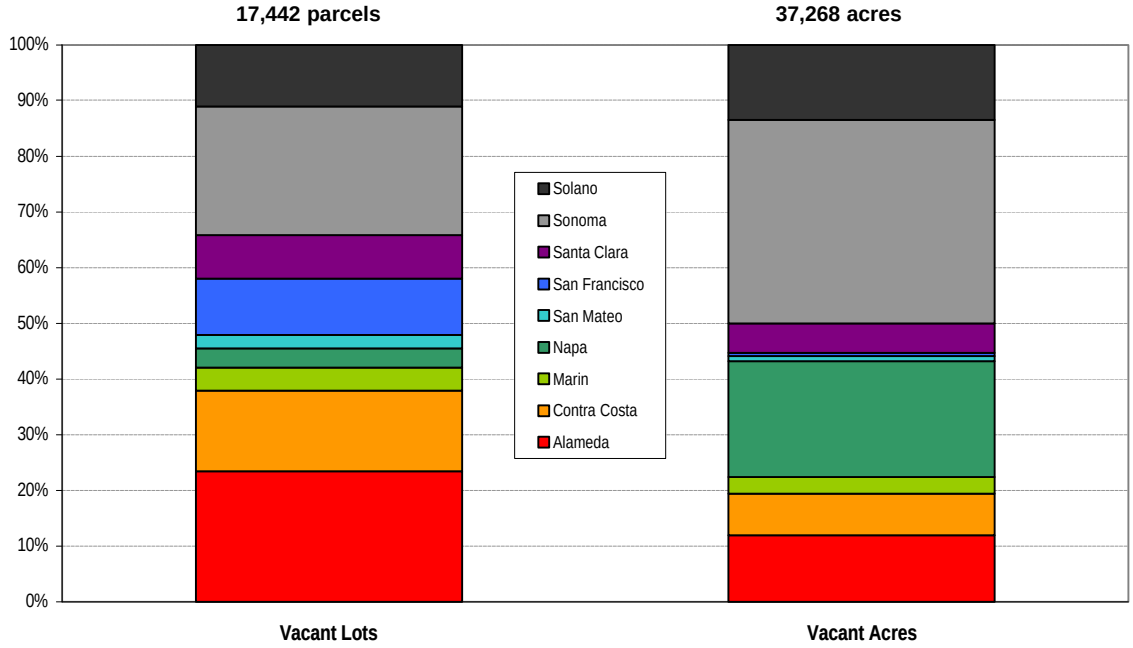
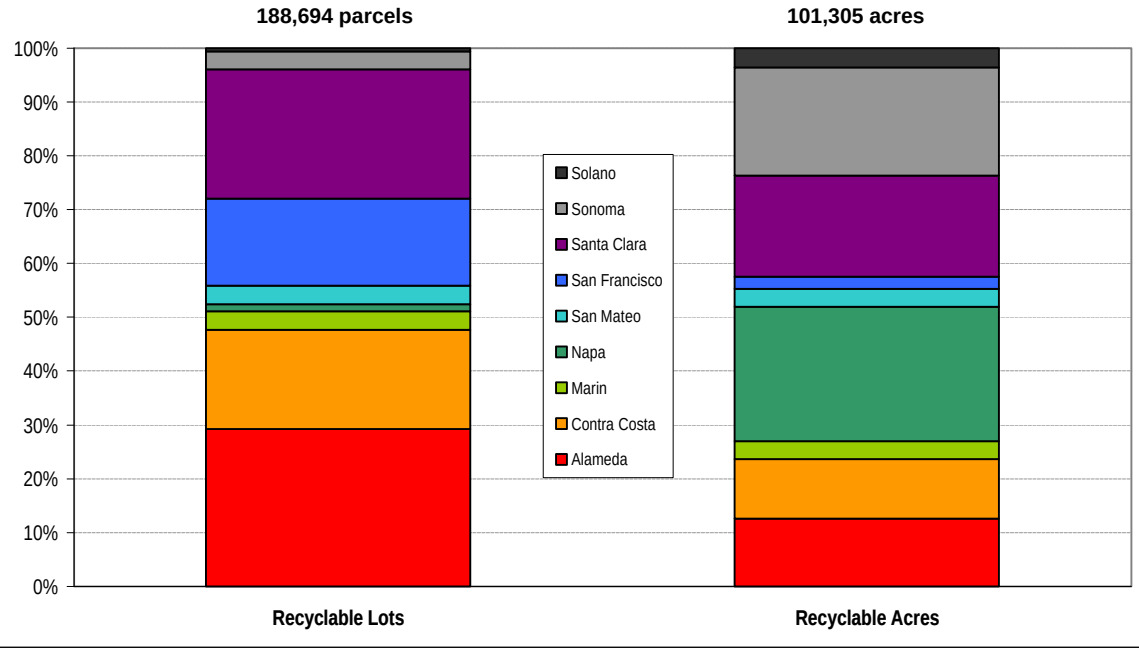
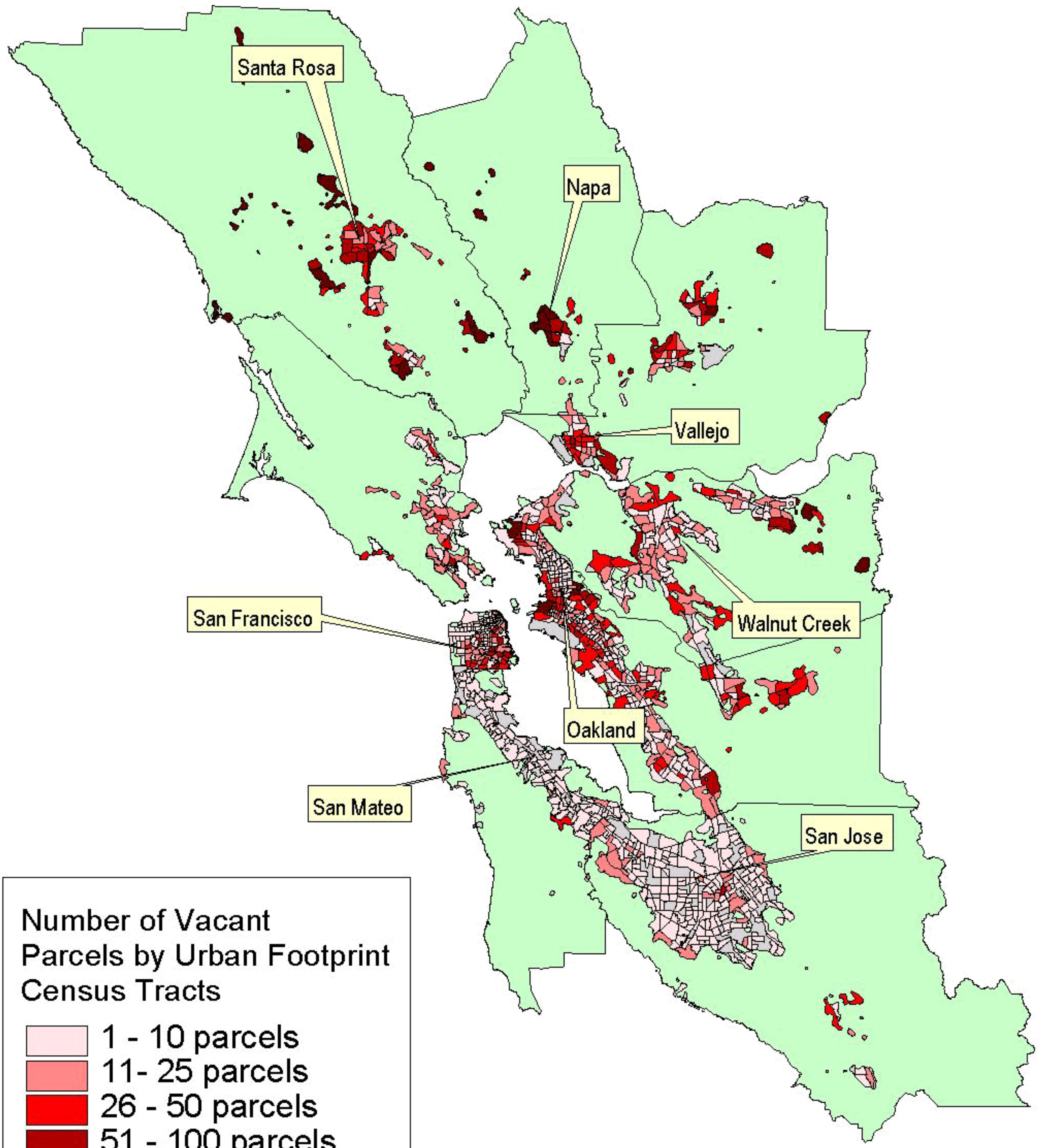


Exhibit 2B: Distribution of Recyclable Lots and Acreage by County



Map 1:
Vacant Parcels by Census Tract



Number of Vacant Parcels by Urban Footprint Census Tracts

- 1 - 10 parcels
- 11- 25 parcels
- 26 - 50 parcels
- 51 - 100 parcels
- 101 - 1,000 parcels
- Urban Footprint

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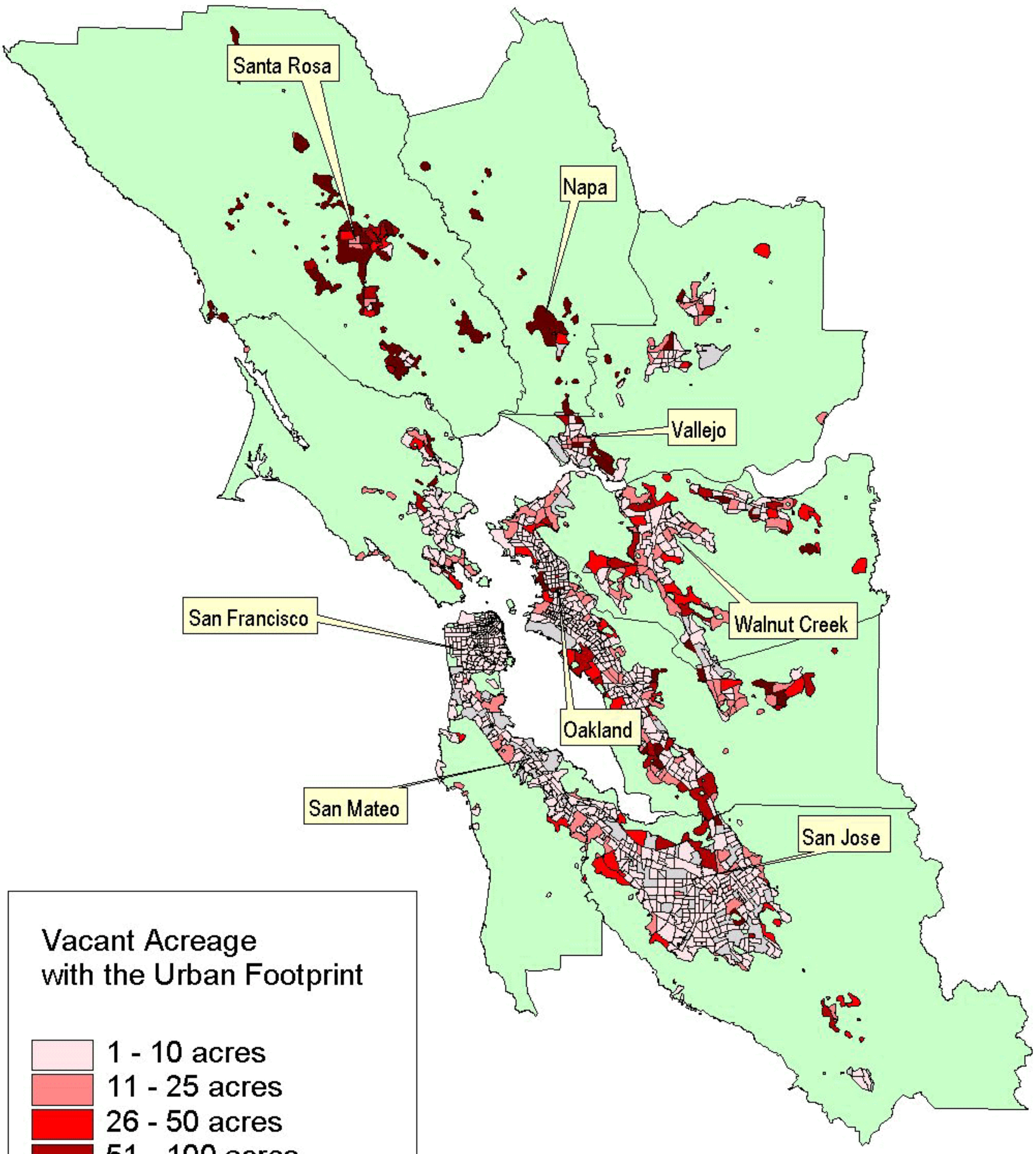
Map 2:
Vacant Acreage by Census Tract



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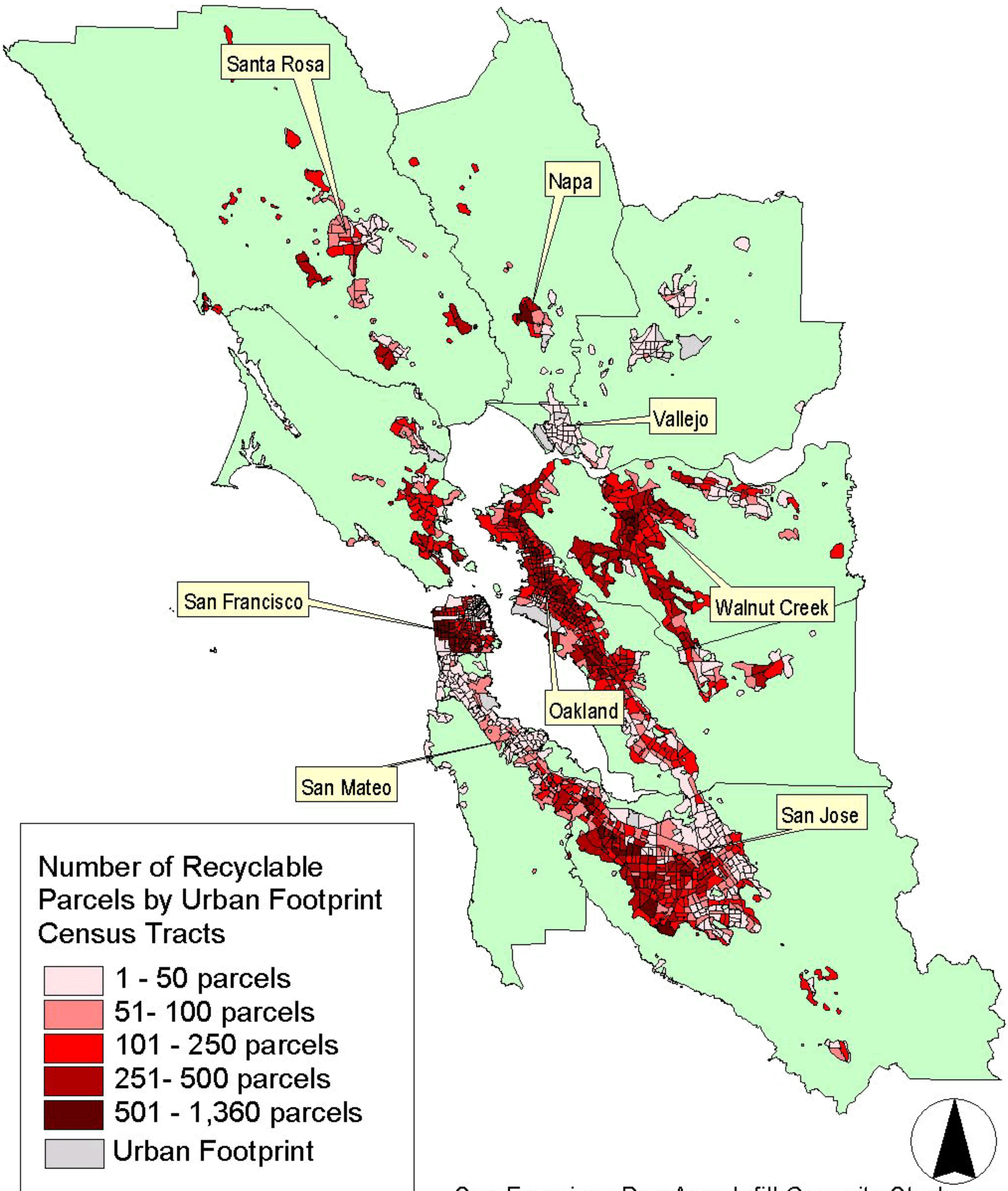
The Geographic Distribution of Refill Sites

The vast majority of infillable parcels and acreage fall into the category of recyclable or refill lands. Refill lands are developed and improved lots that are economically under-utilized given current real estate market conditions. As noted previously, we identified economically under-utilized parcels as those in which the assessed structure value was 90% or less than the assessed land value. The concept of under-utilization is an economic one, not a social or physical one. Many of the structures on economically under-utilized sites have great architectural value, or are valued by the community, or are precious to their owners regardless of their economic value. This caveat notwithstanding, substantially underutilized lots are often the first to be redeveloped.

