

SGM-V



SUTTER GOLD
MINING INC.

LINCOLN MINE PROJECT BLASTING AND BLASTING MONITORING

A Presentation to the Amador County Board
of Supervisors

January 8, 2013

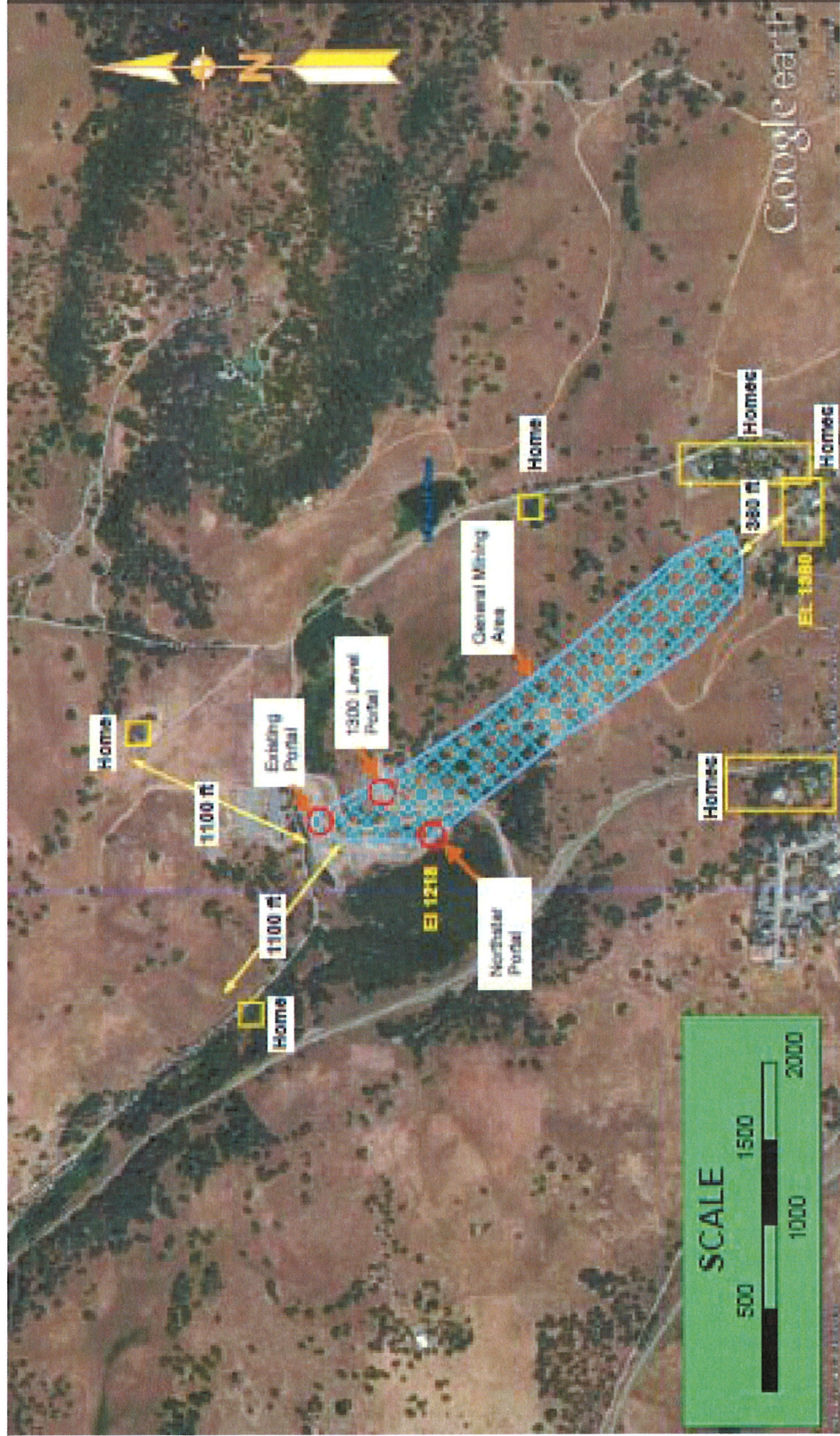
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Blasting & Blast Monitoring Overview



