Northern California and Northern Coastal California Shales, Sandstones,

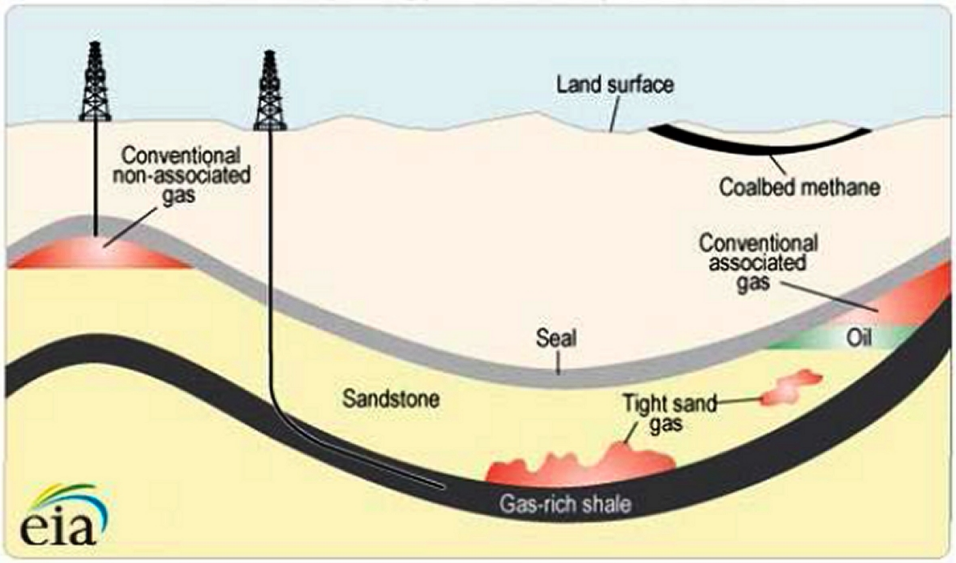
Natural Gas Extraction, Tight-Sands, Tight-Gas, Onshore and Offshore

TOC – 81 pages total, listed by section

STEAM INJECTION IS LITERALLY GLOBAL WARMING
constant comments, and informative research links;
http://banslickwaterfracking.blogspot.com/

Tomas DiFiore POB 612
Little River, CA 95456
iamtomas@mcn.org

Northern California and North Coast Shales, Tight-Sands, Tight-Gas, Un-associated Natural Gas Basins Northern California, Natural Gas Extraction Onshore and Offshore
Part One, TOC – 20 pages total, listed by section



The Monterey Shales produce Oil and Gas, the Franciscan Shales (Northern Coastal Counties) and the Chico Formation of Northern Interior Counties above Sacramento produce mostly dry gas from non-associated gas reservoirs.

The Monterey Shale, the northern extent of which is San Joaquin County, is an oil producing shale formation in which the oil extraction methods produce natural gas liquids. There are many constituents of the wet-gas produced with oil. These are called natural gas liquids. Butane, Propane, are two common ones. Because of 'new' markets for wet-gas liquids, dry gas production from shale has fallen off. Just economics, wet-gas is a by product of oil production.

In other words, the 'lease-held' agreement is for oil, the pay is for the oil. It used to be, that the gas was flared off. Since the oil is paying for the well, the liquids production profit margin causes a price differential that makes un-associated dry-gas wells in the northern part of the state uneconomical to produce. That doesn't mean many wells aren't drilled, and shut-in, awaiting an economic climate that will allow for completion of the well for production.

Will It Be Acid Stimulation or Frac Fluids and Precious Water Used For Well Stimulation?

In the northern part of the State, whether coastal or inland, gas basins are non-associated gas basins meaning no-oil is present. The main constituent of the natural gas is methane. The off shore Eel River Natural Gas Basin is comprised of Methane Gas Hydrates, pure methane (nearly) and is technically termed 'dry gas'.

The Point Arena Offshore Oil Basin is different but a similar case in point, an oil basin yes, but not Monterey Shale.

The southern basin edge is upturned and crops out west of the San Andreas fault system in the Gualala area. Three offshore wells drilled in the mid-1960's penetrate the complete basinal section of Paleogene and Neogene rocks. The Neogene section was deposited in this transform setting following the Mendocino triple junction formation and initiation of the ancestral San Andreas fault system. Neogene rocks contain a shallowing-upward sequence that includes the Miocene, Monterey-equivalent Point Arena formation.

The Point Arena basin contains a major, northwest-trending, seismically-defined structural boundary. *AAPG Search and Discovery Article #90935©1998 AAPG Pacific Section Meeting, Ventura, California*

Geology of North Coastal California

"Continuing detailed studies of the Franciscan have created an even more complex picture of its formation. It appears that Franciscan rocks represent not one but several, accreted terrains.
http://www.krisweb.com/hydrol/geology.htm
These separate Franciscan blocks represent the remnants of several oceanic plates that met their end against the edge of the North America. So far, at least nine different blocks or terrains have been identified. Studies of radiolaria contained in the chert, paleomagnetic analysis of limestone and detailed studies of the mineral content of the greywacke sandstones are some of the tools that geologists are using to complete this picture.

The area where Franciscan rocks are seen can be broadly divided into three belts. In the Coastal Belt, a northwest trending zone between Eureka and the Russian River, Franciscan rocks are mainly greywacke and shale sequences that are not disrupted as other parts of the Franciscan Formation.

The Central Belt, including the San Francisco Bay Area, is found east of the Coastal Belt and this part of the Franciscan Assemblage is a jumble of rocks. Isolated small blocks of exotic

greenstone, blueschist, eclogite, chert or greywacke 'float' in a matrix off highly sheared mudstone. Geologists term this mixture a mélange, adopting a cooking term used to describe a soup that contains floating chunks of goodies. In the Franciscan mélange, the 'soup base' or matrix of sheared mudstone, and the floating chunks are blocks of more resistant rock types."

More Information can be found in the document and web page links provided below:

Harris Quarry Expansion Draft EIR Page 87; County of Mendocino parallel to the coast.
The Franciscan Complex of Jurassic-Cretaceous age.
http://www.co.mendocino.ca.us/planning/pdf/Geology_and_Soils.pdf

Geologic units in Mendocino county, California
http://tin.er.usgs.gov/geology/state/fips-unit.php?code=f06045

The Chico Formation
http://www.bigchicocreek.org/nodes/library/ecr/hydrology_geology.htm

The Big Chico Creek watershed is located in a region that includes the interface between the Sierra Nevada Range to the south, and the remnant volcanic flows of the Cascade Range to the north. Big Chico Creek originates in volcanic rocks, referred to as the Tuscan Formation 4 mil yrs old, the Lovejoy formation at 20 million yrs old, and underlying all is the Chico Formation.

Industry exploits the significance of geologic differences.

Along with Occidental Petroleum, Rango Energy, Inc. drilling has reached a depth of 8,556 feet on the planned 13,000 ft. first well at the Kettleman Middle Dome (KMD) project. Drilling is currently turning through the Temblor Sands that lay directly underneath the Monterey Shale.

The drilling passed through a 1,750 foot thick section of the Monterey Shale and will pass through the Temblor Sands, the Vaqueros sandstone, and the Kreyenhagen Shale before reaching the McAdams formation at 12,000 feet. The McAdams sandstone has been a prolific producer in the adjacent Coalinga and Kettleman North Dome, with over 300 wells producing at an average of over 2.7 MMBOE (million barrels equivalent) per well.
http://www.oilvoice.com/n/Rango_Energy_provides_update_on_the_drilling_operations_on_its_Kettleman_Middle_Dome_project_in_California/d3cbf5d091c7.aspx#gsc.tab=0

In a 2008 paper prepared for a meeting of the Society of Petroleum Engineers, Pinnacle Technologies reported the fracking process "has been applied to a large scale in many Central and Southern California fields to enable economic development and reasonable hydrocarbon recovery. Example formations include the Belridge Diatomite, Stevens Sands, Etchegoin, Antelope shale, McLure shale, McDonald shale, Point of Rocks sands, Kreyenhagen shale, Ranger sands, the UP Ford Shale, and the Monterey shale."

It also stated that "based on the initial experience and formation properties, it is believed that hydraulic fracturing has a significant potential in many Northern California gas reservoirs." El

Shaari, N., W.A. Miner, "Northern California Gas Sands - Hydraulic Fracture Stimulation Opportunities and Challenges," SPE Western Regional and Pacific Section AAPG Joint Meeting, Bakersfield, CA March 31-April 2, 2008.

Acidizing
http://www.sourcewatch.org/index.php?title=California_and_fracking#cite_note-8

Acidizing, also referred to as "matrix acidization," typically involves the injection of high volumes of hydrofluoric acid, a powerful solvent (abbreviated as "HF") into the oil well to dissolve rock deep underground and allow oil to flow up through the well. Conventional fracking, in which water and other chemicals are pumped at high pressure to create fissures in the rocks, reportedly does not work well in many parts of the Monterey Shale. Acidizing, in contrast, is popular in California because the oil-bearing shale is already naturally fractured and buckled from tectonic activity.

Hydrofluoric acid corrodes glass, steel, and rock. Drillers have been injecting it underground for years in diluted quantities (up to 9% HF) to get out the last bits of oil from nearly depleted wells, and injecting in stronger concentrations to dissolve oil-bearing shale. The concentrations of HF acid used by oil companies are unknown, as is what happens over the long term to the rock, and to the HF acid-laced water. A following chapter will discuss acidization further.

Monterey, Kreyenhagen, Bakken, Eagle Ford Shales

The Bakken and Eagle Ford shales are approximately 360 and 90 million years old, respectively, and were deposited on a relatively stable platform; as a result they are thin and widespread, and hence are relatively predictable. The Monterey is 6-16 million years old and was deposited rapidly in an active tectonic regime; as a result it is thick, of limited areal extent, and structurally complex, and hence is much less predictable. An analysis of oil production data from the Monterey Formation reveals the following:

1) While tight oil plays generally produce directly from widely dispersed source rocks or immediately adjacent reservoir, as is the case in the Bakken and the Eagle Ford, this is not the case in the Monterey Formation, where most production has come from localized conventional reservoirs filled with oil that has migrated from source rock.

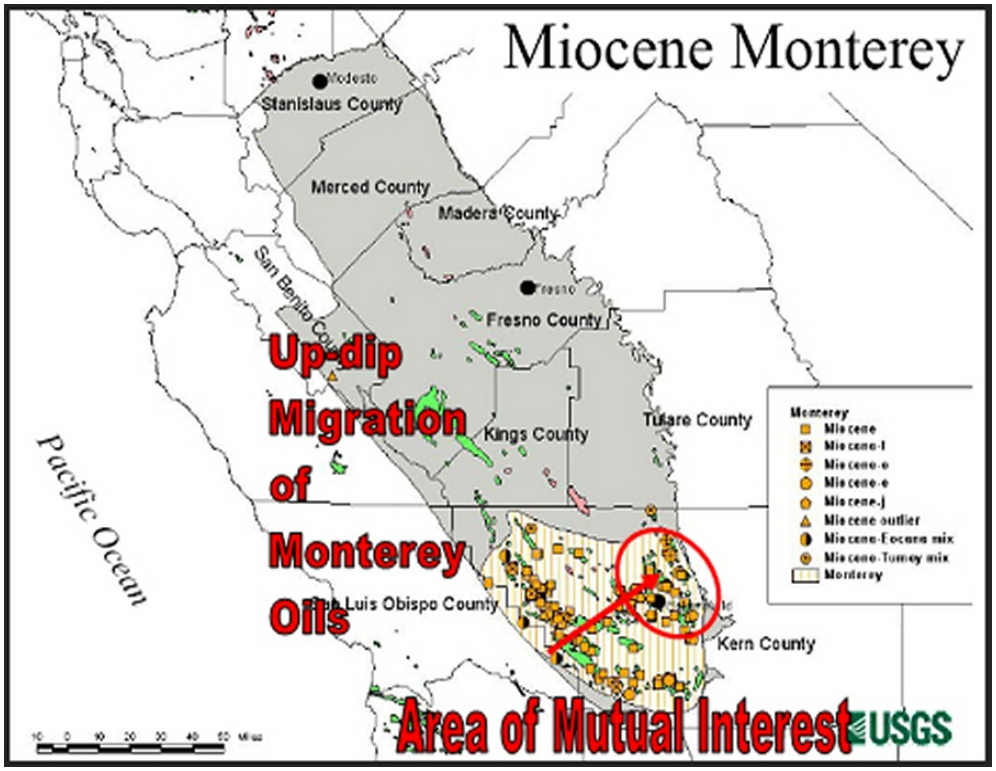
2) 1,363 wells have been drilled in shale reservoirs of the Monterey Formation. Oil production from these wells peaked in 2002. As of February 2013 only 557 wells were still in production.

3) Most wells appear to be recovering migrated oil, not "tight oil" from or near source rock as is the case in the Bakken and Eagle Ford plays. The EIA/INTEK report assumed that 28,032 tight oil wells could be drilled over 1,752 square miles (16 wells per square mile) and that each well would recover 550,000 barrels of oil. Data suggests, that these assumptions are optimistic. http://www.scribd.com/doc/187711217/Drilling-California-A-Reality-Check-on-the-Monterey-Shale

The US Office of Energy Administration (a division of the US Government Office of Energy) estimates that almost 2/3rds (64%) of all the oil shale resources in the contiguous United States are located in California.
http://www.gulfoilandgas.com/webpro1/MAIN/Mainnews.asp?id=19104
Those same published statistics show that the San Joaquin Basin, is in turn the volumetrically richest of the California oil shale basins. The two main oil shales are the Monterey Shale, and the Kreyenhagen Shale, which is thick and extensive.

Targeting the oil shales in the northern part of the San Joaquin Basin, particular emphasis is on the Kreyenhagen Shale where it is not too deeply buried and should not be expensive to exploit. The shale formation outcrops to the west in the project area and plunges down to approximately 11,000 feet in the east.

Miocene Monterey
http://www.oilshalegas.com/montereyshale.html



The Kreyenhagen Shale is a viable exploration target with potential for development with horizontal well technologies. These technologies, now standard for oil shale reservoirs elsewhere, are yet to be tried in the project area or, as far as the Solimar Company is aware of in the adjacent fields that are producing light oil from vertical wells.

Who's Drilling The Kreyenhagen

Occidental Petroleum Corporation (US$84billion) has ambitious plans for the expansion of its oil shale production in California and are the largest acreage holder adjacent to **Solimar.** OXY is competitively leasing in the immediate area of Solimar's Kreyenhagen Project.

New Gulf Resources, a private company from Tulsa, Oklahoma is in the process of drilling an initial three well program on acreage on the flanks of the Kettleman Domes with targets in both the Monterey and Kreyenhagen Shales.

Hess Corporation (US$22 billion), a new entrant into the California oil shale plays has been permitted for the drilling of up to 6 test wells updip to the east from Zodiac Exploration's acreage and deep horizontal well. Hess will be targeting the Kreyenhagen Shale.

Who is HESS?

John B. Hess, Chief Executive Officer of Hess, said, "The sale of our Utica dry gas acreage is an example of our continued commitment to grow shareholder value through ongoing portfolio reshaping. While our wells in the dry gas portion of the Utica were highly productive, we concluded that the potential returns from such an investment, at current and projected natural gas prices, no longer justified retaining this acreage as a strategic part of our overall liquids-based asset portfolio."
http://www.gulfoilandgas.com/webpro1/MAIN/Mainnews.asp?id=32987

Attributes of the California Shales
http://www.oxy.com/OurBusinesses/OilAndGas/UnitedStates/Pages/CalShales.aspx

California shale reservoirs contain abundant interbedded siltstones. Like the Bakken shale in North Dakota and Montana and the Eagle Ford shale in South Texas, the California shales have abundant hydrocarbons currently in place and in a lot of cases thousands of feet of pay thickness. They compare favorably to the Bakken and Eagle Ford on such factors as total organic content, gross thickness, depth, porosity and permeability.

Evidence of environmental impacts in all the above mentioned shale gas plays are everything we've heard about, and the tally isn't in yet.

The northern extent of the Monterey Shale - Sourcewatch:
http://ftp.sourcewatch.org/index.php?title=California_and_fracking

North of the Monterey Shale; the Sacramento Basin is a major gas producing area located in northern California. In 2002, the region produced 81 billion cubic feet of gas from 83 fields and more than 1,000 producing wells. The Knights Landing field which was discovered in 1981 and has produced more than 20 billion cubic feet of natural gas.

The Willows and Greater Grimes fields are located in Colusa, Glenn and Sutter Counties north of Sacramento, California. Depths range from 2,800 feet in the Willows field to 8,900 feet in the Greater Grimes field. 439 wells in the fields producing as of December 31, 2008. The huge Rio Vista Gas field extends into Solano, Sacramento and Contra Costa Counties.

20 Tears Of Diesel Fracking, In The Sacramento Valley
*continuing after 2004 EPA/California Primacy MOA under the UIC of the SDWA

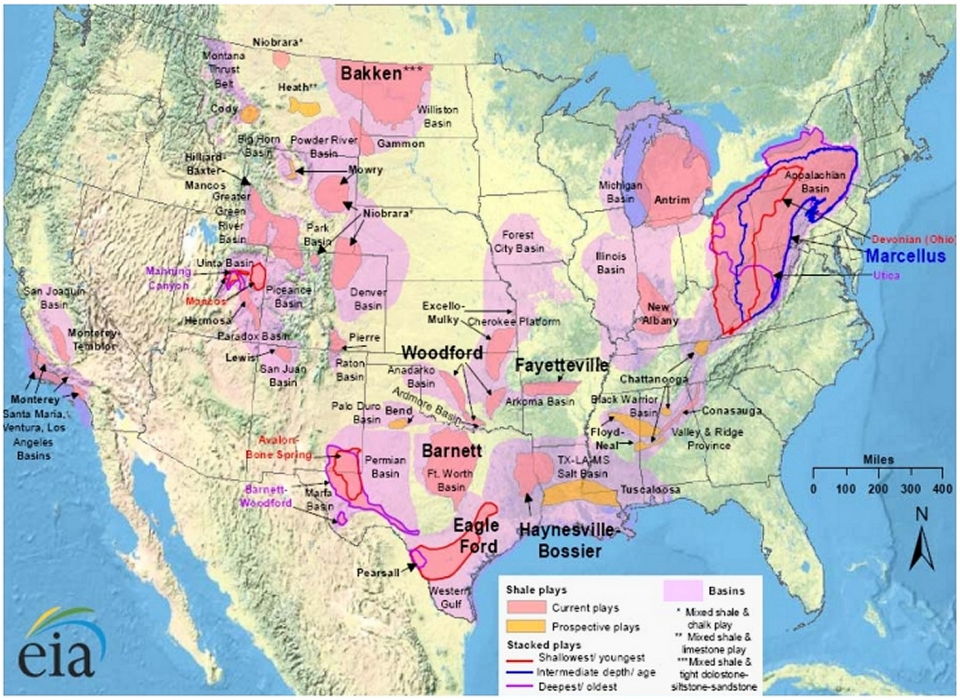
In 2010, Oil & Gas (O&G) industry representatives claimed that diesel was no longer used in hydraulic fracturing operations, but there was increasing evidence that the use of diesel remained widespread. In early 2011, an investigation by members of the U.S. House of Representatives found that drilling service companies injected over 32 million gallons of diesel underground during hydraulic fracturing between 2005 and 2009.

Injecting diesel underground is problematic because of the toxic chemicals it contains, especially the “BTEX” compounds. “BTEX” refers to benzene, tolulene, ethylbenzene and xylene. These chemicals are linked to numerous adverse health effects including cancer, kidney and liver problems and nervous system damage. They are toxic at very low levels and are soluble in water, which is of particular concern when injecting them into the ground in proximity to underground sources of drinking water.

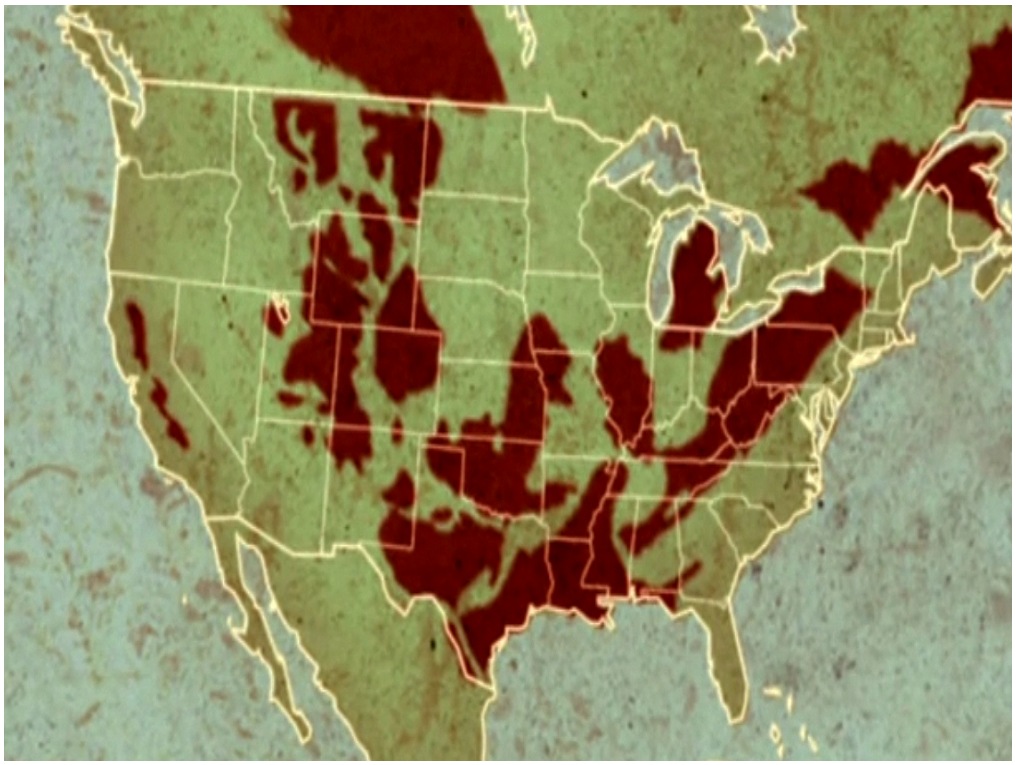
The three leading providers of fracturing services had already signed a "memorandum of agreement," or MOA in 2004 with EPA not to use diesel. Halliburton, BJ Services and Schlumberger then accounted for 95 percent of the "frack jobs" in the country. But the EPA agreement with service providers covered only a narrow set of circumstances drilling into underground sources of drinking water to get methane from coal beds. So a driller could legally inject diesel for most types of fracturing. The driller just needed to get an "underground injection control" permit from EPA or state regulators.

