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January 29, 2008

HAND DELIVERED

Shirley Concolino
City of Sacramento
915 I Street
Sacramento, CA 95814

RE: Greenbriar Development Project

To Whom It May Concern:

The following documents are hereby submitted to the city for inclusion in the Administrative Record for the Greenbriar project. Each of these documents has been referenced throughout the Administrative proceedings; however we would like to ensure that hard copies are included for the Record.

1. Article printouts from www.sacregionblueprint.org

2. Regional Transit Issue Paper Revised; Agenda Item No. 1, Board Meeting Date 12/15/03, Subject: Selecting ~~Alternative 3:~~ Truxel Road Light Rail Transit as the Locally Preferred Alternative for the Downtown/Natomas/Airport (DNA) Corridor

3. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Government Valley Vision Slideshow

4. Transportation Projects Draft Discussion Preferred Scenario, dated September 29, 2004

5. Sacramento Region Blueprint Transportation Land Use Study Article: "Preferred Blueprint Scenario Marks Key Milestone in Process" dated Revised June 2007

6. Sacramento Region Blueprint Transportation Land Use Study Article: "Preferred Blueprint Scenario Marks Key Milestone in Process" dated January 2005

7. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision Slideshow

8. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision Slideshow

9. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision - Regional Scenarios Statistics by Subareas

10. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision – Sacramento Area Council of Governments Public Opinion Toward Growth. Prepared for: Sacramento Area Council of Governments dated October 2004

11. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision Slideshow12. Sacramento Region Blueprint Transportation Land Use Study; Local Government Feature – Article: Sacramento County dated April/May 2007

13. Sacramento Region Blueprint Transportation Land Use Study; Sacramento Area Council of Governments Valley Vision Agenda Elected Officials Summit dated October 14, 2004

14. Discussion Draft Blueprint Preferred Scenario for 2050 Map and Growth Principles

15. North Natomas Joint Vision Area – w/ Preferred Scenario and Base Case maps

16. Article: "Preferred Blueprint Scenario Marks Key Milestone in Process"

17. Examples from the Sacramento Region of the Seven Principles of Smart Growth "Better Ways to Grow"

18. Facsimile from: Jeane Borkenhagen to: Ashle Crocker, dated: Jan. 25, 2007 re: Greenbriar Testimony and S.M.A.Q.M.D Protocol

19. Letter to: Tina Thomas from Jeane Borkenhagen dated: Jan. 25, 2008 re: Mitigation Measure for TAC impact from nearby highways, Greenbriar project SAC20040304Z

20. Sacramento International Airport Comprehensive Land Use Plan

21. 4.1 Noise of the Los Angeles International Airport Master Plan Final EIS/EIR

22. California Airport Land Use Planning Handbook, January 2002

23. Progress on Incorporating Climate Change into Management of California's Water Resources, July 2006

24. Intergovernmental Panel on Climate Change Working Group I: The Physical Science Basis of Climate Change

25. Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways, January 2007 by Sacramento Metropolitan Air Quality Management District

26. Draft Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways dated October 2006

27. October 2006 Copy of Protocol

28. California Water Plan a Framework for Action Update 2005

29. Item 6, Agenda of November 29, 2007 to: Sacramento Area Flood Control Agency Board of Directors from: John A. Bassett subject: Resolution Authorizing the Executive Director to Amend the Contract with EDAW Inc. for Environmental Compliance Documents and Regulatory Permitting Related to the Natomas Levee Improvement Program

30. Map of Sacramento Light Rail

31. Downtown Natomas Airport Response to Natomas Journal and Community Comments dated August 2003

32. Downtown/Natomas/Airport Corridor in the City and County of Sacramento – Draft Program Environmental Impact Report dated December 2007

33. Downtown/Natomas/Airport Corridor – Final Alternatives Analysis Report dated January 2004

34. Downtown/Natomas/Airport Project Overview

35. The Natomas Basin Conservancy – Implementation Annual Report dated March 1, 2002, March 1, 2003, April 30, 2004, April 30, 2005, April 30, 2006, April 30, 2007

36. Final Natomas Basin Habitat Conservation Plan Volume 1 dated April 2003

37. Final Natomas Basin Habitat Conservation Plan Volume2-Appendices dated April 2003

38. Natomas Basin Habitat Conservation Plan Final EIR/Environmental Impact Statement Volume 1 dated April 2003

39. Natomas Basin Habitat Conservation Plan Final EIR/Environmental Impact Statement Volume 2 dated April 2003

40. Implementation Agreement for the Natomas Basin Habitat Conservation Plan

41. Memorandum to: Regional Director, Fish and Wildlife Service, Region 1, Portland Oregon from: Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California dated January 16, 2002

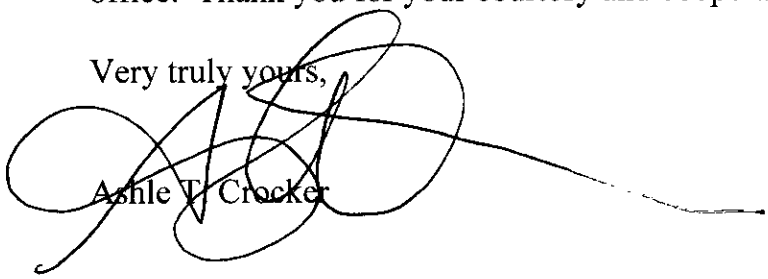
42. Habitat Conservation Plan for the Metro Air Park Project in the Natomas Basin County of Sacramento dated July 2001

43. Map of the Regional location and Permit Area

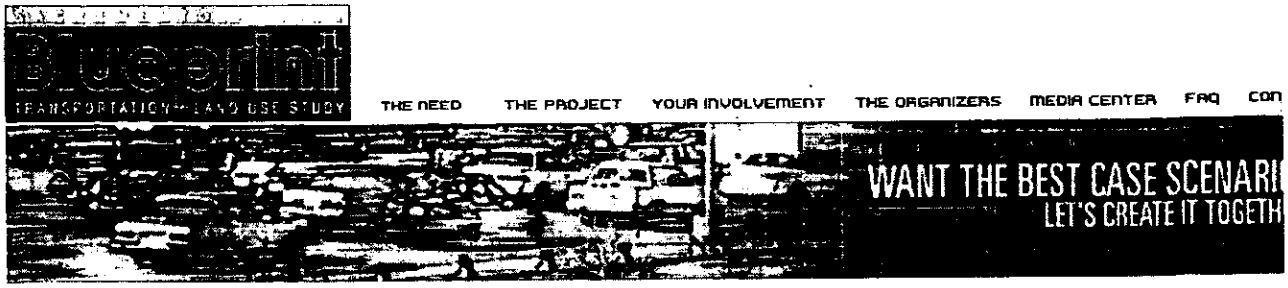
44. Implementation Agreement for the Metro Air Park Habitat Conservation Plan County of Sacramento dated December 4, 2001

If you have any questions regarding the above, please do not hesitate to contact me at this office. Thank you for your courtesy and cooperation in this matter.

Very truly yours,



Ashle T. Crocker



TECHNOLOGY OF PROJECT
BASE CASE
PREFERRED BLUEPRINT SCENARIO
SMART GROWTH PRINCIPLES
LEVELS OF WORKSHOPS
FORUM
AWARDS
ELECTED OFFICIALS SUMMIT
IMPLEMENTATION
LOCAL GOVERNMENT FEATURES
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THE PROJECT

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Base Case

The starting point for the Blueprint process is the "Base Case Study," a projection of how the area would grow if current local government growth and land-use plans are followed through to 2050. Land use and demographic projections show that the six-county region that includes Sacramento, Placer, El Dorado, Yuba, Sutter and Yolo counties will remain an attractive place to live and is likely to grow dramatically. One of the most startling figures to arise from the study is that there will be an estimated 1.7 million more people in the Sacramento Region in 2050 than there were in 2000. As the area grows to over 3.6 million residents, the number of homes will more than double from 713,000 to over 1.5 million.

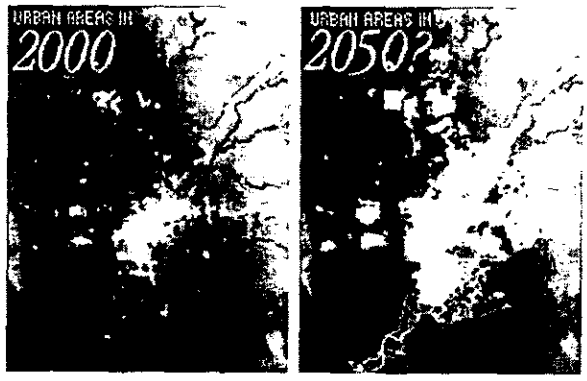
Is there enough land set aside for development under current general plans to support the new homes, jobs and development forecast for 2050? According to the Base Case Study, the answer is no.

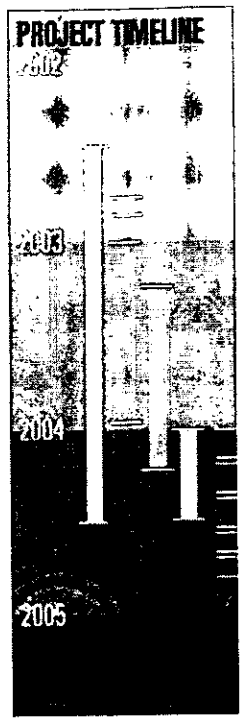
Some Base Case findings:

- The number of jobs in the region will double from 921,000 in 2000 to 1.9 million in 2050. By comparison, in 1950 the region supported only about 100,000 total jobs.
- Households with children under age 18 will drop about 20 percent, while families without children (including "empty nesters") will increase by about 10 percent. This trend will affect the type and preferred location of homes.

- Residents will drive more miles annually and spend more time in their cars, especially during commutes. The average commuter will spend about 160 additional hours annually, or about one week per year, in the car.
- Growth at the current rate will have significant impact on natural land systems. An estimated 43 percent of vernal pools and oak woodlands will be affected under the Base Case.

The following maps detail how development may impact the region under the base case scenario.





TECHNICAL RESEARCH A
MODELING ENHANCEMEN

BASE CASE REGIONAL F
AND INDICATORS

☐ COMMUNITY PLANNING
WORKSHOPS ALL CITIES
AND COUNTIES

☐ ALTERNATIVE REGIONAL
AND INDICATORS

PREFERRED REGIONAL FU
AND INDICATORS FOR MI
TRANSPORTATION PLAN

2004 MILESTONES

■ COMPLETE COUNTYWIDE
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■ CONTINUE TECHNICAL RE
AND COMPLETE PLANS F
ELECTRONIC TOWN HALL

☐ PUBLIC INPUT ON DISCU
DRAFT BLUEPRINT PREFE
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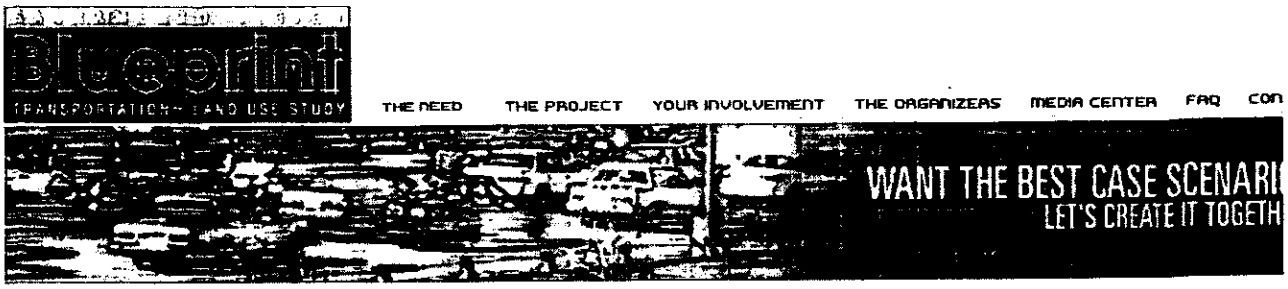
ELECTRONIC TOWN HALL

■ FURTHER TECHNICAL RES
AND STAKEHOLDER INPU
INCLUDING ADDITIONAL

The Blueprint project is a joint effort of the Sacramento Area Council of Governments (SACOG) and Valley Vision.

Funding for the development of the Blueprint Web site was made possible by a grant from the Great Valley Center.



TECHNOLOGY OF PROJECT
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THE PROJECT

Preferred Scenario

The Preferred Blueprint Scenario depicts a way for the region to grow through the year 2050 in a manner generally consistent with the Blueprint growth principles. A special report, available in PDF, provides an overview of the Preferred Scenario approved by the SACOG Board in December 2004.

Preferred Scenario Map

The scenario is a result of numerous public workshops and meetings with local government staff and elected officials. It should be interpreted and used as a concept-level illustration of the growth principles. It was developed with parcel-level data and analysis to help ensure that the growth concepts were being applied in a realistic manner; however, it is not intended to be applied or implemented in a literal, parcel-level manner.

The map assumes certain levels and locations of both "reinvestment" (i.e., additional development on already-built parcels) and greenfield development (i.e., large-scale development on vacant land). The purpose of this mapping is to illustrate, generally, the amount and locations for these types of growth. It is not intended to indicate that a specific parcel should or should not be developed in a particular manner. That level of planning is the responsibility of local governments, and is beyond the specificity appropriate for regional-scale, long-term scenario planning.

Transportation projects were added to the region's road and transit systems in the development and

evaluation of each of the scenarios in the Blueprint Project. The objective in each scenario was to match the transportation system with the land use parameters. While a list of projects was developed and is available for the Preferred Scenario, the purpose of the project list is to provide a generalized priority of transportation investments that fit with the location and amount of development and fit with the smart growth planning concepts.

The list of transportation projects is not a Metropolitan Transportation Plan (MTP) for the region. The MTP is a much more detailed process currently being undertaken. In other words, the transportation system which underlies the Blueprint Map is for educational purposes, and does not reflect a policy recommendation or decision by the Board.

The place type menu is available in PDF format.

The information below is available on CD in PDF format. If you would like to order a copy, please complete the order form.

Region

- Base Case
- Scenario Map
  - The place type menu is available in PDF format.
- Summary Statistics

El Dorado County

Placerville

- Base Case Map
- Scenario Map
- Summary Statistics

Placer County

- Summary Statistics

Auburn

- Base Case Map
- Scenario Map
- Summary Statistics

Colfax

- Base Case Map
- Scenario Map
- Summary Statistics

Lincoln

- Base Case Map
- Scenario Map
- Summary Statistics

Loomis

- Base Case Map
- Scenario Map
- Summary Statistics

Rocklin

- Base Case Map
- Scenario Map
- Summary Statistics

Roseville

- Base Case Map
- Scenario Map
- Summary Statistics

Southwest Placer County

- Base Case Map
- Scenario Map
- Summary Statistics

Placer County Unincorporated

- Base Case Map

- Scenario Map
- Summary Statistics

Sacramento County

- Summary Statistics

Sacramento City

- Summary Statistics

Airport/Airpark

- Base Case Map
- Scenario Map
- Summary Statistics

Arden Arcade/Carmichael/Fair Oaks/Orangevale

- Base Case Map
- Scenario Map
- Summary Statistics

Central Sacramento

- Base Case Map
- Scenario Map
- Summary Statistics

Citrus Heights

- Base Case Map
- Scenario Map
- Summary Statistics

Delta

- Base Case Map
- Scenario Map
- Summary Statistics

East County (within Urban Service Boundary)

- Base Case Map
- Scenario Map
- Summary Statistics

East/Southeast County

- Base Case Map
- Scenario Map
- Summary Statistics

Ek Grove

- Base Case Map
- Scenario Map
- Summary Statistics

Folsom

- Base Case Map
- Scenario Map
- Summary Statistics

Galt

- Base Case Map
- Scenario Map
- Summary Statistics

Northern Sacramento

- Base Case Map
- Scenario Map
- Summary Statistics

North Natomas Vision Area

- Base Case Map
- Scenario Map
- Summary Statistics

Rancho Cordova Community

- Base Case Map

- Scenario Map
- Summary Statistics

Rio Linda/McClellan

- Base Case Map
- Scenario Map
- Summary Statistics

South County

- Base Case Map
- Scenario Map
- Summary Statistics

Southern Sacramento

- Base Case Map.
- Scenario Map
- Summary Statistics

Sutter County

- Summary Statistics

Live Oak

- Base Case Map
- Scenario Map
- Summary Statistics

South Sutter

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- Scenario Map
- Summary Statistics

Yuba City

- Base Case Map
- Scenario Map
- Summary Statistics

Sutter County Unincorporated

- Base Case Map
- Scenario Map
- Summary Statistics

Yolo County

- Summary Statistics

Davis

- Base Case Map
- Scenario Map
- Summary Statistics

University

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- Summary Statistics

West Sacramento

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Winters

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- Scenario Map
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Woodland

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- Summary Statistics

Yolo County Unincorporated

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- Summary Statistics

Yuba County

- Summary Statistics

Marysville

- Base Case Map
- Scenario Map
- Summary Statistics

Plumas Lakes

- Base Case Map
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- Summary Statistics

Wheatland

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- Scenario Map
- Summary Statistics

Yuba County Unincorporated

- Base Case Map
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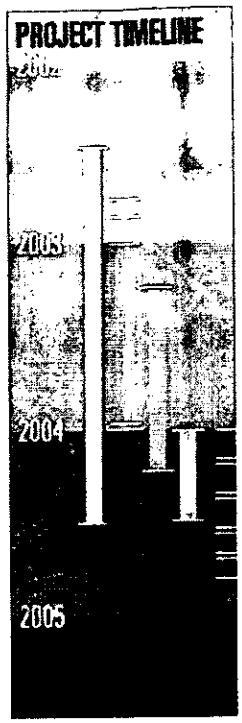

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The Blueprint project is a joint effort of the Sacramento Area Council of Governments (SACOG) and Valley Vision.

Funding for the development of the Blueprint Web site was made possible by a grant from the Great Valley Center.

S . M . A . Q . M . D .

FACSIMILE TRANSMITTAL SHEET

TO:	FROM:
Ashle Crocker	Jan. 25 07
COMPANY:	DATE:
443-9617	6
FAX NUMBER:	TOTAL NO. OF PAGES, INCLUDING COVER:
	Teare Berkenbosch
PHONE NUMBER:	SENDER'S REFERENCE NUMBER:
RE:	YOUR REFERENCE NUMBER:
Crenshaw Testimony + SMAQMD protocol	

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Slides Larry Greene used during his testimony during City Council meeting Jan 22.

ARB's Land Use and Air Quality Handbook

In 1998, ARB identified diesel particulate matter as toxic air contaminant.

In 2004, ARB recommended:

- site new sensitive land uses at least 500 ft. from a freeway or other high traffic roadway (greater than 100,000k ADT)
  - Based on So. Cal freeway studies
  - At 500 ft., approx 70 percent reduction in PM concentrations
- suggested completing site-specific health risk assessment (HRA) if closer than 500 ft.

ARB's Land Use and Air Quality Handbook Cover Letter

To My Local Government Colleagues....

Land use decisions are a local government responsibility. **The Air Resources Board's role is advisory and these recommendations do not establish regulatory standards of any kind.** However, we hope that the information in this document will be seriously considered by local elected officials and land use agencies. We also hope that this document will promote enhanced communication between land use agencies and local air pollution control agencies.