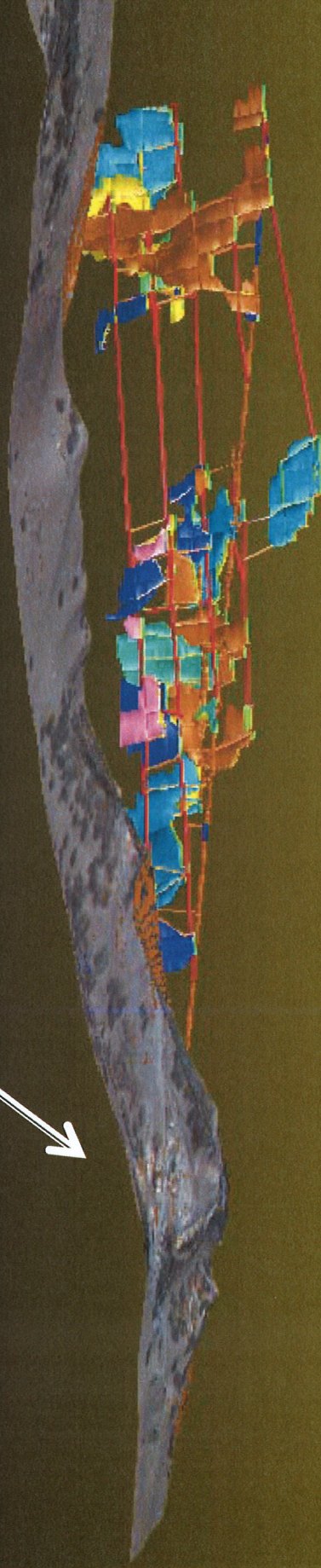
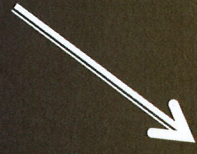
- What, where, why & when is Sutter Gold blasting?
- How and where does Sutter Gold monitor the blasting effects?
- What are the results of the blast monitoring?
- How does the blasting monitoring results compare with prior blast activities & allowable thresholds for the project?
- How do the project thresholds & monitoring results compare with established thresholds for damage and perception?
- Why are some residents reporting blast effects in Amador City?
- What should residents expect in the future as Sutter Gold advances to production?

What, Why, Where & When?



What, Where, Why & When?

Existing Portal & Surface Facilities (1,100-1,300' elev.)