In Jan 20, 2004 near Sacramento, Tri-Valley Corporation re-perforated a 1,000-foot section in its Sunrise-Mayel 2HR in preparation for re-fracturing using diesel oil. Tri-Valley Corporation announced that it had commenced operations to re-enter its Sunrise-Mayel No. 2HR and hydraulically fracture the McClure Shale formation with diesel oil. “The target zone (is) non-water-bearing and not connected with any aquifer.” By September 7, 2004 Tri-Valley made preparations to hydraulically fracture its Ekho No. 1 deep well below 18,000 feet, no well in California like the Ekho No. 1 deep well had ever been fracked.

Two maps, one from the EIA and one from the film Gasland. Notice the extent into Northern California of non-associated 'un-conventional' natural gas reservoirs. Conventional reservoirs, are small in volume but easy to develop, unconventional reservoirs are large in volume but difficult to develop.



Below is the map from the film Gasland 2 depicting 'un-conventional' Natural Gas reservoirs.



Wet or Dry defined:
http://www.glossary.oilfield.slb.com/en/Terms.aspx?LookIn=term%20name&filter=dry%20gas

1. n. [Geology]
Natural gas that occurs in the absence of condensate or liquid hydrocarbons, or gas that has had condensable hydrocarbons removed. Dry gas typically has a gas-to-oil ratio exceeding 100,000 scf/STB. The gas-oil ratio is an important indicator of reservoir energy and the determination of gas resources in a petroleum deposit.

2. n. [Well Completions]
Gas produced from a well that produces little or no condensate or reservoir liquids. The production of liquids from gas wells complicates the design and operation of process facilities at the surface required to handle and export the produced gas.

What's the difference?
http://stateimpact.npr.org/pennsylvania/2012/01/26/what-makes-wet-gas-wet/

Natural gas is a gas comprised of multiple hydrocarbons, the most prevalent being methane. The higher the methane concentration, the "drier" or "colder" the gas is. Other constituents of natural gas are evaporated liquids like ethane and butane, pentane, etc. We refer to these collectively as natural gas liquids (NGLs), or "condensates". The higher the percentage of NGL's, the "hotter" or "wetter" the gas is. NGL's must be stripped out of the gas before it can be put in a pipeline and used. Ethane, which is prevalent in Western PA wet gas, is the feedstock for Ethylene, which is used to make plastics.

The NGL's are worth considerably more than dry gas. In some areas, the value of the gas is more than doubled because of the NGL's. Right now, the commodity price for natural gas is very low due to an oversupply situation.

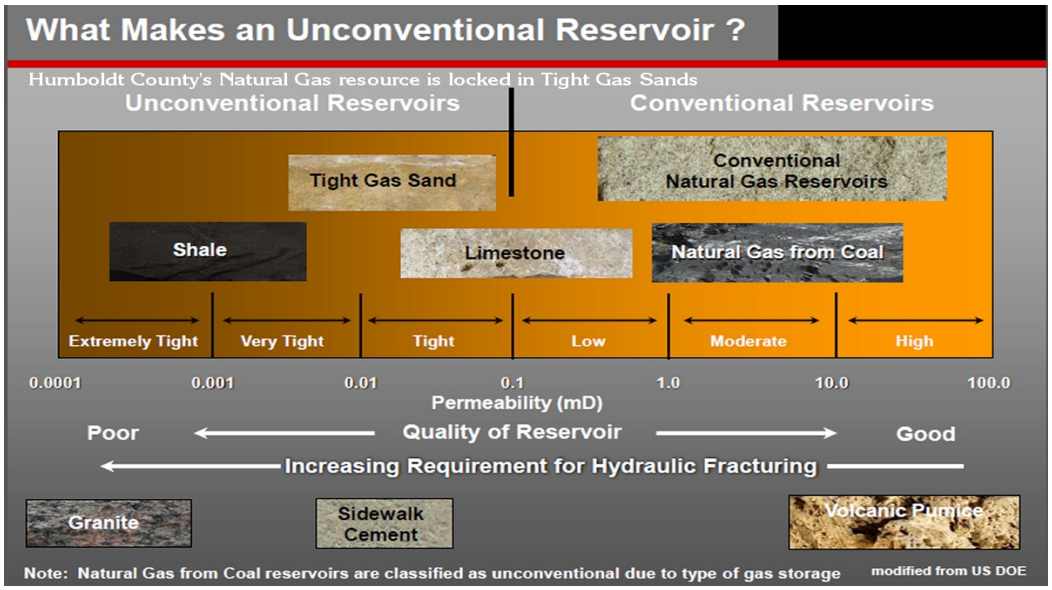
Hydraulic Fracturing And Horizontal Drilling

The methods for extracting gas from tight sand formations are analogous to those methods used for extracting gas from shale. Hydraulic fracturing and horizontal drilling are essential in most formations. http://www.ogfj.com/unconventional/tight-gas.html

Conventional reservoirs are those that can be produced at economic flow rates and that will produce economic volumes of oil and gas without large stimulation treatments or any special recovery process. A conventional reservoir is essentially a high- to medium permeability reservoir in which one can drill a vertical well, perforate the pay interval, and then produce the well at commercial flow rates and recover economic volumes of oil and gas.

An unconventional reservoir is one that cannot be produced at economic flow rates or that does not produce economic volumes of oil and gas without assistance from massive stimulation treatments or special recovery processes and technologies, such as steam injection.

Typical unconventional reservoirs are tight-oil shales,
tight-gas sands, coal-bed methane, heavy oil, and tight-gas shales.



The term tight gas sands refers to low-permeability sandstone reservoirs that produce primarily dry natural gas. A tight gas reservoir is one that cannot be produced at economic flow rates or recover economic volumes of gas unless the well is stimulated by a large hydraulic fracture treatment and/or produced using horizontal wellbores. This definition also applies to coalbed methane, shale gas, and tight carbonate reservoirs. Tight sands produce about 6 tcf of gas per year in the United States, about 25% of the total gas produced.

Tight Gas Sands
http://jmccas1.hubpages.com/hub/Unconventional-Resources

“Tight gas” refers to natural gas produced from reservoirs that have very low porosities and permeabilities. Reservoirs are usually sandstone, although carbonate rocks can also be tight-gas producers. The standard industry definition for a tight-gas reservoir is a rock with matrix porosity of 10% or less and permeability of 0.1 millidarcy or less, exclusive of fracture permeability.

What is a Tight Gas Reservoir?

“Tight gas” lacks a formal definition, and usage of the term varies considerably. Law and Curtis (2002) defined low-permeability (tight) reservoirs as having permeabilities less than 0.1 millidarcies. Therefore, the term "Tight Gas Reservoir" has been coined for reservoirs of natural gas with an average permeability of less than 0.1 mD (1 x 10-16 m^2). A Tight Gas Reservoir is often defined as a gas bearing sandstone or carbonate matrix (which may or may not contain natural fractures) which exhibits an in-situ permeability to gas of less than 0.10 mD.

Tight Gas Reservoir Distribution: Types of Tight Gas reservoirs Onshore or Offshore

Many think of tight or low-permeability reservoirs as occurring only within basin-centered, or deep basin settings. However, tight gas reservoirs of various ages and types produce where structural deformation creates extensive natural fracture systems whether it is basin margin or foothills or plains. Fractured, tight and unconventional reservoirs can occur in tectonic settings dominated by extensional, compressional or wrench faulting and folding. Late burial diagenesis of the sandstone may also result in tight reservoirs. Although "tight gas sands" are an important type of basin-centered gas reservoir, not all of them are Basin-centered gas systems (BCGAs).

What Is A Basin-Centered/Deep Basin Gas System?

Basin-centered gas/Deep Basin (>15,000ft) accumulations are a component of BCGSs that is defined as "an abnormally-pressured, gas-saturated accumulation in low-permeability reservoirs lacking a down-dip water contact". They are characterized by regionally pervasive gas-saturated reservoirs, containing abnormally-pressured gas accumulations.

In southern Mendocino County, the Point Arena Basin holds enormous quantities of oil. 90% of the Eel River Basin in Humboldt County is Offshore.

Basin-Centered Gas: In conventional gas exploration, geo-scientists look for traps and seals. For unconventional tight-gas exploration, however, a basin-centered gas play is most desirable. These regionally extensive gas systems are essentially water-free, with over-pressured gas in low-permeability sands or shales. Such systems experience relatively high decline rates during initial production, but stabilize at very low decline rates, resulting in long-life reserves.

Township Drainage, Well Clusters and Onsite Waste Management are key components of New Technology Concepts for tight gas development. “An enormous volume of unconventional oil and gas will be there to fill the gap once conventional oil begins to decline.”

Both Mendocino and Humboldt Counties have vast reservoirs of oil or natural gas hydrates most of which are just offshore, but development is already underway onshore in Humboldt County with 12,000 acres under lease to tap the Eel River Basin for Natural Gas Hydrates. At least one exploratory well has reached approximately 9,500 feet depth, and producing zones are expected at 4,000 to 6,000 feet and at 9,400 feet. “Production wells will employ fracture stimulation techniques”.

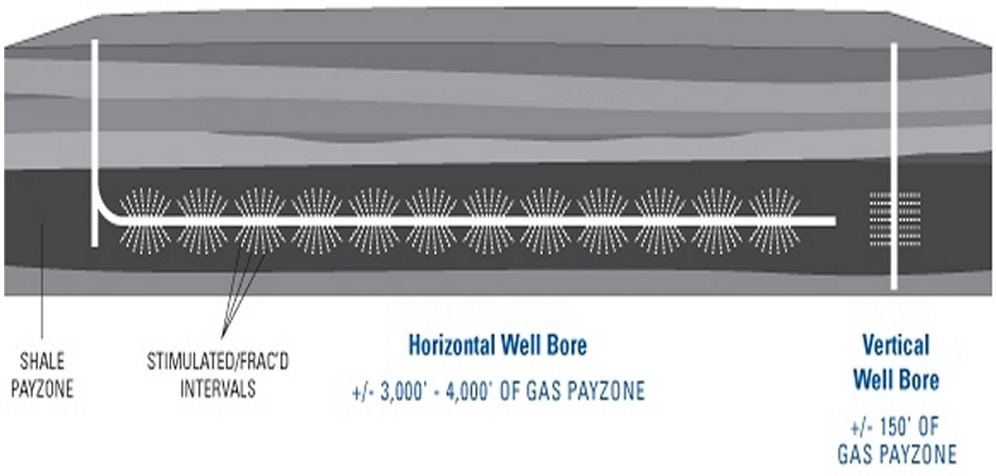
In the southern onshore region of the Eel River Basin, geologically recent west-east-striking faults and folds are superimposed on top of older north- to northwest-trending structures formed as a result of Gorda-North American plate convergence (Clarke, 1987; Nilsen and Clarke, 1987). Seismologically, this is a very active region, and most earthquake hypocenters occur at depths of less than 20 km (Smith and Knapp, 1980).

In southern Mendocino County, the Point Arena Basin holds enormous quantities of oil. 90% of the Eel River Basin in Humboldt County is Offshore

The Mendocino Coast may no longer remain protected from offshore oil. Well maybe offshore oil development and the onshore facilities that support that offshore oil development. That's how the protections read. Local ordinances in the General Plan of Mendocino and the Coastal Element might not adequately cover onshore development of natural gas zones, or access to offshore basins for extraction of Natural Gas Hydrates.

In the 80's un-associated or non-associated gas fields (not associated with oil), were not even considered. As recently as March 21, 2013 DOGGR would not use the term in presentations throughout the State, and dismissed queries amid discussion regarding the locations and production levels of non-associated gas wells in Northern California. A gas field is generally comprised of a number of wells.

Deviant, Slant, Under Balanced, Directional, Horizontal Drilling;
Partial and Full Aquifer Exemptions, SDWA/UIC Permitted Contamination



Forced Pooling and Unitization Of Adjacent Lands Bind Surface Property Rights To Reservoir boundaries under Oil and Gas Protections in law which serve to promote production of oil and/or gas resources at any cost. To every good law of the land, anywhere, there are exemptions for O&G everywhere.

Since the advent of directional drilling, oil companies have eyed the oil and (or) gas reservoirs under State waters and tried to find access to them from onshore or from Federal waters. As we shall see the California educational system has strong ties to the industry. The Redwood Curtain is now in service to Oil and Gas Corporations.

Wednesday, November 3, 2004 from Bakersfield to Houston it is known:
"Tight Gas Sands of the Eel River Basin, California." Jere Jay, INNEX/FOREXCO Energy
http://www.beg.utexas.edu/pttc/archive/nov3-2004-unconventional.htm

But if we visit the online the Humboldt State University Library, Energy and Mineral Resources Section: "This research guide lists both print and Internet maps that cover northwestern California. The table of contents below lists maps by theme and environment." But there are no entries for Energy and Mineral Resources. The only listing with no entries! Seems odd with all the interest in Natural Gas Hydrates and leases.

HSU Library "Energy & Mineral Resources"
http://library.humboldt.edu/infoservices/staff/rls/geospatial/nwcalmaps.htm#energy

Yet, up river, the California Eel River basin drilling nears 06/19/2007
http://www.ogj.com/articles/2007/06/california-eel-river-basin-drilling-nears.html

Three or more wells could be drilled later this year in northwestern California's remote Eel River basin southeast of Eureka. The Bakersfield, California based Foothills Resources Inc., shot 13 sq miles of 3D seismic early in 2007 and controls the 'lease-held' agreements on 12,000 acres surrounding the Grizzly Bluff field in Humboldt County. The Grizzly Bluff #4 well reached a total depth of 9,530 feet on March 24, 2008.
http://www.prnewswire.com/news-releases/foothills-resources-inc-announces-well-tests-in-california-57458537.html

Foothills also accumulated a controlling leasehold position 7 miles northwest of Grizzly Bluff near abandoned Table Bluff gas field. Since 2006, Foothills has acquired additional oil and gas leases in the Eel River Basin, and currently has interests ranging from 70% to 75% in approximately 12,000 additional gross leasehold acres over seven prospects with no depth restrictions.

Now I don't know why academia didn't share this next one! "Our studies show abundant subsurface gas... Analysis of seismic data in the Eel River basin shows that although natural gas in this area is abundant, it is regionally variable and controlled more by stratigraphy than by structure. The abundant gas detected in this basin may affect sediment strength and slope stability, altering both seafloor morphology and sediment transport."
http://www.dtic.mil/dtic/tr/fulltext/u2/a348384.pdf

ONR Grant N000014-96-1-0361 Final Technical Report:
Seafloor Geomorphology, Gas and Fluid Flow, and Slope Failure on the
Southern Cascadia Continental Margin; Daniel L. Orange
Deptartment of Earth Sciences, University of California, Santa Cruz, CA 95064

The Humboldt General Plan lists Natural Gas Resources in Humboldt County
http://www.ci.eureka.ca.gov/civica/bids/inc/blobfetch.asp?blobID=3438
There are natural gas deposits present in Humboldt County. Active gas wells are concentrated in the Tompkin Hills Gas Field. Of the County's 39 gas wells, 31 are currently producing and 8

are considered shut in, meaning they cannot produce gas at their current depths and are sealed off in order to maintain the pressure on remaining deposits. In 2000, net gas production was 1,337,796 million cubic feet (mcf); this represents a 31 percent decrease in gas production since 1992, when net production was 1,927,787 mcf. It further states that in 1992, 34 gas wells were in production and 5 were shut in. Humboldt County contains three inactive oil wells and has not produced oil in at least the past ten years.

FOREXCO, Inc. of Greensboro, NC, secured a 20-year lease (through 2022) to engage in the exploration of natural gas in Humboldt County on the east and west side of the Eel River near Alton to determine potential natural gas reserves. As part of this lease, they have the rights to the exploration and operation of up to five previously developed well sites that have the potential for up to five wells per site. FOREXCO proposed to construct a natural gas collection and transportation system that would cross the Eel River and interconnect with the existing gas sales delivery point at the Pacific Gas and Electric Company's (PG&E) natural gas meter station in Alton. The pipeline will be designed to operate at a maximum allowable operation pressure of 1,360 pounds per square inch (psi). The design of the project allows for greater capacity for possible future development of natural gas reserves west of the Eel River.
http://www.co.humboldt.ca.us/planning/gp/meetings/natl_res/nr_report.asp

What is the significance of access to the Eel River Basin offshore Natural Gas Hydrates?

Methane (Natural Gas) Hydrates in offshore subduction zone sediments hold the world's largest reserves of Natural Gas. More than all combined known global shale gas reserves. Not all coastlines share this geologic feature. The Eel River Basin (offshore) is important enough to be shown on the Global Inventory of Methane Deposits.
http://geology.com/articles/methane-hydrates/

And just for the historical record, 60km off the coast at Crescent City, July 1996 a drilling survey of Offshore Natural Gas Hydrates (in marine sediments, sandstones) was mapped. "This informal report was prepared from the shipboard files by the scientists who participated in the cruise. Preliminary Report No. 67, First Printing 1996.
http://www-odp.tamu.edu/publications

OCEAN DRILLING PROGRAM CALIFORNIA MARGIN
http://www-odp.tamu.edu/publications/prelim/167_prel/167prel.txt
LEG 167 PRELIMINARY REPORT: Leg 167 drilled 13 sites along the climatically sensitive California Margin. Site 1019 (Proposed Site CA-1D)

Site 1019 is located about 60 km west of Crescent City, California, in the Eel River Basin at a water depth of 983 mbsl (Fig. 1). It is the nearshore site of the Gorda Transect. One of the important objectives at this site was to sample gas hydrates. A high-resolution pore-water sampling program was carried out to detect evidence of gas hydrate formation. A logging program was added to measure the extent of gas hydrate formation in situ (permeability).

But the HSU Library mentions not a single resource under Minerals and Energy!

Point Arena Offshore Oil and Gas Basin, Mendocino County

The bulk of natural gas reserves off the California coast, estimated at some 17 trillion cubic feet, are in areas where they often coexist with oil deposits, and therefore can not be touched unless the state were to specifically agree to open those federal waters to oil drilling.

1987 NO OFFSHORE OIL North Coast Moratorium:
The proposed lease sale in 1987, thwarted by the moratorium, would have opened 6.5 million acres off the North Coast. Off Mendocino and Humboldt counties, the tracts for sale lay from 3 to 27 miles offshore, and some of the 24 planned platforms at 300 feet tall and each with dozens of wells, would have been visible from land.

Tourism and commercial fisheries would have been affected, according to an environmental review then, while as many as 240 new oil tanker trips from Fort Bragg and Eureka to San Francisco Bay refineries were predicted. The probability of one or more spills occurring would be 94 percent for accidents involving 1,000 barrels or more, according to documents.
http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/12/28/MN4G14QMVE.DTL#ixzz0WKVRptL0

In 2005, a US panel backed offshore gas drilling
http://www.resilience.org/stories/2005-09-29/other-energy-headlines-30-september-2005#

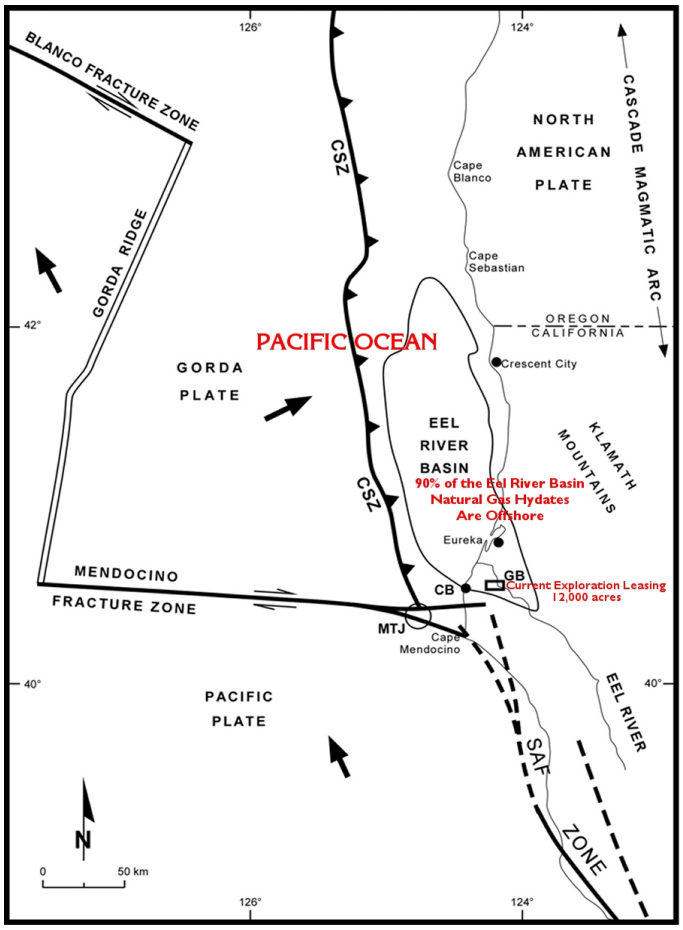
Sacramento Bee September 29, 2005
Two areas off California's coast could be exploited quickly if the bill passes.