About 100,000 acres, or about 3 percent of the land area in the San Francisco Bay Area are in lots that are economically underutilized and could be considered potentially recyclable. In terms of total acreage, Napa County has the most potentially-recyclable land (25,300 acres), followed by Sonoma County (20,300 acres), and Santa Clara (19,000 acres). At the other end of the acreage scale, San Francisco, Marin, and San Mateo Counties include 2,400, 3,300, and 3,300 acres, respectively, of potentially recyclable land. As is the case with vacant land, the number of recyclable parcels is not proportional to acreage. Napa County, for example, includes only 1 percent of the region's recyclable lots but nearly a quarter of its recyclable acreage. San Francisco, on the other hand, includes only 2 percent of the region's recyclable acreage, but 16 percent of its recyclable lots (see Exhibit 2b).

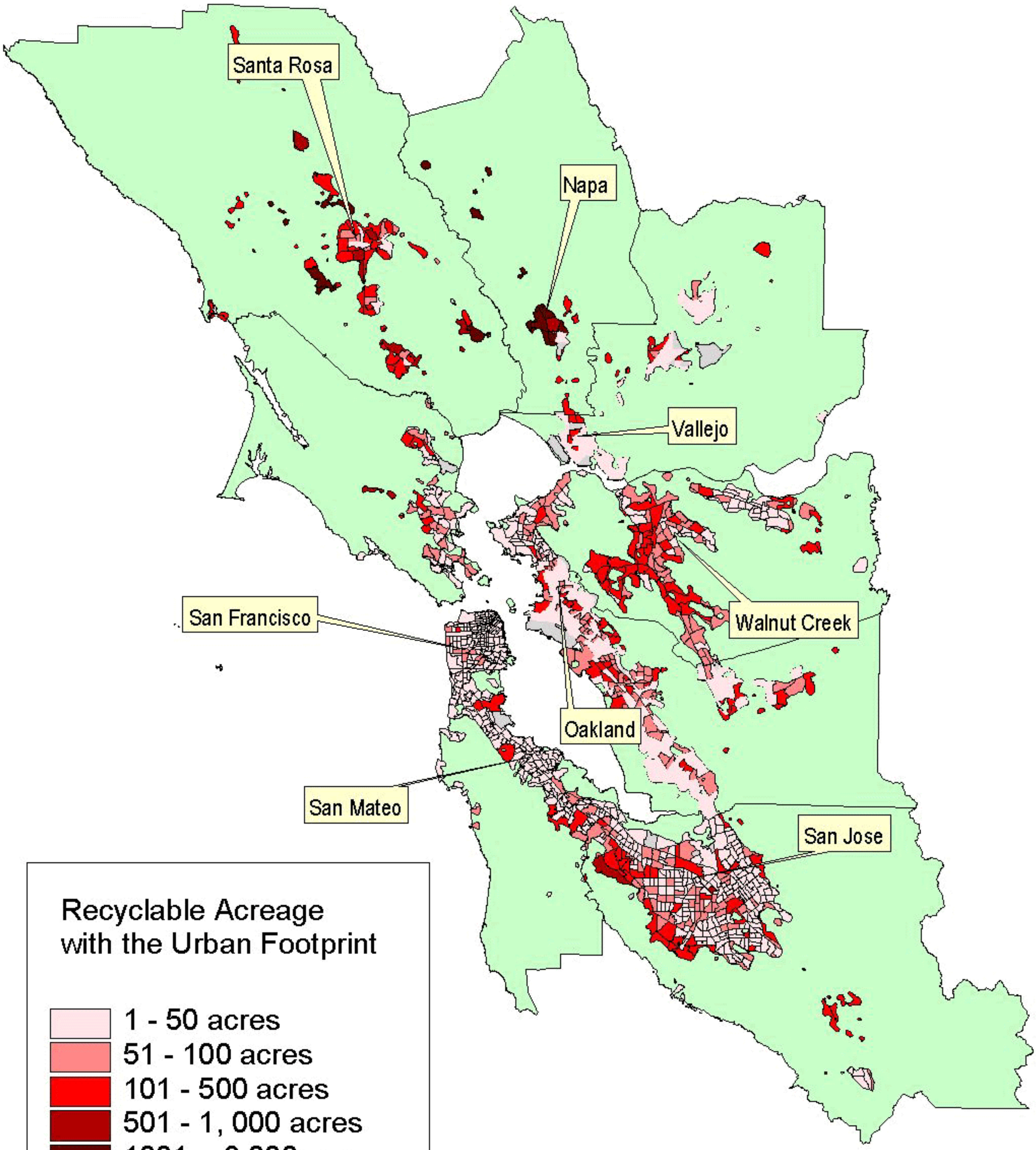
At the sub-county level, the pattern of under-utilized parcels has more to do with economics than land availability (see Map 3 and Map 4). Note, for example, the high degree of apparent economic under-utilization along the western edges of the Santa Clara County, down I-680 in Contra Costa County, and along U.S. 101 in Marin and Sonoma Counties. None of these areas are predominantly industrial, or old and run-down. Quite the opposite: they are some of the most desirable areas in their respective counties. Rather, recent increases in underlying land values in Santa Clara, Contra Costa, and Marin counties have led to imbalances between structure and land values. Houses that several years ago were worth several times their lot values are now worth less than the land upon which they sit. This is precisely why so-called monster houses have become so popular around Silicon Valley: to realize the full economic value of the land requires replacing a not-so-old small house with a brand-new giant house. Other neighborhoods with

Map 3:
Recyclable Parcels by Census Tract



San Francisco Bay Area Infill Capacity Study

Map 4:
Recyclable Acreage by Census Tract



San Francisco Bay Area Infill Capacity Study

large amounts of economically under-utilized land include the Sunset District in San Francisco, and the I-80 corridor in Alameda County.

Current Use Characteristics of Recyclable Sites

Of the 101,000 acres of potentially recyclable land in the Bay Area, the majority (58% or 59,040 acres) is currently in a non-residential use. The amount and share of potentially recyclable land in residential vs. non-residential use varies widely by county. In terms of amounts, Santa Clara County (11, 939 acres) leads the region in the number of potential refill lands currently in residential use. Contra Costa County and Alameda County follow with 8,687 acres and 7,451 acres, respectively. Added together, these three counties have include 67% of the region's residential recyclable land. (see Exhibit 3A and Exhibit 3B). Any effort to boost infill housing production must therefore be focused on these three counties.

In terms of percentages, San Francisco County has the highest percentage of potentially recyclable lands currently in residential use (94%), followed by Contra Costa County (78%) and Marin County (66%). At the opposite extreme, in Napa, only two percent of the potential refill lands are currently in residential use. In Solano County, the share of potentially-recyclable lands in residential use is only 7%; in Sonoma County, its only 35%. Promoting increased housing infill housing construction in these three counties will therefore require many land use changes—a difficult task made more difficult by the fact that Sonoma and Solano counties already see themselves as job-poor and housing-rich. Altogether, these three counties—Napa, Solano, and Sonoma include only 29% of the region' residential recyclable land.

In summary, while the North Bay counties include the majority of the region's refillable acreage, most of that acreage is currently not in residential use. San Francisco and Marin Counties are at the opposite extreme: they have fewer refillable acres, most of which is currently in residential use. Alameda, Contra Costa, and Santa Clara fall between these two endpoints. They have large supplies of refillable land, evenly balanced between residential and non-residential uses.

Caveat Redux

As we noted previously, we are in no way advocating the redevelopment of any or all recyclable lands. Rather, we are pointing out the reality that the Bay Area has far less vacant land available

Exhibit 3A: Current Use Characteristics of Infill and Recyclable Parcels

Site Characteristics	Alameda Parcels		Contra Costa Parcels		Marin Parcels		Napa Parcels		San Mateo Parcels		San Francisco Parcels		Santa Clara Parcels		Sonoma Parcels		Solano Parcels		Total Parcels	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Vacant and Recyclable Parcels	59,347	100%	37,274	100%	7,112	100%	3,097	100%	6,855	100%	32,494	100%	46,577	100%	10,354	100%	3,026	100%	206,136	100%
Vacant Parcels (No Improvement)	4,091	7%	2,518	7%	719	10%	605	20%	423	6%	1,759	5%	1,359	3%	4,033	39%	1,935	64%	17,442	8%
Recyclable Parcels (Improvement/Land Ratio <=0.9)	55,256	93%	34,756	93%	6,393	90%	2,492	80%	6,432	94%	30,735	95%	45,218	97%	6,321	61%	1,091	36%	188,694	92%
Residential	49,970	90%	33,186	95%	6,182	97%	1,347	54%	5,614	87%	28,915	94%	41,513	92%	5,070	80%	769	70%	172,566	91%
Non-Residential	5,286	10%	1,570	5%	211	3%	1,145	46%	818	13%	1,820	6%	3,703	8%	1,251	20%	322	30%	16,126	9%

Exhibit 3B: Current Use Characteristics of Infill and Recyclable Acreage

Site Characteristics	Alameda Acreage		Contra Costa Acreage		Marin Acreage		Napa Acreage		San Mateo Acreage		San Francisco Acreage		Santa Clara Acreage		Sonoma Acreage		Solano Acreage		Total Acreage	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Vacant and Recyclable Parcels	17,234	100%	13,986	100%	4,410	100%	33,059	100%	3,698	100%	2,564	100%	21,028	100%	33,929	100%	8,666	100%	138,573	100%
Vacant Parcels (No Improvement)	4,460	26%	2,783	20%	1,091	25%	7,745	23%	360	10%	190	7%	1,981	9%	13,625	40%	5,032	58%	37,268	27%
Recyclable Parcels (Improvement/Land Ratio <=0.9)	12,774	74%	11,203	80%	3,319	75%	25,314	77%	3,338	90%	2,374	93%	19,047	91%	20,303	60%	3,633	42%	101,305	73%
Residential	7,451	58%	8,697	78%	2,175	66%	622	2%	1,879	56%	2,225	94%	11,939	63%	7,005	35%	273	8%	42,265	42%
Non-Residential	5,323	42%	2,506	22%	1,144	34%	24,692	98%	1,459	44%	149	6%	7,108	37%	13,298	65%	3,361	93%	59,040	58%

for infill development than is commonly supposed, and that any concerted policy effort to promote infill development would therefore have to target potentially recyclable lands. We will leave it to others to determine exactly what such an infill-oriented planning process might look like.

PHASE II: SCREENING FOR FINANCIAL FEASIBILITY

The major barrier to increased infill development is economic not physical. Surprising as it may seem, there are many parts of the Bay Area where multi-family housing construction simply isn't economically feasible given current market rents and development costs—that is, where developers are unable to make a reasonable profit. In this section, we estimate the number of infill parcels and amount of infill acreage upon which it would be economically feasible to develop multi-family housing.

Approach

For apartment construction to be economically feasible, collectible rents must be able to cover operating expenses and debt service as well as generate some minimum return on equity. For single-family construction to be feasible, sales prices must be sufficient to cover land costs, subdivision improvement costs, fees, and construction costs.

To determine which types of infill residential projects would be feasible where, we ran all the parcels resulting from the Phase I analysis through two simple financial feasibility models, one for multi-family rental projects, the other for single-family homes. The multi-family model compared 1999 average rents (by jurisdiction) with the rents required by developers to achieve minimal profitability. Necessary rent levels were defined as the rent that a developer would have to charge for a new two-bedroom unit to cover land costs, hard and soft construction costs, financing, as well as to achieve a minimum yearly cash-on-cash return. Break-even rents and construction costs were computed on a parcel by parcel basis based on the following assumptions:

- Minimum Profitability: We assumed that new multi-family projects would have to generate a minimum annual cash-on-cash return of ten percent to attract financing. Cash-on-cash return is defined as annual before tax cash flow (net of debt service but before taxes) divided by the

initial cash investment. Many residential developers are currently looking for deals that generate a 12-15% (or greater) annual cash-on-cash return, but some will undertake projects that produce consistent, but lower, returns

- Land Costs: Land costs were allowed to vary by location, current land use, and year of prior sale. For parcels that sold in 1998 or 1999, we used the assessor's land value estimate, regardless of the current land use. For single-family sites that sold or were built prior to 1998, we used the 1998-99 census tract average assessor's land value for all single-family parcels. For multi-family sites that sold or were built prior to 1998, we used the 1998-99 census tract average assessor's land value estimate for all multi-family parcels. For non-residential structures that sold or were built prior to 1998, we averaged 1998-99 commercial and multi-family assessed land values by census tract. All calculations were undertaken on a per square foot basis.

- "Hard" construction costs: Hard costs include labor and materials costs. Multi-family hard costs were assumed to vary by county, from a high of $100 per square foot in San Francisco, to $90 per square foot in Alameda, Santa Clara, and San Mateo counties, to $80 per square foot in Contra Costa, Marin, Solano, and Sonoma counties.

- Parking requirements: We assumed developers would provide two parking spaces per two-bedroom rental unit. Parking costs varied from $10,000 per structured parking space in San Francisco, to $5,000 per enclosed-garage space in Alameda, Santa Clara, and San Mateo counties, to $2,000 per carport parking space in Contra Costa, Marin, Solano, and Sonoma counties.

- Soft costs: Soft costs cover all fees and professional services and associated with new construction. Soft costs were estimated at 30% of hard costs.

- Financing costs and provisions: We assumed project developers would be able to access permanent financing at a rate of 8% per year, with an amortization period of 30 years, and underwriting based on a 75% loan-to-value ratio. These financing terms mirrored those in effect in late 1999.

- Operating expenses and vacancy rates: Operating expenses were assumed to be a flat 30% of

rental income. Long-term vacancy rates were assumed to be 3% in San Francisco, San Mateo, Santa Clara, and Alameda counties, and 5% in Marin, Sonoma, Napa, Solano, and Contra Costa counties. These estimates are consistent with most lenders underwriting practices.

- Rents: Market rent data were obtained from the RealFacts Company for 1999 by property, and then averaged to the jurisdiction level. RealFacts' apartment database is limited to projects with 100 or more units.

Exhibit 4 demonstrates the use of the multi-family screening model to evaluate the financial feasibility of developing three archetypal infill parcels in San Francisco, Santa Clara, and Contra Costa counties. Consider first the San Francisco archetype: It is a 50-unit per acre apartment building on a half-acre lot. Only one parking space is required per unit. The typical two-bedroom unit is 800 square feet in size, and ten percent of building square footage is devoted to common areas (e.g., hallways and stairs, laundry rooms, etc.). The underlying land cost is $70 per square foot of lot area. "Hard" construction costs, as noted above, are $100 per square foot; soft costs add another 30 percent to the cost of construction. The cost of providing structured parking is $10,000 per space. The total cost of building this project in San Francisco, including land costs, hard and soft construction costs, and parking costs, is about $4.7 million. Given current interest rates and underwriting standards, about 75% of this amount could be financed, leaving the developer to raise an initial cash stake of $1.17 million. A comparable 60-unit apartment building constructed in Santa Clara County would cost $11.6 million and require the developer to raise $2.9 million in cash. A similar 75-unit apartment building in Contra Costa County would cost $10.7 million to build, and would require $2.7 million in initial cash.

