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Cultivation, Capital, and Contamination: Urban Agriculture in Oakland, California

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Cultivation, Capital, and Contamination:
Urban Agriculture in Oakland, California

by

Nathan Crane McClintock

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Abstract

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Urban agriculture has enjoyed renewed popularity across North America over the past few years due to a vibrant food justice movement challenging disparities in access to healthy food, as well as to municipal policy and planning efforts focusing on urban sustainability and public health. Using qualitative and quantitative methods, this dissertation links critical political economic analysis and practical, action-oriented research grounded in community engagement to uncover the historical and geographic conditions necessary for the rise of a vibrant urban agriculture movement in Oakland California. In addition to being critical and reflective, this dissertation is also prescriptive in its examination of urban agriculture's potential to scale up in way that contributes significantly to food justice and urban sustainability.

These two tasks mark the division of the dissertation into two equal parts comprised of three chapters each. Broadly, Part 1 (Origins) examines the historical and contemporary conditions, both necessary and contingent, that have given rise to the current urban agriculture movement in Oakland. In Chapter 1 I use the theoretical framework of "metabolic rift" (which I disaggregate into three interrelated forms: ecological, social, and individual) to explore the multiple origins of urban agriculture as a global phenomenon and demonstrate how it arises in response to the upheavals and alienation inherent to a capitalist political economy. In Chapter 2, I argue that understanding urban agriculture in Oakland today requires examining the city's uneven development. Through a historical overview of Oakland's economic geography from the early 20th century to the dawn of the Neoliberal era, I explain how the "demarcated devaluation" of industrial and commercial capital concentrated poverty in the city's flatlands and diminished food access for low-income people of color. In Chapter 3 I explain how the contemporary urban agriculture movement arose in response to this devaluation. Through a relational history linking seminal moments of flatlands activism (the Black Panther Party's Free Breakfast Program, the environmental justice movement, and a social justice-oriented urban greening movement) to the contemporary food justice movement, I reveal how a multi-racial, cross-class alliance was formed around urban agriculture which was able to contest the material implications of flatlands devaluation in new political arenas, marshalling financial support. These scalar politics have led to urban agriculture's increased institutionalization and ongoing policy efforts to scale it up.

Part 2 (Obstacles and Opportunities) addresses the environmental and policy obstacles that must be addressed before such scaling up of urban agriculture can take place. Drawing on

participatory methods, the three chapters in this part address specific technical questions defined in collaboration with community members. In Chapter 4 I present a GIS-based inventory of potential urban agriculture sites and calculate their potential contribution to vegetable consumption in Oakland. Overall, the inventory identified more than 800 acres of publicly owned land that could potentially be used for food production. Devoting 500 acres to urban agriculture could contribute 19 to 48% of current vegetable consumption in Oakland (or 6 to 15% of recommended consumption) depending on production methods.

In Chapter 5 I evaluate the extent to which soil lead (Pb) contamination may be an obstacle to the expansion of urban agriculture in Oakland. I use a combination of GIS and spatial statistics to characterize the spatial distribution of Pb on vacant land at multiple scales across Oakland and to identify relationships between soil Pb levels and anthropogenic factors such as zoning, housing stock, roads, airport, and land use, as well as biophysical factors such as soil series, soil chemical characteristics, and vegetative cover. I also assess the extent to which total soil Pb is actually available for plant uptake. Using samples collected in the field and two greenhouse experiments, I evaluate two chemical extractants (DTPA and $MgCl_2$) in an effort to identify the best proxy for plant available Pb and to relate plant availability to a suite of soil chemical characteristics. While soil Pb levels were significantly higher in West Oakland and residential areas than other parts of the city, levels were generally lower than federal screening levels of 400 parts per million. Old housing stock (and lead paint) proved to be the primary anthropogenic factor affecting soil Pb levels, while soil phosphorus proved to be the most important chemical factor.

In Chapter 6 I focus on the policy obstacles to the scaling up of urban agriculture through a case study on the efforts of the Oakland Food Policy Council (OFPC) to develop new zoning definitions and operating standards for urban agriculture. Ultimately, pressure on City Council members by the OFPC, as well as public pressure following two high profile events (the passage of an urban agriculture ordinance in San Francisco and the citation of a prominent urban farmer for zoning violations), were necessary to motivate planning officials to update urban agriculture zoning in Oakland. I conclude with the observation that while the technical obstacles to urban agriculture's expansion may easily be overcome, political obstacles remain. Furthermore, urban agriculture alone cannot feed a city such as Oakland or mitigate unequal access to healthy food, but rather must be part of a coordinated push for regional equity that addresses all aspects of the food system, from production to processing, distribution, and retailing.

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List of Abbreviations and Acronyms

AB	Assembly Bill
BACUA	Bay Area Coalition for Urban Agriculture
BART	Bay Area Rapid Transit
BCGC	Berkeley Community Gardening Collaborative
BPP	Black Panther Party for Self-Defense
BYA	Berkeley Youth Alternatives
Cal/EPA	California Environmental Protection Agency
CBPR	community-based participatory research
CDE	California Department of Education
CDFA	California Department of Food and Agriculture
CEDA	Community Economic Development Agency (City of Oakland)
CFERP	Community Forestry and Environmental Research Partnerships
CFSC	Community Food Security Coalition
CHHSSL	California Human Health Soil Screening Levels
CSA	community supported agriculture
CUESA	Center for Urban Education about Sustainable Agriculture
CUP	conditional use permit
EBAYC	East Bay Asian Youth Center
EBMUD	East Bay Municipal Utilities District
EBUAA	East Bay Urban Agriculture Alliance
EBUG	East Bay Urban Gardeners
ECAP	Energy and Climate Action Plan
EJ	environmental justice
EPA	United States Environmental Protection Agency
ERS	USDA Economic Research Service
FHA	Federal Housing Administration
FSAT	Food Systems Action Team, a sub-group of the HOPE Collaborative
GIS	geographic information system
HEAC	Healthy Eating, Active Communities
HOLC	Home Ownership Loan Corporation
HOPE	Health for Oakland's People and Environment (HOPE Collaborative)
MLK	Rev. Dr. Martin Luther King, Jr.
NAIP	National Agriculture Imagery Program
NGO	non-governmental organization
NRCS	Natural Resources Conservation Service
OBUGs	Oakland Based Urban Gardens
OFC	Oakland Food Connection
OFPC	Oakland Food Policy Council
OFSA	Oakland Food System Assessment
OPR	Oakland Parks and Recreation Department
PAR	participatory action research
PCGN	People of Color Greening Network
PPGIS	public participation GIS
PRA	participatory rural appraisal
PUEBLO	People United for a Better Life in Oakland
SF	San Francisco
SFUAA	SF Urban Agriculture Alliance
SLUG	SF League of Urban Gardeners
SOL	Sustaining Ourselves Locally
UC	University of California
UCCE	UC Cooperative Extension
UK	United Kingdom
UN	United Nations

List of Abbreviations and Acronyms (*cont'd*)

US	United States of America
USDA	United States Department of Agriculture
ZUC	City of Oakland Zoning Update Commission

Scientific Abbreviations:

As	arsenic
ANOVA	analysis of variance
C	carbon
Ca	calcium
Cd	cadmium
CEC	cation exchange capacity
Cr	chromium
DTPA	diethylenetriaminepentaacetic acid
Hg	mercury
$MgCl_2$	magnesium chloride
N	nitrogen
Ni	nickel
OM	organic matter
P	phosphorus
Pb	lead
PAHs	polyaromatic hydrocarbons
PCBs	polychlorinated biphenyls
pH	negative log of hydrogen
ppm	parts per million
S.D.	standard deviation
S.E.	standard error
Zn	zinc

SI and Imperial Units:

ºC	degrees Celsius
ºF	degrees Fahrenheit
ac	acres
$cmol_c\ kg^{-1}$	centimoles of charge per kilogram of soil
lbs.	pounds
$\mu g\ g^{-1}$	micrograms per gram
$mg\ kg^{-1}$	milligrams per kilogram
Mg	megagram (metric tons)
$Mg\ ha^{-1}$	megagrams (metric tons) per hectare

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Now on to the most important part, the *people* who made this dissertation possible. Few proverbs so perfectly grasp the communal nature of any project as one I learned as a Peace Corps Volunteer in Mali more than a decade ago. *Bamananw ko*, the Bamana say, *bòlòdenni kèlèn tè bèlè ta*, one little finger cannot pick up a stone.

First and foremost, my sincere thanks go to the members of my dissertation committee. My major adviser, dissertation chair, and friend, Nathan Sayre, told me at the beginning, “You can do anything you want as long as it’s good.” His unwavering support of me and the breadth of my dissertation were the solid ground on which I built this project. His ability to publish in both *Antipode* and *Conservation Biology* serve as a model of how to marry the radical with the practical. He turned me onto Marx and Harvey without even trying, and now, five years after once writing a reading response entitled “Bourdieu bored you, too?” for his seminar, I find myself thinking about symbolic capital and class distinction. Also on my committee, Dick Walker inspired me with his passion for California, for cities, and for exposing the layers of capital and politics that have created them. His irreverence was always testament to his reverence for what is right (that is to say, what is left!), and his eloquent but jargon-free prose an asymptote towards which I will always aspire. I was fortunate that my “outside members” were always very much on the inside. The cool and collected (and always impeccably dressed) Jason Corburn in City & Regonal Planning encouraged me to keep a foot in the real world while the other waltzed theoretical. He showed me that policy, participation, *and* post-structuralism can all go into the same package. Gary Sposito in Environmental Science, Policy & Management was always the apotheosis of a renaissance scholar; in a single lecture, he drew connections between 1950s *film noir*, 19th century porcelain manufacture, and isomorphic substitution of aluminum in a clay mineral lattice, all while writing on the board in Chinese and Greek! I have been humbled by the time, lab space, and mentorship he has devoted to me over the last couple of years.

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For Lanya
and
our "mighty yellow bird"
Zari Josefina

So can you understand?
I want a daughter while I'm still young
I want to hold her hand, show her some beauty
before all this damage is done

– *Arcade Fire*

The philosophers have only interpreted the world…
the point is to change it.

– *Karl Marx*

Introduction

On April 29, 1854, Oakland, California's first mayor, Horace Carpentier, gave his inaugural address to the newly seated City Council. In it he asked council members to "not lose sight of the important future which a prudent forecast may justly anticipate" for the city. He continued,

> Oakland has one of the most advantageous sites that could have been selected, alike attractive to the artist and utilitarian. With its background of mountains and valley and its view of islands, trees, bays and inlets, it unites in its landscape in a remarkable degree, the picturesque and the beautiful. Its salubrity of climate, its ease and security of access, the royal aspect of oaks, its enchanting solitudes, its fertility of soil, adapted to the culture of vegetables and flower gardens, its exemption from the rough winds of San Francisco, which are here tempered to an agreeable breeze—all conspire to make it a favorable place of resort and for residences for families who can escape from the dust and turmoil of San Francisco. (quoted in Adams 1932, 17)

More than a century and a half later, Carpentier's ode to the City of Oaks strikes 21st century ears as strangely germane. Oakland's "fertility of soil, adapted to the culture of vegetables and flower gardens" is once again in the limelight. A vibrant urban agriculture movement has taken root over the last few years, drawing the attention of the *Wall Street Journal* and the *New York Times*.[1] Even former San Francisco mayor Gavin Newsom, escaping the dust and turmoil, crossed the Bay to announce the launch of his own city's food system initiative while standing in a West Oakland urban garden (Knight 2009).

While most urban agriculture is quietly tucked away in the interstices of the urban landscape, on forgotten vacant lots and hidden from view in city's backyards, a cornucopia of food justice organizations have taken over vacant lots and underutilized park land in Oakland's flatlands to provide local residents with fresh produce. Distribution takes a variety of forms: community supported agriculture (CSAs)[2] or "grub boxes", sliding-scale farm stands, or farmers markets. Several of the organizations help flatlands residents build gardens in their yards and provide mentorship from sowing to harvest. With the goal of reintegrating food production and consumption, some organizations also offer curricula to educate children about food culture and nutrition through gardening and cooking classes. One organization works with at-risk teenagers to harvest fruit for distribution at senior centers in the Fruitvale and San Antonio neighborhoods. Within the public school system, more than a hundred elementary, middle, and high schools in Oakland now use gardens as classrooms to teach science, health, and nutrition.

The current enthusiasm for urban agriculture dovetails with municipal efforts to make Oakland into a model sustainable city. Oakland has ranked in the top ten green cities several times over the last few years, earning accolades for its role at the forefront of the green jobs movement and its commitment to improving the food system (SustainLane 2008). Beginning

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[1] Broadly defined, urban agriculture denotes the subsistence and/or commercial production of fruits, vegetables, mushrooms, herbs, livestock, meat, eggs, milk, honey, and other raw agricultural products within towns and cities, grown for personal consumption, sale, donation, or educational uses (Hodgson, Caton Campbell, and Bailkey 2011; Smit, Ratta, and Nasr 1996).

[2] A CSA is a direct-marketing arrangement that links producers and consumers. Customers purchase a share at the beginning of the season in exchange for weekly deliveries of a box of fresh produce.

with a food system assessment mandated by the Mayor's Office in 2006, and City Council's vote to establish and provide start-up funds for the Oakland Food Policy Council, urban agriculture has emerged as an important policy issue in the city.

The city's ongoing efforts to update zoning to include urban agriculture have helped to galvanize the movement. On July 21, 2011, two baby goats tethered to the railing of the wheelchair ramp at the North Oakland Senior Center on Martin Luther King, Jr, Way bleated to the throngs entering the building. Inside, Eric Angstadt, the Deputy Director of Planning for the City of Oakland, addressed a crowd of more than 300 people gathered in the enormous ballroom. "There's been a huge change in how we look at food and food production," Angstadt told the crowd, noting that current zoning laws restricting the production and sale of agricultural products date back to 1965 "when there was a greatly different idea about what was appropriate behavior around agriculture" (quoted in Romney 2011; Tian 2011). Angstadt and his staff were there to elicit community input on how best to update the municipal code in relation to urban agriculture. After his presentation, Planning Department staff moved to booths located around the ballroom, labeled with signs such as "animal husbandry", "crop raising", "sales", and "best management practices" to get feedback from attendees on what an urban agriculture ordinance should include. Scores of people crowded around each station, shouting out questions and comments for the staff member manning the booth while another madly scribbled the input from the crowd on butcher paper taped to the wall. Angstadt later told a reporter, "In my twenty years of zoning work, this is the biggest meeting I've seen" (quoted in Florez 2011).

Even though no one at the meeting stated as much, it was only fitting that the planning workshop took place in the North Oakland Senior Center. The sprawling building with a Spanish-tile roof was built as a high school in the 1920s (on what was then called Grove Street). In 1954 it became the campus of Merritt College. Twelve years later, a handful of young black students, building on a long history of Oakland labor activism, well versed in Fanon, Marx, Mao, and Malcolm X, and only a stone's throw away from the white radical counterculture flourishing in Berkeley, founded the Black Panther Party for Self-Defense (BPP). One of the hallmarks of the Panthers' activism in the years that followed was their Free Breakfast program that fed hundreds of schoolchildren daily in the Oakland flatlands, and thousands more in inner-city ghettos across America (Hilliard 2001; Self 2003; Heynen 2009). The BPP's Breakfast Program helped lay the foundations of the food justice movement in Oakland and in cities across America, a movement that has embraced urban agriculture as one of its staple activities. It is food justice's radical challenge to the market logic and externalities of the corporate agri-food system that has caused the urban agriculture movement to thrive.[3]

Throughout the US, food justice activism has taken root in places like Oakland's flatlands, neighborhoods left impoverished in the wake of the deindustrialization and disinvestment beginning in the 1950s and '60s. Supermarkets shut their doors decades ago, unable to generate profits in areas where purchasing power had declined in concert with the

[3] The ravages of the industrial agri-food system, or "corporate food regime" (McMichael 2009; Holt-Giménez and Shattuck 2011), have been the focus of volumes of research for decades. Defining these issues lies outside the scope of dissertation, as I assume the reader is at least already familiar with the basics. For excellent and accessible introductions, see Schlosser's *Fast Food Nation* (2005), Pollan's *Omnivore's Dilemma* (2006), and Patel's *Stuffed and Starved* (2008). For the following themes, see the accompanying references: on California agribusiness, with particular emphasis on labor (Wells 1996; McWilliams 1999; Walker 2005b); on the globalization of the food system (Friedmann 1982; Bonanno et al. 1994; Goodman and Watts 1997); on the public health impacts (Magdoff, Foster, and Buttel 2000; Nestle 2002); on agricultural technology (Goodman, Sorj, and Wilkinson 1987; Kloppenberg 2005); on corporate organic (Guthman 2004).

flight of jobs (Eisenhauer 2001). Low rates of personal vehicle ownership in these areas have further limited the ability of residents to drive to supermarkets in affluent areas; as a result, many people shop at neighborhood liquor stores that carry little fresh produce. While not without its critics, the term *food deserts* has entered mainstream parlance as a way to describe these areas where fresh produce and other healthy, culturally appropriate, and affordable food options are limited or non-existent (Zenk et al. 2005; Shaw 2006; Raja, Ma, and Yadav 2008; Beaulac, Kristjansson, and Cummins 2009; USDA 2009).[4]

Urban agriculture often arises opportunistically in these neighborhoods abandoned by capital. Vacant land abounds in most food deserts, due to the same processes that led to job loss, diminished purchasing power, and limited access to healthy, affordable food. As the case has been in cities throught the world, from Depression-era Detroit to present day Dakar, urban food production serves as a safety net for city dwellers, a coping strategy to supplement diets with fresh and nutritious food. Activist Leon Davis explains:

> Food is the key, food is the gold. Even when people get kicked out of their apartments and they're out there homeless on the street, they're still going to have to acquire food. … if you don't establish a network with food as a basis, you're going to have more thieving, more people are going be stealing from stores, robbing people because they don't have no money, so they can buy food. Not so they can buy drugs, but so they can buy a sandwich. People robbing each other so they can buy a sandwich. So food production needs to ramp up. More local farms, not just in the outlying areas, but right here in the city, people growing, knowing how to grow. (Davis 2009)

For many urban agriculture activists, alternative food procurement strategies such as urban farming also represent a radical rejection of the corporate food regime, of its homogenization and commodification of food and foodways, of the alienation of the consumer from the producer, of the market logic that determines who has access to healthy food and where. To this end, urban agriculture is an attempt to re-embed food production and exchange with socio-cultural values otherwise obscured or effaced by industrial production and retailing. As Melvin Dickson, former manager of the BPP's Free Breakfast Program in East Oakland, explains, "Food justice tends to bring people together to work together to see their common interest as a community… When people eat food that they've grown together, it creates a certain bonding and appreciation for one another… you suddenly begin to see how we fit together" (Dickson 2010).

The urban agriculture movement's verdant growth has led to a flourish of interest at the policy level. As the discourse of "urban sustainability" rises to dominance, and as public health officials and planners converge on the idea of the "healthy city" (Corburn 2009), urban agriculture makes sense. Advocates frequently cite its multiple functions and contributions to greener and healthier cities, from improving nutritional and psychological health (Armstrong 2000; Bellows, Brown, and Smit 2003; Alaimo et al. 2008), and building community (Hammond

[4] Just as the term "food desert" enters mainstream parlance, the jury is still out on whether or not it is an appropriate metaphor. Food may well be available in these so-called "food deserts," but it is generally of poor nutritional value. Fast food outlets may abound while fresh fruit or vegetables are nowhere in sight. Some opt for the term "health food deserts" or "fresh food deserts" while others reject the image of a bleak and parched urban landscape, opting for the lush and primordial "junk food jungles." Others hope to throw out such sensationalist taxonomy altogether, with its potentially racialized subtext linking people of color to exotic and/or depraved environments (Guthman 2008a).

2001; Saldivar-Tanaka and Krasny 2004), to reducing the urban "ecological footprint" and improving access to fresh and nutritious food in urban food deserts (Smit and Nasr 1992; Mougeot 2005; van Veenhuizen 2006). The promise of fresh vegetables, physical activity, green space, job creation, stormwater retention, greenhouse gas mitigation, neighborhood beautification, "eyes on the street", and community-building may sound too good to be true, but has rallied enough support within city halls and planning departments that real changes are taking place on the policy landscape to incorporate urban agriculture into municipal plans.[5]

Within academia, many social scientists praise urban agriculture and other alternative food provisioning systems for their reclamation of the commons, restitution of values to the food system, and challenge to the corporate food regime (Kloppenberg, Henrickson, and Stevenson 1996; Feenstra 2002; Lyson 2004; Gottlieb and Joshi 2010). Critical geographers and critical food scholars, however, are less sanguine. Many have pushed back against these ideas, arguing that such alternative food movements are intrinsically neoliberal despite their claims of being a radical (or at least progressive) alternative to the mainstream industrial agri-food system (Allen and Guthman 2006; Guthman 2008a, 2008b; Pudup 2008). These critiques are grounded in a growing body of political economic research on neoliberalism, the dominant free market ideology that took hold in the US under Reagan and that has since fueled corporate deregulation and the dismantling of the New Deal social welfare system (Harvey 2005). Neoliberal*ization* (a set of processes, as distinguished from neoliberal*ism*, an ideology) has entailed both the "rolling back" of the safety net and government oversight, and the "rolling out" of new social and economic relationships that further fuel capitalist accumulation (Brenner and Theodore 2002; Peck and Tickell 2002; Brenner, Peck, and Theodore 2010).[6]

One especially visible roll-out mechanism is the increased dependence on non-profit, voluntary, faith-based, or community-based alternatives (so-called "flanking organizations" because they buttress the weakened state) to deliver services and entitlements once provided by the government. "Through their piecemeal actions," writes Noel Castree, these flanking organizations "do not threaten the neoliberal order or encourage others to seriously challenge it" (2010, 1744). For such scholars, the myriad food justice organizations transforming vacant lots into urban gardens in Oakland and in cities across North America fall within this category. They argue that despite their radical intent, the good deeds of such organizations actually underwrite the neoliberalization process by providing food to those hit hardest by the roll-back of the welfare state (Allen and Guthman 2006; Guthman 2008b), or by taking over maintenance of parks in the wake of budget shortfalls (Perkins 2009a). Borrowing from Guthman (2007b), these movements, despite their oppositional intentions, are ultimately more "Pollyannian" than "Polanyian", i.e., rather than representative of what Karl Polanyi (2001) described as a "protective counter-movement" buffering society from the ravages of an unrestrained market, such initiatives are unknowingly and naively implicit in roll-out neoliberalization.

Critiques of urban agriculture are not limited to the ivory tower. Many community activists worry about urban agriculture's role as a spearhead of gentrification. With a growing

[5] Municipal ordinances supporting urban agriculture have recently passed in a number of cities, including Seattle (Seattle City Council 2010), San Francisco (McMenamin 2011; Terrazas 2011), and Cleveland (Kleinerman 2009; Gillespie 2010) among others. In Chapter 6, I discuss these developments in Oakland.

[6] The end result is a tremendous concentration of wealth by a small elite, at the expense of the wages, rights, and health of the majority (Harvey 2005), and the simultaneous degradation of the physical environment (Heynen et al. 2007). Examples of roll-out neoliberalization include privatization, marketization, market-friendly reregulation, flanking mechanisms, and shifting discourse to self-sufficiency and personal responsibility (Brenner and Theodore 2002; Brenner, Peck, and Theodore 2010; Castree 2010).

number of urban agriculture organizations competing for an shrinking pool of grant funding, some call into question the legitimacy and right of food justice organizations run by outsiders to operate in low-income communities of color. Some of these organizations are accused of "poverty pimping", painting a bleak picture of food access in the flatlands in order to tap into foundation capital (Cadji 2011). Some see the hordes of young, white do-gooders invading the flatlands, shovels and wheelbarrows in hand to "bring good food to others" (Guthman 2008a), not only as naïve and insensitive, but downright colonial and exploitative. The website of one black-run organization in West Oakland proclaims,

> We are now dealing with the gentrification of the food security movement… While there are a plethora of urban farm and community garden efforts in the Bay Area, the vast majority of them are founded, operated and/or owned by non-Black carpetbaggers who have recently moved into predominantly Black neighborhoods looking to be urban pioneers and "civilize the urban jungle." (Village Bottom Farms 2011)

Others are more guarded in their critiques, but share the same view. Discussing urban agriculture programs in West Oakland, one food justice activist explains,

> There are questions about whether or not they are doing something that works towards justice in the community. There are unintended consequences, basically, that are a disservice to justice... Even though they're doing backyard gardening, that's really awesome and that gets at food sovereignty and things like that, but in terms of the bigger picture, like economic disparities, gentrification, power, and leadership, and things like that… It's an organization that's not from there. [They] don't intend to do it, but when they're out in the garden or park and getting lots of attention, people would drive by who never felt comfortable there before, and they would see them there, and say, "Oh, what are you doing?" and start asking questions, and then be like, "Oh, we can do that, too, let's move in." I mean, it's cool and all that, but this whole anarchist hipster DIY thing… it's exploiting cheap land. (Khanna 2011)

This analysis comes at a particularly critical moment. Over the last decade, Oakland's overall population dropped by 2%, but its black population has declined by 25%, a loss of 33,000 African Americans since 2000. At the same time, historically black West Oakland has seen a 13% *increase* in population and a serious demographic shift: the black population dropped from 65 to 50% of West Oakland's total population, and the white population rose from 6.5 to 15%. More than 3,000 blacks left, and more than 2,200 whites moved in (US Census Bureau 2010).

While the critiques (and celebrations) from academia and activists are compelling, I think they are incomplete. Through this dissertation I show that they oversimplify urban agriculture and are ultimately limiting, both for analysis and action. Let me briefly explain. First, while the gentrifying potential of urban agriculture is a legitimate concern, I would argue that it is overstated. Focusing on the few dozen urban agriculture activists turning over soil in vacant lots and providing backyard garden mentorship to a couple hundred West Oakland residents obscures the real growth machines powering gentrification in Oakland. It also shifts attention away from the processes that give rise to urban agriculture in the first place and that force organizations to rely on volunteer labor and to fight for funding. Second, I contend that the "urban agriculture as neoliberal" critique overlooks both urban agriculture's radical antecedents and its revolutionary possibilities. At the same time, I think the "urban agriculture as radical" (like the urban agriculture boosterism that has dominated development literature for the last fifteen years, and that now permeates public health and planning) is blind to how urban agriculture activism might foster ongoing accumulation and exacerbate racial and class disparity.[7]

I contend that it's not one or the other, radical or neoliberal, but, rather, a Janus face, simultaneously a radical counter-movement *and* an actually-existing form of roll-out neoliberalization existing in dialectical tension. Indeed, contradictory processes of capital both *create opportunities for* urban agriculture (on land left vacant either via the retreat of capital or via speculation/monopoly rent) and *impose obstacles to* its expansion (such as increased competition for funding, environmental contamination externalized from production, and rising land values once sites are improved and gentrifiers move in). To debate whether urban agriculture is good or bad, neoliberal or radical, bourgeois and gentrifying or grassroots and radical, is not particularly constructive. Indeed, this approach forces us to answer a question that is too simple;[8] not only is urban agriculture both radical and neoliberal, gentrifying and unifying, *it has to be* both. Indeed, as I demonstrate in this dissertation, it wouldn't arise as a viable social movement without elements of both.

Moreover, it is precisely this tension that makes urban agriculture a site of contestation over urban space and place. Many struggles surrounding urban agriculture—who practices it and where and for what goals—are also deeply entwined with race politics, tapping into far older and deeper global and local histories of racial oppression and dispossession. As a result, the stakes of contestation are even higher, further obscuring both the underlying structural roots of the conflict, as well as the historical precedents of the kinds of cross-racial, cross-class alliances that successfully challenged racial and environmental injustices in the past.

What these interpretations make clear is that the expansion of urban agriculture is a fraught and complex and messy process that is continually evolving. As such, I think existing critiques are ultimately counterproductive. They divide necessary alliances and pander to race politics, obscuring historical precedents of such alliances and undermining opportunities for radical change. Furthermore, they fail to address the movement's most pressing needs. Conversely, Panglossian assertions of urban agriculture's infinite ability to steward green jobs, food security, healthy eating, and greenhouse gas mitigation will ultimately prove disappointing. Clearly, we have to have a more sophisticated approach to understanding urban agriculture, where it comes from, where the roots of food insecurity lie, and how to address its impact.

Making sense of it all cannot be done in the abstract. Understanding urban agriculture, its multiple functions, its entanglements, and its future potential demands a close look at the specific context in which it takes place. An appropriate methodology depends on, first and foremost, making sense of the multiple relations that have converged at a particular time and place, relations extending from the soil to the air to the body to flows of capital and the politics and policies that direct them. This is precisely what I attempt to do with this in-depth case study of urban agriculture in Oakland. With its explosion of gardens, a highly mobilized food justice movement, and municipal commitment to developing a coherent urban agriculture policy, Oakland provides an ideal case for such a study. Broadly, my dissertation attempts to integrate a

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[7] I admit to having been firmly entrenched in this camp at the beginning of my dissertation research, as documented by a working paper that I wrote in 2008 for the Institute for the Study of Social Change (McClintock 2008). With time, I became less convinced of urban agriculture's sweeping possibilities (see the dissertation's Conclusion).

[8] I'm grateful to Nathan Sayre for pointing this out and that Aristotle referred to such a framing as a false dichotomy or false dilemma, an inductive fallacy.

critical understanding of urban agriculture by linking a *relational* history of place to applied research questions relevant to activists on the ground.[9] Unique in its thematic and methodological breadth, the project explores both the origins of Oakland's vibrant urban agriculture movement and the potential to scale up in way that contributes significantly to the food needs of Oakland's flatlands and the city as a whole.

On methods and research questions

While at Berkeley, I spent almost as much time in the city planning and environmental science departments as I did in geography, so my methodological toolkit was packed with a heterogeneous assortment of qualitative and quantitative approaches. For the most part, I've taken my analytical framework from subfields of human geography, notably critical urban geography and political ecology. Grounded in the Marxian political economic tradition of historical materialism, political ecology uncovers linkages between environmental change at the field scale and broader social, political, and economic trends, arguing that ecological change cannot be understood in isolation from the specific historical and geographic dynamics from which it arises (Robbins 2004; Neumann 2005). While its empirical grounding has mainly been in rural areas of the Global South, political ecology has been increasingly applied to urban settings, integrating spatial, social, and political economic insights of critical urban theorists (Gandy 2003; Heynen, Kaika, and Swyngedouw 2006b; Heynen 2006b; Evans 2007; Krueger 2007). As a result, urban political ecologists have made progress in breaking down a false dichotomy between human and "natural" environments, underscoring that even natural spaces are delineated or reconstructed thanks to human activity. This work draws on older critical arguments from urban and economic geographers about how capitalist development is inherently uneven (Walker 1978; Harvey 2007; Smith 2008). This unevenness is delimited spatially via patterns of investment (residential, industrial, etc.) mediated by technical mechanisms such as planning, zoning, insurance risk and bond ratings, but also by a range of social and political processes ranging from the building of class alliances and growth machines to "block busting" and gentrification (Walker 1981; Logan and Molotch 1987; Harvey 1989; Smith 1996; Hackworth 2007).

Theoretically and empirically, the growing field of urban political ecology—and the relational concepts of space that have informed critical geography (cf. Lefèbvre 1991; Massey 1994)—was a particularly useful point of embarkation for my study of urban agriculture in Oakland. It allowed me to conceive of urban agriculture—and urban nature, more broadly—as produced at the intersection of multiple social relations and flows of capital (Heynen, Kaika, and Swyngedouw 2006a; Smith 2008).[10] Insights from political and economic geographers and

[9] By "relational history" I mean a chronological sketch of the various spatial and historical linkages of individuals, institutions, flows of capital, and ideas that gave rise to urban agriculture—as a movement and as productive space—in Oakland. Doreen Massey's (2005) conception of space as "temporary constellations" (141) made up of "bundles" of intersecting "space-time trajectories" (119) is a particularly useful lens through which to understand how space is produced at particular historical conjunctures; it arises both from contingency or happenstance *and* from necessary preconditions, i.e., historical foundations laid by previous arrangements, constellations, or bundles. To understand a physical space, one must therefore excavate the palimpsest of "sedimentary layers" of social, political, economic, and material relations (Massey 1995).

[10] This relational perspective is not unique to political ecology. See Boggs and Rantisi (2003), for example, on the relational turn in economic geography.

planning theorists have also helped me to understand these networks and the scalar politics employed to create them (Cox 1998; Kurtz 2003; Martin, McCann, and Purcell 2003; Smith and Kurtz 2003; Mendes 2007; Pierce, Martin, and Murphy 2011).

The more time I spent in the field working with people in the urban agriculture movement, however, the more I began to see the limits of engaging solely at the level of critique. Working in sustainable agriculture prior to starting my PhD, I had facilitated training workshops on soil management, sustainable farming, and agroforestry for small groups of farmers and extensionists in the Global South. Once my doctoral work was underway, I quickly realized that I once again wanted to look *forward* with the prescriptive eyes of a practitioner engaged with community activists in the field. Rather than stopping at a critique of a movement or an exposé of its contradictions, I wanted to explore the limits and possibilities of urban agriculture's scaling up. Could it grow from a smattering of tiny gardens to something larger, a central component of a more just and sustainable food system?

In his *Theses on Feuerbach*, written in 1845, Karl Marx famously stated, "The philosophers have only interpreted the world, in various ways; the point is to change it" (Marx in Tucker 1978, 145). If the point is to change it, then we need to sketch out *what* it is that we want as an alternative, and, equally as important, *how* to get there. Planners, architects, public health and public policy researchers, and environmental engineers, among others—often derogatorily termed "technocrats" or "programmers"—tend to be the ones who end up drafting the actual blueprints for alternative futures. As such, they also tend to be the ones who must bear the brunt of responsibility (and scholarly critique) when utopian visions fall short. For many critical social scientists, there is a distinct division of labor at play. Anthropologist Tania Murray Li (2007, 2) writes, "the positions of critic and programmer are properly distinct." Programmers, she writes, are required "to frame problems in terms amenable to technical solutions" and therefore "are not in a position to make programming itself an object of analysis. A critic," she concludes, "can take a broader view" (ibid.).[11]

I don't fully agree with Murray Li's assessment. While I agree that there is a certain freedom in academic inquiry that allows one to ask questions that might challenge the assumptions driving a program, I don't believe that programming—or the kind of applied, quantitative research that feeds into it—must proceed as a separate endeavor. Furthermore, I would argue that the singularity of critique as a method has ultimately hobbled the creative visioning of emancipatory possibilities within critical geography. If everything is ultimately neoliberal after all, then where does that leave us?

Taking his fellow radical geographers to task for acquiescing to a paralyzing view of capitalism's creative/destructive forces, Nik Heynen (2006a, 926) writes,

> I wonder how many of us have settled for the inevitability of these notions because we are afraid of being laughed at and being labeled naive and foolishly utopian? I would

[11] This type of critique would amount to Gramscian *praxis* in the true sense, i.e., the labor of the organic intellectual to identify these contradictions and slippages and to rework "common sense", to reframe our understandings of everyday life, to peel back the blinders that allow us to passively accept injustice as "just the way it is." Yet the work of the organic intellectual still strikes me as only part of the necessary project. As such, I echo Sarah Wakefield's call for a form of praxis that bridges academic praxis (ie, writing and teaching) to more engaged forms of "praxis on the outside" (Wakefield 2007).

argue that there is a fundamental need within a *really radical geography*[12] to mobilize the possibilities of utopian alternatives and refocus on these issues once again. I think we must refuse, impossible as it may seem by its very definition, to settle for the brutality of contemporary sociospatial circumstances. (Heynen 2006a)

When taken as an end rather than as a means to an end, I contend that critique can stifle the creation of alternative models that are so desperately needed. Richard Walker nicely captures the tension that many of us feel between being a critic and advocating for an alternative future. In the preface to his book on the history of Bay Area green space preservation, he writes, "My red side tells me I should have been more critical of everything and everyone, but my green side wants this to be an upbeat lesson in the art of the possible (which we sorely need in these dire times)" (Walker 2007, xviii).

While many social scientists have argued for and celebrated the emancipatory possibilities of activist scholarship (cf. Castree 2000; Fuller and Kitchin 2004; Chatterton 2008; Hale 2008; Piven 2010), action research is much more rare in human geography than in "programmer" disciplines such as public health and planning.[13] *How* to mobilize and realize the "art of the possible" is, to a certain extent, a methodological question that we are unprepared to tackle from a critical standpoint. Indeed, while critique plays a vital role in revealing injustices, reframing debates, and evaluating successes and failures, I would argue that this "broader view", as Murray Li describes it, has actually *narrowed* the methodological framework that critical/radical geographers use. Since the backlash against quantitative geography in the 1970s, critical geographers have generally eschewed quantitative methods. Such methods were (and frequently still are) viewed as positivist and essentialist, anathema to theoretical advances in our understanding of situated or relational knowledge, and have even been characterized as anti-radical or politically conservative (on this history, cf. Barnes 2009; Kwan and Schwanen 2009; Wyly 2009).[14] As a result, the tools of the trade have been Marx, Gramsci, Foucault, and Haraway, rather than remote sensing, regional plans, and regression analysis. With this division of labor, the nuts-and-bolts of *how* to change a broken system have been largely left to the programmers, who, as social scientists rightly point out, are often not critical enough.

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[12] Heynen (2006a) defines a "really radical geography" as one that directly addresses issues of survival, "a geography that is about sustained bodily existence at its root" and that "does not take for granted the fundamental material necessities of human bodies surviving amidst dire material inequality" (919).

[13] While there is a rich tradition within political ecology of researchers partnering with local stakeholders (Rocheleau 2008, 1994), critical, qualitative analyses dominate political ecology, leading geographer Peter Walker to ask on separate occasions, "Where's the ecology?" (Walker 2005a) and "Where's the policy?" (Walker 2006). I don't want to imply, however, that critical/radical geographers are not engaged in applied research. On the contrary, examples of activist scholarship abound: The Athens Urban Food Collective (Nik Heynen and Hilda Kurtz), FoodShare Toronto (Sarah Wakefield, Harriet Friedmann), the Rutgers Fisheries Project (Kevin St. Martin), the numerous justice-oriented mapping projects of Syracuse Community Geography, a decade of "hybrid" action research projects under the auspices of the Community Economies Collective (J.K. Gibson-Graham), the Centre for Civil Society's mobilization for climate justice in South Africa (Patrick Bond), and the list goes on. These projects and many others are working with activists on the ground to create alternatives, and their work should serve as models and a clarion call for the rest of us.

[14] Ironically, it was one of the founding fathers of quantitative geography, William Bunge, who was also one of the earliest radical geographers. As Merrifield (1995) explains, Bunge's Detroit Geographical Expedition in the early 1970s, was, in effect, "a search for situated knowledge" in the inner-city that cultivated "a partisan, responsible and accountable vision of urban society that could be constructed in such a way as to inform action" (52).

My methodological goal with this dissertation, therefore, is to push the limits of critical/radical geography through a marriage of radical political economic analysis and practical, action-oriented research. Simply put, I seek to radicalize applied research and to make radical analysis more applied. There are two key components to my approach: community engagement and an interdisciplinary blend of critical theoretical/empirical and quantitative analysis. Let me first address community engagement. If we are to transform visions of these possible worlds into reality, it requires as much input from the public as possible. A number of disciplines have cooked up a veritable alphabet soup of participatory methodologies on which to draw, bringing together researchers and activists in the field, to develop research agendas, to collect data, to interpret results. In agricultural development, "participatory rural appraisal" (PRA) and "participatory action research" (PAR) became the norm, due in part to the input of applied anthropologists (Rhoades and Booth 1982; Chambers 1994; Pretty 1995).[15] In planning, "collaborative" and "communicative" methods, rejecting the top-down approaches that previously defined the discipline and practice, are now the norm (Healey 1992; Forester 1999; Innes and Booher 2010). In public health, community-based participatory research (CBPR) is highly valued (Minkler and Wallerstein 2003). Finally, environmental justice research has brought together researchers and community members who mobilize "street science" and other forms of collaborative data collection and interpretation to in the struggle for equity (Pulido 1996; Morello-Frosch, Pastor, and Sadd 2002; Corburn 2005; Pellow and Brulle 2005). With the exception of some "feminist" participatory methods (Rocheleau 1994, 1995; Sharp 2005) and public participation GIS (Elwood 2006; Ghose 2007), action research methods nevertheless remain relatively undeveloped in critical geography, despite repeated calls for their integration (Fuller and Kitchin 2004; Pain 2004, 2007; Fuller 2008).

The second key component of my approach is a hybridized quantitative-qualitative method. I think that some modicum of interdisciplinarity is essential when thinking about agriculture and the environment, that understanding food systems, agriculture, and urban ecology requires analyzing the intersection of biophysical and social processes. To this end, I think there is a real value in crunching numbers and making maps. As Elvin Wyly argues, "strategic positivism" can and should be marshaled, rather than resisted" (2009), and should be used as a tool of radical change "devoted to the creation of new and emancipatory alternatives" (2011, 907). During a redux of the perennial qualitative vs. quantitative debates, Plummer and Shepherd (2001) wrote in *Antipode*, "An emancipatory economic geography must also move beyond critique, both to provide a deeper understanding of the spatial dynamics and social consequences of capitalism as we know it and to use this understanding as a basis for thinking about other possible worlds" (196), a task that requires both quantitative and qualitative approaches.

With this dissertation, my intent has been to engage with and add to growing fields of critical food studies and urban political ecology, while contributing to measurable change on the ground. Responding simultaneously to Karl Zimmerer's (1994) call for a "new ecology" that integrates human geography, and to Peter Walker's (2005a, 2006) critiques of the scientific and

[15] Early on in my sustainable agriculture life, I was deeply inspired by the work of Roland Bunch's revolutionary book *Two Ears of Corn: A People-Centered Guide to Agricultural Improvement* (Bunch 1982) which challenged traditional top-down "transfer of technology" extension and integrated Paolo Freire's popular education theories into more "horizontal" forms of extension: farmer field schools, farmer-to-farmer exchanges, and the incorporation of indigenous knowledge in on-farm research. While doing similar work in Nepal, Mali, Bangladesh, Haiti, and Senegal, I next discovered the Participatory Rural Appraisal work of Robert Chambers, Bob Rhoades, and other "Farmer First" and "Beyond Farmer First" practitioners (cf Rhoades and Booth 1982; Chambers 1994; Scoones and Thompson 1994). It was this work that served as my initiation into the world of participatory research.

policy lacunae within political ecology, I have done my best to integrate qualitative and quantitative methods from geography, environmental science, and planning in the assessment of social and environmental change at multiple scales. To ensure that the work be relevant to needs on the ground, I've engaged as much as possible along the way with multiple publics—academic, public sector, non-profits, and flatlands community members—through interviews, participant observation, working with interns, engaging in policy advocacy, and meeting with a community advisory committee.

So here's what the process looked like. For three years, beginning in Fall 2006, I co-taught an undergraduate urban agriculture course that allowed me to ask and think through some of the broader theoretical questions undergirding urban agriculture as a global phenomenon, insights that appear in Chapter 1. As a fellow at UC Berkeley's Institute for the Study of Social Change, I began to theorize the spatial production of the flatlands and the relationship between the flight of capital and the rise of urban agriculture movement in Oakland, explorations that laid the groundwork for Chapters 2 and 3.[16] At this point, my central research question, the first of four research questions that would eventually guide my project, was a simple geographical one:

> ***Research Question 1:*** *Why has urban agriculture gained such purchase in Oakland at this particular moment in history, or more specifically, what have been the historical and contemporary conditions, both necessary and contingent, that have given rise to urban agriculture here and now?*

I began to delve into the historical and theoretical material to answer this question and began seeking out organizations and individuals to interview. In addition to getting their perspectives on Oakland's growing urban agriculture movement, I wanted to find out what kinds of questions these urban agriculture practitioners and food justice activists were themselves asking. Around that time, in Fall 2007, the HOPE Collaborative was organized. HOPE, which stands for Health for Oakland's People and Environment, was an umbrella organization bringing public agencies, non-profits, and community members together to the same table to talk about food justice and the built environment. Oakland was one of eight cities and one Indian reservation funded by the W.K. Kellogg Foundation to develop an action plan over two years.

Between October 2007 and June 2009, I volunteered with HOPE as a participant observer. During this time, we conducted an assessment of the food system and built environment in six "micro-zones" in the poorest neighborhoods of the flatlands. The assessment included interviews, inventories, community listening sessions, and *charrettes* that involved mapping and visioning a healthier, greener Oakland.[17] The work resulted in a report and action plan that was submitted to the Kellogg Foundation (cf. Herrera, Khanna, and Davis 2009; HOPE Collaborative 2009). I worked primarily with the Food System Action Team (FSAT) during that year and a half process, and represented the FSAT as a HOPE delegate to the Kellogg Foundation's national Food and Fitness Working Group Meeting in Detroit in June 2008.

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[16] This work was released as a working paper (McClintock 2008). While much of it survived in Chapter 2, my theorization of urban agriculture as a Polanyian counter-movement all but disappeared in Chapter 3.

[17] While *charrette* is an everyday term in planning, architecture, and design, it may need defining for geographers and environmental scientists. In essence, it is an iterative collaborative planning exercise, wherein sub-groups of planners, designers, and other stakeholders work together to craft a proposed solution to a design problem. They then present their ideas to the whole group for discussion.

That summer, as I was developing my dissertation proposal, I also got my hands dirty. I volunteered with two urban agriculture groups; on Saturdays in West Oakland, I participated in City Slicker Farms' weekly backyard garden builds, and on Wednesdays in East Oakland I volunteered with Oakland Food Connection's urban agriculture and nutrition youth training program at E.C. Reems Academy. I also served as a backyard garden mentor, providing quarterly visits to two households between June 2008 and June 2010.

Something that came up again and again among HOPE members and the urban agriculture organizations I was working with was the need to know what the potential was for urban agriculture to expand. The second half of my dissertation thus came to be defined by this broad question: *what are the obstacles to scaling up urban agriculture and how might these be overcome?* Initially, key sub-questions included: where was there more land, who owned it, how much was there, and how much food could we grow on it? These concerns ultimately formed my dissertation's second research question:

> ***Research Question 2:*** *To what extent could urban agriculture on Oakland's vacant and underutilized public land contribute to the city's food system?*

To answer this, I began a land inventory in Summer 2008 on a computer in the City of Oakland's Redevelopment Agency, working in collaboration with city planner David Ralston. This was slow going, as I was teaching myself GIS at the same time. In Fall 2008 I established an advisory committee made up of members of the different groups I was working with to help me define the scope of the project. I applied to HOPE for a mini-grant in January 2009. With the funds I was able to hire Jenny Cooper, one of my former urban agriculture students and UC Berkeley Geography undergraduate, as a research assistant. I detail the process and outcomes of the inventory in Chapter 4.

Both within the Advisory group, and more generally in the field, discussions frequently arose about soil contamination, another potential obstacle that took center stage in my research:

> ***Research Question 3:*** *To what extent could soil contamination at these sites undermine food production by placing consumers at risk and how should we best measure this risk?*

To answer this, I applied for pilot funding from the Division of Agriculture and Natural Resources Analytical Lab at UC Davis in Summer 2009 to sample 20 of the sites identified by the land inventory. Several of my former urban agriculture students helped out with this, as did interns working with City Slicker Farms. In 2010, I received a National Science Foundation grant to scale up the soil assessment. With the help of a couple undergraduate research assistants, I sampled soil at nearly a hundred more sites and conducted a greenhouse experiment to assess lead uptake by plants. This work is the subject of Chapter 5.[18]

The next level of engagement came with the Oakland Food Policy Council, an entity created by City Council to inform food policy decisions, as I discuss in Chapters 3 and 6. It was first seated in September 2009 and I was brought on board due to my experience with HOPE as well as my role as an academic, a liaison between university research and policy. We began to think about the planning and policy obstacles to scaling up urban agriculture. This became the final research question for my project:

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[18] Rather than describing the inventory and soil sampling methods here, I have included separate methodologies in Chapters 4 and 5, respectively.

Research Question 4: *How do existing municipal zoning codes hinder the formal expansion of urban agriculture in Oakland, and how might they be updated, reformed, or reworked to facilitate its scaling-up?*

Building on a brief assessment of Oakland's existing zoning code that I conducted for the land inventory, OFPC interns and council members completed a policy scan of existing zoning and health ordinances that directly affect various aspects of the municipal food system. Working within the City Innovations group, I then helped to develop recommendations for an update to the city's zoning code to allow urban agriculture to expand in Oakland. Chapter 6 focuses on this work.

Figure 0.1 is a schematic diagram of the collaborative networks I established during this research project, and the ways in which I was able to link university resources (students, professors, labs) to community stakeholders (urban agriculture and food justice organizations, city agencies, and community members) through my multi-phased research. Those well-versed in the alphabet soup of participatory methods may call foul, arguing that my research was not actually "participatory" because community members were not be present during all stages of the process, from developing the research agenda to data collection and analysis (Israel et al. 1998; Minkler and Wallerstein 2003). The project was nevertheless informed by participatory methods and was designed around ideas gathered during informal discussions, interviews, focus groups, design charrettes, and frequent brainstorming sessions with HOPE Collaborative's governmental, organizational, and community partners, Oakland Food Policy Council members, and urban agriculture program participants. Indeed, I intentionally tailored my dissertation to meet their research needs. I formulated and re-formulated my research questions in an iterative fashion, integrating stakeholders' feedback. I presented versions of my research proposal for approval to HOPE partners and staff throughout 2008 then presented to the FSAT in January 2009.[19]

At a September 2009 Community Forestry & Environmental Research Partnerships workshop in South Carolina, my community partner Barbara Finnin, the Executive Director of City Slicker Farms, commented that these kinds of collaborations are so valuable because organizations like hers are unable to answer the questions they need answered; in general, they lack the staff and financial resources needed to gather and analyze data themselves. As such, I was (and am) acutely aware of my positionality as a researcher and of the power dynamics that go along with that role. Despite my attempts to engage my collaborators more fully, I nevertheless played the role of "the expert" on some levels. But this was simply the reality of the situation due to a number of factors: the individual (and lonely!) nature of GIS work, statistical analysis, and writing; the limited time and resources of my research partners; limited research funding which precluded me from hiring community members as field assistants; and limited time, given the constraints of a dissertation timeline and the fact that I also had to teach to pay the bills. Put simply, classical participatory research demands time and money that a doctoral

[19] Community members on the FSAT were generally supportive of my proposal; however, they wanted to know how their communities would immediately benefit from the study. They also expressed that safety must be included in the final site selection criteria. I revised my proposal to include employment and on-the-job training for two community members, and invited new community residents to join the Advisory group. Sadly, this most important part—job training and employment for two community members— never materialized due to time and funding constraints, something that would have been less of an issue were I a true "programmer" with a real project budget and time to manage it! I also reframed my proposal following Built Environment Action Team and Steering Committee recommendations to ensure cooperation from city agencies.

student and community partners are hard pressed to find. Nevertheless, I view my project as an example of *collaborative* and *engaged* research, a fluid and dynamic articulation of what participatory research actually looks like on the ground. This, to me, is ultimately what was essential about the approach.

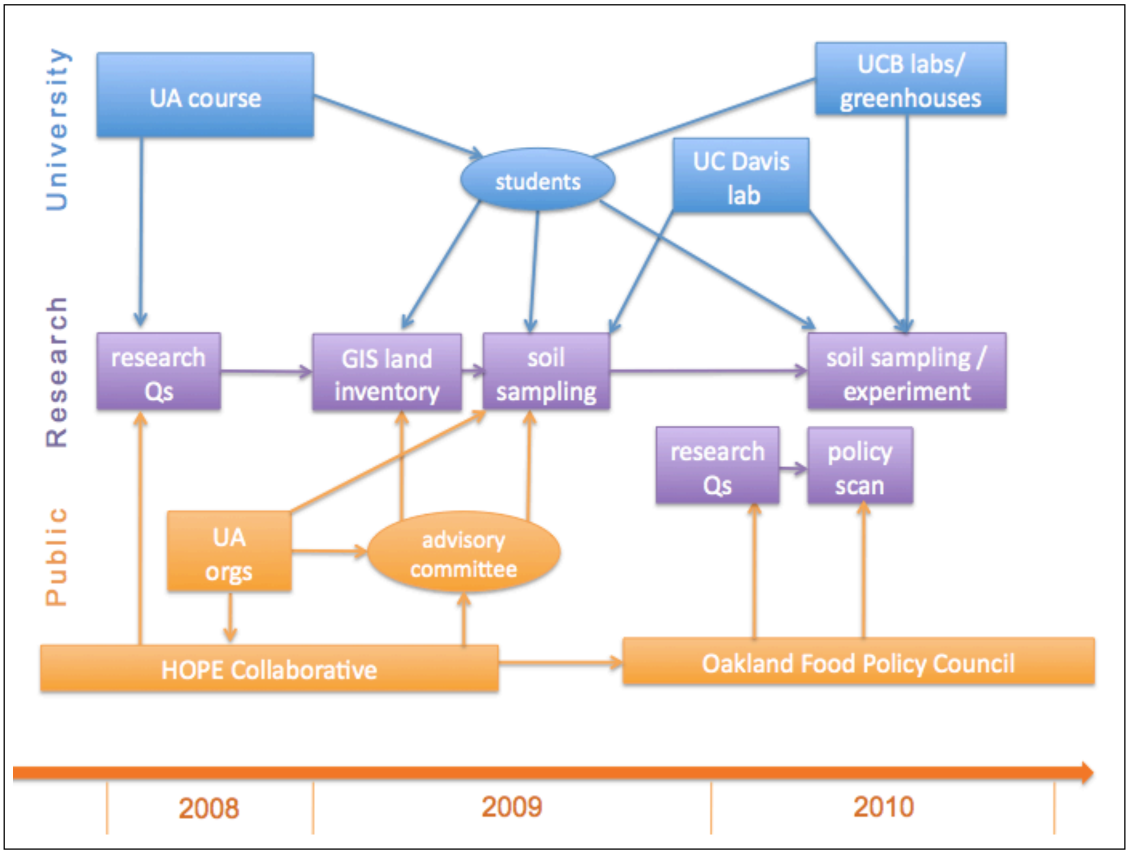

Figure 0.1: Engaging community through the research process. The top band (blue) represents university actors, the bottom (orange) various community stakeholders. Various stages of my dissertation research link the two in the center band (purple). A timeline runs along the bottom.

An overview of the dissertation

This dissertation simultaneously uncovers the historical and geographic conditions necessary for urban agriculture to arise in Oakland, and, arising from the collaborative approach outlined above, addresses the questions that were most pressing to people on the ground. These two tasks mark the division of the dissertation into two roughly equal parts. The first half, ***Part 1: Origins***, addresses Research Question 1 across three chapters. These include a broad theorization of urban agriculture, a historical analysis of the uneven development of food access in Oakland, and a relational history of the urban agriculture movement's rise to address these inequities. The second half, ***Part 2: Obstacles and Opportunities***, addresses the environmental and policy obstacles that must be addressed before urban agriculture can be successfully scaled up in any coordinated manner. The three chapters in this part address the specific technical questions defined in collaboration with community members (Research Questions 2, 3 and 4 on land availability, soil contamination, and zoning obstacles, respectively).

In ***Chapter 1*** I use the Marxian concept of "metabolic rift" to explore the multiple origins of urban agriculture as a global phenomenon, but one that arises for different reasons in different places. While scholars have used the theory to expose the manifold ways in which the industrial agri-food system disrupts ecological processes, I argue that, as currently theorized, metabolic rift fails to fully address the nuances of spatial and temporal scale, and underemphasizes the social disruptions inherent to the process. I begin the chapter by differentiating among three interrelated dimensions of rift—ecological, social, and individual—then demonstrate how urban agriculture has arisen largely in response to crises of capital accumulation and the rescaling of production that follows. I examine urban agriculture's potential to rescale food production and ecological processes. I also elaborate how urban agriculture can "de-alienate" urban dwellers both from the food they eat (by re-integrating production and consumption) and from the biophysical environment (through the process of manual labor).

Having outlined a theoretical framework through which to understand urban agriculture writ large, I turn my focus to Oakland in ***Chapter 2***. Understanding urban agriculture in Oakland today, I argue, demands that we first understand how and why food deserts developed in the flatlands. This chapter, a historical overview of Oakland's economic geography from the early 20th century to the dawn of the Neoliberal era, tells that story. Using economic and demographic census data, primary source archival materials, and secondary source histories, I explain how the ebb and flow of industrial and commercial capital in and out of Oakland, guided by racialized investment and urban planning practices, shaped the city's landscape and concentrated poverty in the flatlands. Through this process (that I refer to as "demarcated devaluation"), the city's food deserts emerged in these same neighborhoods, diminishing food access for low-income people of color.

The devaluation of the flatlands was a necessary condition for the rise of the urban agriculture movement in Oakland. In ***Chapter 3*** I trace the roots of the contemporary urban agriculture movement in Oakland to responses to this devaluation. I first focus on three seminal moments of radical activism that laid the groundwork for today's food justice movement: the Black Panther Party's Free Breakfast Program, the Environmental Justice (EJ) movement of the 1990s and 2000s, and an urban greening movement built on a foundation of racial and social justice. I then explore how various groups converged on urban gardening as a strategy for social change, building on a long history of Bay Area gardening by school children, immigrants, and community groups, and tapping into a large network of sustainable agriculture education programs. Finally, I outline current efforts by urban agriculture organizations in Oakland and ongoing initiatives to scale up through local food policy and planning.

Four central themes emerge over the course of this relational history. First, the growth of urban agriculture has relied on alliance-building across racial, ethnic, and class lines. Second, it was through these multicultural alliances that activists were able to contest the material implications of flatlands devaluation in new political arenas. Third, both the multi-ethnic alliances and cross-scalar politics allowed—and to a certain extent were prerequisite to—financial support. In many cases, funding came in the form of grants from private foundations and government agencies, providing not only much-needed money, but also a badge of legitimacy in the eyes of local government as well as other funders. Finally, urban agriculture's growth as a movement—along with the trickle of capital that fed it—can clearly be linked to its increasing institutionalization and ongoing efforts to scale up. What remains to be seen is the extent to which institutionalization dilutes the radical motivations that lie at the foundation of the urban agriculture movement in Oakland. This chapter reveals both the necessary historical conditions and contingencies that gave rise to urban agriculture in Oakland. Through this chapter it becomes clear how dichotomous critiques (e.g., urban agriculture as neoliberal, urban agriculture as gentrifying) and boosterish advocacy (e.g., urban agriculture as radical, urban agriculture as panacea) alike fail to capture these conjunctural requirements as well as the possibilities they suggest for change.

In Part 2, the dissertation then shifts its focus from the origins of urban agriculture in Oakland to technical issues confronting its scaling up.[20] First and foremost, scaling up urban agriculture requires an assessment of potential expansion onto the city's vacant parcels and open space. Following a brief review of existing land inventories and their role in food policy, ***Chapter 4*** details a collaborative project to inventory vacant parcels and assess their potential agricultural use. Working with an advisory committee of stakeholders from public agencies, non-profits, and community members, I integrated GIS, tax assessor and census data, aerial imagery, and crop reports to identify potential urban agriculture sites and calculate their potential productivity. Overall, the inventory reveals more than 800 acres of untapped potential on public land. Depending on farming practices, I report that even a modest commitment by the city to devote 100 acres of land to urban agriculture could contribute as much as 10% of existing vegetable consumption levels (or 1% of recommended consumption levels). I conclude the chapter by discussing limitations to the analysis and detail the project's role in ongoing policy efforts.

As city planners and food justice activists join forces to expand urban agriculture on vacant land, the public has raised some concern over heavy metals and other contaminants left over from Oakland's industrial past. In ***Chapter 5***, I draw on methods from environmental science to evaluate the extent to which soil contamination may be an obstacle to the expansion of urban agriculture. Using GIS to analyze soil sample data collected in 2009 and 2010 from over a hundred sites identified in the land inventory, I explore the spatial distribution of lead in vacant and underutilized land across Oakland. The chapter represents both a methodology for site assessment and an application of the "precautionary principle", in that it assesses the risk of lead contamination before efforts to scale up proceed, in order to ensure that they do not endanger populations they intend to serve. Ultimately, lead contamination did not prove to be as great a risk as many thought. As expected, soil lead levels were highest in West Oakland and residential areas and lowest in open space and city parks. The density of old housing stock proved to be the primary anthropogenic factor affecting soil lead levels, while soil phosphorus proved to be the most important chemical factor. Finally, lead uptake by plants does not appear to pose a real risk

[20] A brief caveat applies here. As I engage with these applied questions in Part 2, my language and tone are markedly different than in Part 1. This is mainly a reflection of the fact that I am writing for different audiences (due in no small part to the Balkanization of social and biophysical sciences into distinct and separate academic disciplines). The format of an environmental science journal, for example, is relatively standard (e.g., brief introduction, detailed methods, results and discussion, conclusion). This differs significantly from that of a human geography journal, where little import is placed on method, but instead on the development and execution of an argument that engages with an existing body of theory. These differences extend to syntax and grammar, as well. In the sciences, passive voice construction is the norm, while in the social sciences and humanities it's the devil's handmaiden. Similarly, most scientific data is reported (note the passive construction…) in the past tense, as they reflect the outcome of a particular investigation taken at a particular moment in time; to report them in the present tense implies something more static or universal. These differences are readily apparent in Chapter 5.

in the soils studied; lead in surface soil is likely a more important source of exposure. I also argue that a similar assessment should be used to investigate the risk of other heavy metals or organic contaminants.

In the dissertation's final chapter, ***Chapter 6***, I focus on the policy obstacles to the scaling up of urban agriculture. The chapter is a case study on the efforts of the Oakland Food Policy Council (OFPC) to develop an action plan for food systems change in Oakland. I first outline the process by which the OFPC prioritized food system goals before focusing more specifically on its efforts to create new zoning definitions and operating standards for urban agriculture. I detail obstacles we faced in gaining the attention of city officials and moving our policy agenda forward. Ultimately, it took pressure on City Council members and a couple of high profile events to get planning officials to tackle urban agriculture zoning: first, the passage of San Francisco's urban agriculture ordinance, and second, the crackdown on urban farmer and author Novella Carpenter, whose book *Farm City* is quickly becoming required reading for "urban homesteaders". Both events helped to expose the limits of Oakland's zoning code. I conclude the chapter by reviewing the OFPC's lessons learned and situate the changes within the context of the ongoing update process.

I conclude the dissertation with some reflections on my methodological approach, its limitations, and its contributions to the analysis of urban agriculture and to critical geography, planning, and urban ecology more broadly. I also offer some final thoughts on urban agriculture's future limits and possibilities in Oakland. Beyond a reclamation and celebration of the "fertility of soil, adapted to the culture of vegetables and flower gardens" as trumpeted by Mayor Horace Carpentier more than a century and a half ago, what lies at stake is urban agriculture's potential contribution to the just city, the sustainable city, and just sustainability. I hope that this dissertation provides a first step in navigating urban agriculture's role therein. In the end—and, more importantly, in the beginning—radical change requires roadmaps…

Part 1: Origins

Chapter 1:

Why Farm the City?
Towards a Theory of Urban Agriculture

Urban agriculture is sprouting up in the empty spaces of post-industrial landscapes throughout the industrialized world—in vacant lots, road medians, parks—evoking the patchwork of vegetable gardens and livestock enclosures that are a part of the urban streetscape in much of the global South. The spike in oil and food prices in late 2007 and early 2008, and the shocks of the current economic meltdown has led to a tightening of belts and a growing interest in urban agriculture as a way to lower food costs. Sales of vegetable seeds since the meltdown have increased 20 percent and stories on urban agriculture crop up in the news on a daily basis. In Washington First Lady Michelle Obama and a handful of fifth-graders from a nearby elementary school plant a vegetable garden, the first of its kind at the White House in sixty years. In Vancouver the city council legalizes chicken ownership. In London "guerrilla gardeners" plant a vegetable patch on a roundabout. In Detroit goats and chickens graze some of the 60 square miles of vacant lots left fallow as capital abandoned the city.

The renewed interest in urban agriculture should come as no surprise. Historically, urban food production in the US and Britain has flourished in such periods of economic crisis. As we find ourselves once again in the throes of a crisis of capitalism, the popularity of urban agriculture in the Global North has surged and the discourse surrounding it has shifted from one of recreation and leisure to one of urban sustainability and economic resilience. Even the terms used to describe it have shifted in the Global North; "urban agriculture" is replacing "community gardening" in everyday parlance, placing it (despite its much smaller scale) in the same category as urban farming in the Global South, where livestock and small plots of food crops have persisted as part of the urban landscape.

While the motivations and functions of urban agriculture vary greatly across the globe, the widespread discourse surrounding urban agriculture in the North does little to differentiate it from its Southern counterpart. Over the last decade or so, as concern over the ecological impacts of urbanization adopts an increasingly Malthusian timbre, government agencies, NGOs, and farmers groups have touted the potential for urban agriculture to help buffer incomes and food security in the rapidly urbanizing South (Smit, Ratta, and Nasr 1996; Mougeot 2005; van Veenhuizen 2006). They extol the virtues of urban agriculture's multi-functionality: it improves food security and creates jobs, serves as a sink for urban waste, and cools cities. The distance between production and consumption—so-called "food miles"—decreases, lowering fossil fuel use and transportation costs. In the North, advocates echo this discourse, also adding urban agriculture's ability to strengthen a sense of community, reconnect consumers with farmers, raise awareness of environmental and human health, and keeps money circulating locally. Ecological farming practices reduce the amount of agri-chemicals used, curbing environmental pollution and threats to public health. In short, advocates argue that urban agriculture creates a more ecologically-sound, resilient, and productive landscape (Smit, Ratta, and Nasr 1996; Viljoen 2005).

An undifferentiated view of urban agriculture and its possibilities, however, may result in its prescription as a panacea for urban ills without consideration of the geographic particularities of a city. Can we generalize about why people farm in the city? And more importantly, can we make broad claims about why people *should* farm urban spaces? To better understand the dynamics *giving rise to* urban agriculture in various settings in both the North and South and the ways in which urban agriculture has developed as a multi-functional *response to* these dynamics, a theoretical framework bridging political economy, urban geography, agroecology, and public health would be helpful not only for agri-food scholars, but also for practitioners wishing to engage with urban agriculture. The theory of metabolic rift offers one such lens. Over the last decade, environmental sociologists and geographers have elaborated Marx's argument that the development of capitalism (and the urbanization that followed) alienated humans from the natural environment and disrupted our traditional forms of "social metabolism", the material transformation of the biophysical environment for the purpose of social reproduction (Foster 1999; Moore 2000; Swyngedouw 2006; Clark and York 2008).[21]

Understanding metabolic rift first requires briefly addressing metabolism, a concept that has been used since the early nineteenth century to describe the material and energetic exchanges both within an organism (at the biochemical level) and between the organism and its environment. To understand metabolism as a socio-ecological process, we must return to the rise of soil chemistry in the late 1830s, when Justus von Liebig, the father of modern soil science, employed metabolism (*Stoffwechsel* in German) to explain the cycling of nutrients between soil, crops, animals, and humans, essentially expanding the scope of metabolism from the organismal scale to the ecosystem. Following the work of Scottish political economist/scientist/gentleman farmer James Anderson, who linked the decline of soil fertility to the expansion of large-scale farming, Liebig helped reveal how the rapid urbanization that accompanied the Industrial Revolution disrupted nutrient cycling in agriculture and depleted soil fertility.[22] As food production intensified and agricultural products were transported increasingly longer distances from rural farms to a growing population of urban consumers, soil nutrients utilized by food and fiber crops were flowing from rural soils into cities and foreign ports. There they ultimately ended up in the form of excrement polluting urban streets, sewers, and rivers, rather than cycled back into the fields from which they were extracted. As Marx (1981) noted in Volume 3 of *Capital*, "they can do nothing better with the excrement of 4 ½ million people than pollute the Thames, at monstrous expense" (195).

Liebig's discovery of soil nutrients provided a scientific rationale to Marx's attempts to understand the ways in which capitalist modes of production alienated humans from nature and from one another.[23] Drawing heavily on Liebig's insights into declining soil fertility, Marx sought to explain in more detail how human action stewards, transforms, or disrupts natural processes. Labor, for him, was the key to understanding this relationship: "Labour is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature" (Marx 1976, 283).

[21] For a detailed reviews of the history of "metabolism" and its use as a conceptual theory, first by natural scientists and later by Marx and other social scientists, see Foster (1999, 2000) and Heynen et al (2006a). Marxian geographers and political ecologists have further advanced Marx's theory of metabolism by showing how social processes produce nature (Heynen, Kaika, and Swyngedouw 2006a; Harvey 1996; Smith 2008).

[22] Liebig published *Agricultural Chemistry* in 1840, in part, as an effort to address the crisis of declining soil fertility. Ironically, his discovery of the role of soil nutrients in plant growth ultimately fueled the further expansion of the crisis; industrial production of synthetic phosphate fertilizer in 1843 enabled large-scale farmers to overcome limiting nutrient deficiencies. The resulting increase in production ultimately accelerated the depletion of soil nutrients, leading Liebig to become critical of capitalist agriculture by the late 1850s (Foster 2000, 151).

[23] Anderson's work was extremely important to Marx as well. Arguing against earlier arguments that rent, or the value of land, was derived from an inherent fertility, Anderson linked declining rent to declining soil fertility caused by overproduction (Foster 2000, 144-147). This intersection of natural and social science was a crucial stepping-stone for Marx's development of his theory of metabolism.

Understanding the linkages between mid-19th century environmental crises (such as declining agricultural soil fertility and rising levels of urban pollution) and the squalor of the worker therefore necessitated an understanding of the processes that disrupted (or created a "rift") in pre-capitalist forms of social metabolism. Marx ascribed this rift to the expansion of capitalist modes of production (the rise of wage labor, in particular), and to urbanization arising from industrialization and the displacement of small-scale agriculture:

> Large landed property reduces the agricultural population to an ever decreasing minimum and confronts it with an ever growing industrial population crammed together in large towns; in this way it produces conditions that provoke an irreparable rift in the interdependent process of social metabolism, a metabolism prescribed by the natural laws of life itself. The result of this is a squandering of the vitality of the soil, which is carried by trade far beyond the bounds of a single country. (Marx 1981, 949)

As he explains, this process also cleaves a biophysical rift in natural systems (such as nutrient cycles), leading to resource degradation at points of production and pollution at points of consumption. Finally, this rift reifies the dichotomy between city and country, urban and rural, humans and nature, obscuring and effacing the linkages between them.

Many environmental sociologists have used the theory of metabolic rift to explain shifts in nutrient cycling under capitalist agriculture as Marx did (Foster 1999; Foster and Magdoff 2000; Clark and York 2008), as well as the ways that sustainable agriculture might help to overcome this rift (Foster and Magdoff 2000; Clausen 2007; Clow and McLaughlin 2007). Others have expanded the scope of analysis to include broader ecological crises: global warming (York, Rosa, and Dietz 2003; Clark and York 2005), fisheries depletion (Clausen and Clark 2005), and the ways in which the development of global capitalism has driven ecological succession (Moore 2000; Prew 2003). Despite Marx's conception of social metabolism as a fundamentally *socio*-ecological process, however, most scholarship on metabolic rift has emphasized the *ecological* dimensions of crises of capitalist accumulation.

If, as Marxian geographers and political ecologists have argued, understanding "socio-natures" (such as cities, agricultural landscapes or other areas of resource extraction) demands that we uncover the ways in which social and natural processes are co-produced through social metabolism (Harvey 2006; Swyngedouw 2006; Smith 2008), it is first necessary to situate urban agriculture's emergence *at a particular location* within the specific historical and geographical context. The purpose of this paper is therefore twofold. First, I contribute to the existing conceptualization of metabolic rift by more explicitly emphasizing its *social* dimensions. I discuss three interdependent yet distinct forms or dimensions of metabolic rift: 1) *ecological rift*, which includes both the rift in a particular biophysical metabolic relationship (such as nutrient cycling) and the spatio-temporal rescaling of production that follows in its wake; 2) *social rift*, arising from the commodification of land, labor, and food at various scales; and 3) *individual rift*, the alienation of humans from nature and from the products of our labor. Rather than a triad of separate processes, these three unified dimensions of metabolic rift are co-produced, but can be differentiated as a function of both the scale at which metabolic rift occurs, and by the grain and extent of observation. I should stress here that my intention is not to lay claim to Marxian neologisms. Rather, I hope to bridge and clarify existing concepts and incorporate them into a single framework that accords equal weight to ecological and social aspects. As such, a theory of metabolic rift emphasizing its multiple dimensions may be used more precisely to analyze and explain historical and contemporary transformation of the agri-food system.

My second goal in this chapter is to use this expanded view of metabolic rift both to shed light on the different dynamics driving the emergence of urban agriculture in various parts of the world, and to show how urban agriculture, in turn, attempts to overcome these three forms of metabolic rift. With added emphasis on social rifts in metabolism operating at multiple scales, this expanded framework can help us understand both social and ecological dimensions of urban agriculture's multi-functionality, from its attempts to overcome disruptions in ecological cycles to its ability to reclaim public space, re-embed food production and consumption with socio-cultural significance, and reconnect consumers with their food and the environment.[24] Understanding urban agriculture in this way may be of service not only to academics, but also to policy makers, planners, non-profit workers, and urban agriculture advocates as they frame discussions of urban agriculture and develop future policy and programs in Oakland and elsewhere.

Ecological Rift: Rescaling metabolism

The form of metabolic rift most discussed by scholars is what I refer to more specifically as ecological rift. According to their arguments, the imperative of spatial expansion inherent to capitalism has cleaved a rift between city and country, humans and nature. In search of new spaces for ongoing accumulation, capital has also disrupted sustainable biophysical relationships such as nutrient cycles. As Moore (2000, 137) argues, "systemic cycles of agroecological transformation" triggered by new modes of capitalist production "usher in a new more intrusive and more globalized exploitation of nature by capital." Capital's ongoing expansion therefore creates a cycle of "rifts and shifts" whereby attempts to address a metabolic rift in one place simply lead to "geographic displacement" of ecological crisis (Clark and York 2008). In an often-cited example, the expansion of capitalist agriculture in Europe and North America led to a soil fertility crisis during the 19th century. A mad dash for new sources of fertility ensued, notably for South American guano and saltpeter, and a nascent synthetic fertilizer production industry developed. The scramble to locate new sources of fertility drove imperialist expansionism which ultimately displaced the metabolic rift elsewhere (Foster 1999; Foster and Magdoff 2000; Clark and York 2008). As Engels explained in the late 19th century, each technological triumph over nature leads to other crises: "For each such victory takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel the first" (Engels 1959, 12). These short-term technological fixes inevitably generate new metabolic

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[24] The origins of this paper actually lie in my use of metabolic rift as a pedagogical tool to explain urban agriculture's multi-functionality in both the Global South and North. For three years I co-taught an undergraduate course on urban agriculture in which we used the theory to frame our interdisciplinary study of urban agroecosystems. It enabled us to bridge disciplinary divides, linking social science analyses of urbanization and the rise of the industrial agri-food system to biophysical science understandings of soil and insect ecology and a hands-on lab practicum in which students grew their own food. Framing the course this way allowed students to understand—both intellectually and experientially—how urban agriculture simultaneously arises from metabolic rift *and* attempts to overcome it. Similarly, this framework has helped me make sense of the various forms of urban agriculture I have encountered in the field as both a researcher and extensionist working in the US, Latin America, West Africa, South and Southeast Asia over the last decade.

rifts, amounting to "a shell game with the environmental problems [capitalism] generates, moving them around rather than addressing the root causes" (Clark and York 2008, 14).

However, this shell game is not just a matter of space, but also a matter of scale. While a rift in a *particular metabolic process* occurs at a *particular scale*, social metabolism of nature continues at new spatial and temporal scales as production is relocated or becomes dependent on new inputs. Capitalist rationalization of agriculture (farm consolidation, separation of crops and livestock, the advent of imported and synthetic fertilizers) arose from the pursuit of new markets and from the need to avert crises of production, such as falling rates of profit due to competition, a decline in availability of raw materials, or environmental pollution and declining worker health resulting from production practices (cf. Moore 2000, 2008). These shifts in production severed *particular* metabolic interactions. The separation of animal and crop production in industrial farming systems, for example, ruptured cycling of nutrients (between soil, crops, livestock, and manure) at the farm scale, leading to an increased reliance on off-farm inputs, such as fertilizers and feed shipped in from other regions. This rift in nutrient cycling therefore resulted in a *rescaling* of social metabolism; put simply, the inputs necessary to sustain human life under this new production system came from farther and farther away.

Sustaining social metabolism under a food production system that depletes rather than regenerates the resource base depends not only on such *spatial* rescaling, but also on *temporal* rescaling. Rescaling requires what ecologists refer to as spatial and temporal "subsidies" to the food web (Polis, Power, and Huxel 2004), inputs that are produced on a different geographic and/or time scales. Since a subsidy is cross-scalar (i.e., it comes from afar away or is not renewable in our lifetime), its incorporation into a metabolic system inherently creates a new ecological rift as it is depleted; it is impossible to close the loop between the source and sink of such a cross-scalar subsidy. During the aforementioned crisis in soil fertility, for example, guano and nitrates were mined from decades- and centuries-old deposits from Peru and Chile, then transported across oceans to Europe and America (Foster and Magdoff 2000; Clark and York 2008). Replenishing these stocks would have been impossible within the span of a single cropping season, much less within the span of a human life. Once guano stocks were exhausted, agribusiness interests turned to synthetic fertilizers. The natural gas and petroleum needed to produce synthetic fertilizer and power tractors is millions of years-old, drawn from gas fields and oil wells around the globe and shipped to factories and refineries before being used thousands of miles from the point of extraction.[25] It becomes easy to see how ecological rift scales up, making social metabolism a global affair, dependent on millions-year-old subsidies from tens of thousands of miles away. If, as Huber (2009, 108) argues, fossil fuel use is "an internal and necessary basis to the capitalist mode of production," ecological rift and the resulting spatio-temporal rescaling of social metabolism is internal and integral to the contemporary agri-food system.

Relocalizing these nutrient cycles and reducing dependence on petroleum-based food production lie at the heart of urban agriculture's potential to mitigate metabolic rift. British agronomist Sir Albert Howard (1943), concerned that organic wastes (human, animal, and crop residues) were rarely cycled back to their point of origin in large-scale agriculture, plaintively pondered, "Can anything be done at this late hour by way of reform? Can Mother Nature secure even a partial restitution of her manurial rights?" (40). While unclear if he was aware of Marx's

[25] Engels' noted this temporal shift occurring under capitalist modes of production: "the working individual is not only a stabilizer of the present but also, and to a far greater extent, a squanderer of past, solar heat" (Engels in Foster 2000, 166).

views on social metabolism (and if so, it is doubtful that as a servant of the British crown he would have admitted as much!), Howard echoed the concerns of Liebig, Marx, and Engels. Noting that "the Chinese have maintained soil fertility on small holdings for forty centuries" and inspired by the traditional farming practices he witnessed around him in the colonies, Howard championed compost use over chemical fertilizers and pondered a possible transformation of the industrial model where waste would be cycled back to farmland. Howard's notion dovetailed with what Engels envisioned in 1878:

> Abolition of the antithesis between town and country is not merely possible. It has become a direct necessity of industrial production itself, just as it has become a necessity of agricultural production and, besides, of public health. The present poisoning of the air, water and land can be put an end to only by the fusion of town and country; and only such fusion will change the situation of the masses now languishing in the towns, and enable their excrement to be used for the production of plants instead of for the production of disease. (Engels in Tucker 1978, 723)

In this same tradition, mending ecological rift via the recycling of organic waste is central to urban agriculture across the globe. This concept of returning nutrients to agricultural soils in the form of urban waste is vital to overcoming the "antithesis between town and country" and is fundamental to a "restitutive" agriculture. While few urban planners and mainstream development practitioners likely look towards Marx and Engels for inspiration, these obscure passages describing metabolic rift are particularly prescient, relevant not only to the development of sustainable agriculture, but also to urban waste management and the impending environmental crises of mega-urbanization (cf. Davis 2006, 121-150).

For millennia, farmers worldwide have maintained soil fertility on small plots through the application of organic waste; urban farmers are no exception. Adapting to the rising cost of chemical fertilizers and stagnant market prices for their produce, urban farmers in many parts of the South rely on intensive applications of manure from urban and peri-urban livestock production, ash, and composted garbage as a free or low-cost fertilizer and soil conditioner. Peri-urban livestock producers, in addition to tapping rising urban demand for meat, dairy, and eggs, sell manure to urban market gardeners and to large-scale vegetable farms in the urban outskirts. To profit from compost's fertilizing potential, farmers frequently cultivate the peripheries of garbage dumps or establish illicit contracts with garbage truck or cart drivers to obtain compost for their fields, paying them to simply dump a load of garbage in their fields while en route to central collection facilities. Advocates argue that redirecting the organic fraction of waste streams to agricultural production in urban areas and their hinterlands will help to boost soil fertility, as well as reduce soil and water pollution arising from heavy agrochemical use and large concentrations of waste deposited in landfills, dumps, and waterways (Smit, Ratta, and Nasr 1996; Dreschel and Kunze 2001).

Yet to truly close the nutrient cycle and diminish the impacts of this ecological rift, human waste from urban consumers would need to be returned to the crops' fields of origin. Every day, on average, every human produces 1 to 1 ½ kg of nutrient-rich feces. Human waste, or "night soil", is a common source of organic fertilizer in urban and peri-urban agriculture, though less commonly promoted (much less discussed) due to cultural biases and to the higher public health risks associated with its application. Despite the social stigma, foul odor, and contamination risk of its use, there is stiff competition among farmers for access to night soil. In one study, two-thirds of farmers surveyed in two peri-urban zones in northern Ghana used human waste in their fields (Cofie, Kranjac-Berisavlevic, and Dreschel 2005). In China, in particular, application of human waste to farmland has been central to both urban waste management and agricultural production, but has been diminishing as rapid industrialization and urbanization transform agricultural production at the urban edge (Smit, Ratta, and Nasr 1996).

While such forms of restitutive soil fertility management In the Global South generally arise from creative exploitation of limited resources and adaptation to limited access to land, fertilizer, and credit, they have been celebrated by urban farming advocates worldwide as fundamentally sustainable practices. In North America and Europe, where the discourse of ecological sustainability generally informs urban agriculture practice, the age-old nutrient cycling practices used in the Global South are a cornerstone of urban agriculture advocacy. Practices such as compost application, planting of nitrogen-fixing cover crops, and incorporation of crop residues are presented as a sustainable way to close the nutrient cycle and reduce urban ecological footprints. Indeed, application of compost to urban soils can also provide other environmental services, such as reducing erosion, improving drainage and water holding capacity, controlling pathogens, and immobilizing heavy metals. For commercial growers in peri-urban areas, a growing consumer demand for local and organic food often drives the transition to more ecologically-sound farming practices. A growing number of municipalities collect green waste (a combination of yard trimmings and food scraps) for composting. Much of the compost is sold at low cost or provided for free to local farmers, landscapers, and gardeners.

Infrastructure for the collection, composting, and distribution of compost seems to be the greatest hurdle preventing urban agriculture's ability to minimize ecological rift in nutrient cycling. Nevertheless, development workers and planners are optimistic about its role and argue that with improved waste management technology, access to land, and policies favoring agricultural production in urban areas, urban agriculture can contribute significantly to feeding the world's cities and mending ecological rift by restoring "Nature's manurial rights", rescaling production to a more local level, and relying less on petroleum-based inputs and other cross-scalar subsidies.

Social Rift: Commodification

Drawing on Marx's analysis of soil fertility depletion, most scholars have emphasized *ecological* dimensions of metabolic rift. According to Marx's conception of social metabolism, however, ecological rifts develop in conjunction with social processes, notably the rise of wage labor. If, as Marx argued, understanding these rifts depends on understanding the linkages between wage labor and capital, the utility of metabolic rift as a theoretical framework through which to view the agri-food system stands to gain from added emphasis on what I call "social rift". Two historically interrelated processes, collectively theorized by Marx as primitive accumulation, are central to social rift: the commodification of land and the commodification of labor. The clearing and/or dispossession of subsistence farmers and herders from common land has resulted in the proletarianization of rural populations who flood into urban centers in search of work: "the systematic theft of communal property was of great assistance…in 'setting free' the agricultural population as a proletariat for the needs of industry" (Marx 1976, 886).[26]

[26] Marx (1976) states that this process "appears as 'primitive' because it forms the pre-history of capital, and of the mode of production corresponding to capital" (875). The original German *ursprüngliche Akkumulation* has also been

Understanding this social rift is not only essential to explaining urbanization, but to elucidating the linkages between urbanization and the agri-food system. The rise of large- and industrial-scale farming has entailed the consolidation of land and expansion of mechanization and other new farming technologies, both of which reduce the demand for agricultural labor. This was evident in Europe at the dawn of the capitalist era, in the US during the latter half of the 20th century (Cochrane 1993; Mazoyer and Roudart 2006), and more recently in China where as many as 70 million farmers were dispossessed by expanding land markets in the last decade of the 20th century (Harvey 2005, 146-147). In the Global South, a host of pressures—structural adjustment programs, land consolidation, drought, war, expansion of natural resource extraction and biofuels plantations—has dispossessed rural populations over the last several decades and fueled the growth of megacities and their slums across the globe (Davis 2006). Indeed, as Marx (1976) predicted, "Part of the agricultural population is therefore constantly on the point of passing over into an urban or manufacturing proletariat" (795).

Social rift is a central driver of urban agriculture in the Global South, where production of food is often a subsistence activity. Between 70 and 75 percent of farmers in a survey of urban agriculture in Nairobi, for example, produced for household consumption, citing hunger and the need for food as their principal motivation (Freeman 1991; Ali Memon and Lee-Smith 1993). Similar rates have been found in other parts of Africa, with lower rates in Asia, and Latin America (Egziabher et al. 1994; Mougeot 2005; van Veenhuizen 2006). A recent FAO study revealed that over 30 percent of households in 11 of the 15 countries studied engage in some form of urban agriculture. The results also showed the urban poor are more likely to practice urban agriculture than wealthier city dwellers (Zezza and Tasciotti 2010). Rural migrants often discover on arrival in urban centers that prospects for employment are slim. Many must therefore improvise new means of survival, particularly in those cities where social services were gutted under structural adjustment during the 1980s and '90s. Many embark on small-scale agriculture on marginal plots of land tucked in between housing, industry, and infrastructure, within the city itself or in its immediate hinterlands, in order to buffer themselves from the socio-economic upheaval of dispossession from their land and from the lack of formal employment opportunities in the city and its peripheral slums.[27] The slashing of government jobs under structural adjustment in many parts of the Global South also drove members of the urban professional class to embark on urban agriculture projects to augment their diets, and for those selling on informal local markets, to supplement their income.[28]

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translated as "original" or "primeval" accumulation. This violent history of primitive accumulation "written in the annals of mankind in letters of blood and fire" (ibid.) includes, among others, "enclosure" of the English commons, and other colonial and/or imperialist examples of dispossession such as the Trail of Tears, the Scramble for Africa, and the more recent colonization of the Brazilian Amazon. See Polanyi (2001) and Williams (1973) for deeper discussions of the enclosure of the English commons. It is crucial to understand that primitive accumulation is not a process solely relegated to the "pre-history of capitalism", but is an ongoing process of commodification of public goods and spaces that extends beyond the historical enclosure of the commons centuries ago (DeAngelis 2004). This "accumulation by dispossession" (Harvey 2003) of resources is visible as contemporary markets expand to incorporate such diverse commonly-held resources as water, genes, and knowledge (Goodman and Watts 1997; Kloppenberg 2005).

[27] Mike Davis (2006) describes the "urban involution" occurring in many cities of the Global South where population growth outpaces economic growth, leading to the expansion of the informal economy and more extreme forms of self-exploitation necessary for survival.

[28] This dynamic of returning to the land in times of economic turmoil is not new. Marx (1976) notes that when northern Italy's vibrant commercial sector was "annihilated" by the new world economy of the late 15th century,

According to Guyer (1987) subsistence and small-scale urban food production, along with the informal food economy to which it contributes, often undermine the expansion of more formal markets. At the same time, however, self-provisioning effectively subsidizes the cost of social reproduction within the larger capitalist economy (Wolpe 1972; Hart 2002; Arrighi 2008); in short, wages can stay lower if workers are feeding themselves, ultimately facilitating the accumulation of capital.[29] Urban agriculture therefore exists in tension with capital, arising as a strategic response to social rift on one level by exploiting underutilized land and buttressing against the expansion of commercial agri-food markets in poor areas, while subsidizing ongoing accumulation on a more macro-level. Such coping mechanisms generally shift an additional burden onto the shoulders of urban women, in particular (Meillassoux 1983; Hvorka, de Zeeuw, and Njenga 2009). In addition to expending her energy on food production and jobs in the informal economy, a female farmer may also divert income earned from sale of surplus produce towards the purchase of additional ingredients for a meal; as a Senegalese extensionist explains, "Whatever a woman earns [from her gardens] goes directly into the cooking pot" (McClintock 2004, 26).

A straightforward Marxian analysis of the combined impact of low wages and dispossession from the land can largely explain the rise of urban agriculture and its continued presence in the Global South. Indeed, primitive accumulation is ongoing as Southern countries integrate more fully into the global economy and communally managed property "enclosed" by titling arrangements and emerging land markets. In the North, however, such processes happened longer ago; it is therefore helpful to draw also on the work of Karl Polanyi (2001) in order to understand how social rift has produced urban agriculture in the North. Polanyi describes in detail how land, labor, and money are bought and sold as "fictitious commodities", fictitious because they were not produced to be sold as a commodity. Under the expansion of *laissez faire* economic liberalism, they are increasingly subject to the whims of the free market (ibid., 60). In times of economic crisis, when the market value of the fictitious commodities fluctuates dramatically, an "avalanche of social dislocation" tends to follow (ibid., 42). Polanyi argues that without a moral economy of mutual aid in times of need, the unchecked buying and selling of these fictitious commodities risks unleashing social upheaval:

> Robbed of the protective covering of cultural institutions, human beings would perish from the effects of social exposure…. Nature would be reduced to its elements, neighborhoods and landscapes defiled, rivers polluted…the power to produce food and raw materials destroyed. (ibid., 76)

Wages left to *laissez faire* or free market logic decline as surplus labor enters the market (a process which, as we have seen, is fueled by the ongoing primitive accumulation), depressing wages which lowers work and living standards (Marx 1976; Harvey 2007). Land—and by extension natural resources—valued only as a production input or commodity for exchange can be over-exploited for short-term gain with little consideration of its long-term productivity. In sum, "leaving the fate of soil and people to the market would be tantamount to annihilating them" (Polanyi 2001, 137). To protect people from extreme social dislocation, a "protective

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"urban workers were driven *en masse* into the countryside, and gave a previously unheard-of impulse to small-scale production, carried on in the form of market gardening" (876).

[29] Self-exploitation and the resulting deflection of reproduction costs therefore allow accumulation to also take place *without* dispossession, as Hart (2002) and Arrighi (2008), and Berry (1993) have argued.

counter-movement" inevitably arises (ibid., 71-80) which ranges in form from communal networks of support to government intervention and regulation.

With the rise of rapid urbanization during the industrial era, urban agriculture repeatedly arose as part of a counter-movement to protect the population from the social dislocation resulting from "leaving the fate of soil and people to the market." Subsistence food production was part of the American and European urban landscapes well into the 20th century. As urban areas developed during industrialization, urban agriculture often served as a coping strategy, significantly subsidizing the social reproduction of workers as in the South today. In Britain, the Commons Act of 1876 and various Allotment Acts (1832, 1887, 1908, 1922, 1925, and 1950) obliged local governments to provide citizens with space for food production (Crouch and Ward 1988). In the US subsistence production was actively practiced and encouraged well into 20th century in urban centers such as Los Angeles, where chickens, pigs, beans, and tomatoes were common sights in the small yards of worker housing (Nicolaides 2001). Community gardens in the US and allotment gardens in the UK grew in number during times of economic hardship and austerity, but not due to household coping alone. Governments often orchestrated the growth of urban agriculture during these crisis periods as a part of a coordinated protective measure. Urban food production served not only to buffer food security, but also to quell potential unrest (Moore 2006). As America industrialized in the late 19th century, a growing pool of unemployed gathered in urban areas. Municipal governments provided garden plots and seeds to stave off hunger and unrest. During the Depression of 1893, the mayor of Detroit launched a so-called Potato Patch plan—later adopted across the US—to provide the unemployed with vacant lots between ¼ and 1 acre each. More than 1,500 families farmed small vacant lots between an eighth- to a half-hectare each on 455 acres (184 ha). Gardens were intended not only to provide food and employment, but also to create self-respect and to help assimilate recent immigrants. During the Great Depression urban agriculture again provided food and jobs for the masses of unemployed. The New Deal Federal Emergency Relief Administration spent $3 billion on relief gardens between 1933 and 1935 alone. One gardening program in New York City transformed 5,000 vacant lots into highly profitable gardens by 1934 (Brown and Jameton 2000; Lawson 2005).

Garden programs also exploded during wartime. Liberty gardens proliferated in the US during the First World War as a government response to the food riots gripping the nation. Under the guidance of the National War Garden Commission, more than 5 million gardeners cultivated "idle" land. During World War II, under the National Victory Garden Program 20 million gardens produced 40 percent of America's food by 1944. During the economic recession of the 1970s, "inflation" gardens flourished in America's inner-cities with a boost from the back-to-the-land ideals of the environmental movement and the USDA's $1.5 million Urban Gardening Program. During this period community gardeners and activists took over thousands of vacant lots left fallow as industrial and residential capital abandoned US cities (Schmelzkopf 1995; Brown and Jameton 2000; Lawson 2005).

This same notion of local food production as a safety net for city dwellers drives many of today's initiatives. Leon Davis, a community activist in Oakland, California, explains:

> Food is the key, food is the gold. Even when people get kicked out of their apartments and they're out there homeless on the street, they're still going to have to acquire food. For people out on the streets, how can they get fed for that day? "When my stomach get growling, man, and I don't have no money in my pocket, I'll go steal something out the

> store," you see? So if you don't establish a network with food as a basis, you're going to have more thieving, more people are going be stealing from stores, robbing people because they don't have no money, so they can buy food. Not so they can buy drugs, but so they can buy a sandwich. People robbing each other so they can buy a sandwich. So food production needs to ramp up. More local farms, not just in the outlying areas, but right here in the city, people growing, knowing how to grow. (Davis 2009)

As Davis argues, local food production is central to a local food system that is accessible to all, and is necessary in order to stave off precisely the sort of social dislocation arising from economic crisis that Polanyi warned of. The Obama administration is on the same page, and launched the American Recovery and Reinvestment Act, a Keynesian protective counter-movement vaguely reminiscent of Franklin Roosevelt's New Deal to stave off the social upheaval due to widespread unemployment. Evidently, the US government is once again onboard in the promotion of urban agriculture as a means of guaranteeing food security for the urban poor. Following the precedent set by the First Lady's South Lawn garden, the Corporation for National and Community Service, the public-private partnership housing AmeriCorps and other government-sponsored domestic volunteer programs, published an online "toolkit" on how to establish a community garden as a means to "expand access to healthy local food". The document explains:

> Community gardens provide access to traditional produce or nutritionally rich foods that may otherwise be unavailable to low-income families and individuals…. Community gardens allow families and individuals, without land of their own, the opportunity to produce food. Oftentimes gardeners take advantage of the experiential knowledge of elders to produce a significant amount of food for the household.[30]

The discourse of crisis driving these programs was used not only to justify urban agriculture, but also to denigrate it as an act of welfare for the poor once crises had passed. As such, crisis discourse helped to obscure the subsistence role that urban agriculture has *always* played in urban landscapes, as well as to devalue urban agriculture in times of prosperity (Moore 2006). Indeed, when the economy improves and adjacent land values rise, urban agriculture is no longer seen as a public good but an obstacle to development. In New York's Lower East Side during the 1970s, for example, municipal government promoted community gardens as "a productive use of land considered to be relatively useless." The gentrification of nearby SoHo in the 1980s, however, led to rising land values and a growing interest in development, and eventually to a moratorium of leasing vacant land for gardens and the bulldozing of several squatter gardens. Tensions also arose within the community over whether to use vacant lots as space for gardens or for low-income housing (Schmelzkopf 1995). These tensions between development and urban agriculture are often racialized, as in the case of the South Central Farms. The 14-acre community garden was originally established in 1993 by the Los Angeles Regional Food Bank in an effort to bring healthy food to the impoverished neighborhood. In the now famous case, the gardens (which provided food for more than 350 families) were bulldozed

[30] Online: http://www.serve.gov/toolkits/comm-gardens/index.asp (accessed 22 June 2009)

in 2006 following a long and nasty legal and political battle between Latino/a activists, a black city councilor, and a white Jewish land owner (Barraclough 2009; Irazábal and Punja 2009).[31]

Urban agriculture's relation to social rift does not lie with land alone. Food, even while produced as a commodity in the capitalist agri-food system, functions in a similar manner to Polanyi's other fictitious commodities. Understanding food as a fictitious commodity like land further clarifies urban agriculture's ability to mend social rift. Its treatment as a simple commodity to be bought and sold according to market logic effaces the complex weave of relations running through its production, distribution, preparation, and consumption. The rapid transformation of the agri-food system during the 20th century was due in large part to the expanded commodification of food, from patented seeds to artificial ingredients and fast food restaurants. As food has become increasingly processed and packaged, the culture and traditions surrounding food production and consumption have gradually been obscured by the market-based ideology of cheap food (Levenstein 2003; Schlosser 2005).

The socio-cultural significance of food and agriculture rarely factors into calculations of profit margins; certain social relations woven into the agri-food system—agricultural and culinary knowledge and its cultural significance, for example—are impossible to quantify and either resist commodification or are erased by a commodified agri-food system. Since the middle of the last century, the commodification of food has systematically unraveled many of these existing social relations and created new commodity-driven relations of production and consumption that "undermine the source of all wealth—the soil and the worker" at multiple scales (Marx 1976, 638). Farming has evolved into a highly-specialized industry based on inputs and outputs and which engages less than 2 percent of the U.S. population; over-application of agri-chemicals have poisoned farmworkers and created a massive "dead zone" in the Gulf of Mexico; agricultural and culinary knowledge have been lost; diabetes, heart disease, and obesity have followed on the heels of junk food consumption worldwide.

As a protective counter-movement, urban agriculture attempts to mitigate social rift by *de*-commodifying land, labor, and food. Various case studies in North America have illustrated how gardens are a site of interaction between various ages and ethnic groups, where knowledge about food production and preparation is shared and community ties strengthened (Saldivar-Tanaka and Krasny 2004; Shinew, Glover, and Parry 2004; Baker 2005). Urban agriculture produces new commons, by returning—at least partially—the means of production to urban populations. The verdure emerging from cities' marginal spaces—road medians, infrastructure rights of way, vacant lots, wasteland—signals both a reclamation of what remains of the commons and the creation of new commons from the interstitial spaces skipped over by capital or left fallow in its retreat.

While the forces giving rise to it differ between the Global North and South, urban agriculture joins together these tiny tesserae into a fertile mosaic in both places, where gardens grown along the abandoned railroad right of way in Detroit are not unlike those growing alongside rusted rails in Bamako. Goats and cattle graze weeds growing up amid the cement blocks and rebar of all-but-abandoned buildings. A bean patch is tucked in the 3-meter wide strip of road shoulder between the asphalt and the wall of a government building. An abandoned racetrack is a patchwork of vegetable gardens irrigated from a nearby drainage ditch. Industrial brownfields in the US and Europe are transformed into urban green space dotted with community gardens (De Sousa 2004; LaCroix 2010; Mogk, Kwiatkowski, and Weindorf 2010).

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[31] Paradoxically, urban gardens that arise from undervalued vacant land may ultimately *contribute* to the rising property values adjacent to the gardens (Voicu and Been 2008), ultimately threatening their tenure.

The commons are not solely the vacant spaces and wastelands of the world's cities, but once included *all* agricultural resources and foodways that have been commodified (or lost to substitution by a commodity)—land, seeds, water, soil fertility, biodiversity, agricultural and culinary knowledge. Several case studies note the biodiversity and knowledge conserved in urban gardens, particularly by immigrant groups, despite the difficulties in retaining these spaces in a commodified landscape where land value trumps usufruct rights and municipal codes are often at odds with farming practices such as compost production, wastewater recycling, and small livestock husbandry.[32] As Johnston (2008) argues, alternative food movements such as urban agriculture can ultimately reclaim these once-common resources from the enclosure of capitalist commodification by:

> ensur[ing] that access to basic life-goods like food can be met through non-commodity channels, particularly when sufficient purchasing power is lacking… Reclaiming the commons does not necessarily mean that markets and individual consumption styles are eradicated, but it does demand that markets be reembedded in social structures that ensure that nutritious, sustainable food goes not only to those who can afford it but to everyone. (100-101)

For many forms of urban agriculture, this sort of Polanyian counter-movement amounts to a wresting away of food production and consumption from the market via the valorization of unquantifiable socio-cultural values and relations traditionally inherent in food. For guerrilla gardeners and food justice advocates it more explicitly represents a radical rejection of a commodified agri-food system via the appropriation of land and labor for purposes other than the accumulation of capital.