WASHINGTON: A House committee voted Wednesday to end long-standing moratoriums that have prevented opening new areas off the coast of California and other states to natural gas development.

If enacted into law, the provision could immediately open for development the Eel River basin in Northern California and the smaller Pitas Point gas field in the Santa Barbara Channel.

The federal Minerals Management Service estimates that there is some 2 trillion cubic feet of natural gas in those deposits, mostly in the Eel River area, in Humboldt County, California.

Eel River basin in Northern California



Northern California Rivers Flow Into Frac Wells And Steam Injection Wells

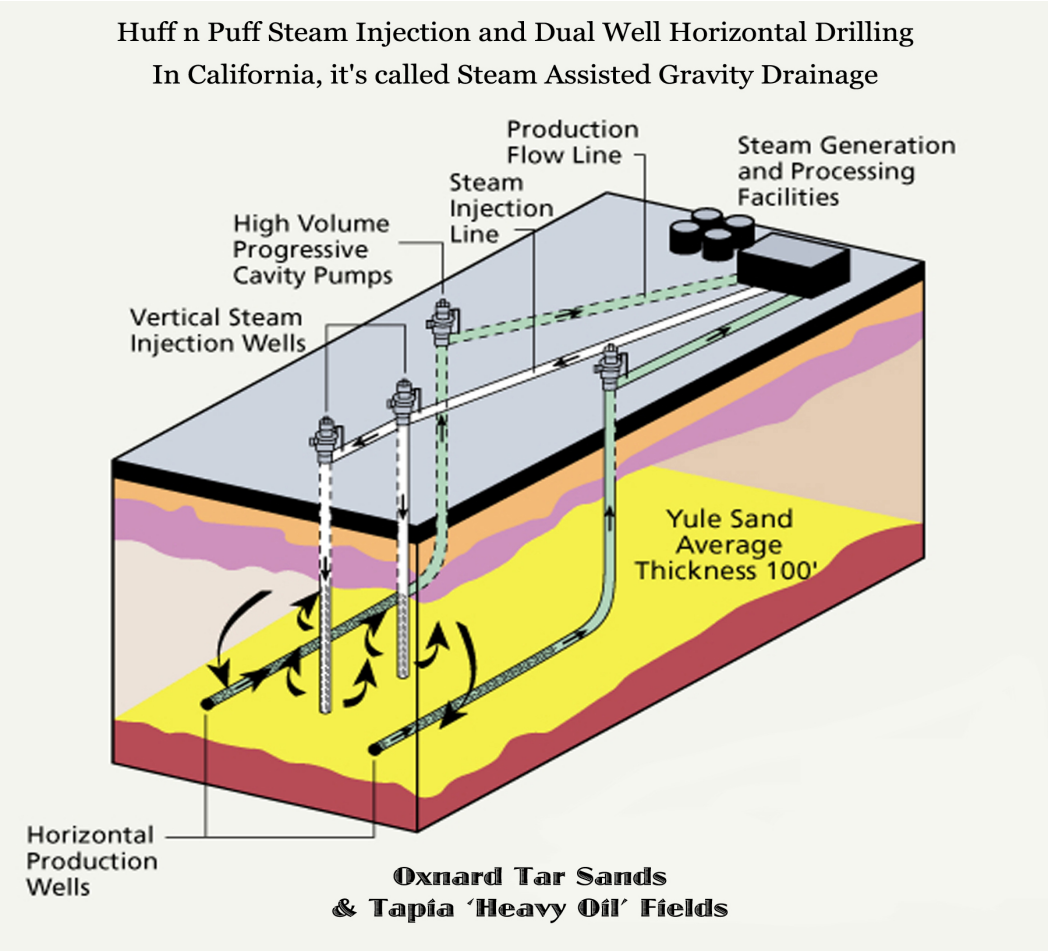
Canadian Technology In The Monterey Shale,
September 2006 Water Usage By Steam Injection Vaca Tar Sands At Oxnard, CA

Old, conventional recovery methods have typically recovered in the range of 25% in the heavy oil interval and new methods suggest double that or more may be achievable according to experts. Tri-Valley could eventually drill as many as 20 dual horizontal wells.

Called SAG-D for steam assisted gravity drainage, the wells involve sets of upper and lower horizontal well bores with continuous steaming being injected into the over bore to help the heavy oil drain into the under bore for recovery. Tri-Valley acquired its first 25 million BTU steam generator for use on the Vaca wells.
http://www.rigzone.com/news/oil_gas/a/36104/TriValley_Begins_Operations_in_Pleasant_Valley

Tri-Valley Corporation successfully completed the first extended steam cycle on two of seven horizontal wells at the company's Pleasant Valley heavy oil project in Oxnard, California. Peak

rates for the project's heavy oil lease have temporarily reached 1,000 barrels of oil per day (BOPD). The company initiated a second cycle on two additional wells at the site. Steam Assisted Gravity Drainage (SAGD) technology materially increases well recovery.
http://www.rigzone.com/news/oil_gas/a/93063/TriValley_Sees_93_in_Revenues#sthash.DIYtmD4T.dpuf

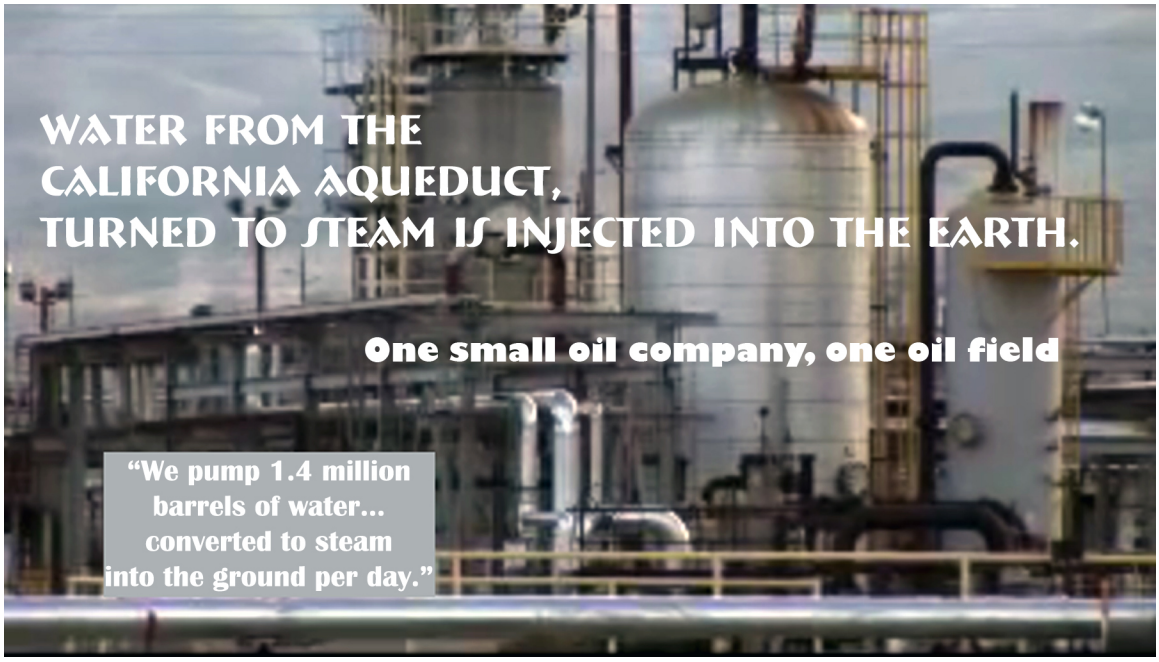


Steam Injection Is Literally Global Warming

Steamed Earth GHG Emissions, AB 32, And Streamlined Environmental Laws

Out west in California, one company, in one oil field each day uses 60 million gallons of water per day from the California Aqueduct and injects it as steam into wells in a process not covered by SB 4 Well Stimulation Regulations, called Steam Injection. Cyclic steam injection repeats this process for a week or more at a time, when the ground cools slightly, production begins and oil flows up out the well. When production falls off, the process is repeated.

Watch the video, This American Land; Mixing Oil And Water: 4 min
http://www.youtube.com/watch?v=d6I0wcCpEJg&feature=youtu.be



If only applied 12 weeks in a year, that's 5 billion gallons allocated from the California Aqueduct, taken from the aquifers, rivers and watersheds of the northern part of the State.

The math below is pretty close, though slightly rounded.

1.4 million barrels a day. 42 (gallons) x 1.4 million is 58,800,000 almost 60 million gallons. That's 184 acre feet each day. A seven day cycle equals 1288 acre feet of water usage, and with 12 cycles per year, that's 15,456 acre feet of water per year turned to steam, and injected underground in one oil field. Compared to the water usage of a single family of four, in a 3 bedroom household, that's roughly equivalent to the yearly water usage of 700-1000 families in California, each day. In one week, a quantity of water which could serve the yearly needs of 5,000 – 7,000 California families is pumped down into the ground, as steam.

The steam/water comes back out with the oil, as produced water. As production falls off, steam injection is again applied, hence the term "Cyclic Steam Injection". That means that in one year, in one oil field in California, the quantity of water used to steam the earth would serve 60,000 to 70,000 households (single family of four, 3 bedroom) including landscape needs.

Yet in the 2011 report issued by the Public Policy Institute Center, as elsewhere, water usage by oil and gas operations in the state is never mentioned; not even once.

Managing California's Water From Conflict to Reconciliation

http://www.ppic.org/main/publication.asp?i=944

At least the document includes a topographical map of groundwater aquifer basins in California on page 193, adjudicated basins DWR Bulletin 118 Aquifers
505 pages full report 8 MB download
http://www.ppic.org/content/pubs/report/R_211EHR.pdf

As in the document, and on any day, in any broadcast or drought related news story, water usage by oil and gas operations in the state is never mentioned; not once.

In the 505 page PPIC report, the only use of the term 'natural gas' occurs under the heading "Water As A Commodity". It states that "the broad economic and environmental effects of storing, moving, and using water make it necessary to regulate these functions to protect public values. But water is also a commodity, an input into the production of goods and services, with a price and a market value, much like electricity or natural gas."

Why is it, that oil and gas production is seemingly non-existent in the State of California according to the Public Policy Institute of California 2011 report "Managing California's Water From Conflict to Reconciliation"?

One answer is that the Resources Legacy Fund Foundation, along with the Stephen Bechtel Jr. Foundation and the David and Lucile Packard Foundation, fund the Public Policy Institute of California (PPIC) studies advocating the construction of the peripheral canal and twin tunnels. The RLFF and Packard Foundation along with the Gordon and Betty Moore Foundation funded the Marine Life Petroleum Act.

Contaminate Migration Expected Under SB 4 "Well Stimulation Regulations" for California, Acidization: Acid Fracking, Matrix Acidizing, The Great Waste Of State: Steam Injection
Part Two TOC – 26 pages total, listed by section

This Is Your Brain On Meth(ane)

Perhaps California has only received half the legal description of 'New' Interim Well Stimulation Regulations required under the intent of SB 4. There is not enough actual information to undertake a Statewide EIR. It therefore seems appropriate to halt by Moratorium and Ban, all hydro fracking in California and acid fracking well stimulation techniques used in horizontal or slant, and deviant (HSD) drilled boreholes, and multiple HSD boreholes from a single pad.

Yes that's spelled M-O-R-A-T-O-R-I-U-M.

Reasons abound to outlaw the use of water intensive extraction methods of hydrocarbons. Not including localized personal health perspectives, or impacts to ecosystem services and functions at 'the source' – rivers in the North State, basin-aquifers, groundwater systems, fish populations etc., five concerns follow.
1) Increased burden of wastewater,
2) 'Wellbore Welfare' Enhanced Oil Recovery and related Federal subsidy dollars as 'fields mature' and 80% of California's oil fields are 'mature assets',
3) Exemption of aquifers,
4) The release of GHG emissions from 'California Surface Expressions' adjacent to Steam Injection Wells and full field (oil field) steam flood scenarios lasting weeks, including Steam Assisted Gravity Drainage EOR combining vertical steam injection wells and dual horizontal wellbores – the heavier the oil, the more steam is applied',
5) As horizontal drilling technology expands into the California production horizon of natural gas in the 'dry gas fields' north of the Monterey Shale, more water usage can be expected.

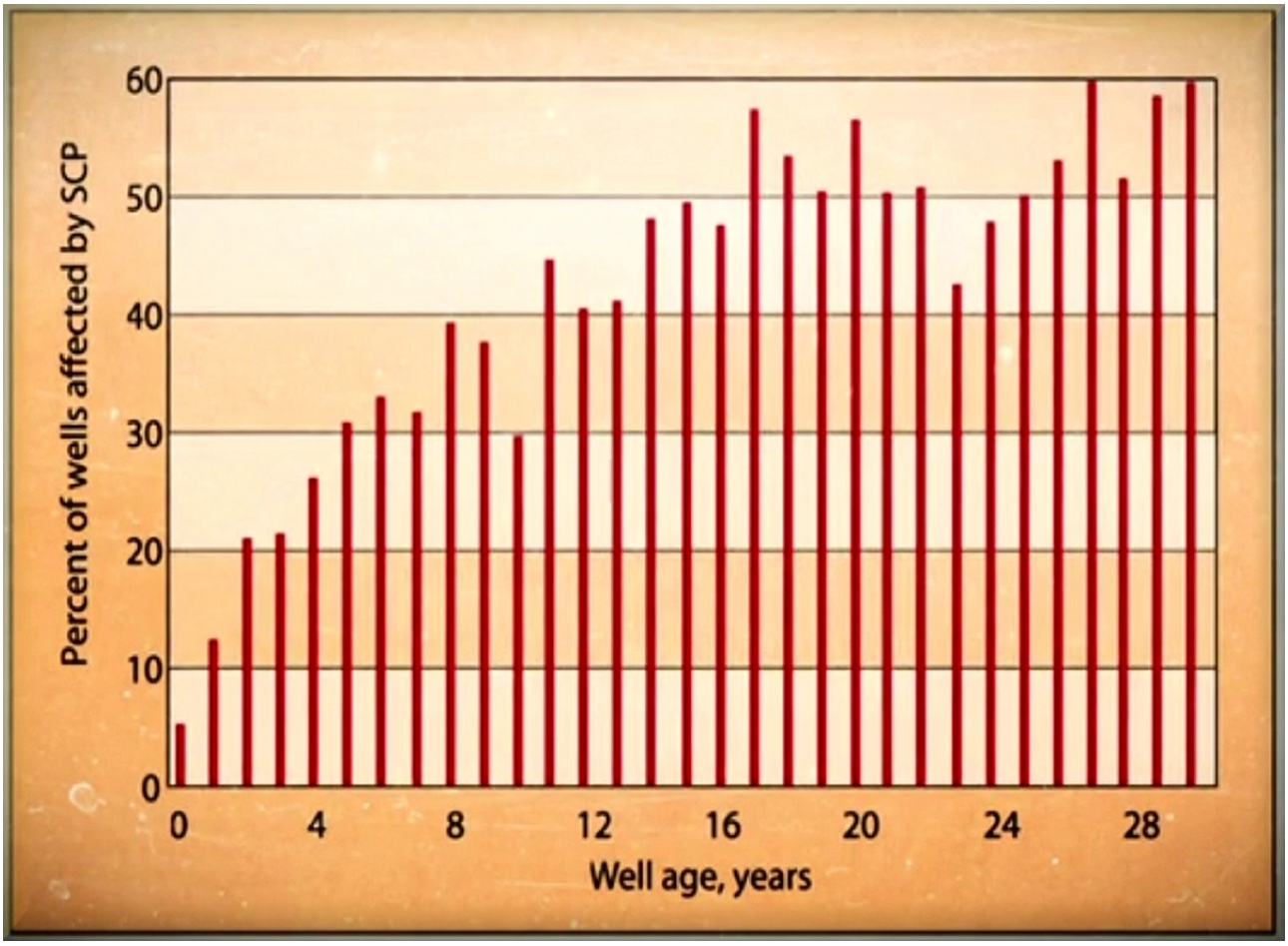
Expect Contaminate Migration, under SB 4 “Well Stimulation Regulations” for California.
As defined and stated under groundwater monitoring requirements: A well-specific (also referred to as “well-by-well”) or area-specific (also referred to as “oil or gas field-specific”) groundwater monitoring plan shall include all of the following:
(1) A map and cross section of the well borehole(s) to undergo well stimulation treatment, showing the well name(s), extent and orientation of the planned fracture network, the stratigraphic depths of protected waters, **and the stratigraphic depths of low-permeability zones that will function to slow the migration of fluids towards protected waters or the surface**.

1783.4. Groundwater Sampling, Testing, and Monitoring.
A contingency plan for reporting information in the event of a well failure. A “well failure” means instances where the well casing has been compromised producing a subsurface leak into water bearing zones and is a potential threat to groundwater quality.

Well Casing Failures a.k.a. Sustained Casing Pressures

It's really quite simple to understand, cement shrinks, and cracks.
5 per cent of all wells drilled show a cement failure immediately.
Based on the history of conventional wells, and recent peer reviewed research:

“Probablistically, the range of events expected for longer wells, with higher pressures, larger volumes of frac fluids, and more wells per pad, are that we should expect a higher accident rate. And that is what we're seeing.”



By the time an oil or gas well of 30 years of age, 50% of all wells FAIL.
Hundreds of thousands of onshore wells. Thousands of offshore wells.
There's a probability that 1 in 20 cement jobs will fail immediately.

“Because the annulus, between the casing and the rock, is now open from below to above, we now have a migration pathway so that anything that's down there in the way of salts, heavy metals, other deleterious things that were stored in the rock now have a pathway, a vector, and something to carry them upwards. And there will be methane migration.”

Published on Jun 20, 2012
23 minute video
Dr. Anthony Ingraffea discusses gas well construction, hydrofracking, micro annular casing leaks
http://www.youtube.com/watch?v=N60hcRzAK_0

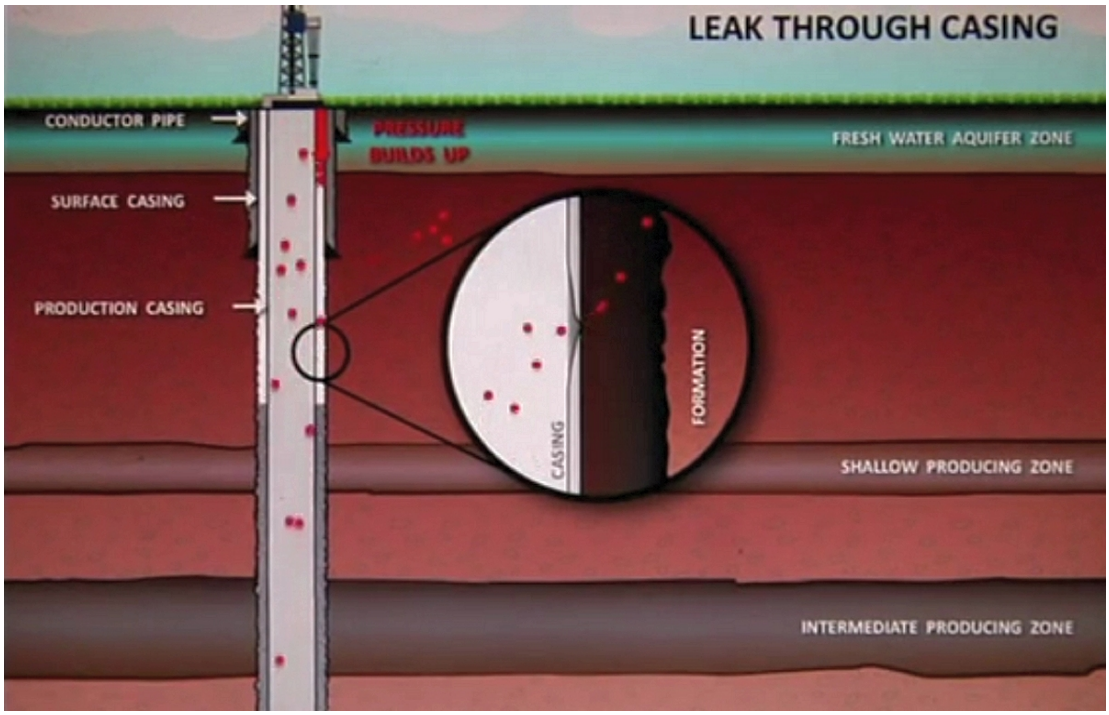
Tony Ingraffea is the Dwight C. Baum Professor of Engineering and Weiss Presidential Teaching Fellow at Cornell. Since 1974, he has conducted RD in various aspects of oil and gas drilling, cementing, fracing, and pipeline science, engineering and technology.