In order to meet the 10% cash-on-cash return requirement, the San Francisco project would have to annually spin-off a minimum post debt service before-tax cash flow of $117,000. Adding back in debt service payments, operating expenses, and projected vacancy losses, the project would have to achieve a scheduled gross income of $631,000 annually, or $2,100 per month per unit to be financially viable. The comparable minimum required rent for the Santa Clara County archetype is $2,180 per month. For the Contra Costa archetype, it is $1,640 per month.

Exhibit 4: Calculation of Required Break-Even Rents for Archetypal Multi-family Projects in San Francisco, Santa Clara, and Contra Costa Counties, 1999

	Line	Item	San Francisco	Santa Clara County	Contra Costa County	Data Source
PROJECT OUTLINE	1	Parcel size (acres)	0.5	2	3	Parcel data file
	2	Density (units per acre)	50	30	25	Average density of nearby projects
	3	Parking spaces per unit	1	2	2	See text
	4	Average unit size	800	850	850	See text
	5	Common area (%)	10%	10%	10%	See text
DEVELOPMENT COST STRUCTURE	6	Land cost/SQFT	$70.00	$50.00	$25.00	Parcel data file, see text
	7	Construction cost/SQFT	$100.00	$90.00	$80.00	See text
	8	Soft costs percentage	30%	30%	25%	See text
	9	Parking cost/space	$10,000	$5,000	$2,000	See text
FINANCING STRUCTURE	10	Maximum loan-to-value(cost)-ratio	0.75	0.75	0.75	See text
	11	Mortgage interest rate (%)	8.0%	8.0%	8.0%	See text
	12	Term (years)	30	30	30	See text
	13	REQUIRED CASH-ON-CASH RETURN	10.0%	10.0%	10.0%	See text
OPERATING ASSUMPTIONS	14	Average vacancy rate	3.0%	3.0%	5.0%	See text
	15	Expense Ratio (%)	30.0%	30.0%	30.0%	See text
DEVELOPMENT SUMMARY	16	Land cost	$1,522,500	$4,350,000	$3,262,500	Line 1 x 43,500 x Line 6
	17	Residential units	25	60	75	Line 1 x Line 2
	18	Total built square footage	22,000	56,100	70,125	(Line 17 x Line 4) x (1 + Line 5)
	19	Parking spaces	25	120	150	Line 17 x Line 3
	20	Total development cost	$4,676,550	$11,626,080	$10,715,475	Line 16 + ((Line 18 x Line 7) x (1 + Line 8)) + (Line 19 x Line 9)
	21	- Supportable mortgage (cost* L/V)	$3,507,413	$8,719,560	$8,036,606	Line 20 x Line 10
	22	Required initial cash	$1,169,138	$2,906,520	$2,678,869	Line 20 - Line 21
BREAK-EVEN RENT CALCULATION	23	Required (before-tax) cash flow	$116,914	$290,652	$267,887	Line 22 x Line 13
	24	+ Debt service	$311,554	$774,536	$713,871	=PMT (Line 11, Line 12, - Line 21)
	25	Net operating income	$428,468	$1,065,188	$981,758	Line 23 + Line 24
	26	+ Operating expenses	$183,629	$456,509	$420,753	Line 27 - Line 25
	27	Rent revenue after vacancies	$612,097	$1,521,697	$1,402,511	Line 25 / (1 - Line 15)
	28	+ Vacancy losses	$18,931	$47,063	$73,816	Line 29 - Line 27
	29	Scheduled gross income	$631,028	$1,568,760	$1,476,328	Line 27 / (1 - Line 14)
	30	MINIMUM REQUIRED MONTHLY UNIT RENT	$2,103	$2,179	$1,640	Line 29 / (Line 17 x 12)

How do these required rents compare to current market rents? According to RealFacts, a real estate research firm that tracks rents throughout the Bay Area, the median monthly rent for two-bedroom apartment units in San Francisco in 1999 ranged between $2,025 and $2,465. By this standard, the San Francisco archetype *would* be economically feasible to undertake. The only locations in Santa Clara County where 1999 market rents even began to approach the required minimum rent of $2,179 listed in Exhibit 4 were in Palo Alto and Cupertino. There were localities in Contra Costa County where 1999 monthly rents were not at all close to the minimum required rent level of $1,640.

The situation isn't this dire everywhere. There are many individual locations where land costs are lower than the averages shown in Exhibit 4. There is also much more site to site and city to city variation in construction costs, parking requirements, soft costs, and expense ratios than is shown in Exhibit 4. Still, the fact remains that because of the Bay Area's high land and construction costs, constructing new multi-family housing in most parts of the Bay Area is anything but a slam dunk.

We took a more basic approach to determining the prospective financial feasibility of single-family projects. Starting with the 1999 median new home price for each jurisdiction or area—as obtained from the California Construction Industry Research Board—we successively subtracted construction costs, fees, subdivision improvement costs, and land costs to estimate the builder's profit. If the builder's profit per unit exceeded 5% of the sales price or $5,000, we judged the project to be economically feasible. Average lot sizes and densities were determined by jurisdiction, based on assessor's data. Construction costs were allowed to vary by county, as were subdivision improvement costs and fees. Estimated land costs, as noted above, varied by land use, location, and year of prior sale. For parcels which sold in 1998 or 1999, we used the assessor's land value estimate, regardless of the current land use. For single-family sites which sold or were built prior to 1998, we used the 1998-99 census tract average assessor's land value for all single-family parcels. As with the multi-family analysis, all cost calculations were undertaken on a per square foot basis.

Results of the Feasibility Screens

The results of these feasibility screens are summarized in Exhibit 5. Exhibit 5A considers parcels

and Exhibit 5B considers acreage. In terms of parcels, we estimate that 16% of the region's 206,000 available infill parcels, or 32,860 individual parcels, could today be economically developed in multi-family rental use—that is, generate a minimum 10% cash-on-cash return—given current market conditions. In terms of acreage, the percentage is much higher: in the current market environment, we estimate that 58,173 acres of potentially infillable land (or 42% of the region's 138,573 infillable acres) could be profitably developed as multi-family housing. The percentage of infill parcels which might feasibly be developed in single-family use is much lower (10% vs. 16%), but the percentage of infillable acreage is much higher (60% vs. 42%). Region wide, we estimate that 21,190 infillable parcels, comprising 82,560 acres, could potentially be developed with single-family houses.

As with prior analysis, these results vary significantly by county. Excluding Sonoma and Napa counties for reasons discussed earlier, the Bay Area county with the most economically viable infillable acreage is Santa Clara: 9,000 acres of infillable land in Santa Clara County pass the single-family economic feasibility test, and 8,800 acres pass the multi-family test. Land prices and construction costs in Santa Clara County are high, but housing prices and rents are proportionately higher—the result of too few new homes having been built in recent years. A similar logic applies in Marin County, where, we estimate, there are 3,300 and 2,230 acres of infillable land which could be economically developed as multi-family, and single-family housing, respectively.

Alameda County has the region's second largest supply of potentially infillable land after Santa Clara, but far less of it is economically feasible to develop as housing. Given current market conditions, only 438 acres of potentially infillable land in Alameda County are economically feasible to develop in multi-family use. Alameda County apartment rents are simply not high enough to cover the county's high land costs. Because housing prices in Alameda County are proportionately higher, many more acres, 7,600, pass the single-family feasibility test. A similar logic holds for Contra Costa County. Because land and construction costs are so high relative to apartment rents, only 6% of Contra Costa's infillable acreage could be economically developed as multi-family housing. The comparable percentage for single-family homes is 21%.

Exhibit 5A: Infill and Recyclable Parcels: Financially-feasible for New Residential Development

Site Characteristics	Alameda Parcels		Contra Costa Parcels		Marin Parcels		Napa Parcels		San Mateo Parcels		San Francisco Parcels		Santa Clara Parcels		Sonoma Parcels		Solano Parcels		Total Parcels	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Vacant and Recyclable Parcels	59,347	100%	37,274	100%	7,112	100%	3,097	100%	6,855	100%	32,494	100%	46,577	100%	10,354	100%	3,026	100%	206,136	100%
Financially-feasible for new multi-family rental development	674	1%	1,212	3%	4,322	61%	1,789	58%	214	3%	6,052	19%	13,201	28%	5,364	52%	34	1%	32,862	16%
Financially-feasible for new single-family development	4,112	7%	1,643	4%	910	13%	1,273	41%	1,121	90%	2,165	7%	4,838	10%	5,003	48%	124	4%	21,189	10%

Exhibit 5B: Infill and Recyclable Acreage: Financially-feasible for New Residential Development

Site Characteristics	Alameda Acreage		Contra Costa Acreage		Marin Acreage		Napa Acreage		San Mateo Acreage		San Francisco Acreage		Santa Clara Acreage		Sonoma Acreage		Solano Acreage		Total Acreage	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Vacant and Recyclable Parcels	17,234	100%	13,986	100%	4,410	100%	33,059	100%	3,698	100%	2,564	100%	21,028	100%	33,929	100%	8,666	100%	138,573	100%
Financially-feasible for new multi-family rental development	438	3%	881	6%	3,310	75%	19,618	59%	295	8%	651	25%	8,803	42%	23,613	70%	564	7%	58,173	42%
Financially-feasible for new single-family development	7,606	44%	2,981	21%	2,228	51%	31,842	96%	1,768	48%	214	8%	9,035	43%	26,845	79%	44	1%	82,564	60%

Because their urban footprints are mostly built-out, San Francisco and San Mateo County have less land available for any type of infill development. In San Francisco, 651 acres of potentially infillable land could be economically developed as multi-family housing; 214 acres could be economically developed or re-developed as single-family housing. In San Mateo County, the comparable acreage totals are 295, and 1,768, respectively.

Different dynamics also characterize the three North Bay counties. Infill sites in Solano County are in short supply, hence, their prices are relatively high. The housing market, on the other hand, is fairly competitive—the only Bay Area county for which this is true. High infill land prices coupled with low housing prices and rents make infill development an iffy proposition. Given current market conditions, only 564 acres of potentially infillable land in Solano County are economically feasible to develop in multi-family use. On the single-family side, only 44 acres pass the feasibility test. The situation is the opposite in Sonoma and Napa counties, where housing prices and rents are comparatively high and infill land is plentiful, and hence cheap. Nearly 20,000 acres of infillable land in Napa County could be economically developed as apartments. In Sonoma County, the comparable figure is 23,600 acres. Even more land could feasibly be developed in both counties in single-family use.

A Caveat: Market Conditions Can Change

Extreme care should be taken interpreting these results, which are based on a 1999 snapshot of Bay Area housing markets. Market conditions can and do change, sometimes quickly. Sites in East Palo Alto long regarded as economically un-buildable are now the object of intense competition. Likewise, a strong market for premium apartments and lofts has developed in San Francisco's South of Market area. Downtown Oakland is finally and gradually being gentrified. As (and if) Silicon Valley prosperity continues emanating outward, parcels once passed over as problematic will see their values increase. Similarly, to the extent that housing starts continue to lag job growth, housing prices and rents will continue to be bid upward, making more housing construction economically, if not politically, feasible.

PHASE III: DENSITY SCENARIOS & INFILL POTENTIAL

In this section we present and discuss the methodology used to estimate prospective infill densities, as well as evaluate the range of infill capacities associated with different densities. We

consider the Bay Area as a whole, but also focus on individual counties, as well as specific areas targeted for increased infill development. These include transit-rich neighborhoods, job-rich neighborhoods, and impoverished neighborhoods.[4]

Approach

Infill capacity depends as much on development densities as it does on land supply. The higher the allowable density, the greater the housing or commercial yield from a given set of infill lots. The lower the allowable development density, the lower the yield.

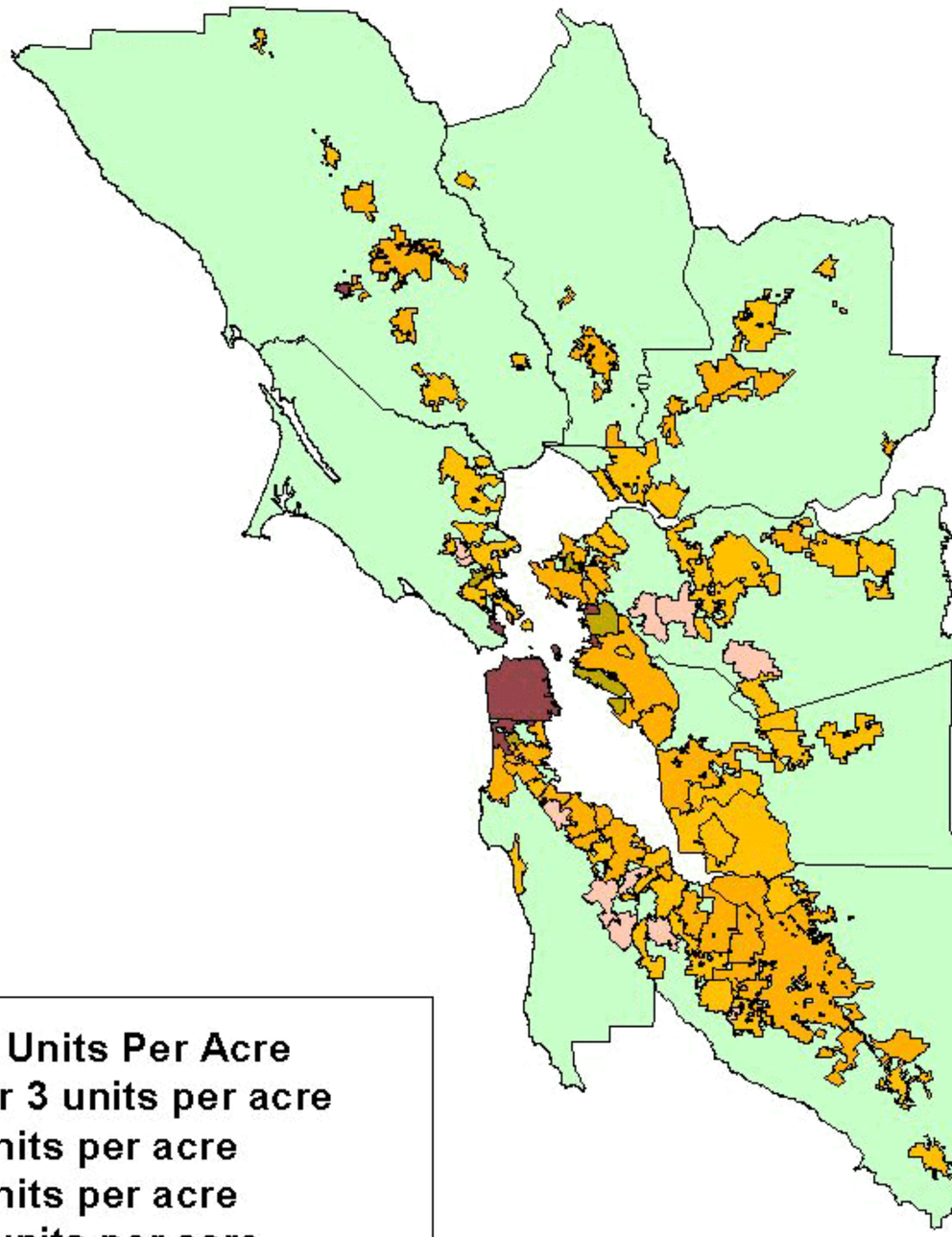
No land use issue is subject to more debate than density. Generally speaking, elected officials and neighborhood representatives—those most active in the development entitlements process—start from the position that prospective infill densities should match or be less than current densities, so as not to overstress neighborhoods and public services. Urban designers, private developers and transit advocates, on the other hand, tend to favor higher-than-prevailing densities as a means of maximizing economic and social returns.