~4220 Feet



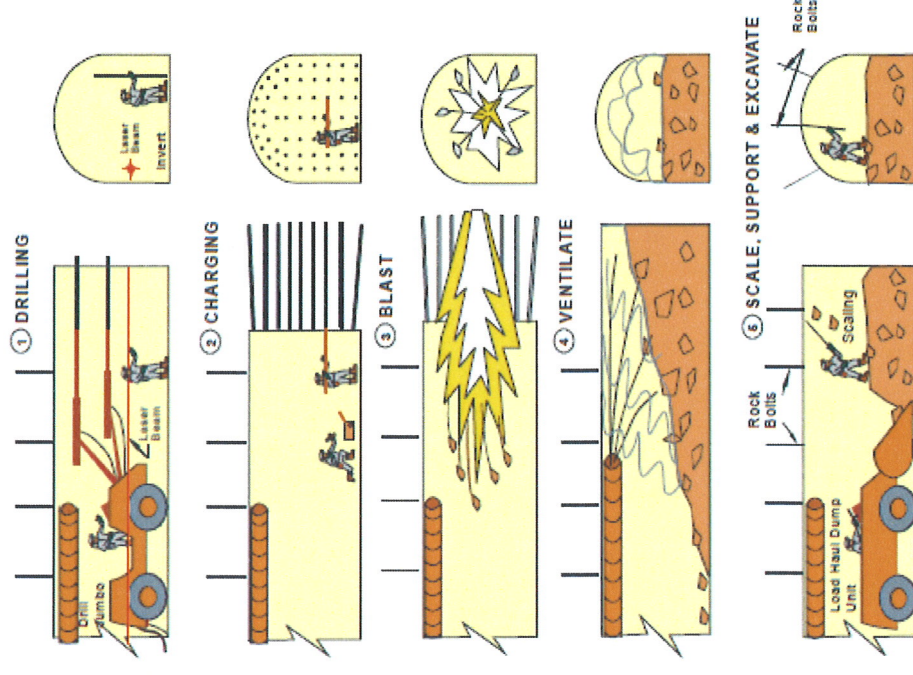
View Looking East at -5° Dip

- Colors Identify Stope Panels/Meins
- Existing Workings in Brown
- Current Mine Design Drifts/Declines in Red
- Modeling and Design in Surpac™ software

Drilling & Blasting During Mine Development Work



- Level development: advancing ~ 8'x9' heading a distance of ~ 8'/blast: working on 4 levels
- ~ 8.5'-long drill holes are charged with ANFO using, on average, about 150-200 pounds per blast (25-33% of the blast sizes used while driving the decline in 1989-91)
- Each blast is comprised of up to 20-40 small (5-10 pound), closely spaced charges, separated by 100-300 milliseconds (c.f. up to 15 small blasts/blast in '89-90)
- A portion of the energy from each blast breaks only the amount of rock necessary to the desired degree
- The balance of the energy is transmitted as ground vibrations & air overpressures (acoustic waves, many of which are below the range of human hearing)
- We monitor ground vibrations using a seismograph equipped with a microphone to measure the air overpressures



Graphics from Revey, 2008

Blast Energy Propagation: Ground Vibrations



- A portion of the blast energy breaks the rock and lifts it out so that it can be excavated and removed
- The balance of the blast energy is transmitted from the blast site as ground vibrations and air overpressures (acoustic waves)
- Ground vibrations radiate out from the blast site, reducing in magnitude like ripples when a stone is thrown into a pool of water
- Ground vibrations move rapidly (2,500-7,200 ft/sec) through rock and quickly attenuate in a linear fashion with increasing distance
- We measure ground vibrations with portable seismographs

Blast Energy Propagation: Air Over Pressures



- Air over pressures do not radiate outward uniformly from underground mine blasts; they are constrained & directed by the tunnels, exiting through the portal entrances
- Air over pressures travel at 1,126 ft/sec, more slowly than ground vibrations; attenuation is less rapid & non linear
- Air over pressures from blasting include mostly a low frequency component (<20Hz) that is not heard but may be felt and an audible component (>20-20k Hz)
- We use special, very sensitive microphones to monitor air over pressures
- Meteorological conditions can focus or reinforce air over pressures at distances

Blast Design, Monitoring & Management



- Before beginning blasting we completed design calculations to assure compliance with CUP limits for minimizing potential impacts (ground vibration & air over pressure)
- Retained an independent, third party expert to prepare the required blast monitoring plan
- Obtained County approval of the plan
- Procured monitoring equipment
- Retained a third party to train our personnel and manage monitoring reports and data
- Implemented the blasting plan & monitoring program
- Continually review blast effects, monitoring data & reported events to adjust & “fine-tune” our program as appropriate