Enormous amounts of pressure exerted in natural gas drilling operations, up to 13,500 psi, can disrupt the underlying rock, resulting in methane contamination.
http://www.desmogblog.com/fracking-the-future/danger.html

A report by hydrogeologist Geoffrey Thyne entitled "The Garfield County Hydrogeologic Study" outlines how methane migration from natural gas drilling led to the contamination of domestic water wells and West Divide Creek.

According to Dr. Anthony Ingraffea, methane contamination can occur from "disturbances of previously blocked migration paths through joint sets or faults, or by puncturing pressurized biogenic gas pockets and allowing migration through as-yet un-cemented annulus, or through a faulty cement job." In large scale hydraulic fracturing operations, underground fracture propagation is difficult to predict according to the BC Oil and Gas Commission.
http://www.damascuscitizens.org/Colorado_COGCC-Hydogeologic-Thyne.pdf
http://www.bcogc.ca/document.aspx?documentID=808&type=.pdf

"It doesn't matter whether they are hydraulically fractured or horizontal wells, they leak! In fact it is the way of all wells sooner or latter that they are going to leak. They are going to leak because the cement shrinks. And when the cement shrinks it pulls away from the geological layer that it's sealed from. Then it serves a conduit straight up into groundwater aquifers."



New Study: Frac Fluids Can Migrate to Aquifers Within Years
http://protectingourwaters.wordpress.com/2012/05/02/new-study-frack-fluids-can-migrate-to-aquifers-within-years/

Where man-made fractures intersect with natural faults, or break out of the Marcellus layer into the stone layer above it, the study found, "contaminants could reach the surface areas in tens of years, or less."

"The study also concluded that the force that fracking exerts does not immediately let up when the process ends. It can take nearly a year to ease. As a result, chemicals left underground are still being pushed away from the drill site long after drilling is finished. It can take five or six years before the natural balance of pressure in the underground system is fully restored, the study found."

A new peer-reviewed scientific study has concluded that fracking chemicals injected into the ground could migrate toward drinking water supplies far more quickly than some experts had previously predicted.
http://www.propublica.org/article/new-study-predicts-frack-fluids-can-migrate-to-aquifers-within-years

"Scientists have theorized that impermeable layers of rock would keep the fluid, which contains benzene and other dangerous chemicals, safely locked nearly a mile below water supplies. This view of the earth's underground geology is a cornerstone of the industry's argument that fracking poses minimal threats to the environment. But the study, using computer modeling, concluded that natural faults and fractures in the Marcellus, exacerbated by the effects of fracking itself, could allow chemicals to reach the surface in as little as "just a few years."

"Simply put, [the rock layers] are not impermeable," said the study's author, Tom Myers, an independent hydrogeologist whose clients include the federal government and environmental groups.

Acidization, Minimal Impacts By Linguistics Approach, Psy-Ops of Confusion

A lot was left out of the regulations. Hydroflouric acid in frac fluids? Acid used in 'pre-frac preparation' may be excluded along with mud-acid. The 7% concentration threshold requirement under Section 1780 would not apply. Concentrations of pre-frac acids can be 28% per cent to base fluid. Reporting the use of Hydrofluoric acid and Hydrochloric acid fracking fluids, is more important than anyone may realize. Fracture acidizing, involves pumping highly pressurized acid into the well, physically fracturing the reservoir rock and dissolving the permeability inhibitive sediments (like quartz).

While the regulations seem to cover acidization, by industry standards, there are gaps in the shared knowledge base. Acids are used in drilling muds, later as mud-acids, and as pre-frac fluids in preparation for 'well stimulation' in concentrations to 28%. There are pre-washes and post-washes.

1780. Purpose, Scope, and Applicability.
(a) The purpose of this article is to set forth regulations governing well stimulation treatments, as defined in Section 1761, subdivision (a)(1), except that the requirements of this article do not apply to acid matrix stimulation treatments that use an acid concentration of 7% or less. Nor is an operator required to obtain a permit under Public Resources Code section 3160, subdivision (d), prior to performing an acid matrix stimulation treatment that uses an acid concentration of 7% or less.

(c) For purposes of this article, **a well stimulation treatment commences when well stimulation fluid is pumped into the well, and ends when the well stimulation treatment equipment is disconnected from the well**.

How Much Acid Can California Geologic Strata Take?

Stimulation operations can be focused solely on the wellbore or on the reservoir; it can be conducted on old wells and new wells alike; and it can be designed for remedial purposes or for enhanced production. Its main two types of operations are matrix acidization and hydraulic fracturing. Most matrix stimulation operations target up to a ten foot radius in the reservoir surrounding the wellbore.
http://www.spe.org/tech/2012/06/well-stimulation/

"Hydraulic fracturing, which includes acid fracturing, involves the injection of a variety of fluids and other materials into the well at rates that actually cause the cracking or fracturing of the reservoir formation. Major technology developments in (non)proppant-fracturing well stimulation, as evidenced by the numerous publications over the last few years, have been primarily in carbonate acidizing."

"However, the industry uses a lot of acid in the noncarbonates. One of those areas is in spearheading fracturing treatments to reduce near-wellbore tortuosity, most of these in sands and shales." [Tortuosity: the near wellbore pressure loss due to multiple fractures.]

These multiple fractures nearest the wellbore cement casing exterior, are the result of the proximity of the propagation of the initial shockwave of fracture technique. Tortuosity is inherent in the drilling process.

This Is The Ground Beneath Your Feet On Acid

A type of stimulation treatment, acidizing is performed below the reservoir fracture pressure in an effort to restore the natural permeability of the reservoir rock. Well acidizing is achieved by pumping acid into the well to dissolve limestone, dolomite and calcite cement between the sediment grains of the reservoir rocks.

There Are Two Types Of Acid Formation Treatment: Matrix Acidizing And Fracture Acidizing

A matrix acid job is performed when acid is pumped into the well and into the pores of the reservoir rocks. In this form of acidization, the acids dissolve the sediments and mud solids that are inhibiting the permeability of the rock, enlarging the natural pores of the reservoir and stimulating flow of hydrocarbons.

While matrix acidizing is done at a low enough pressure to keep from fracturing the reservoir rock, fracture acidizing involves pumping highly pressurized acid into the well, physically fracturing the reservoir rock and dissolving the permeability inhibitive sediments. This type of acid job forms channels through which the hydrocarbons can flow.
http://www.rigzone.com/training/insight.asp?insight_id=320&c_id=4

Sands versus Carbonates

In pursuing heavy oil and bitumen resources, the energy industry historically focused on sand deposits. Beginning in the 1960s the oil sands were developed through a combination of surface mining and underground or in situ development. In situ development initially utilized vertical wells in a cyclic steam stimulation (CSS) process and, more recently, has used horizontal wells in the SAGD process Steam Assisted Gravity Drainage.

Monterey-Type Rocks All Over California Are Good Producers

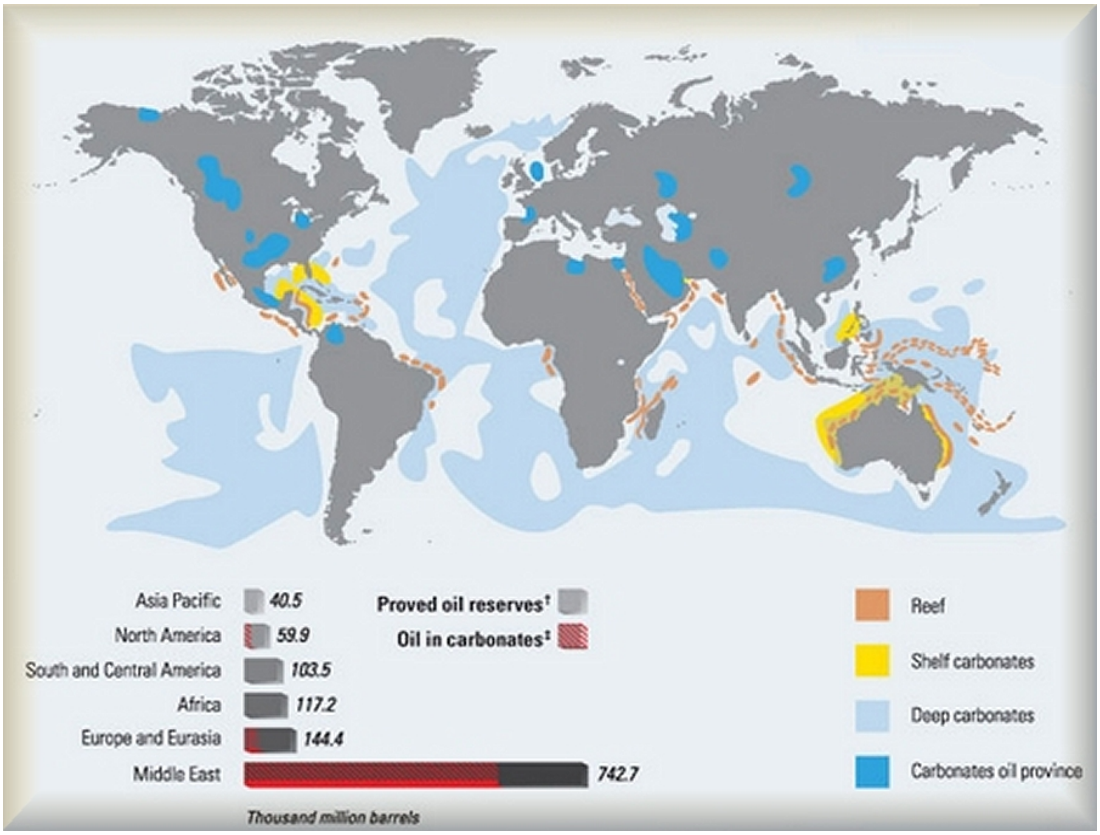
Diatoms are part of the marine plankton that make their shells from hydrated amorphous silica (opal). Under certain conditions, their remains can dominate the pelagic sediments. These conditions prevailed throughout most of California's sedimentary basins during most of the Tertiary Period. In deep basins that are anoxic at depth, the diatoms accumulate in fine millimeter-scale or thinner layers, and the organic material is preserved. With burial and heat, the amorphous opal (opal-A) of the original diatoms is converted progressively to opal-Ct (opal-cristobalite) and eventually to quartz. There is a commensurate decrease in rock volume and porosity and an increase in brittleness.

Original opal-A has a real rock porosity of 60% or more, since there is porosity inside the diatom shells as well as around them. Opal-Ct has porosity ranging from 35%-45%, and quartz phase rocks can have porosity from 0% to about 25%. With these ranges of porosity, diatomaceous rocks can have tremendous storage potential, and by using modern methods of well completion and stimulation Monterey-type rocks all over California are good producers.

Geologically, It's A Whole Other World

Carbonates are sedimentary rock such as limestone formed from decayed organisms like coral and plankton. If exposed to high salinity water over millions of years and under the right conditions, limestone transforms into dolomite. Dolomite reservoirs typically offer better porosity and permeability systems than limestone reservoirs as they are more susceptible to karsting, a process whereby slightly acidic rainwater dissolves or leaches the rock. Many super-giant conventional reservoirs such as Ghawar, Saudi Arabia and Kirkuk, Iraq are carbonates

It is estimated that more than 60% of the world's oil and 40% of the world's gas reserves are held in carbonate reservoirs. The Middle East, for example, is dominated by carbonate fields, with around 70% of oil and 90% of gas reserves held within these reservoirs.



California Focus: Fracking, Acidizing with Hydrofluoric Acid

"In California, at least, the obsession with fracking may be misplaced. In recent months, policymakers have begun to realize that the debate about fracking may be a distraction from the technology that's the more likely candidate for tapping the Monterey Shale: A technique, already widely in use in the oil industry, known as acidizing."
http://thenextgeneration.org/blog/post/monterey-shale-series-distracted-by-fracking

Dave Quast, of California Energy in Depth (TakePart interview) that acidizing uses generally between 750 and 2000 gallons, 85 percent of which is water. Acidizing with Hydrofluoric Acid (HF) works much better than fracking in the Golden State because the oil-bearing shale is already naturally fractured and buckled from tectonic activity. "We know it's dangerous, but we don't know what it does downhole. There are known and unknown dangers."
http://www.takepart.com/article/2013/09/02/acid-california-fracking-acidizing-monterey-shale?cmpid=organic-share-twitter

So much isn't known about hydrofluoric acid use by the Oil and Gas Industry. Three things are: the concentrations used by oil companies, what happens over the long term to the rock when a rock-dissolving chemical is injected into geologic sub-strata, and what happens to those 2000 gallons of hydrofluoric acid-laced water? September 02, 2013 By RL Miller
http://www.takepart.com/author/rl-miller
A climate blogger, RL is chair of the California Democratic Party's Environmental Caucus.

There Are Two Types Of Acid Treatment: Matrix Acidizing And Acid Fracking; from Distracted By Fracking, Robert Collier August 2013 Next Generation article:
Drilling the Monterey Shale Parts 1 & 2: The Most Dangerous Chemical You've Never Heard Of

A matrix acid job is performed when acid is pumped at low pressure into the oil well and into the texture of the reservoir rocks. The acids dissolve the sediments and mud solids that are inhibiting the permeability of the rock, enlarging the natural pores of the reservoir and stimulating the flow of oil. The acids physically fracture the reservoir rock and dissolve the sediments that are blocking the flow of oil.

Because Hydrofluoric acid is so successful at dissolving anything it touches, drilling companies add other substances to the mix to prevent the acid from dissolving the oil well's steel casings (intended) to keep the oil and chemicals from leaching into the surrounding rocks and water table.

A low-volume form of acidizing has long been used nationwide, including in California. This process typically occurs in aging oil wells during the final stages of production, as a means of coaxing out the last dregs of oil before the well is abandoned. In contrast, the tactic now being pioneered in California appears to involve much higher volumes of injected acid as a primary technique for new wells. (To alleviate tortuosity)

Both Hydrofluoric (HF) and hydrochloric acid (HCl) are used, and are sometimes combined, depending on the geology. However, the sandstones and silicates that are prevalent in the Monterey Shale lend themselves especially to HF use.

In many cases, HF acid is created at the oilfield by mixing hydrochloric acid with ammonium fluoride and immediately injecting the mix down the well. Creating the HF acid on site is accepted as safer than offsite production, as it reduces the risk of transport accidents.

California Surface Expressions Are Steaming Sinkholes

Steam Injection and Surface Expressions (off-gassing, sinkholes, micro-seismic activity) all documented by DOOGR and DOC (over 300 instances) just before Governor Jerry Frackinator Brown Water elected to 'change the watch' and fired the heads of both departments.

Tim Kustic, California's oil and gas supervisor, said sinkholes are "relatively rare." He said the agency is considering new regulations in a bid to "eliminate or curtail" seeps and spills of oil in steam injection operations. "Our intent is to learn from this experience," he said.
http://www.sacbee.com/2012/05/22/4506927/california-agency-says-oil-workers.html

A 'surface expression' connected to 'cyclic steam injection' and seepage surrounding Chevron's Well #20 became a 'sinkhole' that claimed the life of Oil Field worker and Mechanical Engineer, Robert Taylor. Meters used by oil companies to monitor ground movement in the area registered shifting underground in the eight days prior to and on the day Robert David Taylor died in June 2011, the state Division of Oil, Gas and Geothermal Resources said in its report.

Sacramento Bee State Records Act Request led to report that said steam injection drilling started in the area around Well 20 in the mid-1990s and that spills and seeps began about a year later. It identified about 30 spills and seeps in the area. In most cases, oil and water flowed to the surface slowly, the report said. But for more than 2 months, 100 barrels of oil and water a day came to the surface as seepage related to steam injection at one well... the surface expression near well #20 in 2011 at the Chevron Midway-Sunset Field.

Both Chevron and Berry employed the same operating company TRC in the Midway-Sunset Oil Field, east of Bakersfield. Both companies and lease-operator were ordered to halt steam injection at these wells and any nearby wells at distances from 300 to 800 feet, by DOGGR in summer of 2011. It is known that for more than 2 months, 100 barrels of oil and water a day came to the surface as seepage related to steam injection at one well between June 21st and July 19th in 2011, the Chevron well #20 in the Midway-Sunset Oil Field. TRC did not halt injection for over 2 months while it waited to appeal the decision at an administrative hearing.

On Aug. 3, an order to halt steam injection describes "at least two new" surface expressions within 40 feet of the first one near Well 20. One of the new expressions had a five-foot radius.

On August 5 there were more problems and another order to TRC. "A volatile eruption began from the existing surface expression in the vicinity of Well 20," the order reads. "Expelling rocks, other material, and emitting fluid and steam." DOGGR said TRC then reported to them that on Aug. 3 and 4, the company had been doing cyclic steam injection to a well near the original accident site. That order also revealed that Well 20 was "damaged," and fluids and gas on the ground were first reported to the agency before 2008.

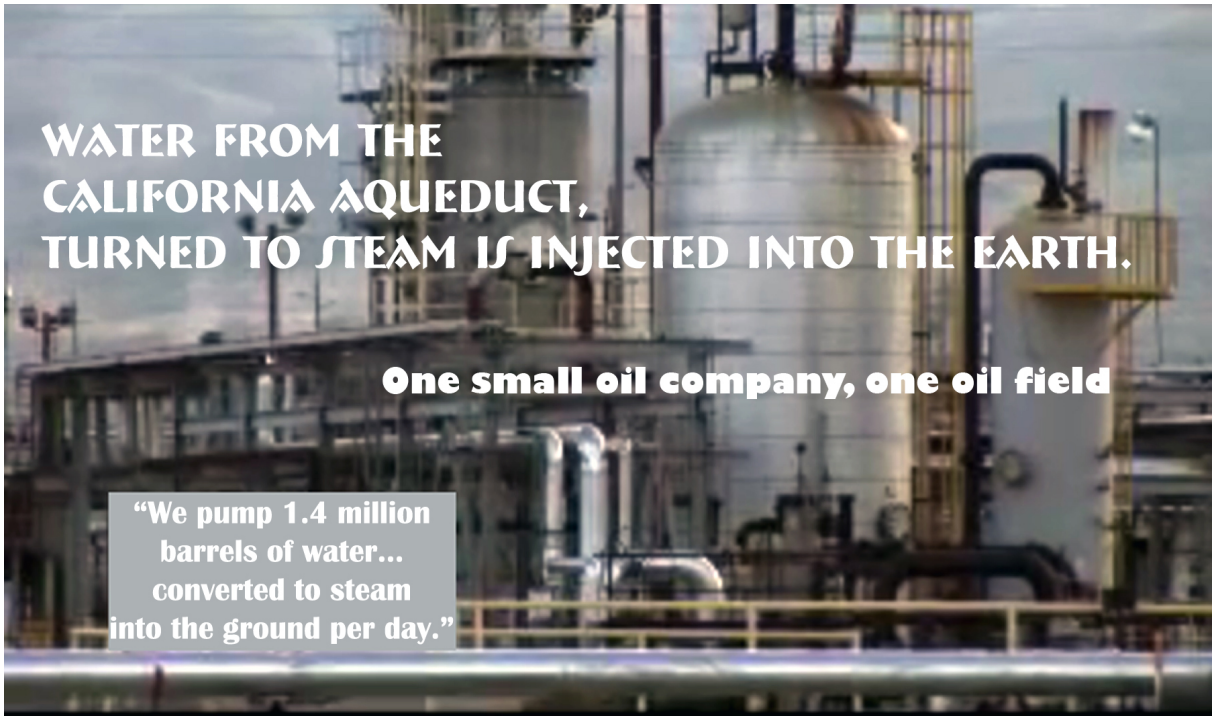
Elena Miller, Head of DOGGR and Derek Chernow, Head of DOC, were fired after turning off the steam to 10% of the Midway Sunset Oilfield. They were lobbying the Brown administration even before Taylor's death, and on Nov. 3, 2011, Gov. Jerry Brown fired Chernow and Miller. Under their successors, Mark Nechodom and Tim Kustic, the state Division of Oil, Gas & Geothermal Resources relaxed the permitting process. From Nov. 15 through early January, 77 injection drilling permits that had been on hold were granted under the division's new review process, according to the state.

Miller, a lawyer installed in 2009, was particularly concerned about the environmental impact of injection drilling, including the possibility of oil contaminating underground sources of drinking water. In August, Miller mentioned a "re-eruption" on Berry Petroleum land, telling Chernow in an email that "the ground shook, fluids went up 60 (feet) in the air, and solids were blown out of the site of the eruption."

In February, new leadership at DOGGR lifted a ban that had prohibited Berry from cyclic steaming within 150 feet of any seeping wells at Midway-Sunset. Before Berry could resume cyclic steaming there though, the company had to show that the steam does not cause oil and other fluids to seep to the surface. When it resumed production additional wells failed, and every well within 150 of that one had to be shut down as well.

In The Arid Productive Farmlands Of California Drought Solution Numero Uno
TURN THE STEAM OFF IN THE OILFIELDS
https://www.indybay.org/newsitems/2014/01/22/18749570.php

60 Million Gallons Turned To Steam Per Day in one oilfield.
60 million gallons a day taken from the California Aqueduct.



Compared to the water usage of a single family of four, in a 3 bedroom household, that's roughly equivalent to the yearly water usage of 700-1000 families in California, each day.