INTERIM CHAIRMAN,
CALIFORNIA AIR RESOURCES BOARD

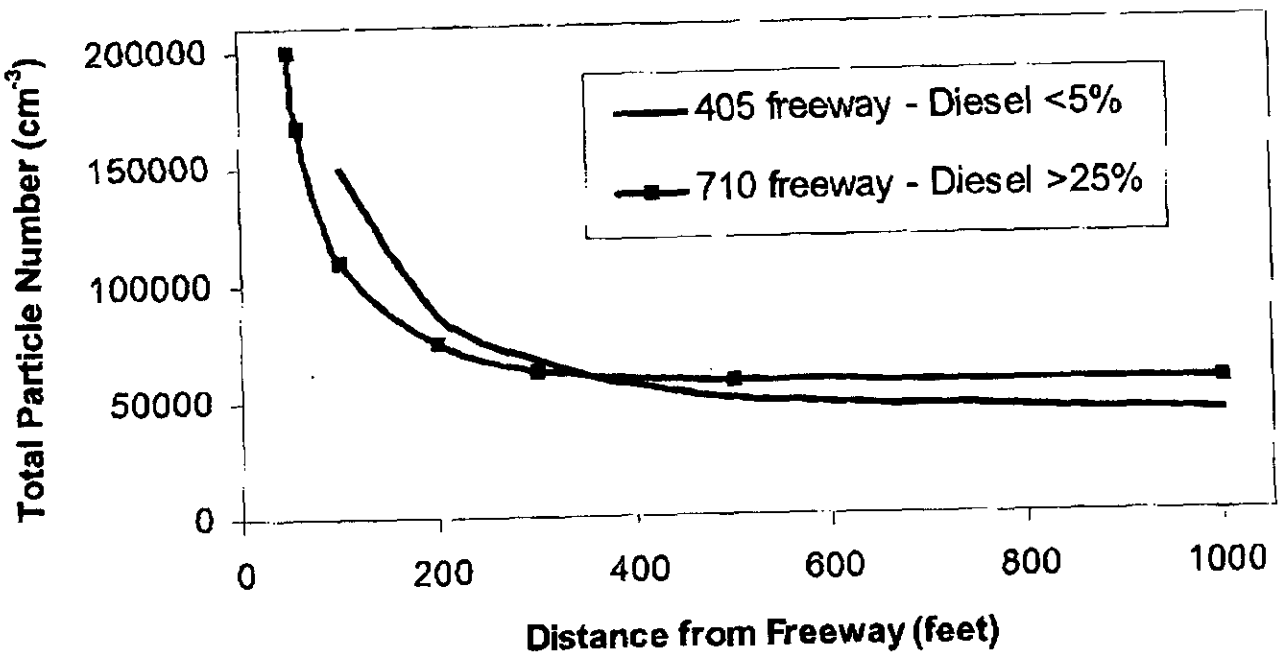
ARB's Land Use and Air Quality Handbook

Key Health Findings

- Reduced lung function in children was associated with traffic density, especially trucks, within 1,000 feet and the association was strongest within 300 feet. (Brunekreef, 1997)
- Increased asthma hospitalizations were associated with living within 650 feet of heavy traffic and heavy truck volume. (Lin, 2000)
- Asthma symptoms increased with proximity to roadways and the risk was greatest within 300 feet. (Venn, 2001)
- Asthma and bronchitis symptoms in children were associated with proximity to high traffic in a San Francisco Bay Area community with good overall regional air quality. (Kim, 2004)
- A San Diego study found increased medical visits in children living within 550 feet of heavy traffic. (English, 1999)

ARB's Land Use and Air Quality Handbook

Figure 1-1
Decrease In Concentration of Freeway Diesel PM Emissions With Distance



Protocol Objectives

- establishes a consistent cancer risk disclosure process that does not require a site-specific HRA for every project within 500 feet of a major roadway
- provides more information to planners and decision makers
- raises awareness of the need for mitigation

local land use jurisdictions retain all authority and decide after considering all relevant factors whether the project is appropriate

SACRAMENTO METROPOLITAN
AIR QUALITY
MANAGEMENT DISTRICT

Larry Greene
AIR POLLUTION CONTROL OFFICER

Ms. Tina A Thomas
Attorney
Remey Thomas, Moose and Manley, LLP
455 Capitol Mall, Suite 210
Sacramento, CA 95814

January 25, 2008

RE: Mitigation measure for TAC impact from nearby highways, Greenbriar project SAC20040304Z

Dear Ms. Thomas,

Thank you for your letter of January 15, 2008 in which you stated the Greenbriar project applicant has agreed to the planting of fine-needled conifer trees in the freeway buffer area to mitigate air quality impacts. It is our understanding that mitigation measure 6.2-4 has been revised to reflect this mitigation of an off-site Toxic Air Contaminant (TAC) impact. We appreciate the proponent's willingness to create this vegetation buffer.

The issue of the impact of mobile sourced Toxic Air Contaminants coming from the nearby highways or major roadways is one which has gained recent attention since the 2005 publication of the CARB Air Quality and Land Use Handbook: A Community perspective. Studies have been on-going to determine the nature of that impact on nearby sensitive receptors of roadway traffic. There have also been recent studies about measures that could be effective mitigation for the impact.

We requested a tree buffer for both highways (I-5 and SR 99) adjacent to the Greenbriar project primarily because of the results of studies (attached) done by Dr. Thomas Cahill of UC Davis. Dr. Cahill's study was laboratory-based and found a 65-85% reduction of fine particles at certain wind velocities in a wind tunnel with specific vegetation in it. Obviously, the mitigation efficiency of trees out next to a highway, subject to various wind speeds, will be different from those in the laboratory. However, we are encouraged enough by Dr. Cahill's work to offer up a densely planted tree barrier as an acceptable mitigation for the Greenbriar project.

We also assume that the scientific community will be testing the effectiveness of other mitigation measures such as filters, walls, etc. We hope the proponent will be willing to consider some of those measures for this project, if, in the future, they are found to be promising.

Sincerely,

Jeane Borkenhagen
Associate Planner

CC: Scott Johnson City of Sacramento
Leslie Buford City of Sacramento
Dr. Tom Cahill

Enc: Erin Fujii, Jonathan Lawton, Tom Cahill, et al, "Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size."

777 12th Street, 3rd Floor ♀ Sacramento, CA 95814-1908
916/874-4800 ♀ 916/874-4899 fax
www.airquality.org

Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size

Final Report to
The Breathe California of Sacramento Emigrant Trails Health Effects Task Force (HETF)
and Sacramento Metropolitan AQMD

January 15, 2008

Erin Fujii, Project Manager, wind tunnel program
Jonathan Lawton, Project Manager, chamber studies

with Thomas A. Cahill, David E. Barnes, Chui Hayes (IASTE intern)l and Nick Spada,
The DELTA Group, University of California, Davis 95616

and the active collaboration of The Health Effects Task Force (HETF), Jan Sharpless, Chair, Breathe California, Sacramento/Emigrant Trails, and the Pacific Southwest USFS Urban Forest Program, Dr. Greg McPherson, UC Davis.

Executive Summary: We have measured the removal rate of particulate matter passing though leaves and needles in realistic vegetation configurations as a function of particulate size. Two methods were used:

1. We generated particles in the UC Davis wind tunnel and collected them by size before and after they passed through vegetative layers at low wind velocities. (redwood, deodar, and live oak) in 50 separate runs, each with 8 particle size modes before and after the vegetation,
2. We generated particles into a 3.4 m^3 static chamber and allowed particles to diffuse to vegetation. (redwood, deodar, live oak, and oleander), followed by decay in time of mass concentrations, 8 size modes, over the next 2 to 3 hours

We especially focused on the ability of finely needled and leaved trees to remove the most dangerous highway pollutants, very fine (< 0.25 μm) and ultra fine (< 0.1 μm) particles from diesel and smoking cars near roadways.

The results of the tunnel study were that all forms of vegetation were able to remove 65% to 85% of very fine particles at wind velocities below about 1.5 m/sec (roughly 3 mi/hr) during the 2 to 4 seconds in which the particles were within the vegetation chamber. Redwood and deodar were about twice as effective as live oak.

The chamber studies were performed with effective wind velocities less than 0.1 m/sec to allow diffusion to surfaces without the impaction that occurs in the wind tunnel. However, the very fine particles were essentially removed from the chambers during fill and in the 1 minute equilibration time allowed in the experiment by coagulation, diffusion to chamber walls, and vegetation. By sharply reducing the amount a vegetation, (to roughly a few percent of that used in the tunnel studies), we were able to obtain adequate particles in the slightly coarser 0.26 to 0.34 μm size mode and follow the decay of these particles in time.

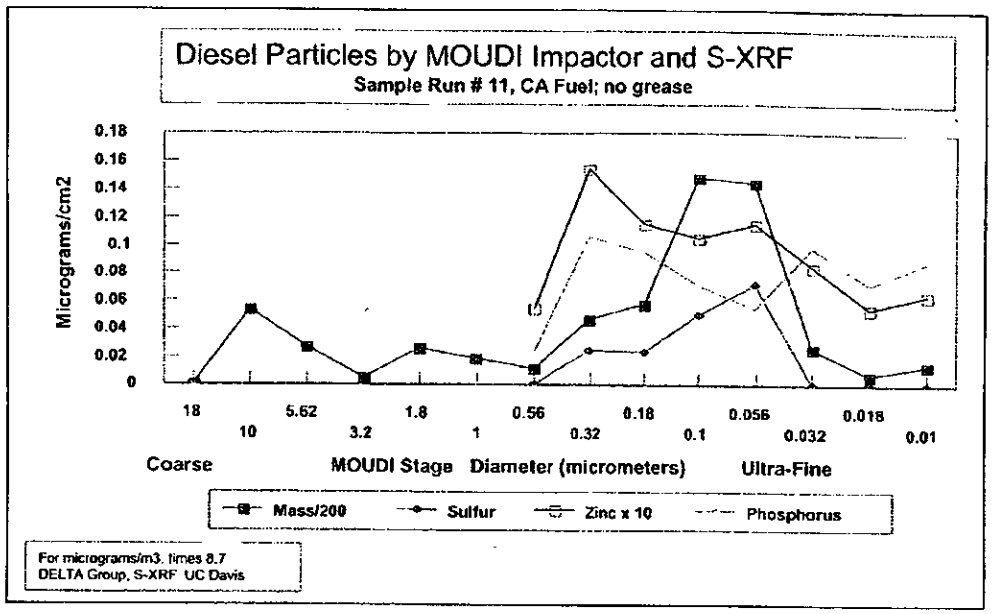
Table of Contents

Introduction

There is a crisis in the field of environmental regulation of particulate matter. The antiquated measuring technology (24 hr mass, one day in six) has lead to statistically based mass standards, originally TSP (< 35 μm) then in 1987 PM_{10} (< 10 μm) and now after 1997 $PM_{2.5}$ (< 2.5 μm), that have little connection to causality in morbidity and mortality. Most of the fine mass we breathe is harmless, but within it are harmful agents. Robert Devlin (US EPA) listed then in a AAAR meeting in 2003:

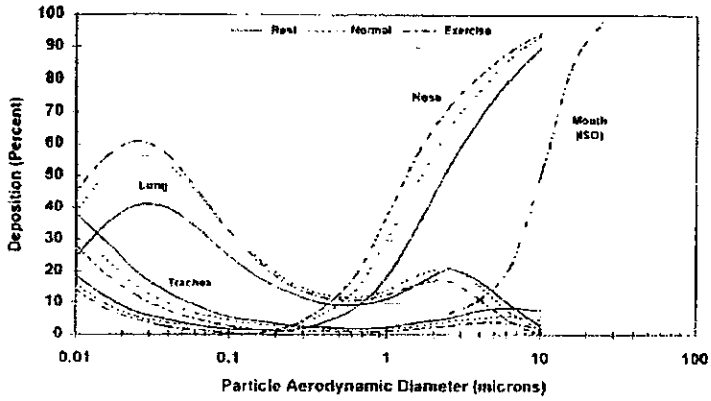
1. Biological agents, fungi, spores, bacteria,
2. Acidic aerosols (evidence weakening),
3. Fine transition metals in the lung,
4. Ultra fine insoluble particles of any kind,
5. High temperature organic products (diesel, smoking cars...).

As an example, I present below a graph of diesel exhaust we measured under a contract with DRI. Note that a very small amount of mass at 0.01 μm results in an enormous number of particles.



These particles, which include carcinogenic compounds (PAHs) and transition metals, match the peak of deep lung capture (below), and thus pose a grave health risk (70% of all the impact of all California TACs combined – CA ARB Almanac)

Particle Size versus Persent Deposition



Journal of Inhalation Research (1995).

This figure shows the relationship between particle size and what percent is deposited in different parts of the respiratory tract.

Roads are always going to act as pollution sources to nearby areas. Our work with the Breathe California (neé American Lung Association) Health Effects Task Force has shown major and unacceptable impacts of non-freeway arterials, such as Watt Avenue, on schools and residences. Since we can not assume all pollution can or will be eliminated, the Health effects Task Force, working with the DELTA Group, CalTrans, and Sacramento County, is studying the effectiveness of vegetation both in the roadway right of way and between the roadways and schools and residences. The recent realization that almost all the most dangerous roadway particles are in the very fine (< 0.25 μm) and ultra fine <0.1 μm) modes offers the possibility of using vegetation as a removal mechanism, based on the relatively high diffusion lengths and sticky nature of these particles. The literature is devoid of such information, but the results could have a major impact on roadway design in future as well as offering retrofit possibilities in the present.

Thus there are two problems – identify and measure these particles in the community (our reports, 2002 and 2005 for Breathe California plus a lot of work at UCLA), and find ways to remove them from the air.

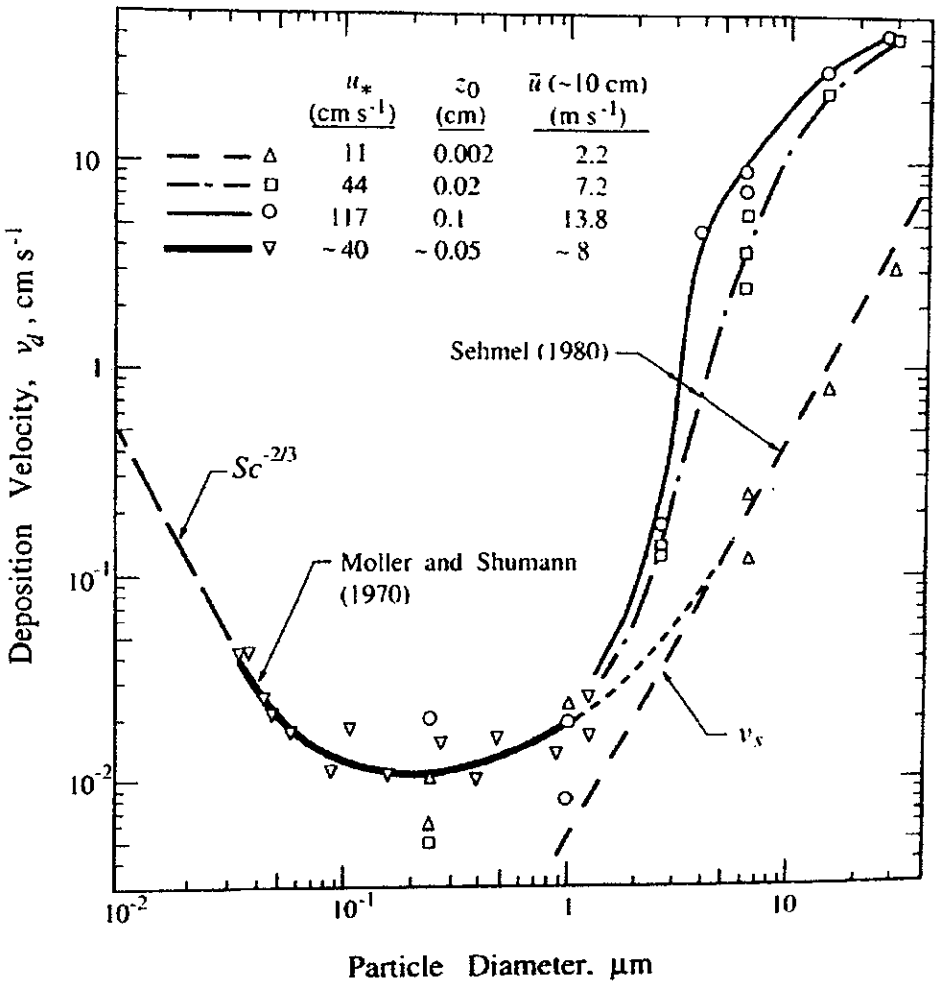
The mitigation of these particles falls into 4 classes, and represents the heart of the effort of the Breathe California of Sacramento Emigrant Trails work for 2005-2007:

1. Mitigation at the source – support AB1807 on particle in smog check, etc,
2. Mitigation in highway design – out "green Highways initiative with CalTrans and the ARB),
3. Mitigation for the right of way fence to the receptor dwelling, school house, ...,
4. Mitigation via indoor air control.

In these efforts, vegetation may be able to play a role, especially as the most dangerous particles have a high diffusion velocity.

Theory of Particle Deposition

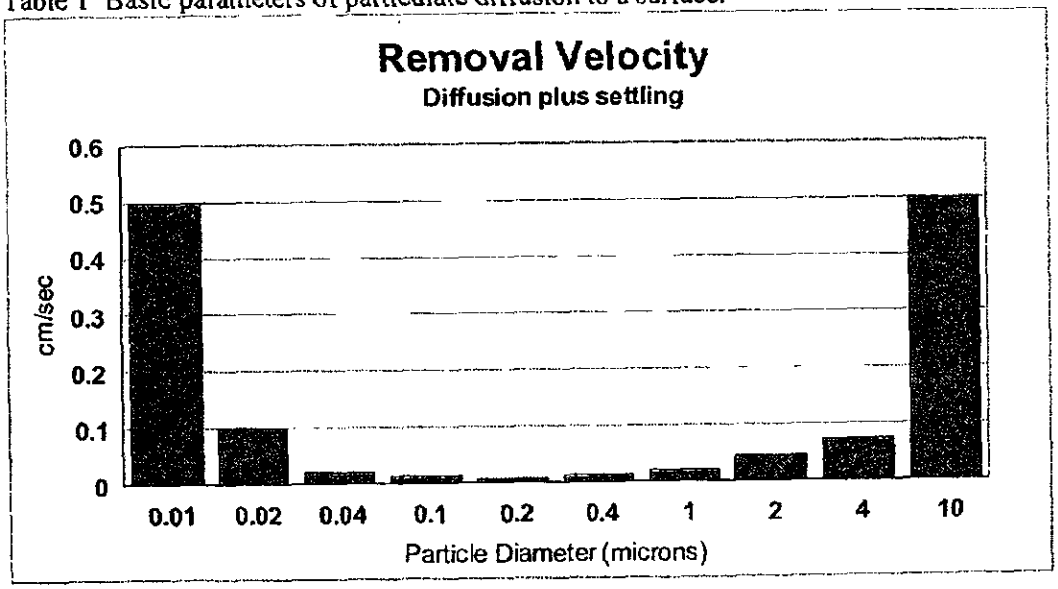
Particle removal rates for the ultra fine particles (< 0.1 μm) are greatly enhanced over accumulation mode particles (~ 0.5 μm) because the finer particles can diffuse more easily to surfaces. Since they are oil rich, they then stick and are removed from the air. This has the results that the most important particles for human health are also those that can be most easily removed by diffusion to a surface, assuming such a surface is available. Removal of theses particles occurs at later times in rainfall, sloughing of leaves and needles, etc.


u_* (cm s^{-1})
z_0 (cm)
$\bar{u}$ (~10 cm) (m s^{-1})
11
0.002
2.2
44
0.02
7.2
117
0.1
13.8
~40
~0.05
~8
Sehmel (1980)
$Sc^{-2/3}$
Moller and Shumann (1970)
v_s
Deposition Velocity, v_d, cm s^{-1}
Particle Diameter, μm
10
1
10^{-1}
10^{-2}
10^{-2}
10^{-1}
1
10

The basic physical parameters are summarized in Seinfeld and Pandas, 1889, pg 970, which have then been extend to our situation in Table 1, column 7.

Particle diameter microns	Diffusion Theory cm2/sec	Diffusion Theory mm/sec	cp cm/sec	Dep. vel. S&P pg970 cm/sec	Settling velocity cm/sec	Migration v = 1 m/sec 10 m veg.
0.002	1.28E-002	0.866	4965	Total		10 sec
0.004	3.23E-003	0.435	1760			distance cm
0.01	5.24E-004	0.175	444	0.500		5.0
0.02	1.30E-004	0.087	157	0.100		1.0
0.04	3.59E-005	0.046	55.5	0.022		0.2
0.1	6.82E-006	0.020	14	0.015		0.2
0.2	2.21E-006	0.011	4.96	0.010		0.1
0.4	8.32E-007	0.007	1.76	0.015		0.2
1	2.74E-007	0.004	0.444	0.018	0.004	0.2
2	1.27E-007	0.003	0.157	0.030	0.015	0.3
4	6.1E-008	0.002	0.056		0.075	0.8
10	2.38E-008	0.001	0.014		0.500	5.0

Table 1 Basic parameters of particulate diffusion to a surface.



Calculations for removal rate in realistic conditions are complex, and involve both the res9idence time of the particles in the 3 dimensional arrays of surfaces and the deposition velocity. If the average spacing of the surfaces is, for example, 1 cm, then a 0.1 μm particle would require 50 seconds to reach the surface (100% removal rate). One would then have a 50% removal rate with 25 seconds residence time, etc.

If one considers smaller particles at the peak of the number and surface area distributions, 0.02 μm, the time becomes 10 seconds, and for 0.01 μm particles, 2 seconds.

Thus, provision of a high surface area of vegetation adequate to slow (but not stop) wind motion will maximize particle removal rates. This effect is in addition to the wind transfer function effect, with the lateral wind resistance of the vegetation tipping the wind transport vector to a more vertical direction driven by the waste heat (engine exhaust plus hot pavement) of the highway. (Cahill et al, 1974; Feeney at al, 1976).

Specifically, we originally proposed to:

1. Configure the wind tunnel with particulate inputs, two particulate DRUM samplers, one before and one after a removable frame holding various kinds of vegetation. The frames will include screens to preclude losses of materials into the tunnel
2. The smoke/diesel/ozone input will be introduced, and the tunnel operated at up to 5 wind low velocities, with a return to the lowest at the end for a QA check.
3. The DRUM samplers will operate continuously, collecting particles on greased substrates in the size modes from > 5.0, 5.0 to 2.5, 2.5 to 1.15, 1.15 to 0.75, 0.75 to 0,56, 0,.56 to 0.34, 0.34 to 0.26, and 0.26 to 0.09 microns. For the diesel smoke, a < 0.09 micron filter will be added.
4. Analyze all samples for mass using the DELTA Group soft beta ray mass system matched to the periods on constant wind velocity in the tunnel in a time resolution of 1 ½ hr for the DRUM samples, 24 hr for the filter samples.
5. Provide a Final Report on all aspects of the project, including an extensive section on the Quality Assurance of the results.

In practice, we were unable to obtain a diesel source, and ended up relying on road flares. No work was done for ozone.

However, we added the chamber studies, not call for in the original proposal, as a way to study process at very low wind velocities typical of winter stagnation periods in the Sacramento valley.

