APPENDIX B

EXHIBITS FROM DOCUMENT L; SHUTE, MIHALY & WEINBERGER LLP

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EXHIBIT 1

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BRAD OLSON
Environmental Programs Manager
East Bay Regional Park District
P.O. Box 5381
Oakland, CA 94605-0381
(510) 544-2622

Overview: Twenty years of professional experience working on environmental planning, natural resource conservation and restoration projects in northern California; recognized technical and policy-level expertise with rare, threatened and endangered species impact assessments, and mitigation, conservation and recovery efforts; and active participant in several regional efforts to acquire, protect, restore and manage plant and animal habitats and open space corridors in Alameda and Contra Costa Counties.

Professional History

East Bay Regional Park District, Environmental Programs Manager. 1996 to present. Manage the Environmental Review and Geographic Information Systems Department which consists of three key programs; 1.) Environmental Review of CEQA and NEPA documents, 2.) Resource Enhancement Program, and 3.) GIS Analysis and Mapping.

- Serve as District representative to a ten-agency planning team, which is preparing a multi-species Habitat Conservation Plan for a 185,000-acre area in Contra Costa County. Negotiated agreements with sponsoring agencies to form a Joint Powers Agency to develop the plan. Conducted presentations on the HCP before the District's Board of Directors and represent the District on three standing committees preparing the HCP.
- Negotiated agreements to restore a 100-acre tidal marsh and habitat for Delta smelt, salt marsh harvest mouse and black rail at Martinez Regional Shoreline in Contra Costa County. Oversaw preparation of restoration plans, and obtained a $325,000 CALFED grant and $4,500,000 in project funding.
- Performed or managed botanical and amphibian surveys for the 1120-acre Bosley and 408-acre Dyer Ranch acquisitions in Alameda County. Documented 150 plant species and populations of San Joaquin spearscale and California red-legged frog, tiger salamander, golden eagle, loggerhead shrike and prairie falcon. Negotiated agreements totaling $4,549,835 to acquire, restore and manage habitats on these properties.
- Performed or managed botanical, reptile and amphibian surveys for the 1045-acre Clayton Ranch acquisition in Contra Costa County. Documented 250 plant species and populations of Alameda whipsnake, California red-legged frog, tiger salamander and pond turtle. Negotiated mitigation agreements, conservation easements, and obtained $204,000 to restore wetlands and riparian habitat.
- Prepared CEQA/NEPA documentation and managed hazardous materials assessments for acquisition of the 1800-acre Eastshore State Park in Alameda and Contra Costa Counties. Oversaw testing, analysis and remediation in compliance with California Regional Water Quality Control Board requirements. Negotiated $3,500,000 in remediation funding and identified $1,500,000 in remediation savings.
- Successfully developed and implemented a GIS management and reorganization plan, and a new GIS facility, obtained reclassification of existing GIS positions and budget augmentation to hire new GIS staff, purchased new equipment and software, and implemented mentoring, training and career development programs.

Olson Botanical Consulting, Principal Botanist. 1993 to present.

- Performed six years of botanical surveys, documented 410 plant species, including 13 special-status plants at a 680-acre Boy Scout Camp in Alameda County. Documented and mapped populations of Napa dwarf flax, spring lessingia and Mt. Hamilton coreopsis which were previously unknown from the East Bay. These surveys have documented that this property is one of the most diverse and significant botanical resources in California.
- Monitoring the effects of invasive non-native vegetation and fire on native plant communities and special-status

plants at the Big Creek Preserve in southwestern Monterey County for five years. Performing annual monitoring of vegetation which is used by students at U.C. Santa Cruz for plant taxonomy courses.

- Developed an extensive collection of 12,000 photographic color slides of rare and unusual plants and plants communities in California and other western states for sale and use in botanical reports.

Resource Management International, Supervising Principal Consultant. 1994 to 1996.

- Managed and performed spotlighting surveys for San Joaquin kit fox following US Fish and Wildlife Service protocols. Delineated jurisdictional wetlands, prepared permit applications and mitigation plans, and obtained a §404 permit/§401water quality waiver for the 567-acre Brentwood Country Club in Contra Costa County in 120 days. Managed and reviewed project team work products, conducted technical training for junior field staff, administered project budget, and completed all work under budget.
- Brought a restored tidal marsh on Corte Madera Creek in Marin County into compliance with Army Corps permit requirements by designing and performing remedial restoration, preparing a mitigation plan with new performance goals and success criteria, and establishing a maintenance and monitoring program. Managed work of subcontractors and project team, prepared and executed contracts, and completed work on budget.
- Prepared an impact assessment to plant communities, special-status plants and wetlands for a 220-mile natural gas pipeline project between Malin, Oregon and Tracy, Nevada. Worked with an interagency committee to determine impact significance and to formulate mitigation measures to reduce impacts.
- Inventoried and monitored vernal pool vegetation at McClellan Air Force Base facilities in Yolo, Sacramento and Sutter Counties. Prepared a monitoring report and management plan for the endangered Crampton's tuctoria and Solano grass that met U.S. Fish and Wildlife requirements and Air Force needs.

Port of Oakland, Associate Port Environmental Planner. 1991 to 1994.

- Managed preparation of the $60.6 million Oakland Airport Roadway Project EIR in Alameda County. Prepared the scope, budget and schedule, selected and hired consultants, reviewed technical work products, and managed a multi-disciplinary team. Conducted public scoping meetings and chaired an interagency technical advisory committee which oversaw environmental review and made policy recommendations.
- Managed a monitoring program for a wetland mitigation project at the Galbraith Golf Course in Oakland. Installed monitoring equipment, and monitored site hydrology, erosion, vegetation and wildlife. Prepared annual reports, managed remedial actions and established new success criteria to gauge project performance.
- Overlaid jurisdictional wetlands with California least tern and snowy plover habitat to identify a routing for a communications cable project at the Oakland Airport in Alameda County and obtained project approval using Nationwide Permits instead of an individual permit process.

Caltrans, District Biologist. 1987 to 1991.

- Performed wetlands delineation, special-status species surveys and an inventory of oak trees affected by highway widening near Kenwood in Sonoma County. Prepared a natural environment study which assessed impacts and proposed mitigation measures for freshwater marsh, riparian woodland, oak woodland, dwarf downingia and Kenwood Marsh checkermallow. Coordinated with local agencies and conservation groups.
- Performed surveys in serpentine communities on San Francisco Water District Lands for the San Mateo thornmint, western dwarf flax, Franciscan wallflower, and fountain thistle. Identified project impacts, formulated mitigation measures and evaluated various project alternatives in San Mateo County.
- Prepared a biological assessment of highway widening impacts to the Emeryville Crescent Marsh in Alameda County. Surveyed for salt marsh harvest mouse, California clapper rail, salt-marsh yellowthroat and Point Reyes bird's-beak, and prepared a wetlands assessment. Obtained concurrence of "no adverse affect" within 60 days.

Natural Resource Conservation Service, Soil Conservationist. 1983 to 1987.

- Received an early completion award for managing the preparation of an EIR/EIS and biological assessment for the

Marsh-Kellogg Creek Flood Control Project and watershed plan in eastern Contra Costa County.

- Performed small-mammal trapping, blunt-nosed leopard lizard and giant garter snake surveys and habitat assessment for the San Joaquin kit fox at the site of a proposed waste-water treatment facility in western Kern County. Prepared a biological assessment for the U.S. Fish and Wildlife Service and obtained an opinion of "no adverse effect" to special-status species.

College Education

Bachelor of Science, Natural Resources, Humboldt State University, 1983.

Associate in Arts, General Education, Diablo Valley College, 1980.

Continuing Education and Training

- Jurisdictional Delineation of Wetlands: U.S. Army Corps of Engineers. Huffman Associates.
- Revegetation and Restoration Planning. Society for Ecological Restoration.
- Society for Ecological Restoration Conferences, Oakland, Ft. Lauderdale and San Francisco.
- Restoring Diversity: Is Reintroduction an Option for Endangered Plants?. CPC, St. Louis.
- Rare and Endangered Plants of Oregon. Oregon Native Plant Society
- Jepson Herbarium Workshops: Compositae, Polemoniaceae, Lillies, Carex, White Mtns, and Sierra Nevada.
- Habitat Evaluation Procedures Certification. U.S. Fish and Wildlife Service.
- California Environmental Quality Act. Association of Environmental Professionals.
- Community First Aid and CPR, plus annual refresher courses. American Red Cross.
- 40-Hour HAZWOPER Training. Network Environmental Systems, plus annual refresher courses
- Advanced Open Water Scuba Diving Certification. Pacific Association of Diving Instructors (PADI).

Professional Memberships/Affiliations

- Rare Plant Chair and Rare Plant Scientific Advisory Committee - California Native Plant Society
- Board of Directors - California Society for Ecological Restoration
- Research Affiliate - UC Berkeley and Jepson Herbaria
- Association of Environmental Professionals
- Society of Wetland Scientists
- The Nature Conservancy

Publications

- "Martinez Resource Enhancement Project" in *Ecesis*, Winter 2002.
- Contributor to Ertter and Bowerman. *Flowering Plants and Ferns of Mt. Diablo.* 2002. Jepson Herbarium.
- *Status of Rare, Threatened and Endangered Vascular Plants in Alameda and Contra Costa Counties*, 3rd Ed. Mar. 1994. California Native Plant Society.
- "Rare Plant Notes: Mt. Diablo Sunflower (Helianthella castanea)" in *The Bay Leaf*, Feb.1991.
- "Trail Notes: Poison Oak" in *The Bay Leaf*, Jan. 1991.

Honors and Awards

- Excellence in Transportation Award for the Martinez Regional Shoreline Enhancement Project, from the California Department of Transportation
- Rare Plant Conservation Award from David Magney, President, California Native Plant Society for outstanding contributions to rare plant conservation.
- Letter of Appreciation from Janet Nichols, Sonoma County Board of Supervisors, for environmental work on Highway 12 widening in Sonoma County.
- Letter of Appreciation from Charles Roberts, Port of Oakland Executive Director, for contributions to the growth and development of the Port of Oakland.

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EXHIBIT 2

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John Waters, Mine Manager
Black Diamond Mines Regional Preserve

The Mine manager is responsible for all aspects of the mining function at Black Diamond Mines Regional Preserve and provides assistance to other organizations and District departments in mining related matters. The mining function can be divided into three broad areas: abandoned mine safety (reclamation), underground public access, and technical support.

Abandoned Mine Safety consists of the identification and analysis of mining-related public safety hazards, the development and construction of reclamation solutions (mine closures and subsidence prevention structures), and inspection and maintenance of completed projects. I have been involved in more than 200 projects over a 28 year period and have developed the District's written Abandoned Mine Safety Program.

Underground Public Access consists of three programs: Free access Workings, Special Use, and Hazel-Atlas mine (underground museum and visitor center).

Free Access Workings provide visitors with unrestricted underground access to eight representative examples of Preserve geology and mining technology. The Mine Manager is responsible for the identification, development, and maintenance of these workings.

The Special Use Program serves researchers, educators, District staff, commercial enterprises, and others whose objectives require access to underground resources in either maintained or abandoned mines. In practice, most of the use has been for research and for educational programs in engineering and geology at the college and professional level. Federal government agencies that have made use of this program include the Bureau of Mines, Bureau of Land Management, U.S. Geological Survey, and Mine Safety and Health Administration. State agencies include Department of Health Services, Department of Industrial Relations and Division of Mines and Geology. Universities use includes the University of California at Berkeley, University of Nebraska, San Francisco State University, and Stanford University. Organizations and Private Industry users include American Institute of Mining Engineers, Association of Engineering Geologists, and Chevron Petroleum.

Special use often involves my participation as a researcher, lecturer or trainer (I am a federally certified mine safety instructor). The research is exclusively geological; lectures are on geology, engineering, mine reclamation and underground public access development; and training is in the areas of mine safety, hazards, and rescue.

The **Hazel-Atlas Mine** program consists of the development and maintenance of an underground museum and visitor center. Approximately 14,000 sq. ft. of underground space are currently maintained for public access and development is in progress on an additional 36,000 square feet. Current attendance is approximately 23,000 visitors annually.

Technical Support involves assistance to District departments and outside organizations and consists of providing assistance in various mining-related matters, primarily resource development and hazard abatement. Resource development consultations have included Empire Mine (California Dept. of Parks and Recreation), Hite Mine (U.S. Forest Service), New Almaden Mine (Santa Clara County Parks), and Lawson Adit (University of California). Mine hazard abatement consultations have included subsidence problems Camanche Reservoir (three sites - East Bay Municipal Utilities District), vertical shaft failure (Midpeninsula Regional Open Space District), and abandoned mine openings (Nature Conservancy).

Publications **September 21, 2002**
John Waters, Mine Manager
Black Diamond Mines Regional Preserve

Waters, J., 1978, "Black Diamond Mines," Underground Space, v. 2 no. 3, pp. 143-150

Sullivan R. and Waters J., 1980, "History of the Mount Diablo Coal Field, Contra Costa County, California," CALIFORNIA GEOLOGY, v. 33, pp. 51-59

Waters, J., 1990, "Black Diamond Mines: Development of an Historic Mining Area," Proceedings of the 1989 Historic Mining Conference, Death Valley National Monument, Barker, L.R. and Huston, A.E., ed., pp. 119 -121, Division of National Register Programs, National Park Service, San Francisco, California.

Sullivan, R., Waters, J. and Sullivan, M.D., 1995, "The Geology and Sequence Stratigraphy of the Black Diamond Mines Regional Preserve," Pacific Section AAPG/SEPM Meeting Field Guide, San Francisco, California, pp. 1-46.

Sullivan, M.D., Sullivan, R., Waters, J., 1999, "Sequence Stratigraphy and Incised Valley Architecture of the Domengine Formation, Black Diamond Mines Regional Preserve, California," Geologic Field Trips in Northern California, Wagner, D.L. and Graham, S.A., ed., pp. 202-213, California Department of Conservation, Division of Mines and Geology

EAST BAY REGIONAL PARK DISTRICT

MINING OPERATIONS MANAGER
(Director of Mining Operations)

REPORTS TO: Interpretive Parklands Unit Manager

SUPERVISES: Mining Operations Supervisor and contractors, consultants and volunteers engaged in tasks related to the mining function.

GENERAL FUNCTION
Under direction, serves as the manager of the unit charged with the development, operations and maintenance of the Black Diamond Mines Regional Preserve.

PRINCIPAL DUTIES AND RESPONSIBILITIES
This position directs and oversees the work of this unit and provides assistance to District departments and other organization in mining related matters. The position is responsible for developing programs and policies, providing designs and specifications, and issuing guidelines for implementation in the following areas:

- Abandoned Mine Safety: Hazard identification; the design and construction of mine closure, reclamation, subsidence prevention, and habitat development projects.
- Mining Museum: Development of a major underground interpretive, recreational and educational facility in cooperation with the District's Interpretive division.
- Regulations and Procedures: Development of regulations, policies, procedures and programs applicable to the mining function, and acts as liaison with other agencies and organizations assisting or regulating District mining activity.
- Development Program: Development of funding or other assistance related to the mining function through government agencies, private organizations and individuals.
- Free Access Workings: Identification and development of underground workings that provide unrestricted public access to examples of Preserve geology and mining technology.
- Training Program: Development and presentation of training programs for District staff and other agencies and organizations in areas related to the mining function, such as geology and mine safety, technology, development, operations, and emergency response.
- Technical Assistance: Provide District departments and other organizations assistance in mining related matters, such as hazard assessment and abatement, reclamation, and underground development and operations.
- Special Use Program: Approval, coordination and development of criteria for the use of maintained or abandoned areas of the mines by researchers, educators, District staff, commercial enterprises, and others whose objectives require access to underground resources.

MINIMUM QUALIFICATIONS
Education: Four year degree in geology, engineering, or related field (additional qualifying experience may be substituted for two years of education on a year for year basis); and

Experience: Six years experience related to abandoned mine land hazard abatement and reclamation and/or the design, construction, maintenance and operation of underground public use facilities, at least three years of which must have been in a responsible supervisory position; and

License: A current and valid California driver's license is a condition of initial and continued employment in this classification.

KNOWLEDGE, SKILLS AND ABILITIES
Technical knowledge of underground mines, related State and Federal safety regulations, and the methodology related to their safety, maintenance, development and use as public facilities. Ability to research, develop and administer programs and procedures related to abandoned mine land reclamation and hazard abatement and the development and operation of underground public use facilities. Ability to develop and maintain productive and cooperative working relationships with all levels of District staff and with out-of-agency interface.

CONDITIONS OF EMPLOYMENT
Current and valid CPR and First-Aid certificates are a condition of employment beyond the probationary period. A valid Mine Safety Instructor certificate from the State of California, Federal Mine Safety and Health Administration, or other acceptable agency or organization is also a condition of employment beyond the probationary period.

Employment Category: Management, Range MG02

(MINOPMGR.JOB)cm

EXHIBIT 3

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August 27, 2003

Joseph G. Weber, Chairperson
Antioch Planning Commission
P.O. Box 5007
Antioch, CA 94531

Subject: City of Antioch General Plan and EIR – Sand Creek Focus Area Option C
Black Diamond Mines Regional Preserve

Dear Chairperson Weber:

At the August 13, 2003, Antioch Planning Commission hearing the East Bay Regional Park District ("District") identified a Sand Creek Focus Area Option C, which we believe can substantially mitigate all of the significant impacts to Black Diamond Mines Regional Preserve resulting from proposed development in the Sand Creek Valley. The District's Option C is very similar to Option B described in the draft General Plan and EIR, with the addition of expanded buffers to protect parkland and sensitive natural resources, and funding mechanisms provided to abate mine hazards and fund open space management.

Following the Planning Commission meeting, Antioch Planning staff requested the District to provide a map and more formal description of the District's Option C. The following is our analysis of the three options and their potential effects to Black Diamond Mines Regional Preserve. The attached map and visual simulation show Option C. The map shows the proposed park buffers, open space, corridors, Empire Mine Road closure and a potential residential area. The visual simulation shows the view from the Stewartville Trail with Option C in place.

Sand Creek Focus Area Options:

Option A: This option would result in significant adverse impacts to park aesthetics, police services, fire safety, park operations, mine failure, public safety, cultural resources, special-status species and wildlife corridors. These impacts will be described in detail in our comment letter.

Option B: This option would substantially reduce visual impacts to the Stewartville Trail; however, the Star Mine Group Camp and the Black Diamond Estates open space would still have significant visual impacts. The demand for police and fire services would be greatly reduced by eliminating development and creating an open space buffer along ¾ of the proposed development boundary with Black Diamond Mines. A similar buffer of unspecified width would be required along the southern boundary of the Black Diamond Estates open space. Creation of these buffers would eliminate development on top of former coal mines, thus greatly reducing impacts from mine failure, subsidence and public safety, and reducing impacts to cultural resources of this historic mining area.

2950 Peralta Oaks Court P.O. Box 5381 Oakland, CA 94605-0381
TEL 510 635-0135 FAX 510 569-4319 TDD 510 633-0460 www.ebparks.org

Increased costs to operate District parks could be mitigated by Option B if permanent funding mechanisms are required to offset long-term costs. Impacts to San Joaquin kit fox and Alameda whipsnake would be reduced within the Sand Creek focus area; however, the proposed wildlife corridor is too narrow and it lacks a protected corridor connection to Cowell Ranch. Option B will significantly impact California red-legged frog and California tiger salamander north of Sand Creek. These significant impacts will be described in detail in our comment letter.

Option C: This option would eliminate significant visual impacts to Black Diamond Mines because it would provide an adequate buffer between the park and proposed development. Adequate funding is also required to mitigate significant impacts to police services, fire safety and park operations. Buffer lands that are set aside to mitigate for impacts should be dedicated as permanent open space that allows for appropriate public access. A permanent funding mechanism should be established that provides for mine closure, runoff water quality treatment, and long-term management through a Geological Hazards Abatement District. In addition, a Landscaping and Lighting District or Zone of Benefit should be established to provide long-term funding for management of fences, fire roads, hiking trails and staging areas, police and fire services, and habitat management.

The proposed wildlife corridor would be expanded at its northwestern end to exclude development in an area east of Black Diamond Mines, north of Sand Creek and west of Empire Mine Road. The mid-point of the corridor would be expanded to ½ mile in width. The southeastern end of the corridor would be connected to Cowell Ranch.

Recommendation:

We urge the Planning Commission to consider Option C for the Sand Creek Focus Area. It allows for a reasonable development foot print in an area relatively free of environmental and geotechnical constraints. It mitigates potentially significant impacts to Black Diamond Mines Regional Preserve and establishes a scenic open space and wildlife corridor in the South Antioch planning area. We also urge the Commission's consideration of the Rural Alternative for the South Antioch planning area, which would allow for appropriate development within the existing City limits and provide for the protection of open space outside the Urban Limit Line. We also encourage the City's participation in the East Contra Costa HCP/NCCP, especially if the City intends to proceed with annexation and development outside the Urban Limit Line.

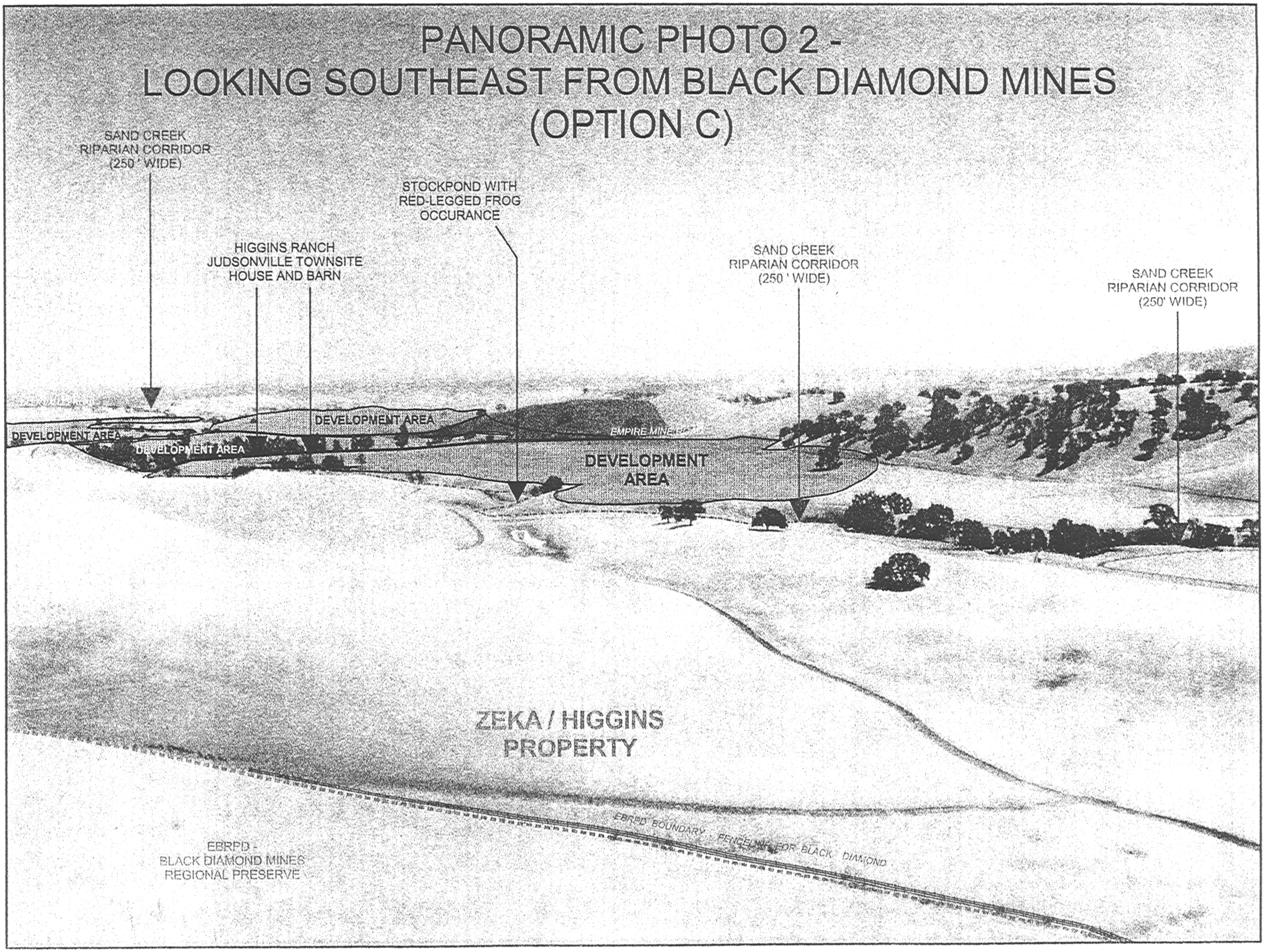
The District will be submitting additional written comments on the draft General Plan and EIR before the close of the public comment period on September 8, 2003. Please call me at (510) 544-2622 should you have any questions regarding our letter.

Sincerely yours,

Brad Olson

Brad Olson
Environmental Programs Manager

Attachments (2)
cc. Victor Carniglia


PANORAMIC PHOTO 2 -
LOOKING SOUTHEAST FROM BLACK DIAMOND MINES
(OPTION C)
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
STOCKPOND WITH
RED-LEGGED FROG
OCCURANCE
HIGGINS RANCH
JUDSONVILLE TOWNSITE
HOUSE AND BARN
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
SAND CREEK
RIPARIAN CORRIDOR
(250' WIDE)
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT
AREA
ZEKA / HIGGINS
PROPERTY
EBRPD BOUNDARY
FOR BLACK DIAMOND
EBRPD -
BLACK DIAMOND MINES
REGIONAL PRESERVE

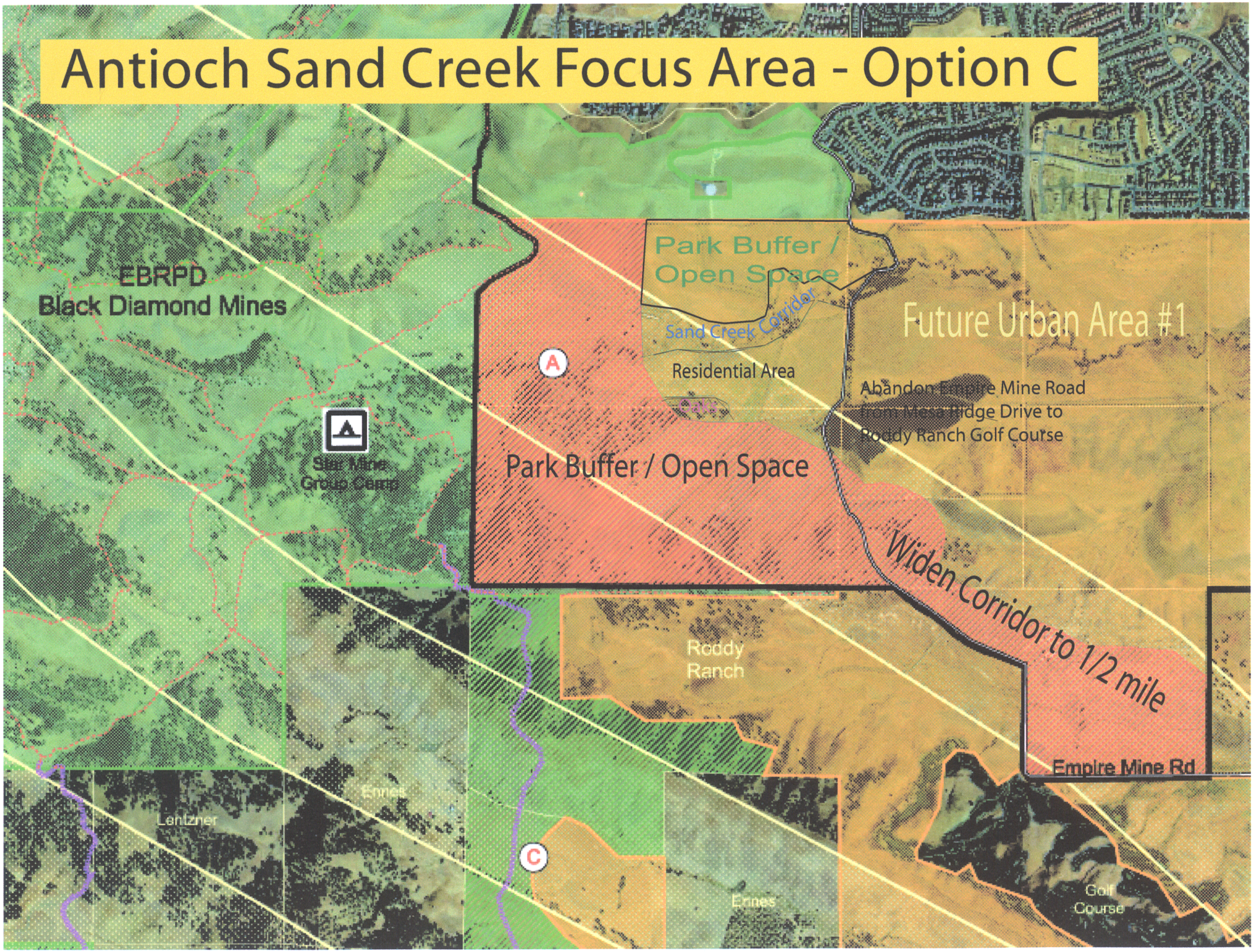

Antioch Sand Creek Focus Area - Option C
EBRPD
Black Diamond Mines
Star Mine
Group Camp
Park Buffer /
Open Space
Sand Creek Corridor
Residential Area
A
Future Urban Area #1
Abandon Empire Mine Road
from Mesa Ridge Drive to
Roddy Ranch Golf Course
Park Buffer / Open Space
Widen Corridor to 1/2 mile
Roddy
Ranch
Empire Mine Rd
Lentzner
Ennes
C
Ennes
Golf
Course

EXHIBIT 4

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SHUTE, MIHALY & WEINBERGER LLP
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CHRISTY H. TAYLOR
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LAUREL L. IMPETT, AICP
CARMEN J. BORG
URBAN PLANNERS

ELIZABETH M. DODD
DAVID NAWI
OF COUNSEL

August 27, 2003

Hand Delivered

Chairperson Weber and
Members of the Planning Commission
City of Antioch
P.O. Box 5007
Antioch, CA 94531-5007

Re: City of Antioch General Plan Update Draft Environmental Impact Report
August 27, 2003 Public Hearing

Dear Chairperson Weber and Members of the Planning Commission:

Because your Planning Commission is this evening holding a public hearing on the City of Antioch's proposed General Plan Update and the associated Draft Environmental Impact Report ("DEIR"), we wish to inform you that we are currently reviewing those documents on behalf of the East Bay Regional Park District ("EBRPD"). We will submit comprehensive written comments on the legal adequacy of the General Plan Update and DEIR prior to the close of the official comment period established by the City. As in the past, our comments will include analysis prepared by EBRPD staff who have technical expertise relevant to the issues raised by the DEIR and General Plan Update.

The purpose of this letter is to alert you to some of the salient violations of the California Environmental Quality Act ("CEQA") (Public Resources Code Section 21000 et seq.), the CEQA Guidelines (California Code of Regulations, title 14, Section 15000 et seq.) and State Planning and Zoning Law (Gov't Code § 65000 et seq.) thus far identified during our review of the General Plan Update and DEIR.

Through its General Plan Update, the City proposes to encourage major new development on thousands of acres of open space land at the southern end of the City, both inside and outside of the City's urban limit line. The DEIR fails to acknowledge the full extent of the adverse environmental impacts of such sprawling urban development. For example, the DEIR improperly downplays the implications of the clear conflict between the proposed General

Plan Update and applicable growth-limiting land use policies (e.g., the Contra Costa County 65/35 Land Preservation Plan).

Similarly, the DEIR seriously understates the gravity of the General Plan Update's impacts on biological resources, aesthetic and visual resources, and regional park facilities operated by the EBRPD. We note, for example, that despite numerous past requests from the District, the City still has not prepared any analysis of how the proposed development would affect views from neighboring EBRPD land. Similarly, the DEIR fails to adequately analyze and mitigate for significant impacts to sensitive species that are known to inhabit grassland communities in East Contra Costa County (e.g., San Joaquin kit fox, California tiger salamander, western burrowing owl).

The DEIR's analysis of alternatives is also flawed because it is improperly skewed in favor of the General Plan Update and against alternatives that would involve less intensive development (e.g., the "No Project, Existing General Plan Alternative", the "Rural Alternative" and the "Reduced Density Alternative"). The DEIR's conclusion that the alternatives are environmentally inferior to the proposed General Plan Update in the area of "population and housing" is not supported by substantial evidence. In fact, there are a number of feasible and responsible alternatives available to the City. The EBRPD is pleased, for example, that the City has developed a feasible scaled back alternative for the development of the Sand Creek area (Option B).

The EBRPD advocates an alternative (Option C) that would constrain development to within the City's existing urban limit line and, similar to Option B, tailor development in the Sand Creek region to avoid areas that are especially environmentally sensitive and are also hazardous, due to past mining operations. The details of the EBRPD's proposal are contained in a separate document being presented to you this evening.

Thank you for your consideration of these preliminary comments.

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP

OSA L. ARMI

[P:\EBRPD\Antioch\SMW Letter v.2.wpd]

EXHIBIT 5

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SWAIM BIOLOGICAL CONSULTING
4435 First Street, #312
Livermore, CA 94551
Phone: (925) 455-8770
Fax: (925) 455-6106

August 26, 2003

Mr. Joe Di Donato
East Bay Regional Park District
2950 Peralta Oaks Court
P.O. Box 5381
Oakland, CA 94605-0381

RE: Capture of Alameda whipsnakes at the eastern edge of Black Diamonds Regional Park, Antioch, Contra Costa County, CA

Dear Joe:

The purpose of this letter is to provide you with the results of our survey effort for the Alameda whipsnake (*Masticophis lateralis euryxanthus*) near the southeastern corner of Black Diamond Mines Regional Park (Attachment A). A summary of the results to date is presented below.

A free-ranging Alameda whipsnake was observed on June 15 as we staged equipment for the trapping survey. The snake was not captured, but was positively identified. On the 18th of June a small adult female Alameda whipsnake was hand captured in the same location (Attachment B). That day we set four traplines in the area that the Alameda whipsnake was observed. On June 23 two Alameda whipsnakes were captured in different traplines. The captures included a new male whipsnake (Alameda whipsnake # 2 on Attachment B) and the same female that was originally captured on June 18th approximately 300 feet to the west (Alameda whipsnake #1 on Attachment B). We deactivated the traps a few days later due to extreme temperatures in the region. It is likely we will expand our efforts during the fall when hatchling Alameda whipsnakes are active.

I have conducted trapping surveys for this species at over 25 different sites in Alameda and Contra Costa Counties over the last 15 years during my thesis work and various research and consulting projects. The habitat in the study area is optimal for the Alameda whipsnake and is contiguous with areas of similar habitat both to the west within Black Diamond Mines and well to the east and south on private lands. We had three Alameda whipsnake captures and an observation of an Alameda whipsnake in just over a week at this site with relatively minimal effort. This would indicate that a thriving population of Alameda whipsnakes inhabit both Black Diamond Mines Regional Park and the surrounding region.

It should be noted that Alameda whipsnake habitat is not limited to scrub and chaparral. Based on telemetry data, results of trapping surveys, and numerous opportunistic observations of the Alameda whipsnake, grassland, woodlands, and riparian corridors are also used by the Alameda whipsnake on a regular basis, especially where rock outcrops are present. I have attached a table which provides specific data on use of habitats 500 feet or greater from scrub communities.

Please call if you have any questions regarding this letter or need further information.

Sincerely,

Karen E. Swaim
Herpetologist

Attachments: A: Regional Map, B: Study Area with AWS observations C: Whipsnake observations >500 feet from scrub.

cc: Brad Olsen, EBRPD

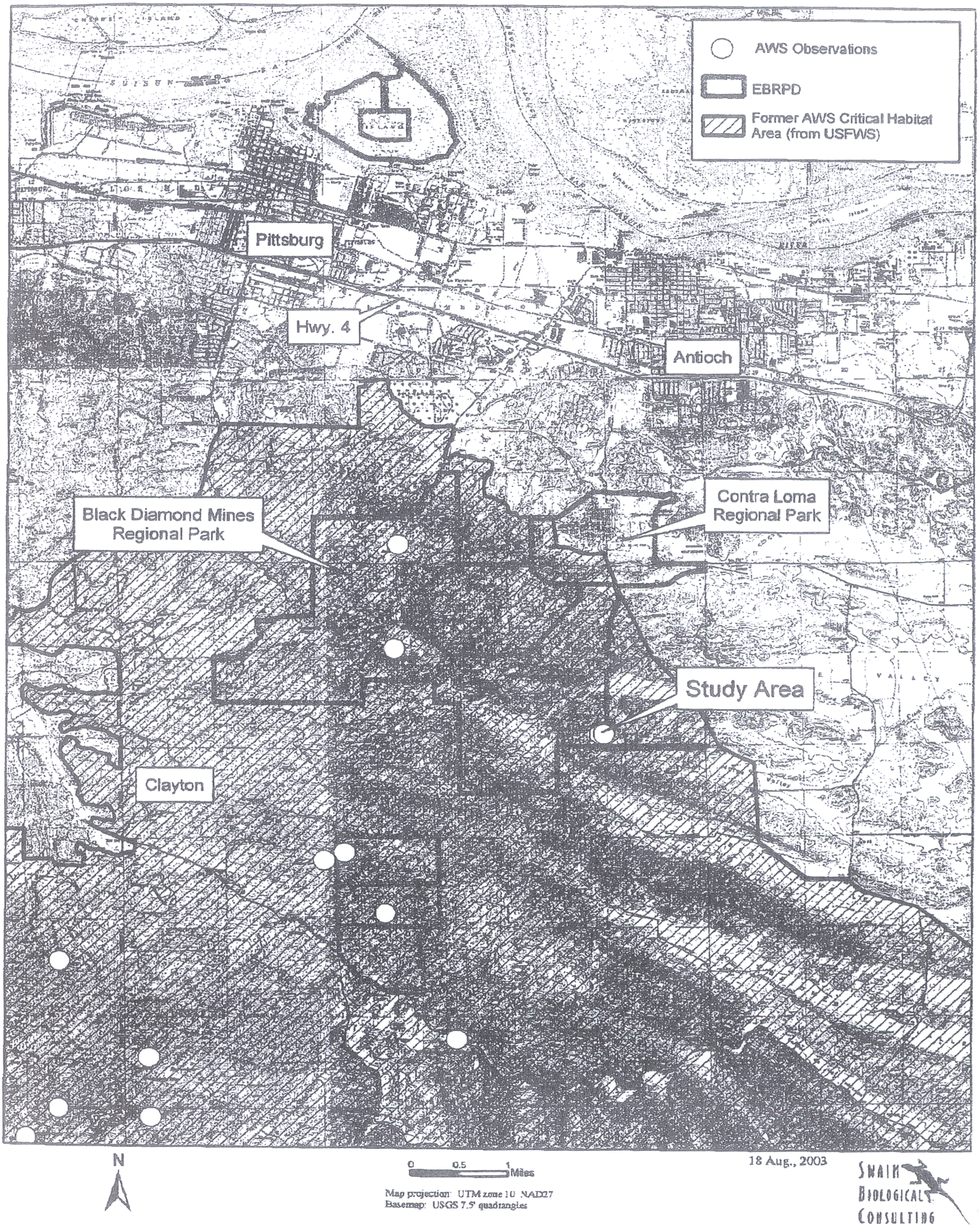
Harry McQuillen, USFWS

Dan Buford, USFWS

Janis Gan, CDFG

Carl Wilcox, CDFG

Attachment A



Attachment B

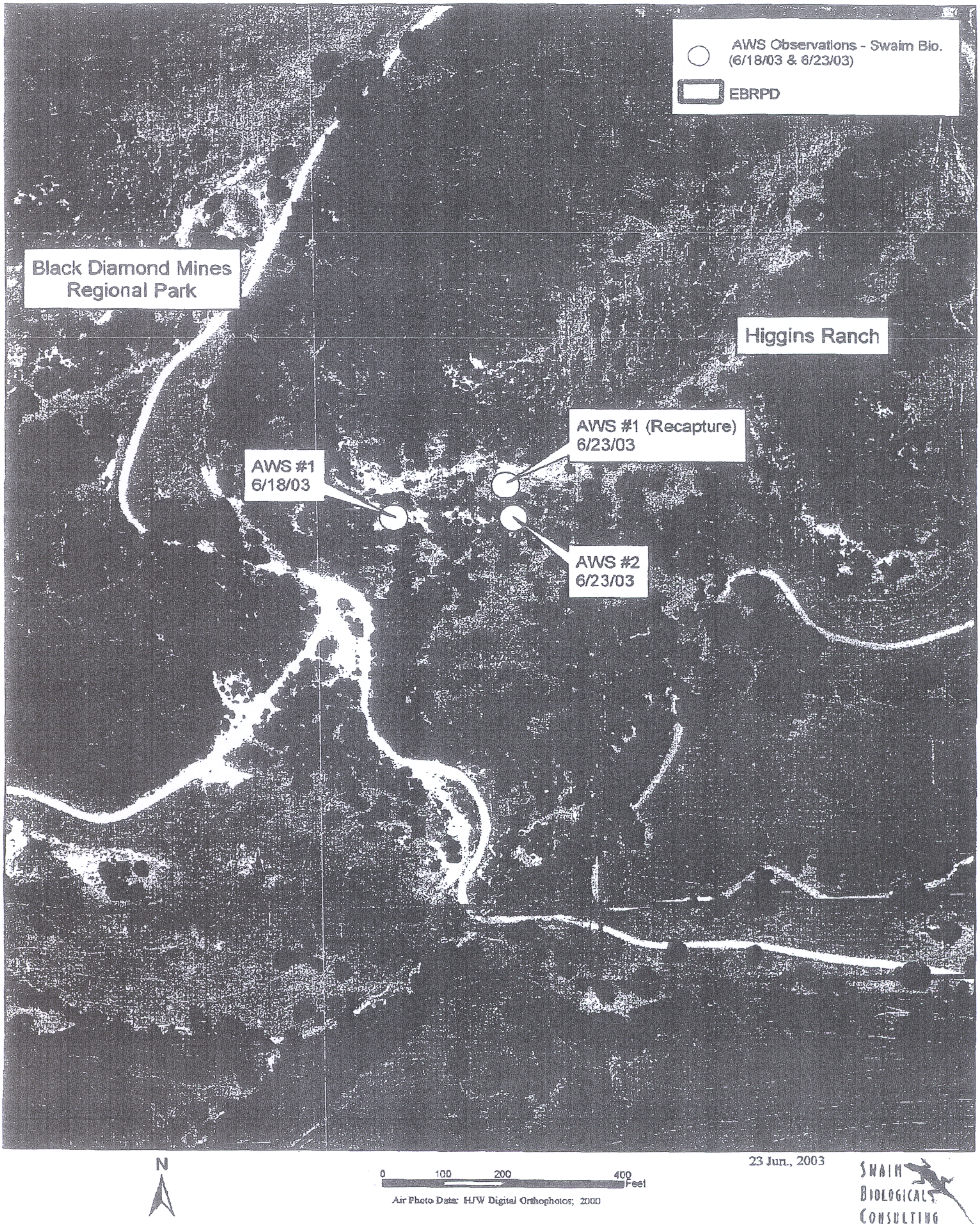


EXHIBIT 6

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THE SUNDAY TIMES • NOVEMB
CONTRA COSTA • BA

East County considers fe

Process is meant to accommodate conservation and development concerns

By Matt Weiser
TIMES STAFF WRITER

ANTIOCH — A federal plan to save East County's endangered species from extinction in the new century has quietly been winning support from developers and city planners.

Though many hurdles remain, the proposal, called a habitat conservation plan, would preserve vast areas of East County as protected habitat for rare plants and animals. In other areas set aside for development, builders would be freed from the high cost and uncertainty that species protection often entails.

The process is designed to address many of the traditional shortcomings of the Endangered Species Act, which has been criticized for focusing on the recovery of individual species rather than whole natural communities.

"It's just plain, good environmental land use," said Mike McGill of McGill, Martin & Self, an engineering firm and consultant to many East County developers.

"The development of a habitat conservation plan makes a lot of sense because it provides long-term rationality for setting aside land areas that can be used for development and land areas that are there for flora and fauna."

The stakes are high in East County, where the population is projected to increase 60 percent and almost 16,000 acres of open space is slated for development.

In the way are such rare species as the San Joaquin kit fox, California red-legged frog, tiger salamander and Alameda whipsnake. All have declined in number as land development has eliminated natural habitat.

Loss of habitat is the root problem of species decline worldwide, according to a report this fall by the Sierra Club and the U.S. Public Interest Research Group. The report quotes a Nature Conservancy study that found one-third of all American plants and animals at risk of extinction.

Species loss, according to the report, is proceeding at a rate unmatched since the extinction of the dinosaurs 65 million years ago and far beyond the rate at which new species are evolving.

The decline in species diversity threatens to disrupt the natural processes on which human life depends and eliminate many resources that contribute to medicine and agriculture.

The problem has been especially acute in fast-growing California, which has by far the highest number of imperiled plants and animals, according to the Nature Conservancy.

Many of California's vanishing creatures, including those in East County, make their home in native grasslands. This type of habitat was named one of the 21 "most-endangered ecosystems" in America in a report by Reed Noss, a leading conservation biologist.

"Unless we address it, there is a high degree of risk to some of the species," said Peter Cross, chief of the San Joaquin Valley branch of the U.S. Fish and Wildlife Service. "Certainly (in East County), the kit fox is just right in the face of where development is headed."

East County is consistently one of the fastest-growing regions in California, and many of the area's threatened species occur on private land slated for development. To encourage preservation of habitat on these lands, the Fish and Wildlife Service has been meeting with city officials and developers for the past year to promote a habitat conservation plan.

First opposed to the concept, local planners are beginning to embrace it as a way to prevent stricter development controls that will eventually be necessary if rare species decline further.

"It sounds like something that may have some merit to it," said Antioch City Attorney Bill Galstan. "The advantage of a habitat management plan is that it offers some protection during the time period of the plan."

During that time period, which is typically 50 years, the Fish and Wildlife Service guarantees that areas designated for development will not be subject to new species protection rules.

This removes uncertainties that exist today when a developer wishes to build but may never be sure in advance what will be required or how much it will cost.

Builders and city officials, in return, must agree in advance to set aside areas of prime wildlife habitat that can never be developed. In some cases, the land may remain in agriculture if this does not conflict with the needs of species.

Areas of lesser-quality habitat may be buildable, but the developer would have to replace it by purchasing equal- or better-quality land elsewhere that would be dedicated as permanent habitat. The purchase thus helps secure and enlarge existing habitat areas.

Cross said it is important for details of a habitat conservation plan to be worked out by local players, who may have unique ideas to contribute, so that everyone has a stake in the plan.

East County offers a lot of promise, he said, because there is a lot of important land that still hasn't been developed or already lies in public hands.

"We're trying to use the habitat conservation plan process, in part, to open up new ideas," said Cross.

"It's not that we have to stop development. It's just that we've got to think about what's the best way to do it to be compatible with the

DAVID CASSIDY, a California Department of Fish a[nd ...] foxes in Black Diamond Mines Regional Park.

"It's not that we have to stop development. It's just that we'\ think about what's the best wa be compatible with the needs o endangered species as well as t of people. We can accommodat

chief, San Joaquin Valley branch, U.S. Fis[h ...]

needs of endangered species as well as the needs of people. We can accommodate both."

Boundaries of the plan would probably match the habitat of the San Joaquin kit fox. The small fox is considered an "umbrella species" because of its broad distribution in the region and large habitat that overlaps many of the area's other troubled species.

Thus, protecting habitat for the fox will preserve other plants and animals at risk.

This also achieves protection of an "ecosystem" rather than a single animal. To do this, it is vital to secure the involvement of neighboring jurisdictions, and toward this end the process still faces big road blocks.

Brentwood, for example, has yet to express any support for the plan. And though some of the city's pro-

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TIMES FILE

California Department of Fish and Game scientist aide, positions a live animal trap during a daily check of the traps for kit ond Minos Regional Park.

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— Peter Cross,
San Joaquin Valley branch, U.S. Fish and Wildlife Service

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posed development lies in the path of important kit fox habitat, city officials see no mandate for a conservation effort based on the fox.

"Our general feeling right now is that we're not sure that kit foxes have really established habitat in this area," said Mike Leanna, Brentwood's chief planner "There's never been any identified sightings."

A relatively new tool, habitat conservation plans are credited with getting private property owners on board with endangered species advocates — instead of fighting them at every turn.

In Bakersfield and Kern County, for example, such plans have been successful in protecting habitat for kit fox populations there.

In California, Oregon and Washington, about 2.5 million acres of forest land is protected by such plans.

But many environmentalists have begun to warn that habitat conservation plans go too far.

The Sierra Club says too many such plans are rarely tied to environmental results or even to the recovery of specific species.

The plans also don't allow enough flexibility to change tactics as knowledge of protected species changes.

"Until the problems of habitat conservation plans are fixed, they shouldn't be used," said Alyssa Rosen, an associate regional representative for the Sierra Club.

