

Engineering Geology Applied in The Mining Industry

(Is there really a difference between the engineering geology and mining geology, or is it just semantics?)

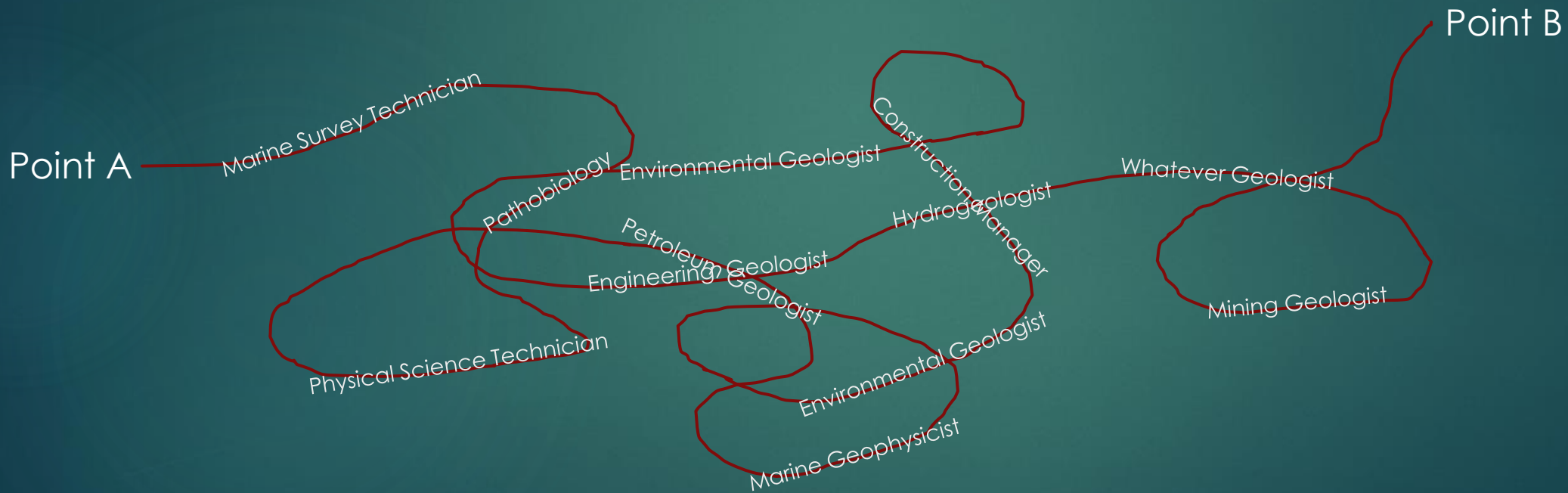
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- ▶ Adjunct Professor of Mining Engineering at the Colorado School of Mines
- ▶ AEG Past President (2005)
- ▶ Co-chair Strategic Outreach Committee
- ▶ And a whole bunch else!



How did I get into mining?



QUIZ – Who came first?

Engineering Geologist

Mining Geologist

Fred Flintstone

Our engineering
geology roots are
in mining.



Early Tunnel Stabilization in a Prehistoric Greek Mine.



Photo Source: www.crystalinks.com



Slope stabilization
~4,000 years old. Great
Orme Mine, Llanduno
North Wales

Grime's Grave Flint Mining Site, ~4,000 BCE, Thetford, England



Photo Source: <https://www.landtraces.com/grimes-graves-neolithic-flint-mines>

Georg Bauer, *De re metallica*, 1556

GEORGII AGRICOLAE

DE RE METALLICA LIBRI XII QVI

bus Officia, Instrumenta, Machinae, ac omnia denique ad Metallum spectantia, non modo luculentissime describuntur, sed & per effigies, suis locis insertas; adiunctis Latinis, Germanicisque appellationibus ita ob oculos ponuntur, ut clarius tradi non possint.

E I V S D E M

DE ANIMANTIBUS SUBTERRANEIS Liber, ab Autore recognitus: cum Indicibus diuersis, quicquid in opere tractatum est, pulchre demonstrantibus.



BASILEAE M D LVI

Cum Privilegio Imperatoris in annos v.
& Galliarum Regis ad Sexennium.



Mining Geology or Engineering Geology?



QUIZ – Investigations performed by mining geologists are fundamentally different from those performed by engineering geologists.

True

False

Mining Geologists and Engineering Geologists share the same skill sets.



Photo Source: Kentucky Historical Society

Engineering Geology Subdisciplines

- ▶ Geohazards
- ▶ Seismology
- ▶ Slope Stability
- ▶ Hydrogeology
- ▶ Environmental Geology
- ▶ Rock and Soil Mechanics
- ▶ Etc.