The 2013 California Green Building Code Water Use Modifications states: "A new 3 bedroom single family home with 4 occupants is modeled to use, 174,000 gallons of water per year. The majority of this is for landscaping." In one week, in one oil field, the yearly water usage of between 5,000 – 7,000 California families is pumped down into the ground, as steam. It comes back out with the oil, as toxic produced water.

In the video Mixing Oil & Water, it is shown how just one oil company injects steam into the ground for 7 days in a row, then there is a soaking period followed by a production cycle. As production falls off, steam injection is again, applied – hence the term "Cyclic Steam Injection".

Mixing Oil & Water: 4 min video
http://www.youtube.com/watch?v=d6I0wcCpEJg&feature=youtu.be

The math below is pretty close, though slightly rounded.

1.4 million barrels a day. 42 (gallons) x 1.4 million is 58,800,000 almost 60 million gallons. That's 184 acre feet each day. A seven day cycle equals 1288 acre feet of water usage, and with 12 cycles per year, that's 15,456 acre feet of water per year turned to steam, and injected underground.

Compared to the water usage of a single family of four, in a 3 bedroom household, that's roughly equivalent to the yearly water usage of 700-1000 families in California, each day.

In one week, a quantity of water which could serve the yearly needs of 5,000 – 7,000 California families is pumped down into the ground, as steam. It comes back out with the oil, as produced water. As production falls off, steam injection is again applied, hence the term "Cyclic Steam Injection". That means that in one year, in one oil field in California, the quantity of water used to steam the earth would serve 60,000 to 70,000 households (single family of four, 3 bedroom) including landscape needs. Now let's look at indoor water use only.

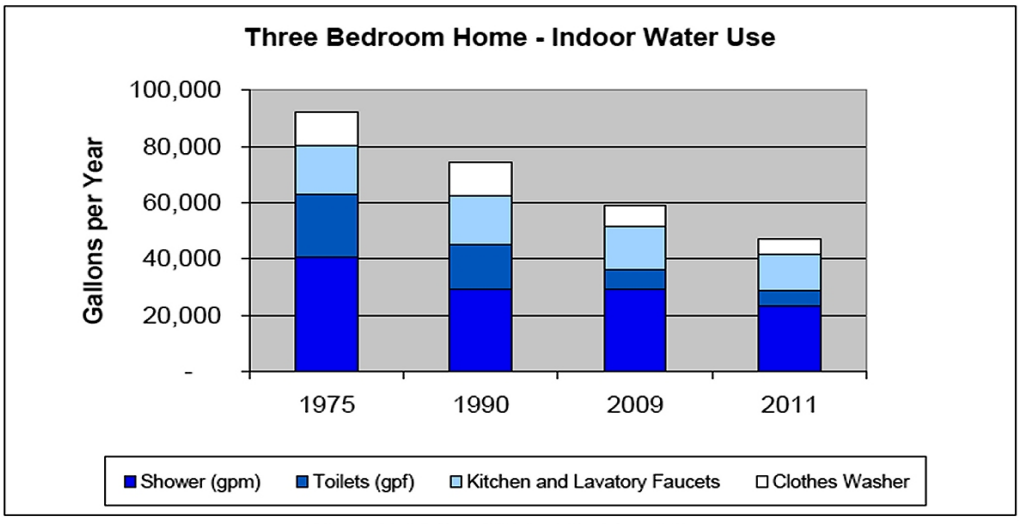


Figure 3: Indoor Water Use Over Time

Probably a larger percentage of the population lives without rural landscaping needs in California, or comparable individual residential city landscapes with trees and grass, gardens, animals etc. So looking at only indoor water use for the same 3 Bedroom family of 4, the figure drops dramatically to less than 60,000 gallons, closer to 50,000, split the difference and just a quick mental adjustment of the math would show that:

50,000 to 60,000 is about one third of 174,000 (yearly use in gallons) for a single family of four, in a 3 bedroom household indoor water use only,

Logically, if we then multiply by 3; 700-1000 families in California, (the comparative water use each day above) grows to a figure of 2100-3000 families.

Based on these calculations, each year, in one oil field in California, the quantity of water used to steam the earth would serve 180,000 to 210,000 households in yearly indoor water use.

Under full-scale cyclic steam injection operations, it is probable that about 100 to 120 million barrels of oil could be recovered; if continuous steam displacement is applied successfully, recovery could approach 200 to 240 million barrels. More steam, more steam!

From Kern County, California to the Alaskan Tundra Big Oil Is Steaming the Earth, and releasing GHG emissions at the planet's surface. How many mercury toxic CFL light bulbs does it take to save one billion kW per hour?

Extreme Oil Drilling (National Geographic)
http://www.youtube.com/watch?v=QP2GejkLdwA

“It takes 81 trillion btu’s everyday just to warm the ground at Kern. 25 square miles to 1600 feet deep. It takes so much energy, enough to power one large air conditioner for every human being on the planet.” 81 Trillion btu's per day to heat Kern County to 200 degrees.

Kilowatt Hours (Kwh) to btu (british thermal unit) conversion table shows the most common values for the quick reference.
1 Kwh = 3,412.14163 Btu/hr

81 Trillion btu's per day
81 trillion divided by 24 (hours) =

3,375,000,000,000 btu per hr
3,375,000,000,000 btu divided by 3,412 btu/hr =

989,155,920.281 kwh
almost a billion KW per hour

For the sake of our water, our air, our rivers, our food, and our communities, we need to Ban Fracking in California. A Fracking Moratorium would create a time frame for expanded

development of existing sustainable portfolios of energy, and not trade maximum exploitation rate loan guarantees against environmental impacts for international market edge.

Watch the 2012 the KQED film "State of Thirst" video on California Water Management. It contains a clear animation of the flow of water throughout the State!
http://www.youtube.com/watch?v=panaJZaffYk

No, neither oil nor gas are mentioned. Oil and water don't mix, but toxins leech, and contaminates migrate. Oil And water aren't usually mentioned together in funded research or special edition news segments, and not even in recent educational videos on California Water Management. When it comes to water resources in the State, one never hears any mention of oil and or gas production. Like twin tunnel vision, there's a duality of mental states of denial.

The Frackinator Denominator In Water Conservation

1) The agricultural sector uses around 80 percent of all of the water withdrawn in California.
2) The agricultural sector uses around 80 percent of all of the water withdrawn for human use in California (34.2 million acre-feet per year agricultural use divided by a total human use of 43.1 maf).

This California number is the same as the global estimate of agricultural water use: 80% of the water humans use goes to agriculture. Using this number, agriculture only uses around 41% of the state's water. From: San Francisco Chronicle The denominator problem: Misleading use of water numbers...Dr. Peter Gleick, President, Pacific Institute (2009)
http://www.sfgate.com/cgi-bin/blogs/gleick/detail?entry_id=46314

In California, where nearly half of the nation's fruits and vegetables are grown with water from as far away as the Colorado River, the perennially cash-strapped Golden State's governor is proposing to spend $25 billion to divert more of the Sacramento River from the north to the south. Near Bakersfield, a private project is underway to build a water bank, essentially an artificial aquifer.

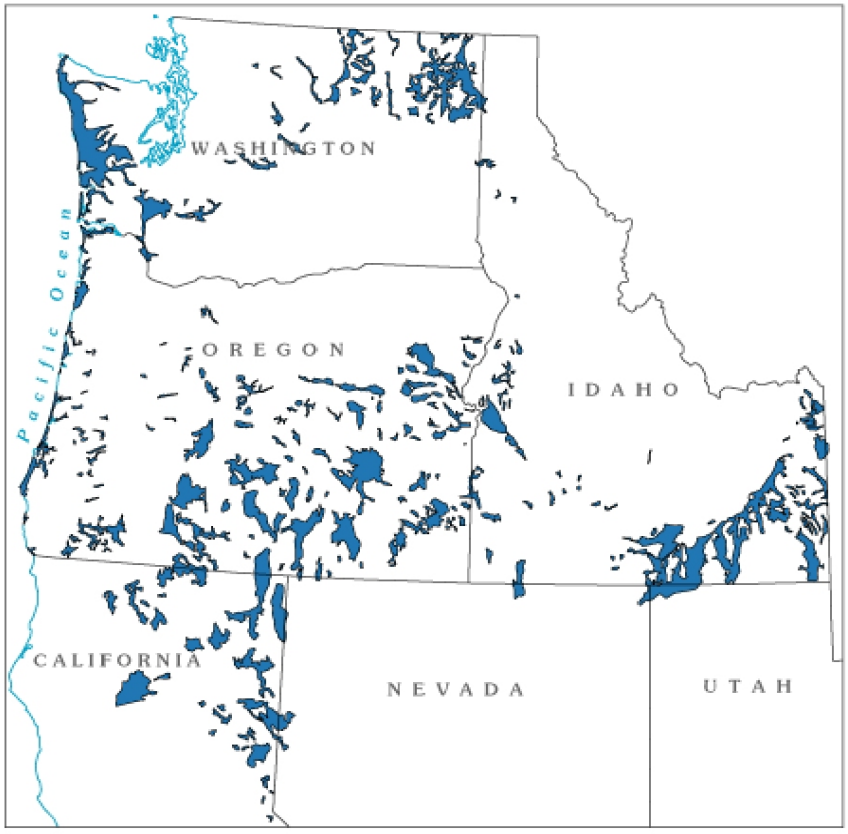
Still, more than 100 exemptions for natural aquifers have been granted in California, some to dispose of drilling and fracking waste in the state's driest parts. Though most date back to the 1980s, the most recent exemption was approved in 2009 in Kern County, an agricultural heartland that is the epicenter of some of the state's most volatile rivalries over water.
http://www.huffingtonpost.com/2012/12/11/epa-aquifer-exemptions-injection-wells_n_2277914.html

In 1981, shortly after the first aquifer exemption rules were set, the EPA had to lower the bar for exemptions as part of settling a lawsuit filed by the American Petroleum Institute. Since then, the agency has issued permits for water not "reasonably expected" to be used for drinking. The original language allowed exemptions only for water that could never be used.
http://www.propublica.org/documents/item/537118-spe-article-aquifer-exemption-00029760

Oil companies have been the biggest users of aquifer exemptions by far. Once an exemption is

issued, it's all but permanent; none have ever been reversed. Permits dictate how much material companies can inject and where, but impose little or no obligations to protect the surrounding water if it has been exempted.
http://www.propublica.org/article/trillion-gallon-loophole-lax-rules-for-drillers-that-inject-pollutants

The EPA and state environmental agencies require applicants to assess the quality of reservoirs and to do some basic modeling to show where contaminants should end up. But in most cases there is no obligation, for example, to track what has been put into the earth or, except in the case of the uranium mines to monitor where it ends up.
http://pipeline.post-gazette.com/news/archives/24953-epa-allowed-waste-injection-to-pollute-at-least-100-aquifers



Unconsolidated-deposit aquifers, which consist primarily of sand and gravel, are the most productive and widespread aquifers in Idaho, Oregon, and Washington.

Underground Safe Drinking Water vs Underground Injection of Hazardous Wastes
An Eloquent Argument For The End To Aquifer Exemptions

In August of 2012, On behalf of Eastern Navajo Diné Against Uranium Mining ("ENDAUM") a letter of intent to challenge the Aquifer Exemption Issued to Hydro Resources, Inc. for Church Rock was sent to Senators and the EPA. The Navajo Nation challenged an Aquifer Exemption

permit application which is well below the EPA threshold, at 3,000 TDS. The language of their legal arguments shine a light on the process as only native voices could.

Based On The Statutory Language

"The Act's requirements for protecting USDWs are found in 42 USC § 300h. Specifically, the Act provides that drinking water programs have requirements that, at a minimum, assure that no underground sources of drinking water will be endangered by any underground injection. Id. at 300h(b)(1), 3(C).

The Act further provides that underground injection endangers drinking water sources if:
1) such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and
2) if the presence of such contaminant my result in such system's not complying with any national primary drinking water regulation or may otherwise affect the health of persons.

H.R. Rep. 95-338, 123 Cong. Record 3658-3659 (1977) (emphasis added); see also, Phillips Petroleum Co. v. U.S. Environmental Protection Agency, 803 F.2d at 560 (concluding that if a requirement on injecting activities is necessary to assure that underground sources of drinking water are not endangered, whether that requirement impedes mineral recovery is irrelevant because the "clear and overriding concern" of Congress in passing the Act was to assure the safety of "present and potential sources of drinking water").

California Fracking May Produce Radioactive Wastes And Release Radioactive Gas

Fracking not only uses chemicals that can contaminate drinking and groundwater, it also releases large amounts of natural radioactivity from the ground into the air, including Radium-226, which has a half-life of 1,600 years.

Horizontal hydraulic fracturing for dry natural gas in California has the potential to result in the production of large amounts of waste materials containing Radium-226 and Radium-228 in both solid and liquid mediums. This type of radioactive material is particularly long-lived, and could easily bio-accumulate over time and deliver a dangerous radiation dose to potentially millions of people long after the drilling is over.

In NY it has been found that the brine that returns to the surface can contain up to 16,000 picoCuries per liter of Radium-226, research shows. The discharge limit in effluent for Radium 226 is 60 pCi/L, and the EPA's drinking water standard is 5 pCi/L.
http://treichlerlawoffice.com/radiation/nysdoh_marcellus_concerns_090721.pdf

The New York Times has reported that 116 of 179 Marcellus wells in Pennsylvania had high levels of radiation in wastewater samples. Water used to hydraulically fracture the deep, 380 million-year-old shale layer and release the natural gas it holds, comes back as radioactive wastewater.

Public Drinking Water Intakes Do Not Often Test For Radiation Levels

Radiation Sources in Natural Gas Well Activities
http://ohsonline.com/Articles/2012/10/01/Radiation-Sources-in-Natural-Gas-Well-Activities.aspx?m=1

The risk is from exposure to increased concentrations of ionizing radiation, which is naturally present in the ground in the forms of radium, thorium, uranium, lead, and/or radon (Horn, 2009; EPA, 2011). The secretary of Energy's 2009 final report mentioned the potential for radioactive isotopes only once in the 23-page report. However, the study by Horn (2009) and subsequent investigations by The New York Times (Urbina, 2011) have resulted in more attention to the matter by the Department of Energy (DOE) (McMahon, 2011).

Sources of Radiation: The Earth itself is radioactive, and the ground contains a variety of radioactive isotopes. Coincidentally, deposits of natural gas tend to have higher concentrations of radioisotopes, and this fact has been used by geologists to locate natural gas deposits (EPA, 2011). This naturally occurring radioactive material (NORM) is typically composed of one or more of the following elements:

Uranium and its decay products (including Radon)
Thorium and its decay products
Radium and its decay products
Lead-210

The metals usually do not exist in their free metallic form but are found in the geology as salts. Uranium salts are generally not soluble in water, but radium salts are. Thus, the water existing within the rock formations, called formation water, has high concentrations of both salts, hence the term "brine water" and radioactivity.

When A Well Is Installed, Radioactivity Can Come To The Surface In Several Ways:

Drilling fluid- During the drilling process, the rock cuttings must be removed so drilling can continue. To this end, drilling fluid is used to bring the rock cuttings to the surface. The drilling fluid can be a liquid, a gas, or a combination of the two. Drill fluid itself is usually a mud-like substance that contains the rock cuttings, which may have radioactive solids, and formation water, which likely has radioactive salts (Resnikoff, et al., 2010).

Fracking- Anywhere from 10 to 40 percent of the water used in fracking comes back up the well (Urbina, 2011) carrying formation water and concentrations of salts that dissolve in the frack water, which includes NORM.

Production- Formation water, which contains high concentrations of salts and radioactivity, is brought to the surface along with the extracted gas and oil. Radon gas is also extracted along with the natural gas.

Underground and Background Radiation: NORM; TERM; TENORM

The natural radiation of the Earth, generally not a cause for concern, is called background radiation, or normally occurring radioactive material. However, any process that concentrates natural radiation produces technologically enhanced NORM, or TENORM, technologically enhanced naturally occurring radioactive material. TENORM poses a higher risk to people due to higher concentrations of radioactive materials.

The work involved in drilling and maintaining wells produces TENORM, such as:

Scale- Salts have a specific solubility in water. Once that solubility level is reached, no more of that salt will dissolve in the water. Excess salt, including radioactive salts, will precipitate out on nearby solid surfaces, including the well head and casing. Other areas that can have radioactive scale deposits include the water lines associated with separators, heater treaters, and gas dehydrators.

Recycling water- Radioactive salts are not easily filtered out of water. Each time the water is sent down the well, the concentration of radioactivity in the water increases. In addition, if chemical scale inhibitors are used, the concentration of radioactivity remains in the water.

Companies typically use recycled water in many different ways in an effort to be environmentally conscious and efficient. Companies will routinely spray recycled water on unpaved roads several times a day as a dust suppressant, which could expose workers and the environment to increased radiation levels. In the winter, recycled water can also be sprayed on roadways to de-ice the roads, having a similar result. When injected as waste into underground 'exempted aquifers' they can settle to the bottom where they will reside for a long time. A Beneficial Use Designation under law allows this brine water to be used for de-icing paved road surfaces, dust control on dirt roads etc.*

Separation pits- Separation pits are used to divide the solids, including drill cuttings, from the liquids (formation water and drilling fluids). As the solids settle out, they may contain increased concentrations of radioactive material. The liquids may also have increased radioactive concentrations. A similar concept to the separation pits, shale shakers are used to separate solid and liquid wastes. Both the liquid and solids may contain elevated radioactivity.

Filters- Often cloth or bag filters are employed in the process of cleaning the water before reuse. The fine sediment that collects in the screen or filter may contain elevated radioactivity.

Sludge- Sludge is composed of dissolved (potentially radioactive) salts that precipitate from produced water as its temperature and pressure change.

Equipment- As a result of work processes that spread radioactivity over the work site, the equipment can become contaminated with radiation. Gas processing equipment with the highest radiation levels includes reflux pumps, propane pumps and tanks, and more (EPA, 2011).

Radioactive Levels, Regulations, Recycling and Re-Use

Many studies have been done across the United States to determine the concentration of NORM within specific natural gas formations, in Pennsylvania (Pennsylvania Geology, 2008), Arkansas (Arthur et al., 2008), and Louisiana (STRONGER, 2011). Some of these same studies have reported radioactivity levels for NORM at natural gas wells. However, other studies report widely different values for radioactivity at wells in the United States based on geographic location (EPA, 2011), radioisotopes studied (Rahon, 2010), and processes studied (Smith et al., 1996).

The New York Times reported that hydraulic fracturing wastewater at 116 of 179 deep gas wells in the state contained high levels of radiation and its effect on public drinking water supplies is unknown because water suppliers are required to conduct tests of radiation only sporadically.

There is no safe level of toxins, "The current scientific consensus postulates that there is no known safe level of exposure to radioactive materials."

TENORM is defined by the National Research Council of the National Academy of Sciences as: Technologically Enhanced Naturally Occurring Radioactive Materials are any naturally occurring radioactive materials not subject to regulation under the Atomic Energy Act whose radio nuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities.

While federal and state agencies have tried to develop ways to protect humans and the environment from harmful exposure to the radiation in such materials, TERM remains a challenging problem in the United States. Because many industries and types of products potentially contribute to excess radiation production, including mineral extractions and refining, oil and gas production, drinking water treatment processes and wastewater treatment plants, scientists, researchers and legislators are struggling to find viable solutions.

Highly corrosive salts, carcinogens like benzene and radioactive elements like radium, can occur naturally thousands of feet underground. Other carcinogenic materials can be added to the wastewater by the chemicals used in the hydrofracking itself. While the existence of the toxic wastes has been reported, thousands of internal documents obtained by The New York Times from the Environmental Protection Agency, state regulators and drillers show that the dangers to the environment and health are greater than previously understood.

Recycling and Re-use Concentrates Radiation, Then Disperses It To Road Surfaces

What Beneficial Use Designations are allowed under California law that serve to mitigate costs of disposal of otherwise hazardous materials? Is there really a cost savings? Beneficial Use Designations (BUD) of Fracking Flowback and Wastewater starts in California's Water law. Using brine to water roadways to control dust or as a de-icing agent

People can be exposed to radioactive materials from drilling and fracking operations when trucks hauling waste materials travel past their homes, when crops are grown on contaminated soil, and when farm animals ingest radioactive deposits on plants.

Today's Investment In Oilfield Water Management (Recycling)

Much Is Made Of Investment In Oilfield Water Management but; recycling of wastewater and decontamination of produced water is still just a hopeful myth at the end of 2013.

"After two years searching for a blockbuster investment in oilfield water management, fund manager Judson Hill is still holding on to his money. Hill's NGP Energy Capital Management saw potential in what looked like a hot growth area in energy: treating and recycling the 21 billion barrels of wastewater flowing annually from U.S. oil and natural gas wells, particularly from shale.

Instead, it found the market "too fragmented and too frothy," said Hill, a managing director at the private equity firm in Texas whose latest fund has invested $3.6 billion. It's not as though we look back and say, WOW, half the ones we passed on were just home runs. They weren't." http://climatechangepsychology.blogspot.com/2013/12/oil-gas-methane-news-from-rjs.html

Fracking Bonanza Eludes Wastewater Recycling Investors
http://www.bloomberg.com/news/2013-11-26/fracking-bonanza-eludes-wastewater-recycling-investors.html

Picking a winner in water treatment eludes even Schlumberger Ltd. (SLB), the world's largest oilfield services provider. Schlumberger jumped into water recycling years ago envisioning a fast-growing, vibrant new specialty. "We've spent millions and millions of dollars evaluating virtually every available and reasonable-looking technology out there, always hoping we'd find the silver bullet, said Mark Kidder, who runs Schlumberger's oilfield water management unit. We've found nothing."