"A habitat conservation plan itself is not a bad idea. The problem is that it has these really rigid parts to it that aren't good for species "

But in East County, the habitat conservation plan is already succeeding in one critical respect: It's got people thinking about the importance of preserving habitat instead of fighting over single animals.

"Because it's going to cover a wide range of species, you don't have to get into this debate of do we have a kit fox here or not," McGill said.

"What you're trying to do is set aside enough land to really give those animals a long-term chance for survival."

EXHIBIT 7

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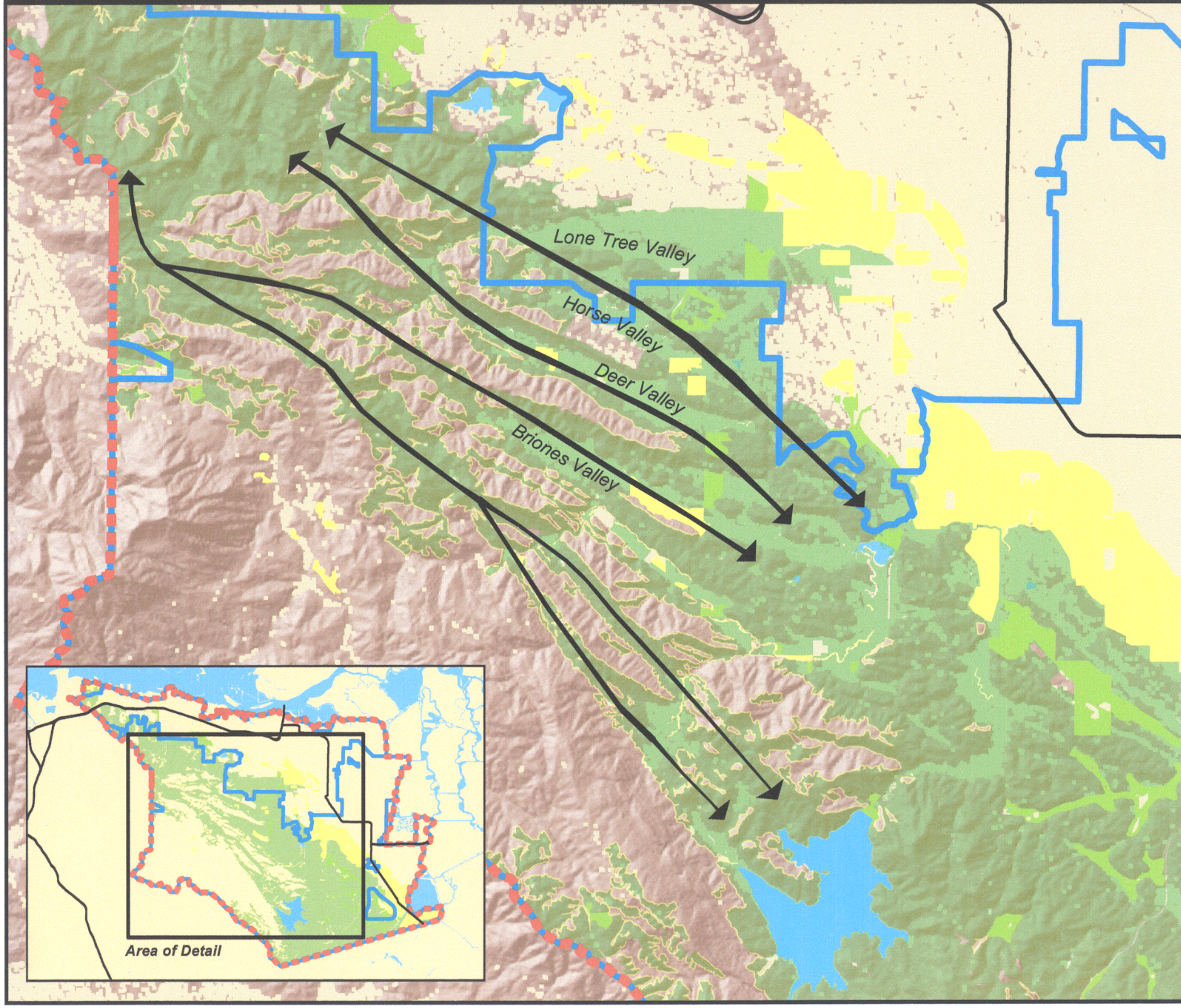
Figure 6-4: Potential Primary Kit Fox Corridors Through Zone 2

DRAFT



PRELIMINARY DRAFT

Legend

- Inventory Area
- Urban Limit Line
- Suitable Core Habitat
- Suitable Low Use Habitat
- Kit Fox Corridor

This map presents outcomes of a preliminary draft habitat model that is described in an accompanying memo. The purpose of the model is to identify areas within the inventory area where the species occurs or could occur based on known habitat requirements. This information is being presented in this early draft form to explain the modelling process and to solicit comments on that process. Please refer to the accompanying memo for an explanation of the assumptions and limitations of the preliminary draft model.

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Miles

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Jones & Stokes

January 8, 2003

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EXHIBIT 8

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Exhibit 8

Report on the Potential Impacts of the City of Antioch's General Plan Update on the San Joaquin Kit Fox

Prepared by Brad Olson, Environmental Programs Manager
East Bay Regional Park District
Date: August 27, 2003

The proposed developments in Sand Creek Valley (Option A) and development of Roddy Ranch would likely sever the two largest and most significant kit fox migration corridors in the east Contra Costa area. The Briones Valley corridor is already constrained by ranchette development near Deer Valley Road. The southern corridor is constrained by the Los Vaqueros Reservoir and would be severed if Los Vaqueros were expanded as proposed. Such a scenario would likely result in the local extinction of San Joaquin kit fox in the Antioch to Round Valley area. Those individual kit foxes that remained in isolated areas would become reproductively isolated, would become genetically unfit to changing habitat conditions and would be subject to further incremental loss of habitat and predation. Such a scenario would eventually lead to larger scale kit fox extinction in eastern Contra Costa County.

The East Bay Regional Park District has prepared the attached visual representation attached hereto that maps the existing and proposed developments and lays out kit fox movement corridors in the area between Black Diamond Mines Regional Preserve and Cowell Ranch State Park. The following is an explanation of the assumptions, observations and conclusions from this mapping *and* analysis.

Assumptions/Explanations:

- The kit fox corridors were derived from the draft corridor map developed for the East Contra Costa HCP/NCCP, Figure 6.4 and accompanying discussion in the draft HCP/NCCP. A map is attached hereto. The corridors are shown at a ½ mile width for illustration purposes, the actual width of the corridor varies with topography, vegetation type, etc. Its purpose is to give some idea of what a ½ mile corridor looks like on the landscape and where potential land use conflicts emerge.

- The dark orange "proposed Antioch Corridor / Mitigation Area" is taken from Figure 10, Appendix D of the Antioch General Plan DEIR. This proposed corridor appears to have been used as the basis for developing Option B for the Sand Creek Area.

- The light orange development areas of Antioch (i.e. Sky Ranch I & II, Future Urban Area 1, Roddy Ranch and Ginochio properties) are taken from the Antioch draft General Plan and DEIR. The light orange for Brentwood (i.e. SPA's G and H, and the Vineyards at Cowell Ranch) are taken from the Brentwood General Plan. Finally, Fox Ridge Manor is a minor subdivision proposal before Contra Costa County.

- The lavender colored areas are locally approved major developments in the mapping area.

- The dark green areas are conservation easements. Of most significance being the Roddy Ranch conservation easement in Deer Valley.

- The color aerial photography is from June 2002.

- The parcel data is from Contra Costa County.

Observations:

- One proposed option for the Antioch Corridor (Option B) is too narrow in its southern area (about 800 feet wide). It also dead ends at Roddy Ranch and should be shown how it would link to Cowell Ranch (which is the stated goal in the DEIR and the East Contra Costa HCP/NCCP). The other proposal for Sand Creek area (Option A) would sever this movement corridor altogether, severely impacting the kit fox.

- Antioch has in the past proposed to abandon Empire Mine Road if the Sand Creek area is developed. We could find no such commitment in the General Plan and DEIR. Absent such a closure, any corridor through the area would be greatly impaired. As wildlife gets concentrated into this narrow corridor with an active public road, road kill would greatly increase and the long-term viability of this corridor would be jeopardized.

- The General Plan Figure 4.10 shows the entire 2,100 acre Roddy Ranch area as proposed development. The actual developable area is considerably less because the map does not show the 875-acre conservation easement and 173 acres of golf course. Our map shows about a 1080-acre potential development area when all of these constraints are placed within the Roddy Ranch. This area is shown in light orange on the map. Even with this reduced footprint and establishment of the proposed "Antioch Corridor" under Option B, it appears that development of Roddy Ranch would sever the two northern kit fox corridors by placing up to 2,625 housing units in these two areas, which presently separate Black Diamond Mines from Cowell Ranch. There is no discussion of this impact in the General Plan or DEIR, much less the more severe impacts that would be associated with adoption of Option A. Such analysis is deferred to a future Specific Plan and EIR. The remainder of Roddy Ranch between the two corridors also provides good potential whipsnake habitat, as evidenced by the recent capture of whipsnake at Black Diamond Mines.

- Development of the SPA's (Special Planning Areas) "G" and "H" properties in Brentwood would likely be limited to the northeastern portion of the property (as mapped in Figure 10 of the subject DEIR) where a high school and middle school are proposed for construction. This development will likely have significant impacts to tiger salamander and burrowing owl, however, there would still be room for a viable kit fox corridor on the western and southern portions of the property, which is open grassland, but considerably steeper than the developable area.

- The proposed Fox Ridge Manor Development on the Tysinger property could potentially sever the eastern end of the Briones Valley corridor. This is based upon the assumption that existing ranchette developments to the north and south effectively act as barriers to kit fox movement. The same concern also exists for the southern end of the Deer Valley corridor, however, there is still room for passage to the north of the ranchettes on the SPA's G and H properties.

- The southern most corridor would be severed by a Los Vaqueros expansion. Future kit fox movement would likely be only east of the expanded reservoir. We did not map this area.

Conclusions:

- It appears that there are development threats to all of the kit fox corridors between Cowell Ranch and Black Diamond Mines shown on the enclosed map.

- The northern two corridors (i.e. Sand Creek/Horse Valley and Deer Valley) are at present the least constrained by development and they contain the widest swaths of valley bottom grassland habitats.

- There appears to be a viable corridor through the Option B area, provided it is wide enough, Empire Mine Road is abandoned, the corridor is properly buffered and it connects to Cowell Ranch; we call such an alternative Option C. *See Exhibit 3* to Shute, Mihaly & Weinberger letter.

- If Option A or Option B is selected for the Sand Creek Area, the objective of preserving a viable kit fox corridor in the Sand Creek Valley could not be accomplished. This is a significant and unmitigated impact not addressed in the

DEIR. Selection of Option C with an adequate protected corridor to Cowell Ranch may reduce this impact to a less-than-significant level.

- If significant development of the valley bottom grassland areas occurs on Roddy Ranch, the objective of preserving a viable kit fox corridor in Horse Valley and/or Deer Valley between Cowell Ranch and Black Diamond Mines could not be accomplished. This is a significant and unmitigatible impact not addressed in the DEIR.

- It appears that preservation of only the two impaired southern corridors (i.e. Briones Valley and west side of Los Vaqueros Reservoir) would <u>not</u> be enough to keep kit fox populations viable north of Cowell Ranch. This is based upon the assumption that Los Vaqueros is <u>not</u> expanded. This is a significant impact not addressed or mitigated in the DEIR. Antioch's participation in a regional habitat conservation effort would be the only effective means for Antioch to preserve these corridors.

- With loss of the two northern corridors (i.e. Sand Creek/Horse Valley and Deer Valley) and <u>with</u> a Los Vaqueros Reservoir expansion of 300,000 or 500,000 acre-feet, local extinction between Round Valley and Black Diamond Mines would likely occur. This is a significant cumulative impact not addressed or mitigated in the DEIR

BLACK DIAMOND MINES TO COWELL RANCH

East Bay Regional Park District

- EBRPD Lands
- Other Open Space
- Conservation Easements
- Proposed Development
- Approved Development
- Proposed Antioch Corridor / Mitigation Area
- East Contra Costa HCP Kit Fox Corridor
- Urban Limit Line
- Existing Trail
- Existing Regional Trail
- Proposed Regional Trail
- Major roads
- Reference Photo

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Interagency Environmental Review
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August 27, 2003

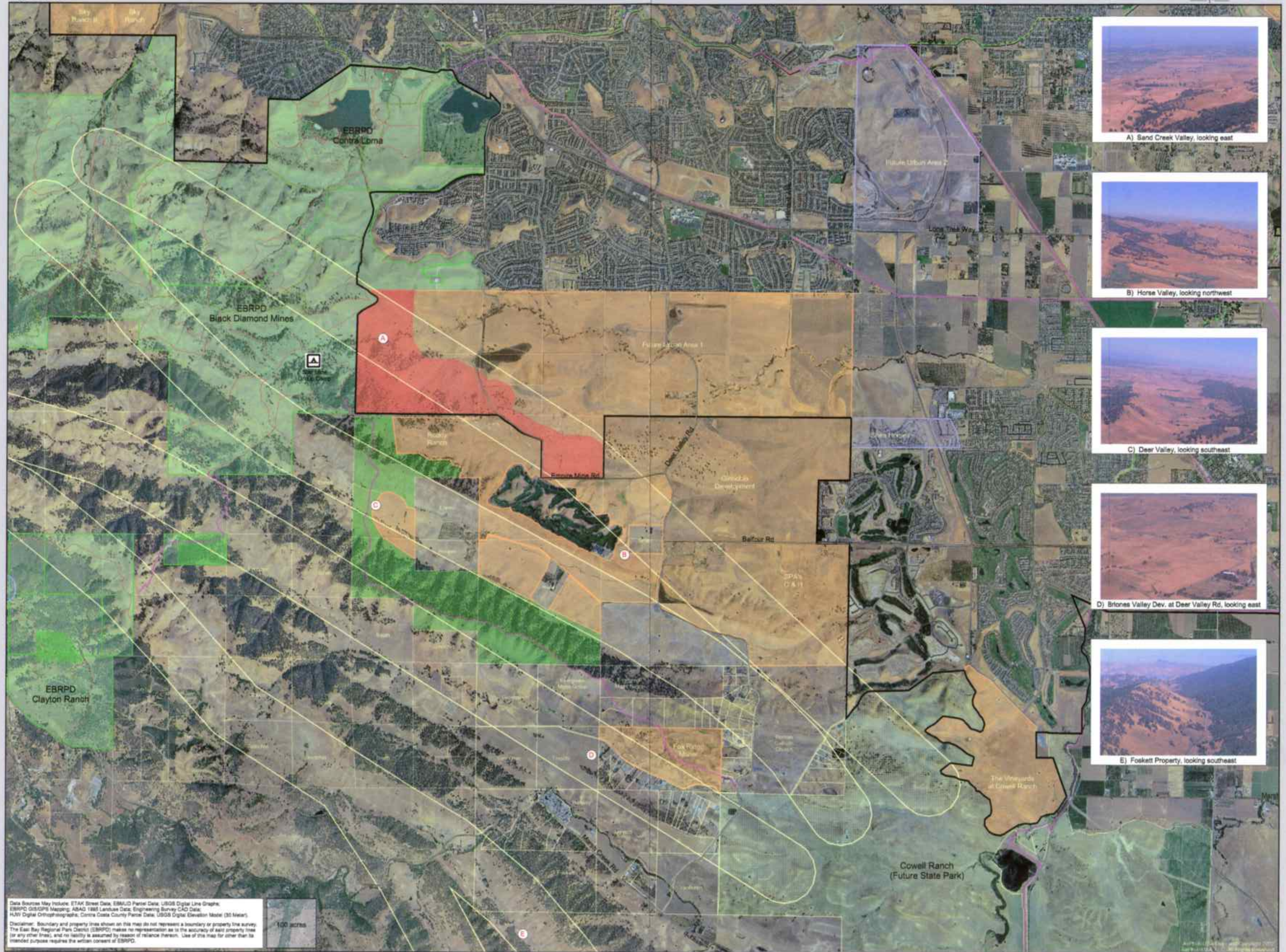

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EXHIBIT 9

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HCPA East Contra Costa County Habitat Conservation Plan Association

DATE: June 30, 2003

SUBJECT
Notice of Preparation (NOP) to prepare an Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Issuance of Incidental Take Permits Associated with a Habitat Conservation Plan and Natural Community Conservation Plan for East Contra Costa County, California.

INTRODUCTION
Pursuant to the California Environmental Quality Act (CEQA), the East Contra Costa County Habitat Conservation Plan Association (Association) and the U.S. Fish and Wildlife Service (Service) plan to prepare an EIR/EIS on the East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan (Plan). The Association is a Joint Powers Authority consisting of the following seven member agencies: Contra Costa County; cities of Brentwood, Clayton, Oakley, and Pittsburg; Contra Costa Water District; and East Bay Regional Park District.

The Plan has identified a 170,000-acre planning area that includes watersheds draining the eastern flanks of Mount Diablo in East Contra Costa County, California. Members of the Association intend to request Endangered Species Act (Act) permits for 7 species federally listed as threatened or endangered and 19 other species that are either listed as threatened or endangered under the California Endangered Species Act or identified as a Federal or State species of concern (see Table 1 for full list of species and their status). The permits are needed to authorize take of listed species that could occur as a result of implementation activities covered under the Plan (see Proposed Implementation Activities below).

EAST CONTRA COSTA COUNTY HABITAT CONSERVATION PLAN/ NATURAL COMMUNITY CONSERVATION PLAN

Covered Species
Currently, 26 species are proposed for coverage under the Plan. Table 1 lists those species and their current status. Species may be added or deleted during the course of Plan development based on further analysis, new information, agency consultation, and public comment.

Plan Area
The Plan area includes approximately 170,000 acres in East Contra Costa. The southern boundary of the Plan area is defined by the Alameda-Contra Costa County line. The boundary from the county line to Mt. Diablo is defined by the Kellogg Creek and Marsh Creek watersheds. From the peak of Mount Diablo to the north, the western boundary follows the Mount Diablo Meridian to the City of Clayton Sphere of Influence to include the entirety of the City of Clayton Sphere of Influence within the Plan area. The

northwestern boundary follows the watershed line in the hills between Pittsburg and Concord but excludes the City of Concord and Concord Naval Weapons Station. The northern boundary of the inventory area was defined by the limit of urban development along the San Joaquin River shoreline. It excludes current and historic tidal areas (as determined by Soil Conservation Service soil surveys [1977]) to avoid the need to cover Delta-exclusive species and natural communities. The eastern boundary of the inventory area was defined based on the course of the most western Delta sloughs between Oakley and the Alameda–Contra Costa County line near Clifton Court Forebay. Former tidal areas were also excluded from the eastern boundary of the inventory area. In addition, the community of Discovery Bay was excluded because it is already built-out and will not require additional coverage under the Act. The Clifton Court Forebay in the southeastern corner of the County was excluded because no activities are contemplated in that area that will require coverage under the Act.

Proposed Implementation Activities

Because the Plan is still under development, the list of covered activities has not been finalized. The following implementation activities are currently under consideration by the Association and Service for coverage under the Plan.

1. Residential, commercial, and industrial development
2. Road and highway construction and maintenance
3. Water infrastructure construction and maintenance
4. Flood control project construction and maintenance
5. Sanitary system infrastructure construction and maintenance
6. Rural recreational facility construction, maintenance, and operation
7. Recreational use of rural parks and preserves
8. Mining facility construction, operation, and maintenance (if requested by mining companies)
9. Miscellaneous development in rural areas (to be defined)
10. Population surveys, species relocation, habitat restoration, management, and scientific research on preserve lands or potential preserve lands
11. Clearing, grading, or filling of natural communities for new irrigated agriculture (if requested by agricultural community)
12. On-going operations of existing agriculture (if requested by the agriculture community)

One project has been identified that will be excluded from the take permit: the potential expansion of the Los Vaqueros Reservoir. This project would obtain any necessary take authorization in a separate consultation between the U.S. Bureau of Reclamation and the Service. During Plan development, other projects may also be identified as excluded from the Plan.

Mitigation

Under the Plan, the effects of covered activities are expected to be minimized and mitigated through participation in a conservation program, which will be fully described in the Plan. The focus of a conservation program is to provide long-term protection of covered species by protecting biological communities in the Plan area. Because the Plan is also a Natural Community Conservation Plan, it will also contribute to the recovery of the listed covered species and to the conservation of non-listed species to try to prevent their listing in the future.

Components of a conservation program are now under consideration by the Association and Service. These components will likely include:

- avoidance and mitigation measures,
- habitat preservation,
- habitat restoration and enhancement,
- monitoring and adaptive management, and
- research.

ENVIRONMENTAL IMPACT REPORT/STATEMENT

The Association and Service will prepare a joint document in compliance with CEQA and the National Environmental Policy Act (NEPA). The Association will be responsible for the scope and content of the document for CEQA purposes, and the Service will be responsible for the scope and content of the document for NEPA purposes.

The EIR/EIS will consider the proposed action (issuance of ESA permits), and a reasonable range of alternatives. A detailed description of the proposed action and alternatives will be included in the EIR/EIS. It is anticipated that several alternatives will be developed, which may vary by the level of conservation, impacts caused by the proposed activities, permit area, covered species, or a combination of these factors.

The EIR/EIS will also identify potentially significant impacts on biological resources, land use, air quality, water quality, mineral resources, water resources, economics, and other environmental issues that could occur directly or indirectly with implementation of the proposed action and alternatives. For all potentially significant impacts, the EIR/EIS will identify mitigation measures where feasible to reduce these impacts to a level below significance.

PUBLIC MEETING

Two public meetings have been scheduled to provide an overview of the proposed action and obtain feedback. The meetings will be held on:

July 17, 2003, 3:30 p.m. – 5:00 p.m.
July 17, 2003, 7:00 p.m. – 8:30 p.m.

The public meetings will be held at:

Pittsburg City Hall, Council Chambers
65 Civic Drive
Pittsburg, CA 94565

SUBMITTING COMMENTS

Written comments from interested parties are invited to ensure that the full range of issues related to the proposed action are identified. All comments received, including names and addresses, will become part of the official administrative record and may be made available to the public. Information, written comments, or questions related to the preparation of the EIR/EIS should be received on or before August 4, 2003. Written comments should be directed to the contact below.

FOR FURTHER INFORMATION CONTACT:

John Kopchik
Contra Costa County Community Development Department
651 Pine Street
Martinez, CA 94553
(925) 335-1227

Additional information may also be found at the following website: www.cocohcp.org

SUPPLEMENTARY INFORMATION

Persons needing reasonable accommodations in order to attend and participate in the public meeting should contact John Kopchik at (925) 335-1227 as soon as possible. In order to allow sufficient time to process requests, please call no later than one week before the public meeting. Information regarding this proposed action is available in alternative formats upon request.

Table 1. Special-Status Species Proposed for Coverage by the ECCC HCP/NCCP *[Note: List is preliminary]*

Common Name	Scientific name	Status[1] State	Status[1] Federal
Mammals			
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*	CSC	FSC
San Joaquin kit fox	*Vulpes macrotus mutica*	ST	FE
Birds			
Tricolored blackbird	*Agelaius tricolor*	CSC-1	FSC
Golden eagle	*Aquila chrysaetos*	FP	BGPA
Western burrowing owl	*Athene cunicularia hypugea*	CSC-1	FSC
Swainson's hawk	*Buteo swainsoni*	ST	–
Reptiles			
Silvery legless lizard	*Anniella pulchra pulchra*	CSC	FSC
Alameda whipsnake	*Masticophis lateralis euryxanthus*	ST	FT
Giant garter snake	*Thamnophis gigas*	ST	FT
Amphibians			
California tiger salamander	*Ambystoma californiense*	CSC	FPL
California red-legged frog	*Rana aurora draytonii*	–	FT
Foothill yellow-legged frog	*Rana boylii*	CSC	FSC
Invertebrates			
Longhorn fairy shrimp	*Brachinecta longiantenna*	–	FE
Vernal pool fairy shrimp	*Brachinecta lynchi*	–	FT
Midvalley fairy shrimp	*Brachinecta mesovallensis*	–	FSC
Vernal pool tadpole shrimp	*Lepidurus packardi*	–	FE
Plants		**CNPS**	
Mount Diablo manzanita	*Arctostaphylos auriculata*	1B	–
Brittlescale	*Atriplex depressa*	1B	–
San Joaquin spearscale	*Atriplex joanquiniana*	1B	–
Big tarplant	*Blepharizonia plumosa*	1B	–
Mount Diablo fairy lantern	*Calochortus pulchellus*	1B	–
Recurved larkspur	*Delphinium recurvatum*	1B	–
Diablo helianthella	*Helianthella castanea*	1B	–
Brewer's dwarf flax	*Hesperolinon breweri*	1B	–
Showy madia	*Madia radiata*	1B	–
Adobe navarretia	*Navarretia nigelliformis* ssp. *nigelliformis*	1B	–

[1]**Status:**

Federal

FE Federally Endangered
FT Federally Threatened
FPT Federally Proposed for Threatened Listing
FPL Federally Proposed for Listing
FPD Federally Proposed for Delisting
FD Federally Delisted
FSC Federal Special Concern Species
BGPA Bald Eagle and Golden Eagle Protection Act

State

SE State Listed as Endangered
ST State Listed as Threatened
CSC California Special Concern Species
CSC 1 Bird Species of Special Concern; First Priority
CSC 2 Bird Species of Special Concern; Second Priority
CSC 3 Bird Species of Special Concern; Third Priority
SR State Rare (plants)
FP Fully Protected
1B California Native Plant Society, Rare or Endangered in California and Elsewhere

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EXHIBIT 10

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Exhibit 10. Recent kit fox sitings.

1.	Black Diamond Mines - October 2, 1996 - Steven Bobzien (EBRPD) and David Casady (CDFG) starting at 19:54 hrs observed one adult for 24 minutes foraging in open grasslands southeast of Stewartville Camp. This sighting is one mile west of the Zeka/Higgins property.
2.	Black Diamond Mines - October 3, 1997 - David Casady (CDFG) at 20:05 hrs observed an adult near the intersection of Stewartville and Ridge Trails. This sighting is within 100 feet of the Zeka/Higgins property.
3.	Black Diamond Mines - September 12, 1999 - Traci Parent (EBRPD) at 09:40 observed an adult on Somersville Road and Markley Creek just south of Sidney Flat. This sighting is 2.5 miles west of the Zeka/Higgins property.
4.	Bethany Reservoir - Late November or early December 1998 - Laurie Briden (CDFG) observed three kit fox. This sighting is 13 miles southeast of the Sand Creek Specific Plan area.
5.	Vasco Caves - Late May 2001 - Don Bright and Tammey Mueller (EBRPD) at 08:30 hrs observed an adult in the center of the Preserve. This sighting is 11 miles southeast of the Sand Creek Specific Plan area.
6.	Vasco Caves - July 2, 2002 - Dan Mordell (EBRPD Preserve Residence) at 16:30 hrs observed an adult for 20 minutes in the center of the Preserve. This sighting is 11 miles southeast of the Sand Creek Specific Plan area.
7.	Brushy Peak - July 16, 2002 - Dave Riensche (EBRPD) at 17:25 hrs observed an adult at 20 feet coming out of the drainage just south of pond 001. This sighting is 13 miles south of the Sand Creek Specific Plan area.
8.	Brushy Peak - August 20, 2002 - Geoff Monk (Wildlife Biologist/Consultant) at 20:47 hrs observed and adult at 20 feet on the road near the historic tomb at the north end of the Preserve. This sighting is 12 miles south of the Sand Creek Specific Plan area.
9.	Carnegie State Recreation Area - August 2, 2002 - Rhona Chickwood (State Park biologist) between 18:30 - 19:00 hrs observed two kit fox. This sighting about 22 miles southeast of the Sand Creek Specific Plan area.

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EXHIBIT 11

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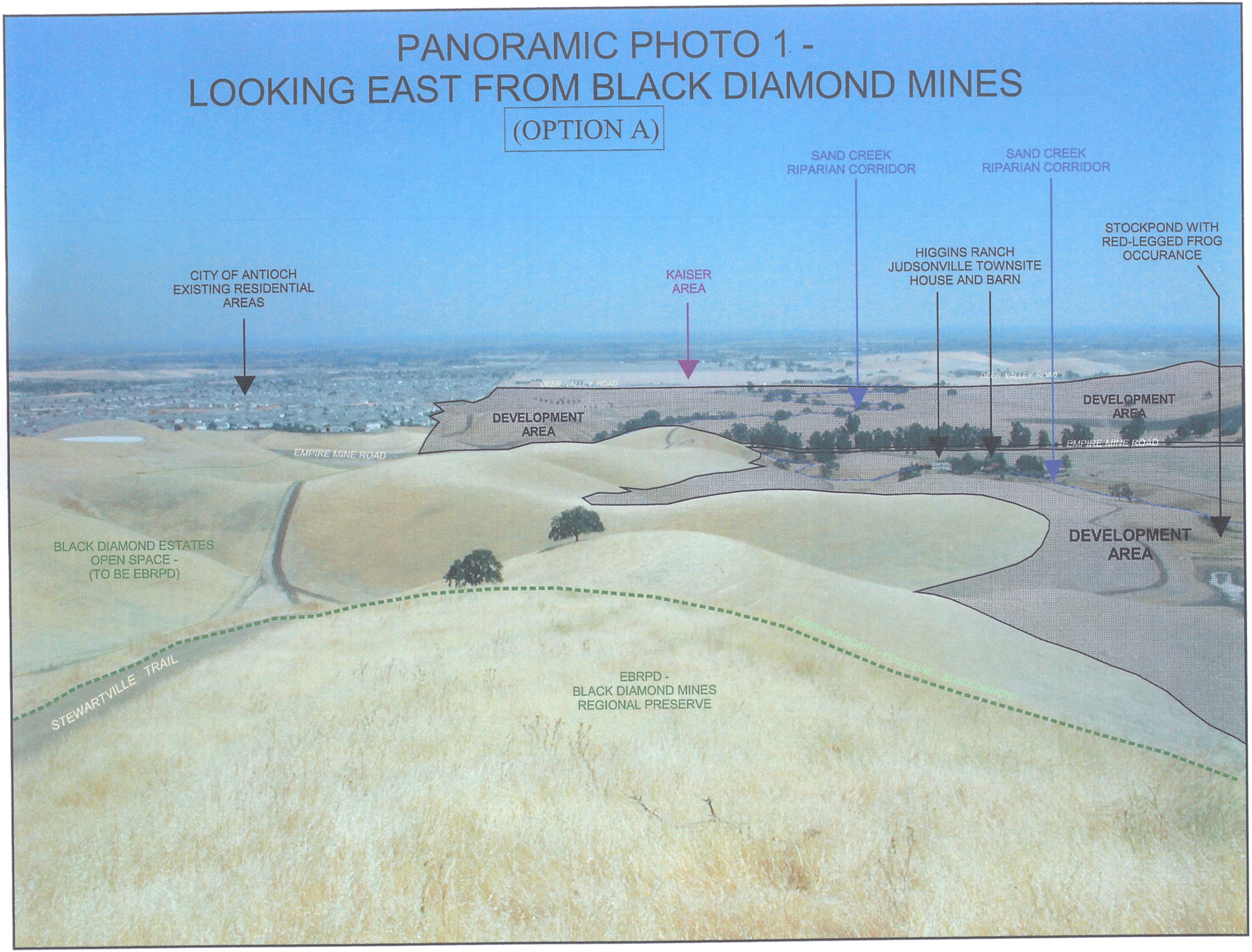
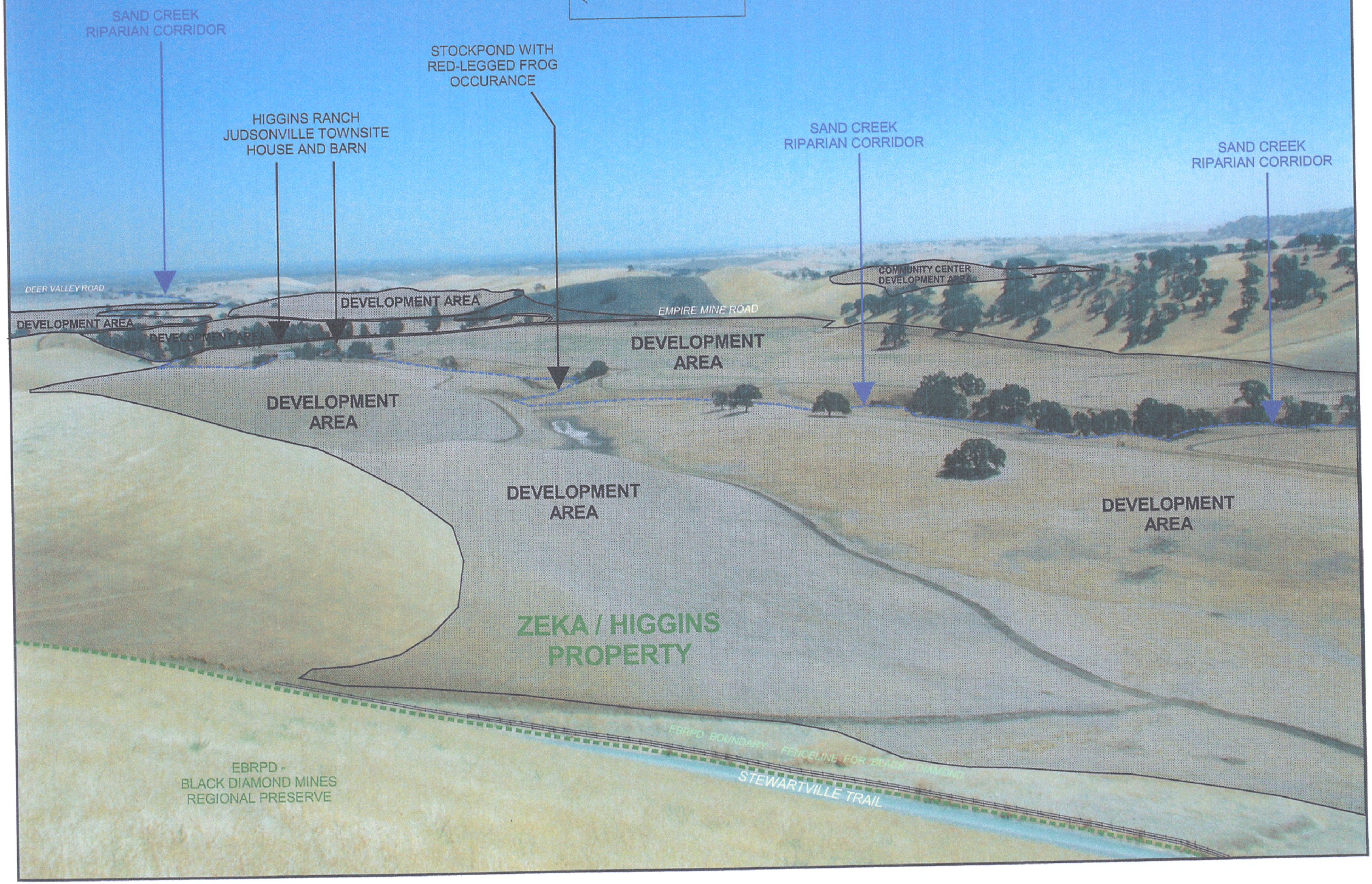

PANORAMIC PHOTO 1 -
LOOKING EAST FROM BLACK DIAMOND MINES
(OPTION A)
SAND CREEK RIPARIAN CORRIDOR
SAND CREEK RIPARIAN CORRIDOR
STOCKPOND WITH RED-LEGGED FROG OCCURANCE
HIGGINS RANCH JUDSONVILLE TOWNSITE HOUSE AND BARN
CITY OF ANTIOCH EXISTING RESIDENTIAL AREAS
KAISER AREA
DEER VALLEY ROAD
DEER VALLEY ROAD
DEVELOPMENT AREA
DEVELOPMENT AREA
EMPIRE MINE ROAD
EMPIRE MINE ROAD
DEVELOPMENT AREA
BLACK DIAMOND ESTATES OPEN SPACE - (TO BE EBRPD)
STEWARTVILLE TRAIL
EBRPD - BLACK DIAMOND MINES REGIONAL PRESERVE

PANORAMIC PHOTO 2 -
LOOKING SOUTHEAST FROM BLACK DIAMOND MINES
(OPTION A)



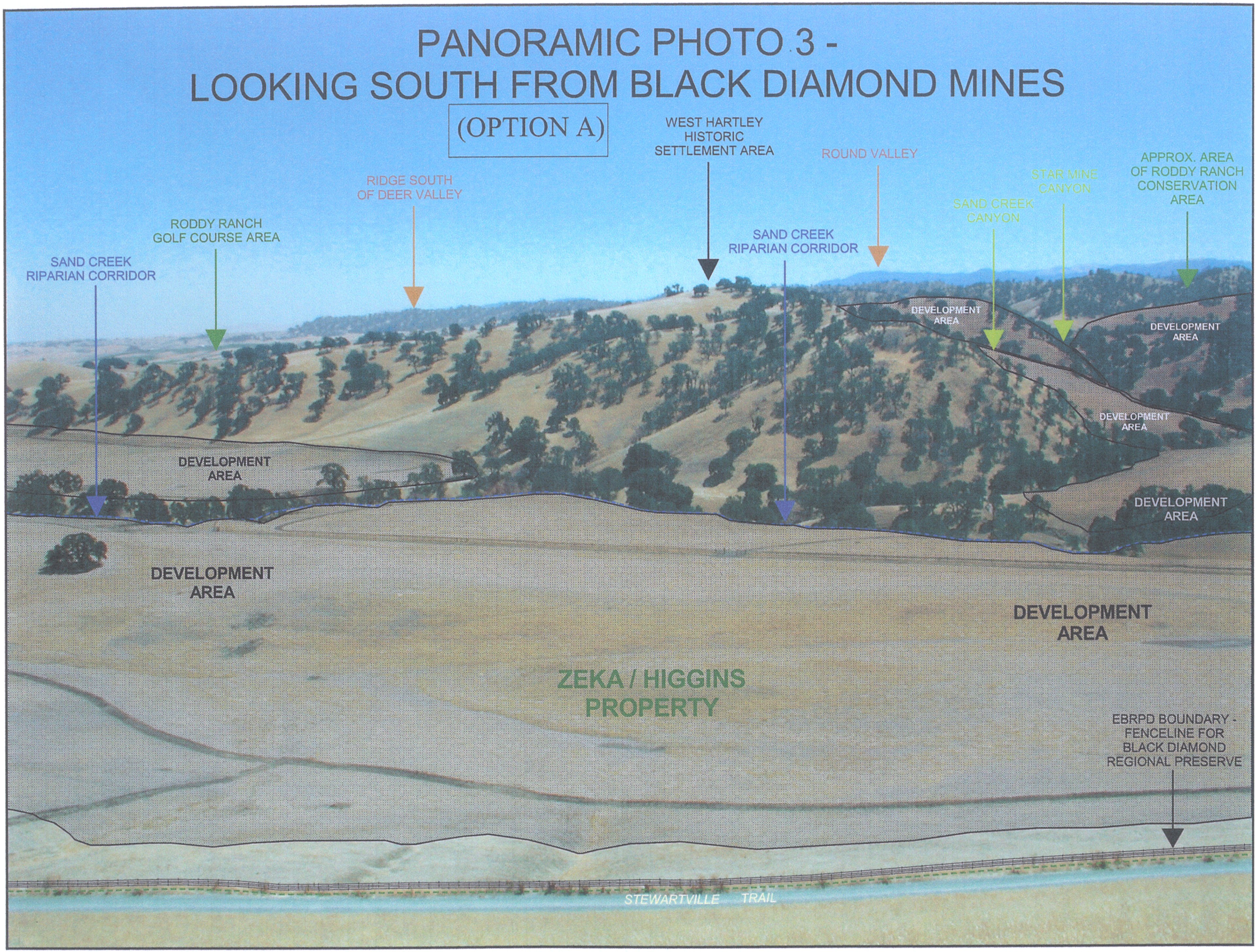

PANORAMIC PHOTO 3 -
LOOKING SOUTH FROM BLACK DIAMOND MINES
(OPTION A)
WEST HARTLEY HISTORIC SETTLEMENT AREA
ROUND VALLEY
RIDGE SOUTH OF DEER VALLEY
APPROX. AREA OF RODDY RANCH CONSERVATION AREA
STAR MINE CANYON
SAND CREEK CANYON
RODDY RANCH GOLF COURSE AREA
SAND CREEK RIPARIAN CORRIDOR
SAND CREEK RIPARIAN CORRIDOR
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
ZEKA / HIGGINS PROPERTY
EBRPD BOUNDARY - FENCELINE FOR BLACK DIAMOND REGIONAL PRESERVE
STEWARTVILLE TRAIL

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EXHIBIT 12

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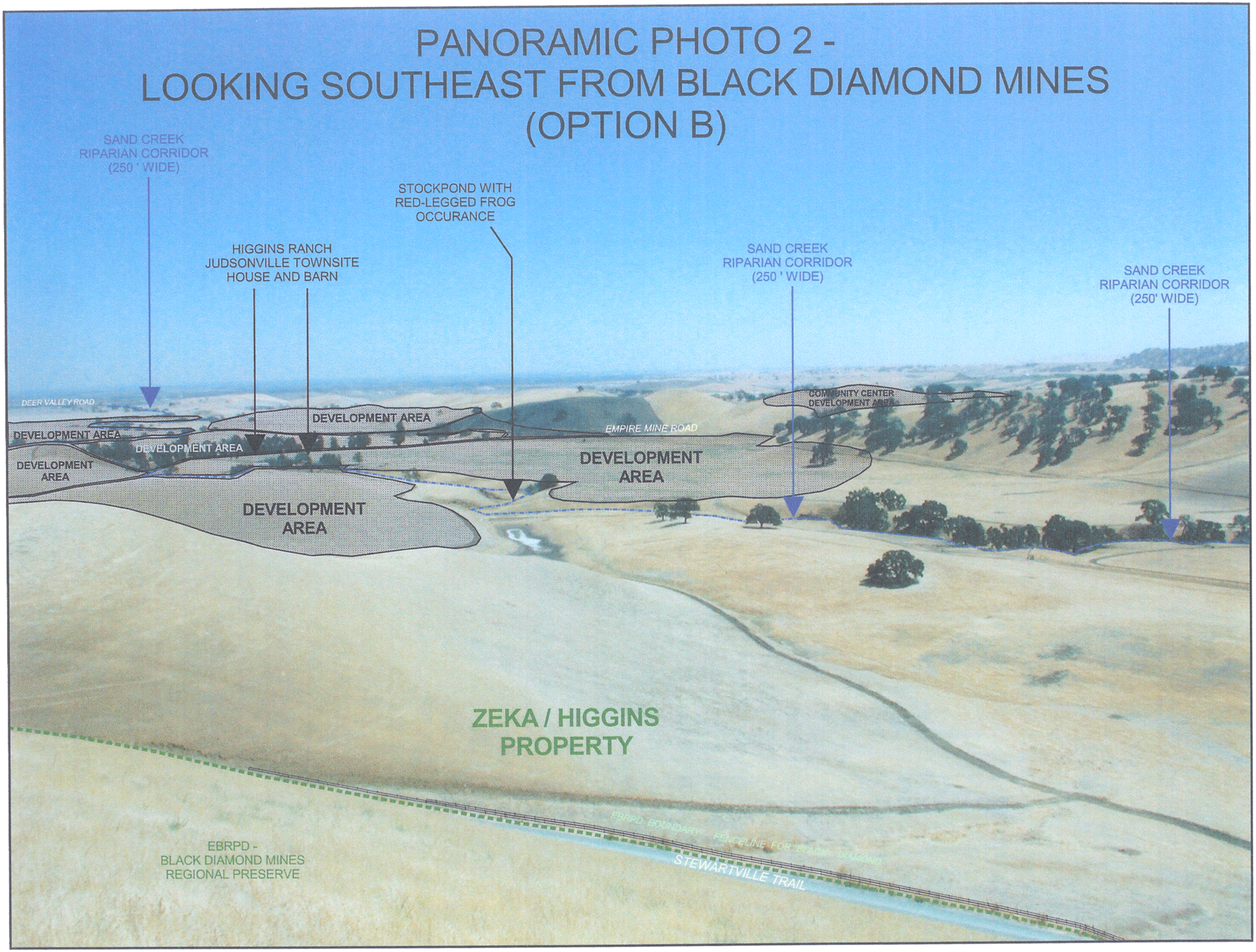
PANORAMIC PHOTO 2 -
LOOKING SOUTHEAST FROM BLACK DIAMOND MINES
(OPTION B)
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
STOCKPOND WITH
RED-LEGGED FROG
OCCURANCE
HIGGINS RANCH
JUDSONVILLE TOWNSITE
HOUSE AND BARN
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
SAND CREEK
RIPARIAN CORRIDOR
(250' WIDE)
DEER VALLEY ROAD
COMMUNITY CENTER
DEVELOPMENT AREA
DEVELOPMENT AREA
EMPIRE MINE ROAD
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT
AREA
DEVELOPMENT
AREA
DEVELOPMENT
AREA
ZEKA / HIGGINS
PROPERTY
EBRPD BOUNDARY - FENCELINE FOR BLACK DIAMOND
STEWARTVILLE TRAIL
EBRPD -
BLACK DIAMOND MINES
REGIONAL PRESERVE

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EXHIBIT 13

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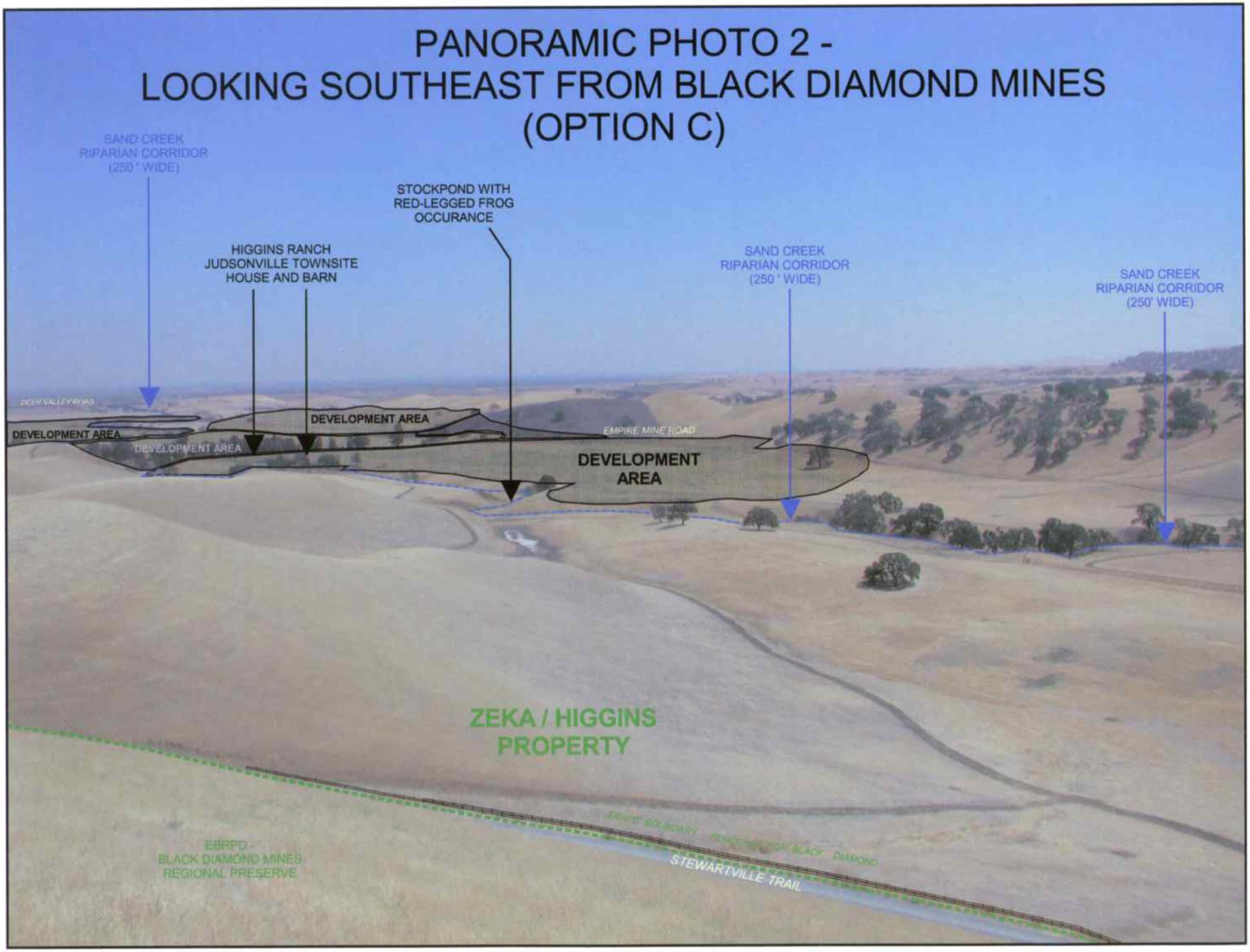
PANORAMIC PHOTO 2 -
LOOKING SOUTHEAST FROM BLACK DIAMOND MINES
(OPTION C)
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
STOCKPOND WITH
RED-LEGGED FROG
OCCURANCE
HIGGINS RANCH
JUDSONVILLE TOWNSITE
HOUSE AND BARN
SAND CREEK
RIPARIAN CORRIDOR
(250 ' WIDE)
SAND CREEK
RIPARIAN CORRIDOR
(250' WIDE)
DEVELOPMENT AREA
DEVELOPMENT AREA
DEVELOPMENT AREA
EMPIRE MINE ROAD
DEVELOPMENT
AREA
ZEKA / HIGGINS
PROPERTY
EBRPD -
BLACK DIAMOND MINES
REGIONAL PRESERVE
STEWARTVILLE TRAIL

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PRESERVE HISTORY

INDIANS have lived in the greater Bay Area for thousands of years. Black Diamond was located in the backcountry between three tribes: Chupcan (Concord), Volvon (Clayton) and Ompin (Pittsburg). All three nations spoke the Bay Miwok language.