Mining Geology Subdisciplines

- ▶ Ore Grade Control
- ▶ Minerals Exploration
- ▶ Slope Stability
- ▶ Hydrogeology
- ▶ Environmental Geology
- ▶ Rock and Soil Mechanics
- ▶ Etc.

Roles in Common: Engineering Geologist and Mining Geologist.

- ▶ Site Investigation/Geologic Feasibility Study
- ▶ Earthwork Design – Cut Slopes and Tunnels
- ▶ Ground Control – Slope Stability and Tunnel Stability
- ▶ Groundwater - Supply and Control
- ▶ Geologic Investigation for Material Properties
- ▶ Environmental Compliance

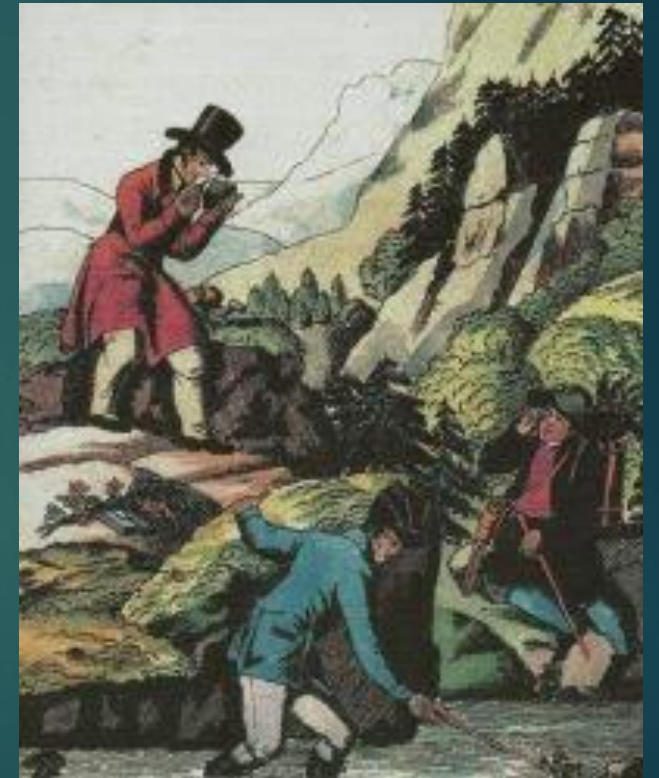


Photo Source: www.palaeos.com

The tunnel doesn't care what you call yourself.