As of October, November, and December of 2013 there were only "recurring losses to other investors that sunk hundreds of millions of dollars into companies that promised to solve water concerns by treating water. Publicly traded targets including Nuverra Environmental Solutions Inc. (NES), GreenHunter Resources Inc. (GRH) and Aqua-Pure Ventures Inc. (AQE) which have all reported a succession of losses since 2011. Shares of the three companies have fallen an average 46 percent during the past 21 months."

Of the $31 billion spent each year on managing water resources in U.S. and Canadian oilfields, $2.8 billion, less than 10 percent, is spent on recycling. *PacWest Consulting Partners LLC.*

BUD- Beneficial Use Designation

Besides recycling, another method of turning liability to profit is the 'beneficial use designation' under both California DTSC and California Water Law. No matter the name of the State in which unconventional gas reservoirs are fracked, there are a variety of methods employed to

manage Shale Gas Extraction Wastewater (SGEW). These range from disposing of it (untreated) deep underground in injection wells, treatment as necessary to allow it to be re-used in other hydrofracturing procedures, and treating it to a degree necessary that it can be discharged to surface waters or surface evaporation ponds (pits).

Considerations have included that:
1) "It is desirable to identify a beneficial use for the concentrated salt solution, or brine, as well as the dried salt cake that may be produced by the various treatment processes. One apparent possible use is the application to roads as a winter de-icing agent."

"Brine from traditional oil and gas drilling has been used for years as a de-icing agent. There are also brine wells specifically for brine production. Traditional, in this sense, generally means drilling that does not use the hydraulic fracturing process (no chemical additives). However, concern has been raised that the brine, or salt cake obtained from treated SGEW may contain trace amounts of chemicals from the hydrofracturing process as well as constituents dissolved in the produced water and brought to the surface by the gas extraction."

"Research from the Bureau of Oil and Gas Management (PA) indicates that Shale Gas Extraction Wastewater (SGEW) includes a high content of hazardous heavy metals, such as barium and strontium. There is also concern about radioactivity. The Marcellus Shale play is known to generally be more radioactive relative to other geologic formations."

2) "Of course, the radioactivity of deeply buried shale is of no concern. However, what is natural or normal at that depth is not natural on the surface of the ground and concern is being expressed about the radioactivity of products resulting from Marcellus Shale extraction. These previously buried materials are referred to as naturally occurring radioactive materials (NORMs). When materials containing NORMs are processed or refined, the radioactive material may become more concentrated to create technologically enhanced naturally occurring radioactive materials (TENORMs). The primary radionuclides of concern are Radium 226 (Uranium-238 decay series) and Radium 228 (Thorium-232 decay series)".

Excerpts From: Chemical Analysis Of Major Constituents And Trace Contaminants Of Rock Salt and SGEW salt (BUD) Bureau of Water Standards, Pennsylvania

High Concentrations Of Both Barium And Strontium

"Rock salt is a sedimentary rock, which is classified as an evaporate. Naturally occurring rock salt is formed from the evaporation of inland seas. The rock salt contains the minerals found in that particular body of water; mostly sodium, chloride, calcium, magnesium, potassium, and sulfate. These are the major elements found in rock salt. All of these substances are highly soluble in water."

"Shale is also a sedimentary rock: however, it is classified as a clastic rock layer. Clastic sedimentary rocks are composed predominantly of broken pieces of older weathered and eroded rocks and are classified based on grain size, clastic and cementing material (matrix)

composition, and texture. Shale is a fine-grained, clastic sedimentary rock composed of mud that is a mix of flakes of clay minerals and tiny fragments (silt-sized particles) of other minerals, especially quartz and calcite. Many of the minerals that make up shale are insoluble in water.

“Marcellus Shale is black shale, a dark, thinly laminated carbonaceous shale, exceptionally rich in organic matter and sulfide and often containing unusual concentrations of certain trace elements such as uranium, vanadium, copper, and nickel. Conversely, data from the SGEW analysis indicates that high concentrations of both barium and strontium are usually present.”

Naturally occurring rock salt was formed from the evaporation of inland seas. Its primary constituents are sodium, chloride, calcium, magnesium, potassium, and sulfate. Rock salt generally contains between 90 to 98% sodium chloride.

The salt content in SGEW may exceed 7 times that of sea water. Approximately 77% of the rock salt used in the US is used for highway de-icing.

California Also Uses Rock Salt On Mountain Passes In Winter Snow Or Ice Conditions.

This BUD Is Definitely Not For You

For the sake of our rivers and streams, groundwater recharge basins, and watershed drainages, there should be No Beneficial Use Designation for Frac Wastewater Applications To Road Surfaces – whether dirt, rocked, or paved allowed anywhere in California.

The Following Solid Wastes Are Not Hazardous Wastes: California Water Code Sections defer to DTSC California Department Toxic Substances Control

25141.5. (a) When classifying a waste as hazardous pursuant to the criteria in paragraph (8) of subdivision (a) of Section 66261.24 of Title 22 of the California Code of Regulations, as that section read on January 1, 1993, the department shall incorporate the department's decision into a regulation, if the department determines that the waste's classification as a hazardous waste is likely to have broad application beyond the producer who initiated the request.

(12)(i) Oil-bearing hazardous secondary materials (i.e., sludges, byproducts, or spent materials)
(b) Solid wastes which are not hazardous wastes. The following solid wastes are not hazardous wastes:

(5) Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy.

Volume: 27
Date: 2012-07-01
Original Date: 2012-07-01
Title: Section 261.4 - Exclusions.
Context: Title 40 - Protection of Environment. CHAPTER I - ENVIRONMENTAL PROTECTION AGENCY (CONTINUED). SUBCHAPTER I - SOLID WASTES (CONTINUED). PART 261 - IDENTIFICATION AND LISTING OF HAZARDOUS WASTE. Subpart A – General.
http://www.gpo.gov:80/fdsys/pkg/CFR-2012-title40-vol27/xml/CFR-2012-title40-vol27-sec261-4.xml

CALIFORNIA HEALTH AND SAFETY CODE
http://www.leginfo.ca.gov/.html/hsc_table_of_contents.html

http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=25001-26000&file=25310-25327

25315. "Federal act" means the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. Sec. 9601 et seq.).

25316. "Hazardous substance" means:
(a) Any substance designated pursuant to Section 1321 (b)(2)(A) of Title 33 of the United States Code

25317. "Hazardous substance" does not include:
(a) Petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance in subdivisions (a) to (f), inclusive, of Section 25316, and natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas), or the ash produced by a resource recovery facility utilizing a municipal solid waste stream.

Resource Conservation and Recovery Act (RCRA)

Congress enacted the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580)

on October 21, 1976. RCRA required EPA to "promulgate regulations identifying characteristics of hazardous waste and listing particular hazardous waste" that would be subject to hazardous waste management standards. EPA also was required to develop standards for the owners and operators of hazardous waste treatment, storage and disposal facilities.

In response to this mandate, EPA proposed regulations for managing hazardous waste under Subtitle C of RCRA on December 18, 1978 (43 FR 58946). Included in these proposed regulations was a deferral of hazardous waste requirements for six categories of waste which EPA termed "special wastes" until further study and assessment could be completed to determine their risk to human health and the environment. The six categories of special wastes included: 1) Cement kiln dust, 2) Mining waste, 3) Oil and gas drilling muds and oil production brines, 4) Phosphate rock mining, beneficiation, and processing waste, 5) Uranium waste, 6) Utility waste (i.e., fossil fuel combustion waste)

These wastes typically are generated in large volumes and, at the time, were believed to possess less risk to human health and the environment than the wastes being identified for regulation as hazardous waste.

On October 12, 1980, Congress enacted the Solid Waste Disposal Act Amendments of 1980 (Public Law 96-482) which amended RCRA in several ways. Pertinent to special wastes was the addition of sections 3001(b)(2)(A) and 3001(b)(3)(A). These new sections frequently referred to as the Bentsen and Bevill Amendments exempted "special wastes" from regulation under Subtitle C of RCRA until further study and assessment of risk could be performed. Specifically, the Bentsen Amendment (§3001(b)(2)(A)) exempted drilling fluids, produced waters, and other wastes associated with the exploration, development, and production of crude oil or natural gas or geothermal energy. The Bevill Amendment (§3001(b)(3)(A)(i-iii)) exempted fossil fuel combustion waste; waste from the extraction, beneficiation, and processing of ores and minerals (including phosphate rock and overburden from uranium ore mining); and cement kiln dust.

The Bevill and Bentsen Amendments also required EPA to complete full assessments of each exempted waste and submit a formal report to Congress on its findings. Section 8002 explicitly identified the requirements for each special waste study and established deadlines for submission of the final reports. After completion of each respective "Report to Congress", EPA was then required to make a final regulatory determination within six months as to whether the special waste in question warranted regulation as a hazardous waste under Subtitle C of RCRA.

Remote Aquifer Basins and Public Drinking Water Supplies: Protected Water Designations - Aquifer Exemptions - Legislation, Health Impacts, Disposal Wells, Pathways of Migration Natural Gas Extraction Onshore and Offshore
Part 3 TOC – 58 pages total, listed by section

Spring 2013 Saw A Flurry Of Fracking Legislation Introduced In California

As awareness grew, Legislative hearings commenced. Then under pressure, DOGGR released the "Interim Rules" to meet Senate Bill 4 recommendations, but actually in the process, guts any stringent language, giving the greenlight to fracking.
http://www.californiaenvironmentallawblog.com/oil-and-gas/activity-in-the-california-legislature-reduces-the-likelihood-and-effect-of-a-fracking-moratorium/

But Assembly Bills and Senate Bills continued in an attempt to address Public Notification of Drilling and Fracking, 'produced water' and the wastewater from fracking. Several good Bills were held up in Appropriations, or just plain put on hold in the suspended file.

For a quick review that's in lay terms:
http://www.cleanwateraction.org/page/stop-fracking-ca-2013-legislative-priorities

The most ambitious in my opinion was AB 699
Santa Cruz Sentinel 04/16/2013
SACRAMENTO A bill regulating water use by oil producers was authored by Assemblymember Mark Stone, D-Scotts Valley, the bill would have required companies to disclose the source and amounts of water used in production, including fracking. The legislation, AB 669, would have required oil companies to produce wastewater plans, which must be approved by regional water quality control boards. Currently, industry disposal wells are overseen by the Department of Oil, Gas and Geothermal Resources.

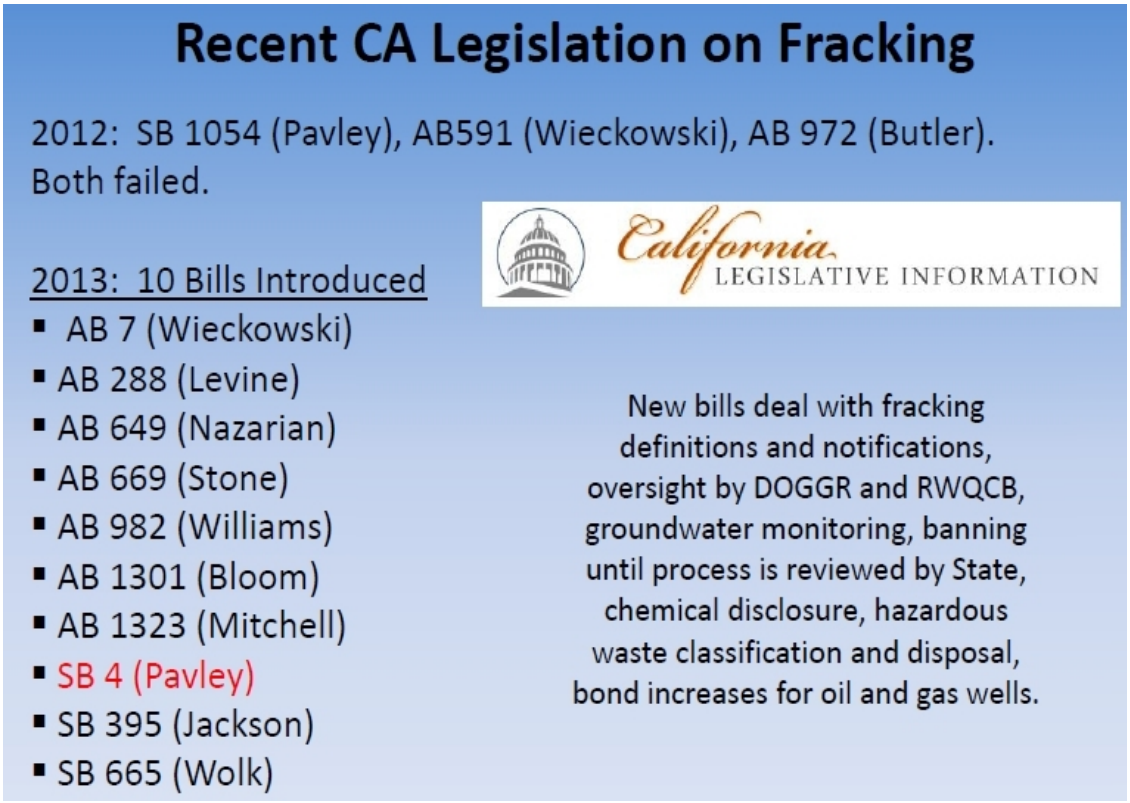
In 2012, California oil drillers extracted and reinjected more than 120 billion gallons of water, according to statistics provided by the Western States Petroleum Association.
http://www.mercurynews.com/science/ci_23039934/california-bill-would-target-fracking-industrys-water-usehttp://www.mercurynews.com/science/ci_23039934/california-bill-would-target-fracking-industrys-water-use

AB 982
Introduced by Assembly Member Das Williams
(Coauthor: Senator Wolk) February 22, 2013
Amended in Assembly - May 07, 2013; gutted* were any references to wastewater
AB 982, as introduced, Williams. Oil and gas: hydraulic fracturing.
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB982

*3203.2. Any notice of intent to drill, rework, or deepen a well where hydraulic fracturing will occur, shall include all of the following information:
(a) A description of the estimated quantity of water planned to be used in the hydraulic fracturing process.
(b) The source or sources of the water to be used.
(c) A specific plan for disposing of wastewater produced by the hydraulic fracturing process.

On Feb. 20, 2013, Sen. Hannah-Beth Jackson, D-Calif., introduced SB 395 to regulate water

produced during fracking operations. The bill would have required the regulation of "produced water," defined to expressly include water produced by fracking, as a hazardous waste by the California Department of Toxic Substances Control. This "hazardous waste" designation would give the DTSC authority to regulate the management of fracking wastewater, including the requirement for hazardous waste manifests to transport these fluids and add another administrative layer to the regulation.



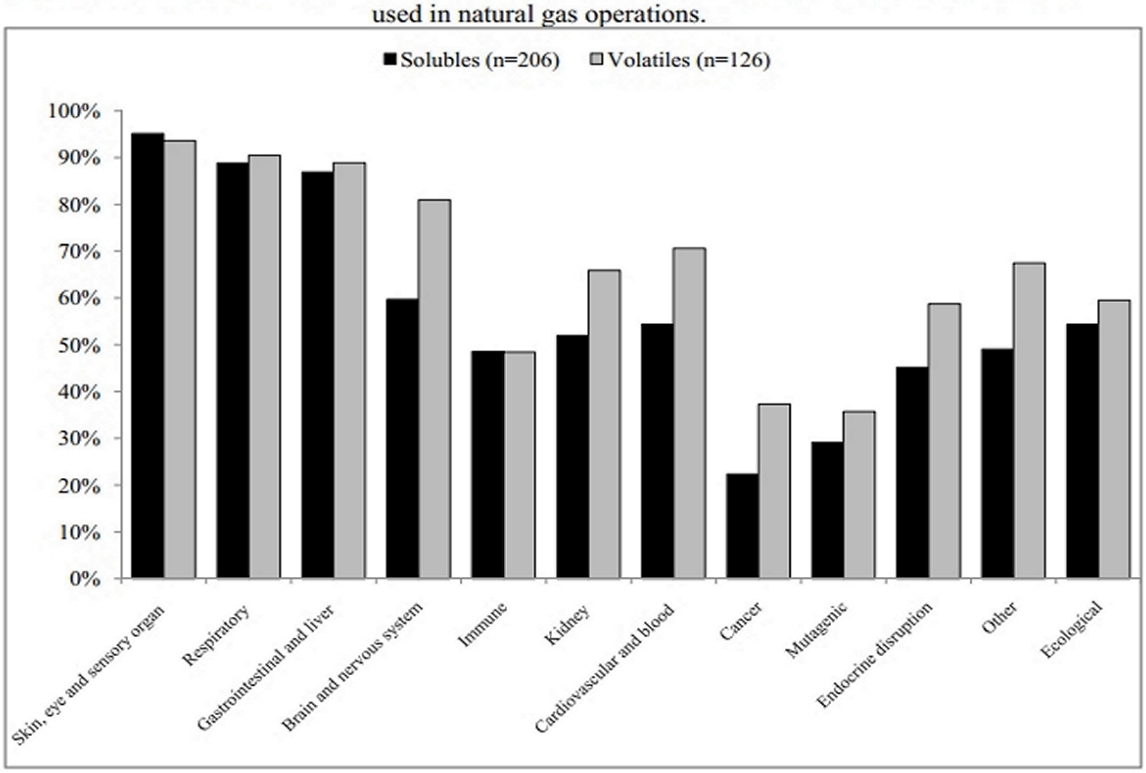
Specific Linguistics Are The Antidote To Sound Bytes

All Bills failed to pass. But each year, the push to assign accountability on a powerful industry in California is renewed and gets further into the general conversation of the population. Each year as more involvement by citizens produces new peer reviewed studies, reports, surveys, and documentation of impacts, our language skills grow.

Health Data On Fracking Fluid, Drilling, And Produced Chemicals In The Air And Water

In a recently published study, Dr. Theo Colborn et al. (2012) identified 944 products used in the fracking process in the US, of which only 14% provided 95% to 100% of the ingredients, while 43% provided less than 1% of the ingredients. The researchers generated profiles of possible health effects from the chemicals identified in the natural gas process (Figure 3). Of these identified chemicals, over 90% were found to affect the skin, eyes, and sensory organs; approximately 50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; and 25% could cause cancer and mutations.

Figure 3. Profile of possible health effects of soluble and volatile chemicals with CAS numbers used in natural gas operations.



Profile Of Possible Health Effects of Soluble
(water contaminating) and Volatile (air contaminating,
Chemicals With CAS Numbers Used In The Fracking Process

"Natural Gas Operations From A Public Health Perspective" - Accepted for publication in the International Journal of Human and Ecological Risk Assessment, September 4, 2010. Published September-October 2011. "Natural Gas Operations from a Public Health Perspective" Theo Colborn, Carol Kwiatkowski, Kim Schultz, and Mary Bachran TEDX, The Endocrine Disruption Exchange, Paonia, CO, USA

"A list of 944 products containing 632 chemicals used during natural gas operations was

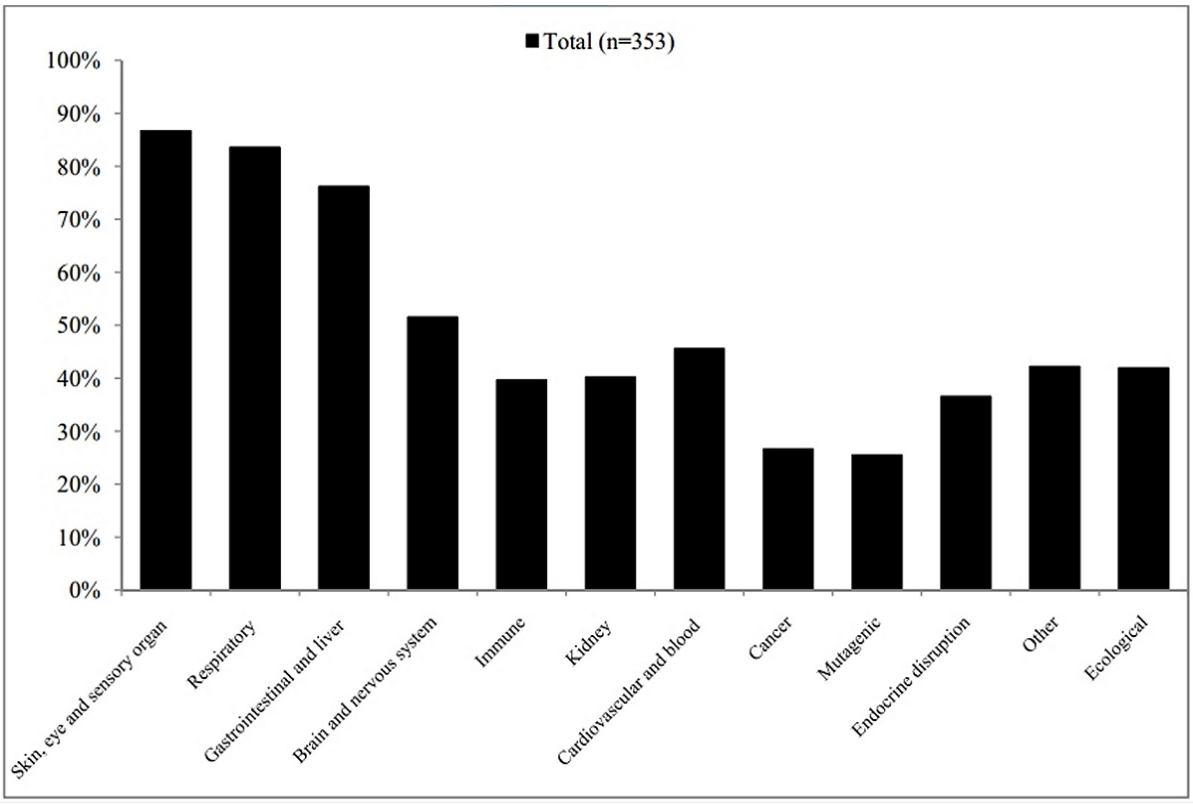
compiled. Literature searches were conducted to determine potential health effects of the 353 Chemicals identified by Chemical Abstract Service (CAS) numbers. More than 75% of the chemicals could affect the skin, eyes, and other sensory organs, and the respiratory and gastrointestinal systems."
http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf

"Approximately 40-50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; and 25% could cause cancer and mutations. Results indicate that many chemicals used during the fracturing and drilling stages of gas operations may have long-term health effects not immediately expressed."