With the arrival of Spanish, Mexican and American settlers after 1772, the Bay Miwok way of life was rapidly destroyed. However, in spite of pressure to the contrary, many California Indians still practice the traditions of their ancestors.

COAL MINING From the 1850s to the early 1900s, five coal mining towns thrived in the Black Diamond area: Nortonville, Somersville, Stewartville, West Hartley and Judsonville. As the location of California's largest coal mining operation, nearly four million tons of coal ("black diamonds") were removed from the earth. The residents of the mining towns were from all over the world, and their life was characterized by hard work and long hours. People from all over the world were drawn to the area's five mining towns, and as many as 900 miners, some as young as eight years old, labored in hundreds of miles of underground workings. At the peak of operations, the coal field was reported to have been the population center of Contra Costa County.

The coal mines had a significant impact on California's economy. By the time operations ceased due to rising production costs and the exploitation of new energy sources, much of California's economy had been transformed from a rural to an industrial base.

SAND MINING In the 1920s underground mining for sand began near the deserted Nortonville and Somersville townsites. The Somersville mine supplied sand used in glass making by the Hazel-Atlas Glass Company in Oakland, while the Nortonville mine supplied the Columbia Steel Works in Pittsburg with foundry (casting) sand. Competition from Belgian glass sand and the closing of the steel foundry ended the sand mining by the late 1940s. Altogether, more than 1.8 million tons of sand had been mined.

RANCHING Until the discovery of coal, cattle ranching was the major industry in this area. After the mines closed, some miners found a new career in ranching. Abandoned mining town buildings became barns; railroad ties were used as fence posts; boilers were converted into water troughs. Descendants of original mining families still graze cattle in the Preserve.

A REGIONAL PRESERVE The East Bay Regional Park District began acquiring land for Black Diamond Mines Regional Preserve in the early 1970s. Today, most of the mining district is within the Preserve's nearly 5,717 acres. The area is an ideal location for hiking and picnicking. Naturalists conduct a variety of programs relating to the Preserve's natural and historic resources. For more information, call (925) 757-2620.

PRESERVE FEATURES

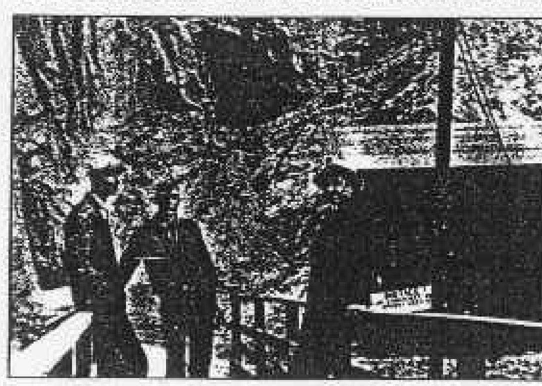
VEGETATION The Preserve's 65 miles of trails traverse areas of grassland, foothill woodland, mixed evergreen forest, chaparral, stream vegetation and exotic plantings. Notable among the latter are several tree species introduced by the coal miners. These include the black locust, pepper tree, almond, eucalyptus and tree of heaven.

Black Diamond is noted as the northernmost location of Coulter pine, black sage, desert olive and dudleya. In addition, several species that are restricted to the Mount Diablo area occur here, including the Mt. Diablo globe lily, Mt. Diablo helianthella and Mt. Diablo manzanita. In the springtime, the hills are covered with some of the most remarkable wildflower displays in the Bay Area.

WILDLIFE Black Diamond Regional Preserve supports a healthy wildlife population, and it is not uncommon for the observant hiker to see the tracks of raccoons, skunks, opossums, rabbits and deer. Mountain lions, bobcats, foxes and coyotes are occasionally spotted, while birds of prey soar overhead. Over 100 species of birds have been seen, from the rare golden eagle to the ever-present meadowlark. The side-blotched lizard has its northern limit in the Preserve, and several rare animal species have been found here – the white-tailed kite, the Alameda striped racer, the red-legged frog and the California tiger salamander.

ROSE HILL CEMETERY Although little remains of the coal mining communities, a historic cemetery serves as a monument to the lives of the former residents. Buried here are children who died in epidemics, women who died in childbirth, and men who died in mining disasters. Although more than 10 nationalities resided in the mining area, Rose Hill was a Protestant cemetery that served as the burial ground for many of the Welsh residents.

WON'T YOU HELP US? Over the years, vandalism has taken its toll on the cemetery, which the Park District is attempting to restore. If you have information concerning people buried here or the location of missing gravestones, please call the Black Diamond office at (925) 757-2620.



Courtesy, Dorothy Greathouse Collection

Trestle to sand bunker at Hazel-Atlas upper workings, 1933. From left: Oscar Peterson, sand mill foreman; Art Latham, mine foreman; Bob Bennett, manager of Hazel-Atlas glass plant, Oakland, CA.

PARKLAND RULES

PARK GATES ARE OPEN to the public during hours posted at the park entrance. Unless otherwise posted, CURFEW changes seasonally, and is posted at the park.

BICYCLES may be ridden on designated bicycle trails and on fire or service roads, unless otherwise posted. Bicycles are not permitted, either ridden, walked or carried, in areas posted "No Bicycles," or on narrow hiking or narrow equestrian trails. State law requires that all bicyclists under age 18 wear an approved helmet while riding on trails and roadways. Riders should call out or sound a warning when overtaking other trail users.

DOGS must be leashed and under control at any posted area, parking lot, picnic site, lawn or developed area. Owners must always carry a leash (six-foot maximum). Dogs may be off-leash in open space and undeveloped areas of parklands, provided they are under control at all times. Dangerous animals are not allowed in the parks. Please dispose of your dog's waste by placing it in a garbage can.

SWIMMING, WADING and other water contact activities are not permitted.

PLANTS, ANIMALS, GEOLOGIC, ARCHAEOLOGIC OR HISTORIC OBJECTS are protected by law. Please do not disturb or remove any of these features.

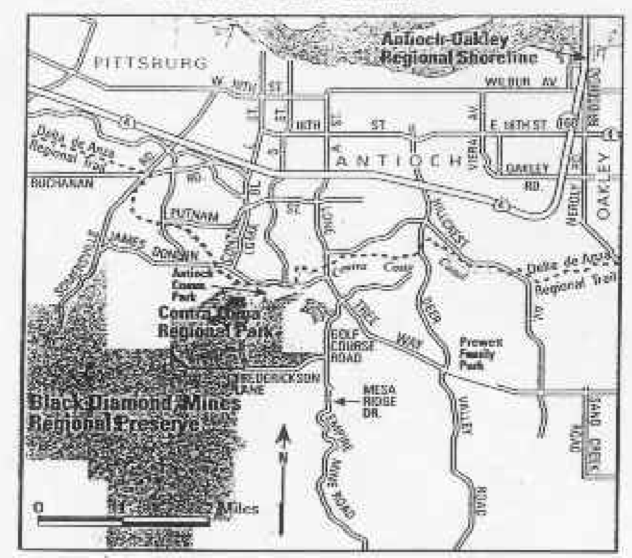
HELP PROTECT PARK WILDLIFE by not releasing or feeding ducks, cats or other animals. Do not feed wild park animals; enjoy them from a distance.

FIRES are permitted in barbecues only. CAMPSTOVES are permitted in designated camps only, and must be placed at least 30 feet from flammable materials. FIREWORKS are not permitted in any Regional Parkland.

FIREARMS or BOWS AND ARROWS are not permitted on regional parklands except at established ranges. Crossbows, spears, slingshots, air pistols or rifles, and other dangerous weapons are prohibited anywhere on regional parklands.

TO REACH BLACK DIAMOND MINES REGIONAL PRESERVE:

In Contra Costa County: Take Highway 4 to the Somersville Road exit in Antioch. Drive south (away from the river) on Somersville Road to the Preserve entrance.

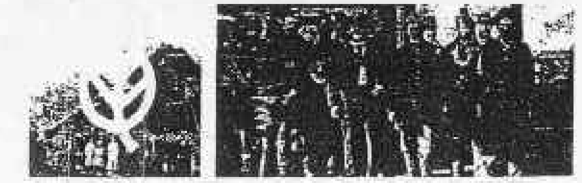


East Bay Regional Park District
2950 Peralta Oaks Court, P.O. Box 5381
Oakland, CA 94605-0381 (510) 562-PARK
http://www.ebparks.org

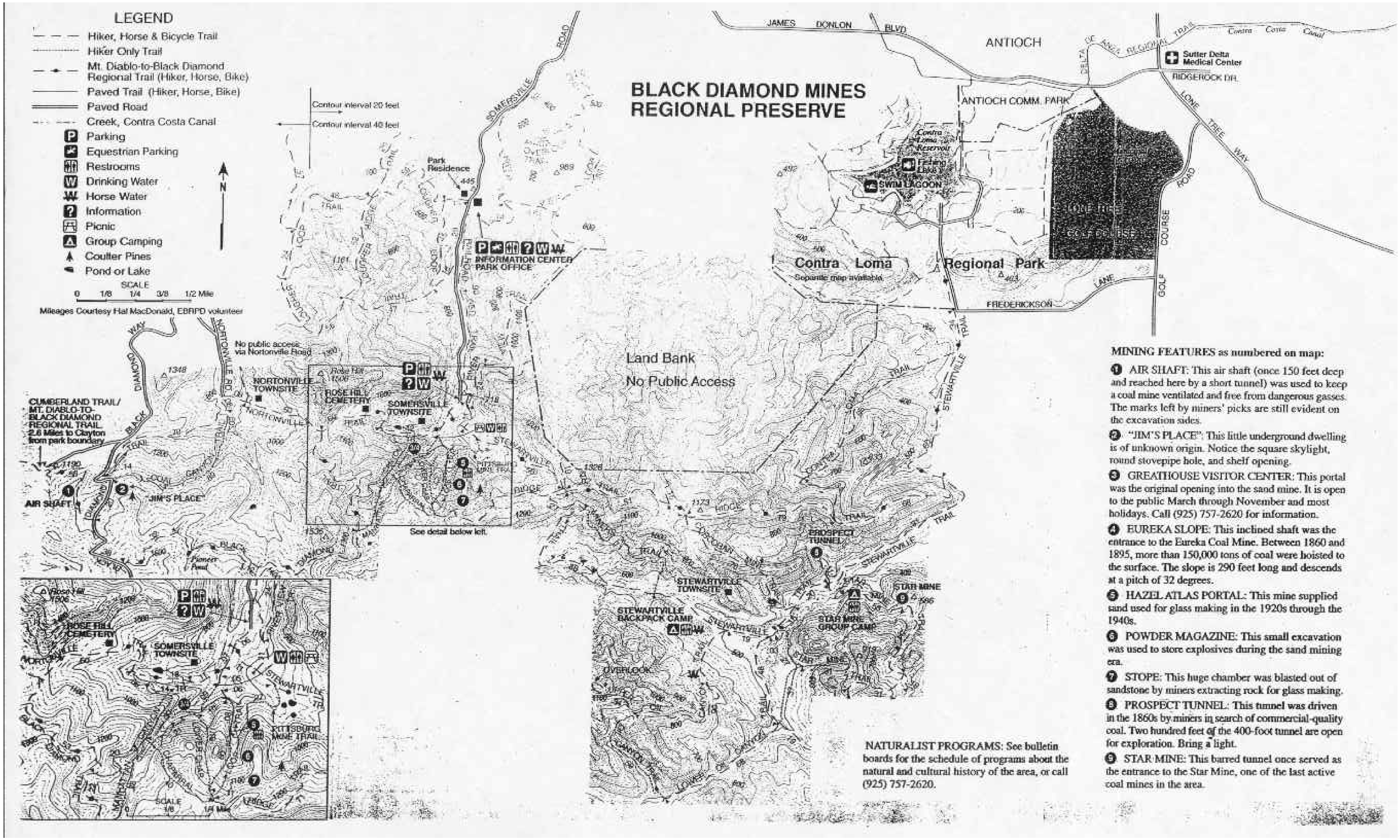
Printed on recycled paper 3/02 Cost: 50 cents

BLACK DIAMOND MINES

REGIONAL PRESERVE



EAST BAY REGIONAL PARK DISTRICT



MINING FEATURES as numbered on map:

❶ AIR SHAFT: This air shaft (once 150 feet deep and reached here by a short tunnel) was used to keep a coal mine ventilated and free from dangerous gasses. The marks left by miners' picks are still evident on the excavation sides.

❷ "JIM'S PLACE": This little underground dwelling is of unknown origin. Notice the square skylight, round stovepipe hole, and shelf opening.

❸ GREATHOUSE VISITOR CENTER: This portal was the original opening into the sand mine. It is open to the public March through November and most holidays. Call (925) 757-2620 for information.

❹ EUREKA SLOPE: This inclined shaft was the entrance to the Eureka Coal Mine. Between 1860 and 1895, more than 150,000 tons of coal were hoisted to the surface. The slope is 290 feet long and descends at a pitch of 32 degrees.

❺ HAZEL ATLAS PORTAL: This mine supplied sand used for glass making in the 1920s through the 1940s.

❻ POWDER MAGAZINE: This small excavation was used to store explosives during the sand mining era.

❼ STOPE: This huge chamber was blasted out of sandstone by miners extracting rock for glass making.

❽ PROSPECT TUNNEL: This tunnel was driven in the 1860s by miners in search of commercial-quality coal. Two hundred feet of the 400-foot tunnel are open for exploration. Bring a light.

❾ STAR MINE: This barred tunnel once served as the entrance to the Star Mine, one of the last active coal mines in the area.

NATURALIST PROGRAMS: See bulletin boards for the schedule of programs about the natural and cultural history of the area, or call (925) 757-2620.

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Proceedings

15th International Conference
on
Ground Control in Mining

Golden, Colorado, USA
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Subsidence Misconceptions And Myths

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ABSTRACT

Subsidence due to coal mining is poorly understood by non-specialists. This has led to numerous misconceptions and myths based on limited observations and lack of knowledge. The three most common are:

1. Mine maps are inaccurate.

2. Deep mines are not a problem.

3. If no subsidence has occurred for many years after mining, there is no risk of future subsidence.

Maps are important during mining and most are carefully prepared. Future use to evaluate conditions at mine level often includes drilling to confirm what the map shows. Usually, little or no effort is made to tie the surface survey of the property to the mine survey, to conduct a well designed drilling program to confirm the mine map, or to drill test borings vertically. When a mine entry is encountered rather than a coal pillar, or vice versa, and conditions at mine level appear different than anticipated, the first reaction is the mine map is inaccurate.

The idea of a safe depth from subsidence is often based on the false premise that mining results in sufficient breakup of the overlying rock strata that bulking compensates for the coal extracted. The safe depth idea first appeared in the literature about 1880 and remained prevalent well into this century. Sadly, it is still encountered. The modern understanding of fragmentation of the immediate mine roof with the overlying beds sagging down on the broken roof rock was first described in 1900. With full extraction mining, either longwall or retreat room and pillar, surface subsidence occurs regardless of the depth of the mine. Subsidence over longwall mines at depths of 2000 feet can be 90 percent of the mined seam thickness.

Numerous studies of undermined sites conclude that mining occurred many years ago and since no subsidence has occurred, there is no risk of future movement. This is true if sufficient

coal pillars have been left to support the overlying strata. However, every year subsidence occurs over mines that have been closed for 100 years or more. In a study of subsidence incidents over the Pittsburgh Coal, the senior authors found that 50 percent of the incidents occurred above mines that had been closed for at least 50 years and 10 percent over mines closed for at least 80 years.

INTRODUCTION

Extraction of materials by underground mining may result in subsidence of the ground surface. Damage from subsidence probably occurred with the earliest mining. Early in the 15th century court records from the County of Durham in England indicate a jury awarded £200 for repair of a house damaged by coal mining (Young and Stoek, 1916). In Cheshire, England, shafts were sunk shortly after 1670 to mine a shallow salt bed. Serious surface breaks occurred in 1750 (Young and Stoek, 1916).

Even though subsidence due to mining has been with us for centuries, the mechanics which govern the extent and amount of movement are poorly understood by non-specialists. This lack of knowledge and limited observations have led to numerous misconceptions and myths. The three most common are:

1. Mine maps are inaccurate.

2. Deep mines are not a problem.

3. If no subsidence has occurred for many years after mining, there is no risk of future subsidence.

The authors present their experiences with respect to Items 1 through 3 with the hope of having fact counter these often repeated but incorrect statements.

MINE MAP ACCURACY

Many mine maps are accurate. Maps are important during mining and most are carefully prepared. Long after mining, the mine maps may be used to evaluate conditions at mine level. This often includes drilling to confirm what the map shows. Usually, little or no effort is made to tie the surface survey of the property to the mine survey. When a mine entry is encountered rather than a coal pillar, or vice versa, and conditions at mine level appear different than anticipated, often the mine map is charged with being inaccurate.

In the late 1960's at the site of a very large coal fired power plant in West Virginia (the main plant area had been stripmined and the foundations bypassed the loose stripmine backfill) the substation area exhibited numerous sinkholes formed by collapse of the mine roof. A map of the abandoned mine workings was available but an extensive drilling and borehole camera investigation did not encounter conditions (pillars and mined areas) as indicated by the map. Careful review by the project geologist and perhaps a bit of luck indicated a shift of 15 feet in boring locations produced excellent agreement with the mine map. In this case, differences in survey control between the surface property map and the mine map wrongly implied the mine map was inaccurate. The new found confidence in the mine map permitted a rational decision on foundation design and mine stabilization for each structure in the substation, as well as roadways. This resulted in a substantial cost savings. The plant has been expanded several times, most recently with the addition of scrubbers in 1995. The mine map has continued to be found accurate in the work on these additions.

Carelessness also produces myths. In an evaluation of alleged subsidence damage to a house in southwestern Pennsylvania, an engineer using the plan of the housing development located the damaged house on the mine map. He then located a boring by pacing from the corner of the house. When the boring encountered a coal pillar rather than a mine void the engineer claimed this showed the mine map was not accurate. You be the judge on this example.

In another case near Pittsburgh, Pennsylvania, an old mine map showed several large blocks of coal. The drilling investigation for a large suburban mall encountered mined areas rather than solid coal. When shown this example of yet another inaccurate mine map, the senior author pointed out notes on the map which showed the large blocks of coal had been leased to others in the 1920's. Why would you lease coal unless you planned to mine it? In this case the information shown on the mine map was not fully understood by those conducting the site exploration.

During a trial on alleged subsidence damage, an engineer from a major coal company was testifying to the accuracy of his company's maps. A foolish attorney asked, "How do you know the mine maps are accurate?" He answered, "To place materials from the surface down a hole into a mine car I use the mine map to locate a hole in the center of the mine rails or when I need to extend electricity from the surface to the mine, I locate a hole at the side of the entry so I can place the electric switch box on the side of the pillar. Then I pay the driller to drill slowly with minimum pressure on the drill bit so the hole remains vertical." This testimony made a great impression on the judge and was a major setback to the attorney who asked the question.

Control of an underground fire in Pennsylvania's Anthracite Region necessitated the construction from ground surface of concrete plugs in four rock tunnels that connected underground mine workings in adjacent coal seams. The rock tunnels were each 10 feet wide and located 330 to 470 feet below ground surface in a sequence of sandstone, shale, conglomerate, and coal strata dipping at 70 degrees. As many as two mined coal seams had to be penetrated by the five holes drilled to each targeted tunnel. Through a combination of careful surveying, the use of stabilizers on the drill tools, and a requirement that the drill holes be maintained vertical to a tolerance of 4 inches per 100 feet of depth (checked with a borehole verticality survey before payment to the driller was authorized), all four rock tunnels were intercepted at the locations indicated by the 80-year old maps and the concrete plugs were successfully constructed.

The authors were recently involved in evaluation of subsidence as the cause of damage to a structure in northern West Virginia. For subsidence to have caused the damage several coal pillars would have had to crush under the overburden load of 250 feet of rock. The coordinates of the coal pillars were checked with the coal company that mined this now abandoned and flooded section of mine and a surveyor familiar with the coal company's coordinate system was retained to locate borings. Three borings were drilled and all encountered their targets - relatively narrow coal pillars which were found to be intact.

DEEP MINES ARE NOT A PROBLEM

The idea of a safe depth from subsidence is usually based on the false premise that mining results in sufficient breakup of the overlying rock strata that bulking compensates for the volume of coal extracted and prevents subsidence. The concept of a safe depth can be valid for very deep mines where the ground strains from subsidence are too small to damage a specific structure.

An early expression of a safe depth resulted from an 1825 study of mine subsidence in the city of Liege, Belgium. A commission concluded that an interval of 300 feet between the mine workings and the ground surface was more than sufficient to prevent subsidence (Young and Stoek, 1916).

The Prussian government appointed a commission in 1868 to collect information from other countries on the influence that mine workings may have on surface buildings. They found that the majority of Belgian engineers believed that when the coal is entirely removed, the most careful packing gives no guarantee against damage to surface buildings. In England the commission found the opinion that the working of coal at every known depth may affect the surface, but at depths greater than 400 meters (1300 feet) it can cause damage only to certain buildings (Young and Stoek, 1916).

In 1885, H. Fayol, a French mine director, summarized the contradictory opinions of the time concerning mine subsidence as follows (Zwartendyk, 1971):

1. (a) Subsidence movements reach the surface irrespective of the depth of mining.

   (b) Subsidence movements do not reach the surface when the workings exceed a certain depth.

2. (a) Subsidence extends to the surface without diminution.

(b) Subsidence decreases upward.

Fayol's investigation, backed by model studies, led him to propose that subsidence is limited to a dome over the mined area and that surface subsidence diminishes in proportion to the depth of the workings (Young and Stoek, 1916). Fayol's work on dome theory and the safe depth postulate had great influence for many years after.

Sadly, safe depth based on the bulking concept is still encountered. The modern understanding of fragmentation of the immediate mine roof with the overlying beds sagging down on the broken roof rock (Figure 1) was first described in 1900 by Wachsmann (Young and Stoek, 1916). With full extraction mining, either longwall or retreat room and pillar, surface subsidence occurs regardless of the depth of the mine. Subsidence over longwall mines at depths of 2000 feet can be 90 percent of the mined seam thickness.

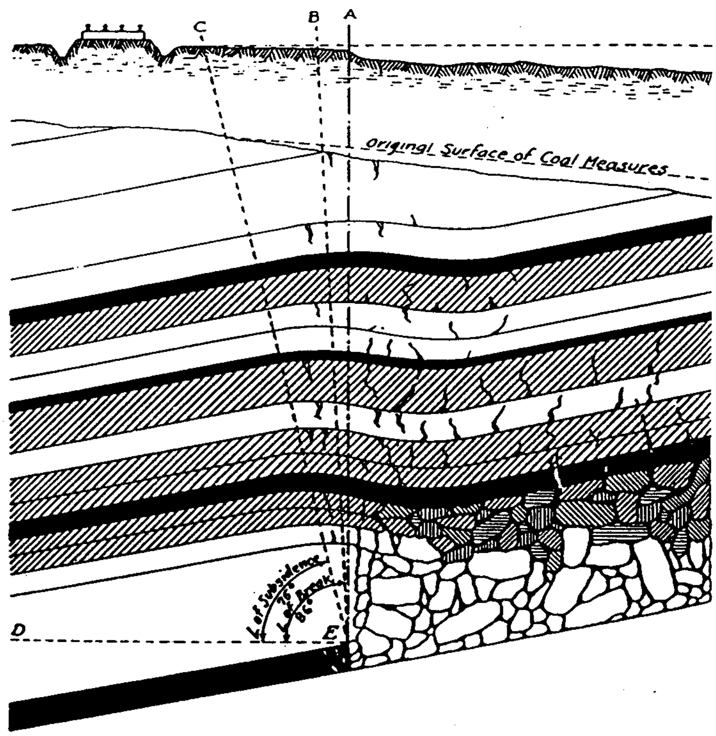

Figure 1. Angles of fracture of rock and of subsidence in Marl (Source: Wachsmann, 1990; Young and Stoek, 1916).

Abandoned mines frequently have the safe depth concept applied to them since most incidents of subsidence are found to be due to mines at shallow depth. An early paper on experience in the northern Appalachian Coal Field (Gray and Meyers, 1970) indicated no reported damage to structures where the cover above the mine was greater than 100 feet. A 1977 study of subsidence over the Pittsburgh Coal (Gray, et al., 1977) reported a case of subsidence that covered 40 acres and damaged a school and 42 houses. The mine depth varied from 230 to 450 feet.

Bruhn, et al., (1981) found from experience with subsidence over abandoned mines that: unless total extraction has been achieved, there is no identifiable height above an abandoned mine that ensures a site total freedom from subsidence, nor necessarily a reduction in severity of damage. An increased interval above mine level, however, seems generally associated with a reduced frequency of subsidence. The latter is due to the mechanics of subsidence movements which in areas of thick overburden above a mine require that coal pillars fail over a wide area for the movements to propagate to the ground surface. If the failed area at mine level has dimensions significantly less than the critical width, the amount of subsidence may be small (Gray, 1990).

SUBSIDENCE VERSUS TIME

Numerous studies of undermined sites conclude there is no risk of future movement since mining occurred many years ago and no subsidence has occurred. This is true if sufficient coal pillars have been left to support the overlying strata. However, each year subsidence occurs over mines that have been closed for 100 years or more. In a study of subsidence incidents over the mined Pittsburgh Coal, the senior authors found that 50 percent of the incidents occurred above mines that had been closed for at least 50 years and 10 percent over mines closed for at least 80 years (Gray, et al., 1977).

Subsidence cannot be ruled out merely because it has not been recognized in the first 50 or 100 years after mining. If abandoned mine openings beneath a site have not been designed for long-term stability, the potential for subsidence remains until the openings collapse, or until they are stabilized by backfilling, grout columns, or some other means (Gray, et al., 1974).

A corollary to the misconception that subsidence will occur shortly after mining is the following: If subsidence has occurred, no additional movements will occur. This statement is true for full extraction mining where movements occur with mining and are essentially complete within a year or two. Gray and Meyers (1970) present an interesting case history in which a site 270 feet above an old mine was monitored by survey from 1916 to 1922. Full extraction of the coal occurred in late 1916 and movements virtually ceased by January 1919. Maximum subsidence was 3 feet 10 inches. A brittle stone house was built on the site in 1922. When examined in 1960 prior to demolition for a college high-rise building, no cracks were present indicating all subsidence movement did cease prior to 1922.

Where full extraction mining has not occurred, subsidence can be a discontinuous process with movements separated by years. Subsidence above an abandoned mine can occur as a single event or it can be discontinuous over many years. Pillar failure can be delayed, progressive, or sporadic. It should be evident that site surveillance programs of a few months' duration or, in fact, indefinite duration, cannot provide definitive evidence that a site overlying a mine with open voids will experience no future subsidence (Bruhn, et al., 1981).

Some time after mining, perhaps eons, complete collapse of abandoned entries and rooms is to be expected. Until that point is reached, the ground surface overlying a mine may experience a variable frequency of subsidence incidents; perhaps only a few incidents immediately after mining, while the rock surrounding the openings is still relatively sound; increasing numbers of incidents for an extended period of time as progressive deterioration and failure of the rock surrounding the openings becomes more pronounced and later, a diminishing number of incidents as the void spaces at mine level become fewer and fewer. This sequence is shown conceptually in Figure 2. Unless total extraction has been achieved or coal pillars have been designed for long term stability, subsidence may occur long after mining and may not be limited to a single episode (Bruhn, et al., 1981).

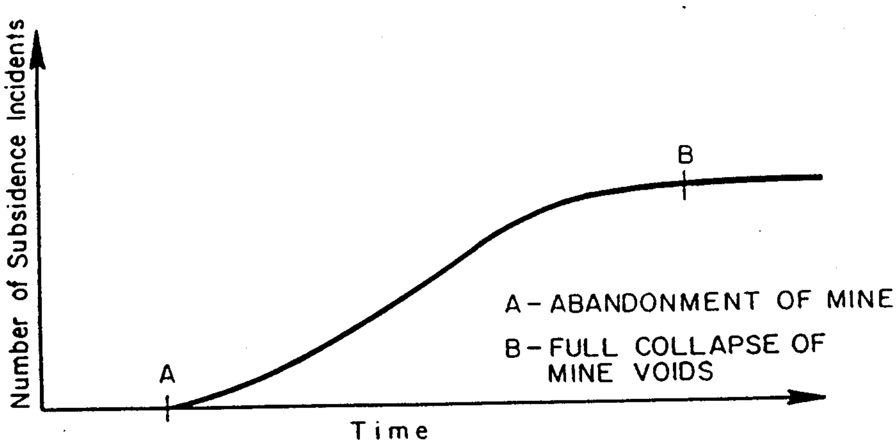

Figure 2. Conceptual representation of the possible incidence of subsidence above above an abandoned mine containing open voids (Bruhn, et al., 1981).

Figure 3 shows a community in western Pennsylvania that has experienced subsidence on at least four occasions over the past 50 years. Subsidence appears first to have taken place in the 1920's while mining was in progress. After abandonment of the mine, a long period of quiescence followed until 1964, when three homes were damaged by subsidence in an area measuring 300 by 400 feet that overlapped part of the 1921 subsidence area. This was followed in mid-1972 by subsidence of seven homes 400 feet east of the 1964 area, and in late 1972 by subsidence of six more homes in an area that partially coincided with the southerly part of the 1964 area. Subsidence stopped for the next few months but resumed in April 1973, affecting an area 450 by 800 feet and damaging 14 more homes. At nearly the same time, two other homes 1,100 feet east were similarly damaged by subsidence (Bruhn, et al., 1981).

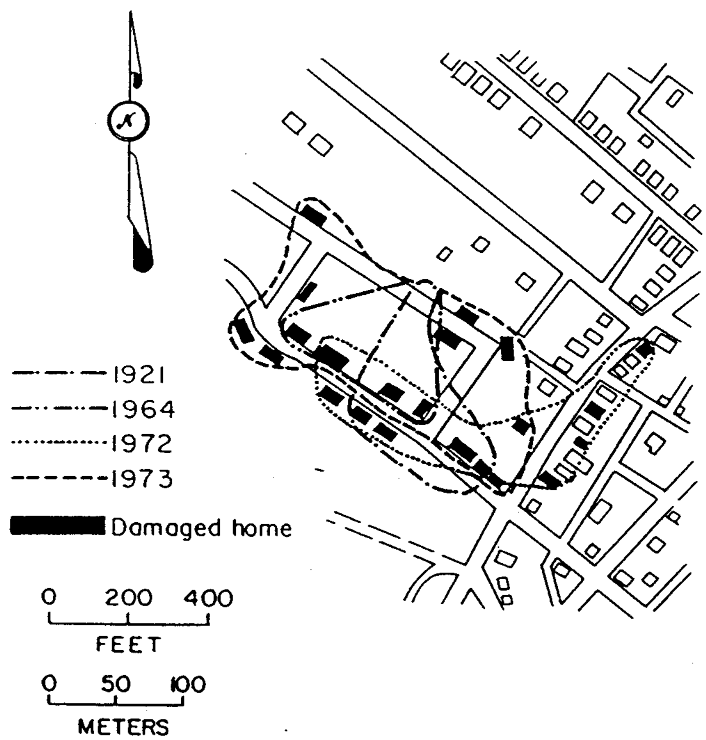

Figure 3. Community that has experienced multiple incidents of abandoned mine-related subsidence (Bruhn, et al., 1981).

Multiple episodes of subsidence were documented at 33 other sites in the Pittsburgh region, each episode representing a report of damage to a structure or the appearance of a hazardous condition. Figure 4 shows data from 19 of these sites. Data from the remainder are nearly identical. Multiple subsidence episodes of lesser significance may have taken place at these or other sites and not been recorded. Stephenson and Aughenbaugh (1978) report on multiple subsidence episodes at Johnston City, Illinois.

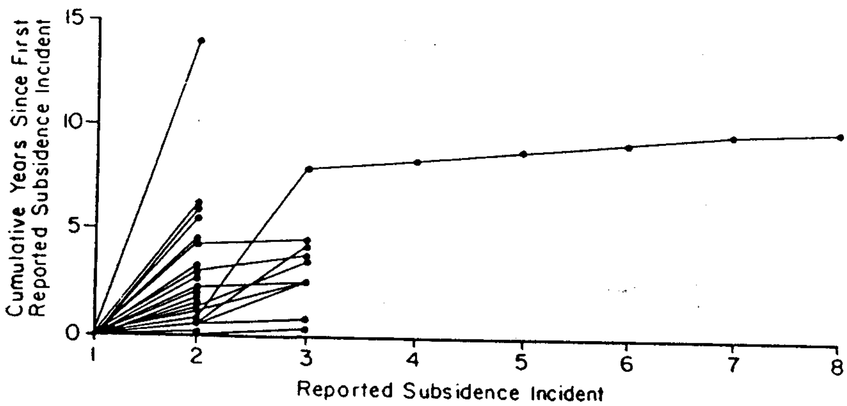

Figure 4. Intervals of recurrent subsidence at 19 sites overlying abandoned mines in the Pittsburgh Coal Region (Bruhn, et al., 1981).

Inasmuch as multiple episodes of subsidence above abandoned mines are not uncommon, a subsidence occurrence at a site is perhaps prudently interpreted as one of a continuing series of subsidence episodes that may have begun sometime earlier and will continue sporadically until such time in the future as collapse of underground mine openings is complete (Gray and Bruhn, 1984).

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EXHIBIT 16

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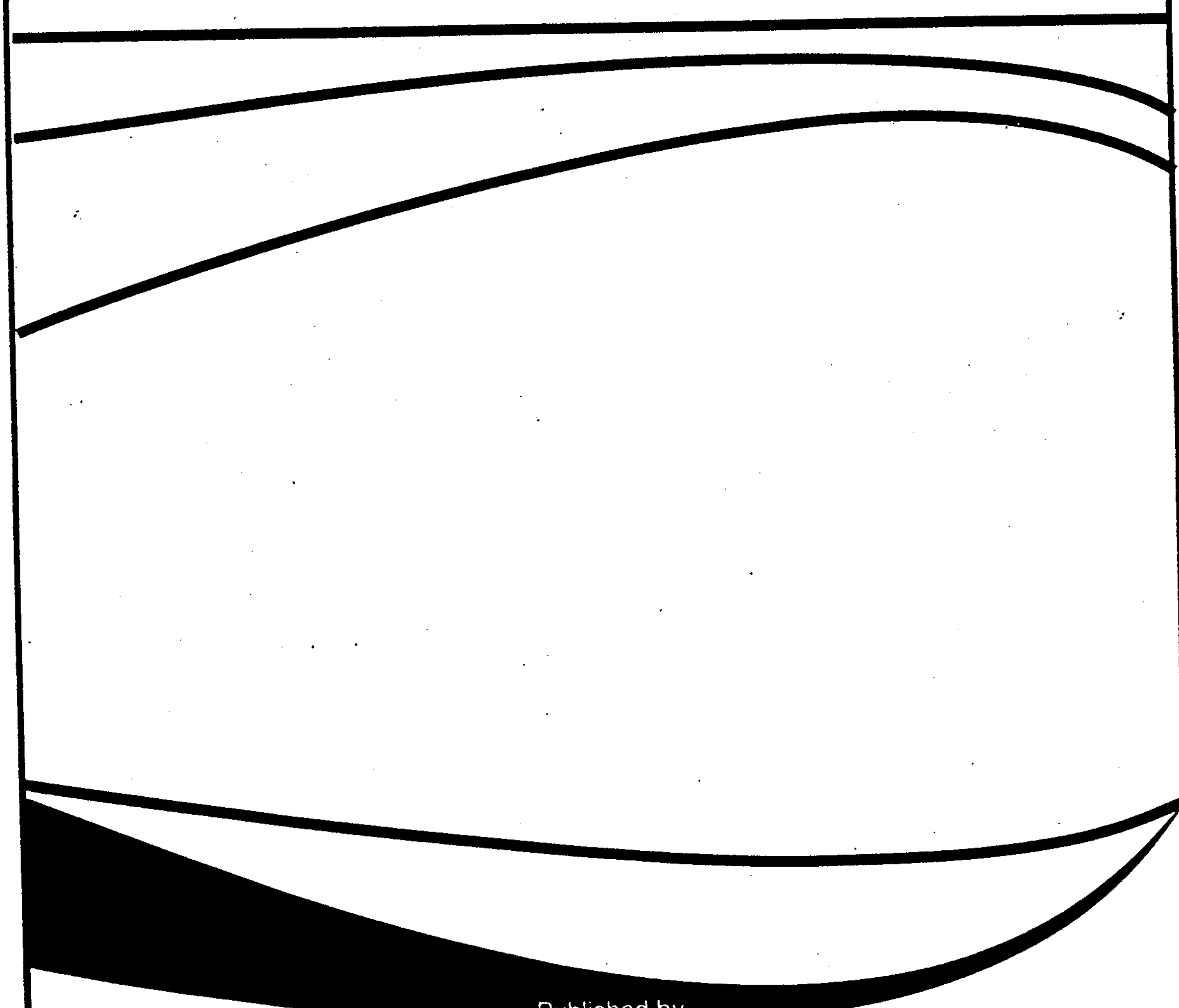
SURFACE SUBSIDENCE ENGINEERING

SYD S. PENG



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8

SUBSIDENCE OVER ROOM AND PILLAR MINING

8.1 INTRODUCTION

Under room and pillar mining if the extraction ratio is low, (i.e., < 50%) a pillar can support the overburden without collapse and there will be no surface subsidence whatsoever. In other words, if the pillar sizes are properly determined to support the overburden weight, the roof strata cannot cave and there will be no surface subsidence, provided the entry width is small and properly reinforced so that a continuous roof fall leading to piping or the total collapse of the roof does not occur. Under the prevailing mining conditions in the US if only development mining is employed in room and pillar mining (i.e., no pillar extraction), the extraction ratio is usually less than 50% and generally no surface subsidence will occur.

If pillar mining is employed, surface subsidence may occur, depending on the extraction ratio and the size of the remnant pillars (or stumps) left in the gob. The higher the extraction ratio, the smaller the stump pillars left behind in the gob. As the size of the stump pillars becomes smaller, the possibility of their supporting the roof without collapse is smaller. If all stumps are crushed completely, the roof will collapse and surface subsidence will occur. Again, whether surface subsidence occurs, it depends on whether the remaining stumps can support the overburden or not. Therefore, since the weight of the overburden which the stump pillars have to support is proportional to the mining depth, a fixed-size stump pillar can support the overburden at a shallow depth, but will collapse under greater depths. In this context extraction ratio is not the only parameter for determining whether surface subsidence will occur. Furthermore, during pillar mining a pillar can be cut away in many ways to finally reach the same extraction ratio. Therefore, the safest way to determine whether or not surface subsidence will occur in room and pillar mining is to compare the strength of all stump pillars in the panel of interest with the weight of the overburden that the pillars have to support. If they are too small to support the overburden, surface subsidence will occur.

Under normal mining practices the characteristics of surface subsidence profiles vary with methods of mining. In the US there are two types of coal mining methods, i.e., longwall and room and pillar mining. Longwall mining is indisputably a total extraction method, but different percentages of coal recovery are achieved in room and pillar mining. Recovery is much higher for sections with pillar extraction than those without pillar extraction. For those without pillar extraction, coal recovery increases with increasing entry width or decreasing pillar size. For those with pillar extraction, the total coal recovery depends on the amount of coal extracted from each pillar which is in turn dependent on the roof conditions and methods of pillar extraction. Bauer and Hunt (1981) analyzed the characteristics of the subsidence profiles due to the three types of mining methods in Illinois. Fig. 8.1 shows the range of locations associated with the following profile features: profile edge, maximum tensile curvature, maximum slope, maximum compressive curvature, and maximum subsidence. The scatter of the data increases with decreasing percentages of extraction. The profile is much sharper for longwall mining and becomes milder as percentage of extraction decreases; for longwall mining the profile edge is always beyond the opening, while in room and pillar mining it may fall within. The location of maximum tensile strain moves outward, while that of the maximum compressive strain moves inward as the percentage of extraction decreases and the maximum subsidence decreases with decreasing extraction ratio.

The general concepts discussed in this chapter may not apply to the entry development sections between two longwall panels where roof caving in both panels are very severe and overlap each other. Consequently, it must be treated differently.

8.2 CASE STUDIES

Kohli et al. (1982) described several case studies on surface subsidence due to room and pillar mining with pillar extraction. In one case, the seam was 6 ft thick and ranged from 650 to 800 ft deep. The panel was 720 ft wide (Fig. 8.2) and was developed with seven entries. Each entry was 18 ft wide and the pillars were driven at 88 ft center-to-center between entries and crosscuts. During retreating, two additional pillars (pillars J and K) were developed, two blocks ahead of the pillar line, to take the barrier pillar, 160 ft wide, between panel No. 1 and No. 2. Pillar extraction began by taking a central slice across the whole panel, beginning from pillar O through J. After that, each pillar was sliced by 6 wing-slices, 3 on each side, leaving 4 stumps, 2 on each side. One of each pair was triangular shaped approximately 6 ft wide by 26 ft long. The other was trapezoidal, 26 ft long by 16 ft and 10 ft wide at the upper and lower bases, respectively. This resulted in a total extraction ratio of 85% within the panel. Obviously the stump pillars were not large enough to support the overburden and collapsed completely. The final subsidence profiles were rather smooth, just like those under total extraction (Fig. 8.3). The maximum subsidence on Lines A and B was about 3 ft for an average mining height of 6 ft, but the locations of the maximum subsidence were skewed toward panel No. 1. Along Line D, the central portion was flat-bottomed, but the maximum subsidence was only 2 ft, mainly because Line D was only two blocks from the right-side edge. Notice in every profile there was heaving of as much as 0.3 ft, beyond the edges above the solid coal.

In another case (Fig. 8.4), the seam was 6 ft thick under 650 to 850 ft cover. Three panels, 710, 400, and 350 ft wide, respectively, were extracted side by side. The entries were 18 ft wide and the pillars at 88 ft center-to-center between entries and crosscuts. Pillar extraction was practiced the same way as described previously. According to the mine maps, there was no barrier pillar left between the adjacent panels. Thus after extraction the three panels formed a common gob of more than 1460 ft wide. This was reflected in the development of the subsidence profile along the county road. After Panel No. 1 was mined, the maximum subsidence of 1.2 ft occurred at Monument No. 1. This was increased to 1.6 ft after the extraction of Panel No. 2 and went to a further 1.8 ft after the extraction of Panel No. 3. The final maximum subsidence of 4.3 ft occurred at Monuments No. 6 through No. 8, while the remaining portion of the county road showed rebound. However it must be noted that the subsidence profiles were rather bumpy and fluctuated, perhaps an indication of the irregular stump pillars that were left and crushed at various time after mining.

Moebs (1982) surveyed the subsidence profiles of four room

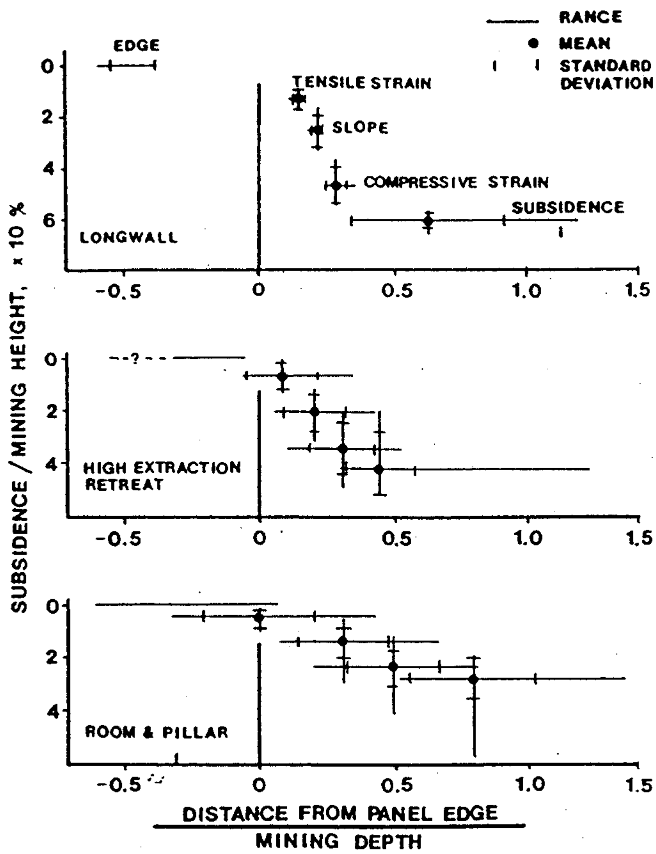


Fig. 8.1. The locations and trends of surface subsidence features under three types of coal mining methods (Bauer and Hunt, 1981).

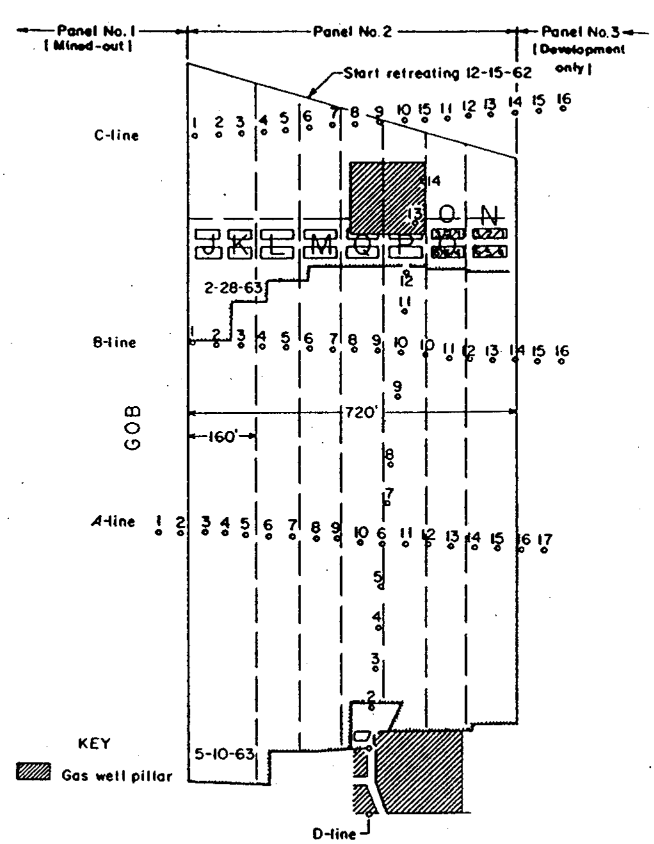


Fig. 8.2. Panel layout and pillar extraction plan - Case 1 (Kohli et al., 1982).

and pillar sections with pillar extraction within a radius of 30 miles in southwestern Pennsylvania. The sections were developed by entries 16 ft wide on 65 to 100 ft centers. Pillars were then extracted by the pocket and wing method, producing a total coal recovery of 75 to 90%. Two to three lines of monuments were set up along transversal and longitudinal crosssections of the pillared sections spaced at 40 or 50 ft centers. As can be seen in Table 8.1, some trends can be detected among the four mine sections in that subsidence factor is proportional to the width-to-depth ratio of the section and the coal recovery. Other factors such as angle of draw, maximum slope, and minimum radius of curvature vary without discernible trends. Moebs (1982) attributed the wide variance of data to contrasting geological and mining conditions.

Choi and Dahl (1981) reported a subsidence study over a room and pillar mining section that recovered 90% of the coal (Fig. 8.5). The mining height was 5 ft with a cover from 510 ft to 650 ft thick. The panel, 200 ft wide was developed by a three-entry system at 55 and 45 ft center-to-center across the entries. The crosscuts were driven in a staggered manner at 100 ft centers. Each entry was 14 ft wide. The panel was developed on retreat 3 blocks ahead of the pillar line. The sequence of panel development and pillar extraction is numbered as shown in Fig. 8.5. The wings left between cuts No. 6, 7, 8, and 9 were 2 ft wide. Fig. 8.6 shows the final subsidence contours measured when the panel was completely pillared. In this figure the subsidence monuments are black dots spaced at 100-ft centers across the panel and at 50-ft centers along the panel edge direction. Notice that the ratio of maximum subsidence to mining height was approximately 0.4, a result of the very narrow panel width as compared to the mining depth. From these figures it was concluded that with clean extraction up to 90%, the subsidence profiles in room and pillar mining are as smooth as those in longwall mining; that the effect of surface topography (when the slope is from 25 to 40%) is so small that the average depth may be used for subsidence computation; and that the time-dependent subsidence was less than 5% of the total subsidence value.