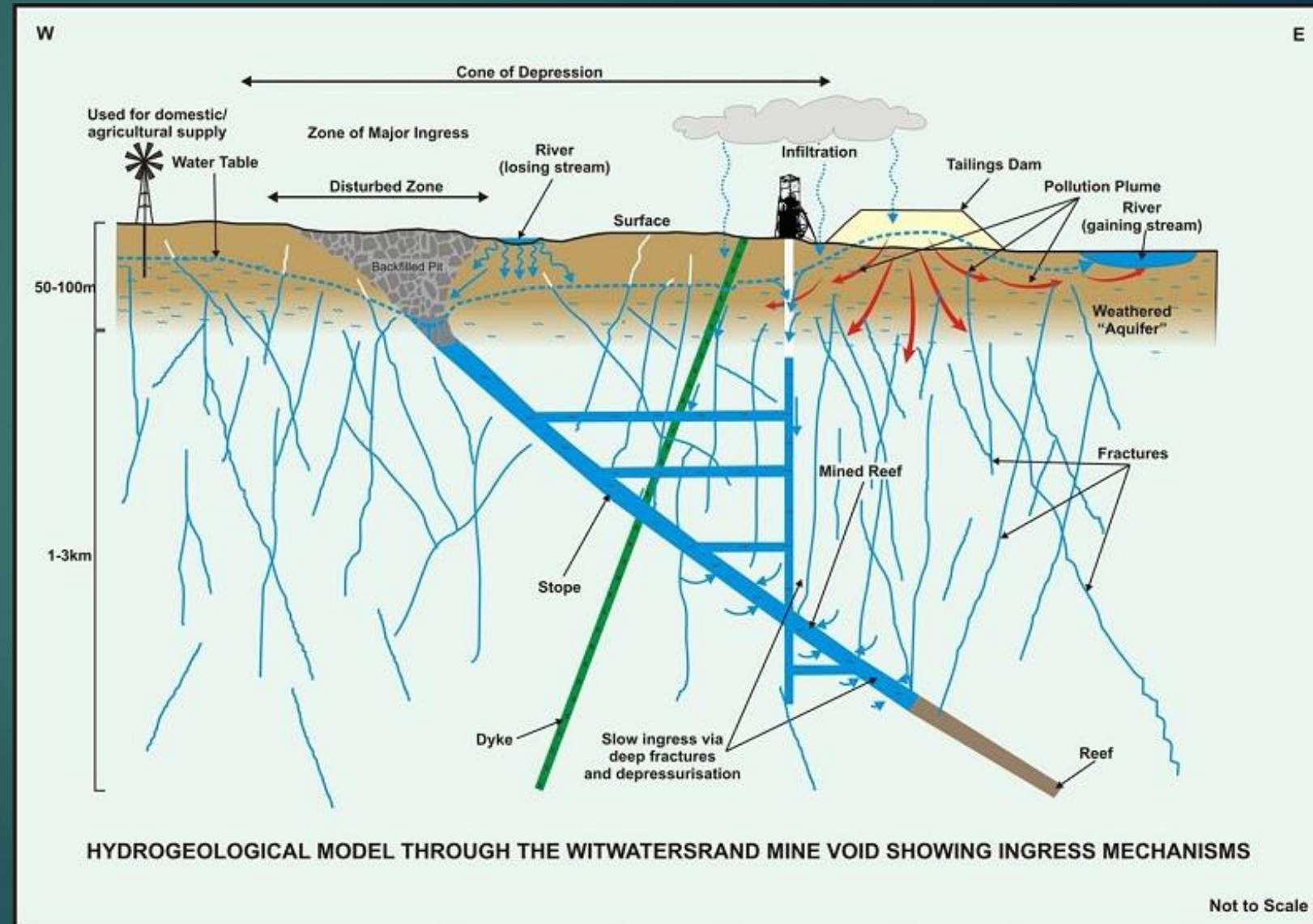


Photo Source: Aiken Standard, March 8, 2017

Do the slopes know
the difference?



Hydrogeological characterization in a mining setting.



Picture from South African Department of Water and Sanitation's website.

Is there really a significant difference between site characterization for minerals exploration projects and engineering geology projects?



Photo by the author.

The First Environmental Law in the United States

- ▶ Sediment accumulation downstream from mining operations on the Yuba River in the Motherlode of California.