C. Experiments

1. Technological Resources

The primary studies were based on the 20 m long UC Davis wind tunnel, which we reconfigured as a low velocity wind tunnel, and a 3.5 m^3 static chamber for diffusion removal studies. The technical resources available include trained faculty, staff and student personnel, plus:

1. Two DELTA Group 8 stage rotting drum (DRUM) impactors, with size collection from > 5 μm to 0.09 μm particle aerodynamic diameter.

a. For the diesel/car aerosols, an after filter collects from 0.09 to 0.0 μm continuously.

2. DELTA Group's recently developed soft beta ray mass measurement system for DRUM Apiezon-L coated Mylar substrates.

3. DELTA Group Synchrotron induced X-Ray Fluorescence (S-XRF) capabilities at the LBNL Advanced Light Source Beam Line 10.3.1 (presently operated by UC Davis by Dr. Cliff at DAS)
4. DELTA Group optical attenuation vs wavelengths, 350 nm – 820 nm (in final development phase)

For more on our technology See http://delta.ucdavis.edu for details

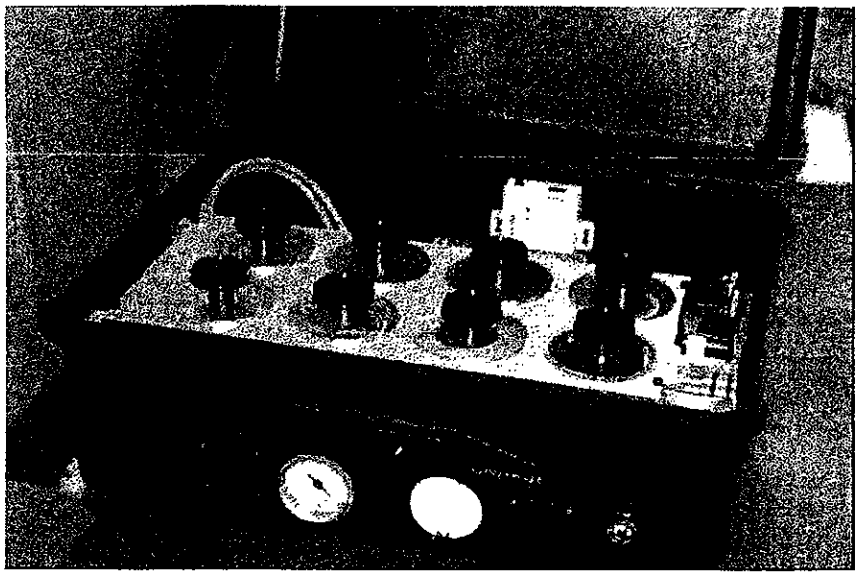


Figure 1 DELTA Group 8 DRUM sampler - case open, inlet off.

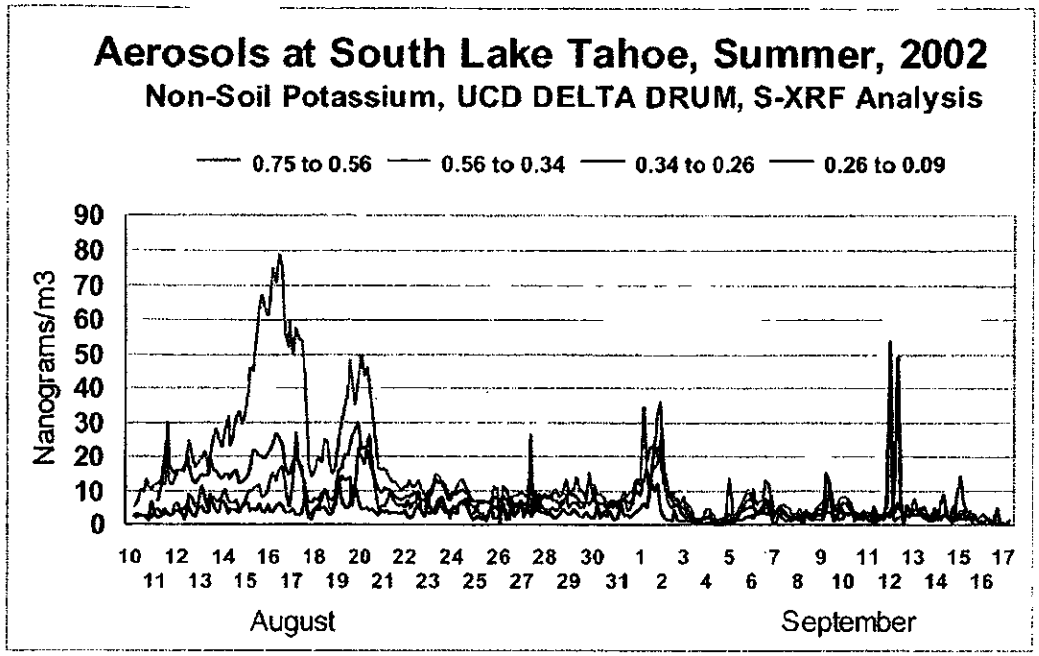


Figure 2. Forest fire smoke at South Lake Tahoe, dominated by $0.56 > D_p > 0.34$ µm.

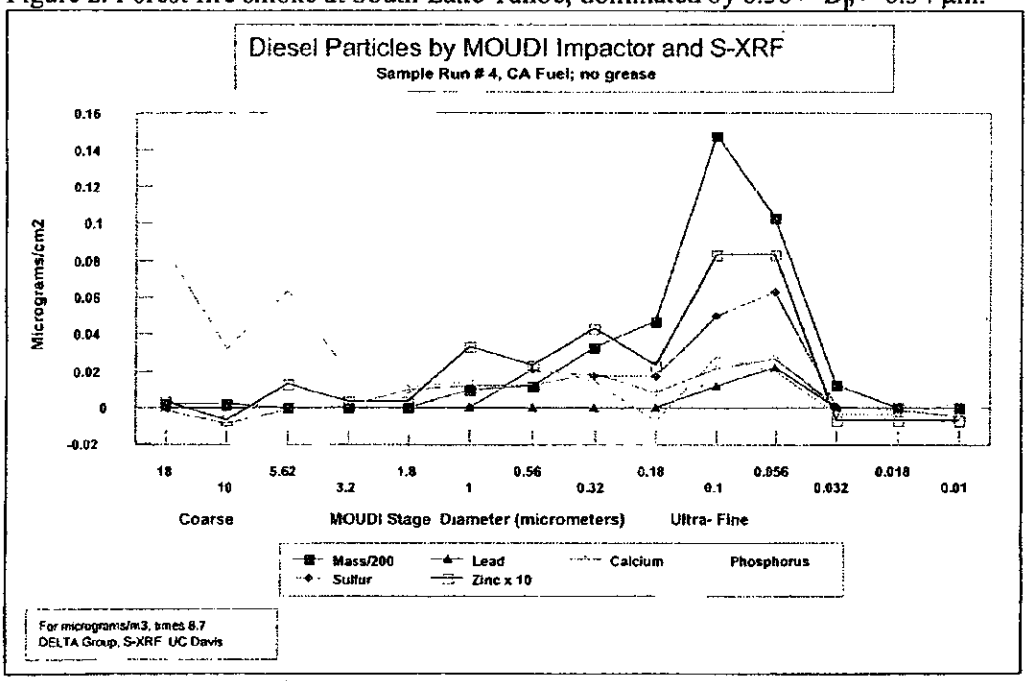
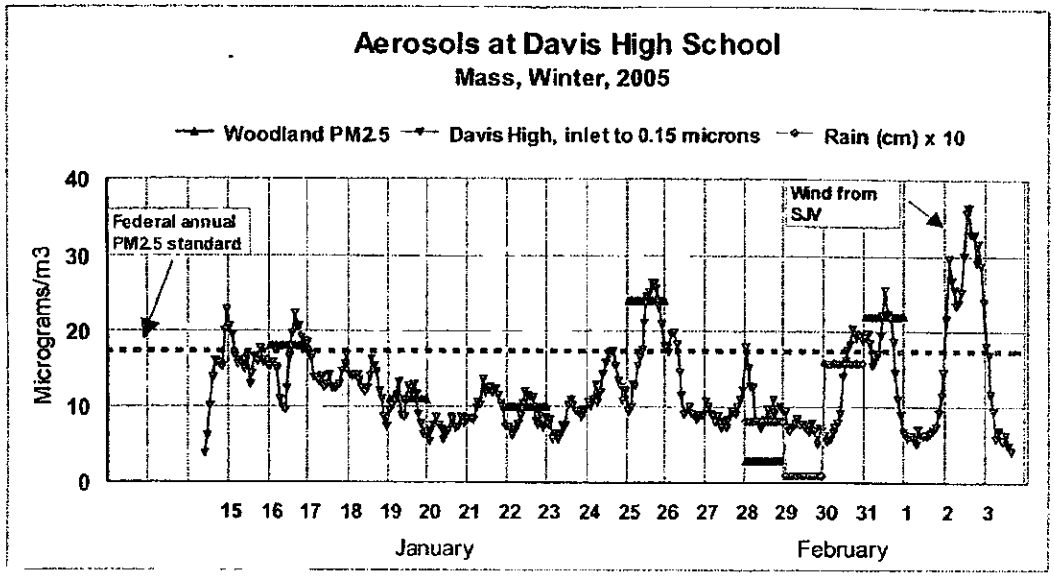


Figure 3: Diesel smoke from DELTA Group's collaboration with Desert research Institute, showing diesel smoke dominated by < 0.32 µm very fine particles.

Soft Beta ray Mass measurements

Below we compare masses measured at Davis HS by DRUM impactor and soft beta ray mass measurements to the Woodland Yolo-Solano APCD district 1 day in 3 filter based site. Agreement is excellent except for one rainy day.



2. Wind tunnel studies

With the assistance of Prof. Bruce White, his graduate student Dave, and funding from the grant, we have been able to clean, repair, and modify the UC Davis low velocity wind tunnel for the vegetation studies.

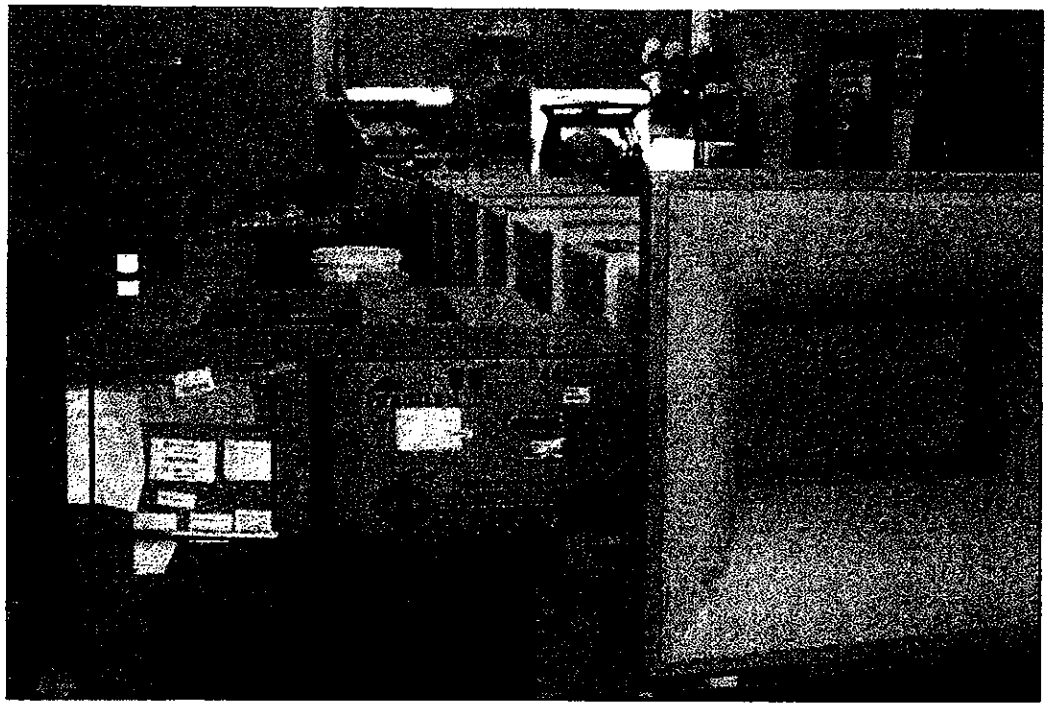


Figure 1 The 60 ft UC Davis low velocity wind tunnel. The collimators on the entrance are shown, then the 20 ft section for flow treatment, and in the distance the end of the tunnel and outside exhaust.

The wind tunnel was instrumented with wind flow measurers and profilers, a pair of DELTA Group 8 drum samplers, from circa 12 μm down to 0.09 μm diameter, two Dustrak nephelometers, all placed in front of and after the vegetation section..

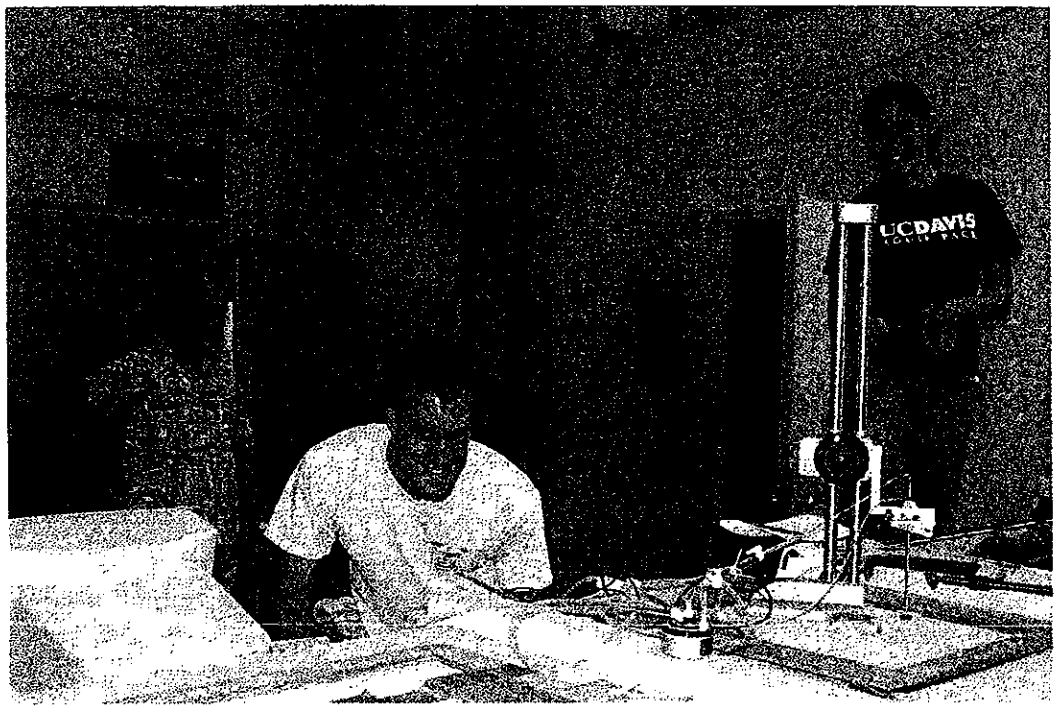


Figure 2 Dave is calibrating the wind flow devices while Erin is mounting the sampler inlets on the exit section.

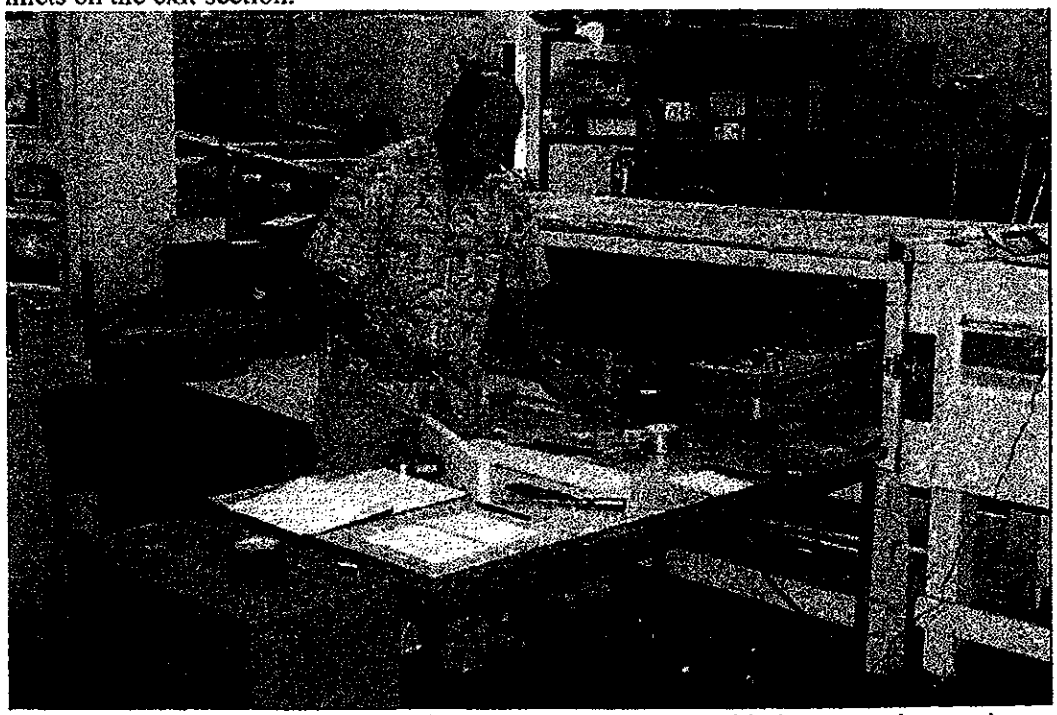


Figure 3. Dave Barnes next to the inlet DRUM and Dustrak, with the vegetation section beside him. The exit DRUM and Dustrak can be seen behind him.

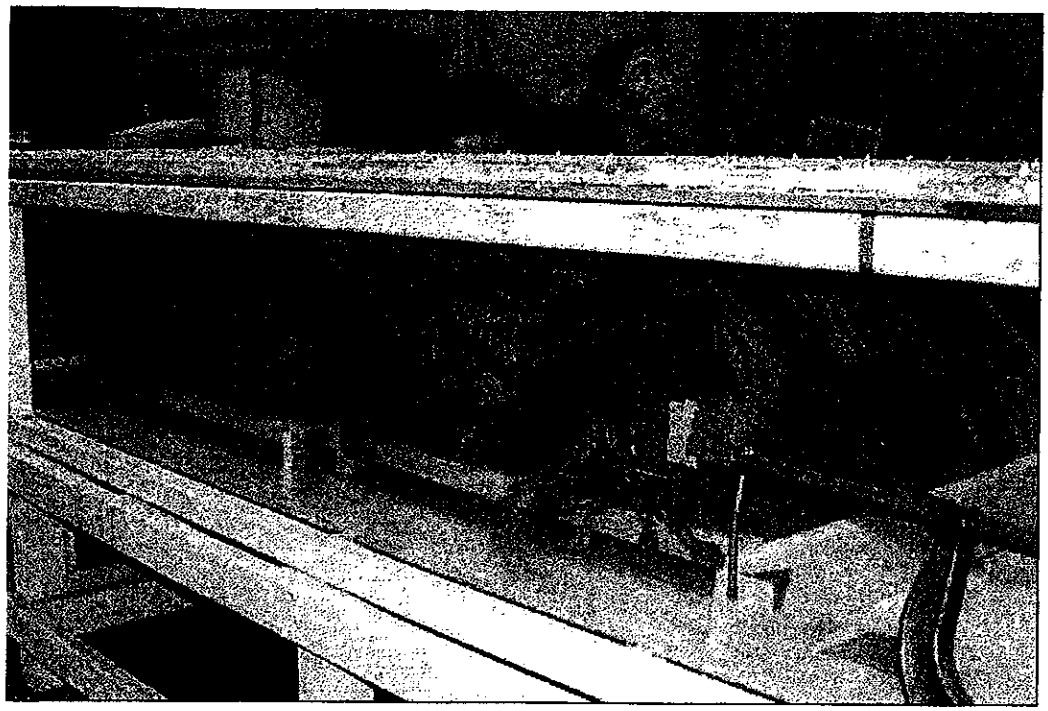


Figure 4 Redwood vegetation in place. Erin worried about something.

Figure 5 Exit inlets for DRUM and Dustrak.