Individual Rift: Alienation

Social and ecological dimension alone cannot fully explain the rise of urban agriculture in the North. For many, a certain lifestyle politics drives the attraction to the urban farming; "getting in touch with nature" or "learning where our food comes from" are common tropes. It is important then to home in on how metabolic rift impacts individuals' consciousness. As a broader social rift is cleaved by the commodification of land and labor, people experience an internalized dimension of metabolic rift, which I refer to as "individual rift". Essentially what Marx called alienation (*Entaüsserung* in German) from labor and from nature, it manifests as the perception of self as external to the environment. While this dimension of metabolic rift is perhaps the most difficult to overcome due how deeply rooted it is in the social processes outlined above, individual rift can be addressed—and potentially overcome—through urban agriculture more easily than can other forms of rift precisely because it arises at the level of the individual consciousness.

Two interrelated forms of alienation are central to individual rift: alienation from labor and alienation from nature. First, individual rift arises from our alienation from the fruits of our labor. As discussed above, the social rift in metabolism arises from the commodification of labor

[32] See Corlett et al. (2003) on biodiversity and agricultural knowledge in Hmong gardens in Sacramento. Airriess & Clawson (1994) describe how Vietnamese gardeners in New Orleans burn crop residues to fertilize soil in violation of city codes.

and the separation of the worker from the means of production (e.g., the land). What this means is that under capitalist production a wage laborer no longer owns the finished product he or she creates. Rather than producing something for his or her own use, the worker produces it for the capitalist (e.g., an agribusiness corporation) to sell as a commodity to earn profits used to fuel further accumulation. As Sohn-Rethel (1978, 109-116) argues, the root of this alienation lies in the division of intellectual and manual labor, a long historical process cemented at the dawn of capitalism via the rationalization of labor and which intensified individual rift.[33] The later "Balkanization of knowledge" into social and natural sciences encouraged the division of labor, further alienating humans from nature as a result of the "inadequate understanding of how these knowledges connect with one another in the process of producing the concrete outcomes in which we are interested" (Dickens 1996, 21). Due to this division of manual and intellectual labor, the rationalization of production through technological advances and the de-skilling of labor has further alienated the worker from the product and the whole process of production. In short, the more that science enters into production, the less the worker understands about the process of production and the more his or her creative capacity is undermined (Braverman 1974, 428).

Second, the separation from land as discussed in the previous section is central to individual rift. From both ecological and Marxian perspectives, humans simultaneously shape and are shaped by the ecosystems to which we belong. More specifically, we *are* the nature around us. Nature is, Marx theorized, integral to human life and development (Dickens 1996, 57). As István Mészáros (2005, 124) explains, "the historically primary relationship between man and nature [is] *nature's relation to itself*, on the grounds that man is a specific part of nature." Since "earth is the first condition of man's existence, land is, of course, absolutely *inalienable* from *man*" (ibid., 134), and by extension, inalienable from all sorts of non-quantifiable social significance; precisely why Polanyi considered it inseparable. It follows, then, that the expropriation and commodification of land and nature—a process central to the cleaving of social rift—rends not only a material rift between land and labor, but also an internalized rift in our cognitive and experiential understanding of ourselves as functional organisms existing as a part of a larger ecosystem.[34]

This alienation from nature is well documented in developmental psychology, education, and evolutionary biology, as well. The shift from direct to "increasingly abstract and symbolic" contact with the outside environment in the contemporary political economy (Orr 2002, 291) limits affective, cognitive, and evaluative development in children (Kahn and Kellert 2002), leading to a rise in childhood behavioral problems, popularly referred to as "nature deficit disorder" (Louv 2008). Several studies have concluded that exposure to vegetation and green space is essential to children's cognitive development, can reduce attention deficit disorder, and

[33] According to Sohn-Rethel's analysis, the alienation of the worker from his or her product did not necessarily arise solely in the capitalist era, but was an ongoing historical process that—while beginning in the classical era with the development of Euclidean geometry—grew wider during the Renaissance era. The "unity of head and hand" inherent to artisanal production slowly diminished as design became the domain of mathematicians, engineers, and military architects, and basic construction left to craftsmen.

[34] Admittedly, alienation from land and labor alone cannot account for individual rift between humans and nature. For decades geographers and environmental historians have attempted to trace the origins of the human vs. nature dualism, ascribing the cleavage to Aristotelian logic and its resurgence during the Age of Enlightenment and to the material development of human powers that allowed for the objective manipulation of nature (Glacken 1967; Williams 1973; Smith 2008, 10-48).

reduce crime and "mental fatigue" or desperation in impoverished urban areas (Kuo and Sullivan 2001; Taylor, Kuo, and Sullivan 2001).

From the Marxian perspective, the *de*-alienation of humans both from the fruits of our labor and from the natural or biophysical world depends on our active metabolism of nature through labor.[35] By physically laboring the soil, sowing seeds, cultivating, harvesting, and preparing food, urban agriculture mends individual rift by reengaging individuals with their own metabolism of the natural environment. Not only do experiences in the garden bring the urban farmer, gardener, or beekeeper into direct contact with the biophysical environment—soil, plants, water, sunshine, rain, worms, insects, birds—as prescribed by the behavioral scientists cited above, but also allows him or her to experience and metabolize the surrounding landscape, transforming it into a product that he or she can consume. The urban farmer's labor thus sutures individual rift, reintegrating the human with nature as well as de-alienating the laborer from the fruit of his or her labor. In this case, labor's fruit is more than metaphor, as it may indeed be a fruit, vegetable, honey, milk, eggs, or meat.

Several public health and education studies have linked urban agriculture to enhanced natural science and nutritional knowledge, and improved mental and physical health (Morris and Zidenburg-Cherr 2002; Twiss et al. 2003; Pothukuchi 2004; Hermann et al. 2006; Wakefield et al. 2007). Recent immigrants to North American cities rely on urban agriculture as a means of alleviating boredom and putting their agrarian skills and knowledge to work. For Hmong women in Sacramento, urban gardening "structured their time, and provided a sense of accomplishment, as they grew their own produce, and supplied their children, grandchildren, and families with food," countering the culture shock and feelings of dependence and uselessness they felt upon arrival to the US (Corlett, Dean, and Grivetti 2003, 377). A study by Airriess & Clawson (1994) on urban agriculture practiced by Vietnamese refugees in New Orleans reported similar findings.[36]

Such attempts to overcome individual rift by reengaging with the processes of food production and consumption lie at the center of the urban agriculture movement in the Global North. As I argue above, urban agriculture arises as a counter-movement in response to economic crisis and to the commodification of land and labor. Yet viewing urban agriculture in this way alone does not fully grasp urban agriculture's multiple origins, functions, and forms. Focusing on individual rift—particularly in the North where a longer history of wage labor has perhaps rendered alienation from manual labor and the biophysical environment more acute—helps to illuminate the important role that urban agriculture serves in late capitalist economies while differentiating its various forms. While guerrilla gardening and food justice initiatives may arise from an explicitly counter-hegemonic challenge to the capitalist food system as described in the previous section, the groundswell of interest in backyard and community gardening appears to be largely linked to efforts to lessen the impact of individual rift and is not necessarily radical. While individual rift is arguably much more widespread in the North than in the cities of the South where linkages to agrarian livelihoods remain intact, within a generation or two, urban dwellers in the South may also experience similar alienation from their food. The words of a

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[35] Emphasis on the importance of hands-on experience and manual activity is not solely the domain of Marxian scholars, but also lie at the foundations of developmental psychology and learning theory, particularly in the cognitive constructivism of Piaget (1972) and social constructivism of Vygotsky (1978). The integration of intellectual and manual labor as outlined by Marxians (Ollman 1976; Sohn-Rethel 1978; Dickens 1996) is also central to experiential learning theory and praxis (Dewey 1938; Kolb 1984).

[36] It is important to note here that many of these refugees also use urban agriculture as a coping strategy to deal with persistent poverty in the neighborhoods where they were resettled.

young woman from Bamako poignantly illustrate this: "Why should we care about agriculture, about soil erosion? That's the domain of rural peasants" (Personal interview with the author, 5 July 2006, Bamako, Mali).

While I'm not arguing that *everyone* can or should grow his or her own food, my intention is to show how the practices associated with urban agriculture—tilling, planting, weeding, watering, harvesting, composting—are a force of *de*-alienation. Urban agriculture, from this perspective, can help reestablish a *conscious* metabolic relationship between humans and our biophysical environment by reintegrating intellectual and manual labor. It is also important to emphasize that this dimension of rift is a necessary prerequisite to the ongoing expansion of capitalist modes of production. If, as Marx argued, nature is alienable from humans, we can easily make the link between ecological and human health; damage to the environment is therefore damage to one's self. Moreover, complacency towards what we would otherwise perceive as self-destructive actions *depends on* individual rift; to perceive and experience environmental degradation as a solely external process rather than one simultaneously internal and external depends on this alienation. Recognizing this form of rift and understanding the forces which cleave it is therefore an essential first step to mitigating it.

Conclusion

As I have shown in this chapter, metabolic rift has three interrelated and interdependent dimensions—ecological, social, and individual—operating at multiple scales. Understanding these interdependent dimensions of metabolic rift this way is valuable for both theory and practice. The traditional emphasis on cycles of environmental degradation used by most metabolic rift theorists can help to illustrate how ecological crisis is rescaled upwards and outwards due to the expansionary logic of global capital, but a singular focus on this ecological dimension may be crippling. While it may elucidate the agri-food system's dependency on cross-scalar ecological subsidies, it may fail to identify the fault lines and fractures in such a system that an added focus on individual and social dimensions of metabolic rift can offer. It is precisely along these fault lines that practices such as urban agriculture arise and where policy makers, planners, non-profit workers, and urban agriculture advocates alike may locate and seize opportunities to transform the agri-food system into one more equitable, healthy, and ecologically sustainable. While metabolic rift is arguably irreparable within the logic of a capitalist system, using this multi-dimensional framework may better reveal the locations of these potential points of engagement.

In addition, understanding urban agriculture through this lens not only helps to explain how and why urban agriculture arises in different parts of the world, but may also reveal opportunities for its expansion as part of a growing network of local food systems. As we have seen, urban agriculture frequently arises as a protective counter-movement at a *local* level from the inevitable crises of capitalism (such as the one in which we find ourselves currently) unfolding at the *global* level; I detail this process in Oakland over the next two chapters. A certain momentum develops, however, whereby these small-scale movements—occurring as an inchoate patchwork of local sites—evolve into a semi-coordinated force, spurred on by increasing public visibility, and eventually, regional or national level support. North-North, South-South, and North-South associational linkages have also helped to mobilize support for urban agriculture globally, unified in part by a shift in discourse in the North from "community gardening" to "urban agriculture".[37] Urban farmers and urban agriculture policies in the South have served as models for urban agriculture activists in the North; similarly, media, resources, and technical information from Northern organizations such as the Resource Centres on Urban Agriculture and Food Security and the Centre for Information on Low External Input and Sustainable Agriculture have benefited urban agriculture extension work in the South. Understanding the social dimensions of urban agriculture is critical to any such transformation.

As I argue above, de-commodifying food, the land on which it is grown, and the labor with which it is produced first requires attention to individual rift; the de-alienation of humans from the biophysical environment is a necessary prerequisite. This may occur either via individual engagement or via formal or informal efforts to reintegrate humans and nature, and intellectual and manual labor, through experiential education and praxis. A de-alienated population provides the critical mainstay of support for ongoing resistance to the inevitable attempts at re-commodification. Crucial then is the creation and protection of a new agrarian commons created among the urban fallows, the cultivation of associational linkages between urban producers and consumers, and investment in other policy frameworks and infrastructure necessary to promote urban food production as a multi-functional practice.

Indeed, urban agriculture should be framed and supported in a way that addresses the multiple dimensions of metabolic rift. These first important steps towards the gradual "abolition of the antithesis between town and country," intellectual and manual labor, humans and nature, are underway in urban gardens worldwide. The potential to scale it up in Oakland and elsewhere remains to be seen. Promoting the growth and vitality of these urban agricultural spaces through coordinated policy, planning, and action across scales—from individual decision-making to municipal planning to national and global policy—remains the grand task ahead.

In the chapters that follow, I bring Oakland back into focus and show how urban agriculture has arisen in response to the various faces of metabolic rift. I turn first to the history of Oakland's uneven development and the social rift that resulted, a process that was necessary for urban agriculture to take root.

[37] I discuss this discursive shift in more detail in Chapter 3.

Chapter 2:

From Industrial Garden to Food Desert: Demarcated Devaluation of Oakland's Flatlands

A dilapidated liquor store stands at the corner of 17th and Center in West Oakland. With its plastic sign cracked and yellowed, its paint pockmarked and peeling away in long lesions from the store's warped clapboard siding, it could be a clichéd metaphor for the decay of America's "inner cities" during the post-industrial era. But it is also representative of the disproportionate number of liquor stores in urban communities of color. Establishments such as these (see Figure 2.1) often serve as the sole food retailer in areas that planners and food justice activists have come to call "food deserts." [38]

Figure 2.1. Corner store sign, Lower San Antonio (East Oakland). This kind of store serves as the primary food retail in Oakland's flatlands neighborhoods. Photo by the author, May 2010.

A recent report to Congress by the USDA Economic Research Service defines food desert as an area "with limited access to affordable and nutritious food, particularly such an area composed of predominately lower income neighborhoods and communities" (USDA 2009, 1). A number of articles and reports over the last few years have attempted to characterize and identify food deserts in the US, Canada, Britain, and Australia. Most have concluded that in the US, food deserts disproportionately impact people of color (Smoyer-Tomic, Spence, and Amrhein 2006; Beaulac, Kristjansson, and Cummins 2009). While many studies have drawn spatial and/or statistical correlations between race and the absence of supermarkets (Zenk et al. 2005; Raja, Ma, and Yadav 2008; Lee and Lim 2009), researchers have also found that small corner stores and ethnic grocers are abundant in these food deserts (Short, Guthman, and Raskin 2007; Raja,

[38] See Footnote 4 in the Introduction for a brief comment on the politics of the term "food desert". I use this term here simply in metaphorical contrast to Oakland's history as an "industrial garden."

Ma, and Yadav 2008). Nevertheless, fresh and nutritious produce is rarely available at these small stores, and the type of food generally tends to be of poorer quality and less healthy, high in sugars and saturated fats (Cummins and McIntyre 2002).

Food access in Oakland's food deserts mirrors these national trends. Statistics portray a bleak picture of inequity in Oakland: 87 percent of school children receive free or reduced lunch; 20 percent of families live below the federal poverty line; one in three children will develop diabetes; one-third of Alameda County residents are food insecure (OFPC 2010; Beyers et al. 2008). This is particularly striking, given Oakland's position at the heart of Bay Area "foodie" culture, where gourmet restaurants abound and fresh organic produce is available at a farmers' market every day of the week (Farley 2010).[39] Indeed, the landscape of food access in this city of 391,000 is a bifurcated one, where topography largely demarcates access to fresh and affordable food. In the lower-income "flatlands" of North, West, and East Oakland (see Figure 2.2), fast food restaurants and liquor stores dominate food retail, while in the affluent Oakland hills, supermarkets and gourmet are much more readily accessible. This geography also marks the demographic make-up of the city; while there are exceptions, Oakland's flatlands are largely home to people of color while the hills are mostly white. Between a quarter and a third of people in the flatlands live below the poverty line; median income is 25 percent lower than the citywide average (see Figure 2.3). The flatlands host the lowest percentage of home ownership and the lowest levels of educational attainment. Unemployment here is roughly twice the citywide rate. Crime and public health statistics overlap in a more or less identical fashion.

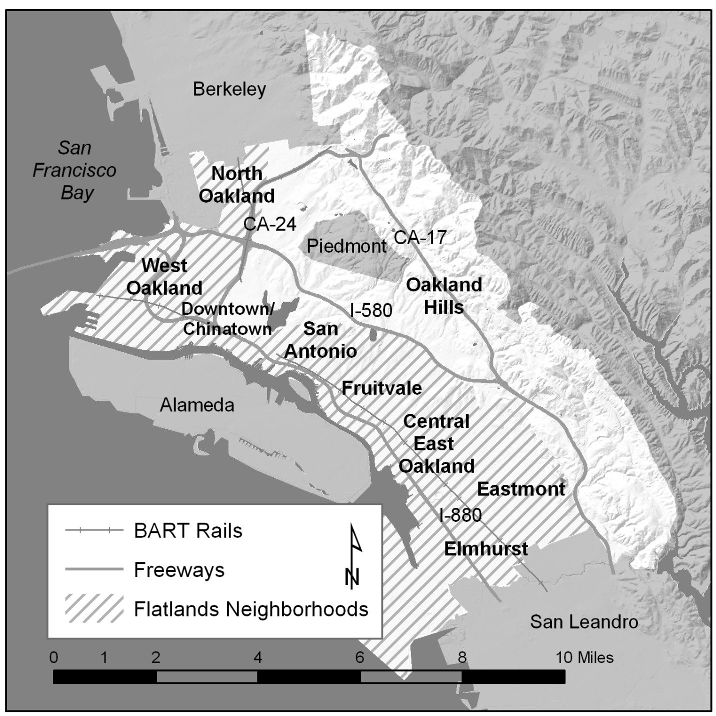

Figure 2.2. Oakland, California and its major districts. Flatlands neighborhoods are shaded.

[39] It is also ironic because food processing was once a cornerstone of the city's economy and two major supermarket chains, Safeway and Lucky Stores, were once headquartered there (Walker 2001, 2005b).

In predominantly black flatlands neighborhoods, such as West Oakland and Central East Oakland, these statistics are even bleaker. A recent public health report states that an African American child in West Oakland is seven times more likely to be born into poverty as a white child born in the Oakland hills, and likely to die 15 years earlier due to higher likelihoods of diabetes, hospitalization, cancer, stroke, and heart disease (Beyers et al. 2008). In a recent study using a human development index—a measure of life expectancy, earnings, and educational attainment—the Oakland hills rank 11 of 233 census neighborhood and county groups in California, while the flatlands rank 222 (Burd-Sharps and Lewis 2011).

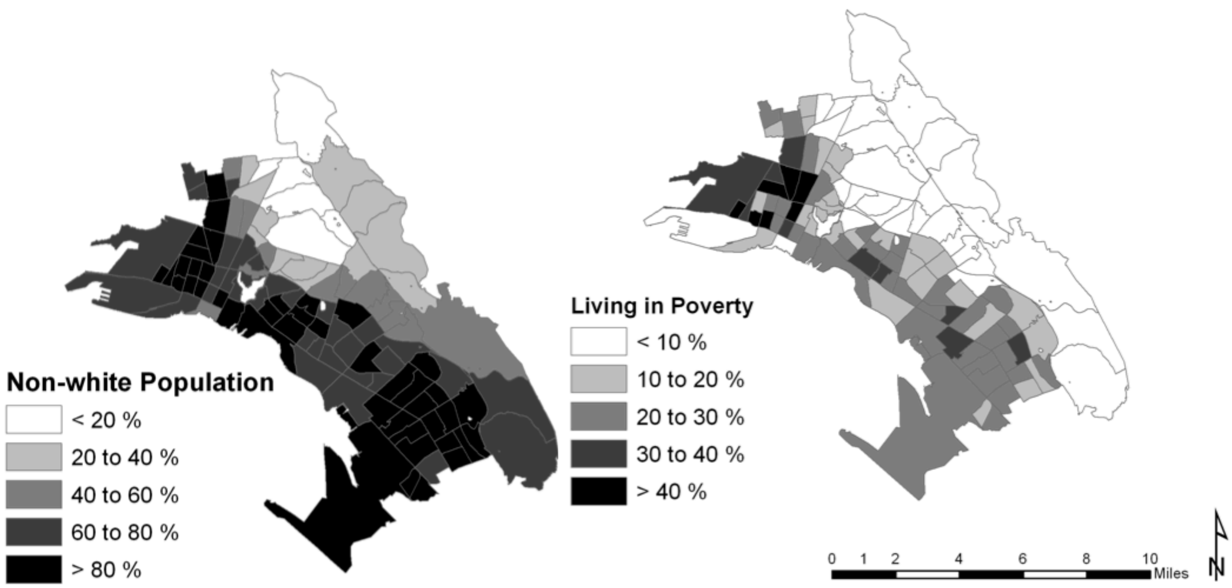

Figure 2.3. Oakland's racialized socioeconomic landscape. The Oakland hills are home to the majority of the city's white (non-Latino) population, while the majority of people of color reside in the flatlands (left). Poverty is also concentrated in the flatlands (right). Data source: US Census, 2000 (SF-3).

It is precisely in these flatlands neighborhoods that the city's food deserts can also be found. And it is here that food justice movements have taken root. Yet to better understand Oakland's food deserts and to recognize the emancipatory potential of urban agriculture and other food justice initiatives that have emerged as a solution, it is helpful first to understand the forces that have hewn the urban landscape into a crude mosaic of parks and pollution, privilege and poverty, Whole Foods and whole food deserts. Few studies move beyond a geospatial or statistical inventory of food deserts to unearth these historical processes. In this chapter I focus on the structural role of capital in order to emphasize the extent to which the history of capital defines the urban environment. Driving down MacArthur or International Boulevards "in the cuts", the rough and tumble streetscapes of the Oakland flatlands, provides a glimpse into how capital's dynamic cycles—its ebbs and flows—have shaped both the built environment and the social relations woven through it, leaving an almost entirely treeless and worn landscape of used car dealerships, taco trucks, liquor stores, dilapidated storefronts, and the occasional chainlinked vacant lot.

Understanding the historical and structural roots of this urban landscape is fundamental to understanding the individual and collective agency that adapts to or resists its development. Indeed, the history of the contemporary urban agriculture movement in Oakland really begins here. With this in mind, I tap existing histories of Oakland and urbanization in California, demographic and economic data, and current "grey literature" to broadly trace the historical geography of Oakland's flatlands during the periods of industrialization and deindustrialization, roughly from the turn of the century to the "neoliberal turn" of the 1980s. I draw on theoretical insights from the growing field of urban political ecology to shed light on the structural processes that have restricted access to healthy food for residents of the flatlands, arguing that a combination of industrial location, residential development, city planning, and racist mortgage lending unevenly developed the city's landscape and concentrated the impacts of capital devaluation within the flatlands, a process I refer to as "demarcated devaluation" and which ultimately created the city's food deserts.

Root Structure: Devaluation of Urban Capital

To understand Oakland's food deserts, the diet-related illnesses impacting flatlands residents, and the food justice initiatives that have arisen in response, an analysis of the historical processes that have unevenly shaped the city's socio-ecological landscape is a necessary first step. Environmental sociologists, political ecologists, and urban geographers have described the material transformation of the biophysical environment and human populations by political economic processes such as capitalism (Foster 1999; Gandy 2003; Heynen, Kaika, and Swyngedouw 2006a). David Harvey (2006) stresses the interconnected nature of society and environment; understanding one cannot be done without understanding its relation to the other:

> On the ecological side…we have to understand how the accumulation of capital works through ecosystemic processes, re-shaping them and disturbing them as it goes. Energy flows, shifts in material balances, environmental transformations (some of them irreversible) have to be brought thoroughly within the picture. But the social side cannot be evaded as somehow radically different from its ecological integument…The circulation of money and capital have to be construed as ecological variables every bit as important as the circulation of air and water. (88)

Such an analysis necessarily takes place at multiple levels. In his analysis of urban hunger in Milwaukee, Nik Heynen (2006c) underscores the importance of looking across scales to understand the connections between hunger and its causes. The physical experience of hunger, malnutrition, or the body's biochemical metabolic process cannot be treated as disconnected from the larger-scale processes determining the availability of food. Indeed, the chain of causality spans several levels of scale, from the individual to the household, from neighborhood to municipality, and from national to global.[40] Viewing socio-ecological change this way

[40] Rather than envisioning these relations as a nested hierarchy, however, it is helpful to think of a complex web of interconnectivity. Global economic restructuring in the neoliberal era, as well as increasing access to technology and information, have undermined and reorganized the traditional hierarchical relationships.

certainly complicates analysis (and demands a certain level of interdisciplinarity) but may ultimately offer a more nuanced understanding of the links between ecology, public health, and social change.[41]

The web of social and political relations driving and shaping these changes is complex and multi-dimensional. Nevertheless, at the risk of being seen as an economic determinist, I want to focus on one process that is fundamental to the transformation of the urban landscape and the creation of food deserts: the devaluation of certain types of capital. It undergirds the structural processes of uneven development and the social disruption that emerges in response. Nowhere is this process so readily apparent as in post-industrial cities such as Oakland. Cities are ground-zero of humans' transformative power, where the influx of capital is visibly inscribed on the landscape in the form of buildings and infrastructure, as roads, bridges, power lines, rail lines, sewers. During historical moments of capital over-accumulation following economic booms, surplus capital is invested in this kind of fixed or immobile capital, transforming the urban environment.[42] During economic downturns, as capital retreats from urban industrial zones, the post-industrial city nevertheless retains its industrial character, albeit devalued, dilapidated, and scarred by pollution. The built environment of the past inhibits future investment because it is simply cheaper to go elsewhere.[43] Rents fall, unemployment rises. Both labor and fixed capital are devalued. Harvey (2001) writes, "The geographical landscape which fixed and immobile capital comprises is both a crowning glory of past capital development and a prison which inhibits the further progress of accumulation" (247). These zones left fallow inside the city by capital's retreat belong to what Richard Walker (1978) has called "a lumpengeography of capital," or "a permanent reserve of stagnant places" awaiting new investment once land and labor values have been sufficiently devalued.[44]

From this perspective, the contemporary cityscape is a map of previous cycles of capital accumulation and devaluation, a palimpsest of building, decay, and renewal.[45] The walls of this prison of fixed capital are often clearly delineated by planning, policy, property taxes, and political boundaries. These buttresses and ramparts, whether or not they were crafted with intention, effectively *demarcate and quarantine devaluation* to prevent its impacts from bleeding

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[41] Rather than stop at an explanation of how the biophysical environment, human bodies, or social relations are transformed by flows of capital, we should also address how these flows are then resisted, reconfigured, or redirected in response. This dialectic helps unravel the classic "structure versus agency" binary by instead emphasizing the creative and destructive tension between "actors" (biophysical and social, individual and collective) operating at the same or different spatiotemporal scales. Distinguishing structure from the agency of individual actors becomes simply a question of shifting the spatio-temporal grain and extent of analysis, in essence, zooming in to identify the actions of an individual actor and zooming out to see how these individual actions operate collectively on larger scales over time and space.

[42] According to Harvey's analysis, when there is an overaccumulation of surplus capital or labor, it either seeks a spatial fix to find new spaces for investment (2001) or enters into a "second circuit" of capital, and is invested in this kind of "fixed capital" to avoid a crisis of devaluation of one or the other (1989).

[43] In such cases capital actually undermines its own means of production by fouling its resource base; see James O'Connor (1998) on capitalism's "second contradiction".

[44] In the urban morphology literature, the term "urban fallow" denotes derelict land and buildings, abandoned, obsolescent, and awaiting redevelopment, the final successional phase of a so-called "burgage cycle" of urban development (Clark 2001). Viewing urban fallow as part of a broader lumpengeography of capital helps to locate these investment cycles within a larger spatial geography of capital.

[45] Doreen Massey (1995) incorporates social relations into this palimpsest. Using a vivid geomorphological metaphor, she describes the series of "sedimentary layers" laid down by past cycles of investment. These layers embody not only physical fixed capital, but also the associated negotiations and struggles between capital and labor (and society more broadly).

over, both metaphorically and materially.[46] As environmental justice literature reveals, this process of demarcated devaluation has been highly racialized historically through zoning, redlining, and neighborhood covenants (Maantay 2002; Morello-Frosch 2002; Matsuoka 2003; Self 2003; Boone et al. 2009).

Human populations viscerally experience these ebbs and flows of capital. As countless cases in the era of deindustrialization illustrate, capital devaluation has historically been the harbinger of social upheaval in the form of migration, poverty, hunger, crime, and declining public health. Given the extent to which the urban landscape is shaped by capital and its crises of accumulation, urban social struggles against the socioeconomic upheaval that follows are interwoven with struggles for a more equitable environment. Perhaps less obvious to many mainstream environmentalists, struggles to protect or clean up the urban environment are equally as entwined within struggles for social justice; as Swyngedouw and Heynen (2003) point out, "processes of socio-ecological change are…never socially or ecologically neutral" (911). Understanding the food justice movement in Oakland and elsewhere therefore depends on understanding the structural forces, generally, and capital devaluation more specifically, that gave rise to the movement in the first place. Applying this analytical framework, I devote the remainder of this chapter to outlining Oakland's 20th century history of industrialization and deindustrialization, demarcated devaluation, and the consequent creation of the city's food deserts.

An Industrial Garden Grows

In reference to her childhood home of Oakland, Gertrude Stein famously wrote, "there is no there there." While these words have been used to belittle Oakland for the seventy years that have passed since their publication, they remain poignant when taken in their original context. Stein had returned to the city decades later and was unable to recognize the childhood home of her memories in the vast expanse of new housing sprawling eastwards from downtown (Rhomberg 2004). The transformative power that had effaced the "there" of Stein's turn-of-the-century childhood home continued to reshape Oakland as industrial and residential capital flowed and ebbed throughout the rest of the twentieth century.

Advertising Oakland as a "city of homes," speculators from the mid-19th century onwards hoped to cash in on its proximity to San Francisco's bustling commercial center (Scott [1959] 1985). The promise of the seemingly paradoxical union of Arcadia and Utopia that was the aesthetic hallmark of California development—pastoral landscapes embodied within an ordered, neighborhood logic (McClung 2000)—fueled a vibrant housing sector in Oakland, drawing the wealthy merchant class to the Oakland hills and foothills. Echoing the language of Mayor Horace Carpentier's 1852 speech (see the dissertation's introduction), a booster for housing in Oakland's lower foothills in 1911 advertised "home sites from which [to] look down on the cities about the bay…far removed from the dirt and turmoil of the work-a-day world" (Scott [1959] 1985; Bagwell 1982).

At the same time, completion of the transcontinental railroad and construction of its terminus in Oakland in 1869 accelerated the expansion of industry from San Francisco to the East Bay; the arrival of iron works, canneries, cotton and lumber mills, breweries, and carriage

[46] As Harvey (2006) elaborates, this concentration of devaluation constitutes another form of capital accumulation by dispossession; by confining devaluation elsewhere, new sites can monopolize production.

factories fueled further industrial agglomeration around the rail terminals in West Oakland and the estuary waterfront at the southern edge of downtown (Bagwell 1982; Walker 2001). A 1910 promotional booklet published by the Oakland Chamber of Commerce features a world map with all shipping lines leading to "Oakland Opposite the Golden Gate, The Logical Port and Industrial Center of the Pacific Coast" (Scott [1959] 1985).[47]

Worker housing emerged primarily in West Oakland, between the downtown business district and the rail and shipping terminus. The displacement of San Francisco residents following the 1906 earthquake was a boon for Oakland, bringing in a new workforce and new demands for housing. With population and industry growing at a rapid pace and aided by the extension of horsedrawn and electric streetcar lines, Oakland expanded to the north and east, annexing previously autonomous communities such as Temescal, Claremont, Brooklyn, Fruitvale, Melrose, and Elmhurst by 1909 (Scott [1959] 1985; Bagwell 1982; Groth 2004).

World War I saw a massive influx of military capital into Oakland. Automotive manufacturers such as the Durant Motor Company, Hall-Scott Motor Company, Chevrolet, and General Motors expanded considerably during these years, earning Oakland the moniker "Detroit of the West." Shipbuilding dominated the port, and employed upwards of 40,000 in 1920. Drawn by the promise of jobs, new workers, many of them African Americans and immigrants, flooded in by the thousands. Wartime industrialization and the boom that continued through the '20s saw the expansion Oakland's residential development alongside the construction of new factories eastwards into the orchards and pastures of the annexed townships (Bagwell 1982; Ma 2000; Walker 2001). Integrating the pragmatism of locating industry where land was available with the reformist planning vision of Ebenezer Howard and Lewis Mumford, planners and developers in Oakland (as in Southern California) embraced the paradigm of the "industrial garden": the dispersal of industry away from the mixed-use downtown core but closely tied to nearby, semi-autonomous residential neighborhoods. In these industrial garden suburbs, factory workers would return home by bus or rail to a neighborhood of small, single-family homes, each with a yard or garden. Proponents pushed "garden living" in these quiet and tranquil respites far—but not too far—from the factory grind as a cure to the social and health risks already well-documented in the mixed-use urban slums of the Northeast, Chicago, and to a lesser extent in the older downtown cores of San Francisco, Oakland, and Los Angeles (Hise 1997, 2001; Self 2003). Urban and rural modes of survival came together here, as workers clocked out and headed home to tend vegetables, chickens, and goats in their yards (Johnson 1993; Nicolaides 2001). As Mike Davis (1997) writes, the industrial garden was "a new kind of industrial society where Ford and Darwin, engineering and nature, were combined in a eugenic formula that eliminated the root causes of class conflict and inefficient production" (358); in essence, by keeping the worker happy, productivity could increase while nipping a restive labor movement at the bud.

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[47] Urban growth obviously does not arise of its own accord but is stewarded by a "growth machine," a coalition/class alliance of business owners, developers, media, and industrialists (Logan and Molotch 1987). In Oakland much of the growth in the earlier part of the century was due in large part to the efforts of the city's powerful growth machine, a class alliance that included Francis "Borax" Smith, owner of the Key System, mayors Frank Mott (1905-1915) and John Davie (1915-1931), and the city Chamber of Commerce. The dynamo at the center of it all was the conservative pro-business *Oakland Tribune* under the ownership of the Knowland family from 1915 to 1977. The Knowlands' powerful control of media consolidated the growth machine's grip on city politics for much of the 20th century. This growth machine resisted San Francisco's repeated efforts to incorporate Oakland into a regional metropolis. Rather than being periphery to San Francisco's core, Oakland's growth machine pushed on several occasions to become the core of an East Bay metropolis (Rhomberg 2004; Self 2003; Scott [1959] 1985).

During the New Deal the vast expanse of small homes that had cropped up as part of the industrial garden expanded rapidly. Beginning in 1934, a flood of highly subsidized, low-interest mortgage loans from the newly created Federal Housing Administration fed the growing suburbs; East Oakland soon filled in with suburban developments of small Mediterranean-style single-family homes. As in other California industrial centers, developers consolidated land purchase, subdivision, construction, and sales in order to maximize efficiency and minimize costs. Vast tracts of small houses, mostly prefabricated or built from kits with nearly identical floor plans, created an economy of scale that dovetailed nicely with the contemporary planning vision of neighborhood cohesion, mixed use, and garden cities to create quintessential industrial gardens. In order to expand homeownership, housing production had to be reorganized into a quasi-Fordist system of on-site assembly of prefab components to perfect the "minimum house": a small, single-family home constructed as cheaply as possible but comfortable and unique enough to satisfy the dream of home ownership (Hise 1997). The newly subdivided suburban landscape was rapidly filled in with these small, single-family homes erected virtually overnight.

However, market forces alone were not responsible for the shifting landscape. While the social idealism of Ebenezer Howard's garden cities and Lewis Mumford's inclusive "eco-topian" regions undergirded the vision of many suburban planners, the pragmatism of industrial location, the whims of individual developers, and the rising power of racist homeowners' organizations soon elided their utopian vision. Indeed, the flows of capital defining Oakland's urban landscape were clearly racialized. The federally-subsidized dream of homeownership in the industrial garden was not available to everyone; people of color rarely qualified for FHA loans because these were to be applied only to newly constructed homes and, contrary to Howard's vision of universalist garden cities that welcomed and nourished all workers, new home developments in the suburban industrial gardens were racially exclusive. Until 1948 racial covenants established by developers and homeowners' associations prevented people of color from moving in and disturbing social divisions seen as "natural" (Hise 2001; Self 2003; Sugrue 2005). Even after the Supreme Court made racial covenants illegal via *Shelley v. Kraemer* in 1948, such obstacles remained in practice. Contractors were rarely able to secure loans for construction for non-whites in a "Caucasians only" neighborhood and realtors feared "the wrath of white homeowners" (Sugrue 2005).

The racialized demarcation of urban space taking place between the wars was not new in California. For decades the labor movement in California had already laid the groundwork for the formation of a virulent form of white class-consciousness via their aggressive exclusion of Asian, Latino, and African American workers (McWilliams [1949] 1999; Saxton 1971; Daniels 1977 [1959]). Easy access to low-cost, single-family homes in close proximity to East Oakland's factories simply fueled racist and exclusionary sentiments by creating a sense of bootstrap entitlement. Homeownership thus helped heterogeneous European and Euro-American populations of workers consolidate as a spatially and racially homogenized labor force of "whites," geographically distinct from the radicalism of recent European immigrants and African Americans in West and North Oakland and along the estuary.[48] Suburbanization of industry and housing was thus a way to escape from the working class and "to attract a better brand of labor, removed from the 'bad moral atmosphere' of the inner city, and promising the stability of homeownership for the 'better class' of workers" (Walker 1981, 400).

[48] This promise of homeownership, which in the Hoover years had risen to be the symbolic pinnacle of American citizenship, was central to the reformist planners' attempt to "Americanize" (read "deradicalize") recent European immigrants and subsume them into a growing class alliance of white, working-class homeowners (Hise 1997).

As new workers flooded into Oakland during World War II, housing was scarce. Trying to defuse tensions between blacks and southern white migrants, the Oakland Housing Authority located black-only housing projects in West Oakland and corresponding projects for whites in East Oakland. Most of these housing projects were located in industrial areas on landfill and adjacent to railroads. The black population of Oakland grew nearly six-fold between 1940 and 1950, but African Americans were rarely allowed to rent outside of West Oakland due to racial covenants and similar barriers to renting in the new industrial gardens. Ramshackle dwellings in West Oakland were converted and subdivided to accommodate the new migrants. In the post-war years the razing of temporary war migrant housing in the East Bay only increased the housing squeeze. In 1940, 15 percent of West Oakland's housing units were overcrowded; the percentage doubled a decade later (Johnson 1993).

The practice of bank redlining also stopped the flow of mortgage and property investment capital into parts of the city where people of color resided. Working with banks and local realtors, the Home Owner's Loan Corporation (HOLC) and its parent organization, the Federal Home Loan Bank Board, developed Residential Security Maps and Surveys that divided cities into ranked sections. Most African American neighborhoods were ranked "D – Fourth Grade" for "hazardous" and colored red on the maps. Homes in these areas rarely qualified for loans. On the other hand, white neighborhoods were ranked higher if they had racial covenants that offered "protection from adverse influences" such as "infiltration of inharmonious racial or nationality groups" (Maantay 2002; Sugrue 2005).[49] While discriminatory lending existed before the creation of these maps, they helped to reify the delineation between rich and poor, whites and people of color.[50] Even after redlining was prohibited under the 1968 Fair Housing Act, it continued in a self-reproducing, de-facto manner due to a complex of factors, from zoning and housing prices to the spatialized legacy of denied loan applications (Kantor and Nyusten 1982), as well as the relocation of home insurance agencies to the suburbs (Squires, Velez, and Taueber 1991).

A 1937 HOLC Residential Security Map of Oakland and associated report reveals the spatial logic of redlining (see Figure 2.4). The related area reports for most flatlands neighborhoods warned potential investors of "detrimental influences", notably the "infiltration" of "lower grades" such as "Negros", "Orientals", "shopkeepers", "lower classes", "relief families", and "foreign born". On Oakland's north-south axis, neighborhoods west of Grove Street (now Martin Luther King Way) all appear as Grade D. This redline separated blacks from whites, effectively ghettoizing North and West Oakland.[51] East 14th Street (now International Blvd.) served as the east-west redline in East Oakland through the 1950s, limiting blacks to a few blocks adjacent to the industrial zones. Oakland's Asian population was effectively quarantined, as well, from the late 19th century until 1920. Chinatown, south of downtown and west of Lake Merritt, received a D rating (HOLC Area D-11) due to the "predominance of Orientals", an "indication of future slum condition" (HOLC 1937). By the '30s, some Asian were able to move

[49] For an example of the actual documents used, see Part II: Home Rating Instructions of the 1935 FHA's *Underwriting Manual: Underwriting and Valuation Procedure Under Title II of the National Housing Act. Federal Housing Administration, Washington, DC.* Available online: http://salt.unc.edu/T-RACES/fha.html (accessed 10 August 2010).

[50] Some argue that redlining did not actually restrict lending, but that higher interest rates in redlined areas may have prevented investment by builders and buyers (Hillier 2003).

[51] As Self (2003) describes, this boundary gradually moved farther east to Telegraph Ave, the major north-south artery connecting downtown Oakland to Berkeley.

to blue-collar neighborhoods along San Pablo Avenue in West Oakland and into the San Antonio district, precisely the "infiltration" that the HOLC Area Reports used to redline a neighborhood.

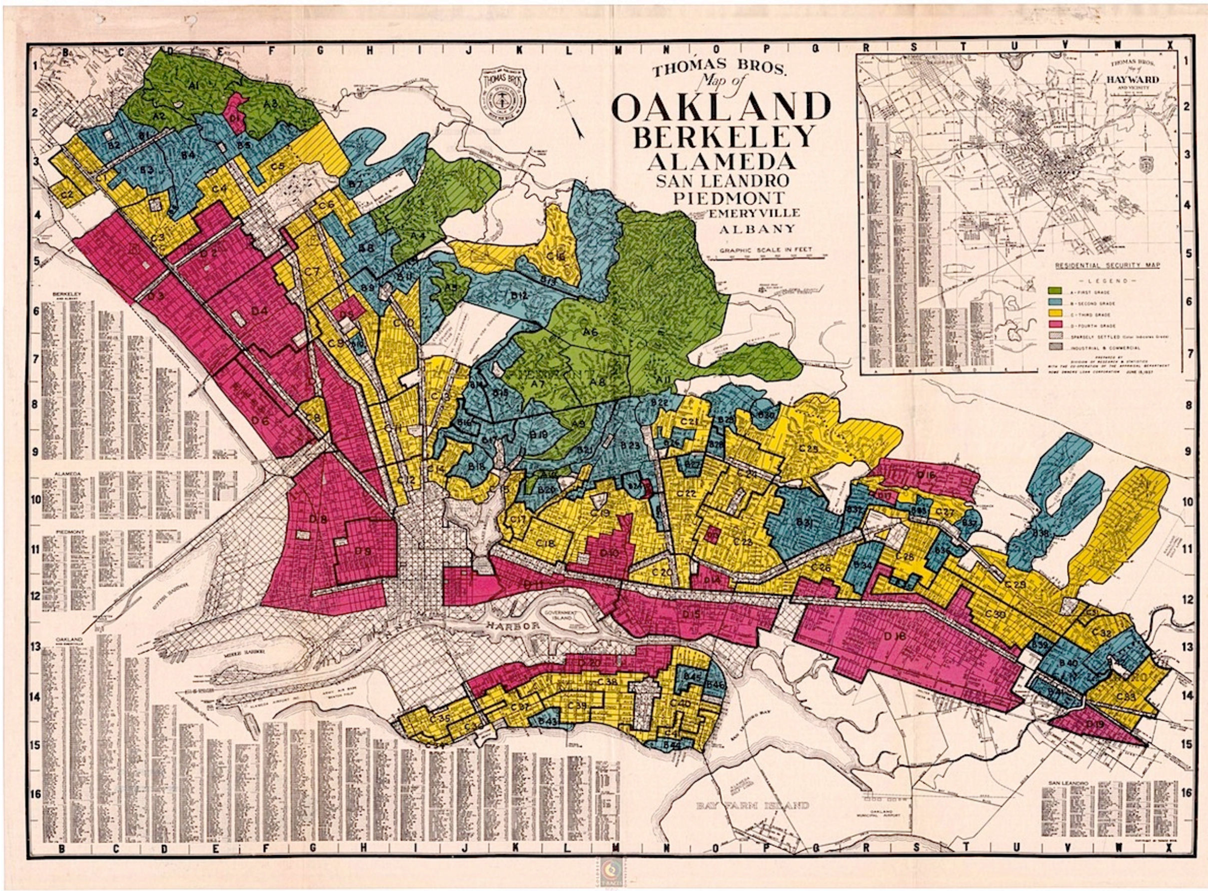

Figure 2.4. The 1937 Home Owner's Loan Corporation Residential Security Map for Oakland. "Redlined" neighborhoods (Class D) appear here as dark grey. Along with the adjacent Class C areas (which appear yellow in the original map), these delineations continue to define Oakland's flatlands neighborhoods. Source: T-RACES: a Testbed for the Redlining Archives of California's Exclusionary Spaces (http://salt.unc.edu/T-RACES, accessed 9 June 2010).

Like the Chinese, the presence of any "low class foreign born" laborers was enough for HOLC to paint a neighborhood red. The Area Report for the Jingletown neighborhood (Area No. D-15), home to a largely Portuguese millworker population, was also classed as "hazardous" due to

> Detrimental influences: Odors from industries; heterogeneous mixtures of old two-story homes and old one-story cottages (latter predominating). Predominance of foreign inhabitants, infiltration of Negroes and Orientals… This area lies below east [sic] Fourteenth Street (below the tracks) and is poorly regarded; semi-slum area. There are only a few Negroes and Orientals, but the low class foreign element is large. (HOLC 1937)

By the late 1930s, large swaths of the flatlands, the first of the industrial garden neighborhoods constructed during the inter-war boom years, had already been rated "Yellow" for "C – Third Grade" or "Declining", the result of "decreasing desirability" due to aging homes and "infiltration" by "lower grade elements". One such area was the Fruitvale district, where a large Mexican population had developed much earlier to work in the adjacent canneries and orchards (Ma 2000; Self 2003; Maly 2005). By the late '30s, the ten- to twenty-year-old worker cottages in HOLC Areas C-19, C-20, and C-26 were no longer "highly regarded by mortgage institution officials" due to the "threat of infiltration by lower grades", "proximity to areas infiltered [sic] by Negroes," and the growing population of "foreign born" and "Latin races" who already comprised up to 20 percent of the district at the time (HOLC 1937). The mere arrival of blacks, however, seemed to be enough to tip the risk scale from yellow to red. A large part of the adjacent San Antonio district (Area D-10) received a D grade: "This area is similar to C-19 in appearance but infiltration of Negroes necessitates hazardous rating" (HOLC 1937).

Redlining and yellowlining, along with racial covenants and federal housing subsidies, stewarded and demarcated a highly racialized urban landscape of prosperity and neglect for much of Oakland's industrial boom years and after. The Oakland hills and most of East Oakland's industrial garden suburbs remained predominantly white and affluent, while West Oakland, Chinatown, and the slightly more dilapidated East Oakland neighborhoods adjacent to E. 14th Street (San Antonio and Fruitvale) were left high and dry as investment waned. Like West Oakland's housing stock, labor—human capital—was also devalued as an influx of post-war migrants saturated the labor market, joining the ranks of the unemployed.[52] As Massey and Denton (1993) argue, segregation bred "hypersegregation," the emergence of "ghetto culture" and the decline (and flight) of the black middle class, cleaving an even greater economic rift between West Oakland and the East Oakland garden suburbs, migrants and old timers, blacks and whites, industrial growth and senescence.

Demarcated Desertification

If industrial relocation and FHA-funded residential development were the source of capital flows that irrigated East Oakland's industrial garden from the 1920s to the '40s, homeowners associations, zoning, and redlining were the dikes that initially prevented this capital from flowing back towards West Oakland, and then effectively quarantined its devaluation to the few areas where people of color were allowed to live. New capital continued to flow in. Between January 1945 and December 1947 roughly $300 million was spent on the expansion of new industrial plants in the Bay Area (Whitaker 1992). Within the city itself, however, devalued fixed capital—a landscape of aging housing stock and obsolete factories—left little room for new industry to take root.

A highly coordinated growth machine of industry, developers, boosters, and white laborers driven by the promise of homeownership and jobs diverted this latest flow of capital to the greenfields of the newly incorporated industrial suburbs—San Leandro, Hayward, Fremont, San Lorenzo, Newark, Union City, Milpitas—that flanked the East Bay between Oakland and San Jose. Vast tracts of agricultural land were incorporated into these pro-business

[52] The ranks of the unemployed become the rank-and-file of the "industrial reserve army", brought in when necessary to meet production demands or to lower wages when production costs rise, and cast back into the reserve when no longer needed (Marx 1976; Harvey 2007).

municipalities, zoned as industrial, and sold for prices below industrial land prices in Oakland.[53] National companies such as General Motors and Caterpillar built branch plants on these fertile greenfields, and defense contracts showered the new industrial suburbs with federal capital, ensuring rapid growth. As the data in Table 2.1 illustrate, manufacturing nearly doubled in Alameda County (outside of Oakland) between 1948 and 1967. Here at the urban edge of the new suburbs, industry was given a *tabula rasa*. In essence, these new suburban municipalities provided a more favorable business climate, spatially removed from the pressure cooker of the urban center's working class and the grip of recalcitrant city politicians (Walker 1981; Self 2003). In the words of the Bay Area Council, which helped drive industrial suburbanization, suburban employees were "more loyal, more cooperative, more productive workers than those in big cities" (cited in Johnson 1993, 212). The implicit (and at times explicit) message to future investors was that this suburban workforce was largely white.

Table 2.1. Decline of manufacturing in Oakland and increase in Alameda County

Year	**--- Manufacturers ----**		**------------ Workers -----------**		**Value added by manufacture**	
	Oakland	Rest of Alameda Co. [a]	Total	Rest of Alameda Co. [a]	$ (millions)	Share of Alameda Co. total (%)
1939	549	344	15,935	10,911	67.7	55
1947	701	485	25,601	28,437	207.6	51
1958	824	727	24,305	25,751	377.1	47
1967	748	956	19,100	36,200	417.1	32
1977	692	1,365	16,300	42,200	739.1	34
1987	717	1,735	11,800	35,500	1,095.7	16

[a] Calculated by subtracting Oakland data from Alameda Co. data.
Data source: US Census Bureau (1947, 1958b, 1967b, 1977a, 1987)

Just as in East Oakland during the interwar years, industry and housing in the new suburbs went hand in hand, part of a concerted planning effort to disperse industry and the suburban residential developments that followed in its stead. These industrial shifts and the prosperity of the post-war era further fertilized the American dream of homeownership. Large-scale housing developments in the urban periphery and the expansion of automobile ownership cultivated suburban development and white flight, draining urban areas of their tax base. Just as

[53] Neil Smith attributes the devalorization of housing to three sources: advances in the productiveness of labor and/or technological advances, style obsolescence, and physical wear and tear (Smith 1996, 62-70). In the case of industry in Oakland, technological advances (and related increases in the scale of production) required more space than was available in the city itself, making greenfields particularly attractive. At the same time, repairing physical wear and tear at existing plants in Oakland was not cost-effective when greenfield sites were so much cheaper. In the words of Smith, "undermaintenance frees up capital that can be invested elsewhere" (ibid., 65). As investment in maintenance declined and capital shifted to the suburbs, the landscape of aging, unmaintained fixed capital grew in Oakland's flatlands; the so-called "rent gap" (ibid.) between *potential* and *capitalized* ground rent slowly began to grow. The gap, however, was not large enough to attract redevelopment in West Oakland until the housing boom of the 2000s and the development of old warehouse spaces into condos for commuters. In East Oakland, the rent gap is still not great enough and sites similar to the one in Figure 2.5 are commonplace.

the industrial garden of East Oakland was watered with a strong mix of industrial and residential capital during the World War I and 1920s boom years, and with capital available through FHA loans in the '30s and '40s, the new industrial garden suburbs grew rapidly in the post World War II era as a result of this same combination of industrial capital and federal housing subsidies. As Oakland de-industrialized and new factories sprouted in the suburbs, working class white Oaklanders followed, lured by homeownership and proximity to jobs, just as they had done in the previous wave of inter-war and wartime suburbanization. Between 1949 and 1951 only 600 units among the 75,000 constructed in the Bay Area were open to blacks (Johnson 1993). Upwardly mobile whites left the East Oakland flats to join the downtown ruling elite in their Oakland foothills and hillside neighborhoods, taking their cash with them.[54] In Elmhurst, for example, white residents made up 82 percent of the neighborhood's population in 1960 and median income was $6,154, only about 2 percent lower than the citywide median income; a decade later whites made up only slightly more than a third, while on the other side of the city boundary in San Leandro, people of color were excluded. Median income in Elmhurst dropped to 10 percent lower than that of the city (Whitaker 1992).

As capital was channeled into the industrial suburbs, it began to dry up inside the city's boundaries, leaving the once-verdant urban economy parched of tax revenue. By the mid 1960s, the number of manufacturers within Oakland had begun its steady decline. Between this downward trajectory and the steady growth of manufacturing in the new industrial suburbs, Oakland's share of Alameda County's industrial productivity dropped from more than half to less than a third in the four decades following World War II (cf. Table 2.1).[55] More than 130 factories shut their doors and nearly 10,000 manufacturing jobs were lost by 1977 (see Figure 2.5). Unemployment skyrocketed as a result. The unemployment rate in 1964 was 11 percent but for blacks was almost twice that high. Business ownership was absentee for the most part; by 1978, only 25 percent of businesses in East Oakland were locally-owned (Henze, Kirshner, and Lillow 1979).

This trend continued in the '80s as jobs shifted from the traditional manufacturing and warehousing sectors to a service-based industry. The Bay Area on the whole benefited from a boom during this period, with a 15 percent growth in jobs between 1981 and 1986. Oakland, however, reaped little in the way of this regional bounty; employment grew only by 1.5 percent during these same years. The flatlands bore the brunt of job loss during this period. West Oakland and Fruitvale lost eight to ten percent of jobs. In the Elmhurst and San Antonio districts, employment decreased by roughly a third (Landis and Guhathakurta 1989).

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[54] Explanations of "white flight" from the black city center largely revolve around a) white fear of an inundation of blacks into their neighborhoods, b) the American dream of homeownership fueled by post-war prosperity, and c) the expansion of automobile ownership and "car culture." While aspects of this reading of history are certainly valid, the story of suburbanization is more nuanced than this old school view of a big bang spewing "little boxes made of ticky-tacky" outwards from ground zero at the city center, pulling all the scared white folks with it. By refocusing on the greater logic of metropolitan regionalism and industrial dispersal that helped to steward extensive, dispersed residential development, we can move beyond the urban/suburban dualism and the common trope that suburbanization should be read as a rejection of the city in general (Hise 1997; Walker 1981).

[55] While Oakland's industrial economy was diversified enough that it did not suffer "the urban crisis" to the same extent as the Rust Belt cities in the Northeast and Midwest (Sugrue 2005), it nevertheless followed the same trend.

Figure 2.5. Abandoned ironworks, Elmhurst (East Oakland), one of more than a hundred factories that stopped production between the 1950s and 1980s. Photo by the author, February 2008.

As East Oakland's industrial garden withered and whites fled to the suburbs and hills, housing there became available to upwardly mobile people of color for the first time. The Oakland border with San Leandro truly became a color line. Just as East Oakland's industrial garden communities had excluded people of color via racial covenants, new housing developments in places like San Leandro and San Lorenzo excluded people of color using racial covenants and informal "gentlemen's agreements" between realtors and homeowners' associations. Creating a class alliance with developers, increasingly conservative white homeowners in the new suburbs helped to exert political pressure to further confine devaluation to the Oakland flatlands. Proposition 14, a 1964 ballot initiative sponsored by the California Real Estate Association and supported by 65 percent of voters statewide, essentially overturned the federal Fair Housing Act, passed the year before. In 1978 this same alliance was able to pass the infamous Proposition 13, which severely limited cities' ability to raise property taxes. The resulting decrease in property taxes took a toll on Oakland's already impoverished flatlands, as inflow of revenue was squeezed by more than $14 million, leading to facilities closures and cuts to public services (Self 2003; Rhomberg 2004).

As earlier in the century, Oakland's demographic shifts in the era of deindustrialization were not simply black and white, but multihued. Changing immigration policies in 1965 allowed a greater influx of Latinos into Oakland, primarily into the already heavily Mexican Fruitvale district. Many of the new arrivals worked in low-end service jobs in the industrial suburbs to the south (Hondagneau-Sotelo 1994). By the late 70s and early 80s, the impoverished flatlands became a major center of refugee resettlement for Salvadoran, Guatemalan, Khmer, Lao, Hmong, Khmu, Mien, and Vietnamese fleeing the Cold War's bloody battlegrounds in Central America and Southeast Asia. Resettlement programs in poor areas of East Oakland kept the majority of these immigrants poor, adding to an already large and devalued pool of cheap labor for the postindustrial economy (Ong 2003). Social networks provided entry into formal market niches and a vibrant, yet self-exploiting, informal economy, much of it centered in Chinatown, San Antonio, and Fruitvale (Marech 2002; Maly 2005).

As the former industrial garden dried up, some new capital (in the form of federal urban redevelopment and freeway construction) did flow into the economically parched urban landscape, yet the promised jobs and opportunities never emerged. To the contrary, urban redevelopment ultimately displaced thousands of residents from their homes. Several of the most "blighted" areas were razed under the aegis of urban renewal (often referred to more contemptuously as "Negro removal"). Thousands were displaced and forced to relocate. Single-family homes and duplexes were subdivided to accommodate those displaced, adding an additional strain on the dilapidated housing stock. Redlining prevented or dissuaded any new investment for housing repair. Housing in the East Oakland flatlands eventually became dilapidated, as well, due in part to a large number of absentee landlords who were homeowners who had followed the industrial garden to the suburbs, or speculators who bought their devalued property at firesale prices. By 1978 more than two-thirds of East Oakland's single-family homes and apartments with more than five units were owned by absentee landlords (Henze, Kirshner, and Lillow 1979). Rents grew for increasingly decrepit housing, driving up vacancy rates to the point where the City of Oakland declared a "state of emergency" in April 1974 in response to the high number of vacant and abandoned housing units in East Oakland. These 1,200 empty units were seen as a result of the "blighting influence" of E. 14th Street, the major artery running the length of East Oakland. More than half of the structures assessed in the 1972 Elmhurst Redevelopment Project were categorized as containing "building deficiencies."[56] By the late 1980s, almost a third of vacant houses in the flatlands were considered in "poor" condition by the City of Oakland's Office of Community Development (Whitaker 1992).

As this chapter demonstrates, the devaluation of capital in Oakland was contained in the flatlands via racist policy and practice. The construction of major transportation corridors through the flatlands also helped to materially reinforce these existing spatial and socioeconomic divisions in Oakland, as in other post-industrial American cities, physically demarcating the boundaries between investment and abandon, rich and poor, whites and people of color. Plans for the Nimitz, MacArthur, and Grove-Shafter Freeways were approved in 1958 by the all-white Oakland city council (Self 2003). The Grove Shafter (California Route 24/Interstate 980), which was placed immediately adjacent to the old Grove Street redline, effectively severed West Oakland from downtown. The MacArthur (Interstate 580) divided the flatlands from the hills. The Nimitz (Interstate 880), which parallels the MacArthur, was sited through the city's industrial corridor along the city's southwestern edge, roughly separating the majority of factories and warehouses and access to the estuary from the flatlands residential areas. Other construction projects were sited in devalued flatlands neighborhoods where land values were low and the political power of the community marginal. The Cypress Freeway was constructed right through the middle of West Oakland, razing hundreds of homes and displacing thousands of

[56] The state of emergency led to a host of redevelopment initiatives, including the Home Maintenance and Improvement and Urban Homesteading programs.

residents.[57] The Bay Area Rapid Transit (BART) system, which began in 1964, had a similar impact on the flatlands. In most of the flatlands, the BART tracks were placed above ground to reduce costs. Construction of the BART line between downtown and the trans-Bay tunnel destroyed 7th Street in West Oakland, the cultural and economic center of Oakland's African American community and displaced several hundred families, many of whom moved to East Oakland where they were faced with rents two to three times as high as what they paid in West Oakland (Whitaker 1992). Small businesses (including grocers) also felt the impact of redevelopment as their clientele was displaced.

The port and its rail lines, the freeways, the Bay Bridge, and the BART were constructed to link Oakland to the region and to position it as a major transportation hub for the economically vibrant Bay Area. But as Self (2003) argues, capital and people flowed above West Oakland on freeway overpasses and BART tracks, channeled to San Francisco's enduring commercial center and Oakland's growing industrial suburbs. These conduits of capital served as physical boundaries of devaluation of existing fixed capital in the flatlands, material structures demarcating what zoning and redlining succeeded in doing invisibly on paper. Not only did the benefits of the freeway and BART system—the hallmarks of urban modernity—bypass the flatlands, their construction was marked by dispossession and displacement of Oakland's flatland residents.

Retail in the Red

As capital devaluation become more and more contained in the flatlands, the city's retail landscape changed dramatically. A depressed flatlands economy made it difficult to retain major retail, including supermarkets. For example, when the new Eastmont Mall, built on the site of the former East Oakland GM factory, held its grand opening in November 1970, it beckoned customers with the promise of unlimited parking and two major department stores, a four-plex movie theater, and food court. By the '80s, however, falling purchasing power and an increase in drug dealing and related violent crime around the mall led to a major decline in retail sales. During the 1990s both department stores closed, as did the mall's Safeway supermarket. With the mall's anchor stores gone, business occupancy dropped to only 30 percent (*Oakland Tribune* 16 Mar 2007). By 1987 only four department stores continued to operate within the city limits (Rhomberg 2004).

This pattern of capital flight and devaluation transformed food access during the era of deindustrialization in the Oakland flatlands and in U.S. "inner cities" on the whole. Across the country, food retail had been gradually changing first since the arrival of chain grocers stores prior to World War I and then by chain supermarkets in the 1930s. After the Second World War, supermarkets (both chain and independent) dominated the lion's share of food retail. Driven by the entry of women into the workforce, a growing demand for one-stop shopping, automobile culture, and a massive influx of new processed foods derived from subsidized commodities, supermarkets became more and more popular. Shopping centers, a new model of retail often "anchored" by a supermarket, sprouted up in the new white suburbs across America. By 1960 more than two-thirds of groceries were purchased at supermarkets. Unable to compete with the

[57] The Cypress Freeway collapsed in 1989 during the Loma Prieta earthquake, killing 42 people. In response to public outcry over the socioeconomic impact of its original location, the new freeway was built farther west, adjacent to the Port. The old Cypress viaduct is now Mandela Parkway.

economies of scale enjoyed by supermarkets, many small grocers went out of business. The power of corporate supermarket chains increased during this period as well. Chain supermarkets slowly drove the independent chains out of business, waging "price wars" to secure turf. By 1975 corporate food retailers controlled about two-thirds of the food retail market, draining capital from the local economy and funneling it off to corporate headquarters (Eisenhauer 2001; Walker 2005b).

As food retail became concentrated in the aisles of major supermarkets, food access became increasingly dictated by supermarket location. By the 1970s nationwide economic "stagflation" caused supermarket retail to founder. Mergers and leveraged buy-outs of competing chains hit less competitive, inner-city markets hard; between 1978 and 1984, Safeway alone closed more than 600 stores in these neighborhoods (Eisenhauer 2001). The boarded-up hulls of failed supermarkets littered the shoals of America's post-industrial cities; many remained shuttered, others converted to churches, and only some rigged anew as thrift or dollar stores for consumers with declining purchasing power. While the number of supermarkets in urban areas declined, however, the overall number of supermarkets increased. By the mid-'90s, in urban areas the poorest urban neighborhoods had roughly half the retail supermarket space than did the richest urban neighborhoods (ibid.).

During the '80s and '90s superstores took over the helm of food retail, spatially concentrating food access in locations often only accessible by car. For working class people, falling wages and retail capital's retreat from post-industrial urban centers meant that cheap food availability was limited to big box stores and fast food joints (Walker 2005b; Mamen 2007). A "junk food jungle" took root in the barren stretches of the fresh food desert throughout poor neighborhoods in post-industrial America, capitalizing on the niche left by the retreat of groceries and supermarkets and a demand for food that was easily accessible, convenient, and cheap, sending the incidence of diabetes and obesity skyrocketing (Goldstein et al. 2008). Liquor stores followed a similar successional logic. With the ebb of food retail capital, liquor stores began to serve as the primary source of food provisioning in America's inner cities, yet prices for their goods were often higher than those found at a supermarket, and fresh fruits and vegetables were unavailable.[58]

Food retail in the Oakland flatlands paralleled these national trends. Between 1935 and 1987, the total number of grocery stores in Oakland dropped five-fold, from over 1,000 to about 200 while the average number of employees per store increased nearly seven-fold. These shifts signal not only the arrival of supermarkets and consequent concentration of the food retail sector, but also the steep decline in service to the city's growing population, an overall decrease from 36 to 5 stores per 10,000 residents (see Table 2.2). The decline hit the flatlands even harder. In West Oakland, the number of grocery stores declined from 137 in 1960 to 22 in 1980, due largely to supermarket penetration (Fuller 2004), a drop from nearly 25 percent of all of the city's stores to just above 10 percent. By the 1990s, many of these same supermarkets that had pushed out the small grocers in the flatlands had also closed their doors in response to falling profits. The Safeway at Eastmont Mall, one of the mall's anchor stores, closed at this time. In a particularly ironic twist, two of the country's four leading supermarkets, Safeway and Lucky Stores, were headquartered in Oakland, yet access to quality food in the once bountiful industrial garden of

[58] Decreasing access to healthy food marked a visceral rift and shift in social metabolism, as described in Chapter 1. The devaluation of inner-city neighborhoods and the ensuing flight of food retail—coupled with the rise of fast food and the high-fructose corn syrup (Pollan 2006; Schlosser 2005)—transformed the caloric and nutritional intake of inner-city residents.

Oakland's flatlands had evaporated as capital reinvested outside of the city lines. One can conclude from the data in Table 2.3 that the rapid growth of the suburbs precipitated the decline of Oakland's share of food stores, but Oakland's sales nevertheless began to lag disproportionately due to the declining purchasing power of the city's population. By the late 1980s, a third of Alameda County's food stores were located in Oakland, but these accounted for only a quarter of the county's total food sales.

Table 2.2. Consolidation and decline of grocery stores in Oakland

Year	Number of grocery stores [a]	Number of paid employees	Employee to store ratio	Stores per 10,000 people [b]
1935	1,086	1,923	1.8	35.9
1948	828	1,783	2.2	21.5
1958	525	1,513	5.3	14.3
1967	394	2,065	10.8	10.9
1977	257	1,913	11.1	7.6
1987	201	2,349	11.7	5.4

[a] For 1958 to 1987 retail data, Standard Industrial Classification (SIC) Code 541 was used. For 1935, "Grocery stores without meat" and "Combination stores (Grocery stores with meat)" were aggregated; for 1948, grocery stores with and without meat were aggregated. Grocery stores accounted for roughly two-thirds of "Food Stores" (SIC Code 54) for all years.
[b] Calculated using population data from the nearest Decennial Census year (1940 to 1990)
Data source: US Census Bureau (1935, 1948, 1958a, 1967a, 1977b, 1988)

Table 2.3. Decline of Oakland's share of food stores and sales in Alameda County

Year	Oakland's share of Alameda Co. totals		
	Population (%) [a]	Food stores (%) [b]	Sales (%)
1935	59	66	64
1948	52	63	57
1958	40	55	45
1967	34	50	38
1977	31	37	29
1987	29	34	24

[a] Calculated using population data from the nearest Decennial Census (1940, 1950, 1960, 1970, 1980, and 1990)
[b] For 1958 to 1987 retail data, Standard Industrial Classification (SIC) Code 54 was used. For 1935, data for the category "Food Stores" was used; for 1948 data, "Food Group" was used.
Data source: US Census Bureau (1935, 1948, 1958a, 1967a, 1977b, 1988)

With the retreat of the supermarkets and closure of small-scale groceries, food retail in the flatlands has been largely left to liquor stores. Statistics help to describe a landscape of food access not unlike that of many other food deserts. In 1935 there were more than eight grocery stores for every liquor store in Oakland; by 1977, there were less than two.[59] In the flatlands the number of liquor stores per person (three to six stores per 1,000 residents) was two to four times the city average in 2007. There are four times as many fast food restaurants and convenience stores as grocery stores and produce vendors in the East Bay (Spiker, Sorrelgreen, and Williams 2007). No supermarkets serve residents in West Oakland and recent plans for British supermarket giant Tesco to open a West Oakland store have fallen through. A recent survey by a food justice initiative found that in six flatlands neighborhoods, residents reported having to leave their neighborhoods to find affordable, healthy food (HOPE Collaborative 2009). West Oaklanders have to cross into the redeveloped box store land of neighboring Emeryville to shop at Pak N Save. Similarly, in East Oakland's Council District 6, no national grocery chain exists.[60] Most East Oaklanders find the best deals across the city border; one focus group participant noted, "Oakland dollars are going to San Leandro" (ibid., 16). Another noted, "I wish we could have more fresh foods rather than junk food, candy, and soda that we're all used to eating because that is the only thing around" (ibid.). Participants said that they want more stores that sell healthier foods and better quality produce. Another study highlights residents' acute awareness of the difference not only in availability, but also of quality: "Yes, there's a difference in the stores in our area compared to the stores in Montclair or somewhere else [in the Oakland hills]. You know, the vegetables are great up there, everything is so beautiful. And you come down, I think we get ours last off the truck" (Treuhaft, Hamm, and Litjens 2009, 33).

Conclusion

This history of demarcated devaluation of the Oakland flatlands suggests that food deserts arise from an incredibly complex intersection of historical forces operating at multiple spatial and temporal scales. In this chapter I uncover only a few of the many sedimentary layers of the urban palimpsest, that of industrial, residential, and retail capital and some of the ways in which their ebbs and flows were spatially demarcated, notably through racist policy decisions, and how these changes, in turn, impacted the metabolism in the flatlands. Further excavation is needed to map more fully the uneven terrain of food access in the flatlands. Other layers need to be uncovered: the role of food policies operating at multiple scales, from federal to local, farm subsidies to food stamps and free lunch; the politics of city contracts and bidding, development and redevelopment programs, planning and zoning; how current economic and demographic shifts in the flatlands may both fuel and fight the advances of food justice activists.

Across the street from the liquor store on 17th Street where we began, the verdure of an urban garden spills through a chain link fence. A colorful orange and yellow sign hanging on the gate advertises a community food security project, welcoming passers-by into the cultivated chaos of garden vegetation. Flanking the entrance to the garden, a produce stand is stocked with

[59] Calculated using data from the Census of Business 1935, 1948, 1958, and 1967; and Census of Retail Trade 1977 and 1988 (see notes for Tables 2.2 and 2.3).

[60] A recent announcement by Kroger to open two new 72,000 square-foot Foods Co. stores in East Oakland made national news, one of them in Foothill Square where Lucky's and Albertson's stores closed their doors several years earlier.

a kaleidoscope of brightly colored peppers, persimmons, chard, and salad greens, sold at cost to the ethnically diverse crowd gathered around the display. When viewed as a metaphor, this actual urban streetscape seems almost contrived—a moral standoff between garden and liquor store, nutrition and intoxication, growth and senescence, stewardship and abandon. As symbols, these two spaces have come to represent opposing forces in the struggle for food justice in the food deserts of the flatlands and elsewhere. But on a material level, these two types of food outlets have very real impacts on urban livelihoods, provisioning low-income communities with quite different types of food—fresh organic produce or highly-processed packaged food—leading to very real differences in nutritional intake and wide-reaching effects on public health. In the next chapter I explore the movement that created gardens such as these in response to the rift in metabolism arising from the devaluation of the flatlands.

Chapter 3:

From Panther Power to People's Grocery: Unearthing Urban Agriculture's Roots in the Flatlands

A Latina wearing denim overalls raises her fist. In the other hand she grips a trowel. Flanking her left, an African American woman triumphantly holds up two ears of corn in one hand and grips a shovel in the other. To her right, an Asian American male wearing hip sneakers cradles a basket of brightly colored fruits and leafy greens. Behind the three, a sunburst rises from behind the silhouette of an urban skyline. People's Grocery's stylish logo, like that of several other food justice and urban agriculture organizations, evokes old-school Black, Brown, and Yellow Power bravado (cf. Pulido 2006) with Third World agrarian revolutionary aesthetics (think Salvador Salgadão's stark black and white portraits of landless peasants in Brazil), hip-hop cartoon superhero stylings, as well as the illustrated cornucopias that once plastered fruit crates and California booster posters (see Figure 3.1).

The small gardens run by organizations such as People's Grocery are tucked away in the margins and interstices of an urban landscape of asphalt streets, houses of wood and stucco, and buildings of brick and concrete. While they produce only a minimal amount of fresh produce for residents living in Oakland's food deserts, they have been central to raising awareness in the flatlands about food justice, nutrition, and urban sustainability. By interlacing discourses of food, health, economic development, a safe built environment, and social justice, these organizations are explicitly drawing attention to the uneven distribution of resources in Oakland and the interconnectivity between the health of flatlands citizens and their ability to produce and access food. Like the powerful image depicted in the People's Grocery logo, the mission statements of these organizations (see Table 3.1) articulate food justice as a radical, urban, multi-ethnic movement committed to improving access to healthy food in the city's flatlands. A discourse of equity, empowerment, sustainability, localization, health, and community figures centrally.

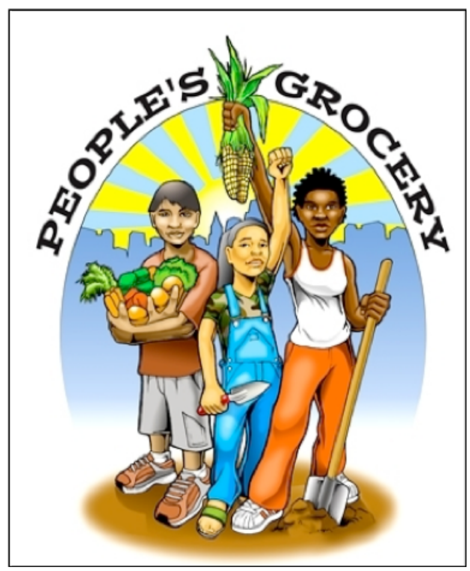

Figure 3.1: People's Grocery logo. Source: www.peoplesgrocery.org

Urban agriculture lies at the heart of their common mission to ensure equitable access to healthy food in Oakland's poorest communities. Many of these organizations provide flatlands residents with fresh produce either via community supported agriculture (CSA) subscriptions,[61] sliding scale farm stands, or farmers' markets. Most conduct some form of garden-based education, either directly with schools, building gardens that are used for hands-on learning about biology and nutrition, or by bringing community members to the gardens for workshops on sustainable gardening techniques. Others help community members build gardens in their backyards and provide one-on-one gardening mentorship. Some organizations also teach people how to

[61] A CSA is a direct-marketing arrangement that links producers and consumers. Customers purchase a share at the beginning of the season in exchange for weekly deliveries of a box of fresh produce.

prepare the food they grow or how to plan a balanced diet. The majority of these programs operate in West Oakland (see Figure 3.2).

Table 3.1: A selection of food justice urban agriculture organizations and projects in Oakland, California

Organization	Mission	Activities
Acta Non Verba	"to create a safe and creative outdoor space for children and youth participating in the program… to deepen their understanding of food production and strengthen their ties to the larger community… us[ing] urban farming, education and vocational training as the catalyst of community change and elevation of the standard of living in the inner city."	The Youth Urban Farm Project at Tassafaronga Recreation Center in East Oakland
City Slicker Farms	"to empower West Oakland community members to meet the immediate and basic need for healthy organic food for themselves and their families by creating high-yield urban farms and backyard gardens"	Backyard garden construction and mentorship; four urban gardens and sliding scale produce stands
Forage Oakland	This project is about viewing food as a shared pleasure and a shared resource, redistributing it to those who will enjoy it… to construct a new model-- and is one of many neighborhood projects that will eventually create a network of local resources that address the need and desire for neighborhoods to be more self-sustaining in meeting their food needs.	Mapping, harvest, and sharing of fruit in North Oakland's flatlands
Oakland Based Urban Gardens (OBUGS)	"to build healthy communities through programs offered to children, youth, and families in a network of school and neighborhood gardens, green spaces, and farmers' markets"	Garden-based education in elementary and middle schools in North and West Oakland
Oakland Food Connection (OFC)	"Focused on food, community, and culture. OFC promotes nutritional awareness, access to healthy foods and the connections between people and our planet. … [to] bridge the gap between diverse food sources and the people who need and use them. We give residents the knowledge they need to better their own communities"	Gardening, cooking, and nutrition education at schools in East Oakland; small farmers market
People's Grocery	"to build a local food system that improves the health and economy of West Oakland… Our work involves increasing local supply of fresh foods; advocating for living-wage business and job opportunities; and developing strong relationships and community leadership"	Greenhouse and garden at the California Hotel; "Grub Box" CSA and "Wholesale Hookup" buying club; anti-racism/anti-oppression training/food justice allyship program
Phat Beets Produce	"to create a healthier, more equitable food system in North Oakland through providing affordable access to fresh produce, facilitating youth leadership in health and nutrition education, and connecting small farmers to urban communities via the creation of farm stands, farmers' markets, and urban youth market gardens"	"Beet Box" CSA; farmers markets and produce stands at Children's Hospital; a community garden, youth internship program, and workshops at Dover Park
Planting Justice	"to democratize access to affordable, nutritious food by empowering disenfranchised urban residents with the skills, resources, and inspiration to maximize food production, economic opportunities, and environmental beauty in our neighborhoods"	Network of school and community gardens and "food forests"; weekly workshops on permaculture, culinary skills, and food justice

Statements for each organization were taken from its website/blog: Acta Non Verba (www.anvfarm.org); City Slicker Farms (www.cityslickerfarms.org); People's Grocery (www.peoplesgrocery.org); Oakland Food Connection (www.foodcommunityculture.org); Phat Beets Produce (www.phatbeetsproduce.org); Planting Justice (www.plantingjustice.org); Forage Oakland (forageoaklandmanifesto.blogspot.com). All sites accessed 1/31/2011.

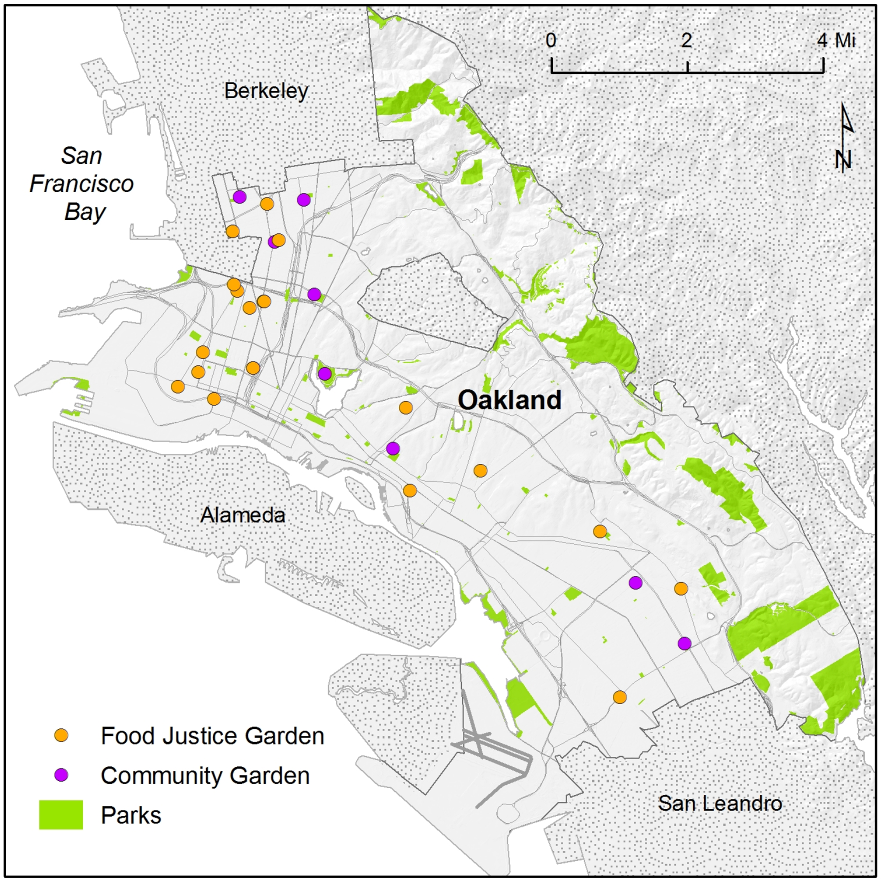

Figure 3.2: Food justice and community gardens in Oakland. Note the abundance of parks/open space in the Oakland hills as compared to the flatlands. Map by the author.

While the mission of organizations such as these is clear, their multiple historical roots are less evident, buried and intertwined over the course of decades. In the previous chapter, I focused on the manifold ways in which capital shapes the urban environment, and more specifically the ways in which a lack of access to healthy food in the Oakland flatlands has been spatially demarcated and "produced" through a historical combination of redlining, racial covenants, deindustrialization and white flight, and construction of the freeway system and BART. A complementary understanding of urban agriculture as a movement that explicitly responds to the inequity of food access demands a similar historical exploration. While a detailed, exhaustive history of urban agriculture in Oakland merits an entire book, my intent here is to build on the flatlands history laid out in Chapter 2 by tracing the various histories that converged to create the vibrant food justice-oriented urban agriculture movement we find in Oakland today.[62] As I argue in the dissertation's introduction, this kind of relational history is

[62] I have intentionally left out Oakland's agricultural "prehistory" in this chapter, e.g., the Chinese gardeners and truck farmers who provided a large percentage of the city's produce at the turn of the century (Ma 2000), the orchards of Fruitvale that fed the canneries and the workers, and the Italian greenhouses in Temescal (Bagwell 1982). While this early history provides an important back-story to the history of Oakland's foodshed, the overlapping movements I present here arose in response to the demarcated devaluation of the flatlands that I described in Chapter 2.

fundamental to understanding *why* urban agriculture has taken root at a particular historical conjuncture. In addition to uncovering the origins of urban agriculture in Oakland, this history also provides an analytical framework for understanding urban agriculture in other places.

Several interconnected themes emerge over the course of this history. First, the growth of urban agriculture has relied on alliance-building across racial, ethnic, and class lines. In most cases, movements led by people of color succeeded in drawing attention to their causes and scaling up programs only through allying with white liberals, progressives, and radicals. This does not belie the authenticity of grassroots movements of color or call into question their intrinsic power or ability to mobilize for change. Rather, it is an indicator of the difficulty of marshaling material resources in devalued "lumpengeographies" (Walker 1978) such as the flatlands, as well as of the extent to which the struggles of people of color have been rendered invisible to white America. This leads to a second central theme: scalar politics. Through these multicultural alliances, urban agriculture activists were able to contest the material implications of flatlands devaluation in new political arenas. This "politics of scale", according to Cox (1998), entails the expansion of a local struggle to new extra-local "spaces of engagement" precisely to defend "spaces of dependence", or the social relations specific to a particular place (in this case, the flatlands neighborhoods in which urban agriculture activists live and work) that mediate everyday life.[63] Third, both the multi-ethnic alliances and cross-scalar politics allowed—and to a certain extent were prerequisite to—financial support. In many cases funding came in the form of grants from private foundations and government agencies, providing not only much-needed money, but also a badge of legitimacy in the eyes of local government as well as other funders. Finally, urban agriculture's growth as a movement—along with the trickle of capital that fed it—can clearly be linked to its increasing institutionalization. Urban agriculture has increasingly been advocated and practiced by small non-profit community-based organizations (CBOs) or non-governmental organizations (NGOs). The rise of the "non-profit industrial complex" (as many urban agriculture activists critically call it, self-reflexively situating themselves therein) corresponds to the shifting urban political economy of the American city in the era of neoliberal rollback of the welfare state and rollout of non-profits, charities, and volunteerism to (partially) fill in the gaps (Brenner and Theodore 2002; Peck and Tickell 2002).

I contend that these four themes running through the story—alliance-building, cross-scalar politics, funding, and institutionalization—were crucial to the current momentum surrounding urban agriculture in Oakland and ongoing efforts to scale it up. They also show that urban agriculture is more than simply community gardening. Rather, it is a networked alliance of people advocating food production in the city for different reasons. It is not just a bunch of do-gooders practicing a form of lifestyle politics (akin to recycling or driving a hybrid) in an effort to mend the individual metabolic rift, nor is it just grassroots activists clamoring to crush corporate food system in an effort to protecting against social metabolic rift. There is a politics to scaling up that only a relational history can reveal. Understanding these four themes helps to explain how urban agriculture is dynamic, emerging as the culmination of multiple histories and relationships at a particular time and place. This perspective helps us move beyond the simplistic and dichotomous interpretations of urban agriculture that dominate both the academic literature and discussions on the street.[64] Furthermore, understanding that the spread of urban agriculture

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[63] A growing body of research shows how such scalar politics operate within food system activism (cf Smith and Kurtz 2003; Heynen 2009; Mendes 2007).

[64] I am referring here to both the "urban agriculture as panacea" perspective, as well as the "urban agriculture as radical" vs. "urban agriculture as neoliberal/gentrifying" views that I address in the dissertation's introduction.

has depended on the mobilization of multi-racial, cross-class alliances will be crucial to navigating the micro-politics of scaling up urban food production in the future.

Rather than addressing the importance of these themes systematically (as one might expect when making claims about their centrality), I have opted to tell the story in a more or less chronological fashion, flagging these themes as they arise at various points throughout the history. The chapter proceeds as follows. In Part 1 I focus on three seminal moments of radical activism that laid the groundwork for today's food justice movement. I begin with the Black Panther Party's Free Breakfast Program that began in 1968. This is a cornerstone of Oakland's food justice story, arising in direct response to the devaluation of the flatlands described in the preceding chapter. I then jump ahead to the Environmental Justice (EJ) movement of the 1990s and 2000s, before discussing how EJ gave rise to an urban greening movement built on a foundation of racial and social justice. In Part 2, I explore how various groups converged on urban gardening as a strategy for social change, building on a long history of Bay Area gardening by school children, immigrants, and community groups, and tapping into a large network of sustainable agriculture education programs. In Part 3 I return to the current efforts by urban agriculture organizations in Oakland. I conclude in Part 4 by examining ongoing initiatives to scale up and institutionalize urban agriculture through local food policy and planning.

Before proceeding with this history, I first want to offer a caveat. Throughout this history I focus primarily on the work of various organizations involved in urban agriculture in the East Bay flatlands. Indeed, on a certain level, this chapter serves as an institutional history of urban agriculture in Oakland and the East Bay. Unfortunately, this approach runs the risk of placing too much emphasis on organizations and their founders at the expense of the hundreds of women and men, organizational staff and volunteers, or community members with no affiliation whatsoever, whose visions, ideas, and labor were ultimately responsible for the real changes that took place. It is not my intent to disregard their stories or downplay the importance of their contributions. Given the grain of analysis, I have tried to include so-called key players. As a result, in the case of organizations, I risk giving too much credit to the figureheads and not enough to the numerous individuals who supported them materially and intellectually.

1. Radical Groundwork

As the logos and mission statements of Oakland's food justice organizations attest, urban agriculture in Oakland is not simply about gardening. Rather, it has self-consciously grown out of a history of radical local activism. In the sections that follow, I bring together three key historical moments that shaped today's urban agriculture movement in Oakland's flatlands: the Black Panther Party's Food Programs, the environmental justice (EJ) movement, and the work of Urban Habitat, an organization whose work laid the critical theoretical foundations to the food justice movement that followed.

The Panthers Dig In

Nearly forty years before urban agriculture and food justice became a rallying point for activists in the flatlands, a radical countermovement arose in Oakland in response to the plight of the African Americans, eventually growing from a flatlands movement to one boasting 5,000 active members working in forty-five chapters and branches nationwide (Heynen 2009). By the mid 1960s the impact of capital flight and demarcated devaluation had begun to take its toll on Oakland. The capital-parched flatlands of West and North Oakland proved fertile ground for revolution. Conditions for African Americans living in America's ghettoized inner cities had deteriorated considerably; the Watts riot of August 1965 was perhaps the most infamous of dozens of uprisings at the time that boiled up in response to the separate and unequal treatment by an increasingly heavy hand of the law. A few months after the events in Watts, a group of young activists studying at Merritt College on Grove Street in North Oakland formed the Black Panther Party for Self-Defense (BPP) in response to the growing number of cases of police brutality. In addition, the group's founders Huey Newton and Bobby Seale were incensed by the escalation of war in Vietnam, where they viewed the Vietnamese peasants as oppressed by US militarism. Drawing theoretical and material inspiration from the likes of Mao, Fanon, Guevara, Malcolm X, and Marx, the Panthers drew parallels between the plight of blacks in Oakland and oppressed peoples worldwide. They used the language of dependency theory to describe Oakland as a colonized "periphery", exploited and oppressed socioeconomically—and at times violently—by the white bourgeoisie of the downtown "core" (Self 2003).[65] Heynen (2009, 416) explains that Huey Newton's theory of "revolutionary intercommunalism" placed the struggles of the black inner-city within a global context of anti-imperialist struggles in places such as Vietnam, Cuba, Mozambique. This created a new "spatial model" linking otherwise disparate ghettoized and colonized communities, each with its own set of social institutions mediating social reproduction, that alone and isolated would be incapable of resisting capitalism's universal reach.

While the BPP is perhaps best known for protecting the city's black population against harassment from a predominantly white police force, it also launched several social programs to fill in gaps left by capital's flight and the urban decay that followed. A central goal was to improve access to a healthy and balanced diet. Section 10 of the October 1966 BPP Party Platform and Program "What We Want, What We Believe" states: "We want land, bread, housing, education, clothing, justice and peace" (cited in Foner 2002). To help facilitate this goal, several BPP programs brought bread and other food to Oakland's flatlands neighborhoods. The Free Breakfast for School Children program

> was created because the Black Panther Party understands that our children need a nourishing breakfast every morning so that they can learn.… It is a beautiful sight to see our children eat in the mornings after remembering the times when our stomachs were not full, and even the teachers in the schools say that there is a great improvement in the academic skills of the children that do get the breakfast. At one time there were children that passed out in class from hunger, or had to be sent home for something to eat. But our

[65] Dependency theory arose in the 1960s as a reaction against modernization theory, the dominant idea that societies simply evolved along a linear trajectory from primitive to technological, a theory edified through Rostow's "stages of economic growth" model (Rostow 1959); according to this modernization model, Africans and Latin American *campesinos*, for example, were simply more primitive than Europeans, and would develop only via entry into a capitalist economy. Dependency theory, on the other hand, contested this view of a "natural" evolution, positing instead that underdevelopment was the result of economic relationships between developed and less-developed countries. Building on the work of Hans Singer and Raúl Prebisch, who observed deteriorating terms of trade for commodity exporting countries (Singer 1950; Prebisch 1950), Marxian and development economists helped to clarify the international division of labor, the exploitative relationship between colonial powers—the "core"—and their colonies—the "periphery"—(Gunder Frank 1966; Baran and Sweezy 1966), insights that would later inform world-systems theory (Wallerstein 1976).

children shall be fed, and the Black Panther Party will not let the malady of hunger keep our children down any longer. (*The Black Panther*, March 26, 1969, cited in Foner 2002, 168)

The breakfast program began in September 1968 at Saint Augustine's Church in West Oakland, and eventually expanded to include other meals.[66] It was operated out of local schools, churches, and community centers throughout the flatlands. Melvin Dickson administered the program at the BPP's Oakland Community School on International Boulevard at 61st Avenue in East Oakland from 1973 to 1982. The simple, unassuming building (which, ironically, lies in the shadow of the magnificent "City Beautiful" era brick and Spanish tile tower and warehouse complex built by Mutual Stores and later owned by Safeway), fed 200 children three meals a day. While local flatlands stores and businesses provided most of the food for the BPP programs, small gardens planted outside of the homes, offices, and schools of BPP members supplemented the meals overall with fresh produce, and served as educational spaces for children (see Figure 3.3). In an interview Dickson (2010) recalls,

> Anytime we had a facility that had the space, we'd put a little garden in the backyard so the children would have something… It grew as a matter of need… When Huey [Newton] got out of prison [in 1970], that's when we started getting facilities, little plots of land and that's when we got into the gardening. And so we was thinking about food, how it was an important need that we had, so if we had a plot of land, use it, and put some cabbage over there, or put some tomatoes over there and supplement the foods that we pulled in from donations.… I think that growing food on the land for the Black Panther Party came out of the need to have food, from poverty. It wasn't so much you was thinking nutrition. The nutrition part came later on when we got the school and the community.

As I describe in Chapter 1, urban agriculture in the Global North historically arose as a coping mechanism in times of economic hardship, a means of mitigating the "social rift" caused by integration into an urban economy based entirely on wage labor.[67] This phenomenon also explains the majority of urban agriculture practiced in the Global South today, as evidenced by the number of urban poor engaged in urban agriculture (Zezza and Tasciotti 2010). In the US, the heydays of urban agriculture coincided with the major crises of capital—the recessions of the 1870s, 1890s, and 1970s, the Great Depression, and during the two World Wars (which were crises of capital in their own right!) when families were strapped for resources and their purchasing power precariously limited (Lawson 2005; Moore 2006).

This is also the economic context in which cultivation in the Oakland flatlands took place in the late 1960s and early 1970s. The Panthers used gardening as a coping mechanism and means of supplementing their diets, as well as a means to strengthen community members engaged in a struggle against oppression. The agricultural knowledge of the previous generation was central to this. "We did come out the South, many of us. Huey's family come from the South. So did Bobby. Most of the members' families come out the South, so we had a tradition

[66] See Heynen (2009) on how the BPP program was so successful that it served as the model for the USDA's School Breakfast Program, scaled up from a series of pilot projects to a nationwide program in 1975.

[67] I say "historically" here to differentiate from the lifestyle politics that drives many people today to engage in urban agriculture as a means of overcoming "individual rift" as I describe in Chapter 1.

of growing food and gardening back there," Dickson (2010) explains. Melvin Dickson was from rural Arkansas, BPP Chief of Staff David Hilliard from Alabama, Seale from Texas, Newton from Louisiana. Even though they tapped cultural traditions and knowledge of their parents and grandparents to cultivate the devalued flatlands landscape, urban agriculture for the Panthers and others living in the flatlands at the time was no expression of lifestyle politics or celebration of an agrarian legacy. Dickson continues, "But it was not a movement. The movement at that time was consumerism… everybody wanted to go shop at Safeway… People coming from the farms and trying to get into the urban lifestyle" (ibid.). Indeed, urban agriculture for the BPP and its members arose from necessity.

Figure 3.3: A poster on display at the office of the Commemoration Committee for the Black Panther Party in Berkeley, CA, shows children eating breakfast (left) and gardening (right) at a BPP Community School in Oakland. The poster heading (not seen here) reads, "The World is Children's Classroom," and is followed with, "Our approach is that learning should be a full and ongoing experience" (right). Photos of the poster taken by the author, January 2010.

The BPP's foray into food justice arose in part from the relationships they cultivated with other radical "counterculture" groups. These interactions with groups of hippies, back-to-the-landers, and communards who *did* view agriculture as central to a shift in lifestyle politics, in turn, informed BPP understandings of health and nutrition. Dickson comments,

> People was making connection between health and nutrition and began to question the things we eat, you know, like white sugar. Part of our policy that we would stop cooking white rice, and to stop using white flour [laughs] and we start using whole grain and cut back on the red meats and start using fish, and cooking fish and poultry with less cholesterol. I was making soy burgers back in the '70s! We was making soy burgers but making it taste good! [laughs] You know, for the children! (ibid.)

The predominantly white hippie counterculture was “a key part of the vanguard of that alternative food movement” according to Dickson, “so we can’t take all the credit... They had a big influence on the party in terms of food and nutrition.” Indeed, the idea for the Free Breakfast Program actually arose from the Panthers interactions with the San Francisco Diggers, a communitarian anarchist group of artist-activists based in the Haight-Ashbury District.[68] Seeking to exist outside of the capitalist system, the Diggers provided free food to the public every afternoon in the Golden Gate Park Panhandle.[69] For the Diggers and other communards, growing food was central to existing outside of capitalist exchange, a means of reclaiming the means of production (Roth 2011).[70] Diggers founder Emmett Grogan frequently visited the BPP office in Oakland. In his autobiography David Hilliard recalls how the Diggers’ Free Food program in the Haight inspired the Panthers to develop their own version of it.

> One day, [Bobby Seale] enters the office after Emmett has left off bags of beans and rice. "Damn, this is a good idea," he says. "We should do this." "We are doing it," the officer of the day says. "No, we should establish it. Every day. A Free Food Program. Get contributions from the local businessmen and put together packages. Help people survive." And the Free Food Program starts. (Hilliard 2001, 181)

Not limited to inspiration alone, the counterculture also offered material support. A large portion of the produce that the BPP provided to flatlands residents came from not only the Diggers, but from other communards and other back-to-the-landers who wanted to support the radical ideals of the BPP. Dickson (2010) remembers:

> Many in that counter culture movement was always around the Party, and would always offer food and brought food to us that they grew.… We needed that food, and they knew we could use it!… They would bring us food, eggs and stuff, whatever they’d put out in their communes. That had an influence on the party. So it was a kind of symbiotic relationship that we had.…

This spirit of multi-racial coalition-building that linked the BPP to the Diggers and other radical counter culture groups would ultimately carry over into future movements in the flatlands.

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[68] The SF Diggers took their name from a 17th century radical movement in England led by Gerrard Winstanley and William Everard. Protesting the enclosure of the commons, the Diggers (or True Levellers) took over the wastelands of Saint George’s Hill, Surrey, in 1649 to establish an agrarian commune. They believed that the English Civil War and the execution of Charles I marked the defeat of the nobility and land owning aristocracy, and that land should be returned to the common folk. Their movement was crushed a year later and the commune cleared away (Hill 1972), an event memorialized centuries later by the 1974 folksong “The World Turned Upside Down”, written by Leon Rosselson and later popularized through versions by folk rockers Dick Gaughan and Billy Bragg. Like the original Diggers, the SF Diggers sought to do away with capitalist forms of exchange and revitalize the commons (Roth 2011).

[69] Members of the Diggers and the associated San Francisco Mime Troupe were instrumental in the creation of a large urban farm in 1974 at the intersection of Army, Portrero, and US Highway 101 near Bernal Heights in San Francisco. In addition to growing food, The Farm, as it was known, was home to over 70 farm animals, served as a community center, rehearsal space, classroom, and eventually a punk rock club before it was razed in 1987 to make way for La Raza Park, now called Portrero Del Sol Park (Blankenship 2011).

[70] While they grew some of the food themselves or procured it from rural communes, they also gave away donated or scavenged produce that could not sell in the supermarkets. It is unclear, however, how they justified or explained the contradiction that such giveaways were produced by the capitalist system they were renouncing.

Moreover, contemporary food justice activists are drawing on the history and symbolism of these radical roots. I argue that through this use of the BPP as symbolic and cultural capital, the food justice movement has been able to build alliances between across color and class lines, distinguishing itself while allying with the mostly white, less radical alternative food movement. I turn next to another movement that laid similar foundations for the food justice movement.

East Bay EJ

Two decades later, the environmental justice (EJ) movement in the East Bay arose in response to the disproportionate impact of toxics and air pollution on communities of color, particularly in the Oakland flatlands. Environmental contamination in Oakland followed the same spatial patterns as the poverty and racial segregation outlined in the previous chapter; the city's industry has always been concentrated in the flatlands next to the Bay and adjacent to the Port, has been the epicenter of these struggles over air quality. Asthma rates for children are seven times higher in West Oakland than in the rest of the state due to the concentration of diesel exhaust and industrial fumes. Indeed, in West Oakland in the early 2000s, per capita exposure to diesel particulate emissions was five times higher than other parts of the city, and industries there released more than seventeen tons of toxics annually, almost as much as had been released by the facilities in the rest of the city (Costa et al. 2002).

Poor people of color lacked the political clout to demand the enforced regulation of these industrial polluters. Furthermore, white, middle-class environmentalists tended to overlook "unnatural" urban areas, as they were more concerned with wilderness, open space, and the San Francisco Bay itself than the urban environments surrounding it (Anthony 2003; Duncan and Duncan 2004; Walker 2007).[71] Drawing on the toxics movement that gathered momentum in the early '80s in the American South, the EJ movement mobilized a multi-racial coalition of various groups focusing on toxics, land use, transportation, public health, and job safety to hold industry and local governments responsible for systematic discrimination (by intent or by outcome) against low-income communities of color (Gottlieb 1993; Anthony 2003; Bullard 2005; Pellow and Brulle 2005).