Kohli (1984) measured the surface subsidence due to room and pillar mining with pillar extraction in the Cedar Grove seam. The seam was 57 in. thick and 1000 ft below the surface. The panel under study (Panel No. 3 in Fig. 8.7) was driven by a five-entry system from the submains toward the bleeder end leaving a barrier pillar 100 ft wide between Panel No. 2 and Panel No. 3, plus a bleeder pillar for Panel No. 2. Each entry was 20 ft wide, and the chain pillars were square at 70 x 70 ft. centers. Pillar extraction began from the bleeder end. The pillar plan called for the extraction of the bleeder pillar for Panel No. 2, the barrier pillar, and three chain pillars adjacent to it on Panel No. 3. The fourth pillar on the right side of Panel No. 3 was to be left for the bleeder pillar. However, during the first 500 ft of retreating, severe floor heave problems developed near the barrier pillar area. The pillar plan was revised to leave the bleeder pillar for Panel No. 2 alone and split the barrier pillar into large blocks, while fully extracting all four pillars in Panel No. 3. The revised plan was carried out for the rest of the panel and the floor heave problems disappeared. Fig. 8.8 shows the detailed plan of the sequence of pillar extraction. The coal recovery was estimated at 75%.

Fig. 2.16 shows the progressive development of the subsidence profiles. As mentioned in Chapter 2, the final subsidence profile assumed a shape such that its center was located approximately at the center of the combined width of Panel No. 2 and its bleeder pillar, the barrier pillar, and Panel No. 3. It is obvious that

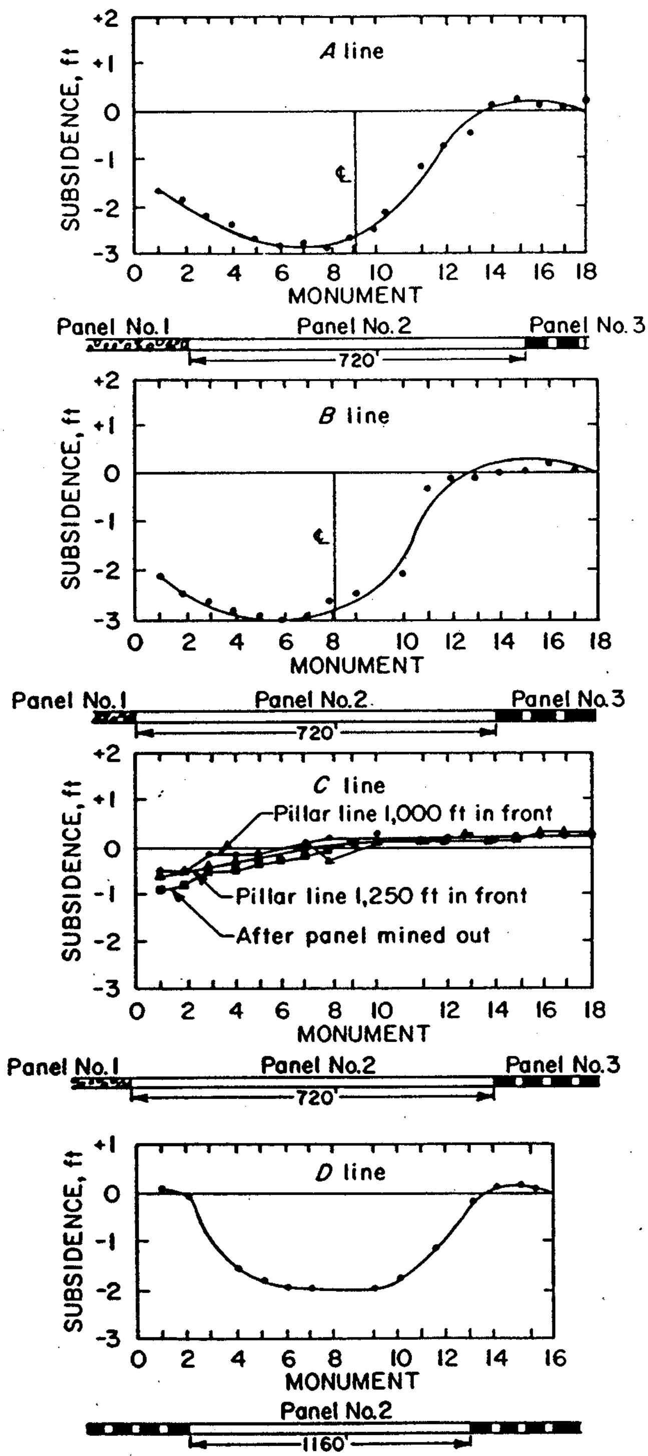


Fig. 8.3. Surface subsidence profiles for Case 1 (Kohli et al., 1982).

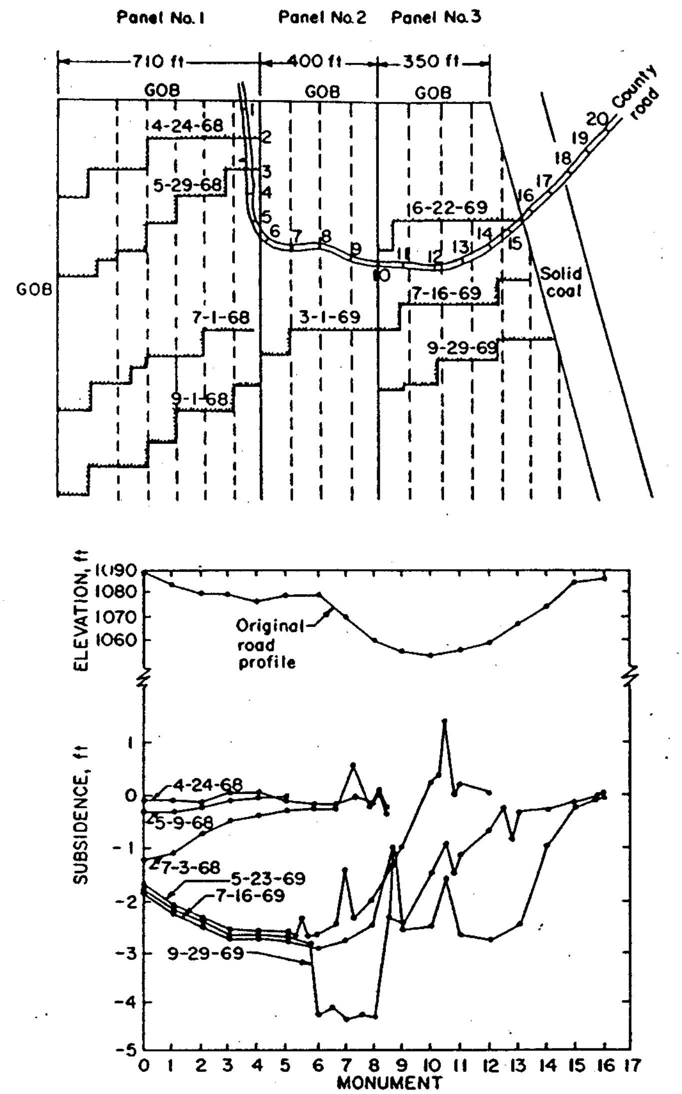


Fig. 8.4. Panel layout and surface subsidence profile for Case 2 (Kohli, et al., 1982).

individually both Panel No. 2 and No. 3 had a very small panel width-to-depth ratio and were in the lower end of the subcritical opening range. Surface subsidence, if any, due to the extraction of either panel alone would be very small. However after the extraction of Panel No. 3 and the splitting of the barrier pillar, the overburden strata above Panels No. 2 and No. 3 began to bend and sag at the center portion, crushing the barrier pillar blocks and the bleeder pillars. This accounted for the fact that the maximum surface subsidence was only 1.48 ft, or 31% of the mining height. Another reason, of course, was that even the combined panel width was still subcritical in size (width/depth = 0.84). Three months after mining, the maximum subsidence increased to 1.52 ft, an increase of 2.6% of the final subsidence.

Bruhn and Speck (1986) investigated the effects of surface subsidence due to room and pillar mining with full pillar extraction in the Lower Kittanning coal seam. The seam was 5.5 ft thick and located 600 ft below the surface. The surface was smooth and flat. The panel was trapezoidal in shape, with widths of 450 ft (upper side) and 810 ft (lower side), and 600 ft high (Fig. 8.9). The entries were 17 ft wide. The chain pillars were on 60-ft centers between entries and 90-ft centers between crosscuts. The panel was developed southwest toward the bleeder entries while pillar extraction began row by row from the southwest corner immediately next to the bleeder entries and worked toward the main entry. In each row, chain pillars were extracted from west to east. Fig. 8.10 shows the sequence of pillar extraction. When implemented as planned, the total extraction reached 76%.

Table 8.1 Features of room and pillar sections and their measured subsidence parameters by Moebs (1982)

Mine	Seam depth (ft)	Seam thickness (ft)	Section width (ft)	Section length (ft)	Ratio of width to depth	Maximum subsidence (ft)	Maximum slope (%)	Minimum radius of curvature (mile)	Angle of* draw (degree)	Subsidence factor	Coal recovery (%)
1	700–850	6.5	450	1700	0.58	0.94	7	0.86	9, 25	0.14	70
2	300–350	6.5	360	380	1.05	1.91	25	0.25	28, 41	0.29	75
3	350–400	6.5	430	2000	1.15	3.23	34	0.24	24, 38	0.50	80
4	350–400	4.7	840	1940	2.10	2.91	28	0.43	19, 37	0.62	90

*Measured at opposite ends of the monument line.

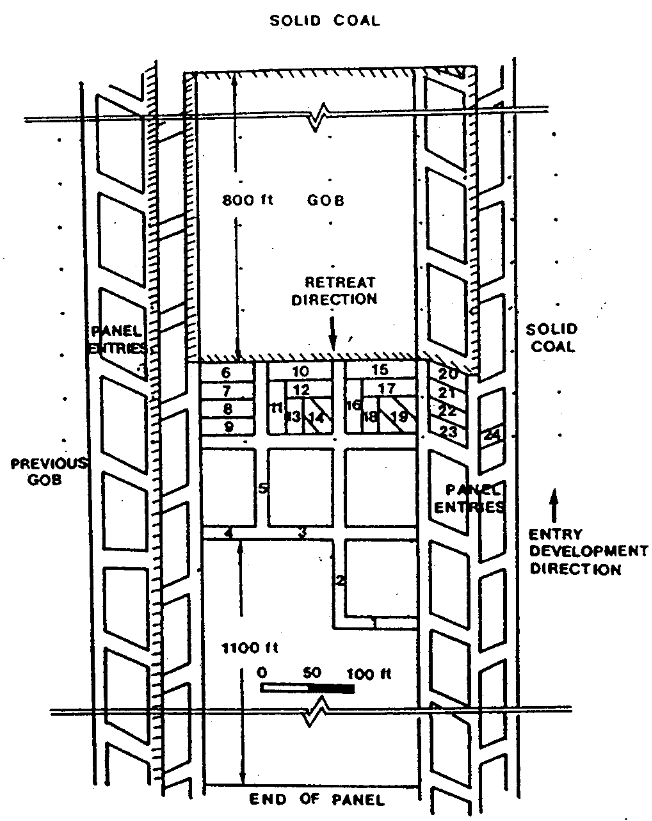


Fig. 8.5. Sequence of pillaring for the case investigated by Choi and Dahl (1981).

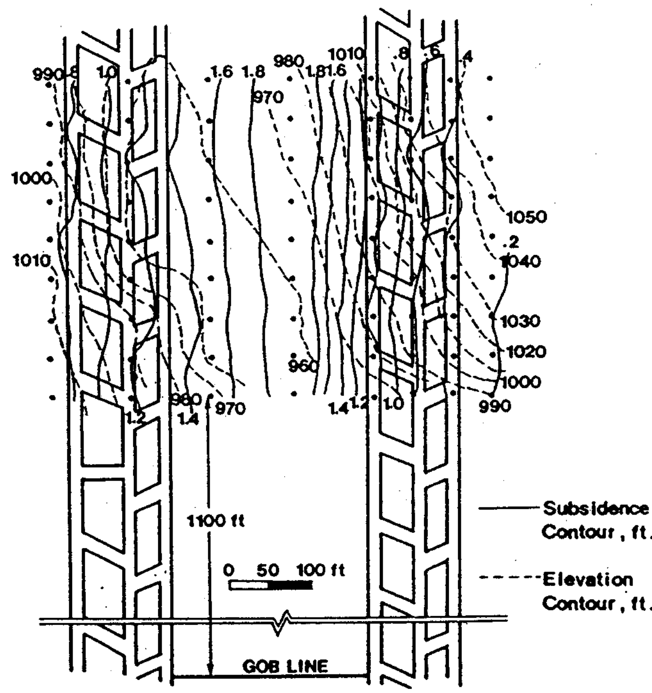


Fig. 8.6. Measured final surface subsidence contours as measured by Choi and Dahl (1981).

A comprehensive monitoring program was performed, as shown in Fig. 8.11. It included surface subsidence and displacement surveys, and surface boreholes for subsurface strata caving, and water level measurements. Fig. 8.9 shows the subsidence contours when the panel mining was completed. The subsidence contours were rather symmetrical about the panel center. The maximum subsidence occurred at the panel center with 1.75 ft giving rise to a subsidence factor of 0.31. Along the north and northeast corners there was a heaved zone of 350 to 400 ft wide, while in the south corners surface subsidence extended farther out, because the chain pillars in the bleeder entries punched into the floor. Thus the angle of draw ranged from 4 to 40°, depending on the condition of edges of the panel.

Horizontal displacement perpendicular to the retreat mining direction (or transverse displacement) was first detected along the west longitudinal line after 44 of the 85 pillars had been extracted. The maximum transverse displacement increased with the size of the mined-out gob. After complete pillar extraction it was 0.22 ft at 3/10, and 0.38 ft at 6/10 of the undermined line length south of the northern gob edge for the west and east longitudinal lines, respectively. From the point of maximum displacement, the transverse displacement decreased on both sides toward the gob edges. It vanished at both ends of the west line.

For the east and west leg survey lines which were midway across the panel, the maximum transverse displacement occurred at the locations 0.24 and 0.31 times the panel width from the gob edge for the west and east leg lines, respectively. The maximum value increased with gob size. The transverse displacement decreased toward and vanished at the panel center. In the opposite direction it also decreased toward, but did not vanish at the panel edges.

Horizontal displacement parallel to the retreating mining direction (or longitudinal displacement) was detected later than the transverse displacement. At each stage of mining, longitudinal displacment was toward the center of the gob from both the mov-

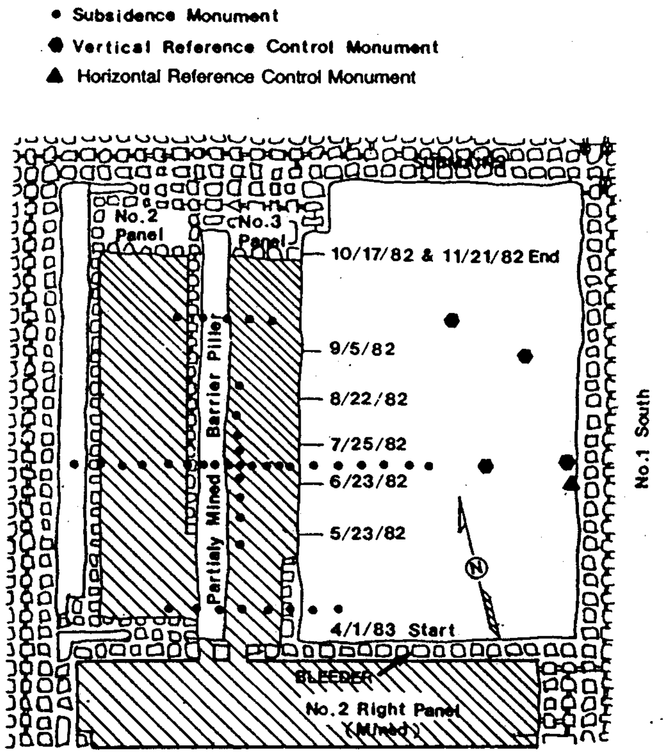


Fig. 8.7. Panel layout showing monument locations for the case investigated by Kohli (1984).

ing retreating line and the bleeder entries sides. The longitudinal displacement profile displayed three zero points-one at each end and the other at the center of the gob, and two intervening lobes.

The triangular monuments were used to define the direction and magnitude of principal ground strains at the center of the triangles. Fig. 8.12 shows the changes of ground strains for a triangular monument beyond the southern gob edge. Before survey No. 10 (which was performed when 40 of the 85 pillars had been extracted), both the principal and minor strains were compressive. After that the principal strain became tensile and moved toward the direction of retreating. Notice that survey No. 16 was conducted at the end of the pillar mining.

Ground movement did not terminate with the completion of the panel mining. In fact, six months after mining the maximum subsidence increased 0.4 ft, or 24% of that measured right after mining. There was a similar percentage of increase for the horizontal displacements. The time-dependent ground movement was most likely due to the compaction of the crushed stump pillars and the fact that the panel was subcritical in size.

8.3 PILLAR DESIGN FOR PREVENTION OF SURFACE SUBSIDENCE

As mentioned earlier, if the chain pillars are properly designed to support the overburden, surface subsidence will not occur. A good review of the design of coal pillars can be found elsewhere (Peng, 1986a). In general there are two methods for pillar design. The traditional method involves determining the pillar strength in the laboratory using small-sized coal samples and comparing it with the expected loading. The latest method calls for structural analysis of the mine, taking into account the interaction between roof, pillar and floor and mining sequence (Tang and Peng, 1987). It has been demonstrated (Peng, 1986b; Tang and Peng, 1987) that the structural analysis is the best method in terms of determining the rational pillar size, and that the traditional method usually predicts much larger pillars than does structural analysis, and that different pillar strength formulae predict different sized pillars.

A. Traditional Method

In this method it is recognized that coal pillar strength varies with size and shape of the specimen:

a. for size effect

$$S_1 = K_1\sqrt{d} \tag{8.1}$$

b. for shape effect, there are five applicable formulae, according to Bieniawski (1983).

(1) Obert-Duval formula (Obert and Duvall, 1967)

$$S_2 = S_1\left(0.778 + 0.222\,\frac{W_p}{H}\right) \tag{8.2}$$

(2) Holland formula (Holland, 1964)

$$S_2 = S_1\sqrt{\frac{W_p}{H}} \tag{8.3}$$

(3) Holland-Gaddy formula (Gaddy, 1956)

$$S_2 = S_1\frac{\sqrt{W_p}}{H} \tag{8.4}$$

(4) Salamon-Munro formula (Salamon and Munro, 1967)

$$S_2 = \frac{K_1\,W_p^{0.46}}{12\,H^{0.66}} \tag{8.5}$$

(5) Bieniawski formula (Bieniawski, 1983)

$$S_2 = S_1\left(0.64 + 0.36\,\frac{W_p}{H}\right) \tag{8.6}$$

where S_1 is the uniaxial compressive strength of the cubical pillar, d is the side length of the cubical specimen, K_1 is constant, and S_2 is the strength of coal pillar with width W_p and height H.

The pillar loading is usually determined by using the tributary area loading concept. This assumes that a pillar supports uniformly the weight of the rock overlying the pillar as well as one-half the width of rooms or entries on each side of the pillar. Thus the average pillar stress, σ_a, for a square pillar is

$$\sigma_a = \frac{P}{W_p^2} = \frac{(W_o + W_p)^2\gamma h}{W_p^2} \tag{8.7}$$

and for a rectangular pillar

$$\sigma_a = \frac{P}{L_pW_p} = \frac{(L_p + W_o)\,(W_p + W_o)\gamma h}{W_pL_p} \tag{8.8}$$

where p is pillar loading, γ is the average weight per unit volume of the overburden, h is seam depth, L_p is the length of the rectangular pillar, W_p is the width of the square or the rectangular pillar, and W_o is entry or room width.

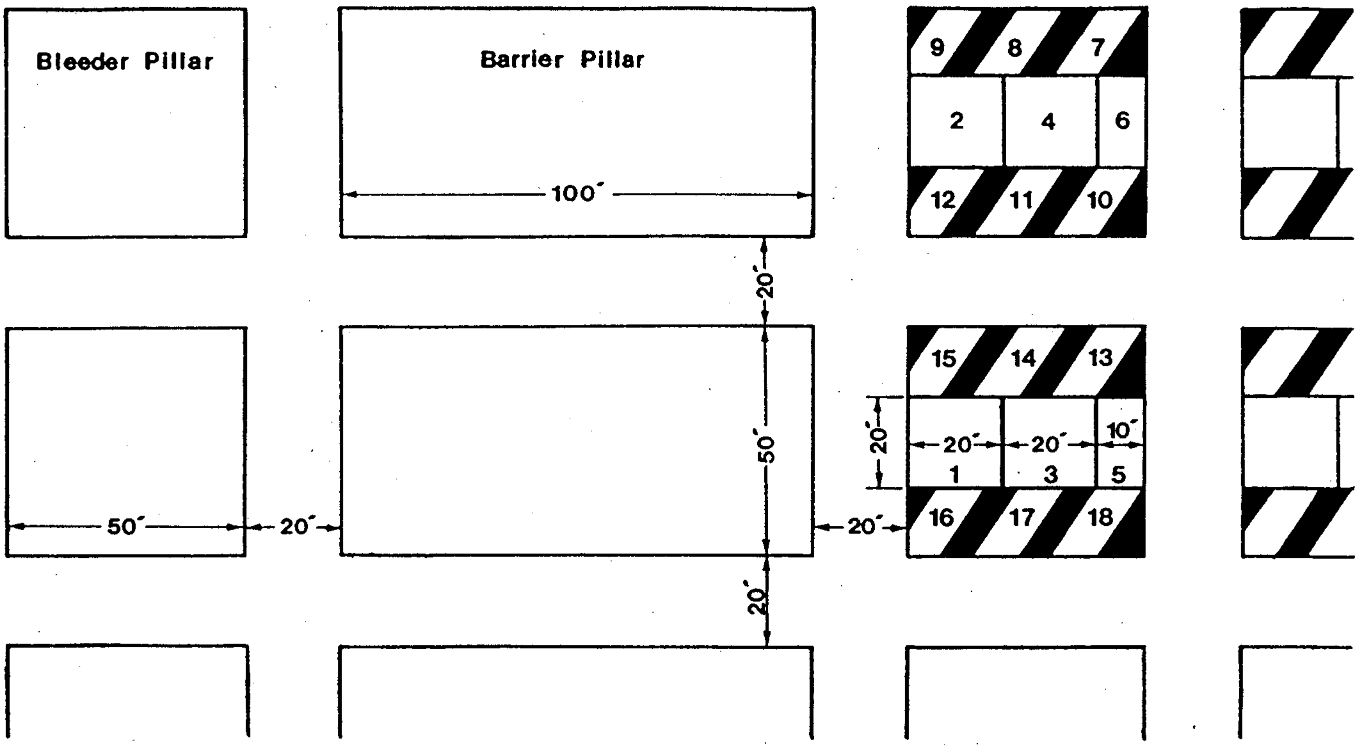


Fig. 8.8. Sequence of pillaring for the case investigated by Kohli (1984).

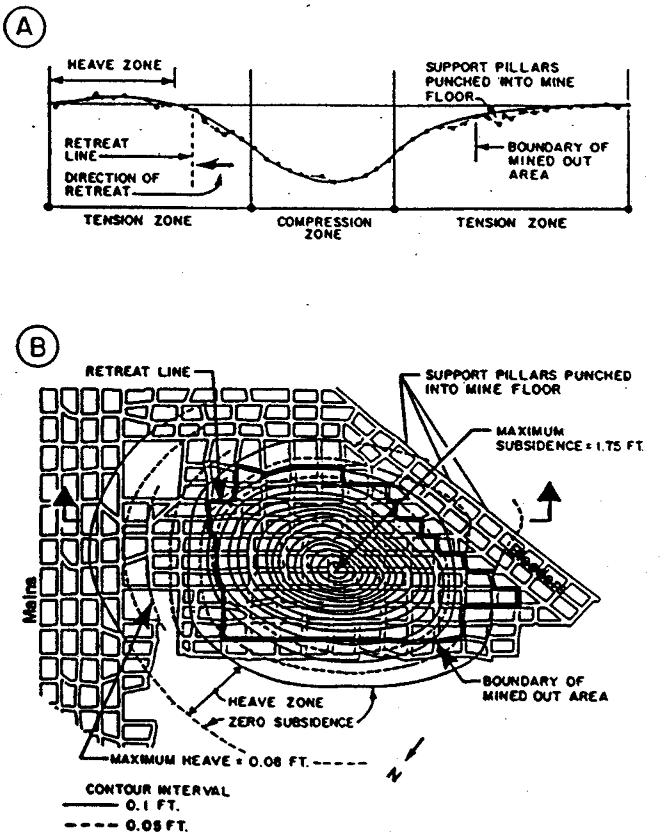


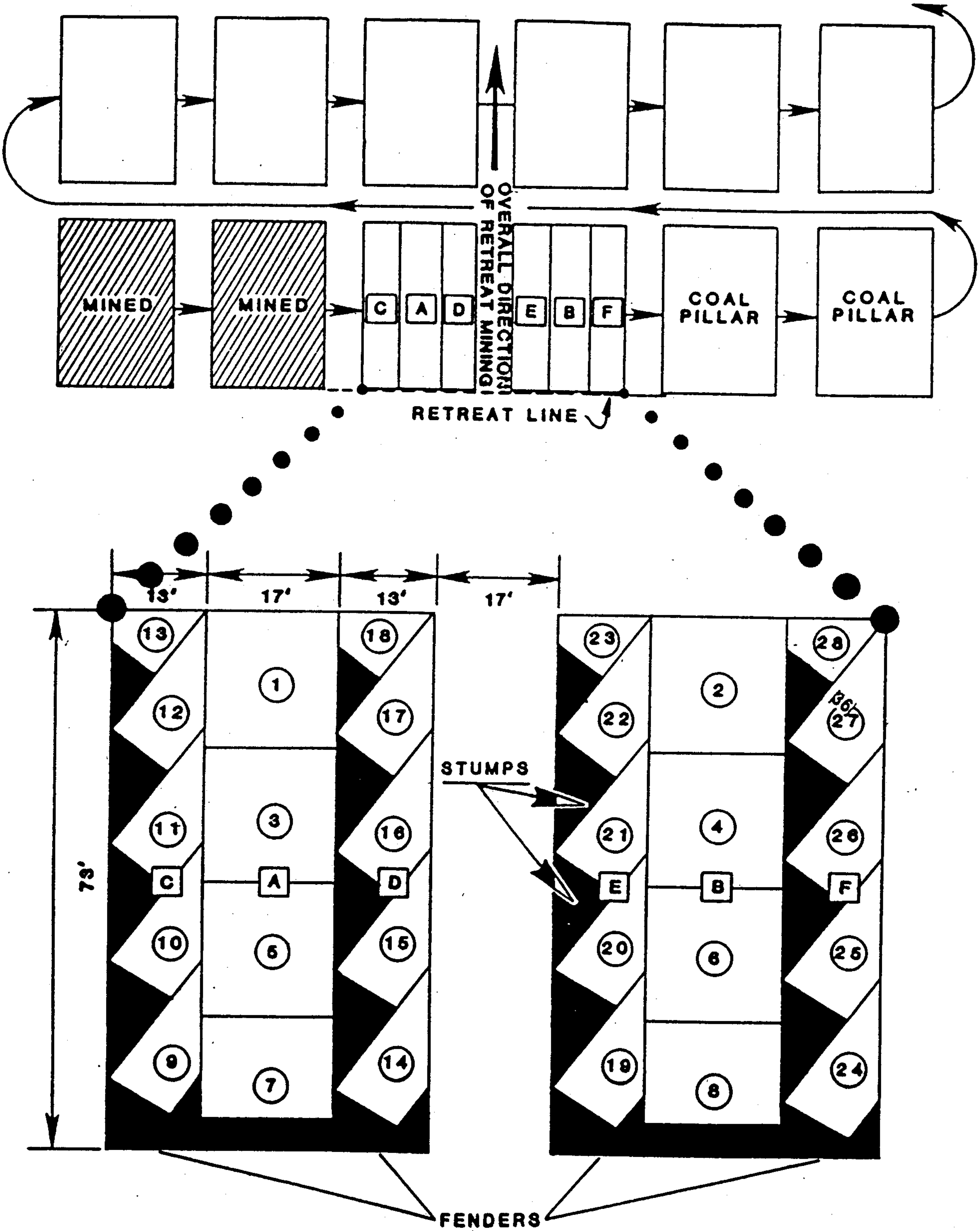
Fig. 8.9. Subsidence profile (A) and subsidence contours (B) as measured by Bruhn and Speck (1986).

When using the traditional method for determining the pillar size, coal samples are selected from the mine site. It is recommended that the samples be selected uniformly across the whole seam height within the pillar core and that there be a minimum of five samples from each foot of seam height. Each sample is then cut into a small cubical specimen of the same size and tested for strength according to standard procedures (ASTM, 1990). Substituting the sample side dimension d and the laboratory-determined strength into Eq. 8.1, the constant K_1 is obtained. By equating Eq. 8.7 or 8.8, as appropriate, to any one of the formulae selected from Eqs. 8.2 through 8.6 and with K_1, seam height H, entry width W_o, seam depth h, and average unit rock weight γ known, the pillar width can be determined by the trial and error method. Sometimes a safety factor of 1.5 to 2.0 is applied to pillar strength S_2.

As mentioned earlier, the various pillar strength formulae predict a wide range of pillar strengths. In the extreme case, the pillar sizes differ by a factor of two to three (Fig. 8.13).

B. Structural Analysis

Structural analysis of the mine usually employs finite element modeling. The stress distributions determined within the mine structure by the finite element method are more accurate because this method takes into account the effects of roof and floor properties on pillar stress. It has been demonstrated that the shape effects of coal strength are actually brought about by the mismatch of material properties between the roof or floor and coal pillar at the interface and that shape effects increase with the width-to-height ratio of the pillar. The traditional method ignores such a factor. Also, finite element modeling usually incorporates more realistic failure criteria that consider the strength increase of coal as some function of confining pressure. In addition, the tributary area loading concept states that the pillar must bear the whole overburden weight tributary to it. In practice however, the stratigraphic nature of the coal measure overburden tends to offer a



A, 1 - Order in which portions of each pair of coal pillars is removed by a continuous miner.

Note: Posts and other support are not shown.

Fig. 8.10. Sequence of pillaring as depicted by Bruhn and Speck (1986).

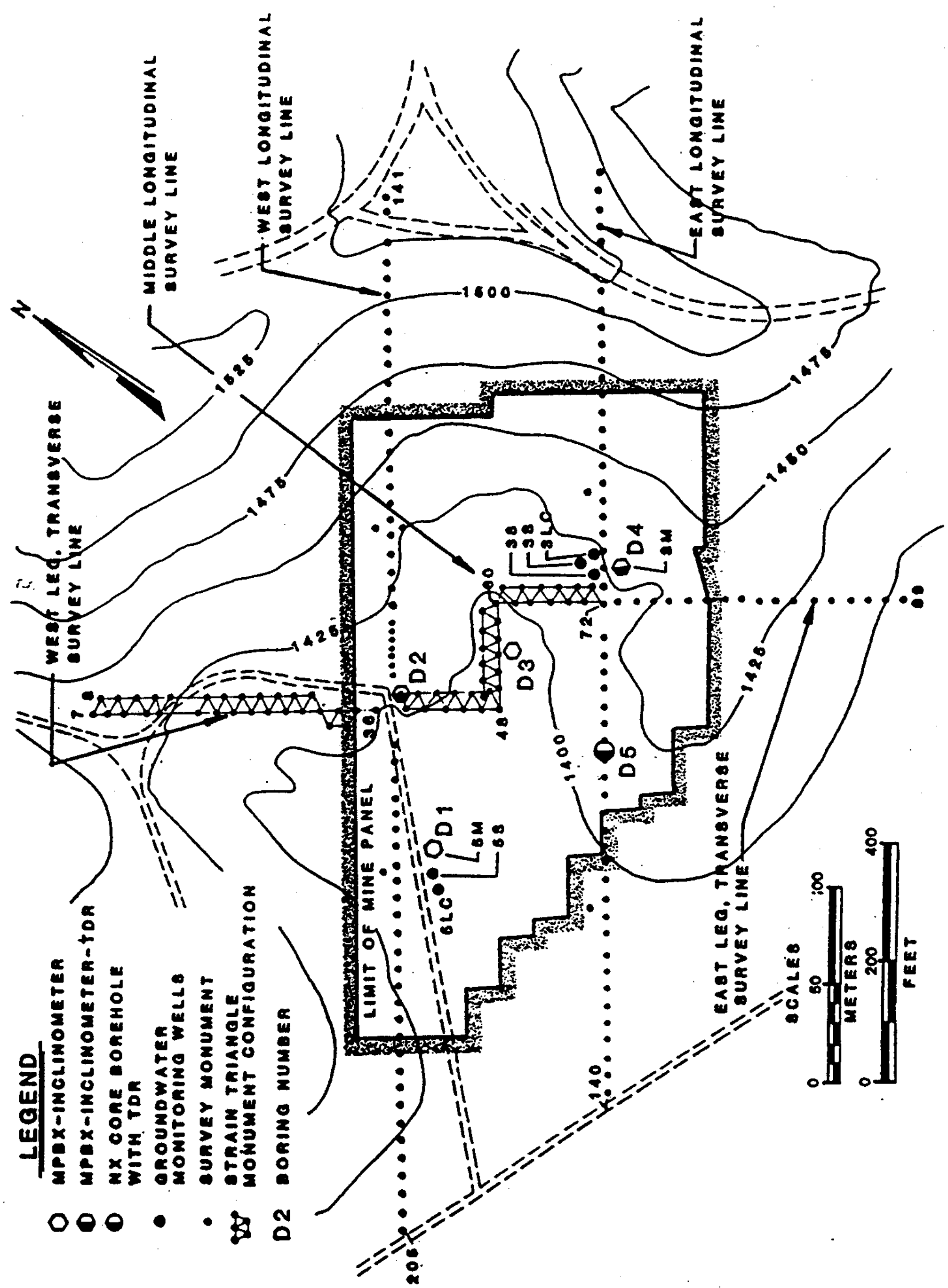


Fig. 6.11. Locations of subsurface and surface instrumentation of the case investigated by Bruhn and Speck (1986).

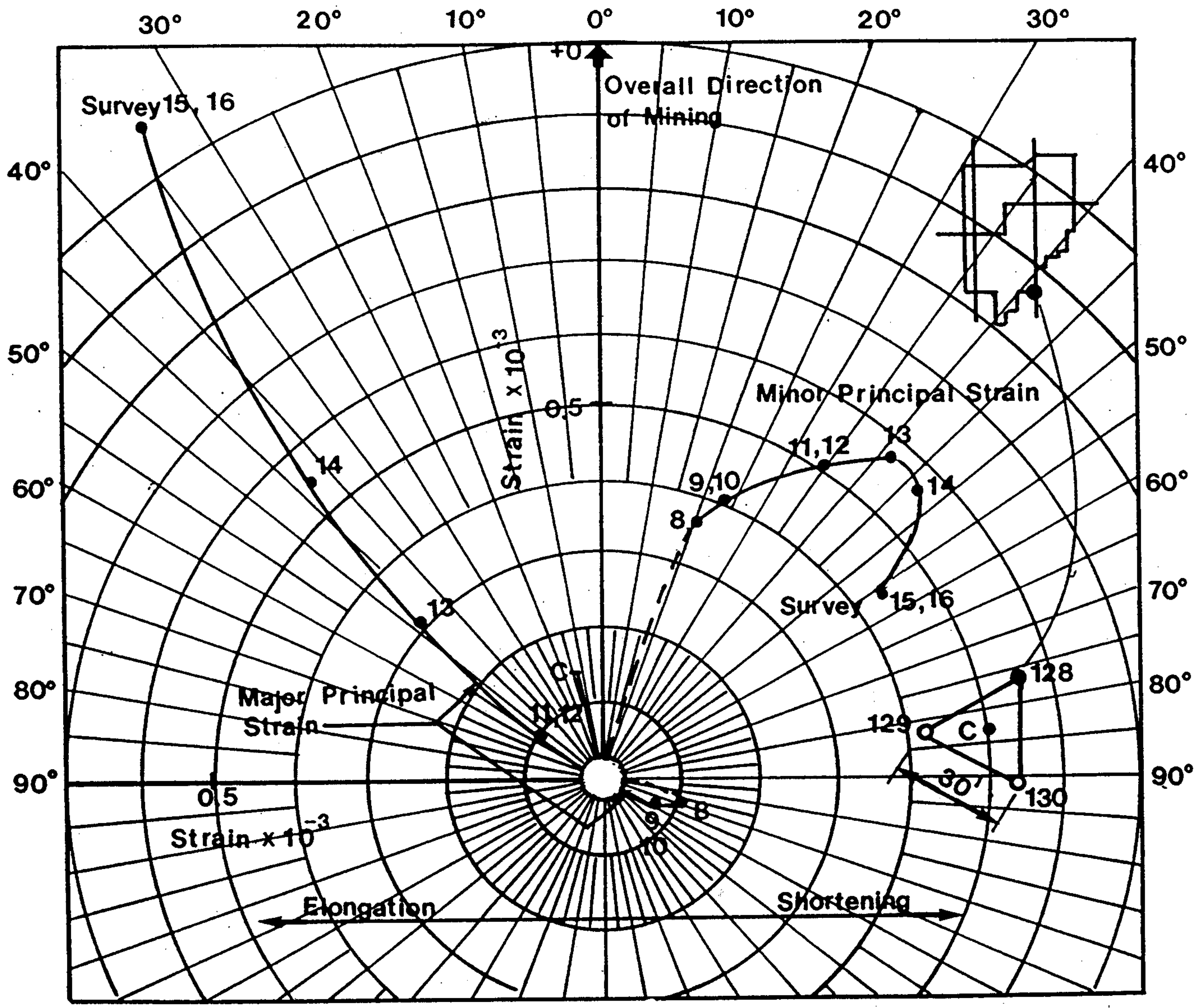


Fig. 8.12. An example of changes in principal strains as pillaring progresses (Bruhn and Speck, 1986).

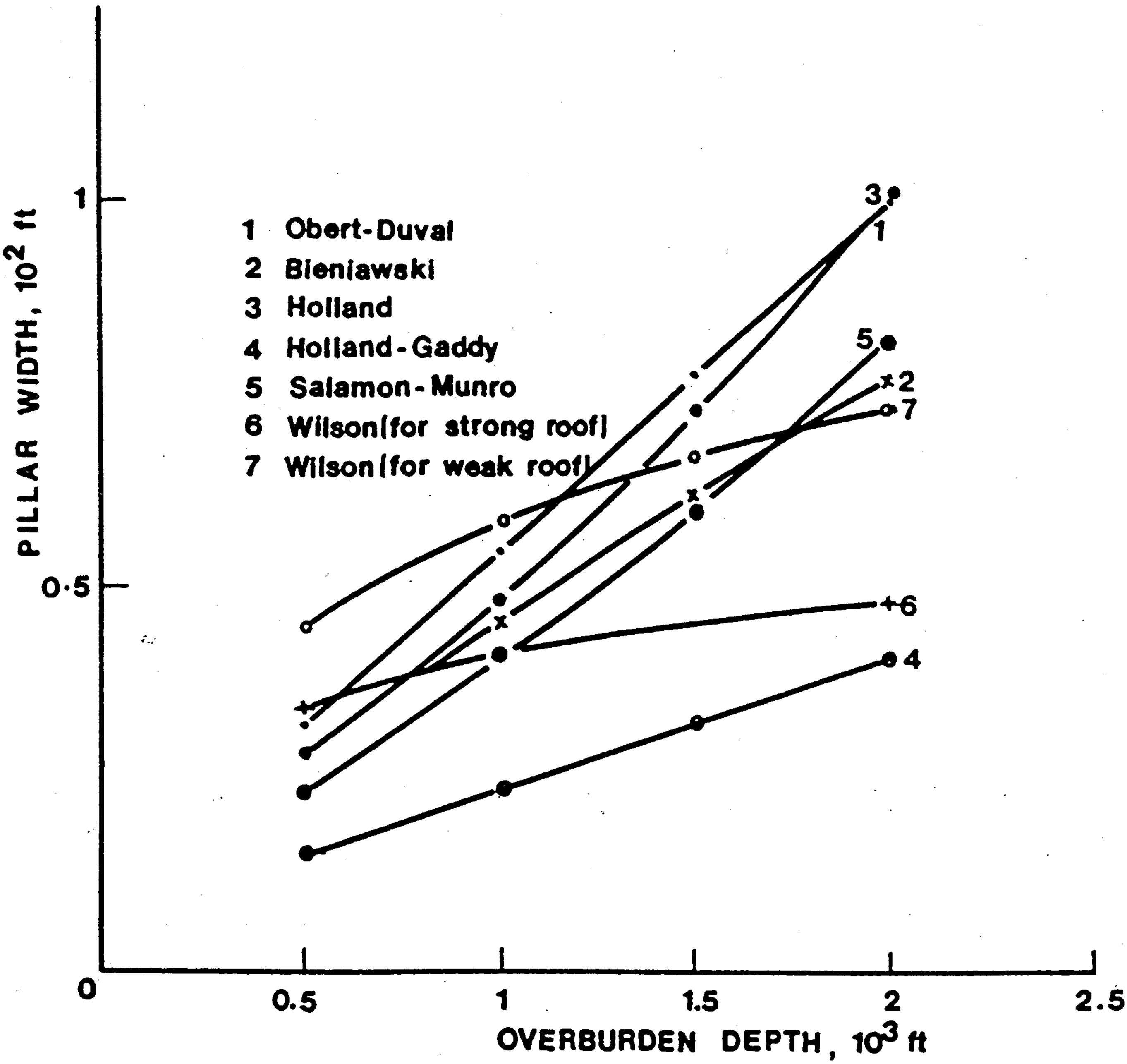


Fig. 8.13. Large range of pillar strength predicted by various pillar strength formulae (Peng, 1986a).

certain degree of self-support and thus the actual pillar loading in most cases is less than that estimated by the tributary area loading concept. Therefore, with all of these factors considered, finite element analysis produces much better results for pillar design.

Table 8.2 Safety factors of stump pillars determined by various strength formulae (Tang and Peng, 1987)

	Overburden depth, ft		
Formula	148	208	288
Obert and Duvall (1967)	0.630	0.447	0.324
Holland (1964)	0.750	0.533	0.385
Bieniawski (1983)	0.800	0.565	0.411

For instance Tang and Peng (1987) designed a mine plan for room and pillar mining in the Upper Freeport seam, where average thickness was 4 ft. The seam depth ranged from 144 to 287 ft with the typical value being about 200 ft. The immediate roof was interbedded gray and dark shale, approximately 45 ft thick, overlain by sandstone 40-ft thick. The floor was fireclay and shale. The mechanical properties of the coal, roof, and floor rocks were determined in the laboratory.

The 3-dimensional finite element method was employed for the design of entry width and pillar size. In the analysis 1/5 of the strength and Young's modulus as determined in the laboratory and the modified Drucker-Prager yield criterion (see Section 4.6) were used. The results recommended that during development, both entries and crosscuts be 18 ft wide, while the chain pillars be square and 70 ft^2, and that during retreat pillaring, each chain pillar be split centrally both ways into 4 square stump pillars, 18 ft wide at the corners.

The safety factor for all of the stump pillars as determined by the finite element modelling was greater than 1.0. In other words, they were safe to support the overburden. In fact underground observations showed that they remained intact long after retreat pillaring. However the safety factors for the stump pillars as determined by various pillar design formulae indicated that they would fail (Table 8.2).

9

SUBSIDENCE AND STRUCTURAL DAMAGES ABOVE ABANDONED COAL MINES

9.1 INTRODUCTION

There are approximately 70,000 abandoned coal mines nationwide, which is about 35 times the number of underground coal mines presently operating. The US Bureau of Mines estimates that there are over 8 million acres of undermined land due to the extraction of coal, metals, and nonmetals. Subsidence has affected more than 2 million acres, and more than 99% of the subsidence is related to underground coal mining. There is reason to believe that some of the remaining 6 million acres of the undermined land have a high potential to subside.

The expansion of housing, highways, commercial structures, and other facilities has required the use of many areas that are underlain by abandoned coal mines, and this growth will continue. Many subsidence problems are derived from the collapse of abandoned underground coal mines. There are numerous abandoned mine workings in the anthracite fields of northeastern Pennsylvania, in the Appalachian bituminous fields, the Illinois Basin, the Rock Springs, Wyoming area, and other areas of the United States (Gray et al., 1976). Various room and pillar patterns of mining have been used in the dipping anthracite seams and the nearly flat-lying bituminous seams with considerable variation in the percentage of coal extracted. The progressive deterioration of pillars, mine floors, and mine roofs after long exposure to air and water may later result in the collapse of strata over the mine entries, the crushing of the remaining coal pillars, or the bearing failure of the mine floor beneath the coal pillars. Subsidence then results as the collapse reaches the ground surface in the form of differential strains, depressions, cracking of the ground, and sinkhole development. Subsidence over active longwall mines, which occurs concurrently with mining or is completed within a short period following coal extraction, has been studied extensively over the past decade. On the other hand, subsidence over abandoned coal mines receives little attention by the researchers, mainly because it is difficult to predict and takes place decades after mining has ceased.

The techniques of investigating the subsidence events over abandoned coal mines are similar to those employed for active mines except that at the outset, it is necessary to determine whether or not the subsidence events are mining-related (Chugh et al., 1986; Cummings and Singh, 1986; Peng and Hsiung, 1986). This calls for the identification and confirmation of abandoned mine workings under or near the affected surface structures. Generally old mine maps, if available, are acquired, the surface boreholes are drilled for confirmation of the accuracy of the mine maps and determination of the potential for continued subsidence. Subsidence monuments are established and periodic surveys conducted to determine the amount and trends of surface movement in and around the affected surface structures; surface boreholes are used to investigate the integrity of the underground structures (i.e., roof, coal pillars, and floor) by TV camera. They are also used for monitoring the vertical and horizontal movements of the subsurface strata by Sondex (FPBX) and inclinometer (PFBI), respectively, for determining the continuity of the subsidence events. Tape extensometers, crackmeters, etc., are used to monitor the development trends of major cracks in the structures or on the ground. These data are used to identify the causes of the subsidence events. Finally, abatement methods are selected to stabilize the structures. It must be noted that most subsidence events over abandoned coal mines are reported after the fact, and investigations are begun some time after reporting, that the subsequent measured movements are generally much smaller than that attained in the active mines, and that due to lack of knowledge about the damage conditions and the exact location of the abandoned mine workings with respect to the affected surface structures, the precise causes of surface subsidence or surface structural damages are in most cases very difficult to identify.

9.2 TYPES OF SURFACE SUBSIDENCE

According to Gray et al. (1977), after examining 354 incidents of subsidence above abandoned mines in the Pittsburgh metropolitan area, the subsidence features have a mean diameter (i.e. the average of long and short dimensions) from less than 1 ft to 1600 ft, with 84% less than or equal to 15 ft; the subsidence features have a depth ranging from less than 1 ft to 48 ft, with 89% less than 25 ft; 66% of the subsidence features are deeper than they are broad. Nearly 59% of the subsidence features occur with overburden less than 50 ft thick and 81% less than 100 ft thick. No subsidence features occur with overburden thicker than 450 ft (Fig. 9.1). Occurrence of subsidence incidents varies from immediately to more than 100 years after mining (Fig. 9.2).

In analyzing the characteristics of approximately 3000 chimney subsidence features along the Colorado Front Range, Matheson and Eckert-Clift (1986) examined historical aerial photographs on 4- to 14-year intervals between 1937 and 1967 and found that the majority of observable surface subsidence features occurred within 30 to 40 years after mining.

According to Gray et al. (1977), the most prevalent subsidence features over abandoned mined land are sinkholes, with depths of more than 3 ft, and troughs or sags, usually less than 3 ft deep. Sinkholes are steep-sided pits, while troughs are shallow depressions much wider in area than sinkholes.

A. SINKHOLE SUBSIDENCE

A sinkhole is caused by the collapse of a mine roof that works its way upward. If it is not arrested during the process it will eventually reach the surface and emerge as a sinkhole. The process is governed by the thickness and character of the overburden, the width and height of the mine openings.

Sinkholes are usually 3 to 20 ft deep and may be 2 to 40 ft in diameter, although most are fewer than 16 ft across (Gray et al., 1977; DuMontelle and Bauer, 1983). Newly formed sinkholes have steep sides with straight or bell-shaped walls. At times, they appear to be conical in profile with the apex upward. If the topsoil collapses, the top portion will widen to form an hour-glass shape. Sinkhole subsidence usually occurs over abandoned mines less than 165 ft deep (Hunt, 1979).

Matheson and Eckert-Clift (1986) found that chimney sinkholes are likely to occur when the ratio of overburden thickness to mining height (h/m) is less than 4 to 5. When h/m is between 5 and 10 to 11, the potential occurrence of chimney sinkholes decreases rapidly. When h/m is more than 10 to 11, less than 10% of the mine openings that collapse will induce sinkholes on the surface.