Blast Monitoring Equipment



2012 Blast Monitoring Summary



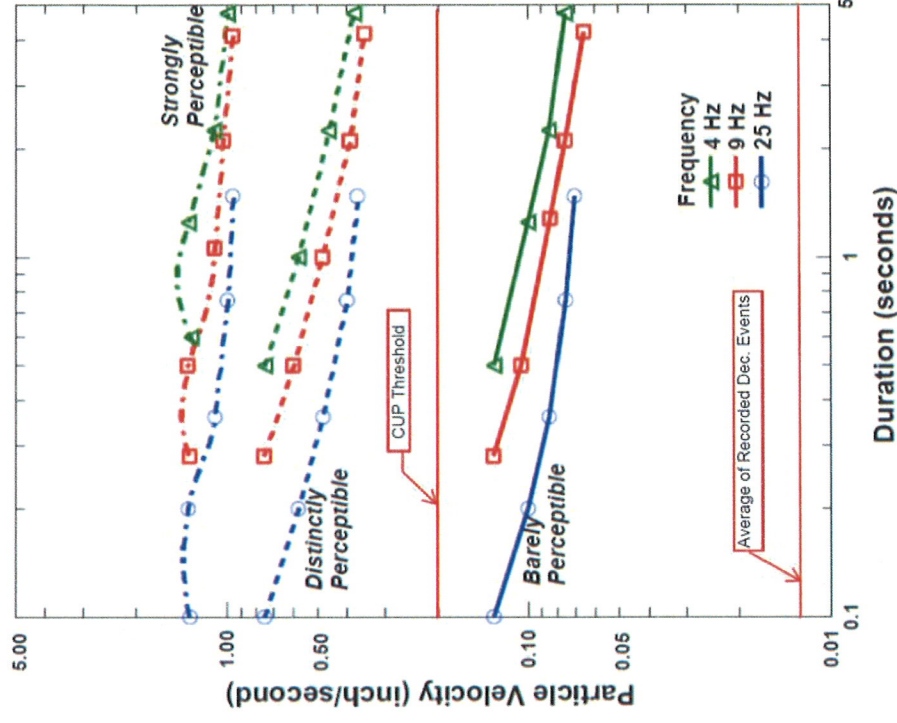
2012 Blasting, Monitoring & Reported or Felt Blast Event Results

	September	October	November	December	Total
Blast Events	10	44	47	50	151
Recorded Events	1	9	6	6	22
% Not Recorded	90%	79%	87%	88%	85%
Reported Events	0	0	0	14	14
% Not Reported	100%	100%	100%	72%	91%
Events w/in CUP Limits	10	44	47	50	151
% Within Limits CUP	100%	100%	100%	100%	100%

Human Response to Ground Vibration



- The allowable limits for ground vibration, measured at the nearest residence located along the project boundary is 0.20 inches per second (in/sec)
- The nearest residences are located approximately 1,100 feet from the portal entrances
- The allowable limits (0.20 in/s) is much less than the limits for the work in '89-91: for low frequencies (<40HZ) 0.50 in/sec for lath & plaster, 0.75 in/sec for drywall and for higher frequencies 2.0 in/sec for all types of construction



Source: Wiss & Parmelee, 1974

Ground Vibration Limits for Structural Damage



Probable Effects	Ground Vibration Level (PPV in inches/second)
Potential Damaged Structure (type)	Transient (blasting)
Average of Recorded Dec. Events	Continuous
Ruins & Ancient Monuments	0.013
Fragile Buildings/CUP Limit	0.12
Historic & Some Old Buildings	0.1
Older Residential Structures	0.25
New Residential Structures	0.3
Modern Commercial/Industrial	0.5
Plaster Cracks in Res. Structures	1.0
	2.0
	4.0

Source: Caltrans, 2004

Ground Vibration Limits for Average Human Response



Probable Effects	Ground Vibration Level (PPV in inches/second)
Human Response	Transient (blasting) Continuous
Average of Recorded Dec. Events	0.013 NA
Barely Perceptible	0.04 0.01
Allowable Limit per CUP	0.20 NA
Distinctly Perceptible	0.25 0.04
Strongly Perceptible	0.9 0.10
Severe	2.0 0.4

Source: FHWA, 2011