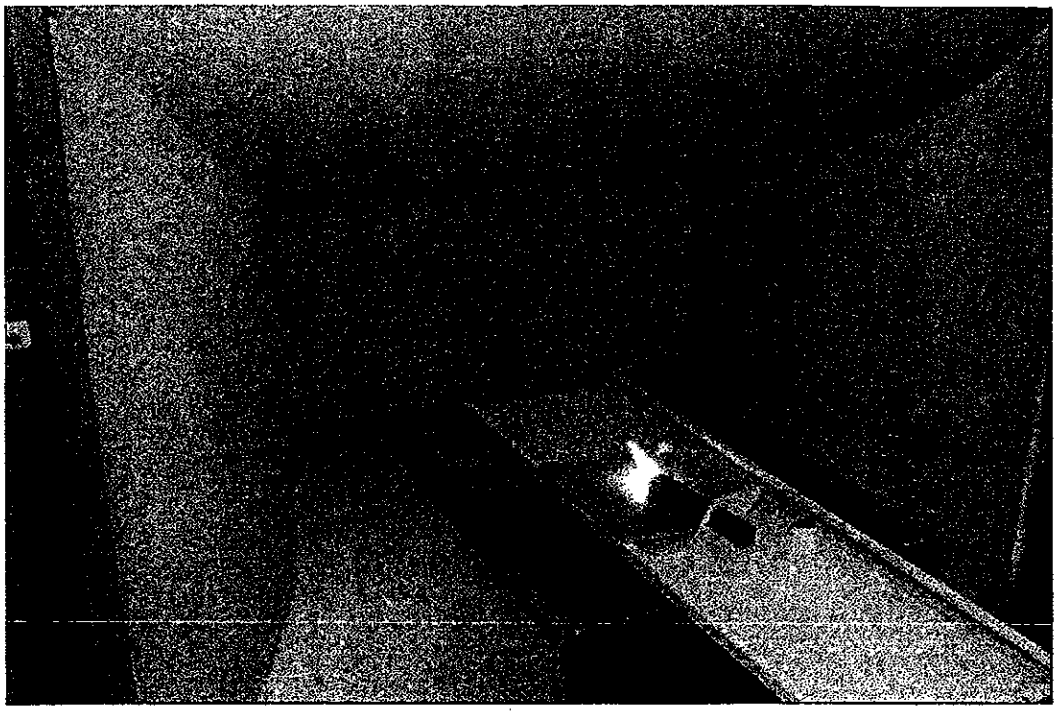
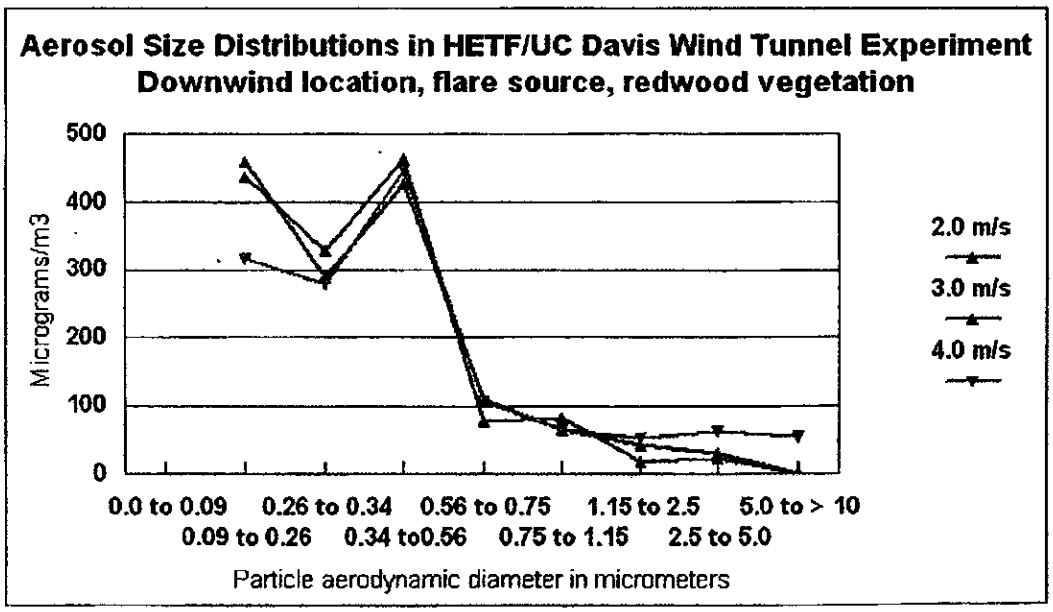


Figure 6 Use of a road flare to generate accumulation mode and very fine aerosol. The flare lasted 15 minutes with the output integrated on the 8 non rotating stages, inlet and exit. The mean aerosol level before the tests was 13 $\mu g/m^3$, and during the test 250 $\mu g/m^3$.



Figyure yyy Three runs on flare particles with an empty tunnel. Note that the differences reflect both differences in the flare burn and all uncertainties associated with the beta gauge measurements.

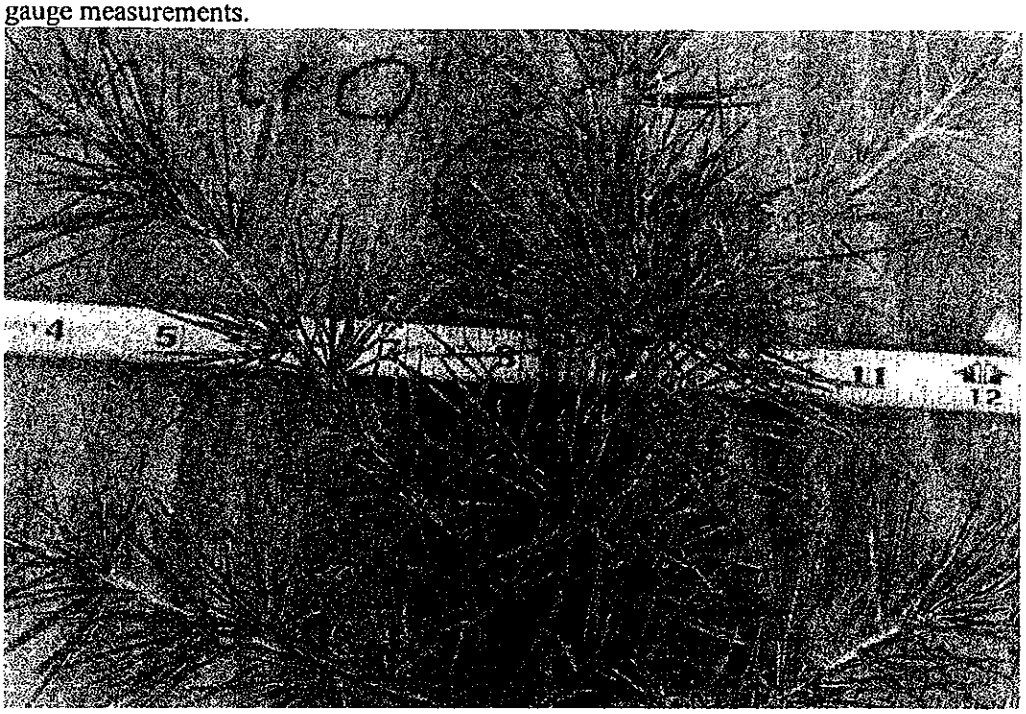
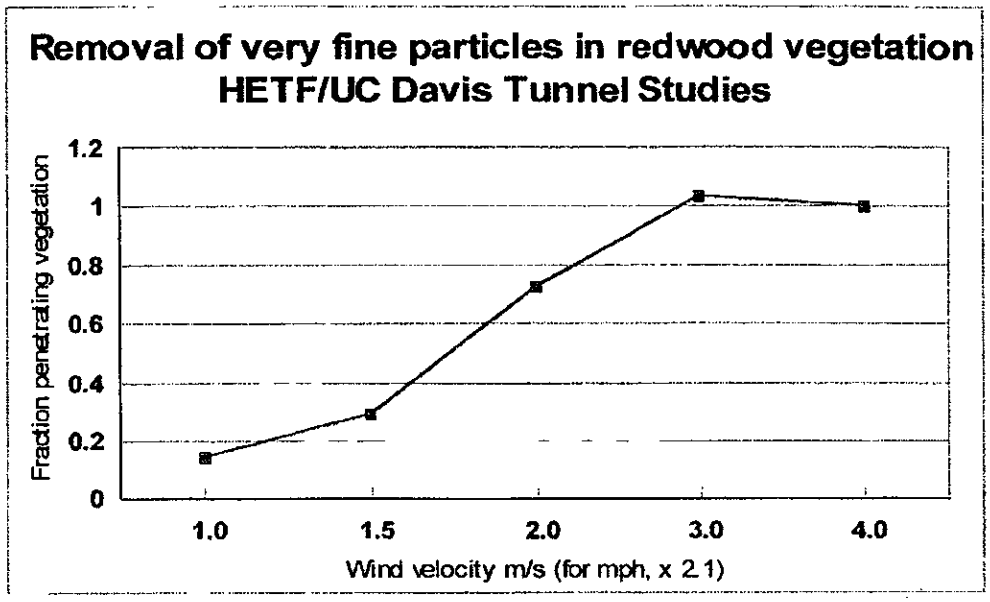


Figure yyy Example of measurements made to determine branch and needle area.

Two types of data are available from these tests. First, since we have a direct measurement of the volume of air in the tunnel, and since the flares proved surprisingly uniform in their ability to generate fine particles, (Figure yyy), we can simply measure the particle mass after the vegetation to detect removal, with the concentrations corrected for the dilution rate. Figure yyy shows an example of this type of test.

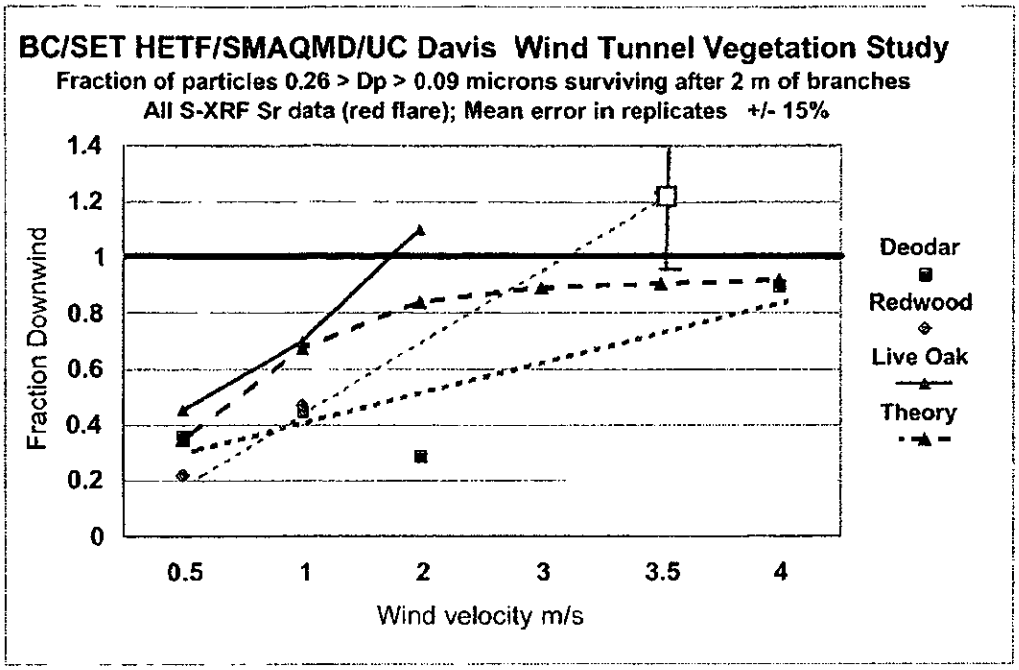


Figyre yyy Removal rate of very fine particles on redwood branches via the dilution method.

The second type of measurement involves comparison of the upwind versus downwind DRUM sampler data. These results had higher uncertainties, partially caused by the ± 15% uncertainty in replicates, part by suspected non uniformities in the particle distribution after moving through the vegetation. Efforts were made to reduce this by placing air barriers at all edges designed to avoid air passing around the vegetation rather than through it, but variations were still much higher than via the dilution method.

Figure yyy shows the results of these tests for very fine particles. S-XRF strontium data were used, as it was unique to the flare and did not occur in background air, but mass data are also available from all runs.

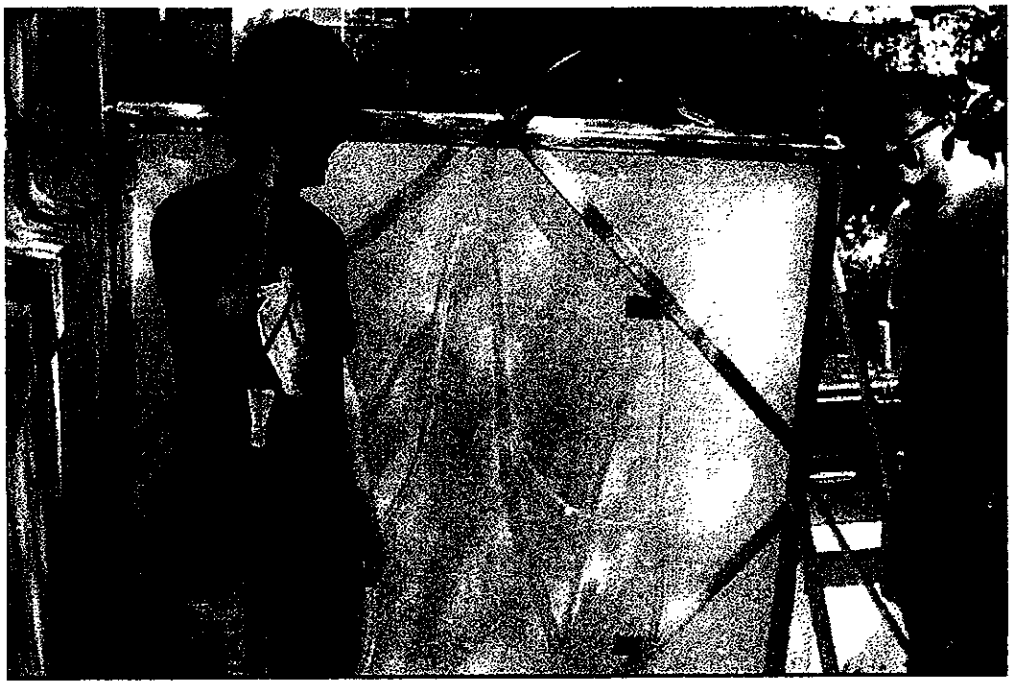
The ploy marker "theory" was based on a deposition velocity (Figure yyy) of 0.1 cm/sec, but suffers from the wildly non-uniform leaf and branch configuration that makes quantitative calculation unreliable. It should merely be used as a qualitative measure of expected behavior versus exposure time in the vegetation array.



3. Chamber studies

The chamber studies were based on an attempt to perform a diffusion-limited particle removal study without the complexity of air motion and impaction of particles inherent in the wind tunnel studies.

A plastic chamber 1.5 m/side (3.5 m^3) was constructed, with a removable side wall and a frame at the bottom into which was places fresh vegetation: oleander, redwood, deodar, and live oak, derived from prunings for the UC Davis grounds program. The placement was designed to provide a reasonable natural mass of vegetation far less dense than the vegetation array used in the tunnel study.



As in the tunnel study, particles were derived from highway flares placed in a sealed combustion chamber. Air was inserted into this chamber at the rate of roughly 10 L/min, and the smoke pushed through a 10 cm diameter plastic tube into the center of the chamber. The velocity of the incoming smoke was a few cm/sec, and it fell like slow motion stream of water towards the bottom of the changer during the fill process. After the flare was burned (originally for the full 15 min, later reduced to 1.5 min), the input air was stopped from the burn chamber.

After 1 min, the DRUM sampler was started (10 L/min) and 10 L/min of new filtered (stretched Teflon) ambient input air was added at 4 points in each near corner of the chamber on the vertical wall opposite the smoke input. The purpose of this was to provide clean make up air for that lost into the DRUM sampler and provide low velocity mixing. The DRUM input was a 5 cm diameter aluminum tube in the center of the chamber.

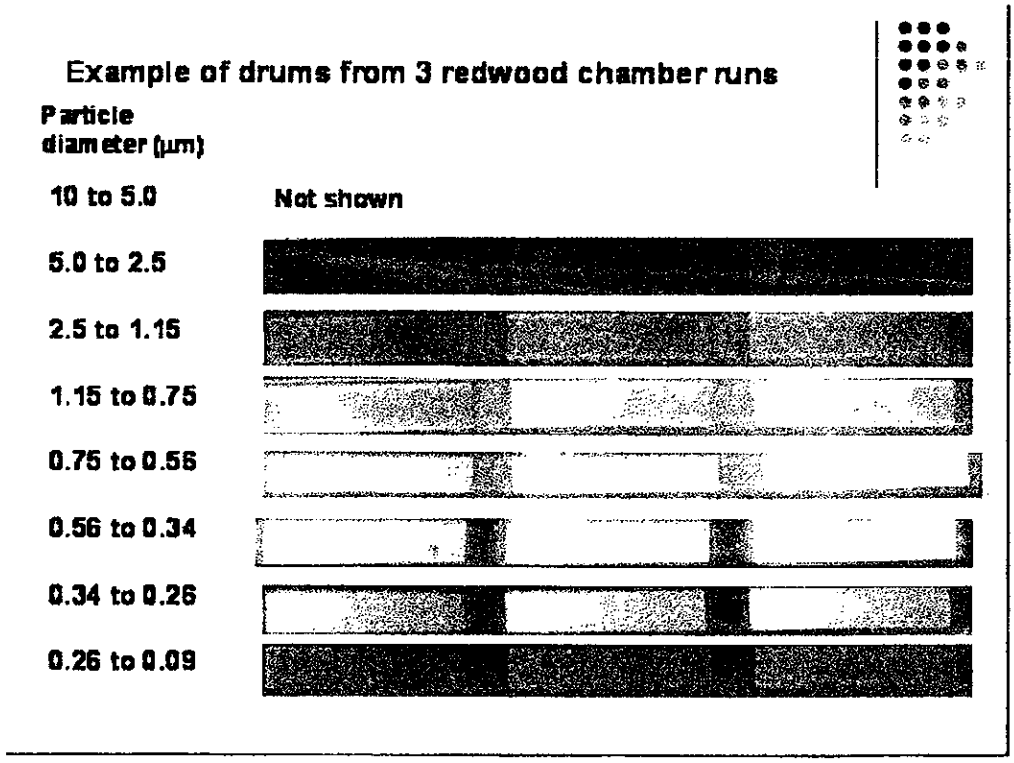


Table xxx shows the measurements made during the chamber studies. Each study involved multiple runs of the 8 stage impactor, generally of duration 1 to 3 hr in duration. Typically 3 measurements were made on a single set of drum strips. The samples were then beta gauged, and mass profiles provided.

The initial set runs were done with the empty chamber and a 15 minute flare burn. The chamber was visually observed to be uniformly filled with flare smoke, which then decreased in time. Note that the removal rate of the DRUM impactor, 10 L/min, would take 350 minutes, almost 6 hr, the empty the chamber. The first runs were on oleander branches, essentially loosely filling the chamber (10 to 12 m^2 of branch and leaf surface area). Two points were immediately evident. First, that the mass of aerosols present in the filled chamber was a small fraction, circa 10%, of the mass of aerosols in the empty chamber. Second, almost all particles in the very fine ($0.26 > D_p > 0.09$ μm) size mode were absent. Note that the comparison of the empty chamber and filled chamber studies argues against ant serious role in coagulation in reducing the aerosol concentrations.

In a way, these measurements by themselves proved the effectiveness of vegetation in removing very fine aerosols from the flare smoke, and especially those in the very fine. Theory predicts that the unmeasured low end of the ultra fine mode were even more effectively scavenged (see Figure xxx). However, the process was so facts that it was invisible to the DRUM, so the experiment was modified in two ways:

1. the amount of vegetation was greatly reduced, until the leaf area was on the order of 1.5 m^2, rather than 10 m^2.
2. the length of the flare burn was reduced to 1.5 min.

The empty chamber runs were then duplicated, now with lower concentrations. With this revised protocol, the concentrations in the chamber seen with the b ranched in place were increased to the point where measurements could be made. Figure yyy shows an example of one set of three runs taken on redwood branches using this protocol.

From these runs, two quantitative results are available. First, the concentration seen at the beginning of each run was a measure of the effectiveness of particle removal by the vegetation during the fill ands 1 minute delay before the DRUM started to sample. Second, the decay versus time was then available to examine the removal process.

Table xxx shows the data on the initial concentrations, while Figure yyy shows examples of the decay rate for each type of vegetation.

D. Interpretation and Conclusions

The data above show that the basic premise of the study has been confirmed. Vegetation does remove particles from the atmosphere, especially very fine particles such as diesel exhaust, and that removal is semi-quantitatively predicted by theory. These data thus encourage the use of vegetation to not only disperse but to capture and remove the most toxic components of aerosols, very fine < 0.25 μm) and ultra fine (< 0.1 μm), from the air. When vegetation is placed near sources, such as along roads, there will be mitigation at the source before it is dispersed into the local and regional air mass.

The differences in the two types of study are intriguing, and a clear and unique explanation is not derivable from the present data alone. However, there are important points to note in the information from each study that can help in interpretation.