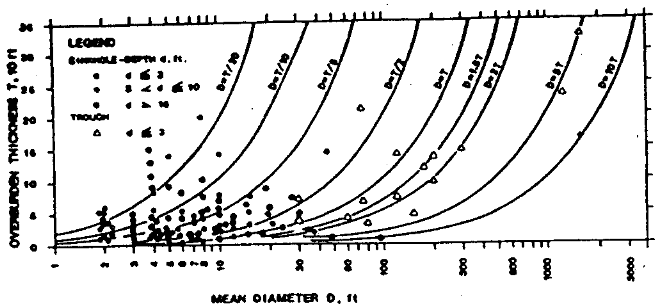


Fig. 9.1. Diameter and depth of subsidence features vs. overburden thickness (Gray et al., 1977).

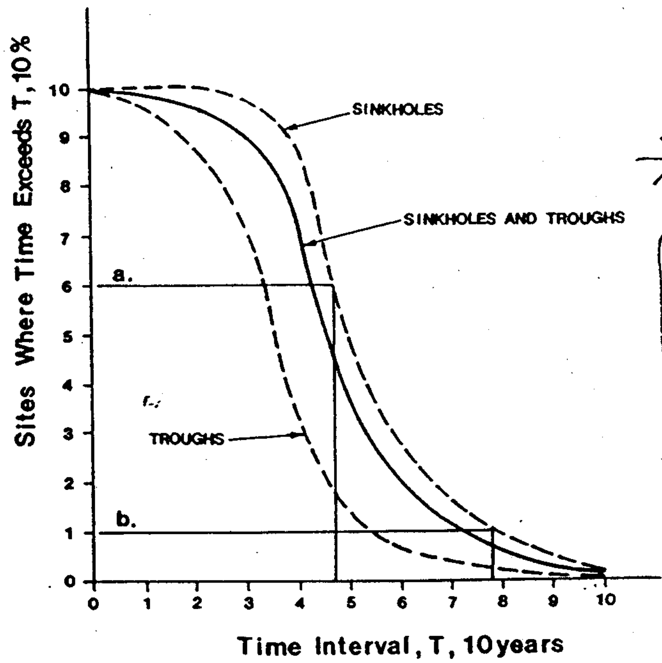


Fig. 9.2. Minimum time interval between mining and subsidence (Gray et al., 1977).

B. SAG OR TROUGH SUBSIDENCE

Sag or trough subsidence is a gentle depression over a broad area. These depressions are semi-eliptical to circular shaped, partially or fully outlined by tension cracks; and may or may not contain compression ridges. Troughs are usually 1.5 to 3 ft deep and range from 30 ft to one-third of a mile in diameter. The diameter-to-depth ratio ranges from 10 to over 500. Profiles or troughs over abandoned mines resemble those over active mines.

Troughs are caused by the following three events: roof caving above the opening, crushing of pillars, or punching of the pillars into the mine floor. Troughs with diameters larger than 30 ft are most likely due to pillar failure and pillar punching into floor, while smaller troughs are attributable to roof caving. Weak or flooded floors tend to favor pillar punching, while competent roof and floor tend to favor pillar failure. It is thought that troughs due to pillar failure are developed several decades after mining, while those due to pillars punching into a floor are developed 10 to 15 years after mining.

Tension cracks form as the ground is pulled apart. Generally, they are parallel to the boundaries of the depression.

Compression ridges form as the ground is squeezed and are found in or near the deepest part of the sag.

9.3 CAUSES OF SURFACE SUBSIDENCE

Most of the abandoned coal mines were mined by the room and pillar method. These mines generally are very shallow and very irregular, with unsupported roof spans of varying widths. The possible causes of the two types of delayed subsidence are: (1) the opening between pillars is too wide, (2) the individual pillar is too small to carry the overburden load, and/or (3) the pillar punches into the mine floor. The basic mechanism is the gradual deterioration and final failure of the roof, floor, and coal pillars. The time for the occurrence of subsidence above abandoned coal mines depends on the rate of deterioration. Generally speaking, time-dependent or delayed subsidence is difficult to predict and, in a sense, difficult to control.

As a mine opening collapses and closes, the failure will propagate to the surface. This can take place by the stoping of roof falls, downwarping of the overlying strata, fractures, or a combination of the three processes (Aughenbaugh and Elifrits, 1983). Failure of the roof causes the caving to migrate upward in an action called stoping. If stoping reaches the surface, sinkhole-type subsidence will take place. If the bedrock is only a few feet thick and the surface deposits are loose, these materials may subside and wash into adjacent mine voids in such a way that they produce a surface hole deeper than the collapsed height of the mine void. On the other hand, failure of the floor and coal pillars will result in downwarping of the overlying beds. The surface expression of this action is trough-type subsidence. Fracturing of the overlying strata can occur either with roof failure and stoping, or with floor and pillar failure and the downwarping of the overburden.

The type of material overlying the mine will dictate how and when the failed cavity will reflect to the surface and cause subsidence. The main reason subsidence problems vary from one coal mining area to another is because the geologic conditions are different. Soft rocks and soils generally have less capacity to maintain a bridge across a cavity than competent rocks. When stoping, downwarping, or fracturing reaches the soft rocks and soil masses, the time delay in subsidence manifesting itself at the surface becomes short. Lateral variations in the geologic conditions of the overburden will determine what surface areas are first afflicted with subsidence over an abandoned mine. Geologic structures, such as faults and joints, will generally increase the possibility of subsidence occurring in a shorter period of time.

The surface above an abandoned coal mine may undergo more than one period of subsidence, because of the nature and cyclic deterioration of room and pillar coal mines. Until all the cavities in the mine affecting the site within the area covered by the angle of draw have collapsed and closed, future subsidence can and will occur. After all the mine voids have closed, residual subsidence can still occur as the roof fall material is compacted and the settlement reflects to the surface.

9.4 SURFACE STRUCTURAL DAMAGE

As described in Section 5.5, the typical home in the Northern Appalachian Coalfield has a frame superstructure and a basement made of concrete blocks. In Illinois, homes are generally similar to those in the Northern Appalachian Coalfield, but instead of basements, they may have crawl spaces with foundation walls only a few courses of block in height. Abandoned coal mines are commonly 40 to 300 ft below the ground surface. Building deformations that result from subsidence generally begin at foundation level and propagate upward through the basement to the superstructure and roof. The characteristics of building deformations in the compression, tension, and maximum slope zones are briefly summarized below.

A. COMPRESSION FEATURES

Severe foundation damage is commonly observed in houses that are affected by ground movement in the compression zone. In

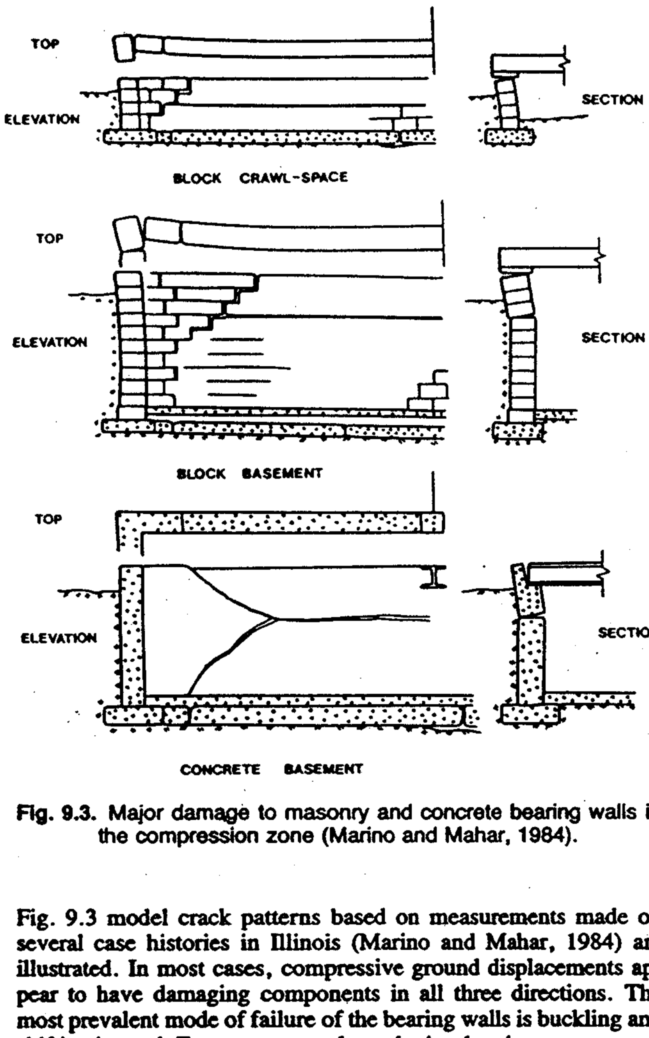


Fig. 9.3. Major damage to masonry and concrete bearing walls in the compression zone (Marino and Mahar, 1984).

Fig. 9.3 model crack patterns based on measurements made on several case histories in Illinois (Marino and Mahar, 1984) are illustrated. In most cases, compressive ground displacements appear to have damaging components in all three directions. The most prevalent mode of failure of the bearing walls is buckling and shifting inward. From a structural standpoint, bearing concrete and masonry walls have a higher resistance to ground movements in in-plane bending than out-of-plane bending. However, sagging of the wall commonly produces cracking and crack offset along the diagonal at the corners of the walls. Major damage in the superstructure is related to brick/masonry veneers. Most common in brick veneers are horizontally oriented moment and diagonal tension-related cracks near the level of the first floor joists. More brick damage occurs over blocks than concrete foundations because concrete basements are stronger and behave more like rigid bodies. Even if they are warped and bulged, sided and paneled exteriors are much more resilient than brick.

B. TENSION FEATURES

More houses are affected by tensile than compressive movements because a much larger spatial area of the sag is in tension. Deformations and rigid body movements of homes located in the tension zone initially occur and concentrate along construction joints or presubsidence settlement and shrinkage cracks. Major modes of foundation failure have been found to be induced by the bending, shear, and extension strains. Diagonal to vertical cracks form when the critical tensile stress/strain of the foundation element is exceeded. These foundation cracks normally develop extension and shear offsets. The location and nature of the damage is affected by the relative direction of the ground movements (Fig. 9.4). Masonry bearing walls appear more susceptible to wall torsion than concrete walls. As in the compression zone, major superstructure damage is found in the tension zone where a brick/masonry veneer is above a severely damaged foundation. Crack and crack offsets in the brick are most commonly related to in-plane bending, shear, and extension deformations. The major cracks are oriented diagonally to vertically. Siding or paneling is much less susceptible to damage.

C. MAXIMUM SLOPE EFFECTS

Houses located in the maximum slope portion of the sag (which includes the point of inflection) tend to have noticeably sloped (tilted) floors which require releveling and replacement of the foundation. Houses spanning the inflection point will be subjected to both compressive and extensional deformations in the compression and tension portions of the sag, respectively.

D. LOCATION AND SIZE EFFECTS

The relative size and location of the structure with respect to the sag determines the characteristics of the induced foundation deformation. Foundation stresses and tilt will be affected by the ratio of house length, ℓ, to sag diameter, D. When ℓ/D is small, the house will commonly lie in either the tension or compression zone, which may include the maximum slope. For intermediate values of ℓ/D, the subsidence-house interaction will be more complicated. The house may span the inflection point and both compression and tension features will be observed at the opposite ends of the house. At large ℓ/D ratios, the foundation response will usually be 3-dimensional and include sagging.

E. STRUCUTRAL MONITORING

A successful monitoring program takes into account the existing damage and the types of distortion a structure is likely to undergo as a result of additional ground movements. In general, strucutral deformations are due to differential settlement, tilt, and tension, or compression strains. The first step in establishing a monitoring program is to locate the position of the structure relative to the subsidence trough and to study the damage. This is usually accomplished during the initial field reconnaissance. In many cases, ground cracks, separations between the foundation and soil, and tension cracks in the foundation elements will help delineate the tension portion of the sag. The compression zone can be identified by locating compression ridges in the pavement or ground, and compression failures of foundation walls and utilities. In addition to locating the position of the structure in the depression, it is also important to determine the orientation of the building relative to the ground movements (Gibon and Mahar, 1983).

Survey monuments and settlement points should be established to determine the present and future vertical displacements of the strucutre. Horizontal movements of a wall or differential movements between walls can be measured by a tape extensometer to evaluate the stability of the wall(s) and structure. Tilt measurements, using a plumb bob, should be taken at the corners and midpoint of a wall to evaluate rotational deformation of the wall and wall stability. The crack patterns should be mapped and characteristics of relative displacements along the same cracks should be made using a 3-dimensional crackmeter. Detailed mapping of crack patterns and measurement of relative movement across cracks, along with wall tilts, will provide invaluable data on the causes of damage, location of the structure in the subsided area, deformational history of the structure, expected response to ground movements and strains, and levels of damage (Gibon and Mahar, 1983). Overall, the structural monitoring program should be designed to determine the behavior of structures in response to ground movements, and to estimate future performance of the structure on a site-specific basis.

9.5 PREVENTION/CONTROL OF STRUCTURAL DAMAGE

Many of the future residential houses in the Appalachian area and Illinois will be developed over abandoned coal mines which

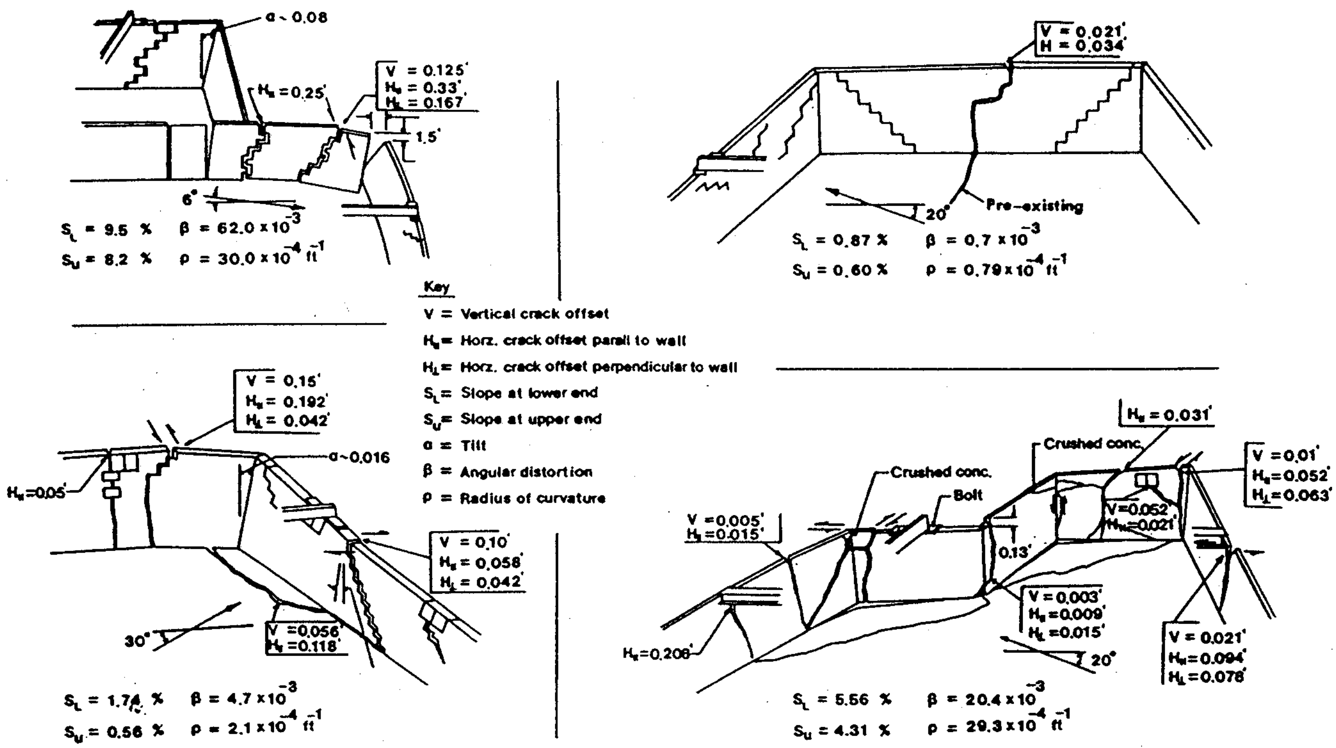


Fig. 9.4. Isometric views of major damage to masonry and concrete bearing walls in the tension zone (Marino and Mahar, 1984).

exhibit no apparent instability at present. These houses should be constructed only if there is reasonable assurance that, under the most critical anticipated subsidence conditions, housing units would not collapse or suffer structural damage requiring major repairs or replacement of structural elements, and that access road, drainage systems, and utilities can be maintained so that they will continue to function adequately. Modifications should be made in the design of structures and utilities to prevent or minimize future subsidence effect. On the other hand, subsidence-induced structural damage to existing houses over abandoned coal mines should be corrected and controlled using proper technologies.

9.5.1 Prevention of Structural Damages

The following possible strategies should be considered to reduce subsidence risk when buildings are located over abandoned coal mines (Yokel et al., 1982):

1. Backfill the mine or construct grout columns at mine level; use conventional foundation according to soil conditions.
2. Place structures on specially designed drilled piers extending below mine level.
3. Place structures on shallow footings and design for resisting subsidence. Some of the options are: (1) the building could be made stiff enough to resist anticipated horizontal strains and distortions; (2) the building could be made flexible enough to accommodate anticipated horizontal strains and distortions without suffering unacceptable damage; (3) forces acting on the foundation could be reduced by low-friction layers or bearings, protective layers of compressive material, or other means; (4) buildings and utilities could be designed to allow for corrective measures which could compensate for anticipated effects of subsidence.
4. Relocate structures to areas where adequate pillar support is available.
5. Building units should preferably be slab on grade and be one or two, or at most, three stories high. The plan dimension of a building should generally be less than 80 to 100 ft across any diagonal.
6. Buildings should be oriented with the narrow dimension in the direction of the maximum anticipated subsidence slope, to minimize the effect of ground strains.
7. If ground compression is anticipated, compressible backfill should be provided around the basement walls and other deep foundation elements. Alternatively, a narrow trench can be excavated, at a distance not exceeding 1/2 times the basement depth from the exterior face of the basement wall, and backfilled with compressible material.
8. The grades of gravity-flow pipelines should be increased (or decreased), depending on location in the subsidence trough, so that the lines will remain functional after subsidence.
9. Joints between adjacent pipe segments should be flexible enough to accommodate translations (length changes) and rotations resulting from anticipated subsidence effects.
10. To avoid unnecessary, expensive remedies, the National Bureau of Standards' recommenations on building design and construction should be followed.

9.5.2 Subsidence Control

Two distinctly different subsidence control technologies have been developed in the US for abandoned coal mines. They are; (1) point support methods and (2) areal backfilling. Point support methods are used to protect individual structures, or even individual foundation elements of structures, whereas areal backfilling techniques are to protect entire neighborhoods or urban districts hundreds of acres in extent (Huck et al., 1982).

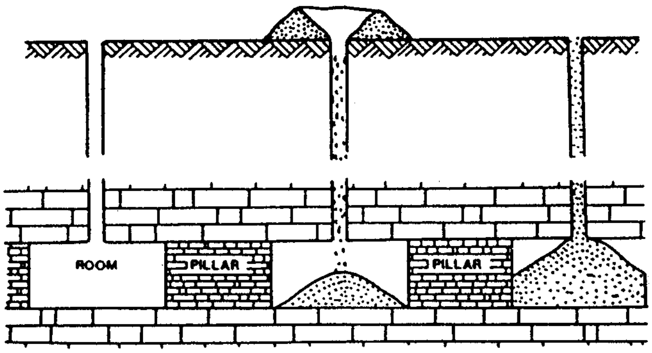


Fig. 9.5. Gravity backfilling for point support (Huck et al., 1982).

1. Point Support Methods

Point support methods are employed by civil engineers in the design of a new structure or the protection of an existing structure. The costs of point support methods involve a large number of boreholes and the use of expensive materials in relatively small quantities.

(a) Gravel Columns

Gravel columns may be placed in the mine opening using the methods shown in Fig. 9.5. Boreholes are drilled through mine strata and gravel poured down the boreholes to form a pile on the mine floor. The objective is to place as much gravel as possible in the mine openings and to achieve firm contact with the mine roof. The filling of a significant fraction of the open mine space reduces the amount of potential subsidence simply by removing open volume within the mine.

(b) Grout Columns

The grout column shown in Fig. 9.6 begins with the installation of a conventional gravel column which is placed around a grout pipe that extends through the borehole into the mine opening. When the gravel column is in place, portland cement grout is injected in stages. At each stage, sufficient grout is injected to fill the interstices in the gravel and build a column approximately 6.6 ft in diameter and 3 ft tall. The grout pipe is then raised one meter and the next stage of grout is injected. The process builds a column of grouted gravel to the mine roof. The borehole above the mine roof is then filled with grout so that any strata separations are filled with grout.

(c) Flyash Grout Injection

A flyash-portland cement grout is designed for a compressive strength of 800 psi and is fluid enough to enter small crevices. It is carried to boreholes by pipe and hose, and poured down the borehole in free fall (Fig. 9.7). The column of grout is built up disk by disk to eventually contact the mine roof. The borehole is then filled with grout and any strata separation in the mine roof is grouted.

(d) Fabric Formed Concrete

In this method, a borehole is drilled from the surface through the mine opening and a short distance into the mine floor. A tube of civil engineering fabric is then placed around a grout pipe, and the assembly lowered into the borehole. Concrete is then pumped from the grout pipe to inflate the fabric tube from the bottom up, creating a concrete column keyed into the mine floor and roof (Fig. 9.8).

2. Areal Backfilling

Areal backfilling involves the filling of mine voids to provide general protection to urban areas that may be measured in square miles. The technique involves large quantities of material such as

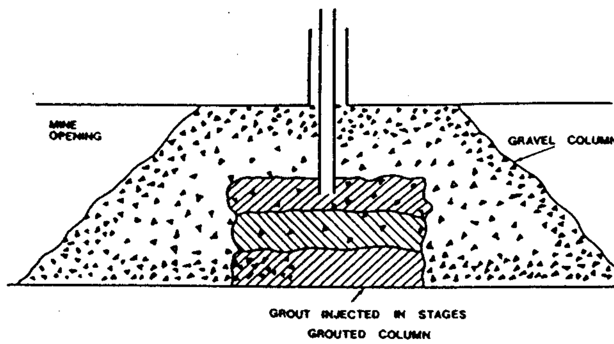


Fig. 9.6. Grout column (Huck et al., 1982).

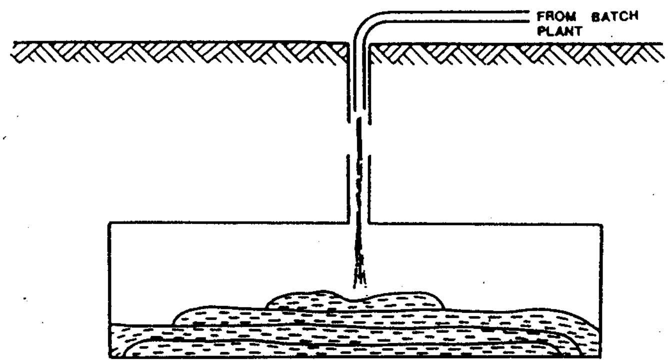


Fig. 9.7. Gravity feed injection/portland cement grout (Huck et al., 1982).

coal mine refuse or flyash, which is available locally at low cost and which is undesirable on the surface. In contrast to the point support methods, which are typically gravity feed methods, areal backfilling usually involves pressure injection.

(a) Pumped Slurry Injection

The pumped slurry injection method, sometimes called the Dowell Process, is usable in either dry or flooded mines. As shown in Fig. 9.9, a borehole is drilled into the mine and the casing is sealed into the roof strata so that positive pressure can be exerted. A slurry of mine refuse, containing 16% solids by weight, and with maximum grain size of 0.4 to 0.8 in. is injected into the flooded mine opening. Turbulence immediately beneath the borehole keeps the solids in suspension, but they settle out a short distance from the borehole, forming an angular deposit around it. As more slurry is injected, this deposit grows higher, and as its top grows near the mine roof, flow velocities over the top increase, so that solids are carried over the deposit and settle only on the outside. The process can inject as much as 260,000 to 390,000 cubic yards of solids at a single borehole, although the average amount injected is more nearly 20,000 to 26,000 cubic yards. Depending on the seam height and extraction ratio in the abandoned mines, sufficient material can be injected to fill mine voids less than 2.5 to 25 square miles in area. The system required for pumped slurry injections is shown in Fig. 9.10. Coal mine refuse is crushed and trucked to a mining-pumping facility. Mixing water is usually obtained from a deep-well pump drawing water directly from the flooded mine. From a single mixing location, slurry pipelines can feed a large number of boreholes, each of which is backfilled in sequential order.

(b) Flyash Slurry Injection

Flyash slurry can be injected into an abandoned mine using a pumping system very similar to that described previously.

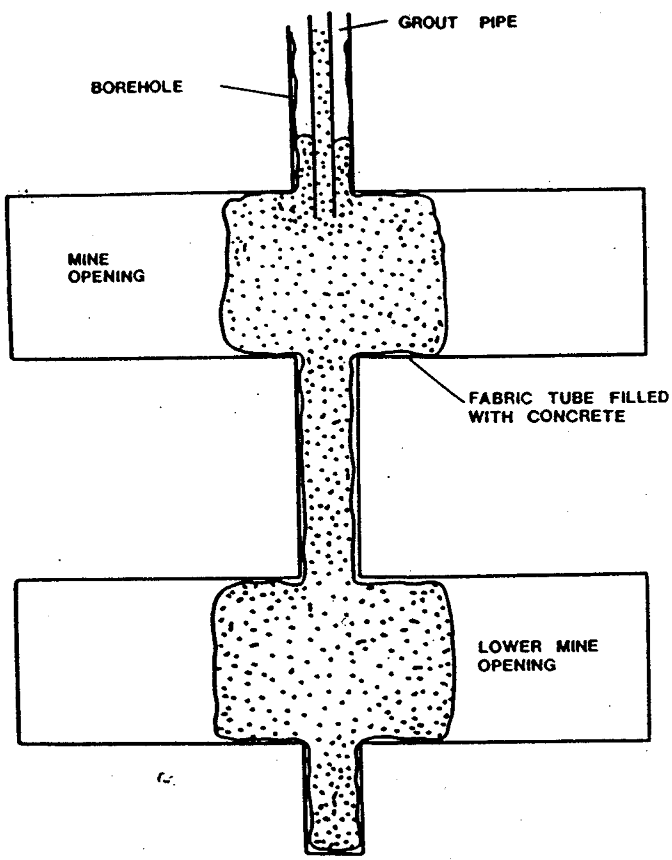


Fig. 9.8. Concrete pillar case in fabric tube (Huck et al., 1982).

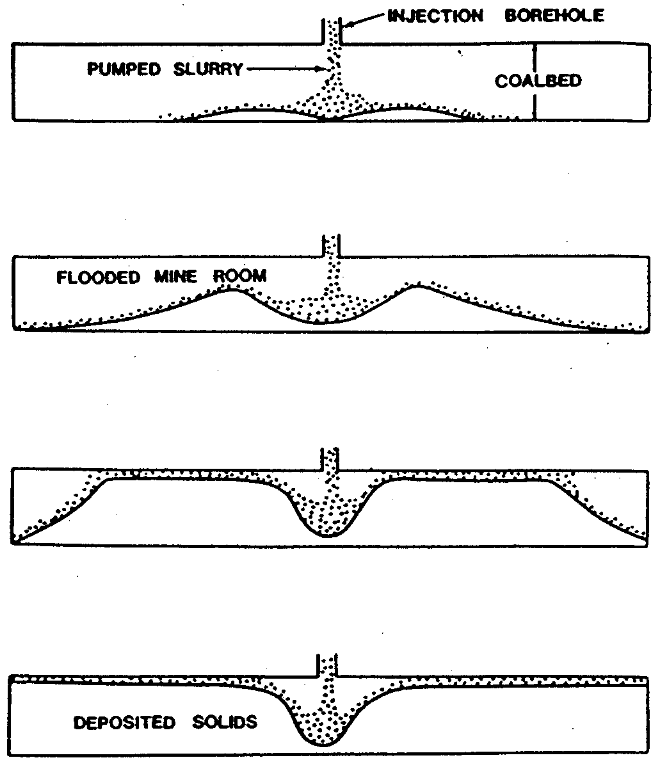


Fig. 9.9. Sectional view at the point of slurry injection showing movement of particles and growth of deposits (Huck et al., 1982).

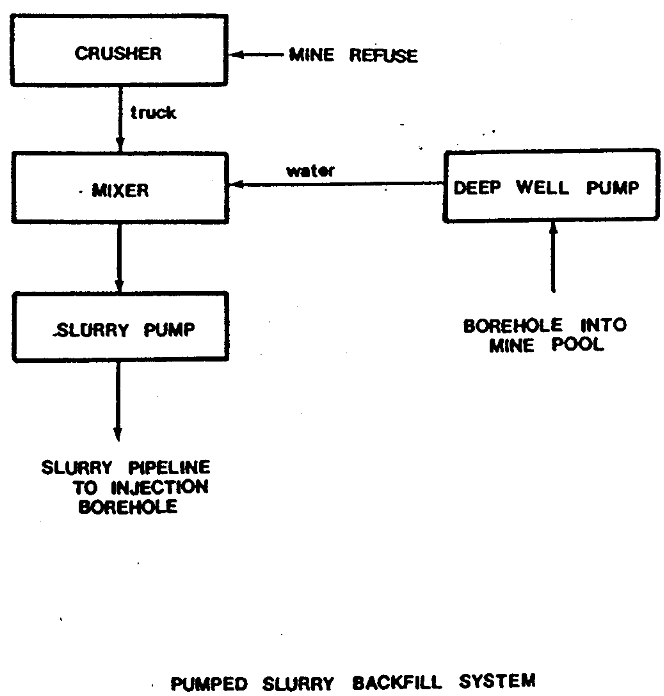


Fig. 9.10. Pumped slurry backfill system (Huck et al., 1982).

Because of its greater fluidity, a flyash slurry with 50 to 60% solids is highly pumpable and travels great distances underground.

9.6 PREDICTION OF SURFACE SUBSIDENCE

Prediction of surface subsidence over abandoned room and pillar mine lands is much more complicated than that over active mines. It requires information concerning the stability of mine structures, i.e., roof, coal pillar, and floor, which is alway difficult to assess. In fact, many reported incidents of house or building damage are not mining-related, although damage features are more or less the same. Causes for nonmining related subsidence (Peng et al., 1988) include landslides, expansive soil, frost action, limestone solution, soil piping, organic soil drainage, differential settlement, and fluid withdrawal. The most positive way to determine whether it is mining-related is to identify if old mine workings exist under the structures in question. To this end, surface borehole drilling in conjunction with or without borehole TV cameras has been the most common method. Other methods, such as radio imaging techniques (Schotsch and Sutton, 1991) and in-seam seismic methods (Gelmacher and Slade, 1990) have also been used.

The occurrence of sinkhole or chimney subsidence is due to local mine roof failure in shallow coal seams. The affected area is small and its epicenter is most likely beneath the bottom of the sinkhole. Therefore the location of the failure zone and the influence area of a sinkhole subsidence can be easily determined.

In case of sag subsidence, the theory (e.g., probability influence function method) developed for active mining subsidence with some modifications, can be applied to abandoned mine land subsidence. In sag subsidence the most likely parameters that can be positively identified are tilt of structure and ground cracks where maximum tensile strain occurs. Using these two parameters, Peng et al. (1988) proposed the following steps to locate the surface subsidence area, underground failure zone, and to reconstruct the true subsidence profiles:

1. Determine the offset of inflection point, d and radius of major influence r using $d = 0.2h = 0.4r$ (h = seam depth).

2. Measure the distance between the centerpoint of the ground tension cracks and the tilted structure along a chosen direction.

3. Draw a horizontal line to represent the ground surface and locate the centerpoint of the ground cracks and damaged structure.

4. Locate the inflection points in the inner side of the center of the ground cracks with a distance of 0.4r.

5. Locate the left- and right-side edges of the opening (or underground failure zone) by an offset, d, from the left- and right-side inflection points, respectively.

6. Measure the distance x between the center of the tilted structure and the closer one of the inflection points.

7. Determine the maximum possible subsidence using Eq. 4.34.

8. Determine the maximum possible slope using Eq. 4.38.

9. Apply Table 4.5 to construct the subsidence profile.

10. Determine the angle of draw.

11. Check the angle of draw and see if it is a reasonable number. If it is, skip step 12.

12. If the angle of draw is not reasonable, redo step 5 assuming it is subcritical openings in which the inflection points are located beyond the opening (or failure zone).

EXHIBIT 17

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Site Description
Mine Opening C71
Black Diamond Mines Regional Preserve

May 31, 2002

Mine opening C71is located in the NW ¼ of NW ¼ Section 13, T1N, R1E, MDBM. It is approximately 75 feet at bearing 25° east of south from the gate at the west end of the Park District's narrow strip of property on Section 13 that runs the length of the boundary common to Sections 12 and 13.

The opening is most probably a vertical exploration or ventilation shaft driven on the Black Diamond vein. It is associated with either the West Hartley or Star mine, which share a common boundary line near the opening. W.A. Goodyear, writing in the 7th Annual Report of the [California] State Mineralogist (pages 143 & 144), describes a shaft driven about 3000 feet east of this feature as having hit what was tentatively identified as the Black Diamond vein 120 feet from the surface.

Two roughly triangular vertical openings (approx. 1'x 1' and .5'x .5') are spaced about 2 feet apart in rock and soil fill that appears to block a vertical, or possibly steeply inclined shaft driven through competent sandstone. Because of the fill material, the size of the original opening could not be determined.

The openings were located at the north end of a shallow excavated depression approximately 25 feet long by 19 feet wide. A mound of material at the south end of the depression contained light-weight tan shale typical of the near-surface appearance of the area's coal seams.

Both openings were tested for carbon dioxide gas (CO^2) using a Drager Multi Gas Detector with the probe at the maximum depth to which it could be inserted. The larger of the two openings showed no contamination at 4 feet. The smaller opening showed 3,500 ppm (.35%) CO^2 at 18 feet, indicating a connection to the coal workings.

BLACK DIAMOND MINES REGIONAL PRESERVE

EAST BAY REGIONAL PARK DISTRICT

MINE OPENING C71

Scale: 1"=1000'

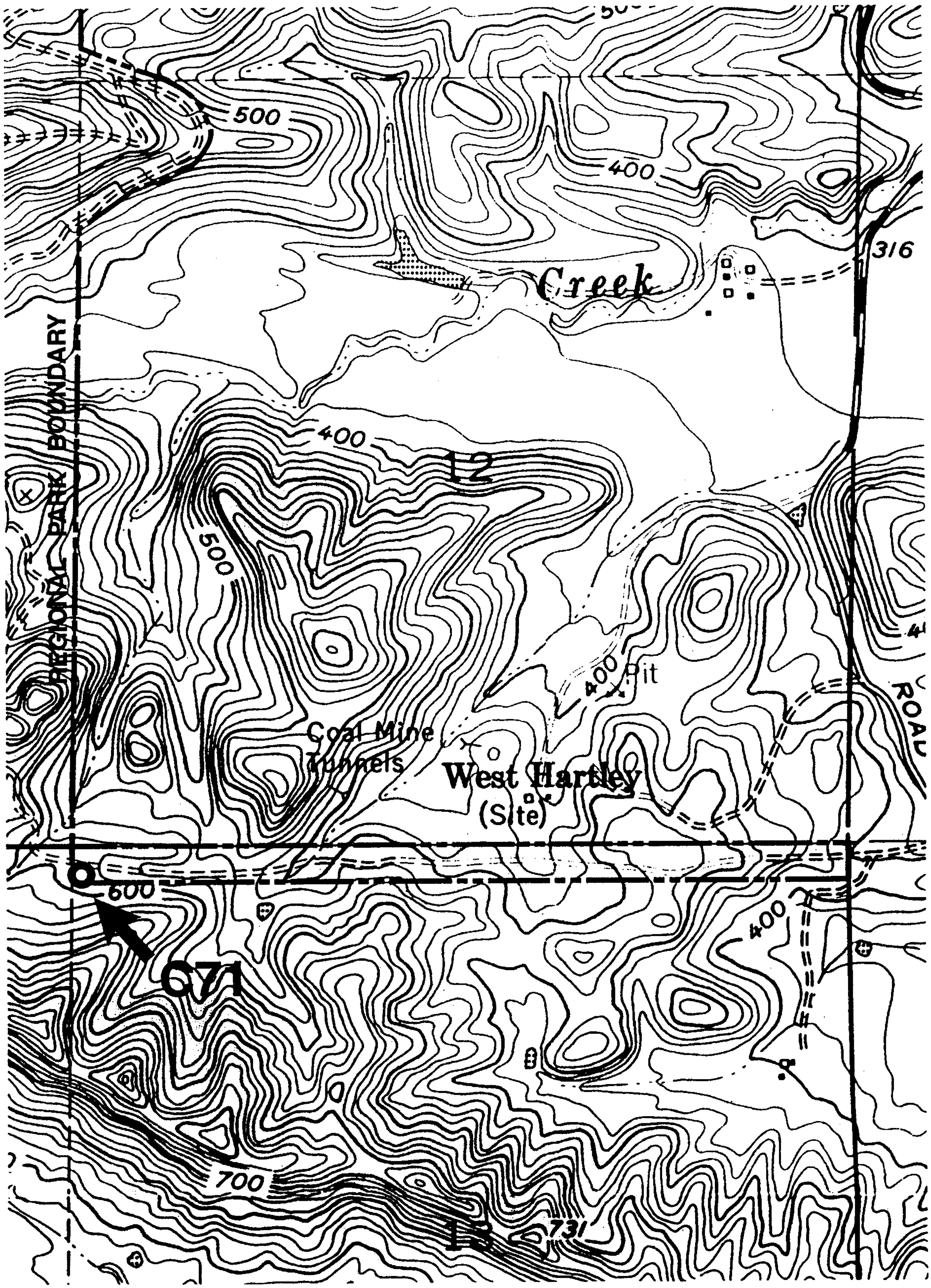

EXHIBIT 18

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CALIFORNIA STATE MINING BUREAU.

WILLIAM IRELAN, Jr., State Mineralogist.

SEVENTH ANNUAL REPORT

OF THE

STATE MINERALOGIST.

For the Year Ending October 1, 1887.

SACRAMENTO:
STATE OFFICE : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1888

have never, even from their lowest depths, produced any better or harder coal than was a great deal of that which came from the top of the very highest workings on the Black Diamond bed, more than five hundred feet above the old "Upper Black Diamond Gangway." And this is not all: It is true, as a general rule, throughout all the Mt. Diablo mines, that when a depth of from one hundred to three hundred feet is attained, measured on the dip of the bed from the outcrop, there is after and below that no further improvement in the quality of the coal which can be shown to be to any extent dependent upon or connected with the additional increase in the depth.

Since 1870, a tunnel has been driven in Stewart's Mine from the Clark bed northerly entirely through the ridge and out to daylight on its northern side. Since the completion of this tunnel all the coal mined has been taken out through it, thus saving some two miles of cartage around and over the hill.

It is not probable that this mine has ever been a profitable one to work. And though it has produced in the aggregate a considerable quantity of coal, it has not been worked continuously, but irregularly and spasmodically, sometimes lying idle for many months, and then again producing as high as from nine hundred to one thousand tons of coal per month. After this sort of fitful life for some eight or ten years, it has recently again shut down, and it is doubtful whether it will ever be much more worked hereafter.

Going east from Stewart's Mine, we next find in the bottom of a cañon near Cochrane's house and close to the center of Section 11, the outcrops of two beds, which in all probability represent the Clark bed and the Black Diamond bed respectively. At this point the beds run very nearly east and west, and dip to the north at an angle which Cochrane states to be about 32°.

Some prospecting was done at this locality years ago, but the coal was not found good enough to warrant mining.

Beyond Cochrane's, as we go east, the thickness of the strata and the characteristics of the various beds themselves change so much that, though there is, of course, no lack of positive opinion on the subject among some of the men who are pretty familiar with the ground, and though there are here and there a few facts known which really do point to some probability in the matter with reference to certain beds, yet it is impossible, in the light of all the developments hitherto made, to recognize anywhere, with any certainty, a single bed as being identical with either the Clark or the Black Diamond bed of the Mount Diablo mines.

The next development to the east of Cochrane's, is in the northeast part of the southwest quarter of Section 12. Here a slope was sunk about two hundred feet, some years ago, in a direction of north 16° west, magnetic, upon a bed of coal with a pitch of about 27°. There was no coal visible here at the surface of the ground, but only a slightly carbonaceous shale for the first eighty or ninety feet. But then the coal began to come in, and at the bottom of the slope there is said to have been three feet of pretty clean, though rather soft, coal, with a good sandstone roof. It is also said that two small schooner loads were once shipped from the bottom of this slope.

Empire Mine.

The next development is at the locality now known as the "Empire Mine." This is in the southwest part of the southeast quarter of Section 12. A slope was originally sunk here about two hundred feet in 1860 or 1861, when the work was stopped by the influx of water which the parties had not the means to handle. There was visible here at the surface of the ground only a little streak of soft clay-shale about eight or ten inches thick, which was of rather a light yellowish hue, being but very slightly colored by carbonaceous matter, and having sandstone immediately above and below it. This could not be called a very promising outcrop, certainly. But, on going down, it was found that this streak of shale increased steadily and rapidly in thickness, and also grew rapidly more and more carbonaceous, till, at the depth of one hundred feet slope distance, it had already developed into a four and a half foot bed of what might very properly be called coal, though it was still impure and very soft and friable. Its quality still continued to improve rapidly to the bottom of the slope. It was, however, abandoned.

But in the year 1875, Mr. George Hawkshurst, the Superintendent of the Union Mine, at Somersville, in connection with one or two other parties, again took hold of this old slope, cleaned it out, enlarged it, furnished it with a double track, put up pumping and hoisting machinery, and sunk it to the depth of six hundred feet (slope distance), and then drove a gangway both ways from its foot.

My last visit to this property was December 11, 1876. At this time the gangway was driven about three hundred feet west and nearly four hundred feet east from the slope, with a general course of N. 75° E., magnetic, the dip of the bed being about 23°, and the direction of the slope itself being N. 6° E., magnetic.

The coal along this gangway ranges from three feet six inches to a little over four feet in thickness. At the west face of the gangway it was four feet three inches thick. Of this, the upper twelve inches was tolerably clean coal; the next twelve inches was "bony," and the lower two feet three inches was clean coal, though rather softer than the average Mount Diablo coal. The floor of the bed is sandstone. Along the roof of it there runs a stratum of from five to eight inches of soft clay-slate, which, however, is not continuous, the solid sandstone sometimes coming down to the coal. Above this little streak of slate there is everywhere good solid sandstone. In the eastern part of the gangway there is one fault, which consists of a downthrow to the east of just about the thickness of the vein. West of the slope, there are only one or two little jumps, of a few inches each.

From a point a few feet east of the foot of the slope a tunnel was driven south some three hundred feet through the sandstone, in order to strike an underlying bed which had been previously discovered by a little shaft sunk about ninety feet south of the mouth of the slope, and one hundred feet deep. This bed, as seen in the shaft, is said to consist of three feet of good, clean coal, like the bottom bench of the upper bed, without any "bone," and with good sandstone roof and floor. This bed they had not yet reached in the tunnel at the time of my visit, though at a distance of a little less than two hundred feet from the upper bed they had passed through a small coal seam, about eighteen inches thick. Since that time, however, they have struck the lower bed in the tunnel, and found it, as I am told, to consist here of a bottom bench of twenty-two or twenty-three inches clean coal, overlaid by about fourteen inches of worthless "bone." The appearance of this "bone" at the depth where the tunnel strikes it, while there was no "bone" at the bottom of the little shaft so much nearer the surface of the ground, is not an encouraging fact with regard to the future prospects for a mine upon this bed.

At a point some six hundred feet south of the mouth of the slope, and very close to the section line between Sections 12 and 13, there has been another little shaft sunk about ninety feet, and from the bottom of it a drill-hole was pushed some thirty feet lower. They are reported to have passed through several little streaks of coal in this shaft, and at the bottom of the drill-hole to have struck something which they believe to be the Black Diamond bed, as they assume the bed upon which the slope is sunk to be the Clark bed, and the one struck in the tunnel to be one of the "Little Veins" between the two. But this assumption, though not improbable, is, as already stated, by no means proven.

A recent survey shows that the mouth of the Empire Mine is about four hundred feet above tide-water, and that a railroad from there to the village of Antioch, on the San Joaquin River, will be about five and a half miles long, and will have two tunnels, aggregating something over one thousand feet in length. It is the present intention of the owners to build this road.

Teutonia Mine.

Next east of the Empire Mine comes the old "Teutonia." This is in the south part of the southwest quarter of Section 7, T. 1 N., R. 2 E., the mouth of the mine being only about one hundred aud fifty feet north of the section line. This mine was furnished with steam hoisting and pumping machinery. But at the time of my first visit to it in September, 1869, it had already been idle and abandoned for some two years, and nothing has been done there since. According to the best information which I have been able to obtain, however, relating to this mine, the slope, which was furnished with a double track and with sheet-iron mine-cars, went down upon a bed of coal about four hundred feet, with a pitch of about 26°. From the bottom of the slope a gangway was driven east something like one hundred feet. Just west of the slope the bed was broken by a large fault jumping up to west, beyond which the work was never carried. The bed was about thirty-six inches thick, the lower half of it being bright, clean, shelly coal, not very hard, and the upper half being "bony." It will be noticed that this description of the bed itself is remarkably like that of the bed which was struck by the tunnel in the Empire Mine in the latter part of December, 1876; and it is indeed not at all unlikely that it may be in reality the same bed.

The fact is worth noticing here that on October 11, 1875, before the underlying bed had been found at the Empire Mine, Mr. J. Cruikshank (who is well informed as to the early work which was done in this region), in some notes which he gave me, placed the Teutonia Slope on a bed underlying the "Clark Vein," and located the outcrop of the "Clark Vein" itself at a point some distance to the north of the mouth of the Teutonia Slope.

On the northeast quarter of Section 18, T. 1 N., R. 2 E., there is another old slope, known as the "Israel Opening." This slope is said to be some two hundred feet deep, with a pitch of about 25°. It is said, furthermore, that at its bottom there was three feet of clean and tolerably hard coal, and that some rooms were opened and several cargoes of coal once shipped from here. It is supposed that this slope is on a bed which underlies the one on which the Teutonia Slope is sunk.

On the northwest quarter of Section 16, T. 1 N., R. 2 E., there are several small openings, only one of which is worth mentioning now. This is a slope which runs down about north magnetic with an average pitch of 21°. It is said to be about two hundred feet deep, and also that at the bottom of it there were three feet of clean coal, with sandstone roof and floor. In December, 1876, the lower part of this slope was full of water, down to the surface of which it was one hundred and thirty-five feet, and at this depth there was nothing like good coal to be seen, but only a streak of dirty "croppings" about one foot in thickness.

Rancho de Los Meganos.

On going still further to the east from here, there is for some distance hardly any exposure of the rocks at the surface, and there have never been any holes sunk until we reach the southeast quarter of Section 22, and the northeast quarter of Section 27, upon the Rancho de Los Meganos, in T. 1 N., R. 2 E. Here there are known to exist at least three beds of coal of workable thickness, associated with heavy deposits of a good quality of fire-clay.

A small shaft in the south part of Section 22, known as the "Hoisting Shaft," and eighty-eight feet in depth, shows the following section of the strata, the measurements being vertical, and beginning at the top or mouth of the shaft:

	Ft.	In.
Clay and clayey material	34	4
Black clay	14	8
Coal	2	4
White clay, hard and somewhat sandy	4	8
Coal	0	4
Blue fire-clay	5	0
Coal	3	6
Clay (with three regular coal seams, about one foot thick each)	8	0
Coal	7	0
Clay	3	0
Coal	1	2
Clay	4	0

There has been mined here, chiefly from the "seven-foot" and the "three and a half-foot" beds, through shallow slopes and shafts, without the use of other power than that of hand and horse, an aggregate of probably somewhere between five thousand and ten thousand tons of coal, most of which has been used under the boilers at the "Engine Shaft."

The general course of strike of the beds here is about N. 72° W., magnetic, and their dip to the northeast, but so far as yet explored, somewhat variable in amount, ranging from 16° to 26° at different points.

The "Engine Shaft" is sunk at a point about eleven hundred feet north-easterly from the line of outcrop of the beds, is about three hundred and eighty feet deep, and is divided into three compartments, two hoisting and one pumping, each compartment being eight feet by five feet clear, inside of timbers. The shaft is well timbered and is a good piece of workmanship. At its bottom there is a seven-foot bed of coal upon which a gangway was driven west in 1868, to a distance of two hundred and seventy-five feet from the shaft. No gangway was ever driven east from the shaft, and the foot of the shaft itself is in a fault which appears to be an upthrow to the east of considerable magnitude. Very little coal was ever mined from here, and what was taken out was burned under the boilers at the shaft. The quantity of water to handle here was pretty large, and the shaft was furnished with a Cornish pump, the pumping engine having a twenty-two-inch cylinder with forty-eight-inch stroke, and being geared four to one. The hoisting engine has 16″×48″ cylinder and is geared three to one.