To accommodate a range of perspectives, infill capacities were identified using six alternative densities. The minimum density for each jurisdiction was set as its average historical net density, as obtained by dividing the total number of housing units by residential acreage.[5] Average historical net densities among Bay Area cities range from less than one unit per acre in rural and upper-income communities to more than 25 units per acre in older, core cities (see Map 5). Average historical net densities are generally highest around San Francisco Bay and decline as one moves outward.

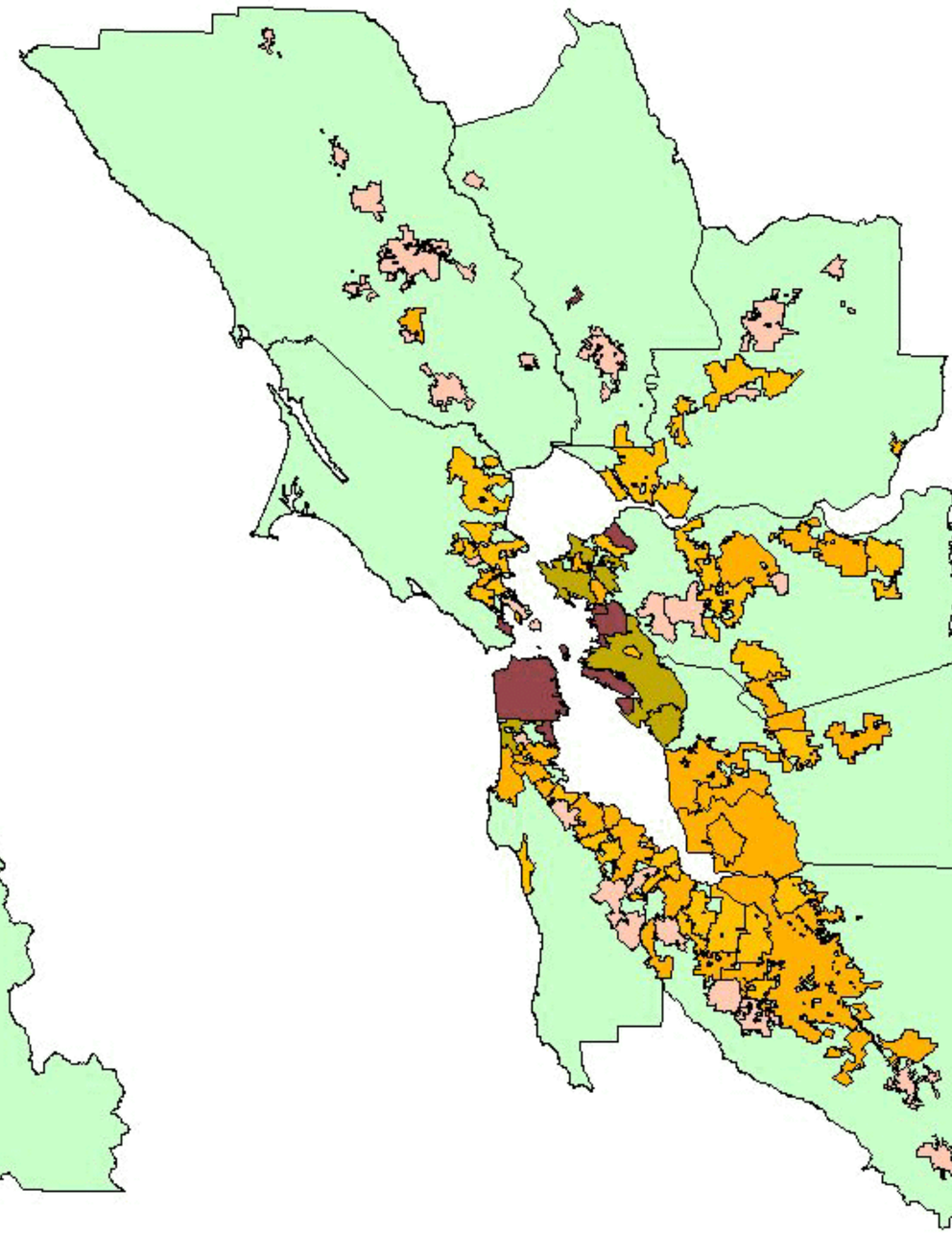
History provides only a partial picture of current real market realities. Developers in some parts of California are currently building housing at densities that are higher than historical averages—mostly in response to higher land and housing prices. In other areas, developers are building housing at lower than historical densities. To contrast infill levels at *historical densities,* with infill levels at *recent densities*, we went back to the assessors' data files to estimate recent net average densities. We did this by averaging the per-unit lot sizes of homes and apartments built between 1995 and 1999. Recent residential densities range from a low of 1 unit per acre in Gilroy, to a high of 21 units per acre in Emeryville (see Map 5).

Map 5:
Historical and Current Density by City

Historical Density by City



Current Density by City



Number of Units Per Acre

- Under 3 units per acre
- 3-6 units per acre
- 6-9 units per acre
- 9-12 units per acre
- 12 or more units per acre

San Francisco Bay Area Infill Capacity Study

Historical and recent densities can vary widely, depending on how one defines "recent." San Francisco's historical density, for example, is the highest in the Bay Area. Yet most of the housing constructed in San Francisco during mid-1990s was built at densities far lower than historical levels. This year, on the other hand, new housing projects in San Francisco are being built at densities higher than historical levels.

A principal argument for promoting infill is to make more intensive use of existing urban land, infrastructure, and services. To do so, it makes sense to consider densities that are higher than either historical or recent densities. How much higher? In addition to historical and recent densities, we evaluated infill levels at 125% of historical densities, 150% of historical densities, 100% of recent densities, 125% of recent densities, and 150% of recent densities. Increasing average densities by 50 percent above historical levels would result in prospective residential development densities that range from a low of 1.5 units per acre to a high of 60 units per acre. Increasing them by 50% above recent residential densities would result in residential development densities that range from a low of 1.5 units per acre to a high of 31 units per acre. Appendix C includes a city-by-city listing of all six-density sets.

Our decision to investigate the infill benefits of higher densities was not uncontroversial. Many who commented on earlier drafts of this paper believe that higher-than prevailing densities would not be acceptable to existing residents or local elected officials. Others believed that we were insufficiently ambitious in pushing the density envelope, and should have investigated density levels at 200% or more of historical densities.

Total Infill Potential-The Regional Picture

Assuming all available infill sites are developed as housing, and depending on the development density, the San Francisco Bay Area could accommodate between 890,000 and 1.39 million additional housing units within the existing urban footprint—that is, without further greenfield development (Exhibits 6, 7 and 8; Maps 6 and 7). The low end of this range assumes new infill housing is constructed at average historical densities. The high end assumes that new housing is constructed at 150% of historical average densities. If instead of historical densities, new infill housing were constructed at *recen*t average densities, the amount of infill housing the region could accommodate would fall to 357,000 units.

Exhibit 6: Net Housing Development Potential in All Infill and Recyclable Parcels by Density Scenario

County	Net New Housing Units if developed at:						Net Financially-feasible New Housing Units if developed at:					
	Historic Local Densities	Recent Average Densities	125% of Historic Densities	125% of Recent Average Densities	150% of Historic Densities	150% of Recent Average Densities	Historic Local Densities	Recent Average Densities	125% of Historic Densities	125% of Recent Average Densities	150% of Historic Densities	150% of Recent Average Densities
Alameda	72,326	98,051	95,804	132,624	122,905	171,935	6,316	4,424	8,177	5,769	9,842	7,074
Contra Costa	37,510	40,795	50,592	56,233	64,948	72,998	3,691	2,559	4,713	3,276	5,757	4,002
Marin	19,743	5,835	25,482	7,886	31,640	10,012	15,942	4,875	20,475	6,545	25,264	8,222
San Francisco	35,363	12,533	44,776	18,165	61,344	27,003	11,514	5,441	14,115	7,071	17,611	9,029
San Mateo	14,791	12,845	19,325	16,796	24,186	20,887	1,199	959	1,535	1,234	1,865	1,518
Santa Clara	75,798	58,953	100,540	77,901	127,922	98,822	28,979	19,559	37,970	26,251	47,227	33,192
Solano	36,293	21,845	45,469	27,354	54,630	32,951	2,717	1,296	3,394	1,623	4,074	1,951
Bay Area net of Napa & Solano Counties	291,824	250,857	381,988	336,959	487,575	434,608	70,358	39,113	90,379	51,769	111,640	64,988
Napa	248,266	85,339	310,510	106,770	372,863	128,208	184,522	44,984	230,780	56,290	277,090	67,593
Sonoma	350,787	20,840	438,947	26,396	527,478	31,974	291,232	6,599	364,160	8,344	437,271	10,109
Bay Area Total	890,877	357,036	1,131,445	470,125	1,387,916	594,790	546,112	90,696	685,319	116,403	826,001	142,690

Exhibit 7: Net Infill Housing Unit Potential by County, Density Scenario, and Financial Feasibility (excluding Napa and Sonoma Counties)

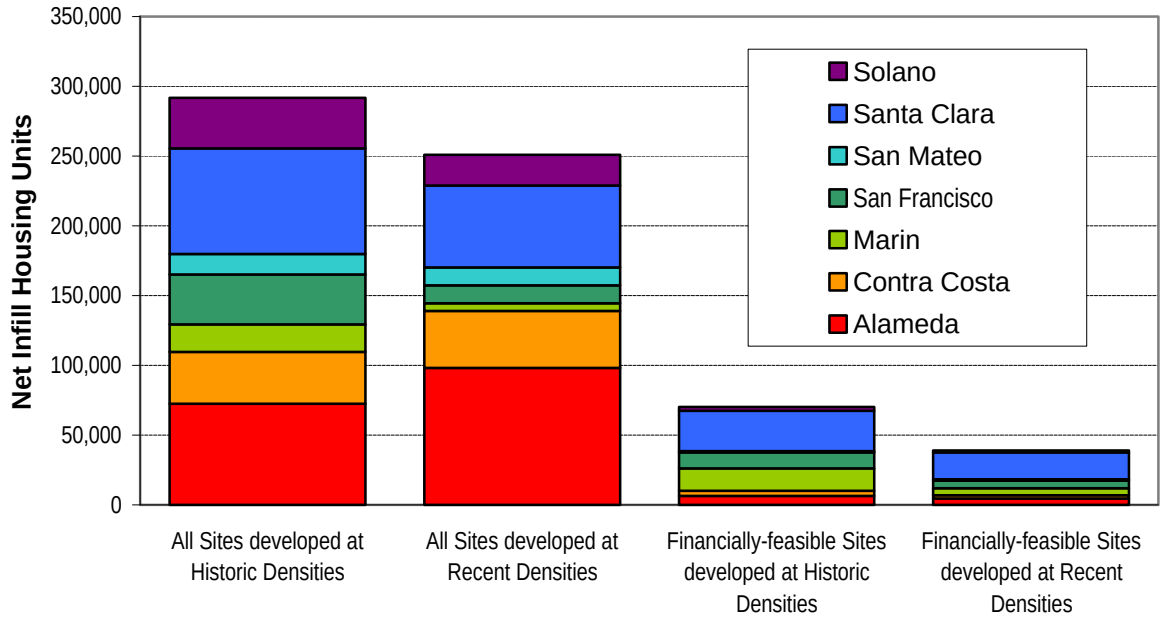
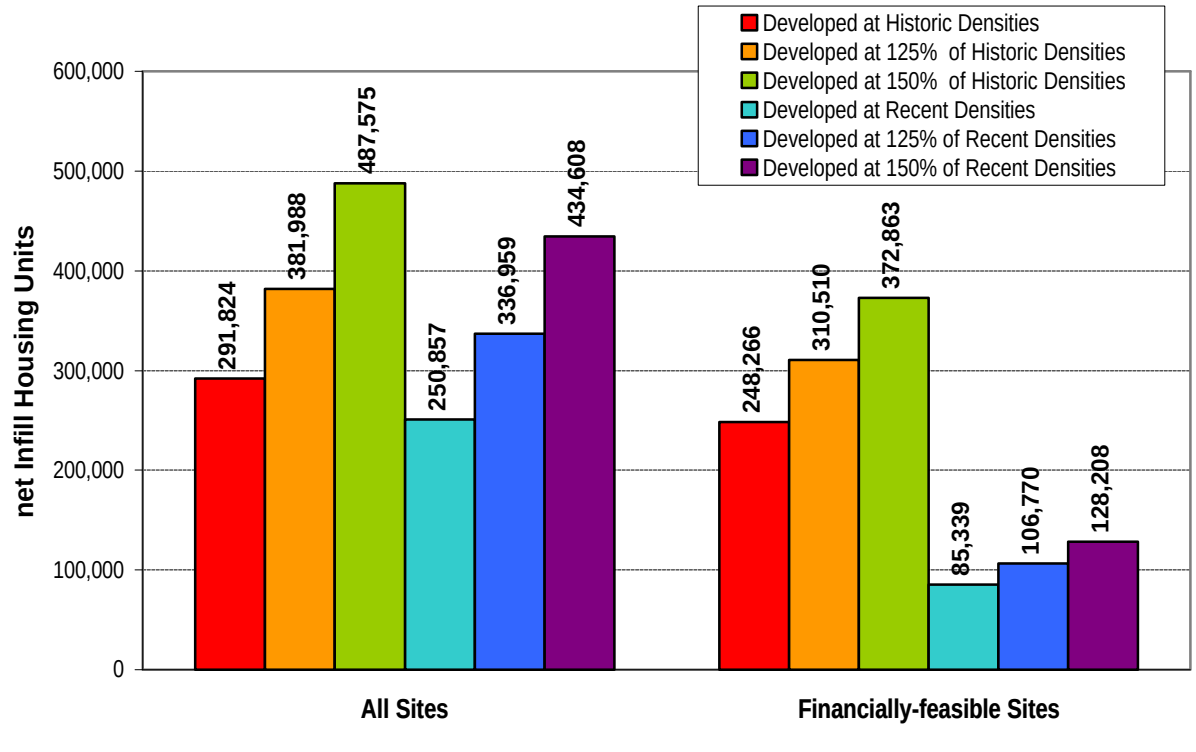
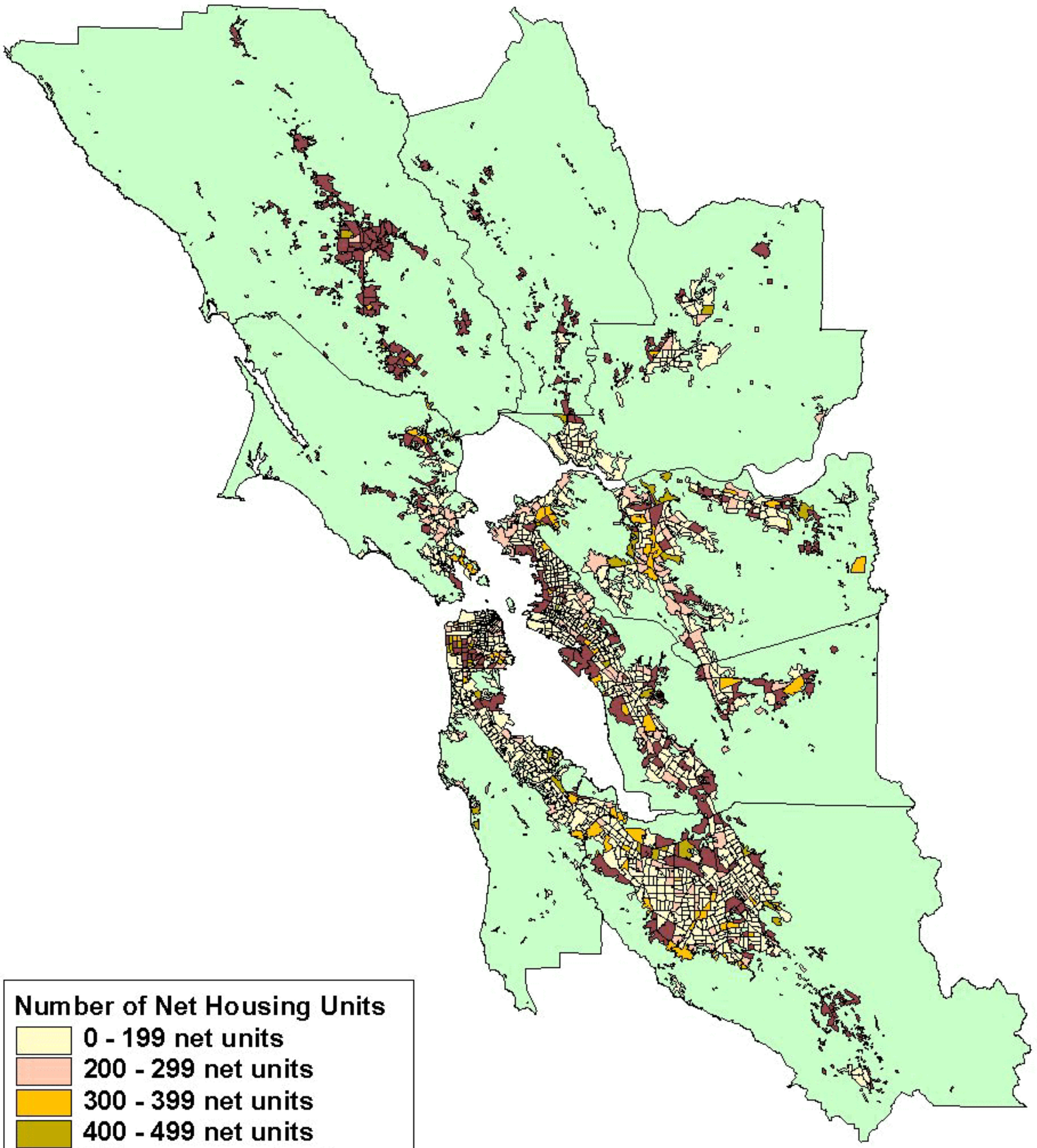