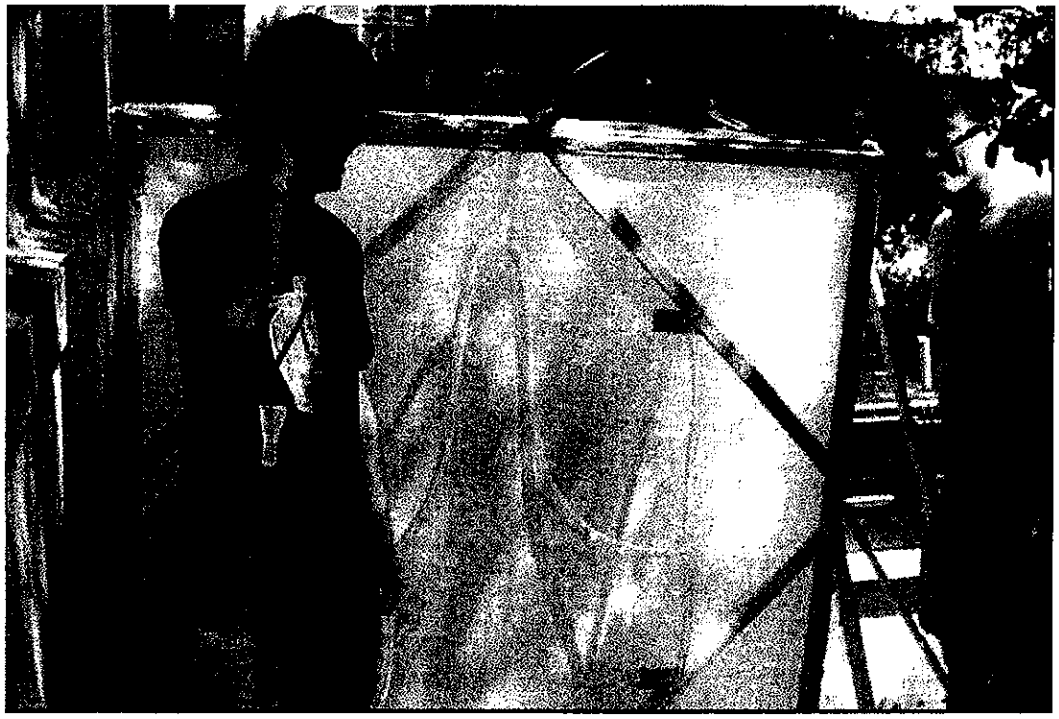
1. The air velocity of the tunnel study was from 0.5 m/s to 4 m/s, that of the chamber study circa 0.05 m/sec.
2. In the tunnel study, redwood and deodar were the most effective removal agents, twice as good as live oak, but in the chamber study live oak was much more effective than either redwood or deodar.

We propose that the differences in the leaf and branch structure are key to these differences, as the redwood and deodar have most of the capture area closely packed onto the branches, while the live oak is a much more open structure that allows air to pass through rather than over the branches.

Appendicx A

Run Summary Data

Set:	Run #	Date	Vegetation/PM	Velocity	gth of Run	egelence enhanc	Comments
itain stages 1-8)							
1	1	09/18/2006	Redwood/flare	1.03	875	6	none
	2	9/18-9/19	Redwood/no PM	1.06	1750	15	ard scaffold/pie plate
	3	19-Sep	Redwood/flare	0.49	1110	28	as above
	4		Redwood/flare	1.99	1150	29	as above
	5		Redwood/flare	4.08	1150	29	as above
	6		Redwood/flare	1.015	1115	30	as above
	7		Redwood/no PM	1.975	3960	31	as above
2	8	09/20/2006	Redwood/woodsmoke	2			as above
	9		Redwood/woodsmoke	4			as above
	10		Redwood/woodsmoke	1.05			as above
	11		Redwood/woodsmoke	0.54			as above
	12	09/24/2006	spun glass filter/flare	0.99			as above filter facing w rong w ay
	13		spun glass filter/flare	2			as above filter facing w rong w ay
3	14		spun glass filter/flare	1			as above filter facing ok, filter bloc
	15		spun glass filter/flare	1.97			as above
	16		spun glass filter/flare	3.91			as above
	17		spun glass filter/flare	0.51			as above
	18		spun glass filter/flare	0.98	480		as above blockages in stg. 7/8 rem
	19	09/25/2006	live oak/flare	0.94	480		as above
	20		live oak/flare	1.99	360		
4	21		live oak/flare	3.13	360		
	22		live oak/flare	0.53	360		
	23		live oak/flare	1.04	360		
	24		live oak/woodsmoke	1	900		
	25		live oak/woodsmoke	2.02	1200		
	26		live oak/woodsmoke	3.95	1200		
	27		live oak/woodsmoke	0.56	900		
	28		live oak/woodsmoke	0.98	900		
	29	09/26/2006	diedar/woodsmoke	1.01	900		
	30		diedar/woodsmoke	2	900		
5	31		diedar/woodsmoke	3.91	1200		
	32		diedar/woodsmoke	0.5	903		
	33		diedar/woodsmoke	0.95	885		
	34		diedar/flare	0.97	390		
	35		diedar/flare	2	360		
	36		diedar/flare	3.82	360		
	37		diedar/flare	0.52	360		
	38		diedar/flare	1.02	360		
	39		electrostatic filter/flare	1.01	315		
	40		electrostatic filter/flare	1.98	330		
6	41		electrostatic filter/flare	4	360		
	42		electrostatic filter/flare	0.51	331		
	43		electrostatic filter/flare	0.5	360		ı of tunnel, blow ing perpendicular to tunnel
	44		electrostatic filter/flare	0.97	315		as above
	45		paper filter/flare	0.93	360		as above
	46		paper filter/flare	1.88	360		as above
	47		paper filter/flare	2.55	360		as above
	48		paper filter/flare	0.5	348		as above with afterfilter
	49		paper filter/flare	1.95	373		as above
	50		spun glass filter/flare	0.97	360		



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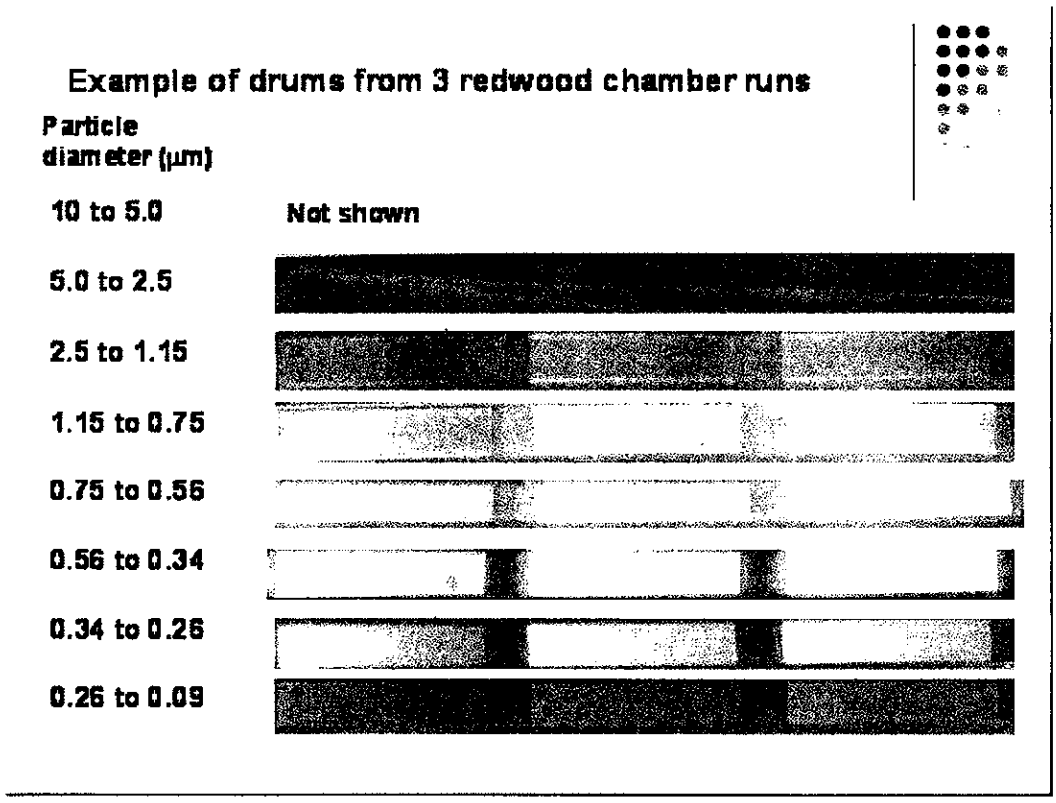

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In a way, these measurements by themselves proved the effectiveness of vegetation in removing very fine aerosols from the flare smoke, and especially those in the very fine. Theory predicts that the unmeasured low end of the ultra fine mode were even more effectively scavenged (see Figure xxx). However, the process was so facts that it was invisible to the DRUM, so the experiment was modified in two ways:

1. the amount of vegetation was greatly reduced, until the leaf area was on the order of 1.5 m^2, rather than 10 m^2.
2. the length of the flare burn was reduced to 1.5 min.

The empty chamber runs were then duplicated, now with lower concentrations. With this revised protocol, the concentrations in the chamber seen with the b ranched in place were increased to the point where measurements could be made. Figure yyy shows an example of one set of three runs taken on redwood branches using this protocol.

From these runs, two quantitative results are available. First, the concentration seen at the beginning of each run was a measure of the effectiveness of particle removal by the vegetation during the fill ands 1 minute delay before the DRUM started to sample. Second, the decay versus time was then available to examine the removal process.

Table xxx shows the data on the initial concentrations, while Figure yyy shows examples of the decay rate for each type of vegetation.

D. Interpretation and Conclusions

The data above show that the basic premise of the study has been confirmed. Vegetation does remove particles from the atmosphere, especially very fine particles such as diesel exhaust, and that removal is semi-quantitatively predicted by theory. These data thus encourage the use of vegetation to not only disperse but to capture and remove the most toxic components of aerosols, very fine < 0.25 μm) and ultra fine (< 0.1 μm), from the air. When vegetation is placed near sources, such as along roads, there will be mitigation at the source before it is dispersed into the local and regional air mass.

The differences in the two types of study are intriguing, and a clear and unique explanation is not derivable from the present data alone. However, there are important points to note in the information from each study that can help in interpretation.

1. The air velocity of the tunnel study was from 0.5 m/s to 4 m/s, that of the chamber study circa 0.05 m/sec.
2. In the tunnel study, redwood and deodar were the most effective removal agents, twice as good as live oak, but in the chamber study live oak was much more effective than either redwood or deodar.

We propose that the differences in the leaf and branch structure are key to these differences, as the redwood and deodar have most of the capture area closely packed onto the branches, while the live oak is a much more open structure that allows air to pass through rather than over the branches.

Appendicx A

Run Summary Data

Set: ıtain stages 1-8)	Run #	Date	Vegetation/PM	Velocity	gth of Rur	egetence enhanc	Comments
1	1	09/18/2006	Redw ood/flare	1.03	875	6 none	
	2	9/18-9/19	Redw ood/no PM	1.06	1750	15 ard scaffold/pie plate	
	3	19-Sep	Redw ood/flare	0.49	1110	28 as above	
	4		Redw ood/flare	1.99	1150	29 as above	
	5		Redw ood/flare	4.08	1150	29 as above	
	6		Redw ood/flare	1.015	1115	30 as above	
	7		Redw ood/no PM	1.975	3960	31 as above	
2	8	09/20/2006	Redw ood/w oodsmoke	2		as above	
	9		Redw ood/w oodsmoke	4		as above	
	10		Redw ood/w oodsmoke	1.05		as above	
	11		Redw ood/w oodsmoke	0.54		as above	
	12	09/24/2006	spun glass filter/flare	0.99		as above	filter facing w rong w ay
	13		spun glass filter/flare	2		as above	filter facing w rong w ay
3	14		spun glass filter/flare	1		as above	filter facing ok, filter bloc
	15		spun glass filter/flare	1.97		as above	
	16		spun glass filter/flare	3.91		as above	
	17		spun glass filter/flare	0.51		as above	
	18		spun glass filter/flare	0.98	480	as above	blockages in stg. 7/8 rem
	19	09/25/2006	live oak/flare	0.94	480	as above	
	20		live oak/flare	1.99	360		
4	21		live oak/flare	3.13	360		
	22		live oak/flare	0.53	360		
	23		live oak/flare	1.04	360		
	24		live oak/w oodsmoke	1	900		
	25		live oak/w oodsmoke	2.02	1200		
	26		live oak/w oodsmoke	3.95	1200		
	27		live oak/w oodsmoke	0.56	900		
	28		live oak/w oodsmoke	0.98	900		
	29	09/26/2006	diedar/w oodsmoke	1.01	900		
	30		diedar/w oodsmoke	2	900		
5	31		diedar/w oodsmoke	3.91	1200		
	32		diedar/w oodsmoke	0.5	903		
	33		diedar/w oodsmoke	0.95	885		
	34		diedar/flare	0.97	390		
	35		diedar/flare	2	360		
	36		diedar/flare	3.82	360		
	37		diedar/flare	0.52	360		
	38		diedar/flare	1.02	360		
	39		electrostatic filter/flare	1.01	315		
	40		electrostatic filter/flare	1.98	330		
6	41		electrostatic filter/flare	4	360		
	42		electrostatic filter/flare	0.51	331		
	43		electrostatic filter/flare	0.5	360	ı of tunnel, blow ing perpendicular to tunnel	
	44		electrostatic filter/flare	0.97	315	as above	
	45		paper filter/flare	0.93	360	as above	
	46		paper filter/flare	1.88	360	as above	
	47		paper filter/flare	2.55	360	as above	
	48		paper filter/flare	0.5	348	as above	w ith afterfilter
	49		paper filter/flare	1.95	373	as above	
	50		spun glass filter/flare	0.97	360		

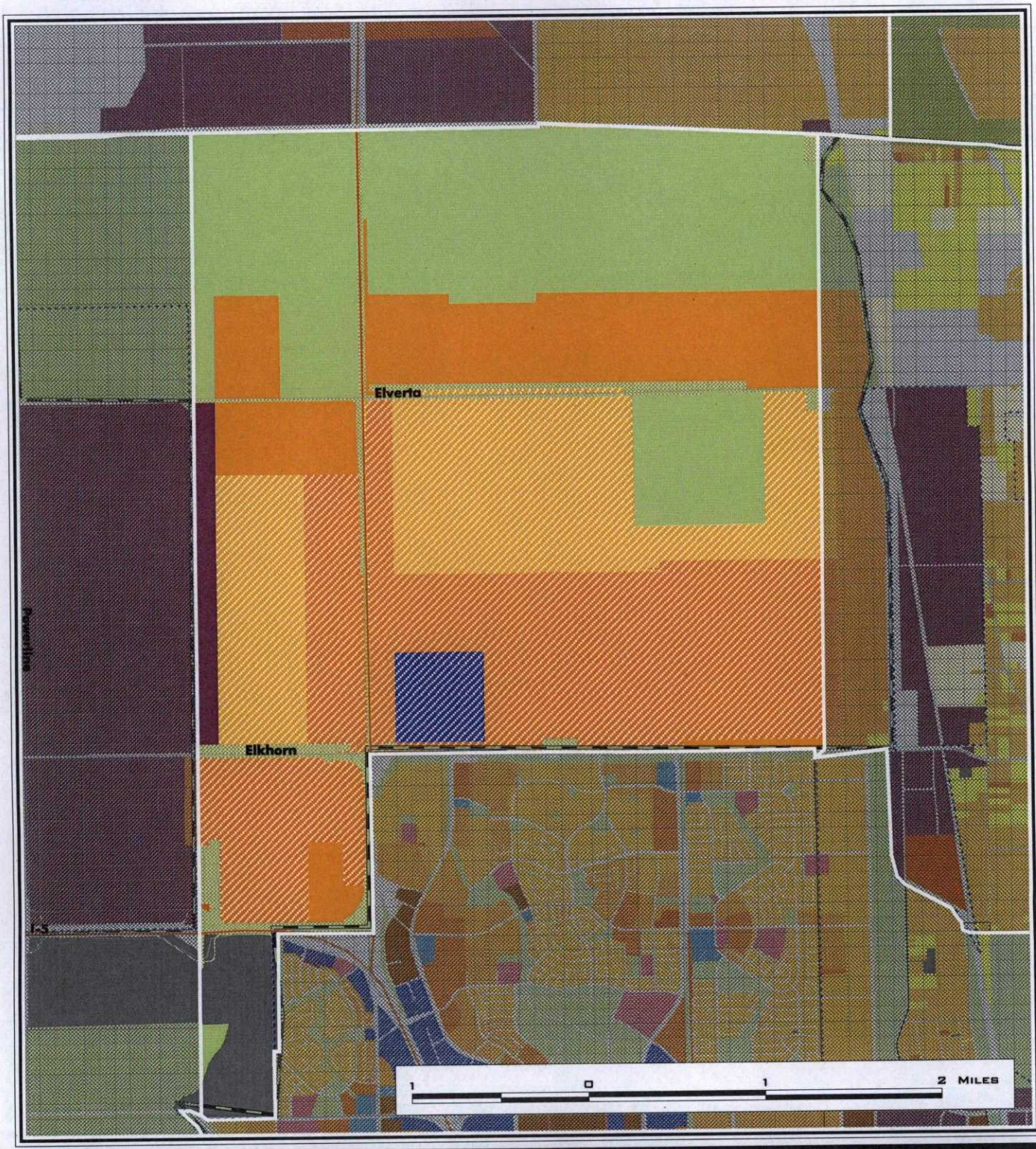
NORTH NATOMAS JOINT VISION AREA		
SCENARIO	**Base Case**	**Draft Preferred Blueprint Scenario**
Growth in Jobs: 2000-2050	10,846	8,868
Growth in Housing Units: 2000-2050	25,858	41,437
Balance of Jobs/Housing in 2000:	N/A	N/A
Balance of Jobs/Housing Growth (2000-2050):	0.2	0.2
Balance of Jobs/Housing in 2050:	0.2	0.2
New Housing Growth through 2050 (by type):		
Rural Residential (Existing N/A)	0%	0%
Large Lot Single Family (Existing N/A)	86%	13%
Small Lot Single Family (Existing N/A)	1%	58%
Attached Products (Existing N/A)	14%	29%
Total Housing Product Mix through 2050:		
Rural Residential	0%	0%
Large Lot Single Family	86%	13%
Small Lot Single Family	1%	58%
Attached Products	14%	29%
New Job Growth through 2050 (by sector):		
Retail Jobs (Existing N/A)	70%	55%
Office Jobs (Existing N/A)	30%	45%
Industrial Jobs (Existing N/A)	0%	0%
Public/Quasi-Public Jobs (Existing N/A)	0%	0%
Total Job Mix through 2050:		
Retail Jobs	70%	55%
Office Jobs	30%	45%
Industrial Jobs	0%	0%
Public/Quasi-Public Jobs	0%	0%
Growth through Re-investment in 2050:		
Jobs	0%	0%
Dwelling Units	0%	0%
Type of Trips:		
Auto	95.5%	76.8%
Transit	0.8%	5.4%
Bike and Pedestrian	3.8%	17.8%
Vehicle Miles Traveled		
Per Day per Household	43.4	30.8
Pct Vehicle Hours in Heavy Congestion on Freeways and Arterials	41%	32%

Discussion Draft Preferred Scenario Summary

This areas develops approximately consistent with the North Natomas Vision:

- Significant amounts of land remain in open space;
- Just over 90,000 people live here by 2050;
- About 9,000 jobs are added, mainly retail and professional service offices that serve local needs. The main employment for these residents comes from the Airport and Air Park, south Sutter County, McClellan, downtown Sacramento and Roseville/Rocklin;
- Small lot single family products are the predominant housing type, the attached townhomes, rowhouses, condominiums and apartments the second largest type.