Since the late 1980s grassroots organizations in the East Bay, often with the help of local environmental think tanks and policy "intermediaries", have successfully fought polluters in the streets and courtrooms over the flatlands' soils and the skies above, demanding protection for the health of the area's residents. The campaign by People United for a Better Life in Oakland (PUEBLO) around the issue of lead poisoning, for example, won the creation of the Alameda County Lead Poisoning Prevention Program, which provides free lead screening. In another East Oakland case, a community group concerned with the health in the neighborhood surrounding Verdese Carter Park, the former site of a battery factory, successfully petitioned the EPA to force the factory's parent company to remove 17,000 tons of contaminated soil and remediate dozens of contaminated homes in the vicinity (EPA 2011). In the early 1990s, West Oakland residents, led by Chappell Hayes and the Clean Air Alternatives Program succeeded in forcing CalTrans to halt the rebuilding the Cypress Freeway through residential neighborhoods after its collapse in the 1989 Loma Prieta earthquake, and to re-site it through industrial areas (US DOT 2000). Later, a coalition of activists called West Oakland Neighbors was able to challenge the expansion of the Port of Oakland, winning the creation of waterfront green space and the re-

[71] On the origins of this dualism that equated "nature" with "wilderness", see Cronon (1996) and Smith (2008).

routing of diesel trucks (Gulick 2002).[72] In the early 2000s, the Chester Street Block Club Association and the Coalition for West Oakland Revitalization, working alongside Greenaction, succeeded in shutting down the Red Star Yeast factory, a facility that released over 33,000 tons of toxic emissions annually (Burt 2002; Costa et al. 2002; DeFao 2002). In East Oakland's Fruitvale District, the Coalition for Healthy Communities and Environmental Justice joined with PUEBLO, the Center for Environmental Health, and Greenaction, and triumphed in 2001 after a four-year battle to shut down the Integrated Environmental Systems medical waste incinerator which had been polluting since the early 1980s (Fischer 2001). While the movement against these industries was sometimes fractious (and at times, fractured) due to disagreements over potential job loss, the coalitions were ultimately strong

Unlike the Black Panther Party's Food Program, nothing about the EJ movement spoke directly to the issue of food access. What the EJ movement did provide, however, was training in the trenches for a generation of activists. It mobilized community members to act; victories cultivated a sense of empowerment and reclaimed a political voice that had been silenced by decades of flatlands devaluation, while failures underscored the importance of ongoing resistance.[73] The EJ movement also drew attention to the flatlands and to the injustices that have produced them as a social and ecological space. Importantly, the movement fostered and galvanized alliances between policy and research intermediaries and community-based organizations and neighborhood residents. Alliances such as these would be central to the success of the urban agriculture and food justice movement that was slowly beginning to coalesce in the flatlands at the same time.

Rethinking Urban Habitats (or, Carl and Karl)

A pivotal moment connecting EJ to what would become the food justice movement occurred around the same time and involved a theoretical shift in the way that struggles over race, poverty, and environment were framed. A new "spatial justice" framework (Pastor, Benner, and Matsuoka 2009) helped to highlight the interrelations between racial and economic segregation, built environment, and access to entitlements such as healthy food, clean air and water, and open space. This new theoretical framing was forged in large part through the efforts of Carl Anthony and Karl Linn. By the early 1990s Anthony had become a prominent voice in the Bay Area EJ movement. Like other EJ activists, he attempted to shift the attention of the

[72] In 2007 community activists working with the Pacific Institute's "Ditching Dirty Diesel" program pressured the Port to create a Comprehensive Truck Management Plan to address exhaust and traffic concerns. The Port released a plan in 2009 that EJ activists found unsatisfactory, and the fight is still underway (Booth 2009).

[73] A Polanyian analysis helps to situate Oakland's EJ movement within the explanatory logic of capitalism's "double movement". Flatlands activists mobilized to counter the social upheaval that arose when land, labor, and money were left to the unrestrained logic of the market (Polanyi 2001). Many of the true costs of production—diesel exhaust, toxic fumes and plumes—have been externalized, left off the balance sheets and instead internalized by the air, water, soil, and human bodies of the flatlands. Organizing in resistance to these industries that left "neighborhoods and landscapes defiled, rivers polluted" (76), Oakland's EJ activists cultivated a moral economy of mutual aid and alliance. By forcing the government to acknowledge the impact of pollution on public health in the flatlands, new regulations followed, forcing capital to reorganize; in short, their actions resulted in a partial re-embedding of social relations into the market. Contamination—like the unemployment, hunger, and physical violence that gave rise to the BPP—concentrated in the flatlands due to this process of demarcated devaluation, marked the "acute social dislocation" Polanyi described, and became rallying points for social change and a protective countermovement. The vision and energy of this movement would soon become central to the growth of urban agriculture in the flatlands.

mainstream environmental movement towards urban areas, and fought to overcome what he termed the "apartheid of consciousness"—the belief that social and environmental issues were somehow distinct—keeping inner-city people of color and white suburban environmentalists from joining forces to tackle environmental issues. Studying architecture at Columbia University in the 1960s while working as a civil rights activist on the side, Anthony began to think about the relationships between social justice and the built environment. He later became involved in the "community design" and "advocacy planning" movements, both of which emphasized moving the process of urban planning and design out of the hands of technocrats and into those of low-income communities (van Gelder 1999; Anthony 2003).

In the late 1980s, Carl Anthony reconnected with Karl Linn, a landscape architect who had led a long and productive life as a farmer, psychologist, landscape architect, and educator on three continents.[74] The two were old friends, having met in North Philadelphia in the early 1960s when Linn was teaching landscape architecture at the University of Pennsylvania. Through his "community design-and-build service education program" Linn and his students worked with community members in ramshackle neighborhoods and vacant lots throughout the city. He was later instrumental in the community gardening movement of the 1970s and was a founding member of the American Community Gardening Association (Linn 2005). Anthony (2003) credits Linn with giving him "some sense that you could actually put together a social agenda and an environmental design agenda" (30).

When Linn moved to Berkeley in 1986 upon his retirement, the two joined forces to expand awareness within the white environmental world of the issues of social, racial, and economic justice that were at the forefront of concern for people of color. The underlying structural conditions of the flatlands—the demarcated devaluation I described in the previous chapter—proved fertile ground in which a productive synthesis of the theories and activism of the two men could take root. Until this point, environmental groups, many of them located in the Bay Area, focused primarily on struggles to conserve wilderness areas at all costs, often conflating subsistence resource use by indigenous peoples with large-scale capitalist resource extraction. Linn urged Anthony (who was wary of the underlying and overt racism he had seen amongst white environmentalists in Berkeley over development issues surrounding the redevelopment of the 4th Street commercial district) to connect with David Brower and other white environmentalists, some of whom were supporting social justice struggles in the Global South. On Linn's urging Anthony joined the board of Brower's Earth Island Institute, provided that that he "could create a program that would really address the environmental issues from the perspective of social justice" (ibid., 30). In a 2003 oral history, Anthony remembers, "What we found was that every environmental issue was also a social justice issue. As we began to get into it, we could see the connections … We had to have more of a sense that these issues have to be together" (ibid., 32). In 1989 Urban Habitat was born.

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[74] Linn's worldview was deeply influenced by his upbringing and early experiences. He was born in Germany in 1923 to Jewish parents: a Belorussian Zionist father and a "acculturated" German mother who, inspired by her coterie of socialists, humanists, and feminists, gave up a successful financial career to start a farm north of Berlin. Linn was deeply influenced by his early life there. With the rise of the Nazis, Linn's family fled to Palestine, where Linn managed his family's modest farm, studied agriculture, and founded a kibbutz. Disenchanted with the chauvinism of Israeli nationalism, he turned to Trotskyism. He later moved to Switzerland to study psychology and finally to the US. He eventually studied landscape architecture and joined the faculty of the University of Pennsylvania, where his attention to social justice and community participation riled his superiors but won him the respect of his colleagues and the communities with whom he worked.

Unique in its focus on the urban environment and domestic social justice concerns, the program grew quickly with the influx of funding, notably philanthropic endowments such as the San Francisco Foundation. It grew to become the Earth Island Institute's second largest program, before finally separating from the Earth Island Institute and becoming an autonomous organization in 1997.[75] In developing the project's magazine, *Race, Poverty & Environment*, Anthony and Urban Habitat networked with the national EJ movement, leading a delegation to the First People of Color Environmental Leadership Summit in 1991. Throughout the 1990s, Urban Habitat tried to push the EJ movement beyond its primary emphasis on toxics by focusing on broader structural discussions about the built environment and urban sustainability. Anthony recalls,

> Partly because of my own personal training as an architect and an urban planner, I've been saying, "We're concerned with not only the siting of hazardous waste, we're concerned with the siting of everything—schools, grocery stores, parks, prisons, universities, freeways." The basic argument that I try to put forward is that the siting of these facilities is a symptom and a symbol of a much bigger problem. It has to do with the lack of capacity in these communities to actually shape the environment in ways that sustain them and in ways that are ecologically sound… We've tried to take a constructive role … by saying, "The environmental justice movement needs a larger conception of the environment, and it needs a larger conception of justice." (Anthony 2003, 70-71)

As Pastor, Benner, and Matsuoka (2009) explain, Urban Habitat pioneered the use of the "flatlands framework" to illuminate the inequities between the affluent white populations living in the East Bay hills, surrounded by a network of regional parks and views of the Bay, and the low-income populations living below in concrete flatlands, surrounded by toxic soil, water, and air.[76] They write, "a spatial justice agenda was essentially filling in for a racial (or, more appropriately, multiracial) agenda" (69). Indeed, the multiracial agenda of low-income blacks, Asians, and Latinos was likely threatening to whites and could have been written off as "race politics". By framing their struggles spatially, EJ and social justice activists were able to consolidate struggles about poverty, race, health, and environment into a uniform theory that was perhaps more tenable for white allies, if for no other reason than the disparities between the flatlands and hills were (and continue to be) so strikingly visible. Adopting a flatlands framework therefore allowed activists to expand both their spaces of dependence (from a particular neighborhood in East or West Oakland, Berkeley, or Richmond, to a larger territory defined simply as the flatlands) *and* their spaces of engagement by connecting with white liberal environmentalists at regional and national levels, along with municipal planners and public health officials.

This way of framing environmental issues in the Bay Area would become central to strategies of both the growing EJ movement (in part due to Urban Habitat's advocacy) and the food justice movement that was to follow. Indeed, Urban Habitat's work helped to integrate discussions of the built environment and urban planning and design into the EJ movement's primary concerns over the siting of toxic facilities. At the same time, it was able to bring urban concerns to the attention of mainstream environmentalists and concern over equity to an

[75] For more on this separation, which arose from the ongoing resistance of the organization's white environmentalists to think critically about race and social justice, see Anthony (2003, 58-62).

[76] See Figure 3.2 for the disproportionate concentration of open space and parks in the hills.

otherwise design- and economic development-oriented field of urban planning and community development. Linn had spent years developing community gardens and "neighborhood commons" and was interested in continuing this work under the auspices of Urban Habitat. He and Anthony then formed the People of Color Greening Network in order to facilitate the fusion of social justice with landscaping and community gardening by highlighting the lack of safe, green spaces in the flatlands and working with community members to transform weedy vacant lots strewn with garbage into verdant gardens and community spaces. As I explain in the next section, members of this network would play a central role in the rise of urban agriculture and food justice in 1990s.

2. Sowing Seeds

At the same time as the environmental justice movement and Urban Habitat were gaining steam, urban gardening was enjoying renewed popularity throughout the Bay Area. As I detail below, various gardening initiatives that were taking place in Oakland and the Bay Area in the 1990s slowly began to grow together into today's flourishing food justice-oriented urban agriculture movement. Tapping into the 1970s community gardening movement that remained active in Berkeley, a newer, more radical group of gardeners drawing on Urban Habitat's vision of integrating environmentalism and social justice began to redefine urban agriculture in the Bay Area. A push for school gardens brought new sources of funding to urban agriculture and the area's many opportunities for formal training in agriculture provided it with a growing legion of inspired youth with technical skills. Finally, large immigrant populations in the flatlands both inspired and facilitated the spread of urban agriculture programs to schools and community gardens.

Breaking Ground

The buzz in the 1990s around urban gardens didn't just appear out of nowhere. Community gardens have been scattered across the dense urban fabric of Oakland, Berkeley, and San Francisco at least since the last major wave of community gardening swept through the nation in the 1970s. It was at that time that urban gardeners, inspired by a back-to-the-land ethic, environmentalism, and hippie counterculture, responded to the era's economic crisis and urban decline by transforming vacant lots into lush oases, supported by USDA and municipal programs, and taking advantage of a slump in land values and construction (Warner 1987; Schmelzkopf 1995; Von Hassel 2002; Lawson 2005; Blankenship 2011). Due in part to the dominant left-leaning culture of the Bay Area, and to the visibility of the counter-culture, community gardens took off during this period as an expression of a new lifestyle politics rooted in environmentalism. Helga and William Olkowski's *The City People's Book of Raising Food* was published in the late 1970s, drawing on the couple's experiences as urban homesteaders in Berkeley and providing urban back-to-the-landers with the necessary basics to live sustainably and off the grid before such catchphrases entered mainstream discourse (Olkowski and Olkowski 1977). The following year they published *The Integral Urban House: Self Reliant Living in the*

City which detailed their efforts to create a closed nutrient cycle by growing their food and recycling waste on an eighth-acre lot (Javits et al. 2008).[77]

In Oakland, a network of community gardens was folded into the city's Parks and Recreation Department in the late 1970s, and by 1978 the city had a community garden coordinator, Jacoba van Steneren, who would remain in her position for the next twenty-seven years. Across the Bay, Pam Peirce started up the San Francisco League of Urban Gardeners (SLUG) in 1983 "with the primary intention of providing land security, structure, and horticultural education to community gardeners in San Francisco" following the de-funding of the city's community gardening program (see also Lawson 2005; Pudup 2010; Peirce 2011), one of many cuts to public expenditures that have defined the urban political economy in the neoliberal era (Fainstein et al. 1986). Many of the gardens created during this heyday continue to provide Bay Area green thumbs with a year-round bounty of fresh produce.

The rise of California cuisine in North Berkeley's Gourmet Ghetto, with its emphasis on seasonal, locally grown, organic produce, also influenced urban growers in the area. Around 1982 Chez Panisse chef Jean-Pierre Moulle began incorporating a French *potager*, or kitchen garden, into the restaurant's fare and began buying arugula from a woman a few blocks away. Kitchen staff at Chez Panisse tended a small 200 square-foot garden as part of their work shifts. Alice Waters sent people up to study bio-intensive farming with a few hours north of Berkeley. They also began seriously to consider investing in land for a farm that would be vertically integrated into the restaurant (Kraus 2011). Kona Kai Farms Market Garden, a half-acre spot in an industrial neighborhood at Fifth Street and Hearst in Berkeley, began selling produce to Chez Panisse and other high-end restaurants in the Bay Area in 1986 (Green 1993).

These linkages between California cuisine, urban gardens, and the incipient sustainable agriculture movement in the Bay Area's hinterlands were essential to the development of the urban agriculture movement in Berkeley and Oakland. The Bay Area was a veritable geographic agglomeration of social change activism, both a central node in the American environmental movement (Walker 2007; Gottlieb 1993) and rallying ground for farmworker rights campaigns (Shaw 2008). Environmental, social justice, and public health activists found a common nemesis in the Central Valley's industrial agriculture and its toxic externalities.[78] Nevertheless, even though large numbers of hippies headed for communes in the hinterlands (Roth 2011), "back-to-the-land" communitarianism as an alternative wasn't for everyone. California cuisine, with its freshness and seasonality, linked the taste buds of affluent urban consumers to the hinterlands in a visceral way. "Urban homesteading" allowed city dwellers embrace an anti-consumerist agrarian vision without abandoning the fruits of the progressive culture that defined the Bay Area metropolis. Local, sustainable food production and the consumption of its products served as common ground for the environmentally-minded and connoisseurs of fine cuisine. While California cuisine and its more recent "foodie" incarnations, such as the Slow Food and "locavore" movements, have been critiqued for being elitist and bourgeois and for blindly emphasizing "local" as a bottom line (Born and Purcell 2006; Guthman 2008b; Allen 2010; DeLind 2010), they have nevertheless served as an entry point for many Bay Area food systems activists. Urban gardens, after all, are as local as one can get for those living in the city.

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[77] These forays into urban sustainability were clearly an attempt to mend both ecological and individual manifestations of metabolic rift, as I describe them in Chapter 1.

[78] On the rise of the sustainable agriculture movement in California, see Allen et al. (2003), Guthman (2004), and Walker (2005b). For broader histories of sustainable agriculture, see Lyson (2004), Allen and Sachs (1993), and Allen (2004).

Radical Radicles

As people continued to turn their compost piles and prep their garden beds in the Bay Area's community gardens, something more radical began to take root in the early 1990s. In May 1992 the Center for Urban Education About Sustainable Agriculture (CUESA) organized the East Bay Community Gardening and Greening Conference in Berkeley's Tilden Park. This event marked one of the key moments when the urban EJ movement converged with the high-end foodie culture of Berkeley's so-called Gourmet Ghetto and the Bay Area's mostly white community gardening crowd. Funded by the San Francisco Foundation, which was increasingly interested in social justice thanks to the work of its star recipient, Urban Habitat, the conference heavily emphasized social justice. This ultimately helped to seed the discourse of the gardening movement (replete with its language of "fresh, healthy, local, ecological, sustainable") with notions of equity. Speakers included not only foodies such as Alice Waters, but also activists such as Urban Habitat's Carl Anthony and Cathrine Sneed, whose Garden Project in San Francisco provided job training and support for former inmates.[79] A 15-page East Bay Community Gardening and Greening Coalition Resource Directory that mapped area gardens and organizations was published in conjunction with the event. Over the next few years, CUESA published maps, guides, and directories that bridged these different movements, and organized annual Open Garden Day tours around the Bay Area (Kraus 2011). This mapping of urban agriculture activity signaled the protean institutionalization of urban agriculture as a movement, rendering these garden spaces legible—and legitimate—in the eyes of funders and local government, whose support, in turn, was necessary to foster further movement building.

The People of Color Greening Network (PCGN), the Urban Habitat project that Linn and Anthony created, began to take a more prominent role in the new hybrid movement. It was actively involved in the 1992 conference due, in part, to the San Francisco Foundation's growing interest in EJ. Linn (2005) remembers,

> Some of us also participated in community gardening conferences that were staged in the East Bay by [CUESA director] Sibella Kraus. She asked me to involve people of color because the San Francisco Foundation insisted that they would only help finance the conference if the organizers also involved people of color. (181-182)

David Ralston, a young architect and planner, was invited by the group's founders to join the PCGN. He recalls the origins of the group and ponders its theoretical orientation:

> I don't know why I gravitated towards it but I did see a role for open space and gardens and food production as part of the city… We were coming out of EJ movement. It was talking about communities of color and the whole connection to the environment. People like Carl Anthony were trying to connect the social justice movement with the EJ movement so it was all connected to that whole thing. I imagine, too, at that time, '92, that whole Rio Earth Summit was going on. So that was probably in the air, stuff that I wasn't even fully connected to at the time. But … the issue of connecting environmentalism to urban issues was starting to be the push. (Ralston 2009)

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[79] On Sneed's work, see Pudup (2007), Sneed (2000), and Van Cleef (2002).

The PCGN helped to bridge various urban greening initiatives run by people of color throughout the Bay Area. They led workshops on urban gardening and presented on panels at various conferences (Linn 2005).

A key member of the PCGN was Mohammed Nuru, a British landscape architect of Nigerian origin. Nuru was an original member of the association and helped to channel Urban Habitat/PCGN's vision of urban environmental justice into community gardening efforts in San Francisco. Linn, who was on SLUG's volunteer Board of Directors alongside Pam Peirce, advocated for Nuru to be hired to take over the organization. According to Peirce (2011), SLUG had always tried to integrate social justice and gardening: "From the beginning we fostered employment readiness and training among at risk populations because we needed construction teams to build and improve gardens. We felt that training and employment were good purposes we could serve while getting the work done" (ibid.). Under Nuru, however, SLUG scaled up the job training component and foregrounded the organization's social justice orientation. In early 1994 SLUG, working in collaboration with City College and the SF Housing Authority, combined urban agriculture with a job training program for 26 residents from the nearby Alemany and Portrero housing projects. The Community Farming Project trainees began to slowly transform the unkempt St. Mary's Park, a dumping ground tucked between the 280 freeway and a steep hillside in the park, into a three acre farm. The next summer, the SLUG's Youth Garden Interns broke ground for St. Mary's Urban Youth Farm. In honor of the event, Mayor Frank Jordan proclaimed July 7th SLUG Day. One of the interns, Bhanica Adams, spoke at the event and emphasized the importance of providing local youth with employment opportunities: "We're not selling drugs like we used to, we're not dead like we're supposed to be, and we're not in jail like we should be" (quoted in Bicho and Nuru 1995, 5). The organization's success cannot be attributed to Nuru alone, but also to his staff, an interracial group of young women and men, who were phenomenal when it came to fundraising and program development (Brahinsky 2011) and by 2000 SLUG had a budget of two million dollars (Feenstra, McGrew, and Campbell 1999; Lawson 2005; Pudup 2010). Again, the influx of public and private funding and partnership with governmental entities marked a growing legitimacy for urban agriculture in the eyes of the state.[80]

Building on SLUG's successes in San Francisco, Nuru, Linn, and other PCGN members joined with Tom Branca of the Merritt College Landscape Horticulture Program to create East Bay Urban Gardeners (EBUG), which was briefly the primary organization coordinating urban agriculture in Oakland outside of the Parks and Rec Community Gardening Program. According to Ralston, who eventually ran EBUG in 1998 and '99, EBUG was a marriage of the 1970s and 1980s community gardening "old timers" such as Branca and the new PCGN activists who together revitalized a few older gardens and open spaces:

> We did take over some of the land trust sites and worked with some of the old timers—the original board members [of EBUG] were the old timers. The 12th and Center site, the Pippin site out here in East Oakland, those were the two ones, and I think Jungle Hill [in the Allendale neighborhood], we started doing some plans for. … And then there's the Lakeside Demonstration Garden. The city made that land available for all those groups to

[80] Indeed, this growing legitimacy coincides with the neoliberal rollout of non-profits as primary providers of social welfare, so called "flanking institutions" (Brenner and Theodore 2002; Jessop 2002; Peck and Tickell 2002; Castree 2008).

> come in there to do a demonstration garden. And we were one of those groups that came in there. So that gave us a focus. (Ralston 2009)

Ultimately, EBUG only worked at this small handful of sites around Oakland. Nevertheless, their activity represented the growing emphasis on social justice among urban agriculture practitioners in the Bay Area.

Gardening for Community Food Security

Most of the justice-oriented urban agriculture efforts cropping up at the time were concentrated in flatlands of southwest Berkeley just across the city limits from Oakland. The majority of these projects pushed the boundaries of conventional community gardening by emphasizing youth employment and food security. These efforts, which predominantly employed young African Americans, helped to increase the involvement of people of color in urban agriculture. Shyaam Shabaka, a PCGN member and co-founder of EBUG, and Melody Ermachild Chavis, a white neighborhood activist, founded Strong Roots in 1994. Shabaka had spent time working on a horticulture project in Mali and hoped to reconnect African Americans with "the lost agricultural heritage that's rightfully ours" (quoted in Chavis 1997). The Strong Roots motto was "Gardening for Survival" and employed fourteen youth at six gardens throughout Berkeley, including at a vacant lot at the corner of Sacramento Ave. and Woolsey St. that was home to drug deals and drive-by shootings. Funding came in part from the federal Summer Youth Employment and Training Program before it was axed by the 1995 budget under Newt Gingrich's Contract for America. Other funding came from a federal substance abuse prevention program (Chavis 1997; Lawson 2005).

A host of similar programs cropped up at the same time, focusing on youth employment and training. Berkeley Youth Alternatives (BYA) Director Niculia Williams and UC Berkeley Landscape Architecture student Laura Lawson started the BYA Garden Patch as an alternative to the fast food breakfasts that most of the children attending BYA's programs were eating. In 1994 the garden was established with the labor of community members, AmeriCorps and East Bay Conservation Corps volunteers, and UC Berkeley students. Through the '90s it grew to include community garden plots and a Youth Market Garden that provides youth with employment and on-the-job training and the organization with revenue. By 1998 the Youth Market Garden had earned more than $10,000 in sales. Cut flower sales added to revenue, as did a twenty-five member sliding scale CSA (Feenstra, McGrew, and Campbell 1999; Lawson 2005, 274-280).

In 1993, the same year as the BYA Garden Patch was planned, Spiral Gardens was created "by a handful of individuals dedicated to urban greening, innovative organic farming methods, food security, and environmental justice issues" on Sacramento Avenue in South Berkeley, across the street from the Strong Roots garden (Spiral Gardens 2011). A project of the Agape Foundation for Nonviolent Social Change, the organization grew vegetables, herbs, and native plants for sale, in addition to offering community gardening plots and horticulture workshops. One of the founders, Daniel Miller, also ran the Urban Gardening Institute, a garden-based job training and microenterprise program for people enrolled in a drug rehabilitation program and transitioning from homelessness. The program was run through Building Opportunities through Self-Sufficiency at several homeless shelters, residential hotels, and community gardens. The two programs merged in 1997 and in 2004 became a 501(c)(3) non-profit called the Spiral Gardens Community Food Security Project (ibid.).

Berkeley's justice-oriented urban agriculture activists also gained inspiration and material support from a growing national movement that brought together anti-hunger, sustainable agriculture, farm labor, environmental, and health and nutrition activists (Gottlieb and Joshi 2010, 83-84). In the summer of 1994, the Community Food Security Coalition (CFSC) formed and drafted their equity-based vision for integration into the Farm Bill. While most of their recommendations failed under a Republican-controlled Congress, the 1996 Farm Bill included a provision to provide annual funding for projects that would "meet the needs of low-income people, increase the self-reliance of communities in providing for their own needs; and promote comprehensive responses to local food, farm, and nutrition issues" (USDA, cited in Gottlieb and Joshi 2010, 197). These Community Food Project Grants would play a role in the East Bay over the next decade, some destined for school gardens, others to developing local community food security gardens. Alliances with CFSC activists also helped to galvanize the fledgling justice-oriented urban agriculture movement by linking activists in the East Bay to a larger national network that shared ideas, information, and other resources through newsletters, conferences, working papers, small grants, and email list-serves, once again opening up new spaces of engagement to defend spaces of dependence, first in Berkeley's flatlands and later in Oakland.

Berkeley essentially served as a hub of urban agriculture innovation, attracting activists and organizations that were, in turn, able to marshal public and private funding necessary to sustain the equity-oriented urban agriculture activity. Many of the same people working on projects in Berkeley later became involved in Oakland. Indeed, the food security and youth employment projects in South Berkeley were mere blocks from the boundary of North Oakland. Many of the young activists involved in urban agriculture at the time actually lived in Oakland where rent was cheaper. One former activist working in one of the South Berkeley gardens blames changes in rent control in Berkeley for his move to West Oakland in the mid '90s; in 1995 the passage of a state law, AB 1164, allowed landlords in Berkeley to raise rents when units became vacant and many young activists were simply priced out of Berkeley.

One activist who helped transition justice-oriented urban agriculture across the city boundary was Grey Kolevzon, a white urban agriculture activist who has helped develop as many as thirty school and community gardens in Oakland since the late 1990s. After working as a tutor at an elementary school in East Oakland's Lower San Antonio district, Kolevzon worked for the National Parks Service for a couple of years before moving back to the Bay Area in 1995 to work for Spiral Gardens (Kolevzon 2011). His time away from the city inspired left him to devote his life to helping urban communities reconnect to the environment through agriculture:

> It was living there [in the Parks] that I realized that a lot of my life was going to be about connecting more deeply to nature (and helping others to do so), but for me, as a city dweller, that meant growing food in public places, because at some level I realized food is at the heart of the relationships between land and human communities. That was because my grandparents were small-scale subsistence farmers in the South, and I spent time there as a youth, and it was when I was there that I really understood for the first time that the world was "alive"… I decided I wanted to learn how to garden, in a community setting, on public/unused urban lands, and sought out Spiral Gardens—they were the people doing what I really wanted to do... (ibid.)

During this period, Kolevzon lived in various neighborhoods throughout the Oakland flatlands. After working with the two Berkeley projects, he then devoted his time to working with the public schools in these neighborhoods, either as a garden instructor or leading field trips on bicycles. Working alongside fellow educators and community activists in Oakland, he helped to lay the groundwork for the same kinds of programs that were cropping up all over Berkeley.

This work was not easy, however. Justice-oriented gardening initiatives were slower to take root in Oakland. While the community food security projects in Berkeley were in full force, The City of Oakland's community gardening program and EBUG were the only groups visibly active in the city. EBUG's reach was limited and they never got off the ground in the same way that SLUG was able to across the Bay. In his oral history, Linn (2005) remembers, "Despite good intentions and endless meetings, EBUG only got involved in a few projects in Oakland and wasn't able to sustain its efforts" (182). A lack of coordination led to a lot of duplication of ideas and programs, some stepping on toes for funding and garden space, and difficulties in trying to coordinate the initiatives. Sibella Kraus, organizer of the 1992 gardening conference, remembers, "You know, it got a bit territorial… There were already sort of disparate groups. It was hard to cohere. It just seemed that there were already people doing various individual things" (Kraus 2011). There were also tensions between people engaged in urban agriculture for recreational purposes and those who wanted to use urban agriculture an avenue for food security and social justice. Gardeners in Oakland, predominantly white middle-aged middle-class folks, were "sticks in the mud compared to folks in Berkeley," one former Berkeley garden activist remembers. He continues:

> The Oakland community gardeners, they had their own thing going. There was no drive to take over the food system like we did. It was just recreational gardening, they had a good program, but that was that. They weren't trying to take over vacant lots and do what we were doing.

Another prominent justice-oriented urban agriculture activist involved in the movement at the time was less diplomatic when I mentioned this assessment of the divide between community gardening and food justice urban agriculture.[81] He stated flatly, "No, the Oakland Community Gardening Program people actually *actively resisted* what we were doing. They didn't want us doing anything there." This tension speaks not only to the territoriality that likely arose from competition over funding and space, but also to the collision of two different urban agriculture paradigms. With its emphasis on social justice and job creation, the community food security movement envisioned urban agriculture as more than the recreational spaces cultivated by the green lifestyle-oriented community gardening paradigm.

Apart from the vibrant work underway in Berkeley, the smattering of gardens across Oakland remained largely recreational until the early 2000s, due in part to what appears to be a turf scuffle, as much over access to material resources—garden plots, vacant lots, funding—as over an ideology of what Oakland's gardens should be used for. These tensions did not run along racial or class lines, however. Apart from the PCGN/EBUG activists, most of the justice-oriented food security urban agriculture activists were young middle-class whites, but their vision, however, was one steeped in the radical spatial justice logic espoused by the PCGN/EBUG activists. As with the Panthers and EJ movement, these multiracial alliances were fundamental to the spread and institutionalization of urban agriculture. The growth of school gardens would help give justice-oriented urban agriculture initiatives a shot in the arm while increasing their profile in the eyes of the mainstream.

[81] I have kept both these individuals anonymous upon their request.

A Garden in Every School

By the early 1990s several school gardens had sprouted up. A few of these were in Oakland, but like the community gardens, the nexus of school gardening activity in the Bay Area was in Berkeley. Ground was broken at Willard Middle and LeConte and Malcolm X Elementary Schools. These new gardens were by no means the first in Berkeley's history. A 1918 history of Berkeley's public schools dedicates a short chapter to the school gardens that were used to "provid[e] vital contact with the facts and forces of nature" and "to teach children order, industry, respect for labor, and thrift, besides a love and sympathy for the wonderful and beautiful" (Waterman 1918, 115).[82] While the emphasis three-quarters of a century later was perhaps less about industry, labor, and thrift, fostering a love for nature was surely still on the agenda. Perhaps new to the garden-based curriculum was an emphasis on nutrition.

In March 1997, another CUESA conference helped to galvanize the importance of urban gardens in the East Bay as well as draw national attention—and funding—to the area's fledgling school garden initiatives. Like the previous conference that helped bring an emphasis on social justice into the urban agriculture discourse, this event helped to emphasize the linkages between urban agriculture and nutrition. Held at MLK Middle School, "A Garden in Every School: Cultivating a Sense of Season and Place" was intended to cultivate a vision of fresh and nutritious food for all school children, and brought school system officials, teachers, planners, and gardeners under the same roof. CUESA Director Sibella Kraus recalls, "The thinking was that a high end farmers market in San Francisco is making a difference to some people, but not to others…. We thought we'd maybe get thirty people or fifty, but we got 900 people! It completely sold out. People were just really ready for it to happen" (Kraus 2011). The event coincided with the establishment of the Edible Schoolyard at the school. Founded by Chez Panisse's owner Alice Waters, the Edible Schoolyard incorporates garden- and cooking-based education, connecting fresh food to healthy lunches. The program has been widely lauded and replicated (albeit at much more modest scales) nationally, and has become a model for revamping the school food system.[83]

The parents of school children were also central to the expansion of school gardens, and urban agriculture more broadly. Beebo Turman, a pre-school teacher, parent, and backyard gardener met with Alice Waters and "six or eight other parents" at a Parent-Teacher Association meeting at King Middle School in 1993 and began organizing, writing grants, and fundraising to get the Edible Schoolyard up and running. In January 1995, she joined forces with several other urban agriculture activists in Berkeley, including Karl Linn, Yolanda Huang who was in charge of Berkeley's school garden program, Melody Ermachild Chavis and Shyaam Shabaka of Strong Roots, Daniel Miller of Spiral Gardens, Ecology Center staff member Clem Clay, and Patrick Archie (whose RISE Urban Farm project at the Gill Tract I discuss in the next section). The group founded the Berkeley Community Gardening Collaborative (BCGC) to share resources such as tools and compost. Turman (2011) explains, "The driving force was us all working land in our own little bailiwick, but [we felt], 'Wouldn't it be helpful if we all joined forces?'" In addition to the material benefits, the organization also served to unite the disparate groups into a

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[82] At Hawthorne, Edison, Jefferson, and Franklin schools, gardens were located on school grounds. At Whittier, Washington, Emerson, Hillside, and LeConte schools, gardens were built on nearby vacant lots.

[83] The project is not without its critics, both on the ground and within the ivory tower. Critics see the program as non-replicable outside of affluent communities due to the sheer amount of financing it receives from the Chez Panisse Foundation (Pudup 2008; Guthman 2007a).

politically legitimate entity, facilitating access to city land and city liability insurance (Archie 2011). The BCGC got a small grant for tools, and eventually a grant to pay for a part-time director. Turman took over this role in 1998, and seeing that the Willard and LeConte schools were struggling, began to work with Huang and the California Nutriton Network to obtain funding for gardening and cooking teacher salaries at six Berkeley schools. The state chipped in shortly thereafter. Turman remembers, "Sacramento said, 'Here's a million dollars for more schools.' Move over Edible Schoolyard! Next year we had ten schools" (Turman 2011).[84]

Indeed, the successful expansion of school gardens and garden-based education in Berkeley can be traced in large part to this inflow of funding, from Berkeley's white upper-middle class of "foodies", money from private foundations such as the Chez Panisse Foundation and the California Endowment, and public assistance from programs such as the California Department of Public Health's Network for a Healthy California. As in the early part of the 20th century, school gardens blossomed across California in the 1990s and 2000s due largely to this mix of public and private funding. So successful was the Edible Schoolyard and the campaign by the BCGC, Ecology Center, and Chez Panisse Foundation that in 2000 Berkeley voters overwhelmingly passed a $116 million bond measure that included improvements to the public school food system and that would allow for more on-site fresh food preparation.

Surprisingly, given the systematic gutting of public funding in California (Walker 1995; Schrag 2004; Walker 2010), a series of state programs has been key to the spread of urban gardens in California's schools. The Garden in Every School Initiative was started in 1994 through the Nutrition Services Division of the California Department of Education. At the time, about 1,000 of 8,000 public schools statewide had school gardens. More than a third of the state's schools participated in the initiative, and a series of legislative acts at the state level helped to cultivate these projects in the mid- to late '90s: Assembly Bill (AB) 1014 (Instructional School Gardens) in 1999, Senate Bill 19 (The Pupil Health, Nutrition, and Achievement Act) in 2001, and AB 1634 (Nutrition Education) in 2002. By 2003 around 3,000 of 9,100 schools in California had gardens, most in elementary schools. In 2006 the State Assembly passed AB 1535, the California Instructional School Garden Program, a $15 million program that guaranteed every school in California between $2,500 and $5,000 to promote, develop, and sustain instructional school gardens (CDE 2011). The program was supported in Oakland with the help of Alameda County Cooperative Extension through the Food Stamp Nutrition Education Program in collaboration with the Master Gardener Program, a USDA funded program developed in the 1970s to train city-dwellers in horticulture.[85] By 2009 gardens had been established at 113 schools in Oakland (see Figure 3.4), nearly double the number of gardens in 2006. Indeed, nearly three-quarters of the city's school gardens were implemented or maintained using California Department of Education Instructional Garden grants made available under AB 1535 (Farfan-Ramirez et al. 2010).

While justice-oriented urban agriculture had failed to take root in Oakland in the mid 1990s, funding for school gardens began to flow into the city during the last few years of the millennium thanks in large part to the energy across the city line in Berkeley. In addition to the influx of funding for school gardens, the East Bay was ripe with young activists eager to get their hands dirty. Many of the activists got their start in the school gardens and community food

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[84] The BCGC also helped to get a USDA Community Food Project grant that allowed activists to form the Berkeley Food Policy Council, an organization that pushed for the inclusion of urban agriculture and sustainable food systems in the city's general plan.

[85] Alameda County's Master Gardener program has been in existence since 1981.

security project gardens in Berkeley before spreading southward into Oakland. As I discuss next, many also received some level of formal training in agriculture at one of the many institutions in the Bay Area.

Figure 3.4: School gardens in Oakland and environs (map by the author, in Farfan-Ramirez et al. 2010)

School-Grown Activists

The role of formal education in cultivating the urban agriculture movement in the Bay Area cannot be understated. Home to the University of California (UC) Berkeley, Stanford, three Cal State Universities, several private universities and colleges, and numerous community and technical colleges, the Bay Area has been a magnet for progressive youth, many of whom have formed the backbone of urban agriculture movement in Oakland. Students from UC Berkeley were central to the rise of urban agriculture in the East Bay. In 1971 Berkeley students started a small organic garden at the corner of Virginia and Walnut Streets as a student-initiated class project for the new Introduction to Interdisciplinary Studies course. The project evolved into to a course called Urban Garden Ecosystems that provided students with hands-on experience in the garden (Archie 2010). Many of these students went on to work with the growing number of urban agriculture projects sprouting up around Berkeley. Professor Miguel Altieri's highly popular Agroecology course—equal parts biophysical science and critique of industrial agri-food system—steadily spawned a growing contingent of sustainable agriculture activists and scholars throughout the 1990s and 2000s.

One UC Berkeley graduate who was particularly instrumental to linking various organizations and community members was Patrick Archie. Inspired first by his Urban Garden Ecosystems class project of establishing a garden for the homeless and then by his post-graduation work on sustainable farms in Latin America, he returned to Berkeley intent on using urban agriculture as a lever of community economic development, creating jobs through food production. In 1995, Archie, who had been active with EJ campaigns in the East Bay and Central Valley during college, sought out a radical organization of color, the East Bay Asian Youth Center (EBAYC) to partner with in order to establish a youth employment project at the Gill Tract, the abandoned UC Cooperative Extension (UCCE) Experimental Station on the Berkeley-Albany border. "Lots of folks got into food through EJ. We were active with EJ and interested in economic justice… Food and ag was a way to create jobs" (Archie 2011).

At first, UC administration was cool to the idea. Archie explains, "A vice dean warned me, 'The kids will get shot, the buildings will get burnt down, or someone will eat a head of lettuce, get sick, and sue the University for a million dollars'" (ibid.). Despite the initial resistance at the university level, he was able to secure a 3-year memorandum of understanding from higher up the chain of command, the head of the Division of Agriculture and Natural Resources, and secure Community Development Block Grant and Summer Youth Employment and Training Program funding. The 3-acre RISE Urban Farm employed youth through AmeriCorps, the East Bay Conservation Corps, and UCCE's 4H program and sold cut flowers and dry farmed tomatoes to local markets, and in the second and third years, provided food for thirty local low-income families through a CSA program (Feenstra, McGrew, and Campbell 1999; Archie 2011). In Summer 1997, EBAYC sponsored a "Summer Urban Agricultural School" for junior high students at the Gill Tract.

> It was off the hook! This radical multicultural youth development program teaching urban agriculture at the Gill Tract! We had two Muslim brothers, an African American woman, we had Grey [Kolevzon]… a whole group of twenty-somethings sitting around, coming up with this urban agriculture curriculum for junior high kids! And urban agriculture meant everything! There were units on sunshine, units on water, units on justice… (Archie 2011)

Ironically, the success of the program ultimately led to its downfall. The farm attracted the attention of Food First, a radical food policy think tank based in Oakland, which gathered together a loose coalition of thirty non-profits and individuals intent on turning the Gill Tract into a center for sustainable urban agriculture and food systems. This group, the Bay Area Coalition for Urban Agriculture (BACUA), proposed that the center be a joint community/university partnership and home to cutting edge research on urban agriculture, provide extension and outreach to the public, host a farmers market and community garden plots, and unite non-profits working in food and nutrition security, sustainable urban design, and environmental work. The social justice and food security component of their vision was explicit, but did not eclipse an emphasis on more practical—and politically safer—issues such as training in organic farming techniques and research on local food systems (BACUA 1997).

The proposal was submitted to UC College of Natural Resources in February 1997 and received a frosty response, in no small part due to the BACUA's adversarial stance in statements to the press. The idea of a motley assortment of community groups occupying prime real estate was perhaps too much for the University to handle, and the political language of social equity too much a liability. Archie was warned by a UCCE staffer not to use the word "community" in conjunction with the program because it sounded too radical, no doubt a difficult order to follow when the farm was running a CSA.[86] By fall of 1997, "the writing was on the wall. We were either going to get pushed off the land or UCCE would take over the Farm. It was too political, the land was worth too much money, we didn't have the political clout, I didn't have the juice to take it up to the next level," Archie recalls. The UCCE did take it over for a final year before shutting the program down.

Despite the collapse of BACUA and proposals to sell the Gill Tract to developers, student interest in urban agriculture has been enormous and has continued to grow. The Urban Garden Ecosystems course (now called Urban Agriculture) continues to provide practical skills in ecological horticulture, while bridging social sciences, planning, and public health.[87] Students are required to volunteer with local urban agriculture organizations, and many of them go on to work within the local sustainable agriculture and food justice movements. Some have become farmers in the Bay Area hinterlands and throughout the US. During spring semester, graduates of the course teach an Introduction to Organic Gardening course to other students. The related Berkeley Urban Gardening Internship program also connects UC Berkeley students with local urban agriculture organizations (Archie 2011). Over the last few years Oakland's urban farms and gardens have both benefited from the labor of UC Berkeley's urban agriculture students while serving as a hands-on classroom.[88]

Several other horticulture and sustainable agriculture courses and programs at nearby colleges and universities have also fed into the local knowledge base. The Landscape Horticulture Program at Merritt College, founded by EBUG co-founder Tom Branca, has provided students with agricultural skills ranging from plant propagation, greywater reuse, and permaculture. One of the founders of Spiral Gardens, Christopher Schein, continues to teach permaculture alongside a faculty and staff pool of several other instructors who are actively

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[86] CSA stands for "community supported agriculture".

[87] As I mention in the introduction of the dissertation and in a footnote in Chapter 1, I co-taught this course for three semesters from 2006 to 2008.

[88] While the large number of UC Berkeley students interested in urban agriculture has been a boon for food justice organizations in the East Bay, it is not unproblematic. I briefly discuss the implications of a large volunteer pool of mostly middle-class white and Asian college students in the dissertation's introduction and conclusion. See also Melcarek (2009) and Guthman (2008a).

engaged in urban homesteading. Since 1994, the Occidental Arts and Ecology Center, a training center in northern Sonoma County with connections to the Olkowski's Integral Urban House of the late 1970s, has provided training for hundreds of activists in permaculture and other ecological farming techniques, in order to help activists create "democratic communities that are ecologically, economically and culturally sustainable in an increasingly privatized and corporatized economy and culture" (Occidental Arts and Ecology 2011). The Agroecology Apprenticeship in Ecological Horticulture at UC Santa Cruz has also provided critical training for Bay Area urban agriculturalists. More than 1,300 people have been through the program since it began in the late 1960s. A recent survey of about a third of past apprentices revealed that 69 percent of them are still doing food system work (Perez 2009). Roughly one third of these are active in the Bay Area, with more than 15 percent in the East Bay. Scores of former apprentices have gone on to work in the Bay Area food system with organizations such as Berkeley Youth Alternatives, Oakland SOL, the Berkeley Food Systems Project, EBAYC's RISE Youth Development Collaborative, Spiral Gardens, and Sunnyside Organic Nursery, among others. At UC Davis the Student Farm Summer Internship Program, as well as sustainable agriculture courses at the College of Marin and Santa Rosa Junior College, have also helped to link Bay Area urban agriculture activists with the vibrant sustainable agriculture community of the Bay Area's hinterlands, providing them with technical knowledge and experience that has slowly filtered into the gardens of the East Bay's flatlands, adding to the already-existing reservoir of agricultural knowledge that many residents of the flatlands maintain themselves.

Agrarian Transplants

Central to the story of urban agriculture in Oakland's flatlands are the vast number of migrants and immigrants who have come from agrarian backgrounds and who have continued to grow food in their home gardens. When I commented on the apparent lack of urban agriculture activity in Oakland in the mid 1990s compared to what was happening in Berkeley, Daniel Miller, founder of Spiral Gardens, replied, "Oh, there was plenty of urban agriculture taking place in Oakland back then. It was just happening in folks' yards" (Miller 2011). As I explain in Chapter 2 and in my discussion of the Black Panthers in Part 1 above, most of Oakland's African American population can be traced to a large wave of migration from the rural South during World War Two. Many younger African Americans in the flatlands—second or third generation Oaklanders—talk about how their parents or grandparents grew up on a farm and what they used to grow. Many participants in flatlands urban agriculture programs—City Slicker Farms' Backyard Gardening Program in West Oakland, for example—are middle-aged African Americans who grew up eating from their parents' gardens in Oakland, Berkeley, and Richmond.

More recent arrivals have carried on such an agrarian tradition. A large immigrant population in East Oakland (particularly in the San Antonio and Fruitvale districts) plays a visible role in flatlands urban agriculture. The rolling range and orchards of the Peralta family's Rancho San Antonio was long ago transformed by several waves of industrial and residential capital. Yet amidst the dense mix of once-stately ramshackle Victorians, craftsman bungalows, and worn out apartment complexes built in the 1960s and 70s, tiny patches of Asian bitter eggplants and runner beans and Mexican *quelite* greens thrive. Fruitvale has long been Oakland's Latino enclave. San Antonio (also called East Lake) is the city's most ethnically diverse district: 42% Asian and Pacific Islander (mostly Cantonese-speaking Chinese and Southeast Asian, in particular, Vietnamese, Cambodian, and Khmu, Mien, and Hmong from Laos), alongside significant African American (24%), Latino (23%), and white (8%) populations (ACPHD 2001; Maly 2005).

Many of these residents were settled in the neighborhood in the 1970s and 1980s, fleeing the economic and political repercussions of post-war Southeast Asia. Several refugee relocation organizations such as Lao Family Community Development, the International Rescue Committee, and Refugee Transitions are either located in this part of Oakland or locate families here due to affordable rent, proximity to public transit, and the presence of existing communities (Chang 2010). Arrivals of refugees from around the globe—ethnic Nepalis from Bhutan, Burmese Karen and Karenni, Meskhetian Turks from Russia's Black Sea region, Bosnians, Ethiopians, Eritreans, and Iraqis—have added to San Antonio's ethnic diversity since the 1990s. Many of these recent immigrants come from agrarian backgrounds and cultivate vegetables in their yards. As I discuss in Chapter 1, immigrants such as these engage in urban agriculture for a number of reasons: to supplement their diets, to sell produce informally to other immigrants, to alleviate boredom, stress, or isolation in a strange new environment. For many it is a way to maintain ties to their homelands and cultural identity through agricultural and culinary traditions (Airriess and Clawson 1994; Saldivar-Tanaka and Krasny 2004; Gottlieb and Joshi 2010).

Several coordinated urban agriculture efforts have taken place in this part of Oakland. In 1999 and 2000, garden activist Grey Kolevzon worked with community members and the Friends of Peralta Hacienda Historical Park to start an afterschool educational garden program at the Peralta House in San Antonio, the historic homestead of the Rancho San Antonio. Once the program was up and running, Lao Family Development, one of the resettlement organizations, proposed connecting the schoolchildren with Mien refugees at the Peralta garden, as well. Lao Family had been having trouble advancing a literacy program for Mien youth. Inspired by a school in nearby Richmond that had created a successful tutoring program that brought Southeast Asian youth together with elders, the organization invited Mien elders to teach the youth about gardening. The project was hugely popular among the youth and their parents and an unexpected outcome was close collaboration between the neighborhood's African American youth and Mien elders (Kolevzon 2011; Mollica 2011). The educational garden grew into a community garden that remains under the care of a number of Mien, Latino, and African American families (see Figure 3.5).

In 2003 the Alameda County Public Health Department, Oakland Unified School District, and EBAYC partnered with a number of other organizations including Cycles of Change, Urban Ecology, Oakland Children's Hospital, Clinica de la Raza, the City of Oakland Parks and Recreation Department, and several community groups to form San Antonio Neighbors for Active Living. This umbrella organization applied for and acquired a Healthy Eating, Active Communities grant from the California Endowment, a foundation that funds health and wellness projects. While the initiative was broad in scope, one of the program's goals was to "Establish and expand local and family-operated urban farms to supply organic fresh produce to school-based produce stands and neighborhood stores". One of the projects funded was the development of the San Antonio Park Community Garden (see Figure 3.5). As with Peralta House, immigrant parents were interested in the afterschool gardening program underway at Roosevelt Middle School in San Antonio. The grant allowed EBAYC/Cycles of Change to expand the program into San Antonio Park, across the street from the school. The grant also helped San Antonio residents establish and run Full Circle Farms in neighboring Alameda and Sunol, a peri-urban community 25 miles from Oakland (HEAC 2011; Kolevzon 2011).

Figure 3.5: Community gardens at San Antonio Park (left) and Peralta Hacienda (right), East Oakland. Photos taken May 2010.

More recently, another initiative has arisen to assist refugees in the flatlands. The East Bay Refugee Gardens Project, sponsored by Community Health for Asian Americans, works with three refugee community groups. In a small garden tucked between a basketball court and a ramshackle Victorian, gardeners from the Cambodian Women's Group, the Bhutanese American Community Center, and the Burmese Refugee Family Network cultivate and harvest alongside one another (see Figure 3.6). The garden provides participants with fresh produce, but also a sense of community. One Cambodian woman, Sotheavy Tan, explains, "We thought a garden would be a space where people could socialize, do things together away from home" (quoted in O'Brien 2010). Zack Reidman, a recent transplant to Oakland who had worked on urban garden projects in Maine, started up the program as an outgrowth of his work as a tutor with two of the refugee settlement programs working in East Oakland. Many of the refugees Reidman tutored came from agrarian backgrounds and were eager to grow food once again. He is attempting to cobble together a network of small spaces

> for as many families as possible to have a 15-by-20 foot plot. It's my personal agenda to create as many small gardens as possible… There'd be greater efficiency in a large space but there's something to be said for these smaller outposts throughout Oakland. People can walk, it's not so much of a logistical nightmare. And being truly local is something to consider" (Reidman 2010).

For Dhimal Bhawani, an ethnic Nepali who had worked in Ministry of Agriculture prior to fleeing Bhutan, these small spaces are ideally only a stepping stone to finding spaces large enough for commercial-scale agriculture that would enable families to earn a living (Bhawani 2010).

Figure 3.6: Bhutanese Nepali men gardening at the 11th Avenue East Bay Refugee Garden Project site, San Antonio, East Oakland. Photo taken November 2010.

While it's clear that non-profits and public agencies have helped to facilitate the creation of urban agriculture spaces for Oakland's immigrant communities (and to a far lesser extent, for African American migrants who arrived earlier from the rural South), it is important to underscore that these formal spaces serve only a fraction of those engaged in urban agriculture. Most of Oakland's urban farmers actually grow food in their yards instead of in larger community or shared gardens. Indeed, these urban farmers—who may actually form the majority—are strikingly absent from Oakland's growing food justice-oriented urban agriculture movement. Food justice activist Navina Khanna addresses this contradiction,

> One of the things that struck me … in East Oakland was seeing how many people have gardens in their backyards. I mean, those people are not calling what they do urban agriculture, there's not write-ups about them in any magazine, they're not being invited to any conferences or being told their work is so radical or getting grant money to do it, it's just what they do. I had my garden, I'm like the foodie, I get paid to think about and talk about food all the time, but I had four different neighbors, middle-aged black men who grew way more beautiful vegetables than me and they would bring vegetables over to my house that were way better than anything that I could grow. But they don't even know that there's this group of people that are paid to think about and paid to talk about it. And their faces are not the faces of the urban ag movement that's talked about like a brand new thing, like it's a novel idea. They're not part of the formal movement but they're part of something. (Khanna 2011)

This is perhaps because they are growing for household consumption, an act not seen as particularly radical or tied to a particular movement. Indeed, like the home gardens dotting the yards of Oakland's industrial garden half a century earlier, the motivation for many is simply to grow food for their families. For many these gardens are also a means of maintaining cultural ties or agricultural and culinary knowledge, rather than an expression of a particular lifestyle politics or a radical rejection of the corporate food regime. Their invisibility, I argue, is also a result of the growing institutionalization of the urban agriculture movement and the development of the “non-profit industrial complex” that has both subsumed and fueled the urban agriculture movement in Oakland. Ironically, while these urban farmers are largely absent within the movement, they serve as material and symbolic inspiration for urban agriculture activists throughout the flatlands, providing concrete examples not only of how and what to grow in the city, but also what the city should look like and how its denizens should feed themselves.

By the early 2000s, these various threads had begun to converge. The radical activism of the Black Panther Party and community coalitions of EJ activists laid the foundations of struggle against the devaluation of Oakland’s flatlands neighborhoods and forged the necessary links across race and class to draw attention to their struggles. Urban Habitat’s “flatlands framework” helped to illuminate environmental injustices in the East Bay and aided in this rescaling of the claims of neighborhood activists, expanding their spaces of engagement (Cox 1998) to include mostly white, mostly Berkeley-centered allies from the environmental, community gardening, and sustainable agriculture movements. The fusion of their concerns resulted in a social, economic, and environmental justice-oriented engagement with gardening that was able to tap into new funding streams for job training and school garden-based nutrition education. Activists sailed freely between projects and organizations, between Berkeley, San Francisco, Oakland, and the Bay Area hinterlands, following funding streams and leaving behind new gardens in their wakes.

3. Cultivating Food Justice

Over the last decade, a new food justice-oriented urban agriculture movement has taken root in Oakland’s devalued flatlands, one that activists have built on a historical foundation of radical activism while drawing on the human and material resources of an increasingly institutionalized network that bridged urban agriculture, nutrition, and economic development and that was legitimate in the eyes of funders. This growing network of radical activists, urban gardeners, and institutions was new; it was more overtly political than the community gardening movement of the past, with more of a multi-racial, cross-class draw. It was even more political than the community food security movement that took hold in mid-1990s, drawing more explicitly on the spatial justice framework to define the inequities of food access in the flatlands and on the historical legacy and symbolism of Oakland’s past and contemporary social justice and EJ activism. Through its increasing connection with institutions, it has also been better positioned to interface with planners and policy makers.

The new “food justice” movement has embraced urban agriculture as a key component. Urban agriculture is about more than simply urban gardening. It is a political act, a rejection of the corporate food regime and commitment to overcoming the devaluation of the flatlands. Indeed, even the use of the term “urban agriculture” is an act of scalar politics, whether conscious or unconscious; by calling what they do urban agriculture rather than community gardening, food justice activists in the flatlands are connecting their actions to those of urban residents in the slums of the Global South struggling to mend the metabolic rift inherent to urbanization (see Chapter 1).[89] Furthermore, the adoption of the term urban agriculture also

[89] Only in the last few years has the term “urban agriculture” been applied to food production in the cities of the Global North. Database searches using the term prior to the late 1990s yield only Global South results; instead, the terms “urban gardening”, “community gardening”, and “allotment gardening” yield research on cities in the Global North.

legitimizes urban food production by tapping into a decade of advocacy for urban agriculture as a sustainable development strategy in the Global South (cf. Smit and Nasr 1992; Egziabher et al. 1994; Smit, Ratta, and Nasr 1996). By invoking this new "scale frame" (Kurtz 2003), food justice activists have expanded their space of engagement to a global scale, not unlike the BPP succeeded in doing decades earlier (Heynen 2009).[90]

Also like the BPP movement, the city's food justice activism in has been centered in West Oakland since the dawn of the new millennium, and urban agriculture has, in some ways, provided a new channel for the Panthers ideological legacy. Concerned with the lack of nutritious food in West Oakland, David Roach started up a farmers market at McClymonds High School in West Oakland in 1994. Four years later he started up an organization called Mo' Better Foods that has worked to cultivate relationships between the few African American farmers still operating in California and West Oakland residents. Roach, an African American and key figure in the history of Oakland's food justice movement, views agriculture as vital to economic development for black communities. In an address to the Ecological Farming Conference, Roach underscored the centrality of agriculture to a community's self-sufficiency. African Americans need to actively engage in farming "to take care of ourselves… It's okay to want to be a farmer. I want independence. I want freedom." In his address, he was critical of the ways in which social services exacerbate poverty rather than investing in real structural reform: "Every agency has pillaged our community," creating a system of "handouts that lead either to prison or unemployment" (Roach 2006). Urban agriculture, according to Roach, should not be viewed as the solution, but rather should be viewed as only a small part of the solution. The structural issues—the decline of black farmers, the lack of community-owned retail selling healthy food, the lack of economic opportunity—must take precedence (Roach 2007).

Roach, along with Dana Harvey, a white woman, was heavily involved in organizing one of the first collaborative efforts to think holistically about the food system in the flatlands. In 2001, Roach, Dana Harvey, and the Environmental Justice Initiative, a local EJ program, organized the West Oakland Food Collaborative to come up with a strategic plan to improve food access and food security, while addressing the political and economic conditions of the city's most devalued area. A nine-month planning process, funded by a grant from UC Davis, brought activists and agencies to the same table. In the end, they identified the following as necessary components of a vibrant West Oakland food system: a farmers' market, liquor store "conversion", a cooperative grocery, community green space, and small business development (PolicyLink 2011; West Oakland Food Collaborative 2011). The Mandela Farmers' Market, and later the Mandela Cooperative Grocery both arose from this initiative (Alkon 2007). As Alkon (2008) explains, the Collaborative "cast the struggles of African-American farmers and food-insecure West Oakland residents as manifestations of racism and poverty, which can be addressed through the creation of a local food system" (281), and ultimately served as a "hub for community organizing" (283).

[90] Hilda Kurtz (2003) defines scale frames as "the discursive practices that construct meaningful (and actionable) linkages between the scale at which a social problem is experienced and the scale(s) at which it could be politically addressed or resolved" (894).

Figure 3.7: A City Slicker Farms backyard garden mentee with raised bed (left). A sign (right) welcomes visitors to the Wow Farm, a garden in West Oakland that produces for the organization's sliding scale farm stand. The sign explains the NGO's mission of "providing locally and organically grown produce for West Oakland".

Around the same time, Willow Rosenthal, a white woman living in West Oakland, began gardening a vacant lot at the corner of 16th and Center Streets with her neighbors. She explains, "I wanted to be a farmer, and I didn't want to just grow food for wealthy people. I really believed in the organic movement, and I had come up through that being mentored by some other farmers who were really amazing" (quoted in Mark 2008). She realized, however, that the sustainable agriculture movement in which she had cut her teeth had a limited reach in places like West Oakland. She continues,

> We're doing this because of the conditions we are in, because we want to make sure that the folks who really need this food are able to get it. This organic movement is wonderful, but it's still leaving out people who are at the bottom economically. So I really want to see more — not just lip service paid to the idea of equity — but more actual commitments financially and in terms of resources. (ibid.)

Rosenthal was initially inspired to grow food in an urban setting by Daniel Miller of Spiral Gardens in South Berkeley (Henry 2011). She and several partners eventually raised enough money to purchase the lot, where they established a small produce stand with a sliding scale, ranging from "Free Spirit" (free) to "Sugar Mama/Sugar Daddy" (a premium farmers' market or Whole Foods price to subsidize the free produce). City Slicker Farms, as she called her organization, eventually expanded to three other small lots and a schoolyard throughout West Oakland and developed a backyard gardening program, where volunteers help West Oakland residents install and plant two raised garden beds, and provide mentorship every few months (see Figure 3.7). City Slicker Farms is now one of the most recognized urban agriculture organizations in Oakland, and has received several high profile grants to expand their work in the past few years, including a $4 million dollar grant to purchase and develop a large 1.5 acre urban farm park on a former brownfield (City Slicker Farms 2011).

In 2003 another major food justice organization cropped up. Brahm Ahmadi, Malaika Edwards, and Leander Sellers had been working with City Slicker Farms when they decided to expand the network of urban gardens at other sites throughout West Oakland. Once the organization got off the ground in 2003 they hired neighborhood teens to be peer educators. They eventually set up a "mobile grocery", a brightly colored panel van filled with fresh vegetables that parked in various locations around the neighborhood. People's Grocery had taken root. Ahmadi, an Iranian American from Los Angeles who studied Sociology at UC Santa Cruz, had been active in Oakland's EJ movement for a couple years before starting People's Grocery. Like the EJ movement, food justice shared an emphasis on environmental racism, economic and health disparities. Ahmadi felt that it was a logical progression from EJ to food justice, that food justice was in fact an "outgrowth of EJ" (Ahmadi 2009). The link between EJ and food justice made sense at multiple levels: "Nutrition, and land, and economic development. Those were really kind of the three things that started to triangulate for me" (ibid.). Simultaneously reading up on the "social determinants of health" literature, and specifically interested in the relationship between malnutrition and resistance to toxins, Ahmadi turned to the work of Carl Anthony and Urban Habitat to guide his thinking about land use and structural racism. He continues, "[I was] craving something different, craving to be more entrepreneurial, craving to create alternative models. I connected the dots and saw this food security issue, and started learning about that." Ahmadi found that food justice was a way to tackle multiple drivers of inequality in West Oakland, but only if it helped the community move away from a dependant "recipient" model towards a more economically self-sufficient one.[91]

Food justice for Ahmadi also allowed for a certain positive, creative freedom to design and implement a vision of an alternative model that differed from the EJ approach, which relied primarily on organizing. "On a personal level, I was just burning the hell out on organizing as a model," Ahmadi admits. "It was really fatiguing. You were always challenging something, you were always angry about something, it was a fight you were in and creating, and it was not a very nourishing way of being. A lot of people burn out." With food justice work, on the other hand,

> There are so many more things you can do strategically. And so that's what really attracted me to wanting to make the shift in the work, because I was burned out and tired of that and thirsting more for more proactive and positive models to create these alternatives that we need to have in place if we really want to be successful in creating resilient communities. (ibid.)

Ahmadi's story highlights the emphasis on growth and change, on sustainability and community development that dominates the discourse employed by urban agriculture and food justice organizations. For many activists, there is a sense of personal satisfaction or fulfillment that arises from developing creative strategies for changing the food system, from envisioning what a just sustainability might look like, and actively working to achieve this alternative vision. The

[91] Contradictorily, however, the so-called "non-profit industrial complex" that has supported the growth of the urban agriculture movement in Oakland has arguably perpetuated this recipient model, a fact that many activists are acutely aware of (Cadji 2011).

material realization of this vision—a garden, a farm stand, a grub box—and the labor necessary to bring them to fruition, serve both the individual activist and the surrounding community.[92]

In East Oakland at the turn of the millennium, urban agriculture was mostly taking place in school gardens, community gardens, and people's backyards, rather than through organizational garden projects. In terms of organized food justice-oriented urban agriculture activity, Grey Kolevzon's work with Cycles of Change and EBAYC described in the previous section was concentrated primarily in San Antonio and Fruitvale. Few food justice organizations ventured into "Deep East Oakland", the area east of Fruitvale, comprising a number of flatlands neighborhoods such as Elmhurst, Eastmont, and Melrose. Jason Harvey, founder of Oakland Food Connection, often tells the story of growing up in East Oakland where his mother supported him and his brother on food stamps. After a stint in the Air Force, Harvey returned to Oakland and got involved with the West Oakland Food Collaborative in 2003 (Harvey 2010). In early 2005 he began scouting out the work of the various organizations and noted that very little food justice work was happening in East Oakland where he had grown up. Soon after he established Oakland Food Connection, formally establishing it as a 501(c)(3) in 2007. Much of his work is concentrated in the area along MacArthur Boulevard in East Oakland, with a small farmer's market, café, and bulk whole foods retail outlet in the Laurel neighborhood, a rooftop garden at E.C. Reems Academy, a charter school next to Castlemont High, his alma mater, as well as gardens at a handful of other schools (see Figure 3.8). He focuses on both food production and culinary education, underscoring the linkages between "food, community, and culture" (Harvey 2008, 2011).

Figure 3.8: Oakland Food Connection's rooftop garden at E.C. Reems Academy, July 2008.

Another East Oakland urban agriculture program grew out of Slide Ranch, an educational farm in Marin County where schoolchildren from San Francisco, Oakland, and Richmond learn about sustainable agriculture on one or two day field trips. Four of the garden-based educators working there were inspired by the way the children "blossomed" at Slide Ranch, but wanted to

[92] Indeed, as I argue in Chapter 1, it is urban agriculture's ability to both de-alienate the individual from labor and (urban) nature *and* re-embed the food system with social relations that attracts so many young activists.

create a similar space within an urban area itself rather than busing them to a rural area. So they began searching for a space in Oakland and found an apartment with a large yard "perfect for a garden" advertised on Craigslist. They moved into the apartment on 23rd Avenue and International Blvd. in East Oakland's San Antonio District (D'Souza 2010).

Shereen D'Souza, a South Asian American who grew up in New Jersey, had been working with hillside farmers and starting school farms in rural Honduras, before moving to SOL in 2004 on the invitation of one of the founders. She worked for Oakland Based Urban Gardens (OBUGs) in West Oakland as a garden-based educator for several years before taking the helm of the California Food and Justice Coalition, a statewide food justice policy advocacy group. She describes SOL as "a living space, as well as a food justice project… We grow as much of our own food as possible, we have chickens and gardens, we buy bulk food from either Mandela Foods Coop or Rainbow and also if we need produce we go to the farmers markets" (ibid.).

SOL offers classes on sustainable agriculture and urban agriculture to neighborhood school groups, "and for older students, a critique of the industrial food system" (ibid.). Mostly the youth come to SOL with other organizations that have included Bantaay Srei, an organization that helps Southeast Asian girls transition out of sex work; Street Level Health Project, an organization working with the children of *jornaleros* (day laborers); and Cycles of Change, a bicycle-oriented job training and education organization. Their central program is a summer intern project for teens. She explains that SOL's reach is limited due to meager funding. This was by choice, as their focus has primarily been on creating a sustainable living center rather than an NGO. Almost all of the funds they receive go towards paying youth interns from the neighborhood. She explains the rationale for staying small:

> It's a small project, but intentionally we haven't really gone after major funding. And it's something we debate. But we also have a critique of the non-profit industrial complex. So, even though for most of us, that's our bread, working in non-profits outside of SOL, we have been reluctant to really expand it in that type of way. (ibid.)

D'Souza also explains that urban agriculture has been a successful rallying point among youth in the community and a key space of intervention of SOL's food justice work:

> Because we started really heavily focused on garden-based education, we have a lot of connections to the community and other organizations. In terms of working with kids in that neighborhood, I feel like we really have it down, you know, and there's a lot of buy in to our goals and that kind of thing. But with adults, we're not so good because that hasn't been our forte. A lot of us were garden-based educators before. (ibid.)

To connect with adults from the neighborhood, SOL's members have decided to open up their living space (which includes a large common room with a high ceiling) as well as their gardening space:

> Because we don't have the capacity to run as many programs as we would like to, that's a contribution we can make, just opening up that space and let community groups use it as they see fit. There's a poetry group, and there's a day laborer group that uses our kitchen, there's a couple of gardening groups that use the garden regularly. And so, of late, that's

been our strategy, to let the community decide what to do with our space without us necessarily having to be part of the process. (ibid.)

But she is cognizant and candid about the fact that class differences may ultimately separate the organization (which is, first and foremost, a communal living space) from the community it serves. She explains,

> I think there's that complication because it might be outside of the comfort zone of people originally, authentically from the neighborhood… The way we share space, the way we live, the way we share resources, the way we share food, the foods we buy, in my opinion, show privilege. To bring someone in and say we're not going to buy meat as a house, you know, I think it would be really complicated… Being run by people living there, there's been that additional complication. A lot of our conversations about the project happen over dinner, you know, and if the people eating dinner together are the people that live there, this homogenous group of college educated folks, there's that complication, you know?

Like many urban agriculture activists, D'Souza is very aware of the race and class politics that arise when young people living collectively—an expression of lifestyle politics that informs many people's commitment to urban agriculture —establish themselves in a low-income flatlands neighborhood. Yet it does not seem to hinder their effectiveness.[93] SOL is comprised mostly of college-educated, middle-class people of color in their mid-twenties to mid-thirties, most of whom work in social services or non-profit, and include a SF Public Health Department employee, a private solar industry worker, two teachers, a garden educator, among others. "In terms of class, without knowing for sure, I'd say most people come from privilege. I'd say at the least, higher working class, lower middle class" (ibid.).

This demographic seems to be common within the food justice and urban agriculture movement. While many of the activists are white, upper middle class, twenty- and thirty-somethings, nearly as many are people of color, some from slightly more modest economic backgrounds, representing various racial/ethnic origins. Many identify as mixed race, biracial, or multiracial. With some exceptions, few are actually from the neighborhoods in which they work and most come from a level of privilege higher than that of the populations they work with. Indeed, the contemporary food justice-oriented urban agriculture movement in the Oakland flatlands in many ways parallels the multi-ethnic coalitions that were central to the previous historical moments I've identified thus far. A recent post to the East Bay Urban Agriculture Alliance describing a new urban agriculture collective highlights the diversity of participants:

> I am a member of a 'guerrilla' garden group in East Oakland named the Land and Life Garden Collective. The group has been around about a year and is made up of mostly young, Spanish speaking activists. I am a Yukon River Indian - Athabascan and am an elder, I suppose, but since I still have my 92-year-old mother, I am but a child… I live in the neighborhood as do others in the collective… The land, at the corner of Ygnacio and Vicksburg Ave. in the Melrose district of East Oakland, is in a legal limbo land and has been a blighted, vacant lot for over 30 years. We now have 10 fruit trees and approx. 50

[93] This dynamic has raised concerns that urban agriculture and food justice activists act as a force of gentrification, as I address in the dissertation's introduction and conclusion.

> other flowers, succulents, veggies, grasses, etc. all in the early stage… We have lots of support from the community, we are teaching approx. 20 children as well. We have greens growing and have given away bunches as well as gleaned fruits/veggies. (posted by yukonriverwoman, 22 March 2011)

The diversity of the participants—perhaps reflective of Oakland's flatlands neighborhoods themselves—is a key feature distinguishing Oakland's contemporary urban agriculture movement from both the community gardening wave of the 70s and 80s and Berkeley's job training and community food security gardens of the 90s. Furthermore, the discourse employed by Oakland's urban agriculture activists is more overtly radical, often framed around the concept of food justice and grounded in the flatlands framework and explanations of the corporate food system. The shift in terminology from "community gardening" to "urban agriculture" is also significant, marking a new scale frame linking the flatlands to global struggles for food justice and food sovereignty. It is this shift in discourse—with its emphasis on urban agriculture as a means of planning for sustainability—that has also informed its ongoing expansion and allowed for its integration into policy efforts.

4. Growing Interest: Scaling Up Through Food Policy

If the last three sections detail the rise of urban agriculture and food justice in Oakland's flatlands, the following section perhaps speaks to its future directions, upward and outwards. As urban agriculture programs grounded in food justice began to take root in the flatlands in the early 2000s, a growing emphasis on the somewhat intractable goal of "sustainability" began to filter into Oakland's municipal planning decisions. In the eyes of the city government, urban agriculture was for the most part a recreational pastime managed by the Parks and Rec Community Gardening Program, which had steadily managed its eight gardens on a shoestring over the previous couple of decades. Only when city officials began thinking holistically about what constitutes a "sustainable city" was urban agriculture even taken seriously as something more significant than a handful of community gardens. Until recently, urban agriculture only took root on vacant sites at the interstices of the city, arising ephemerally on devalued land whenever and wherever the market allowed. But as a component of a sustainable city, urban agriculture must be a perennial part of the urban landscape, a planned part of the city, rather than simply a default land use in times of economic slump.

David Ralston, former director of EBUG and member of the People of Color Greening Network, has been an active advocate of urban agriculture within the municipal government since the early 2000s. Working first in Planning and later in Redevelopment, he had been focusing on how to designate private, undeveloped floodplain land as open space, creating a network of linked greenways and open space and "having a green character intertwined within the city" (Ralston 2009). He recalls that during his previous foray into urban agriculture with EBUG through the '90s,

> We weren't thinking systemically, we weren't thinking about these kind of networks, we were thinking about building a garden for a particular community that they could be part of. And maybe if there were some entrepreneurial people, they would walk around and sell some of that stuff and do a small-scale CSA. So it was just like a traditional community garden. Just for community. To supplement their diet and have a positive impact on their health. (ibid.)

When thinking about scaling up beyond the individual vacant lot, the issue of private property seemed to be a major obstacle. Vacant land in the Bay Area is simply too rare—and therefore valuable—to turn into gardens. Landowners often fence their property off and wait for the next real estate bubble to sell. Ralston was interested in finding ways to rezone large properties (over five acres, for example) as urban open space. Shy of eminent domain, there is little one can do if such a change in land use classification reduces the economic potential of the property. Studying the land use histories of the urban watersheds he was interested in, Ralston discovered that many had been agricultural in the early part of the 20th century and decided that urban agriculture could be "a viable open space land use that could have some economic return for people" in the 21st century as well. "It all just came together, back towards ag." He explains,

> You cannot take away people's economic potential on that land, so agriculture turned out to be a viable use. You're not restricting them from doing anything on the land. I had worked with EBUG, and we had talked about this with Jungle Hill, like 18 years ago, so in the back of my mind I'd already been thinking about gardens and agriculture, but then it all came together thinking about land use, that this would be a really good avenue to preserve open space but also to help food production in the city… We started talking more about sustainability and looking at things citywide and systemically and the open space thing. Ecological planning. Then urban agriculture as a larger system really answered a lot of questions. (ibid.)

In 2003 Oakland mayor Jerry Brown hired Randy Hayes, founder and board president of the Rainforest Action Network, to lead the Mayor's Office of Sustainability. Hayes, who the *Wall Street Journal* once tagged as an "environmental pit bull", was a diehard advocate of local, community-led economic development as an alternative to global corporate capitalism. In his Oakland Sustainability Overview, he describes "The Green City Revolution":

> Cities are the place to deliver the solutions. Those solution need to reach all people, even as we work to leave less and less of an ecological footprint with each subsequent generation. Oakland, a wonderfully diverse city with a great climate, can serve as a model for a livable future. This will require continued bold thinking and action on the part of our community leaders, local business leaders, and elected officials. Oakland citizens have made a great start, but there is much more to do – such exciting and historically important work! (Hayes 2005)

Hayes' Office of Sustainability focused primarily on reducing energy use and bringing hybrid and hydrogen vehicles into the public transit fleet. Under Hayes' tenure, Oakland also joined the Chicago Climate Exchange, and teamed up with Greenpeace, Friends of the Earth, and the Cities of Boulder, Santa Monica, and Arcata in a lawsuit against several federal agencies for violating the National Environmental Policy Act by funding "certain overseas industries that exacerbate climate change" (Mayor's Office 2006). In 2005 Mayor Jerry Brown, along with the mayors of 50 other cities around the world, signed the UN World Environment Day Urban Environmental Accords and pledged that Oakland would become a more ecologically sound, economically dynamic, and socially equitable city by 2012. As a result of steps taken toward this commitment, it ranked in the top ten sustainable cities in 2005, 2006, and 2008 (Mitchell 2006; Swenerton 2007; SustainLane 2008).

The high sustainability rankings were due in part to the city's inclusion of the food system into its sustainability plan. In January 2006 on the recommendations of the Life Enrichment Committee, the Oakland City Council authorized the Mayor's Office of Sustainability "to develop an Oakland food policy and plan for thirty percent local area production" (Oakland City Council 2006a). Building on a food assessment for Alameda County conducted in 1999, and inspired by similar assessments in Toronto, Vancouver, San Francisco, Portland, Chicago, and a number of other North American metropolises, two UC Berkeley graduate students in the Department of City and Regional Planning completed the Oakland Food Systems Assessment for the Mayor's Office of Sustainability in May 2006 (Unger and Wooten 2006).

The document has since served as a springboard for food systems change in Oakland. Upon the report's recommendation, the City Council unanimously passed Resolution No. 80332, approving a seed grant for $50,000 to establish a municipal food policy council whose mission would be "to cultivate a sustainable food system by eliminating hunger, increasing health, expanding a greener economy, and honoring diversity for all current and future generations of Oakland, especially the least served, by ensuring the availability and accessibility of a wide variety of local, safe, sustainably-grown, and nutritious food" (Oakland City Council 2006b). The Oakland Food Policy Council (OFPC) was seated in 2009 and has since developed an Action Plan that includes first steps towards "transforming Oakland's food system," including advocating for the protection and expansion of urban agriculture (OFPC 2010).[94]

Arising from the same food systems vision, the Health for Oakland's People and Environment (HOPE) Collaborative, an umbrella organization consisting of several community development organizations and spearheaded by the Alameda County Public Health Department, the Food Bank of Alameda County, and the Community Food Security & Nutrition Policy Program of Alameda County UC Cooperative Extension, competed for and won a two-year planning grant in 2007 for $495,200 from the W.K. Kellogg Foundation to develop a municipal program encompassing economic development, local food systems, green built environment, and public health education. HOPE was unique in the diversity of stakeholders it brought together: city officials, non-profit workers, food justice activists, students, homeless people, and homemakers. Teams of Collaborative members surveyed six "micro-zones", ¼ mile radius areas surrounding central intersections in the six poorest flatlands neighborhoods, interviewing community members and surveying food prices and availability in local stores. They also conducted several community listening sessions and design charettes (Herrera, Khanna, and Davis 2009; HOPE Collaborative 2009) and funded an inventory of vacant land in Oakland with agricultural potential (McClintock and Cooper 2009) which has since been used by the OFPC and Oakland Climate Action Coalition to support their recommendations.[95] HOPE continues to serve as the community engagement arm of the OFPC.

[94] I discuss the work of the OFPC in detail in Chapter 6.
[95] The inventory is the subject of Chapter 4.

While Oakland briefly seemed to be a national leader when it came to formally expanding urban agriculture thanks to the release of the Oakland Food System Assessment, the activity of the HOPE Collaborative, and the creation of the OFPC, municipal interest in urban agriculture briefly waned. The election of Ron Dellums as Oakland mayor saw the dissolution of the Mayor's Office of Sustainability and the city's entire sustainability program was shifted onto the shoulders of one man in the Public Works Department. Other cities soon took up the mantle, making strides in urban agriculture policy: Seattle, for example, declared 2010 as the "Year of Urban Agriculture" (Bird 2010) and passed a sweeping overhaul to allow the expansion of urban agriculture (Seattle City Council 2010); Cleveland legalized livestock ownership (Kleinerman 2009) and committed $1.1 million to a pilot urban farm (Gillespie 2010).

In San Francisco, efforts to scale up urban agriculture through policy reform gained momentum, as well, ironically due to the visibility of urban agriculture across the Bay. Mayor Gavin Newsom actually announced his Healthy and Sustainable Food for San Francisco Directive (Executive Directive 09-03) in July 2009 standing in front of City Slicker Farms' WOW Farm in West Oakland, "a junkyard-turned-farm in West Oakland that could serve as a model for how land could be converted in San Francisco" (Knight 2009). The Directive signaled municipal commitment to improving the food system, and specifically addressed the importance of encouraging urban agriculture through "community, backyard, rooftop, and school gardens, edible landscaping, and agricultural incubator projects" (Newsom 2009, § 2.e) and ordered all city departments "having jurisdiction over property [to] conduct an audit of land suitable for or actively used for food producing gardens or other agricultural purposes" (§ 4.a), a response to public pressure to facilitate urban agriculture on the city's more than 3,000 privately owned and 2,000 publicly owned vacant lots in the city (Green 2008). In the year and a half that followed, an umbrella organization of urban agriculture activists called the SF Urban Agriculture Alliance (SFUAA), working in conjunction with the SF Food Policy Council (which was formed under the Directive), pushed through one of the nation's most comprehensive pieces of urban agriculture legislation: Ordinance 66-11. Passed by the City's Board of Supervisors in April 2011, it greatly expanded the area where urban agriculture is permitted in San Francisco and allowed sales of produce by home gardeners (McMenamin 2011; Terrazas 2011).

Back in Oakland, despite the dragging of feet by the Dellums administration, interest in urban agriculture is slowly managing to take root within City Hall. These changes were due to the activity of the OFPC whose recommendations received airtime during the 2010 mayor race. At-Large Council Member Rebecca Kaplan, during her bid for election in the 2009 mayoral race, included food issues in her platform and has consistently advocated for adopting the OFPC's recommendations. While she did not win the election, she continues to advocate for progressive food system overhauls from her seat on the Council, including the expansion of urban agriculture in the city. At the January 2011 presentation of the OFPC's *Transforming the Oakland Food System* report to a Council sub-committee, Kaplan lobbied the committee to support the OFPC's recommendations for urban agriculture zoning changes. Kaplan's support—and further pressure on Planning staff by City Council President Jane Brunner—was essential for getting the Planning Department to begin integrating urban agriculture into the current zoning update. The passage of SF's urban agriculture ordinance also provided a significant boost to urban agriculture advocates in Oakland. Pesticide Watch, one of the NGOs active in the SFUAA helped to found the East Bay Urban Agriculture Alliance (EBUAA) in February 2011. The organization, made up of a combination of "urban homesteaders" and food justice activists, has been engaged with the OFPC and Oakland-based NGO Bay Localize to finalize recommendations to the city for its integration into the zoning update. Many of the involved urban agriculture activists were also motivated by the highly publicized case of urban farmer and author Novella Carpenter who was cited for non-compliance with city permit requirements (Kuruvila 2011a, 2011b). Under mounting pressure both from City Council and the public, the Planning Department launched a plan to update urban agriculture zoning, a process that has galvanized community members, as evidenced by the July 2011 meeting I discuss in the dissertation's introduction. The first phase of the zoning update, approved by City Council in October 2011, was the legalization of sales of produce grown in home gardens (Romney 2011; Rubenstein 2011).[96] While these changes at the policy level to scale up urban agriculture are only beginning in Oakland, they signal a transition from lip service to implementation on the part of municipal government. Indeed, Planner David Ralston captures the shift in the receptivity of city officials, "Now they won't laugh you out of town when you talk about urban agriculture" (Ralston 2010).

Conclusion

In a modified version of the People's Grocery logo that briefly appeared on fundraising website for non-profits, a white male in a baseball cap stands to the left of the other three young urban farming activists, one hand on a shovel, the other on the Asian male's shoulder (see Figure 3.9). This addition seems odd at first, an apparent afterthought, or perhaps a nod toward politically correct multicultural inclusiveness, or simply a more accurate representation of Oakland's demographic make-up. But the addition also befits the story of the rise of the contemporary urban agriculture movement in Oakland. At each historical moment, from the Black Panthers to the EJ campaigns, to the rise of garden-based community food security and job training programs and urban agriculture's current food justice-oriented incarnation, the success of urban agriculture activism has depended on multiracial, cross-class coalitions; indeed, as history sadly tells us, such alliances are necessary because the efforts of the poor acting alone are likely to be crushed. In addition to capturing the demographic of the 21st century urban agriculture movement (and of the city itself), grounded in the ideology of food justice, the alternate logo pays homage to the radical groundwork underlying the food justice movement. In the cases of the Black Panther Party, the EJ movement, and Urban Habitat, activists challenged the racial, political, economic, and ecological disparities between the flatlands and the hills. The struggle for healthy food, clean air, and green space mobilized community members at these different moments. Their successes depended on the discursive rescaling of the language of struggle in a way that helped cultivate multiracial and cross-class alliances. Using the language of Cox (1998), these

Figure 3.9: A variation of People's Grocery logo. Note the addition of a white male, as compared to Figure 3.1. Source: http://allatonce.org/nonprofits (accessed 9/16/11)

[96] I return to these developments surrounding urban agriculture policy in Oakland in greater detail in Chapter 6.

groups were able to expand their spaces of engagement through this politics of scale, to defend and improve their spaces of dependence, their neighborhoods and the food they eat.

These coalitions, in turn, were able to marshal the resources necessary to grow the movement, tilling up vacant lots for food production, education, and youth employment. As organizations grew with the slow trickle of public and private funding, they became legitimate in the eyes of funders, who then opened the spigot further. While the specific goals of the urban agriculture organizations varied, their gardens nevertheless served as training grounds and/or inspiration for the current generation of food justice-oriented urban agriculture activists, intent not only on teaching nutrition and science, but also on creating an alternative provisioning strategy in Oakland's flatlands while raising awareness of the structural inequities of the corporate food regime.

Returning to the logo, the rays of sunlight beaming upwards, silhouetting the urban skyline and raised fists of the activists, embody the hope and vision of the food justice movement, the dawn of a just and equitable food system that contributes not only to the health of the city's inhabitants, but also to broader goals of environmental sustainability and economic justice. On one level, these urban agriculture organizations have helped to move Oakland closer to these goals, as the growing patchwork of gardens and food policy attest. On another level, however, the increasing institutionalization of the urban agriculture movement begs the question: what has been lost as these efforts have been formalized, as funding ebbs from one urban agriculture initiative and flows to another, as cross-class, multiracial coalitions are formed, as action in the streets and vacant lots and gardens is translated into grant proposals and zoning codes? Furthermore, can we consider urban agriculture to be radical? To what extent does urban agriculture actually function as an alternative provisioning system and what is the extent of its reach?

I conclude by highlighting a few key considerations. First, let me reiterate the absence of the city's majority urban farmers in the contemporary urban agriculture movement, the immigrant and migrant populations who continue to grow food for home consumption and maintenance of cultural traditions (or, in the language of political economy, social reproduction). Food justice activists use this form of urban agriculture as symbolic capital to strengthen their claims, frequently proffering it as an example of urban agriculture's contribution to food security, neighborhood beautification, cultural value, and ecological sustainability. As urban agriculture has become a *movement*, however, largely dominated by a multiethnic group of young, educated, middle class activists, these urban farmers play a limited role in defining the urban agriculture movement as a movement. While some reap the benefits of urban agriculture programs—garden space at a new community garden, for example—many are simply unaware that a movement even exists.

Second, the institutionalization of the urban agriculture movement has depended on funding. Organizations frequently compete for the same modest grants and end up fighting for proverbial crumbs. Moreover, these crumbs, in turn, can ultimately define the missions of the organizations. If the funding "flavor of the month" happens to be school gardens, then school gardens become a central focus of the activity of these organizations (which, in turn, define the movement). Many urban agriculture activists are quite aware of this dependent relationship, as well as the dependence of communities on outside NGOs for the implementation of urban agriculture and other programs. The centrality of the "non-profit industrial complex" (as many urban agriculture activists critically call the hand that feeds them) is, in many ways, simply an outgrowth of the so-called neoliberal turn, where NGOs have rolled out to fill in the gaps in the social safety net left by the roll back of the Keynesian welfare state (Brenner and Theodore 2002; Peck and Tickell 2002; Allen and Guthman 2006). The ability of such a movement, so dependent on relatively small flows of public and private funding, to effect structural change or create a just alternative to the corporate food regime (with its inherent inequities), much less to sustain itself, is doubtful.

Finally, the scalar politics employed by urban agriculture activists and their radical antecedents exemplify the power of coalition building and the ability to slowly shift the dominant paradigm surrounding the food system, slowly revealing its connections to city planning and public health. Ultimately the story of urban agriculture in Oakland is one of urban agriculture's *de*-radicalization and its institutionalization into the mainstream. But rather than a story of its urban agriculture's appropriation by (or "selling out" to) the mainstream, it is a story of change arising from *within* the system due precisely to urban agriculture's new place within the system.[97] Changes *are* taking place on some structural level as food policy is slowly drafted, adopted, and implemented. The extent to which these changes, piecemeal and limited in reach, coalesce and evolve into a robust framework of incentives and regulation that truly challenges the corporate food regime remains to be seen.

[97] I am indebted to Seth Lunine for this insight.

Part 2: Obstacles & Opportunities

Chapter 4:

Cultivating the Commons?
Assessing Urban Agriculture's Potential on Vacant Land in Oakland

While most urban agriculture in North America takes place in private backyards, many urban gardens and farms have cropped up in vacant lots, both publicly and privately owned. As urban agriculture activists, community members, local governments, and non-profit organizations become increasingly committed to expanding local, sustainable food production, both in order to reduce the urban "ecological footprint" and to improve access to healthy food in urban food deserts, the the large number of vacant lots in America's cities are taking center stage in the effort. In addition to the thousands of community gardens that have sprouted up in empty city lots, dozens of larger-scale urban agriculture initiatives have recently taken root on large vacant parcels or in underutilized city parks with the goal of ramping up local food production, making healthy food accessible in urban food deserts, and providing job training and youth employment (Nordahl 2009). Most are launched in collaboration with public agencies through use agreements (see Table 4.1), while others have lease agreements with private landowners or land trusts.

As I discuss in Chapter 1, many urban farmers consider practicing urban agriculture on such vacant lots as reclamation of "the commons", the open spaces, fallows, or wastelands that were historically central to the livelihoods and subsistence of small farmers and laborers.[98] Urban agriculture, as an alternative food source rooted in these commons "ensures that access to basic life-goods like food can be met through non-commodity channels, particularly when sufficient purchasing power is lacking" (Johnston 2008, 100). Such spaces serve not only as sites of production of nutritious produce, but also as recreational spaces where people enjoy the outdoors or share company and culinary and agricultural knowledge (Saldivar-Tanaka and Krasny 2004; Wakefield et al. 2007).

As the shift towards planning for "healthy cities" gains momentum (Corburn 2009) and planners and public health officials alike consider the linkages between food systems, health, and the built environment (Muller et al. 2009; Pothukuchi 2009), locating sites for urban agriculture has become a priority. In the past few years, researchers and planners have conducted inventories in Portland (Balmer et al. 2005), Vancouver (Kaethler 2006), Seattle (Horst 2008), Cleveland (Taggart, Chaney, and Meaney 2009), Detroit (Colasanti and Hamm 2010), and Toronto (MacRae et al. 2010), among others, to locate vacant land with agricultural potential. Some studies have taken the additional step to identify the potential production capacity of the land.

To address the inequities in food and health in the flatlands, food justice organizations in Oakland have eyed the numerous vacant lots in low-income flatlands neighborhoods (particularly in West Oakland) as potential sites for urban agriculture. Until this dissertation research, the scale of such potential production was unknown, both in terms of its spatial extent and its potential contribution to the food system. In this chapter, I detail the development, implementation, results, and outcomes of an inventory of vacant land in Oakland that I conducted in collaboration with one of these food justice initiatives, the HOPE Collaborative, and one of its participating organizations, City Slicker Farms. The goals of the inventory were:

[98] See Chapter 1, especially the section entitled "Social Rift" and Footnote No. 26, on the enclosure of the commons and its relationship to urban agriculture.

1) to identify potential sites for urban agriculture on vacant and underutilized public land in Oakland; 2) to quantify this land; and 3) to estimate its potential contribution to Oakland's food system.

Table 4.1: Some urban agriculture initiatives operating on public land in North America

City	Organization	Public Agency/ Landowner	Description
Alameda, CA	Alameda Point Collaborative	City of Alameda	Ploughshares Nursery and the Growing Youth program on a decommissioned military base
Albuquerque, NM	Rio Grande Community Farm	City of Albuquerque Open Space Division	50-acre organic farm, and includes a 2-acre community garden; offers workshops to the public on farming and traditional foodways, and donates some of its produce to local food banks.
Ashland, CA	Dig Deep Farms	Alameda Co. Fire Department	With support from the Alameda Co. Deputy Sheriffs' Activities League, operates a CSA, provides employment and nutrition education from its garden on land owned by the fire station in Ashland
Boston, MA	The Food Project	Dudley Street Neighborhood Initiative / City of Boston	3 mini-farms on vacant land obtained through partnerships with the Dudley Street Neighborhood Initiative and the city
Brooklyn, NY	Added Value	NYC Parks Green Thumb Program	2 ¾ acre Red Hook Community Farm was established by on a dilapidated playground and grows food for sale to local restaurant and at farmers markets
Brooklyn, NY	East New York Farms	NYC Parks Green Thumb Program	a large market garden on city-owned land and coordinates a farmers market and CSA
Denver, CO	Sprout City Farms	Denver Public Schools	In cooperation with Denver Urban Gardens and the public school, the farm is located on unused school grounds, provides 40 families with a weekly CSA and the school cafeteria with organic produce
Oakland, CA	City Slicker Farms	Oakland Parks and Recreation Department	Community market garden at a small park
Oakland, CA	Phat Beets Produce	Oakland Parks & Recreation Department	Children's Hospital Healthy Hearts Youth Market Garden in partnership with community members
Portland, OR	Zenger Farm	City of Portland's Bureau of Environmental Services	A 6-acre organic farm adjacent to a 10-acre wetland, offering courses on sustainable agriculture, wetland ecology, food security, and healthy eating.
San Francisco, CA	Alemany Farm	San Francisco Recreation and Parks Department	4½ acre urban farm provides the surrounding low-income neighborhood with fresh produce, jobs, and educational opportunities
Springfield, OR	Food for Lane County Youth Farm	Springfield School District	3-acre farm provides summer jobs to a dozen at-risk youth; produces nearly 45 tons of food annually, half of which goes to the food bank, and half marketed to the public via a 30-member CSA and a weekly farm stand run by the youth.
Toronto, ON	Toronto Urban Farm	City of Toronto and Toronto and Region Conservation Authority	8 acres of public land in one of the city's most disadvantaged areas. The farm provides the community with produce and employment opportunities and composts organic waste from local businesses

The chapter is organized as follows. In the first section, I provide the context for the *Cultivating the Commons* project, a geographic information system (GIS)-based inventory of Oakland's vacant and underutilized public land. I then present the methods and results of the inventory, including both GIS-based spatial analysis and "back of the envelope" estimates of urban agriculture's potential contribution to Oakland's fruit and vegetable consumption. Given the iterative nature of the research process, methods and results are described in tandem. I then briefly report the results of an inventory of privately owned vacant land, before discussing the release of and reaction to the original report. I conclude with a discussion of potential limitations of the analysis, and future steps to hone the methodology and move forward with the promotion of urban agriculture at these sites.

Towards an inventory of vacant and underutilized land in Oakland

In 2006 the Oakland City Council embraced a goal of sourcing 30 percent of its food locally, and passed a resolution to support a food system assessment for the city (Oakland City Council 2006a). The resulting Oakland Food System Assessment (OFSA), completed for the Mayor's Office for Sustainability by two UC Berkeley City and Regional Planning students, evaluated the existing avenues of food distribution and consumption in Oakland, including existing food production in the local "foodshed", an area that comprises the counties surrounding Oakland (many with significant agricultural production) and that extends to approximately 200 miles from the city (Unger and Wooten 2006). While the vast majority of food consumed in Oakland comes from outside of this area, local food systems advocates have underscored the importance of having food production within the city itself in order to promote education about the food system, reduce the "food miles" between production and consumption, enhance green space, and create "green job" opportunities.

However, at the time of the OFSA, the potential contribution of food production within the city limits had not yet been studied. As a result, the OFSA's first recommendation regarding local food production was to: "Initiate an inventory of land that is potentially suitable for urban agricultural production. Such an inventory would ideally include both suitable public land (e.g., rights-of-way, easements, parks) and private land (e.g., rooftops, vacant lots, backyard gardens)" (Unger and Wooten 2006).[99] More recently, the HOPE Collaborative contracted Public Health Law and Policy and Food First to conduct a meta-analysis of existing data on production, distribution, consumption, and waste recovery in Oakland's food system. One of the gaps in data identified by the meta-analysis was the need for an inventory of vacant land in Oakland in order to calculate the city's agricultural potential, noting that "Oakland's urban food production capacity has not been fully evaluated" and that "it would be useful to have a better sense of production capacity in order to understand land acquisition and programming needs/costs" (Wooten 2008, 19).

As I explain the dissertation's introduction, my research project emerged to fill this gap. Based on conversations in the fall of 2007 with HOPE Collaborative members (including the authors of the OFSA and several urban agriculture organizations), I decided to move forward with an inventory as part of my dissertation research. In Summer 2008, working in collaboration

[99] The OFSA also contains a "Blueprint for a Publicly Owned Vacant Land Inventory & Management Plan for Urban Agriculture Use" which was authored by City Slicker Farms founder Willow Rosenthal (see Chapter 3).

with David Ralston at the City of Oakland's Redevelopment Agency, I began collecting the necessary geospatial data to conduct such an inventory. Progress was slow through the rest of the year as I learned GIS on the fly, eventually developing a methodology and series of base maps. In early 2009, the HOPE Collaborative's Food System Action Team collectively prioritized the need for such an inventory or assessment as a crucial first step in developing policy and action related to developing a robust food system for low-income food deserts in the flatlands, and provided me with a mini-grant to complete the inventory (under the fiscal sponsorship of City Slicker Farms). The funding allowed me to hire an undergraduate research assistant, Jenny Cooper. The two of us completed the majority of GIS-based analysis and mapping between January and June 2009.

Following my commitment to participatory and relevant research, I established a community advisory committee—made up of members from urban agriculture and food systems organizations, city planners, and community members. During three face-to-face meetings and over email, advisory committee members provided us with vital input in a number of areas: the location of potential sites, criteria for selection of potential sites, and feedback on what type of information would be useful in the finished inventory. In addition, they provided comments on several drafts of the report between June and September 2009.[100]

The final report, *Cultivating the Commons: An Assessment of the Potential for Urban Agriculture on Oakland's Public Land* (McClintock and Cooper 2009), was released in October 2009. The hope was that such an assessment of Oakland's agricultural potential could be used to inform policy decisions concerning Oakland's food, health, and environmental quality. We also intended for the report to be used by non-profit organizations and city officials as a tool with which to identify potential sites for food production. The report included a "Land Locator" (included here as Appendix A1) to serve this purpose.

Initially, Portland's Diggable Cities land inventory (Balmer et al. 2005) provided the methodological framework for this project, as did a UC Berkeley Master's of Landscape Architecture thesis on the West Oakland food system (Harper 2007). We then put out a request for information on land inventories to the Community Food Security Coalition's Urban Agriculture list-serve and were informed of inventories conducted by planning students in Vancouver (Kaethler 2006) and Seattle (Horst 2008). Following the lead of the Portland, Seattle, and Vancouver inventories, our initial intention was to locate Oakland's existing "commons", land that is owned by public agencies and therefore a public resource. More specifically, rather

[100] As I explain the dissertation's introduction, the participatory research design was iterative (Israel et al. 1998), building on my active engagement with the HOPE Collaborative's Food Systems Action Team, and informal interviews and brainstorming sessions with participating community-based organizations and food justice activists. The various components of the inventory were shaped by the needs expressed by the community advisory committee. The integration of community participation is common in environmental justice research and policy advocacy (Petersen et al. 2006; Metzger and Lendvay 2006; Costa et al. 2002). The approach reflects not only the broader "communicative turn" in planning (Healey 1992) that prioritizes participation and collaboration (Forester 1999; Innes and Booher 2010), but also the co-production of science for healthy city planning, what Corburn (2009) describes as a "polycentric, interactive, and multipartite sharing of information" (11) bringing together researchers, government agencies, and lay publics. On a more immediate and practical level, as Mendes et al. (2008) concluded in their study of land inventories in Portland and Vancouver, the success of moving from land inventory to successful implementation of urban agriculture projects relies on the successful integration of stakeholders into the inventory and planning process.

than simply identifying existing community gardens, we were interested in locating the fallow, vacant, or unused commons that could potentially produce food for the city.[101]

Figure 4.1: The inventory included existing open space (top left), lawns (top right), city parks (bottom left), and vacant lots, some of which contained mixed surface (bottom right). Photos taken in June 2009.