Exhibit 8: Net Infill Housing Unit Potential by County, Density Scenario, and Financial Feasibility (excluding Napa and Sonoma Counties)



Map 6:
Net Housing Units by Historical Density by Census Tract



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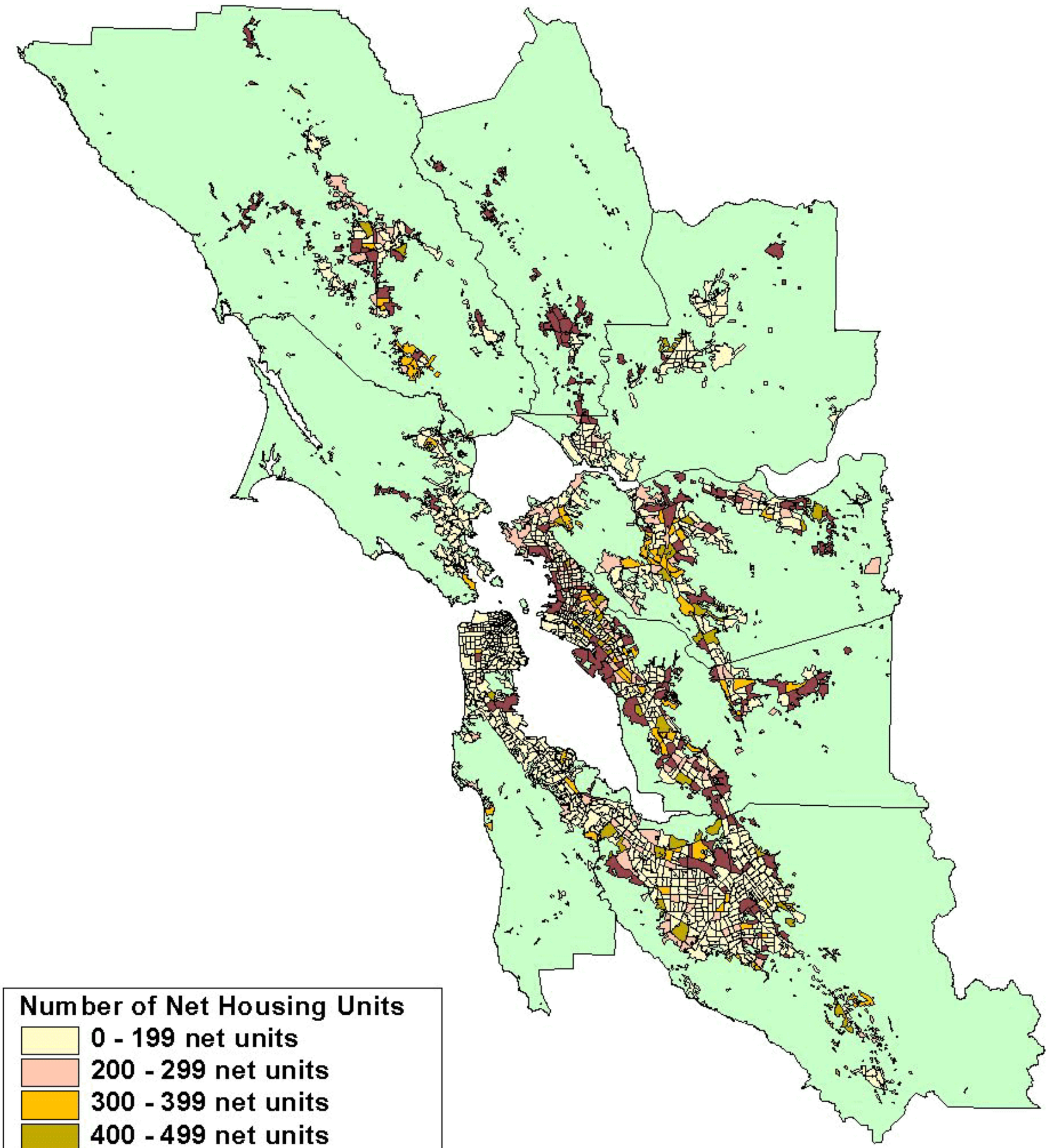
Map 7:
Net Housing Units by
Current Density by Census Tract



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These estimates are significantly inflated by the contributions of Napa and Sonoma Counties. Both counties have uncharacteristically large urban footprints containing tremendous amounts of vacant land. Netting out these two counties yields a more realistic range of 290,000 to 488,888 potential infill units. All results are reported as net additional housing units, which means they are net of the number of housing units currently located on potential refill sites.

Between now and the year 2020, the Association of Bay Area Governments projects that the Bay Area will need an additional 400,000 housing units to accommodate anticipated population and job growth. Thus, depending on where and how densely infill housing is developed, between 70% and 125% of the region's 20-year housing need could optimistically be expected to be accommodated via infill.

We say optimistic for several reasons. Some, perhaps many, available infill sites will likely be reserved for commercial or industrial development. This will reduce the supply of sites available for housing. Second, in many parts of the Bay Area—particularly Marin, San Francisco, and Solano counties—recent development densities have been well below historical densities. Residential land recycling in such locations thus results in a decrease in residential units. Third, and most important, residential development of many infill sites is simply not financially feasible given current market rents and development costs. Consider the right-hand side of Exhibit 6: evaluated at current local densities, and excluding Napa and Sonoma counties, imposing a 10% return requirement on new housing development would reduce the infill potential of the Bay Area from 291,000 new housing units to just over 70,000 units. Evaluated at recent densities, the region's residential infill capacity would be even lower, just 39,000 units.

As with everything in the Bay Area, infill potential— and the effects of zoning and economic constraints on that potential—varies by county. County results are reported in order of infill potential.

Santa Clara County: Of the nine Bay Area counties, Santa Clara has the most residential infill potential, at least on paper. If every potential infill site in Santa Clara County were developed at current density levels, the county could accommodate another 76,000 housing units without further incursion into greenfield areas. Developed at recent average densities instead of historical densities, this total falls to 59,000 units. By way of comparison, ABAG projects that the demand

for housing in Santa Clara County will increase by the equivalent of about 100,000 units between 2000 and 2020.

Achieving this level of production will not be easy. One-third of the county's recyclable land is zoned for non-residential development. Particularly in the "golden triangle" area of Sunnyvale, Santa Clara, and San Jose, housing will have to compete with commercial development. Economics are another problem. Land prices are so high throughout Santa Clara County that, except for the high-end of the market, new apartment construction simply isn't financially feasible. Of the 76,000 housing units that could potentially be built, only between 35% and 40% pencil-out financially.

Alameda County: Evaluated at current average densities, Alameda County includes enough infill sites to accommodate 72,000 additional housing units. Evaluated at recent average densities, that total rises to 98,000 housing units. Assuming a 50% increase over recent densities, Alameda County could accommodate an additional 172,000 infill housing units. By way of comparison, ABAG projects that the demand for housing in Alameda County will grow by the equivalent of 64,000 housing units between 2000 and 2020. Promoting increased infill activity would not result in a significant change in land use patterns as most of Alameda County's potential refill acreage is currently zoned for residential use.

The biggest constraint to expanding infill housing production in Alameda County is financial: less than 9% of the 72,000 infill housing units which could potentially be developed within Alameda County (assuming current densities) are financially feasible in today's real estate market. This is because apartment rents in the northern and eastern parts of the county are fairly low relative to land and construction costs.

Contra Costa County: Contra Costa County includes sufficient infill acreage to accommodate 37,500 additional housing units, evaluated at current average densities. Because densities are on the upswing in Contra Costa County, this total rises to 40,800 units if evaluated at recent average densities. Allowing for further increases in density, Contra Costa County includes sufficient infill land to accommodate nearly 73,000 additional housing units. According to the Association of Bay Area Governments, the demand for housing in Contra Costa County will grow by the equivalent of 61,000 units between 2000 and 2020.

As in Alameda County, most potential infill sites and acreage are already zoned for residential development. The biggest constraint to increased infill development in Contra Costa County, as in neighboring Alameda County, is financial. Given current rent levels and development costs, only 6% to 10% of the infill housing units in Contra Costa County that are physically feasible are also economically feasible.

Solano County: Solano County includes sufficient infill land to accommodate 36,000 additional housing units, if developed at current densities. Developed at recent densities, this acreage could accommodate 22,000 additional units. By way of comparison, ABAG projects that the number of households in Solano County will grow by almost 50,000 between 2000 and 2020.

Both these estimates are likely to be optimistic. Like Sonoma and Napa counties (see below), but unlike the rest of the Bay Area, most of Solano County's potential infill acreage is currently designated for non-residential use. Even more problematic, given current apartment rents and construction costs, fewer than ten percent of the infill units that are physically feasible are also economically feasible.

San Francisco: San Francisco, as noted earlier, contains very little vacant land. Most of the sites available for infill housing will have to be redeveloped. Fortunately, most refill sites and acreage in San Francisco are either zoned for housing or already in residential use. This is important in a city reluctant to alter its existing land use pattern. Evaluated at current average densities, the City and County of San Francisco includes enough infill sites to accommodate 35,000 additional housing units. By way of comparison, ABAG projects that the demand for housing in San Francisco will increase by the equivalent of about 25,000 units between 2000 and 2020.

The major constraints to expanded infill housing production in San Francisco are financial and political. On the financial side, and depending on the density scenario, between 30% and 43% of potential acreage could be profitably developed as housing. As high as apartment rents are in San Francisco, land and development costs are even higher. On the political side, in response to neighborhood concerns about parking and over-development, housing densities in San Francisco have been declining. The average density of San Francisco homes built between 1995 and 1999 was only about one-third of the density of the pre-1995 housing stock. Should these trends continue, instead of physically accommodating 35,000 additional infill housing units, San

Francisco could accommodate fewer than 13,000 additional units.

Marin: The Association of Bay Area Governments projects that the demand for housing in Marin County will increase by about 9,000 units between 2000 and 2020. There is enough available infill capacity in Marin County, evaluated at current average densities, to accommodate nearly 20,000 additional housing units—twice the amount of unit need projected by ABAG. Zoning is also not a problem: about 2/3 of infill acreage in Marin County is zoned for residential development. And because Marin County apartment rents are comparatively high, most potential infill units pass the economic feasibility test.

The biggest constraint to expanded infill housing production in Marin County is likely to be resident concerns about density. Recent residential densities in Marin County are only about a quarter of historical densities. If the trend toward reduced densities were to continue, instead of 20,000 additional infill housing units, Marin County would only be able to accommodate 6,000 units.

San Mateo: San Mateo County is mostly built-out and has little remaining vacant or recyclable land. At current average densities, we estimate that San Mateo County could accommodate another 14,700 infill units. If developed at recent average densities, this total would fall to approximately 13,000 additional units. Both of these estimates are on the optimistic side. About half of San Mateo's recyclable acreage is zoned for commercial development, and there is a strong demand for new office development, especially along Highway 101.

Economics is an even bigger problem. Apartment rents in San Mateo County, although rising, are relatively low compared to land and construction costs. Except for the high-end segment of the apartment market, additional multi-family construction simply doesn't pencil out. Depending on the density scenario, only 7% to 8% of potential infill units are financially feasible.

Sonoma County: If every infill parcel in Sonoma County were developed at historical densities, the county could accommodate more than 350,000 additional housing units. By way of comparison, between 2000 and 2020, the demand for housing in Sonoma County will grow by the equivalent of 45,000 housing units according to the Association of Bay Area Governments. In fact, this estimate is wildly over-stated. Because so many unincorporated areas of Sonoma

County are developed at urban densities, the county has a huge urban footprint—one that encompasses parcels that in other counties would be judged as greenfield lands. The amount of refill acreage available for housing is also overstated, partly because much of it is designated for non-residential use, but also because of the low-density nature of Sonoma County commercial uses.

The use of historical densities to estimate potential future infill is also problematic. Because it developed as a series of rural towns, Sonoma County historical densities are actually quite high. Recent development, however, has been occurring at much lower densities. The differences between historical and recent densities are startling. If all available infill parcels were developed at recent average densities instead of historical average densities, Sonoma County could accommodate 21,000 additional infill units, not 350,000.

Unlike other parts of the Bay Area, economics are not the major impediment to infill development in Sonoma County. Compared to market-rate apartment rents, land prices are still relatively low, making multi-family housing construction financially feasible. This may change when and if the recent tidal wave of rising land prices finally reaches Sonoma County.

Napa: The infill situation in Napa County closely parallels that of Sonoma. In theory, Napa County could accommodate nearly 250,000 additional infill housing units, if developed at current densities. Developed at recent densities, this total falls to 85,000 infill units. Both totals are more than enough to accommodate the 12,000-unit demand increase projected by ABAG for 2020.

In fact, Napa County's infill potential, although sizeable, is far less than these numbers would indicate. As in Sonoma County, many of the sites identified as infill sites should more appropriately be identified as greenfield sites. Likewise, particularly in the southern part of the county, many potential sites are designated for non-residential uses. Economics plays a lesser role. Napa County apartment rents are surprisingly high, so apartment construction is economically feasible. Depending on the density scenario, between 50% and 75% of potential infill housing units pass our basic financial feasibility test.

Infill Targets of Opportunity

To many of its champions, infill isn't just about building housing and saving greenfield. It's also about making greater use of available transit service, increasing opportunities for walking, and re-investing in economically depressed and socially isolated neighborhoods. Put another way, infill is also a mechanism for promoting what many call "sustainable development."