North Natomas Joint Vision Area



RESIDENTIAL "BUILDING" TYPES
- Rural Residential
- Single Family Large Lot
- Single Family Small Lot
- Attached Residential

EMPLOYMENT "BUILDING" TYPES
- Retail
- Office
- Industrial
- Public

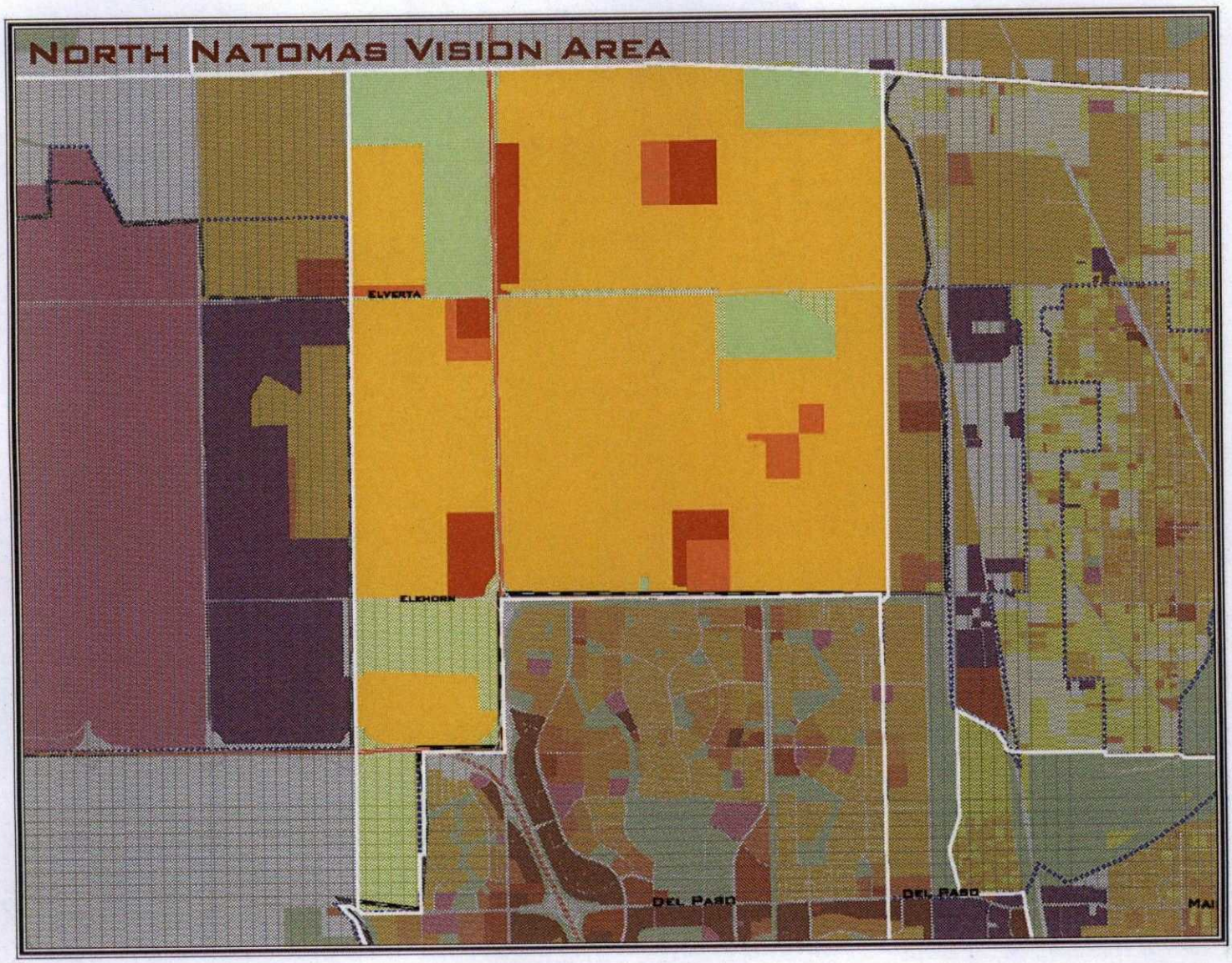
NON-URBAN "LAND USE" TYPES
- Agriculture
- Forest
- Open Space
- Parks
- Water

RESIDENTIAL "PLACE" TYPES
- Medium Density Mixed Residential
- High Density Mixed Residential

MIXED-USE "PLACE" TYPES
- Low Density Mixed-use Center or Corridor
- Medium Density Mixed-use Center or Corridor
- High Density Mixed-use Center or Corridor
- Employment Focus Mixed-use Center or Corridor

- Vacant Urban Designated Lands (2050)
- Vacant Rural Residential Lands (2050)

Preferred Scenario


NORTH NATOMAS VISION AREA
ELVERTA
ELKHORN
DEL PASO
DEL PASO

Base Case

SPECIAL REPORT JANUARY 2005

SACRAMENTO REGION Blueprint TRANSPORTATION + LAND USE STUDY

Preferred Blueprint Alternative

Blueprint Awards

The Sacramento Region Blueprint: Transportation/ Land Use Study has received praise from throughout the state and nation:

One of the "Top 50" programs in Harvard University's "Innovations in American Government" Competition, Kennedy School of Government (2003)

The Governor's Award for Environmental and Economic Leadership (2003)

The Federal Highway Administration/Federal Transit Administration Transportation Planning Excellence Award (2004)

The American Institute of Architects California Chapter Presidential Citation (2004)

The Environmental Council of Sacramento (ECOS) Environmental Leadership Award (2004)

U.S. Environmental Protection Agency—National Award for Smart Growth Achievement (2004)

American Leadership Forum Mountain Valley Chapter Thanks to You Award (2004)

Association of Metropolitan Planning Organizations—National Award for Outstanding Achievement (2004)

Preferred Blueprint Scenario Marks Key Milestone in Process

The approval of the Preferred Blueprint Scenario for 2050 by the SACOG Board of Directors in December 2004 marked a key step in the Blueprint process, a three-year effort to engage the public and local government leaders in crafting a vision for the Sacramento region's future growth.

The Project was initiated by the SACOG Board of Directors after it viewed regional computer modeling results showing that current growth patterns and transportation investment priorities would result in significant increases in congestion in the future.

A joint effort by SACOG and its civic partner Valley Vision, the Blueprint Project is bringing together local officials, civic groups, environmental advocates, the development community, business leaders and the public in a first-ever attempt to guide how the region grows over the next 50 years.

Seeking broad input from the ground up, SACOG and Valley Vision in March 2003 launched a series of 37 workshops in neighborhoods, cities and counties throughout the region. By the time the workshops and two Regional Forums had concluded in April 2004, more than 5,000 participants had used the project's interactive modeling software to study how the region might look under different land use scenarios.

The first-ever Regional Elected Officials Summit in October 2004.

Input from the workshops helped create four distinct growth scenarios for further study, including a 'Base Case' that shows how the region would look if growth patterns of the recent past continue. The four were the focal point of the Regional Forum in April 2004 that drew nearly 1,400 people. Asked to select a preference, Forum participants overwhelmingly rejected the Base Case in favor of alternatives providing for a greater range of housing choices, reinvestment in already developed areas and closer integration of jobs and housing.

Following the Forum, a 1,300 person public opinion telephone poll on growth issues in SACOG's six-county region was conducted by noted pollster Wirthlin Worldwide. City and county elected officials in the region were then invited to a first-ever Regional Summit to discuss a Draft Preferred Blueprint Scenario and the results of the Wirthlin Poll.

The public opinion poll found strong support for the Blueprint growth principles *(found on pages 4–5 and 8–9 of this special report)* in all six counties of the SACOG region. The elected officials at the Summit also supported these growth principles.

The Board's approval of the Blueprint as a voluntary ideology or framework for future growth in the region is only the beginning.

The next steps in the Blueprint process are outlined starting on page 10 of this special report.

What the Blueprint Maps Show

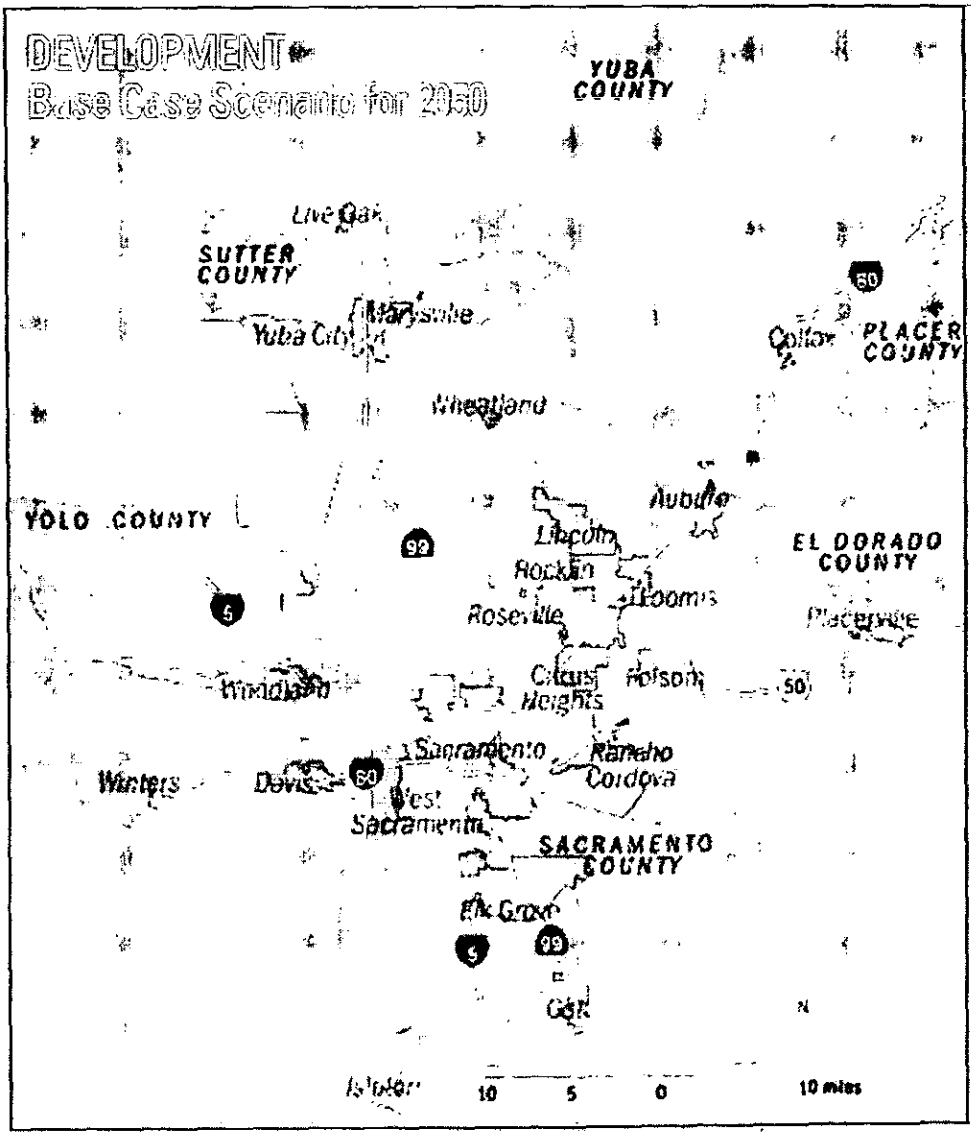
The Blueprint map *(shown in comparison to the base case on this page, and in detail in the center spread of this report)* depicts a way for the region to grow through the year 2050 in a manner generally consistent with the growth principles summarized on page 4–5 and 8–9 of this report. The map is a result of numerous public workshops and meetings with local staff and elected officials. The map is intended to be interpreted and used as a concept-level growth principles. It was developed with parcel-level data and analysis to help ensure that the growth concepts were being applied in a realistic manner; however, it is not intended to be applied or implemented in a literal, parcel-level manner.

For example, the map assumes certain levels and locations of both "reinvestment," i.e. additional development on already built parcels) and greenfield development, i.e. large-scale development on vacant land). The purpose of this mapping is to illustrate, generally, the amounts and locations for these types of growth. It is not intended to indicate that a specific parcel should or should not be developed in a particular manner. That level of planning is the responsibility of local governments, and is beyond the specificity appropriate for regional scale, long-term scenario planning.

The Base Case and the Preferred Blueprint Scenario for 2025:

How the Scenarios Compare

The starting point for the Blueprint Project is the Base Case Scenario, which shows how the region would develop through 2050 if patterns of the recent past continue. Under the Base Case Scenario, growth would continue outward into largely rural areas and on the fringes of development. The Preferred Blueprint Scenario—the option developed as an alternative—takes a different approach. Built on the principles of smart growth, it includes a greater range of housing products, reinvest-



ment in already developed areas, protection of natural resource areas from urbanization, and more transportation choices. The maps below depict the differences between the two scenarios.

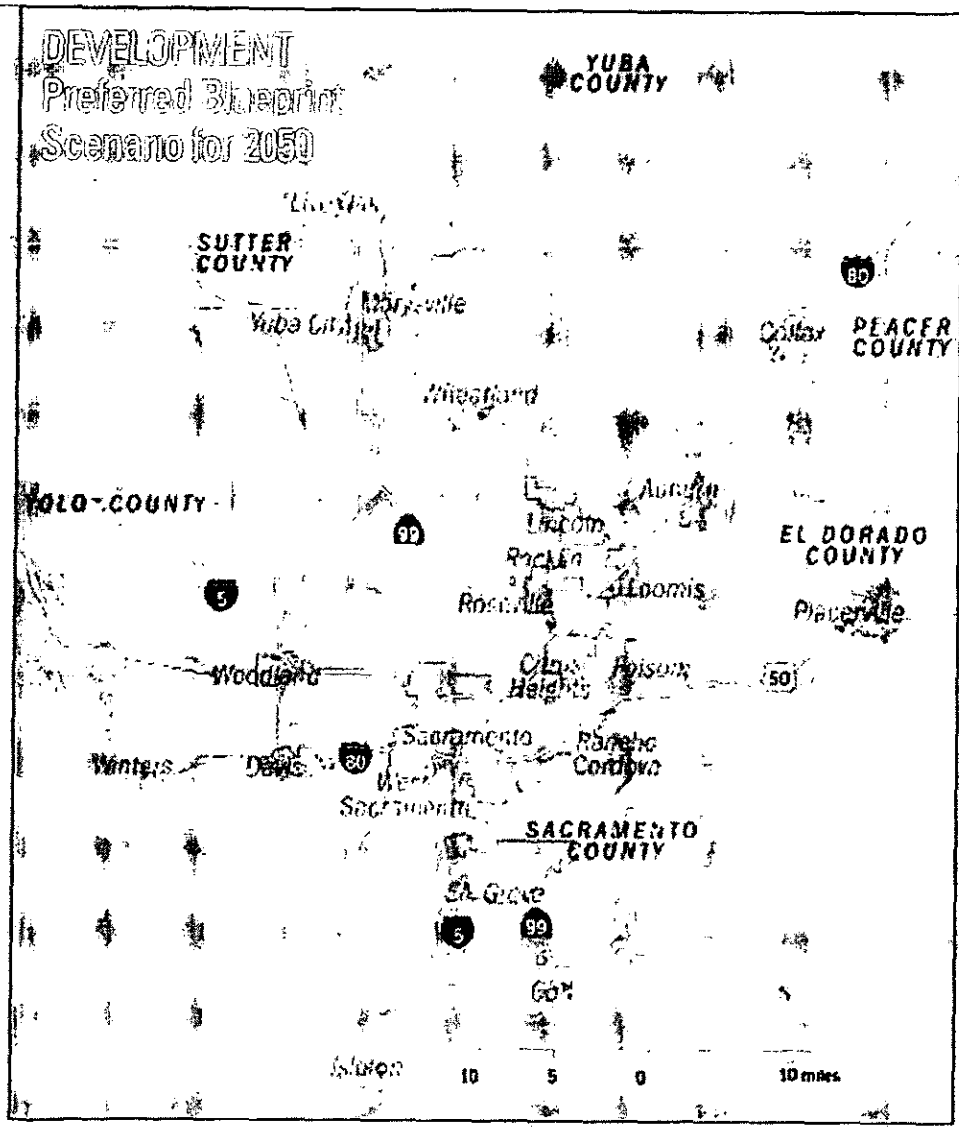
How to read the maps

The orange areas show where current development exists, plus new buildings constructed through 2050, and some vacant land for future growth. The green areas show a variety of types of undeveloped areas, including lands protected from development through conservation easements, parks, and natural resources such as wetlands, vernal pools and hardwood stands that are preserved in 2050. The beige areas are mainly agricultural lands, but they also include some lands currently designated for development that remain undeveloped in 2050.

How would life in 2050 be different with each scenario?

The typical resident living in a version of a future typical of the "Base Case Scenario" in 2050 would probably live in a house on a fairly large lot in a subdivision with houses that look a lot like theirs. They would travel to work longer distances than are typical today, and arrive there much more slowly due to significant increases in congestion. Trips to shopping and entertainment would also be fairly lengthy and slow.

Typical residents living in a future typical of the Preferred Blueprint Scenario in 2050 would probably live in a house on a smaller lot, in a neighborhood with some larger houses and some attached row houses, apartments and condominiums. They would drive to work, but the trip would be shorter than today, and the time needed to get there would be about the same as today. Sometimes they might take the train or bus. Most of their shopping and entertainment trips would still be in a car, but the distances would be shorter. And some of these shopping trips might be taken by walking or biking down the block to a village or town center that has neighborhood stores with housing on top of them, and a small park or plaza.



Key to the Map

- areas of existing and future development
- green areas (e.g. open space, parks, wetlands, vernal pools, stream corridors, hardwood stands)
- agriculture and other undeveloped lands
- rivers, streams and lakes
- city boundaries
- highways
- county boundaries

Note: Some vernal pools in Yuba, Sutter and southwest Placer counties are preserved, but are not shown on these maps.

Note: El Dorado County elected not to directly participate in this phase of the Blueprint process due to ongoing issues associated with their General Plan.

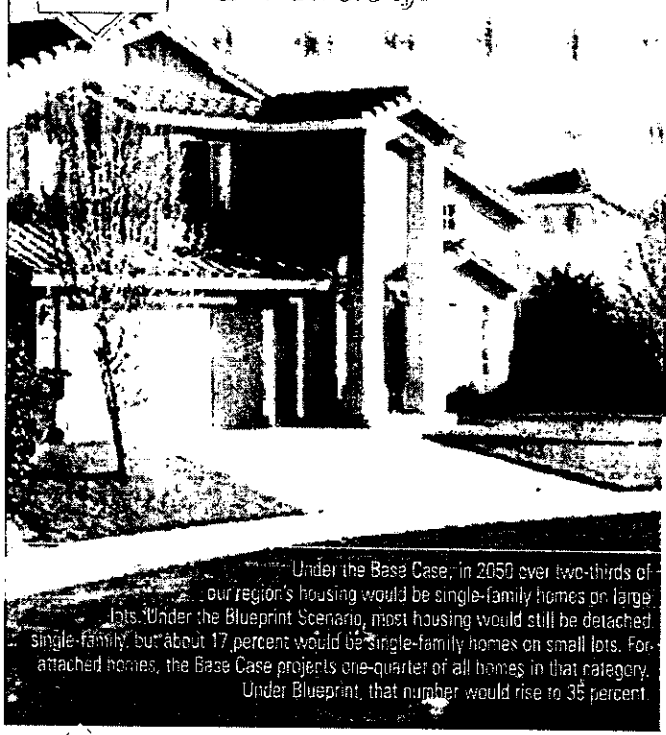
For detailed information

To view the complete land use maps, including where industry, homes, shopping and other uses would be located in the region, please go to www.sacregionblueprint.org and click on "The Project" tab at the top of the page. There you may view maps for each city and major county area in the region and a variety of statistical and narrative information about the scenarios.

BLUEPRINT SCENARIO PERFORMANCE ON SMART GROWTH PRINCIPLES

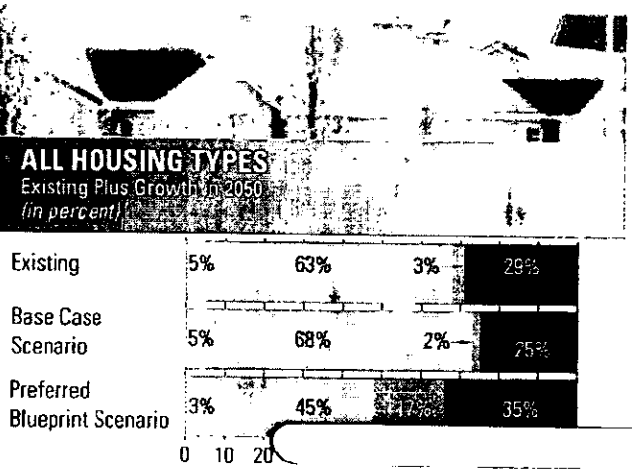
Housing Choice and Diversity

Providing a variety of places where people can live—apartments, condominiums, townhouses, and single-family detached homes on varying lot sizes—creates opportunities for the variety of people who need them: families, singles, seniors, and people with special needs. This issue is of special concern for the people with very low-, low-, and moderate-income, often our teachers, other public employees and professionals, as well as retail employees, service workers and other people for whom finding housing close to work is challenging. By providing a diversity of housing options, more people have a choice.



Under the Base Case, in 2050 over two-thirds of our region's housing would be single-family homes on large lots. Under the Blueprint Scenario, most housing would still be detached single-family, but about 17 percent would be single-family homes on small lots. For attached homes, the Base Case projects one-quarter of all homes in that category. Under Blueprint, that number would rise to 35 percent.

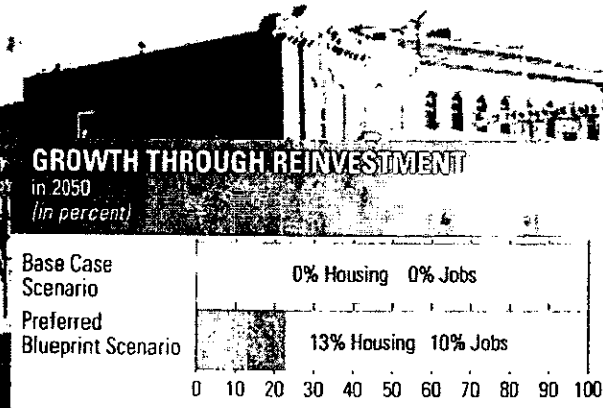
ALL HOUSING TYPES
Existing Plus Growth in 2050
(in percent)



Use Existing Assets

In urbanized areas, development on infill or vacant lands, intensification of the use of underutilized parcels (for example, more development on the site of a low-density retail strip shopping center), or redevelopment can make better use of existing public infrastructure. This can also include rehabilitation and reuse of historic buildings, denser clustering of buildings in suburban office parks, and joint use of existing public facilities such as schools and parking garages.

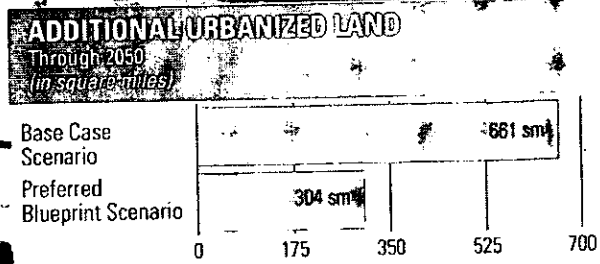
GROWTH THROUGH REINVESTMENT
in 2050
(in percent)



Under the Base Case Scenario, all new development would be on vacant land. The Blueprint Scenario suggests 13 percent of all new housing, and 10 percent of all new jobs, would occur through reinvestment.