[101] Geographer Kevin St. Martin (2009) describes such an approach as "a cartography of the commons that can effectively recast space as a site of multiple economic possibilities and resources as the basis of community livelihoods" (494). He continues that mapping *existing* commons is not enough and "does not so much disrupt the cartographic discourse of capitalism as it maps islands of difference to be defended from a powerful, coherent, and ultimately global capitalism" (ibid.). Developing such a cartography of the commons that actually disrupts capitalism, rather than simply designating and protecting such spaces, requires "mapping a space into which a commons future might be projected" (495). A counter-map of Oakland's agricultural commons therefore should include both *existing* and *potential* spaces of production.

Upon initial examination, we quickly realized that the amount of actual *vacant* public land (e.g., land with no *existing* use, such as a park or lawn or playing field) in Oakland is limited. We therefore chose to broaden the scope of our investigation to include *any* public land that could *potentially* be used for agricultural production. We expanded the study to include lawns, fields, and other open spaces that are currently part of a park or adjacent to a government facility (see Figure 5.1). We did not include open green spaces that clearly have a specific use, such as playing fields. For the most part, we excluded parking lots, but in a handful of cases, we included some that appeared to have been abandoned. Such sites could be used for food production in greenhouses or raised beds, or could house agricultural infrastructure such as a barn, storage area, or composting facility. The decision to include all such spaces—vacant lots, lawns, park turf, abandoned parking lots—was not to advocate for the farming of every single square foot of vacant, park, and open space in Oakland; rather, the goal was to delineate the commons, to identify *potential* spaces of food production and to estimate the productive capacity of these spaces in a scenario where urban agriculture would be integrated with other uses.[102]

The research process has been iterative. In Fall 2010, I worked with another undergraduate research assistant, Snehee Khandeshi, to apply the same methods to a data layer of privately owned vacant land. I also conducted a finer-grained slope analysis to make a more conservative estimate of potentially arable land and to identify optimal sites. A revised version of the report was released in December 2010, coinciding with the launch of an improved website that includes an interactive WebGIS version of the Land Locator, and the printing of hard copies by Food First for distribution to city officials. Since then, two new land inventories have been published that estimate the potential contribution of urban agriculture to vegetable consumption in Detroit (Colasanti and Hamm 2010) and Toronto (MacRae et al. 2010). Inspired by the methods used in these two inventories, I have refined the productivity calculations for Oakland and report them below.

Methods and Results

GIS-based Land Inventory

We used ArcGIS 9.3 geographic information system (GIS) software to identify, delineate, and catalog areas where crops could potentially be grown, as well as to calculate slope, area, and aspect of the sites.[103] The land included in the inventory belongs to public agencies spanning multiple administrative levels, from municipal to federal (see Table 4.2). We first used Alameda County Tax Assessor's parcel data obtained from the City of Oakland's GIS database to identify the nearly 2,600 publicly owned parcels totaling over 10,000 acres of land, or more than a third of Oakland's total 56.1 mi^2 (35,904 acres) of land.

We then used 1-meter satellite imagery from the National Agriculture Imagery Program (NAIP) to identify which parcels contained open space that could potentially be used for food production. We excluded fully developed parcels from the inventory and retained parcels with more than 500 ft^2 of open space. We then clipped out buildings and developed areas such as

[102] Again, this conception of the commons draws on St. Martin's argument that rather than being "a discrete and localized entity," the commons are "a trend, knowledge or process present to varying degrees in any given location" (St. Martin 2009, 496).
[103] See Appendix A2 for a more detailed GIS methodology.

roads, playing fields, and parking lots. We cross-checked all sites with more recent imagery using Google Maps (both satellite and "streetview" perspectives) and ground-truthed approximately ten percent of the sites.

We classified each parcel by ground cover (soil/grass, hard surface, mixed surface, or dense vegetation) and removed land with dense vegetation from the final inventory. The land with dense vegetation was classified separately as land with agroforestry potential. The aggregated remaining area (which included soil/grass, hard surface, and mixed surface) formed the total area classified as having production potential. We then calculated the average slope of each parcel and also assessed whether parcels are within 10 feet of an EBMUD meter, ¼ mile of a school, and/or ¼ mile of an AC Transit bus stop. In the revised inventory, average slope was calculated for each 100 m^2 grid square of the identified sites in order to identify how much of the overall land has a slope under 30 percent.[104] We used 30 percent as a practical threshold slope for cultivation; while agriculture is practiced on slopes greater than 30 percent in many parts of the world, terracing or other stabilization techniques are generally required.

Table 4.2: Public lands assessed for the report

Type of Land	**Landowner or Managing Agency**	**Total Public Land**		**Public Land w/ Urban Agriculture Potential**		
		No. Parcels	Acres	No. Parcels	Acres	% of Total Area
Municipal:						
	City of Oakland	1,167	6,659.4	206	232.7	19.4
	Oakland Parks & Recreation	**	**	266	629.1	52.5
	Redevelopment Agency	104	32.9	8	2.1	0.2
	Housing Authority	343	127.9	13	2.3	0.2
	Oakland Unified School District	165	493.2	10	5.8	0.5
County:						
	Alameda Co. Flood Control	114	50.9	25	8.9	0.7
	Alameda Co. Superintendent of Schools	1	1.8	1	0.6	0.1
	Peralta Community College District	23	188.9	24	36.5	3.0
	AC Transit District	8	23.8	1	0.6	0.1
	County of Alameda	29	159.8	1	8.9	0.7
Regional:						
	Bay Area Rapid Transit (BART)	100	59.4	8	1.9	0.2
	East Bay Municipal Utilities District	115	405.0	48	28.0	2.3
	East Bay Regional Parks District	100	835.8	65	109.0	9.1
State:						
	University of California Regents	19	748.8	41	92.6	7.7
	State of California	248	195.0	39	42.7	3.6
Federal:						
	Amtrak	8	19.1	0	0	0
	US Postal Service	6	9.2	0	0	0
	Other federal land	21	496.7	0	0	0
Total ++		2,551	10,013	756	1,201.7	100

** Oakland Parks and Recreation land is included in City of Oakland total listed in the row above.
++ The sum of individual rows may slightly exceed the total due to rounding

[104] A 100 percent slope is a 100-foot rise over a 100-foot run, equivalent to a 45-degree angle.

Ownership or Management

The vast majority of land identified in the inventory (629 acres, or 53% of the total) is currently owned or managed by the Oakland Parks and Recreation Department (see Table 4.2). The City of Oakland owns an additional 233 acres (19%) of identified land. East Bay Parks manages an additional 9% of the total. The University of California owns most of the land identified in the northern hills adjacent to the UC campus, roughly 8% of the total. Peralta Community College, East Bay Municipal Utilities District, and the State of California also own significant acreage with agricultural potential. No potential sites were identified on federal land.

Spatial Distribution

Overall, we identified roughly 1,202 acres of open space (not including land with dense vegetation) on 496 aggregated sites consisting of 756 individual tax parcels (see Figure 4.2). The sites are distributed relatively evenly across the city, but the vast majority of acreage with agricultural potential is located in East Oakland. A large number of sites are also located in West Oakland. While a significant amount of open space is located on public land in the Oakland hills, much of this land is fragmented, located on steep slopes, and inaccessible by road.

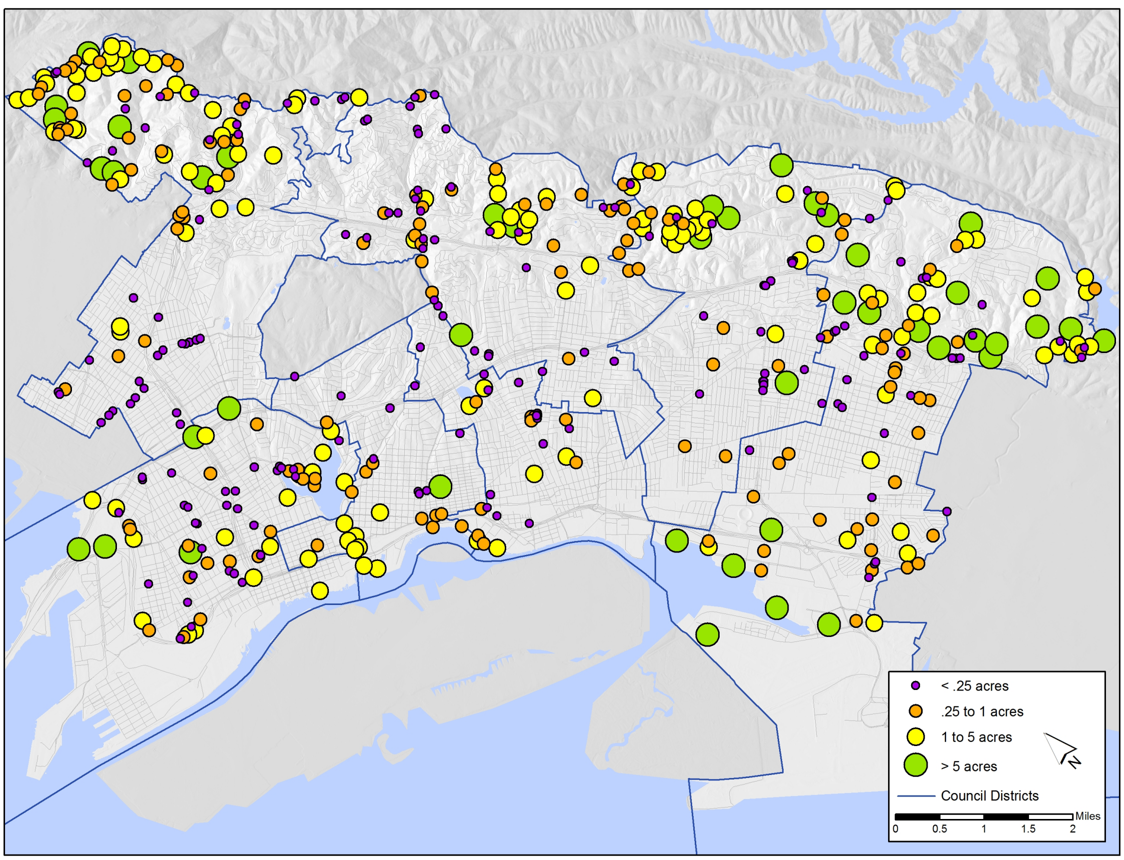

Figure 4.2: Spatial distribution of identified sites with urban agriculture potential, stratified by total parcel area. Note the high concentration of sites in the North Oakland hills (top left). Most of these sites are too steep to farm.

More than a third of the sites are small parcels less than ¼ acre. These small sites would be best suited for community gardens. Another third of the sites are between ¼ acre and 1 acre and might be best used as community gardens or small market gardens run by urban agriculture organizations. A final third of the sites are between 1 and 5 acres and could be developed as large market gardens or "mini-farms" run by urban agriculture organizations or leased to individual commercial urban farmers. Finally, 45 sites are greater than five acres and could be used as urban farms managed by urban agriculture organizations or leased to commercial farmers for large-scale urban production (see Table 4.3).

Table 4.3. Identified sites by size and potential use

Site Size	No.	Total acres	Potential Use
Less than ¼ acre	178	22.3	Community gardens
Between ¼ and 1 acre	144	81.6	Community gardens, small market gardens
Between 1 and 5 acres	129	296.7	Large market gardens, mini-farms
More than 5 acres	45	801.1	Urban farms, grazing
Total	496	1,201.7	

<u>Access to Transit, Schools, and Water</u>

The vast majority of undeveloped publicly owned land is within walking distance of public transportation: 610 of 756 identified parcels are within a ¼ mile of an AC Transit bus stop. Additionally, 32 percent of identified parcels are within a quarter mile of a school. There is an EBMUD water meter within ten feet of 7.5 percent of the parcels (totaling 88 acres).[105]

<u>Ground cover</u>

Eighty-eight percent (1,078 acres) of publicly owned land is arable (soil/grass ground cover). Only 124 acres have more than 500 ft^2. of both hard surfaces and soil/grass ground cover, while 30 acres (26 parcels) consist entirely of hard surface ground cover. Parcels such as these with impermeable ground cover would be suitable for greenhouses, compost processing, distribution centers, and/or storage.

<u>Slope and Aspect</u>

The land is almost evenly divided between level, sloping, and steep land (see Figure 4.3). More than a third of the land (nearly 410 acres) is level to gently sloping land (under a 10 percent slope). Roughly the same amount is gradual (10 to 30 percent) to steeply sloping (greater than 30 percent). Parcels with the most level terrain would be optimal for community gardens.

Aspect, or directional exposure to the sun, is another key consideration when considering crop production, particularly on moderate to steep slopes. Overall, 11.6 percent of the total area faced northwest, north, or northeast. Our "optimal site" calculation of west, south, or east-facing

[105] Due to data limitations, access to water was based on spatial proximity. Precise information about water accessibility at a specific site is available from the East Bay Municipal Utilities District.

parcels with a slope below 30 percent yielded a total of 730.1 acres, or 62.2 percent of the total area (see Table 4.4).

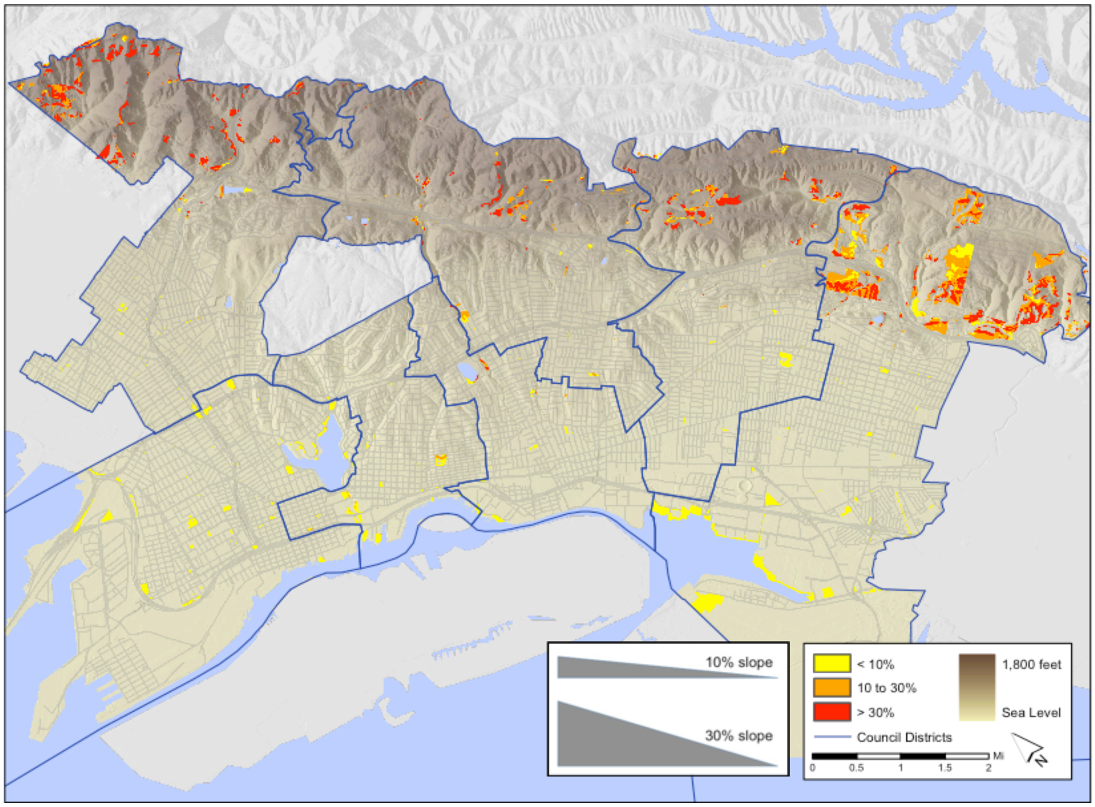

Figure 4.3: Identified parcels categorized by slopes (< 10%, 10 to 30%, and > 30%).

Table 4.4: Land area disaggregated by slope and aspect

	Acres **	% total	Description
Slope			
Under 10%	409.6	34.1	Flat terrain to gradual slope (< 5.7 degrees)
10 to 20%	211.0	17.6	Gradual to moderate (5.7 to 11.3 degrees)
20 to 30%	207.2	17.2	Moderate to steep (11.3 to 16.7 degrees)
Over 30%	374.1	31.1	Very steep (> 16.7 degrees)
Total	1201.9	100.0	
Aspect			
NW-N-NE	140.0	11.6	Often shaded
W-SW-S-SE-E	1061.9	88.3	Receives more direct sunlight
Total	1201.9	100.0	
Aspect + Slope			
Optimal	730.1	60.1	Western, southern, or eastern exposure, slope under 30%
Less Desirable	471.8	39.9	Northern exposure, slope greater than 30%
Total	1201.9	100.0	

** Total difference in area (0.2 ac) is due to conversion from vector to raster data.

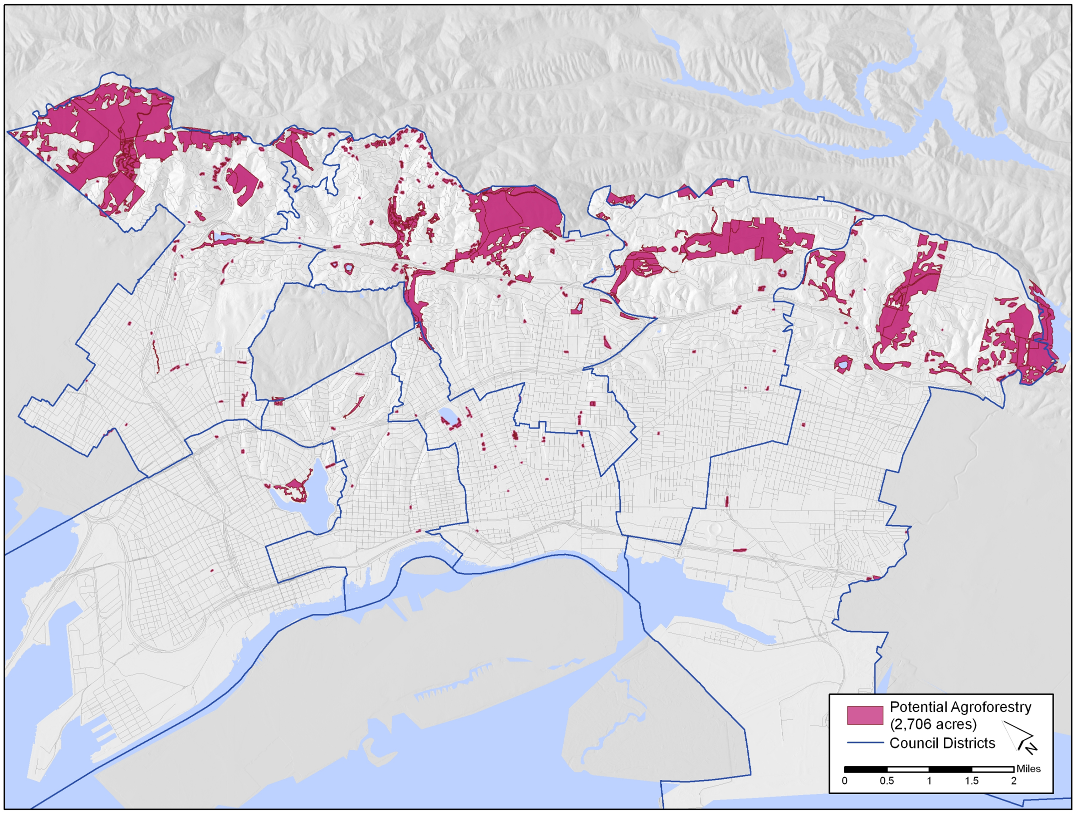

Figure 4.4: Potential agroforestry on public land under tree cover or dense vegetation (totaling 2,706 acres).

Agroforestry Potential

We identified roughly 2,706 acres of dense vegetation (forest, woods, dense shrubs) on public lands in Oakland (see Figure 4.4). While these sites are not included in the overall acreage reported in the previous sections, we included them here to show the extent of Oakland's agroforestry potential. Non-timber forest products, including fruit trees, mushrooms, honey, and small livestock (e.g., poultry, goats, rabbits) can be produced in wooded areas. Since most of this land lies in areas zoned as Open Space or Resource Conservation in the Oakland hills, however, it would be important to first investigate which types of agricultural and/or agroforestry activities are permitted in these areas under existing land use definitions. Such heavily vegetated land not only has agroforestry potential but also serves as a refuge for biodiversity and corridors for the movement of wildlife. A holistic urban greening plan might consider spatial connectivity and how best to incorporate potential urban agriculture sites into this network of wildlife corridors.

Agricultural Zoning

I address the ongoing agricultural zoning update in detail in Chapter 6. At the time of the inventory, municipal zoning codes allowed "Agriculture, Mining, and Extractive Activities" in most parts of the city only with a conditional-use permit. According to the existing use definition, agricultural uses included crop production, animal raising, and plant nurseries. In some parts of the city, all three types of agricultural activity were permitted. Elsewhere, crop and animal production were permitted, while in other locations, particularly along commercial strips, only plant nurseries are permitted. No agricultural uses were permitted in areas zoned for heavy industry (see Chapter 6, Figure 6.1, for a map illustrating these limits).

Calculating Consumption

To calculate the fruit and vegetable needs of Oakland's population, I used population data (sex and age cohorts) from the 2010 US Census. I then aggregated cohorts into larger groups based on USDA and Center for Disease Control recommendations for fruit and vegetable intake. Currently, the USDA recommends 2.5 to 3.5 cups of vegetables per day (456 to 639 lbs/year) for males ten and older, and 2 to 2.5 cups/day (365 to 456 lbs/year) for females ten years old and over. Children under ten should eat 1 to 1.5 cups/day (182 to 274 lbs/year). The recommendations are slightly lower for fruit, ranging from 1 to 2 cups per day. Based on Oakland's 2010 population of 390,724, the aggregated demand of Oaklanders totals roughly 90,766 tons of vegetables per year and 63,410 tons of fruit (Table 4.5).

Table 4.5: Oakland's recommended fruit & vegetable needs

	Oakland Population (2010) [a]	**Fruit**			**Vegetables**		
		Individual	**Citywide**		**Individual**	**Citywide**	
		(cups/day) [b]	(lbs/year)	(tons/year)	(cups/day) [b]	(lbs/year)	(tons/year)
Males							
< 5 yrs	13,396	1	13,396	1,222	1	183	1,222
5 to 9	11708	1.5	11708	1603	1.5	274	1603
10 to 14	10500	2	10500	1916	2.5	456	2395
15 to 19	11,293	2	11,293	2,061	3	548	3,091
20 to 34	46,201	2	46,201	8,432	3.5	1,916	14,755
35 to 79	91,836	2	91,836	16,760	3	4,928	25,140
> 79 yrs	4,585	2	4,585	837	2.5	913	1,046
Females							
< 5 yrs	12,703	1	183	1,159	1	183	1,159
5 to 9	11,286	1.5	274	1,545	1.5	274	1,545
10 to 14	10,325	1.5	274	1,413	2	365	1,884
15 to 19	11,163	1.5	274	1,528	2.5	456	2,547
20 to 44	79,322	2	1,825	14,476	2.5	2,281	18,095
45 to 64	51,250	1.5	1,095	7,015	2.5	1,825	11,691
>64 yrs	25,156	1.5	1,369	3,443	2	1,825	4,591
Total	**390,724**			**63,410**			**90,766**

[a] Data source: (US Census Bureau 2010)
[b] Data source: (USDA 2010)

Table 4.6: Oakland's estimated current and recommended fresh vegetable consumption by crop, based on national per capita consumption (loss-adjusted availability)

Fresh vegetable crop	U.S. per capita consumption [a]	Oakland: Current consumption (estimated)	Oakland: Recommended consumption
	(lbs/year)	(tons/year)	
Artichokes	0.2	42	197
Asparagus	0.3	57	269
Bell peppers	4.6	908	4,308
Broccoli	1.8	360	1,710
Brussels sprouts	0.1	27	129
Cabbage	3.9	761	3,611
Carrots	5.5	1,067	5,062
Cauliflower	0.2	47	225
Celery	3.8	737	3,498
Collard greens	0.1	28	132
Sweet corn	0.3	64	304
Cucumbers	2.9	570	2,703
Eggplant	0.3	60	284
Endive	0.1	18	83
Garlic	1.3	253	1,198
Head lettuce	11.4	2,226	10,559
Kale	0.1	15	70
Leaf lettuce	4.9	961	4,556
Lima beans	0.0	2	8
Mushrooms	1.6	316	1,501
Mustard greens	0.2	29	140
Okra	0.2	31	149
Onions	9.3	1,821	8,637
Potatoes	27.0	5,271	25,001
Pumpkins	1.9	362	1,716
Radishes	0.3	51	241
Snap beans	1.0	201	953
Spinach	0.6	126	599
Squash	2.2	423	2,009
Sweet potatoes	1.4	281	1,332
Tomatoes	10.2	1,997	9,473
Turnip greens	0.1	22	106
Total fresh vegetables	**97.9**	**19,134**	**90,766**

[a] Data source: (USDA 2010)

Two recent studies (Colasanti and Hamm 2010; MacRae et al. 2010) assess the potential for vacant land to contribute to *actual* consumption rather than *recommended* consumption. Following Colasanti and Hamm (2010), I used consumption data from the USDA ERS Loss-Adjusted Food Availability Database (USDA 2010) which calculates average national per capita fruit and vegetable consumption from aggregate production, adjusting for losses between production and consumption. Table 4.6 above reports per capita fresh vegetable consumption by crop at the national level and extrapolates to an estimate of current consumption in Oakland. Using the percent share of overall fresh vegetable consumption, I calculated the recommended citywide annual consumption by crop using the total recommended vegetable consumption calculation of 90,766 tons. According to the USDA, Americans annually consume 97.9 lbs of fresh vegetables per capita and 54.2 pounds of fresh fruit per capita. Assuming that Oakland follows the same pattern, Oaklanders currently consume 19,126 tons of fresh vegetables (or 21 percent of the recommended total) and 10,589 tons of fresh fruit each year (17 percent of the recommended total).[106]

Calculating Productivity

Using sustainable farming techniques, one acre of land can produce an average annual yield of 10 to 20 tons of vegetables, depending on management techniques. For the original *Cultivating the Commons* report, we used a conservative yield estimate of 10 tons/acre to calculate the potential productivity. This figure was derived from the average statewide yields of 15 crops grown in Oakland (CDFA 2010), as well as interviews with three organic farmers in Northern California and Oregon. A Toronto study (MacRae et al. 2010) simply uses Statistics Canada data unadjusted for losses, while a Detroit study (Colasanti and Hamm 2010) uses USDA data to calculate farm to consumer losses at different stages in the commodity chain. They also use three different production scenarios to estimate the amount necessary to meet consumer demands: high-productivity biointensive, low-productivity biointensive, and commercial. Following the Detroit researchers' methodology, I averaged California statewide yield data from 1998 to 2008 (CDFA 2010) for the vegetable crops listed in the USDA ERS Loss-Adjusted Food Availability Database (USDA 2010) as well as low and medium yields for biointensive methods (Jeavons 2002). The low biointensive yield data assumes a beginning gardener. Unlike Colasanti and Hamm, I chose to use medium biointensive yields rather than the high biointensive yields (which many gardeners argue are unrealistic). On average, vegetable yields under conventional growth average 13.2 tons per acre (see Table 4.7). Low biointensive yields are slightly higher (15.4 tons/acre) while medium biointensive yield averages are twice as high (30.8 tons/acre).

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[106] Vegetable consumption is closely correlated to education and income, with significant differences in consumption between races/ethnic groups (Casagrande et al. 2007). Indeed, considering that 22% of Oakland's population lives in poverty relative to 15% nationally (US Census Bureau 2010), the amount of fruits and vegetables actually consumed is likely lower. Additionally, African Americans consume less produce on average and comprise 28% of the city's population (compared to 13% nationally). Lower consumption rates are likely a function of higher rates of poverty (28% in Oakland and nationally) and a disproportionate chance of living in a food desert (Beaulac, Kristjansson, and Cummins 2009). Furthermore, the USDA averages likely do not reflect Oakland's ethnic—and culinary—diversity; the culinary traditions of the city's large Asian and Latino populations (17% and 25% of the city's population, respectively, versus 5% and 16% of the US population) are rich in vegetables, many of which are not represented in the USDA data.

The national USDA database reports average estimated post-harvest losses at various stages between farm and table: farm to retail, retail to consumer, and inedible share (i.e., the portion of the raw vegetable, such as stems, that are not actually consumed). Table 4.7 lists these losses for each crop of interest. On average, there is a 63 percent loss in weight from farm to table. Crop production plans must therefore account for these losses when attempting to meet a population's consumption needs.

Table 4.7: Average yields (under conventional and biointensive methods) and average losses for vegetable crops

	Average Yields			Average Losses			
Crop	**Conventional**	**Bio-intensive (low)**	**Bio-intensive (medium)**	**Farm to retail**	**Retail to consumer**	**Inedible share**	**Total farm to table loss**
	(tons / acre)			(%)			
Artichokes	6.1	n.d.	n.d.	7	19	60	49
Asparagus	1.5	2.1	4.1	9	9	47	57
Bell peppers	15.0	7.8	15.7	8	8	18	73
Broccoli	7.5	5.7	11.3	8	12	39	59
Brussels sprouts	9.0	15.5	30.9	8	19	10	71
Cabbage	20.0	20.9	41.8	7	14	20	68
Carrots	15.0	21.8	43.6	3	5	11	83
Cauliflower	9.0	9.6	19.2	8	14	61	50
Celery	36.5	52.3	104.5	7	5	11	80
Collard greens	8.5	20.9	41.8	12	38	43	45
Cucumbers	12.0	34.4	68.8	8	6	27	69
Eggplant	10.0	11.8	23.5	10	21	19	63
Escarole /endive	7.8	n.d.	n.d.	10	47	14	54
Garlic	8.5	13.1	26.1	19	7	14	69
Head lettuce	18.0	16.3	32.7	7	9	16	74
Kale	10.0	16.6	33.1	12	39	39	46
Leaf lettuce	11.5	29.4	58.8	7	14	21	68
Mushrooms	35.9	n.d.	n.d.	6	13	3	53
Mustard greens	7.5	39.2	78.4	12	63	27	81
Onions	22.5	21.8	43.6	6	10	10	78
Potatoes	18.5	21.8	43.6	4	7	0	90
Pumpkins	12.0	10.5	20.9	10	11	30	63
Radishes	11.5	21.8	43.6	3	21	10	73
Snap beans	5.0	6.5	13.1	6	18	12	71
Spinach	8.0	10.9	21.8	12	14	28	61
Squash	10.0	10.9	21.8	10	13	17	69
Tomatoes	15.0	21.8	43.6	15	13	9	70
Turnip greens	n.d.	5.4	10.9	12	41	30	49
Fresh vegetables	**13.2**	**15.4**	**30.8**	9	18	24	**63**

n.d. = no data
Source data: (Jeavons 2002; CDFA 2010; USDA 2010)

Table 4.8: The local/seasonal share of current and recommended levels of consumption in Oakland based on seasonality (possible months of production)

Crop	Total months of production	Possible local/seasonal share of production based on seasonality (%)	Possible local/seasonal share of: estimated current consumption levels	recommended consumption levels
			------------------------ (tons)	-----------------------
Artichokes	10	83	35	164
Asparagus	5	42	24	112
Bell peppers	7	58	530	2,513
Broccoli	12	100	360	1,710
Brussels sprouts	12	100	27	129
Cabbage	12	100	761	3,611
Carrots	12	100	1,067	5,062
Cauliflower	10	83	39	187
Celery	9	75	553	2,624
Collard greens	11	92	26	121
Sweet corn	0	0	0	0
Cucumbers	6	50	285	1,352
Eggplant	4	33	20	95
Endive	12	100	18	83
Garlic	12	100	253	1,198
Head lettuce	12	100	2,226	10,559
Kale	12	100	15	70
Leaf lettuce	12	100	961	4,556
Lima beans	0	0	0	0
Mushrooms	12	100	316	1,501
Mustard greens	6	50	15	70
Okra	0	0	0	0
Onions	12	100	1,821	8,637
Potatoes	11	92	4,831	22,918
Pumpkins	4	33	121	572
Radishes	12	100	51	241
Snap beans	12	100	201	953
Spinach	12	100	126	599
Squash	5	42	176	837
Sweet potatoes	0	0	0	0
Tomatoes	6	50	999	4,737
Turnip greens	7	58	13	62
Fresh vegetables			**15,869**	**75,274**

[a] Data source: (USDA 2010)

The Detroit study also considers seasonality and the ability to produce a specific crop in the local agroecosystem. Following their methodology, I used the number of months that a particular crop can be grown in Oakland to calculate the possible local/seasonal share of production (see Table 4.8). Four of the USDA database crops—lima beans, okra, sweet corn, and sweet potatoes—require warmer and sunnier conditions and do not grow well in Oakland, and therefore do not contribute to the possible local share of production. Based on this percentage and estimated current and recommended consumption listed in Table 4.6, I calculated the potential *local/seasonal* share of current and recommended consumption.

In order to calculate overall production necessary to meet both estimated current consumption and recommended consumption levels, it is necessary to factor in the farm-to-table losses. The final calculation ranges from 28,884 tons needed to meet estimated current consumption levels to 137,016 tons to meet recommended levels (see Table 4.9). Based on possible local/seasonal contribution to production listed in Table 4.8 above, overall local contribution to production needs is slightly lower.

Table 4.9: Total and locally possible vegetable production (including losses) necessary to meet existing and recommended consumption needs in Oakland

	Production needed to meet:	
	estimated current consumption levels	**recommended consumption levels**
	---------------------- (tons)	-------------------
Total production needed (including losses)	28,884	137,016
Possible local/seasonal share of total production (including losses)	23,954	113,630

Calculating Potential Contribution of Vacant Land to Production

As I mention above, we used a conservative yield estimate of 10 tons/acre annually in the original *Cultivating the Commons* report to calculate the potential productivity of Oakland's vacant land. Using this estimate, Oakland's 828 acres of arable public open space could potentially produce as much as 8,280 tons of vegetables, or 9 percent of the recommended annual vegetable consumption needs of the city (not including losses). Using a conservative average fruit yield of 5 tons per acre (also derived from CDFA yield averages), the same amount of land could produce 4,140 tons of fruit, or roughly 6 percent of the recommended total for the city.

This was a first attempt at a rough "back of the envelope" calculation to illustrate the hypothetical potential for Oakland's publicly owned land to contribute to the *recommended* diets of the city's population. Of course, not all of the city's open space should be converted to agriculture and the push for urban farming should not overpower other uses of urban green space; after all, public open spaces must serve multiple purposes. Taking this into consideration, we recommended a hypothetical use of only half of the available open space for urban agriculture. As such, we estimated that the city's public land could produce nearly 4.5 percent of Oakland's vegetable needs, or 3 percent of fruit. An even more conservative estimate would take into consideration that small community or school gardens may not be as productive as commercial market gardens and mini-farms. As such, we offered 3 percent of vegetables or 2 percent of fruit as a safer, more realistic estimate, with the caveat that intensive ecological horticulture practices can increase yields dramatically.

Based on the consumption and production recalculations described above, however, the contribution may indeed be higher. I present here the estimated contribution to Oakland's current and recommended vegetable consumption using four different land use scenarios (see Table 4.10). The first two scenarios use the total acreage calculated in the GIS inventory. Scenario 1 assumes that all 828 acres of land with a slope under 30 percent slope would be used for vegetable production, while Scenario 2 uses the 730 "optimal" acres (i.e., the 828 acres excluding all north-facing land). Scenarios 3 and 4 represent two arbitrary amounts of land—500 and 100 acres, respectively—that could be set aside for urban agriculture, for example, by an act of City Council. Also calculated is the potential contribution under three agricultural management practices: conventional, biointensive (low), and biointensive (medium): 10, 15, and 25 tons/acre, respectively.[107]

Table 4.10. Potential contribution of urban agriculture on public land to Oakland's estimated and recommended vegetable needs under three management types and four land use scenarios

Consumption Level	Agricultural management practice	Avg. Yield (tons/ ac)	Area needed (acres)	Land Use Scenario 1 (828 ac)	2 (730 ac)	3 (500 ac)	4 (100 ac)
				(% contribution to vegetable needs)			
Current (estimated)	Conventional	10	2,582	32.1	28.3	19.4	3.9
	Biointensive (Low)	15	1,722	48.1	42.4	29.0	5.8
	Biointensive (Med)	25	1,033	80.2	70.7	48.4	9.7
Recommended	Conventional	10	12,250	6.8	6.0	4.1	0.8
	Biointensive (Low)	15	8,167	10.1	8.9	6.1	1.2
	Biointensive (Med)	25	4,900	16.9	14.9	10.2	2.0

The calculations presented in Table 4.10 above shed light on urban agriculture's surprising potential in Oakland. Even the most modest goal of devoting 100 acres to vegetable production could, under ideal growing practices, could yield nearly 10 percent of the city's vegetable consumption. Dedicating 500 acres could produce nearly half of the estimated current consumption needs. Because recommended consumption is so much lower than current consumption, urban agriculture's potential to meet these recommendations is lower. The modest 100-acre scenario would, at best, contribute 2 percent to the city's food recommended consumption needs, while the 500-acre scenario could deliver between 4 and 10 percent depending on management practices.

[107] For the sake of developing a "back of the envelope" metric for other studies, I rounded down to a slightly more conservative average yield for each of these management practices than those presented in Table 5.6.

Private Land

Using a shape file of Oakland's vacant parcels obtained from the UC Berkeley Department of City and Regional Planning, we followed the same GIS protocol in Fall 2010 and Spring 2011 to calculate the amount of potentially arable privately owned vacant land. Using ArcGIS 10, we verified the parcel file using current Bing Maps satellite imagery (a feature of the updated software) instead of NAIP imagery. In this case, however, we did not reshape or clip parcel polygons due to the high volume of parcels in the original data set (4,249 individual parcels). Instead, if the parcels were at all developed, they were removed entirely from the inventory under the assumption that the landowner had an existing use for the property. Similarly, forested or heavily vegetated sites were also removed from the total.

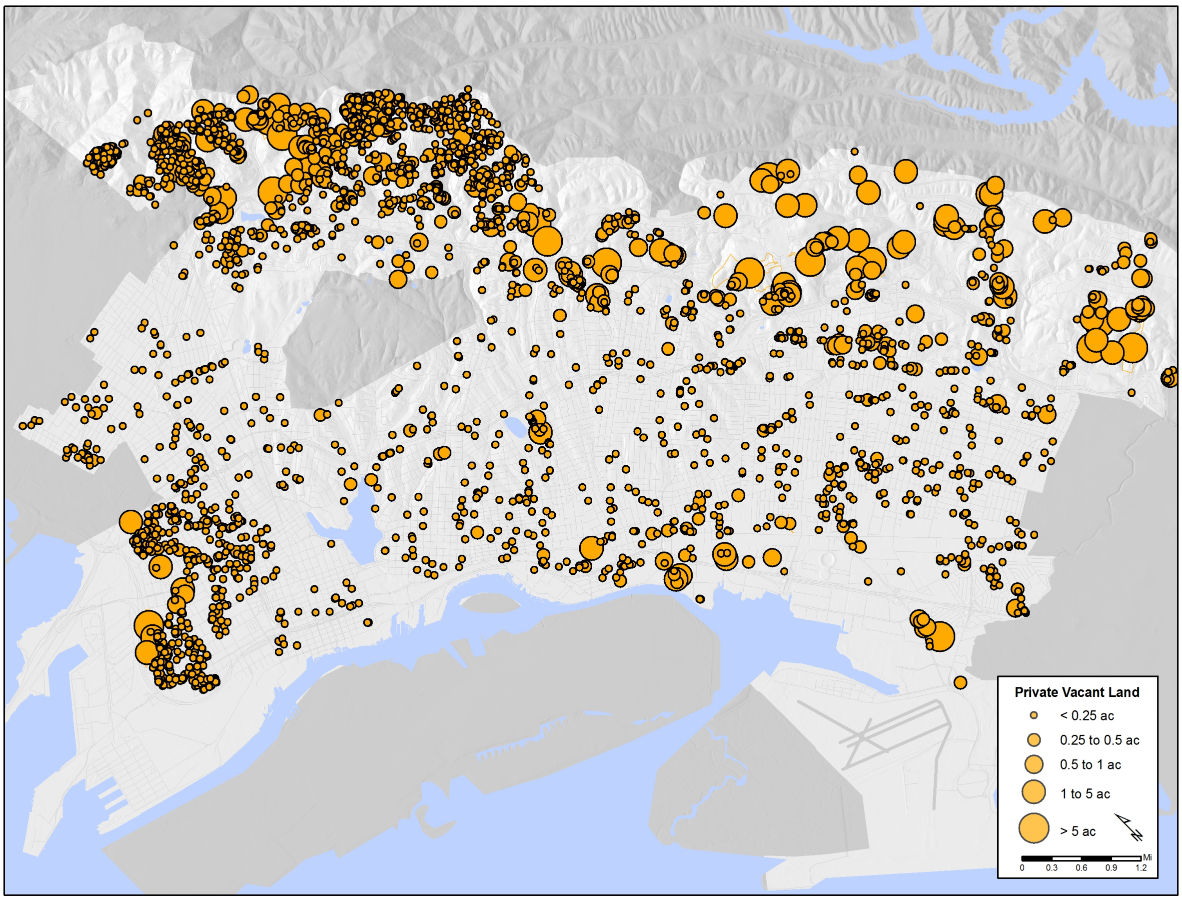

Figure 4.5: Privately owned vacant land in Oakland.

Overall, we identified 3,008 privately owned vacant parcels, totaling 864 acres (see Figure 4.5). The vast majority of this land consists of lots smaller than ¼ acre (2,484 lots totaling 289 acres). Fifteen large parcels (5 acres or greater) account for 262 acres, or about a third of the land (see Table 4.11).

Table 4.11: Size distribution of privately owned vacant land in Oakland

Parcel Size	No. Parcels	Total Acres
100 ft^2 to ¼ acre	2,484	289
¼ to ½ acres	338	113
½ to 1 acres	115	81
1 to 5 acres	56	119
> 5 acres	15	262
Total	**3,008**	**864**

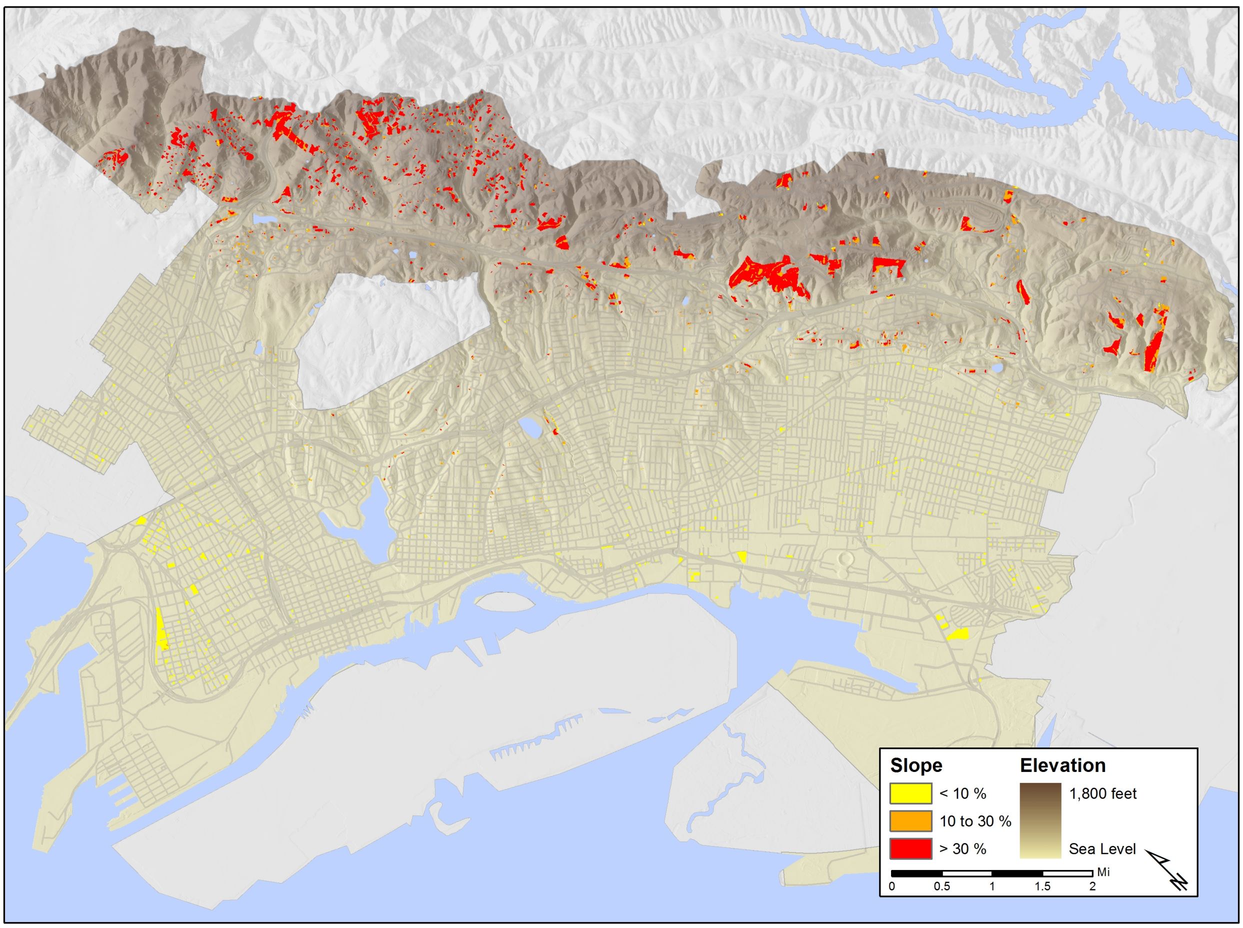

Figure 4.6: Slope analysis of privately owned vacant lots in Oakland.

A slope analysis of vacant lots reveals that only 40 percent, or 337 acres, of the overall area has less than a 30 percent slope (see Figure 4.6). Many of the largest parcels are located on steep slopes in the Oakland hills, likely the reason that they have not been developed. Using the methods described above to calculate potential contribution of urban agriculture to Oakland's food system, private vacant could contribute an additional 3,370 tons under conventional farming practices, and as much as 8,425 tons under medium-yield biointensive methods, or 13 to 33 percent of Oakland's estimated current vegetable needs, or 3 to 7 percent of recommended needs (see Table 4.12).

The analysis also reveals that a majority of arable sites are located in the flatlands where urban agriculture advocates are most active and the need for healthy produce the greatest. Unlike the public land inventory, however, calculating the potential contribution of private vacant lots is, for all practical purposes, simply an exercise. The limitations to accessing private land via policy or regulation are manifold, given the sanctity of private property in the US. Nevertheless, the analysis reveals that private land in Oakland could potentially make a minor contribution to the city's food system if the proper policies were developed to incentivize landowners to grant urban farmers use of their property. A municipal government could waive blight fines or provide property tax credits for vacant property owners allowing cultivation on their property, for example.

Table 4.12. Potential contribution of urban agriculture on private vacant lots to Oakland's estimated and recommended vegetable needs under three management types

Consumption Level	**Agricultural management practice**	**Avg. yield** (tons/ac)	**Area needed** (acres)	**Potential contribution to vegetable needs** (%)
Current (estimated)	Conventional	10	2,582	13.1
	Biointensive (Low)	15	1,722	19.6
	Biointensive (Med)	25	1,033	32.6
Recommended	Conventional	10	12,250	2.8
	Biointensive (Low)	15	8,167	4.1
	Biointensive (Med)	25	4,900	6.9

Release of the *Cultivating the Commons* Report and Public Response

The *Cultivating the Commons* report was officially released to the public on October 30, 2009. A press release was circulated and the report was made available for download both at the project website (www.urbanfood.org) and the Oakland Food Policy Council site (www.oaklandfood.org). Using Google Analytics, we were able to track the number of visits to the project site. Within the first month (November 2009), 525 unique visitors viewed the site. While the vast majority of visits were from California, the report was viewed across the US and in 42 countries in North and South America, Europe, Africa, and Asia. Because the report is also available for download from the Oakland Food Policy Council (OFPC) website and Google Analytics set up three days after the initial release and press release, this count reflects only a partial number of visitors. On average, the site receives 200 to 300 visits monthly. As of October 12, 2011, the site had received 10,191 visits from 117 countries since its launch, with more than 7,700 "absolute unique visitors", most of whom (43%) accessed the site from California.

Cultivating the Commons was released in conjunction with a groundbreaking ceremony for the City Slicker Farms Community Market Garden in West Oakland. The garden is an example of the collaboration envisioned in the report, where food justice programs establish gardens and mini-farms on underutilized open space. The director of the Oakland Parks and Recreation Department Audree Jones Taylor heralded the new market garden as a model of collaboration between the city and food justice organizations, providing food in so-called “food deserts” while relieving some of the financial burden of the parks maintenance for the city.[108]

A second edition of the report, which included a revised calculation of productivity based on a finer-grained analysis of slope and aspect was released a year later to coincide with the release of the OFPC’s action plan, *Transforming Oakland’s Food System*. Twenty-five hard copies of the report were printed by Food First (the Institute for Food and Development Policy), the OFPC’s legal and fiscal home, and were distributed alongside the OFPC report to City Council members, and officials from the city’s Planning and Redevelopment Departments.

Print and internet media coverage of the report contributed to public interest in the project. An article on the release of the report appeared in the *Oakland Tribune* and *Contra Costa Times* on 7 November 2009, and was the day’s top headline on the *Tribune* website and one of the “Most Emailed Articles”. Other local news websites such as Oakland Local and Oakland North also highlighted the report, as did the Vancouver-based City Farmer site (www.cityfarmer.info), a clearinghouse of news stories related to urban agriculture.

Given the current fervor for urban agriculture, the report has proven a useful tool for policy advocates and practitioners alike. As I will discuss in Chapter 6, the report was used to develop the Oakland Food Policy Council’s recommendations to the City last year (OFPC 2010). More recently, Oakland Climate Action Coalition relied on the study to develop an Energy and Climate Action Plan (ECAP) for Oakland. In February 2011 the Coalition presented a draft of the ECAP to City Council that recommended "securing and cultivating 1,000 acres of underutilized public and private lands for sustainable agriculture and community gardens." While the Council did not guarantee a specific acreage, they approved language calling for increased acreage and a zoning update for urban agriculture, and pledged to work to increase access to both private and city-owned lands (Lehmer 2011). Several organizations have used the Land Locator to identify potential sites for expansion of urban agriculture programs, and as part of a local high school’s Sustainable Urban Ecology and Design curriculum program as they move forward with a proposal to develop an urban garden in a neighboring park.

While the media attention attracted the attention of urban agriculture advocates and planners interested in extending similar studies to their own cities, it also raised the ire of at least one Oaklander concerned that urban agriculture would come into conflict with open space. The reader, posting a comment posted the morning of the *Oakland Tribune* article, vented:

[108] Sadly, this relationship speaks to a fundamental contradiction: the rise of urban agriculture in Oakland and elsewhere in the US has occurred in tandem with municipal budget shortfalls and consequent slashing of parks funding. In such dire economic times as these, parks departments depend on for-profit, non-profit, and volunteer groups to maintain low-priority parks and open space. The reliance of municipal governments on these kinds of outside organizations, so-called “flanking mechanisms” (Castree 2008), exemplify the “roll out” of non-state actors to fill in the gaps in the social safety net (including maintenance of public goods such as parks and infrastructure) left by the “roll back” of the state in the current neoliberal era (Peck and Tickell 2002; Brenner and Theodore 2002). For more on the role of for-profit and non-profit groups in parks, see Perkins (2009a, 2009b).

> Right, let's turn some of Oakland's last natural open space in the South Hills into farm land. Get outa here. Take this acreage away and you've got a few hundred vacant lot plots going. That works for me, but leave Knowland Park and surrounding areas unmolested. (Posted by nmnutz, 11/7/09, 7:26 am)

While one must not assume that public comments posted to websites or blogs are representative of a majority, the comment does highlight potential land use conflicts that may arise if significant acreage is shifted to urban agriculture. I return to this and other potential obstacles in the final section of this chapter.[109]

Limitations and Future Directions, Lessons Learned

This project represents a necessary first step in assessing the potential expansion of urban agriculture in Oakland. While the inventory was comprehensive, there were some limitations worth noting. One primary limitation was the currency of geospatial data. Even though the tax assessor data file was purported to be updated quarterly (as noted in the file's metadata), there were several instances where a parcel had been sold and developed since the last update. Indeed, there appeared to be a lag time before the shape files were updated to correspond with the tax assessor database, accessible from a different site. Because of the dynamic nature of development plans and real estate transfers, data would ideally be crosschecked with managing agencies and the online tax assessor database; time and labor constraints prevented us from doing so. An even more precise tally of public land would require an audit of vacant or underutilized parcels with urban agriculture potential by individual agencies and municipal departments, such as the one recently conducted in San Francisco following an Executive Order (Newsom 2009). As an outside researcher without access to the tax assessor database, it was only possible to provide this "snapshot" of vacant land in 2009. To make the information in this inventory more available to the public, a searchable online interactive GIS version of the inventory would ideally be linked to the existing tax assessor database and updated as sites are ground-truthed and determined to be inappropriate for agriculture, if they are discovered to fall under an existing development plan, or are sold or transferred to another owner.

The currency of aerial imagery was also an obstacle. When this project was completed, only 2005 NAIP imagery was available, thus the visual record of land use was already four years old. To account for this, we crosschecked all sites using Google Maps to see if they had been developed in the interim. While we were able to then delete newly developed sites from the inventory, we were unable to account for changes in vegetation. New NAIP imagery, flown in Summer 2009, was released in October 2009 after we had completed the project. Since this inventory was conducted, a newer version of ArcGIS has been released that allows users to add a current Bing basemap image. For analysts using Q, GRASS, or other open source GIS software, the new NAIP imagery is a free alternative, but has slightly lower resolution than Bing or Google.

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[109] Indeed, attempts by a school, food justice organization, and OPR to establish a garden at King's Estates Open Space, one of these South Hills open space areas sites identified in the report, were stalled by one particularly vocal environmentalist at a community input meeting. The opponent, angered that the garden was being proposed in a Resource Conservation Area, managed to convince community members, who had been up to that point supportive of the idea, that conservation and food production are not compatible.

The study also revealed the limitations of a visual assessment. Even with 1-meter resolution, what appears to be arable in an aerial or satellite-photo may not necessarily appear as such on the ground. The annual grasses of the Bay Area turn a golden brown color during the dry season, making them difficult to distinguish from bare dirt or concrete at some sites. To account for the limitations posed by visual assessment, we ground-truthed as many sites as possible. At the time of the 2009 release of the report, we had visited roughly 10 percent of the sites. In cases where urban agriculture would be impossible, we removed the site from the inventory.[110] While we visited more than one hundred and fifty sites, and cross-checked all sites using Google Maps Streetview, further assessment of sites should be conducted to determine if all of them are actually viable for food production. Indeed, it was this ground-truthing that ultimately prompted the revised slope analysis in 2010 to remove slopes that would realistically be too steep to farm.

The next step would be to prioritize site suitability. The sites identified in this inventory were categorized based on size, slope, and aspect. While information on ground cover, presence of a water meter, accessibility to public transportation, and proximity to schools were included for each site listed in the Land Locator, these factors (selected by the advisory committee) were not used in the report as a measure of land suitability or aggregated into a measure to be used for ranking site suitability; rather, they were simply presented as relevant data to help guide such decisions. A prioritization or ranking of sites for suitability could include some or all of these factors, as well as new ones.[111] Soil quality, in particular, is an issue in urban areas. Many urban soils have high levels of lead and other contaminants due to point sources such as chemical spills or flaking paint from houses and non-point sources such as atmospheric deposition of particles from industry and vehicle exhaust and brake wear.[112] Incorporating soil sample data, along with EPA Brownfields and California Department of Toxic Substances Control data, are essential to future stages of site suitability assessment.

Other factors and methods would also help to narrow down the overall suitability. Since the completion of our inventory in 2009, several other land inventories have been released, including metropolitan Cleveland/Cuyahoga County (Ohio), Halifax (Nova Scotia), Boulder (Colorado), and Somerville (Massachusetts). Each of these inventories includes additional variables that could be used in a finer grain analysis. Some of these analyses are more dependent on high-resolution geospatial data than others. The Halifax inventory, for example, uses LiDAR data to model potential sun exposure at different times of day in potential backyard gardens in several sample neighborhoods, and calculated an additional 22% loss of available space due to shading (Nipen 2009). The Somerville report cites the methods used in *Cultivating the Commons*, but also includes soil type and population density in their analysis (Bickerdike et al. 2010). The Cleveland inventory, conducted by the Cleveland-Cuyahoga County Food Policy Coalition, cites our methodology but also includes presence of hydrological features and soil, as well as proximity to community gardens greenhouses and other consumer markets. Furthermore,

[110] We further ground-truthed an additional one hundred and twenty sites in 2010, but this was only possible due to a National Science Foundation grant funding a comprehensive soil sampling project (see Chapter 5).

[111] In the report's Appendices, we included a proposed set of criteria for urban agriculture sites that originally appeared in the Oakland Food System Assessment (Unger and Wooten 2006). Criteria include size, slope, soil quality, tenure, access, availability of water, and waste disposal.

[112] In Chapter 5 I present the results of an assessment of lead (Pb) at more than a hundred sites identified in this inventory. The assessment needs to be expanded to include other metals and organic contaminants such as PCBs. Preliminary analysis indicates that Pb levels are lower than expected across the city, but that levels are highly variable at each site and are dependent on a number of variables including soil type, density of pre-1940s housing, distance to major roads, and levels of soil carbon and soil phosphorus.

it excludes industrial and brownfields sites. Rather than visually identifying and clipping forested areas, the inventory used remote sensing software to classify land use categories (Taggart, Chaney, and Meaney 2009). Similarly, the Boulder study also relies on sophisticated remote sensing methods to identify potential arable land, including lawns greater than 1,000 square feet (Welty 2010).

One of the major drawbacks of our approach was its labor intensiveness. The visual assessment of each parcel was incredibly time consuming, and clipping out vegetation and buildings and other reshaping of polygons added a significant level of detail to the project. The HOPE mini-grant funded 140 hours of GIS work, but we easily spent twice this amount of time on the GIS work alone. The use of remote sensing software to process aerial imagery would certainly speed up the process, but would be complicated by shading from buildings and differentiating dry vegetation from other surfaces. Using higher-resolution imagery for the entire city would also require significant computer memory and data processing capabilities. As a result, some of the inventories listed above assessed parcels in only certain areas of the city (e.g., Halifax, Boulder, Detroit, and Toronto) and extrapolated their results.

There are clearly also limitations to calculating vegetable consumption (and by extension, necessary production) at the city or neighborhood scale. Interpolating consumption based on national averages is clearly problematic, especially when the demographic of poverty, race, and ethnicity—all of which factor into food consumption patterns—differ between the municipal and national scale. Consumption patterns between the flatlands and hills are surely different, hence the activism that has emerged to address these inequities! A more accurate estimate of consumption would require in-depth assessments stratified along socio-economic lines. This would also help to reveal the full spectrum of crop varieties that people actually consume in Oakland. Similarly, estimates of the local/seasonal share of crop production should be fine-tuned using crop yield data specific to East Bay agroecosystems.

Relying on population estimates is also problematic. The difference in the 2010 estimated population and actual population was a significant source of error in the original report, completed before the 2010 Census took place. For the original report, I used the 2006 estimated population for 2010 of 423,000 along with sex and age cohort data from the 2000 Census to extrapolate the city's recommended consumption. The timely release of 2010 Census data, however, revealed that Oakland's population has *decreased* by nearly 10,000 people since 2000, and is actually 32,000 people less than the 2006 estimate for 2010. The difference between the estimated and actual populations amounted to a difference in estimated consumption of roughly 3,000 tons.

I would also argue that the USDA loss estimates are likely too high for a localized food system. Indeed, they reflect the average losses for vegetables that travel more than 1,000 miles on average from farm to plate (Weber and Matthews 2008). Under a localized production system where more produce is sold at farm stands and farmers' markets, we can assume lower rates of loss between retail and consumer. For this reason, our overall production estimates are likely more conservative than they need to be. It is important to keep in mind that this project, like other inventories, solely sought to provide a rough estimate of urban agriculture's potential contribution to the food system. The use of aerial imagery and yield and consumption data based on state and national averages necessarily brings a certain level of error into the calculation.

Despite the methodological limitations outlined above, mapping the commons—both existing and potential—was an important first step in an ongoing process to bring urban agriculture's potential to fruition in Oakland. It will surely take a long time for cultivation of the commons to reach the 100 or 500 acres as envisioned in the scenarios presented earlier. As the comment by the angry *Oakland Tribune* reader illustrates, the real work in planning for urban agriculture lies in negotiating the varied interests of multiple stakeholders. Additional analyses, as described above, may help stakeholders prioritize sites, but the prioritization process itself will depend on how well differing views of land use are negotiated and integrated and on how such spaces are valued.

In addition to the group of people concerned that urban agriculture may infringe on the conservation of "wild", "natural", or "pristine" open space,[113] there are other interests who simply challenge urban agriculture primacy as a legitimate use for vacant land. In the eyes of some, these sites are simply too valuable and should be sold to developers. As one Parks and Recreation employee (who wished to remain anonymous) reported, "At a meeting where urban ag was discussed, 'suits' from other city departments overtly said that they don't want people starting to garden city property, because once the land value increases and they want to develop it, it will be difficult to kick them off" (anonymous OPR staff, personal communication, 12/21/10). Making the case for urban agriculture may be difficult when a parcel's market value is set as the bottom line.[114]

Clearly, the politics of negotiating competing uses of vacant land is far more complex than identifying potential sites of production. Ultimately, the delineation of polygons is only a preliminary step in the long process of mapping Oakland's agricultural commons. Nevertheless, mapping both existing and potential agricultural sites not only identifies locations and posits their potential contribution to the food system, but also helps to embed the landscape with alternative possibilities, a first step in realizing a vision of what an alternative food system might look like. How this vision is ultimately interpreted and mobilized—and by whom—will also become part of this process.[115]

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[113] I use scare quotes here to call into question what constitutes such categories, particular in an urban environment. See Smith (2008) on the production of nature, Cronon (1996) on the production of wilderness, and Heynen et al (2006a) on the production of urban natures.

[114] This tension reflects a fundamental paradigmatic incompatibility. For urban farmers, gardens are "appropriated localized 'places' saturated with incommensurable use value" while for the entrepreneurial city, such sites are "abstract 'spaces' of commensurable exchange values" (Schmelzkopf 2002, 335).

[115] This raises a fundamental tension when mapping the commons. If mapping is a necessary prerequisite to capitalist profit seeking (Harley 1988), an inventory of vacant land—despite anti-corporate, food justice-oriented motivations—may open up new spaces for capitalist accumulation. By rendering these unused spaces legible, inventories essentially risk subsidizing land speculation, providing developers or speculators with a free catalog of unused spaces.

These theoretical concerns became concrete almost immediately. In the days following the release of the report, I received several calls and emails from businessmen seeking to take advantage of free or cheap land in order to tap into the burgeoning urban agriculture sector. This prompted me to be more explicit on the role of public land in urban agriculture in the 2010 revision of the report, noting:

> Given the high cost and limited supply of undeveloped acreage in the Bay Area, Oakland's public land offers the most affordable option for urban food production. And as *public* land, it should arguably be used to benefit the public. At the same time, this public land should not simply be enclosed and turned over to commercial enterprise; parks and open space must remain open to the public. In addition to community gardens, urban agriculture in these spaces should be educational and explicitly serve the interests of food justice and be integrated into other open space and recreational uses. Commercial urban agriculture, with proper revision of zoning, is better suited for the large tracts of land located in formerly industrial areas of the city. Many of the privately owned vacant lots would be suitable for commercial urban agriculture, as would publicly owned vacant land that is not currently zoned as a park or open space. (McClintock and Cooper 2009, 25)

In the report's conclusion, I reiterate, "Urban agriculture *must not replace public parks and open space*, rather it should be integrated into public spaces with respect to existing uses and needs. Community participation is essential in this regard" (ibid., 30). Furthermore, I frequently raised the concern with fellow members of the Oakland Food Policy Council as we drafted urban agriculture policy recommendations in late 2010. As I describe in Chapter 7, our proposed zoning permits residential and civic/community urban agriculture citywide, including in public parks and open space, but requires for-profit urban agriculture organizations to obtain a conditional use permit and to restrict them from operating in public parks and open spaces. As this anecdote illustrates, a critical cartography of the commons must also engage with how countermapping is ultimately used and by whom.

Chapter 5:

Looking for Lead in All the Wrong Places? Soil Contamination at Existing and Potential Urban Agriculture Sites

As urban agriculture grows in popularity, the large number of vacant parcels in post-industrial cities such as Oakland are a prime target for expansion (LaCroix 2010; Mogk, Kwiatkowski, and Weindorf 2010). However, as food production ramps up on such land, public concern is growing over the environmental hazards that may be associated with urban agriculture (Goldenberg 2009; Murphy 2009; Runk 2011; Seltenrich 2011a). Many of the vacant lots contain contaminants that may be a material legacy of a site's industrial past, or simply a function of its proximity to a freeway or some other source of airborne pollution. Originating from both point and non-point sources, urban soils generally exhibit high concentrations of both synthetic organic contaminants, such as polychlorinated biphenyls (PCBs) and other dioxins, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (Krauss and Wilcke 2003; Aichner, Glaser, and Zech 2007), and heavy metals such as arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn) (Sanchez-Camazano, Sanchez-Martin, and Lorenzo 1994; Alloway 2004). Their presence has elicited concerns among researchers that produce grown in urban gardens may place the health of consumers at risk (Scheyer 2004; Nabulo, Oryem-Origa, and Diamond 2006).

The fact that some of the most polluted urban areas serve as a central rallying point for food justice activism is perhaps one of urban agriculture's greatest contradictions. But it is one that makes sense spatially and historically. As I explained in Chapter 2, it was the same economic process of demarcated devaluation that created food deserts and unemployment in cities such as Oakland that also led to the abandonment of industry, the decline of residential housing stock, and the increase of vacant land.[116] Indeed, the plethora of vacant lots abandoned by deindustrialization are located right next door to the people whose access to healthy food was curbed by this same flight of capital. If these vacant lots also happen to be the most polluted, then urban agriculture could potentially impose new environmental health burdens on populations already suffering from exposure to toxins and a lack of healthy food. Indeed, as planners, public health officials, and community activists push for the scaling up of urban food production in food deserts, the material legacy of the industrial past soil contamination may prove to be a serious hurdle.

Efforts to scale up urban agriculture—particularly via large-scale expansion into formerly industrial areas, areas near to freeways, and older residential areas—must take such risks into consideration. Despite the well-intentioned efforts to scale up food production in Oakland, however, no systematic study of soil contamination at potential garden sites has been conducted to date. Phase I and Phase II Environmental Impact Assessments (which include soil sampling and land-use history) may exist for particular sites, but are limited in scope to the individual parcel and are cost-prohibitive to small urban agriculture organizations and low-income residents. Similarly, extensive research-grade soil sampling is too expensive for the general public, while more affordable soil labs may lack the quality control standards of research-grade labs. If food production is to occur on vacant land in Oakland, a systematic soil assessment should be a vital first step to identify potential risks arising from the expansion of the very urban

[116] The impacts of such processes are even more pronounced in Rust Belt cities such as Detroit and Cleveland.

agriculture programs established to improve public health. Such an assessment should not stop solely at obtaining contaminant levels in the soil at individual sites, but should also take into consideration the sources and spatial distribution of contamination in order to better identify areas of potential risk.

This chapter represents a first step in devising such a methodology. In the pages that follow, I evaluate the extent to which soil contamination—soil Pb contamination, specifically—may hinder the expansion of urban agriculture in Oakland. This work represents an application of the "precautionary principle" (Morello-Frosch, Pastor, and Sadd 2002), in that it assesses risk *before* urban agriculture projects are launched in order to ensure that soil is safe for food production and that production on these sites does not ultimately endanger populations they intend to serve. As I explain in the dissertation's introduction, this soil assessment arose from concerns raised by a number of urban agriculture and food justice advocates and practitioners. The central question that frequently arose, and that ultimately served as a guiding question for this component of my dissertation research, was straightforward: how contaminated is the soil in Oakland? The question was broad, but spoke to the concerns of urban agriculture organizations and backyard gardeners alike. It is also particularly timely given the City of Oakland's push to include urban agriculture in the current zoning update (see Chapter 6).

The chapter consists of three distinct but interrelated analytical parts, each addressing a different aspect of the research project. To a certain degree, each part stands alone as a scientific journal article might, with a brief introduction, methods section, results and discussion, and conclusion. At the same time, I've attempted to integrate the three parts into a single coherent chapter. Taken as an ensemble, the chapter represents a methodology for assessing contamination at potential urban agriculture sites in Oakland. Due to a limited budget, I focused solely on Pb in this study. Why Pb? It is the element everyone has heard of, the one that journalists write about, and the one people ask about when ready to plant a garden. I hope, however, that this assessment will serve as a point of embarkation for future research on a wider spectrum of contaminants at potential urban agriculture sites in Oakland.

The chapter is organized as follows. Section 5.1 provides a general overview of Pb contamination. In Section 5.2 I use a combination of GIS and spatial statistics to characterize the spatial distribution of Pb on vacant land at multiple scales across Oakland (city, neighborhood, and site), paying particular attention to differences between geographic zones and land use. In Section 5.3 I use a variety of statistical analyses to identify relationships between soil Pb levels and anthropogenic factors such as zoning, housing stock, roads, airport, and land use, as well as biophysical factors such as soil series, soil chemical characteristics, and vegetative cover. Finally, in Section 5.4 I assess the extent to which total soil Pb is actually available for plant uptake. I evaluate two different chemical extractants (DTPA and $MgCl_2$) in an effort to identify the best proxy for plant available Pb and relate plant availability to a suite of soil chemical characteristics. I conclude the chapter with some general comments on the lessons learned.

Before proceeding, I want to offer a brief note on the chapter's title. Beyond the obvious play on the Johnny Lee's 1979 hit song from the *Urban Cowboy* soundtrack, the meaning of the title will become clear by the end of the chapter. First, soil Pb levels were lower than everyone expected, posing less of a direct obstacle to the expansion urban agriculture. Second, phytoavailable Pb (i.e., the Pb that is absorbed by the plant through its roots) proved to be less of a concern than the Pb from the surrounding soil that may adhere to the leaves. Finally, the title refers to the difficulties I had obtaining permission from the managing agencies and property owners to collect soil samples. When I attempted to go through the proper channels to gain access, phone calls were never returned and emails never answered. If there was actual human contact, without fail, it devolved into a wild goose chase where I was referred to someone else in the chain of command, who, in turn, never responded to my requests.

What was clearly at stake was an issue of liability. Not so much about our personal safety when entering a site, but about the potential fallout if we were to find out that the soil was contaminated. Similarly, some urban agriculture activists were concerned that my work would get all the community gardens shut down. My research was a potential Pandora's box. According to due diligence laws, a property owner must disclose records of contamination upon the sale of a property and is legally responsible for remediation costs that could run in the hundreds of thousands of dollars.

No one forbade me from conducting this research; they simply ignored me. After months of waiting to hear back, I decided to take a more practical tack, employing the familiar strategy of "Don't ask permission now, ask forgiveness later". I ordered three fluorescent yellow surveyors vests from a construction supply company, and my research assistants and I got started.

5.1. A brief overview of soil Pb contamination

While urban soils may indeed be a "toxic soup" of contaminants, Pb has taken center-stage in discussions over the potential risks of urban agriculture, both because it is ubiquitous in urban areas and because of the health risks it poses, especially to children. Ingestion of soil and dust are primary pathways of exposure to Pb. Research has shown direct correlations between soil Pb and blood Pb levels, especially in children, who are particularly susceptible to Pb poisoning; while adults generally absorb less than 5% of ingested Pb, children absorb up to 50% (Mielke et al. 1983; Mielke and Reagan 1998; Mielke et al. 2007; Laidlaw and Fillippelli 2008). Because Pb is similar in ionic structure to calcium (Ca), the body will utilize Pb in place of Ca when excess Pb is present in the bloodstream. As a result, Ca-mediated processes are altered or disrupted. During childhood development, Pb can be incorporated into bone, and continually released into the bloodstream as bone regenerates over time. When incorporated into nervous system, it blocks glutamate receptors, interfering with chemical signals from the brain (Needleman 2004). The long-term impacts of Pb poisoning can be severe. High blood Pb levels have been correlated with learning disabilities, attention deficit/hyperactivity disorder, mental retardation, juvenile delinquency, and crime, including homicide (Landrigan et al. 2002; Nevin 2007; Wright et al. 2008). Furthermore, Pb poisoning is an environmental justice issue, in that it disproportionately impacts the poor and people of color (Mielke et al. 1984; Sutton et al. 1995). A "social determinants of health" framework sheds light on the ways in which a host of social factors, ranging from malnutrition to dilapidated housing, can result in increased Pb exposure, uptake, and absorption (Krieger and Higgins 2002; Marmot 2005).

The presence of Pb in the built environment is not new. Humans have been extracting Pb from the Earth for thousands of years. Beginning in the Copper Age, and increasing with the subsequent Bronze and Iron Ages, Pb was mined for use in various metal wares. It was also released into the atmosphere as a by-product of smelting. With the advent of coinage and plumbing, the extraction, consumption, and atmospheric emission of Pb grew steadily (aside from a drop following the decline of the Roman Empire). With the Industrial Revolution, Pb extraction and emissions soared exponentially. Fossil fuel combustion was a primary source of

Pb emission, and the scale of emissions increased due to the massive scaling up of industrial production. Taller smokestacks also led to wider dispersion (Nriagu 1998).

While sources of Pb pollution in urban areas include old batteries, solder, and plumbing (Davies 1995; Kabata-Pendias 2011), its ubiquity in urban areas is due largely to its use as additive in gasoline for seven decades of the 20th century. Beginning in 1923, the use of tetraethyl Pb as an anti-knock additive in gasoline gave a boost to anthropogenic Pb levels worldwide; the dominant source of Pb emissions had become mobile. Lead emissions from gasoline increased in the 1950s due to the growth of automobile use and the expansion of freeway systems (and related decline in public transit), as well as to restrictions on benzene use as an anti-knock additive, thereby increasing demand for tetraethyl Pb (Nriagu 1990, 1998; Mielke, Laidlaw, and Gonzales 2010). Between 1927 and 1994, American cars released an estimated 5.37 million metric tons (Mg) of Pb into the atmosphere. Emissions peaked around 1970 at more than 200,000 Mg per year, almost half of global Pb emissions (Mielke, Laidlaw, and Gonzales 2010). In the 1980s, the annual median atmospheric deposition of Pb in North America was 4.26 kg ha^{-1}; a "substantial contribution" came from vehicle exhaust (Sposito and Page 1984, 303).

The other principal source of Pb in American cities is house paint. Over 6 million Mg of Pb was used in paint in the US between the 1880s and the late 1970s, peaking at 1.2 million Mg used in the 1920s. Even though Pb concentrations in paint declined steeply by mid-century, high levels of Pb remain on the interior and exterior walls houses to this day (Mielke and Reagan 1998; Mielke et al. 2008) A HUD study estimated that in the US, lead paint covers 1.046 million mi^2 (2.079 million km^2)—roughly a third of the total area of the US—of exterior surfaces of housing stock in the United States, or an average of 996 ft^2 (92.53 m^2) of lead-based paint per housing unit. Much of the exterior paint Pb has ended up in the soil over the past century; indeed, 52% of houses built before 1978 have yard soil Pb levels > 400 mg kg^{-1}, the EPA threshold (Jacobs et al. 2002). As paint flakes off with age, or is removed during sandblasting, small fragments contaminate the soil. As a result, soil Pb levels tend to increase with proximity to a house (Mielke et al. 1984; Sutton et al. 1995). One square foot of paint with a federally acceptable concentration of 1 mg cm^2 single paint chip may contain between 1 and 5 mg cm^{-2} of Pb can produce Pb dust several orders of magnitude higher than legal levels (Jacobs et al. 2002).

As the devastating impacts of Pb on public health came into focus by the mid-20th century, efforts to reduce exposure to Pb gained traction.[117] There was a gradual phase-down of Pb additives in gas beginning in 1975. In 1984 the US Senate passed the Airborne Lead Reduction Act, leading to a ten-year phase-out of leaded gas that took effect in January 1986. A total ban went into effect on January 1st, 1996 (Bridbord and Hanson 2009; Mielke, Laidlaw, and Gonzales 2010). The use of leaded paint was also curtailed by an act of Congress. Lower limits were set on interior house paint beginning in the 1940s, and beginning in the early 1970s, similar limits were set for external paint. The Consumer Product Safety Act of 1977 banned the sale of paint with more than 0.06% Pb content (Sutton et al. 1995). These regulatory changes, combined with widespread Pb poisoning prevention initiatives, resulted in declines in blood Pb levels in children and can be considered a success story in environmental policy (Levin et al. 2008; Bridbord and Hanson 2009).

[117] Indeed, concern over Pb poisoining also drove much of the early research on urban soils. Pressure to regulate Pb coincided with the last great wave of urban gardening in the 1970s, resulting in a body of research on garden soils as a potential pathway of exposure to Pb and other heavy metals (Koeppe 1977; Spittler and Feder 1979; Chaney, Sterrett, and Mielke 1982; Preer, Akintoye, and Martin 1984).

Nevertheless, the material legacy of historical Pb emissions from automobiles, industry, and paint remains in the soil to this day. The Environmental Protection Agency (EPA) has set the federally acceptable total Pb level in soils at 400 mg kg^{-1}. California Human Health Soil Screening Levels (CHHSSL) for lead are higher than EPA screening levels. In 2009 Cal/EPA's Office of Environmental Health Hazard Assessment lowered the Residential Soil Screening Level for soil Pb from 150 mg kg^{-1} to 80 mg kg^{-1}, the concentration estimated to incrementally raise blood Pb levels by 1 μg dL^{-1} (Carlisle 2009).

These environmental health standards are based on *total* soil Pb levels. Lead exists in a vast number of solid-phase forms, however, and total Pb is simply an aggregate measure of the various forms present in a given sample. Due to lead's chalcophilic nature (i.e., its affinity for sulfur), the primary mineral form of Pb is galena (PbS). This ore form ultimately weathers to become anglesite ($PbSO_4$).[118] Because it can replace Ca^{2+} through isomorphic substitution, Pb also weathers to (or precipitates as) a carbonate such as cerussite ($PbCO_3$) and a variety of apatites ($3[Pb_3(PO_4)_2]\cdot Pb(Br, Cl, F, OH)_2$. Pyromorphite [$PbCl_2\cdot 3Pb_3(PO_4)$] and mimetesite [$PbCl_2\cdot 3Pb_3(AsO_4)_3$] are also common secondary Pb minerals. All of these forms are highly stable under a middle range of pH conditions. Lead is also frequently associated with iron (Fe) and manganese (Mn) hydroxides. Free Pb ions (Pb^{2+}) complex easily with other ions or organic matter (OM), or simply adsorb onto the negatively charged clay or humic surfaces. Its divalent charge allows it to replace other cations such as K and Ca. In the soil solution, it exists in cationic form as Pb^{2+}, $PbCl^+$, and $PbOH^+$, as well as in anionic forms: $PbCl_3^-$ and $Pb(CO_3)_2^{2-}$ (Kabata-Pendias 2011).

Many of the more labile forms of Pb originate from anthropogenic sources. Lead oxides (PbO, PbO_2, and Pb_3O_4) were historically used in batteries and as a red pigment in paint (Davies 1995; Ponizovsky and Mironenko 2001; Kabata-Pendias 2011). The Pb carbonates hydrocerrusite $2Pb(CO_3)_2\cdot Pb(OH)_2$ and "white lead" [$(PbCO_3)_2\cdot Pb(OH)_2$] were also commonly used as a white pigment in paints. Like simple Pb phosphate [$Pb_3(PO_4)_2$], another common form of Pb, these two carbonates are more susceptible to weathering than Pb found in more highly-crystalline phases. Another form of Pb is the Pb chromate phoenicochroite [$Pb_2O(CrO_4)$], which was historically used in paint manufacturing. Its solubility is controlled by pH; at pH > 8, it dissolves into the $HPbO^{2-}$ ion (Clark, Brabander, and Erdil 2006). Most of the Pb emitted in automobile exhaust was released as Pb halides such as PbBr, PbBrCl, Pb(OH)Br, and $(PbO)_2PbBr_2$. Such salts are highly unstable and complex quickly into carbonate, oxycarbohydrate, or oxide phases (Davies 1995; Kabata-Pendias 2011). While less common in urban areas, Pb arsenate ($PbHAsO_4$) was commonly applied as a pesticide in orchards (Davies 1995). In cities with agricultural pasts such as Oakland—the Fruitvale district, for example, was named for the vast orchards that eventually supplied the city's canneries (Maly 2005)—even such agricultural sources of Pb must be considered.

[118] Weathering, the breaking down of soil minerals by physical processes such as freezing, thawing, and bioturbation, and by chemical processes such as hydrolysis and protonation, occurs in an integrated, simultaneous, and interdependent manner. While weathering of the clay minerals in a particular soil proceeds over time according to a predictable sequence (as identified by the Jackson-Sherman weathering stages), rates of weathering are highly variable due to the surrounding physical and chemical environment (Brady and Weil 2002; Sposito 2008). Furthermore, to maintain stoichiometric equilibrium, an individual element such as Pb "flip-flops" back and forth between different mineral forms, as it solubilizes, sorbs, and precipitates in a new mineral form. Lead that was deposited from automobile emissions in the last century may therefore end up bound in the same mineral lattice as Pb released from natural chemical weathering of a primary mineral over thousands of years.

5.2 Assessing of the spatial distribution of soil Pb in Oakland at multiple scales

As urban agriculture advocates push for the scaling up of food production in cities, assessing soil contamination at potential sites of production will be paramount. A growing body of research in several academic disciplines sheds light both on the processes soil contamination, and the vast palette of analytical tools available to assess contamination. Since the late 1970s, an active USDA research program has focused on the human health risks associated with heavy metals contamination in urban soils (Chaney, Sterrett, and Mielke 1982; Sterrett et al. 1996). Environmental scientists, straddling the fields of soil science, geochemistry, and geographic information science, have long focused on soil contamination in urban areas, identifying both the sources and distribution of environmental contaminants (Li et al. 2004; Rawlins et al. 2005; Clark, Brabander, and Erdil 2006; Wong, Li, and Thornton 2006). A number of these studies assess heavy metals levels in urban gardens (Spittler and Feder 1979; Preer, Akintoye, and Martin 1984; Moir and Thornton 1989; Finster, Gray, and Binns 2004; Clark, Brabander, and Erdil 2006; Witzling, Wander, and Phillips 2011). More recently, urban ecologists have begun to examine the impacts of land use and other anthropogenic disturbance on soil ecology and geochemistry (Lorenz 1979; Effland and Pouyat 1997; Scharenbroch, Lloyd, and Johnson-Maynard 2005; Pickett and Cadenasso 2009). In land use planning, researchers have focused on how to best incorporate measures of soil contamination into urban soil quality assessment and management (Craul 1992; Schindelbeck et al. 2008).

Researchers have reported a wide range of soil Pb levels collected around the world (see Table 5.2.1). Background levels, derived from data collected in remote areas where anthropogenic Pb deposition is minimal, range from 15 to 30 mg kg^{-1}.[119] These levels are closest to natural concentrations of Pb in the Earth's crust, which are generally estimated to be 15 mg kg^{-1} (Wedepohl 1995). In general, Pb levels are highest in areas with the highest levels of anthropogenic disturbance, notably farmland, cities, industrial zones, and along transportation corridors. In agricultural areas, elevated Pb concentrations have been attributed to fertilizers and pesticides (Kalbasi et al. 1994; Hu et al. 2006). In industrial areas, Pb is generally attributed to atmospheric deposition downwind from smelting (Rawlins et al. 2006; Douay et al. 2007; Schulin et al. 2007) or in mine tailings (Clevenger 1990). Along highways, Pb contamination is attributed to exhaust emissions (Gratani, Taglioni, and Crescente 1992; Teichman et al. 1993), while in urban areas, most Pb contamination is attributed to paint or old housing and exhaust emissions (Sutton et al. 1995; Clark, Brabander, and Erdil 2006; Wu et al. 2010).

In addition to variability due to land use and sources of contamination, variability in soil Pb levels can also be attributed to differences in sampling and analytical methods. The depth of soil sampling is a key factor. Lead is generally found in the upper-most soil horizons, due to historical deposition and resuspension of soil and dust particles. In general, deeper samples are more likely to be diluted. Most studies sample at a depth of 0 to 10 cm, but many others sample to 20 cm. In the US, most environmental health research samples the top 3" (7.62 cm). Differences in sampling regimes (i.e., sampling patterns, number of samples) and analytical methods (e.g., X-ray diffraction versus digestion) may also result in variability (Pyle et al. 1995).

[119] Some would argue that nearly all soil Pb is likely anthropogenic in origin, however, given that atmospheric circulation is global.

Table 5.2.1: Soil Pb concentrations found in urban and rural settings in other studies. Reported values are the arithmetic mean concentration unless otherwise noted.

Location	Total Pb (mg kg^{-1}	± S.D.)	Sample depth (cm)	Reference
Background Levels				
Oakland hills	14.2	± 4.4	n.r.	(City of Oakland n.d.)
California, USA	23	(med.)	5-15	(Goldhaber et al. 2009)
Western USA	17	± 1.8	20	(Shacklette and Boerngen 1984)
Eastern USA	14	± 2.0	20	(Shacklette and Boerngen 1984)
Earth's crust	14.8	n.r.	n.r.	(Wedepohl 1995)
Rural Agricultural Areas				
Eastern Scotland, UK	18.4	n.r.	0-10	(Paterson, Sanka, and Clark 1996)
Ebro basin, Spain	17.54	± 10.51		(Rodríguez Martín, Arias, and Grau Corbí 2006)
Jura region, Switzerland	57	± 41.7	0-25	(Atteia, Dubois, and Webster 1994)
Piemonte region, Italy	20	± 8.5	0-20	(Biasioli, Barberis, and Ajmone-Marsan 2006)
Zhejiang province, China	13.54	± 20.0	0-15	(Liu, Wu, and Xu 2006)
Urban gardens				
Baltimore, USA	100	(med.)	20-30	(Mielke et al. 1983)
Boston, USA	1,425	± 990	0-10	(Finster, Gray, and Binns 2004)
Chicago, USA	135	n.r.	0-30	(Witzling, Wander, and Phillips 2011)
Hangzhou, China	36.4	n.r.	0-20	(Jin et al. 2005)
Washington, DC	680	n.r.		(Preer, Akintoye, and Martin 1984)
Urban Areas				
Aberdeen, UK	94.4	n.r.	0-10	(Paterson, Sanka, and Clark 1996)
Bangkok, Thailand	47.8	± 52.7	0-5	(Wilcke et al. 1998)
Mumbai, India	42.6	± 62.1	n.r.	(Ratha and Sahu 1993)
Hong Kong, China	94.6	± 61.0	0-15	(Li et al. 2004)
Ibadan, Nigeria	95.1	± 126.7	0-15	(Odewande and Abimbola 2008)
Lubbock, USA	41.8	± 4.9*	0-2	(Brown et al. 2008)
Miami, USA	152	± 169	0-20	(Chirenje et al. 2004)
Murcia, Spain	67.91	±11.45*	0-5	(Acosta, Faz, and Martinez-Martinez 2010)
Naples, Italy	262	± 337		(Imperato et al. 2003)
Sevilla, Spain	148	± 187	0-10	(Morillo et al. 2008)
Shanghai, China	70.7	± 5.1*	0-10	(Shi et al. 2008)
Talcahuano, Chile	35.2	± 43.3	0-10	(Tume et al. 2008)
Torino, Italy	149	± 120.6	0-20	(Biasioli, Barberis, and Ajmone-Marsan 2006)
Uppsala, Sweden	25.5	(med.)	0-5	(Ljung, Otabbong, and Selinus 2006)
Wolverhampton, UK	206	± 120	0-15	(Thums, Farago, and Thornton 2008)
Xuzhou, China	43.3	± 26.1	0-10	(Wang and Qin 2007)

n.r. = not reported; med. = median value, no standard deviation; * reported value is standard error

For this research project, we drew on the methods used in many of the studies cited above to assess soil Pb levels at more than a hundred potential urban agriculture sites in Oakland identified in the *Cultivating the Commons* land inventory. The goal of the research was to identify potential contamination at the selected sites, while gaining a broader understanding of how and where particular land uses in Oakland impact soil Pb levels. More specifically, I address the following research objectives in this section: 1) to quantify average soil Pb concentrations across Oakland; 2) to characterize city-scale variation in Pb levels across land uses and geographic regions; and 3) to assess variation at the site-scale.

Methods

<u>*Study Site Description*</u>

This study was conducted in the city of Oakland, California (geographic coordinates: UTM 10N 37.804444, -122.270833), an urban center with a population of 391,000 (2010) and core city of the San Francisco Bay Area metropolitan region (population 7.468 million). Three primary topographic zones define the city's physical geography: flatlands, foothills, and hills. The flatlands are low-lying areas adjacent to the San Francisco Bay to the city's west and Alameda Estuary and San Leandro Bay to the south. A large percentage of this land is comprised of fill (e.g., dredged sediment, construction debris, quarried rocks), particularly around the Port of Oakland and the Oakland airport (Welch 1981). The foothills are formed on a gentle fan of alluvium spreading downwards from the Oakland hills, a series of undulating, parallel ridges running along the city's eastern portion along a northwest-southeast axis. Part of California's Coast Range, the Oakland hills have been thrust upwards along the Hayward and Moraga faults over the past million years and continue to rise (Sloan 2006). The climate is Mediterranean with wet winters and dry summers with morning fog. Average annual precipitation is 582.7 mm (22.94"), with the majority (89%) of the total rainfall occurring between November and April. September is the hottest month with an average high temperature of 27ºC (80.6ºF); January is the coldest month, with an average high of 14.5ºC (58.1ºF) (NOAA 2004). Native vegetation consists of a mosaic of plant communities, including oak woodland, coastal shrub, and coastal terrace prairie, with large coniferous (redwood) stands in the drainages (Beidleman and Kozloff 2003). Soils are a mix of urban land (highly mixed, heterogeneous fill) and urban land complexes. Endogenous soil series in the flatlands are derived from sedimentary, alluvial parent material, while the hills are dominated by a number of excessively drained loams weathered from uplifted conglomerate and ultrabasic metamorphic rock (Welch 1981). See Appendix B1 for more detail on the formation of Oakland's soils.

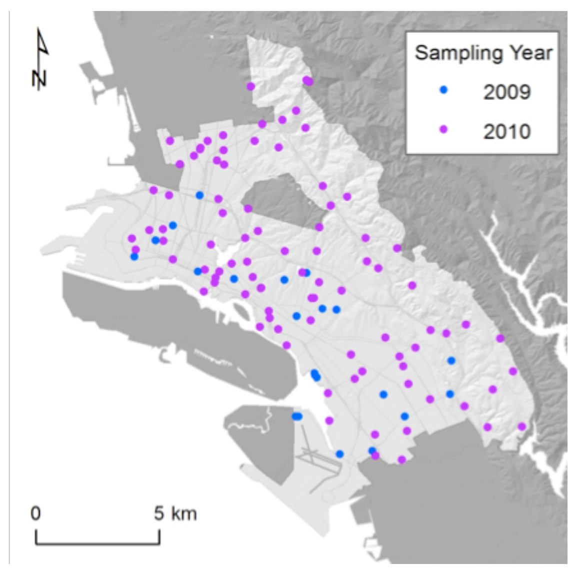


Figure 5.2.1: Soil sampling locations

Sampling Site Selection

In 2009, the *Cultivating the Commons* project's Community Advisory Committee (see Chapter 4) selected 20 of 495 potential urban agriculture sites identified by the inventory as prime candidates for preliminary soil testing. Selection was based on size, proximity to underserved populations, accessibility to public transport, and equal distribution across the Oakland flatlands. A site located in the Oakland Hills on never-developed open space (King's Estates) and another site (16^{th} St.), with levels of Pb that were known to be high, were included as low and high reference points, respectively.

The granting of National Science Foundation funding in 2010 allowed the project to expand considerably. An additional 90 sites were selected from the *Cultivating the Commons* Land Locator in order to map the spatial distribution of Pb levels at the city-scale. Efforts were made to select sites from all regions of the city. Twenty sites were randomly selected from each of Oakland's seven City Council Districts using ArcGIS. Following site visits, many of these sites were excluded due to inaccessibility (fences, vegetation, or steep slopes). Several new sites were later selected from the inventory to fill in geographic gaps. For the most part, sites were evenly distributed across five geographic zones in the flatlands (North, West, Central, and East Oakland) and the Oakland hills (see Figure 5.2.1). A Moran's I test of spatial autocorrelation was conducted to verify that sites were randomly spaced across the city rather than clustered. At three sites where different land uses or soil types were visible, sampling was conducted along a gradient. Upon sampling, each site was classified within a typology of four land use types: garden; park; vacant; or open space (see Table 5.2.2). Each land use type served as a proxy for different edaphic types related to the level of anthropogenic disturbance and vegetation typically encountered in a site under such land use. See Figure 5.2.2 for examples of these land use types.

Table 5.2.2: Typology of land use types, level of anthropogenic disturbance, and related edaphic characteristics

Land use	Level of anthro-pogenic disturbance	Vegetation	Soils
Garden	++++	Vegetable crops, e.g., chard/beets (*Beta vulgaris*), peas (*Pisum sativum*), collards/kale (*Brassica oleracea*), tomatoes (*Solanum lycopersicum*), lettuce (*Lactuca sativa*)	Frequent, tillage, addition of compost, cultivation
Park	+++	Turf grasses, e.g., Bermuda grass (*Cynodon* spp.), Kentucky bluegrass (*Poa pratensis*), perennial ryegrass (*Lolium perenne*), fescue (*Festuca* spp.); frequently irrigated and mowed, occasionally fertilized	Shallow and compact, high in clay content; often laid on top of clay cap or landscape fabric; heavy foot traffic and occasional vehicle traffic (mowers, trucks)
Vacant	++	Early succession invasive species common in highly disturbed and compacted areas, e.g., yellow star thistle (*Centaurea solstitialis*), fennel (*Foeniculum vulgare*), wild radish (*Raphanus sativus*), curly dock (*Rumex crispus*), slim oat (*Avena barbata*); some sites mowed annually	Compacted, coarse and gravelly soil associated with previous disturbance; occasional traffic, grading, addition of fill, and/or other surface disturbance
Open space	+	Native and exotic grasses and weeds, older succession than vacant; some sites annually mowed or grazed with goats, but natural cycling of litter generally occurs	Deeper, more porous soils, some native; higher in OM due to litter cycling

Plant Sampling

To qualitatively characterize the vegetation the four land use types listed in Table 5.2.2, representative samples were collected from two vacant sites and two open space sites and identified using a botanical key (Beidleman and Kozloff 2003). Turf grass species were identified using the online University of California Statewide Integrated Pest Management website.[120]

Figure 5.2.2: Examples of four land use types used as an analytical typology: gardens (top-left); parks (top-right); vacant land (bottom-left); and open space (bottom-right).

Soil Sampling and Analysis

In July 2009, ten of the twenty sites identified by the Community Advisory Committee were selected for a fine-grained analysis in order to assess the extent to which Pb levels vary at the site-scale. An eleventh site in West Oakland (9th Street) was sampled in May 2010 on the

[120] Online: http://www.ipm.ucdavis.edu/TOOLS/TURF/TURFSPECIES/index.html

request of the landowner, a community development organization interested in developing an urban garden. At the six smallest sites, we overlaid a 25’ × 25’ (7.52 m × 7.52 m) sampling grid in order to detect the spatial distribution of Pb across the site. At three of the larger sites (King’s Estates, Oakport, and Harbor Bay) the grid squares were 50’ × 50’ (15.24 m × 15.24 m). At one of the largest sites (Doolittle), grid squares were 100’ × 100’ (30.48 m × 30.48 m), as the site was topographically and edaphically homogenous. At sites where distinctly different soils were visible, each soil was assessed separately; at one site (Oakport), three distinct soils were clearly evident; another (Harbor Bay), two soils were present.

Each grid square was evenly delineated into 9 sub-sections. After surface litter or vegetation was removed, a representative sample collected from each at a depth of 5 to 10 cm (depending on penetrability) using a stainless-steel core auger A Trimble Pathfinder GPS unit (Trimble Navigation, Ltd, Sunnyvale, CA) was used to record the geospatial coordinates at each sample point.

The nine cores from each grid square were mixed together into a single composite sample (henceforth “grid-sample”) representing an average of the grid square. ArcInfo 10 (Esri, Redlands, CA) was then used to calculate the mean center of the nine cores, a “spatial mean” geographic coordinate corresponding to the grid-sample data. Additionally, a 10 g sub-sample was taken from each grid-sample and composited to form a “site-sample”.

Site-samples and data collected from the remaining ten 2009 sites and for all 2010 sites were used to analyze Pb levels at the city-scale. For the city-scale sites, 12 soil cores (5 to 10 cm) were collected from points evenly distributed within each site. Because the potentially arable area of each site varied in size, samples were collected in a radius ranging from 25’ to 100’. GPS coordinates were logged for each soil core removed.

All soil samples were oven dried at 70°C, ground and sieved using a Standard Model No. 3 Wiley Mill (Arthur H. Thomas Co., Philadelphia, PA) with 2 mm mesh. Soil pH, total carbon, and total nitrogen for all samples was measured at UC Berkeley by Jabari Brown, an undergraduate research assistant. Soil solution pH was measured using a 1:1 M mixture of soil and de-ionized water (EPA 2007, method 9045D). Soils were agitated for 5 minutes and allowed to settle for 24 hours prior to measurement using a Thermo Electron Orion 920A pH meter (Sigma-Aldrich, St. Louis, MO). Total C and N were measured using an Elantec Elemental Analyzer (CE Instruments, Lakewood, NJ). Total Pb for all samples was determined at the UC Davis Analytical Lab (Davis, CA) using a nitric acid/hydrogen peroxide closed vessel microwave digestion (Sah and Miller 1992) and Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES).

Finally, all 2009 site-samples were also analyzed at the UC Davis Lab for bulk density, cation exchange capacity (CEC), OM, total N & C, exchangeable macro- and micronutrients, and certain metals.

Neighborhood-Scale Data

To assess Pb distribution at the neighborhood-scale, we used data collected by the City Slicker Farms Backyard Garden Program. The organization installs raised garden beds for residents throughout West Oakland and routinely collects soil samples prior to installation. Each data point consists of four composited samples collected with a stainless-steel garden trowel from a depth of 0-10 cm. Two composite samples are generally collected for each site, but additional samples are often collected from larger sites. Samples are sent to the U Mass Soil

Testing Laboratory (Amherst, MA) and tested for a range of soil fertility indicators and extractable heavy metals using the modified Morgan method (Wolf and Beegle 1995). The lab estimates total Pb from the modified Morgan-extracted Pb level using the following conversion equations: for soils with extracted Pb < 25 ppm, estimated total Pb = 26.91 + (12.28 × extracted Pb); 250 to 160 ppm, estimated total Pb = 242.2 + (5.988 × extracted Pb); > 160 ppm, 443.9 + (5.317 × extracted Pb).

GIS and Statistical Analysis

Points and polygons recorded by the GPS unit were imported into an ArcGIS 10 geodatabase. The program was used to calculate the mean center of the X- and Y- values from the twelve cores taken from each site and the nine cores from each grid-square. The resulting coordinate was assigned to the composite sample data.

Site-scale data were overlaid onto National Agriculture Imagery Program (NAIP) orthophotos. ArcGIS 10 was used for all mapping (Datum/Projection: WGS 1984 UTM Zone 10N) and spatial statistics (Moran's I, Getis-Ord G_i^*). Statistical analyses were completed using JMP 9 software (SAS Institute, Cary, NC) and included linear regressions, distribution tests (Shapiro-Wilk W, Kolmogorov's D), tests of equal variance (O'Brien, Brown-Forsythe, Levene, Bartlett), and nonparametric means comparisons (Steel-Dwass). Specific analyses are described in more detail in the results. One site with a total Pb level of 2,262 mg kg^{-1} was removed as an outlier from analysis, as it was several standard deviations higher than the highest quantile. Mean values are followed by the standard error (± S.E.).