At least that's the idea. What's the reality? To find out—and leaving aside for the moment the question of exactly how one "targets" infill— we duplicated the infill potential analysis presented in the previous section for five sets of target neighborhoods. They include: (1) transit-rich neighborhoods; (2) job-rich neighborhoods; (3) concentrated poverty neighborhoods; (4) transit corridors/job-rich neighborhoods; and (5) transit corridors/concentrated poverty neighborhoods (see Maps 8, 9, and 10). As above, we considered infill potential regardless of financial feasibility, as well as incorporating a 10% profitability criterion. The results are as follows:

Transit-Rich Neighborhoods: Transit-rich neighborhoods were defined as lands within a quarter-mile radius of major AC Transit corridors and Amtrak, BART, CalTrain, light rail, and ferry stations (see Map 7). Increased residential development near transit, the argument goes, allows for greater utilization of existing transit service, reduced auto-dependence, and reduced road congestion and air pollution. If developed at historical densities, the Bay Area's major transit corridors could accommodate another 39,300 housing units (see Exhibit 9). This includes both infill and refill properties. If developed at recent average densities, the total would fall to 33,000 units. Increasing densities by 50% over historical levels would boost total infill units in transit corridors to 67,000. The vast majority of additional units would be located in three counties: Alameda (+13,600 units if developed at historical densities), San Francisco (+12,100 units if developed at historical densities), and Santa Clara County (+7,400 units). Elsewhere in the Bay Area, opportunities for transit-centered infill development are fairly negligible.

Given the extent of transit service in the Bay Area, these totals are lower than one might expect. There are three reasons why this is the case. First, we defined transit-rich neighborhoods solely as locations where riders could access regional transit service. We did not include local bus corridors, of which there are hundreds. Second, Alameda, Santa Clara, and San Francisco

counties—the three Bay Area counties with the most extensive regional transit service—are all fairly built-out and do not include much vacant land within their respective urban footprints. Third, most of the recyclable sites that fall within transit corridors are not economically underutilized. That is, they are occupied by structures worth at least 90% of the underlying site value. This last criteria is the most binding. Presumably, there are many more opportunities for transit-oriented development on sites that are adjacent to a transit line and are *not* economically underutilized.

Of all the infill units that could be developed within transit corridors, fewer than one in four is currently financially feasible. The reason is obvious. Apartment rents and housing prices near transit stops are no higher than elsewhere in the area; in most cases they are lower. Land, development, and construction costs, on the other hand, are often higher. This finding suggests that in the short-run, at least, encouraging greater transit-oriented development throughout the Bay Area will require some form of governmental assistance, either through land assembly and write-downs, regulatory relief, or lower-cost debt financing, or cash grants.[6] The financial side of the infill equation may improve in the long-run, but only if properties near transit stations begin selling or renting at premiums.[7]

Job-Rich Neighborhoods: Bay Area employment is extremely dispersed. According to the Association of Bay Area Governments, the nine-county region includes 365 census tracts with 3,000 or more jobs per square mile (see Map 8). It is this high degree of job-dispersion that is responsible for much of the region's traffic congestion. But it also presents an opportunity: one way to reduce traffic congestion, at least during commute hours, would be to encourage more housing construction within walking distance of employment.

Excluding Napa and Sonoma counties, the region's job-rich census tracts include sufficient infill land to accommodate over 70,000 additional housing units, if developed at current densities (see Exhibit 10). Developed at recent average densities, this total falls to 69,000 units. Developed at 150% of current densities, it rises to 120,000 units. As with transit-oriented development, the vast majority of these opportunity sites are in Alameda, Santa Clara, and San Francisco counties. To the extent that employment continues decentralizing, the number of infill opportunity sites in job-rich neighborhoods can only increase. Another potential positive is the increasing acceptance of mixed-use development. During the early 1990s, for example, a number of suburban business

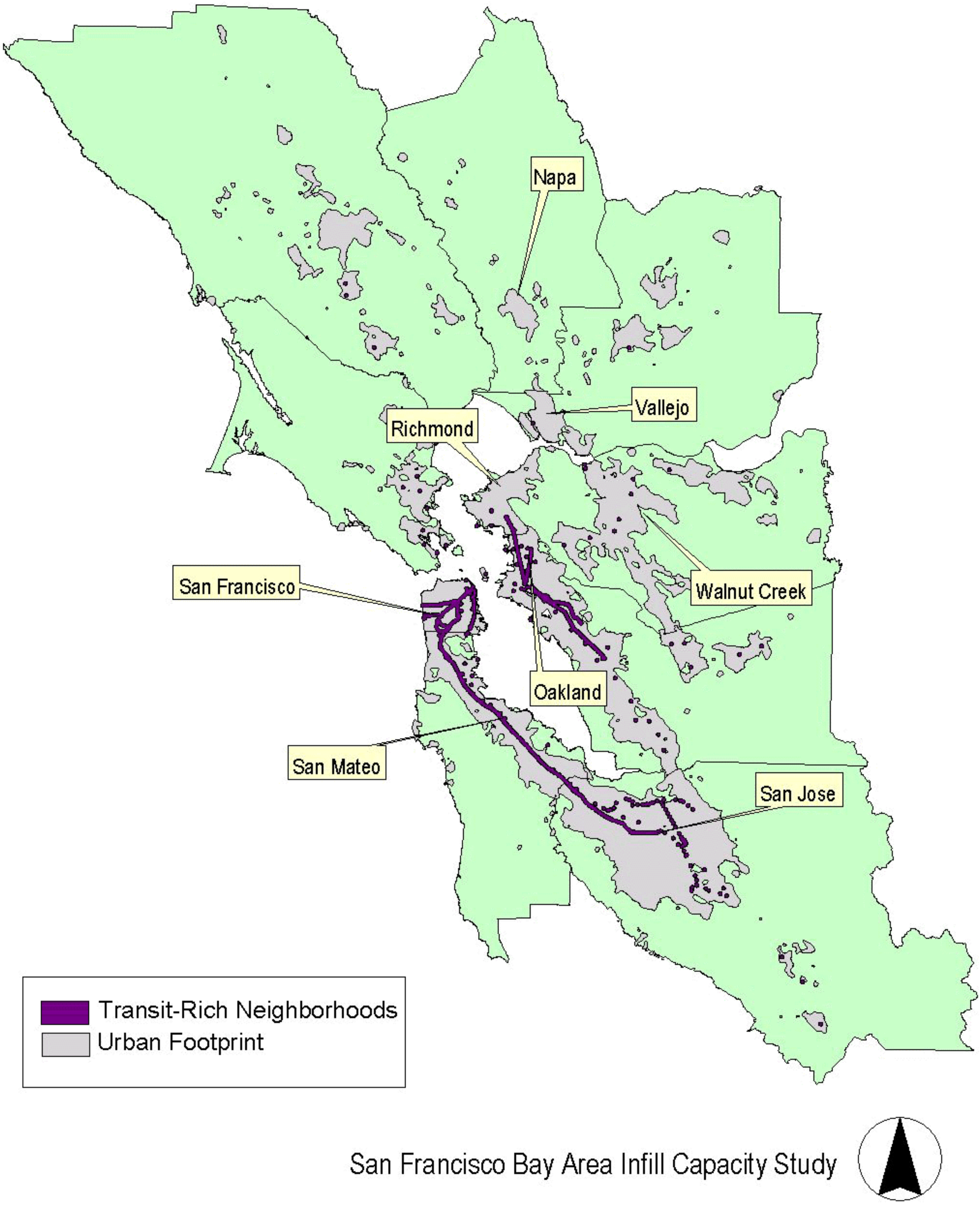
park developments were opened up to mixed use development and housing. Loft and live-work development continue to be extremely popular. And in San Francisco, plans are on the drawing board for combined buildings, which combine office and housing.

These promising trends notwithstanding, the economics of developing housing adjacent to commercial development remains tricky. New office and retail developments tend to push up land prices, often well above residential levels. Parcels adjacent to office/retail developments are sometimes small or are unusually shaped. Additional parking must also be accommodated, often in structures. All of these add to development costs. Of the 70,000 to 120,000 additional infill housing units that could be developed within job-rich census tracts (excluding Napa and Sonoma counties) only 12,000 - 20,000 units are financially feasible given current rent levels and construction costs. Allowing for additional infill development in census tracts adjacent to job-rich tracts, this range could conceivably double.

Most-Impoverished Neighborhoods: Poor households typically pay more for inferior quality housing. Focusing infill housing development (as well as other supporting investments) in low-income neighborhoods is one way of trying to re-integrate those neighborhoods back into the regional fabric. Based on 1990 census data, the Northern California Council for Communities identified 46 neighborhoods (comprised of 142 census tracts) as “concentrated poverty neighborhoods,” needing active reinvestment (see Map 9). These 46 neighborhoods, excluding those in Napa and Sonoma counties, could accommodate 21,000 additional housing units if developed at current average densities (see Exhibit 11). If developed at recent densities, this total falls to just over 20,000 units; at 150% of current densities, it rises to 34,000 housing units. Among counties, Alameda has by far the greatest infill potential (among concentrated poverty neighborhoods), followed by Solano, Contra Costa, San Francisco, and San Mateo far behind.

Why are infill opportunities in these neighborhoods so paltry? One answer is these neighborhoods lack vacant sites. Regardless of their economic status, the Bay Area’s core neighborhoods include relatively few vacant parcels. They also lack obvious refill sites. Not only are buildings in concentrated poverty neighborhoods worth less than structures in wealthy neighborhoods, so is the land underneath those structures. Thus, while many properties may be old and under-maintained, they might not meet the economic criteria of being underutilized. Put another way, there are few development bargains.

Map 8:
Transit-Rich Neighborhoods



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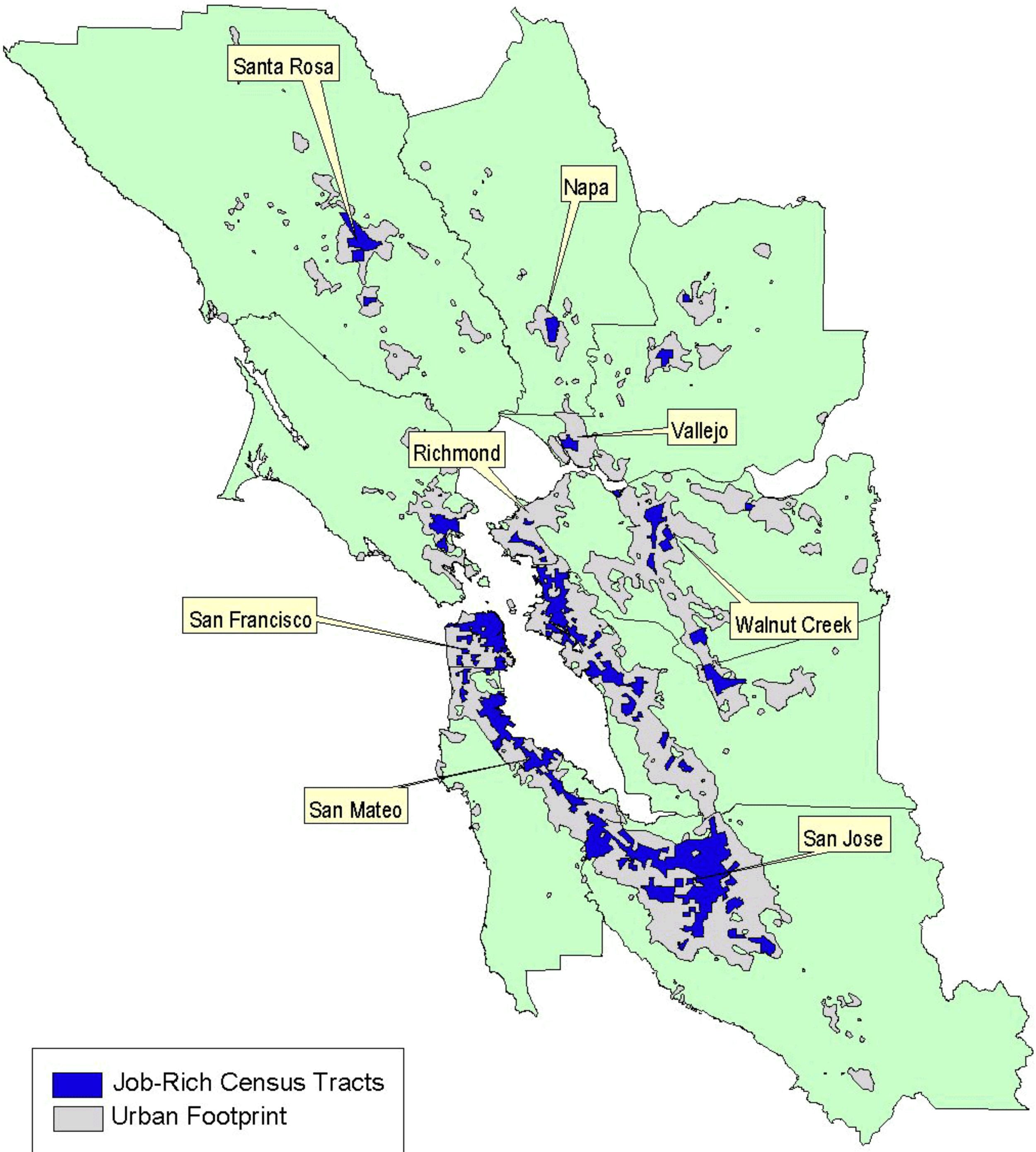
Map 9:
Job-Rich Neighborhoods



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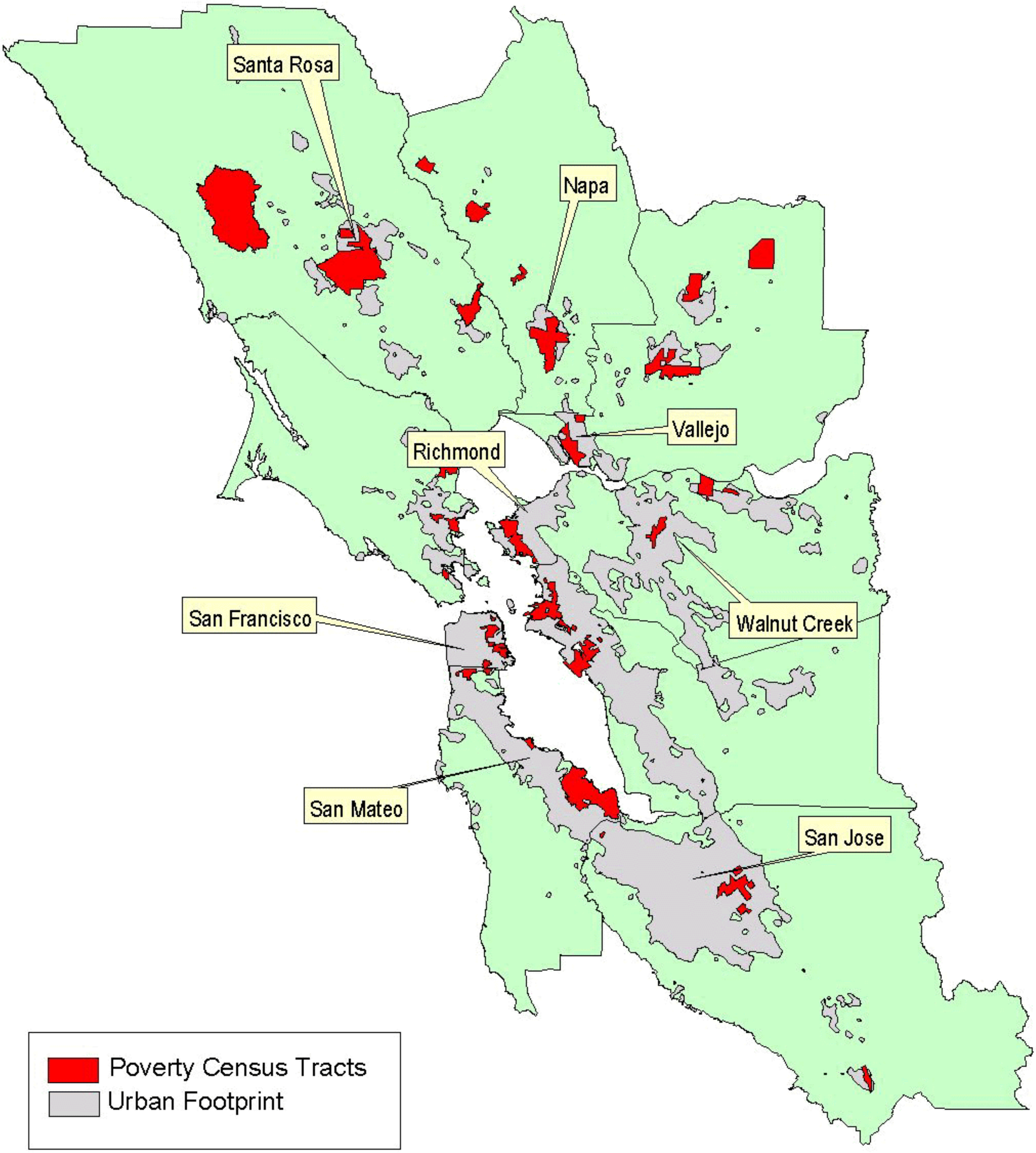
Map 10:
Most Impoverished Neighborhoods



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Economics makes the picture worse still. Of the 21,000 or so potential infill units identified above, fewer than 1,000 could be economically developed in today's market. The reasons for this are simple. As low as land costs are in distressed neighborhoods (compared with non-distressed neighborhoods), rents are even lower. Such is the cycle of disinvestment: the further and further neighborhoods fall behind the prevailing market, the more difficult it becomes for them to catch-up, and the greater the subsidy amounts needed to promote redevelopment. Among the 46 concentrated poverty neighborhoods identified by the Bay Area Sustainability Alliance, not one unit of market-rate housing was built during the 1990s. There is another trap as well. The greater the role of market-rate developers and projects in promoting the redevelopment of distressed neighborhoods, the greater the potential for gentrification and displacement. Pessimistic as they are, these findings suggest that if infill development is to be the mechanism by which residents of concentrated poverty neighborhoods are reintegrated into the regional economy, the infill process itself must be carefully planned, financed, and managed.