Compact Development

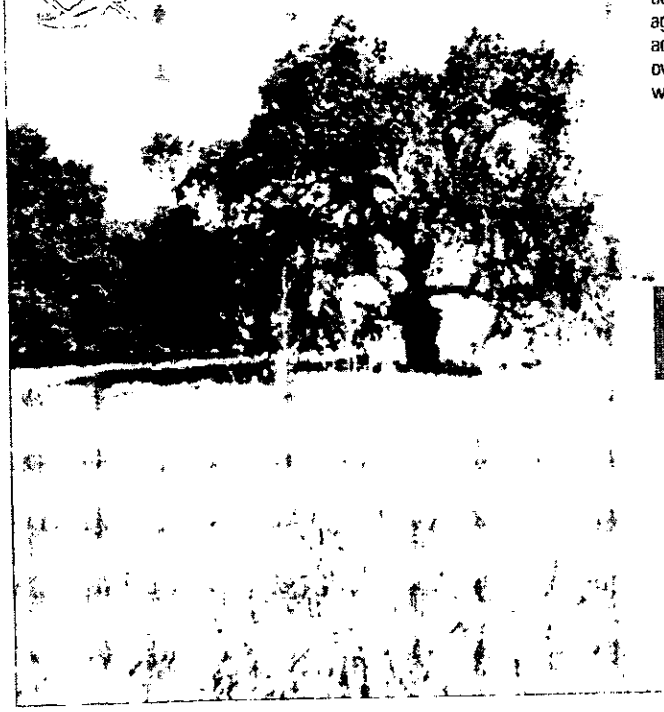
Creating environments that are more compactly built and that use space in an efficient but aesthetic manner can encourage more walking, biking, and public transit use, and shorten auto trips

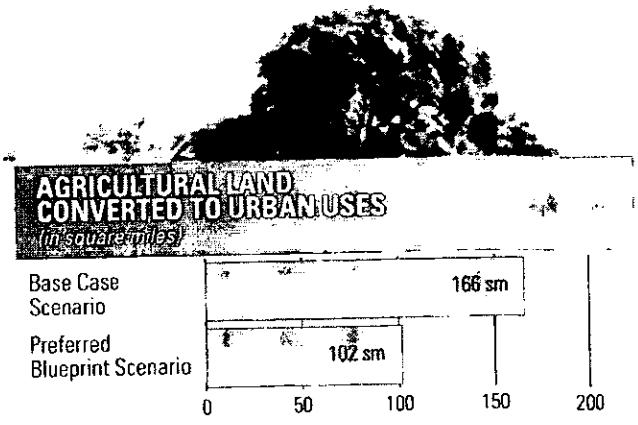


Under the Base Case, new development would need an additional 661 square miles of land by 2050. In the Blueprint Scenario, 304 square miles of new land would be needed for urban uses.

Natural Resources Conservation:

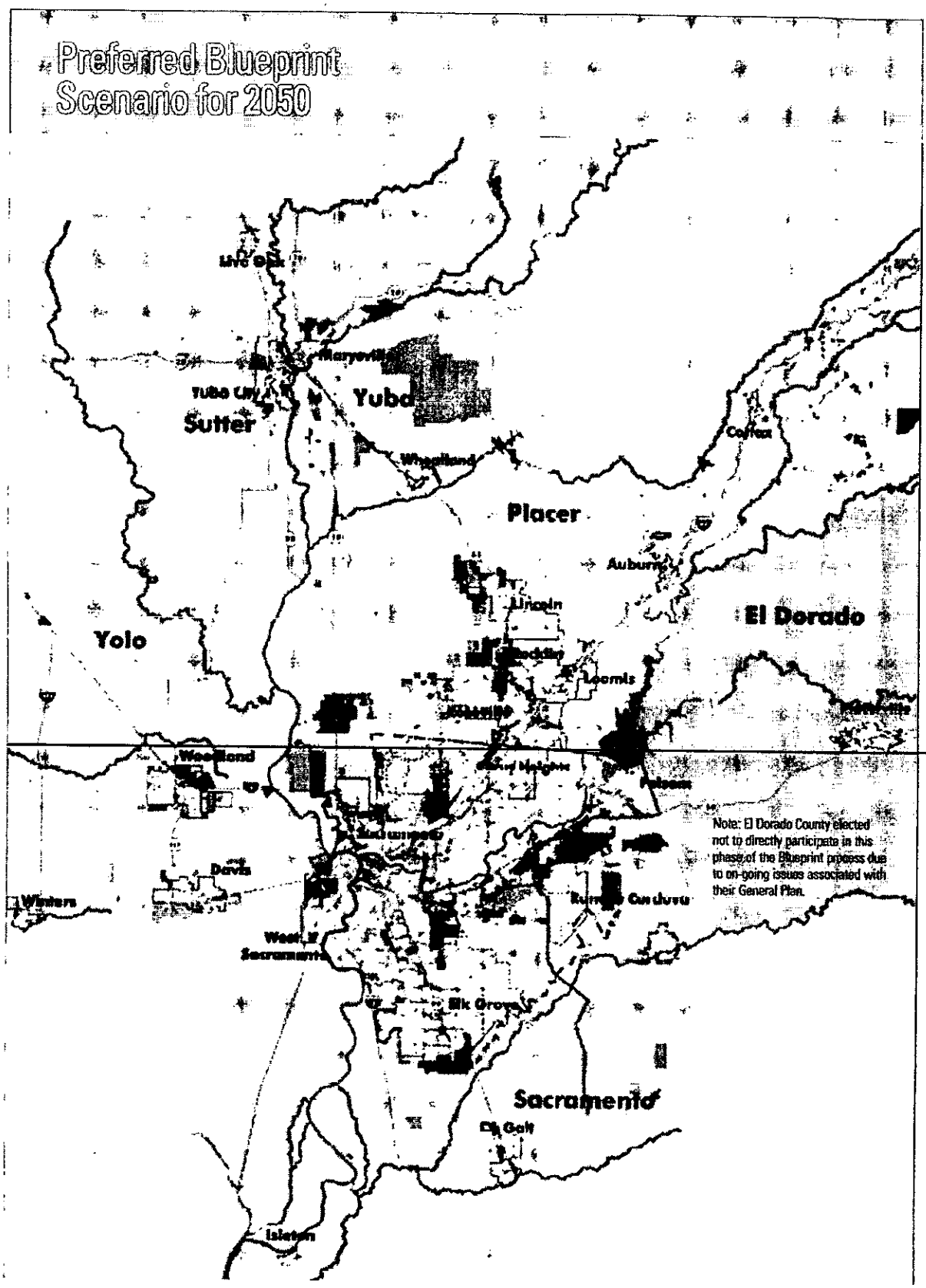
This principle encourages the incorporation of public-use open space (such as parks, town squares, trails, and greenbelts) within development projects, over and above state requirements. It also includes wildlife and plant habitat preservation, agricultural preservation and promotion of environment-friendly practices such as energy efficient design, water conservation and stormwater management, and shade trees to reduce the ground temperatures in the summer. In addition to conserving resources and protecting species, this principle improves overall quality of life by providing places for everyone to enjoy the outdoors with family outings and by creating a sense of open space.





The Base Case would convert 166 square miles of agricultural land into urban uses. With the Blueprint Scenario, 102 square miles would be converted from agricultural to urban uses.

Preferred Blueprint Scenario for 2050



Residential "Building" Types

- Rural Residential
- Single-family, Large-lot
- Single-family, Small-lot
- Attached Residential

Employment "Building" Types

- Retail
- Office
- Industrial
- Public

Non-Urban "Land Use" Types

- Agriculture
- Forest
- Open Space
- Parks
- Water

Residential "Place" Types

- Medium-density, Mixed Residential
- High-density, Mixed Residential

Mixed-Use "Place" Types

- Low-density, Mixed-use Center or Corridor
- Medium-density, Mixed-use Center or Corridor
- High-density, Mixed-use Center or Corridor
- Employment-focus, Mixed-use Center or Corridor

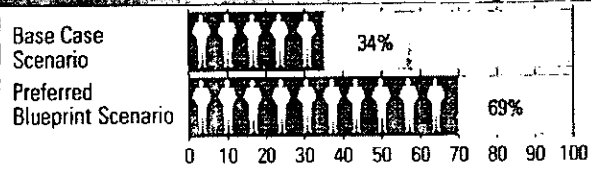
- Vacant Urban-designated Lands (2050)
- Vacant Rural Residential Lands (2050)

BLUEPRINT SCENARIO PERFORMANCE ON SMART GROWTH PRINCIPLES

Design for Quality:

The design details of any land use development—such as the relationship to the street, setbacks, placement of garages, sidewalks, landscaping, the aesthetics of building design, and the design of the public right-of-way (the sidewalks, connected streets and paths, bike lanes, the width of streets)—are all factors that can influence the attractiveness of living in a compact development and facilitate the ease of walking and biking to work or neighborhood services. Good site and architectural design is an important factor in creating a sense of community and a sense of place.

PEOPLE LIVING IN AREAS WITH GOOD OR EXCELLENT PEDESTRIAN FEATURES
(in percent, 2050)

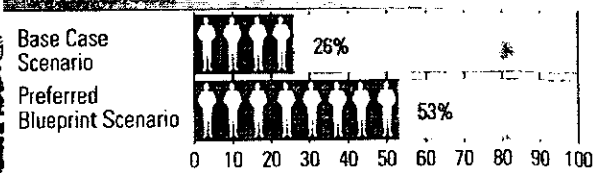


In the Base Case, 34 percent of people would live in pedestrian-friendly neighborhoods. In the Blueprint Scenario, in 2050 that number would rise to 69 percent.

Mixed Use Developments:

Well planned and designed mixed use developments encompass all of the elements of the other growth principles. Buildings homes and shops, entertainment, office and even light industrial uses near each other create active, vital neighborhoods, or villages. This mixture of uses can be either in a vertical arrangement (mixed in one building) or horizontal (with a combination of uses in close proximity). These types of projects function as local activity centers, contributing to a sense of community, where people tend to walk or bike to destinations and interact more with each other. Separated land uses, on the other hand, lead to more, and longer, automobile trips because of the distance between uses. Mixed land uses can occur at many scales. Examples include: a housing project located near an employment center, a small shopping center located within a residential neighborhood, and a building with ground floor retail and apartments or condominiums on the upper floor(s).

PEOPLE LIVING IN AREAS WITH GOOD MIX OF JOBS AND HOUSING
(in percent, 2050)

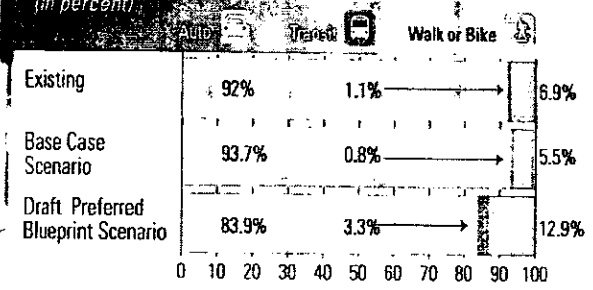


Under the Base Case scenario, 26 percent of people would live in communities with a good, or balanced, mix of land uses by 2050. In the Blueprint Scenario, 53 percent would live in balanced communities.

Provide Transportation Choices

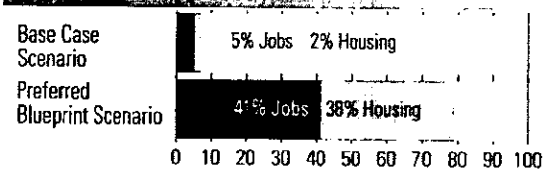
Developments should be designed to encourage people to sometimes walk, ride bicycles, ride the bus, ride light rail, take the train or carpool. Use of Blueprint growth concepts for land use and right-of-way design will encourage use of these modes of travel and the remaining auto trips will be, on average, shorter.

TYPE OF TRIPS
(in percent)



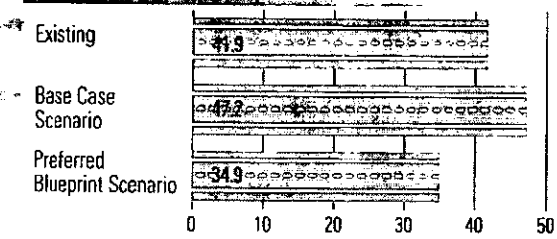
The Blueprint Scenario reduces the number of trips taken by car by about 10 percent. These trips are shifted to transit, walking or biking.

GROWTH NEAR TRANSIT
Within walking distance of 15-minute or better transit service



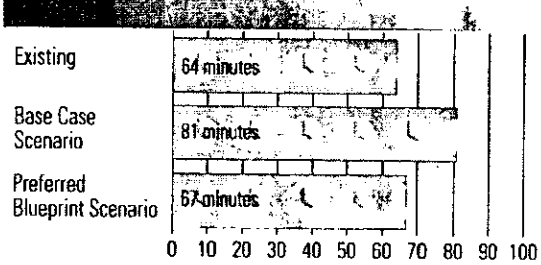
In the Base Case, 2 percent of new housing and 5 percent of new jobs are located within walking distance of 15-minute bus or train service. In the Blueprint Scenario, those figures rise to 38 percent of new houses and 41 percent of new jobs.

VEHICLE MILES TRAVELED
(per household per day)



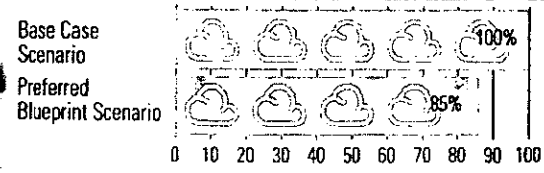
The number of vehicle miles traveled per day per household declines from 47.2 miles to 34.9 miles.

DAILY VEHICLE MINUTES OF TRAVEL
(per household per day)



Total time devoted to travel per household per day declines from 81 minutes to 67 minutes.

PER CAPITA CARBON DIOXIDE AND SMALL PARTICULATES EMISSIONS
(from vehicles 2050)



With the Blueprint Scenario, per capita, there would be 14 percent less carbon dioxide (greenhouse gas) and particulates (related to asthma) compared to the Base Case.

Next Steps for the Blueprint Project

This section outlines what is expected to occur in the year 2005 and beyond related to using the data, analysis and growth concepts that have been developed through the Blueprint process to date.

SACOG will work with its member cities and counties to:

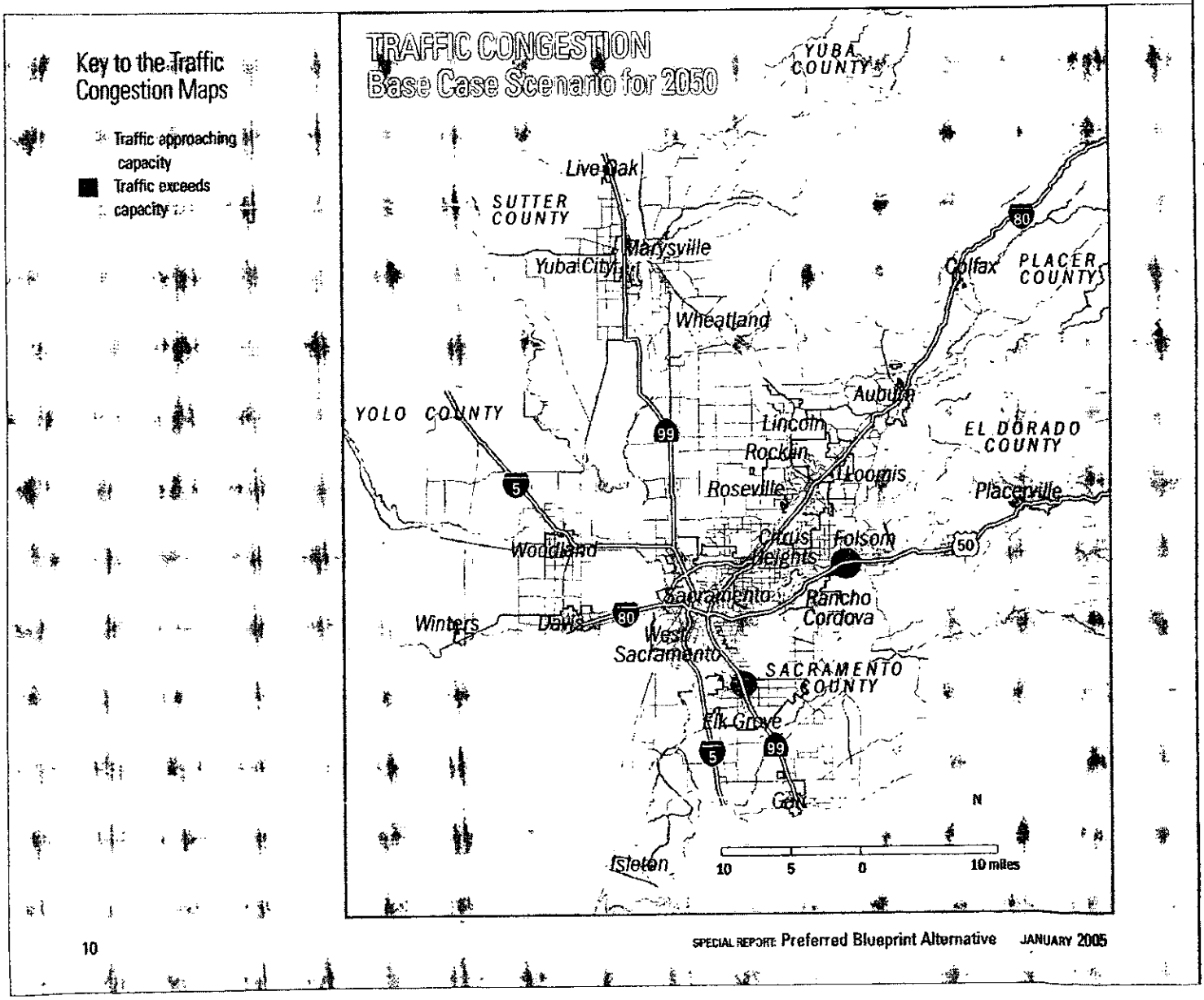
Maintain and enhance the regional database, research and modeling tools and make them available for use on an on going basis.

Continue to implement the Community Design Program in order to provide incentives for capital and planning projects that are consistent with Blueprint.

Provide technical assistance to local governments and the development community to develop plans and design projects that are consistent with Blueprint.

Develop a tool-box of Best Planning and Development Practices that are consistent with Blueprint (e.g. model codes, Guidebook for using Blueprint principles to promote neighborhood livability, street design guidelines, on-line tutorials and manual for using the PLACE³S software, model educational and citizen involvement practices, etc.).

Track and publicize local planning and development actions consistent with Blueprint, and consider implementing a Blueprint awards or certification system.



In 2005, prepare a 2030 growth forecast and land use allocation that represents the best estimate of what type of development is most likely to occur, taking into consideration past and projected market, demographic and regulatory trends and consideration of actions local governments have taken and any future actions they indicate they are likely to take to help support Blueprint growth principles (see following "Notes" for further details).

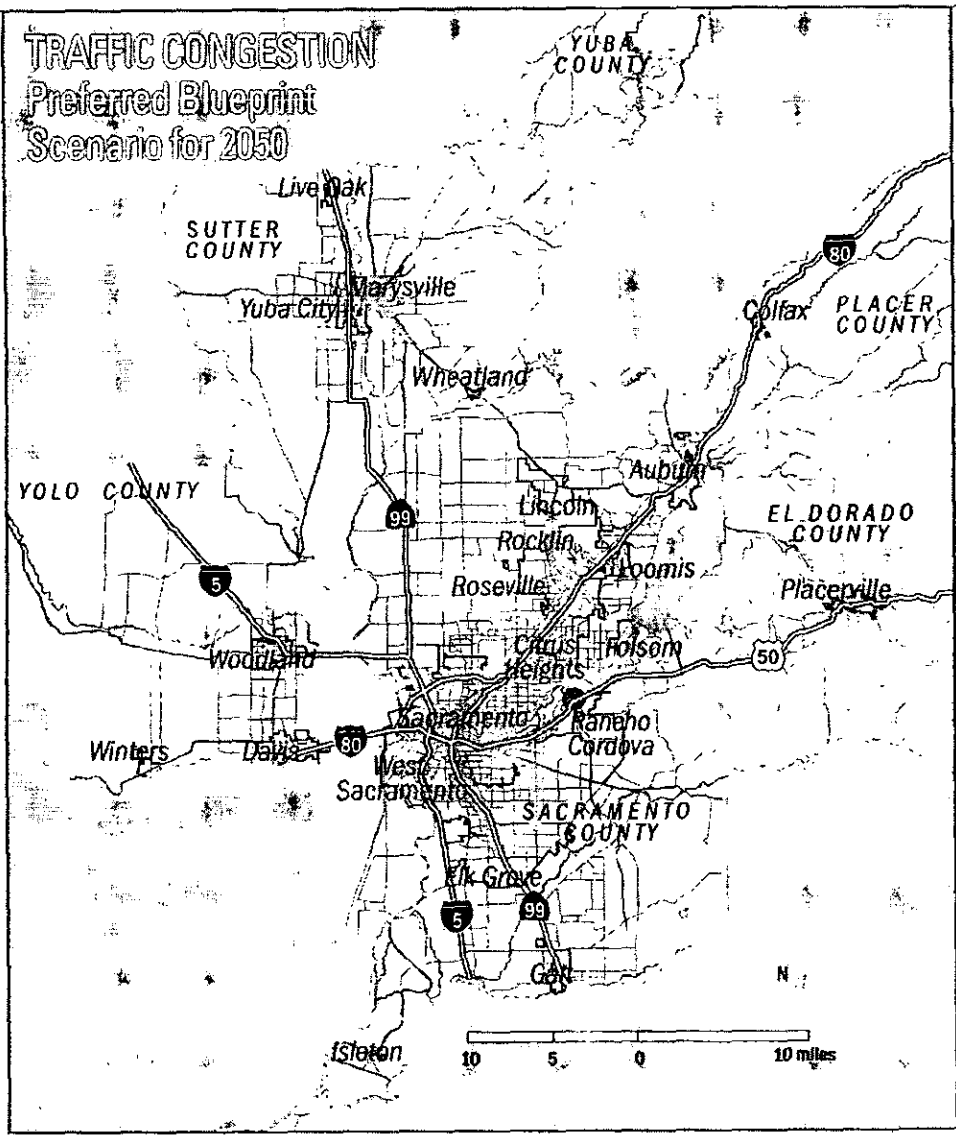
Develop and implement a Benchmarking system to occur on a regular basis to track the extent to which the region is growing in ways that improve the transportation system and air quality, and are consistent with Blueprint. Examples of topics to be monitored included, but are not limited to: transportation system performance (e.g. congestion, travel times, trip distances, types of trips), type and amount of housing constructed, air emissions, mix of land uses, and amount of new land devoted to urbanization. The system must take into account local differences, market and regulatory considerations, and the fact that many aspects of Blueprint will need to be phased in over time.