Site-scale land use history

To recreate land use histories for the site-scale analyses, a number of maps and aerial photographs were consulted. First, Sanborn Fire Insurance maps from 1899, 1903, 1925, and 1952, were downloaded from the ProQuest Digital Sanborn Maps Library (http://sanborn.umi.edu, accessed Aug 28, 2011). City of Oakland street maps published by the Alameda County Chamber of Commerce in 1902, 1909, 1918, 1923, and 1937, as well as aerial ortho-photographs (1:300 scale) taken in 1981 and 1994 for the City of Oakland's Office and Planning and Building were consulted at the UC Berkeley Earth Sciences Library Map Collection. Finally, NAIP ortho-photos from 2005 were also consulted.

Results and Discussion

City-Scale

Mean total Pb concentration was 108.7 ± 13.7 mg kg^{-1}, and ranged from 3 to 979 mg kg^{-1}. Median Pb concentration was 63.5 mg kg^{-1}. The distribution of the data was highly skewed (skewness = 3.957, kurtosis = 18.717), with most sites having Pb levels under 100 mg kg^{-1} (see Figure 5.2.4 a) To determine if the data was normally or lognormally distributed, Pb values (both original and log-transformed) were plotted against quantiles, and fit with a regression line (see Figure 5.2.4 b). Additionally, a Shapiro-Wilk W test of the original data revealed that the data was not normally distributed and a Kolmogorov's D test verified that the transformed data was actually lognormal. The lognormal distribution of Pb is consistent with other research on Pb and other contaminants (Wang and Qin 2007; Liu, Xia et al. 2010). This trend of lognormality is due to either additive or multiplicative processes; in short, a site that is contaminated tends to become even more contaminated (Blackwood 1992; Limpert, Stahel, and Abbt 2001).

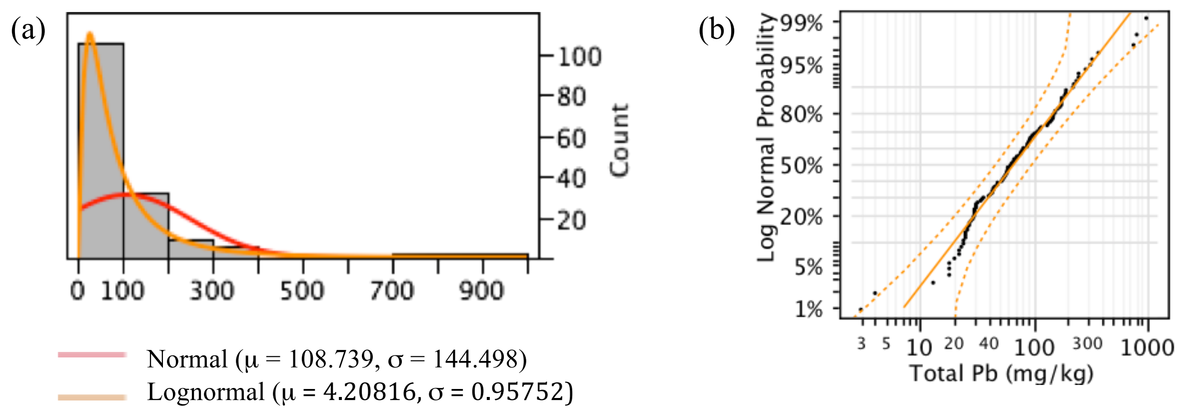


Figure 5.2.4: (a) Distribution histogram (a) of total Pb levels (n = 112) fit with normal (red) and lognormal (orange) curves. (b) A plot of lognormal quantiles against total Pb on a log-scale axis reveals a linear fit.

The data set was also tested for spatial autocorrelation (the degree to which features tend to be geographically clustered or dispersed) using Moran's I test. The test calculates the likelihood that clustering within a dataset appears due to random chance. An index value of 1 equals perfect spatial correlation or clustering, 0 equals a random spatial pattern, and -1 equals perfect dispersion (SAS Institute 2010). The Moran's I test of total Pb levels revealed no spatial autocorrelation at the city-scale (index = 0.043, p = 0.648).

A "hot spot" analysis using a local point pattern spatial autocorrelation test (Getis-Ord G_i^*) of the city-scale data, however, revealed significant clustering of elevated Pb concentrations in the southern half of West Oakland, and around San Leandro Bay near the Oakland airport. While the Moran's I test is a global test of spatial autocorrelation, where the variance of an individual point is measured against the entire dataset, the Getis-Ord G_i^* test statistic is calculated by comparing the sum of a point and its nearest neighbors to the sum of all points in a given study area. The statistic, a z-value, indicates where high or low values (i.e., values with high standard deviations from the overall mean) cluster spatially (Getis and Ord 1992).

Overall, total soil Pb levels were much lower than expected. Citywide mean concentrations were far below the EPA's contamination screening levels of 400 mg kg^{-1} but above the state level of 80 mg kg^{-1}. Total Pb levels exceeded background levels. Metamorphic ultramafic (or ultrabasic) rock from the mantle, such as Coast Range Oliophites found in the Green Valley complex, are common in the Bay Area. These rocks are enriched in metals relative to the average levels in the continental crust (Hornberger et al. 1999). In one study, background Pb levels sampled from Oakland soils derived from Great Valley complex, were 21.5 mg kg^{-1}, as much as twice Pb concentrations levels found in soils formed from other geologic units (City of Oakland n.d.). Nevertheless, mean soil Pb in our study was approximately five to seven times higher than background levels previously reported for the Oakland hills, California, and the Western United States. We can therefore assume that elevated levels are due to deposition from anthropogenic sources. Mean Pb levels in Oakland were similar to those found in other cities worldwide (see Table 5.2.1).

Significant differences in total Pb concentrations were identified between geographic zones and land use types (see Table 5.2.4). Four tests of equal variance (O'Brien, Brown-Forsythe, Levene, and Bartlett tests) revealed that variance between groups for geographic zones, land use types, and zoning types was unequal. As a result, standard statistical comparisons of means and ANOVA that assume normal distribution of data could not be conducted. Since the total Pb data was also highly skewed and lognormally distributed, a comparison of medians or other non-parametric comparisons of means was more appropriate.

Table 5.2.4: Mean soil Pb levels (mg kg $^{-1}$) by geographic zone and land use type at 112 sites in Oakland

Type	**Zone**	**n**	**Total Pb** (mg kg $^{-1}$)			
			Mean ± S.E.	Median	Min	Max
Garden	Central	3	178 ± 78.5	148	59	326
	North	2	142 ± 95.0	142	47	237
	West	1	248 n/a	248	248	248
Open Space	Central	6	84 ± 28.4	60	41	225
	East	6	223 ± 113.3	176	3	756
	Hills	18	28 ± 1.7	28	18	45
	North	2	111 ± 80.0	111	31	191
Park	Central	25	102 ± 13.5	87	22	315
	East	14	60 ± 7.3	60	13	107
	Hills	3	54 ± 11.9	59	31	71
	North	8	76 ± 14.7	80	25	148
	West	5	93 ± 30.8	77	20	187
Vacant	Central	5	167 ± 56.2	154	30	370
	East	4	120 ± 46.7	95	43	248
	Hills	3	50 ± 19.3	35	26	88
	North	2	214 ± 71.3	214	143	286
	West	5	407 ± 200.6	117	56	979
Total		**112**	**109 ± 13.7**	**64**	**3**	**979**

Analysis (Pb): UC Davis Analytical Lab

Figure 5.2.5 shows quartile box-and-whisker plots for comparison of medians across geographic zones, land use types, and zoning classification, as well as the geographic distribution of points belonging to these analytical groups. Median Pb levels in West Oakland were higher than in other parts of the city. Levels were likely higher than in the other geographic zones due to the age of the built environment. As I discuss in Chapter 2, West Oakland is the oldest part of the city and the historical nexus of industry, warehousing, and transportation (Scott [1959] 1985; Bagwell 1982; Walker 2001). Lead levels here can be attributed to a number of anthropogenic sources. First, smelting and other polluting industries were common in this part of Oakland. Second, West Oakland is ringed by freeways. Vehicle exhaust, particularly from the Port of Oakland, has been correlated with air pollution in West Oakland (Costa et al. 2002; Fisher, Kelly, and Romm 2006; Palaniappan, Prakash, and Bailey 2006); Pb contamination originating from vehicle exhaust would have followed these same patterns of deposition. Finally, 37% of the housing stock in West Oakland was built before 1940 (US Census Bureau 2000); indeed, most of the houses in this area date from the 1870s to 1910s (Groth 2004).

A Steel-Dwass multiple comparisons test for groups of unequal size (a nonparametric version of the Tukey's q-test) revealed that mean total soil Pb concentrations in the Oakland hills were significantly lower than in West Oakland ($p = 0.0032$), North Oakland ($p = 0.0039$), Central Oakland ($p < 0.0001$), and East Oakland ($p = 0.0038$). Low Pb levels in the Oakland hills can be attributed to several factors. First, while the area is primarily residential, the housing stock is much younger. Second, most of the samples collected in the hills were collected in open space. A Steel-Dwass comparison between land use types reveals that Pb levels in open space were significantly lower than in parks ($p = 0.0124$), vacant lots ($p = 0.0043$), and gardens ($p = 0.0310$). Most of these areas, which are managed by the Oakland Parks and Recreation Department or the East Bay Regional Parks District, have never been developed. Not only was construction hindered by steep slopes and residential zoning, but also by the concerted efforts of Bay Area environmentalists during the 1970s to preserve open space (Walker 2007). Such concentration gradients, from low Pb levels in rural or peri-urban areas to high Pb levels in the urban core, are common. In samples taken along three transects across Lubbock, for example, Brown et al. (2008) found that Pb levels were exponentially lower at the outer edge of the city (2.8 mg kg^{-1}) than in the urban core where they peaked at 174 mg kg^{-1}. Mielke found similar patterns in Baltimore (Mielke et al. 1983) and New Orleans (Mielke et al. 2008)

Much of the open space (as a land use classification) in East Oakland, however, actually lies in areas zoned for industry along the Alameda Estuary and San Leandro Bay (see Figure 5.2.5 b and c). Total Pb levels in East Oakland's open space (223 mg kg^{-1}) were almost ten times higher than in the hills. Median Pb levels in industrial zones were higher than residential and open space zones, and mean total Pb levels slightly higher than in areas zoned as urban open space ($p = 0.0879$, Steel-Dwass comparison).

Median Pb levels in park soils were slightly higher than under open space land use, but lower than soils in gardens and vacant lots. As a land use classification, parks were defined by a predominance of turf grass. In general, turf grass grown elsewhere is laid down during development of a park. Lead concentrations are therefore only a measure of the total Pb deposited since the site's development. While the age of parks varies considerably, some are obviously recent (as evidenced by new construction and landscaping), which would result in lower Pb levels than in adjacent soils.

Lead levels in gardens are likely elevated due to the fact that most are located in residential zones, where Pb contamination from old housing stock is highest. Moreover, all sampled gardens are located in some of the oldest parts of the city: North, West, and Central Oakland. It is also possible that Pb levels in garden soils are elevated due to applications of compost that may contain high concentrations of heavy metals. One study comparing heavy metals in ten different municipal solid waste composts from around the US found average Pb concentrations of 234 mg kg^{-1} (He, Logan, and Traina 1995). In another study of 46 US municipal composts, Pb concentrations ranged from 22 to 913 mg kg^{-1}, with a median concentration of 221 mg kg^{-1} (Epstein et al. 1992).

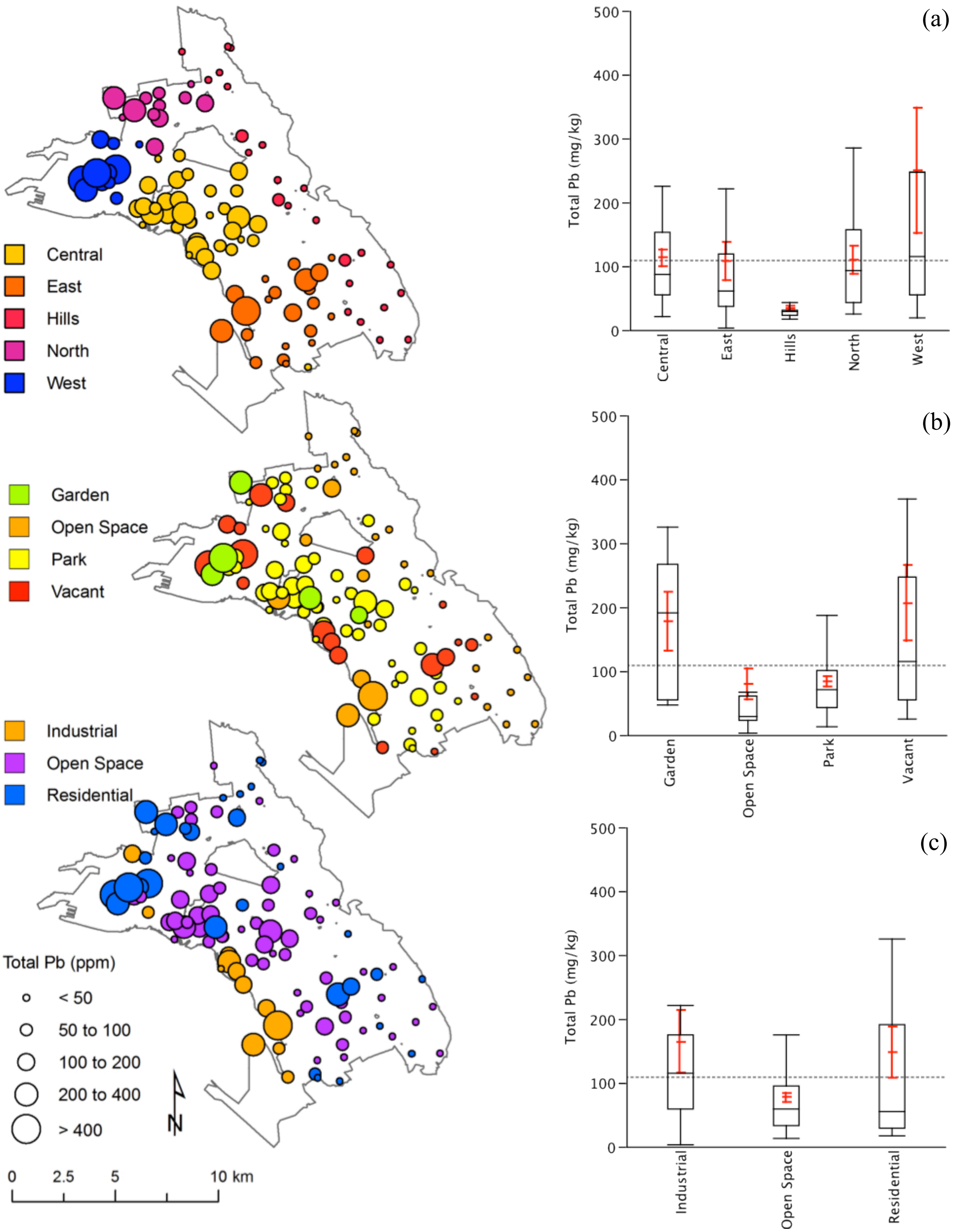


Figure 5.2.5: Total Pb levels (mg kg^{-1}) by (a) geographic zone, (b) land use type, and (c) zoning classification type of the site and/or surrounding area. Box plots represent 25th, 50th, and 75th percentiles. Red lines indicate the arithmetic mean and one standard error above and below the mean. The dotted line represents the grand mean. Analysis (Pb): UC Davis Analytical Lab

Neighborhood-Scale

Overall, estimated total Pb concentrations at 116 houses in West Oakland were higher than city-wide averages, but similar to the West Oakland levels identified in the city-scale analysis. Estimated total Pb ranged from 0 to 3,329 mg kg^{-1}, with a mean of 370 mg kg^{-1} and a median of 273 mg kg^{-1} (see Table 5.2.5 and Figure 5.2.6) Like the city-scale data, distribution was lognormal (skewness = 4.16, kurtosis = 24.74).

Table 5.2.5: Chemical characteristics of soil samples collected from residential yards in West Oakland (n = 260)

	Estimated Total Pb	Modified Morgan-extracted Pb	Cd	Ni	Cr	P	Ca	pH	CEC (meq cmol$_c^{-1}$)
	(mg kg^{-1})								
Mean	369.8	35.1	0.3	0.4	0.1	58.2	3,204.1	6.8	17.8
Median	273.0	20.0	0.2	0.3	0.0	38.0	2,526.5	6.9	14.9
Min	0.1	0.0	0.0	0.0	0.0	2.0	690.0	0.5	5.6
Max	3,329.0	543.0	3.3	2.3	7.4	2,074.0	14,620.0	10.1	64.3
Std Err	23.5	3.6	0.0	0.0	0.0	8.6	128.9	0.0	0.7
CV	102.5	163.8	113.8	79.1	653.9	237.4	64.6	10.3	59.8

Data source: City Slicker Farms Backyard Garden Program

A Moran's I test of spatial autocorrelation for the West Oakland data revealed no significant clustering of total Pb concentrations (index score = 0.062, p = 0.706). Using the Getis-Ord G_i^* test on the neighborhood-scale data, however, reveals some significant clustering of elevated Pb levels in the southwest corner of West Oakland (see Figure 5.2.7). A Getis-Ord G_i^* analysis of city-scale data reveals clustering ("hot spots") in the same area. The clusters identified in both the city-scale and West Oakland datasets is adjacent to a brownfield, the former site of the Phoenix Iron Works, a foundry that operated from 1901 until the early 1990s when the relocation of the Cypress Freeway forced it to shut its doors (Letzing 2004). Lead is emitted as a byproduct of iron smelting and elevated soil Pb levels are common in areas surrounding iron smelters (Schulin et al. 2007; Zhang et al. 2011).

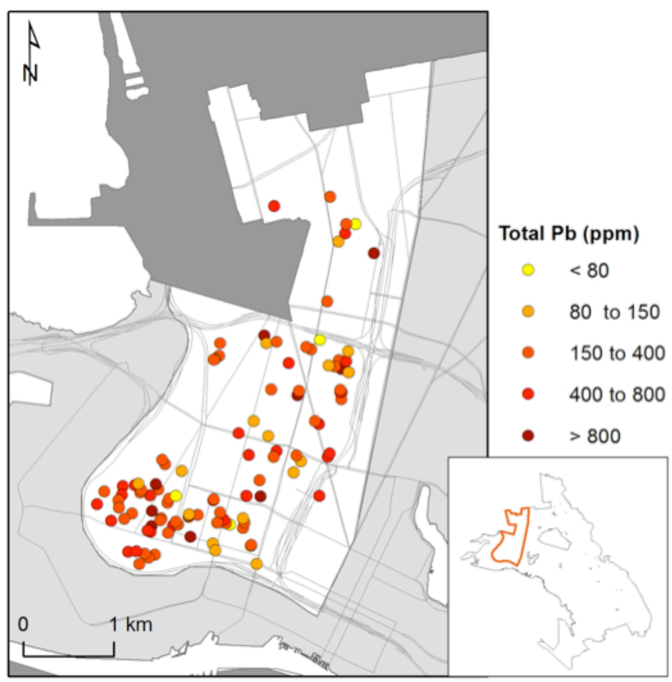


Figure 5.2.6: Estimated total soil Pb concentrations (mg kg^{-1}) in residential yards in West Oakland (n=116).
Data source: City Slicker Farms Backyard Garden Program

The neighborhood-scale data also reveal a "cold spot", where low values are clustered together along Union and 10th Streets. Residential yards in these areas belong to units in the Acorn

Apartments, public housing that was built in 1996 after the original 1960s Acorn housing project was razed. With the new construction, original soil was likely removed and new soil and turfgrass brought in during landscaping.

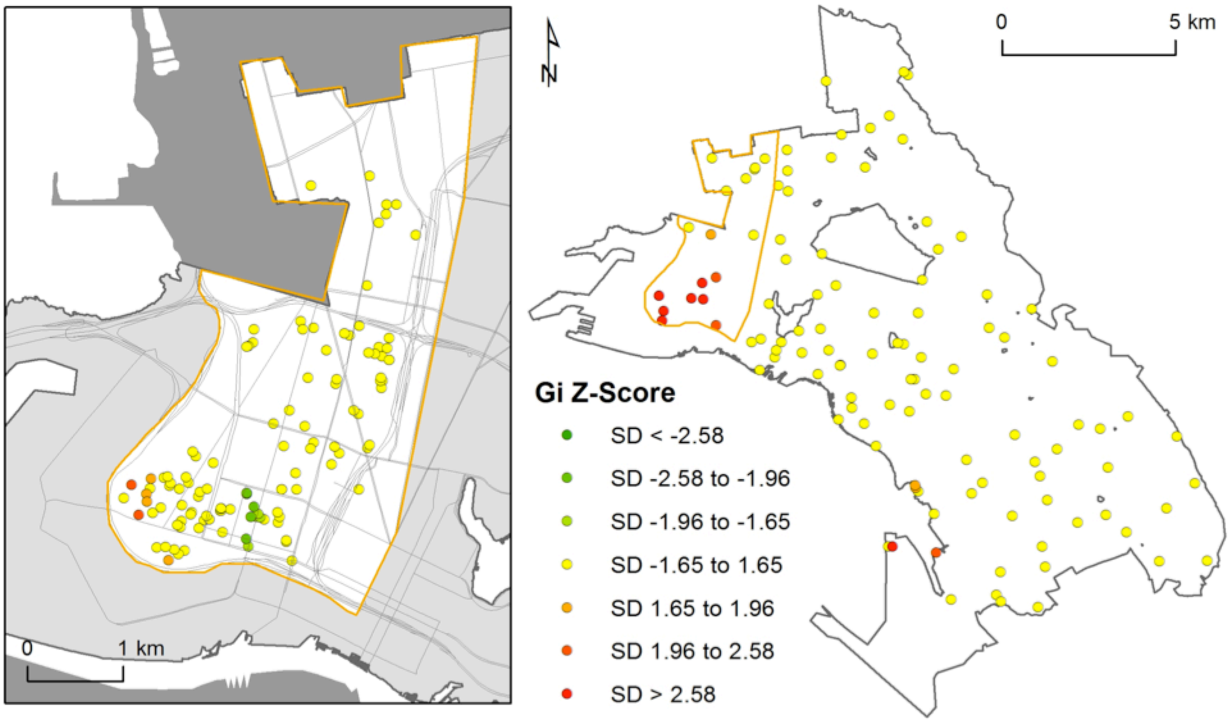


Figure 5.2.7: A Getis-Ord G_i* statistical "hot spot" analysis of estimated total Pb concentrations in (a) West Oakland and (b) Oakland. The Gi^* score is also the standard deviation (SD) from the average value of a point's neighbors. A high z-score (red) indicates clustering of high soil Pb concentrations while a low z-score (green) indicates spatial clustering of low Pb concentrations. Median z-scores (yellow) indicate that there is no significant spatial relationship between a site's Pb concentration and that of neighboring points.

Site-Scale

Analysis of eleven sites reveals that Pb concentrations vary significantly at the site-scale. Variability at each site was generally high (Table 5.2.6), particularly in West Oakland. A Moran's I test for each site reveals spatial autocorrelation at five of the sites (see Table 5.2.7). As expected, Pb levels at the two West Oakland residential lots (Filbert and 9th Street) were much higher than EPA screening levels. These high levels are consistent with their geographic location and the age of the neighborhood, as explained in the city-scale results above. According to Sanborn Fire Insurance maps from 1952, dwellings stood on both sites as late as 1952. While clustering of elevated Pb levels at the western end of the 9th Street site do not lie on the footprint of the house, the area was littered with garbage and appears to have been used as a dumping ground in the past.

Table 5.2.6: Total Pb (mg kg^{-1}) at selected sites throughout Oakland

Site	Land use	Grid samples (n)	-------------------- **Total Pb** (mg kg^{-1}) ---------------- Mean (± S.E.)		Median	Min	Max
West Oakland							
9th St.	Vacant	7	1,023	± 126.0	1,080	636	1,422
Filbert	Vacant	8	685	± 101.4	664	402	1,233
Central Oakland							
Brookdale	Park	12	88	± 8.1	86	44	131
Jungle Hill	Open Space	16	41	± 2.7	37	25	65
East Oakland							
Columbia Gardens	Park	14	92	± 8.8	75	61	169
Doolittle	Vacant	8	74	± 21.2	56	30	218
Harbor Bay (soil 1)	Open Space	18	176	± 40.9	113	20	536
Harbor Bay (soil 2)	Open Space	8	221	± 71.9	162	38	651
Oakport (soil 1)	Open Space	12	4	± 0.9	2	2	12
Oakport (soil 2)	Open Space	6	3	± 0.2	3	2	3
Oakport (soil 3)	Open Space	10	175	± 26.6	154	68	346
Tassaforonga	Park	6	107	± 7.6	105	85	141
Oakland Hills							
98^{th} Ave.	Vacant	12	60	± 20.9	42	24	288
King's Estates	Open Space	13	18	± 1.2	19	11	26

Analysis (Pb): UC Davis Analytical Lab

Table 5.2.7: Moran's I test of spatial autocorrelation total soil Pb concentrations at multiple scales (city, neighborhood, and site). An index score of 1 indicates that clustering is not due to random chance, 0 indicates complete randomness, and -1 indicates perfect dispersion.

Scale of Analysis	n	Index Score	Expected Index	Variance	z-score	p-value	
City							
Oakland	112	0.043	-0.009	0.013	0.457	0.648	
sub-sample	49	0.123	-0.021	0.069	0.585	0.559	
Neighborhood							
West Oakland	116	0.062	-0.009	0.036	0.377	0.706	
Site							
9^{th} Street	7	0.497	-0.167	0.136	1.803	0.071	*
Filbert	8	0.414	-0.143	0.213	1.208	0.227	
Jungle Hill	16	0.037	-0.067	0.035	0.549	0.583	
Brookdale	12	0.209	-0.091	0.079	1.067	0.286	
King's Estates	13	0.315	-0.083	0.080	1.405	0.160	
Oakport	28	0.683	-0.037	0.027	4.410	<0.01	***
Tassaforonga	6	-0.124	-0.200	0.061	0.308	0.758	
98^{th} Avenue	12	-0.210	-0.091	0.008	-1.349	0.178	
Harbor Bay	26	0.319	-0.040	0.028	2.139	0.032	**
Doolittle	8	0.140	-0.143	0.028	1.690	0.091	*
Columbia Gardens	14	0.408	-0.077	0.055	2.061	0.039	**

*p<0.10, ** p<0.05, *** p<0.01

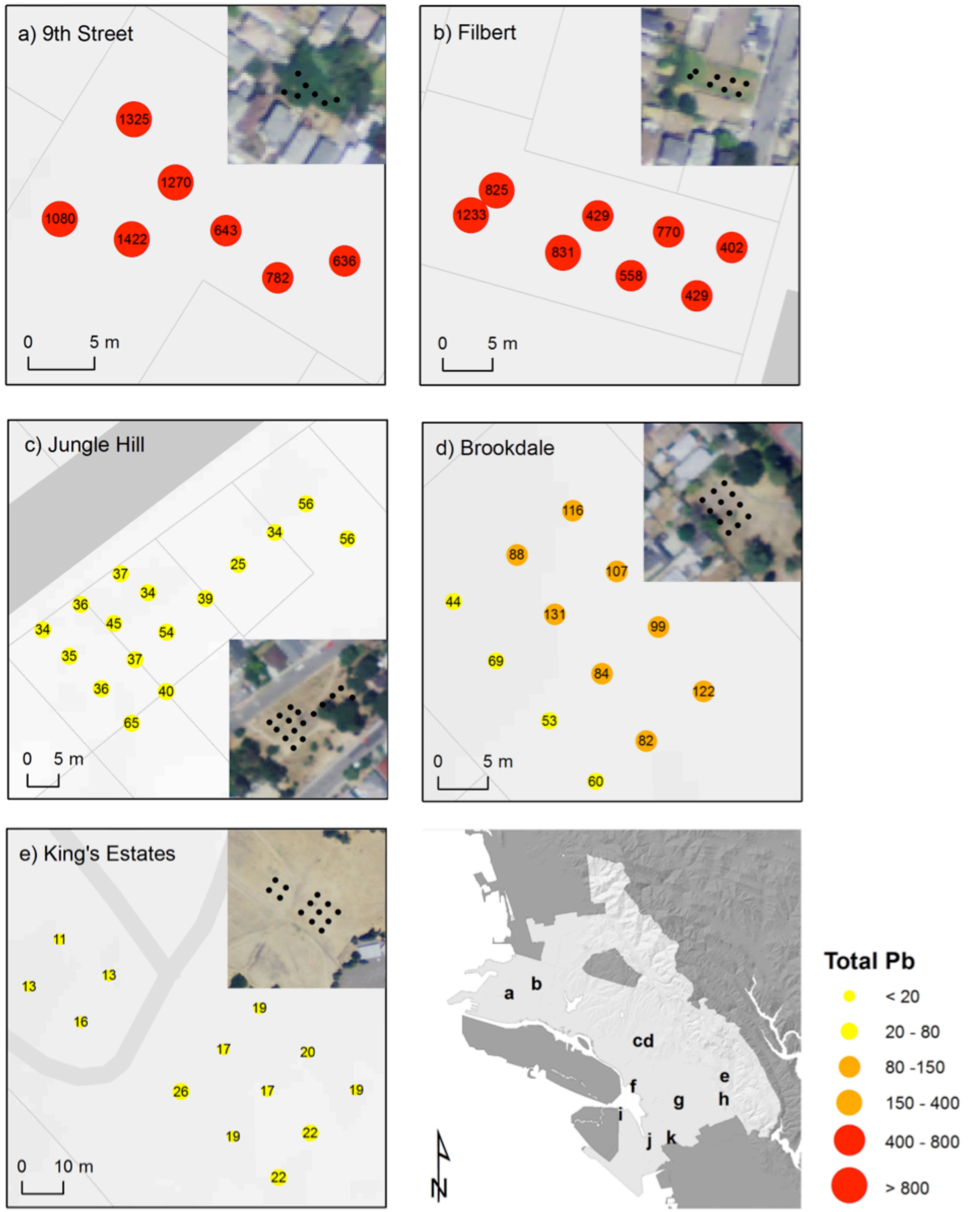


Figure 5.2.8: Total soil Pb concentrations (mg kg^{-1}) at eleven sites in Oakland. Each circle represents both the mean Pb value and mean center of nine soil cores (0 – 10 cm) taken from a grid square of 25' × 25' (a, b, c, d, g, h, k), 50' × 50' (e, f, i), or 100' × 100' (j). Red circles indicate Pb values above EPA screening level (400 mg kg^{-1}), orange above previous (150 mg kg^{-1}) and current (mg kg^{-1}) CHHSSL Pb screening levels. Mean centers of each grid square are also represented with black dots in the inset. Sites locations are indicated on the map of Oakland (bottom right). Analysis (Pb): UC Davis Analytical Lab

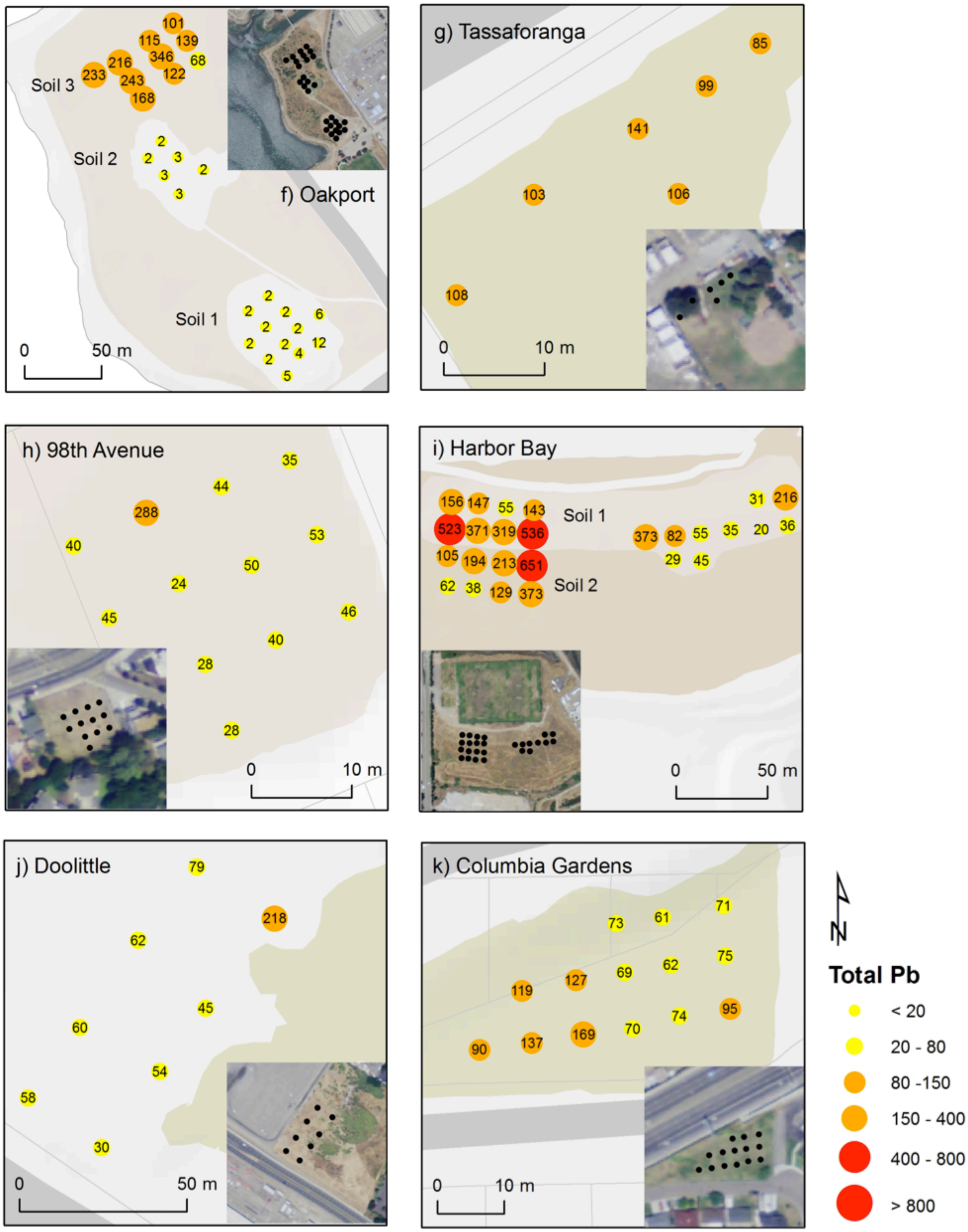


Figure 5.2.8 (cont'd)

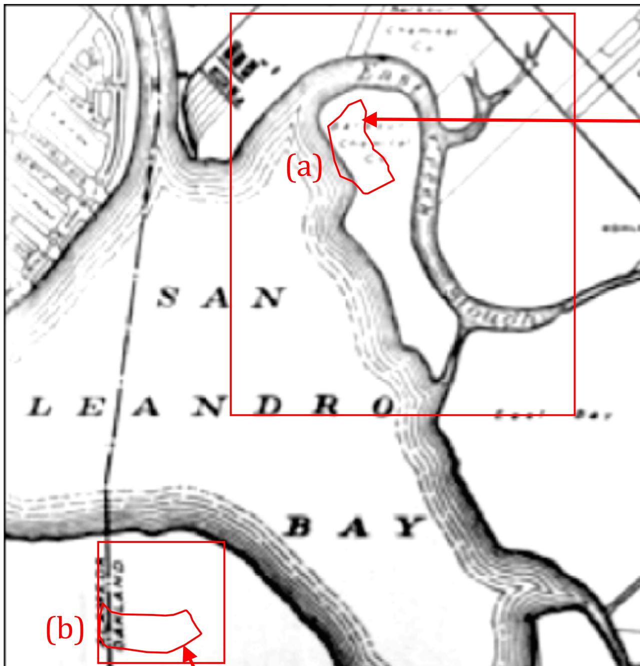


Figure 5.2.9: The 1918 map at left shows the tidal flats surrounding San Leandro Bay in East Oakland. Approximate locations of the (a) Oakport and (b) Harbor Bay sites are outlined in red. Both sites received significant amounts of artificial fill during the 20th century, much of it likely dredge material from the Alameda Estuary. The East Creek Slough was filled in during the 1960s or 1970s. Sources: Map: Alameda County Chamber of Commerce (1918); Photo: NAIP, USDA (2005)

Figure 5.2.10: Harbor Bay site in 1981 (left), 1994 (center), and 2005 (right). The Engine Test Facility is visible to the right in the 1994 and 2005 photos. Sources: (1981 & 1994 imagery) City of Oakland Office of Planning; (2005 imagery) National Agriculture Imagery Program, USDA

Soil Pb levels in other parts of the city were generally lower, with the exception of two sites in East Oakland, Oakport and Harbor Bay Parkway (Figure 5.2.8 e and i), both of which are located in industrial areas built on artificial fill along next to the San Leandro Bay. Maps and aerial photography indicate a century of disturbance at both sites. The Oakport site is located on East Bay Municipal Utilities District land, and is managed by the East Bay Regional Parks District as part of the Martin Luther King, Jr., Regional Shoreline. A 1918 map shows an island in the tidal flats owned by the Barbour Chemical Co. where the Oakport site is currently located (see Figure 5.2.9), with ownership changing hands several times over the first half of the century. The natural shoreline is still visible in the 1952 Sanborn map. However, a 1981 aerial photo reveals that the site had reached its current extent, indicating that major transformation occurred during the 1960s and 1970s, including the filling of East Creek Slough. While the shoreline has remained the same for at least the last thirty years, fill is occasionally added to the site. The soil at the northern end of the site (Oakport soil 3) approached EPA screening levels, while those at the southern and central end (soils 1 and 2) were much closer to background levels. Soils 1 and

2, which were sandier than soil 3 (see Appendix B2) appear to have been deposited recently; there was a noticeable drop in elevation (approximately 0.25 m), marking the limits of where soil 2 fill had been spread by a bulldozer. Vegetation in soil 3, including large *Baccharus* shrubs and high annual grass (*Avena barbata*), was much more established, indicating that the soil had been left undisturbed for some time. Vegetation on Soils 1 and 2 was dominated by earlier succession species such as yellow star thistle (*Centaurea solstitialis*), common in highly disturbed areas (Roché and Roché 1991). Elevated Pb levels in soil 3 may also be related to higher clay content (14%), two to three times higher than the other two soils, as well as to CEC (22.9 $cmol_c\ kg^{-1}$), two to five times higher than the other soils.

Figure 5.2.11: Harbor Bay, East Oakland. Note the flaring from the Engine Test Facility to the left, a possible source of deposition. Photo: June 2009.

The Harbor Bay site, owned by the Port of Oakland, lies at the north end of Oakland International Airport's historic North Field, and immediately south of the Spunkmeyer Soccer Field. Built on artificial fill on the tidal flats of Bay Farm Island in 1927, North Field was the airport's first runway.[121] Aerial photographs from 1981 and 1994 show two structures on the western half of the field. In 1994, the eastern half of the site appears to have been graded, and possibly covered with new fill (see Figures 5.2.10). Clustering of elevated Pb levels appeared at the western end of the Harbor Bay site and seem to be associated with activity visible in the 1994 photo. It appears that fill was applied on the eastern half of the site, perhaps diluting Pb concentrations. Elevated Pb concentrations are also possibly a legacy of atmospheric deposition from the adjacent Engine Test Facility (see Figure 5.2.11). Cadmium and manganese concentrations at this site were also much higher than at the other sites included in the 2009 site-scale analyses (see Appendix B3). The 2005 photo also shows a difference in the soils (or possibly vegetation) on the two halves of the site. In 2009 during sampling, however, it was evident that new fill had been added on the northern half of the site (Soil 1, Figure 5.2.8 i).

As expected, Pb levels in the three parks sampled were generally low. Since all three sites are now city parks, new soil and turfgrass was likely brought during construction. Several houses built in the 1940s were located on the Columbia Gardens site, but were demolished in the early 2000s for the widening of 98th Avenue, a major thoroughfare linking Interstate 880 to the airport. A retaining wall/sound wall now separates the site from 98th Avenue. Lead levels greater than 90 mg kg^{-1} were clustered at the western end of the site, but do not appear to be related to land use history. According to the 1952 Sanborn map, the Tassaforonga site was located on vacant US Government land. At the Brookdale site, a dwelling and outbuilding were present as late as 1952, but Pb levels at the site were relatively homogeneous and do not reflect the footprint of the buildings, likely the result of site's development as a park.

Lead levels at two open space areas, King's Estates in East Oakland and Jungle Hill in Central Oakland, were also low. Both sites are considered Resource Conservation Areas by the

[121] At 7,020 feet (2.138 km), it was the longest runway in the world at the time of its construction. Dedicated by Charles Lindbergh, it was also the point of embarkation for Amelia Earhardt's ill-fated voyage a decade later.

Oakland Parks and Recreation Department, and are maintained infrequently; due to steep slopes, both sites are grazed annually by a herd of goats. Both sites appear unchanged in 1981, 1994, 2005, and 2009 aerial imagery. Lead levels at King's Estates are similar to natural background levels; indeed, the site has never been developed.

Figure 5.2.12: Jungle Hill, Central Oakland. Landslides in the 1930s and 1970s destroyed several houses here. Photo: June 2009.

At the Jungle Hill site, geomorphology may also have played a part in low Pb levels. Massive mixing of soils following a series of landslides may have diluted whatever surface deposition of Pb had been there (see Figure 5.2.12). The site was once home to several houses. No development appears on the 1903 map, which was made 6 years prior to the city's annexation of its eastern territory. By 1925, however, the neighborhood was well established and three houses built on the bluff above the sampling site. During the 1930s, two of the houses collapsed during a landslide. In the 1970s, the final house collapsed. The site became a park, first owned by the Santa Rita Community Land Trust, later ceded to Oakland Parks and Recreation (Oakland Museum of California 1997).

Finally, while a not captured by the Moran's I test, a high Pb concentration in one grid-square at the 98th Avenue site (Figure 5.2.8 h) is possibly a legacy of an old fire station that once stood on the property. A 1952 Sanborn Fire Insurance map shows the Engine No. 26 and Truck No. 8 station on the northeast corner of the lot in approximately the same location as the elevated Pb levels. The station is also visible in 1981 and 1992 aerial photos.

Conclusions

In addition to characterizing Pb contamination at potential food production sites throughout the city, the research presented in this section also helps to identify key trends that may be of use to urban agriculture advocates as they consider where to initiate new projects. Futhermore, this research underscores the importance of scale when determining contamination. While geomapping at city-scale or neighborhood scale can ultimately reveal geographic trends, assessing risks associated with Pb contamination must ultimately be carried out at individual sites. As the site-scale research reveal, there is often significant variability across a site.

A multi-scalar analysis also reveals several interrelated trends. First, geography matters; soil Pb concentrations were highest in West Oakland (the oldest part of the city) and lowest in the Oakland hills. Second, land use has a significant effect on Pb levels. Soil Pb tended to be higher in gardens and vacant lots, and lower in parks and late-succession open space. Third, the city's zoning classifications (which are tied to land use at a coarser level) also affect Pb levels. In this study, soil Pb tended to be higher in residential and industrial zones than in open space. Analysis of spatial autocorrelation at all three scales was also able to highlight the relationship between certain land use histories and soil Pb levels. In the next section, I attempt to link differences in soil Pb concentrations to specific anthropogenic and soil-related factors.

5.3. Assessing the influence of anthropogenic factors and soil characteristics on soil Pb

As I report in the previous section, Pb levels in Oakland soils are much higher than background levels generated by geomorphic processes alone. Indeed, it would be an understatement to say that human activity has altered the chemical make-up of urban soils. In a post-industrial landscape such as Oakland, this is particularly true. Urban geochemical records often reveal distinct periods of anthropogenic disturbance. Sediment cores taken from the San Francisco Bay reveal the chronology of contamination. Significant levels of polyaromatic hydrocarbons (PAHs) can be associated with high levels of burning beginning with Spanish conquest and continuing through combustion of petroleum products. Mercury (Hg) in the sediment can be traced to hydraulic mining beginning in the mid-19th century, which raised Hg levels to 20 times baseline concentrations. High concentrations of both organic contaminants such as PAHs, PCBs, and DDT, and metals in sediment cores from the 1940s to 1980s can be attributed to agricultural, industrial, and mining activities, with the greatest level of contamination identified in core layers dating from the 1950s to '70s. Mercury, Pb, and DDT levels have declined significantly since the 1970s (Hornberger et al. 1999).

While some Pb atmospheric deposition of Pb has been traced to a smelter located on the edge of the San Pablo Bay, the majority of Pb contamination in the Bay Area has been attributed to automobile exhaust (Martens et al. 1973; Hornberger et al. 1999). Mielke et al. (2010) calculated that 31,922 Mg of Pb was emitted in the San Francisco/Oakland Metropolitan Area between 1950 and 1982, 40% of which (17,025 Mg) was in the form of particles > 10 μm. Due to their weight, particles of this size do not travel far from the point of emission, while particles < 10 μm can be carried throughout the atmosphere. A study of Pb contamination along Interstate 880 in Oakland illustrates the relationship between emissions and Pb levels. Constructed in the 1950s, the 880 is Oakland's busiest freeway. By the 1970s, more than 97,000 vehicles used it daily. By the 1990s this number had increased to more than 372,000. Soils closest to the freeway exceeded state and federal criteria for hazardous waste (1,000 mg kg^{-1}). In 90% of samples, sub-surface Pb levels exceeded surface levels, indicating a decline of Pb deposition following the ban on leaded exhaust (Teichman et al. 1993).

Point-source Pb pollution from industry is also a critical consideration. East Oakland's Verdese Carter Park, for example, is located on the former site of a Pb battery factory that operated from 1912 to 1975. The City of Oakland purchased and razed the property in 1976, removing over 5,700 cubic yards (4,358 m^3) of Pb-contaminated soil over the next two years. An additional 17,000 cubic yards (12,997 m^3) were removed from the park in 1994 following community demands to mitigate ongoing Pb contamination. Twenty-three homes in a seven-block vicinity of the site with Pb levels over 1,000 ppm were also remediated in 1996 (EPA 2011).

Another primary point source of Pb contamination in Oakland's soils is old housing stock. Ninety-percent of housing structures in Oakland were built before 1979 (the ban on Pb-based exterior house paint went into effect two years later). More than a third of the city's structures (55,339), however, were built in 1939 or earlier (US Census Bureau 2000) when Pb concentrations in paint were at their highest. In West Oakland, many of the houses date from the late 19th century; throughout the flatlands, many other homes were built following the 1906 earthquake in order to house the tens of thousands who lost their homes (Scott [1959] 1985). In the century or more since the construction of many of Oakland's houses, large quantities of paint have flaked off onto surrounding soil. Scraping or sandblasting prior to repainting has also resulted in marked increases in the soil of residential lots. While the amount of anthropogenic deposition of Pb began to decline in the late 1970s with the gradual phaseout of leaded fuels and paints (Hornberger et al. 1999), the Pb deposited during this era remains in the soil and continue to circulate between air, soil, and water (Clark, Brabander, and Erdil 2006; Laidlaw and Fillippelli 2008).

Understanding the anthropogenic effects on soil Pb can help to explain soil contamination at a large geographic scales and hint at the source of contamination. By analyzing the relationship between soil Pb and other soil characteristics, we can better understand how such anthropogenic change—including deposition of Pb—impacts the soil, while illuminating important variables to consider if we attempt to model or predict potential contamination at future urban agriculture sites. In this section, I attempt to relate soil Pb levels in Oakland to both anthropogenic sources of contamination and soil chemical characteristics. Identifying these factors may help not only to explain the historical sources of contamination, but will also lay the groundwork for predicting potential areas where urban agriculture may be hindered by soil contamination. I conclude with a brief discussion and example of predictive mapping.

Methods

To characterize soil contamination in urban areas, many researchers have relied on geostatistics to characterize spatial patterns, and on multivariate statistical analyses to identify relationships between contamination and independent variables related to soil characteristics and land use. In many studies, researchers use GIS to calculate spatial attributes of sources and sinks of pollution such as the distance to a freeway or the density of factories in a given area (Ratha and Sahu 1993; Faccinelli, Sacchi, and Mallen 2001; Li et al. 2004; Zhang 2006; Thornton et al. 2008; Liu, Xia et al. 2010; Wu et al. 2010). In this section, I use both spatial data and linear regression models to relate total soil Pb to both anthropogenic and soil-related variables.

<u>*Soil samples and analysis*</u>

To assess anthropogenic influences on soil Pb levels, I used the city-scale dataset described earlier in the chapter; sampling protocol and analysis are described the Methods section of Section 5.2. To assess the influence of selected soil chemical properties, I used a subset of 50 samples selected from the city-scale data set. The samples were selected to equally represent the factors addressed above: geographic location (the Oakland hills, and the North, West, Central, and East Oakland flatlands) and land use type (open space, garden, vacant, and park), as defined in Section 5.2. Sub-sample locations are presented in Figure 5.3.1. In addition to total Pb, pH, C, and N analysis described in Section 5.2, the fifty samples were analyzed for total phosphorus (P) and calcium (Ca) using a nitric acid/hydrogen peroxide closed vessel microwave

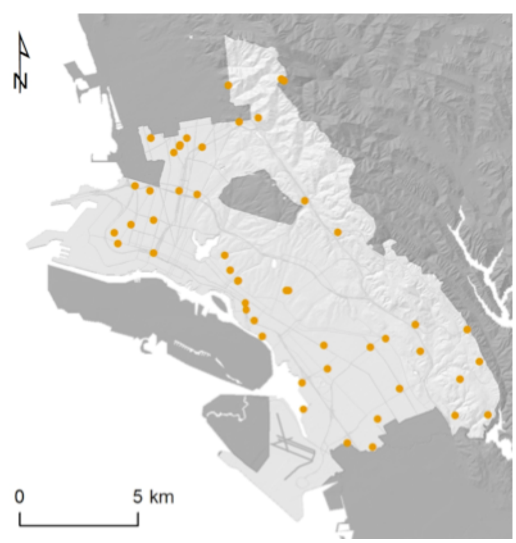


Figure 5.3.1: Sub-samples selected for additional analysis of soil chemical properties

digestion (Sah and Miller 1992) and Inductively Coupled Plasma Atomic Emission Spectrometry. Samples were analyzed at UC Davis Analytical Lab (Davis, CA). Chemical characteristics for the sub-sample soils are presented in Table 5.3.1.

Table 5.3.1: Chemical characteristics of soil sub-samples (n=49)

	Total	DTPA - extracted	$MgCl_2$ - extracted	------ Total ------				C/N ratio	pH
	------ Pb ------			Ca	P	C	N		
	------ (mg kg^{-1}) ------								
Mean	139	27.7	3.4	6,895	720	45,279	3,386	13.5	6.7
S.E.	29.1	5.6	0.9	425.9	50.5	2,856.9	204.6	0.3	0.1
Median	58	11.0	0.7	6,420	670	45,498	3,541	13.0	6.7
Min	13	0.5	0.0	2,330	310	14,269	680	10.3	5.9
Max	979	153.6	32.5	15,520	1,990	95,861	7,117	21.0	7.6
CV	146.6	141.2	195.6	43.2	49.1	44.2	42.3	16.3	6.1

Analyses: (Pb, Ca, and P) UC Davis Analytical Lab; (pH and C) Jabari Brown, UC Berkeley

GIS and statistical analyses

ArcInfo 10 was used for all mapping (Datum/Projection: WGS 1984 UTM Zone 10N) and spatial statistics (kriging, Moran's I, Getis-Ord G_i^*). Statistical analyses were completed using JMP 9 software (SAS Institute, Cary, NC) and included least squares linear regressions, analysis of variance (ANOVA), distribution tests (Shapiro-Wilk W, Kolmogorov's D), nonparametric correlations (Spearman's ρ) and comparison of means (Steel-Dwass). Total Pb data was distributed similarly to that of the overall data set: highly skewed (skewness = 2.889, kurtosis = 8.524) and lognormal with lognormal distribution. As a result, total Pb data was log-transformed when necessary to meet assumptions of normality for regression and ANOVA. One outlier (total Pb = 2,262 mg kg^{-1}) was removed from analysis.

To identify anthropogenic sources associated with Pb deposition, a linear regression model was used to test the relationship of several anthropogenic factors to total soil Pb levels. Initially, variables of interest included land use type (garden, open space, park, and vacant), zoning type (residential, industrial, and open space), as well as distance to major roads, distance to industrial sites, distance to the Oakland airport, density of pre-1940s housing stock (see Figure 5.3.2). Soil type (which includes 17 different soil series) was also included, given that 75% of Oakland's soils are classified as "urban land" or urban land complexes, defined as consisting of "mainly heterogeneous fill" (Welch 1981, 24).

Multiple runs of various iterations of the model revealed that zoning type, distance to the airport, and distance to industry were not significant ($p>0.10$) and were therefore excluded from the final model, which included housing stock, soil type, land use type, and distance to major roads. Given that the local point pattern Getis-Ord G_i^* test (as discussed in Section 5.2) revealed slight spatial autocorrelation of Pb levels, it was necessary to include geographic coordinates in the linear regression model. The addition of these X and Y coordinates greatly improved the coefficient of determination (or R^2) of the model, a measure of the model's ability to account for variability in the data. Residuals were tested for spatial autocorrelation using Moran's I to verify that the linear model was appropriate for the data set.

Three statistical tests (Spearman's nonparametric correlation, ANOVA, and principal components analysis) were conducted to tease out the relationships between Pb and other soil chemical factors known to complex with Pb: Ca, P, and C (as a measure of soil OM), and pH, which mediates its solubility and the weathering of Pb-complexes. Regression and ANOVAs of soil type on total Pb, Ca, P, C, and pH were also conducted.

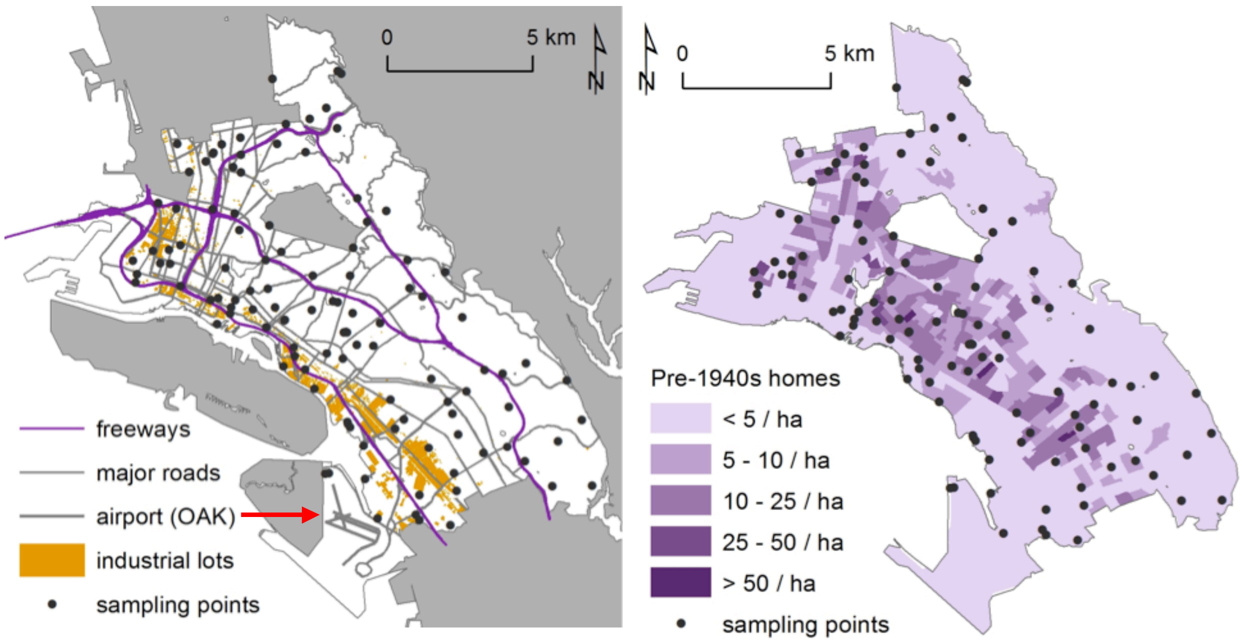


Figure 5.3.2: Spatial distribution of anthropogenic factors likely affecting total soil Pb levels: (left) major roads, freeways, industry, and the airport; (right) pre-1940s housing stock (units ha^{-1}) by census block. Sampling sites are indicated by black dots.

Results and Discussion

Influence of Anthropogenic Factors

Results of the regression are presented in Table 5.3.2. As I discuss in Section 5.2, total Pb levels for Oakland are similar to those found in other industrialized cities, but are higher than lithogenic background levels reported for the city, state, and the US on the whole. As in most urban areas, one can assume that these elevated levels of Pb originate from anthropogenic sources. Of the various effects tested by the model, the density of pre-1940s housing stock was most significant ($p = 0.0241$), while the distance of a site to a major road had a less pronounced effect ($p = 0.1241$) on log total Pb. Estimates for the specific parameters (i.e., specific soil and land use types) revealed that two soil types in particular significantly affected total Pb concentration (see Appendix B4). While not significant ($p = 0.12$) according to this version of the model, the urban land-Baywood complex soil series was significant in previous iterations of the model (I will discuss this anthropogenic soil type in more detail in the next section). Land use type was also significant in this model (p = 0.0375); parameter estimates reveal that this effect is due mostly to low soil Pb levels in parks underlying the turfgrass (p = 0.0510). To a less extent, open space (p = 0.14) also appears to be an explanatory factor in the ability of land use to explain variance.

Table 5.3.2: ANOVA and effects tests of a multiple linear regression and ANOVA of log (total Pb) on geographic coordinates, soil type, distance to major roads, and density of pre-1940s housing stock (R^2=0.42)

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F	
ANOVA						
Model	24	43.43099	1.80962	2.6570	<0.0005	*
Error	87	59.25476	0.68109			
C. Total	11 1	102.68575				
Effects Tests						
X-coordinate	1	0.6408428		0.9409	0.3347	
Y-coordinate	1	0.8987776		1.3196	0.2538	
Soil type	17	6.3207064		0.5459	0.9211	
Density of pre-1940s housing units	1	3.5906436		5.2719	0.0241	*
Land use type	3	6.0125993		2.9426	0.0375	*
Distance to major roads	1	1.6424193		2.4115	0.1241	

In some ways, these results echo findings from previous studies, where both freeway emissions and old housing stock were responsible for contamination. A number of studies find significant relationships between freeway proximity and contamination. In an Italian study conducted before a ban on leaded gasoline took effect, researchers found a linear correlation in soil Pb levels and number of vehicles traveled on adjacent highways. Levels rose during summer months when traffic volume was higher (Gratani, Taglioni, and Crescente 1992). In another Italian study, Imperato et al. (2003) reported two- to six-fold increases in soil Pb in four garden and three roadside soils in Naples between 1974 and 1999. In a study in a suburb of Sydney, Australia, researchers using a generalized linear model found that the distance of a sampling site to a road significantly affected Pb, Zn, Cu, and Cd concentrations in the soil, and along with soil disturbance, accounted for 24% of variation (Markus and McBratney 1996).

What stands out in this study of Oakland, however, is the extent to which the density of old housing stock explained variance in Pb levels. This variable far outweighed other factors, and is likely due to the age of the majority of Oakland's housing. In a study of soils and house paint at 358 houses in Oakland, Sutton et al. (1995) found that the age of housing stock correlated with total Pb levels (which averaged 897 mg kg^{-1}). They found that homes built prior to 1920 were ten times more likely to have soil Pb levels > 500 mg kg^{-1} than houses built after 1950. The difference appears to be due to decreases in the concentration of Pb actually found in the paint itself. The median Pb concentration in exterior paint on houses built before 1920 was 31,406 µg g^{-1} but only 440 µg g^{-1} in homes built after 1970. In a Minneapolis study, Mielke et al. (1984) reported median soil Pb levels of 938 mg kg^{-1} next to painted homes while median levels outside brick and stucco homes was 526 mg kg^{-1}. The results of a Los Angeles study also highlight the relative importance of house paint as a source of contamination in urban areas. Wu et al. (2010) found a strong correlation between age of housing stock and soil Pb, accounting for 54% of variance in Pb concentrations in residential areas. Their regression model included both parcel age and distance to major surface streets, and had greater explanatory power in residential areas (R^2 = 0.61) than in commercial areas (R^2 = 0.32). Parcel age explained less variance in data collected in industrial and commercial areas, as well as in data collected closer to freeways.

Influence of soil chemical properties

Spearman's rank correlation (an alternative to the standard Pearson's correlation which demands normal distribution of data) highlights the statistically significant relationships between total Pb, Ca, P, and C (see Table 5.3.3). Phosphorus ($p < 0.01$) and C ($p < 0.0001$) correlated most closely to Pb. Calcium ($p < 0.05$) also correlated with Pb. These correlations are similar to others found in the literature. Thums et al. (2008) also reported a positive Spearman's ρ correlation between total Pb and total organic C. In a study of urban soils in Spain, Acosta et al. (2010) found that Pb was negatively correlated with pH and positively correlated with organic C. Similarly, Vega et al. (2010) found that competitive binding of Pb increases with CEC and pH and decreases with increasing sand and Mn-oxide content. Clay content reduces sorption and (with no effect on retention) while OM increases retention (but no effect on sorption). Soils with pH > 5.45 and CEC > 11 $cmol_c\ kg^{-1}$ had the highest binding capacities, while soils with pH < 5.45 and low OM content (< 37 $g\ kg^{-1}$) had the least binding capacity. In this study, however, total Pb did not correlate with pH. Soil pH levels did not vary considerably across the city (pH 6.7 ± 0.1).[122] As I will discuss in Section 5.4, pH plays a significant role in the *solubility* of Pb in the sampled soils, but because total Pb is an aggregate measure of both labile and recalcitrant forms of Pb, soil pH does not necessarily impact the overall presence of Pb.

Table 5.3.3: Spearman's ρ non-parametric correlation matrix of soil chemical characteristics (total Pb, Ca, P, C, and pH) in sub-sample of urban soils (n = 49)

	Pb	Ca	P	C	pH
Pb	0	0.3078 *	0.4467 **	0.4268 ***	-0.1496
Ca		0	0.4790 **	0.4266 **	0.6282 ***
P			0	0.7015 *	-0.0313
C				0	-0.1221
pH					0

*** (ρ<0.0001). **(ρ<0.01), *(ρ<0.05)

Analysis of variance (ANOVA) of a multiple linear regression of log-transformed Pb on pH and log-transformed Ca, P, and C, highlights the highly significant effect of P on Pb (Table 5.3.4). At the same time, Ca, C, and pH do not significantly explain variance, despite the correlation of Ca and C with total Pb. While the regression model explains only a third of the variability (R^2 = 0.34) of total soil Pb, the model's overall ability to explain error is highly significant ($p < 0.0005$). The analysis underscores the strong relationship between Pb and P, and

[122] In general, urban soils tend to have higher pH than surrounding rural areas due to construction debris that and heterogeneous fill that decrease the acidity of the soil (Biasioli, Barberis, and Ajmone-Marsan 2006).

implies that most of the Pb at the sampled sites is bound to P. Given the neutral to slightly-alkaline pH of the soils, the Pb has most likely precipitated as a recalcitrant Pb phosphate (Scheckel and Ryan 2002; Zhang, Ryan, and Bryndzia 1997).

Table 5.3.4: ANOVA and effects tests of a multiple linear regression and ANOVA of log[total Pb] on log[total log[total Ca], log[total P], log[total C], and pH (R^2=0.34)

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F	
ANOVA						
Model	4	18.207396	4.55185	5.5951	0.0010	*
Error	44	35.795782	0.81354			
C. Total	48	54.003178				
Effects Tests						
Log (total Ca)	1	0.0001475		0.0002	0.9893	
Log (total P)	1	4.2649505		5.2425	0.0269	*
Log (total C)	1	0.8002099		0.9836	0.3267	
pH	1	0.0110138		0.0135	0.9079	

*(ρ<0.05)

Influence of soil type

The highest Pb levels were found in the soil types with the greatest level of anthropogenic disturbance, notably urban land, urban land-Baywood complex, and urban land – Clear Lake complex (see Table 5.3.5). Urban land-Baywood complex (see Figure 5.3.3) is the dominant soil in West Oakland, and is a sandy textured soil whose parent material consists of surficial sediments, notably Quaternary beach and dune sand transported by prevailing winds from the San Francisco peninsula during the last interglacial period. Clear Lake soils are dominant in Central and East Oakland. Derived from weathered Holocene alluvium, they are found in poorly drained basins located at the base of the massive Pleistocene alluvial fan which covers most of the upper flatlands, forming the gentle upward gradient of the foothills (Welch 1981; Sloan 2006).

While soil type did not appear as a significant variable in the model testing anthropogenic factors, ANOVAs of regressions on total Pb, Ca, P, C, and pH nevertheless provide insights into some of the correlations reported above. Soil type had a significant effect on log-transformed total Pb, Ca, and P, but did not significantly affect log C or pH (see Table 5.3.6). Urban land ($p < 0.01$), urban land- Baywood complex ($p < 0.0001$), and urban land-Clear Lake complex ($p < 0.05$) all had a significant effect on variance of log-transformed total Pb. Urban land-Baywood complex ($p < 0.01$), and urban land-Clear Lake complexes ($p < 0.05$) also had significant effects on variance of log total P. Millsholm silt-loams ($p < 0.01$), well-drained, shallow soils found in the Oakland hills and which consist of shale and fine-grained sandstone residuum, had a significant effect on log total Ca. These soils had the lowest mean Ca levels (3,614 mg kg^{-1}).

Table 5.3.5. Soil series, level of anthropogenic disturbance, and total Pb, Ca, P, C, and pH (mean ± S.E.)

Soil	Anthro-pogenic disturbance	n	Pb	Ca	P	C	pH
			(mg kg^{-1} ± S.E.)				
Clear Lake clay	+	1	30	14,010	840	54,807	7.2
Climara clay	+	1	22	6,110	310	25,775	7.1
Gilroy clay loam	+	1	28	9,880	550	22,968	6.8
Laugenour loam	+	1	48	7,060	810	43,792	6.9
Los Osos – Millsholm complex	+	1	24	10,290	440	26,455	7.2
Maymen loam	+	2	53 ± 35	5,440 ± 1,890	415 ± 25	41,711 ± 26,546	6.8 ± 0.1
Maymen – Los Gatos complex	+	2	38 ± 8	5,390 ± 680	410 ± 90	35,365 ± 10,749	6.6 ± 0.6
Millsholm silt-loam	+	5	27 ± 1	3,614 ± 800	434 ± 21	28,865 ± 3,378	6.6 ± 0.2
Sycamore silt-loam	+	1	34	6,420	750	41,471	6.1
urban land	++++	5	292 ± 127	9,103 ± 1,356	703 ± 119	58,684 ± 13,113	6.7 ± 0.3
urban land – Baywood complex	+++	4	527 ± 217	7,679 ± 1,118	1,309 ± 329	56,776 ± 16,343	6.9 ± 0.1
urban land – Clear Lake complex	+++	7	136 ± 31	6,371 ± 533	914 ± 130	51,614 ± 5,635	6.5 ± 0.1
urban land – Danville complex	+++	6	94 ± 43	7,386 ± 1,260	684 ± 73	48,600 ± 8,001	6.8 ± 0.2
urban land – Tierra complex	+++	11	109 ± 26	6,772 ± 1,066	737 ± 78	46,823 ± 4,145	6.6 ± 0.1
Xerorothents – Millsholm complex	++	1	18	4,710	400	16,467	7.2

Analyses: (Pb, Ca, and P) UC Davis Analytical Lab; (pH and C) Jabari Brown, UC Berkeley

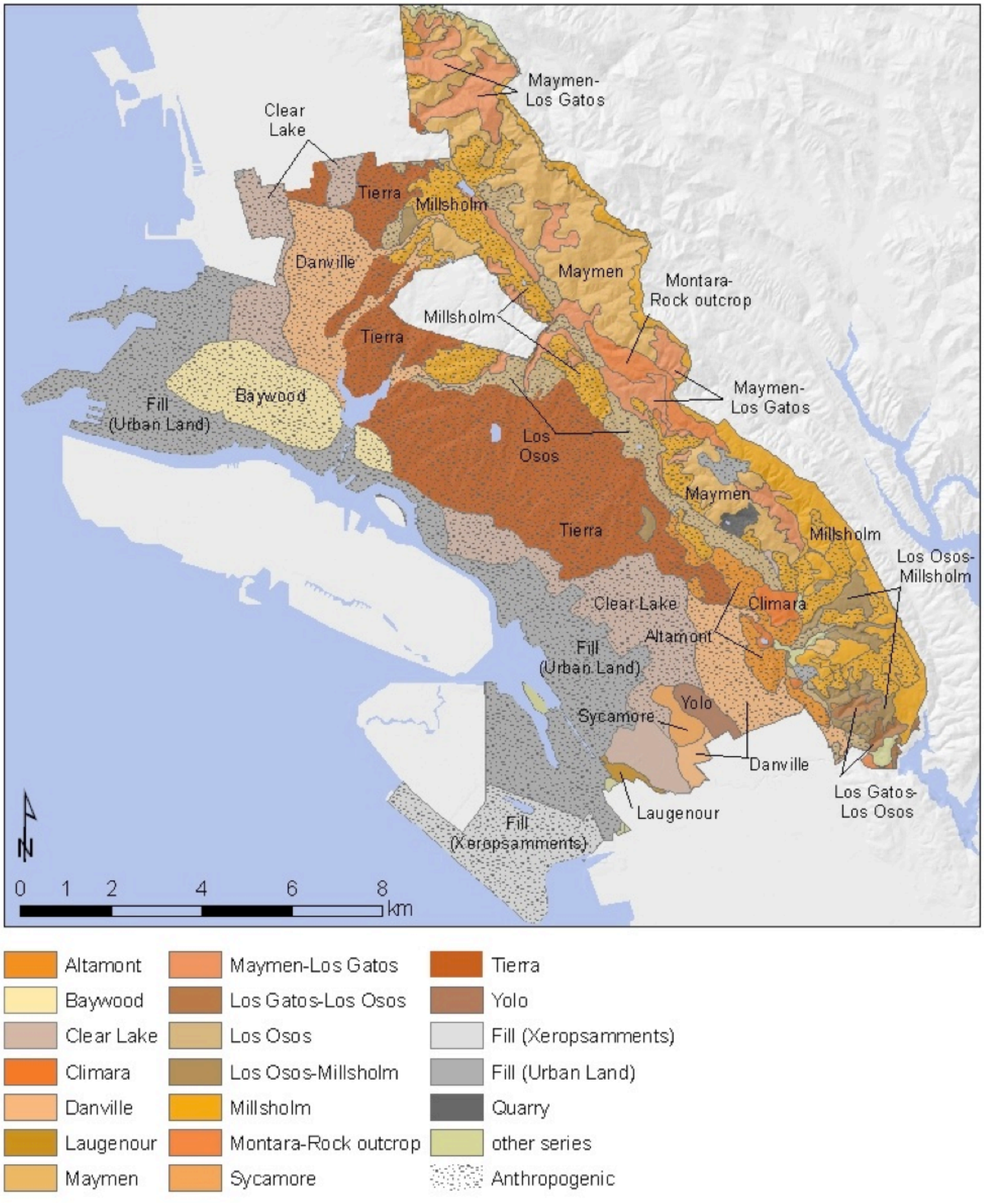


Figure 5.3.3: Soil series in Oakland. Anthropogenic soils, including urban land complexes, are represented with a grey dappled texture. These soils account for more than 75% of the city's soils.
Data source: NRCS (http://soildatamart.nrcs.usda.gov/)

Table 5.3.6. ANOVAs for regressions of log Pb, log Ca, log P, and pH on soil type

Dependent Variable	Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F	R^2
Log Pb	Model	14	30.666653	2.19048	3.1914	0.0028 **	0.57
	Error	34	23.336524	0.68637			
	C. Total	48	54.003178				
Log Ca	Model	14	4.0819394	0.291567	2.0362	0.0452 *	0.46
	Error	34	4.8685459	0.143193			
	C. Total	48	8.9504854				
Log P	Model	14	4.6414147	0.331530	2.3159	0.0228 **	0.49
	Error	34	4.8672049	0.143153			
	C. Total	48	9.5086196				
Log C	Model	14	3.287644	0.234832	1.0369	0.4433	0.30
	Error	34	7.700470	0.226484			
	C. Total	48	10.988114				
pH	Model	14	1.8701391	0.133581	0.7265	0.7338	0.23
	Error	34	6.2517446	0.183875			
	C. Total	48	8.1218837				

** $p < 0.01$, * $p < 0.05$

It is difficult to positively identify what about a particular soil series makes it a significant factor in soil contamination, particularly in areas heavily disturbed by humans.[123] Anthropogenic soils are particularly difficult to characterize, because they are highly variable, “a continuum of ‘human-altered’ soil bodies intermixed with discrete islands of unaltered ‘natural’ soil bodies” (Effland and Pouyat 1997, 217). Given the scale of a soil survey, the variation inherent in an urban soil may not be captured by a soil series. Indeed, the urban land category is simply a miscellaneous “catch-all” for disturbed soil consisting of “mainly heterogeneous fill” (Welch 1981, 24). In urban land complexes, the pedon (a small, three-dimensional soil area that is used to define the characteristics of soil series) is shared by urban land and a “natural” soil series “so intricately mixed or so small in size that they cannot be shown separately on the soil map” (ibid., 6).

Nevertheless, the statistical relationship between urban land, urban land complexes, and soil Pb (as well as the P and Ca that Pb complexes with), points to the importance of anthropogenic disturbance. The urban land-Baywood complex is dominant in West Oakland, which, as I have discussed, is the oldest part of the city. Industry (including smelting), the Port of Oakland, and the freeways encircling West Oakland are all important sources of Pb contamination, as is the old housing stock covered with Pb-based paint. But other important factors mediating Pb levels are due to biophysical processes operating on much longer time scales. The Baywood complex’s elevated levels of P and Ca may be due in part to short time-scale anthropogenic sources, such as calcareous building materials or phosphorus-rich organic waste, but are also the product of thousands of years of weathering of parent material. The soil’s

[123] Effland and Pouyat (1997) describe such disturbance as “urbanthro-pedoturbation”, a process they define as “any human-initiated, non-agronomic activity that influences the compositions and genesis of soil” (217).

sandy texture is derived from the parent material, Holocene beach and dune sand blown across the river valley that later became the San Francisco Bay (Sloan 2006).[124] What becomes clear is that soil Pb contamination—like urban soil formation (urbanthro-pedogenesis) itself—is the result of the intersection of both biophysical and social processes. Attempting to isolate the origins and causality is highly complex due to the interaction of numerous variables, operating at vastly different spatial and temporal scales.

Conclusion: From analyses to prediction?

In this section, I used statistical analyses to identify both anthropogenic and soil-based factors affecting total Pb levels at potential urban agriculture sites in Oakland. The density of pre-1940s housing stock had the greatest explanatory power in the regression model, indicating that the primary source of anthropogenic Pb contamination is likely Pb-based paint. Land use was also significant; a site's use as a park significantly explained lower Pb levels. Less significant, but showing a clear trend, nonetheless, was the distance to major roads, a historic source of atmospheric Pb pollution. Phosphorus appeared as the most important soil factor explaining variance of Pb levels, but correlations between Ca, C, and Pb also point to the various associations typical of Pb. Finally, the role of anthropogenic soil disturbance also appears to influence soil Pb. In one of the regressions, urban land and two urban land complexes significantly explained variance in soil Pb levels.

The data and analysis I have presented thus far help lay the groundwork for predictive mapping of soil Pb levels across the city. While outside the scope of this chapter, modeling, testing, and validating various interpolations of citywide soil Pb levels seem a logical next step. The Pb data provide a critical baseline for such mapping. The identification of key anthropogenic variables such as pre-1940s housing and land use type, as well as soil chemical characteristics such as P and C, are critical to fine-tuning estimations of where one might expect soil Pb levels to be higher or lower. Various spatial interpolation methods have been used to predict the risk of contamination, including kriging (Cattle, McBratney, and Minasny 2002; Hooker and Nathanail 2006; Saby et al. 2006) and inverse distance weighted interpolations (Hu et al. 2006; Kaur and Rani 2006). These interpolation methods can be fine-tuned to reflect the variance that these multiple factors explain.

Such interpolation is also a useful means of visualization of general spatial trends. I offer a preliminary effort here. With this interpolation, however, comes the caveat that future iterations demand thorough testing and statistical validation. An interpolation of total soil Pb in Oakland using ordinary kriging (spherical) reveals increasing Pb levels moving from the hills towards the flatlands, with the highest levels (> 400 mg kg^{-1}) found in West Oakland and in the area surrounding San Leandro Bay in East Oakland adjacent to Oakland Airport (see Figure 5.3.4). In the first figure (5.3.4 a), only total Pb is included in the kriging. Levels in West Oakland are largely above the EPA screening level for Pb (400 ppm), with another significant area surrounding the airport. In the second map (5.3.4 b), I included total P as a co-kriging variable. Note that the map becomes more heterogeneous and variability appears to increase, particularly in Central Oakland. The third figure (5.3.4 c) includes the two variables that had the greatest

[124] These sands originated during the Pleistocene, as Sierran granite was ground by glaciers and sediments transported along the San Joaquin and Sacramento Rivers, deposited along the river's floodplains and at the mouth of the river, which was located out by the Farallon Islands. Sands were transported eastwards by prevailing winds, deposited across the northern end of the San Francisco Peninsula, West Oakland, and western Alameda (Sloan 2006; Welch 1981).

statistical effect on overall total Pb levels in the Oakland samples: total P and the density of pre-1940s housing. Note that the inclusion of the second co-kriging variable actually lowers the intensity of Pb levels across the map, leaving only the two hotspots identified earlier (in south West Oakland and around San Leandro Bay) using the Getis-Ord G_i^* test. An interpolation of Pb levels in West Oakland using the City Slicker Farms Backyard Gardening Program data also reveals the hotspot in the South Prescott neighborhood around the former site of the Phoenix Iron Works. A co-kriging using both total P and pre-1940s housing stock increases the overall area with total Pb levels (see Figure 5.3.5).

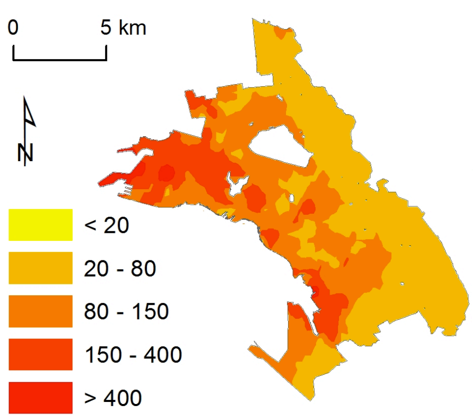


Figure 5.3.4: Interpolations of total soil Pb concentrations (mg kg^{-1}) in Oakland: (a) ordinary spherical kriging using total Pb concentrations, (b) co-kriging using total Pb and total P, and (c) co-kriging using total Pb, total P, and pre-1940s housing density (units ha^{-1}).

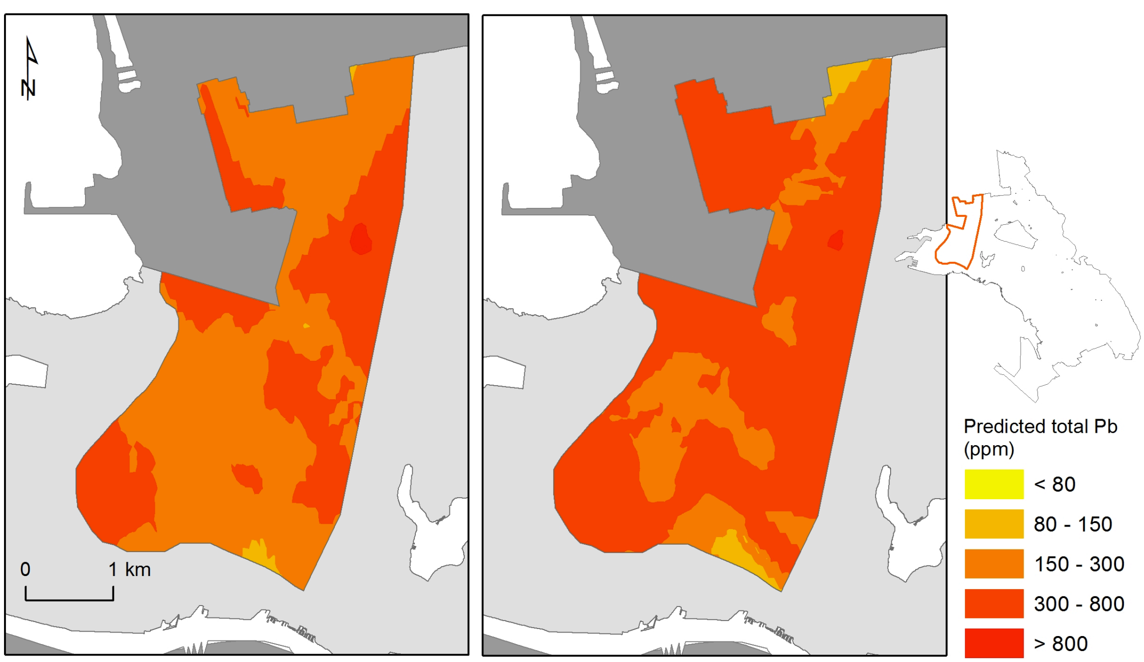


Figure 5.3.5: Interpolations of total soil Pb concentrations (mg kg^{-1}) in West Oakland: (a) co-kriging using total Pb and total P, and (b) co-kriging using total Pb, total P, and pre-1940s housing density (units ha^{-1}). Soil data source: City Slicker Farms Backyard Gardening Program.

Such maps may prove useful for urban agriculture planners and practitioners by flagging West Oakland and industrial areas around San Leandro Bay as areas of higher risk. Nevertheless, their ability to actually predict Pb levels is doubtful. To effectively interpolate depends on having access to a sufficient number of data. Moreover, as the site-scale analysis reveals, Pb levels are highly variable. Any interpolation or geochemical map at the neighborhood- or city-scale will inherently fail to capture this site-scale variability. Without such site-scale data for a greater number of sites across the entire city, it is difficult to test the kriging's ability to accurately predict Pb levels (Woodbury 2003). Furthermore, given the variability of Pb levels at the site-scale, I would argue that a city-scale kriging is really only useful for identifying general trends. Neighborhood-level and city-level Pb mapping is simply too coarse to be able to accurately predict risk of exposure to Pb and using a city-scale map to predict Pb levels at the site-scale would simply be irresponsible.

5.4. Assessing the phytoavailability of Pb in Oakland's soils

In the previous sections I characterized the spatial distribution of soil Pb in Oakland at city-, neighborhood-, and site-scales, and identified the anthropogenic and chemical factors impacting total Pb levels. However, total Pb is an aggregate measure of Pb in its various phases; not all of this Pb is *bioavailable*, i.e., in a form that can be taken up a plant or absorbed by a human gastrointestinal tract following ingestion. While current federal and state Pb standards are intended to protect humans from the risk of Pb poisoning, they are based on total Pb levels which tell us little about how much is actually bioavailable—a percentage that is ultimately soil specific—and therefore little about the potential risk to human or plant health. In this section, I am concerned primarily with *phytoavailable*, or plant available, Pb.[125]

Plant root hairs passively absorb the cationic forms of Pb (Pb^{2+}, $PbCl^{+}$, and $PbOH^{+}$), either via mass flow or diffusion of the soil solution, or via direct contact by the root as it grows (Dudka and Miller 1999; Kabata-Pendias 2011). The phytoavailability of Pb ultimately depends on the solubility of the particular Pb mineral or complex. During the weathering process, Pb solubility is largely controlled by pH (Sauvé, McBride, and Hendershot 1998; Sauvé and McBride 1998). The formation and solubilization of various Pb minerals is also mediated by concentrations of P (Kalbasi et al. 1994; Sauvé and McBride 1998) and Ca (Singh, Ma, and Harris 2001; Badawy et al. 2002; Ponizovsky and Tsadilas 2003). Organic matter content is also important to Pb solubility (Martínez, Jacobson, and McBride 2004).

To identify the various species of Pb in the total soil Pb pool—and to estimate the potential bioavailability of Pb—researchers conduct sequential extractions. In these studies, total soil Pb is separated into various fractions using extractants of varying strengths (Sposito, Lund, and Chang 1982; Clevenger 1990; Imperato et al. 2003). Most speciation studies separate the total soil Pb pool into exchangeable, Fe/Mn-oxides, carbonate, organic, and residual fractions. In most cases, the majority of Pb is found in carbonate and residual fractions (Sposito et al. 1983; McGrath and Cegarra 1992). With time, more of the Pb moves into the residual fraction as the more labile forms of Pb precipitate. Results of speciation studies are generally pH dependent. In a review, Ponizovsky and Mironenko (2001, 267) conclude that in alkaline soils, Pb is generally bound in the carbonate, organic, and residual fractions, while in neutral soils, it is mostly bound to Fe- and Mn-oxides and OM. In slightly acidic and acid soils, 10 to 70% of Pb may be found in the exchangeable fraction.[126]

Assuming that plant available metals are located on mineral surfaces and can therefore be desorbed by other cations, many studies equate exchangeable Pb with phytoavailability. Most speciation studies use water and salts such as KNO_3, $CaCl_2$ and $MgCl_2$ to measure exchangeable Pb. Based on a review of 104 studies, Menzies et al. (2007) concluded that neutral salt extractants (such as 0.01 M $CaCl_2$ or 0.1 M $NaNO_3$) were the best predictors of metal

[125] Within the agronomic and environmental science literature, "bioavailable" generally refers to labile forms of an element that can be accumulated by a plant. In public health and environmental health literature, however, bioavailability refers to the fraction that can be absorbed into a human's bloodstream via the gastrointestinal tract. To avoid confusion, I use the terms "plant available" and "phytoavailable" in this chapter.

[126] However, as Ponizovsky and Mironenko (2001) note, the species identified by such studies "have no unique chemical interpretation… The exchangeable fraction cannot be taken as the amount of Pb (II) that can be exchanged, the carbonate fraction as $PbCO_3$, and so on" (275), noting that the Fe-Mn exides fraction could be Pb oxide or carbonate, and the residual fraction Pb sulfide, or Pb occluded by silicates or sorbed within the interlayer of clay minerals. They also warn against comparing availability when extraction methods and soil characteristics are so different.

phytoavailability. Others argue, however, that a measure based on the exchangeable fraction fails to account for the organic acids exuded by the roots themselves, which lower the pH in the rhizosphere and ultimately solubilize more Pb and increase the amount Pb in the soil solution. In an effort to determine the best method for determining the phytoavailability of heavy metals, Feng et al. (2005) compared DTPA, EDTA, $CaCl_2$, and $NaNO_3$ extractants to a solution of acetic, lactic, malic, and formic acids. While the single extractants did not correlate with tissue Pb, the Pb extracted with the combination of acids correlated with root Pb ($p<0.10$). Others argue that they key to understanding bioavailability lies in determining the activity of the free Pb^{2+} ion. Rather than measuring Pb speciation of the solid phase, Sauvé et al. (1997) partitioned Pb dissolved in the soil solution into organic complexes, inorganic ion pairs, and free Pb^{2+}. They found that solubility was directly proportional to pH and the log of total soil Pb.

In short, there is no simple formula to determine how much Pb is bound up in primary or secondary mineral forms, complexed with OM or other elements, or floating in the soil water solution. We should not assume that exchangeable Pb levels equate to the phytoavailable fraction, as these fractions "will not relate directly to the proportion taken up by plants or other organisms" (McGrath and Cegarra 1992, 314). Much to the frustration of urban farmers who would like a more accurate measure of the risk of growing crops in soils contaminated with Pb, there is no standard measure of plant available Pb.[127]

In this section I explore this elusive measurement of Pb phytoavailability in order to better characterize the extent to which crops might absorb soil Pb in Oakland gardens. First, I compare the amount of Pb removed by two chemical extractants, diethylenetriaminepentaacetic acid (DTPA) and magnesium chloride ($MgCl_2$), to total Pb levels of the soils discussed in the previous sections. Second, I identify the soil chemical properties that mediate these extractants. Finally, I compare the amount of Pb actually taken up by different crops (collards, chard, and mustard) grown in an urban garden and in the greenhouse in an effort to identify the best proxy for plant available Pb.

Methods

Field Soil and Plant Tissue Sampling

Sampling protocols for the city- and site-scale data is described in Section 5.2 of this chapter. Additional soil samples and crop biomass samples were collected from a garden in West Oakland belonging to a food justice organization.[128] The garden is located in Oakland's oldest neighborhood where most homes more than one hundred years old. The site is adjacent to an auto mechanic, a postal transfer facility, residential homes, and bounded to the north by a major

[127] As a result, soil testing labs use a variety of different methods to assess plant availability of metals. Most urban farmers in Oakland send their soil samples to UMass Soil and Plant Testing Lab in Amherst, MA, simply because it is the cheapest test available. Soil test reports include a measure of "exchangeable" Pb, Zn, Cu, Ni, and Cd in addition to nutrient analysis for $10 per sample. The lab uses a "modified Morgan" extractant which consists of 0.62 M ammonium hydroxide (NH_4OH) + 1.25 M acetic acid (CH_3COOH) at pH 4.8 to extract Pb and the other metals. Other soil labs generally charge around $10 per element. Some soil labs (such as UC Davis Analytical Lab) have used diethylenetriaminepentaacetic acid (DTPA) as an extractant for all metals. While DTPA-extracted Cu and Zn has been correlated with plant uptake of the two metals (Cajuste, Cruz-Díaz, and García-Osorio 2000), it has not yet successfully proven to be a good proxy for plant bioavailable Pb.

[128] See Figure 5.2.2, top-left, earlier in this chapter. The picture shows the garden where sampling occurred. Red flags indicate where soil cores and leaves were collected.

thoroughfare and above-ground mass transit rails. While the garden is home to a diversity of crops, we sampled two leafy green species common in Oakland gardens for the analysis: Swiss chard (*Beta vulgaris* var. *cycla*) and collards (*Brassica oleracea* var. *acephala*). Two beds of collards and two beds of chard were each divided into three equal sections. We then removed the above-ground portion of three representative plants from each bed section and composited them into a single plant sample (n=6 for each crop). Soil cores (10 cm) were collected from within 5 cm of the base of each plant sampled and composited for each bed section (n=12). Baseline soil chemical characteristics for the garden soil (a sandy loam) are reported in Tables 5.4.1 and 5.4.2.

<u>*Greenhouse Experiment*</u>

We removed soil from two sites known to contain high concentrations of soil Pb (see Table 5.4.1) for use in two experiments conducted at the UC Berkeley Oxford Tract Greenhouse in April 2010 (Experiment 1) and August-September 2010 (Experiment 2). A sandy loam used in Experiment 1 was removed from an abandoned garden in West Oakland owned by the same organization where high levels of Pb were discovered in during soil sampling in 2009. Experiment 2 soil, a clay loam, was removed from a residential yard in North Oakland (see Figure 5.4.1). Soil was homogenized with a shovel and sifted through a ¼-inch "hardware cloth" mesh screen to remove large aggregates, gravel, and other objects (e.g., broken glass, plastic) commonly found in urban soils. We filled 2-gallon (7.57 L) pots with sifted soil. A composite soil sample (100 g) was collected from each of five replicates at the beginning of the experiment. Baseline soil physical and chemical characteristics of the two experimental soils are found in Tables 5.4.1 and 5.4.2.

Table 5.4.1: Baseline soil Pb concentrations (total, DTPA-extracted, and $MgCl_2$-extracted) of two urban soils used in greenhouse experiments and another sampled in the field

Soil	Total Pb	DTPA-Pb	$MgCl_2$-Pb
	(mg kg^{-1})		
Experiment 1	2,520 ± 37.8	366.5 ± 5.7	26.2 ± 0.7
Experiment 2	690 ± 37.7	170.5 ± 6.3	2.9 ± 0.2
Garden	277 ± 36.6	57.6 ± 3.5	1.9 ± 0.4

Analyses: UC Davis Analytical Lab

Table 5.4.2: Baseline chemical and physical characteristics of two urban soils used in greenhouse experiments and another sampled in the field

Soil	Sand	Silt	Clay	CEC	pH	Total Ca	Total P	C	N	C/N
	(%)			(cmol$_c$ kg^{-1})		(mg kg^{-1})				ratio
Experiment 1	79	12	9	18.2	7.0	7,140	1,870	35,039	2,047	17.1
Experiment 2	27	36	37	49.2	7.3	10,945	900	37,098	2,486	14.9
Garden	74	16	9	22.6	7.0	10,810	1,460	89,073	7,117	12.5

Analyses: UC Davis Analytical Lab (soil texture, CEC, Ca, P); Jabari Brown, UC Berkeley (pH, C, N)

Figure 5.4.1: Removal of Experiment 1 soil from a West Oakland garden (left) and Experiment 2 soil from a North Oakland residential yard (right).

We applied municipal solid waste compost (Alameda County Waste Management Authority, Oakland, CA) made from yard waste and food scraps to the two experimental soils at several different rates to represent a range of application rates that might be applied in an urban garden. In Experiment 1, we applied compost at two treatment rates: 25 and 50 Mg ha^{-1} (dry weight), or 91 and 182 g per pot (wet weight), respectively (see Figure 5.4.2a). After thorough mixing, a composite soil sample (100 g) was taken from each replicate by compost treatment was sampled from each replicate (Exp 1, n=15; Exp 2, n=25). In Experiment 2, compost was applied at four rates (25, 50, 100, and 250 Mg ha^{-1} dry weight, equivalent to 107, 214, 429, and 858 g compost, wet weight). A no-compost control was included in each experiment to isolate the effects of the compost. In Experiment 1, two leafy vegetable crops, collards and Swiss chard, were used for a 3 × 3 factorial experimental design (2 crops + control, 2 rates of compost + control). In Experiment 2, mustard (*Brassica juncea* var. *foliosa*) was used in a 2 × 5 factorial experimental design (1 crop + control, 4 rates of compost + control). Chemical characteristics of the compost are reported in Table 5.4.3.

Table 5.4.3: Chemical characteristics of municipal solid waste compost used in Experiments 1 and 2

Compost	**pH**	**C**	**N**	**C/N ratio**	**Pb** (mg kg^{-1})
		------------ (mg kg^{-1})	-----------		
Experiment 1	7.0	190,800	17,300	11.03	42.1
Experiment 2	7.5	211,100	17,400	12.13	68.3

Analyses: A&L Western Laboratories

Each experiment was replicated five times in a randomized completed block design. Irrigation was constant across treatments, with each pot receiving ~500 mL of water two to three times weekly via a drip emitter (Figure 5.4.2b). Plants were rotated randomly within each block every two weeks to account for bias due to microclimatic variation in the greenhouse. Once plants had reached maturity (approximately 1 month for Experiment 2 mustard and 6 weeks for

Experiment 1 chard and collards), shoot biomass was cut at the soil surface and weighed. The soil was removed from each pot, thoroughly mixed on a large piece of paper, and sampled (100 g). In Experiment 1, plant roots were removed at this time and washed thoroughly with tap water to remove soil.

Figure 5.4.2a: Experiment 1 compost application rates: 0, 25, and 50 Mg ha^{-1}.

Figure 5.4.2b: Experiment 2 mustard in randomized complete block design, irrigated using drip emitters.

Soil and Plant Sample Preparation and Analysis

All soil samples were oven dried for a minimum of 48 hours, weighed (to calculate moisture), ground and sieved using a Standard Model No. 3 Wiley Mill (Arthur H. Thomas Co., Philadelphia, PA) with 2 mm screen. All plant tissue samples were first washed thoroughly to remove soil adhering to the surface. Samples were then dried with a paper towel and oven dried at 70°C for one week, Dried samples were ground and sieved using a Thomas Wiley Mini-Mill (Thomas Scientific, Swedesboro, NJ). All soil and plant samples were sent to UC Davis Analytical Lab for analysis. Total soil and total plant Pb was determined using a nitric acid/hydrogen peroxide closed vessel microwave digestion (Sah and Miller 1992). Soil Pb was also extracted using DTPA per Lindsay and Norvell (1978) and magnesium chloride ($MgCl_2$) per Tessier et al. (1979). All digests/extracts were analyzed using Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Compost was sent to A&L Western Laboratories (Modesto, CA) for analysis for pH, and total C, N, and Pb.

Statistical analysis

Linear regressions, means comparisons, and pairwise correlations were calculated using JMP 9 software (SAS Institute, Cary, NC). For data analysis, ability of an extractant to remove Pb from the total soil Pb pool was calculated as:

$$\% \text{ extracted} = (\text{extracted Pb} / \text{total Pb}) \times 100$$

where extracted Pb is DTPA-Pb or $MgCl_2$-Pb. A multiple regression model was then used to explain % Pb extracted as a function of total Ca, total P, total C, pH, Ca × pH, P × pH, and C ×

pH. Uptake of soil Pb by plant tissue relative to soil Pb concentrations (total and extracted) was calculated as a bioconcentration factor (BCF) (Samsøe-Petersen et al. 2002) reported as a percentage:

$$\text{BCF (\%)} = (\text{tissue Pb} / \text{soil Pb}) \times 100$$

where tissue Pb is the concentration of Pb in the plant shoots (mg kg^{-1}) and soil Pb is the total or extracted Pb concentration (mg kg^{-1}) in the associated soil sample.

Results and Discussion

Comparison of DTPA and $MgCl_2$

Mean extraction rates by DTPA and $MgCl_2$ are reported in Table 5.4.4. Overall, DTPA extracted about 21% percent of total Pb. While the extractant removed as much as 51% from some samples, median percentages were roughly the same as mean percentages. Magnesium chloride, on the other hand, extracted less than 1% (0.93%) of total Pb on average. Median extraction rates were even lower (0.5%). Regression of DTPA-Pb (mg kg^{-1}) on total Pb (mg kg^{-1}) revealed a strong quadratic relationship (R^2 = 0.97) between the two (see Figure 5.4.3 a). Addition of compost did not significantly affect DTPA-Pb concentrations or the percent of total Pb extracted by DTPA, but likely accounted for some of the variation along the Y-axis of the plot. A plot of $MgCl_2$-Pb on total Pb follows a logarithmic trend (R^2 = 0.90) (see Figure 5.4.3 b). $MgCl_2$-Pb levels for most of the field samples and all of the Experiment 2 samples were below 5 mg kg^{-1} even as total Pb concentrations approached 1,000 mg kg^{-1}.

(a) $y = 0.2488072x - (4.1113 \times 10^{-5})\,x^2$
$R^2 = 0.97$

(b) $\text{Log}(y) = 0.0013133x$
$R^2 = 0.90$

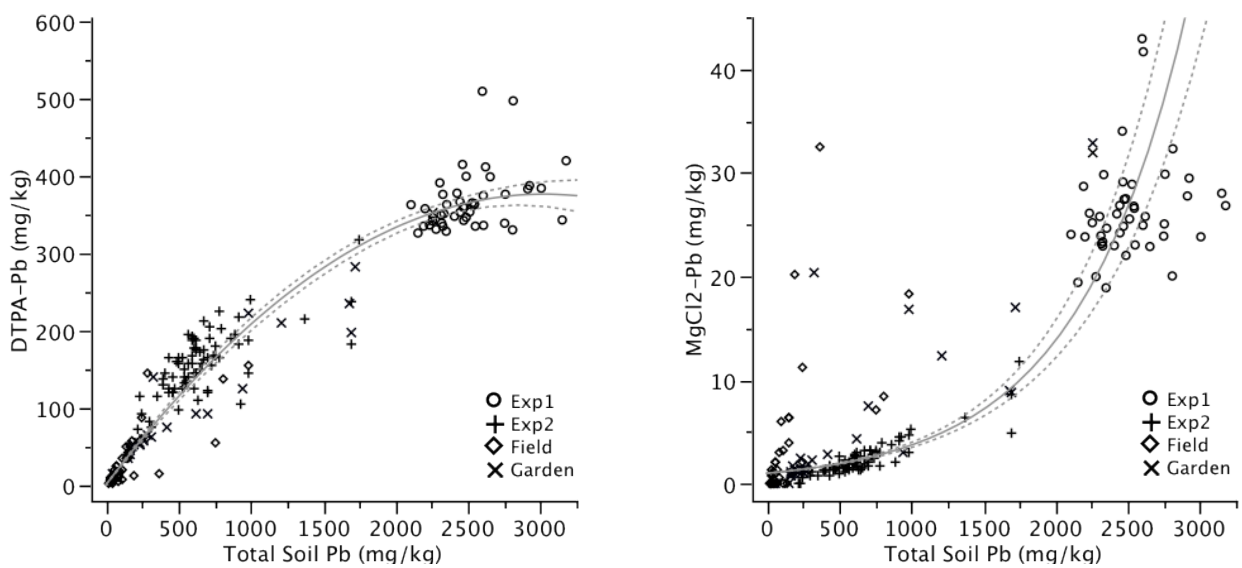


Figure 5.4.3: Relationship of total Pb (mg kg^{-1}) to (a) DTPA-Pb (mg kg^{-1}) and (b) $MgCl_2$-Pb (mg kg^{-1}). Dotted lines represent 95% confidence.