Evaporation Pits or Ponds And Chemicals – All Liners Leak!

"Shown in Figure 5 are the health effects of the 40 chemicals and metals reported in the New Mexico evaporation pits. These chemicals produced a health profile even more hazardous than the pattern produced by the drilling and fracking chemicals. Upon further investigation, we discovered that 98% of the 40 chemicals found in the pits are listed on USEPA's 2005 CERCLA (Superfund) list and 73% are on the 2006 EPCRA List of Lists of reportable toxic chemicals. Of the nine chemicals found to exceed the New Mexico state limits, all are on the CERCLA list and all but one are on the EPCRA List of Lists."

Profile Of Possible Health Effects Of Chemicals With
Cas Numbers Used In Natural Gas Operations.



Along with federal support for increased leasing, legislative efforts have granted exclusions and exemptions for oil and gas exploration and production from a number of federal level environmental statutes, including the "Clean Water Act, the Clean Air Act, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, better known as the Superfund Act), the Resource Conservation and Recovery Act (RCRA), the Toxic Release Inventory under the Emergency Planning and Community Right-to-Know Act (EPCRA), and the National Environmental Policy Act (NEPA) (Oil and Gas Accountability Project 2007)."

The most recent of these efforts was an amendment included in the 2005 Energy Policy Act that prevented the use of the Safe Drinking Water Act to regulate certain activities, known as hydraulic fracturing, which are involved in 90% of natural gas drilling. The cumulative effect of these exemptions and exclusions has been to create a federal void in environmental authority over natural gas operations, leaving the responsibility primarily up to the states.

Hydrochloric Acid, Hydrofluoric Acid

HF acid as a laboratory waste is considered a 'hazardous waste' and should be placed in a chemically compatible container with a sealed lid and clearly labeled. Labs are required to complete a Hazardous Chemical Label and submit a pickup request. EHS-M-031 02282008

In oil and gas drilling operations, Hydrochloric acid has been the mainstay, with primarily hydrofluoric acid and formic and acetic acids being the complimenting acids. Specialty acids, such as phosphonic, sulfamic, and others, are also used.

While matrix acidizing is done at a low enough pressure to keep from fracturing the reservoir rock, fracture acidizing involves pumping highly pressurized acid into the well, physically fracturing the reservoir rock and dissolving the permeability inhibitive sediments. This type of acid job forms channels through which the hydrocarbons can flow.

Mud-Acid, Drilling Muds, Pre-frac Acidization

There are different acids used to perform an acid job on wells. A common type of acid employed on wells to stimulate production is hydrochloric acids (HCl), which are useful in removing carbonate reservoirs, or limestones and dolomites, from the rock. Also, HCl can be combined with a mud acid, or hydrofluoric acid (HF), and used to dissolve quartz, sand and clay from the reservoir rocks.
http://www.reuters.com/article/2013/06/19/us-california-oil-acidjobs-idUSBRE95I04320130619

HAPs, VOCs, Ground Level Ozone Pollution

Several of the air pollutants associated with natural gas development and production can negatively affect human health. Benzene is a known human carcinogen, and ethylbenzene, acetaldehyde, formaldehyde, and crotonaldehyde are classified as possible human carcinogens by the U.S. EPA. Furthermore, toluene, xylene, and benzene may also cause other non-cancer health effects, such as birth defects.

Many of these air pollutants cause short-term neurological effects, such as dizziness and headaches, and short and long term respiratory effects, such as nose and throat irritation and decreased lung function. Seniors, children and those with medical conditions are more susceptible to chemical exposures. Residents living less than ½ mile from natural gas wells are at greater risk for health effects compared to residents who are living greater than ½ mile from wells (Colorado School of Public Health, University of Colorado).

Potential Health Impacts from Hazardous Air Pollutants (HAPs)

•VOCs "Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system." Some can cause cancer in animals; some are suspected or known to cause cancer in humans. Examples: Methanol, Benzene
•Aldehydes (formaldehyde) Skin, eyes, nose, and throat irritation
VOCs: http://www.epa.gov/iaq/voc.html
Hydrogen Sulfide: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=388&tid=67

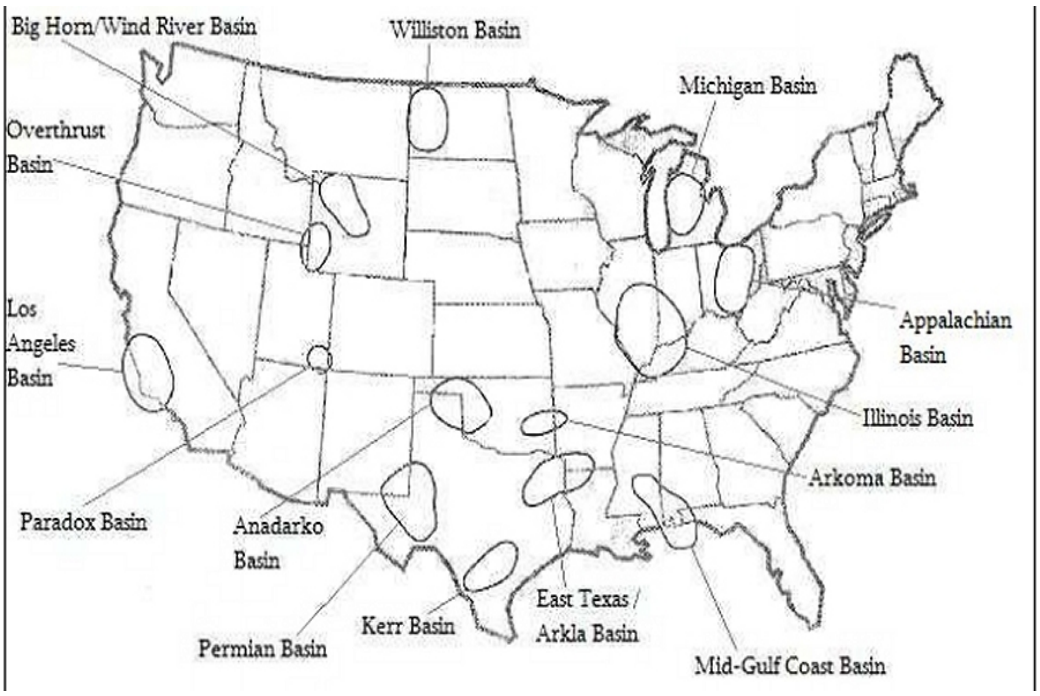
Potential Health Impacts from Ozone

•Aggravation of asthma, bronchitis & emphysema and increased susceptibility to pneumonia & bronchitis
•Linked to bladder, breast, and lung cancers, stroke, diabetes, and premature death
•Permanent lung damage with repeated exposures
•Increases reactivity to other asthma pollutants/triggers
•Throat irritation, congestion, coughing, and chest pain
•Wheezing and breathing difficulties
•Inflammation of lung linings (like sunburn)
Source: http://www.epa.gov/air/ozonepollution/health.html
American Lung Association, "Health Effects of Ozone and Particle Pollution," State of the Air, 2011; President's Cancer Panel, Reducing Environmental Cancer Risk: What We Can Do Now, 2008-2009 Annual Report (National Cancer Institute, May 2010).

It is important to note that there is a tradeoff when using combustors versus not controlling condensate tanks at all. Combustion of fugitive VOC emissions generates carbon monoxide, carbon dioxide, and nitrogen oxides, whereas venting results in VOC emissions. Therefore, vapor recovery is preferred over venting or combustion for controlling fugitive VOC emissions Well completion operations emit the higher levels of contaminants than drilling operations.

Sweet Gas, Sour Gas – Natural Gas Fields by Hydrogen Sulfide Percent Content (Wet or Dry)

Between 15 To 25 Percent Of Natural Gas In The U.S. May Contain Excessive Hydrogen Sulfide



1) People living near oil and gas development sites may be chronically exposed to low, yet dangerous ambient H 2S levels, as well as to accidental high-concentration releases. A 1993 EPA report to congress on the emissions of hydrogen sulfide from oil and gas extraction acknowledges that because of the proximity of oil and gas wells to areas where people live, the affected population may be large. i

2) OSHA reports show that over 10 years, 22 oil/gas workers died in the U.S. as a result of H2S. ii

3) A study in the Journal of the Air Pollution Control Association stated that the hazard zone for sublethal effects around sour gas wells encompasses from less than 400 meters up to 6500 meters, while lethal exposure to hydrogen sulfide could occur as far as 2000 meters from the source. iii

4) According to research by Lana Skrtic: "The literature on human health and hydrogen sulfide reveals serious and lasting physiological and neurological effects associated with acute exposure. The health effects of chronic exposure to lower levels of H2S, as documented in several studies, also include persistent physiological and neurological disturbances. Oil and gas facilities can be expected to accidentally and routinely emit hydrogen sulfide in concentrations that span a wide range and are associated with a variety of health effects. iv

i EPA, "Report to Congress on Hydrogen Sulfide Emissions," p.III-65.
ii http://www.osha.gov/dep/fatcat/fatcat_weekly_rpt_09112009.html
iii Layton, David W. and Richard T. Cederwall. 1987. "Predicting and Managing the Health Risks of Sour-Gas Wells." Journal of the Air Pollution Control Association. 37: 1185-1190
iv Hydrogen Sulfide, Oil & Gas, and People's Health 2006, Lana Skrtic, Master's Thesis for University of California, Berkeley

Hydrogen Sulfide Is The Predominant Impurity In Natural Gas

Methane (CH4) is the predominant component of natural gas, comprising 70 to 90 percent, while other gaseous hydrocarbons, butane (C4H10), propane (C3H8), and ethane (C2H6), account for up to 20 percent. Contaminants present in natural gas, which have to be removed at natural gas processing facilities, include water vapor, sand, oxygen, carbon dioxide, nitrogen, rare gases such as helium and neon, and hydrogen sulfide.

• Wet gas: natural gas that contains chemicals besides methane
Natural gas liquids (NGLs) = ethane, propane, butane, isobutane
Higher amounts of VOCs such as BTEX
• Dry gas: natural gas with lower quantities of NGLs and a low moisture content
Lower amounts of VOCs
Marcellus gas is generally "dry" except for the western end
• Ozone has been tracked over 200 miles beyond their original source
• VOCs have higher impacts on people living within ½ mile of wells

Selected excerpts:
Clean Air Council Marcellus Shale Program
Air And Health Impacts of Natural Gas Matt Walker, Community Outreach, Clean Air Council mwalker@cleanair.org
Colorado School of Public Health, University of Colorado
EPA Ground Level Ozone Pollution: http://www.epa.gov/air/ozonepollution/health.html
Adaptions from Allen Robinson, Carnegie Mellon
http://iom.edu/~/media/Files/Activity%20Files/Environment/EnvironmentalHealthRT/2012-Apr-30/Robinson.pdf

Chemicals that cause or may cause cancer, reproductive effects or birth defects
• Vary a lot
Some have "pungent, irritating odors"
Some have a Sweet smell (Benzene)
Or Paint thinner smell (Toluene)
• Includes Volatile Organic Compounds
A variety of chemicals emitted as gases that include known and suspected carcinogens
• Examples of HAPs (also VOCs): Benzene, Toluene, Ethylbenzene, Xylene, and Formaldehyde
• EPA data shows that some of the largest air emissions occur as natural gas wells are being completed (flowback process = 3 to 10 days)
• Sources: compressor stations, open-air impoundments, dehydration units, condensate tanks
http://www.epa.gov/iaq/voc.html

BREAKING NEWSTORY: Recent Research by the Center for Public Integrity, InsideClimate News and The Weather Channel investigates the effects of H2S emissions on communities.
"Gripping Report and Film Reveal How Fracking Boom Destroys Texans' Lives"
http://ecowatch.com/2014/02/18/report-film-fracking-boom-destroys-texans-lives/

Surface and Groundwater Impacts

Since Jan. 1, 2013 oil and gas drilling in Colorado has resulted in a total of 495 chemical spills. Twenty-two percent of those spills impacted groundwater or surface water contamination, according to the latest state data being tracked by the Center for Western Priorities' new Toxic Release Tracker.
http://westernpriorities.org/colorado-toxic-release-tracker/

According to the tracker, data from the Colorado Oil and Gas Conservation Commission's spill database, shows 71 spills impacted groundwater and 41 spills impacted surface water in 2013.
http://www.huffingtonpost.com/2014/01/16/colorado-toxic-release-tracker_n_4604678.html

Associated Press Details Contaminated Wells
A Jan 5, 2014 published AP investigation reviewed state data on water contamination allegations related to fracking that it was able to obtain from state agencies. Among the findings in the AP's review:

- Pennsylvania had confirmed at least 106 water-well contamination cases since 2005, out of more than 5,000 new wells;
- Ohio had 37 complaints in 2010 and no confirmed contamination of water supplies; 54 complaints in 2011 and two confirmed cases of contamination; 59 complaints in 2012 and two confirmed contaminations; and 40 complaints for the first 11 months of 2013, with two confirmed contaminations and 14 still under investigation;
- West Virginia had about 122 complaints that drilling contaminated water wells over the past four years, and in four cases the evidence was strong enough that the driller agreed to take corrective action;
- A Texas spreadsheet contains more than 2,000 complaints, and 62 of those allege possible well-water contamination from oil and gas activity, although none have been confirmed.

The Associated Press review of complaints of contamination of water supplies casts doubt on the industry and it's view that it rarely happens.
http://www.usatoday.com/story/money/business/2014/01/05/some-states-confirm-water-pollution-from-drilling/4328859/

Houston Prefecture, State of Texas, US
TENORM Contamination: Radioactive Water Wells
http://www.khou.com/news/State-lowballs-radiation-scores-in-Texas-drinking-water-107125648.html

For more than 20 years, the Texas Commission on Environmental Quality under-reported the amount of radiation found in drinking water provided by communities all across Texas despite the EPA's warning in June of 2004 of potential loss of primacy. TCEQ consistently subtracted each test's margin of error from those results, making the actual testing results appear lower than they actually were. In one case, the utility was able to avoid violations for nearly 20 years, thanks to the Texas CEQ subtractions. Released e-mails from the Texas Commission on

Environmental Quality show the agency's top commissioners directed staff to continue lowering radiation test results, in defiance of federal EPA rules, even after 2009.

Repeatedly, Oil and Gas Industry and Pocket Politicians Have Proven To Be Unaccountable.

'Aquifer exemptions' under the SDWA, constitute a 'takings' of the 'Public Commons'.

SB 4 Well Stimulation Regulations additional language of Protected Water'. DOGGR added language to the Interim Well Stimulation Regulations SB 4 package, after close of comments on December 24, 2013 that clarifies the term 'protected water' under the Safe Drinking Water Act - which exempts fracking. Again;

The 'PROTECTED WATER' designation is explicit under the Safe Drinking Water Act, which itself EXEMPTS FRACKING.

No Added Value In Added Language- "Clarification was added that an aquifer deemed exempt under the U.S. Safe Drinking Water Act is not protected water." The text of the interim SB 4 regulations with revisions highlighted can be found here. http://www.conservation.ca.gov/dog/Documents/Final%20Interim%20Regulations%20with%20Highlights.pdf

The very real potential for cumulative impacts under the 'protected water' and 'aquifer exemptions' clause, added to SB 4, by DOGGR, after close of comments, Dec. 24, 2013 can be viewed as a lease-held lock down on future water resources of the North State and Northern Coastal Region. Once an aquifer is contaminated it can't be undone, except at great cost.

Aquifer exemptions exist under the SDWA to benefit the oil and gas and mining industry (production, waste disposal). The 'protected water' clause which is very specific under the SDWA, is the gateway to aquifer exemptions.

Basin Aquifer Exemptions Under DOGGR Regulations SB 4 'additional language'
article and linked PDF (24 pages 2.5 MB)
https://www.indybay.org/newsitems/2014/01/09/18748969.php

That's the long version, here's a short one.

Remote groundwater basin and sub-basin aquifers, solely because of economics of delivery for public use, and because they occur in geologic association with oil and gas reservoirs, and particularly the unassociated natural gas basins on the North Central Coast, North Coast, and North State interior; may now, by default, be exempt from California Water Law and protections. Basin and sub-basin aquifers or portions thereof, can be delineated with private boundaries affecting surface rights, i.e., privately held boundaries of aquifers by oil and gas lease operators for use in oil or gas production, including disposal of produced water. The aquifer exemption carries with it, a permitting process for the allowance of contamination of a portion of the aquifer, or the entire basin.

Aquifer Exemptions are based first on hydrocarbon production, and weighted against the economic feasibility of hooking up to a 'public water system'.

SDWA 40 CFR 141.2 defines public water systems as those systems: that provide piped water for human consumption and are equipped with at least 15 connections or regularly serve at least 25 people.

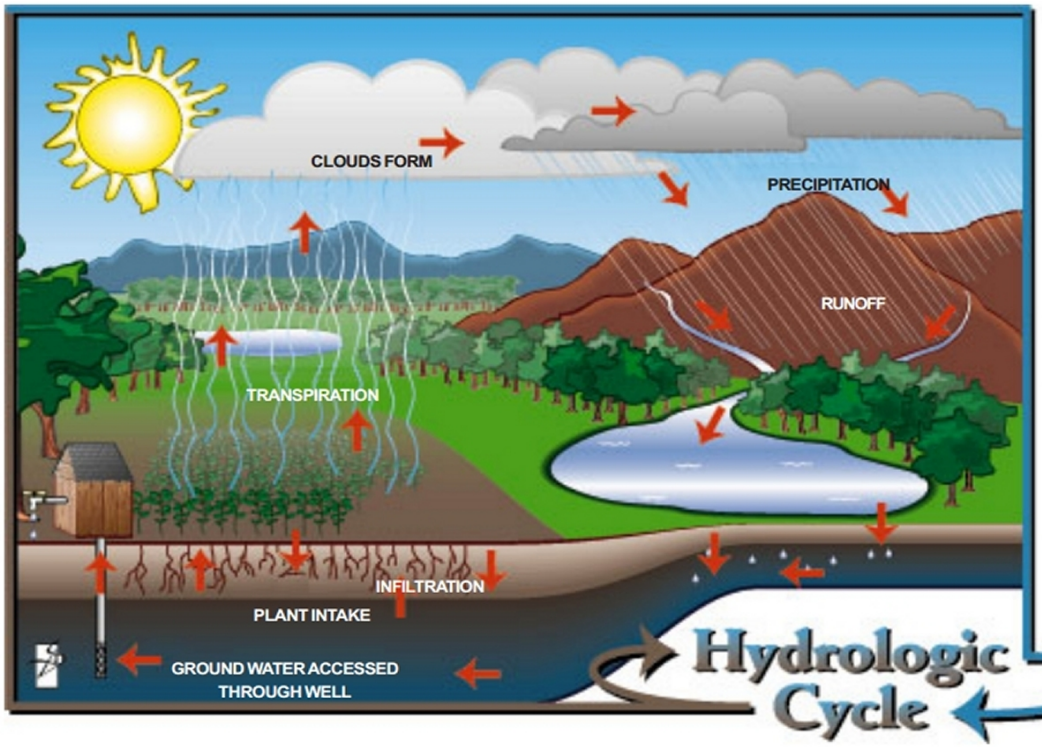
Public water systems include the following:
Community water systems; Nontransient noncommunity water systems; Noncommunity water systems; States were required to establish “wellhead protection areas”.

The first consideration in local governments at every level right now, at the beginning of 2014 is 'finding new sources, or a new supply' of water, fresh water, drinking water, irrigation water. DOGGR and DOC, in their promulgation of Regulations and preparation of the SB 4 Well Stimulation Regulations **Statewide EIR**, have overlooked the rural nature and population density in the northern and northwestern geographic areas of District 6.