Job-Rich Neighborhoods and Transit-Rich Neighborhoods: Where people live and work determine how far and in what direction they have to travel during their daily commute. Building housing units near jobs that are in transit-rich neighborhoods is key to sustainable development. Developing these parcels at higher density could improve mobility, increase job access, and reduce traffic congestion. Parcels in transit-rich neighborhoods *and* job-rich neighborhoods are excellent candidates for higher density development. These parcels, if developed at the historical local densities, will yield 19,522 additional housing units. If these parcels were developed at 150% of the historic local density, 32,345 housing units would be added to the region's housing stock. The paucity of parcels in transit-rich neighborhoods and job-rich neighborhoods suggests that the majority of transit-rich neighborhoods are independent of job-rich neighborhoods and vice-versa. It may be more politically feasible to develop at 150% of the historic local density, but the net housing gain barely makes a dent into the projected housing for the region. Seventy-two percent of the additional housing stock would be in Alameda and San Francisco counties. Even though we could potentially add 20,000 housing units at the historical local densities, only 4,266 units could be added on parcels that were financially profitable. Seventy-three percent of the additional housing stock on financially profitable land would be in Alameda County, 18% would be in San Francisco County and 9% would be in Santa Clara County.

Exhibit 9: Net Housing Development Potential Among Infill and Recyclable Parcels in Transit-rich Neighborhoods, by Density Scenario

County	Net New Housing Units if developed at:			Net Financially-feasible New Housing Units if developed at:		
	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities
Alameda	13,609	17,670	23,888	3,713	2,269	5,816
Contra Costa	995	995	1,681	0	0	0
Marin	301	195	490	184	133	307
Napa	0	0	0	0	0	0
San Francisco	12,101	3,586	21,467	1,981	617	3,194
San Mateo	4,228	4,085	6,614	4	2	12
Santa Clara	7,446	6,237	11,966	3,306	2,782	5,185
Solano	25	17	43	0	0	0
Sonoma	640	171	961	417	98	626
Bay Area Total	39,345	32,956	67,110	9,605	5,901	15,140

Exhibit 10: Net Housing Development Potential Among Infill and Recyclable Parcels in Job-rich Neighborhoods, by Density Scenario

County	Net New Housing Units if developed at:			Net Financially-feasible New Housing		
	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities
Alameda	25,510	32,583	41,812	4,524	2,649	6,954
Contra Costa	3,806	4,553	6,331	10	13	18
Marin	3,234	697	5,148	865	493	1,456
Napa	51,095	20,849	76,679	30,312	8,259	45,493
San Francisco	10,317	4,452	17,018	1,646	647	2,543
San Mateo	6,184	5,325	9,677	482	355	737
Santa Clara	22,504	20,136	37,663	4,385	4,039	7,442
Solano	1,123	674	1,721	2	2	4
Sonoma	21,008	2,588	31,682	11,175	118	16,676
Bay Area Total	144,781	91,857	227,731	53,401	16,575	81,323

Exhibit 11: Net Housing Development Potential Among Infill and Recyclable Parcels in Impoverished Neighborhoods, by Density Scenario

County	Net New Housing Units if developed at:			Net Financially-feasible New Housing Units if developed at:		
	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities
Alameda	8,061	10,688	13,217	482	188	811
Contra Costa	2,709	3,488	4,544	7	10	11
Marin	474	298	760	146	103	239
Napa	110,579	45,173	165,997	72,007	22,472	108,089
San Francisco	2,427	1,286	3,663	504	208	755
San Mateo	2,005	1,351	3,216	9	8	14
Santa Clara	1,751	1,542	2,836	110	107	176
Solano	2,856	1,718	4,345	111	58	168
Sonoma	38,831	5,043	58,595	20,074	743	30,077
Bay Area Total	169,693	70,587	257,173	93,450	23,897	140,340

Exhibit 12: Net Housing Development Potential Among Infill and Recyclable Parcels in Job and Transit-rich Neighborhoods, by Density Scenario

County	Net New Housing Units if developed at:			Net Financially-feasible New Housing		
	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities
Alameda	9,640	11,974	16,189	3,110	1,901	4,826
Contra Costa	735	693	1,201	0	0	0
Marin	59	40	83	5	4	7
Napa	0	0	0	0	0	0
San Francisco	4,430	1,855	7,350	764	281	1,169
San Mateo	1,908	1,619	3,004	3	2	8
Santa Clara	2,733	2,277	4,492	384	340	681
Solano	8	7	12	0	0	0
Sonoma	9	11	14	0	0	0
Bay Area Total	19,522	18,476	32,345	4,266	2,528	6,691

Exhibit 13: Net Housing Development Potential Among Infill and Recyclable Parcels in Impoverished and Transit-rich Neighborhoods, by Density Scenario

County	Net New Housing Units if developed at:			Net Financially-feasible New Housing Units if developed at:		
	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities	Historic Local Densities	Recent Local Densities	150% of Historic Local Densities
Alameda	2,419	3,452	4,052	174	68	289
Contra Costa	63	90	117	0	0	0
Marin	63	46	89	9	10	13
Napa	0	0	0	0	0	0
San Francisco	1,175	632	1,725	152	56	218
San Mateo	282	240	447	1	1	2
Santa Clara	335	292	505	9	9	14
Solano	23	17	39	0	0	0
Sonoma	0	0	0	0	0	0
Bay Area Total	4,360	4,769	6,974	345	144	536

Impoverished Neighborhoods and Transit-Rich Neighborhoods: Connecting poor neighborhoods to the regional economy is another key element to building a sustainable community. Focusing higher housing development in transit-rich neighborhoods is one strategy that could be used to increase housing and transportation access in poor neighborhoods. Several transit oriented development projects are underway or are on the drawing boards in poverty neighborhoods, (e.g., Fruitvale BART station, Richmond BART station, and MacArthur BART station). These parcels, if developed at the historical densities, will yield only 4,360 additional housing units. If they are developed at the recent local densities, 4,769 additional housing units could be accommodated. If these parcels were developed at 150% of the historic local density, 6,974 housing units would be added to the region's housing stock. Eighty-two percent of the additional housing stock would be in Alameda and San Francisco counties. The picture is not very optimistic in terms of adding housing; the picture is even more discouraging when we look at the financial feasibility of the land and how much housing could be added. Only 345 additional housing units could be added on financially profitable land if developed at the historic local densities. If developed at the recent local densities, 144 additional housing units could be added. Most all the housing units on financially profitable land is in Alameda and San Francisco counties.

Policy Approaches To Targeting Infill

Assuming it was the policy of local, regional, or state government agencies[8] to target infill, how might that be accomplished? Pro-infill public policies can take three forms: (1) government agencies and non-profit entities, together with private partners, can take it upon themselves to acquire infill sites and construct infill projects; (2) government agencies can offer subsidies to reduce the costs of infill development in select locations; and, (3) public agencies may relax selected land use and environmental regulations and/or reduce development fees. The first option is commonly associated with the federal urban renewal program of the 1950s and 1960s and remains politically unpopular on anything other than a case-by-case basis. The second and third options, although politically more feasible than the first, have their own difficulties, particularly in California, where local governments are chronically strapped for cash and where the local regulatory process is always uncertain.

The generic difficulties of developing infill housing aside, different circumstances will require

different approaches. To promote infill development in concentrated poverty areas will require a combination of land acquisition, deep construction and occupancy subsidies—at least in the short-run—and regulatory relief. To promote infill development in and around transit stations will likely require some combination of land write-downs and loosened zoning and density restrictions. Depending on the target market, subsidies may also be required. To promote greater residential infill activity near job centers will require local governments to actively "zone-in" mixed use projects, as well as to loosen density and use restrictions. In all such cases, it is hoped that early, focused, and successful government intervention will help reduce the risks of successive infill developments and demonstrate to private developers that the market for infill housing is real, sizeable, and most of all, profitable.

CONCLUSIONS AND RECOMMENDATIONS

The results of this analysis lead to five conclusions regarding the potential for increased residential infill activity in the San Francisco Bay Area. First, there is ample land available for infill housing construction. Depending on the county and the density of new development, upwards of 1/3 of projected housing demand could be accommodated within the existing urban footprint. Second, most of the land available for infill development is not currently vacant—that is, it is already developed and would have to be recycled. Third, most recyclable sites are currently in non-residential use, and may therefore be difficult and/or expensive to make available for residential use. There are likely political difficulties as well. Cities hoping to expand their jobs base may be reluctant to release or rezone under-utilized commercial sites for residential use whatever the need for housing. Fourth, in many jurisdictions, building at higher-than-historical densities offers significant potential for increasing residential infill yields. At the same time, advocating for expanded infill development *and* for higher densities is likely to make the task of convincing suburban communities to accept more infill development all the more difficult. Lastly, the biggest constraint to developing infill housing is economic, not physical. Because of high land costs and construction costs, and despite record high rents, there are many infill locations where multi-family housing simply doesn't "pencil out." For infill housing to be developed in these locations, some form of subsidy or market intervention will be required.

Beyond these general findings, several specific conclusions emerge regarding opportunities, or the lack thereof, for targeted infill. The conventional wisdom is that there are ample infill and

land recycling opportunities near rail transit stations, near regional job centers, and in previously passed-over poverty neighborhoods. In fact, the opportunities for infill and refill in such neighborhoods are more limited than commonly understood:

- Infill land within the Bay Area's transit-rich neighborhoods, if developed at historical densities, could accommodate another 39,300 housing units. This includes both infill and refill properties. Increasing densities by 50% over historical levels would boost total infill units in transit corridors to 67,000. In fact, most of the neighborhoods around transit stops are quite built-out. Nor are the properties in such neighborhoods systematically undervalued. Other than building directly on transit properties (such as parking lots), development opportunities near transit stops consist mostly of replacing one housing use with another. This will not be easy in the current market environment where fewer than one-in-four infill housing units near transit is financially feasible.

- There are even fewer infill development opportunities in the region's most impoverished neighborhoods. Excluding those in Napa and Sonoma counties, infill and refill parcels in the region's 46 most impoverished neighborhoods could accommodate only 21,000 additional housing units if developed at current average densities. If developed at 150% of current densities, this total rises to 34,000 housing units. As with transit-rich neighborhoods, concentrated poverty neighborhoods include relatively few vacant parcels. They also lack obvious refill sites. While many of the properties in these neighborhoods may be old and under-maintained, they do not meet our criteria of being economically under-utilized. In the current market, development in such locations will require significant public intervention and/or subsidy.

- Opportunities for developing infill housing near job centers are somewhat greater. Excluding Napa and Sonoma counties, the region's job-rich census tracts include sufficient infill land to accommodate over 70,000 additional housing units, if developed at current densities. Developed at 150% of current densities, this total rises to 120,000 units.

In addition to data summaries and analysis, this paper includes links to the individual parcel data behind the analysis. How might Bay Area jurisdictions take best advantage of this data for their own infill planning efforts?

1. Check vacant land parcel records for accuracy. The data used in this study is drawn from county tax assessor's parcel files. Jurisdictions interested in promoting increased infill development should review these records for accuracy, paying particular attention to parcel size, location, zoning attributes, and whether or not the parcel is actually vacant.

2. Review the roster of under-utilized parcels. We used a single region-wide improvement value-to-land value ratio of .9 to identify parcels, which are economically underutilized. This may or may not be appropriate in all locations and circumstances. Local planners should review our list of under-utilized parcels accordingly.

3. Distinguish between individual infill/refill opportunity parcels and parcel clusters: Because the infill and refill parcel data are already geo-coded, it is possible, with a little additional work, to locate them on a map and to distinguish small individual parcels from larger parcel clusters. From a planning perspective, it is also possible to identify parcels and parcel clusters that are most appropriately developed in residential use vs. non-residential use. Lastly, it is possible to identify parcels that are currently constrained from being developed by environmental conditions, adjacent land uses, and/or unfavorable economics. We have undertaken these assessments using region-wide criteria which may or may not be appropriate for individual municipalities.

4. Develop pro-infill approaches and programs to deal with specific infill constraints at particular locations. Encouraging greater infill activity will require matching appropriate programmatic approaches to particular sites. In some locations, the principal constraint to infill development is lots that are either too small or are too oddly shaped to be economically developed. Publicly-coordinated site assembly initiatives could help address this issue. Elsewhere, residential infill may be inconsistent with local zoning designations—designations which could be changed where appropriate. Where site acquisition and or infrastructure costs are too high (relative to rents or sale prices), local redevelopment agencies could undertake land write-downs, or help finance new infrastructure development. Lastly, there may be specific parcels where, in the name of broad-scale community development, local governments, foundations, lenders, and others wish to concentrate their efforts.

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NOTES

[1] None of these arguments are particularly new. All were used in the 1940s and 1950s in a slightly different form to justify large-scale urban renewal. Where today's approaches to infill development differ from urban renewal is in their emphasis on smaller-scale development appropriate to the existing neighborhood context, and in their de-emphasis on site clearance and large-scale land assembly.

[2] The "urban footprint" was identified on the basis of the "urban" category used by the California Farmland Mapping and Monitoring Project (CFMMP). CFMMP sets the line between urban and non-urban at roughly one-unit per two acres.

[3] Despite changes in assessment practices following the 1978 passage of Proposition 13, we found little evidence that the improvement-to-land ratio was biased across time.

[4] As identified by the Bay Area Sustainability Alliance. Impoverished census tracts were defined as those in which the median income was less than 50% of the county-wide median household income.

[5] Based on published estimates by the Association of Bay Area Governments.

[6] Indeed, all the transit-oriented development projects developed so far in the Bay Area have required one or more forms of government assistance.

[7] In the Washington, D.C. area, for example, apartments adjacent to Metro stops generally rent for $200 - $500 more per month than non-adjacent units. Such premiums are to be found nowhere in the Bay Area.

[8] We include agencies such as BART or MUNI as regional public entities.