Table 5.4.4: Percent of total Pb extracted by DTPA and $MgCl_2$ by soil type

Soil Type	n	Total Pb (mg kg^{-1} ± S.E.)	Extracted by DTPA (% ± S.E.)	Extracted by $MgCl_2$ (% ± S.E.)	DTPA/$MgCl_2$ ratio*
Field	57	125.4 ± 26.3	20.50 ± 1.33	1.85 ± 0.37	11.8
Garden	19	599.1 ± 118.7	21.74 ± 1.14	0.85 ± 0.19	32.4
Exp1	38	2,520.6 ± 37.8	14.63 ± 0.24	1.05 ± 0.03	14.2
Exp2	26	659.1 ± 34.1	25.81 ± 0.75	0.34 ± 0.01	78.0
All	140	919.3 ± 66.3	21.32 ± 0.56	0.93 ± 0.10	44.1

*DTPA/$MgCl_2$ ratio = % extracted by DTPA / % extracted by $MgCl_2$

The DTPA rates of extraction are similar to those found in other studies. Li and Shuman (1997), for example, reported Pb extraction rates of 5.9 to 23% by DTPA in eight Georgia soils. Lead extraction by $MgCl_2$, on the other hand, was slightly lower than in other studies. Cajuste et al. (2000) reported extraction of 2.6 to 3.8 mg kg^{-1} by $MgCl_2$, or 2.3 to 3.2% of total Pb levels in the five soils analyzed. Rates of extraction were similar to other measures of exchangeable Pb. Sposito et al. (1982) reported exchangeable Pb (KNO_3-extracted) averaging 1.6 mg kg^{-1}, or 2.3% of total Pb, in three different soils amended by annual applications of sewage sludge high in Pb. Jones (2000) reported exchangeable Pb levels of 0.9 to 1.6% in five paint-contaminated Oakland soils, while carbonate fractions accounted for 42 to 76% of total Pb.

As the data in Table 5.4.4 reveal, however, rates of extraction in this study differed across soil types. In Experiment 1 soils, in which total Pb ranged from 2,000 to 3,000 mg kg^{-1}, DTPA was able to extract only 15% of total Pb, while in the field soils (vacant, open space, and parks), garden soils, and Experiment 2 soils, DTPA was able to extract 20 to 25%. Furthermore, $MgCl_2$-Pb levels rose relative to DTPA-Pb only at high levels. As DTPA-Pb levels rose to 300 mg kg^{-1}, $MgCl_2$-Pb in most samples remained relatively stable and did not increase beyond 10 mg kg^{-1}. However, in soils where total Pb was higher (> 1,000 mg kg^{-1}) and DTPA-Pb higher (> 300 mg kg^{-1}), $MgCl_2$ was able to extract significantly more Pb. A plot of the DTPA-Pb/$MgCl_2$-Pb ratio illustrates this trend (see Figure 5.4.4), where DTPA's ability to extract Pb relative to $MgCl_2$ declines as total Pb reaches ~1,000 mg kg^{-1}.

The data therefore suggest that at lower total Pb concentrations, DTPA is able to extract the recalcitrant forms of Pb that $MgCl_2$ is unable to extract. Once the total Pb pool increases above ~1,000 mg kg^{-1}, however, DTPA is no longer able to extract Pb to the same extent. The Pb found at these higher levels (> 1,000 mg kg^{-1}) is likely a different form of Pb. If, as the data in Section 5.3 suggest, high soil Pb levels are related to old housing stock (and by extension, Pb paint), we can assume that Pb found in highly contaminated soil is the highly recalcitrant form found in paint, notably Pb carbonates and Pb chromates. DTPA is unable to chelate Pb found in these forms.

Neutral soil pH also likely affected the solubility of the Pb. The solubility of the Pb chromate phoenicochroite, for example, is controlled by pH, where it dissolves in favor of $HPbO^{2-}$ at pH >8 (Clark, Brabander, and Erdil, 2006). In this study, soil pH rarely exceeded pH 7. In soils with lower total Pb levels, Pb was likely bound to OM or clay surfaces. The high clay content (baseline 37%) and high CEC (baseline 49.2 $cmol_c$ kg^{-1}) of the Experiment 2 soils may also explain the higher Pb levels in the samples. The large number of exchange sites in the clayey soil may have simply acted as a sink for labile Pb. As it is a stronger extractant than a simple salt such as $MgCl_2$, DTPA was able to chelate with labile Pb^{2+} that was only weakly bound to clay surfaces. Indeed, under neutral and alkaline conditions, DTPA is able to chelate with Pb cations, removing them from OM and clay surfaces (Li and Shuman 1997). $MgCl_2$, on the other hand, was likely unable to outcompete Pb^{2+} for the exchange sites on the clay surface. Indeed, on average, DTPA was able to extract 78 times more Pb than was $MgCl_2$ from Experiment 2 soils. In garden soils, DTPA was able to extract 32 times more Pb than $MgCl_2$. These soils were high in OM, receiving regular applications of compost over the course of the growing season. As a result, total C concentrations in these garden soils were more than twice that of the other soils sampled in the study. Even though the soil texture of garden soils and Experiment 1 soils was almost identical (indeed, Experiment 1 soil was removed from one of the gardens sampled), total Pb levels were several times higher. As discussed above, the Pb in this soil was likely in another form, and DTPA was no longer able to chelate organic-bound Pb. The ratio of DTPA- to $MgCl_2$-Pb is therefore significantly lower, half of that found in other garden soils. While soil texture data is not available for all of the field soils, we can assume that they behaved similarly to the low Pb garden soils.[129] However, $MgCl_2$ was overall slightly more effective in extracting Pb from these soils as compared to the garden soils. This is likely because less Pb was bound up with OM in complexes too strong for a salt to break.

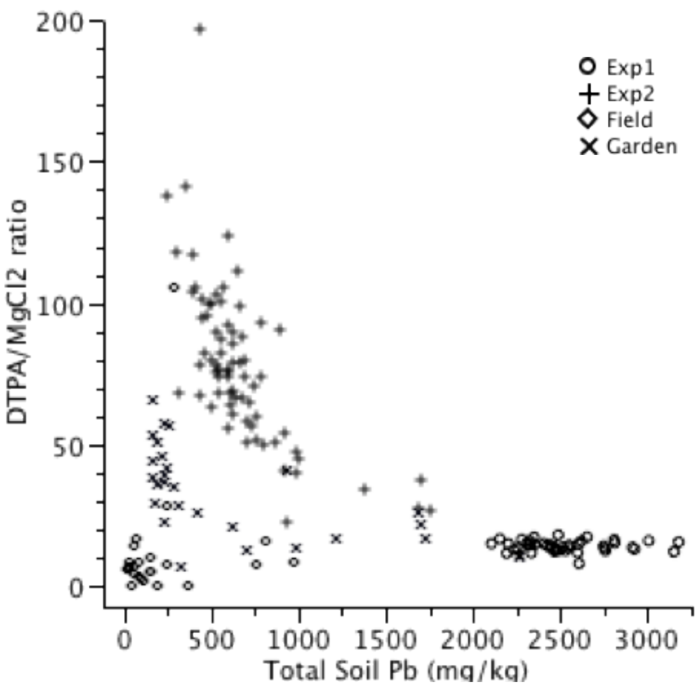


Figure 5.4.4: DTPA/$MgCl_2$ ratio versus total soil Pb (mg kg^{-1}).

Correlation and ANOVA between extracted-Pb and soil chemical characteristics

A Spearman's ρ correlation test was selected to identify significant relationships between the different forms of Pb and other factors that commonly mediate Pb solubility: phosphorus (P),

[129] Soil texture for eight of these soils can be found in Appendix B2.

calcium (Ca), carbon (C), and pH (see Table 5.4.5). The Spearman's ρ is a non-parametric test, necessary because the classic Pearson's correlation requires normal distribution of values. As I discussed in the previous section, Pb, C, Ca, and C are all lognormally distributed. As evidenced by the regressions presented in Figure 5.4.3, total Pb, DTPA-Pb, and $MgCl_2$-Pb concentrations are all highly correlated.

As expected, total Pb was correlated with P, Ca, and C. Surprisingly, however, total and DTPA-Pb did not correlate with pH which is generally a key factor mediating Pb solubility (Sauvé, McBride, and Hendershot 1998). The lack of correlation is likely due to the relatively narrow range of pH measurements in the soil samples. Mean pH across all sites was 6.7, ranging from 5.9 to 7.6, whereas Pb solubilization generally occurs under more acid conditions, at pH < 5.5 (Sauvé, McBride, and Hendershot 1998; Sauvé and McBride 1998). $MgCl_2$-Pb, on the other hand, was negatively correlated with pH ($p<0.01$). A linear regression (see Figure 5.4.5) revealed that the amount of Pb extracted by $MgCl_2$ decreased as pH rose. Other researchers have reported similar findings (Thums, Farago, and Thornton 2008).

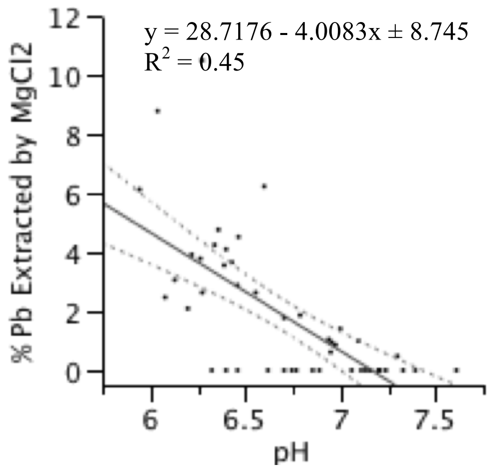


Figure 5.4.5. Effect of pH on $MgCl_2$ extraction of total Pb (n = 49)

Table 5.4.5: Spearman's ρ non-parametric correlation matrix of total Pb, DTPA-Pb, and $MgCl_2$-Pb and other soil chemical characteristics (Ca, P, C, and pH) in sub-sample of urban soils (n = 49)

	Total Pb	DTPA-Pb	$MgCl_2$-Pb	P	Ca	C	pH
Total Pb	0	0.8765***	0.7174***	0.5570***	0.3078*	0.5004***	-0.0539
DTPA-Pb		0	0.5740***	0.4655**	0.3136*	0.3597*	-0.0698
$MgCl_2$-Pb			0	0.3630*	-0.1718	0.3803**	-0.4918**
P				0	0.4790**	0.7121***	0.0347
Ca					0	0.4266*	0.6282***
C						0	-0.1731
pH							0

*** (ρ<0.0001). **(ρ<0.01), *(ρ<0.05)

While the Spearman's correlations reveal significant correlations between soil chemical characteristics, they cannot isolate the predominant factors mediating Pb extraction. Analysis of variance (ANOVA) can help identify these factors. As data in Table 5.4.6 reveal, pH was the only significant factor explaining variability in the % total Pb extracted by DTPA (there was no linear relationship between pH and DTPA, however). On the other hand, a number of independent variables had a significant effect on the amount of Pb that $MgCl_2$ was able to extract; the effects of total Ca and C concentrations were highly significant ($p<0.0001$), as was the effect of pH ($p=0.0017$), as well as the interactions of pH with Ca ($p=0.0006$) and C (0.0007). Total P did not show a significant effect on the percentage of Pb made available by either of the extractants. Given the narrow, mid-range of soil pH, most Pb was likely tightly bound with P in a recalcitrant mineral such as pyromorphite, therefore having no impact on extractability. As discussed earlier, most speciation studies have found the majority of Pb in the residual and carbonate fractions, unable to be extracted by either a salt such as $MgCl_2$ or chelate such as DTPA.

Table 5.4.6: ANOVA for % Pb Extracted by DTPA (R^2=0.87) and $MgCl_2$ (R^2=0.72)

		--------- **% Extracted by DTPA** ---------				--------- **% Extracted by $MgCl_2$** ---------			
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**	**Prob > F**	**Sum of Squares**	**Mean Square**	**F Ratio**	**Prob > F**
ANOVA									
Model	7	23166.028	3309.43	39.1980	<0.0001*	322.49514	46.071	15.2201	<0.0001
Error	42	3546.001	84.43			127.13231	3.027		
C. Total	49	26712.029				449.62745			
Effects									
Ca	1	90.2180		1.0686	0.3072	111.26087		36.7566	<0.0001*
P	1	2.8918		0.0343	0.8541	0.24014		0.0793	0.7796
C	1	335.9263		3.9788	0.0526	72.65511		24.0027	<0.0001*
pH	1	2843.1842		33.6756	<0.0001*	33.96992		11.2225	0.0017*
Ca*pH	1	0.0012		0.0000	0.9970	41.90836		13.8450	0.0006*
P*pH	1	125.7503		1.4894	0.2291	2.26979		0.7499	0.3914
C*pH	1	20.1118		0.2382	0.6280	40.94416		13.5265	0.0007*

* ($p<0.05$)

Total, DTPA-Pb, and $MgCl_2$-Pb as proxies for plant bioavailability

Concentrations of Pb in plant tissue in chard, collards, and mustard are reported in Table 5.4.7. While compost additions led to increased plant growth, they did not significantly affect total shoot tissue Pb concentration in crops grown in either of the experimental soils. In Experiment 1, chard accumulated significantly higher concentrations of Pb than collards ($p<0.001$), averaging four- to six-fold higher concentrations. Concentrations of Pb in both crops in Experiment 1 were higher than Pb concentrations in mustard grown in Experiment 2. Similarly, in crops grown in the field (see Table 5.4.8), concentrations were significantly higher in chard than in collards. Overall, concentrations of Pb were relatively low.

Total shoot Pb, total soil Pb, DTPA-Pb, and $MgCl_2$-Pb were all highly correlated (see Table 5.4.9). Results from other studies have been highly varied. Some studies have found similar correlations between total soil Pb and shoot Pb (Finster, Gray, and Binns 2004; Clark, Brabander, and Erdil 2006), while others have found little to no correlation. In a comparison of DTPA, EDTA, $CaCl_2$, and $NaNO_3$ extractants, Feng et al. (2005) found no correlation with shoot Pb in barley. In another study, $CaCl_2$-extracted Pb correlated w/ tissue Pb in tea plants while DTPA-Pb did not correlate. A linear regression model using $CaCl_2$-Pb, total soil Pb, pH, OM, and CEC accounted for 74 to 95% of variance (Jin et al. 2005).

Table 5.4.7: Mean tissue Pb concentration (mg kg^{-1}) in experimental crops grown in the greenhouse

Compost rate	Chard (Exp 1)			Collards (Exp 1)			Mustard (Exp 2)		
	Mean ± S.E.	Min	Max	Mean ± S.E.	Min	Max	Mean ± S.E.	Min	Max
Mg ha^{-1}	(mg kg^{-1})								
0	21.5 ± 1.8	17.6	26.2	4.9 ± 0.8	2	6.3	1.5 ± 0.2	1	1.9
25	26.3 ± 5.4	13.8	43.1	4.7 ± 0.7	3.2	7	1.2 ± 0.2	1	1.7
50	32.4 ± 5.9	18.3	49.2	4.9 ± 0.6	3.2	6.8	1.7 ± 0.4	0.8	3.2
100	. .	.	.	. .	.	.	1.2 ± 0.2	0.7	1.5
250	. .	.	.	. .	.	.	1.6 ± 0.3	1	2.7

Analysis (tissue Pb): UC Davis Analytical Lab

Table 5.4.8: Mean tissue Pb concentration (mg kg^{-1}) in crops sampled in the field soil

Crop	Tissue Pb (mg kg^{-1})		
	Mean ± S.E.	Min	Max
Chard	3.3 ± 0.9	1.4	7.5
Collards	0.6 ± 0.3	0.2	1.5

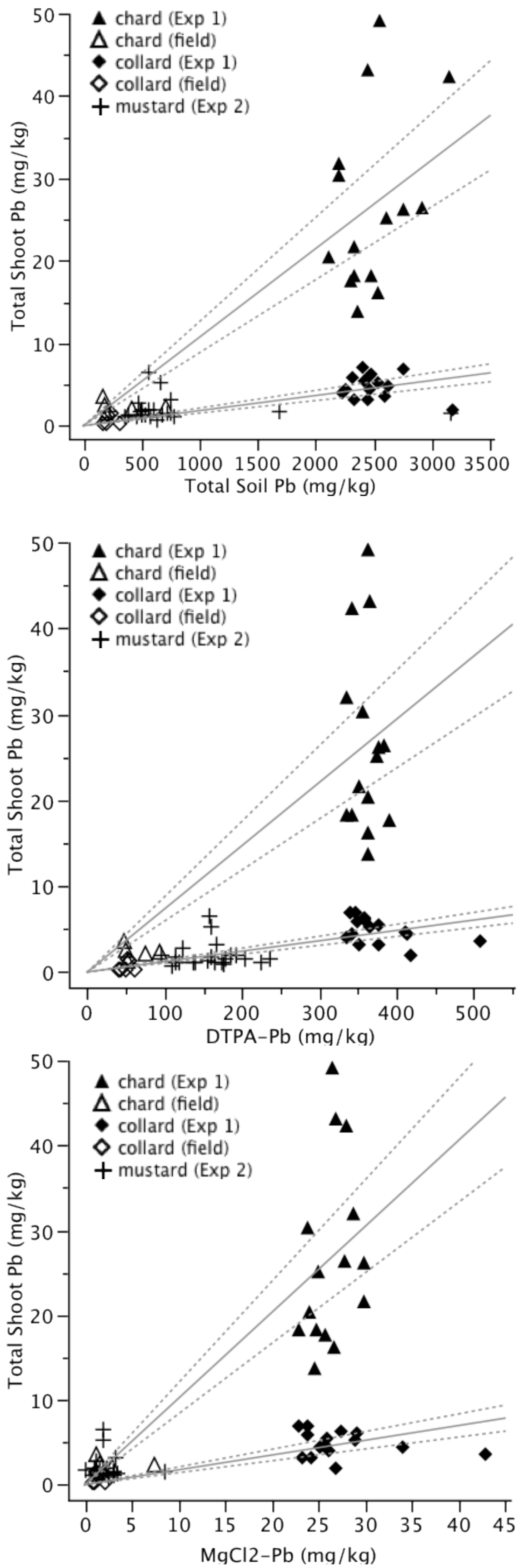
Analysis (tissue Pb): UC Davis Analytical Lab

Table 5.4.9: Spearman's ρ non-parametric correlation matrix comparing shoot Pb, total Pb, DTPA-Pb, and $MgCl_2$-Pb in field and experimental soils (n = 62)

	Total Shoot Pb	Total Soil Pb	DTPA-Pb	$MgCl_2$-Pb
Total Shoot Pb	0	0.7087***	0.6794***	0.7495***
Total Soil Pb		0	0.9148***	0.8929***
DTPA-Pb			0	0.8754***
$MgCl_2$-Pb				0

*** $p < 0.0001$

(a)
(b)
(c)



(a) Chard: $y = 0.0107x \pm 0.0019$
$R^2 = 0.88$

Mustard/
Collards: $y = 0.0018x \pm 0.0003$
$R^2 = 0.76$

(b) Chard: $y = 0.0108x \pm 0.0142$
$R^2 = 0.86$

Mustard/
Collards: $y = 0.0121x \pm 0.0018$
$R^2 = 0.81$

(c) Chard: $y = 1.0136x \pm 0.1823$
$R^2 = 0.87$

Mustard/
Collards: $y = 0.1741x \pm 0.0341$
$R^2 = 0.71$

Figure 5.4.6: Linear relationship between total shoot tissue Pb and (a) total soil Pb, (b) DTPA-Pb, and (c) $MgCl_2$-Pb (mg kg^{-1}). Dotted lines represent 95% confidence.

Bioconcentration factors (BCFs) are presented in Table 5.4.10. As the concentration data show, Pb levels in chard were significantly greater than in either collards or mustard (see Figure 5.4.6). In both the field and Experiment 1, BCFs for chard were significantly higher than for collards ($p<0.0001$). A Steel-Dwass nonparametric rank comparison (which allows for comparison across groups with different sample sizes and parameters) also showed that BCFs for chard were significantly higher than both collards and mustard ($p<0.0001$). Chard BCFs ranged from 1.07 to 1.36% of total soil Pb concentrations, 5.67 to 7.44 % soil DTPA-Pb, and up to 200.14% of soil $MgCl_2$-Pb. Percent uptake by collards and mustard was significantly lower, ranging from 0.20 to 0.29% of total Pb, and 1.00 to 1.31% of DTPA-Pb.

Table 5.4.10: Bioconcentration factors (BCFs) indicating ratio of tissue Pb to total, DTPA-, and $MgCl_2$-Pb pools. Values are mean (%) ± S.E.

Plant	Soil	n	Total Pb	DTPA-Pb	$MgCl_2$-Pb
			BCF (%)		
Chard	Field	6	1.36 ± 0.43	5.67 ± 1.65	200.14 ± 77.77
	Exp 1	15	1.07 ± 0.11	7.44 ± 0.79	100.95 ± 10.04
Collard	Field	6	0.28 ± 0.11	1.17 ± 0.48	50.12 ± 19.73
	Exp 1	15	0.20 ± 0.02	1.31 ± 0.12	18.20 ± 1.72
Mustard	Exp 2	20	0.29 ± 0.04	1.00 ± 0.11	166.76 ± 81.41

These BCFs are similar to those reported elsewhere. In Chinese cabbage (the same species, but different variety than collards), Liu et al. (2010) reported tissue Pb concentrations of 0.52 to 8.68 mg kg^{-1} in plants grown in total soil Pb levels of 500 mg kg^{-1}, or BCFs of 0.10 to 1.74%. In cabbage grown in soil Pb levels of 1,500 mg kg^{-1}, tissue concentrations ranged from 1.86 to 16.2 mg kg^{-1}, equivalent to a BCF of 0.01 to 0.12%. Voutsa et al. (1996) studied uptake by vegetables in an agricultural soil adjacent to an industrial area and Greece and found higher levels of bioconcentration: 2.4% (0.57 mg kg^{-1}) in cabbage, 46.3% (11.2 mg kg^{-1}) for lettuce, and 6.3% (1.52 mg kg^{-1}) for endives. In contaminated garden soils in Boston (475 to 3684 mg kg^{-1}), Clark et al. (2006) reported bioconcentration in mustard between 1.9 to 4.0% (10 to 79 mg kg^{-1}) and 1.0% (14 mg kg^{-1}) by collards.

Differences in Pb uptake between the plant species are likely due in part to differences in plant physiology. Individual plants take ions at varying rates depending on their size. Transpiration rates are greater in larger individuals, which can result in higher elemental concentrations in the shoot tissue. Liao et al. (2006), for example, reported that Pb uptake in lettuce correlated to soil Pb concentrations but also to transpiration rates. Different species also transpire at different rates, utilize different nutrients at different rates, and translocate them differently. In a review, Dudka and Miller (1999) noted that mean Pb concentrations in a variety of crops grown in uncontaminated soils ranged from 0.01 to 0.53 mg kg^{-1}. Finster et al. (2004) reported a range of bioconcentration in leafy vegetables, from less than 0.1% (< 10 mg kg^{-1}) accumulation by red chard and mustard to 2.64% (22 mg kg^{-1}) by Swiss chard. Tissue concentrations vary within an individual plant, as well. Due to the size of the Pb ion, very little Pb moves into shoot tissue, and even less into fruit and grain tissue. In general, Pb concentrations are highest in root vegetables, followed by leafy greens, and lowest in fruits and grains (Dudka and Miller 1999).

Figure 5.4.7. Indicators of Pb toxicity in collards (left) and chard (right) in Experiment 1.

There is also a physiological limitation to the amount of any given element that a plant can take up. After a certain threshold that is both plant- and element-dependent, a plant will experience symptoms of toxicity. While there appears to be a linear relationship between tissue Pb and soil Pb, the relationship is only linear when soil Pb concentrations are low. At higher concentrations, concentrations inevitably reach a plateau. The ratio of tissue Pb to soil Pb then decreases due to saturation and eventual toxicity as soil Pb concentrations increase beyond a certain level, particularly in highly contaminated soils (Samsøe-Petersen et al. 2002).

Signs of Pb toxicity were visible in both crops in Experiment 1 (see Figure 5.4.7) due to the elevated soil Pb levels (>2,500 mg kg^{-1}). Collard and chard growth was slightly stunted. Collards exhibited signs of P deficiency and chard exhibited chlorosis in the interveinal areas, symptomatic of Fe or Mn deficiency. It is possible that the complexation of Pb with Fe and/or Mn may have restricted their uptake by the plants. Furthermore, older leaves in all plants were chlorotic, a symptom of nitrogen deficiency. High levels of Pb can damage cell membranes, leading to lower transpiration and concomitant nitrate deficiency. High levels of Pb also become toxic precisely because they replace nutrient cations on exchange sites, resulting in nutrient deficiencies. Lead physically blocks adsorption sites in root tips, leading to decreases in Ca, Fe, and Zn. Calcium deficiency in root tips inhibits cell division and elongation, leading to stunting (Sharma and Dubey 2005).

Another mechanism likely responsible for explaining low rates of uptake in shoot tissue is the accumulation of Pb in the root tissue and as Pb phosphate precipitates in the root zone. Elevated pyromorphite [$Pb_5Cl(PO_4)_3$] concentrations are often found in the rhizosphere (Cotter-Howells and Caporn 1996; Sharma and Dubey 2005), suggesting that the variations in pH associated with root exudates and ion exchange cause rapid phase changes of Pb in the root zone. Meyers et al. (2008) reported intracellular uptake of Pb at the root tip, as well as the formation of dense Pb aggregates surrounding the roots, validating earlier findings (Koeppe 1977). Finster et al. (2004) found a strong linear correlation between soil Pb and root tissue Pb in 41 plant samples ($R^2 = 0.65$). Mean root Pb was 12% of total soil Pb, while shoot tissue Pb was 27% of root Pb. In collards, root Pb concentrations were 4% of soil Pb concentrations, while shoot tissue contained only 0.3% of soil concentrations. Similarly, Witzling et al. (2011) reported Pb concentrations in lettuce leaf tissue that were 5% of total soil Pb concentrations versus 11% in roots. Rather than being translocated upwards and into shoot tissue, Pb in our study was likely absorbed by the root tissue itself. In Experiment 1, the heaviest application rate of compost (50 Mg ha^{-1}) significantly increased root tissue Pb in collards over controls (see Figure 5.4.8). The increase in collard growth due to the fertilizing effect of the compost likely led to greater solubilization and exchange of free Pb^{2+} cations in the rhizosphere.

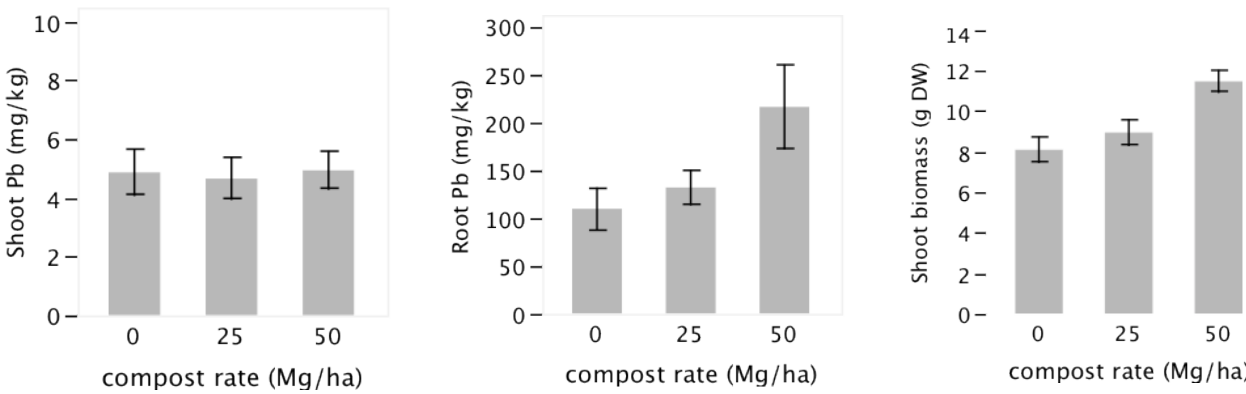


Figure 5.4.8: Collard shoot and root Pb (mg kg^{-1}) and shoot biomass (g DW), Experiment 1. Error bars represent one standard deviation from the mean. Lab analyses: UC Davis Analytical Lab

The extremely high tissue Pb concentrations in chard may also have resulted from greater absorption of Pb following contamination by surface soil deposited on the leaves and stalks during everyday management. In a review of the literature, Davies (1995) notes that as much as 90% of plant tissue Pb concentrations may be due to airborne deposition. Even though leaves were washed thoroughly following harvest, fine soil particles deposited on the underside of leaves or around the base of the plant by the splashing of irrigation water, by weeding, by wind, or by cultivation (for aeration) may have been absorbed into the plant cuticle (Chaney 2011). As such, they would not have been removed by the washing process (Cary and Kubota 1990; Cary et al. 1994). Collards, on the other hand, have much thicker cuticle (evidenced by its smooth, almost rubbery texture), which may have minimized surface absorption of Pb.

Conclusion

As the data in this section reveal, Pb phytoavailability remains an elusive metric. While the concentration of Pb extracted from the soil by a salt such as $MgCl_2$ is closer in terms of scale to the concentration of Pb found in the plant tissue, the data show that the amount extracted depends significantly on both pH and total Pb concentrations. At low total Pb levels (< 1,000 mg kg^{-1}), $MgCl_2$ was unable to extract Pb at a relative rate proportionate to DTPA. Moreover, at lower pH, $MgCl_2$ was able to extract a greater percentage of total Pb than at higher pH. While there is a stronger correlation between total Pb and DTPA-Pb than total Pb and $MgCl_2$-Pb, correlations between shoot Pb and soil Pb were generally weak. In sum, total soil Pb, DTPA-Pb, and $MgCl_2$ are not reliable indicators of phytoavailable Pb.

Perhaps more importantly for urban agriculturalists seeking a reliable metric for plant available Pb, uptake largely depends not only on the soil (notably its pH, OM and clay content), but also on the plant species itself. In this study, Swiss chard sampled both in the field and greenhouse contained higher concentrations of Pb than collards or mustard. Furthermore, and highly relevant to urban production, airborne and waterborne deposition of surface soil Pb, blown or splashed on the plant leaves, is likely more of a concern than uptake by the plant. As most Pb is either absorbed by the roots or precipitated as a Pb phosphate in the root zone, the relative amount translocated to the shoots is minimal.

This is not to say that Pb concentrations in garden crops are not a concern. Rather, these findings underscore the importance of garden management more broadly. Reducing exposure to Pb from garden soils with high Pb levels can be done several ways. First, in soils that have high levels of Pb (> 400 mg kg^{-1}), gardeners should first consider planting in raised beds. If this is not possible, gardeners should, second, plant crop species that take up lower concentrations of Pb (e.g., fruiting plants instead of leafy greens or root vegetables. Third, to reduce contamination by surface soil, beds should be mulched. In addition to increasing water use efficiency by reducing evaporation and raising soil OM levels, mulching prevents soil Pb from splashing or blowing onto the edible portions of the crop. Finally, gardeners should thoroughly wash or peel all vegetables grown in soils with elevated Pb levels. In sum, phytoavailable Pb likely accounts for only a fraction of overall bioavailable Pb that may be ingested.

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Lead Labors Lost? Conclusions and Lessons Learned

In this chapter I've attempted to answer a fundamental question: is soil Pb contamination a major obstacle to the scaling up of urban agriculture in Oakland? Based on the data I've presented here, it appears that the answer is no. Overall, total Pb levels were lower than expected, given the city's industrial past. Expectations were likely high due to existing reports of contamination. As the neighborhood-scale data reveal, the range of Pb is incredibly wide and some samples are frighteningly high. In some such cases, however, a tiny paint chip might have spiked the Pb concentration. In other cases, the sample might have been composited with other samples taken closer to the house where Pb levels are higher. But expectations may have also been high given Pb levels encountered in older cities with longer histories of deposition from industry, traffic, and old housing stock. Lead levels reported in Baltimore, New Orleans, and Boston are generally much higher than those found here in Oakland. In Rust Belt cities, where urban agriculture is spreading rapidly across a post-industrial landscape of vacant lots, soil Pb levels are likely an entirely different story from Oakland.

So then, were we looking for lead in all the wrong places after all?

Perhaps. It is possible that we were looking too *deeply*, that is to say, deeper than the top three inches (7.62 cm). In addition to following standard protocol for geochemical mapping, our rationale was that in an agricultural setting where soil will be tilled up, the soil will be homogenized roughly to the sampling depth of 10 to 15 cm, potentially diluting the overall Pb concentrations. Given the resuspension of Pb onto plant leaves from surface soils, however, capturing the full extent of Pb concentrations in the top layer is important.

Similarly, it is also possible that looking for lead in plant tissue is less important than simply assessing surface soil Pb levels immediately surrounding the plant. Because Pb uptake by plants is minimal, we should ultimately be more concerned by soil splashing up from the surface onto the leaf tissue during irrigation events rather than by how much Pb the plant itself accumulates through uptake and translocation. As such, a shallow sampling at the same depth as environmental health workers may be more appropriate than following standard agricultural and geochemical sampling protocols.

Given the lessons learned, looking for Pb was not an errant mission, nor labor lost. Rather, it was a necessary first step. Indeed, Pb levels *are* high at many sites. West Oakland, in particular, with its long legacy of pollution (and the environmental justice movement that arose in response), is a case in point. Our analysis captured some broad spatial trends as well as some site-specific trends in the Lower Bottoms and South Prescott neighborhoods of West Oakland related to the area's industrial past and the age of its housing stock.[130] The research also shed light on the several important variables mediating soil Pb levels, notably phosphorus levels and age of housing stock. This may help move urban agriculture extensionists and land use planners move towards a finer-tuned approach to assessing contamination risks.

In addition to the practical implications of the soil assessment, this research raises theoretical questions about how to understand urban soils more broadly. Understanding urban soils (and urban ecosystems, in general) truly demands thinking critically about how society shapes the biophysical world. Such research offers the opportunity to link quantitative and qualitative research, to invigorate political ecology with the sound metrics of environmental science and to push urban ecology to better engage with the complexities of social relations. Rather than just plugging a particular social variable into a statistical model, a qualitative understanding of the social processes that occurred in a particular place at a particular time, is fundamental. Indeed, the political ecology of food deserts that I laid out in Chapter 2 can go a long way in starting to make sense of Oakland's soils. While statistical analysis can tease out significant factors (such as the pre-1940s housing stock and the proximity to freeways), thinking about the political economic forces that led to the siting of freeways and to the dilapidation of housing stock is equally as important in making sense of urban soils. Moreover, thinking about these forces is as important to understanding soil contamination as it is to understanding the struggle for food justice.

To conclude, I would argue that soil contamination is ultimately *not* an obstacle to the expansion of urban agriculture in Oakland at a municipal scale. However, soil sample data and land use histories from individual sites should be closely scrutinized as a necessary precaution. Furthermore, assessment not only of Pb, but of other heavy metals (notably As, Cd, Ni, and Zn) should also factor into the planning process. In formerly industrial areas, analyzing for organic contaminants such as PCBs and PAHs should also be conducted.[131]

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[130] The EPA recently launched a two-year Emergency Response project to remediate more than a hundred residential yards in South Prescott. The innovative remediation approach involves amending soils (which average > 800 mg kg^{-1}) with fishbone meal, a hydroxyapatite that complexes with soluble Pb to form the highly recalcitrant pyromorphite. Equally as innovative, community members were active in developing the remediation strategy. In stark opposition to the NIMBYism that drives much neighborhood activism, South Prescott residents did not want the contaminated soil simply shipped and dumped in someone else's backyard, opting instead for a process that uses an organic waste product. Nor did they want a remediation process requiring polluting heavy equipment; instead, fishbone meal is delivered to remediation sites by electric truck. Furthermore, residents demanded jobs, a pressing issue in West Oakland, where unemploymenr rates are double the rest of the city. The project will train and employ 75 workers from the community (Seltenrich 2011a; Barringer 2011).

[131] A preliminary assessment of 11 sites using Dexsil Clor-N-Soil PCB screening kits revealed no significant PCB presence (see Appendix B5). Nevertheless, further assessment of these sites and others would be prudent.

Most importantly, free and easy access to information on how best to grow food in an urban environment is vital urban farmers and gardeners. In the end, the simple management practices I outline at the end of Section 5.4 may be all it takes to overcome the legacy of Pb contamination at most future urban agriculture sites in Oakland. Ultimately, the real obstacles to scaling up urban agriculture may be political. I address this in the next chapter.

Chapter 6:

Where to Farm in the City? Zoning for Urban Agriculture [132]

Until recently, municipal policy regarding urban agriculture in Oakland has been virtually non-existent, despite the growing number of non-profit organizations and community groups, and government agencies that have mobilized to address the inequities of Oakland's food system. Municipal zoning code has failed to keep pace with the proliferation of backyard and community gardens, goats and chickens, and illegal produce stands. Change is slowly happening, however, due in part to the efforts of the Oakland Food Policy Council (OFPC). As I explain in the introduction to the dissertation, I was appointed to the OFPC in 2009, serving for two years as a Council Member. I worked primarily with the City Innovations Working Group, the sub-committee tasked with developing policy recommendations to implement at the municipal level. In this chapter I present our efforts to develop and advocate for planning measures to protect and expand urban agriculture in Oakland. In the first section, I provide an overview of recent efforts by planners and advocates to incorporate urban agriculture into municipal zoning ordinances. I discuss the role of land use controls in supporting urban agriculture and highlight some "best practices" currently underway in the US and Canada. In the second section, I briefly review the history of the Oakland Food Policy Council and process of identifying first policy steps. I then describe our efforts over the last year and a half to update municipal planning code to open up new opportunities for urban agriculture. In the paper's final section, I discuss the lessons learned from our experiences before concluding with recommendations for future policy change in Oakland.

Planning for urban agriculture: Lessons from the field

Over the last decade, food systems have once again come to the attention of city and regional planners (Pothukuchi and Kaufman 1999, 2000; Clancy 2004).[133] Despite efforts to formalize food systems planning (APA 2007; Raja, Born, and Russell 2008; Pothukuchi 2009), however, it remains a relatively unknown field amongst most city and regional planners. Given the lack of food systems expertise within planning departments themselves (Raja, Born, and Russell 2008) as well as the growing emphasis on collaborative approaches to planning (Healey 1992; Forester 1999; Innes and Booher 2010), many planners have worked closely with other public agencies, non-profits, community-based organizations, and citizen activists. Food policy councils have increasingly played a central role in bringing the expertise of such stakeholders to

[132] I am grateful to fellow OFPC members Alethea Harper and Heather Wooten for their contributions to this chapter. A.H. made minor contributions to Section 2 (Paragraphs 2 and 3) on OFPC history and H.W. contributed to Sections 1 (Paragraphs 4 and 5 and Table 6.1) and 5 (Lessons Learned bullet points). Both offered editorial comments.

[133] Challenging the popular idea that food systems are "a stranger to the planning field" (Pothukuchi and Kaufman 2000), Donofrio (2007) delineates three periods prior to the Second World War when planners focused on the food system. Similarly, Corburn (2009, 25-60) explains that planning and public health were fully integrated prior to the design-oriented City Beautiful movement of the 1910s and the post-WWI "siloing" of garbage, water supply and sewerage, housing, occupational safety, and school health into separate municipal departments. The focus on food systems and "healthy cities" thus signals a return to the original concerns of planners.

municipal planners and politicians in cities across the US and Canada (Clancy, Hammer, and Lippoldt 2008; Schiff 2008; Pothukuchi 2009). Food policy councils often serve a range of functions that can help facilitate the integration of food systems into municipal planning and policy: 1) to bring together a diversity of stakeholders from the food system; 2) to integrate and coordinate issues of food, health, transportation, and economic development; 3) to generate locally appropriate policy recommendations; and 4) to formulate programs that help to implement food systems change (Harper et al. 2009, 45). This cross-sector networking of various actors has helped to mainstream concerns over public health (Dixon et al. 2007; Muller et al. 2009) and equity (Wekerle 2004; Allen 2010; Bedore 2010), bringing them into discussions over land use planning.

Given its multi-functionality, urban agriculture figures centrally in the efforts of many community food security and food justice advocates (Bellows, Brown, and Smit 2003; Brown and Carter 2003; Gottlieb and Joshi 2010). Urban agriculture is also of particular interest not only to land use planners, but also to city health officials, economic development staff, and environmental managers, and parks administrators, given its potential to provision cities with food, create jobs, beautify neighborhoods, and provide ecosystems services and educational spaces (Kaufman and Bailkey 2000; van Veenhuizen 2006). Recently, food systems and urban agriculture advocates have worked with planners and food policy councils to inventory vacant and underutilized land for potential agricultural use in cities such as Portland (Balmer et al. 2005), Vancouver (Kaethler 2006), Seattle (Horst 2008), Oakland (McClintock and Cooper 2009), Detroit (Colasanti and Hamm 2010), and Toronto (MacRae et al. 2010), among others.

Identifying vacant land for urban agriculture is a first step, but determining if this land can legally be farmed is equally important. As urban agriculture grows in popularity and practice, more and more communities are undertaking zoning code revisions to promote and protect urban agriculture, and to remove onerous or poorly tailored regulatory barriers (Masson-Minock and Stockmann 2010; Hodgson, Caton Campbell, and Bailkey 2011). As Table 6.1 illustrates, zoning code revisions can address a number of key issues that have been at the heart of debates surrounding urban agriculture policy in Oakland and elsewhere. These include: 1) incorporating definitions for a range of urban agriculture activities; 2) identifying specific areas in a community where urban agriculture is allowed; 3) allowing small-scale entrepreneurial activity to flourish in concert with urban agriculture; and 4) addressing on-site growing practices that have the potential to affect neighbors or the community-at-large, such as parking, fertilizer use, and use of heavy equipment.

Zoning *use definitions* are important because they govern what activities are legally allowed in specific zoning districts. Without a zoning definition, a use is considered to be *de facto* illegal. The examples provided in Table 6.1 show how communities are developing use definitions for a range of urban agriculture activities, from home gardens to urban farms. These definitions provide a meaningful distinction between types of urban agriculture, and allow a community to specify where different types can take place. For example, by creating a distinction between a community garden (generally either smaller in size, or non-commercial, or both) and an urban farm (larger scale/intensity of use, oriented towards growing for sale rather than personal consumption), a community can allow smaller community gardens that serve the neighborhood in residential zoning districts, while limiting urban farms to industrial or commercial districts.

Table 6.1. Urban agriculture best practices

Urban Agriculture Activity	Sample Zoning Code Language	Location / Code
Residential (Home) Garden	*Home gardens*: maintained by those residing on the property. Food and horticulture products are grown for personal consumption, sale or donation. Any land that fits within the description of a CSA [Community Supported Agriculture] cannot be considered a home garden.	Kansas City, MO Zoning Code § 88.312.02-A
Community Garden	*Community Garden* means an area of land managed and maintained by a group of individuals to grow and harvest food crops and/or non-food, ornamental crops, such as flowers, for personal or group use, consumption or donation. Community gardens may be divided into separate plots for cultivation by one or more individuals or may be farmed collectively by members of the group and may include common areas maintained and used by group members.	Cleveland, OH Zoning Code § 33.602
Urban Farm (or "Market Garden")	*Urban Farm* means a use in which plants are grown for sale of the plants or their products, and in which the plants or their products are sold at the lot where they are grown or off site, or both, and in which no other items are sold. Examples may include flower and vegetable raising, orchards and vineyards.	Seattle, WA Municipal Code § 23.42.051
Location	*Home Garden*: Allowed in all Manufacturing; Downtown District; Office, Business and Commercial District; and Residential District zones *Community Garden*: Allowed in all Manufacturing; Downtown District; Office, Business and Commercial District; and Residential District zones *Community Supported Agriculture*: Allowed in all Manufacturing; Downtown District; Office, Business and Commercial District zones. [134]	Kansas City, MO Ordinance No. 100299
On-Site Sales	*Neighborhood Agriculture*: Limited sales and donation of fresh food and/or horticultural products grown on site may occur on site, whether vacant or improved, but such sales may not occur within a dwelling unit. Food and/or horticultural products grown that are used for personal consumption are not regulated. In all districts, sales, pick-ups, and donations of fresh food and horticultural products grown on-site are permitted. In every district except "Residential Districts," value-added products, where the primary ingredients are grown and produced on-site, are permitted. Sales of food and/or horticultural products from the use may occur between the hours of 6 am and 8 pm.	San Francisco, CA Planning Code § 102.35
Management Plan Required	*Market Garden*: Submission of a Management Plan to the Zoning Administrator, Alderperson of the district where the garden is located, Department of Public Health for Madison and Dane County, and any neighborhood and/or business association that serves the area where the garden is located for the following activities as part of a market garden: 1. Animal husbandry; 2. Off-street parking of more than ten (10) vehicles; 3. Processing of food produced on site; 4. Spreading of manure; 5. Application of agricultural chemicals, including fertilizers and pesticides; 6. Use of heavy equipment such as tractors.	Madison, WI Zoning Code § 28.151

Source: Heather Wooten, Public Health Law & Policy, Oakland, CA

[134] *Community Supported Agriculture* is the term used in Kansas City to describe an urban farm/market garden: "*Community Supported Agriculture*: an area of land managed and maintained by an individual or group of individuals to grow and harvest food and/or horticultural products for shareholder consumption or for sale or donation" (Kansas City, MO Ordinance No. 100299)

Additionally, zoning can include *operating standards* that can be used to address a range of onsite practices. Operating standards (or *use regulations*) are additional requirements or regulations to which uses must conform. Operating standards offer communities an additional tool to ensure that potential nuisances or health and safety issues associated with a given use can be minimized. For example, some residents may be concerned that allowing sales (especially in residential zoning districts) will create nuisances (such as increased traffic or noise). However, many communities that have amended their code to address urban agriculture have also lifted restrictions on sales, provided that farmers adhere to specific operating standards. For example, as seen in the excerpt from San Francisco's newly amended code (see Table 6.1), some cities have addressed the issue of potential nuisances associated with commercial urban agriculture activity by curbing the scale of the activity, i.e., by limiting sales to only produce grown on-site (or processed food made from produce grown onsite). Another way municipal code can address potential nuisance or public health issues is through a flexible regulatory scheme, such as a requirement to submit a management plan as a condition of approval of use (see the example from Madison, Wisconsin in Table 6.1). Management plans can be tailored to the specific proposed urban agriculture activities, the size of the site, the surrounding uses, and any special environmental or other issues (e.g., slope, location of water sources, contamination). While each of the cities included in Table 6.1 is unique in terms of existing built environment infrastructure, density, and availability of sites for urban agriculture, the language provided in these codes offer excellent examples for Oakland and other cities. Indeed, the policy recommendations of the OFPC, discussed below, reflect lessons learned from such national best practices.

Seeds of change: The Oakland Food Policy Council

In this section, I introduce the Oakland Food Policy Council (OFPC) and discuss the process through which the group selected urban agriculture as one of its priorities. In 2005 the Oakland Mayor's Office of Sustainability commissioned a study on the Oakland food system. The resulting report, the *A Food Systems Assessment for Oakland, CA: Towards a Sustainable Food Plan* (Unger and Wooten 2006), provided a baseline analysis of the state of the Oakland food system, and recommended the creation of a food policy council to coordinate between food system sectors, bring underserved populations to the food policy table, and recommend policies that would foster the emergence of an equitable, healthy, and sustainable food system. The Oakland City Council approved the idea in 2006 and allocated start-up funding for the OFPC (Oakland City Council 2006b).

Food First (Institute for Food and Development Policy) has served as the OFPC's fiscal sponsor and "incubator" since 2008. After an extensive recruitment and application process, the OFPC seated its first group of members in September 2009. As I discuss in Chapter 3, many of the same players who advocated for and participated in the founding of the OFPC were also active in establishing other local food advocacy and food justice organizations, including the HOPE Collaborative, a W.K. Kellogg-funded Food and Fitness Initiative working to improve health and quality of life in Oakland's most vulnerable communities (Herrera, Khanna, and Davis 2009; HOPE Collaborative 2009). HOPE and the OFPC have evolved as sister organizations, with the HOPE Collaborative focusing on community engagement, and the OFPC translating the priorities of community residents into policy recommendations and advocacy.

During their first year serving as an active council, OFPC members assessed the data and community input gleaned from studies on the Oakland food system and from HOPE's community engagement process and discussed a wide range of ideas for food system transformation. To guide the process of identifying priorities, the OFPC used a tool called *Whole Measures for Community Food Systems* which breaks down the concept of a healthy food system into six "Values": Justice and Fairness; Strong Communities; Vibrant Farms; Healthy People; Sustainable Ecosystems; and Thriving Local Economies (Center for Whole Communities 2009). For each of these six values, the OFPC identified one or more "Recommended First Steps" that will move Oakland toward a healthier food system (see Appendix C1). These first steps were chosen with sensitivity to cost, the appropriate order in which they should be phased in, and political opportunity, and range from encouraging accessible and affordable farmers' markets and healthy mobile vending to developing a Fresh Food Financing Initiative and expanding composting and food scrap recycling. The OFPC's proposed first steps were presented to the community for feedback in a series of listening sessions in summer 2010, and were officially released in *Transforming the Oakland Food System: A Plan for Action* in November 2010.

One of these ten recommended first steps was to "Protect and expand urban agriculture". In order to determine *how* to take these first steps, the OFPC members and interns conducted a scan of over 150 existing city, county, and state policies that have implications for all sectors of the food system in Oakland.[135] Adding to the zoning restrictions identified in *Cultivating the Commons*, the HOPE-funded vacant land inventory (McClintock and Cooper 2009), the OFPC team identified several policies relevant to urban agriculture at the municipal, county, and state levels. Municipal code that could potentially impact urban agriculture ranged from nuisance regulations that could be applied to manure odors or livestock noise, to defining setbacks required for animal shelters and coops, recycling and composting regulations, to permits and inspections required for selling food. County regulations pertain mostly to food safety and controlling disease vectors from livestock, while state regulations include water conservation, animal welfare, and pesticide and fertilizer handling requirements.

As a city-based food policy council, the OFPC primarily focuses its efforts on municipal policy. We therefore focused on potential changes to the city's planning code (see Appendix C2 for existing municipal zoning code related to urban agriculture). When we began our work, Oakland Municipal Code included an existing use classification for "Agricultural and Extractive Activities" (§17.10.590). This general description included two activity types related to urban agriculture: "Crop and Animal Raising" (§17.10.610) and "Plant Nurseries" (§17.10.600). Under this use classification, urban agriculture was allowed in much of the city, but only with a conditional use permit (CUP). A CUP currently costs $2,000 to $3,000 and is a complicated and lengthy process. While crop- and animal-raising was limited to residential zoning districts, plant nurseries were also allowed in commercial districts. Neither agricultural activity was allowed in Oakland's industrial zoning districts, which span the entire length of the city in the flatlands along the waters of the San Francisco Bay and Alameda Estuary (see Figure 6.1).

[135] The OFPC Policy Scan (http://www.oaklandfood.org/home/policy_scan) is an effort to identify policies already "on the books" so future recommendations to improve Oakland's food system are not duplicated. The scan also identifies which agencies are involved so that the OFPC knows whom to form partnerships with when preparing to make formal policy recommendations. While this Policy Scan examined existing policy related to all aspects on the food system—production, processing, distribution, retail, and waste—we limit our discussion here to those related to urban agriculture.

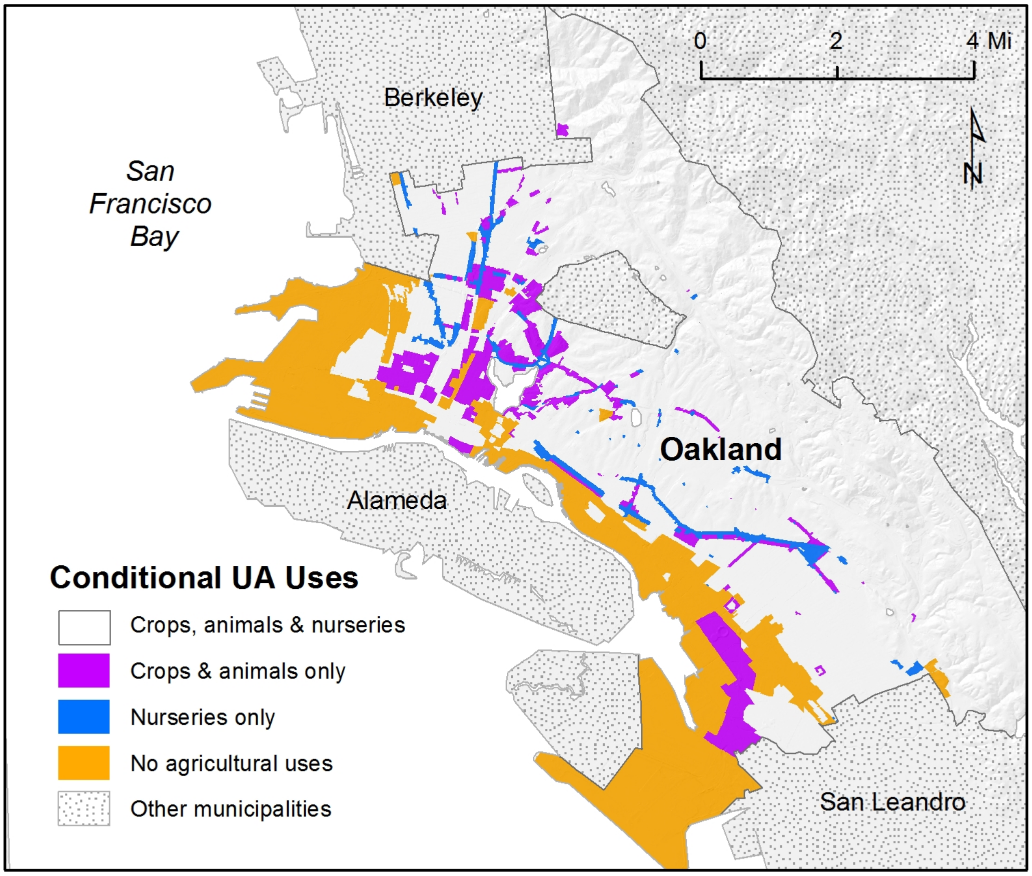

Figure 6.1. Conditionally permitted agricultural uses in Oakland prior to OFPC recommendations and the ongoing municipal zoning update. Under post-recommendation interim zoning, urban agriculture is conditionally permitted in the entire city. Following adoption of the recommendations, residential and civic urban agriculture will be permitted citywide, while commercial urban agriculture will be permitted in commercial and industrial zones, but retain its conditional status in residential zones.

While we felt that a CUP made sense for large-scale commercial urban farms—the type of urban agriculture that still existed in Oakland in 1932 and 1965 when the use definition was written and last updated—the requirement no longer seemed appropriate for the community gardens and small-scale market gardens that typify urban agriculture in Oakland today. Moreover, existing zoning interdicted urban agriculture in the city's industrial districts where large tracts of vacant land are numerous. Even large-scale greenhouse, aquaponic, and hydroponic production were prohibited in these zones because industrial activities were defined as "the on-site production of goods by methods other than agricultural and extractive in nature" (§17.10.540). Updating these use definitions and zoning to better reflect contemporary forms of urban agriculture therefore seemed a low hanging fruit on which to focus during our first year. Furthermore, these changes seemed to also be fundamental to protecting and expanding urban agriculture. We therefore decided that defining *what* exactly urban agriculture is and *where* it can be practiced are the essential first steps.

Developing Zoning for Urban Agriculture in Oakland

Once we had identified the existing regulatory barriers to urban agriculture, the next step was to develop recommendations for how Oakland's zoning code could be revised. Drawing on Public Health Law & Policy's North American inventory of urban agriculture best practices (PHLP forthcoming) such as those included in Table 6.1, as well as model zoning language for community gardens (PHLP 2010), OFPC members compiled a set of zoning use definitions, as well as operating standards, that would provide protection and guidance to community gardens and urban farms.

Cities generally differentiate between urban farms and community gardens in their zoning codes in one of two ways: either by *purpose* or by *size* (and, occasionally, by some combination of both factors).[136] The recommendation put forward by the OFPC was to differentiate by purpose, where "urban agriculture – civic" would apply to gardens where food was grown for personal consumption or donation by a non-profit or community group, and "urban agriculture – commercial" would apply to farms where food was grown for sale (either non-profit or for-profit). Table 6.2 summarizes Oakland's zoning code for urban agriculture before 2011, the recommended changes proposed by the OFPC, as well as the interim revisions adopted by the city in Spring 2011 following a process that we describe in more detail below.

Distinguishing civic urban agriculture as distinct from commercial urban agriculture and allowing it in all parts of the city would lift the financial and bureaucratic obstacles that may stand in the way of community groups and non-profit organizations interested in practicing urban agriculture. Commercial urban agriculture, on the other hand, would be permitted in commercial and industrial zones, but allowed in residential areas only with a CUP. As such, commercial urban agriculture would be privileged in commercial and industrial zones, requiring only business permits and adhesion to operating standards, but no CUP. In residential areas, commercial urban agriculture would retain the status quo of being conditionally permitted. We also drafted operating standards for civic and commercial urban agriculture that outline hours of operation, fencing and structure requirements, and accessibility, as well as the importance of using ecologically sound practices.

Once the OFPC had drafted these initial recommendations for a successful urban agriculture land use policy, it was essential to strategically advocate for these changes among decision-makers. An opportunity to present our ideas arose in late 2009 when Oakland was in the process of undertaking a comprehensive zoning update of residential and commercial districts.[137] While the opportunity for inserting urban agriculture into the zoning update seemed ripe—a comprehensive zoning update is natural policy opportunity to incorporate zoning changes—the timing was slightly off. The City's Community and Economic Development Agency (CEDA) staffers tasked with leading the process were reluctant to take on developing new zoning regulations for urban agriculture because the CEDA Zoning Update Commission had already completed the bulk of its work. During a public comment period, OFPC Councilmembers emphasized the importance of protecting space for urban agriculture in the zoning update at these public forums, but were told by the Deputy Planning Director that there was not time, staff, or

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[136] For an example of distinctions by purpose, see Cleveland, OH Zoning Code § 33.602. For example of differentiation by size, see San Francisco, CA Planning Code § 102.35.

[137] Specific information about the City of Oakland Citywide Zoning Update (2011) is available at: http://www2.oaklandnet.com/Government/o/CEDA/o/PlanningZoning/s/LUC/index.htm

money available to include such changes into the current Zoning Update (C. Waters, OFPC email to CEDA and City Council, September 14, 2010).[138]

Throughout 2010, OFPC members continued to communicate with CEDA and Planning staff over email and in person in an effort to advocate for our recommendations on urban agriculture (as well as farmers' markets and mobile vending), which were becoming more and more concrete. We also began to contact City Councilors to share our urban agriculture zoning recommendations since elected officials have the ability to direct staff to work on specific issues. In September 2010, OFPC members sent a letter to City Council and the Zoning Update Commission requesting that they "direct staff to include these food policy-related areas—and work with the OFPC regarding our recommended amendments—as part of the current Zoning Update process" (C. Waters, OFPC email to CEDA, September 14, 2010). After continued communication with Planning staff and staffers for several City Councilors, the City Council President requested a report (with actionable items) from CEDA on how the OFPC's recommendations could be incorporated into the zoning update. In the report, presented to City Council in October 2010, CEDA staff outlined a phased plan for writing and adopting new urban agriculture zoning regulations, with some minor changes incorporated into the zoning update and more significant changes following (Manasse 2010).

Under the interim zoning text amendment (see Table 6.2) which is currently in effect, urban agriculture is allowed in *all* zoning districts with a CUP, indoor food production (hydroponic, aquaponic, and greenhouse) is allowed use in industrial zones, and urban agriculture is explicitly listed as a civic activity. In June 2011 the City Council Planning Committee voted to approve sales of produce grown without the use of machinery in home gardens and community gardens (Seltenrich 2011b), a change approved by City Council in October 2011 (Rubenstein 2011). The Deputy Director of Planning has expressed his commitment to facilitating urban agriculture to the fullest extent possible. Around the same time, Planning tasked a project leader with launching an official update of urban agriculture zoning, a process that began with the large community meeting described in the dissertation's introduction. Proposed changes will include the OFPC recommendations, and will also propose the creation of an owner-based operating permit as an alternative to the parcel-based CUP for urban farmers wishing to expand the scale of commercial production in residential zones (E. Angstadt, personal communication, June 6, 2011). He also noted that the specific language of our recommendations would need to be tweaked, as the terms "civic", "commercial", and "residential" have distinct use meanings separate from urban agriculture in existing Oakland code. Planning staff, working with a Technical Advisory Group including three members of the OFPC, will finalize the changes to the use classifications during the remainder of 2011 with the intent to include changes in the zoning update by the end of 2011. The proposal will be presented to the public for comment, to the Planning Commission, and finally to City Council for approval.

The adoption of the new zoning regulations has clearly been a slow and complex process. At first, urban agriculture was unable to garner the necessary attention from CEDA staff and City Councilors during the zoning update in comparison to other "hot-button" zoning issues. The request for the CEDA report by the Council President was essential to getting the gears moving. The November 2010 mayoral election also helped boost the profile of the OFPC. During her campaign for mayor, At-Large Councilmember Rebecca Kaplan repeatedly emphasized the importance of adopting the OFPC's recommendations, providing the OFPC some much-needed

[138] The community meeting was held on November 7, 2009, at Peralta Elementary School, Oakland, California.

attention in City Council.[139] The presentation of the OFPC Action Plan, *Transforming Oakland's Food System*, and the revised print edition of *Cultivating the Commons* also helped to raise awareness of urban agriculture among Councilmembers. Finally, as we will discuss in the next section, growing public interest in urban agriculture, helped put the requisite pressure on decision makers to keep the ball rolling.

Engaging with Community

The delay in getting the OFPC urban agriculture zoning recommendations incorporated into the Zoning Update has ultimately proved to be a positive turn of events, as it has gave us time to engage more directly with the public and hone our recommendations for zoning that may ultimately be on the books for decades. Until spring of 2011, there was a lack of education of both the public and decision-makers about how zoning served as a barrier to urban agriculture. Two events have helped to catalyze public interest in the ramifications of zoning on urban agriculture in Oakland, and have fueled dialogue between the public and the OFPC regarding our recommendations: the passage of the San Francisco's urban agriculture Ordinance and the case of Ghost Town Farm.

First, San Francisco's Board of Supervisors unanimously passed Ordinance No. 66-11 on April 12, 2011, which amended the city's planning code to include urban agriculture. It now stands as one of the nation's most comprehensive pieces of urban agriculture legislation (McMenamin 2011; Terrazas 2011). An umbrella organization of urban agriculture advocates called the San Francisco Urban Agriculture Alliance was largely responsible for crafting and advocating for this ordinance. In early 2011 members of the SF group, along with the environmental group Pesticide Watch, helped to convene a similar group, the East Bay Urban Agriculture Alliance (EBUAA), made up of urban farmers from Berkeley, Oakland, Richmond, Vallejo, Hayward, and other parts of the East Bay. The OFPC presented our zoning recommendations to this group in February 2011, seeking input on a number of issues, notably the issue of sales in residential and civic urban agriculture zones.[140]

Second, the case of Ghost Town Farm, a West Oakland urban farm run by author and blogger Novella Carpenter, catalyzed public mobilization around urban agriculture zoning. Carpenter had been operating a working urban farm and pop-up farm stand for a number of years on property in West Oakland she first "squatted" and then purchased. She also maintains a blog in which she details her farming life, including frequent posts about slaughtering rabbits, chickens, and turkeys.[141] In response to complaints by animal rights activists, Oakland zoning enforcement officers cited her for a lack of compliance with existing codes; specifically, the farm stand's on-site sales were technically illegal under the zoning scheme at the time (Keeling 2011; Kuruvila 2011a). This one widely publicized case contributed to both increase the sense of urgency surrounding zoning reform and raised the profile of the many existing urban agriculture

[139] At a January 2011 OFPC presentation to the City Council Life Enrichment Committee, Councilmember Kaplan moved to hear the urban agriculture and mobile vending recommendations during full session of Council. See also Kaplan (2010).

[140] More recently, in an effort to foster a better understanding of urban farming, some EBUAA members have invited Planning staff and City Councilmembers to tour their urban farms and gardens.

[141] See her blog, "Ghost Town Farm: a Blog by Novella Carpenter" (http://ghosttownfarm.wordpress.com/) and *Farm City: The Education of an Urban Farmer* (Carpenter 2009). She eventually applied for a CUP for her farm.

organizations and activities in Oakland (Johnson 2011; Kuruvila 2011b; Let urban farmer grow 2011; Rosenbaum 2011).

While the OFPC did not comment specifically on the Ghost Town Farm case, we used the opportunity to draft a public statement of support for urban agriculture in Oakland (see Appendix C3) in April 2011.[142] In addition to an increase in attendance by the public to OFPC full council and working group meetings, other urban agriculture groups and individual urban farmers mobilized to ensure that the recommendations truly protect and expand urban agriculture. In May 2011, the NGO Bay Localize convened a "Cross Coalition Meeting of Oakland Urban Ag Campaigners" that included members of the OFPC, EBUAA, the Oakland Climate Action Coalition (which has incorporated urban agriculture as a central component of the Climate Action Plan it is developing for the city), and other organizations and individuals involved in urban agriculture. Over the course of several meetings and email exchanges, participating parties commented on the OFPC zoning recommendations. Participants have been expressly concerned with preserving the relatively liberal zoning language regarding livestock, allowing sales in residential and civic urban agriculture zones, and preventing for-profit agribusiness (including medical marijuana) without a vested interest in food justice from taking over available vacant land. The Cross-Coalition presented a statement, signed by more than 40 organizations, to the Planning Department in July 2011 with an overview of these mutually defined recommendations (see Appendix C4). The OFPC continues to work in conjunction with these community partners and others on the City's Technical Advisory Group as the Planning Department finalizes the urban agriculture zoning update over the next few months. The final language in the zoning code will ideally reflect the recommendations of the OFPC and the needs expressed by urban farmers and food justice activists in Oakland.

In addition to the research of OFPC Councilmembers and Food First interns, the overall process has relied heavily on community participation at various stages (see Figure 6.2). First, the goals and values of the OFPC were defined in part through the work of the HOPE Collaborative's community engagement process that included participatory data collection and a series of listening sessions and charrettes (HOPE Collaborative 2009). Second, the OFPC's First Steps were presented for comment to the public at three listening sessions in July and August 2010. Finally, the specific recommendations have been presented to urban farmers, NGOs, and community groups advocating and practicing urban agriculture with the intention of modifying our recommendations to meet their needs. This iterative process—of draft proposals, feedback from community *and* government stakeholders, and modification by the OFPC—forges connections between stakeholders and emphasizes common goals, ultimately increasing the likelihood that changes will actually be implemented in the books and on the ground. As Mendes et al. (2008, 447) illustrate in their comparative study of Portland and Vancouver, the creation of a "networked movement" such as this by "promoting more inclusive and participatory local decision making, and encouraging citizen engagement and buy-in" aids in the integration of urban agriculture into planning and policy decisions.

[142] The OFPC's "Statement on Urban Agriculture" had been signed by 475 people by June 14, 2011. Available at: http://www.ipetitions.com/petition/ofpc-ua/signatures. The statement has not been without its critics, however, drawing the ire of the same animal rights activists concerned with Carpenter's activities (see Rubenstein 2011). They feel that allowing livestock in the city (despite retaining the legal status quo) will open the door for animal cruelty. See Anderson (2011) for the petition to the city to ban urban livestock in Oakland.

Table 6.2. Original, proposed, and interim use definitions and zoning related to urban agriculture in Oakland

	Use Definitions	Zoning
Planning Code prior to OFPC Recommendations	**17.10.590 General description of Agricultural and Extractive Activities** include the on-site production of plant and animal products by agricultural methods, and of mineral products by extractive methods. They also include certain activities accessory to the above, as specified in Section 17.10.040. (Prior planning code § 2450)	
	17.10.600 Plant Nursery Agricultural Activities include the cultivation for sale of horticultural specialties such as flowers, shrubs, and trees, intended for ornamental or landscaping purposes. They also include certain activities accessory to the above, as specified in Section 17.10.040.	Conditionally permitted in most residential and commercial zoning districts; not permitted in industrial zones
	17.10.610 Crop and Animal Raising Agricultural Activities include the raising of tree, vine, field, forage, and other plant crops, intended to provide food or fibers, as well as keeping, grazing, or feeding of animals for animal products, animal increase, or value increase. They also include certain activities accessory to the above, as specified in Section 17.10.040. (Prior planning code § 2461)	Conditionally permitted in most residential zoning districts; not permitted in industrial zones
Initial OFPC recommendations	**Urban Agriculture, RESIDENTIAL** shall consist of land used for the cultivation of fruits, vegetables, plants, flowers or herbs, and/or for animal products and livestock production by a Community Group with the primary purpose of growing food for personal consumption and/or donation. The land shall be served by a water supply sufficient to support the cultivation practices used on the site.	Permit in all residential zoning districts
	Urban Agriculture, CIVIC shall consist of land used for the cultivation of fruits, vegetables, plants, flowers or herbs, and/or for animal products and livestock production by a Community Group with the primary purpose of growing food for personal consumption and/or donation. The land shall be served by a water supply sufficient to support the cultivation practices used on the site. Such land may include available public land. Community gardens are subject to the operating standards set forth in zoning bulletin xx.	Permit in all zoning districts
	Urban Agriculture, COMMERCIAL shall consist of land used for the cultivation of fruits vegetables, plants, flowers or herbs, and/or for animal products, livestock production, or value increase by an individual, organization, or business with the primary purpose of growing food for sale (including for-profit and non-profit enterprises). The land shall be served by a water supply sufficient to support the cultivation practices used on the site. Such land may include available public land. Urban Agriculture COMMERCIAL is subject to the operating standards set forth in zoning bulletin xx.	Permit in all commercial and industrial zoning districts. Permitted in residential zones with a CUP.
Interim zoning for 2011 following initial OFPC recommendations	See "**17.10.610: Crop and Animal Raising Agricultural Activities**" above	Conditionally permitted in all residential and commercial zoning districts
	Indoor food production can be interpreted in the interim, as a "Custom Manufacturing" activity when applied to buildings of less than 10,000 square feet.	Industrial and mixed industrial zoning districts
	Clarify definition of "Community and Botanical Gardens" under "17.10.140: Essential Service Civic Activities" to incorporate OFPC definition	

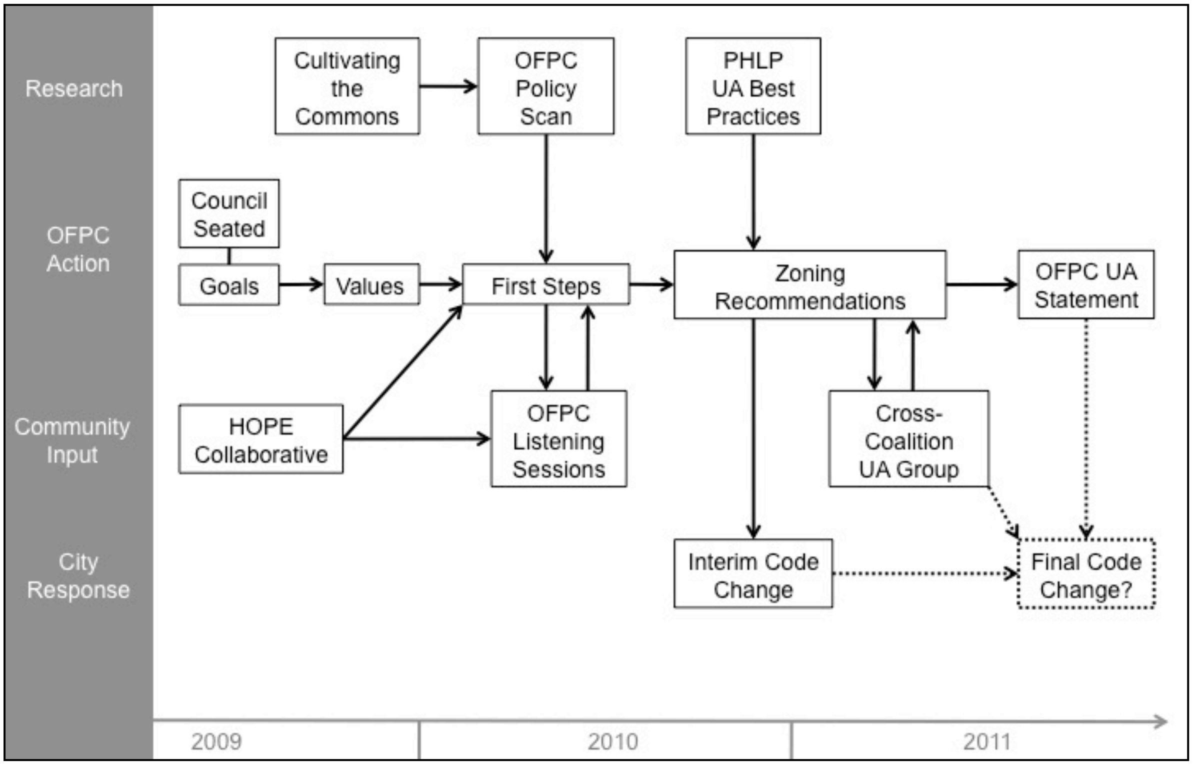

Figure 6.2. Interactions between research, community partners, Oakland Food Policy Council, and city government in the development of a urban agriculture zoning recommendations for Oakland

If at first you don't succeed…
Lessons Learned and Future Directions

As the case study our efforts thus far reveal, updating municipal zoning is a slow and grueling process requiring a great deal of patience and tenacity. The role of the OFPC throughout has been to provide both technical resources and continued advocacy. Providing detailed recommended changes drawn from best practices was one key strategy. Working with City staff, City Councilmembers, consulting with community organizations and urban farmers, and drafting our "Statement on Urban Agriculture" letter that residents and supporters could sign, also exemplify the coordination and community organizing necessary to increase decision-maker awareness and move towards policy change. While still underway, the OFPC's efforts to effect policy change for urban agriculture in Oakland offer a number of wider lessons, both to communities working to adopt new urban agriculture regulations as well as to those communities tackling local food policy more broadly.

1. *Create an advocacy structure that can weather a lengthy policymaking process.* The community organizing, policy research, and advocacy process that led up to Oakland's first round of urban agriculture zoning reform (and that continues today) was several years in the making. One of the key benefits of working through a food policy council is that it institutionalizes resources and partnerships, making it more likely that stakeholders

and advocates are able to continue a policy campaign over a potentially protracted timeline.

2. *Identify the appropriate advocacy "role" early in the process.* Because the OFPC hopes to develop a long-term relationship with city officials and staff, and because the Council's platform is broader than a single issue, using antagonistic or adversarial advocacy techniques was not a preferred strategy. Rather, the strategy was governed by an attempt to build trust, positive relationships, and offer support or resources whenever possible, in essence, remaining as diplomatic as possible while firmly pressing our agenda forward.[143]
3. *Without a perceived "emergency" or immediate problem, action may be postponed.* Garnering attention from both policymakers and city staff is a competitive process. While almost all the staff and elected officials whom the OFPC engaged supported the general idea of urban agriculture, there was not enough momentum to actually move policy reform forward until Ghost Town Farm was cited with a zoning violation, sparking a more widespread outcry for change.
4. *Successful advocacy benefits from both "inside" and "outside" champions.* Even before the Ghost Town Farm incident, City Councilmembers had shown increasing interest in including urban agriculture as part of their own political platforms, as mentioned above. This support was instrumental in moving staff to begin to include urban agriculture in code updates. Early on, leadership in CEDA at the time did not display a personal passion for tackling urban agriculture in the zoning code update. This changed with time, however, and the eventual steadfast commitment of the Deputy Director of Planning provided a serious boost to the zoning changes that are now on the drawing board. In communities where city planning staff or council members become internal champions, urban agriculture policy may benefit from a more streamlined process. Similarly, it was essential to have the expertise of a city government staffer with several years of experience in the Planning Department and other city agencies working with us as an OFPC Councilmember. She helped us identify not only the key players, but also the appropriate protocol to navigate both the complex layers of bureaucracy and politics governing them.
5. *Urban agriculture policy change benefits when it is part of a larger food system plan.* While urban agriculture policy reform certainly can be tackled as a single issue, the OFPC's broad platform with an emphasis on equity brought a number of stakeholders to this process who may not have been attracted to the issue as a stand-alone. For example, OFPC members include representatives from the Alameda County Community Food Bank, the business community, and farmers' market organizations – groups for whom urban agriculture may not be a top food system priority. However, the food system framework has allowed each of these groups to support and champion urban agriculture, situating it within a context of economic development, environmental sustainability, and healthy communities.

[143] This is not to say that more adversarial approaches and overt protest, organizing, or mobilization are not appropriate in some cases. Indeed, including such groups at the table is essential. As a food policy council with an interest in maintaining congenial relations with municipal government, however, it makes more sense to channel or translate the concerns and ideas of more activist organizations into language perhaps less threatening to public officials.

This final point highlights the importance of working on multiple components of food systems change. Indeed, increasing food access cannot be completely addressed simply by increasing urban food production. As Nobel laureate Amartya Sen (1983) reminds us, hunger is rarely a function of limited food production, but rather of limited *entitlements*, or "the command over goods and services," which, in industrialized nations, is mediated primarily by wages and purchasing power. Similarly, food justice work and efforts to improve "access" must extend beyond production, as well as beyond processing, distribution and retail, and waste recycling, to include structural reforms to increase entitlements through a range of mechanisms, notably by expanding economic opportunities in low-income areas. For these reasons, scholars have expressed the dangers of focusing on spatial proximity to healthy food or using "local" as *the* defining characteristic of a just and equitable food system (Hinrichs 2003; DeLind 2010; Born and Purcell 2006; Allen 2010).

Indeed, working to protect and expand urban agriculture is only one of ten first steps that the OFPC defined. Moreover, our action to change zoning is only the first of many steps to scale up urban agriculture in Oakland. Zoning deals only with the question of *where* (and under what conditions) urban agriculture can occur in a community. Advocates have already identified additional policy reforms, such as streamlining the licensing and permitting process (which deals with *who* can practice urban agriculture). Also needed is the creation of a transparent and streamlined process for access to public land through standardized "requests for proposals" and lease agreements. This may include developing use agreement templates for civic urban agriculture on public land and for permitting for commercial urban agriculture and advocating for a sliding scale or tiered fee structure for permits. Other possible policy interventions may address subsidizing liability insurance, water, and urban agriculture extension programs. Ultimately, the extent to which these changes take effect depends not only on our skill as advocates, but also the extent to which city officials perceive an equitable food system as a priority, no easy task considering the vagaries and uncertainties of the political process and the state of municipal, state, and federal budgets. Clearly, the work is only beginning.

Conclusion
or,
Applied Political Ecology, Urban Agriculture, and the Art of the Possible

This used to be real estate
Now it's only fields and trees
Where, where is the town?
Now it's nothing but flowers

The highways and cars
Were sacrificed for agriculture…

This was a discount store
Now it's turned into a cornfield
You got it, you got it!
Don't leave me stranded here
I can't get used to this lifestyle!

-- Talking Heads[144]

In this dissertation, I have attempted to unravel the complex weave of food production, food access, planning, public health, and social equity in Oakland. On an academic level, this project contributes to a better understanding of the interactions between the built environment, urban ecosystems, and public health. Through what I have come to call an *applied political ecology* framework, I've attempted to excavate layers of history—layers that are both social and biophysical—and link them to what is happening here and now, and to the visions that Oaklanders have for the future. This approach has revealed how social and political economic processes have shaped these layers—through cycles of investment and disinvesment, planning decisions, and diverse alliances—and created spaces of both cultivation and contamination in Oakland's post-industrial landscape.

More concretely, this applied political ecology plugged into a larger drive to develop a coherent food system plan for Oakland, in an effort to help the City of Oakland and community-based food justice organizations assess the possibility of scaling up urban agriculture. In addition to folding quantitative, environmental science, and planning methods into critical geographic analysis, I grounded my approach in participatory methods. I intentionally tailored several of my research questions to meet the research needs of a diversity of stakeholders, from urban farmers and community members to public officials and policy advisors. The soil assessment represented the application of the "precautionary principle" to urban agriculture projects, i.e., it assessed the risk of environmental contamination *before* the launch of urban farming projects in order to ensure that sites were safe for food production. Finally, by identifying zoning obstacles that hinder the use of urban land for food production, this work informed Oakland's municipal food policy in its nascent stages.

[144] "(Nothing But) Flowers", *Naked*. Sire, 1988. LP.

In addition to being critical and reflective, this dissertation is also *prescriptive*. As such, this research rises to the call for academic praxis that extends beyond teaching and writing (Fuller and Kitchin 2004; Wakefield 2007). Moreover, by exploring urban agriculture as a possible solution to historicized environmental racism and threats to survival, it contributes to what Nik Heynen (2006a) calls a "*really* radical geography" that explicitly addresses issues of hunger and human welfare.

An applied political ecology approach such as this can be used elsewhere. It could prove an effective way to support other urban agriculture planning initiatives throughout cities in North America and rest of the Global North. It could also help make sense of the global phenomenon of urbanization, one of the major drivers of global change according to the Millennium Ecosystem Assessment, a trend that social and biophysical scientists and policy makers alike are trying to better understand. How to feed an increasingly urbanized world in an ecologically sustainable and socially equitable manner remains a pressing question; how to do so within the context of global economic crisis begs equal attention. If urban agriculture is indeed to be pursued as a resilience strategy in North American cities such as Oakland or in the Global South, we must understand its origins and spatial dynamics in particular cities, as well as the factors that may hinder or facilitate its expansion.

In my examination of these factors in Oakland, I have primarily addressed technical concerns. However, many questions remain unanswered. While the lyrics of a twenty-year-old Talking Heads song may seem an unlikely epigraph for this dissertation's conclusion, they are nevertheless germane. These phrases capture some of urban agriculture's potential contradictions and pitfalls as they simultaneously invoke a utopian vision of a new agricultural commons, emphasizing just how hard it might be to mend the metabolic rift between city-dwellers and the soil that nourishes us. Every utopian rose, after all, has a dystopian thorn.

Indeed, what has become clear to me over the course of this research is that scaling up urban agriculture is hardly a simple question of providing the infrastructure necessary for urban agriculture to flourish, of rescaling nutrient cycling, or of transporting food shorter distances in order to rely less on the spatio-temporal subsidies that define our current metabolism of the environment. At the end of the day, we can rewrite zoning, we can identify potential sites and contamination, and we can remediate these sites if necessary. But, ultimately, these technical obstacles are not the only factors that prevent urban agriculture's transformation of the municipal food system.

While closing the agriculture/urban waste nutrient cycle and reducing food miles may bridge ecological rift to a certain extent, social and psychological rift are harder to mend. Borrowing from the Talking Heads song, how *does* one get used to the urban agrarian lifestyle? On an individual level, education may be the best approach to overcoming alienation from the food system. But mobilizing a large enough population to actually farm on a commercial scale may be more difficult. Agricultural labor can be a backbreaking endeavor beset by economic risk (due to the variability of climate and crop prices) offering little in terms of financial reward. The pay-off has to be large enough to draw a crowd.

This question of valuation extends beyond the individual level to the society more broadly. How can value be ascribed to urban agriculture so that it becomes as much of a priority as housing, commercial centers, and roads when urban space is scarce? Only if food production and agricultural land are once again viewed as public goods rather than commodities will spaces be set aside for agriculture in dense urban areas. Only when deflated agricultural wages rise to reflect the real value of labor required to produce food will people turn en masse to such jobs out of desire rather than necessity. In short, *use value* must trump *exchange value* if urban agriculture is to scale up in any significant way.

Given the limited reach of urban agriculture, it thus becomes clear that the fight for food justice cannot be waged with shovels and compost alone. Growing one's own food is de-alienating, transformative, and an effective means to bring food to those in immediate proximity. It is also a vital means of rallying food justice activists. Yet as it exists now, urban agriculture functions only at the micro-scale; even massive agglomerations of urban gardens are unlikely to meet more than a small percentage of the recommended vegetable demands of a city such as Oakland (as I found through the land inventory detailed in Chapter 4).

The passion and vigor with which food justice activists break new ground in the urban fallows in Oakland and elsewhere must therefore extend to rethinking and rebuilding the metropolitan and regional food system in its entirety—production, but also processing, distribution, retail, and waste recovery—in both urban *and* peri-urban areas. Creative new economic incentives and land use protections will be needed to buffer a fledgling local food system from the continuous cycle of economic booms and busts and competitive pressures of the global food system and land prices. Perhaps most importantly, living wage jobs must be fundamental to the design. Even if significant flows of capital are channeled into the creation of infrastructure for a more just food system, keeping the food system bountiful will remain one of the great challenges.

Again, a vast array of technical solutions is required both to scale up urban agriculture and to overhaul the existing agri-food system. With hard work, I am confident that this can be done. Politics and political economy are more complicated, however. How do we overcome the universal reach of the corporate food regime, driven by its fundamental imperative for profit?[145] How do we mobilize those who are not mobilizing? And how do existing political economic logics reproduce these barriers to mobilization?

As I discuss in the dissertation's introduction, race is the perennial elephant in the room, as the gentrification critiques from the frontlines illustrate. But as I show in Chapter 3, the history of urban agriculture highlights the successes that have been achieved through cross-race, cross-class coalitions. To foster rather than stifle such coalition-building, it is vital that white urban agriculture activists reflect on how they go about doing the work they love and think critically about how they conceive of urban agriculture. Those involved in urban agriculture must avoid approaching food justice as "bringing good food to others" (Guthman 2008a); thinking and speaking about urban agriculture this way only propagates the perception that urban agriculture involves a bunch of white folks engaged in a "civilizing mission" to bring healthy food to uneducated brown and black bodies in "food deserts" and "junk-food jungles".[146] Several

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[145] "Accumulate, accumulate! That is Moses and the prophets!" (Marx 1976, 742)

[146] Equally problematic is the term "urban homesteading". Even though I know that most folks involved in the urban back-to-the-land movement are thinking more about self-sufficiency than about the historical origins of the term, I cringe every time I hear it. For many white Americans and European immigrants, the Homestead Act offered the promise of a new beginning in the American West where they were given free land to cultivate. My great-grandparents fell into this category, leaving East Texas for a quarter-section (160 acres) of cholla cactus scrubland in Quay County, New Mexico in 1906. The homestead grew into the family wheat farm, active through the 1960s. The "Little House on the Prairie" historiography of homesteading, however, obscures the uglier side of Manifest Destiny, notably the genocide and clearance of indigenous people from this land that was seen by the government and its pioneers as unused or empty. Because "homesteading" implies settling on the frontier, to use the term in an urban setting similarly conjures up images of the frontier, where white pioneers settle in wild or hostile neighborhoods of color. Referring to backyard gardening, livestock husbandry, and graywater harvesting as "urban homesteading" therefore only fuels the perception that urban agriculture is a gentrifying tactic, slowly extending

organizations in Oakland, notably People's Grocery and Phat Beets Produce, offer anti-racism training to food justice activists, and require that those working with them go through the program, in order to interrogate their white privilege and the assumptions that come with it. I applaud these efforts and feel they should be integral to any food justice work.

But overcoming the racial politics that currently hinder urban agriculture's scaling up will require more than the self-reflexivity of white activists. The realities of the neoliberal political economy exacerbate these tensions. Brahm Ahmadi, founder of People's Grocery in West Oakland, People's Grocery, expresses the conundrum in which urban agriculture activists find themselves:

> Many of the issues around gentrification for me are outside of the domain of what individuals or small groups can really do… So while we can build in certain practices like, we have a white volunteer base but will provide economic incentives for people of color to participate. Or that we do these trainings and are very explicit about gentrification as a key issue in the neighborhood, and how we're culpable in certain ways for that, and what the risks are when we pursue urban ag as a strategy in the community, those kinds of things. Macro conditions really are beyond us. (Ahmadi 2009)

As I briefly discuss in the introduction, a hallmark of the neoliberal era is the growing dependence on non-profits and volunteerism to provide entitlements. Funding for these groups is limited to modest grants from government agencies and private foundations. As a result, organizations are often left fighting for crumbs. Additionally, with limited funding for staff salaries, the organizations themselves rely largely on volunteers and interns. These organizations, unable to pay staff, must tap the activist spirit of civic activism that drives food justice advocates to rally against the corporate food regime, part of a Polanyian countermovement to re-embed the agri-food system within social relations. Most urban agriculture programs depend on this volunteer labor, the vast majority of which is young, upper middle-class, and white. Therein lies the rub; the presence of these activists only fuels assertions that urban agriculture is a gentrifying force. Such is the radical/neoliberal Janus face of urban agriculture.

But whether macro conditions truly are "beyond us" is a matter of scale, a matter of where we draw the lines around our activism, of how we frame our movement. Again, urban agriculture alone cannot usher in food justice. Food justice requires increased entitlements. It requires jobs and living wages, not just a garden or grocery store in every neighborhood. Rather than an end unto itself, urban agriculture must be a means to an end, but only one of many working in concord towards a unified vision of food justice, the just city, and just sustainability.

I am less sanguine about urban agriculture than I was four years ago when I got started on this project, but only somewhat so. While I am critical of urban agriculture on some levels and aware of its limitations, my goal has also been to explore its possibilities, and in doing so, to provide urban agriculture advocates with information that might help further their cause. As interest in urban agriculture grows, it will continue to be a fraught and messy process. But critiquing these flaws is not enough. As I argue in this dissertation's introduction, the critique alone can stifle visions of alternative futures; the "art of the possible" (Walker 2007) is obscured or forgotten if we focus solely on the cracks and chasms running though our present reality. I

"the new urban frontier" (Smith 1996) until a neighborhood is "tamed", its original inhabitants outpriced, and their culture effaced.

have tried to take that extra step by contributing to efforts to define what "the possible" might look like.

Taking this step to define the possible requires that we take a leap of faith. Perhaps we run the risk of simply being wrong. But if we are to actually implement change, is it not necessary to take such a risk? Noam Chomsky, the apotheosis of activist-scholar, summed it up best in a famous debate he had with social theorist and historian Michel Foucault in 1971. When asked by the moderator what the best alternative to capitalism would be, Chomsky, without hesitation, responds that anarcho-syndicalism offers the best, most democratic, just, and appropriate alternative. When asked if he, too, could advocate for such a system, Foucault comfortably adhered to the trope of a necessary division of labor between action and critique. He responded that he could not propose *any* alternative model, that his role was solely to critique even the most revolutionary of institutions so that "the political violence which has always exercised itself obscurely through them will be unmasked, so that one can fight against them." Chomsky's riposte is simultaneously critical and pragmatic:

> One has to choose a course of action… it is of critical importance that we know what impossible goals we're trying to achieve, if we hope to achieve some of the possible goals. And that means that we have to be bold enough to speculate and create social theories on the basis of partial knowledge, while remaining very open to the strong possibility, and in fact overwhelming probability, that at least in some respects, we're very far off the mark.[147]

Indeed, even the most progressive projects risk evolving (or devolving) into something quite different from the utopian ideals on which they are built. We *don't* know what urban agriculture will look like once it is scaled up. There is always the risk that we will look around at the vegetable fields that were once parking lots, the goats grazing suburban yards, and the building codes requiring rooftop gardens, and cry out, "Don't leave me standing here! I can't get used to this lifestyle!" However, as Chomsky argues, this risk is no reason to sit back as a passive critic, paralyzed from fear of making the wrong choices or taking the required leap of faith necessary to embark on the unknown. If we believe that urban agriculture has a role to play in a more just society, the time is ripe to roll up our sleeves.

[147] Debate transcript available online at http://www.chomsky.info/debates/1971xxxx.htm (accessed 10/3/11).

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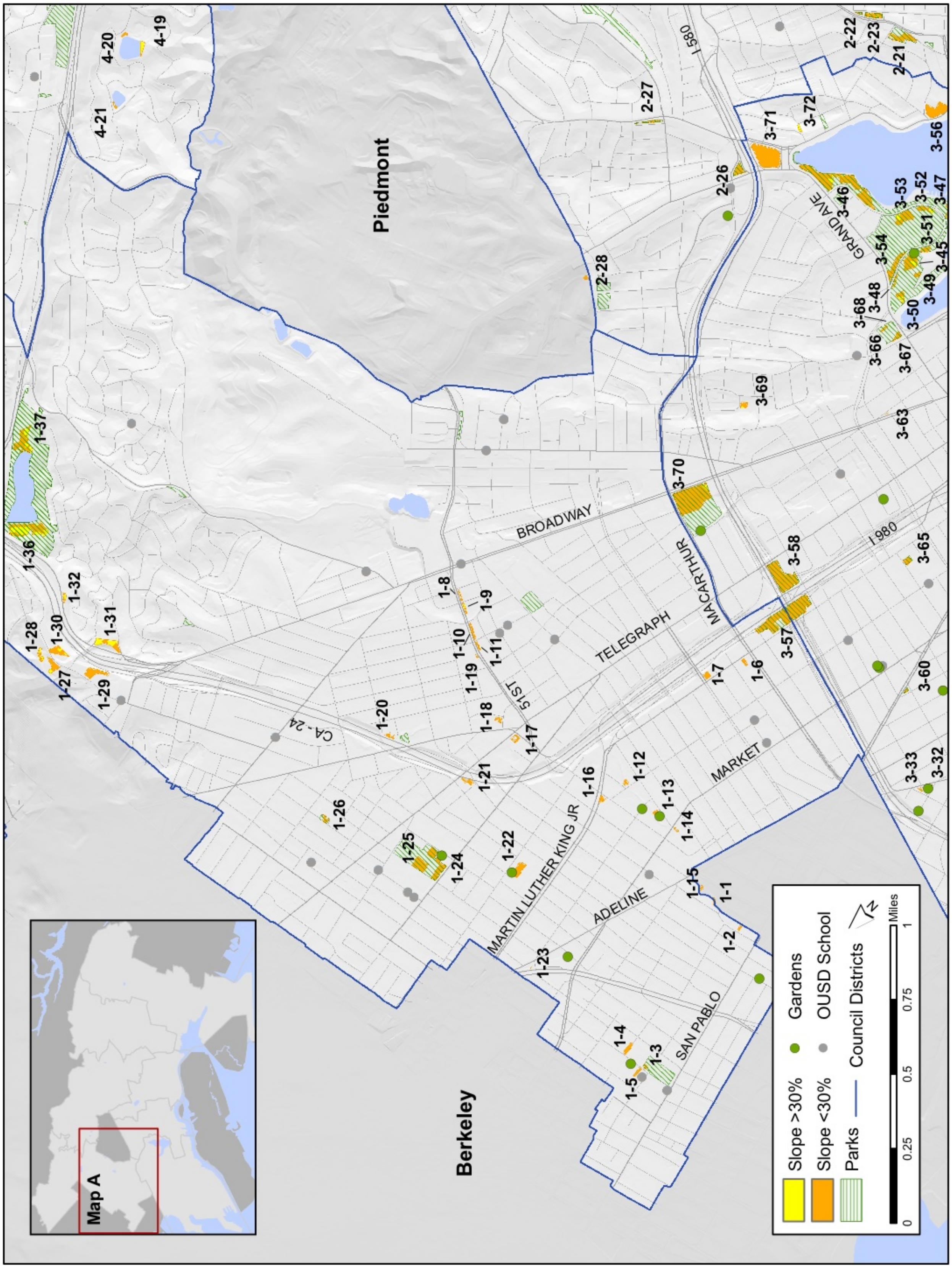
Appendix A1: Land Locator

The Cultivating the Commons Land Locator (McClintock and Cooper 2009) contains seven maps of vacant or underutilized publicly owned sites in Oakland and a corresponding list of parcels identified by this inventory. Sites shown on the maps are either individual parcels, or an aggregate of parcels that are within 25 feet of each other.

On each map, sites are organized by Council District and labeled with an index number (the first number is the Council District, followed by a hyphen). This number is listed in the "Site" column of the index and can be used to look up additional information about each site:

- **Open Area (Total)** – The total area of land without any vegetation in each aggregated site.
- **Owner/Agency** – The public agency or department that owns a given parcel. In some cases, an aggregated site may include parcels owned by different departments and/or agencies.
- **Use** – Current land use for each parcel. Data comes from Oakland Parks and Recreation and the Alameda County Tax Assessor. For some entries, use data may not have been available.
- **Address** – Addresses are listed for each parcel. In many cases the City of Oakland does not supply street numbers for each parcel address.
- **APN** – The Assessor Parcel Number (APN) is the tax identification number for a parcel.
- **Open Area (Parcel)** – The total area of land without any vegetation in each parcel.
- **Ground Cover** – The predominant type (>75%) of ground cover in the aggregated site. Sites with > 75% open land with little to no vegetation are labeled "Soil/Grass." Sites with > 75% cement, gravel, or asphalt, are labeled "Hard Surfaces." Sites that are evenly split between different ground covers are listed as "Mixed Surface." Sites with dense vegetation and/or trees are not included in this index; they are outlined in the agroforestry section of the report.
- **Slope (%)** - The average slope of each parcel.
- **Zoning** – Zoning codes can be found in Appendix D
- **Ag. Use** – Agricultural activities permitted under the site's current zoning with a conditional use permit from the City of Oakland. See Appendix D and Map 7.
- **Gen. Plan** – General Plan land use designations that may override current zoning are included in this column.
  - OS – Urban Open Space
  - EP – Estuary Plan Area
  - RC – Resource Conservation Area
- **$H_2$0** – An "X" is placed in this column if there is an EBMUD water meter associated with at least one of the parcels in the site.
- **School** – An "X" is placed in this column if the site is within ¼ mile of a public school (OUSD).
- **Bus** - An "X" is placed in this column if the site is within ¼ mile of an AC Transit bus stop.

A black line in the index table separates individual sites, while specific parcels are separated only by line breaks. Multiple lines of text within the same site correspond to the parcels that comprise the aggregated site. Each site may be comprised of aggregated parcels; thus, there may be instances in which one site has multiple owners, APNs, addresses, etc.