- ▶ Flooding due to failure of tailings dam.
- ▶ Woodruff vs. North Bloomfield Gravel Mining Company.
- ▶ January 7, 1884, Judge Lorenzo Sawyer's decision.
- ▶ Prohibited hydraulic mining in the watershed areas of navigable streams and rivers.
- ▶ In 1893, the U.S. Congress passed the Caminetti Act, which modified the judge's ruling somewhat by allowing hydraulic mining in those areas only if a debris-retaining dam was built to prevent the debris from flowing downstream.

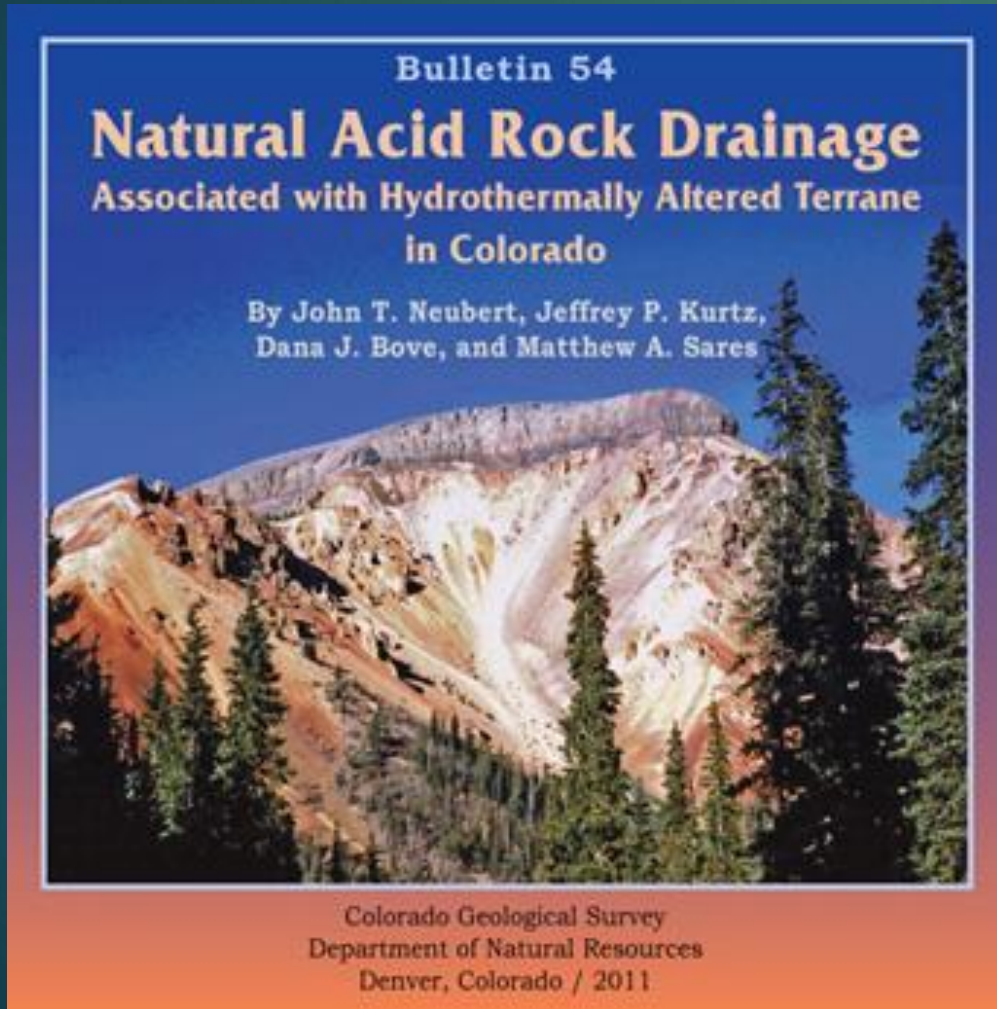
QUIZ – Who should investigate and map mine subsidence?