It was but a few months after reaching the coal at the foot of this shaft, when, the company which owned the property getting into financial trouble, the work was suspended, and the shaft allowed to fill with water. Since that time it has been once again pumped out, and kept clear of water for a month or two, when, owing to similar causes, it was again allowed to refill.

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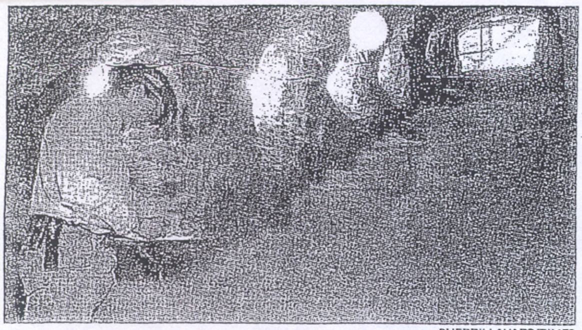


SHERRY LAVARS/TIMES

MINE SUPERVISOR Joe Britton of the East Bay Regional Park District charts air quality inside the Eureka Slope at Black Diamond Mines Regional Preserve in Antioch on Wednesday.

WHAT LIES BENEATH?

4,000-home Antioch project faces delays over abandoned mine threat

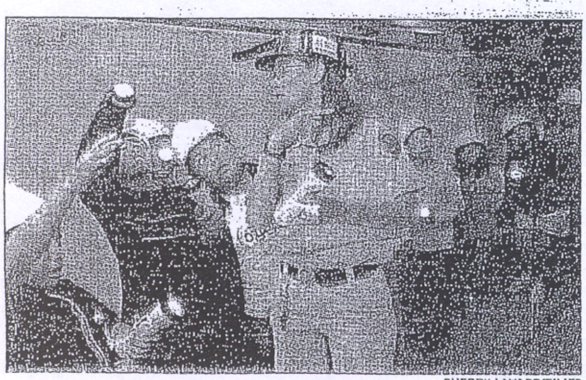
By Jane Ramsey
TIMES STAFF WRITER

AN UNDERGROUND MAZE of abandoned mines in southeast Antioch threatens to delay one of the city's largest and most ambitious development projects.

The proposed Future Urban Area No. 1 development is still being planned, refined and reviewed, but it could eventually cover as much as 2,700 acres at the southern border of the city and include thousands of new homes. The trouble is, no one is quite sure what lies beneath the surface of that land. The region was once home to a mining industry that thrived from the mid-19th to the early 20th centuries. The miners are all gone, but a labyrinth of abandoned mine shafts and tributary tunnels remains.

The 12 known mines in East Contra Costa have hundreds of miles of underground tunnels, said John Waters, mines manager at Black Diamond Mines Regional Preserve. How many of those workings lie beneath the FUA-1 area and what dangers they might pose are questions that have yet to be completely answered. Existing records are incomplete. Some were de-

See MINES, Page 14

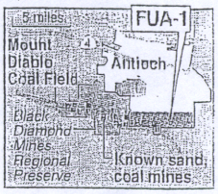


SHERRY LAVARS/TIMES

NATURALIST Sabrina Dussau fields questions from San Pablo fourth graders Erik Maya, left, Jose Bello, Jose Muñoz and Eduardo Hernandez inside the Hazel-Atlas mine.

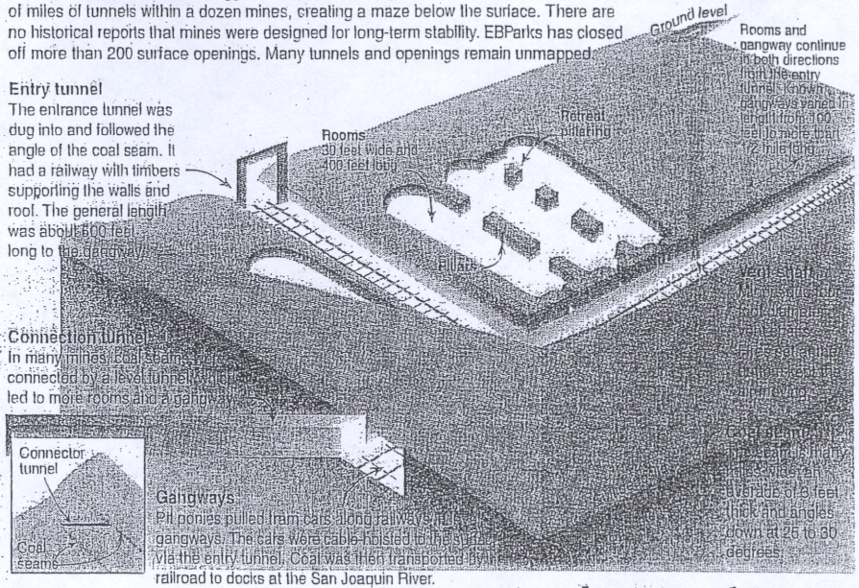
Proposed develo d areas within
Future Urban Area 1

Up to 4,000 housing units, retail, school, other public buildings and a golf course proposed on 2,700 acres, a 1-by-4 mile rectangle.



Tunneling below ...

Mount Diablo Coal Field, the biggest former coal mining area in California, has hundreds of miles of tunnels within a dozen mines, creating a maze below the surface. There are no historical reports that mines were designed for long-term stability. EBParks has closed off more than 200 surface openings. Many tunnels and openings remain unmapped.

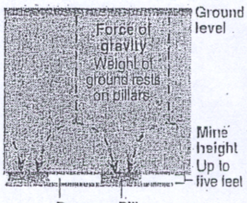


... causes collapses, bringing ...

On August 3, 2002, evidence of retreat pillaring, which leaves the ground above more vulnerable to sinking, was found in one of the mines. Up until then experts believed only the room and pillar method was used; no one knows the extent of retreat pillaring.

Room and pillar

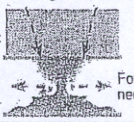
Pillars of coal were left between the rooms to hold up the mine roof. In historical accounts the Star, West Hartley and Empire mines generally have rooms 30 feet wide and 400 feet long. About 60% of the coal was removed; leaving the rest to support the mine roof.



Retreat pillaring or pillar extraction

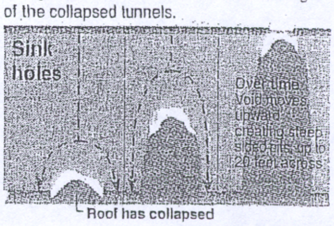
Before abandoning the mines, miners may have removed or reduced the pillars, leaving them too small to permanently support the weight above.

Stump pillars deteriorate faster
Pressure from ground above is greater on the smaller pillars, crushing them, causing mine to collapse.



... dangers above

The collapse below weakens the ground above, causing it to sink. This subsidence causes sink holes and sags, which can occur gradually or suddenly, regardless of the depth of the mine. The ground cannot sink more than the height of the collapsed tunnels.

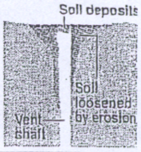


Sags Caused by multiple pillars collapsing. A wide area sinks, sometimes over many acres.

Other potential dangers are ground cracks, slide-prone areas; mine gases or acidic water draining from the mine.

Ventilation shafts pose threats too

The integrity of the shaft walls deteriorates from erosion. The miners closed some shafts by placing timbers across the opening. Soil deposits make openings invisible.



Sources: East Bay Regional Park District; City of Antioch; U.S. Geological Survey; GAI Consultants, Inc.

JOHN MARTIN/TIMES

SHERRY LAVARS/TIMES

NOZZLEMAN Randy Dutton sprays shotcrete into a mine opening near Coal Canyon while working on the Nortonville Maintenance Project at Black Diamond Mines Regional Preserve.

Mines

FROM PAGE 1

stroyed in the 1906 San Francisco earthquake and fire. Others simply vanished over time.

"Abandoned mines pose a real hazard to the general public as the population moves outward to foothills where mining activity occurred," said Doug Craig, manager of the Abandoned Mine Lands Unit at the state Department of Conservation. His unit remediated 56 abandoned mines at 23 sites throughout the state last year. The average cost is about $5,000 per mine. Remediation involves backfilling a mine shaft, blasting it apart or closing it with polyurethane foam.

More precise studies of mine locations in the FUA-1 area are being done by the Zeka Group, owners of the Zeka-Higgins property at the area's western border with the Black Diamond Mines Regional Preserve.

"The geologic studies should pin down the locations of (mines)," said Victor Carniglia, the senior Antioch planner. "The results have not been submitted to the city yet."

The mines and other environmental concerns have already prompted city officials to extend the project's environmental review period. Antioch City Councilman Jim Conley said he has seen the development plans shrink significantly from the 5,000-plus homes originally talked about two years ago.

"We're now down around 4,000 to 3,800 homes and could get lower than that," Conley said. "Mines are one piece of the puzzle."

Conley, who remembers exploring deserted mine shafts as a boy growing up in Clayton, said some mines in FUA-1 are easily accessible "if you knock the boards off."

Developers must find the locations and depths of the shafts to determine where they can build and where they should not, Conley said.

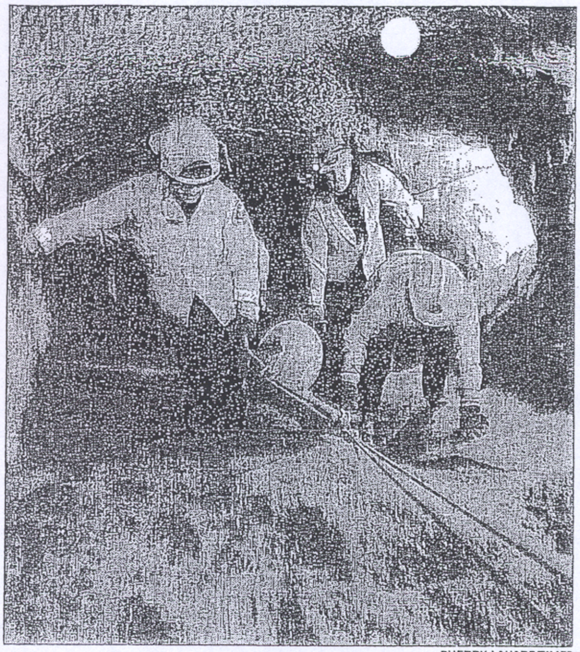
Normally, on any project, if grading is to be done, soil tests and other studies are done to ensure the land is appropriate to be developed, according to Guy Bjerke, acting president of the Home Builders Association of Northern California.

"All kinds of engineers are brought in to see what exists and the best way to achieve the goal of the project," Bjerke said.

In some cases, state officials said, the usual quick fixes for abandoned mines can't be applied. Potentially dangerous gasses from mining days could potentially build up behind a sealed mine. While some venting to the outside with pipes could be done, the practice could also pose habitat problems.

"A lot of planning goes into (remediation)," Craig said. "It req res time and money."

Besides the hazards associated with collapse of underground tunnels and mining rooms, acidic waste from abandoned mines can contaminate water and carry heavy metals.



SHERRY LAVARS/TIMES

FIREFIGHTER Laurel Hildum loses her footing but manages to hold onto her corner of a backboard with a patient during a Regional Parks rescue training exercise Thursday inside a mine near Antioch.

A shaft to pump water from the abandoned Empire Mine surfaces on property in the Antioch planning area. It was partially plugged in 1982, but acid mine drainage flows around the shaft's plug into a tributary of Sand Creek at a rate of 16 gallons per minute according to the planning area's draft environmental impact report. A 1995 effort to further seal the seepage was deemed ineffective by the U.S. Department of the Interior.

Carbon dioxide in abandoned mine shafts also poses a danger. The gas collects and rises or falls depending on existing atmospheric pressure. Four youths were asphyxiated in the early 1980s while they explored a carbon dioxide-filled mine in what is now part of the Black Diamond Mines Regional Preserve.

Coal mining revenues pay for abandoned mine mitigation programs in most western and eastern states. But California has no active coal mines, so it does not qualify for the Surface Mining Control and Reclamation Act money.

Coal in Contra Costa was mined by the "room and pillar" method. Miners hand-dug a three-foot square opening which was then widened into a 30 foot room. They then excavated three-to-five-foot thick seams of coal. By this method, the majority, or 60 percent, of the coal was mined out while 40 percent was left behind in pillars supporting the room.

Miners worked in teams of one experienced journeyman and one apprentice. A journeyman miner could be as young as 13 years old, with apprentices as young as 8.

The room and pillar method is the only method documented in mining records. But another method, retreat mining, has been found at the Nortonville mine in the regional preserve.

Retreat mining was done in much the same way as room and pillar mining, but instead of large pillars, small stumps were left behind in the mined rooms.

The stump pillars can easily be crushed by the weight of the earth above in the process known as subsidence.

Subsidence, the geologic process where mine openings collapse to the surface, comes in two forms, both potentially hazardous to homes built over the old mines.

Sinkhole subsidence is caused by a weakness in the rock. A collapse during mine closure work at the Nortonville mine site is an example of this type of subsidence.

Another, more insidious form of subsidence associated with mines is sag or trough subsidence. In this type, wide areas of land — sometimes many acres — sink or settle several feet below previous levels.

The undocumented retreat mining at Nortonville raises questions about potential abandoned mine hazards for potential homes slated for the land.

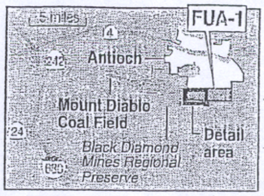
"The question becomes, what else don't we know," Waters said. "If retreat pillaring was done, the whole area could be affected."

Soon after coal was discovered near Mount Diablo in the 1850s, several towns sprang up around coal mine sites in East Contra Costa. Three towns — Somersville, Stewartsville and Nortonville — were within present-day East Bay Regional Parks boundaries. Three others — Jud-

Abandoned mines within the FUA-1

The information below was taken from material published in 1894 and 1897 by the California State Mining Bureau. U.S. Dept. of the Interior, Office of Surface Mining is responsible for abating hazards of coal mines closed prior to 1977. It spends an annual average of $250,000 to abate these hazards and to maintain previously closed openings.

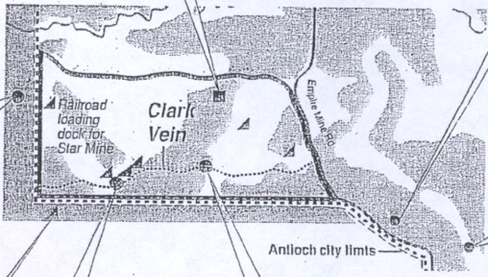
- Proposed development area
- Area with abandoned mines
- Mine entrance
- Large closed shaft
- Small closed shaft
- Black Diamond Mines Regional Preserve



Pumping shaft
This vertical shaft is about 470 feet deep and was made to pump water out of the Empire Mine. The OSM sealed the shaft in 1982 with a 38-foot diameter, steel cone filled with concrete. It was sealed again in 1995 with polyurethane foam. It is still leaking acidic water today.

Tuetonia Mine
The entry tunnel was 400 feet long with a 100-foot long gangway. This coal was thought to be part of the Clark Vein.

Star Mine
Two entry tunnels were dug, one 430 feet long at a 28 degree angle and the other 400 feet long. One was closed in 1975 by EBParks; the OSM closed the other in 1982.



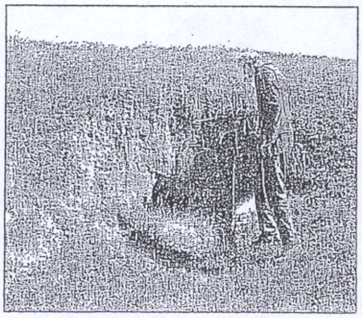
Israel opening
The first coal in the Mount Diablo Coal Field was discovered here about 1854. Rooms were at 200 feet deep, a shallow depth. The mine didn't yield quality coal.

West Hartley Mine
Accounts state this and the Empire Mine had considerable amounts of coal mined. These and the Star Mine were sealed by OSM in 1982.

Empire Mine
In 1861 miners dug 200 feet deep and stopped because of too much water in the tunnel. The entry tunnel later was dug to 1,200 feet; two railways side-by-side ran the whole length. A pumping shaft was added, shown above. A 300-foot connection tunnel led to another seam. The ventilation shaft, shown below, is thought to extend from one of the rooms in the second seam.

Ventilation shaft found 120 feet from FUA-1

An incline ventilation shaft, just 120 feet from the Future Urban Area 1 boundary, was sealed on May 12. It was found May 18, 2002, by a Black Diamond Mines Regional Park ranger. This indicates there was more mining in this area than previously believed. The park seals an average of three mine openings a year.



Someone had closed this shaft with rocks and dirt. Over time, the dirt eroded, exposing the rocks and tunnel. John Waters, mines manager, said that testing detected carbon dioxide, a tell-tale sign of mines. Work crews removed the rocks and determined it was an incline ventilation shaft, believed to be connected to the Empire Mine tunnels.

EBParks

The shaft was plugged by 28 feet of polyurethane foam. The ground will be rehabilitated to its natural slope.

Sources: East Bay Regional Parks; US Geological Survey; US Dept. of the Interior

JONI MARTIN/TIMES

sonville, West Hartley and Empire — are within the future urban planning area.

The coalfields mined in the mid-1800s near Mount Diablo were the most plentiful and important of all the coalfields in California. The mines yielded lignite coal, a soft coal used to produce steam.

During the mid-to-late 1800s, coal was to the world what oil is today — the major source of fuel for industry and homes. Before it was mined from the Mount Diablo fields, coal was brought to the West Coast in sailboats from Australia, Chile and around Cape Horn from Appalachian mines.

The East Contra Costa mines provided more than half of Northern California's industrial energy for about 50 years until 1902, according to Waters. At their peak of operation, up to 900 miners would be underground at any given time, culling the sought-after fuel from veins deep in the earth.

In the first year of production, 200,000 tons of coal were mined out of veins in the East County mines. All told, four million tons of coal were mined from East Contra Costa before the coal industry there shut down completely in 1907. For comparison's sake, approximately 12 million tons of coal per year would keep Southern California powered today.

By the time coal production at Black Diamond ended, coal valued at more than $20 million had been mined.

With coal mining's demise, almost overnight, towns that once sported hotels, stores, fraternal lodges and a seven-room schoolhouse became ghost towns. Labor troubles, foreign competition and a declining demand for the low grade, lignite coal are credited with bringing about the demise of coal mining in East Contra Costa.

Attempts at coal mining in the 1920s, 1930s, and 1940s were unsuccessful.

Silica sand mining replaced coal mining as a successful industry in the Black Diamond mining area in the 1920s. The sand mined in East Contra Costa was used in glass making and in foundry casting until the sand mining industry folded in 1949.

Reach Jane Ramsey at 925-779-7169 or jramsey@cctimes.com.

EXHIBIT 20

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NWC AdPub 143

A MANUAL OF MINE SEARCH AND RESCUE

by
Carl F. Austin
Research Department

NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA, MAY 1968

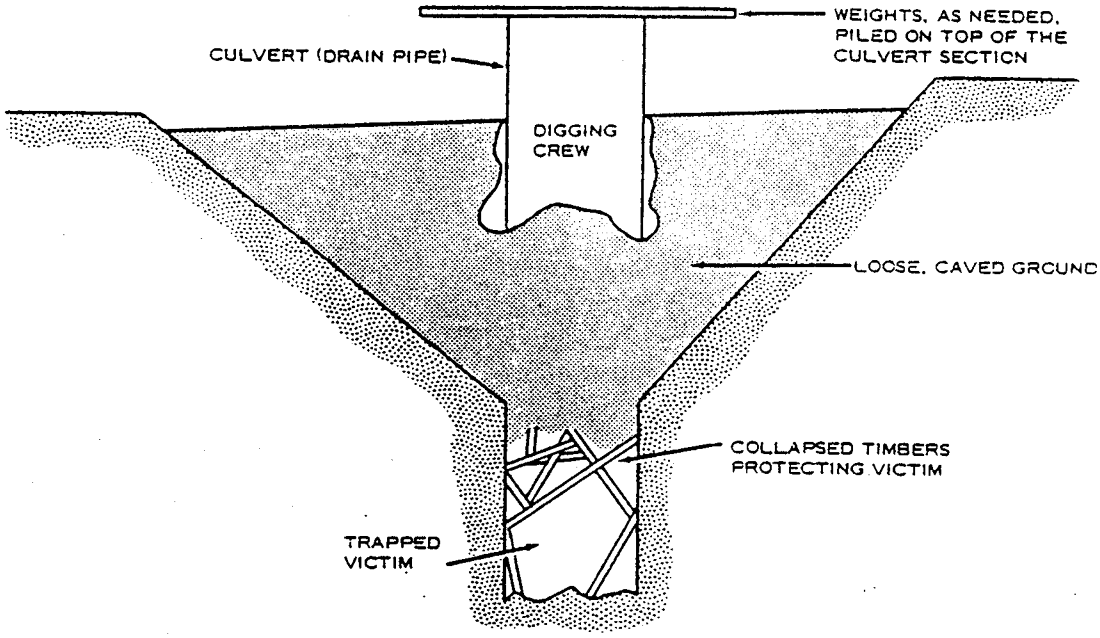


Fig. 20. A Drop Shaft Operation to Recover a Victim From a Well.

openings encountered on the way down. If the shaft falls, the area above the liner could cave-in, or as happened recently in Bakersfield, the victim below could be injured.

CAVE-INS

Without question, the weakest part of nearly all mine workings is the mine portal or the shaft collar, where the rock usually is badly broken and weathered, and often consists of little more than loose rocky soil. Timbers at the portal are subjected to alternate wetting and drying—an ideal situation for fungus damage—and are open to attack from termites and beetle larvae. Mine portals are especially prone to sudden collapse during, and immediately after, rainstorms when the soil (or soil-rock mixture) is both heavy and soft. The same high hazard prevails during thawing weather, since freezes tend to heave and disrupt the normal tendency for rocky soils to form interlocking masses. A view of a common mine portal is shown in Fig. 21. The outermost timber set, which is standing in air, is intact. The second set has collapsed, bringing down two lengths of lagging and, in all likelihood, has brought down the next several sets as well.

A typical mine opening is shown in Fig. 22. The rock between the tunnel back and the dotted line is in tension; the rest of the rock around the tunnel is in compression. Rock is extremely weak in tension, especially when fractured, as most rock is around a mine. This mass of rock in tension is unstable and is the part that is apt to fall into the mine workings when disturbed or left unsupported by timbers. The

ABANDONED MINES

INTRODUCTION

Abandoned mines, quarries, and tunnels have claimed the lives of many adults and children over the years. These abandoned sites pose potential life-threatening dangers for anyone who ventures near them.

People enter abandoned mines for a variety of reasons, ranging from curiosity to vandalism. Those who seek these pastimes often meet with sorrow and misfortune. Many young people (as well as adults) have been killed or injured while attempting to satisfy a desire to explore old mines, caves, and open pits. Several states have a lot of these dangerous places, some of them dating to the early days of prospecting.

Any old mine can be a death trap. Trespassers not only violate the law but they risk their lives and the lives of others.

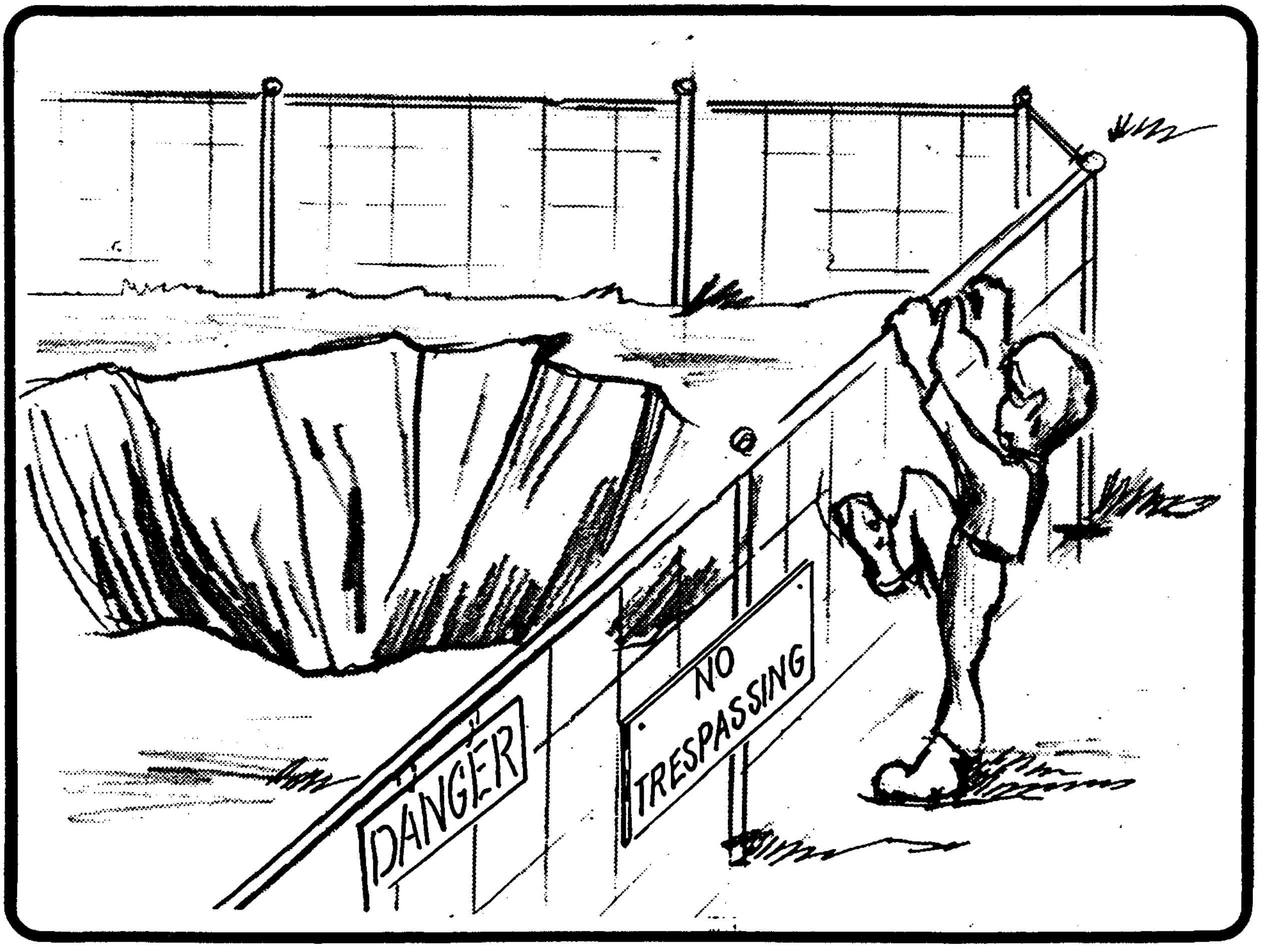
Probably the greatest number of accidents around abandoned mines occur to children. Public schools should teach children about the dangers that exist around these mines. One of the most effective ways of teaching safety in the public schools is to organize a local safety council in every school. These meetings can be conducted by the children themselves with support from concerned leaders. Through this council, the dangers with which children are likely to come in contact can be explained to them. "Fences and No Trespassing" signs will not usually stop children from venturing into a mine or onto a construction site.

While youngsters tend to risk their lives in trying to satisfy some form of curiosity, this failing is by no means confined to children. Each year adults are killed by going onto abandoned areas. In some cases, the loss of life is caused by falling from a rotten ladder. In others, it is due to fall of rock or other material from overhead or from the side. Asphyxiating gases are encountered and sometimes explosive gas is ignited. In several instances, intruders have lost their way and starved to death. Persons seeking shelter from storms have died in abandoned mine or property openings. People walking at night have fallen into unguarded, uncovered, or abandoned openings and been hurt or killed.

Provided in the back of this booklet are illustrations which can be used as handout materials or posters.

Shafts

The top of a mine shaft is especially dangerous. The rock at the surface is often decomposed and timbers may be decayed or missing. Do not walk anywhere near a shaft opening. The whole area is often ready and waiting to slide into the shaft which can be hundreds of feet deep.



Underground Holes and Shafts (Covered and Uncovered)

Underground holes and shafts may be manmade or caused by caving ground. Shafts and abandoned holes are dangerous. Persons falling into underground holes may plunge hundreds of feet to their death. These holes, when covered, can be more dangerous than open holes because the cover may be rotten or broken.

Mine shafts are deceptive because there is little or no light in a dark hole. The feeling of height and normal reaction to "pull back" is not evident in most persons. People who hesitate to look over the side of a tall building show no fear when looking into a mine shaft. Remember — a fall down a mine shaft is just like falling from a tall building.

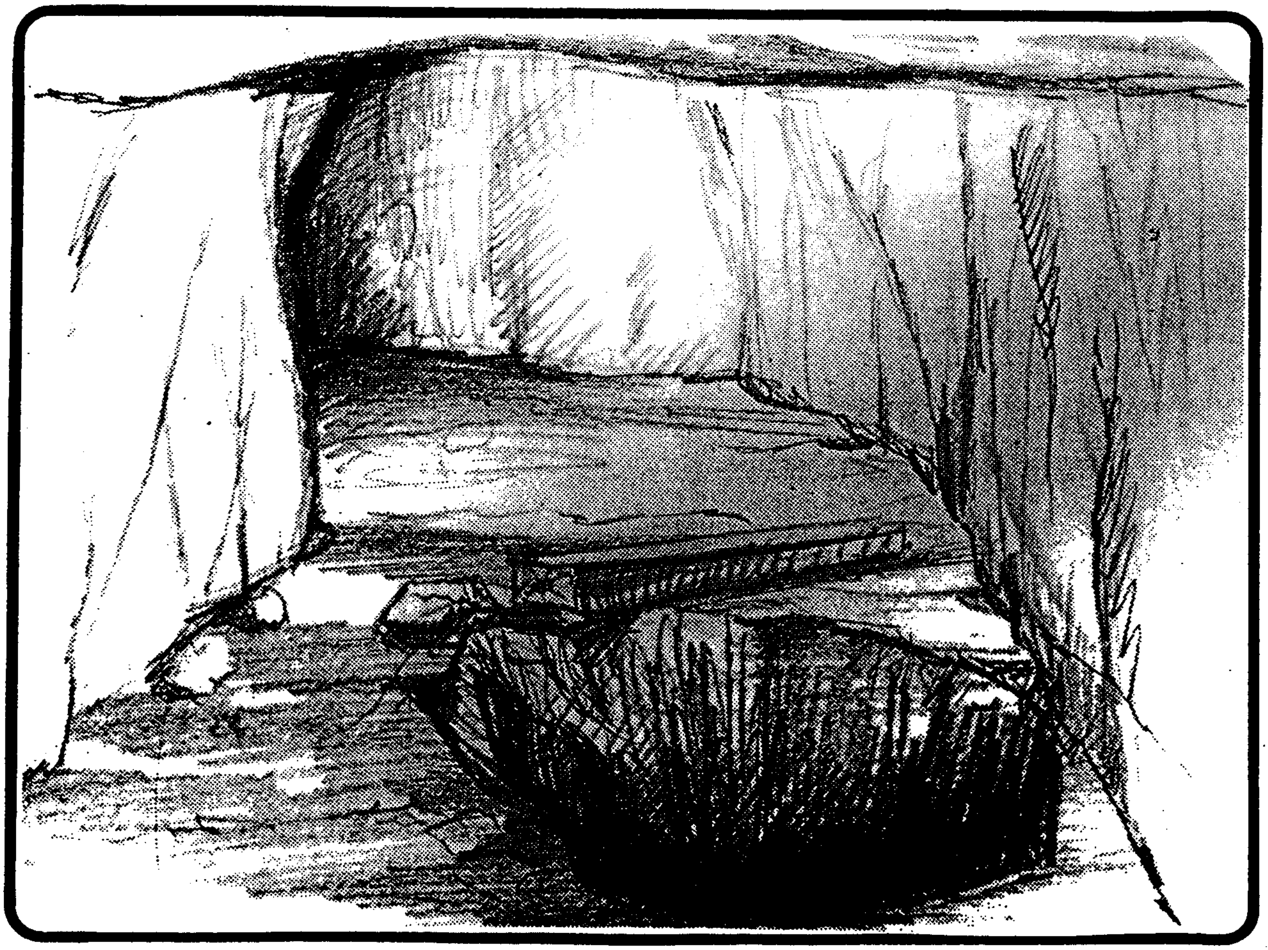


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EXHIBIT 21

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Oakland Tribune

Eastbay

Friday, December 5, 1980

B

Mines have siren lure of danger

Deadly playground

By Steve Lopez
Tribune Staff Writer

PITTSBURG — For decades, the coal and sand mines carved into the East Contra Costa County hills here have charmed youths, offering an irresistible combination of adventure and danger.

They have ignored "no trespassing" signs and warnings of the presence of poisonous gas and hammered their way through concrete and steel barriers to get into their playground.

But East Bay Regional Park District mines expert John Waters refers to it as a deadly playground, rife with the kinds of traps that killed four teen-agers late Wednesday or early Thursday.

"It's absolutely stupid to go into an abandoned mine," said Waters, who located the four bodies early Thursday after snaking through dark mine shafts.

"I wouldn't even want to do it, and mines are my business," he noted. "This is a tremendous problem.

"These people died, so you'll hear about this case, but every few months we dig out injured people.

"I've seen parents come up here with kids and bag lunches and send their kids into the mines to play."

What killed the four boys, according to Waters, was a somewhat freakish set of circumstances which led to an overabundance of carbon dioxide and a lack of oxygen deep in a sand mine.

Very infrequently, often no more than once annually, the right combination of temperature and a rise in barometric pressure disrupts the ventilation in the maze-like network of tunnels and mines, he said.

"Temperatures inside and outside the mines equalize, and the natural ventilating currents come to a stop," Waters explained.

See DEADLY, Page B-2

Long history of peril

By Paul Grabowicz
Tribune Staff Writer

PITTSBURG — The Black Diamond mines area where four teenagers were found dead Thursday has been plagued for 30 years by accidents involving severe injuries and even fatalities to youngsters in the East Contra Costa County area.

Since 1952, five other young people have reportedly been killed in the mines — with the most recent fatal incident occurring 15 years ago.

On numerous other occasions, children have wandered in the area's labyrinth of tunnels for hours before being rescued by authorities or frantic parents.

Since 1960 more than 10 separate incidents of lost or injured youngsters have occurred at the mines, including:

■ March 7, 1976 — Two Concord teen-agers were rescued by authorities after wandering into one of the mines and becoming lost.

■ March 3, 1974 — A 14-year-old Concord boy suffered a fractured skull when he fell 30 feet down a mine shaft.

■ April 25, 1971 — Three Pittsburg boys, ages 16 and 17, were lost for 11 hours in one of the caves before being rescued.

■ July 25, 1968 — Five young people from Contra Costa County were lost in the mines for five hours before one of them managed to get out and alert authorities.

■ April 16, 1967 — A 17-year-old Concord boy fell 35 feet down a mine shaft and sustained minor injuries.

■ March 6, 1966 — Four Concord teen-agers were lost for nearly three hours before being found in one of the caves by sheriff's deputies.

■ May 31, 1966 — Two eighth graders from Lafayette were lost for 24 hours before finally finding their way out of the mines.

See HISTORY, Page B-2

Deadly

Continued from Page B-1

"The gases that collect down in the coal mines, which are buried beneath the sand mines, rise into the sand mines. The oxygen level can get as low as 8 to 10 percent, and the carbon dioxide can overcome you within minutes."

He said there are also traces of methane and other potentially harmful gases, but he believes there are only negligible quantities of them.

Autopsies will be conducted by the Contra Costa County Sheriff-Coroner's Office to determine the exact causes of death.

Waters said he located the bodies about two-thirds of a mile into a sand mine. Near them was a shaft, approximately 18 inches in diameter, that led to a coal mine.

The deadly carbon dioxide was funnelled up through that shaft and into the small chamber the youths were in, he said.

"They probably didn't know what hit them," Waters said. "How long would it take (to die)? Hold your breath and see how long it takes."

To enter the shaft, the youths lowered themselves into a corrugated metal pipe about 45 feet long and at a 45-degree angle, putting them into a main sand mine shaft. They traveled about a mile through the shaft to the point where they died.

The steel pipe they entered through was at one time closed off with cement and steel, but vandals used a jack hammer to pound through 18 inches of steel-reinforced cement and used a torch to melt the steel.

The deaths once again raised the old issue of whether more drastic steps need to be taken to secure the mines.

Officials for the Southport Land and Commercial Co. of San Francisco, which owns the land where the boys died and leases some of it to ranchers, said they have tried repeatedly to secure the caves and post signs warning of the deadly gas, only to have their efforts destroyed or ignored.

The East Bay Regional Park District, which in 1972 purchased the Black Diamond Mines Regional Preserve to the east of the Southport property, has spent thousands of dollars closing off entrances to 80 caves.

History

Continued from Page B-1

■ May 16, 1965 — A 20-year-old Richmond man out for a stroll fell 50 feet to his death in one of the mine shafts.

■ Aug. 7, 1963 — A 15-year-old Pittsburg youth suffered minor injuries after falling 20 feet down one of the shafts.

■ Jan. 20, 1963 — A Pittsburg boy fell 40 feet down one of the mine shafts and injured his back.

One of the most bizarre incidents occurred in 1952, when four youngsters entered one of the shafts and disappeared, never to be heard from again. Their bodies were not recovered, but authorities at the time believed they perished in the deeper recesses of the caves.

Deaths at the mines extend back to 1855 when the mines were first opened, and there have been frequent efforts to make them safe.

Ironically, 14 years ago the Contra Costa County mayor's conference asked the district attorney to explore what could done to eliminate the dangers.

The district attorney, however, found there was little action the county could take in the matter.

EXHIBIT 22

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CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

INSPECTION REPORT

DISCHARGER: OLD EMPIRE MINE — 24 February 1987

LOCATION & COUNTY: West Hartley on Higgins Property, Contra Costa County

CONTACT(S): Ken Burger, Water Quality Specialist; John Water, Mining Superintendent; Rick Yarborough, Mining Technician, East Bay Regional Parks District

INSPECTION DATE: 30 December 1986 and 9 January 1987

INSPECTED BY: Sterling P. Davis

ACCOMPANIED BY: Ken Burger, John Waters, Rick Yarborough

OBSERVATIONS AND COMMENT

On 23 December 1986, Will Bruhns of Region 2 reported a complaint received from Pat Blodgett, EPA (415) 974-8273. Pat was driving on Empire Mine Road on 21 December 1986 and saw a creek two miles south of Lone Tree Way that had dark orange/red scum on the rocks. I inspected the stream on 30 December 1986. The stream (Sand Creek at Empire Mine Road) had a red/brown deposit on the bottom about 1/4 inch thick. Flow was about 16 gpm, pH 3.0, EC 4,200 umhos/cm. Sand Creek is tributary to Marsh Creek, tributary to Big Break, tributary to the San Joaquin River.

On 9 January 1987 I reinspected the creek accompanied by staff of the East Bay Regional Park District listed above. Water samples were collected on Sand Creek at Empire Mine Road, west branch of Sand Creek and south branch Sand Creek at the Old Empire Mine, near West Hartley on the Higgins property. Sample locations are shown on the attached sketch. Samples were analyzed for pH, EC, ICAP metals, SO_4, Cl, total alkalinity and boron. Results are attached.

Flow in Sand Creek at Empire Mine Road was 16 gpm. We traced Sand Creek upstream to determine the source of acid mine drainage. The west branch of Sand Creek near Empire Mine Road had a flow of 1 gpm. Water was clear, vegetation abundant, including grass and cattails, with no deposit on stream bottom.

We followed the south branch of Sand Creek upstream to the source. It runs along Empire Mine Road 1/4 mile and then angles to the southwest to the source of acid mine drainage at the old Empire Coal Mine near West Hartley. Flow comes out of the mine shaft at 15 gpm. Sand Creek was dry upstream of the mine shaft.

Field pH at the mine shaft = 2.6; EC = 4,400 umhos/cm; temp = 59°F. Water was surfacing around the outside of a metal cone placed in the mine shaft opening. Bubbles and a sulfur smell was evident where water surfaced. Vegetation is absent along the south branch probably due to low pH in the water.

John Waters gave me a copy of a report by the Department of the Interior, Office of Surface Mining, Denver, Colorado, entitled "Nortonville - West Hartley Mine Shaft Closure," dated 30 March 1983. The mine shaft was closed in September 1982 with a large metal cone filled with concrete and rocks. The purpose was to protect the safety of visitors and allow mine water drainage to continue. Cost of the closure was $144,446.

They were concerned that an attempt to plug off and seal the shaft may result in a "blowout" at some other location, or cause contamination of a well on the Higgins property about 1/2 mile away, used for irrigation and livestock watering.

The mine shaft is near the abandoned coal-mining town of West Hartley, about three miles south of Antioch in the NW1/4, SE1/4 Section 12, T1N, R1E, MDB&M on Mr. Howard R. Higgins' ranch property, (415) 754-7736.

Coal mining in the area began about 1860 for the low grade lignite coal used by industry for steam generation. Mining stopped about 1900 when petroleum (oil, and natural gas) took the place of coal. Mining at the site began about 1875 by the Empire Mine Company and ceased about 1906. The mine, per Mr. Higgins, started draining in 1940, a year of heavy rain. Summer discharge is about 5 gpm; winter discharge 10 - 15 gpm. When the shaft was being excavated to accept the cone (1982), water discharged at 2,000 gpm when some type of plug was breached. Placing the cone caused the discharge to return to the pre-cone flow of 5 gpm winter and 10 - 15 gpm summer.

I took about 12 slides to finish a roll of Ektachrome 100 film and a 24 slide roll of Kodachrome 64, Cannon AT-1 camera.

Sand Creek downstream receives treated wastewater from stripper oil wells. U.S.G.S. Quad Maps list Sand Creek as an intermittent stream. Oil production facilities and mine drainage are the major source of flow in Sand Creek. Oil production facilities are governed by NPDES permits.

Discharge from oil production facilities exceeds drinking water standards for EC and chlorides; and exceeds agricultural goals for crops for EC, boron and chlorides. However, local water users obtain their domestic and irrigation water from other sources.

INSPECTION SUMMARY:

The entire flow of the south branch of Sand Creek (15 gpm) comes from acid mine drainage from the abandoned Empire Mine on Higgins' ranch property near abandoned West Hartley. The mine shaft, per Mr. Higgins, has been draining since 1940.

The south branch of Sand Creek exceeds water quality criteria for fresh water aquatic life for six constituents (pH, aluminum, beryllium, chromium, nickel, and zinc); exceeds drinking water standards for four constituents (sulfate, EC, iron, and zinc); and exceeds agricultural goals for crops for eight constituents (EC, aluminum, boron, cobalt, iron, manganese, nickel, and zinc).

Sand Creek at Empire Mine Road (below the confluence of south and west branch, flow 16 gpm) exceeds water quality criteria for fresh water aquatic life for six constituents (pH, aluminum, beryllium, chromium, nickel, and zinc); exceeds drinking water standards for three constituents (sulfate, EC, and iron); and exceeds agricultural goals for crops for nine constituents (chloride, EC, aluminum, boron, cobalt, iron, manganese, nickel, and zinc).

The west branch of Sand Creek (flow 1 gpm) exceeds water quality criteria for fresh water aquatic life for one constituent (aluminum); exceeds drinking water standards for two constituents (sulfate and EC); and exceeds agricultural goals for crops for three constituents (chloride, EC, and boron).

Discharge from oil production facilities exceeds drinking water standards for EC and chlorides; and exceeds agricultural goals for crops for EC, boron and chlorides. However, local water users obtain their domestic and irrigation water from other sources.

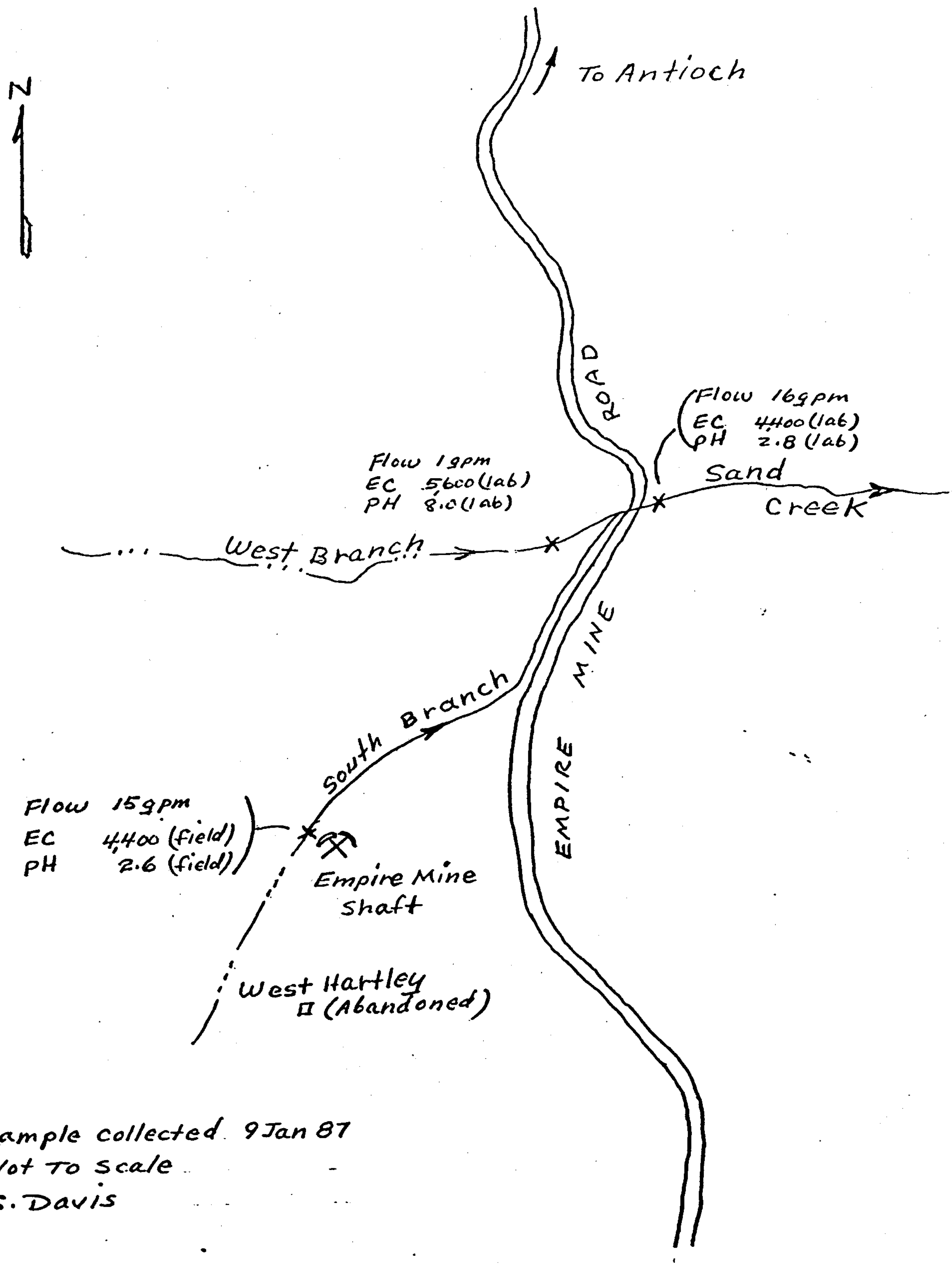
Sterling Davis

STERLING P. DAVIS
Environmental Specialist

SPD/mm

Attachments

ACID MINE DRAINAGE
OLD EMPIRE MINE
WEST HARTLEY



Sample collected 9 Jan 87
Not to scale
S. Davis

ANALYTICAL LABORATORY
A DIVISION OF DEWANTE & STOWELL

1914 S STREET, SACRAMENTO, CALIFORNIA 95814 • 916-447-2946

February 3, 1987
Date Sampled: 1/9/87
Date Sample Received: 1/9/87
Report #111764

State of California
Regional Water Quality Control Board
3443 Routiers Rd.
Sacramento, CA 95827

ATTN: Sterling Davis

ANALYSIS	Sand Creek W. Branch 111764-1	Sand Creek Empire Mine Rd. 111764-2	Sand Creek S. Branch at Empire Mine 111764-3
METALS SCAN BY ICAP			
Aluminum, mg/l	0.56*	166 *,***	259 *,***
Antimony, mg/l	<0.06	<0.06	<0.06
Arsenic, mg/l	<0.2	<0.2	<0.2
Barium, mg/l	<0.2	<0.2	<0.2
Beryllium, mg/l	<0.005	0.052*	0.087*
Boron, mg/l	4.4 ***	2.4 ***	0.69 ***
Cadmium, mg/l	<0.005	<0.005	<0.005
Calcium, mg/l	333	225	142
Chromium, mg/l	<0.01	0.015*	0.023*
Cobalt, mg/l	<0.05	0.37 ***	0.62 ***
Copper, mg/l	<0.025	<0.025	<0.025
Iron, mg/l	<0.1	91 **,***	511 **,***
Lead, mg/l	<0.05	<0.05	<0.05
Lithium, mg/l	0.45	0.42	0.37
Magnesium, mg/l	181	125	78
Manganese, mg/l	<0.015	6.7 ***	11 ***
Molybdenum, mg/l	<0.05	<0.05	<0.05
Nickel, mg/l	<0.04	0.91 *,***	1.5 *,***
Potassium, mg/l	7.0	17	41
Selenium, mg/l	<0.2	<0.2	<0.2
Silver, mg/l	<0.01	<0.01	0.022
Sodium, mg/l	890	400	70
Thallium, mg/l	<0.4	<0.4	<0.4
Tin, mg/l	<0.1	<0.1	<0.1
Vanadium, mg/l	<0.05	<0.05	<0.05
Zinc, mg/l	<0.02	3.2 *,***	5.4 *,**,***

RECEIVED SACRAMENTO CVRWQCB FEB 6 1 01 PM '87

* Exceeds W.Q. Criteria for freshwater aquatic life
** Exceeds Drinking water standards
*** Exceeds Agricultural Goal for crops.