Piedmont
Berkeley
BROADWAY
TELEGRAPH
MACARTHUR
GRAND AVE
MARTIN LUTHER KING JR
ADELINE
MARKET
SAN PABLO
51ST
CA - 24
I 580
I 980
Map A
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3-67
3-68
3-69
3-70
3-71
3-72
4-19
4-20
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Slope >30%
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Parks
Gardens
OUSD School
Council Districts
Miles
0
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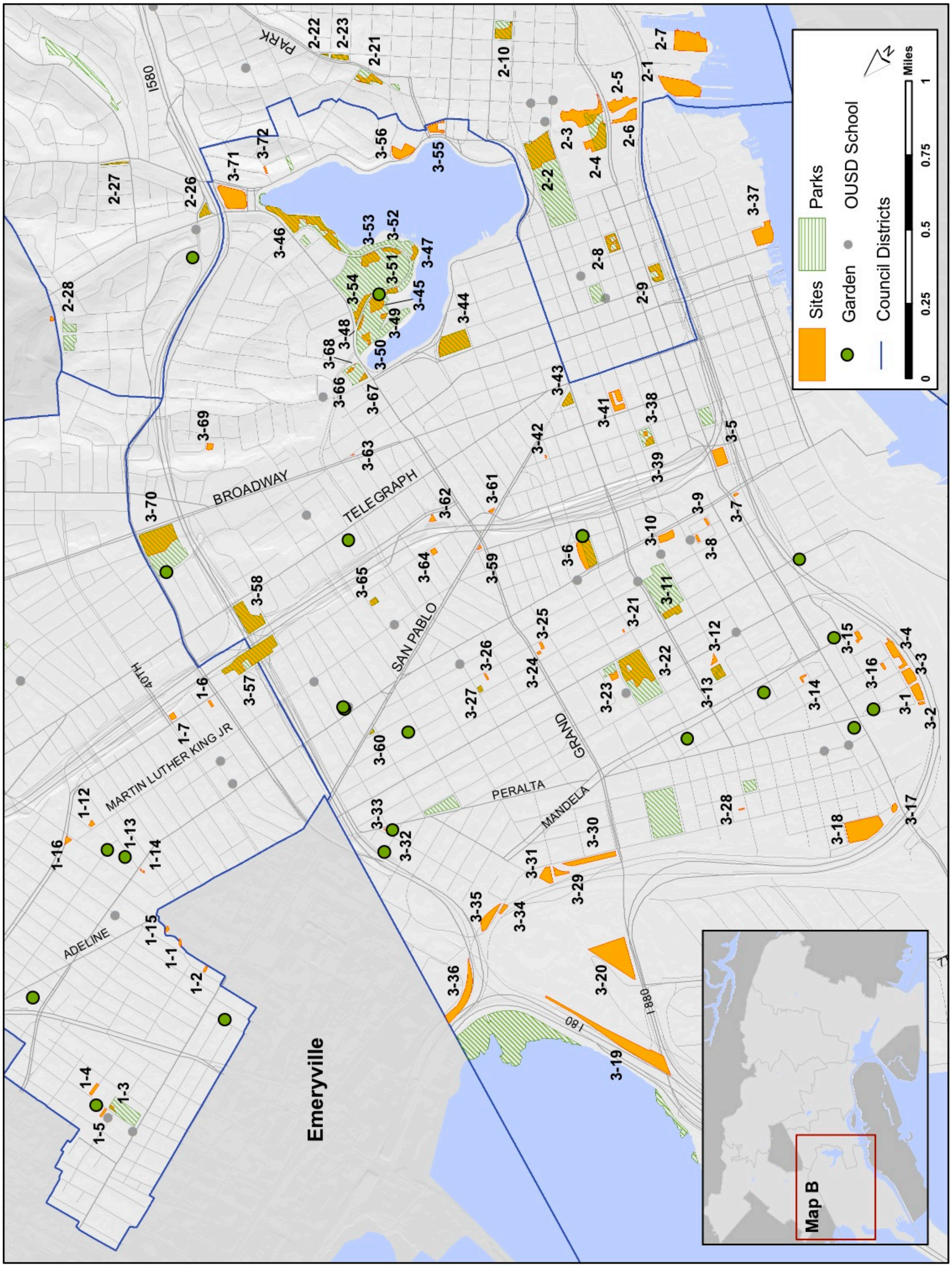
Sites
Parks
Garden
OUSD School
Council Districts
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Map B
Emeryville
BROADWAY
TELEGRAPH
SAN PABLO
40TH
MARTIN LUTHER KING JR
ADELINE
PERALTA
MANDELA
GRAND
PARK
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I880
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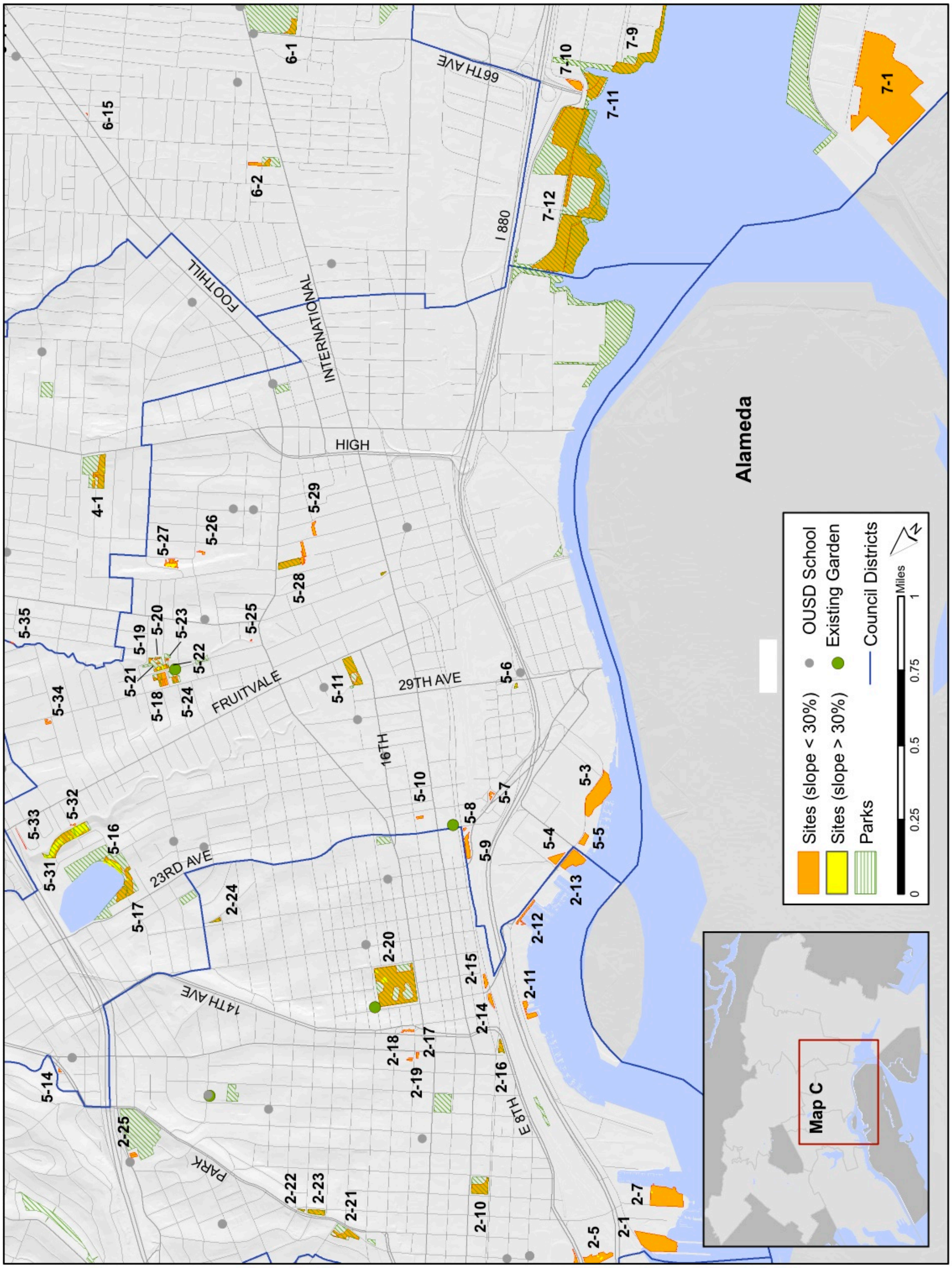
Alameda
Map C
Sites (slope < 30%)
Sites (slope > 30%)
Parks
OUSD School
Existing Garden
Council Districts
Miles
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0.25
0.5
0.75
1
FOOTHILL
INTERNATIONAL
HIGH
FRUITVALE
29TH AVE
16TH
23RD AVE
14TH AVE
PARK
E 8TH
66TH AVE
I 880
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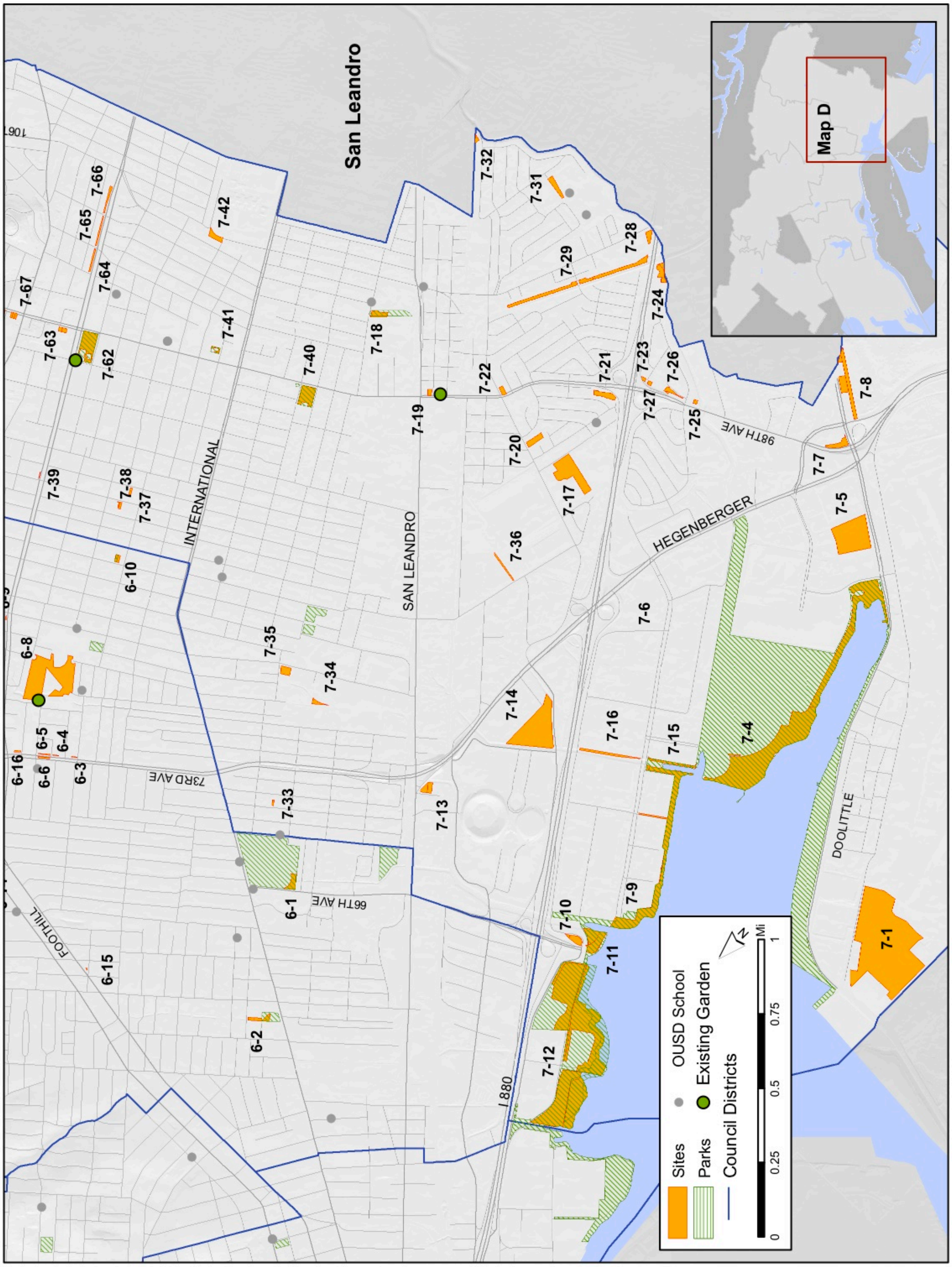
San Leandro
Map D
Sites
Parks
OUSD School
Existing Garden
Council Districts
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INTERNATIONAL
SAN LEANDRO
HEGENBERGER
DOOLITTLE
FOOTHILL
73RD AVE
66TH AVE
98TH AVE
I 880
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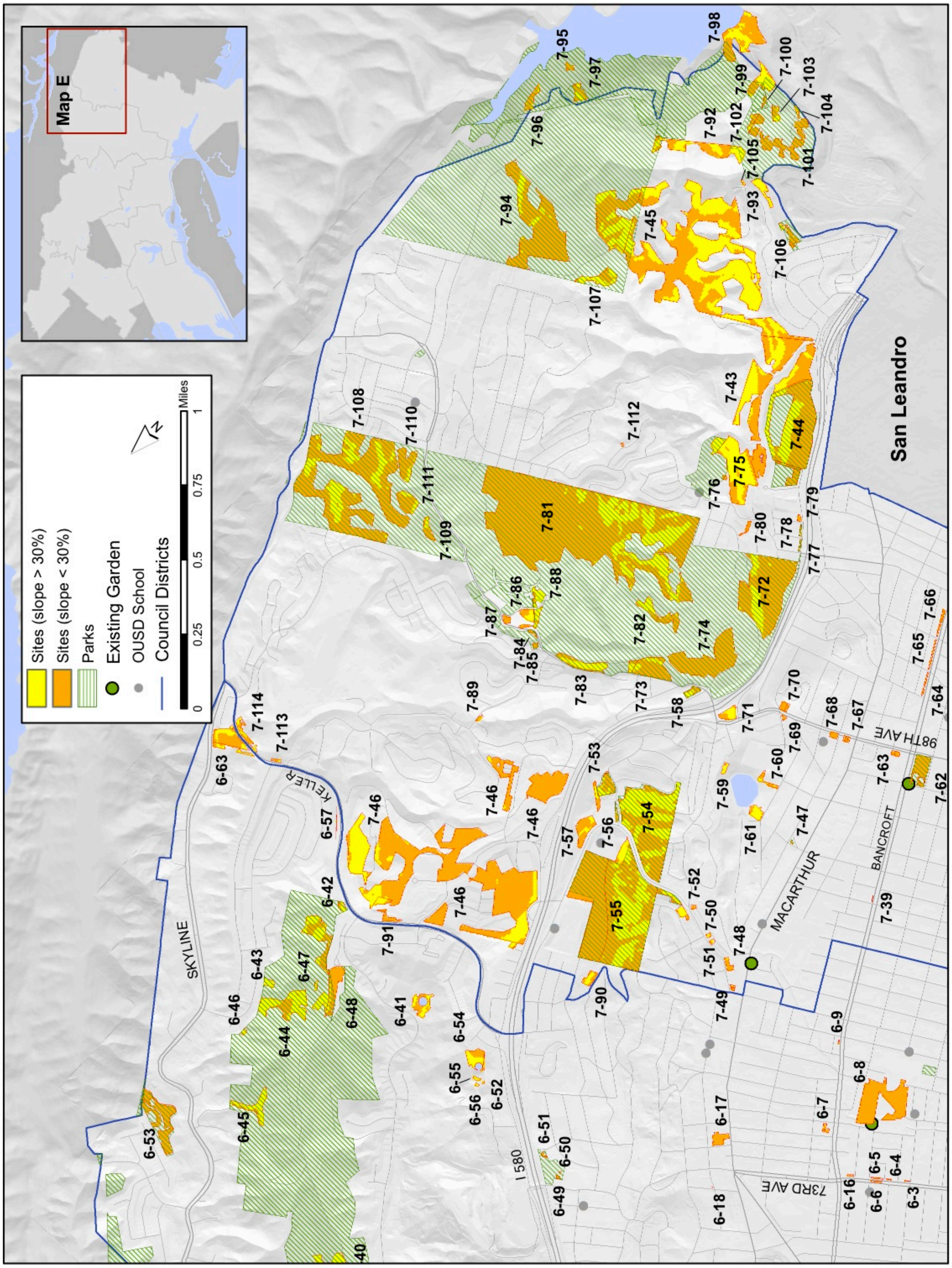
Map E
Sites (slope > 30%)
Sites (slope < 30%)
Parks
Existing Garden
OUSD School
Council Districts
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0.75
1
Miles
N
San Leandro
SKYLINE
KELLER
I 580
MACARTHUR
BANCROFT
73RD AVE
98TH AVE
7-95
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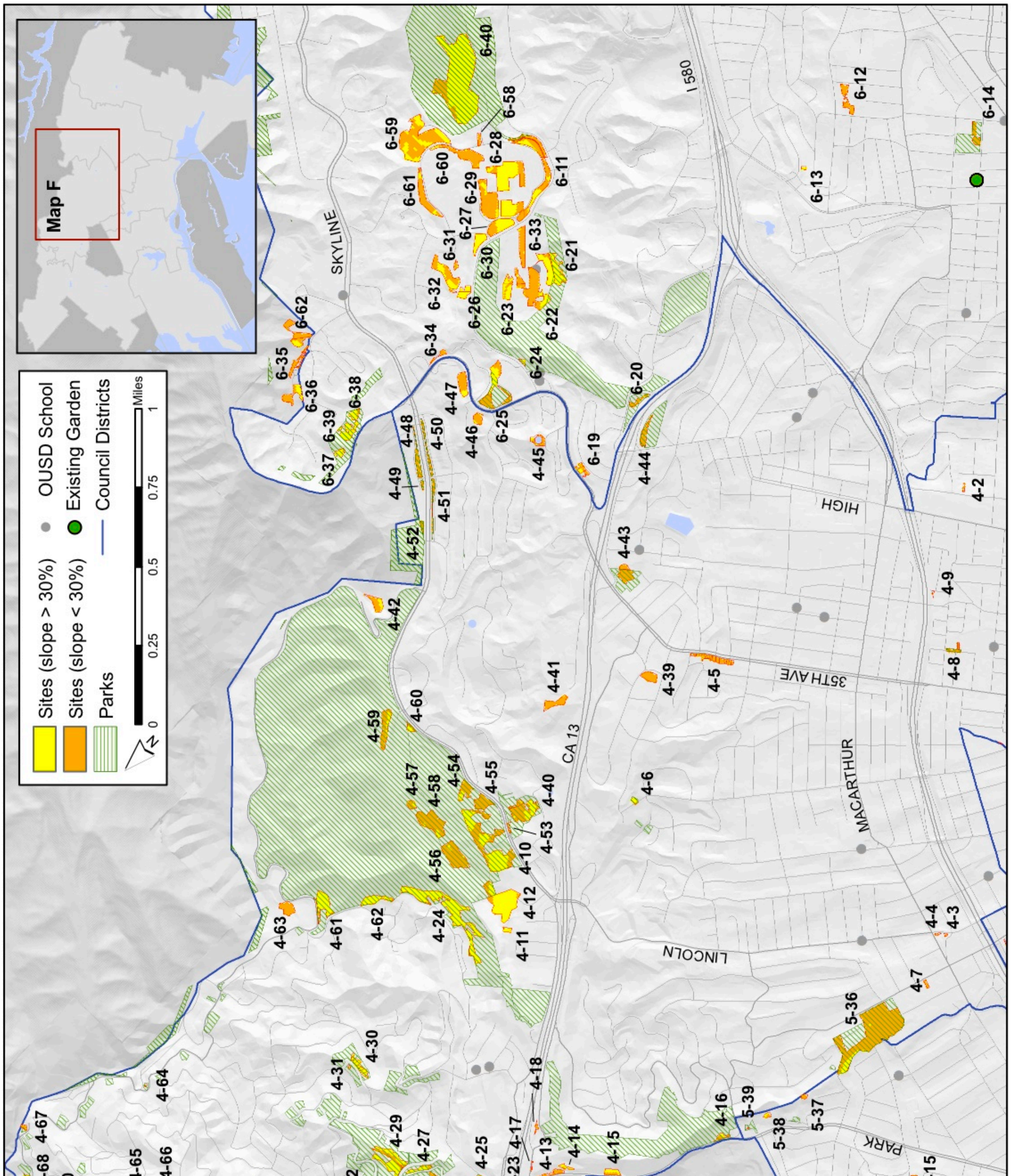
Sites (slope > 30%)
Sites (slope < 30%)
Parks
OUSD School
Existing Garden
Council Districts
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Map F
SKYLINE
I 580
HIGH
35TH AVE
MACARTHUR
CA 13
LINCOLN
PARK
Piedmont
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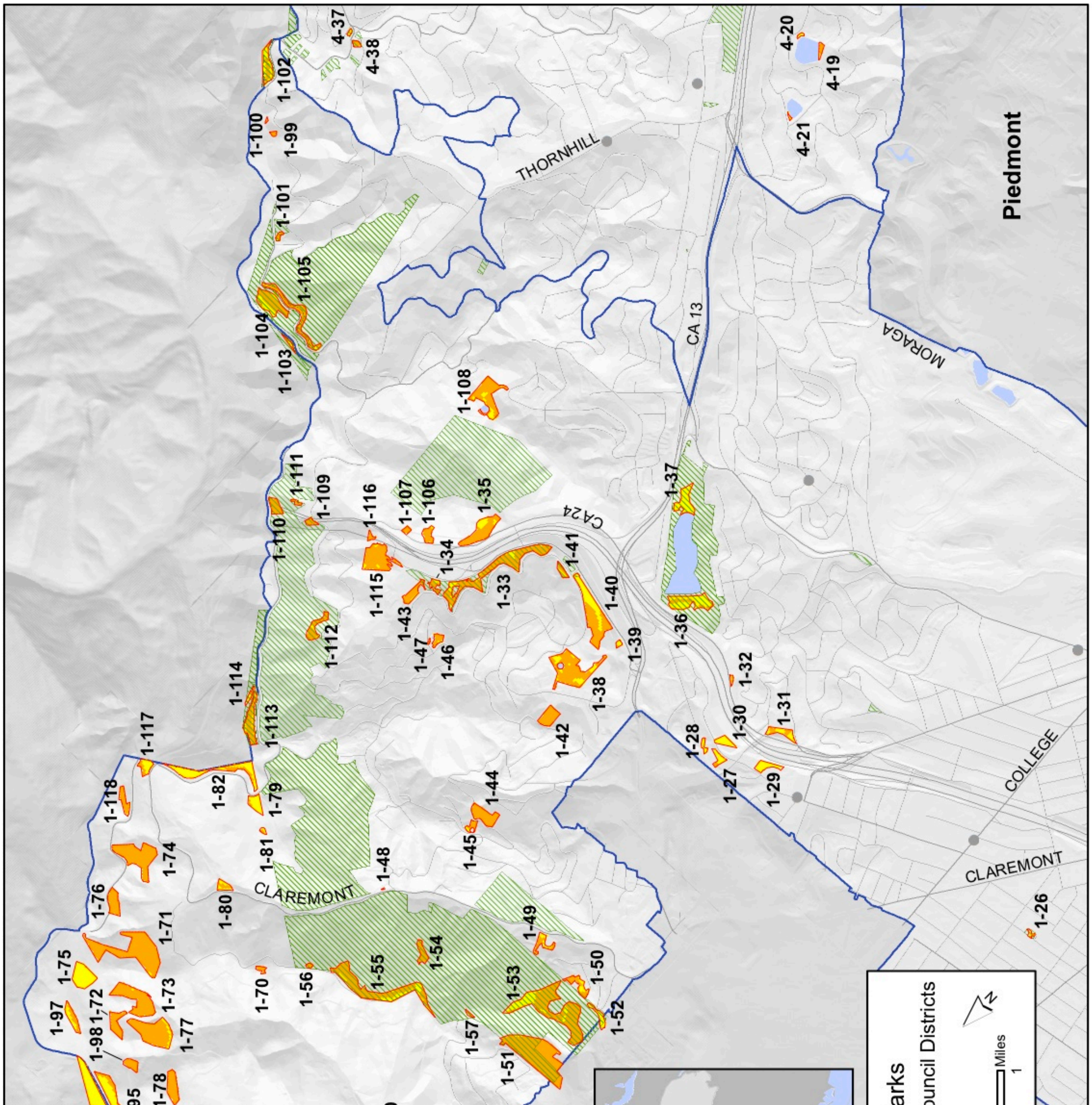
Berkeley
Piedmont
CLAREMONT
COLLEGE
THORNHILL
MORAGA
CA 24
CA 13
Map G
Slope < 30%
Slope > 30%
OUSD School
Parks
Council Districts
Miles
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Site	Open Area (Total) (sq ft)	Open Area (Total) (acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	Open Area (Parcel) (acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
1-1	3,968	0.09	Alameda Co. Flood Control		Adeline St.	94608	013 117501203	3,968	0.09	Soil/Grass	4	R-40 /S-18	1		X		X
1-2	4,180	0.10	Alameda Co. Flood Control		1071 53rd St.	94608	013 117601001	4,180	0.10	Soil/Grass	0	R-40 /S-18	1				X
1-3	5,633	0.13	Parks and Recreation	Golden Gate Rec Center	6124 San Pablo Ave.	94608	016 144204001	5,633	0.13	Soil/Grass	1	OS (NP) /S-18	1	OS	X		X
1-4	12,527	0.29	City of Oakland		62nd St.	94608	016 144206400	12,527	0.29	Soil/Grass	0	R-40 /S-18	1		X		X
1-5	6,561	0.15	Parks and Recreation	Community Garden	1068 62nd St.	94608	016 144402300	6,561	0.15	Soil/Grass	1	R-40 /S-18	1		X	X	X
1-6	5,881	0.14	City of Oakland		3823 M. L. King Jr. Way	94609	012 096400500	5,881	0.14	Soil/Grass	1	C-10	1		X		X
1-7	10,310	0.24	BART		3924 M. L. King Jr. Way	94609	012 096902900	5,500	0.13	Soil/Grass	2	C-30 /S-18	3		X	X	X
					645 40th St.		012 096903000	2,500	0.06		1						
					40th St.		012 096904102	2,310	0.05		0						
1-8	4,353	0.10	City of Oakland		Desmond St.	94618	013 113700302	2,137	0.05	Soil/Grass	4	R-35 /S-18	1		X		X
					Coronado Ave.		013 113702202	2,216	0.05								
1-9	4,839	0.11	City of Oakland		347 51st St.	94609	013 113702402	914	0.02	Soil/Grass	0	R-35 /S-18	1		X		X
					345 51st St.		013 113702503	1,476	0.03		9						
					Coronado Ave.		013 113702702	2,318	0.05		3						
1-10	8,905	0.20	City of Oakland		Lawton Ave.	94609	013 114002402	1,525	0.04	Soil/Grass	0	R-35 /S-18	1		X		X
					367 51st St.		013 114002504	934	0.02								
					51st St.		013 114002602	932	0.02								
					51st St.		013 114002704	968	0.02								
					51st St.		013 114002803	901	0.02								
					51st St.		013 114002904	1,238	0.03								
					355 51st St.		013 114003003	1,235	0.03								
					351 51st St.		013 114003101	1,171	0.03								
1-11	3,156	0.07	City of Oakland		5025 Lawton Ave.	94609	013 114102402	1,037	0.02	Soil/Grass	0	R-35 /S-18	1		X	X	X
					51st St.		013 114104704	632	0.01								
					51st St.		013 114104802	778	0.02								
					377 51st St.		013 114104904	703	0.02								
1-12	6,688	0.15	Alameda Co. Flood Control		4728 West St.	94608	013 116302201	2,520	0.06	Soil/Grass	0	R-40 /S-18	1				X
					4738 West St.		013 116302301	4,168	0.10		0						
1-13	8,774	0.20	Parks and Recreation	Community Garden	876 47th St.	94608	013 116900900	4,408	0.10	Soil/Grass	2	R-40 /S-18	1		X		X
					880 47th St.		013 116901000	4,366	0.10		1						
1-14	2,365	0.05	Alameda Co. Flood Control		4631 Market St.	94608	013 117000601	2,365	0.05	Soil/Grass	0	R-40 /S-18	1		X		X
1-15	4,292	0.10	Alameda Co. Flood Control		Adeline St.	94608	013 117501203	4,292	0.10	Soil/Grass	4	M-20 /S-18	1		X		X
1-16	8,572	0.20	City of Oakland		52nd St.	94608	014 120301700	8,572	0.20	Mixed Surface	0	R-40 /S-18	1				X
1-17	7,883	0.18	City of Oakland	Temescal Branch Library	5205 Telegraph Ave.	94609	014 121900300	7,883	0.18	Soil/Grass	2	R-70 /S-18	2				X
1-18	6,668	0.15	Alameda Co. Flood Control		Redondo Ave.	94618	014 122704400	6,668	0.15	Soil/Grass	0	OS (LP) /S-18	1				X
1-19	1,498	0.03	City of Oakland		386 51st St.	94609	014 123401802	679	0.02	Soil/Grass	3	R-35 /S-18	1		X		X
					388 51st St.		014 123401902	819	0.02								
1-20	6,188	0.14	State of California		Hudson St.	94618	014 125702202	6,188	0.14	Soil/Grass	1	OS (NP) /S-18	1				X
1-21	12,680	0.29	State of California		5619 Telegraph Ave.	94609	015 127700400	5,000	0.11	Soil/Grass	1	R-40 /S-18	1				X
					5600 Carberry Ave.		015 127700800	6,948	0.16		1						
					Carberry Ave.		015 127700901	122	0.00		0						
1-22	33,005	0.76	City of Oakland		Dover St.	94609	015 128102700	33,005	0.76	Soil/Grass	0	R-40 /S-18	1				X
1-23	1,371	0.03	City of Oakland		6031 Genoa St.	94608	015 134700102	1,371	0.03	Soil/Grass	0	R-30 /S-18	1				X
1-24	67,943	1.56	Parks and Recreation	Bushrod Park & Rec. Ctr.	Racine St.	94609	015 137400102	105,378	2.42	Soil/Grass	1	R-50 /S-18	1	OS	X	X	X
					570 59th St.		015 137401000	6,688	0.15			OS (CP) /S-18					
1-26	7,291	0.17	Parks and Recreation	Colby Park	61st St.	94608	016 139404900	7,291	0.17	Soil/Grass	2	OS (PMP) /S-18	1		X		X
1-27	24,447	0.56	Alameda Co. School Spdnt.		6929 Chabot Rd.	94618	048A708401304	24,447	0.56	Soil/Grass	9	R-30/S-14/S-18	1		X		X
1-28	12,345	0.28	BART		Chabot Rd.	94618	048A708501613	12,345	0.28	Soil/Grass	15	R-30/S-14/S-18	1				X
1-29	37,411	0.86	City of Oakland		Chabot Rd.	94618	048A709300301	37,411	0.86	Soil/Grass	4	OS (NP) /S-18	1		X		X
1-30	30,263	0.69	BART		Chabot Rd.	94618	048A720000202	30,263	0.69	Mixed Surface	5	R-30/S-14/S-18	1		X	X	X
1-31	44,324	1.02	EBMUD		Golden Gate Ave.	94618	048A720000402	44,324	1.02	Soil/Grass	14	R-30/S-14/S-18	1		X		X
1-32	6,218	0.14	State of California		Broadway	94618	048A721000105	6,218	0.14	Soil/Grass	12	OS (RSP)/S-14/S-18	1				X
1-33	252,881	5.81	Parks and Recreation	Gateway Gardens	Tunnel Rd.	94603	048H752001401	10,849	0.25	Soil/Grass	26	OS (SU)/S-10/S-14/S-18	1				X
					Tunnel Rd.		048H752001402	59,295	1.36		29	OS (SU)/S-14/S-18					
					158 Caldecott Ln.		048H752001913	57,418	1.32		25	OS (SU)/S-14/S-18					
					Tunnel Rd.		048H752600700	124,577	2.86		25	R-10/S-10/S-14/S-18					
1-34	22,820	0.52	Parks and Recreation	Gateway Gardens	Tunnel Rd.	94603	048H752001402	12,690	0.29	Soil/Grass	29	OS (SU)/S-14/S-18	1				X
					158 Caldecott Ln.		048H752001913	9,326	0.21		25	OS (SU)/S-10/S-14/S-18					
1-35	121,843	2.80	State of California		Tunnel Rd.	94611	048H752600203	121,843	2.80	Soil/Grass	24	R-10/S-10/S-14/S-18	1				X
1-36	120,030	2.76	East Bay Regional Parks		Broadway Ter.	94603	048H753000300	120,030	2.76	Soil/Grass	9	OS (RCA)/S-14/S-18	1	OS			X
1-37	76,427	1.75	East Bay Regional Parks		Broadway Ter.	94603	048H753000300	76,427	1.75	Soil/Grass	9	OS (RCA)/S-14/S-18	1	OS		X	X
1-38	226,877	5.21	OUSD		Hiller Dr.	94603	048H758600100	87,408	2.01	Soil/Grass	22	R-30/S-14/S-18	1				X
			EBMUD		100 Hiller Dr.	94618	048H758600200	139,449	3.20								

Site	Open Area (Total) (sq ft)	(acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	(acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
1-39	7,788	0.18	State of California	Gateway Gardens	Frontage Rd.	94618	048H758600700	7,788	0.18	Soil/Grass	20	R-30/S-10/S-14/S-18	1				X
1-40	215,128	4.94	State of California Parks and Recreation	Gateway Gardens	Frontage Rd.	94618 94603	048H758600700 048H759000100	210,614 4,058	4.84 0.09	Soil/Grass	20 8	R-30/S-10/S-14/S-18	1				X
1-41	18,928	0.43	Parks and Recreation	Gateway Gardens	Hiller Dr.	94603	048H759000300	18,928	0.43	Soil/Grass	23	R-30/S-10/S-14/S-18	1				
1-42	60,769	1.40	Parks and Recreation		Grand View Dr.	94603	048H760201200 048H760201300 048H760201400 048H760201500	14,908 15,095 15,851 14,916	0.34 0.35 0.36 0.34	Soil/Grass	30 32 29 30	R-30/S-14/S-18	1				X
1-43	44,529	1.02	Parks and Recreation EBMUD Parks and Recreation	Gateway Gardens	Tunnel Rd. Tunnel Rd. 320 Caldecott Ln.	94603 94603 94618	048H752001402 048H752001500 048H752005600	889 1,046 42,112	0.02 0.02 0.97	Soil/Grass	29 32 31	OS (SU)/S-14/S-18 OS (SU)/S-10/S-14/S-18 OS (SU)/S-10/S-14/S-18	1				X
1-44	77,848	1.79	Parks and Recreation		Gravatt Dr.	94603	048H760605103 048H760605104	23,489 54,331	0.54 1.25	Soil/Grass	27 31	R-30/S-14/S-18	1				
1-45	17,417	0.40	EBMUD		1076 Amito Ave. Amito Ave.	94705 94603	048H761201600 048H761201700	7,577 9,773	0.17 0.22	Soil/Grass	20 29	R-30/S-14/S-18	1				
1-46	22,454	0.52	EBMUD		Bristol Dr. Bristol Dr. 6855 Sherwick Dr. Bristol Dr. Sherwick Dr. Sherwick Dr. Sherwick Dr.	94603 94603 94705 94603 94603 94603 94603	048H761900800 048H761900900 048H761901000 048H761901100 048H761901400 048H761901400 048H761902101	5,893 6,316 4,808 1,769 12 2,601 616	0.14 0.14 0.11 0.04 0.00 0.06 0.01	Soil/Grass	21 22 23 22 18 18 18	R-30/S-14/S-18	1				X
1-47	1,953	0.04 0.04	EBMUD EBMUD		6855 Sherwick Dr. Bristol Dr.	94705 94603	048H761901000 048H761901100	941 770	0.02 0.02	Soil/Grass Soil/Grass	23 22	R-30/S-14/S-18 R-30/S-14/S-18	1 1			X	X X
1-48	896	0.02	Parks and Recreation		1395 Alvarado Rd.	94603	048H765400101	896	0.02	Soil/Grass	17	R-30/S-14/S-18	1				
1-49	38,366	0.88	EBMUD		Claremont Ave. 7441 Claremont Ave.	94603 94705	048H767200502 048H767200600	27,891 10,182	0.64 0.23	Soil/Grass	23 20	R-30 /S-18	1				
1-50	47,485	1.09	EBMUD		Stonewall Rd.	94603	048H767303600	47,485	1.09	Soil/Grass	20	R-30 /S-18	1	RC			X
1-51	355,044	8.15	Univ. of California Regents East Bay Regional Parks East Bay Regional Parks		W. MacArthur Blvd. Claremont Ave. Panoramic Way	94705	048H769000500 048H769000901 048H769900200	93,002 255,223 3,475	2.14 5.86 0.08	Soil/Grass	28 24 30	R-10 OS (RCA) R-20/S-4/S-18	1 1 1	RC RC			X
1-52	28,493	0.65	East Bay Regional Parks		Claremont Ave.	94705	048H769000901	28,493	0.65	Soil/Grass	24	OS (RCA)	1	RC			X
1-53	352,798	8.10	East Bay Regional Parks		Claremont Ave.	94705	048H769000901	352,798	8.10	Soil/Grass	24	OS (RCA)	1	RC			X
1-54	34,741	0.80	East Bay Regional Parks		Cox Way	94705	048H769503701	34,741	0.80	Soil/Grass	25	OS (RCA) /S-18	1	RC			
1-55	255,676	5.87	East Bay Regional Parks		Panoramic Way	94705	048H769600100 048H769600200 048H769600300 048H769600400 048H769601401 048H769603301 048H769605102	3,385 2,720 3,516 2,011 29,536 119,247 95,262	0.08 0.06 0.08 0.05 0.68 2.74 2.19	Soil/Grass	13 17 14 23 16 19 23	OS (RCA)/S-4/S-18 OS (RCA)/S-4/S-18 OS (RCA)/S-4/S-18 OS (RCA)/S-4/S-18 OS (RCA)/S-4/S-18 OS (RCA)/S-4/S-18 OS (RCA) /S-18	1	RC			
1-56	5,958	0.14	East Bay Regional Parks		Panoramic Way	94705	048H769605401	5,958	0.14	Soil/Grass	31	OS (RCA) /S-18	1	RC			
1-57	6,685	0.15	East Bay Regional Parks		Panoramic Way	94705	048H769706801	6,685	0.15	Soil/Grass	22	OS (RCA) /S-18	1	RC			
1-58	2,851	0.07	City of Oakland		3315 Dwight Way	94704	048H770100200	2,851	0.07	Soil/Grass	25	R-20/S-4/S-18	1				
1-59	26,779	0.61	Univ. of California Regents		Spring Ave.	94704	048H775303901	26,779	0.61	Soil/Grass	18	R-10 /S-18	1				
1-60	55,119	1.27	Univ. of California Regents		Spring Ave.	94704	048H775303901	46,331 8,117	1.06 0.19	Soil/Grass	18	R-10 /S-18	1	RC			
1-61	30,006	0.69	Univ. of California Regents		Spring Ave.	94704	048H775303901	30,006	0.69	Soil/Grass	18	R-10 /S-18	1				
1-62	27,342	0.63	Univ. of California Regents		Spring Ave.	94704	048H775303901	27,342	0.63	Soil/Grass	18	R-10 /S-18	1	RC			
1-63	1,314,252	30.17	Univ. of California Regents		Bailey Ave. Grizzly Peak Blvd.	94704	048H775502901 048H780000201	87,871 1,188,962	2.02 27.29	Soil/Grass	17 21	R-10 /S-18 R-10/S-10/S-18	1	RC			X
1-64	315,745	7.25	Univ. of California Regents		Bailey Ave. Grizzly Peak Blvd.	94704	048H775502901 048H780000201	92,797 223,283	2.13 5.13	Soil/Grass	17 21	R-10 /S-18 R-20	1	RC			X
1-65	117,508	2.70	Univ. of California Regents		Bailey Ave.	94704	048H775502901	31,234 76,469	0.72 1.76	Soil/Grass	17	R-20	1				
1-66	16,204	0.37	Univ. of California Regents		Bailey Ave.	94704	048H775502901	16,204	0.37	Soil/Grass	17	R-10 /S-18	1	RC			
1-67	51,324	1.18	Univ. of California Regents		Bailey Ave.	94704	048H775502901 048H775601701	20,147 31,152	0.46 0.72	Soil/Grass	17 19	R-10 /S-18	1	RC			
1-68	39,292	0.90	Univ. of California Regents		Bailey Ave.	94704	048H775601701	39,292	0.90	Soil/Grass	19	R-10 /S-18	1				
1-69	196,712	4.52	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	196,712	4.52	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-70	11,718	0.27	EBMUD		Panoramic Way	94704	048H790000203	11,718	0.27	Soil/Grass	27	R-10 /S-18	1	RC			
1-71	316,875	7.27	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	316,875	7.27	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-72	57,056	1.31	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	57,056	1.31	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-73	168,349	3.86	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204 048H790000206	40,643 127,113	0.93 2.92	Soil/Grass	26 31	R-10/S-10/S-18	1	RC			

Site	Open Area (Total) (sq ft)	(acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	(acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
1-74	188,776	4.33	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	188,776	4.33	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-75	98,067	2.25	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	98,067	2.25	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-76	59,583	1.37	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	59,583	1.37	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-77	195,266	4.48	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000206	195,266	4.48	Soil/Grass	31	R-10/S-10/S-18	1	RC			
1-78	68,874	1.58	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000206	68,874	1.58	Soil/Grass	31	R-10/S-10/S-18	1	RC			
1-79	42,719	0.98	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000401	42,719	0.98	Soil/Grass	12	R-30/S-11/S-14/S-18	1			X	
1-80	27,726	0.64	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000401	27,726	0.64	Soil/Grass	12	R-30/S-11/S-14/S-18	1	RC			
1-81	7,017	0.16	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000401	7,017	0.16	Soil/Grass	12	R-30/S-11/S-14/S-18	1				
1-82	134,303	3.08	EBMUD		Grizzly Peak Blvd.	94704	048H790000402	134,303	3.08	Soil/Grass	12	R-10/S-10/S-11/S-18	1	RC			
1-83	149,661	3.44	East Bay Regional Parks		Grizzly Peak Blvd.	94704	048H780000102	149,661	3.44	Soil/Grass	11	R-10/S-10	1	RC			X
1-84	66,930	1.54	East Bay Regional Parks		Grizzly Peak Blvd.	94704	048H780000102	66,930	1.54	Soil/Grass	11	R-10/S-10	1	RC			X
1-85	91,037	2.09	East Bay Regional Parks		Grizzly Peak Blvd.	94704	048H780000103	91,037	2.09	Soil/Grass	13	OS (RCA)/S-10/S-18	1	RC			
1-86	4,698	0.11	EBMUD		Grizzly Peak Blvd.	94704	048H780000105	4,698	0.11	Soil/Grass	23	OS (RCA)/S-10/S-18	1	RC			
1-87	6,541	0.15	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	6,541	0.15	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-88	11,988	0.28	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	11,988	0.28	Soil/Grass	21	R-10/S-10/S-18	1	RC			X
1-89	73,305	1.68	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	73,305	1.68	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-90	21,058	0.48	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	21,058	0.48	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-91	37,317	0.86	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	37,317	0.86	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-92	19,601	0.45	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	19,601	0.45	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-93	106,941	2.46	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H780000201	106,941	2.46	Soil/Grass	21	R-10/S-10/S-18	1	RC			
1-94	265,229	6.09	East Bay Regional Parks		Grizzly Peak Blvd.	94704	048H790000100	265,229	6.09	Soil/Grass	12	OS (RCA) /S-18	1	RC			
1-95	134,378	3.08	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	134,378	3.08	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-96	42,672	0.98	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	42,672	0.98	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-97	46,777	1.07	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	46,777	1.07	Soil/Grass	26	R-10/S-10/S-18	1				
1-98	29,581	0.68	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000206	29,581	0.68	Soil/Grass	31	R-10/S-10/S-18	1	RC			
1-99	6,423	0.15	EBMUD		Elverton Dr.	94603	048G744902300	6,423	0.15	Soil/Grass	28	R-30/S-11	1				
1-100	2,505	0.06	EBMUD		Elverton Dr.	94603	048G744902300	2,505	0.06	Soil/Grass	28	R-30/S-11	1				
1-101	8,592	0.20	Parks and Recreation	Open space	Skyline Blvd.	94603	048G745002301	8,592	0.20	Soil/Grass	28	R-30/S-11	1				
1-102	68,796	1.58	East Bay Regional Parks		6998 Skyline Blvd. 7090 Skyline Blvd.	94611	048G745400100 048G745400200	40,319 28,336	0.93 0.65	Soil/Grass	14 13	OS (RCA)/S-10/S-11 R-30/S-10/S-11	1				
1-103	9,370	0.22	East Bay Regional Parks		Grizzly Peak Blvd.	94603	048G746500200	9,393	0.22	Soil/Grass	11	OS (RCA)/S-10/S-11	1	RC			X
1-104	110,934	2.55	East Bay Regional Parks		Skyline Blvd.	94603	048G746500300 048G746500300	6,470 104,463	0.15 2.40	Soil/Grass	20	R-30/S-10/S-11	1	RC			
1-105	102,438	2.35	East Bay Regional Parks		Skyline Blvd.	94603	048G746500400	102,438	2.35	Soil/Grass	28	R-30/S-11	1	RC			X
1-106	33,248	0.76	State of California		Broadway	94603	048H752200100	33,248	0.76	Soil/Grass	20	R-10/S-11/S-14/S-18	1				X
1-107	10,097	0.23	State of California		Broadway	94603	048H752200100	10,097	0.23	Soil/Grass	20	R-10/S-11/S-14/S-18	1				X
1-108	147,986	3.40	EBMUD		Fairlane Dr.	94603	048H756601000	147,986	3.40	Soil/Grass	23	R-30/S-14/S-18	1			X	X
1-109	14,136	0.32	Parks and Recreation	Grizzly Peak Open Space	Grizzly Peak Blvd.	94603	048H751000100	14,136	0.32	Soil/Grass	31	R-30/S-10/S-11/S-14/	1				X
1-110	36,421	0.84	Parks and Recreation	Grizzly Peak Open Space	Grizzly Peak Blvd.	94603	048H751000303	36,421	0.84	Soil/Grass	31	OS (RCA)/S-10/S-11/S-14	1	RC			X
1-111	7,900	0.18	Parks and Recreation	Grizzly Peak Open Space	Tunnel Rd.	94603	048H751000301	3,295	0.08	Soil/Grass	22	OS (RCA)/S-10/S-11/S-14	1	RC			X
1-111	7,900	0.18	Parks and Recreation	Grizzly Peak Open Space	Old Tunnel Rd.	94603	048H751000304	4,471	0.10	Soil/Grass	26	OS (RCA)/S-10/S-11/S-14	1	RC			X
1-112	50,723	1.16	Parks and Recreation	Grizzly Peak Open Space	Tunnel Rd.	94603	048H751200904	50,723	1.16	Soil/Grass	23	OS (RCA)/S-10/S-11/S-14	1	RC			
1-113	83,202	1.91	East Bay Regional Parks		5172 Grizzly Peak Blvd.	94603	048H751300200	83,202	1.91	Soil/Grass	26	OS (RCA)/S-10/S-11/S-18	1				
1-114	9,103	0.21	East Bay Regional Parks		Grizzly Peak Blvd.	94603	048H751300300	9,103	0.21	Soil/Grass	14	OS (RCA)/S-11/S-18	1				
1-115	150,759	3.46	State of California		Frontage Rd.	94618	048H752002000	130,402	2.99	Soil/Grass	25	R-40/S-11/S-14/S-18	1				X
1-115	150,759	3.46	State of California		Frontage Rd.	94618	048H752002102	20,342	0.47	Soil/Grass	26	R-30/S-14/S-18	1				X
1-116	9,899	0.23	State of California		Frontage Rd.	94618	048H752002102	9,899	0.23	Soil/Grass	26	R-30/S-14/S-18	1				X
1-117	37,362	0.86	Univ. of California Regents		Grizzly Peak Blvd.	94704	048H790000204	37,362	0.86	Soil/Grass	26	R-10/S-10/S-18	1	RC			
1-118	37,266	0.86	EBMUD		Grizzly Peak Blvd.	94704	048H790000304	37,266	0.86	Soil/Grass	35	R-10 /S-18	1	RC			
2-1	177,792	4.08	City of Oakland		1 5th Ave.	94606	000O043000102	177,792	4.08	Hard Surface	2	M-40	4	OS			
2-2	206,446	4.74	Parks and Recreation	Oakland Museum	1000 Oak St.	94607	000O045000100	206,446	4.74	Soil/Grass	3	OS (RCA)/S-4	1	OS	X	X	X
2-3	156,916	3.60	Peralta Comm. College BART BART BART Peralta Comm. College Peralta Comm. College Peralta Comm. College		900 Fallon St. 7th St. 7th St. 7th St. 7th St. 7th St. 7th St.	94607	000O045000200 000O045500101 000O045500103 000O045500107 000O045500805 000O045501200 000O045501300	41,272 1,597 2,636 450 29,564 32,440 47,816	0.95 0.04 0.06 0.01 0.68 0.74 1.10	Soil/Grass	5 0 4 0 2 2 3	OS (LP)/S-4 OS (RCA)/S-4 OS (RCA)/S-4 OS (RCA)/S-4 OS (LP)/S-4 OS (LP)/S-4 OS (LP)/S-4	1	OS	X		X
2-4	106,976	2.46	Peralta Comm. College	Channel Park	7th St.	94607	000O045500700 000O045501300	11,540 95,436	0.26 2.19	Soil/Grass	3	OS (LP)/S-4	1	OS	X	X	X
2-5	73,602	1.69	Peralta Comm. College		5th Ave.	94607	000O045501500	73,602	1.69	Soil/Grass	2	OS (LP)/S-4	1	OS	X	X	X
2-6	49,648	1.14	Peralta Comm. College		5th Ave.	94607	000O045501500	49,648	1.14	Soil/Grass	2	OS (RCA)/S-4	1	OS	X		X

Site	Open Area (Total) (sq ft)	(acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	(acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
2-7	183,194	4.21	City of Oakland		28 5th Ave.	94606	000O046000300	183,194	4.21	Hard Surface	3	M-40	4	OS			
2-8	37,601	0.86	Parks and Recreation	Maddison Square	163 9th St.	94607	001 017700100	37,601	0.86	Soil/Grass	0	OS (SU)/S-4	1	OS	X		X
2-9	44,151	1.01	Parks and Recreation	Harrison Square Park	640 Harrison St.	94607	001 018300100	44,151	1.01	Soil/Grass	4	C-40	1	OS	X		X
2-10	54,567	1.25	Parks and Recreation	Clinton Park	655 E. 14th St.	94606	020 012300100	54,567	1.25	Soil/Grass	1	OS (NP)	1	OS	X		X
2-11	26,729	0.61	City of Oakland		1551 Embarcadero	94606	000O048000300	26,729	0.61	Mixed Surface	2	M-40	4	OS			X
2-12	17,581	0.40	City of Oakland		1831 Embarcadero	94606	000O049500100	17,581	0.40	Soil/Grass	2	M-40	4	OS			X
2-13	78,826	1.81	City of Oakland		1965 Embarcadero	94606	000O050000100	78,826	1.81	Hard Surface	1	M-40	4	OS			
2-14	12,405	0.28	City of Oakland		E. 12th St.	94608	019 004100102	12,405	0.28	Soil/Grass	3	M-30	4				X
2-15	10,954	0.25	BART		1631 E. 12th St.	94606	019 004200102	10,954	0.25	Soil/Grass	3	M-30	4				X
2-16	14,573	0.33	Parks and Recreation	Port View Park	1319 E. 14th St. 1341 E. 12th St.	94606	019 003900204 019 003900403	11,870 2,703	0.27 0.06	Soil/Grass	4	OS (PMP)	1			X	X
2-17	4,000	0.09	Housing Authority		1643 13th Av.	94606	020 019300600	4,000	0.09	Hard Surface	1	R-40	1				X
2-18	6,572	0.15	City of Oakland		15th Ave.	94608	020 019500100	6,572	0.15	Soil/Grass	1	C-20	1				X
2-19	4,975	0.11	Housing Authority		1232 E. 29th St. 1228 E. 29th St.	94606	020 021401300 020 021401400	1,925 2,675	0.04 0.06	Hard Surface	1 2	R-40	1				X
2-20	341,571	7.84	Parks and Recreation	San Antonio Park	16th Ave.	94606	020 029500100	341,571	7.84	Soil/Grass	5	R-36	1	OS	X		X
2-21	39,101	0.90	Parks and Recreation	F. M. Smith Rec. Ctr.	267 Newton Ave. Park Blvd.	94606 94608	021 022900300 021 022900505	5,174 33,928	0.12 0.78	Soil/Grass	2	OS (NP)/S-12	1	OS			X
2-22	2,795	0.06	Parks and Recreation	Park Blvd. Park	Park Blvd.	94608	021 027900100	2,795	0.06	Soil/Grass	2	OS (PMP)	1	OS			X
2-23	23,565	0.54	Parks and Recreation	Park Blvd. Park	Park Blvd.	94608	021 027900200	23,565	0.54	Soil/Grass	4	OS (PMP)	1	OS			X
2-24	6,964	0.16	Parks and Recreation	Morgan Plaza	2601 Highland Ave.	94606	022 035000100	6,964	0.16	Soil/Grass	7	OS (AMP)	1		X	X	X
2-25	8,718	0.20	OUSD		1021 MacArthur Blvd. 1025 MacArthur Blvd.	94610	023 040100500 023 040100600	4,547 4,171	0.10 0.10	Soil/Grass	1	R-50	1		X		X
2-26	24,929	0.57	Parks and Recreation	Lake Park Mini Park	Lake Park Way	94610	011 083604202	24,929	0.57	Hard Surface	1	OS (NP)	1	OS	X	X	X
2-27	10,551	0.24	Parks and Recreation	Lakeshore Park	Lake Shore Ave.	94610	011 083902300	10,551	0.24	Soil/Grass	4	C-20/S-9	1				X
2-28	4,043	0.09	City of Oakland		Monte Vista Ave.	94611	012 092600200	4,043	0.09	Soil/Grass	13	OS (SU)	1	OS			X
					3rd St.		000O038000302	606	0.01								
3-1	41,787	0.96			3rd St.		000O039100100	2,198	0.05			OS (NP)	1				
					3rd St.		000O039100200	2,004	0.05								
					3rd St.		000O039100301	36,968	0.85								
3-2	4,614	0.11			3rd St.		000O038000303	4,614	0.11			S-2/S-4	4				
					290 Lewis St.		000O039200100	2,500	0.06								
					3rd St.		000O039200200	2,500	0.06								
					3rd St.		000O039200300	2,500	0.06								
3-3	43,627	1.00			3rd St.		000O039200400	2,500	0.06			OS (NP)	1				
			Parks and Recreation	South Prescott Park	1551 3rd St.	94607	000O039201400	2,500	0.06	Soil/Grass	0			OS		X	X
					1561 3rd St.		000O039201500	12,500	0.29								
					Henry St.		000O039201601	18,627	0.43								
					3rd St.		000O039001008	3,761	0.09								
					3rd St.		000O039201000	5,500	0.13								
					1501 3rd St.		000O039201100	298	0.01								
					Henry St.		000O039201203	11,746	0.27								
3-4	58,407	1.34			1536 3rd St.		000O039201300	5,000	0.11			OS (NP)	1				
					1493 3rd St.		000O039300100	5,500	0.13								
					1491 3rd St.		000O039300500	304	0.01								
					3rd St.		000O039300601	24,619	0.57								
3-5	59,446	1.36	State of California		Castro St.	94607	001 022101401	59,446	1.36	Soil/Grass	1	C-40	1				X
3-6	122,193	2.81	OUSD Parks and Recreation	Marston Campbell Park	1702 Market St. 1600 Market St.	94607	003 005101001 003 005303002	50,884 71,298	1.17 1.64	Soil/Grass	0 1	OS (NP)/S-20	1		X	X	X
3-7	3,118	0.07	City of Oakland		623 Market St.	94607	004 000500600	3,118	0.07	Soil/Grass	1	M-20	1		X		X
3-8	5,509	0.13	City of Oakland		Village Cir.	94607	004 000700400	5,509	0.13	Soil/Grass	0	R-60	2		X	X	X
3-9	5,144	0.12	City of Oakland		Village Cir.	94607	004 000700500	5,144	0.12	Soil/Grass	2	R-60	2		X		X
3-10	36,929	0.85	OUSD		960 10th St.	94607	004 000901405	36,929	0.85	Soil/Grass	0	R-70/S-20	2		X		X
3-11	38,915	0.89	Parks and Recreation	Lowell Park	1026 12th St. 1307 Chestnut St.	94607	004 001301602 004 003503101	1,492 37,423	0.03 0.86	Soil/Grass	0	OS (NP)/S-20	1	OS	X		X
3-12	9,994	0.23	Parks and Recreation	Wade Johnson Park	12th St.	94607	004 003703205	9,994	0.23	Soil/Grass	2	OS (NP)	1	OS	X		X
3-13	42,604	0.98	Parks and Recreation	Wade Johnson Park	Poplar St. 1205 Poplar St. 1316 12th St. 1224 Kirkham St. 1228 Kirkham St.	94607	004 005901400 004 005901500 004 005901600 004 005901700 004 005901802	28,464 4,563 4,240 4,261 1,076	0.65 0.10 0.10 0.10 0.02	Soil/Grass	1 0 0 2 3	OS (NP) OS (NP) OS (NP) OS (NP) M-30	1 1 1 1 4	OS	X		X
3-14	6,457	0.15	City of Oakland		8th St. Center St.	94607	004 006701500 004 006701700	4,120 2,326	0.09 0.05	Soil/Grass	0	R-36	1		X		X
3-15	14,758	0.34	BART		349 Cypress St.	94607	004 007300900	14,758	0.34	Soil/Grass	0	R-36	1				X
3-16	6,092	0.14	Parks and Recreation	Chester Park	319 Chester St.	94607	004 010303500	6,092	0.14	Hard Surface	1	OS (AMP)	1				X

Site	Open Area (Total) (sq ft)	Open Area (Total) (acres)	Agency/Department	Use	Address		ZIP	APN	Open Area (Parcel) (sq ft)	Open Area (Parcel) (acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
3-17	11,657	0.27	City of Oakland		727	Pine St.	94607	006 004502600	11,657	0.27	Soil/Grass	0	R-36	1		X		X
3-18	207,595	4.77	State of California		800	Cedar St.	94607	006 004700100	207,595	4.77	Hard Surface	0	M-20/S-16	1			X	X
3-19	290,123	6.66	State of California			Bay Bridge Approach	0	000O030500103	290,123	6.66	Soil/Grass	0	M-40	4			X	
3-20	268,900	6.17	City of Oakland			W. Grand Ave.	94612	000O030500310	268,900	6.17	Soil/Grass	0	M-40	4				
3-21	1,494	0.03	Redevelopment		1606 1608	Chestnut St. Chestnut St.	94607	005 038701400 005 038701500	85 1,410	0.00 0.03	Hard Surface	0	R-60/S-20	2		X		X
3-22	223,742	5.14	Parks and Recreation	Defremery Park	1269	18th St.	94607	005 038900100	223,742	5.14	Soil/Grass	0	OS (CP)	1	OS	X	X	X
3-23	14,915	0.34	City of Oakland		1181	19th St.	94607	005 040403202	14,915	0.34	Soil/Grass	0	R-50/S-16	1		X		X
3-24	3,639	0.08	Housing Authority		1035	Warring St.	94607	005 041300202	3,639	0.08	Soil/Grass	0	R-50	1				X
3-25	5,998	0.14	Housing Authority		2127	Filbert St.	94607	005 041300800	5,998	0.14	Soil/Grass	0	R-50	1		X		X
3-26	4,150	0.10	Housing Authority			Filbert St.	94607	005 043401200	4,150	0.10	Soil/Grass	0	R-50	1		X		X
3-27	7,604	0.17	Parks and Recreation	McClymonds Mini Park		26th St. Linden St.	94607	005 043400100 005 043403500	3,278 4,326	0.08 0.10	Mixed Surface	0	OS (AMP)	1		X	X	X
3-28	2,312	0.05	City of Oakland		1728	14th St.	94607	007 055101100	2,312	0.05	Soil/Grass	1	R-36/S-16	1				X
3-29	19,040	0.44	State of California			26th St.	94607	007 058100100	19,040	0.44	Soil/Grass	0	M-30	4				
3-30	73,155	1.68	State of California		2221 2211	Wood St. Wood St.	94607	007 058100800 007 058100900	65,689 7,466	1.51 0.17	Soil/Grass	0	M-30	4				X
3-31	43,536	1.00	State of California		2601	Wood St.	94607	007 058300100	43,536	1.00	Soil/Grass	0	M-30	4			X	
3-32	10,381	0.24	Parks and Recreation	Poplar Rec Center		Peralta St.	94609	007 059200100	10,381	0.24	Soil/Grass	0	R-36	1				X
3-33	2,112	0.05	Parks and Recreation	Poplar Rec. Ctr.		Peralta St.	94609	007 059200100	2,112	0.05	Soil/Grass	0	R-36	1				X
3-34	9,993	0.23	State of California		3401	Wood St.	94608	007 060400100	9,993	0.23	Soil/Grass	0	M-30	4				
3-35	55,811	1.28	State of California		3430	Wood St.	94608	007 060500121	55,811	1.28	Soil/Grass	0	OS (LP)/S-4	1			X	
3-36	119,368	2.74	State of California		4300	Eastshore Freeway Eastshore Freeway	94608 94618	007 061800105 007 061800616	29,204 90,164	0.67 2.07	Soil/Grass	1 0	M-40	4				X
3-37	107,543	2.47	EBMUD City of Oakland		 40	Alice St. Jack London Square	94607	000O042000200 000O042000400	1,447 105,949	0.03 2.43	Soil/Grass	2 1	R-80	2	OS		X	X
3-38	4,991	0.11	Parks and Recreation	Lafayette Square Park		10th St.	94607	002 002500100	4,991	0.11	Soil/Grass	0	OS (SU)/S-7	1	OS			X
3-39	16,697	0.38	Parks and Recreation	Lafayette Square Park		10th St.	94607	002 002500100	16,697	0.38	Soil/Grass	0	OS (SU)/S-7	1	OS			X
3-41	49,048	1.13	Redevelopment	City Center Garage		11th St.	94612	002 009703800 002 009703900 002 009704000	28,970 11,252 8,826	0.67 0.26 0.20	Mixed Surface Mixed Surface Soil/Grass	1 2 2	C-55/S-17	2				X
3-42	1,273	0.03	City of Oakland			17th St.	94612	003 006300801	1,273	0.03	Hard Surface	0	C-51/S-17	1				X
3-43	27,327	0.63	Parks and Recreation	City Hall Plaza		City Hall Plaza	94612	003 006700200	27,327	0.63	Soil/Grass	1	OS (SU)/S-8	1	OS			X
3-44	171,582	3.94	Parks and Recreation	Snow Park	274	19th St.	94612	008 063500100	171,582	3.94	Soil/Grass	2	OS (NP)/S-4	1	OS		X	X
3-45	57,149	1.31	Parks and Recreation	Lakeside Park		Bellevue Ave.	94609	010 076400101	57,149	1.31	Soil/Grass	3	OS (RSP)/S-4	1	OS	X		X
3-46	206,200	4.73				Bellevue Ave.	94609	010 076400101	206,200	4.73		3						
3-47	18,540	0.43				Bellevue Ave.	94609	010 076400101	18,540	0.43		3						
3-48	8,197	0.19				Bellevue Ave.	94609	010 076400101	8,197	0.19		3						
3-49	7,472	0.17				Bellevue Ave.	94609	010 076400101	7,472	0.17		3						
3-50	17,511	0.40				Bellevue Ave.	94609	010 076400101	17,511	0.40		3						
3-51	13,604	0.31				Bellevue Ave.	94609	010 076400101	13,604	0.31		3						
3-52	17,392	0.40			291	Grand Ave.	94610	010 076400200	17,392	0.40		2						
3-53	52,561	1.21			291	Grand Ave.	94610	010 076400200	52,561	1.21		2						
3-54	39,052	0.90			291	Grand Ave.	94610	010 076400200	39,052	0.90		2						
3-55	28,948	0.66	Parks and Recreation	Athol Park		Foothill Blvd.	94608	020 018200100	28,948	0.66	Soil/Grass	1	C-20/S-4	1			X	X
3-56	66,230	1.52	City of Oakland			Lake Shore Ave.	94608	021 022501401	66,230	1.52	Soil/Grass	2	OS (SU)/S-4	1	OS		X	X
3-57 3-58	222,446 143,967	5.11 3.31	Parks and Recreation	Grove Shafter Park		M. L. King Jr. Way	94607	Right of Way	222,446 143,967	5.11 3.31	Soil/Grass	1	OS (NP) C-40	1	 OS	X	X	X
3-59	3,051	0.07	Parks and Recreation	Bishop Begin Plaza	2279	San Pablo Ave.	94612	003 002300100	3,051	0.07	Hard Surface	0	C-51/S-4	1				X
3-60	3,372	0.08	Parks and Recreation	St. Andrews Plaza		San Pablo Ave.	94608	005 046900100	3,372	0.08	Hard Surface	2	C-30	3		X		X
3-61	4,335	0.10	Parks and Recreation	Cathedral Plaza Park	2070	San Pablo Ave.	94612	008 064600103	4,335	0.10	Hard Surface	1	C-51/S-17	1				X
3-62	7,781	0.18	City of Oakland BART			24th St. Northgate Ave.	94612	008 066404600 008 066404705	1,604 6,178	0.04 0.14	Soil/Grass	0	C-45	1				X
3-63	525	0.01	City of Oakland		2500	Broadway	94612	008 067300100	525	0.01	Hard Surface	0	C-40 /S-19	1		X		X
3-64	9,798	0.22	Parks and Recreation	25th St. Mini Park	2417	M. L. King Jr. Way	94612	008 067700100	9,798	0.22	Soil/Grass	0	OS (AMP)	1				X
3-65	13,681	0.31	Parks and Recreation	Durant Park	675	29th St.	94609	009 069501300	13,681	0.31	Soil/Grass	1	OS (AMP)	1		X		X
3-66	5,348	0.12	Parks and Recreation	Lakeside Park	200	Grand Ave.	94610	010 076800400	5,348	0.12	Soil/Grass	0	OS (SU)/S-4	1		X		X
3-67	9,087	0.21	Parks and Recreation	Lakeside Park	200	Grand Ave.	94610	010 076800400	9,087	0.21	Soil/Grass	0	OS (SU)/S-4	1		X		X
3-68	397	0.01	Parks and Recreation	Lakeside Park	210	Grand Ave.	94610	010 076800601	397	0.01	Soil/Grass	0	OS (SU)/S-4	1		X		X
3-69	11,832	0.27	Parks and Recreation	Oak Park		Kempton Ave.	94611	010 080602402	11,832	0.27	Soil/Grass	2	OS (AMP)	1			X	X
3-70	229,867	5.28	Parks and Recreation	Mosswood Park House		Wellington St.	94611	012 094100100	229,867	5.28	Soil/Grass	1	C-40 /S-19	1	OS			X
3-71	147,740	3.39	City of Oakland			Grand Ave.	94610	011 083604104	147,740	3.39	Soil/Grass	1	OS (NP)	1	OS	X		X
3-72	3,950	0.09	City of Oakland			Merritt Ave.	94609	023 041501500	3,950	0.09	Soil/Grass	29	R-80	2				X

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4-1	79,427	1.82	Parks and Recreation	Brookdale Park	3935 Nevil St.	94601	032 206903213	25,978	0.60	Soil/Grass	5	OS (CP)	1	OS			X
					3935 Nevil St.	94601	032 206903213	8,186	0.19		5						
					High St.	94608	032 206904101	45,231	1.04		6						
4-2	4,092	0.09	City of Oakland	Courtland Creek	Courtland Ave.	94608	036 244903401	4,092	0.09	Soil/Grass	12	R-30	1				X
4-3	1,925	0.04	City of Oakland		Lincoln Ave.	94602	028 090603500	1,925	0.04	Soil/Grass	2	R-50	1		X		X
4-4	2,446	0.06	City of Oakland		Lincoln Ave.	94602	028 090603600	2,446	0.06	Soil/Grass	10	C-31	1		X		X
4-5	50,603	1.16	City of Oakland		3475 Victor Ave.	94602	029 107300200	3,048	0.07	Soil/Grass	11	R-30	1				X
					35th Ave.	94608	029 107300300	3,410	0.08		18						
					4169 35th Ave.	94619	029 107300400	2,982	0.07		16						
					4163 35th Ave.	94619	029 107300500	2,794	0.06		13						
					4157 35th Ave.	94619	029 107300600	2,700	0.06		10						
					35th Ave.	94608	029 107300702	3,157	0.07		13						
					4151 35th Ave.	94619	029 107300703	5,090	0.12		11						
					4135 35th Ave.	94619	029 107300704	5,328	0.12		11						
					4123 34th Ave.	94619	029 107300801	7,547	0.17		10						
					Midvale Ave.	94608	029 107301402	1,670	0.04		18						
					4109 35th Ave.	94619	029 107301802	2,635	0.06		10						
					4101 35th Ave.	94619	029 107301902	3,135	0.07		9						
					4045 35th Ave.	94619	029 107302002	3,129	0.07		8						
					4039 35th Ave.	94619	029 107302102	3,164	0.07		7						
4-6	8,881	0.20	Parks and Recreation	Jordan Slide Area	2936 London Rd.	94602	029 107502702	8,881	0.20	Soil/Grass	21	R-30	1				
4-7	5,892	0.14	City of Oakland	Dimond Branch Library	3571 Fruitvale Ave.	94602	029A130201300	5,892	0.14	Hard Surface	1	C-31	1		X		X
4-8	15,342	0.35	Parks and Recreation	Allendale Rec Center	3635 Suter St.	94619	032 203007100	10,996	0.25	Soil/Grass	1	OS (NP)	1		X		X
			OUSD		3711 Suter St.		032 203007200	4,328	0.10								
4-9	2,074	0.05	State of California		3355 39th Ave.	94619	032 203106000	2,074	0.05	Soil/Grass	2	R-50	1		X		X
4-10	303,226	6.96	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	303,226	6.96	Soil/Grass	14	OS (RSP)	1	OS			X
4-11	10,048	0.23	Parks and Recreation	Joaquin Miller Park	Woodside Glen Ct.	94608	029 125600100	10,048	0.23	Soil/Grass	21	OS (RCA)	1				X
4-12	200,508	4.60	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	31,176	0.72	Soil/Grass	14	OS (RSP)	1	OS			X
4-12	200,508	4.60	Parks and Recreation	Joaquin Miller Park	Woodside Glen Ct.	94608	029 125600100	169,207	3.88	Soil/Grass	21	OS (RCA)	1				X
4-13	27,234	0.63	State of California		Park Blvd.	94602	029A133000901	27,234	0.63	Soil/Grass	11	OS (SU)	1	OS			X
4-14	10,080	0.23	State of California		Park Blvd.	94602	029A133000901	10,080	0.23	Soil/Grass	11	OS (SU)	1	OS			X
4-15	25,065	0.58	City of Oakland		Park Blvd.	94608	029A133001000	25,065	0.58	Soil/Grass	18	OS (RCA)	1	OS			X
4-16	13,904	0.32	Parks and Recreation	Dimond Park	Leimert Blvd.	94608	029A133001301	13,904	0.32	Soil/Grass	14	R-50	1	OS			X
4-17	2,518	0.06	State of California		Monterey Blvd.	94611	029A133002104	2,518	0.06	Soil/Grass	10	R-30	1			X	X
4-18	4,883	0.11	City of Oakland		Monterey Blvd.	94608	029A133003400	4,883	0.11	Soil/Grass	4	R-30	1		X		X
4-19	12,613	0.29	EBMUD		Estates Dr.	94603	048C718401600	12,613	0.29	Soil/Grass	15	R-30	1				X
4-20	4,703	0.11	EBMUD		Estates Dr.	94603	048C718401600	4,703	0.11	Soil/Grass	15	R-30	1				X
4-21	2,796	0.06	EBMUD		Bullard Dr.	94603	048C718800102	2,796	0.06	Soil/Grass	3	R-30	1				X
4-22	95,421	2.19	State of California		Park Blvd.	94611	048C720000600	95,421	2.19	Soil/Grass	12	R-50	1				X
4-23	31,955	0.73	State of California		Park Blvd.	94611	048C720000600	31,955	0.73	Soil/Grass	12	R-30	1				X
4-24	266,578	6.12	Parks and Recreation	Joaquin Miller Park	Skyline Blvd.	94603	048D720800501	266,578	6.12	Soil/Grass	26	OS (RCA)	1	RC			X
4-25	20,406	0.47	East Bay Regional Parks		Scout Rd.	94611	048D724401203	20,406	0.47	Soil/Grass	13	R-20/S-10	1				X
4-26	5,919	0.14	Parks and Recreation	Shepherd Canyon Park	Park Blvd.	94603	048D724402800	5,919	0.14	Soil/Grass	18	OS (NP)/S-10	1	RC			X
4-27	22,977	0.53	Parks and Recreation	Shepherd Canyon Park	Park Blvd.	94603	048D724402800	22,977	0.53	Soil/Grass	18	OS (NP)/S-10	1	OS		X	X
4-28	31,627	0.73	Parks and Recreation	Shepherd Canyon Park	Shepherd Canyon Rd.	94603	048D724901200	31,627	0.73	Soil/Grass	25	OS (NP)/S-10	1	RC			X
4-29	118,636	2.72	Parks and Recreation	Shepherd Canyon Park	Shepherd Canyon Rd.	94603	048D724901200	55,918	1.28	Soil/Grass	25	OS (NP)/S-10	1	OS			X
4-29	118,636	2.72	Parks and Recreation	Shepherd Canyon Park	Scarborough Dr.	94611	048D725000802	62,525	1.44	Soil/Grass	18	OS (NP)/S-10	1	OS			X
4-30	34,682	0.80	Parks and Recreation	Beaconsfield Common	Beaconsfield Pl.	94603	048D725304300	1,983	0.05	Soil/Grass	28	OS (RCA)	1	RC			X
							048D725304400	4,203	0.10		29						
							048D725304500	5,596	0.13		32						
							048D725304600	4,362	0.10		32						
							048D725304700	2,708	0.06		29						
							048D725304800	5,863	0.13		32						
							048D725304900	4,108	0.09		27						
							048D728002300	2,893	0.07		31						
							048D728002400	2,136	0.05		27						
4-31	2,004	0.05	Parks and Recreation	Beaconsfield Common	2678 Beaconsfield Pl.	94611	048D728002900	2,004	0.05	Soil/Grass	27	OS (RCA)	1	RC			X
4-32	8,013	0.18	Parks and Recreation	Shepherd Canyon Park	Escger Dr.	94603	048D728303100	8,013	0.18	Soil/Grass	26	OS (RCA)/S-10	1	RC			
4-33	5,849	0.13	City of Oakland		Snake Rd.	94603	048E734903100	2,417	0.06	Soil/Grass	11	R-20/S-10	1				X
			East Bay Regional Parks				048F735501900	2,080	0.05		11	OS (LP)/S-10					
4-34	8,642	0.20	Parks and Recreation	Shepherd Canyon Park	5921 Shepherd Canyon Rd.	94611	048E735000502	8,642	0.20	Soil/Grass	11	R-20/S-10	1				X
4-35	16,504	0.38	Parks and Recreation	Shepherd Canyon Park	Cortereal Ave.	94603	048F736503500	2,488	0.06	Soil/Grass	4	OS (LP)/S-10	1				X
			Parks and Recreation		Medau Pl.		048F736503600	9,912	0.23		8	C-27					
			East Bay Regional Parks		La Salle Ave.		048F736602102	2,185	0.05		10	R-50					
4-36	4,067	0.09	East Bay Regional Parks		La Salle Ave.	94603	048F736602102	4,067	0.09	Soil/Grass	10	R-50	1				X

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4-37	4,913	0.11	Parks and Recreation	Open Space	Skyline Blvd.	94603	048E731802600	4,913	0.11	Soil/Grass	7	R-30/S-10/S-11	1				X
4-38	10,534	0.24	Parks and Recreation	Open space	Skyline Blvd.	94611	048F737600601	10,534	0.24	Soil/Grass	30	R-30/S-10/S-11	1				X
4-39	33,509	0.77	Parks and Recreation	Avenue Terrace Playgrnd	Jordan Rd.	94608	029 106701300	33,509	0.77	Soil/Grass	3	OS (NP)	1				X
4-40	117,007	2.69	Parks and Recreation	Joaquin Miller Park	2795 Joaquin Miller Rd. Joaquin Miller Rd.	94608	029 116101300 029 116201200	11,383 105,459	0.26 2.42	Soil/Grass	9 14	OS (RCA)	1				X
4-41	41,412	0.95	State of California		Monterey Blvd.	94608	029 117500103	41,412	0.95	Soil/Grass	12	R-30	1				
4-42	38,401	0.88	Parks and Recreation	Joaquin Miller Park	10902 Skyline Blvd.	94619	029 120000700	38,401	0.88	Soil/Grass	12	OS (RSP)	1	RC			X
4-43	54,026	1.24	Parks and Recreation OUSD	Redwood Heights Rec. Ctr.	3731 Redwood Rd. 38th Ave.	94619 94608	030 186903404 030 186906104	41,720 11,288	0.96 0.26	Soil/Grass	4 3	OS (NP) R-30	1	OS	X		X
4-44	31,496	0.72	Parks and Recreation	McCrea Park	Aliso Ave.	94608	037 260508800	31,496	0.72	Soil/Grass	5	OS (SU)	1	RC			X
4-45	20,595	0.47	EBMUD		Redwood Rd.	94619	037 268700300	20,595	0.47	Soil/Grass	13	R-30	1		X		X
4-46	23,957	0.55	EBMUD		Redwood Rd.	94608	037A313400500	23,957	0.55	Soil/Grass	14	R-30	1		X		X
4-47	50,637	1.16	City of Oakland		Redwood Rd.	94608	037A313600506	50,637	1.16	Soil/Grass	14	R-30	1		X		X
4-48	33,902	0.78	Parks and Recreation	Skyline Islands	Skyline Blvd.	94608	037A314902600	33,902	0.78	Soil/Grass	8	R-30	1				X
4-49	5,880	0.13	Parks and Recreation	Skyline Islands	Skyline Blvd.	94608	037A314902700	5,880	0.13	Soil/Grass	8	R-30	1				X
4-50	27,469	0.63	Parks and Recreation	Skyline Islands	Skyline Blvd.	94608	037A314902900	27,469	0.63	Soil/Grass	8	R-30	1				X
4-51	22,927	0.53	Parks and Recreation	Skyline Islands	Skyline Blvd.	94608	037A315000600	22,927	0.53	Soil/Grass	9	R-30	1				X
4-52	8,294	0.19	East Bay Regional Parks		Skyline Blvd.	94619	037A315006101	8,294	0.19	Soil/Grass	3	R-30	1	OS			X
4-53	5,832	0.13	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 116201200	5,832	0.13	Soil/Grass	14	OS (RCA)	1				X
4-54	46,385	1.06	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	46,385	1.06	Soil/Grass	14	OS (RSP)	1	OS			X
4-55	50,453	1.16	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	50,453	1.16	Soil/Grass	14	OS (RSP)	1	OS			X
4-56	114,509	2.63	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	114,509	2.63	Soil/Grass	14	OS (RSP)	1	OS			X
4-57	17,023	0.39	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	17,023	0.39	Soil/Grass	14	OS (RSP)	1	OS			X
4-58	118,880	2.73	Parks and Recreation	Joaquin Miller Park	Joaquin Miller Rd.	94608	029 120000603	118,880	2.73	Soil/Grass	14	OS (RSP)	1	OS			X
4-59	68,497	1.57	Parks and Recreation	Joaquin Miller Park	10902 Skyline Blvd.	94619	029 120000700	68,497	1.57	Soil/Grass	12	OS (RSP)	1	RC			X
4-60	12,966	0.30	Parks and Recreation	Joaquin Miller Park	10902 Skyline Blvd.	94619	029 120000700	12,966	0.30	Soil/Grass	12	OS (RSP)	1	OS			X
4-61	80,793	1.85	Parks and Recreation	Joaquin Miller Park	Skyline Blvd.	94603	048D720800501	80,793	1.85	Soil/Grass	26	OS (RCA)	1	RC			X
4-62	48,079	1.10	Parks and Recreation	Joaquin Miller Park	Skyline Blvd.	94603	048D720800501	48,079	1.10	Soil/Grass	26	OS (RCA)	1	RC			X
4-63	41,494	0.95	Parks and Recreation	Joaquin Miller Park	Skyline Blvd.	94603	048D720800501	41,494	0.95	Soil/Grass	26	OS (RCA)	1	RC			X
4-64	2,058	0.05	Parks and Recreation	Open Space	Skyline Blvd.	94603	048D729601200	2,058	0.05	Soil/Grass	7	R-30/S-10	1				X
4-65 4-65	8,645	0.20	Parks and Recreation	Open Space	Shepherd Canyon Rd.	94603 94611	048D730700500 048D730707401	3,018 5,627	0.07 0.13	Soil/Grass	33 28	R-20/S-10	1				X
4-66	6,007	0.14	Parks and Recreation	Open Space	Shepherd Canyon Rd.	94611	048D730706903	6,007	0.14	Soil/Grass	24	R-20/S-10	1				X
4-67	6,956	0.16	East Bay Regional Parks		Skyline Blvd.	94611	048D731400102	6,956	0.16	Soil/Grass	9	R-30/S-10	1				
4-68	12,868	0.30	Parks and Recreation	Open Space	Skyline Blvd.	94603	048E732005401	12,868	0.30	Soil/Grass	26	R-30/S-10/S-11	1				
4-69	6,225	0.14	Parks and Recreation	Open Space	Skyline Blvd. Skyline Blvd.	94603 94603	048E732005701 048E732005800	3,984 1,247	0.09 0.03	Soil/Grass Soil/Grass	30 31	R-30/S-10/S-11 R-30/S-10/S-11	1 1				
4-70	3,410	0.08	City of Oakland		Skyline Blvd.	94611	048E732100101	3,410	0.08	Soil/Grass	26	R-20/S-10/S-11	1				
5-3	180,681	4.15	City of Oakland		2090 Diesel St.	94606	000O050500100	180,681	4.15	Soil/Grass	1	M-40	4	OS			X
5-4	25,712	0.59	City of Oakland		1901 Livingston St.	94606	019 005401201	25,712	0.59	Hard Surface	1	M-40	4	EP			
5-5	19,215	0.44	City of Oakland		1899 Dennison St.	94606	019 006000114	19,215	0.44	Hard Surface	1	M-40	4	OS			
5-6	3,330	0.08	Parks and Recreation	Mini Park	2863 Earhart Rd.	94601	019 008402900	3,330	0.08	Soil/Grass	21	M-20/S-13	1		X		X
5-7	5,403	0.12	City of Oakland		1008 23rd Ave.	94606	019 009900400	5,403	0.12	Soil/Grass	1	M-30	4				X
5-8	1,819	0.04	City of Oakland		1143 23rd Ave.	94606	019 010100100	1,819	0.04	Soil/Grass	1	M-30	4				X
5-9	28,718	0.66	City of Oakland		2257 E. 14th St.	94606	019 010100500	28,718	0.66	Soil/Grass	1	M-30	4				X
5-10	4,582	0.11	City of Oakland	Miller Avene Library	1449 Miller Ave.	94601	020 015300600	4,582	0.11	Soil/Grass	2	R-36	1		X		X
5-11	67,837	1.56	Parks and Recreation	Sanborn Rec. Ctr.	Fruitvale Ave.	94608	025 072202600	67,837	1.56	Soil/Grass	1	OS (NP)	1	OS	X		X
5-14	1,982	0.05	City of Oakland		Park Blvd.	94610	023 047902000	1,982	0.05	Soil/Grass	3	R-70	2		X		X
5-15	4,626	0.11	EBMUD		Wake Ave.	94608	024 054501100	4,626	0.11	Soil/Grass	13	R-50	1				X
5-16	30,834	0.71	EBMUD	Central Reservoir Park	2500 E. 29th St.	94602	026 080100102	30,834	0.71	Soil/Grass	8	OS (NP)	1	OS	X		X
5-17	82,751	1.90	EBMUD	Central Reservoir Park	2500 E. 9th St. 2500 Earhart Rd.	94602	026 080100102 026 080100102	47,760 31,855	1.10 0.73	Soil/Grass	8	OS (NP)	1	OS	X		X
5-18	37,429	0.86	Parks and Recreation	Peralta Hacienda Park	2525 34th Ave. 2511 34th Ave. 2501 34th Ave. 3300 Paxton Ave. 2528 Coolidge Ave. 2532 Coolidge Ave. 2540 Coolidge Ave.	94601	027 087500800 027 087500900 027 087501000 027 087501100 027 087501200 027 087501300 027 087501400	3,238 7,756 9,200 5,175 4,025 4,019 3,655	0.07 0.18 0.21 0.12 0.09 0.09 0.08	Soil/Grass	2 2 2 1 1 2 2	OS (SU)	1	OS	X	X	X
5-19	3,190	0.07			3435 Davis St.	94601	027 087603101	3,190	0.07	Soil/Grass	5	OS (SU)	1	OS	X		X
5-20	2,127	0.05			3424 Paxton Ave.	94601	027 087603803	2,127	0.05	Soil/Grass	5	OS (SU)	1	OS	X		X
5-21	1,413	0.03			3424 Paxton Ave.	94601	027 087603803	1,413	0.03	Soil/Grass	5	OS (SU)	1	OS	X		X

Site	Open Area (Total) (sq ft)	(acres)	Agency/Department	Use	Address		ZIP	APN	Open Area (Parcel) (sq ft)	(acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
5-22	14,804	0.34			2500	34th Ave.	94601	027 087603900	2,272	0.05	Soil/Grass	12	OS (SU)	1	OS	X		X
					2506	34th Ave.		027 087604000	2,072	0.05		14						
					2512	34th Ave.		027 087604102	2,787	0.06		8						
					2524	34th Ave.		027 087604201	1,726	0.04		14						
					2466	34th Ave.		027 087702502	1,887	0.04		9						
			Parks and Recreation	Peralta Hacienda Park		34th Ave.		Right of Way	4,000	0.09		14						
5-23	2,155	0.05			2466	34th Ave.	94601	027 087702502	1,078	0.02	Soil/Grass	9	OS (SU)	1	OS	X		X
						34th Ave.		027 087702503	839	0.02		0						
5-24	11,760	0.27			2480	Coolidge Ave.	94601	027 087802200	4,025	0.09	Soil/Grass	2	OS (SU)	1	OS	X	X	X
					2484	Coolidge Ave.		027 087802300	4,025	0.09								
					2488	Coolidge Ave.		027 087802400	3,710	0.09								
5-25	501	0.01	Alameda Co. Flood Control			Eden Ln.	94601	027 088200904	501	0.01	Soil/Grass	0	R-50	1		X		X
5-26	4,060	0.09	Housing Authority		3709	Carrington St.	94601	032 209105002	4,060	0.09	Soil/Grass	5	R-50	1		X		X
5-27	25,142	0.58	City of Oakland	"Jungle Hill" / Santa Rita		Ransome Ave.	94608	032 209107901	4,774	0.11	Soil/Grass	9	OS (RCA)	1		X		X
					2209	Ransome Ave.	94601	032 209108100	3,380	0.08		5						
					2201	Ransome Ave.	94601	032 209108200	2,639	0.06		9						
						Ransome Ave.	94608	032 209108300	1,598	0.04		3						
					2166	Santa Rita St.	94601	032 209109300	2,469	0.06		17						
					2170	Santa Rita St.	94601	032 209109400	3,506	0.08		17						
						Santa Rita St.	94608	032 209109500	3,380	0.08		17						
						Santa Rita St.	94608	032 209109600	3,358	0.08		16						
5-28	68,384	1.57	Alameda Co. Flood Control	Cesar Chavez Park (Foothill Meadows Park)		Bridge Ave.	94601	033 213501002	350	0.01	Soil/Grass	1	R-50	1		X	X	X
			Alameda Co. Flood Control			Foothill Blvd.		033 213502601	6,602	0.15	Mixed Surface		OS (NP)					
			Parks and Recreation			Foothill Blvd.		033 213502602	44,695	1.03	Soil/Grass		OS (NP)					
			Alameda Co. Flood Control			37th Ave.		033 213503701	1,750	0.04	Soil/Grass		R-50					
			Alameda Co. Flood Control		1843	38th Ave.		033 213503703	1,068	0.02	Soil/Grass		R-50					
			Alameda Co. Flood Control		1835	38th Ave.		033 213503802	10,114	0.23	Mixed Surface		R-50					
			Alameda Co. Flood Control			35th Ave.		033 213604301	1,990	0.05	Soil/Grass		R-40					
5-29	11,935	0.27	Alameda Co. Flood Control	Foothill Meadows Extension	1800	38th Ave.	94601	033 213803103	11,935	0.27	Mixed Surface	1	OS (AMP)	1		X	X	X
5-31	141,525	3.25	Parks and Recreation	W.D. Wood Park		McKillop Rd.	94608	026 081002901	40,427	0.93	Soil/Grass	20	OS (NP)	1	OS			X
								026 081004701	98,691	2.27		17						
5-32	1,911	0.04	Alameda Co. Flood Control			School St.	94602	026 082802500	1,911	0.04	Soil/Grass	2	R-50	1				X
5-33	2,520	0.06	State of California			Woodbine Ave.	94602	026 083200903	2,520	0.06	Soil/Grass	1	R-50	1		X		X
5-34	6,156	0.14	City of Oakland	Nicol Park	3042	Nicol Ave.	94602	027 085603300	6,156	0.14	Soil/Grass	2	OS (AMP)	1		X		X
5-35	578	0.01	Alameda Co. Flood Control			Humboldt Ave.	94602	027 089803001	578	0.01	Soil/Grass	0	R-50	1				X
5-36	473,683	10.87	Parks and Recreation	Dimond Park		Lyman Rd.	94608	029A132103601	473,683	10.87	Soil/Grass	8	OS (CP)	1	OS	X		X
5-37	6,688	0.15	Parks and Recreation	Dimond Park		Leimert Blvd.	94608	029A132800101	6,688	0.15	Soil/Grass	13	OS (RCA)	1	OS			X
5-38	7,969	0.18	Parks and Recreation	Dimond Park		Leimert Blvd.	94608	029A132800101	7,969	0.18	Soil/Grass	13	OS (RCA)	1	OS			X
5-39	1,300	0.03	Parks and Recreation	Dimond Park		Leimert Blvd.	94608	029A133000603	820	0.02	Soil/Grass	21	OS (RCA)	1	OS			X
								029A133000704	481	0.01		0						
6-1	31,312	0.72	OUSD	Greenman Field	6701	E. 15th St.	94621	041 413201503	31,312	0.72	Soil/Grass	0	OS (AF)	1	OS	X		X
6-2	24,070	0.55	Parks and Recreation	Rainbow Rec Center	5800	E. 16th St.	94621	038 323400701	11,049	0.25	Soil/Grass	1	OS (NP)	1				X
					5801	E. 17th St.		038 323501100	5,361	0.12								
						E. 17th St.		038 323502000	7,094	0.16								
6-3	1,182	0.03	City of Oakland			Deerwood St.	94605	040 332704103	1,182	0.03	Soil/Grass	0	R-35	1		X		X
6-4	1,255	0.03	City of Oakland		2250	73rd Ave.	94605	040 332803903	1,255	0.03	Soil/Grass	1	R-35	1		X		X
6-5	3,666	0.08	City of Oakland		2320	73rd Ave.	94605	040 332805501	3,666	0.08	Soil/Grass	1	R-35	1		X		X
6-6	4,871	0.11	City of Oakland		2320	73rd Ave.	94605	040 332805501	4,871	0.11	Soil/Grass	1	R-35	1		X		X
6-7	12,841	0.29	Housing Authority			76th Ave.	94608	040 333900602	1,649	0.04	Soil/Grass	1	R-50	1		X		X
					2500	76th Ave.	94605	040 333900603	10,896	0.25	Hard Surface							
6-8	426,420	9.79	City of Oakland			Krause Ave.	94608	040 334300104	426,420	9.79	Soil/Grass	0	OS (CP)	1	OS	X		X
6-9	769	0.02	City of Oakland			Bancroft Ave.	94608	040 337700401	769	0.02	Soil/Grass	0	R-70	2		X		X
6-10	10,425	0.24	Parks and Recreation	85th Ave. Mini Park		85th Ave.	94621	043 456101700	5,247	0.12	Mixed Surface	0	OS (AMP)	1			X	X
					1722	85th Ave.		043 456101800	5,177	0.12		1						
6-11	268,109	6.15	Peralta Comm. College			Leona St.	94608	037 268500131	72,787	1.67	Soil/Grass	16	R-30	1		X	X	X
			City of Oakland			Skyline Blvd.	94608	037A314100105	7,043	0.16		10	OS (RCA)					
			Peralta Comm. College			Equestrian Tr.	94608	037A314100111	15,103	0.35		16	R-30					
			Peralta Comm. College			Equestrian Tr.	94608	037A314100111	83,314	1.91		16	R-30					
			Peralta Comm. College			Equestrian Tr.	94608	037A314100111	48,834	1.12		16	OS (RCA)					
			East Bay Regional Parks			Campus Dr.	94605	037A315100202	38,174	0.88		26	OS (RCA)					
6-12	42,073	0.97	OUSD			64th Ave. Pl.	94605	037A274600501	22,728	0.52	Soil/Grass	9	R-50	1				X
						65th Ave.	94608	037A275100600	19,032	0.44		12						
6-13	4,040	0.09	Parks and Recreation	Open space		Oakdale Ave.	94608	037A278500600	4,040	0.09	Soil/Grass	20	R-30	1				X
6-14	31,926	0.73	Parks and Recreation	Concordia Center	3000	62nd Ave.	94605	038 318800107	31,926	0.73	Soil/Grass	1	OS (NP)	1	OS	X		X
6-15	586	0.01	City of Oakland			Bancroft Ave.	94608	038 320101800	586	0.01	Soil/Grass	1	R-70	2				X

Site	Open Area (Total) (sq ft)	Open Area (Total) (acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	Open Area (Parcel) (acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
6-16	2,959	0.07	City of Oakland		Halliday Ave.	94621	040 333100303	2,959	0.07	Soil/Grass	1	R-35	1		X		X
6-17	46,945	1.08	Housing Authority		7526 MacArthur Blvd.	94605	040A340900113	46,945	1.08	Soil/Grass	3	C-20	1			X	X
6-18	251	0.01	City of Oakland		Ney Ave.	94608	040A341403103	251	0.01	Soil/Grass	0	R-50	1				X
6-19	21,843	0.50	City of Oakland		4655 Geranium Pl. 4665 Geranium Pl. 4673 Geranium Pl.	94619	037 257501501 037 257501700 037 257501800	5,913 9,013 6,077	0.14 0.21 0.14	Soil/Grass	13 18 17	R-30	1				X
6-20	20,292	0.47	Parks and Recreation	Leona Heights Park	Mountain Blvd.	94608	037 260508900	20,292	0.47	Soil/Grass	7	OS (SU)	1	RC			X
6-21	140,402	3.22	Parks and Recreation Peralta Comm. College	Leona Heights Park	McDonell Ave. Leona St.	94608	037 268500116 037 268500140	72,116 67,826	1.66 1.56	Soil/Grass	21 16	OS (RCA)	1	RC	X		X
6-22	174,666	4.01	Peralta Comm. College	Leona Heights Park	Leona St. Equestrian Tr.	94608	037 268500140 037A314100117	154,169 20,352	3.54 0.47	Soil/Grass	16 9	OS (RCA) R-30	1	RC	X		X
6-23	50,870	1.17	Peralta Comm. College	Leona Heights Park	Leona St. Equestrian Tr.	94608	037 268500140 037A314100117	34,976 15,454	0.80 0.35	Soil/Grass	16 9	OS (RCA) R-30	1		X		X
6-24	6,213	0.14	Parks and Recreation	Leona Heights Park	Redwood Rd.	94619	037A313800102	6,213	0.14	Soil/Grass	37	OS (RCA)	1	RC	X		X
6-25	113,813	2.61	OUSD Parks and Recreation	Owen James Main Field	11900 Campus Dr. 5000 Redwood Rd.	94619	037A313800103 037A313800200	35,495 78,308	0.81 1.80	Soil/Grass	17 12	OS (NP)	1		X	X	X
6-26	32,474	0.75	Parks and Recreation Peralta Comm. College	Leona Heights Park	Skyline Blvd. Equestrian Tr.	94608	037A314100109 037A314100111	18,035 13,573	0.41 0.31	Soil/Grass	30 16	R-30 R-1	1		X		X
6-27	77,176	1.77	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	77,176	1.77	Soil/Grass	16	R-30	1		X		X
6-28	186,357	4.28	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	186,357	4.28	Soil/Grass	16	R-30	1				X
6-29	143,247	3.29	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	143,247	3.29	Soil/Grass	16	R-30	1		X		X
6-30	39,809	0.91	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	39,809	0.91	Soil/Grass	16	R-1	1		X		X
6-31	8,056	0.18	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	8,056	0.18	Soil/Grass	16	R-1	1		X		X
6-32	97,622	2.24	Peralta Comm. College		Equestrian Tr.	94608	037A314100111 037A314100111	2,865 93,810	0.07 2.15	Soil/Grass	16	R-1	1		X		X
6-33	59,499	1.37	Peralta Comm. College		Equestrian Tr.	94608	037A314100117	59,499	1.37	Soil/Grass	9	R-30	1		X		X
6-34	11,114	0.26	City of Oakland		Redwood Rd.	94608	037A314403605	11,114	0.26	Soil/Grass	13	R-1	1				X
6-35	26,367	0.61	City of Oakland		Blythen Way	94546	085 010107906	26,367	0.61	Soil/Grass	13	R-10	1	RC	X		X
6-36	47,289	1.09	City of Oakland		Blythen Way	94546	085 010107906	47,289	1.09	Soil/Grass	13	R-10	1	RC			
6-37	15,881	0.36	East Bay Regional Parks		Redwood Rd.	94546	085 010108005	15,881	0.36	Soil/Grass	27	R-30	1				X
6-38	69,473	1.59	East Bay Regional Parks		Redwood Rd.	94546	085 010108005	69,473	1.59	Soil/Grass	27	R-30	1	RC			X
6-39	2,990	0.07	East Bay Regional Parks		Redwood Rd.	94546	085 010108005	2,990	0.07	Soil/Grass	27	R-30	1				X
6-40	671,612	15.42	East Bay Regional Parks		Campus Dr.	94605	037A315100202	671,612	15.42	Soil/Grass	26	OS (RCA)	1	RC			
6-41	77,985	1.79	EBMUD		Rilea Way	94619	037A315200500	77,985	1.79	Soil/Grass	17	R-30	1	RC			X
6-42	18,512	0.42	East Bay Regional Parks		Campus Dr.	94619	037A315201303	18,512	0.42	Soil/Grass	20	R-30/S-18	1				X
6-43	21,144	0.49	East Bay Regional Parks		Campus Dr.	94619	037A315201303	21,144	0.49	Soil/Grass	20	R-30/S-18	1	RC			X
6-44	246,417	5.66	East Bay Regional Parks		Campus Dr.	94619	037A315201303	246,417	5.66	Soil/Grass	20	R-30/S-18	1	RC			X
6-45	107,780	2.47	East Bay Regional Parks		Campus Dr.	94619	037A315201303	107,780	2.47	Soil/Grass	20	R-30/S-18	1	RC			X
6-46	7,802	0.18	East Bay Regional Parks		Campus Dr.	94619	037A315201303	7,802	0.18	Soil/Grass	20	R-30/S-18	1	RC			X
6-47	7,182	0.16	East Bay Regional Parks		Campus Dr.	94619	037A315201303	7,182	0.16	Soil/Grass	20	R-30/S-18	1	RC			X
6-48	387,719	8.90	East Bay Regional Parks East Bay Regional Parks East Bay Regional Parks Alameda Co. Flood Control Alameda Co. Flood Control		Campus Dr. Campus Dr. Campus Dr. Keller Ave. Keller Ave.	94619	037A315201303 037A315201303 037A315201303 037A315201905 037A315201905	6,390 51,915 194,495 134,739 38	0.15 1.19 4.46 3.09 0.00	Soil/Grass	20 20 20 11 11	R-30/S-18 R-30/S-18 R-30/S-18 C-20 C-20	1	RC			X
6-49	3,893	0.09	Parks and Recreation	Burkhalter Rec. Ctr.	Edwards Ave.	94608	040A344103605	3,893	0.09	Soil/Grass	4	OS (NP)	1	OS	X		X
6-50	1,437	0.03	Parks and Recreation	Burkhalter Rec. Ctr.	Edwards Ave.	94608	040A344103605	1,437	0.03	Soil/Grass	4	OS (NP)	1	OS	X		X
6-51	4,850	0.11	Parks and Recreation	Burkhalter Rec. Ctr.	Columbian Dr.	94608	040A344105603	4,850	0.11	Soil/Grass	6	R-50	1	OS	X		X
6-52	1,525	0.04	EBMUD		Mountain Blvd.	94608	040A346100104	1,525	0.04	Soil/Grass	21	R-30	1	RC			X
6-53	236,220	5.42	Parks and Recreation	City Stables	13560 Skyline Blvd.	94619	040A346800803	188,716 46,116	4.33 1.06	Soil/Grass	7	OS (SU)	1	OS			X
6-54	84,689	1.94	EBMUD		Mountain Blvd.	94608	040A346100104 040A384700383	5,261 79,429	0.12 1.82	Soil/Grass	21 19	R-30 R-50	1	RC			X
6-55	6,488	0.15	EBMUD		Mountain Blvd.	94608	040A384700383	6,488	0.15	Soil/Grass	19	R-50	1	RC			X
6-56	2,919	0.07	EBMUD		Mountain Blvd.	94608	040A384700383	2,919	0.07	Soil/Grass	19	R-50	1	RC			X
6-57	585	0.01	City of Oakland		Keller Ave.	94621	043A466400100	585	0.01	Soil/Grass	0	R-30	1				X
6-58	10,561	0.24	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	10,561	0.24	Soil/Grass	16	OS (RCA)	1				X
6-59	312,470	7.17	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	312,470	7.17	Soil/Grass	16	OS (RCA)	1	RC			X
6-60	101,507	2.33	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	101,507	2.33	Soil/Grass	16	R-30	1				X
6-61	79,192	1.82	Peralta Comm. College		Equestrian Tr.	94608	037A314100111	79,192	1.82	Soil/Grass	16	OS (RCA)	1				X
6-62	67,105	1.54	City of Oakland		Blythen Way Balmoral Dr.	94546	085 010107906	23,812 43,292	0.55 0.99	Soil/Grass	13 4	R-10 R-1	1	RC	X	X	X