- Engineering Geologist
- Mining Geologist
- Either One
- Both Together

Opportunities to work together.

Would you want a obstetrician performing your brain surgery, or a brain surgeon delivering you baby?

Acid Rock Discharge



▶ Reconstruction of the V&T RR

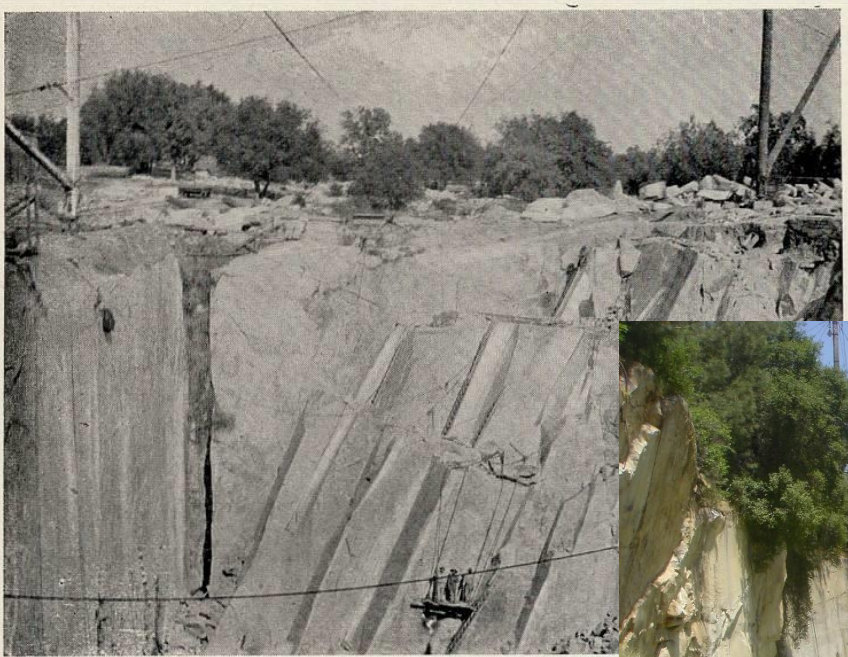


Subsidence over mine workings.



Photographs by the author.

Big Gun Quarry, Rocklin, California Adventure Park



ILL No 10. ROCKLIN GRANITE COMPANY'S QUARRY, P

Image from quarriesandbeyond.org..



Photograph by the author



Image from Quarry Park Adventures.



Original Artwork by Gilly Hathaway

Beware of Silos!

(Why it's important
that we talk.)



Cautionary Tales

IF YOU DON'T THOROUGHLY UNDERSTAND MINING, USE A MINING PROFESSIONAL AND DON'T FORGET THAT THERE ARE PROFESSIONS OUTSIDE OF MINING WHO DO WHAT YOU DO.

2013 Manefay Slide

Before July 20, 2011



After May 2, 2013



NASA Earth Observatory image by Jesse Allen and Robert Simmon, using EO-1 ALL data from the NASA EO-1 team.
The 2011 aerial photograph is from the [National Agriculture Imagery Program \(NAIP\)](#).