Participants at the Yolo County Blueprint workshop review growth alternatives.

Conduct a study of other actions that could be taken to reduce barriers and take

Blueprint Next Steps...

continued on page 12



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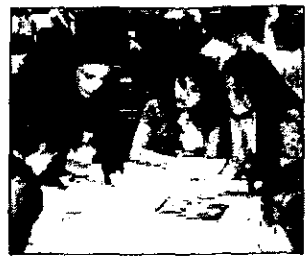
Blueprint Next Steps...

continued from page 11

advantage of opportunities to implement Blueprint growth principles. Recommendations for possible action will be forwarded to the SACOG Board of Directors as opportunities are identified. It is expected that this study would include, but not be limited to: state issues such as CEQA, construction defect liability and prevailing wage reform; amendments to standards, guidelines and decision processes in local codes; systems to manage the supply of land for urban development through multi jurisdictional cooperation that ensure an adequate and reliable supply of land for housing and other uses, reduce upward pressures on land prices, preserve natural resources and farmland and encourage infill and reinvestment; and methods for providing green and open space throughout the region.

The first-ever Regional Elected Officials Summit.

Update the Blueprint Conceptual Map and Growth Principles regularly to include new and better information and knowledge. This will occur annually whenever feasible, and no less frequently than the update cycle for the Metropolitan Transportation Plan.



Over 1,400 area residents participated in the 2004 Regional Forum and made recommendations on Blueprint scenarios.

Notes on Preparation of 2030 Land Use Allocation for the Next Metropolitan Transportation Plan

Each time SACOG adopts an MTP it must first adopt a 25-year growth forecast for the region, and a land use allocation that specifies its best estimate of the most likely places where that growth will occur (i.e. how much and what type of growth will go to each city and county over the next 25 years). These same choices must be made to support the next comprehensive MTP update; however, in order to consider changes to future land use patterns that may occur as the result of the Blueprint Map and Growth Principles a more detailed and explicit process will be necessary. This is important because Blueprint project research clearly shows that changes to local land use patterns could achieve significant benefits to the region's transportation system and air quality. In order to take credit for these transportation and air quality benefits, it must be shown that the changes to the land use pattern are more likely to occur than a continuation of the past land use patterns.

To help create the 2030 land use map and allocation for the next comprehensive MTP update, SACOG recommends that each local government next year develop an individualized strategy for determining how—or if—it will pursue actions, over time, that help to achieve the planning principles in the Blueprint Scenario as planning and growth decisions are made. SACOG staff would provide technical assistance to support these efforts. Each jurisdiction would be asked to pass a resolution in support of a growth allocation and accompanying 2030 map for their jurisdiction that reflect their jurisdiction's needs and interests. Each jurisdiction, at its choice, could also elect to include as part of the resolution a statement of what actions they will agree in principle to pursue that are supportive of implementing the growth allocation and the 2030 Map.

The list of supportive actions is expected to be different for each jurisdiction. Examples of types of actions that could be included are: adoption of guidelines that could be used to consider Blueprint principles in a variety of local planning decisions, changes to decision-making procedures, consideration of General Plan and implementing code amendments, identifying opportunities to encourage reinvestment, and using the regional database and modeling tools in community planning processes. It is expected that these actions will be phased in over several years, and that the local governments will make the final decisions on what specific changes to adopt after completing typical local planning processes, including citizen participation.

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SPECIAL REPORT REVISED JUNE 2007

SACRAMENTO REGION Blueprint TRANSPORTATION / LAND USE STUDY

Preferred Blueprint Alternative

Blueprint Awards

The Sacramento Region Blueprint: Transportation/ Land Use Study has received praise from throughout the state and nation:

One of the "Top 50" programs in Harvard University's "Innovations in American Government" Competition, Kennedy School of Government (2003)

The Governor's Award for Environmental and Economic Leadership (2003)

The Federal Highway Administration/Federal Transit Administration Transportation Planning Excellence Award (2004)

The American Institute of Architects California Chapter Presidential Citation (2004)

The Environmental Council of Sacramento (ECOS) Environmental Leadership Award (2004)

U.S. Environmental Protection Agency—National Award for Smart Growth Achievement (2004)

American Leadership Forum Mountain Valley Chapter - Thanks to You Award (2004)

Association of Metropolitan Planning Organizations—National Award for Outstanding Achievement (2004)

Preferred Blueprint Scenario Marks Key Milestone in Process

The approval of the Preferred Blueprint Scenario for 2050 by the SACOG Board of Directors in December 2004 marked a key step in the Blueprint process, a three-year effort to engage the public and local government leaders in crafting a vision for the Sacramento region's future growth

The Project was initiated by the SACOG Board of Directors after it viewed regional computer modeling results showing that current growth patterns and transportation investment priorities would result in significant increases in congestion in the future

A joint effort by SACOG and its civic partner Valley Vision, the Blueprint Project is bringing together local officials, civic groups, environmental advocates, the development community, business leaders and the public in a first-ever attempt to guide how the region grows over the next 50 years

Seeking broad input from the ground up, SACOG and Valley Vision in March 2003 launched a series of 37 workshops in neighborhoods, cities and counties throughout the region. By the time the workshops and two Regional Forums had concluded in April 2004, more than 5,000 participants had used the project's interactive modeling software to study how the region might look under different land use scenarios.

The first-ever Regional Elected Officials Summit in October 2004

Input from the workshops helped create four distinct growth scenarios for further study, including a 'Base Case' that shows how the region would look if growth patterns of the recent past continue. The four were the focal point of the Regional Forum in April 2004 that drew nearly 1,400 people. Asked to select a preference, Forum participants overwhelmingly rejected the Base Case in favor of alternatives providing for a greater range of housing choices, reinvestment in already developed areas and closer integration of jobs and housing.

Following the Forum, a 1,300 person public opinion telephone poll on growth issues in SACOG's six-county region was conducted by noted pollster Wirthlin Worldwide. City and county elected officials in the region were then invited to a first-ever Regional Summit to discuss a Draft Preferred Blueprint Scenario and the results of the Wirthlin Poll

The public opinion poll found strong support for the Blueprint growth principles *(found on pages 4–5 and 8–9 of this special report)* in all six counties of the SACOG region. The elected officials at the Summit also supported these growth principles.

The Board's approval of the Blueprint as a voluntary ideology or framework for future growth in the region is only the beginning.

The next steps in the Blueprint process are outlined starting on page 10 of this special report

What the Blueprint Maps Show

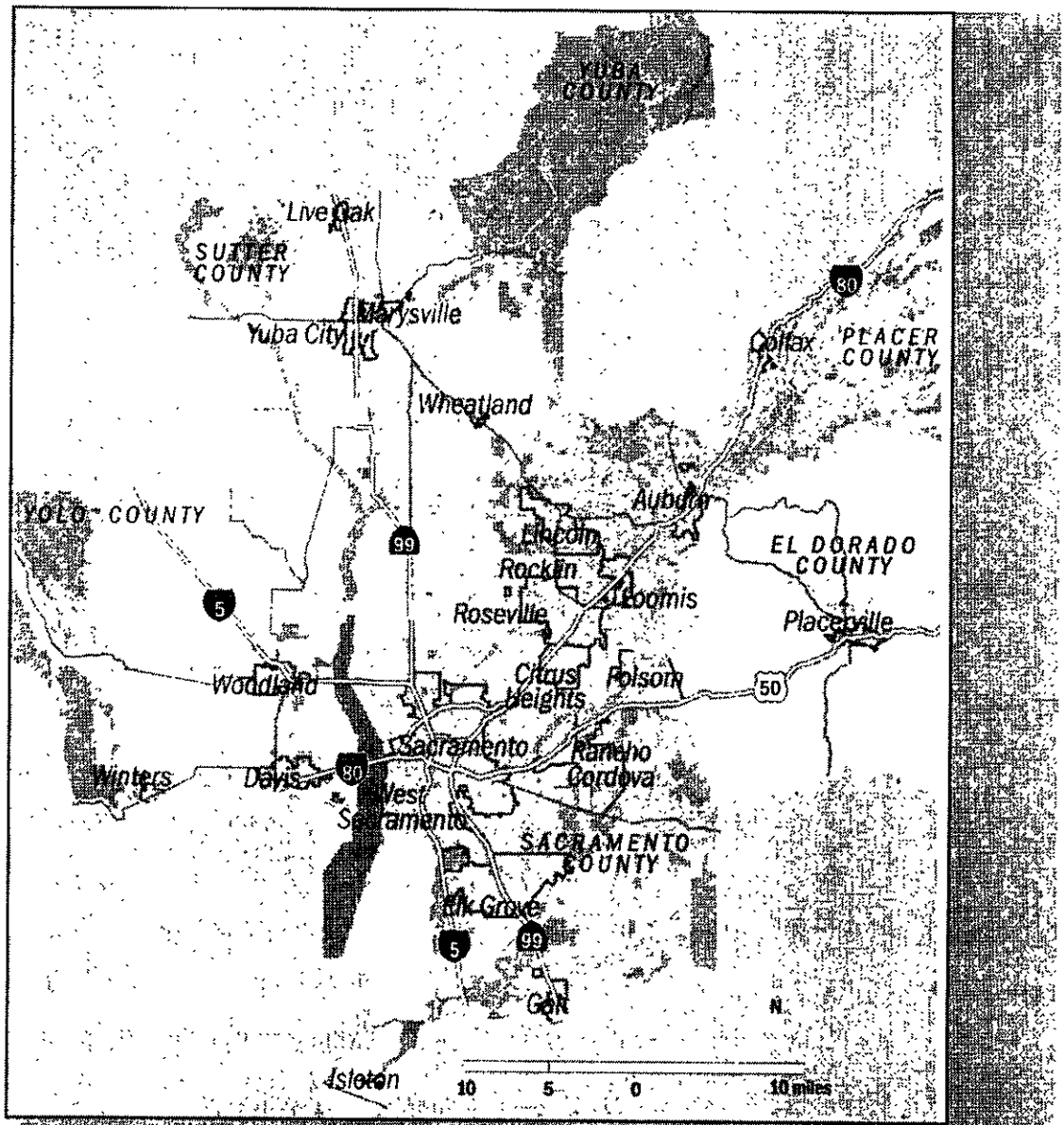
The Blueprint map *(shown in comparison to the base case on this page, and in detail in the center spread of this report)* depicts a way for the region to grow through the year 2050 in a manner generally consistent with the growth principles summarized on page 4–5 and 8–9 of this report. The map is a result of numerous public workshops and meetings with local staff and elected officials. The map is intended to be interpreted and used as a concept-level illustration of the growth principles. It was developed with parcel-level data and analysis to help ensure that the growth concepts were being applied in a realistic manner; however, it is not intended to be applied or implemented in a literal, parcel-level manner.

For example, the map assumes certain levels and locations of both "reinvestment," i.e. additional development on already built parcels) and greenfield development, i.e. large-scale development on vacant land). The purpose of this mapping is to illustrate, generally, the amounts and locations for these types of growth. It is not intended to indicate that a specific parcel should or should not be developed in a particular manner. That level of planning is the responsibility of local governments, and is beyond the specificity appropriate for regional-scale, long-term scenario planning.

The Base Case and the Preferred Blueprint Scenario for 2025:

How the Scenarios Compare

The starting point for the Blueprint Project is the Base Case Scenario, which shows how the region would develop through 2050 if patterns of the recent past continue. Under the Base Case Scenario, growth would continue outward into largely rural areas and on the fringes of development. The Preferred Blueprint Scenario—the option developed as an alternative—takes a different approach. Built on the principles of smart growth, it includes a greater range of housing products, reinvest-



Source: Preferred Blueprint Alternative, June 2007

ment in already developed areas, protection of natural resource areas from urbanization, and more transportation choices. The maps below depict the differences between the two scenarios.

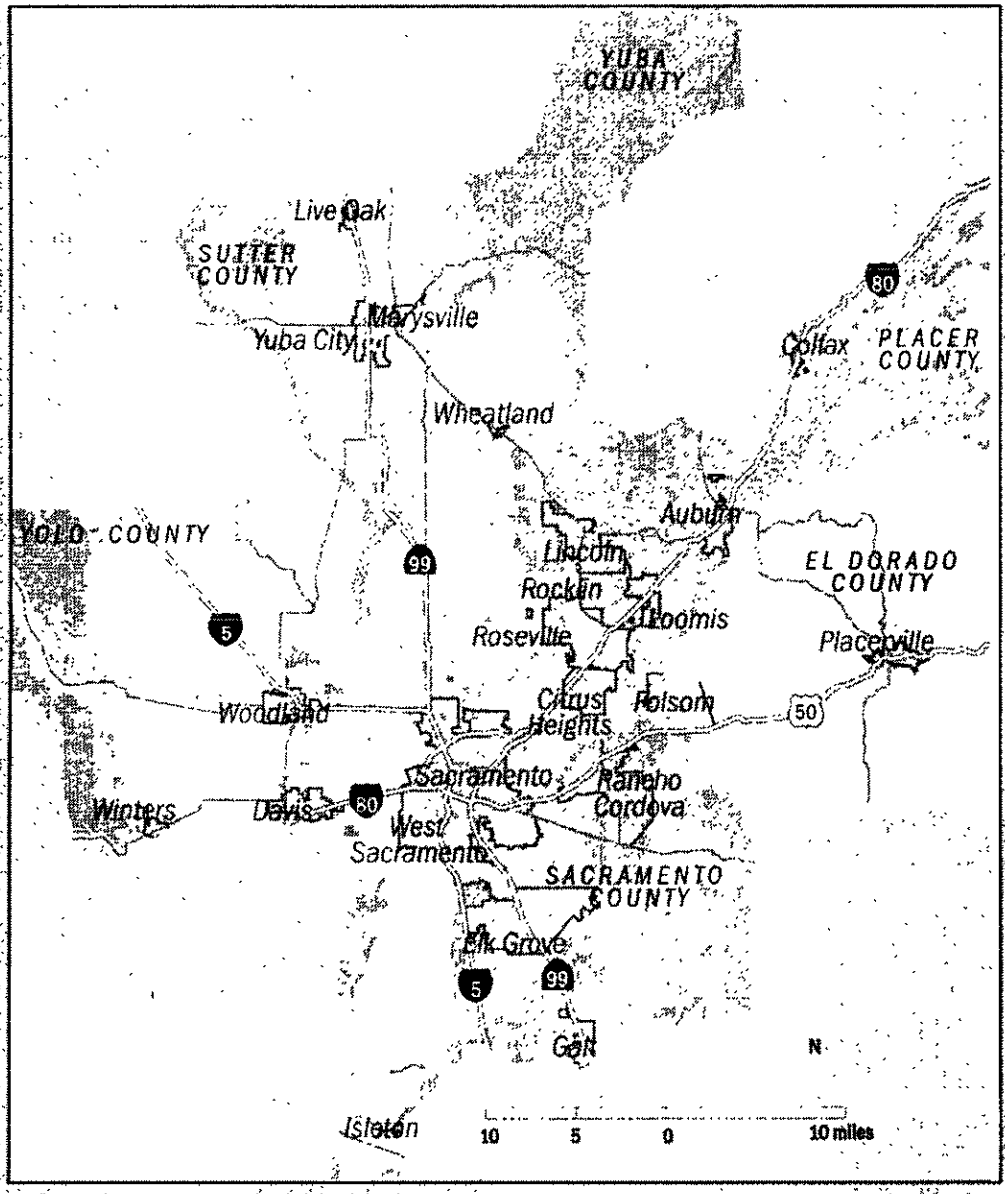
How to read the maps

The orange areas show where current development exists, plus new buildings constructed through 2050, and some vacant land for future growth. The green areas show a variety of types of undeveloped areas, including lands protected from development through conservation easements, parks, and natural resources such as wetlands, vernal pools and hardwood stands that are preserved in 2050. The beige areas are mainly agricultural lands, but they also include some lands currently designated for development that remain undeveloped in 2050.

How would life in 2050 be different with each scenario?

The typical resident living in a version of a future typical of the "Base Case Scenario" in 2050 would probably live in a house on a fairly large lot in a subdivision with houses that look a lot like theirs. They would travel to work longer distances than are typical today, and arrive there much more slowly due to significant increases in congestion. Trips to shopping and entertainment would also be fairly lengthy and slow.

Typical residents living in a future typical of the Preferred Blueprint Scenario in 2050 would probably live in a house on a smaller lot, in a neighborhood with some larger houses and some attached row houses, apartments and condominiums. They would drive to work, but the trip would be shorter than today, and the time needed to get there would be about the same as today. Sometimes they might take the train or bus. Most of their shopping and entertainment trips would still be in a car, but the distances would be shorter. And some of these shopping trips might be taken by walking or biking down the block to a village or town center that has neighborhood stores with housing on top of them, and a small park or plaza.



Key to the Map

- areas of existing and future development
- green areas (e.g. open space, parks, wetlands, vernal pools, stream corridors, hardwood stands)
- agriculture and other undeveloped lands
- rivers, streams and lakes
- city boundaries
- highways
- county boundaries

Note: Some vernal pools in Yuba, Sutter and southwest Placer counties are preserved, but are not shown on these maps.

Note: El Dorado County elected not to directly participate in this phase of the Blueprint process due to ongoing issues associated with their General Plan.

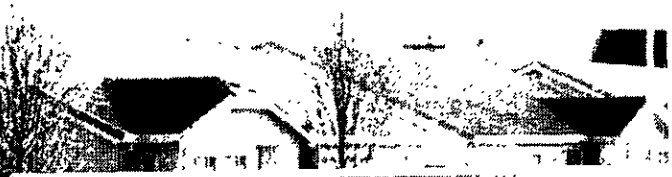
For detailed information

To view the complete land use maps, including where industry, homes, shopping and other uses would be located in the region, please go to **www.sacregion-blueprint.org** and click on "The Project" tab at the top of the page. There you may view maps for each city and major county area in the region and a variety of statistical and narrative information about the scenarios.

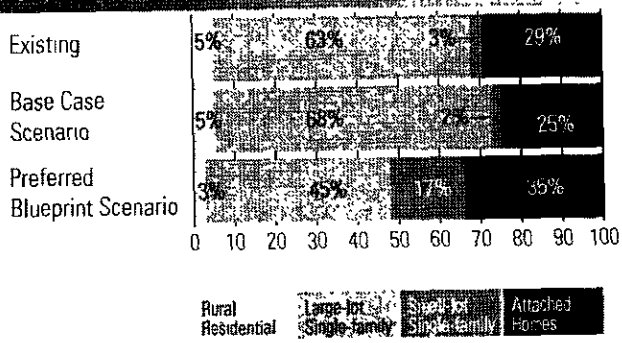
BLUEPRINT SCENARIO PERFORMANCE ON SMART GROWTH PRINCIPLES

Providing a variety of places where people can live—apartments, condominiums, townhouses, and single-family detached homes on varying lot sizes—creates opportunities for the variety of people who need them: families, singles, seniors, and people with special needs. This issue is of special concern for the people with very low-, low-, and moderate-income, often our teachers, other public employees and professionals, as well as retail employees, service workers and other people for whom finding housing close to work is challenging. By providing a diversity of housing options, more people have a choice.

Under the Base Case, in 2050 over two-thirds of our region's housing would be single-family homes on large lots. Under the Blueprint Scenario, most housing would still be detached single-family, but about 17 percent would be single-family homes on small lots. For attached homes, the Base Case projects one-quarter of all homes in that category. Under Blueprint, that number would rise to 35 percent.

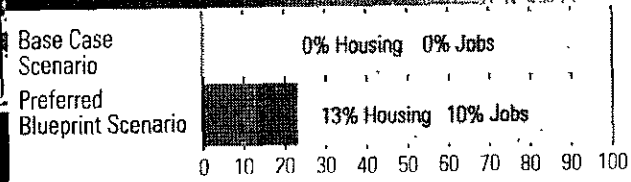


ALL HOUSING TYPES
Existing Plus Growth in 2050
(in percent)



In urbanized areas, development on infill or vacant lands, intensification of the use of underutilized parcels (for example, more development on the site of a low-density retail strip shopping center), or redevelopment can make better use of existing public infrastructure. This can also include rehabilitation and reuse of historic buildings, denser clustering of buildings in suburban office parks, and joint use of existing public facilities such as schools and parking garages.

GROWTH THROUGH REINVESTMENT
in 2050
(in percent)



Under the Base Case Scenario, all new development would be on vacant land. The Blueprint Scenario suggests 13 percent of all new housing, and 10 percent of all new jobs, would occur through reinvestment.