Data Certified By [signature]

Report Approved By Roger Elliott

tma

ANALYTICAL LABORATORY
A DIVISION OF DEWANTE & STOWELL

1914 S STREET, SACRAMENTO, CALIFORNIA 95814 • 916-447-2946

February 3, 1987
Date Sampled: 1/9/87
Sample Received: 1/9/87
Report # 111764

State of California
Regional Water Quality Control Board
3443 Routiers Rd.
Sacramento, Ca. 95827

Attn: Sterling Davis

Sample Description/ Anlab ID#	Chloride mg/l (D.W. Std.)	Sulfate mg/l (D.W. Std.)	Alkalinity mg/l as CaCO3	Spec. Cond. uhmos/cm (D.W. Std)	Boron mg/l	pH
Sand Creek, W. Branch 111764-1	280*** 500	1200** 500	410	5600*,** 1600	4.1	8.0
Sand Creek, Empire Mine Rd. 111764-2	150*** 500	670** 500	-0-	4400*,*** 1600	2.3	2.8*
Sand Creek, S. Branch at Empire Mine 111764-3	37 500	1400** 500	-0-	3900*,*** 1600	0.28	2.7*

* Exceeds w.q. criteria for freshwater aquatic life
** Exceeds Drinking Water Standards
*** Exceeds Agricultural Goal for crops

Data Certified By Gail Cho-Cebrecki
Report Approved By Roger Elliott

:ma

RECEIVED
SACRAMENTO
CVRWQCB
FEB 6 1 01 PM '87

OF CALIFORNIA

GEORGE DEUKMEJIAN, Governor

FORNIA REGIONAL WATER QUALITY CONTROL BOARD—
TRAL VALLEY REGION
ROUTIER ROAD
MENTO, CA 95827-3098

9 April 1987

CERTIFIED MAIL
P 222 392 692

Mr. Howard R. Higgins
P. O. Box 457
Antioch, CA 94509

REQUEST FOR MONITORING STUDY

Enclosed for your information is a copy of an inspection report concerning acid mine drainage from the Old Empire Mine to the south branch of Sand Creek on your property. The mine drainage as it enters south branch, Sand Creek, exceeds water quality criteria for fresh water aquatic life, exceeds drinking water standards, and exceeds agricultural goals for crops.

We are concerned that this discharge may adversely affect beneficial uses of downstream waters. Pursuant to Section 13267 of the California Water Code, you are required to submit to the Regional Board by 9 May 1987, a work plan and time schedule to evaluate the impact of acid mine drainage on Sand Creek.

At a minimum the plan should include monthly monitoring for three months of the mine drainage, of Sand and Marsh Creeks, and of their significant tributaries for flow, electrical conductivity, pH, chloride, sulfate, iron and zinc. At least one sample of the mine drainage shall be analyzed for heavy metals by ICAP analysis. Laboratory analyses shall be submitted monthly. Within 60 days of the last sampling, a report shall be submitted to the Board summarizing the data and evaluating the impact of the drainage on Sand and Marsh Creeks.

If you have any questions, please call Sterling P. Davis at (916) 361-5663.

Kenneth D. Landau

KENNETH D. LANDAU
Senior Engineer

SPD/mm

Enclosures

cc+encl: Warden Larry Kirsch, Department of Fish and Game, Region III, Yountville
Mr. John Water, East Bay Regional Park District
Mr. Ken Axe, Contra Costa County Health Department, Martinez

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EXHIBIT 23

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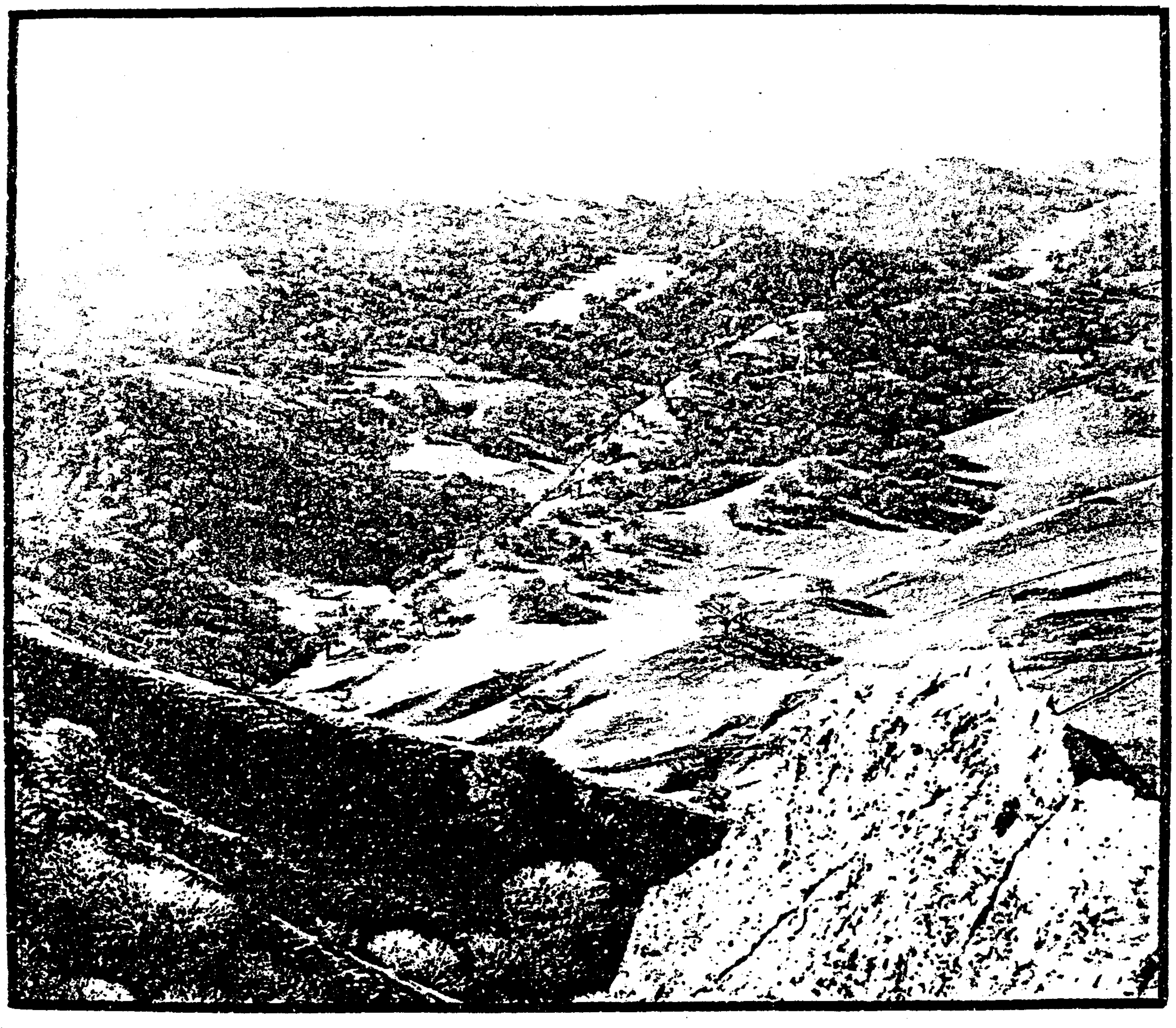
BLACK DIAMOND MINES REGIONAL PRESERVE



Land Use-Development Plan
Environmental Impact Report

BLACK DIAMOND MINES REGIONAL PRESERVE

LAND USE-DEVELOPMENT PLAN
ENVIRONMENTAL IMPACT REPORT

DRAFT: July 1977

REVISED: August 1977

ADOPTED: August 26, 1977
RESOLUTION NO. 1977-8-250

Prepared by:

East Bay Regional Park District
Planning and Design Department
Karen Helms Parsons, Planner
Neil Havlik, Resource Analyst
Peter Koos, Landscape Architect

Contact person: Karen Helms Parsons, 531-9300, Ext. 54
or 530-2960

Photos by Monte Monteagle

Cover Photo: View of Corcoran's Valley and Mt. Diablo

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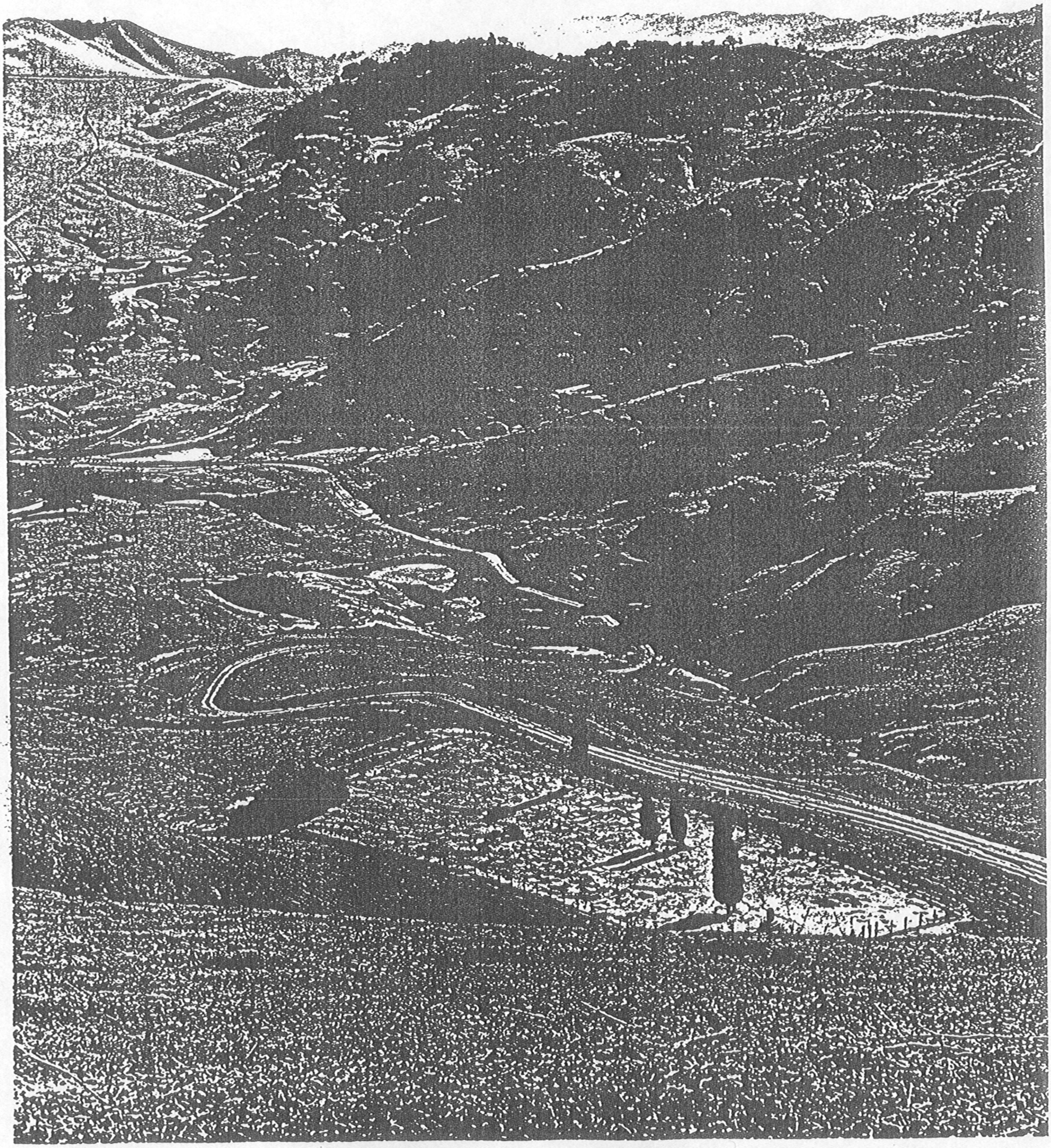
IV. LAND USE-DEVELOPMENT PLAN



IV. THE LAND USE-DEVELOPMENT PLAN

A. PARKLAND CLASSIFICATION

Parkland Classification Policy

The District Board of Directors will classify all parkland units which are, or shall become, a part of the East Bay Regional Park District system, into one of the following classifications: Regional Park, Regional Wilderness, Regional Recreation Area, Regional Shoreline, Regional Preserve, and Regional Trail. In addition, the purpose, standards, planning and management guidelines for each classification are adopted as defined below. (Master Plan, page 10)

The East Bay Regional Park District Master Plan, adopted in 1973, identifies Black Diamond Mines as a Regional Preserve because of its outstanding natural and historical resources.

PURPOSE

A Regional Preserve features an outstanding element of nature or man's past acquired by the District for the purpose of protecting the element and making it available for the enjoyment and education of the public. The essential element of such a preserve may be of an archeological, botanical, geological, historical, open space, scenic or wildlife nature.

MINIMUM STANDARDS

To be considered suitable for designation as a Regional Preserve, an area must meet these requirements:

1. *Have one of the following features:*

   a. *An element of remarkable natural wonder or scientific importance such as rare or endangered plant and animal species and their supporting ecosystems, features illustrative of geological processes, significant fossils or geological features, or unusual topographic features.*

   b. *An element of regional significance associated with the history, tradition or cultural heritage of the East Bay, which merits preservation.*

   c. *An element possessing regional open space values which is part of an adopted regional open space plan.*

2. *Protection of the element in the area by either:*

   a. *Sufficient size to insure an appropriate atmosphere for protecting and enjoying the element; or* *b. Adequate land-use controls that will prevent the adverse development of surrounding lands and waters.*

3. The element of importance in the proposed preserve (except for open space not requiring unrestricted physical public access) must either:

a. Have adjacent to it, or nearby, an area suitable for staging purposes; or

b. Be within another regional parkland which already has adequate staging facilities.

(Master Plan, page 18)

1. Special Features

The Resource Analysis has identified the special features of the park as having historical, geological, botanical, wildlife, scenic and open space value. They are discussed in more detail on page 17.

Black Diamond forms part of the northern edge of a 250 square mile open space dominated by Mt. Diablo which extends from the Antioch-Pittsburg area to the Livermore-Pleasanton area and is between the San Ramon-Clayton Valley and the San Joaquin Valley. This rugged, mountainous area includes many vegetation types and is a major wildlife area of the county. It is designated as a Major Open Space Area by the Contra Costa County Open Space Conservation Plan, 1973 and the ABAG Regional Open Space Plan, Phase II (Summary, April 1972)

2. Protection of Special Features

The Resource Analysis identifies threats to the significant natural resources. These are described on page 18 and discussed further in the EIR.

Protection of special features of the park is accomplished in part by the large size of the Preserve, 3433 acres (including future parkland area of Sidney Flat). Viewshed protection is provided by the topography in most areas. Objectional strip mining could spoil parkland views at adjacent Nortonville townsite if silica sand resources were exploited there.* As mentioned on page 10, residential areas may be developed on the flat lands to the southeast of the park. This may have visual and other impacts on the park.

Several utility easements run through the park which has been described as an "energy corridor" by some utility companies. Additional lines may pose a threat to the resources and scenic qualities of the park. The District has worked with utility companies in the past to reduce the impact of utilities in parks or park viewsheds. It is anticipated that because of the special qualities of the park, the District would try to guide utility companies in finding alternate routes for any future lines proposed through the park.

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*An 11-year legal battle was waged in the 1960's over a proposed strip mining claim on adjacent land. The Park District won the dispute, but scars of initial prospecting are still evident on the landscape and are a reminder of the impact of such actions.

3. <u>Staging Facilities</u>

Sidney Flat area (under option to be purchased), presents the opportunity for ample staging at the northern edge of the parkland closest to adjacent population centers. A suitable location for minor staging is near the Contra Loma entrance at the end of Fredrickson Lane. Other possibilities for staging from the east and west edges of the Preserve may come with future developments in those areas.

B. PROPOSED PROGRAM

In compliance with Regional Preserve guidelines, the major objective of the Land Use-Development Plan is to preserve the significant historical and natural resources of the parkland. The scenic open space quality will be maintained as it is for the enjoyment of sightseers, hikers and equestrians, and development will be held to a minimum. The most significant areas will be located within a Preserve Unit and less unique areas will be placed in the somewhat more flexible Natural Environment Unit.

Another objective of the Plan is to increase visitor use of Black Diamond mines. This will be done by increasing parking in the Preserve Staging Cluster to expand capacity from 280 visitors to 1925 visitors at one time. Another means of increasing visitor use will be to optimize interpretative opportunities of the parkland with a program of naturalist-led tours. The highlight of this program will be a supervised mine walk within the large sandstone rooms of the Somersville sand mines. This proposal will help satisfy the major desire expressed by the public for use of the Preserve area.

C. LAND USE ZONES

1. Preserve Unit

PLANNING AND MANAGEMENT GUIDELINES - PRESERVE UNIT

The element and its surrounding protection buffer should be designated a Preserve Unit, within which the following policies should apply:

1. *The preservation and enhancement of the Preserve element should be the primary planning and management objective, with interpretation and enjoyment of the element being secondary. Development within the unit should be held to the minimum required for public safety, protection and enhancement of the resource. Improvements might include such things as pathways, protective fencing, replanting of indigenous vegetation, overlook areas, explanatory signs, and shelters or fencing to protect fragile elements. Minimal sanitary facilities and potable water supply may be established if required.*

2. *Development within the unit should be designed to be harmonious in appearance with the natural environment or with the style of construction associated with the historical period being featured.*

3. *Within historic buildings, commercial uses (such as crafts, stores, book shops, and art shops) may be permitted if the uses would be harmonious in appearance with the style of the building and would not adversely affect the preservation and enhancement of the historical significance of the structure.*

4. *A Preserve Unit may be a separate site or be contained within any one of the appropriate parkland classifications.*

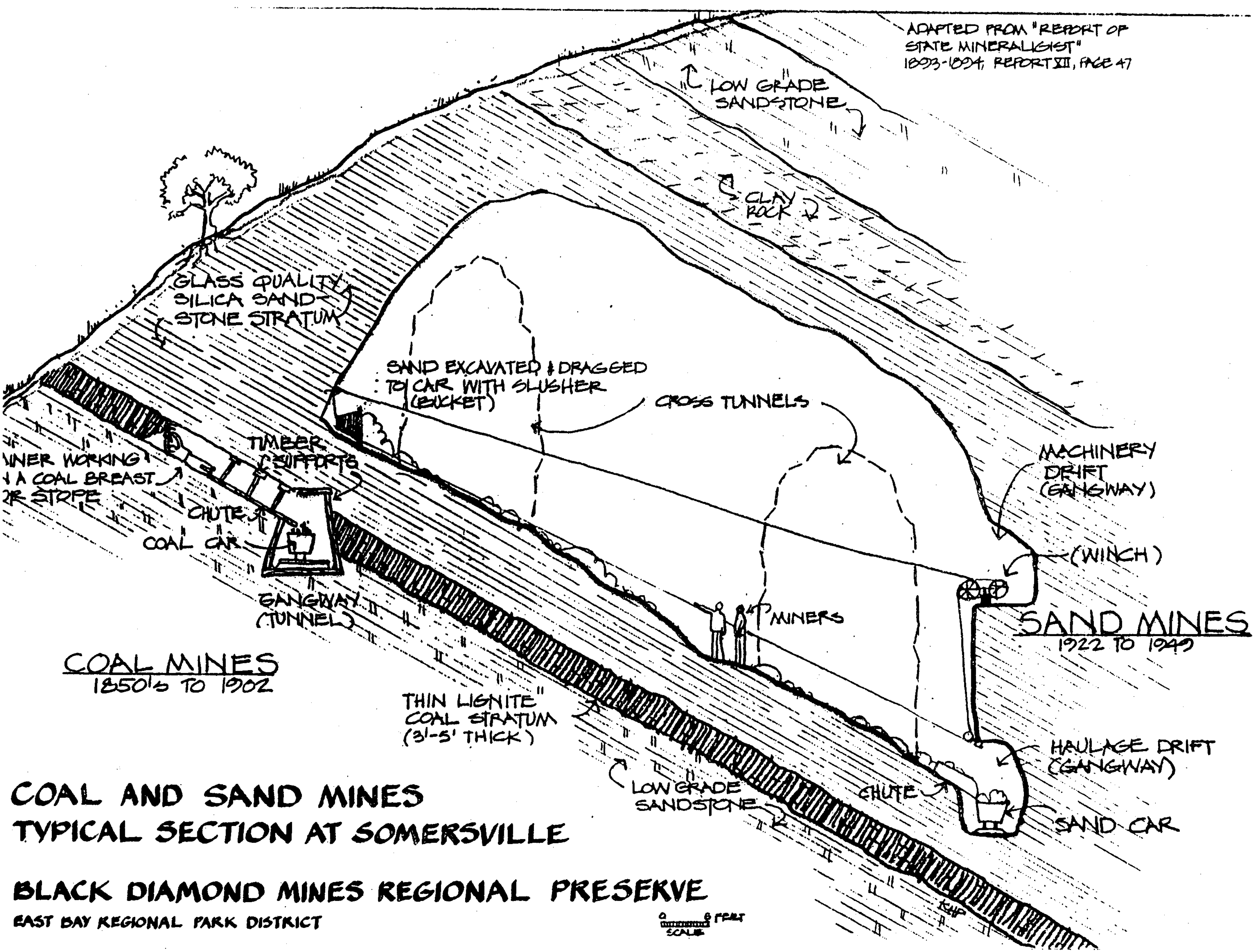
5. *Replanting of native plant communities and the control of adverse ecological processes such as insect infestation or the encroachment of exotic plant communities may be necessary to perpetuate the desired environmental character.*

(Master Plan, page 18)

1065 acres (or 31% of the parkland) are designated as the Preserve Unit. This area includes most of the significant resources outlined in the Resource Analysis. The Preserve Unit is primarily associated with Domengine Ridge, an erosion resistant sandstone ridge with exposed cliffs and rugged pine and chaparral-covered slopes. Beneath the surface are the coal and sand beds which were commercially mined in the past. The coal mining townsites are adjacent to the ridge and are placed within The Preserve Unit because of their historical significance. The Preserve Unit does not include the entire parkland area because an attempt has been made to restrict it to those features that are truly unique within the District. A buffer is provided by the topography in some areas of the Preserve Unit and by the Natural Environment Unit in other areas, which is discussed further on in the text.

The Plan proposes minimal development of the Preserve Unit, placing emphasis on the scenic natural qualities and interesting historical remnants. The primary use of the area is expected to be sightseeing, self-guided nature walks, hiking, and equestrian use. The construction of short loop trails are proposed near Somersville to increase use potential for novice hikers and to help disperse concentrated use. Because of the great interpretative potential of the Preserve, an encompassing educational or interpretative program will be provided with a wide variety of supervised public and group tours which will explore the parkland's interesting plants, wildlife, geology, history and other features.

The tour, expected to be the most popular with the general public, is a one-third mile (or longer) walk through a portion of the Somersville sand mines. (Although portions of the sand mines have been approved for public access, the coal mines beneath are hazardous and will not be included in any tours.) These mines consist of a network or terraced grid of crisscrossing tunnels. Some of these are great cavern-like rooms with 30' x 40' cross sections. The longest of these runs for approximately 800 feet. (Refer to page 33 for a discussion on mine walk capacity.) A modest mining display may be located in one area of the sand mines. No other service facilities will be located there.



COAL AND SAND MINES
TYPICAL SECTION AT SOMERSVILLE

BLACK DIAMOND MINES REGIONAL PRESERVE

EAST BAY REGIONAL PARK DISTRICT

FIG. 10

Imported drinking water will be provided at Somersville and in Corcoran's Valley. Chemical toilets will also be located at these locations.

Historical restoration of the Somersville townsite has been mentioned in previous proposals for Black Diamond Mines. Restoration is allowable under preserve guidelines but is not a goal of this Plan. The existing remnants at the abandoned townsites are worthy historical markers that have intrinsic value of their own and, regardless of restoration, they provide the public with a place to visit or study, and a setting in which to imagine the colorful mining past.* Restoration is seen as a remote opportunity because of the high cost of quality, accurate construction,which is beyond the District's resources at this time and for the foreseeable future. However, restoration could be worked out with grants, gifts, or aid from special interest or commercial groups. If such work were to become feasible the Plan proposes that construction should proceed according to a comprehensive restoration plan which should be based on historical data. Rebuilding should be as authentic as possible. Phasing should provide for unified and logical development. The plan should include assessment of expected impacts of development and use on the townsite and the remainder of the park. The plan should emphasize protective considerations over recreational, commercial, or other emphasis according to preserve guidelines.

2. Preserve Staging Cluster

PLANNING AND MANAGEMENT GUIDELINES - STAGING CLUSTER

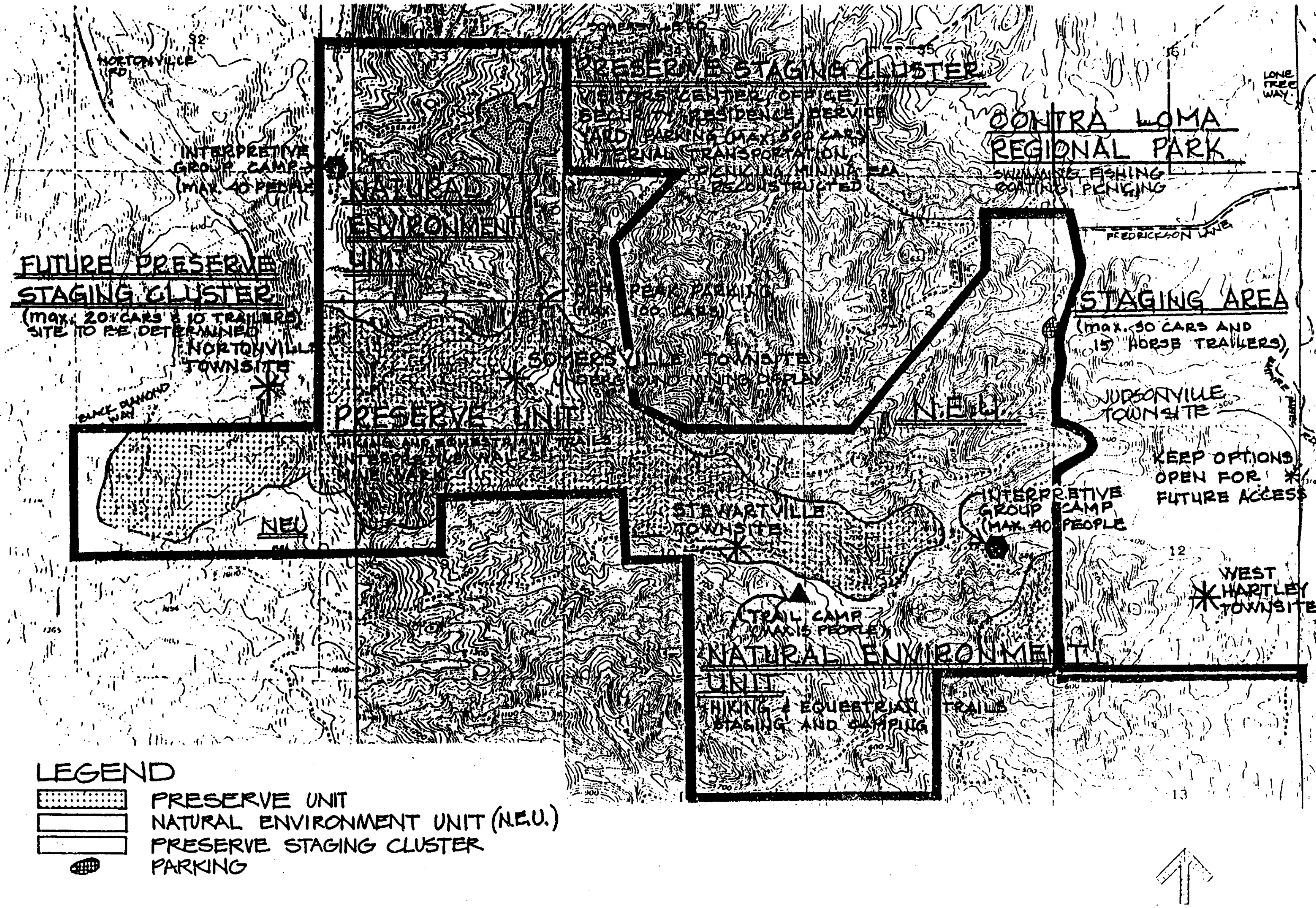
1. *An area near the Preserve Unit suitable for staging and interpretive purposes should be designated a Preserve Staging Cluster. The Cluster should contain adequate and appropriate facilities limited to serve the needs of users of the Preserve Unit. Developed facilities might include such things as a parking area, sanitary facilities, security residence, service yard, interpretive facilities, educational research facilities. educational research facilities.*

2. *The Staging Cluster should be designed and managed to provide an appearance that is natural in character or that harmonizes with the style of the historic period being featured. This may require some replanting of native species and an exacting maintenance program to maintain this character.*

(Master Plan, Page 18)

103 acres (3% of the parkland) are designated by the Plan as the Preserve Staging Cluster which includes the existing parking area, the soon to be acquired Sidney Flat area, and the road and railroad grade between. This cluster provides the opportunity for a flexible management system to meet the needs of light and heavy use periods. Visitors coming to the park during low use periods (generally week days, hot summer or cold winter days), will be able to drive a mile into the park to the existing parking lot which will serve a maximum of 100 cars. A few picnic tables will be located near the lot.

*Attractive wooden signs explaining the significance of historic remnants are now being installed for enjoyment and educational value.



BLACK DIAMOND MINES REGIONAL PRESERVE
LAND USE-DEVELOPMENT PLAN - ZONING

FIG.3

On heavy-use days (generally weekends, holidays, fine spring and summer days), the existing lot will be closed and visitors will stop at Sidney Flat in the larger staging area and take an internal transportation system to the Preserve Unit. A maximum of 500 parking spaces will be provided. The majority will be in a grassy overflow lot and a maximum of 200 spaces will be paved. The railroad grade and a foot trail along Markley Creek will be available for those preferring to walk. Sidney Flat will contain a visitor's center, meadows, picnic area, park office, security residence and service yard. The initial internal transportation system will be a rubber tire vehicle carrying visitors over Somersville Road. If funds become available in the future, construction of a railroad might be considered on the old railroad grade. This would connect Sidney Flat and Somersville.

As noted on page 18 (New Acquisition), Sidney Flat has some historical significance because of its early role in Somersville's development and its buidlings from the mining period (relocated from Nortonville). Although it might be considered as an eligible site for Preserve Unit status, the Plan has chosen to include it in the Preserve Staging Cluster with guidelines providing for the protection of the historic remnants and homestead quality of the site. The Plan proposes that any buildings erected or additions made to existing buildings be constructed in the style of buildings representative of the mining period. Historic type reconstruction at Sidney Flat would be consistent with objectives of the Preserve. These buildings would house the visitor's center and other District facilities. They could be somewhat expanded to represent a typical mining town street and house expanded interpretative or related functions that are appropriate in the mining town atmosphere. Restoration here could be an alternative to restoration within the Preserve Unit at Somersville. Benefits of the alternative are; dispersal of visitor use and reduced impaction of Somersville. Fewer restrictions would be necessary, resulting in lower costs and more flexibility. Difficulties presented by this alternative could be higher staff requirements. If such a program were considered, the Plan proposes that a comprehensive improvement plan preceed any such work. All planting within the Cluster should also reflect the mining era.

The unique resources of the parkland are expected to attract people from the entire Bay Area, although the majority of repeating park users are expected to come mainly from within the 30 Minute Planning Zone. Existing capacity of 280 visitors in the park at one time (based upon 80-car parking area times 3.5 persons per car), will be increased to 1925 visitors (550 cars x 3.5 persons per car).

Peak Use		Low Use Periods	
Sidney Flat	500	Lot near Somersville	100
West End	20	West End	20
Fredrickson Lane	30	Fredrickson Lane	30
	550 cars		150 cars

As mentioned earlier, it is expected that the mine walk will draw the greatest number of visitors. The daily capacity of the tour will be limited by such things as manageable group size, and the number of tours possible per day. Maximum group size is expected to be approximately 20 because of safety concerns, restricted side clearances, ease of supervision and audibility. Thus, it is expected that approximately 300 people could participate on the mine walk in one day. If demand exceeds this number, a reservation system would be necessary. This level could be handled by the existing parking lot capacity; however, it does not take into account increased demand expected for the other areas of the park. Site limitations at Somersville preclude expansion of additional parking and park service facilities there; thus expansion of facilities is proposed at Sidney Flat where site limitations are not a problem.

3. Natural Environment Unit

Areas within the parkland that are not significant enough to be included in the Preserve Unit or are not needed for the Preserve Staging Cluster will be designated as the Natural Environment Unit.*

PLANNING AND MANAGEMENT GUIDELINES - NATURAL ENVIRONMENT UNIT

1. *The purpose of the Natural Environment Unit designation is to assure the protection of natural features and values within a significant portion of a Regional Park.*

2. *The primary management objective is to allow only activities which are compatible with natural environment unit values while preserving, or when necessary establishing, scenic near-natural landscape conditions.*

3. *Development should be limited primarily to making the unit available for public enjoyment in a manner consistent with the preservation of natural resource values. Development may include such things as basic, but not elaborate, improvements necessary for youth group camping and related outdoor activities, hiking, nature study, and horseback riding.*

4. *A Natural Environment Unit may contain a Regional Preserve or a Trail Link; any such unit should be planned and managed according to the guidelines applying specifically to it. A Natural Environment Unit may contain peripheral access staging facilities for internal trails.*

5. *Forest land management techniques such as tree cutting, controlled burning, reforestation and planting programs using indigenous plant materials, and cattle grazing may be used to preserve, maintain, or re-create the desired environmental setting.*
(Master Plan, Page 10)

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*The Natural Environment Unit designation is not listed under Regional Preserve guidelines. However, no designation is clarified for those areas which do not have significance qualifying them for Preserve Unit status, (either resource value or buffer purposes.) The Natural Environment Unit designation (from the Regional Park classification) provides protective guidelines for such areas. Addition of this unit does not make Black Diamond Mines a Regional Park. The philosophy for Black Diamond Mines is one of preservation and the classification of Regional Preserve will remain.

The Natural Environment Unit totals 2265 acres (66% of the parkland) and includes parts of Corcoran's Valley and surrounding hills, the northeastern corner of the parkland near Contra Loma, hill lands surrounding Sidney Flat and a small part of the southwestern edge of the Preserve. This unit contains some remote flat areas but is primarily hilly terrain of varying vegetative types which can be enjoyed by hikers and equestrians. Also included within the unit is a proposed staging area for hikers and equestrians (maximum 30 cars and 15 horse trailers) at the end of Fredrickson Lane.

A primitive trail camp is proposed in Corcoran's Valley if such a program is instituted by the District. A maximum of 15 people could use the camp at one time. Two primitive interpretative group camps are also proposed, one is in Corcoran's Valley and the other is in the valley west of Sidney Flat.

Concern has been expressed about vandalism of the historic remnants at Stewartville at night when the park is less supervised. In order to mitigate this problem the Plan proposes that the group camps be limited to 40 persons at a time and used by those on interpretative or educational outings. Groups should be well supervised and reservations made with the park supervisor. Only two cars per group would be allowed to haul equipment to the group camps.

Some areas of known wildlife value have been included in the Natural Environment Unit rather than the Preserve Unit. The Natural Environment Unit classification has adequate safeguards to protect the wildlife and other resources in these areas, as is being done in similar areas of Regional Parks throughout the District.

4. Circulation

There is an extensive unpaved service and fire road system throughout the park. It is proposed these roads be designated as a system of trails to accommodate local and regional hiking, biking and equestrian needs. For this system most trails will remain as existing with one major link constructed through Manhattan Canyon to connect the Ridge trail with the Black Diamond trail. As mentioned earlier, additional hiking only trails are proposed in the Somersville area for short loop interpretative walks (see figure 11). Equestrian trails are limited to only a few through trails at Somersville and Stewartville to eliminate user conflicts with pedestrians. Nortonville Road and Black Diamond Way are proposed as Regional Bike trails to Black Diamond. Empire Mines Road and Fredrickson Lane are Regional Bike trails to adjacent Contra Loma. Access from Empire Mines Road to the park boundary may be provided for bicyclists in the future. The Ridge trail through the park, with a loop through Corcoran's Valley, is proposed as a Regional hiking and riding trail. This would connect with Contra Loma on the east and the Black Diamond Way trail on the west to Clayton and Mt. Diablo. All-weather roads will continue to serve the staging areas and corrals.

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EXHIBIT 24

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Regional Housing Needs Determination

for the San Francisco Bay Area

2001-2006 Housing Element Cycle

Association of Bay Area Governments
Representing City and County Governments of the San Francisco Bay Area

Regional Housing Needs Determination

for the San Francisco Bay Area
2001-2006 Housing Element Cycle

June 2001

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Acknowledgements

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Chapter II
Housing Needs Determinations

Regional Housing Needs Determination
Association of Bay Area Governments

A. Statutory Requirements

California government code section 65584(a) requires ABAG to distribute the state identified regional housing need allocation to each jurisdiction within the Bay Area region. This section of the code contains a set of guidelines that ABAG must follow when developing the methodology to distribute the state identified regional housing need allocation. These guidelines include two principle components, which are: (1) A region-wide share of the state's Housing Unit goals- determined by HCD, and (2) planning considerations that the methodology must incorporate when determining the distribution of need each jurisdiction in the region will receive.

Methodology Requirements

Region-Wide Share of State Housing Unit Goals

HCD is the state agency responsible for determining the San Francisco Bay Area's region wide share of the estimated statewide housing need for the period of January 1999 through December 2006. The regional numbers supplied by HCD are "goal numbers," and often exceed anticipated growth in housing units cities and counties expect. The methodology used to determine the statewide need, and each region's share of that need, incorporates factors such as vacancy rates, potential growth rates (population, jobs, household formation rates) and demolition of existing housing stock. Both existing and projected need is included in the State's projection of housing need.

ABAG's share of the statewide housing need is provided in the form of a regional allocation of units (230,743) which is divided by income distribution (very-low, low, moderate and above-moderate). ABAG is required to distribute this number to Bay Area jurisdictions based upon a methodology which is developed independent of the one used by HCD to determine statewide housing goals.

Each city and county in the ABAG region must plan for the level of growth assigned by this process, in the update of their respective General Plan Housing Elements.

Guidelines and Planning Considerations

It is ABAG's responsibility to determine the share of the state identified housing need for each city and county within the Bay Area region. That share includes the housing needs of persons at all income levels within the area significantly affected by a general plan of the city or county. This determination must take into account the following planning considerations:

- Market demand for housing
- Employment opportunities
- Availability of suitable sites and public facilities
- Commuting patterns
- Type and tenure of housing need
- Loss of units contained in assisted housing developments, that changed to non-low-income use
- Special Needs Housing requirements

The government code also requires that the distribution of regional housing needs "...seek to reduce the concentration of lower income households in cities or counties which already have disproportionately high proportions of low income households."

The creation of the methodology is essentially ABAG's responsibility, working in coordination with HCD. ABAG is required to provide HCD, along with each city and county in the region, data describing the assumptions and methodology used in calculating the shares of regional housing need. Once ABAG has determined each city and county's share of the regional housing need, HCD may revise the determination to maintain consistency with the statewide housing need. HCD has reviewed and accepted ABAG's RHND program and methodology without comment.

The following section describes the assumptions and methods used by ABAG to meet the statutory requirements defined by the state.

Market Demand for Housing

State law requires that an assessment of the region's housing market be performed when conducting the RHND analysis. This information can best be analyzed and presented locally in each jurisdictions updated housing element. ABAG has relied on the *Projections 2000* forecasts for **population**, **employment** and **households** to determine the RHND allocations for each jurisdiction. The realized demand for housing can be ascertained by analyzing growth projections contained in the *Projections 2000* document. ABAG's forecast considers fertility rates, births, deaths, migration, household size and labor force participation rates, as well as local jurisdictional input, all of which dramatically affects the rate of household formation, and subsequently the housing need associated with this growth.

The region's current housing stock will have to increase substantially to meet the future housing needs of the region's burgeoning population. Between 2000 and 2010, ABAG's forecast shows that the region's population will grow by 251,300 persons to a total population of 7,631,400. ABAG's RHND methodology addresses future housing demand by considering each jurisdiction's share of the region's household and employment growth. This method ensures that future housing demand is met by assigning housing unit allocations in areas where growth is expected to occur.

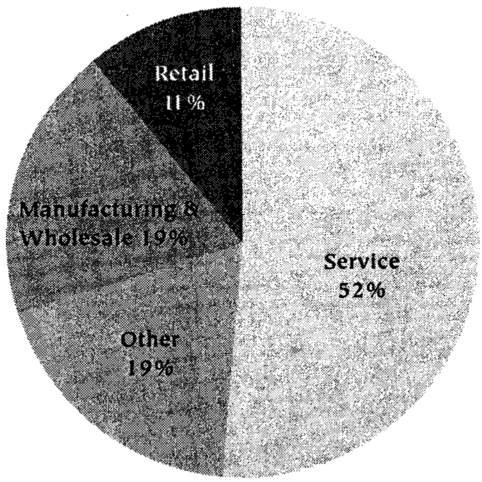
The region's current housing stock will need to increase substantially to meet the future demand of the region's burgeoning population.

Employment Opportunities

State law requires that ABAG consider employment patterns when determining the distribution of RHND allocations for jurisdictions in the region. ABAG's *Projections 2000* forecast contains the employment potential for each of the region's jurisdictions to the year 2020. *Projections 2000* indicates that the region will add nearly a million new jobs over the next twenty years. Over 50 percent of these jobs will be in the services sector (business and professional, health and recreation, social and personal), while the manufacturing and wholesale sectors will comprise 19 percent of the new work force. Retail jobs will include another 11 percent with the remaining 19 percent of jobs being comprised of a variety of professions (ranging from communications, insurance and real estate to construction and transportation).

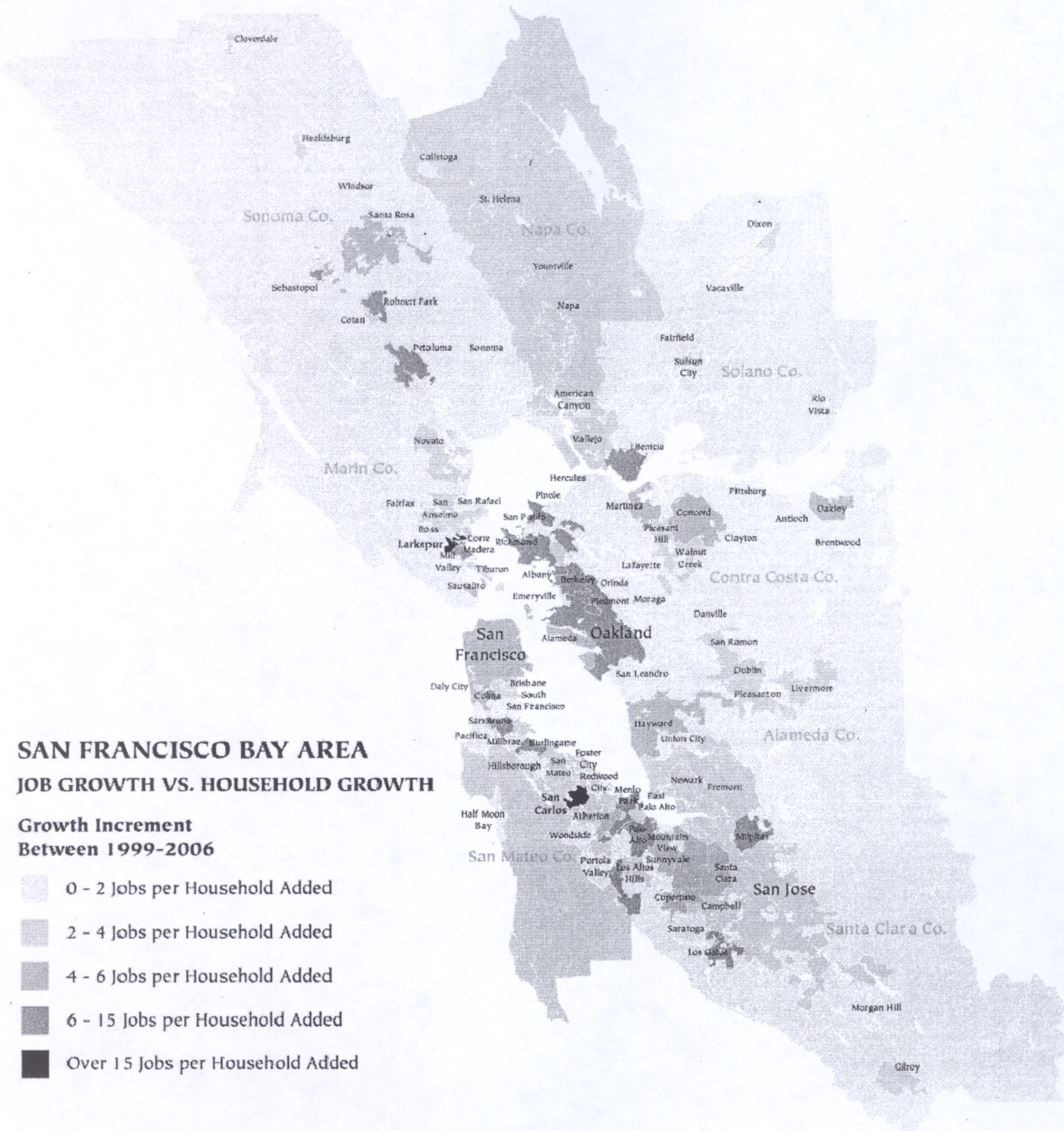
The most significant job growth will be in Santa Clara County (231,000), followed by Alameda (219,550), Contra Costa (140,590), San Francisco (102,800), Sonoma (95,580), Solano (81,270), San Mateo (71,460), Napa (30,110) and Marin (27,000) counties.

Figure 13. Job Demand by Sector



"Other" includes construction, transportation, communications, utilities, finance, insurance, real estate and government, including national security

Figure 14.


SAN FRANCISCO BAY AREA
JOB GROWTH VS. HOUSEHOLD GROWTH
Growth Increment
Between 1999-2006
0 - 2 Jobs per Household Added
2 - 4 Jobs per Household Added
4 - 6 Jobs per Household Added
6 - 15 Jobs per Household Added
Over 15 Jobs per Household Added
Cloverdale
Healdsburg
Calistoga
Windsor
St. Helena
Sonoma Co.
Santa Rosa
Napa Co.
Dixon
Yountville
Sebastopol
Rohnert Park
Cotati
Napa
Vacaville
Petaluma
Sonoma
Fairfield
Suisun City
Solano Co.
American Canyon
Rio Vista
Novato
Vallejo
Benicia
Marin Co.
Hercules
Pinole
Pittsburg
Fairfax
San Anselmo
San Rafael
Martinez
Concord
Oakley
Ross
San Pablo
Antioch
Larkspur
Corte Madera
Richmond
Pleasant Hill
Clayton
Brentwood
Mill Valley
Tiburon
Walnut Creek
Lafayette
Albany
Berkeley
Orinda
Contra Costa Co.
Sausalito
Emeryville
Piedmont
Moraga
Danville
San Francisco
Alameda
Oakland
San Ramon
San Leandro
Dublin
Daly City
Colma
Brisbane
South San Francisco
Pleasanton
Livermore
San Bruno
Hayward
Pacifica
Millbrae
Burlingame
Union City
Alameda Co.
Foster City
Hillsborough
San Mateo
Redwood City
Newark
Fremont
Menlo Park
East Palo Alto
San Carlos
Half Moon Bay
Atherton
Woodside
Palo Alto
Mountain View
Milpitas
San Mateo Co.
Portola Valley
Los Altos Hills
Sunnyvale
Santa Clara
San Jose
Cupertino
Campbell
Saratoga
Santa Clara Co.
Los Gatos
Morgan Hill
Gilroy

During the 1999-2006 RHND time frame, ABAG expects that 422,754 jobs and 177,318 households will be added in the region–a ratio of 2.38 jobs/household. The region's jobs/household ratio in 2000 was approximately 1.45 and in 2010 it will be 1.51. Conventional planning practice suggests that a jobs/housing ratio should be 1.5. While the number of jobs in relation to housing units being added to the region would indicate that we are moving towards a healthy jobs/housing ratio, a closer examination of the disparities of job growth among the region's cities and counties suggests a completely different story.

During the 1999-2006 RHND time frame, many jurisdictions will expect job growth to significantly outpace household growth. For example, the City of San Carlos is planning 19 jobs for every one housing unit added. Many of these jurisdictions have historically had a jobs/household ratio well above the regional average. Another common trait shared by jurisdictions with exceptional job growth is that their housing related costs are among the highest in the region.