Photo Source: Kennecott Rio Tinto

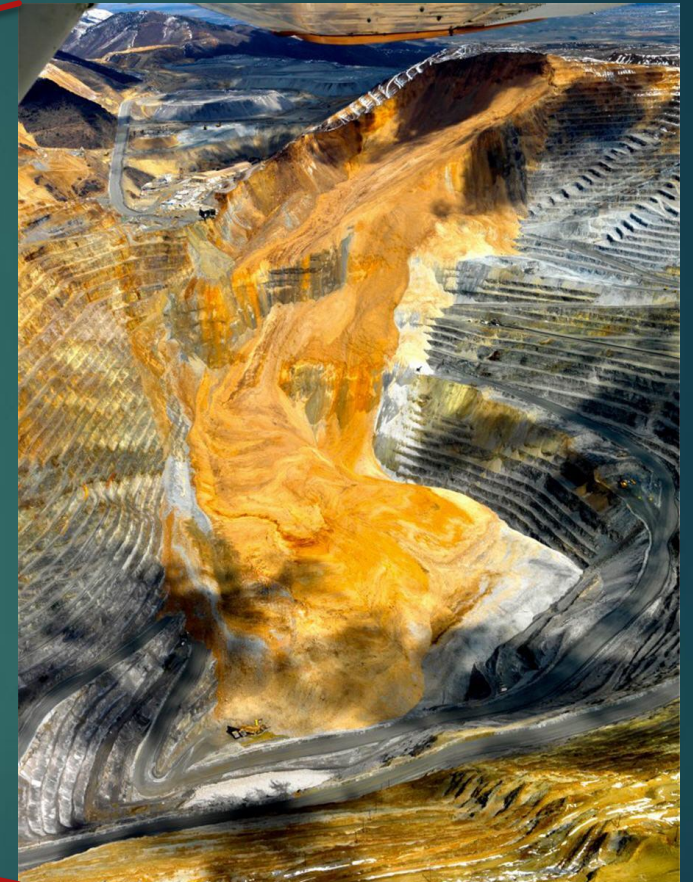


Photo Source: Utah Geological SurveyNotes, v. 48 no. 3, September 2016