Site	Open Area (Total) (sq ft)	Open Area (Total) (acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	Open Area (Parcel) (acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
6-63	165,918	3.81	City of Oakland		Skyline Blvd.	94605	048 686900200	15,669	0.36	Soil/Grass	19	R-20	1				X
			City of Oakland				048 686900200	10,380	0.24		19						
			EBMUD				048 686900300	135,577	3.11		14						
			EBMUD				048 686900400	3,282	0.08		22						
7-1	1,508,109	34.62	City of Oakland	Harbor Bay Pkwy.	8425 Earhart Rd.	94621	042 440401102	1,508,109	34.62	Mixed Surface	1	M-40	4				
7-4	1,175,286	26.98	East Bay Regional Parks	MLK Shoreline Park	Swan Dr.	94608	042 440200909	4,457	0.10	Soil/Grass	0	M-40	4	RC			
			City of Oakland			94608	042 440200911	768,968	17.65		0			OS			
			City of Oakland		Doolittle Dr.	94614	042 441000113	233,774	5.37		1			OS			
			City of Oakland			94608	042 441500305	163,895	3.76		0			OS			
7-5	332,569	7.63	City of Oakland		Doolittle Dr.	94614	042 441000118	332,569	7.63	Soil/Grass	0	C-36/S-4	2				X
7-7	33,518	0.77	City of Oakland		Doolittle Dr.	94608	042 452000112	33,518	0.77	Soil/Grass	0	C-36/S-4	2				X
7-8	117,731	2.70	City of Oakland		Doolittle Dr.	94614	042 452000221	37,265	0.86	Hard Surface	0	M-40	4	OS			X
					10001 Doolittle Dr.	94603	042 452000223	6,516	0.15	Hard Surface							
					Airport Dr.	94608	042 452000400	73,950	1.70	Soil/Grass							
7-9	410,176	9.42	City of Oakland		Edgewater Dr.	94608	041 390200322	405,509	9.31	Soil/Grass	1	M-40	4	OS			X
							041 390201800	3,952	0.09								
7-10	29,323	0.67	City of Oakland		Edgewater Dr.	94608	041 390200500	26,367	0.61	Hard Surface	0	M-40	4	EP			
							041 390200600	2,957	0.07	Mixed Surface							
7-11	105,445	2.42	City of Oakland		Edgewater Dr.	94608	041 390201000	58,430	1.34	Soil/Grass	1	M-40	4	OS			X
							041 390201100	45,083	1.03		1						
							041 390201900	1,825	0.04		3						
7-12	1,401,693	32.18	Parks and Recreation	MLK Shoreline Park	Edgewater Dr.	94608	041 390200322	26,615	0.61	Soil/Grass	1	M-40	4	OS			
			EBMUD		Oakport St.	94621	041 390300207	215,287	4.94		1						
			EBMUD		Oakport St.	94621	041 390300208	385,195	8.84		0						
			Parks and Recreation		Oakport St.	94621	041 390300209	451,465	10.36		1						
			EBMUD		5601 Oakport St.	94621	041 390400105	307,480	7.06		0						
			EBMUD		5601 Oakport St.	94621	041 390400105	14,585	0.33		0						
7-13	28,930	0.66	Redevelopment		73rd Ave.	94621	041 417300103	13,731	0.32	Soil/Grass	1	M-40/S-4	4				X
					728 73rd Ave.		041 417300202	15,199	0.35	Mixed Surface	2						
7-14	388,958	8.93	County of Alameda		8000 South Coliseum Way	94621	042 432800124	388,958	8.93	Hard Surface	0	C-36/S-4	2				X
7-15	26,071	0.60	Alameda Co. Flood Control		Edgewater Dr.	94608	042 443000113	26,071	0.60	Soil/Grass	4	M-40	4	OS			X
7-16	35,738	0.82	City of Oakland		Edgewater Dr.	94621	042 443500601	35,738	0.82	Soil/Grass	5	M-40	4				X
7-17	189,786	4.36	Parks and Recreation	Brookfield Village Park	Jones Ave.	94603	044 505300106	189,786	4.36	Soil/Grass	0	OS (CP)	1	OS	X		X
7-18	29,434	0.68	Parks and Recreation	Stonehurst Park	E St.	94603	045 521400203	29,434	0.68	Soil/Grass	0	OS (NP)	1	OS	X		X
7-19	8,196	0.19	City of Oakland		850 98th Ave.	94603	045 523000101	8,196	0.19	Soil/Grass	0	M-40	4				X
7-20	30,353	0.70	City of Oakland		9507 Edes Ave.	94603	045 529200500	30,353	0.70	Soil/Grass	0	R-50	1		X		X
7-21	34,233	0.79	State of California		98th Ave.	94603	045 529802600	34,233	0.79	Soil/Grass	1	R-30	1		X		X
7-22	11,796	0.27	City of Oakland		620 98th Ave.	94603	045 530405702	11,796	0.27	Soil/Grass	0	R-30	1				X
7-23	3,905	0.09	State of California		9832 Hesket Rd.	94603	045 531900402	3,905	0.09	Soil/Grass	1	R-30	1		X	X	X
7-24	34,777	0.80	Alameda Co. Flood Control		Empire Rd.	94603	045 531903702	6,674	0.15	Soil/Grass	6	R-30	1				
							045 531903703	28,103	0.65		3						
7-25	4,723	0.11	Alameda Co. Flood Control		98th Ave.	94603	045 532000203	4,723	0.11	Hard Surface	4	R-30	1				X
7-26	15,696	0.36	State of California		9842 Koford Rd.	94603	045 532200602	1,485	0.03	Soil/Grass	1	R-30	1				X
			State of California		9848 Koford Rd.		045 532200702	113	0.00		0						
			City of Oakland		9842 Koford Rd.		045 532200703	14,098	0.32		1				X		
7-27	5,257	0.12	State of California		9819 Hesket Rd.	94603	045 532200900	5,257	0.12	Soil/Grass	1	OS (NP)	1		X		X
7-28	16,535	0.38	Alameda Co. Flood Control		105th Ave.	94603	045 537001801	16,535	0.38	Soil/Grass	1	R-30	1		X		
7-29	213,207	4.90	City of Oakland		105th Ave.	94603	045 537002001	58,769	1.35	Soil/Grass	1	R-40	1		X		X
					Knight St.		045 537002200	15,130	0.35		0	R-30					
					105th Ave.		045 537101300	65,329	1.50		0	C-10					
					105th Ave.		045 537002001	58,769	1.35		1	R-40					
					Knight St.		045 537002200	15,130	0.35		0	R-30					
7-31	30,849	0.71	OUSD		El Paseo Dr.	94603	045 542000104	30,849	0.71	Soil/Grass	0	OS (NP)	1		X		X
7-32	5,975	0.14	Alameda Co. Flood Control		Preda St.	94577	075 020700900	5,975	0.14	Soil/Grass	4	R-30	1				X
7-33	2,991	0.07	City of Oakland		1148 71st Ave.	94621	041 413502800	2,991	0.07	Soil/Grass	0	R-50	1		X	X	X
7-34	10,894	0.25	OUSD		79th Ave.	94608	041 421100100	10,894	0.25	Soil/Grass	0	M-30	4				X
7-35	24,364	0.56	OUSD		79th Ave.	94608	041 421100100	24,364	0.56	Mixed Surface	0	R-50	1				X
7-36	14,501	0.33	City of Oakland		85th Ave.	94621	042 431300800	14,501	0.33	Soil/Grass	0	M-40	4				X
7-37	4,816	0.11	Housing Authority		1731 89th Ave.	94621	043 458901000	4,816	0.11	Hard Surface	0	R-30	1				X
7-38	6,889	0.16	Parks and Recreation	88th Ave. Mini Park	88th Ave.	94621	043 459000600	2,015	0.05	Soil/Grass	1	OS (AMP)	1				X
					1803 88th Ave.		043 459000700	4,819	0.11	Hard Surface							
7-39	577	0.01	City of Oakland		Bancroft Ave.	94621	043 460601501	577	0.01	Soil/Grass	1	R-40	1				X
7-40	80,294	1.84	Parks and Recreation	Elmhurst Park	98th Ave.	94621	044 498100900	80,294	1.84	Soil/Grass	0	C-10	1				X
7-41	6,581	0.15	Parks and Recreation	Holly Mini Park	Holly St.	94603	046 542801500	3,529	0.08	Soil/Grass	0	OS (AMP)	1		X		X
					9826 Holly St.		046 542801600	2,951	0.07								

Site	Open Area (Total) (sq ft)	Open Area (Total) (acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	Open Area (Parcel) (acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
7-42	23,748	0.55	AC Transit		105th Ave.	94603	047 551900403	23,748	0.55	Soil/Grass	0	M-20	1				X
7-43	358,146	8.22	Parks and Recreation	Dunsmuir House	Peralta Oaks Ct.	94605	048 565800107	358,146	8.22	Soil/Grass	16	OS (SU)	1	OS	X		X
7-44	1,114,611	25.59	Parks and Recreation	Dunsmuir House	Peralta Oaks Ct.	94605	048 565800107	221,878	5.09	Soil/Grass	16	OS (SU)	1	OS			X
			Parks and Recreation		Peralta Oaks Ct.	94605	048 565800107	16,828	0.39		16	OS (SU)	1				
			EBMUD		Peralta Oaks Dr.	94609	048 565800200	821,287	18.85		15	OS (SU)	1				
			East Bay Regional Parks		2950 Peralta Oaks Ct.	94605	048 565800302	40,881	0.94		6	S-3	4				
7-45	3,511,868	80.62	Parks and Recreation	Dunsmuir House	Peralta Oaks Ct.	94605	048 565800107	275,411	6.32	Soil/Grass	16	OS (SU)	1	RC			X
			Parks and Recreation	Dunsmuir House	Foothill Blvd.	94605	048 581300108	2,500,821	57.41		18	R-30		OS			
			Parks and Recreation	Dunsmuir House	Foothill Blvd.	94605	048 581300108	126,855	2.91		18	R-30		RC			
			Parks and Recreation	Dunsmuir House	Revere Ave.	94603	048 581300204	4,759	0.11		29	R-30		RC			
			Parks and Recreation	Dunsmuir House	Revere Ave.	94603	048 581300204	4,506	0.10		29	R-30					
			Parks and Recreation	Dunsmuir House	Revere Ave.	94603	048 581300205	9,391	0.22		20	R-30		RC			
			Parks and Recreation	Dunsmuir House	Revere Ave.	94603	048 581300205	272	0.01		20	R-30		RC			
			Parks and Recreation	Dunsmuir House	Revere Ave.	94603	048 581300211	56,262	1.29		35	R-30		RC			
			Parks and Recreation	Lake Chabot Golf Course	Foothill Blvd.	94603	048 581300305	524,706	12.05		17	OS (SU)		OS			
			EBMUD	Lake Chabot Golf Course	Foothill Blvd.	94603	048 581300306	4,607	0.11		21	OS (SU)		OS			
7-46	2,787,714	64.00	EBMUD		Fontaine St.	94608	040A345604700	9,342	0.21	Soil/Grass	20	R-30	1	RC	X		X
			City of Oakland		Mountain Blvd.	94605	043A467500321	1,065,746	24.47	Mixed Surface	11	R-50		RC			
			City of Oakland		Mountain Blvd.	94605	043A467500321	294,393	6.76	Mixed Surface	11	R-50		OS			
			City of Oakland		Mountain Blvd.	94605	043A467500321	75,485	1.73	Mixed Surface	11	R-50		RC			
			City of Oakland		Mountain Blvd.	94605	043A467500321	263,199	6.04	Mixed Surface	11	R-50		RC			
			City of Oakland		Mountain Blvd.	94605	043A467500321	916,166	21.03	Mixed Surface	11	R-50		OS			
			EBMUD		Mountain Blvd.	94621	043A467500400	27,771	0.64	Soil/Grass	18	C-10/S-4		OS			
			City of Oakland		Barcelona St.	94621	043A471200100	64,162	1.47	Soil/Grass	12	R-30		RC			
			City of Oakland		St. Andrews Rd.	94603	048 686500201	71,451	1.64	Soil/Grass	11	R-30		RC			
7-47	2,168	0.05	Parks and Recreation		90th Ave.	94621	043A463804100	2,168	0.05	Soil/Grass	6	R-30	1			X	X
7-48	21,066	0.48	City of Oakland		8327 Golf Links Rd.	94605	043A464400902	21,066	0.48	Soil/Grass	8	R-30	1		X		X
7-49	7,078	0.16	City of Oakland		2824 82nd Ave.	94605	043A464400202	2,855	0.07	Soil/Grass	6	C-10	1		X	X	X
					Golf Links Rd.		043A464402509	3,852	0.09								
7-50	5,664	0.13	City of Oakland		8395 Golf Links Rd.	94605	043A465100905	5,664	0.13	Soil/Grass	16	R-30	1		X		X
7-51	6,451	0.15	City of Oakland		8379 Golf Links Rd.	94605	043A465100914	6,451	0.15	Soil/Grass	17	R-30	1		X	X	X
7-52	5,720	0.13	City of Oakland		8477 Golf Links Rd.	94605	043A465101904	5,720	0.13	Soil/Grass	9	R-30	1		X	X	X
7-53	113,230	2.60	Parks and Recreation	King Estates Park	Granada Ave.	94621	043A467500206	2,309	0.05	Soil/Grass	11	R-30	1	RC	X		X
			Parks and Recreation		Granada Ave.		043A467500206	860	0.02		11						
			Parks and Recreation		Crest Ave.		043A467500218	80,419	1.85		15						
			State of California		Granada Ave.		043A467503900	29,571	0.68		15						
7-54	1,078,590	24.76	Parks and Recreation	King Estates Park	Crest Ave.	94621	043A467500224	1,078,590	24.76	Soil/Grass	17	OS (RCA)	1	RC	X		X
7-55	2,345,132	53.84	Parks and Recreation	King Estates Park	Fontaine St.	94605	043A464907207	27,182	0.62	Soil/Grass	19	OS (RCA)	1	RC	X		X
						94605	043A464907207	35,835	0.82		19						
						94621	043A467500225	1,468,419	33.71		16						
						94621	043A467500230	813,698	18.68		9						
7-56	11,936	0.27	Parks and Recreation	King Estates Park	Fontaine St.	94621	043A467500231	11,936	0.27	Soil/Grass	6	OS (RCA)	1	RC	X		X
7-57	103,413	2.37	State of California		Fontaine St.	94621	043A467504000	103,413	2.37	Soil/Grass	15	R-30	1	RC	X		X
7-58	28,889	0.66	Parks and Recreation	Knowland Park	9774 Mountain Blvd.	94605	043A467602401	28,889	0.66	Soil/Grass	15	R-30	1				X
7-59	14,449	0.33	EBMUD		Burr St.	94621	043A476000106	14,449	0.33	Soil/Grass	21	R-40	1				X
7-60	24,836	0.57	EBMUD		Burr St.	94621	043A476000106	24,836	0.57	Soil/Grass	21	R-40	1		X		X
7-61	45,105	1.04	EBMUD		Burr St.	94621	043A476000106	45,105	1.04	Soil/Grass	21	R-40	1				X
7-62	110,244	2.53	Parks and Recreation	Verdese Carter Park	9600 Sunnyside St.	94603	046 546800303	110,244	2.53	Soil/Grass	1	OS (NP)	1	OS	X		X
7-63	11,098	0.25	Housing Authority		2243 98th Ave.	94603	046 547500612	6,537	0.15	Soil/Grass	2	C-10	1		X		X
					2263 98th Ave.		046 547500613	4,561	0.10	Hard Surface		R-50					
7-64	9,618	0.22	City of Oakland		100th Ave.	94603	047 555601903	9,618	0.22	Soil/Grass	1	R-30	1		X		X
7-65	11,699	0.27	City of Oakland		103rd Ave.	94603	047 555702003	11,699	0.27	Soil/Grass	1	R-30	1		X		X
7-66	14,394	0.33	City of Oakland		103rd Ave.	94603	047 555803703	14,394	0.33	Soil/Grass	0	R-30	1				X
7-67	11,249	0.26	City of Oakland		2475 98th Ave.	94605	048 559902600	3,502	0.08	Soil/Grass	8	R-30	1		X		X
					2469 98th Ave.		048 559902700	3,750	0.09			R-30					
					2463 98th Ave.		048 559902800	3,997	0.09			C-10					
7-68	13,705	0.31	City of Oakland		2515 98th Ave.	94605	048 560301400	13,705	0.31	Soil/Grass	5	R-30	1		X	X	X
7-69	4,677	0.11	City of Oakland		2661 98th Ave.	94605	048 561300900	4,677	0.11	Soil/Grass	6	R-30	1		X		X
7-70	20,206	0.46	City of Oakland		2656 98th Ave.	94605	048 561700901	5,689	0.13	Soil/Grass	9	R-30	1		X	X	X
					2660 98th Ave.		048 561701004	14,517	0.33		7						
7-71	50,282	1.15	State of California		98th Ave.	94603	048 565500200	50,282	1.15	Soil/Grass	18	C-10	1				X
7-72	908,738	20.86	Parks and Recreation	Knowland Park	9769 Golf Links Rd.	94605	048 565500300	908,738	20.86	Soil/Grass	10	C-10	1	RC			X
7-73	208,538	4.79	Parks and Recreation	Knowland Park	9769 Golf Links Rd.	94605	048 565500300	186,471	4.28	Soil/Grass	10	C-10	1	OS			X
					Golf Links Rd.	94603	048 616200700	21,654	0.50		19	OS (SU)		RC			
7-74	479,878	11.02	Parks and Recreation	Knowland Park	9769 Golf Links Rd.	94605	048 565500300	479,878	11.02	Soil/Grass	10	C-10	1	OS		X	X

Site	Open Area (Total) (sq ft)	(acres)	Agency/Department	Use	Address	ZIP	APN	Open Area (Parcel) (sq ft)	(acres)	Ground Cover	Slope (%)	Zoning	Ag Use	Gen. Plan	School	H2O	Bus
7-75	589,199	13.53	Parks and Recreation Parks and Recreation OUSD	Dunsmuir House Dunsmuir House Hellman Rec. Area	Peralta Oaks Ct. Peralta Oaks Ct. 3400 Malcolm Ave.	94605	048 565800107 048 565800107 048 616604106	443,759 101,851 41,516	10.19 2.34 0.95	Soil/Grass	16 16 21	OS (SU) OS (SU) OS (NP)	1	OS	X		
7-76	5,406	0.12	Parks and Recreation	Dunsmuir House	Peralta Oaks Ct.	94605	048 565800107	5,406	0.12	Soil/Grass	16	OS (SU)	1	OS	X		
7-77	5,588	0.13	Parks and Recreation	Knowland Park	Peralta Oaks Dr.	94609	048 566102703	5,588	0.13	Soil/Grass	7	R-30	1				X
7-78	6,401	0.15	Parks and Recreation	Knowland Park	Peralta Oaks Dr.	94609	048 566201303	6,401	0.15	Soil/Grass	7	R-30	1				X
7-79	6,162	0.14	City of Oakland		2946 Barrett St.	94605	048 566204702	6,162	0.14	Soil/Grass	7	R-30	1			X	X
7-80	11,350	0.26	EBMUD		3055 Malcolm Ave.	94605	048 566402603	11,350	0.26	Soil/Grass	8	R-30	1		X		
7-81	4,536,994	104.16	Parks and Recreation	Knowland Park	9769 Golf Links Rd. Golf Links Rd.	94605	048 565500300 048 616200107	100,846 4,436,148	2.32 101.84	Soil/Grass	10 11	C-10 OS (SU)	1	OS RC	X		X
7-82	123,561	2.84	Parks and Recreation	Knowland Park	9769 Golf Links Rd. Golf Links Rd.	94605	048 565500300 048 616200107	62,614 60,707	1.44 1.39	Soil/Grass	10 11	C-10 OS (SU)	1	OS			X
7-83	122,348	2.81	Parks and Recreation	Knowland Park	Golf Links Rd.	94603	048 616200700	122,348	2.81	Soil/Grass	19	OS (SU)	1	RC			X
7-84	6,396	0.15	Parks and Recreation	Knowland Park	10100 Golf Links Rd.	94605	048 640200501	6,396	0.15	Soil/Grass	9	OS (RCA)	1	RC			X
7-85	7,392	0.17	Parks and Recreation	Knowland Park	10100 Golf Links Rd.	94605	048 640200501	7,392	0.17	Soil/Grass	9	OS (RCA)	1	RC			X
7-86	82,778	1.90	City of Oakland City of Oakland Parks and Recreation	Knowland Park	Golf Links Rd.	94605	048 640700301 048 640700301 048 640800201	9,240 42,538 28,432	0.21 0.98 0.65	Soil/Grass	16 16 18	OS (RCA)	1	RC			X
7-87	15,737	0.36	City of Oakland		Golf Links Rd.	94605	048 640700301	15,737	0.36	Soil/Grass	16	OS (RCA)	1	RC			X
7-88	44,873	1.03	Parks and Recreation	Knowland Park	Gateview Dr.	94603	048 641100100	44,873	1.03	Soil/Grass	20	OS (SU)	1	RC			X
7-89	5,892	0.14	City of Oakland		Sequoyah Rd.	94605	048 641300405	5,892	0.14	Soil/Grass	14	R-30	1	OS			X
7-90	38,704	0.89	Parks and Recreation	Open space	Sterling Dr.	94605	040A344902301	38,704	0.89	Soil/Grass	16	R-30	1		X		X
7-91	27,005	0.62	EBMUD		Keller Ave. Mountain Blvd.	94619 94621	037A315200900 043A467500400	22,445 3,993	0.52 0.09	Soil/Grass	3 18	R-30 C-10/S-4	1	OS			X
7-92	257,057	5.90	Parks and Recreation	Dunsmuir House	Revere Ave.	94605	048 581300109	257,057	5.90	Soil/Grass	19	R-30	1	OS			
7-93	51,423	1.18	Parks and Recreation	Dunsmuir House	Revere Ave.	94605	048 581300109	51,423	1.18	Soil/Grass	19	R-30	1	RC			
7-94	881,319	20.23	Parks and Recreation	Lake Chabot Golf Course	11450 Golf Links Rd.	94605	048 581300304	881,319	20.23	Soil/Grass	12	OS (RCA)	1	OS			
7-95	12,978	0.30	East Bay Regional Parks	Lake Chabot Golf Course	Estudillo Ave.	94603	048 581300407	12,978	0.30	Soil/Grass	14	OS (RCA)	1	RC			
7-96	44,133	1.01	East Bay Regional Parks	Lake Chabot Golf Course	Estudillo Ave.	94603	048 581300407	44,133	1.01	Soil/Grass	14	OS (RCA)	1	RC			
7-97	49,894	1.15	East Bay Regional Parks	Lake Chabot Golf Course	Estudillo Ave.	94603	048 581300407	49,894	1.15	Soil/Grass	14	OS (RCA)	1	RC			
7-98	327,294	7.51	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300502	327,294	7.51	Soil/Grass	17	OS (RCA)	1	RC			
7-99	121,155	2.78	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300502	121,155	2.78	Soil/Grass	17	OS (RCA)	1	RC			
7-100	7,425	0.17	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300502	7,425	0.17	Soil/Grass	17	OS (RCA)	1	RC			
7-101	185,918	4.27	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300600	185,918	4.27	Soil/Grass	9	OS (NP)	1	RC			
7-102	63,528	1.46	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300502 048 581300600 048 581300600	23,203 20,582 19,575	0.53 0.47 0.45	Soil/Grass	17 9 9	OS (RCA) OS (NP) OS (NP)	1	RC			
7-103	32,799	0.75	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300600	32,799	0.75	Soil/Grass	9	OS (NP)	1	RC			
7-104	9,694	0.22	EBMUD	Chabot Park	Estudillo Ave.	94603	048 581300600	9,694	0.22	Soil/Grass	9	OS (NP)	1	RC			
7-105	3,987	0.09	EBMUD	Dunsmuir House	Revere Ave.	94603	048 614004200	3,987	0.09	Soil/Grass	34	R-30	1	RC			
7-106	43,965	1.01	Parks and Recreation	Sheffield Rec Center	247 Marlow Dr. Revere Ave. Revere Ave. Revere Ave. 251 Marlow Dr.	94605 94603 94603 94603 94605	048 614000100 048 614002703 048 614002704 048 614002704 048 615601200	2,685 2,224 4,480 1,443 31,771	0.06 0.05 0.10 0.03 0.73	Soil/Grass	3 29 23 23 10	OS (NP) OS (RCA) OS (RCA) OS (RCA) OS (RCA)	1				X
7-107	109,608	2.52	Parks and Recreation	Lake Chabot Golf Course	Foothill Blvd.	94603	048 581300305	109,608	2.52	Soil/Grass	17	OS (SU)	1	OS			
7-108	1,752,680	40.24	Parks and Recreation	Knowland Park	Golf Links Rd.	94603	048 616200108	1,752,680	40.24	Soil/Grass	13	OS (RCA)	1	RC	X		X
7-109	42,117	0.97	Parks and Recreation	Knowland Park	Golf Links Rd.	94603	048 616200108	42,117	0.97	Soil/Grass	13	OS (RCA)	1	RC			
7-110	123,150	2.83	Parks and Recreation	Knowland Park	Golf Links Rd.	94603	048 616200108	123,150	2.83	Soil/Grass	13	OS (RCA)	1	RC	X		X
7-111	103,040	2.37	Parks and Recreation	Knowland Park	Golf Links Rd.	94603	048 616200108	103,040	2.37	Soil/Grass	13	OS (RCA)	1	RC			X
7-112	1,933	0.04	Parks and Recreation	Open space	56 Montowwod Way	94605	048 617800200	1,933	0.04	Soil/Grass	7	R-30	1				
7-113	7,560	0.17	City of Oakland		Sequoyah Rd.	94605	048 681800101	7,560	0.17	Soil/Grass	13	R-30	1				X
7-114	43,844	1.01	EBMUD City of Oakland		Keller Ave.	94605	048 686900600 048 686900700	18,875 24,740	0.43 0.57	Soil/Grass	19 18	R-20	1			X	X

Appendix A2: GIS Methodology

Shape files for boundaries (City of Oakland and City Council Districts), infrastructure (streets, EBMUD meters, bus lines, etc.), zoning, and physical geography were obtained from the GIS database at the City of Oakland's Community Economic Development Agency (CEDA) in Fall 2004. Parcel level data ("VWPARCELAPNASSESSOR.shp") from the Alameda County Office of the Assessor were obtained from CEDA in March 2009. Addresses for school gardens (2006 data) was obtained from Alameda County Cooperative Extension. A list of existing community gardens was compiled from the Oakland Parks and Recreation website, and includes UA project gardens City Slicker Farms, People's Grocery, Oakland Food Connection, OBUGs, Village Bottom Farms, Phat Beets Produce, and the East Bay Refugee Project.

One-meter resolution aerial imagery obtained from USDA National Agriculture Imagery Program (NAIP) and used to visually identify vacant parcels. 10-m digital elevation models (DEMs) for Richmond, Briones Valley, Oakland West, Oakland East, Hunter's Point, Las Trampas Ridge, San Leandro, and Hayward were downloaded from the USGS Bay Area Regional Database website (bard.wr.usgs.gov).

Using ArcGIS 9.3, we first identified publicly-owned parcels by querying of Alameda County Tax Assessor's parcel data for "Exempt public agencies" in the "Use Description" field [Selection/Select by Attributes] and exported to a new layer (PublicLand.shp). We then queried the "Owner Name" field to locate parcels owned by city, county, regional, state, and federal agencies (listed in Box 2). Parcels listing the name of an individual in the "Owner Name" field instead of an agency name were excluded from the inventory and deleted from the file.

The publicly-owned parcel layer (PublicLand.shp) was overlaid on 1-m resolution NAIP imagery in order to visually identify vacant parcels. Publicly-owned parcels that were already developed (e.g., buildings, playing fields, parking lots) were excluded from the inventory. Parcels containing more than 500 sq. ft. of undeveloped land were selected and exported to create a new file (Inv.shp). "Undeveloped land" consisted of arable open space (soil or grass), dense vegetation (trees or shrubs), and semi-permeable or impermeable surface (e.g., gravel, asphalt or concrete) that was not clearly in use (e.g., as a parking lot). Developed areas were clipped from each polygon [Editor/Modify Tasks/Cut Polygon Features].

Because imagery was flown in 2005, all undeveloped parcels were cross-checked using current (2009) Google Maps imagery available online (maps.google.com). Parcels that had been visibly developed since 2005 were removed or modified according to the above criteria.

Parcels were analyzed visually using NAIP imagery to determine ground cover. Initially, we selected parcels that fell into the following three categories: 1) Soil/Grass: Parcels containing open soil and grass with less than 25% coverage by dense vegetation or hard surface; 2) Mixed Surface: Parcels containing more than 25% hard surface (asphalt, concrete, or gravel) but at least 500 sq. ft of contiguous open soil/grass; 3) Hard Surface: Parcels containing more than 25% hard surface (asphalt, concrete, or gravel) and less than 500 sq. ft. of contiguous open soil/grass. 4) Dense Vegetation: Parcels containing more than 25% dense vegetation and less than 500 sq. ft of contiguous open soil/grass. We selected parcels by ground cover attribute [Selection/Select by Attributes], exported a new layer of sites from parcels classified as "dense vegetation" (Agroforestry.shp), and then removed these parcels from the inventory (Inv.shp). Parcel polygons containing more than 25% tree cover and more than 500 sq. ft. of open soil/grass were modified. A new polygon for the densely vegetated area was created from the existing polygon [Editor/Modify Tasks/Cut Polygon Features], exported as a new layer, merged to the dense vegetation layer (Agroforestry.shp), and removed from the inventory (Inv.shp). Remaining polygons were classified as Soil/Grass. Parcels (Inv.shp) within 25 ft. of each other were then aggregated using the Aggregate tool [Data Management/Aggregate] to create a new layer (Agg.shp). A new “Index” field was created and each aggregated site was manually assigned an identifying index number based on City Council District and spatial location (south to north, using a 2,500 sq. ft. grid overlay).

Both Parcel (Inv.shp) and Aggregated (Agg.shp) were clipped to remove areas under water (using Land.shp). Open (vacant) area for both Parcel and Aggregated Site layers was calculated using Hawth’s Tools [Table Tools/Add Area Field]. Aggregated sites (and their component parcels) totaling less than 250 sq. ft. were deleted from the inventory. Any remaining individual parcel that is less than 250 sq. ft. therefore belongs to an aggregated site greater than 500 sq. ft. All data was exported to an Excel spreadsheet in order to sort and calculate total areas shown in this report.

To determine parcel slope, DEMs were joined into a single raster file using the raster Mosaic tool [Data Management/Raster/Raster Dataset/Mosaic]. A slope file was created from the DEM mosaic using the Spatial Analyst extension [Surface Analysis/Slope]. Mean slope per parcel (Inv.shp) was calculated using zonal the Zonal Statistics tool [Spatial Analyst/Zonal Statistics].

To determine existing agricultural zoning, city zoning codes were consolidated into four “Permitted Agricultural Use” classifications: 1) Crop/animal raising and plant nurseries; 2) Crop/animal raising only; 3) Plant nurseries only, and 4) Agricultural use not permitted. Permitted Ag Use categories were added to a new field in the Zoning layer (Zoning.shp).

Zoning and Permitted Ag Use (Zoning.shp) and Resource Conservation, Open Space, and Estuary Plan (GenPlan.shp) codes were spatially joined [Analysis/Spatial join/Intersect] to parcels (Inv.shp).

EBMUD meters [Analysis/Spatial join/Within a distance of 10 feet) were spatially joined to parcels (Inv.shp).

Schools and AC Transit bus stops within ¼ mile of parcels were spatially joined to the inventory layer (Inv.shp) [Analysis/Spatial join/Within a distance of ¼ mile to parcels]. Street addresses for the “Existing Gardens” map were georeferenced using on online program (www.batchgeocode.com), saved as a text (.txt) file and imported into ArcGIS. Points were added [Tools/Add XY Data] and classified based on garden type.

Projection for all files and maps is WGS 1984 UTM Zone10N.

Appendix B1: Towards a Socio-Natural History of Oakland's Soils

In a garden in West Oakland, California, the dark, crumbly soil, rich in organic matter (OM) and nutrients is the envy of any urban farmer. A soil sample, however, reveals that soil lead (Pb) levels top 2,000 ppm, well above the somewhat arbitrary contamination screening level of 400 ppm identified by the EPA. As in most post-industrial landscapes, soil contamination is common in cities such as Oakland. The high levels of organic and inorganic contaminants are largely anthropogenic, the result of human activity—industrial and vehicle pollution, deteriorating housing stock, chemical spills. At the same time, the high levels of humic matter and organic nitrogen in the soil, the gold standard in sustainable agriculture and ecological horticulture, are also the result of human activity—the application of compost and planting of N-fixing legumes. Indeed, the line between what is "natural" and what is the result of anthropogenic processes has grown increasingly blurry. In agricultural and urban ecosystems this line is even more difficult to draw.

As we now find ourselves well into the Anthropocene, understanding how social and biophysical processes work together to shape the environment is crucial. The bifurcation of nature and society into separate conceptual spheres was accelerated during the Enlightenment via the "Balkanization of knowledge" into natural and social sciences—separate, estranged families, each largely unintelligible to the other (Dickens 1996; Smith 2008). This false dualism, reified by differing methodologies, journals, conferences, jargon, and political economies of funding, research, and teaching, has kept physical and human geography separate, as well. Rare are the Foucauldians at the biogeographers' colloquia, and even rarer are the geomorphologists who take seriously Lefebvre's theories on the production of space.

Nevertheless, environmental geography is inherently a hybrid of biophysical and social science. Understanding urban ecosystems, in particular, depends on the overcoming this rift. Recent work in urban political ecology highlights the interrelatedness and interplay between social and biophysical processes. Drawing both on Marx's theories of social metabolism of nature—that labor is the means through which humans mediate their physical surroundings—and the ecological systems theories of the 1970s, urban geographers have explained cities as ground zero of metabolism of the biophysical environment (Heynen, Kaika, and Swyngedouw 2006a; Gandy 2003). This metabolism shapes both the environment and the humans dwelling therein. Viewing cities, like any landscape transformed by human activity, as "socio-natures", we can overcome the false dichotomy between what is natural and what is social (Swyngedouw 2006). Understanding socio-natures requires analysis of both biophysical and social factors, and more importantly, the ways in which the two are interrelated. As Harvey (2006) has written,

> We have to understand how the accumulation of capital works through ecosystemic processes, re-shaping them and disturbing them as they go. Energy flows, shifts in material balances, environmental transformations (some of them irreversible) have to be brought thoroughly within the picture. But the social side cannot be evaded as somehow radically different from its ecological integuement….The circulation of money and capital have to be construed as ecological variables every bit as important as the circulation of air and water. (88)

While the growing field of political ecology has attempted to do precisely this work, it has nevertheless failed to fully engage with biophysical and ecological science; as Walker (2005a) asks, “Political ecology: Where’s the ecology?” Indeed, much political ecology better falls into the realm of environmental politics, with little emphasis on biophysical processes. Fifteen years later, Zimmerer’s call for the integration of the biophysical insights from the so-called “new ecology” into geographical research on human-environment interactions remains prescient (Zimmerer 2004). Similarly, ecological research in non-equilibrium, chaos, resilience, and hierarchy theories all stand to benefit from a greater engagement with difficult to quantify social processes, such as flows of capital (as Harvey suggests), environmental regulation, and political mobilization by various stakeholders.

Environmental geographers in general, and political ecologists, more specifically, stand to gain from a greater immersion in the scientific literature—and vice versa. Geomorphologists and soil scientists have certainly attempted to quantify anthropogenic influences on landscape formation. An entire sub-field of soil science focuses on soil erosion related to agriculture. A keyword search of the AGRICOLA database for “erosion” and “tillage” for example, resulted in 579 peer-reviewed journal articles published from 2000 and 2009. A search of abstracts in the Ovid Geography database for “geomorphology” and “agriculture” produced 155 results for the same period. While physical geographers and soil scientists can quantify these impacts, we are left with social questions—who, how, and why?

The intersection of natural and anthropogenic processes are rarely more visible than in urban environments. As in agricultural or other extractive landscapes, soils in urban areas provide us with a perfect example of how geomorphic and anthropogenic processes work in tandem to “produce nature”. Perhaps the result of the aforementioned Balkanization of knowledge, geomorphologists have directed less attention to urban areas, anthropogenic environments where it is difficult to view geomorphic and other biophysical processes at work in a “natural” or undisturbed state. Only 32 abstracts published since 2000 (and listed in the Ovid Geography database) contain both “geomorphology” and “urban”.[148] Most urban geomorphology seems to fall into the realm of fluvial geomorphology and hydrology.

This appendix, intended as a supplement to the discussion of soil contamination in Chapter 5, represents a preliminary attempt to understand the genesis and characteristics of Oakland’s soils. More specifically, I’m interested in teasing out the ways in which geomorphological and anthropogenic processes have worked together (or against each other!) to produce them. In the first part of this Appendix, I briefly review the major factors influencing pedogenesis (or soil formation) with particular emphasis on geomorphological processes and the ways in which human activity can accelerate or impede these processes. In the second part of the Appendix, I explore Oakland’s soils, first discussing the geomorphic and geologic history of the city, then how these processes factored into the formation of the various soils, and finally, the role of human activity in their development.

Part 1. Pedogenesis

Soil (aka, regolith or the pedosphere) is the interface between the atmosphere, biosphere, lithosphere, and hyrdrosphere, a complex natural body consisting of air, water, soil microorganism, decaying OM, and unconsolidated, weathered minerals derived from underlying bedrock. Weathering is either physical or chemical. Physical weathering involves the physical disintegration of rock into smaller sized particles, and eventually into silt, sand, and clay particles made up of component minerals. Temperature plays a role in physical weathering, as

[148] All databases accessed on December 1, 2009

freezing/thawing cycles can lead to shrinking and swelling of water in the rock, leading to fracturing. Bioturbation, or physical movement of rocks and soil by living organisms, can also cleave apart rock; plant roots, for example take advantage of fractures in the rocks both for stability and the moisture and availability of nutrients, cleaving apart rocks as they grow. Abrasion by water, wind, and ice is another primary means of physical weathering (Brady and Weil 2002).

As particle size decreases (and surface area increases), rocks are more susceptible to geochemical weathering by water, oxygen, and organic acids (exuded from plant roots and microorganism) that reduce primary minerals such as feldspar and mica to secondary minerals such as clays and carbonates. There are six basic types of chemical weathering, which occur in an integrated, simultaneous, and interdependent manner: hydration, hydrolysis, dissolution, acid reactions (e.g., carbonation), oxidation, and complexation (see Table B1.1).

Table B1.1: Primary geochemical weathering processes (adapted from Brady and Weil 2002)

Process	**Description**
Hydration	the binding of intact water molecules to a mineral
Hydrolysis	the splitting of water into hydrogen and oxygen and replacement of a cation from the mineral structure by the hydrogen ion
Dissolution	Dissociation of cations due to hydration by water molecules
Acid Reactions	Increased presence of hydrogen which speeds dissolution of minerals (e.g., carbonic, nitric, sulfuric acids)
Oxidation	Oxidation (loss of an electron) when hydrated, destabilizing crystalline structure
Complexation	Formation of chelates by organic acids (oxalic, citric, tartaric, fulvic, humic)

The rates at which physical and geochemical weathering occur depend on several environmental and temporal factors. Berkeley soil scientist Hans Jenny developed a theory of soil formation, or pedogenesis, in the 1940s that identifies five key factors that influence the rate of weathering of parent materials and the subsequent development of regolith: parent material, climate, biotic, topography, and time (Jenny 1941). These factors, well summarized by Brady & Weil (2002), are the following:

Parent Material

The underlying bedrock or parent material impacts the soil texture. Sandy soils are derived from parent material that are coarse-grained, and quartz-rich (e.g., sandstone, granite). Texture then influences the rate of water infiltration, which as discussed above, is a central factor influencing the rate of weathering. The quantity and type of clay minerals in a soil are also determined by its parent material. The chemical makeup of the parent material also influences the type of vegetation that takes root on the soil. As bedrock weathers, it releases soluble, bioavailable nutrients, impacting the acidity of the soil. Certain plant communities are more tolerant of acid soils, others of alkaline soils, some of nutrient rich, some of nutrient poor soils. Parent materials are either residual (i.e., saprolite or bedrock weathered in place) or transported by water (lacustrine, alluvial, marine), wind (eolian), gravity (colluvial), ice (till, moraine), volcanic, or some combination of processes.

Climate

Water is central to most weathering reactions, as summarized above. Precipitation is therefore central to weathering, but the *effective* precipitation—the amount of water that actually reaches the parent material—depends on the interaction with other factors, such as topography, evapotranspiration (related to temperature and plant species), and the overlying soil texture. Temperature is also important, not only in terms of freezing and thawing cycles mentioned above, but to biotic activity metabolizing the regolith. Biochemical reactions can double with every 10°C increase in temperature.

Biota

Vegetation is a major factor in pedogenesis. Ground cover influences effective precipitation and stabilizes soil to prevent erosion. Root growth can accelerate physical weathering by fracturing parent material. Organic acids exuded from plant material can weather primary and secondary minerals in the regolith. Acids exuded by lichen weather bedrock itself. Above and below-ground plant materials becomes soil OM as it decomposes, forming the humic A horizon of the soil. Different plant species have different water and nutrient requirements, leading to plant-related differences in rates of weathering and resulting soil chemistry. Different levels of acidity result from different forms of plant litter and chemical reactions related to weathering, impacting the soil ecology. Differences in pH, moisture, and availability of OM all impact the population and community composition of soil microbes and micro fauna at multiple trophic levels—decomposers, shredders, grazers. These organisms are responsible for disturbing the soil (bioturbation or pedoturbation), allowing for aeration and water percolation, and the release of enzymes that help to form soil aggregates from sand, silt, and clay particles and OM at various stages of decay. Soil aggregation is fundamental to the percolation of air and water, which mediates chemical weathering, and soil stability. Human activity can also be classified as a biotic factor in pedogenesis (I will address this at the end of this section).

Topography

Topography influences soil genesis via a combination of three factors: slope, aspect, and location of parent material. As regolith moves downhill due to hillslope processes, it collects at different thicknesses depending on its location on the slope. On steep slopes, particularly those with little vegetation, soils are thinner. At the bottom of the slope, they tend to be thicker. Soils at the top of a slope or along a ridgeline are generally derived from weathered parent material or saprolite. Soils on the slope itself and at the bottom itself are generally derived from colluvium. In drainages and basins, soils are derived from alluvium. They tend to be thicker and deeply weathered. Soil profiles here are more distinct because they are undisturbed. The downward percolation of water leaches minerals. In basins where drainage is poor, oxidation/reduction processes transform the chemical makeup of the soil. These variations due to a soil's location and development along a topographical gradient form a toposequence or catena. Aspect influences soil formation because it impacts vegetation growth. Moisture levels are generally lower on the slopes with direct sun exposure; vegetation flourishes on the wetter side. Additionally, precipitation carried by prevailing winds will disproportionately saturate slopes facing the prevailing winds, as I will discuss later in the paper. Finally, parent material is a function of topography. Underlying bedrock often differs in different locations due to the geomorphic processes shaped the landscape; for example, sedimentary alluvium is found in an ancient floodplain while metamorphic and granitic bedrock might be found along a ridgeline that was folded up by tectonic processes. As various layers erode away due to hillslope processes, new layers are exposed and weathered.

Time

Time is the last of Jenny's factors. Weathering occurs at different rates due to interactions with all of the various factors listed above. Soil classification is largely based on what stage of weathering is present.

Anthropogenic influences

While we could classify humans as just another biotic factor influencing soil formation, it is important to not underemphasize anthropogenic soil formation over the last several thousand years. While a general review of anthropogenic impacts on landscape processes is outside the scope of this paper, it is important to note that geomorphic processes such as erosion and weathering can be accelerated or transformed by human activity, impacting the four central processes of soil formation: transformations (chemical and physical modifications), translocations (lateral movement, especially by water), additions (input of OM), and losses (due to erosion and leaching) (Brady and Weil 2002). For thousands of years, anthropogenic activity has influenced landscape formation. One researcher estimates that the total amount of earth moved by humans in the last 5,000 years would equal a 4,000 m high mountain range, 40 km wide and 100 km long (Hooke 2000). If current rates continue (6 Mg/year worldwide and 31 Mg/year in the US), the mountain range would double in length over the next century. Anthropogenic soil transport has an enormous influence on soil formation; as Brady and Weil (2002) write, "In surface mining and urbanizing areas today, bulldozers may have an effect on soils almost akin to that of the ancient glaciers; they level and mix soil horizons and set the clock of soil formation back to zero" (61) (see Figure B1.1).

Figure B1.1: Urbananthro pedoturbation. Photos taken by the author, June 2010.

Road construction, in addition to mixing and moving soil, also accelerates erosion. Many unpaved roads in the tropics weather down to bedrock within only a few years of construction. The impact of dams on sediment retention is well documented. Dams have reduced the transport of sediment to the world's oceans by 1.4 billion Mg/yr, for example (Syvitski et al. 2005). Mining of gravel from riverbeds also greatly influences not only sediment loads, but channelization of rivers. One study estimated that 230,000 to 580,000 m^3 of gravel extraction from a river in California caused 5m of channel incision (Kondolf and Swanson 1993). This likely impacts the physico-chemical characteristics of alluvial soils upstream from dams and flow rates that could affect additions and losses of soil material. Currently, 75 billion Mg of soil are removed annually by wind and water erosion, mostly from agricultural land. Agricultural land in the US and Europe loses, on average, 17 Mg/ha annually to erosion; in the Global South, as much as 30 to 40 Mg per hectare are lost each year. On overgrazed pastureland, as much as 100 Mg of soil per hectare are lost annually (Pimentel et al. 1995). Similarly, erosion due to agriculture and other anthropogenic activity has increased the sediment transport in the earth's rivers by 2.3 billion Mg/yr (Syvitski et al. 2005). In urban areas, persistent urbanization on steep, hazard prone soils is a major trigger of landslides at a terrible cost in terms of lives and infrastructure (Alexander 1989; Davis 2006; Gupta and Ahmad 1999).

Part 2. Understanding Oakland's Soils

As I argue in the introduction, understanding urban soils involves engaging with both biophysical and anthropogenic processes. In the remainder of this paper I will focus primarily on the physical processes, as the spatial organization of Oakland's economic development are thoroughly discussed in Chapter 2. Oakland, California, a post-industrial landscape tucked between the San Francisco Bay and California Coast Range, provides an excellent empirical case. A map of Oakland's geology (see Figure B1.2) reflects the multiple layers of geomorphic and anthropogenic processes that have defined the city's physical landscape and the creation of its soils.

Geomorphic Processes

The topography of the East Bay is largely the result of tectonic processes. The movement of the Pacific Plate northward along the San Andeas Fault has created a network of semi-parallel strike-slip and thrust faults, including the East Bay fault system which became active ~12 Ma ago. The dominant Hayward Fault (in black Figure B1.2) is a right lateral strike-slip fault. The land to the west of the fault moves in a northwesterly direction relative to the land east of the fault. This tectonic movement has led to compression due to the orientation of the fault, causing uplift and the formation of undulating, parallel ridges. These Coast Ranges include the Oakland Hills (technically referred to as the Berkeley Hills, and known as the Contra Costa Range prior to that) which have been thrust upwards along the Hayward and Moraga faults over the past million years and continue to rise (Sloan 2006).

As the Oakland hills have risen through tectonic uplift, they have eroded away at a similar rate, exposing a palimpsest of overlying sedimentary rocks and basement complex rocks along the ridge lines. Like most of California's Coast Ranges, the hills feature an incredibly heterogeneous amalgamation of geological material. Layers of shale, siltstone, sandstone, claystone, conglomerate, and volcanic material are folded and faulted in a series of ridges. East of the Hayward Fault, on the eastern slope of the Berkeley/North Oakland hills, a narrow swath of overlying sedimentary rocks is present. These sediments were laid on the sea floor during the Oligocene (23 to 33.9 Ma ago) and Eocene (33.9 to 55.8 Ma ago) epochs, and began to rise with the formation of the San Andreas Fault system 25 Ma ago. By the Late Miocene (11 to 12 Ma ago), these sedimentary layers were at the shoreline. For the most part, however, these layers have eroded away, exposing basement complex rocks on the hills' steep western slopes. These basement layers were formed over 100 Ma during the Mesozoic Era subduction as the Pacific and North American Plates collided. Two major complexes are visible: Franciscan and Great Valley.

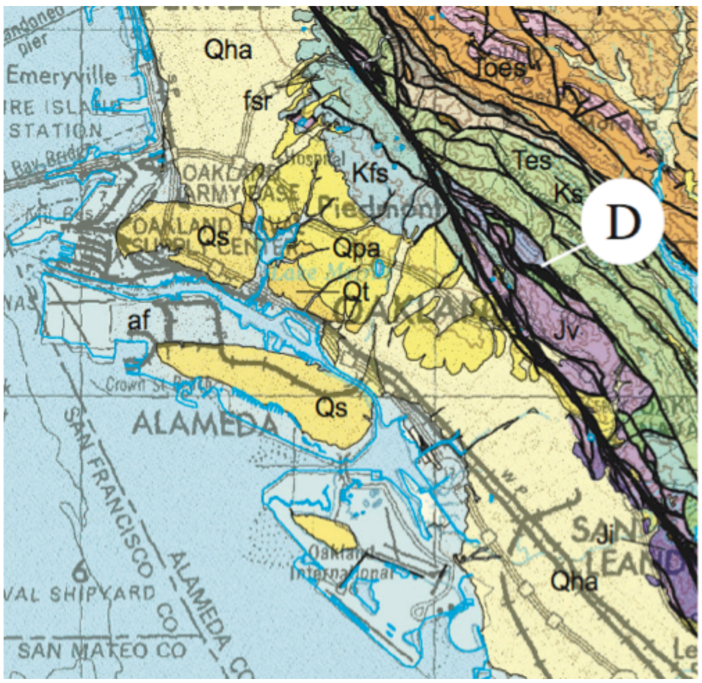


Figure B1.2: Oakland's geology

Surficial Sediments
- af: artificial fill
- Qha: Alluvium (Holocene)
- Qs: Beach and dune sand (Quarternary)
- Qpa: Alluvium (Pleistocene)
- Qt: Marine terrace deposits (Pleistocene)

Overlying Rocks
- Toes: Sedimentary rocks (Oligocene and/or Eocene)
- Tes: Sedimentary rocks (Eocene)

Basement Complex Rocks
- fsr: Franciscan Complex mélange (Eocene, Paleocene, and/or Late Cretaceous)
- Ks: Great Valley complex sedimentary rocks (Cretaceous)
- Kfs: Franciscan Complex sedimentary rocks (Cretaceous)
- Jv: Great Valley complex volcanic rocks (Jurassic)

Source: USGS (http://geomaps.wr.usgs.gov/sfgeo/geologic/details.html)

The Great Valley Sequence was formed during Jurassic and Cretaceous (200 to 65 Ma ago) periods as marine sedimentary layers of shale, sandstone, and conglomerate developed in a fore-arc basin between the subduction trench and volcanic arc paralleling the continent's edge. Most of the Great Valley sedimentary rocks can be found east of the Hayward fault. As these layers have eroded away, however, older outcrops of Great Valley Complex rocks are visible, particularly on the steep western slopes in the hills above East Oakland. This complex consists of Coast Range Ophiolite formed during the Jurassic. This includes basalt from the ocean crust, plutonic rock from the upper mantle, and metamorphosed upper mantle rocks, including serpentinite. To the west of the fault in the hills above North Oakland and Piedmont, Franciscan Complex sedimentary layers of sandstone and shale from the Cretaceous predominate. Just to the north, younger Franciscan mélange from the Early Tertiary dominates. This mélange is made up of basalt from suboceanic lava flows, chert from the skeletons of radiolaria, sandstone and shale deposited in a subduction trench, and various rocks metamorphosed during subduction (Sloan 2006).

Various forms of mass wasting—slumps, debris flow, rock fall, and creep—have contributed to the gradual erosion of the Oakland Hills. Due to their small scale, these events are not easy to identify on a geologic map. But the ongoing prevalence of these events in Oakland underscores their important role in landscape formation, particularly in winter months when the regolith becomes saturated with precipitation. In areas where weathered sandstone dominates and drainage is greater, creep is a dominant process. The smoothing and rounding of the Oakland hills and foothills is due largely to this process. The drier, eastern side of the Oakland Hills and those of eastern Alameda Co. are even more representative. On the western side of the range where precipitation is greater, soil slip, landslides, and debris flow are common. Between 1940 and 1971, over 335 landslides damaged property in Alameda Co. and 659 parcels were devalued (Nilsen, Taylor, and Brabb 1976). See Chapter 5, Figure 5.2.9 b, for an example of a slump in the Harrington neighborhood of East Oakland. Jungle Hill, as locals refer to it, is tucked between Santa Rita St. and Ransome Ave. By 1925, six houses had been built on the site, but during the 1930s, five of the houses collapsed during a landslide. In the 1970s, the final house collapsed. The site became a park, first owned by the Santa Rita Community Land Trust, later ceded to Oakland Parks and Recreation (Oakland Museum of California 1997).

The differential erosion of the Oakland hills is also dependent on the interaction of topography and vegetation. Biomass is greater in drainages and on north-facing slopes, trapping sediment and stabilizing soil. With 90% of precipitation falling between November and April, soils are often saturated. Given the NW to SE orientation of the Oakland hills along the fault and prevailing WNW winds, precipitation is concentrated on from is concentrated on northern slopes. Windward steep slopes receive twice as much rainfall as leeward slopes. During the catastrophic three-day storm that killed 33 people resulted in 18,000 landslides in January 1982, storm winds shifted to the SE, saturating southern slopes protected only by shallow rooted annual grasses. More than half of soil slip/debris flow during the storm occurred on south- to WSW-facing slopes (Pike and Sobieszczyk 2008).

Most eroded material, however, has moved downslope as alluvium. Several creeks have historically drained the ridges, notably Temescal, Glen Echo, Sausal, Arroyo Viejo, and San Leandro creeks. Downslope and dominating the vast majority of Oaklands foothills and flatlands is Pleistocene alluvium. One alluvial fan stretches from Pill Hill (the location of Alta Bates Summit Hospital, south of MacArthur Blvd. between Broadway and Telegraph Ave.) towards East Oakland. Foothill Blvd. runs along its base. In East Oakland, this alluvium sweeps southward downslope in several fan formations along the San Leandro, San Lorenzo, and Alameda drainages. Overlaying these alluvial deposits are more recent deposits of Holocene alluvium, particularly in North Oakland and along the flood plain surrounding Glen Echo Creek and its Broadway and Rockridge branches. In East Oakland this alluvium appears to have been transported by Arroyo Viejo and Sausal Creek drainages.

Further towards the Alameda Estuary, Pleistocene marine terrace deposits are visible southeast of Lake Merritt. Adam's Point, the hilly northern shore of the lake, was the shoreline when the lake and flatlands to the south were underwater during the last interglacial period, ~70 Ka ago.[149] This terrace, like those visible elsewhere along California's Central Coast, was a wave cut bench slowly uplifted by the same tectonic processes giving rise to the Coast Range. Pleistocene deposits of alluvium eventually covered the terrace. The terrace extended west of

[149] http://oaklandgeology.wordpress.com/category/oakland-soil/

Lake Merritt into West Oakland, as well, but appears to have been later buried by Quarternary beach and dune sand blown across the river valley that is now the San Francisco Bay.[150] These sands originated during the Pleistocene, as Sierran granite was ground by glaciers and sediments transported along the San Joaquin and Sacramento Rivers, deposited along the river's floodplains and at the mouth of the river, which was located out by the Farallon Islands. Sands were transported eastwards by prevailing winds, deposited across the northern end of the San Francisco Peninsula, West Oakland, and western Alameda (Sloan 2006). Artificial fill, which I will address later in the paper when I discuss anthropogenic processes, was deposited along the Alameda estuary and San Francisco Bay throughout the 20th century completes the geologic mosaic.

Characterizing Oakland's Soils

Keeping Jenny's factors of soil formation in mind, Oakland's geomorphic history sheds considerable light on the city's pedological landscape. While some sedimentary parent material was transported downslope, some remained atop of ridgelines to be weathered by physical and chemical processes. Indeed, soil erosion and soil formation have been in equilibrium in many of the steeper areas of the hills. Creep, landslides, and debris flows are common in clayey soils when they become saturated with precipitation. The sedimentary materials described in the previous section weather to silt and mostly montmorillonitic clays. Soft and fractured, they weather rapidly. Layers of lime are common, leading to some highly alkaline soils in the hills, such as the Climara clay and Montara-Rock outcrop complex [see Fig. 7]. As soils erode away and sediment transported downslope, the soils remaining on the ridges are generally thinner. Maymen, Millsholm, and Montara series are all shallow soils, excessively drained soils found on the ridges of the Oakland hills (see Table B1.1).

The interaction of vegetation and topography clearly plays a role in the development of Oakland's soils, particularly along drainages and north-facing slopes, as discussed above. The Los Gatos series soils, for example, present in Oakland only in small enough concentrations to be classified as part of a complex (Los Gatos-Los Osos and Maymen-Los Gatos complexes, located at the far northern and far southern ends of the Oakland Hills ridgeline) appear on north-facing slopes. In addition to controlling soil erosion, different vegetation and topographic regimes lead to differential rates of weathering of parent material. Water use, nutrient uptake, exudation of organic acids, and deposition of leaf litter differ under different vegetation regimes, each influence this rate of weathering. As discussed above, greater density of biomass also slows the transport of sediment. In the drainages, Coast Live Oak (*Quercus agrifolia*), California Bay Laurel (*Umbellularia californica*), Manzanita (*Arctostaphylos* spp.), and other trees dominate. Soils have developed in response to these moisture regimes. Lagenour loams, for example, dominate along the San Leandro Creek drainage, where alluvium is recent and drainage is poor. The aspect of a slope also plays a major role in terms of what type of vegetation is present. In the Bay Area, north-facing slopes are often covered with denser vegetation. These slopes are cooler and generally moister, providing a more favorable microclimate for coyote bush (*Baccharis* spp.) and oak, while annual grasses dominate on the south-facing slopes.

[150] I am assuming that the marine terrace wraps around to the west and was simply covered by Pleistocene aeolian deposits of sand.

Table B1.1: Dominant soils of the Oakland hills and foothills

Name	Area (ha)	% of Total Area	Slope (%)	Pedogenetic Factors (parent material, moisture, topography, anthropogenic influence)
Altamont clay	13.4	0.1	15 to 50	weathered from interbedded soft shale, fine-grained sandstone, soft conglomerate; foothills
Azule clay loam	28.7	0.2	9 to 50	weathered from consolidated alluvial sediments, soft shale, or fine-grained sandstone; foothills
Climara clay	76.8	0.5	30 to 50	deep, well-drained, weathered from ultrabasic rock
Laugenour loam, drained	29.2	0.2		deep, poorly drained, formed on recent alluvium adjacent to streams
Los Gatos - Los Osos complex	94.0	0.7	50 to 75	deep, well-drained, formed on steep slopes from sedimentary rock; Los Gatos on north-facing slopes, Los Osos on south-facing
Los Osos silty clay loam	17.6	0.1	9 to 50	moderately deep, well-drained, formed from weathered interbedded sedimentary rock
Los Osos - Millsholm complex	258.0	1.8	9 to 50	Los Osos on steep side slopes, underlain w/ shale; low permeability, erosive, moderately deep; Millsholm is shallow, ridges, medium to rapid runoff
Maymen loam	1,229.5	8.7	30 to 75	weathered sedimentary residuum, excessively drained, shallow, underlain by shale
Maymen - Los Gatos complex	730.2	5.2	30 to 75	weathered sedimentary rock; Maymen shallow, on ridges, excessively drained; Los Gatos on lower and north-facing slopes
Millsholm silt loam	523.2	3.7	30 to 75	residuum of shale & fine-grained sandstone, well drained, shallow
Montara - Rock outcrop complex	171.7	1.2	30 to 75	shallow, excessively drained, steep upland slopes, alkaline; underlain by ultrabasic bedrock
Quarry	33.9	0.2		anthropogenic (mining of pyrite, chalcopyrite, sulfur, and eventually fill for the Port of Oakland)
Xerorthents - Altamont complex	295.9	2.1	30 to 50	anthropogenic (fill, leading to soil heterogeneity, angular shale fragments) + weathered from sandstone and shale; foothills adjacent to the Bay
Xerorthents - Los Osos complex	581.9	4.1	30 to 50	anthropogenic (fill, leading to soil heterogeneity, angular shale fragments) + weathered sedimentary rock; high erosion (30 to 50% slopes)
Xerorthents - Millsholm complex	1,161.5	8.2	30 to 75	anthropogenic (fill, leading to soil heterogeneity, 50% angular shale fragments) + weathered shale, sandstone; rapid runoff, high erosion (30 to 50% slopes)

(Source: USDA 1981 and NRCS 2009)

Table B1.2: Dominant soils of the Oakland flatlands

Name	Area (ha)	% of Total Area	Slope (%)	Pedogenetic Factors (parent material, moisture, topography, anthropogenic influence)
Clear Lake clay, drained	184.0	1.3	0 to 2	deep soil formed in alluvium in basins
Danville silty clay loam	56.6	0.4	0 to 2	deep, well drained, formed on low terraces from alluvium derived from sedimentary rock
Laugenour loam, drained	29.2	0.2		deep, poorly drained, formed on recent alluvium adjacent to streams
Sycamore silt loam, drained	72.4	0.5		deep, poorly drained soils formed on flood plain alluvium + anthropogenic erosion due to agriculture & grazing
Urban land	2,371.3	16.7		anthropogenic disturbance (construction, importation, and mixing of soil and fill); heterogeneous texture
Urban land - Baywood complex	641.0	4.5		Anthropogenic + aeolian deposits of Baywood loamy sand transported from mounds and ridges adjacent to beaches; West Oakland
Urban land - Clear Lake complex	1,164.5	8.2		Anthropogenic (construction) + poorly drained alluvium; flatlands & basins
Urban land - Danville complex	1,037.3	7.3		Anthropogenic (construction) + deep, well drained sedimentary alluvium; slow permeability
Urban land - Tierra complex	2,457.6	17.3	2 to 30	Anthropogenic + weakly consolidated, stratified alluvium and sandstone; slow permeability, susceptible to erosion on 15 to 30% slopes
Xeropsamments, fill	582.0	4.1		Anthropogenic (beach sand dredged from areas adjacent to Alameda Naval Air Station & Oakland Airport); erosion prevented w/ levees
Yolo silt loam	80.3	0.6	0 to 2	Sedimentary alluvium from fans and floodplains

(Source: USDA 1981 and NRCS 2009)

Most of the soils that have developed in the upper flatlands (see Table B1.2) appear to be derived from the massive fan of alluvium washed down the western slopes of the Oakland Hills during the Pleistocene. Tierra series soils, made up of weakly consolidated sediment, dominates in central East Oakland and follow the form of the massive Pleistocene alluvial fan which covers most of the upper flatlands (the gentle upward gradient moving towards the foothills). Pleistocene sedimentary alluvium on the marine terraces in the flatlands has weathered into the Danville series. In poorly drained basins, Holocene alluvium has weathered into Clear Lake series which can be found at the base of the enormous fan. Aeolian transport of Quarternary sandy beach sediment inland towards downtown and Alameda formed the Baywood series soils. The marshy tidal flats of the Bay consist of unconsolidated sediments deposited by tides, currents, and waves. Marsh grasses (cordgrass and pickleweed) trap sediments and prevent erosion. Salt and reduced sulfur compounds are common. The Reyes soils, such as that of Arrowhead Marsh (the tiny triangular spit of land between Bay Farm Island/Oakland Airport and the shoreline) formed in these tidal flats are high in OM (5 to 10%) and become highly acid when aerated.

Anthropedogenic processes

The vast majority of Oakland's soil (nearly three-quarters) can be classified as anthropogenic. Anthropogenic geomorphic processes in Oakland can be classed into two major categories: erosion due to livestock and agriculture, and mechanized transport of regolith for the construction of infrastructure (housing, industry, roads, quarries, drainage canals).

Figure B1.4: Laugenour loam at San Leandro Creek and Hegenberger Rd., East Oakland. Source: maps.google.com

With the granting of the San Antonio Land Grant by the Spanish crown to Luis Peralta in 1820, cultivation and grazing (anthropogenic forms of bioturbation) on steeper slopes began to accelerate the hillslope processes discussed above. With annexation by the US, resource extraction and exploitation intensified. By 1860, almost all of Oakland's redwoods were logged, surely exacerbating soil erosion along the drainages where they were cut. Francis "Borax" Smith opened sulfur mines in 1906 in East Oakland's Laundry Farm Canyon. Tailings up to 150' high are still piled at the headwaters of the creek. Grazing continued, but agriculture, including fruit tree orchards, was widespread in East Oakland. As discussed in Chapter 2, Oakland annexed townships to the east of Lake Merritt in the late 19th century. Industry expanded eastwards along the estuary during the first half of the 20th century, fueled first by the development of the transportation and warehousing sectors and later by shipbuilding, auto manufacturing, and food processing (Scott [1959] 1985; Walker 2001). The massive influx of workers during both wars and an influx of capital from FHA loans saw the massive expansion of residential developments surrounding the factories, an "industrial garden" where both workers and capitalists could flourish (Self 2003).

Much of the formerly agricultural land was developed during this period, with only names (such Fruitvale or the name of the city itself) as reminders of what had preceded urban development. Within Oakland, few agricultural soils remain. Laugenour and Sycamore soils, loams that had developed in the San Leandro Creek floodplain from Holocene alluvium (and likely augmented by sediment transported downstream from the construction of the Lake Chabot reservoir in 1875) were once home to fertile agriculture. The last large expanse of these soils, the last remaining large-scale commercial farm (~10 acres) within the city limits, was located on one of these soils, but was sold to developers only a few years ago (see Figure B1.3).[151]

The introduction of exotic species may have also affected soil formation. Eucalyptus and Monterey pine now dominate the hills, while a century ago, grasses covered the hills, and bay and redwoods grew along drainages. In addition to deposition of OM in the form of litter, the trees retain more moisture which would accelerate chemical weathering. Soils beneath Eucalyptus and Monterey pine are also more hydrophobic, leading to more rapid saturation of

[151] I didn't classify these two soils as anthropogenic in the soils map because they have been impacted to the extent to which the other soils have by urbanization.

the soil under heavy precipitation, risking an increase in landslides and other forms of mass wasting.

While agriculture and plantation of exotics certainly transformed the physical and chemical characteristics of Oakland's soil, the primary anthropogenic process impacting urban soil formation, however, has been construction. The Tierra, Clear Lake, and Danville soils of East Oakland that were once used for grazing and farming were eventually covered with houses, buildings, and roads, all built on foundation material transported from various origins, mixed with concrete, and other materials. The underlying soils exist now only as complexes with "Urban land", soils described the Soil Survey as constituted mostly of "heterogeneous fill", a sort of miscellaneous area covered by infrastructure. Urban land and urban land complexes dominate Oakland's landscape, totaling nearly 10,400 ha, or 75 percent of the city's soil surface.[152] In the hills, several Xerorthents complexes are present. Angular shale fragments mixed in with existing soil are indicative of soil disturbance and the addition of fill to construction sites. Quarries are a major source of fill used for construction. Oakland's largest quarry, first called the Ransome Quarry, and later the Leona Quarry or the Gallaher and Burke Quarry, opened in 1904, extracting material from the Leona Rhyolite, a Great Valley complex ophiolite. The 127 acre quarry was a source of pyrite (iron sulfide), chalcopyrite (iron copper sulfide), and sulfur. Much of this material was used for asphalt and paving material. Fill from the quarry was also used in construction of the Port of Oakland, BART, the Oakland Coliseum, and the airport. The Leona Quarry is still visible on the hillside above Interstate 580 at Edwards Rd, and is now the site of Monte Vista Villas, a development of 404 attached unit luxury condos and townhouses precariously perched above the freeway. To prepare for construction, 3.5 million cubic yards of earth were moved to terrace the once steep quarry walls. The terraces were covered with topsoil and compost. A layer of crushed crab shells, called Chitosan, was laid in a drainage retention basin at the base of the site to filter out sediment (Sloan 2006).

Most of the urban land adjacent to the estuary and Bay is entirely anthropogenic, appearing as "Artificial fill" on the geologic map. By 1935, artificial fill had extended Oakland's shoreline by nearly two miles westward into the Bay. Beach sand (Xeropsamments) collected from the estuary and Bay shorelines was hydraulically moved to adjacent areas and used as fill. In 1939, 6.5 million cubic yards of fill was used to create the Army's Oakland Terminal of the San Francisco Port of Embarkation. An assessment of the former Army Base site revealed that artificial fill extends from the surface to 4 to 8' below the surface. The fill lies on top of a sand layer between 9 to 13.5' which lies atop a 1.5 to 2.5' thick layer of Young Bay Mud, which lies atop a 35 to 50' thick layer of Merritt Sand formation. Rock fill for seawalls quarried at Point Richmond and Point San Pedro, and Leona Rhyolite, a Great Valley ophiolite, from Lake Temescal and Gallagher and Burke quarries. New marine terminals in Outer Harbor of Port created with 2 million cubic yards of fill to create 29 acres of new land (known to engineers as "fastland") (Oakland Army Base EIR 2002).

[152] Using ArcGIS to NRCS Soil Survey data (NRCS 2009), I calculated the areas of individual soil series within the city limits. Results are presented in Tables 1 and 2.

Appendix B2: Physical properties and soil fertility characteristics at selected sites

Site	Land use	pH	Sand	Silt	Clay	OM	Total C	Total N	Total P	C/N ratio	NH_4-N	NO_3-N	Olsen P	Exchangeable K	Exchangeable Na	Exchangeable Ca	Exchangeable Mg	CEC
			(%)								(mg kg^{-1})			(cmol$_c$ kg^{-1})				
9th St.	Vacant	6.8	n.d.	n.d.	n.d.	n.d.	7.92	0.518	0.199	15.3	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Filbert	Vacant	6.9	n.d.	n.d.	n.d.	n.d.	3.83	0.245	0.138	15.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brookdale	Park	6.0	n.d.	n.d.	n.d.	n.d.	4.54	0.36	n.d.	12.6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Jungle Hill	OS		34	35	31	3.71	2.32	0.193	0.046	12.1	5.89	5.24	24.5	1.40	0.43	17.66	10.66	35.2
Columbia Gardens	Park	6.7	43	40	17	6.8	4.4	0.4	0.1	12.0	9.4	16.9	45.6	1.0	0.4	21.1	6.4	35.9
Doolittle	Vacant	6.8	n.d.	n.d.	n.d.	n.d.	2.05	0.12	n.d.	17.0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Harbor Bay (soil 1)	Vacant	6.6	76	14	10	3.47	2.09	0.155	0.046	13.5	6.14	12.48	26.8	0.66	0.08	11.63	2.11	18.6
Harbor Bay (soil 2)	Vacant	6.9	73	17	10	3.12	1.94	0.119	0.043	16.3	4.67	8.71	17.1	0.63	0.10	15.98	2.20	19.3
Oakport (soil 1)	OS	6.3	89	8	3	1.39	0.70	0.054	0.027	12.6	5.66	7.03	31.2	0.46	0.04	2.95	0.54	7.4
Oakport (soil 2)	OS	6.9	82	12	6	1.55	0.96	0.067	0.086	15.2	5.12	60.42	47.5	0.56	0.26	14.38	1.30	9.9
Oakport (soil 3)	OS	6.8	67	19	14	4.06	2.53	0.192	0.044	14.2	5.75	5.09	24.8	0.72	0.10	11.23	3.32	22.6
Tassaforonga	Park	6.1	n.d.	n.d.	n.d.	6.65	4.31	0.343	0.064	12.7	8.73	13.01	35.6	0.86	0.30	17.11	7.33	36.9
98th Ave.	Vacant	7.1	n.d.	n.d.	n.d.	n.d.	2.75	0.201	n.d.	13.7	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
King's Estates	OS	6.8	30	36	34	3.23	2.04	0.178	0.027	12.6	8.59	4.60	6.4	0.74	0.28	22.67	10.05	35.6

n.d. = no data

Appendix B3: Total Pb, Cd, and As, DTPA-extracted Zn, Mn, Cu, and Fe, and KCl-extracted Al (mg kg^{-1}) in selected sites throughout Oakland

Site	Land use	n	---- Total ----		----------- DTPA-extracted ---------				KCl-extracted
			As	Cd	Zn	Mn	Cu	Fe	Al
			---------------------------------- (mg kg^{-1}) --------------------------------						
West Oakland									
9th St.	Vacant	7	n.d.	n.d	n.d.	n.d	n.d.	n.d	n.d.
Filbert	Vacant	8	n.d.	n.d	n.d.	n.d	n.d.	n.d	n.d.
Central Oakland									
Brookdale	Park	12	n.d.	n.d	n.d.	n.d	n.d.	n.d	n.d.
Jungle Hill	Open Space	16	7.91	0.5	12.2	114.7	2.6	196.7	<1.0
East Oakland									
Columbia Gardens	Park	14	7.59	0.6	22.95	36.4	7.15	135.1	<1.0
Doolittle	Vacant	8	n.d.	n.d	n.d.	n.d	n.d.	n.d	n.d.
Harbor Bay (soil 1)	Vacant	18	7.18	2.7	41.7	49.5	13.4	133.9	<1.0
Harbor Bay (soil 2)	Vacant	8	6.98	0.8	32.7	217.2	7	264.1	<1.0
Oakport (soil 1)	Open Space	12	2.58	<0.3	4.5	14.2	0.7	93.6	2.1
Oakport (soil 2)	Open Space	6	2.76	<0.3	7.3	13.9	2.1	44.6	1.2
Oakport (soil 3)	Open Space	10	6.51	0.4	25.9	112	4.2	273.1	<1.0
Tassaforonga	Park	6	6.96	0.5	65.8	57.95	7.4	264.3	<1.0
Oakland Hills									
98^{th} Ave.	Vacant	12	n.d.	n.d	n.d.	n.d	n.d.	n.d	n.d.
King's Estates	Open Space	13	7.53	<0.3	2.8	75.8	3.5	110.2	<1.0

Analyses: UC Analytical Lab
n.d. = no data

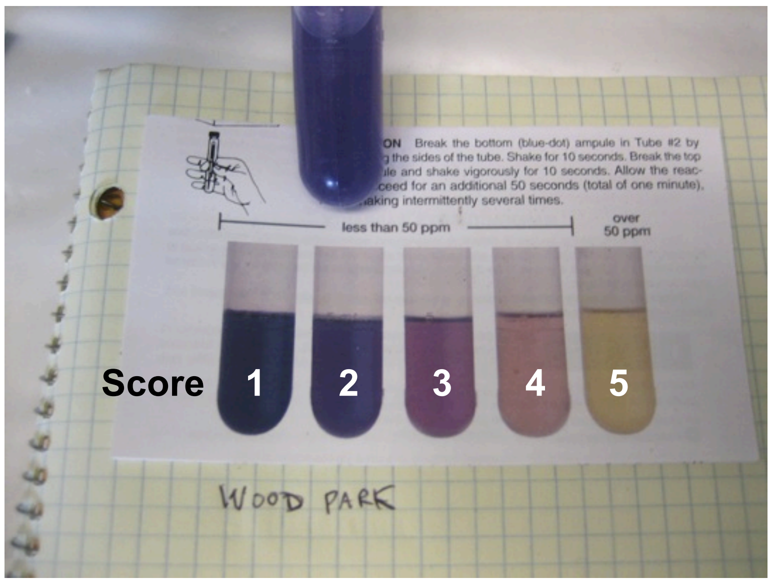
Appendix B4: Parameter Estimates for Log Total Pb = X coord, Y coord, soil type, distance to major road, and density of pre-1940s housing stock

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	306.65928	264.3739	1.16	0.2492
X Coord	-0.000064	0.000066	-0.97	0.3347
Y Coord	-6.362e-5	5.538e-5	-1.15	0.2538
Soil[CLEAR LAKE CLAY]	-0.574366	0.642956	-0.89	0.3741
Soil[CLIMARA CLAY]	-0.453307	0.606766	-0.75	0.4570
Soil[GILROY CLAY LOAM]	0.1396248	0.896947	0.16	0.8767
Soil[LAUGENOUR LOAM]	0.1169421	0.6445	0.18	0.8564
Soil[LOS OSOS-MILLSHOLM COMPLEX]	-0.288212	0.825111	-0.35	0.7277
Soil[MAYMEN LOAM]	0.0554638	0.491487	0.11	0.9104
Soil[MAYMEN-LOS GATOS COMPLEX]	0.188659	0.516203	0.37	0.7156
Soil[MILLSHOLM SILT LOAM]	0.0936769	0.436363	0.21	0.8305
Soil[SYCAMORE SILT LOAM]	-0.233807	0.819559	-0.29	0.7761
Soil[URBAN LAND]	0.0542151	0.358516	0.15	0.8802
Soil[URBAN LAND-BAYWOOD COMPLEX]	0.717191	0.461732	1.55	0.1240
Soil[URBAN LAND-CLEAR LAKE COMPLEX]	0.1540402	0.317805	0.48	0.6291
Soil[URBAN LAND-DANVILLE COMPLEX]	0.0325147	0.323983	0.10	0.9203
Soil[URBAN LAND-TIERRA COMPLEX]	0.2079005	0.245261	0.85	0.3989
Soil[XERORTHENTS-ALTAMONT COMPLEX]	-1.060846	0.824961	-1.29	0.2019
Soil[XERORTHENTS-LOS OSOS COMPLEX]	-0.160185	0.502961	-0.32	0.7509
Soil[XERORTHENTS-MILLSHOLM COMPLEX]	0.6074771	0.475297	1.28	0.2046
Pre40Dens	0.0435757	0.018978	2.30	0.0241*
Type[Garden]	0.2610583	0.284731	0.92	0.3618
Type[Open Space]	-0.302689	0.203211	-1.49	0.1400
Type[Park]	-0.288769	0.145939	-1.98	0.0510
DistMajRd	-0.000884	0.000569	-1.55	0.1241

* ($p<0.05$)

Appendix B5: PCB Screening

We took a subsample of 11 soils to screen for PCBs using Dexsil Clor-N-Soil PCB Screening Kit for Soil (Dexsil Corporation, Hamden, CT). Soils were selected to represent a range of geographic zones and land use types. The screening kit indicates presence of PCBs at levels > 50 mg kg^{-1} based on the color of the soil extractant. We attributed a score of 1 to 5 to each of the samples (see Figure below). Scores of 1 to 4 indicated no PCB presence > 50 mg mg kg^{-1}, while a score of 5 indicates presence of PCBs > 50 mg kg^{-1}. In cases where the sample extractant color was between two colors on the photo chart, we split the difference between the two scores. While two of the sites had scores of 4.5, none of the samples had scores of 5 (see Table below).



Type	Site	Zone	PCB (score)	Total Pb (mg kg^{-1})
Garden	CSF (WOW Farm)	West	2	248
	E. 19th St.	Central	4.5	326
Open Space	Harbor Bay (Soil 2)	East	4.5	221
	Jungle Hill	Central	2.5	41
	Oakport (Soil 3)	East	1.5	175
	Trafalgar	Hills	1.5	30
Park	Verdese Carter	East	2.5	13
	Wood Park	Central	2	23
Vacant	23rd Ave & E. 11th	Central	2	370
	98th & Stearn	East	2.5	35
	Doolittle Rd.	East	1.5	59

Appendix C1: OFPC Recommended First Steps

Value	First Steps
Justice and Fairness	*1. Develop "environmentally-friendly" preferable purchasing protocols.* Partner with the City of Oakland to develop and implement new RFP standards and language prioritizing and outlining "Environmentally Preferable Purchasing Protocols" (EPP) and nutrition standards for all City contracts, phased in over five years.
Strong Communities	*2. Protect and expand urban agriculture.* Create zoning definitions and operating standards for both civic and commercial urban agriculture.
	3. Strengthen community-government links. Foster relationships between key government representatives and community leaders.
Vibrant Farms	*4. Encourage accessible and affordable farmers' markets*. Create zoning definitions and operating standards for farmers' markets.
	5. Scale up local purchasing. Scale up purchasing from local producers, and formalize the collaborations between and aggregation of small farmers.
Healthy People	*6. Promote use of food assistance programs at farmers' markets.* Promote use and acceptance of food assistance program benefits at farmers' markets
	7. Encourage healthy mobile vending. Expand mobile vending regulations to include additional areas of Oakland and encourage fresh food vending.
Sustainable Ecosystems	*8. Synthetic pesticide- and GMO- production free zones*. Build upon the GMO-ban successes of Marin, Trinity, and Mendocino Counties to inform Alameda County-wide policies on pesticide-free and GMO-free zones.
	9. Expand composting and food scrap recycling. Develop a city-wide waste management contract that expands composting and food scrap recycling.
Thriving Local Economy	*10. Develop a "Fresh Food Financing Fund".* Advocate for the development of a "Fresh Food Financing Fund" that will provide financing, technical assistance, and location assistance to new food enterprises in underserved communities.

(adapted from OFPC 2010)

Appendix C2: Existing Zoning Relevant to Urban Agriculture

According to Oakland Municipal Code (Title 17: Planning) "Agricultural and Extractive Activities may be permitted upon the granting of a conditional use permit pursuant to the conditional use permit procedure in Chapter 17.134" in the following zones:

Plant Nursery & Crop and Animal Raising

OS OPEN SPACE
R-1 ONE ACRE ESTATE RESIDENTIAL
R-10 ESTATE RESIDENTIAL
R-20 LOW DENSITY RESIDENTIAL
R-30 ONE-FAMILY RESIDENTIAL
R-35 SPECIAL ONE-FAMILY RESIDENTIAL
R-36 SMALL LOT RESIDENTIAL
R-40 GARDEN APARTMENT RESIDENTIAL
R-50 MEDIUM DENSITY RESIDENTIAL
C-10 LOCAL RETAIL COMMERCIAL
C-20 SHOPPING CENTER COMMERCIAL
C-27 VILLAGE COMMERCIAL
C-31 SPECIAL RETAIL COMMERCIAL
C-35 DISTRICT SHOPPING COMMERCIAL
C-40 COMMUNITY THOROUGHFARE COMMERCIAL
C-45 COMMUNITY SHOPPING COMMERCIAL
C-51 CENTRAL BUSINESS SERVICE COMMERCIAL
M-10 SPECIAL INDUSTRIAL ZONE REGULATIONS
M-20 LIGHT INDUSTRIAL ZONE REGULATIONS

Plant Nursery only

C-5 NEIGHBORHOOD COMMERCIAL
C-28 COMMERCIAL SHOPPING DISTRICT
C-30 DISTRICT THOROUGHFARE COMMERCIAL
HBX-1, HBX-2, HBX-3 HOUSING AND BUSINESS MIX COMMERCIAL
IG GENERAL INDUSTRIAL

Crop and Animal Raising only

R-60 MEDIUM-HIGH DENSITY RESIDENTIAL
R-70 HIGH DENSITY RESIDENTIAL
R-80 HIGH-RISE APARTMENT RESIDENTIAL
R-90 DOWNTOWN APARTMENT RESIDENTIAL
C-25 OFFICE COMMERCIAL
C-36 GATEWAY BOULEVARD SERVICE COMMERCIAL
C-55 CENTRAL CORE COMMERCIAL
C-60 CITY SERVICE COMMERCIAL HBX HOUSING AND BUSINESS MIX

Agricultural and Extractive Activities not permitted

C-52 OLD OAKLAND COMMERCIAL
M-30 GENERAL INDUSTRIAL
M-40 HEAVY INDUSTRIAL
IO INDUSTRIAL OFFICE
CIX-1, CIX-2 COMMERCIAL INDUSTRIAL MIX
S-1 MEDICAL CENTER ZONE REGULATIONS

S-2 CIVIC CENTER ZONE REGULATIONS
S-3 RESEARCH CENTER ZONE REGULATIONS

Other Zone Regulations

S-4 DESIGN REVIEW COMBINING ZONE REGULATIONS
S-5 BROADWAY RETAIL FRONTAGE INTERIM COMBINING ZONE REGULATIONS
S-6 MOBILE HOME COMBINING ZONE REGULATIONS
S-7 PRESERVATION COMBINING ZONE REGULATIONS
S-8 URBAN STREET COMBINING ZONE REGULATIONS
S-9 RETAIL FRONTAGE COMBINING ZONE REGULATIONS
S-10 SCENIC ROUTE COMBINING ZONE REGULATIONS
S-11 SITE DEVELOPMENT AND DESIGN REVIEW COMBINING ZONE REGULATIONS

S-12 RESIDENTIAL PARKING COMBINING ZONE REGULATIONS
S-13 MIXED-USE DEVELOPMENT COMBINING ZONE REGULATIONS
S-15 TRANSIT ORIENTED DEVELOPMENT ZONE REGULATIONS
S-16 INDUSTRIAL-RESIDENTIAL TRANSITION COMBINING ZONE REGULATIONS
S-17 DOWNTOWN RESIDENTIAL OPEN SPACE COMBINING ZONE REGULATIONS
S-19 HEALTH AND SAFETY PROTECTION OVERLAY ZONE
S-20 HISTORIC PRESERVATION DISTRICT COMBINING ZONE REGULATIONS
S-20 HISTORIC PRESERVATION DISTRICT COMBINING ZONE REGULATIONS

Use Classifications:

17.10.590 General description of Agricultural and Extractive Activities.
Agricultural and Extractive Activities include the on-site production of plant and animal products by agricultural methods, and of mineral products by extractive methods. They also include certain activities accessory to the above, as specified in Section 17.10.040. (Prior planning code § 2450)

17.10.600 Plant Nursery Agricultural Activities.
Plant Nursery Agricultural Activities include the cultivation for sale of horticultural specialties such as flowers, shrubs, and trees, intended for ornamental or landscaping purposes. They also include certain activities accessory to the above, as specified in Section 17.10.040. (Prior planning code § 2460)

17.10.610 Crop and Animal Raising Agricultural Activities.
Crop and Animal Raising Agricultural Activities include the raising of tree, vine, field, forage, and other plant crops, intended to provide food or fibers, as well as keeping, grazing, or feeding of animals for animal products, animal increase, or value increase. They also include certain activities accessory to the above, as specified in Section 17.10.040. (Prior planning code § 2461)

Source: Oakland Municipal Code, Source Oakland Municipal Code, Title 17. Planning, Chapter 17.10. Use Classifications, Article II. Activity Types, Part 5. Agricultural and Extractive Activity Types

Municipal Code Related to Animal Raising:

6.04.320 Keeping of fowl.
It is unlawful for any person to keep any ducks, geese, chickens or other fowls in any enclosure in the city unless the exterior boundaries of said enclosures are more than twenty (20) feet from any dwelling, church or school.
It is unlawful for any person to keep, harbor or maintain roosters within the city limit.
This section shall not prohibit the activity authorized under Section 6.04.290 of this code.
This section shall also not apply to and is not intended to regulate any commercial activity that is already regulated by the Oakland Planning Code. (Ord. 12705 § 3, 2005: Prior code § 3-9.28)

6.04.290 Keeping certain animals in apartment house, hotel and business district.
It is unlawful for any person to raise, or keep, live chickens, ducks, geese or other fowl, or pigeons, rabbits, guinea pigs or goats, in any enclosure or yard on property occupied by an apartment house or hotel or in a business district in the city, except when such fowl or animals are kept within a bona fide produce market, commission house or store for purposes of trade and, while so kept, are confined in small coops, boxes or cages. (Amended during 1997 codification; prior code § 3-9.25)

8.14.240 Keeping live fowl and animals.
It is unlawful for any person to keep live chickens, ducks, geese, turkeys, or other live fowl or animals in any cellar or basement underneath any grocery store, market or other place where foodstuffs are kept for sale.
It is unlawful for any person to keep any live chickens, turkey, ducks, geese or other live fowl or animals where foodstuffs are prepared for sale, or sold. (Prior code § 4-3.24)

12.64.050 Animals.
No person shall lead any horse in the limits of any public park in the city or permit any horse that is not harnessed and attached to a vehicle or mounted by an equestrian, to enter the same, and no person shall turn loose into said parks any dogs, cattle, swine, goats or other animals, or permit the same to run at large in such parks, and police officers and park employees are given authority to capture and destroy any cats found running at large within said parks. (Prior code § 6-3.14)

17.102.140 Special regulations applying to private stables and corrals.
The following regulations shall apply in all zones to private stables, corrals, and similar facilities and to the keeping or training of horses, mules, or donkeys as an accessory activity:
A. Conditional Use Permit Requirement. Such uses are permitted only upon the granting of a conditional use permit pursuant to the conditional use permit procedure in Chapter 17.134.
B. Maximum Number of Animals. No more than three such horses, mules, or donkeys shall be kept or trained on any single lot.
C. Minimum Lot Area. Such uses shall not in any case be located on any lot having a lot area of less than twenty-five thousand (25,000) square feet.
D. Location on Lot. No such stable, corral, or paddock shall be located within thirty (30) feet from any lot line.
E. Screening. All open portions of such facilities shall be screened from abutting lots, streets, alleys, and paths, and from the private ways described in Section 17.106.020, by dense landscaping not less than five and one-half (5½) feet high and not less than three (3) feet wide or by a decorative screening fence or wall not less than five and one-half (5½) feet high, subject to the standards for required landscaping and screening in Chapter 17.124 and the exceptions stated in said chapter. (Ord. 12872 § 4 (part), 2008; prior planning code § 7015)

Source: Oakland Municipal Code

Appendix C3: OFPC Statement on Urban Agriculture, April 2011

oakland FOOD POLICY COUNCIL
promoting an equitable & sustainable food system

Statement on Urban Agriculture

April 2011

The Oakland Food Policy Council has identified support for and expansion of urban agriculture (UA) through local policy and coordination as one of our top goals.

Broadly, UA encompasses the cultivation of fruits, vegetables, plants, flowers or herbs, and/or raising animals and livestock in cities. Oakland is already home to a thriving community of urban farmers and gardeners who contribute to our city's culture, health, environment, and economic vitality.

However, our planning process identified a number of areas where Oakland residents could benefit from clearer, updated, and streamlined local policies related to urban agriculture – especially in our zoning code. ***The widely publicized case of Ghost Town Farm, which was recently cited for lack of compliance with Oakland's current zoning codes, highlights the need for an open dialogue about what sort of regulatory framework for UA activities we want to have here in Oakland.*** We would like to use this opportunity to generate public discussion about policy barriers and opportunities related to UA and to continue to urge the City to expedite the revision of existing zoning that in some cases hinders UA in Oakland. Most important, we are interested in promoting a positive and productive dialogue where our policymakers, city staff, and residents can work together to chart a course for the future of UA.

We have identified **two priority areas where we recommend policy changes:**

1. **Update zoning for UA to include a broader and more diverse range of food growing practices.** Under the most recent citywide zoning update that is about to take effect, "Crop and Animal Raising Agricultural Activities" are allowed in all residential and commercial zoning districts with a Conditional Use Permit (CUP). The OFPC is working with the Planning Department to draft new UA definitions and amend the UA sections of the Zoning code in order to both clarify and streamline how different types of UA activities are regulated. **Instead of one blanket policy that applies to all kinds of UA regardless of scale or intensity of activities, we are proposing definitions (and appropriate operating standards) for three types of UA that will help determine where UA can be practiced in Oakland:**

The OFPC is incubated by:

Food First
INSTITUTE FOR FOOD AND DEVELOPMENT POLICY

www.oaklandfood.org
www.foodfirst.org
398 60th Street
Oakland, CA 94618
P: 510-654-4400
F: 510-654-4551

- ***Residential*** UA is any form of plant and animal raising activity on a private residential property by an individual or family with the primary purpose of household consumption (regarding sales of Residential UA surplus, see the next point below). We propose that residential gardens be allowed as-of-right (with no additional permits or fees required) in all residential zones.

- ***Civic*** UA must be organized and operated by a Community Group, which may include local civic associations, public agencies, non-profit agencies, gardening clubs, homeowners associations, or even a group formed for the purpose of establishing a garden. We propose that civic gardens be allowed in all residential zones, and in most commercial zones (it may be appropriate for some commercial areas, such as our downtown, to require a CUP).

- ***Commercial*** UA use is distinguished from Civic UA by the intensity of site cultivation, the size of the site cultivated, and the primary purpose of the site's use, which is growing vegetables, plants, flowers or *for sale* (including for-profit and non-profit enterprises). We propose that commercial UA be permitted in Commercial and Industrial Zones, and in residential zones with a CUP.

We welcome comments from the public regarding these definitions and zoning regulations.

2. **Update zoning for sales of raw agricultural products to allow for small-scale entrepreneurial activities**. Currently, selling raw, unprocessed agricultural products such as produce is regulated by a number of different laws, including Oakland's zoning code (briefly, *where* selling can take place) and by city business permitting and licensing (*who* is allowed to sell). Generally, commercial activity (like selling produce grown onsite) is not allowed under current code in residential zones.

   The OFPC supports modifying our code to allow some sales of raw agricultural products in residential zones. Prohibiting produce sales in residential zones may limit both the healthy food access benefits of urban agriculture and the small-scale entrepreneurial opportunities that it provides to residents. A number of cities, such as San Francisco, CA, Seattle, WA, Cleveland, OH, and Kansas City, MO have recently relaxed prohibitions on sales in residential areas and allowed gardeners to offer their bounty for-sale with appropriate operating standards in place. Additionally, we recommend that any CUP process take into account size and scale of the UA operation (considering such issues as gross sales), and offer a tiered cost structure.

In addition to the priority policy recommendations above, there are several other areas where updated policies could benefit Oakland's urban farmers and gardeners, including raising animals and livestock. For example, Seattle's new urban agriculture zoning increased the number of chickens permitted per household and added other allowed animals, including potbelly pigs. The OFPC also strongly supports the integration of animals into urban food production systems because they provide products that can improve the diets of Oakland's residents (e.g. fresh milk, honey, eggs, and meat). Some urban farmers collect wool and goat hair for cottage industries. Finally, manure is an important fertilizer source for sustainable, ecological food production that is not reliant on petroleum-based chemical fertilizers.

The time is ripe to craft regulations that protect and expand UA, while ensuring that it will consistently be practiced in ways that are compatible with surrounding uses. The OFPC has already compiled suggested zoning code language (including a matrix of zones and UA activities) which we have shared with the City of Oakland Planning & Zoning Department, and we encourage you to contact your City Councilmember to encourage them to support these important policy changes.

The OFPC is prepared to help facilitate this dialogue in any way needed. We, along with all those who have signed this letter, believe that the recommendations outlined above will make for a healthier, more vibrant Oakland.

Signed:

Appendix C4: OFPC / Bay Localize Letter to Planning Department, July 2011

July 20, 2011

Eric Angstadt
Deputy Director of Planning and Zoning
250 Frank H. Ogawa Plaza, Suite 2114
Oakland, CA 94612

Dear Mr. Angstadt:

We, the members of the Oakland Food Policy Council along with the undersigned organizations, urban farms, and coalitions, wish to commend you and your staff for your work to update the City of Oakland's zoning codes to reflect our communities' growing urban agriculture movement and to encourage and facilitate local food production.

By breaking down legal barriers and creating clear operating standards for urban farmers, we can create more community gardens, more local food enterprises, and more affordable, healthy food options for Oakland residents. We can also open up more safe and welcoming spaces where the community can come together, learn hands-on gardening skills and nutrition, and reconnect with the land. Expanding urban agriculture can also help reduce carbon emissions as called for in the city's Energy and Climate Action Plan by cutting the need to transport food. And it can boost the local economy by encouraging food dollars to stay within the community, while creating local green jobs in urban agriculture.

As you embark upon the comprehensive urban agriculture zoning update, we urge you to take the following Seven Key Recommendations for Urban Ag into account, which reflect the ideas and aspirations of a broad, diverse range of voices from within our communities:

1. ***Define Urban Agriculture to include both plant- and animal-based food production.*** While we share the goal of ensuring humane standards of care for animals, excluding them from our urban food system is a denial of basic rights for Oakland residents. The choice of whether to eat meat, eggs, or milk is a personal one, often deeply connected to cultural heritage. That's not up to the city to decide. Through the zoning update process, we can place limits on the number and types of animals that can be raised on a plot of land, setting clear expectations of local residents. By clarifying these policies, we can create a more efficient, well-regulated system that upholds humane standards.

2. ***No backyard slaughterhouses!*** To ensure that only safe, humane, and well-regulated facilities are used for commercial animal slaughter and processing, we urge the city to prohibit commercial slaughterhouses in residential zones, allowing them only in industrial and commercial zones. This will also help preserve the character of Oakland's neighborhoods, while preserving the option of building local food infrastructure.

3. ***Allow for on-site sales of locally-grown produce and value-added goods citywide.*** Affirm the right of all local residents, community groups, and businesses to sell produce grown on-site in all zones, provided they adhere to existing standards and regulations for the zones in which they're operating. To ensure economic viability of food enterprises, the sale of value-added goods, where the primary ingredients are grown and produced on-site, should be permitted. In all zones, sales, pick-ups, and donations of fresh food and horticultural products grown on-site should be permitted.

4. ***Ensure affordable and timely permitting for urban agriculture operations.*** To maximize the participation of residents, community groups, and businesses in local food production, permit fees for initiating urban agriculture operations should be set at the minimum feasible level to allow the city to cover its administrative costs. Further, sufficient staff time should be dedicated to ensure a timely approval process.

5. ***Support process for facilitating community access to public lands for food growing.*** As outlined in Nathan McLintock's *Cultivating the Commons* report, a significant portion of Oakland's produce needs could be met by growing food on city-owned lands. The Planning Department should support the efforts of the Oakland Parks and Recreation Department, community groups, and other public landowners to develop a clear process by which residents and Oakland-based groups can secure access to such lands for growing food that respects and balances the multiple needs and interests of the broader community. This process should give preference to community groups that seek to maximize community benefit, and prohibit for-profit, commercial enterprises.

6. ***Uphold the highest humane, ecological, and neighbor-friendly standards of operation.*** As the operating standards for urban agriculture practitioners are developed, they should a.) seek to meet or exceed existing animal welfare regulations as set forth in state law, reiterating clear penalties for non-compliance; b.) encourage ecological best practices, including water-wise irrigation techniques and technologies, integrated pest management plans and techniques which promote the least toxic pesticides, and public health protection strategies; and c.) outline clear "Good Neighbor Standards" that conform to or exceed existing nuisance and property laws.

7. ***Create clear and comprehensive Urban Agriculture Toolkit.*** The city, in collaboration with community partners, should produce a guide for residents, community-based organizations, and entrepreneurs interested in urban agriculture that clearly outlines a.) the process of starting a community garden or urban farm; b.) the permits, if any, that are needed; c.) the types of operations allowed in each zone; d.) the standards that are expected of local operators; e.) resources for ecological and humane best practices; f) a list of contacts within government around permitting and regulations, and g) a directory of local urban agriculture groups, operations, and related resources.

Thank you in advance for considering these recommendations. We look forward to working with you and your staff in building a locally resilient, equitable food system for Oakland!

Sincerely,

Oakland Food Policy Council, plus the organizations, farms, and coalitions listed below.

cc: Oakland Planning Commission
Oakland City Council
Mayor Jean Quan

SUPPORTING ORGANIZATIONS:

- Acta Non Verba: Youth Urban Farm Project
- Agrariana
- All Edibles
- Bay Localize
- California Food and Justice Coalition
- Center For Popular Research, Education & Policy (C-PREP)
- Center for Progressive Action
- City Slicker Farms
- Communities for a Better Environment
- Communities Rooting Together (CoRooT)
- Community Alliance with Family Farmers (CAFF)
- Community Health for Asian Americans
- DIG Cooperative
- East Bay Urban Agriculture Alliance (EBUAA)
- Ecology Center
- Farm to Table Food Services
- Food & Water Watch
- HOPE Collaborative
- The Institute of Urban Homesteading
- Movement Generation: Justice & Ecology Project
- Natural Logic
- Oakland Food Policy Council (OFPC)
- Oakland Resilience Alliance
- People's Grocery
- Pesticide Watch Education Fund

- Planting Justice
- Pluck and Feather Farm
- PUEBLO
- Spiral Gardens Community Food Security Project
- Sustainable Economies Law Center
- Transition Oakland
- Victory Garden Foundation