Appendix A
Parcel Data

To get a copy of the data used for this report contact:

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Appendix B
Historical and Recent Densities

Appendix B - Historical and Current Density for Selected Cities

COUNTY	City	Historical Density	Greater Than 25 Percent of Historical Density	Greater Than 50 Percent of Historical Density	Current Density	Greater Than 25 Percent of Current Density	Greater Than 50 Percent of Current Density
ALAMEDA	ALAMEDA	11.9	14.9	17.9	14.7	18.4	27.6
	ALBANY	14.0	17.5	21.0	14.0	17.5	26.3
	BERKELEY	10.4	13.0	15.6	15.1	18.8	28.2
	DUBLIN	4.9	6.2	7.4	6.3	7.9	11.9
	EMERYVILLE	40.1	50.1	60.2	20.7	25.9	38.9
	FREMONT	4.9	6.2	7.4	7.9	9.8	14.7
	HAYWARD	6.7	8.4	10.1	8.3	10.4	15.5
	LIVERMORE	4.3	5.4	6.5	6.3	7.9	11.8
	NEWARK	5.4	6.8	8.1	7.3	9.1	13.7
	OAKLAND	8.4	10.6	12.7	11.6	14.6	21.8
	PIEDMONT	3.9	4.9	5.8	5.2	6.5	9.7
	PLEASANTON	5.2	6.4	7.7	5.1	6.4	9.6
	SAN LEANDRO	7.4	9.2	11.1	9.7	12.1	18.1
	UNION CITY	5.4	6.7	8.0	8.9	11.1	16.6
CONTRA COSTA	ANTIOCH	4.5	5.6	6.8	6.6	8.3	12.4
	BRENTWOOD	5.6	7.0	8.4	3.4	4.2	6.3
	CLAYTON	3.2	4.0	4.8	2.8	3.5	5.2
	CONCORD	5.0	6.3	7.5	6.4	8.0	12.0
	DANVILLE	2.4	3.0	3.6	3.7	4.6	6.9
	EL CERRITO	8.2	10.3	12.3	7.4	9.2	13.9
	HERCULES	4.1	5.1	6.1	13.6	17.1	25.6
	LAFAYETTE	1.8	2.2	2.6	1.7	2.1	3.2
	MARTINEZ	5.3	6.6	7.9	5.0	6.2	9.3
	MORAGA	2.3	2.9	3.5	3.6	4.5	6.7
	OAKLEY	4.7	5.9	7.1	3.7	4.6	6.9
	ORINDA	1.3	1.7	2.0	1.6	2.0	3.0
	PINOLE	5.5	6.9	8.3	4.4	5.5	8.2
	PITTSBURG	7.3	9.1	11.0	6.6	8.2	12.3
	PLEASANT HILL	4.8	6.0	7.2	4.4	5.6	8.3
	RICHMOND	7.7	9.7	11.6	9.2	11.5	17.2
	SAN PABLO	9.8	12.3	14.7	8.8	11.0	16.5
	SAN RAMON	4.3	5.3	6.4	7.9	9.8	14.8
	WALNUT CREEK	5.2	6.6	7.9	5.9	7.3	11.0
MARIN	BELVEDERE	3.4	4.3	5.2	4.2	5.3	7.9
	CORTE MADERA	4.0	5.0	6.0	5.2	6.5	9.8
	FAIRFAX	3.9	4.8	5.8	4.3	5.4	8.1
	LARKSPUR	10.6	13.2	15.8	6.8	8.5	12.8
	MILL VALLEY	5.6	7.0	8.4	4.5	5.6	8.4
	NOVATO	4.2	5.3	6.3	3.0	3.7	5.6
	ROSS	0.9	1.1	1.4	1.6	1.9	2.9
	SAN ANSELMO	2.2	2.7	3.2	3.6	4.5	6.8
	SAN RAFAEL	6.0	7.5	9.0	4.4	5.5	8.3
	SAUSALITO	29.3	36.6	43.9	12.3	15.4	23.1
	TIBURON	5.0	6.2	7.5	2.7	3.3	5.0

NAPA	AMERICAN CANYON	7.3	9.1	10.9	5.0	6.3	9.4
	CALISTOGA	5.0	6.2	7.5	2.0	2.5	3.8
	NAPA	6.4	8.0	9.6	2.6	3.3	4.9
	ST. HELENA	4.3	5.4	6.5	3.4	4.3	6.4
	YOUNTVILLE	4.9	6.1	7.3	15.8	19.7	29.6
SAN FRANCISCO	SAN FRANCISCO	25.1	31.4	37.7	16.6	20.7	31.1
SAN MATEO	ATHERTON	0.9	1.1	1.3	1.3	1.6	2.4
	BELMONT	6.4	8.0	9.6	5.1	6.4	9.6
	BRISBANE	6.2	7.8	9.4	12.4	15.5	23.2
	BURLINGAME	7.8	9.8	11.7	3.9	4.9	7.4
	COLMA	9.3	11.6	13.9	1.9	2.4	3.5
	DALY CITY	12.7	15.9	19.1	11.2	14.0	21.0
	EAST PALO ALTO	7.8	9.7	11.7	3.4	4.3	6.5
	FOSTER CITY	8.4	10.5	12.6	6.3	7.8	11.7
	HALF MOON BAY	4.6	5.8	6.9	4.7	5.9	8.9
	HILLSBOROUGH	1.3	1.7	2.0	1.7	2.1	3.1
	MENLO PARK	5.2	6.5	7.8	4.9	6.2	9.3
	MILLBRAE	5.6	7.0	8.4	7.5	9.4	14.1
	PACIFICA	6.8	8.5	10.2	6.5	8.1	12.2
	PORTOLA VALLEY	1.3	1.6	1.9	2.1	2.7	4.0
	REDWOOD CITY	9.0	11.2	13.4	6.8	8.5	12.7
	SAN BRUNO	8.2	10.3	12.4	8.9	11.1	16.6
	SAN CARLOS	5.7	7.1	8.5	4.3	5.4	8.1
	SAN MATEO	7.8	9.7	11.6	7.1	8.9	13.3
	WOODSIDE	0.5	0.7	0.8	0.6	0.7	1.1
SANTA CLARA	CAMPBELL	6.8	8.5	10.2	4.8	6.0	8.9
	CUPERTINO	5.3	6.7	8.0	7.1	8.9	13.3
	GILROY	5.3	6.7	8.0	0.5	0.6	0.9
	LOS ALTOS	3.0	3.8	4.5	3.6	4.4	6.7
	LOS ALTOS HILLS	0.6	0.8	0.9	0.6	0.8	1.2
	LOS GATOS	3.6	4.5	5.4	2.3	2.8	4.2
	MILPITAS	6.0	7.5	9.0	4.8	6.0	9.0
	MONTE SERENO	1.4	1.7	2.1	1.9	2.3	3.5
	MORGAN HILL	4.4	5.5	6.6	1.1	1.4	2.1
	MOUNTAIN VIEW	8.1	10.2	12.2	5.6	6.9	10.4
	PALO ALTO	5.1	6.4	7.7	6.1	7.7	11.5
	SAN JOSE	6.4	8.0	9.6	6.2	7.8	11.7
	SANTA CLARA	7.5	9.4	11.3	5.9	7.4	11.1
	SARATOGA	4.4	5.5	6.6	2.1	2.6	3.8
	SUNNYVALE	7.3	9.1	10.9	5.8	7.3	10.9
SOLANO	BENICIA	5.0	6.2	7.5	4.2	5.2	7.8
	DIXON	4.7	5.8	7.0	2.4	3.0	4.4
	FAIRFIELD	7.0	8.8	10.5	4.0	4.9	7.4
	RIO VISTA	7.1	8.8	10.6	3.2	4.0	6.0
	SUISUN CITY	3.1	3.9	4.7	2.0	2.5	3.8
	VACAVILLE	4.3	5.4	6.5	1.4	1.7	2.6
	VALLEJO	4.6	5.7	6.9	5.7	7.1	10.7
SONOMA	CLOVERDALE	5.4	6.7	8.1	1.2	1.6	2.3
	COTATI	3.4	4.2	5.1	1.3	1.7	2.5
	HEALDSBURG	4.0	5.0	5.9	2.6	3.3	4.9
	PETALUMA	5.1	6.3	7.6	1.6	2.0	3.1
	ROHNERT PARK	6.7	8.4	10.1	7.9	9.8	14.8
	SANTA ROSA	6.1	7.6	9.1	1.5	1.9	2.9
	SEBASTOPOL	46.6	58.3	69.9	2.6	3.3	4.9
	SONOMA	4.1	5.1	6.1	2.6	3.3	4.9
	WINDSOR	6.1	7.6	9.1	2.2	2.8	4.1

Appendix C
Net Housing Units and Acres

Appendix C - Net Housing Units, Net Financially Feasible Housing Units and Acres for Selected Cities

COUNTY	City	Vacant Acres	Non Vacant Acres	Net Housing Units at Historical Densities	Net Housing Units at Current Densities	Net Financially Feasible Housing Units at Historical Densities	Net Financially Feasible Housing Units at Current Densities
ALAMEDA	ALAMEDA	103.4	76.0	1,825	2,313	610	755
	ALBANY	1.6	264.0	1,984	1,985	0	0
	BERKELEY	301.6	1274.1	7,841	14,379	0	0
	DUBLIN	206.0	113.0	1,294	1,685	4	4
	EMERYVILLE	38.2	98.6	4,844	2,279	4,800	2,259
	FREMONT	581.7	969.3	5,146	8,781	634	1,064
	HAYWARD	226.4	1268.5	5,354	6,987	0	0
	LIVERMORE	1450.2	956.4	9,549	14,077	0	0
	NEWARK	61.5	179.4	825	1,145	115	159
	OAKLAND	452.5	3695.6	16,302	25,627	0	0
	PIEDMONT	5.4	268.0	178	298	0	0
	PLEASANTON	470.2	1058.3	7,090	7,067	102	102
	SAN LEANDRO	79.3	1349.7	3,514	5,271	7	8
	UNION CITY	90.8	140.1	899	1,501	44	73
CONTRA COSTA	ANTIOCH	232.9	303.5	1,922	2,890	0	0
	BRENTWOOD	191.9	280.6	2	1	1,873	1,111
	CLAYTON	12.1	73.6	193	160	16	13
	CONCORD	120.9	1434.3	3,683	5,128	161	211
	DANVILLE	119.9	622.4	783	1,412	0	0
	EL CERRITO	15.6	417.8	1,308	1,138	0	0
	HERCULES	0.6	17.6	8	127	4	16
	LAFAYETTE	194.5	1108.4	1,089	1,036	0	0
	MARTINEZ	164.3	488.4	2,507	2,338	0	0
	MORAGA	46.2	312.2	327	611	0	0
	OAKLEY	73.3	276.3	1,552	1,215	0	0
	ORINDA	57.0	794.2	261	392	0	0
	PINOLE	10.4	151.5	411	296	0	0
	PITTSBURG	721.5	246.1	6,594	5,941	0	0
	PLEASANT HILL	44.5	620.7	1,023	906	0	0
	RICHMOND	93.9	788.3	2,927	3,712	0	0
	SAN PABLO	45.0	266.3	1,335	1,106	0	0
	SAN RAMON	123.0	428.1	1,053	2,344	0	0
	WALNUT CREEK	94.0	1315.9	3,932	4,783	0	0
MARIN	BELVEDERE	0.4	14.1	570	156	0	0
	CORTE MADERA	6.3	74.6	131	197	129	193
	FAIRFAX	27.1	52.2	165	184	114	127
	LARKSPUR	2.1	38.7	227	98	214	95
	MILL VALLEY	29.0	249.9	597	395	533	351
	NOVATO	300.5	413.6	2,514	1,726	2,420	1,666
	ROSS	8.4	144.4	25	85	4	13
	SAN ANSELMO	98.4	212.6	344	661	174	332
	SAN RAFAEL	43.9	365.5	1,491	1,011	1,182	803
	SAUSALITO	5.0	39.1	1,017	287	718	199
	TIBURON	10.2	93.1	254	89	216	73

NAPA	AMERICAN CANYON	308.2	532.0	6,054	4,167	5,486	3,776
	CALISTOGA	632.8	2695.5	16,566	6,663	0	0
	NAPA	3747.6	12467.4	102,755	41,860	92,637	37,755
	ST. HELENA	1890.3	5853.0	33,387	26,394	0	0
	YOUNTVILLE	5.7	198.4	971	3,185	747	2,423
SAN FRANCISCO		190.1	2373.7	35,363	12,533	11,514	5,441
SAN MATEO	ATHERTON	13.4	475.2	84	204	2	7
	BELMONT	5.2	111.0	549	426	0	0
	BRISBANE	0.5	8.2	34	74	0	0
	BURLINGAME	20.2	84.9	711	344	0	0
	COLMA		20.9	179	33	0	0
	DALY CITY	19.6	64.1	861	754	0	0
	EAST PALO ALTO	19.9	67.2	577	242	0	0
	FOSTER CITY	0.5	78.1	636	467	577	426
	HALF MOON BAY	12.8	96.6	482	491	0	0
	HILLSBOROUGH	23.2	156.9	141	179	0	0
	MENLO PARK	29.4	326.8	997	930	9	8
	MILLBRAE	3.5	31.6	128	177	1	1
	PACIFICA	51.3	46.1	587	557	286	275
	PORTOLA VALLEY	3.1	39.4	13	34	0	0
	REDWOOD CITY	45.9	416.7	2,702	1,856	229	147
	SAN BRUNO	1.6	48.3	267	296	0	0
	SAN CARLOS	4.0	117.6	439	325	15	11
	SAN MATEO	7.4	208.1	1,012	903	13	11
	WOODSIDE	52.2	385.8	170	192	64	71
SANTA CLARA	CAMPBELL	18.0	476.8	1,686	951	81	35
	CUPERTINO	38.9	641.5	1,171	1,977	980	1,566
	GILROY	33.7	454.9	2,391	159	1,621	107
	LOS ALTOS	24.0	1255.9	1,161	1,548	820	1,036
	LOS ALTOS HILLS	97.0	1126.4	314	312	296	294
	LOS GATOS	38.2	994.7	2,338	1,269	1,765	928
	MILPITAS	383.1	311.8	3,976	3,194	343	279
	MONTE SERENO	8.9	194.7	104	184	102	175
	MORGAN HILL	206.7	1281.8	6,268	1,461	4,785	1,103
	MOUNTAIN VIEW	69.3	757.9	3,847	2,238	349	207
	PALO ALTO	55.1	929.2	1,816	2,342	1,159	1,481
	SAN JOSE	785.5	6809.2	34,530	33,447	8,336	8,083
	SANTA CLARA	18.4	925.5	4,231	3,139	2,428	1,801
	SARATOGA	64.0	1155.3	3,166	1,036	2,458	804
	SUNNYVALE	67.4	1394.7	6,973	5,327	2,005	1,594
SOLANO	BENICIA	36.9	24.7	246	213	0	0
	DIXON	75.5	711.4	3,637	1,824	2,329	1,184
	FAIRFIELD	2434.0	487.6	20,363	11,498	0	0
	RIO VISTA	42.7	179.4	1,538	677	251	112
	SUISUN CITY	900.1	791.8	5,219	3,338	0	0
	VACAVILLE	291.7	217.2	2,147	567	0	0
	VALLEJO	530.1	166.4	3,005	3,728	0	0
SONOMA	CLOVERDALE	523.4	506.7	5,465	1,239	5,425	1,230
	COTATI	110.6	165.3	851	301	836	295
	HEALDSBURG	285.2	898.9	4,524	0	4,082	0
	PETALUMA	1001.5	3548.9	22,238	6,995	5,029	1,582
	ROHNERT PARK	151.2	94.5	1,392	1,646	0	0
	SANTA ROSA	2261.0	3030.8	30,585	7,166	0	0
	SEBASTOPOL	721.6	2292.8	139,769	0	139,061	0
	SONOMA	486.8	1243.2	6,586	0	6,548	0
	WINDSOR	178.3	533.0	4,158	1,427	4,154	1,427