Development after Dredge Mining

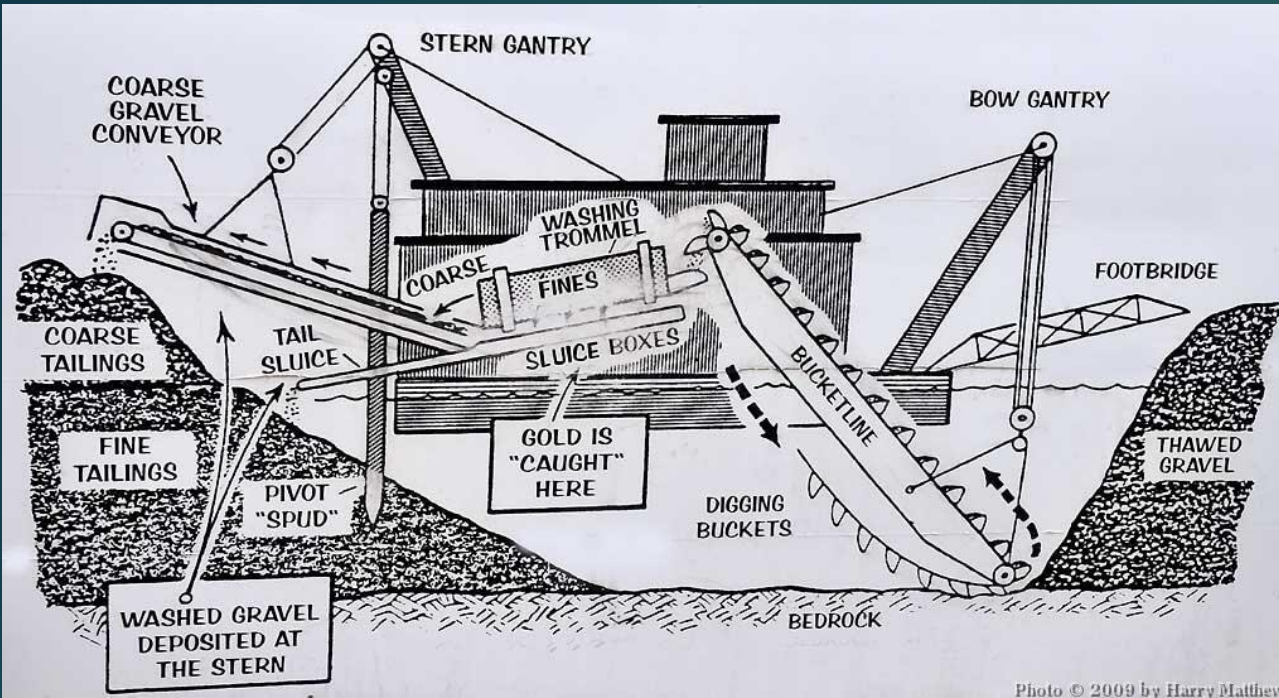
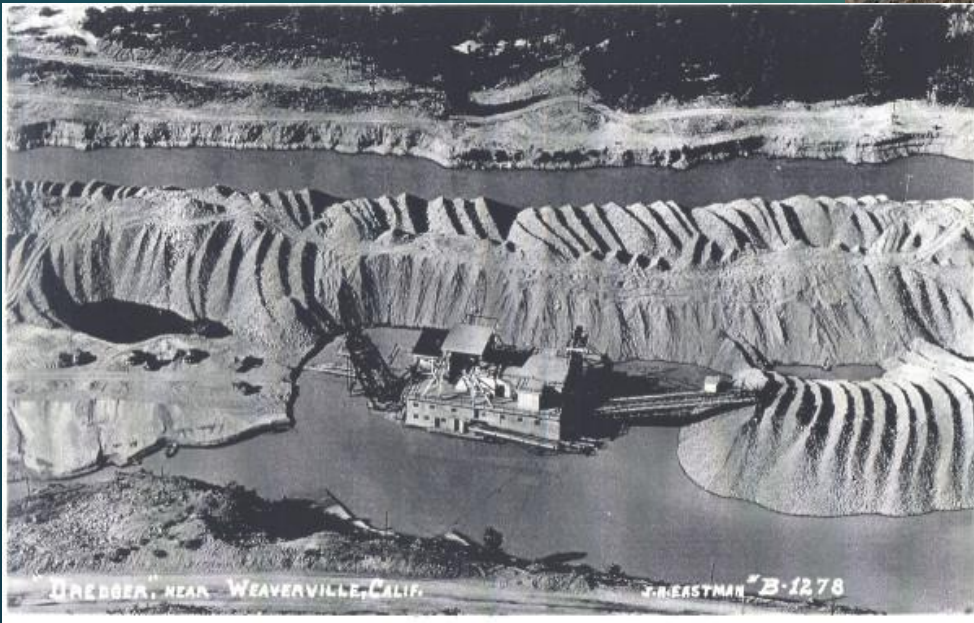
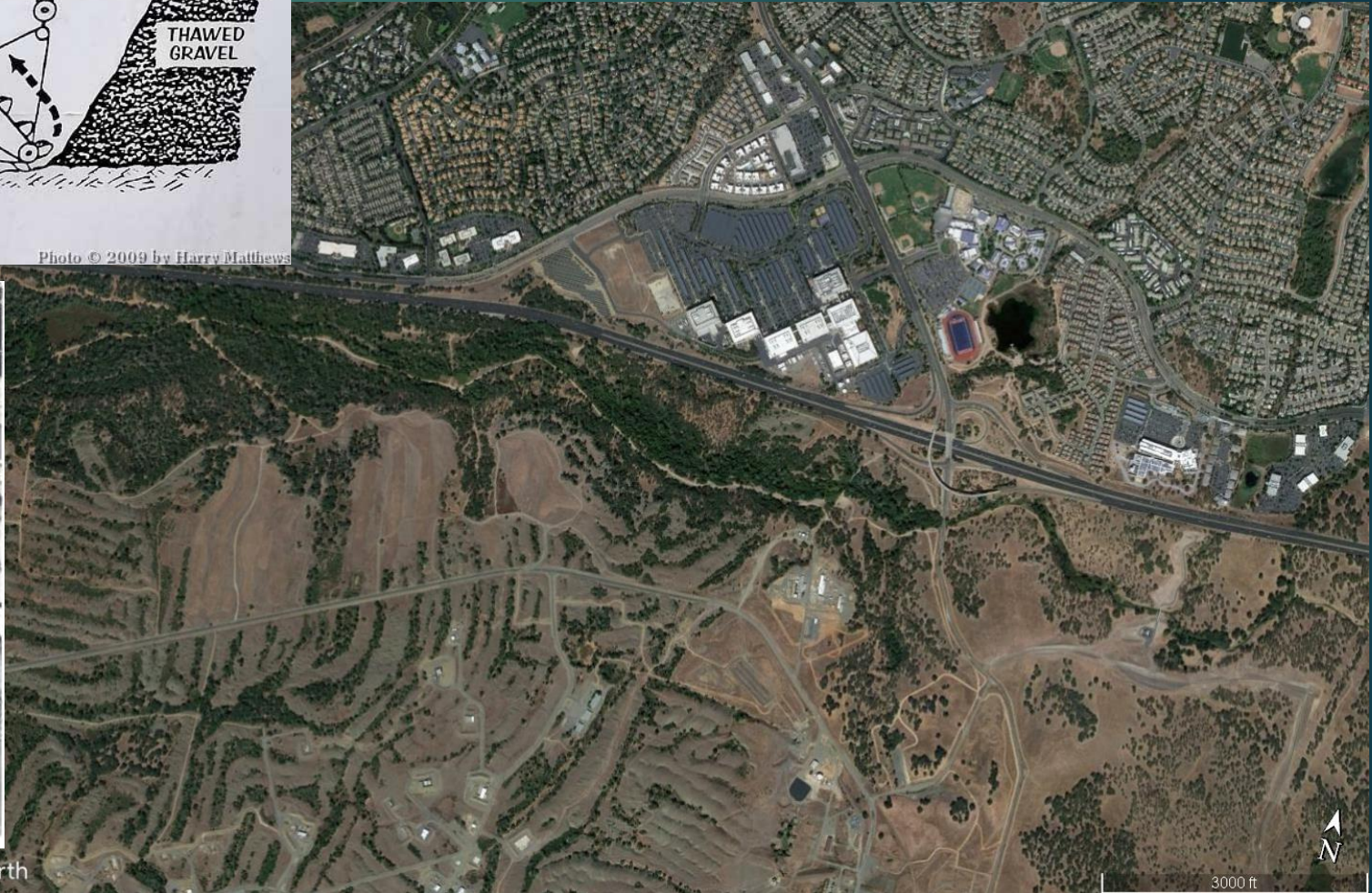