While these jurisdictions maintain the ability to attract business at an increased pace, by not producing housing, workers are forced to endure lengthy commutes from the region's outlying areas–where housing production typically outpaces job growth.

The RHND methodology addresses this issue directly by shifting a larger share of the RHND allocations towards jurisdictions that are planning significant job growth during the RHND time frame. While this action may not directly result in an immediate reconciliation of the jobs/housing relationship in the region, it does move the region closer in this direction.

The *Projections 2000* forecast indicates that local government land use policies–which encourage job growth over household growth–may limit the regions labor supply. Table 2 compares expected job growth with expected growth in employed residents for each of the region's major transportation corridors between 2000 and 2020. The region's projected increase in jobs exceeds projected growth of employed residents by 99,060 individuals for the Bay Area. The Peninsula Corridor (San Francisco and San Mateo counties) has the most serious imbalance of jobs to labor supply growth.

During the 1999-2006 RHND time frame, ABAG expects that 422,754 jobs and 177,318 households will be added in the region-a ratio of 2.38 jobs/household.

The Peninsula Corridor (San Francisco and San Mateo counties) has the most serious imbalance of jobs to labor supply growth.

Table 2. Labor Supply and Job Growth along Transporation Corridors in the Bay Area, 2000-2020

Transportation Corridor	Population Growth	Household Growth	Employed Resident Growth	Job Growth	Labor Deficit/ Surplus
I-680 Corridor	159,800	58,700	118,800	128,410	(9,610)
Highway 4 Corridor	119,200	42,300	73,900	55,360	18,540
I-80 North Corridor	175,400	61,340	118,200	111,380	6,820
I-80 Central Corridor	27,700	9,650	22,800	24,750	(1,950)
I-80 South/ Highway 24 Corridor	52,800	11,890	58,700	72,470	(13,770)
I-880 South Corridor	76,600	23,550	66,500	79,150	(12,650)
Highway 101 Corridor North	140,900	56,240	108,300	122,580	(14,280)
Peninsula Corridor	82,500	40,050	124,000	174,260	(50,260)
Silicon Valley North Corridor	233,800	86,930	190,400	202,010	(11,610)
Silicon Valley South Corridor	27,600	10,920	18,700	28,990	(10,290)
Region	**1,096,300**	**401,570**	**900,300**	**999,360**	**(99,060)**

Source: December 1999, ABAG *Projections 2000*

Existing land use policies that continue to expand job growth without commensurate household growth will force the labor supply to be imported from outside the nine-county Bay Area region. This places a strain on the region's economic health, as well as its transportation system. Increasing the region's housing stock, especially in areas closer to where jobs are produced, will help to sustain the economic prosperity the Bay Area has enjoyed for the past decade.

It is clear that ABAG's *Projections 2000* forecast identifies an employment growth for jurisdictions that far exceeds the necessary household growth available under existing residential land use policies. The cause of this trend relates directly to local land use policies and development practices that focuses attention on job producing uses without equal emphasis on housing production.

While it may be said that the tax and fiscal polices of the state hamper local governments' ability to support residential growth, continuing reliance upon the sales tax revenue generating activities that job growth induces will begin to stymie the very economic growth jurisdictions seek. If this trend continues without public policy intervention that creates housing opportunities nearer to where jobs are being produced, the associated long-term impacts will have a severe impact on the region's economic health as well as the environment.

The region also faces an issue relating to the type of jobs being created and the incomes associated with those jobs. Increased job growth in sectors such as the retail and service industries typically do not command wages that match the housing costs associated with the housing market in several jurisdictions throughout the region. Workers in high tech industries, where wages are typically much higher, have driven the cost of housing up, far beyond the incomes of workers in the service and retail sectors. This issue, coupled with the severe deficit in housing production for the region, adds to the housing crisis.

Table 3. Land Available for Development: 1995-2020 (1,000s of acres)

		Available Land Area by Type (Gross Acres)			
County	Total Area	Available Total	Residential	Commercial Industrial	Percent Available
Alameda	473.3	35.4	22.2	12.8	7.5
Contra Costa	462.0	43.7	34.8	8.9	9.5
Marin	332.7	18.9	13.2	2.7	5.7
Napa	481.2	11.1	8.4	2.7	2.3
San Francisco	29.8	2.1	0.8	1.3	7.0
San Mateo	285.3	21.9	15.9	6.0	7.7
Santa Clara	825.8	33.9	23.7	9.6	4.1
Solano	533.0	33.6	19.0	14.6	6.3
Sonoma	1,013.4	69.9	67.5	2.4	6.9
Region	**4,436.5**	**270.4**	**205.4**	**60.9**	**6.1**

Source: ABAG Local Development Policy Survey database

Availability of Suitable Sites and Public Facilities

ABAG's *Projections 2000* forecast considers land available for residential development as well as its related infrastructure constraints. Data is collected on current land use and development policies of local governments prior to the development of ABAG's forecast. Local development policies include general and specific plans, local zoning practices, moratoriums related to sewer and water infrastructure constraints, building permit allocation measures and growth initiatives.

The data collected represents the supply of vacant and re-developable land available for future household and employment growth. The available land supply incorporates local policy information regarding where and when residential, commercial, industrial and institutional development activities could occur. The ABAG modeling system estimates how much of this available land will be needed to accommodate ABAG's growth projections. This data is also used to direct allocations of household and employment growth to smaller geographic areas.

The land available for residential development is mainly vacant, but includes some developed land with potential for reuse. Although ABAG's local policy survey database uses a minimum density of one unit per ten acres, residential densities are typically at least one unit per five acres. Lower density rural residential areas are found mainly in Marin, San Mateo and Sonoma Counties. Some land is designated "mixed use," permitting a combination of uses such as commercial on the ground floor with residential above.

The available acres identified represent a conservative estimate of the actual land supply. ABAG's database underestimates the potential for the reuse or intensification of developed land. The underestimation applies especially to primarily urbanized communities, including San Francisco, Oakland, and San Jose.

Table 4 compares development potential with projected household growth in the region. It illustrates that ABAG's forecast, especially for residential development, could be constrained by the supply of land available under current land use patterns and zoning regulations.

However, an opinion issued by the California Attorney General's office in 1987 suggests that "...The availability of suitable housing sites must be considered based not only upon the *existing* zoning ordinances and land use restrictions of the locality but also based upon the *potential* for increased residential development under *alternative zoning ordinances* and land use restrictions [emphasis added]." The opinion also states that "...current zoning ordinances and land use restrictions [may not] limit the availability of suitable sites." It further states that "The planning process contemplates an identification of adequate sites that could be made available through different policies and development standards."

While ABAG's regional forecast may exceed the residential development capacity of existing plans, State Housing Element Law encourages jurisdictions to develop alternative land use policies, such as increasing densities in already urbanized areas, that could accommodate the additional growth determined by the RHND process.

"...The availability of suitable housing sites must be considered based not only upon the <u>existing</u> zoning ordinances and land use restrictions of the locality but also based upon the <u>potential</u> for increased residential development under <u>alternative zoning ordinances</u> and land use restrictions "

Table 4. Housing Unit Supply and Projected Household Growth: 1995-2020

County	Total Unconstrained Unit Potential	Projected New Households	Projected New Households
Alameda	84,590	88,250	(3,660)
Contra Costa	111,320	100,500	10,820
Marin	17,890	14,320	3,570
Napa	13,000	14,640	(1,640)
San Francisco	55,020	21,850	33,170
San Mateo	24,500	32,040	(7,540)
Santa Clara	90,850	126,030	(35,180)
Solano	55,990	57,480	(1,490)
Sonoma	50,200	54,830	(4,630)
Region	**503,360**	**509,940**	**(6,580)**

Source: ABAG Local Development Policy Survey database

State Housing Element Law encourages jurisdictions to develop alternative land use policies that could accommodate the additional growth determined by the RHND process

Commuting Patterns

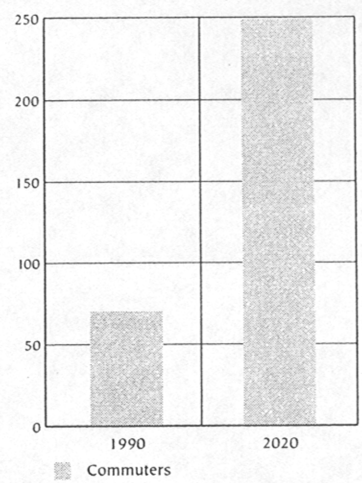
ABAG's forecast for household and employment growth considers commuting patterns as a function of residential and employment choices in its Projective Optimization Land Use Information System (POLIS) model. The model allocates households and employment by considering such factors as commuting flows by mode (automobile and transit) and incorporating several assumptions related to residential and employment choices. These interactions and assumptions are described fully in Appendix D, Overview of the *Projections* Modeling System.

The assumed additions or changes to transportation facilities and services were drawn from MTC's Regional Transportation Plan. The transportation network is incorporated at a regional level and does not include detailed information on local transportation changes and improvements. The highway and transit system assumptions are translated into estimates of peak period service levels by transportation facility mode. Level-of-service estimates are in turn translated into estimates of travel time between locations. These measures of accessibility become key factors in projecting housing as well as job locations.

In general, the effect of "commuting patterns" in the RHND process can be measured by comparing the differences between job growth and the availability of labor supply (households) within the region. As mentioned earlier, jurisdictions' employment growth far exceeds household growth that is available under existing residential land use policies. This is caused by local land use policies and development practices that focus on job producing uses without sufficient emphasis being placed on housing production. Thus, the necessary labor supply that is needed within the nine-county Bay Area region must be met by in-commuting workers.

According to MTC, many more Bay Area workers will live outside the Bay Area. San Joaquin and Sacramento counties both already contain major residential areas from which workers travel to large Bay Area employment centers such as the Silicon Valley and the Tri Valley cities which include San Ramon, Dublin and Pleasanton. In 1990, the average daily inter-regional vehicle miles traveled was 14,065. By 2020, this figure will grow to 30,201–an increase of 115 percent.

Figure 15. In-Commuting



Source: MTC Forecasts

Reducing the gap between employment and household growth may reduce the impacts associated with inter-regional commuting patterns. However, equal importance should also be placed upon the creation of jobs closer to residential areas. In part, the RHND allocations meet these goals by assigning more housing to jurisdictions that are planning increased employment growth, which creates more housing opportunities in areas close to job production. The RHND allocations also serve to reduce the impacts associated with increased housing market costs in areas of high employment growth, while providing an adequate labor supply to sustain the Bay Area's economy, and reduce the growth in long-distance commuting that affects air quality and other environmental resources.

Type and Tenure of Housing

State law requires that the type of housing (i.e., single- and multiple-family and mobile homes) and tenure of housing (i.e., owner and renter), be considered when making the RHND allocations. The Bay Area's regional housing market is very diverse, thus making it extremely difficult to develop factors that can be used to equitably allocate housing need among the jurisdictions in the region within the required timeframe given to ABAG to perform the RHND distribution. However, consideration of these factors is essential to planning for the distribution of housing that will meet the needs each jurisdiction's residents. Therefore, this criterion of State Housing Element Law is best presented in each jurisdiction's updated housing elements, reflecting the needs of the local housing market more accurately.

The most up to date information related to type of housing can be obtained from the state DOF Population and Housing estimates contained in the E-5 report. The latest and most complete information related to tenure of housing can be obtained from the 1990 Federal Census. While Census 2000 was recently completed, the data representing the detailed analysis for housing characteristics (Summary File 3) will not be available until the summer of 2002–well after the December 31, 2001, due date for updated housing elements to be submitted to HCD.

Special Needs Housing

State Housing Element Law requires that the housing needs of homeless people, seniors, disabled individuals, female-headed households and farmworker households be considered when preparing the RHND determinations for the region. ABAG does not maintain data that represents an accurate assessment of the special needs population for each jurisdiction in the region.

Due to the limited time and resources available to prepare the RHND responsibilities for each city and county in the region, it was not feasible to conduct a region wide study to assess the housing needs of this portion of the population. While data describing the characteristics of the special needs population does exist for several jurisdictions in the region, access to data representing the breadth of the region's special needs population is unfortunately, unavailable on a region-wide basis. Furthermore, the data sets that are available cannot be applied equally in a methodology that seeks to fairly distribute each jurisdiction's fair share housing needs responsibilities. Therefore, it is impractical to include the limited data that is available in the RHND methodology to determine the specific special needs housing responsibilities for each city and county in the region.

Each city and county in the region has access to data and resources that can be used to identify the housing opportunities for the special needs population in their respective jurisdictions. Therefore, the analysis of special needs housing is best represented in each jurisdiction's housing elements. For the purposes of this RHND process, the housing needs of the region's special needs population is considered a part of the total RHND allocation assignment determined by ABAG. Each city and county in the region must identify a portion of its total RHND allocation assignment to meet the demand for housing of persons with special needs.

To assist local governments with this task, ABAG has released a document entitled *Blueprint 2001 for Bay Area Housing*, which contains a comprehensive list of programs, strategies and case study examples of successful projects that can be implemented at the local level to address the special housing needs of certain groups. *Blueprint 2001* suggests possible sources of data on persons with special housing needs, which local governments can use to update its general plan housing elements.

Existing and Projected Housing Needs

State law requires ABAG to consider the existing and projected housing needs for each jurisdiction in the region. In past regional housing needs studies, ABAG designed a methodology that separated existing need from total projected need. This methodology determined existing need by identifying a regional vacancy rate goal and then compared this figure with each jurisdiction's existing vacancy rate. The difference in housing units needed to meet the identified regional goal vacancy rate are considered "*existing need*."

HCD's determination of the housing need considers existing vacancy rates when calculating total projected need for the region. HCD's total projected need for the region is 230,743 housing units. ABAG's *Projections 2000* forecast identifies the potential for 185,823 housing units to be added during the RHND timeframe. The difference between these numbers (44,920) represents the existing need for the region. In an effort to simplify the RHND methodology, ABAG considers existing need to be a part of the total projected need assigned to the region by HCD. Each city and county in the region must identify a portion of its total projected need as existing housing needs for its residents in the update of their respective General Plan Housing Elements.

Affordable Rental Housing At Risk of Conversion

According to State Housing Element Law, cities and counties should identify all federal, state, and local subsidized housing in the community, note when the subsidies expire, and determine the cost of replacing that housing. The updated Statewide Housing Plan, prepared by HCD, lists 576 projects with a total of 41,588 units as "At Risk" of being converted from affordable housing stock reserved for primarily low-income families, to market-rate housing.

The expiration of housing subsidies in the Bay Area is a major threat to the limited supply of affordable housing available to low-income families and individuals.

ABAG has released *Blueprint 2001 for Bay Area Housing*, which contains a comprehensive listing of programs and strategies that local governments can implement to ensure the continued availability of affordable housing in the region. In addition, recent changes in State Housing Element Law make it possible for local governments to receive up to 25 percent credit towards meeting its housing needs responsibilities through the implementation of strategies and programs that extend the life of "At Risk" affordable housing.

Consideration of Income Levels

State law requires that ABAG consider the need for housing across the breadth of income levels in the region. The law defines this as "...the share of the housing needs of persons at all income levels within the area significantly affected by the jurisdiction's general plan." The law further requires that the distribution of housing needs "...seek to avoid further impaction of localities with relatively high proportions of lower income households." State law does not however define a method for accomplishing this task.

The most widely used definitions of income categories are those used by HUD to determine eligibility for federal housing assistance. Section 6932 of Title 25 of the California Administrative Code sets forth the income limits used by HCD, which are primarily based upon the HUD income limits.

To determine each city and county's housing needs by income category, ABAG has used the HUD definitions of income categories, as defined below.

Income Categories

Very-low: Those households with income up to 50% of the county's area median income.

Low: Those households with income between 50 and 80% of the county's area median income.

Moderate: Those households with income between 80 and 120% of the county's area median income.

Above-moderate: Those households with income above 120% of the county's area median income.

ABAG used the 1989 income distribution of households for each city, county and the region, as reported by the 1990 Census. The income categories defined in Sections 6910-6932 of the California Administrative Code are used, in accordance with the interpretation of the California Attorney General's Opinion 87-206.

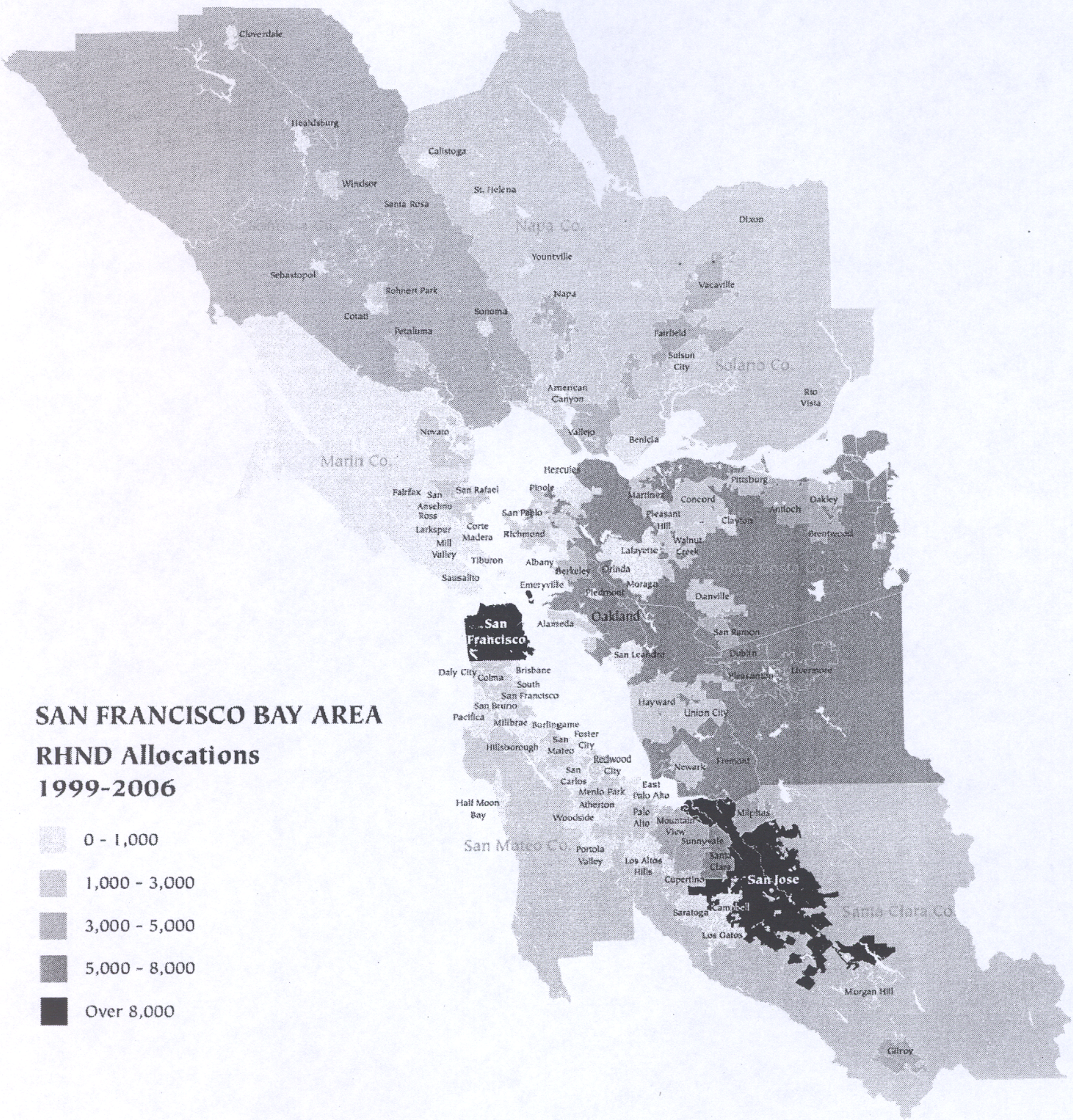
The 1990 Census reports a 1989 median household income for the region as $41,595. Therefore, a household with an income of $20,797 or less would be classified as very low. A household with an income from $20,798 to $33,276 would be classified as low income. A household with an income from $33,277 to $49,914 would be classified as moderate income. A household with an income greater than $49,914 would be classified as above moderate. These income limits were used to estimate the proportion of households in each jurisdiction in the Bay Area in the four income categories.

For the region, 20.5 percent of the households are very-low income, 10.9 percent are low income, 26.4 percent are moderate income, and 42.3 percent are above-moderate income. ABAG, in making its determinations of housing need, has shifted each jurisdiction's 1990 income percentages, as determined by the Census, 50 percent towards the regional averages. This method promotes an equitable distribution of housing opportunities for each income group within the Region. Furthermore, this method meets the goals of state law "...to seek to avoid further impaction" of existing localities with higher proportions of lower income households.

It is certainly true that over the past ten years, incomes in the region have risen substantially,. However, overall, most households in the region with an income that would place them in the above moderate income category still do not make enough money to afford the high housing cost's our region maintains.

The following pages illustrate the total 1999-2006 RHND allocations by income category for each city and county in the Bay Area.

Figure 16.



SAN FRANCISCO BAY AREA RHND Allocations 1999-2006

- 0 - 1,000
- 1,000 - 3,000
- 3,000 - 5,000
- 5,000 - 8,000
- Over 8,000

Table 5.

RHND Allocations by Income Category

San Francisco Bay Area Region

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
ALAMEDA COUNTY	46,793	9,910	5,138	12,476	19,269
CONTRA COSTA COUNTY	34,710	6,481	3,741	8,551	15,937
MARIN COUNTY	6,515	1,241	618	1,726	2,930
NAPA COUNTY	7,063	1,434	1,019	1,775	2,835
SAN FRANCISCO CITY/COUNTY	20,372	5,244	2,126	5,639	7,363
SAN MATEO COUNTY	16,305	3,214	1,567	4,305	7,219
SANTA CLARA COUNTY	57,991	11,496	5,209	15,870	25,416
SOLANO COUNTY	18,681	3,697	2,638	4,761	7,585
SONOMA COUNTY	22,313	4,411	3,029	5,879	8,994
REGIONAL TOTAL	**230,743**	**47,128**	**25,085**	**60,982**	**97,548**

Table 6.

RHND Allocations by Income Category

Alameda County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
ALAMEDA	2,162	443	265	611	843
ALBANY	277	64	33	77	103
BERKELEY	1,269	354	150	310	455
DUBLIN	5,436	796	531	1,441	2,668
EMERYVILLE	777	178	95	226	278
FREMONT	6,708	1,079	636	1,814	3,179
HAYWARD	2,835	625	344	834	1,032
LIVERMORE	5,107	875	482	1,403	2,347
NEWARK	1,250	205	111	347	587
OAKLAND	7,733	2,238	969	1,959	2,567
PIEDMONT	49	6	4	10	29
PLEASANTON	5,059	729	455	1,239	2,636
SAN LEANDRO	870	195	107	251	317
UNION CITY	1,951	338	189	559	865
UNINCORPORATED	5,310	1,785	767	1,395	1,363
Total	**46,793**	**9,910**	**5,138**	**12,476**	**19,269**

Table 7.

RHND Allocations by Income Category

Contra Costa County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
ANTIOCH	4,459	921	509	1,156	1,873
BRENTWOOD	4,073	906	476	958	1,733
CLAYTON	446	55	33	84	274
CONCORD	2,319	453	273	606	987
DANVILLE	1,110	140	88	216	666
EL CERRITO	185	37	23	48	77
HERCULES	792	101	62	195	434
LAFAYETTE	194	30	17	42	105
MARTINEZ	1,341	248	139	341	613
MORAGA	214	32	17	45	120
OAKLEY	1,208	209	125	321	553
ORINDA	221	31	18	43	129
PINOLE	288	48	35	74	131
PITTSBURG	2,513	534	296	696	987
PLEASANT HILL	714	129	79	175	331
RICHMOND	2,603	471	273	625	1,234
SAN PABLO	494	147	69	123	155
SAN RAMON	4,447	599	372	984	2,492
WALNUT CREEK	1,653	289	195	418	751
UNINCORPORATED	5,436	1,101	642	1,401	2,292
Total	**34,710**	**6,481**	**3,741**	**8,551**	**15,937**

Table 8.

RHND Allocations by Income Category

Marin County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
BELVEDERE	10	1	1	2	6
CORTE MADERA	179	29	17	46	87
FAIRFAX	64	12	7	19	26
LARKSPUR	303	56	29	85	133
MILL VALLEY	225	40	21	56	108
NOVATO	2,582	476	242	734	1,130
ROSS	21	3	2	5	11
SAN ANSELMO	149	32	13	39	65
SAN RAFAEL	2,090	445	207	562	876
SAUSALITO	207	36	17	50	104
TIBURON	164	26	14	32	92
UNINCORPORATED	521	85	48	96	292
Total	6,515	1,241	618	1,726	2,930

Table 9.

RHND Allocations by Income Category

Napa County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
AMERICAN CANYON	1,323	230	181	353	559
CALISTOGA	173	44	31	41	57
NAPA	3,369	703	500	859	1,307
ST. HELENA	142	31	20	36	55
YOUNTVILLE	87	21	15	20	31
UNINCORPORATED	1,969	405	272	466	826
Total	7,063	1,434	1,019	1,775	2,835

Table 10.

RHND Allocations by Income Category

San Francisco City/ County

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
SAN FRANCISCO	**20,372**	**5,244**	**2,126**	**5,639**	**7,363**

Table II.

RHND Allocations by Income Category

San Mateo County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
ATHERTON	166	22	10	27	107
BELMONT	317	57	30	80	150
BRISBANE	426	107	43	112	164
BURLINGAME	565	110	56	157	242
COLMA	74	17	8	21	28
DALY CITY	1,391	282	139	392	578
EAST PALO ALTO	1,282	358	148	349	427
FOSTER CITY	690	96	53	166	375
HALF MOON BAY	458	86	42	104	226
HILLSBOROUGH	84	11	5	14	54
MENLO PARK	982	184	90	245	463
MILLBRAE	343	67	32	90	154
PACIFICA	666	120	60	181	305
PORTOLA VALLEY	82	13	5	13	51
REDWOOD CITY	2,544	534	256	660	1,094
SAN BRUNO	378	72	39	110	157
SAN CARLOS	368	65	32	89	182
SAN MATEO	2,437	479	239	673	1,046
SOUTH SAN FRANCISCO	1,331	277	131	360	563
WOODSIDE	41	5	3	8	25
UNINCORPORATED	1,680	252	146	454	828
Total	**16,305**	**3,214**	**1,567**	**4,305**	**7,219**

Table 12.

RHND Allocations by Income Category

Santa Clara County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
CAMPBELL	777	165	77	214	321
CUPERTINO	2,720	412	198	644	1,466
GILROY	3,746	906	334	1,030	1,476
LOS ALTOS	261	38	20	56	147
LOS ALTOS HILLS	83	10	5	15	53
LOS GATOS	402	72	35	97	198
MILPITAS	4,348	698	351	1,146	2,153
MONTE SERENO	76	10	5	13	48
MORGAN HILL	2,484	455	228	615	1,186
MOUNTAIN VIEW	3,423	698	331	991	1,403
PALO ALTO	1,397	265	116	343	673
SAN JOSE	26,114	5,337	2,364	7,086	11,327
SANTA CLARA	6,339	1,294	590	1,786	2,669
SARATOGA	539	75	36	108	320
SUNNYVALE	3,836	736	361	1,075	1,664
UNINCORPORATED	1,446	325	158	651	312
Total	**57,991**	**11,496**	**5,209**	**15,870**	**25,416**

Table 13.

RHND Allocations by Income Category

Solano County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
BENICIA	413	70	49	90	204
DIXON	1,464	268	237	379	580
FAIRFIELD	3,812	761	573	972	1,506
RIO VISTA	1,391	357	190	342	502
SUISUN CITY	1,004	191	123	256	434
VACAVILLE	4,636	860	629	1,172	1,975
VALLEJO	3,242	690	474	779	1,299
UNINCORPORATED	2,719	500	363	771	1,085
Total	**18,681**	**3,697**	**2,638**	**4,761**	**7,585**

Table 14.

RHND Allocations by Income Category

Sonoma County and Cities

Jurisidiction	RHND Allocation	Very Low	Low	Moderate	Above Moderate
CLOVERDALE	423	95	51	128	149
COTATI	567	113	63	166	225
HEALDSBURG	573	112	78	171	212
PETALUMA	1,144	206	124	312	502
ROHNERT PARK	2,124	401	270	597	856
SANTA ROSA	7,654	1,539	970	2,120	3,025
SEBASTOPOL	274	58	35	75	106
SONOMA	684	146	90	188	260
WINDSOR	2,071	430	232	559	850
UNINCORPORATED	6,799	1,311	1,116	1,563	2,809
Total	22,313	4,411	3,029	5,879	8,994

B. Changes in State Housing Element Law Since 1989 RHND Process

The 1998-99 state fiscal budget reinstated the funding which supports the state mandated housing element update process in California. Cities and counties throughout California are once again required to update housing elements based upon the statewide housing goals established by HCD. Jurisdictions in the Bay Area region must update housing elements by December 31, 2001. Since ABAG's last RHND process, state legislators introduced legislation (Assembly Bill 438) that modified Housing Element law significantly.

Assembly Bill 438 (Torlakson, D-Antioch)

State Housing Element law requires city and county planning agencies to provide an annual report to the legislative body on its progress in meeting their share of the statewide housing goals, as determined by the RHND process. A report must be provided to the legislative body, on or before July 1 of each year, using forms and definitions adopted by HCD pursuant to the Administrative Procedure Act. Assembly Bill 438 requires this annual report to also be provided to the Office of Planning and Research as well as HCD.

Assembly Bill 438 sets forth a process that allows each COG to provide a sub-region with its share of the regional housing need. COGs can delegate the responsibility of determining RHND allocations for cities and counties within a sub-region according to a prescribed agreement established between the COG and sub-regional entity.

The most significant change introduced by Assembly Bill 438 addresses concerns raised by cities and counties which suggests that State Housing Element Law focuses too narrowly on construction of new housing units by not considering the rehabilitation of substandard housing units, and efforts to make market rate housing affordable to low income households, as contributing to housing goals established by state law.

Assembly Bill 438 established a procedure that allows a city or county to receive credit for up to 25 percent of its RHND allocation assignments by (1) rehabilitating existing substandard units, (2) purchasing affordability covenants to "buy down" market rate units for the benefit of low-income households, or (3) preserving the affordability of subsidized units at risk of conversion to market-rate status due to the expiration or termination of subsidy contracts. This bill established specific rules and guidelines that must be followed by cities and counties in order for credit to be rewarded. See Appendix C, Assembly Bill 438 (Torlakson, D-Antioch).

C. Methodology Explanation

This section explains ABAG's RHND methodology. It includes a description of the components used in the methodology to distribute the state identified housing need.

ABAG's RHND Methodology

The ABAG Executive Board established an advisory committee–Housing Methodology Committee–to develop the RHND methodology. This committee's primary purpose was to develop an appropriate methodology that both incorporates the planning considerations established in State Housing Element Law, and seeks to fairly distribute the State assigned Regional Housing Needs Allocation to cities and counties in the ABAG region. To accomplish this task, the committee established a set of goals that the methodology should address, as described below.

Methodology Goals

One:	Growth should be based upon current city boundaries, as opposed to sphere of influence boundaries, when determining RHND allocations
Two:	Address over and under-concentration of low income housing throughout the region
Three:	Use the most recent, available, and up to date data source for total number of households in 1999 (1999 DOF E-5 report)
Four:	Use *Projections 2000* to determine growth
Five:	Address State Housing Element Law requirements
Six:	Incorporate ABAG's "Smart Growth" policies
Seven:	Methodology calculation should be simple, easy to understand and explain

Executive Board Policy Directives

The ABAG Executive Board issued several policy directives in order to ensure that the goals identified by the Housing Methodology Committee were implemented in the RHND methodology. These directives are identified below.

Policy Directives

One:	Incorporate a 50% jobs/ 50% household weighted ratio in the RHND methodology to address the jobs/ housing issues in the region.
Two:	Assign 75% of the unincorporated SOI allocations to the cities, and 25% to the counties in order to promote development in urbanized areas rather than on unincorporated lands.
Three:	Establish guidelines that allow jurisdictions to re-distribute the RHND allocations on a county-wide basis during the 90-day Review and Revision Period.

Methodology Components

To address these goals and directives, the RHND methodology was based upon each jurisdiction's share of regional household and employment growth. This growth is based upon each jurisdiction's current city boundaries. The combination of regional shares of household and employment growth were applied in a methodology calculation that assigns housing need based upon the share of the proportional amount of household and employment growth each jurisdiction would have during the 1999-2006 RHND time frame.

ABAG's RHND methodology is comprised of five components; (1) Household growth, (2) Employment growth, (3) Employment (Jobs)/ household ratio adjustment, (4) Sphere of Influence allocations adjustment, (5) Income Distribution calculation. A detailed description of the RHND methodology and its components is discussed on the following pages.

ABAG has developed a methodology that considers household and employment growth as determinants for assigning each jurisdiction its RHND allocations. To determine the first component of the methodology (household growth), the methodology uses two primary sources of data, (1) DOF estimate of households in 1999, and (2) ABAG's forecast of households in 2006.

The DOF estimate of households in 1999 reflects the most recent, available, and up to date data source for total number of households in 1999 for the Bay Area region. ABAG's *Projections 2000* document contains a forecast of households for 2006. The methodology uses the DOF estimate of households in 1999 as a baseline starting point and ABAG's forecast of household in 2006 to determine growth during the 1999-2006 time period. The second component used in the methodology (employment growth) is based solely upon ABAG's *Projections 2000* forecast of employment within the Bay Area region.

ABAG's forecast of employment and household growth includes assumptions associated with demographic changes, the availability of housing (supply), personal income, rising housing prices, labor force participation rates, productivity of the workforce, interest rates and other economic indicators such as the Gross Regional Product. For a more detailed discussion of ABAG's forecast process and assumptions, refer to Appendix E.

Methodology Calculation

ABAG's allocation of housing need for each jurisdiction is based upon forecasts of household and employment growth for current city boundaries between 1999-2006. Each jurisdiction's share of regional household and employment growth is applied to ABAG's share of the statewide housing unit goals (230,743) determined by the Department of Housing and Community Development.

The calculation includes the following five components.

1. **Household growth:** Determine jurisdiction's share of regional household growth.
2. **Employment growth:** Determine jurisdiction's share of regional employment growth.
3. **Jobs/housing ratio adjustment:** Input shares of growth in an allocation formula that is applied to the regional housing need number (230,743).
4. **Unincorporated Sphere of Influence allocations adjustment:** Determine the RHND allocation for the unincorporated SOI boundary of each city, then distribute this portion of the RHND allocation, 75% to the cities, and the remaining 25% to the counties.
5. **Income Distribution component:** Divide the total projected need by income category (Very-low, Low, Moderate, Above-moderate).

1. Household Growth Component

The first component of the RHND methodology involves the determination of each jurisdiction's share of household growth in the region. For the purposes of the RHND methodology, household growth is determined by subtracting the DOF estimate of households in 1999 from ABAG's forecast of households in 2006. This household growth is then divided into the total regional household growth, which derives that jurisdiction's share of regional household growth. See Figure 17 below.

Figure 17. Determination of Household Growth

Households 2006		Households 1999		Household Growth	Regional Household Growth
HH2006*	minus	HH1999**	equals	HHG	RHHG***

$$\frac{HHG}{RHHG} = \text{Share of Regional Household Growth (SHHG)}$$

* ABAG *Projections 2000*
** DOF-January 1999 E-5 Report
*** Regional sum total of jurisdictions household growth

2. Employment Growth Component

The second component of the RHND methodology involves the determination of each jurisdiction's share of employment growth in the region. Employment growth is determined by subtracting ABAG's estimate of employment in 1999 from the 2006 forecast. The jurisdiction's regional share of employment growth is determined by the same method as the regional share of household growth. See Figure 18 below.

Figure 18. Determination of Employment Growth

Employment 2006		Employment 1999		Employment Growth	Regional Employment Growth
Jobs2006*	minus	Jobs1999*	equals	JG	RJG***

$$\frac{JG}{RJG} = \text{Share of Regional Employment Growth (SRJG)}$$

* ABAG *Projections 2000* forecast

*** Sum total of all jurisdictions household growth

3. Employment (Job)/ Household Ratio Adjustment Component (Allocation Formula)

The third component determines each jurisdiction's share of the region wide RHND allocation based upon each jurisdiction's ratio of employment (jobs)/ household growth. Each jurisdiction's share of regional household and employment growth are input into a formula which combines these percentages into a ratio of employment per household which is then applied to the region wide RHND figure (230,743) to determine the jurisdiction's share of the region wide RHND allocation. See Figure 19 below.

4. Sphere of Influence Allocations Adjustment Component

The RHND allocations are based upon current city boundaries, excluding those areas in the city's sphere of influence (SOI), outside the current city boundaries. The unincorporated areas of each county have received a RHND allocation which includes those portions of a city's unincorporated sphere of influence, in addition to those areas outside each city's SOI. This method assigns the county unincorporated, mainly non-urbanized areas an RHND allocation that includes part of the growth that is being planned by the cities.

In recognition of ABAG's "Smart Growth" policies which seek to promote development in already urbanized areas, the RHND allocation associated with growth in the unincorporated portions of each city's SOI has been divided among the cities and counties. The amount of housing need associated with the growth in the SOI areas has been calculated, and the subtracted from the unincorporated portions of each jurisdictions. Each city is assigned 75 percent of this portion of the RHND allocation, with the remaining 25 percent being assigned to each county. See Figure19 below.

Figure 19. Determine the RHND Allocation (Based upon Current City Boundaries)

Share of Job Growth		Weight Factor		Share of Household Growth		Weight Factor		HCD Regional Need		Jurisdiction Need		Uninc. SOI Need (See Step 4.)		Total Projected Need
(SRJG%	x	0.5	+	SHHG%	x	0.5)	x	230,743	=	Jneed	+	usoineed	=	Tneed

The calculation of the RHND allocation attributed to the growth in the unincorporated SOI areas is determined by first separating the geographic areas of growth in the region into three distinct categories. Those categories are as follows:

1. Incorporated areas (inside city jurisdictional boundaries),
2. Unincorporated areas within a county's jurisdictional boundaries and outside any city's jurisdictional boundaries or SOI, jurisdictional boundaries but within its SOI.
3. Unicorporated areas outsides a city's jurisdictional boundaries but within its SOI.

The RHND methodology calculation assigns the unincorporated county areas an allocation that includes categories 2 and 3. In order to separate the RHND allocation for these categories, a separate RHND methodology calculation must be performed using the Local Area Formulation Committee (LAFCO) approved SOI boundaries.

ABAG's *Projections 2000* contains a forecast of growth for jurisdictions by city boundary as well as sub-regional study areas (SSA)–equivalent to each jurisdiction's SOI boundary. However, the DOF E-5 report estimate of occupied households in 1999 does not contain estimates for SOI areas.

In order to perform the RHND methodology calculation using the DOF baseline estimate of households in 1999, it is necessary to determine the number of units attributed to the SOI areas in the DOF estimates. This is accomplished by comparing the DOF estimate with the ABAG forecast by SSA. Figure 20 illustrates how the comparison is performed.

Substituting the ABAG sub-regional study area figure and the interpolated DOF baseline figure in the RHND methodology, results in a RHND allocation based upon adopted LAFCO SOI boundaries. The difference of the combined RHND methodology calculations for the current city boundary and LAFCO approved SOI boundaries, determines the RHND allocation associated with the unincorporated SOI areas. See Figure 19, Page 43.

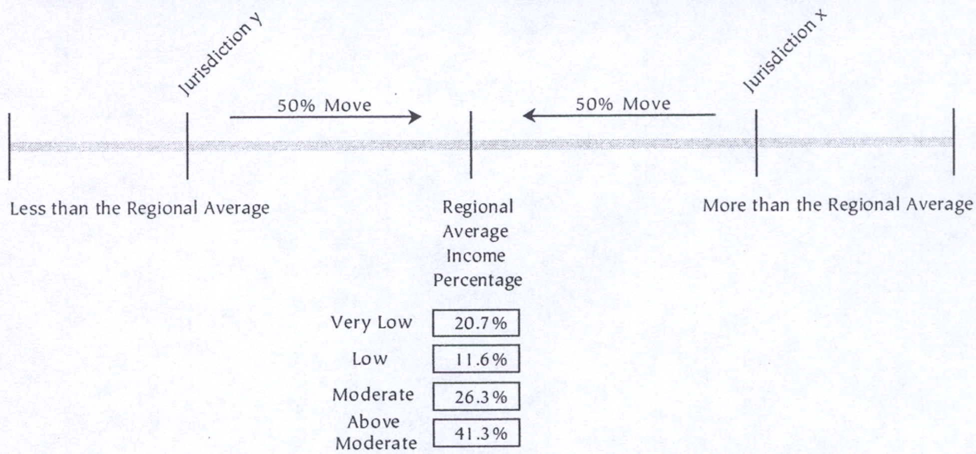
Figure 20. DOF- SOI Determination Formula

$$\text{Interpolated DOF baseline figure representing the SOI} = \text{DOF 1999 baseline figure} + \left(\text{ABAG forecast for sub-regional study areas (SOI)} - \text{ABAG forecast for current city boundaries}\right)$$

5. Income Distribution Component

According to government code, ABAG is required to distribute the total RHND allocation for each jurisdiction by income category (Very-low, Low, Moderate, Above-moderate). Furthermore, ABAG must "...seek to reduce the concentration of lower income households in cities or counties which already have disproportionately high proportions of low income households." ABAG's methodology accomplishes this by shifting each jurisdiction's income distribution as determined by the 1990 Census 50 percent towards the regional average. The distance of each jurisdiction's existing income percentage from the regional average will determine the amount of adjustment applied. See Figure 21 below.

Figure 21. Income Distribution Method: Each Jurisdiction Moves 50% Toward the Regional Average



D. Local Government Review Process

State Housing Element Law establishes a process and schedule for local governments to review the preliminary housing needs determinations made by ABAG, and recommend revisions where appropriate. The review process involves four steps, as follows:

1. Initial determination of preliminary Housing Needs allocations by ABAG.
2. Local review and revision of preliminary Housing Needs allocations.
3. ABAG action on proposed revisions and adoption of final Housing Needs allocations.
4. Opportunity for local government to appeal the final determination of Housing Needs allocations.

Initial Determination of Preliminary Housing Allocations

On June 1, 2000, ABAG released the preliminary RHND allocations for each jurisdiction in the Bay Area. This action initiated the required 90-day review and revision period, which allows jurisdictions to comment, and/or propose revisions to the preliminary RHND allocations.

Review and Revision Period

Bay Area jurisdictions had until August 31, 2000, to submit in writing any proposed revision to the preliminary RHND allocation assignment according to guidelines defined in Government Code, section 65584(a). Proposed revisions must be based upon available data and an accepted planning methodology, as well as be supported by adequate documentation that includes an analysis of the factors and circumstances, which justify revising the preliminary RHND allocations.

ABAG Action on Proposed Revisions

After the 90-day Review and Revision period, ABAG has 60 days to respond to each jurisdiction's comments and/or proposed revisions. ABAG is required to accept any proposed revisions that meet the criteria defined in Housing Element Law that would warrant a revision, and modify the earlier determination of housing need. If the proposed revision does not meet Housing Element Law criteria, ABAG must indicate, based upon available data and the accepted planning methodology, why the proposed revision is inconsistent with the earlier determination of housing need.

By October 30, 2000, ABAG responded to those jurisdictions that requested modifications to the RHND allocations. 77 Bay Area jurisdictions responded to the preliminary RHND allocations. From this group, 29 jurisdictions requested revisions to their RHND allocation assignment.

Appendix G contains the Revision Guidelines, Criteria and Definitions used by ABAG to review proposed revisions made by Bay Area jurisdictions. Appendix H contains a table that summarizes each jurisdiction's proposed revision and ABAG staff's recommended action.

Appeal Process

On November 16, 2000, the ABAG Executive Board adopted the final Housing Needs Determinations for Bay Area jurisdictions. This action initiated an appeals process, as required by State Housing Element Law. The appeal process allows for jurisdictions to appeal their share of the RHND allocations, in writing, within 30 days of the final determination by the council of governments (ABAG).

Ten jurisdictions appealed the final determination of housing need by ABAG. The ABAG Executive Board appointed a special committee to hear and decide the outcome of these appeals. The following paragraph describes the criteria used by ABAG to evaluate each appeal.

Appeal Process Guidelines and Criteria

Government code, section 65584 subdivision (c) para. 2 subpara. (A)), states that a jurisdiction shall have the right to at least one appeal following the final approval of the housing need determinations for the region by the ABAG Executive Board. Any appeal made must be based upon the same state identified criteria as used in the Review and Revision process. In addition, ABAG identified the following criteria and guidelines to be included in the Appeal Process:

- Each jurisdiction in the ABAG region will be given one opportunity to appeal the decision by the Executive Board.
- The jurisdiction that is appealing shall identify another recipient (other jurisdiction(s)) willing to incorporate any proposed reduction in housing need.
- Any revision of housing need will be accomplished within the same county as the appealing jurisdiction.
- Previous available information not raised during the 90-day Review and Revision period cannot be presented during the appeals process.

Appeal Hearings

On January 25, 2001, the Appeal Committee met and decided the outcome of all appeals. Appendix I contains a summary of each jurisdiction's appeal and the Appeal Committee's resolution, deciding the outcome of each appeal.

The Appeal Committee denied eight jurisdiction appeals, and approved two revisions to the RHND allocations (City of Alameda, City of Richmond). See Appendix I. The Appeal Committee's actions were forwarded to the Executive Board for final approval and certification at the Board's March 15, 2001 meeting.

The Executive Board reviewed the Appeal Committee decisions regarding each appeal, and voted to accept all of the Committee's actions with the exception of the revision to the City of Alameda's RHND allocations. The Executive Board approved a resolution, certifying the final RHND allocations. This action finalized the 1999-2006 Regional Housing Needs Determination process.

E. RHND Policies and Guidelines

California state law allows ABAG to adopt policies and guidelines that govern the transfer and/or redistribution of RHND allocations, between city and county jurisdictions, when annexation or incorporation of new jurisdictions occurs during the RHND planning timeframe. The following policy establishes the conditions and process for any such redistribution:

Step 1. Filing of Application for Annexation or Incorporation

Upon receipt of notice of filing from LAFCO for a proposed annexation or incorporation, the city and county will jointly notify ABAG of the proposal, and resulting need for a redistribution of RHND allocations between the county and applicant jurisdiction.

Step 2. Discussion with Annexing/ Incorporating City

During the course of the annexation/ incorporation process, the city and county will negotiate in good faith the number of RHND allocations to be redistributed. The transfer of RHND allocations will be based upon the geographic area that is proposed to be annexed/ incorporated. No net reduction in the RHND allocations between the county and the applicant jurisdiction is allowed.

This means that the total number of housing units by income category accepted by the applicant jurisdiction, plus the remaining number of units by income category attributable to the donor county, shall not be less than the original number of units by income category allocated to the county by the RHND process. Other than satisfying this requirement, the county and annexing/incorporating city may negotiate any redistribution of housing need that is mutually acceptable.

If necessary, ABAG can be consulted jointly by the city and county involved in the annexation/ incorporation process. ABAG will use the approved RHND methodology to determine the total RHND allocations (by income category) that are applicable to the geographic area being annexed/incorporated. The annexation agreement will reflect this determination as a minimum RHND allocation assignment.

Step 3. Annexation/Incorporation Conditions

The city and county involved in the annexation/ incorporation will jointly draft a proposal outlining the conditions and/or agreements covering the transfer of RHND allocations from the county to the annexing/ incorporating city. This proposal shall be submitted to ABAG for review and acceptance prior to its final adoption by the jurisdictions involved in the transfer of RHND allocations. Once ABAG has accepted the proposal, the county will request that the RHND allocation conditions/agreements be included in the LAFCO resolution approving the annexation/incorporation.

Step 4. LAFCO Imposition of Conditions

LAFCO imposes the proposed RHND conditions in the resolution approving the annexation/ incorporation.

Step 5. Transfer of RHND Allocations

RHND allocations will be transferred from the county to the city as specified in the LAFCO resolution.

Step 6. Housing Elements

6a. County Housing Element

The county's housing element should describe assumptions, conditions and implications of any change in RHND allocations resulting from the annexation/incorporation. Following the effective date of an approved annexation/incorporation, the county may amend its housing element to reflect the change in RHND allocations.

6b. City Housing Element Amendment (annexation)

If the annexation and accompanying redistribution of RHND allocations between affected jurisdictions occurs after the statutory housing element amendments have been adopted, any city general plan amendment accompanying an annexation should include amendment of the city's housing element to reflect that change.

OR

6c. City Housing Element (incorporation)

If the incorporation and accompanying redistribution of RHND allocations between affected jurisdictions occurs after the statutory housing element amendments have been adopted, the new city will include the RHND allocation transfer into the housing element adopted for the newly incorporated city.

Step 7. State HCD Review

Transfer of RNHD allocations for incorporations or annexations pursuant to this policy is subject to the review and approval of HCD for consistency with the approved RHND Plan prior to the implementing action.

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