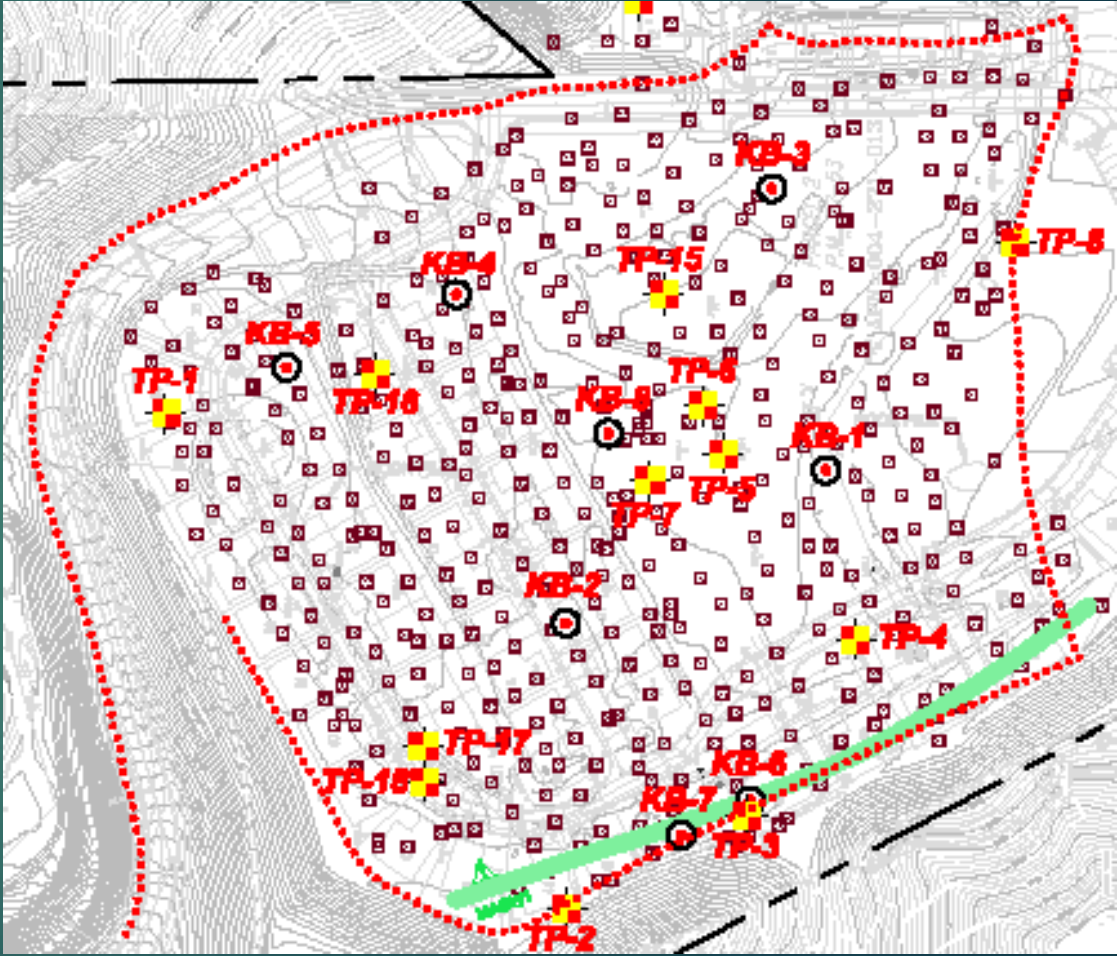
Photo © 2009 by Harry Matthews



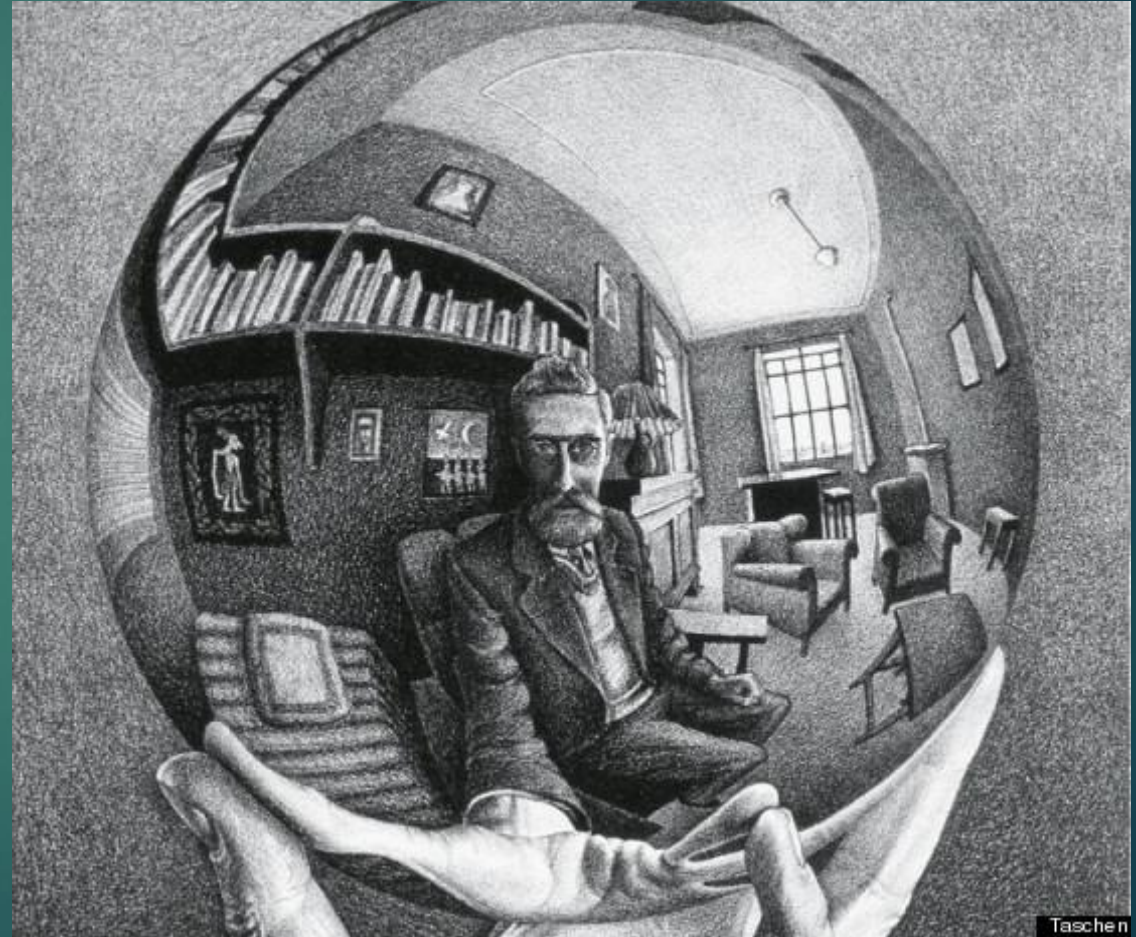
Google Earth



Residential Development over an Area of Historic Mining



Is engineering geology actually mining geology, or is mining geology actually engineering geology?



The answer is, YES!



From Calvin and Hobbes by Bill Watterson