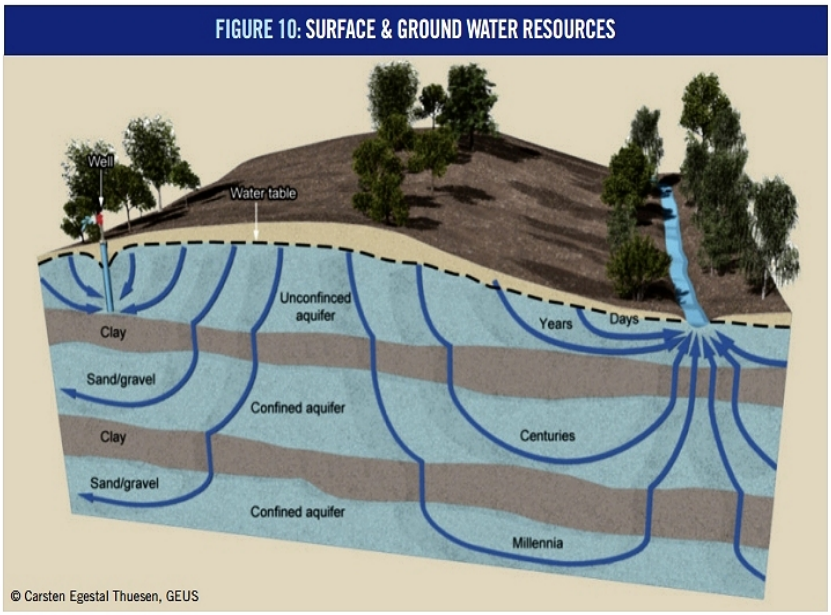
Because of this difference, language adopted under the SDWA regarding 'aquifer exemptions' and 'protected water' definitions and the requirements determining public drinking water sources, is a nuisance under California Water Law.

The EIR impacts analysis should address these regional distinctions.

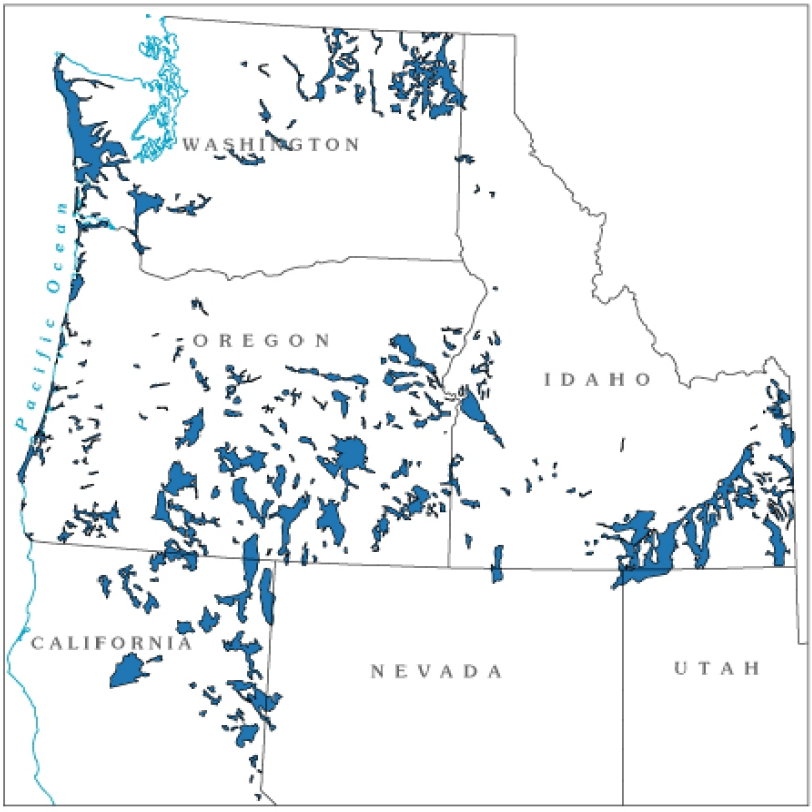
Direct and Indirect impacts to Northern California's Natural Water Supply and Management will be greater in the future with increases in population, food production, etc. I use the tern 'Natural Water Supply' to distinguish between attempts to clean contaminates from aquifers, or desalination and pumping. Natural as in rain, groundwater recharge systems, rivers, wetlands.



Timespans To Recharge Aquifers



Remote Groundwater Basins, Pacific Northwest



Unconsolidated-deposit aquifers, which consist primarily of sand and gravel, are the most productive and widespread aquifers in Idaho, Oregon, and Washington.

California groundwater basin aquifers, solely because of their remoteness to delivery for public use, and because they occur in geologic association with oil and gas reservoirs, and particularly the unassociated natural gas basins on the North Central Coast, North Coast, and North State interior; may now, by default, be exempt from protections, and can be delineated with private boundaries affecting surface rights, i.e., privately permitted for use in oil or gas production.

DOGGR made late revisions to the interim regulations that were originally proposed: This exemption carries with it, a permitting process for the allowance of contamination of a portion of the aquifer, or the entire basin.

- Clarification was added that if the operator determines that there is no protected water in the area, then an Interim Well Stimulation Treatment Notice is not complete unless it includes concurrence from the Water Boards with that determination.
- **Clarification was added that an aquifer deemed exempt under the U.S. Safe Drinking Water Act is not protected water.**

The text of the interim regulations with revisions highlighted can be found here.
http://www.conservation.ca.gov/dog/Documents/Final%20Interim%20Regulations%20with%20Highlights.pdf

No More 'aquifer exemptions' - Protect Northern California Water Resources

The Mendocino County Board of Supervisors on Tuesday 01072014, voted unanimously to declare a local emergency "and imminent threat of disaster" and appointed 1st District Supervisor Carre Brown and 5th District Supervisor Dan Hamburg to the Drought Emergency Ad-Hoc Committee.

Whereas the Mendocino BoS declaration of a local emergency "and imminent threat of disaster" from drought conditions, coincides with the Statewide overall drop recorded in aquifers;
and
Whereas the Aquifer Exemption clause added by DOGGR after December 24, 2013, to the SB 4 Well Stimulation Regulations seeks to remove remote basin and sub-basin aquifers as potential sources to 'public drinking water systems' by enacting the definition of 'protected water' under the SDWA, which contains the Halliburton exemption for fracking;
and
Whereas the 'additional clarification language' by DOGGR and the specific SDWA clause as cited, by it's definition of 'public water source' and subsequent historical use documentation requirements, 1) permits aquifer exemptions for oil and gas production, and 2) also permits contamination of aquifers or portions thereof for 'oil and gas field' operations in the disposal of wastewater or produced water, usually within an 'oil field or gas field lease held boundaries';
and
Whereas this 'new language' disproportionately affects rural, low density population counties in the north State regions where remote basin and sub-basin aquifers provide water sources for wells servicing the needs of families on individual properties for both drinking and irrigation;
and
Whereas in this same region of the North Central Coast, North Coast and North State Interior (DOGGR District 6) local governments have no real history of legal precedents regarding oil and/or gas extraction and water issues - and given the scale of increased exploration and expansion of production projected and since the only protected aquifers in the State (6) have been adjudicated;

SB 4, Fracking & Public Notices: Remote Basin Aquifer Exemptions for Oil and Gas Activities

- Public Notification. At least 30 days before beginning fracking operations, operators must provide to all property owners and tenants within a 1,500-foot radius of the wellhead a copy of the DOGGR permit. The notification must be provided by an independent third party retained by the operator. This person must submit to DOGGR both the names of those notified and the method by which notice occurred.

By the time the operator obtains drilling permits and has met the Public notification guidelines

(through a third party) it's likely that an aquifer exemption permit has already been processed for water for fracking, and possibly a disposal well will have been drilled to use the 'exempted' aquifer or a portion thereof for ('hazardous') waste disposal.

Time lines and work schedules of wellsite or wellpad surface disturbance (roads, landscape modification) are discussed in company press releases filed months ahead of actual start of operations to the SEC to bolster stocks. When operators hire drilling rigs, and crews, it takes months of preparations.

There is no official reason to limit Public Notification to 30 days, or 'at least' 30 days prior.

1783.2. Copy of Interim Well Stimulation Treatment Notice; Notice of Availability for Water Testing, Sampling; Request for Water Testing.
(a) At least 30 days in advance of commencing well stimulation treatment, the operator of the well subject to well stimulation treatment is required to provide to surface property owners and tenants of legally recognized parcels of land situated within a 1500-foot radius of the wellhead of any such well, or within 500 feet of the horizontal projection of the subsurface parts of any such well, the following:
(1) A copy of the Interim Well Stimulation Treatment Notice, approved as complete by the Division;
(2) Notice of the availability of water sampling and testing of any water well located on the parcel that is suitable for drinking or irrigation purposes;
(3) Notice of the availability of water sampling and testing of any surface water located on the parcel that is suitable for drinking or irrigation purposes; and
(4) Information about how to request water sampling and testing, and notice that a request for water sampling and testing must be made within 20 days of receipt of the notification.
(b) A property owner notified pursuant to this section may request water quality sampling and testing on any water well located on the parcel that is suitable for drinking or irrigation purposes and on any surface water located on the parcel that is suitable for drinking or irrigation purposes, provided that the request is made in writing within 20 days of receipt of the notification. Upon receipt of a timely, written request for water quality sampling and testing, the operator shall pay for testing and sampling by one or more qualified independent third-party contractors designated by the State Water Resources Control Board, provided that the sampling and testing is consistent with the standards and protocols specified by the State Water Resources Control Board pursuant to Public Resources Code section 3160(d)(7)(B) and is conducted in accordance with Public Resources Code section 3160, subdivision (d)(7)(A).
(c) For the purposes of this section, “tenant” means a person or entity possessing the right to occupy a legally recognized parcel, or portion thereof.
(d) For the purposes of this section, “horizontal projection” means the surface representation of the horizontal path of the wellbore.
NOTE: Authority cited: Section 3013, 3160, and 3161, Public Resources Code.
Reference: Section 3106, 3160, and 3161, Public Resources Code.

EIR Scoping Concerns: Notifications

1) Notifications, should be based upon groundwater basin or sub-basin aquifers boundaries, and surface area recharge drainage or watershed boundaries per the Notice in advance of commencing well stimulation treatment, including but not limited to; surface property owners and tenants of legally recognized parcels of land above any aquifers under project specific total lease-held acreages.

2) As written, notification does not address rural counties, where large private ownerships (Timber, Ranching, Hunting Clubs) and precludes adjacent tenant or parcel owner notification even with the 500' consideration along the surface representation of the horizontal path of the wellbore. The Coastal Commission needs public notification of ALL drilling permits AND fracking or acidizing projects within the Coastal Zone and offshore.

Division of Oil Gas and Geothermal Resources, Department of Conservation Districts relevant to SB 4 California Well Stimulation Regulations Statewide Environmental Impact Report.

The California Drought of 2014 (web links to supplemental extended story)

As California counties enact local emergency "and imminent threat of disaster" rules and ordinances related to drought conditions, and the State considers water management options, the one phrase on every newscast and in Committee discussion is 'new water supply'.

Options are limited for drought remedies, given the cost of new surface water containment. And yet remote groundwater basin and sub-basin aquifers or portions thereof, by permit application, can be delineated with private boundaries affecting surface rights, i.e., privately held boundaries of aquifers by oil and gas lease operators for use in oil or gas production, including disposal of produced water. The aquifer exemption carries with it, a permitting process for the allowance of contamination of a portion of the aquifer, or the entire basin.

Aquifer Exemptions At The Last Moment

Clarification language was added to SB 4 (December 24, 2013 5:00 pm) after close of Public Comment, that an aquifer deemed exempt under the U.S. Safe Drinking Water Act is not protected water. Aquifer Exemptions are based first on historic or potential hydrocarbon production, and weighted against the economic feasibility of hooking up to a 'public water system'. The 'protected water' designation under the SDWA only serves to permit exemptions of aquifers or portions of aquifers to allow contamination.
http://banslickwaterfracking.blogspot.com/2014/01/the-safe-drinking-water-act-sole-source.html

SDWA 40 CFR 141.2 defines public water systems as those systems: that provide piped water for human consumption and are equipped with at least 15 connections or regularly serve at least 25 people.

Public water systems include the following:
Community water systems; Non-transient non-community water systems; Non-community water systems; States are required to establish “wellhead protection areas”.

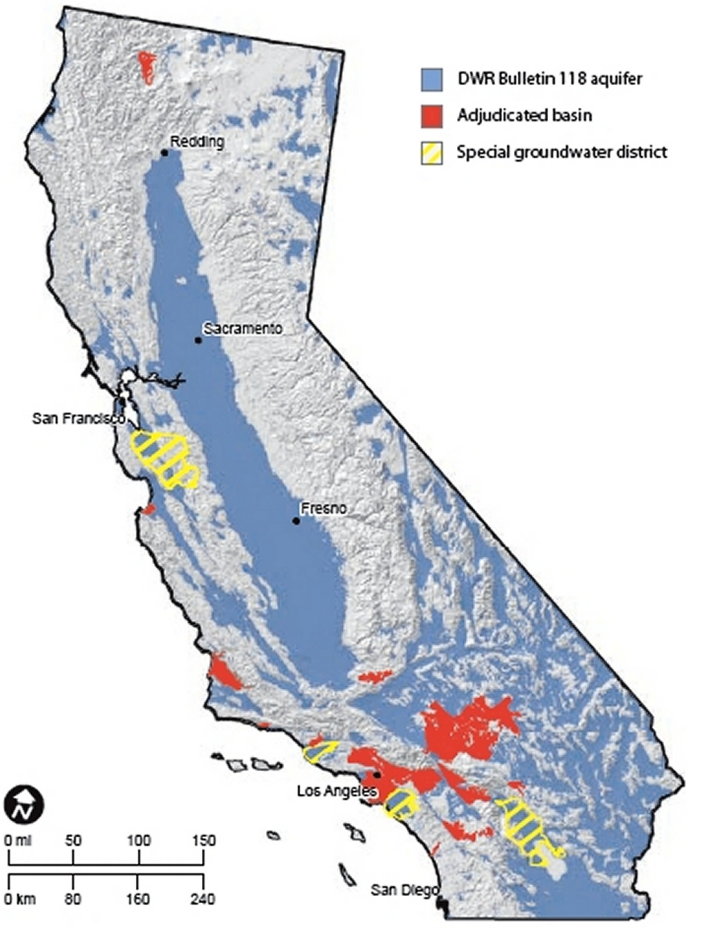
Much of California’s runoff flows into the groundwater basins that underlie most of California’s land area, where it often becomes a major source of water supply. Over the eight year period 1998–2005, (measured in maf) regional average annual water availability, storage, and use; groundwater pumps withdrew an average of 15 maf/year and accounted for 28 to 42 percent of gross agricultural and urban water use. Groundwater is more important in dry years and is particularly important for agricultural and urban uses in several regions.

The California Department of Water Resources’ bulletin on the state’s groundwater basins, Bulletin 118, has been issued only twice since 1980. These reports include little analysis or strategic overview of the condition of California’s aquifers, or how they are employed.

Although Department of Water Resources gathers data on over 400 aquifers in the state, these data are not maintained in a way that allows statewide or regional assessments of aquifer conditions, such as overdraft or contamination. California provides for no state-level regulation

of groundwater. (Garner and Willis 2005; Legislative Analyst's Office 2010).

What makes an aquifer exempt? These rules stem from the Federal/State laws of 'Primacy' regarding enforcement of EPA standards etc, in response to Clean Air Act, Clean Water Act, mining, oil and gas, claims to Aquifer Basins - time frame of 1984.



SOURCE: California Department of Water Resources (DWR).

NOTES: The map shows all groundwater basins (blue), all 22 adjudicated groundwater basins (red), and four special groundwater management districts (Coachella Valley Water District, Fox Canyon Groundwater Management Agency, Orange County Water District, and Santa Clara Valley Water District), all of which exercise authority to levy pump charges. (For a list of adjudicated basins, see www.water.ca.gov/groundwater/gwmanagement/court_adjudications.cfm.) In the Scott Valley (far north on the map), the adjudication included both ground and surface water rights.

The Aquifer Exemption Permit
AQUIFER EXEMPTION SUMMARY SHEET EXEMPTION DESCRIPTION (Township, Range, Section, Quarter section and affected area):
FIELD; AQUIFER TO BE EXEMPTED;
JUSTIFICATION FOR EXEMPTION;

Aquifer is not a source of drinking water and will not serve as a source of drinking water in the future because it:
• Has a TDS level above 3,000 and not reasonably expected to serve as a source of drinking water (economic consideration of delivery)
• Is producing or capable to produce hydrocarbons
• Is producing or capable to produce minerals
• Is too deep or too remote (economic consideration of delivery)
• Is above Class III area subject to subsidence
• Is too contaminated (name contaminant (s));

The Consolidated Permits Regulations (40 CFR §§146.04 and 144.7) allow EPA, or approved State programs with Environmental Protection Agency (EPA) concurrence (Primacy agreement), to exempt underground sources of drinking water from protection under certain circumstances.

An underground source of drinking water may be exempted if:

1. It does not currently serve as a source of drinking water and;
2. It cannot now and will not in the future serve as a source of drinking water because:
(a) If is mineral, hydrocarbon, or geothermal energy producing, or it can be demonstrated by a

permit applicant as a part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible;
(b) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;
(c) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or
(d) It is located over a Class III well mining area subject to subsidence or catastrophic collapse; or
3. The Total Dissolved Solids content of the ground water is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

Specific Information Required For 'Aquifer Exemptions' Permit
§146.04 (b)(1) It cannot now and will not in the future serve as a source of drinking water because: it is mineral, hydrocarbon, or geothermal energy producing or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.

The language of the designation comes from the Underground Injection Program, explicitly left out of the 'new' SB 4 Well Stimulation Regulations, except per the benefit of the industry, i.e., with a clarification of aquifer exemptions to assist extractive industrial surface leases by alter-legal claims on subsurface water rights pertaining to mining and hydrocarbon extraction methods including 'hazardous' waste disposal.

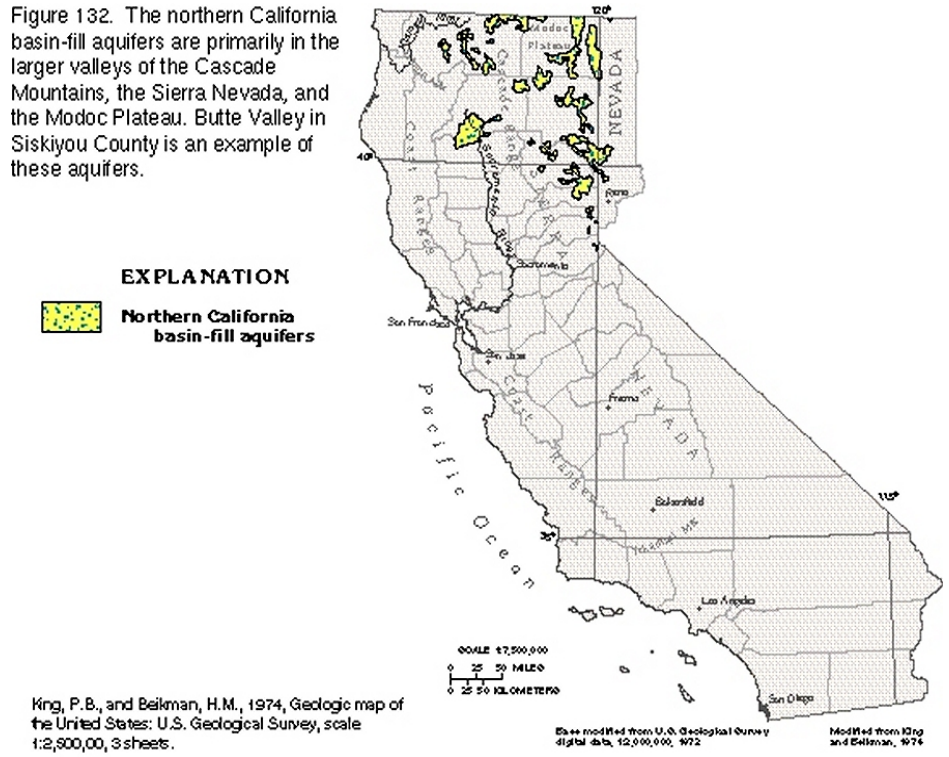


Figure 132. The northern California basin-fill aquifers are primarily in the larger valleys of the Cascade Mountains, the Sierra Nevada, and the Modoc Plateau. Butte Valley in Siskiyou County is an example of these aquifers.

King, P.B., and Beikman, H.M., 1974, Geologic map of the United States: U.S. Geological Survey, scale 1:2,500,00, 3 sheets.

3) The clarification of 'protected water' added by DOGGR after December 24, 2013, to SB 4 Well Stimulation Regulations is a pre-requisite allowing an 'Aquifer Exemption' which serves to remove remote basin and sub-basin aquifers as potential sources to 'public drinking water systems' under the SDWA, which contains the Halliburton exemption for fracking.

4) The 'additional clarification language' by DOGGR and the specific SDWA clause as cited, by it's definition of 'public water source' and subsequent historical use by documentation requirements, 1) permits aquifer exemptions for oil and gas production, and 2) also permits contamination of aquifers or portions thereof for 'oil and gas field' operations in the disposal of wastewater or produced water, usually within an 'oil field or gas field lease held boundaries';

5) This 'new language' disproportionately affects rural, low density population counties in the north State regions where remote basin and sub-basin aquifers provide water sources for wells servicing the needs of families on individual properties for both drinking and irrigation; and Whereas in this same region of the North Central Coast, North Coast and North State Interior (DOGGR District 6) local governments have no real history of legal precedents regarding oil and/or gas extraction and water issues.

6) Every 'aquifer exemption' that is based on economic feasibility or the pretense that "it will not in the future serve as a source of drinking water" or is not currently 'protected water' or 'drinking water supply' and the negative declaration of such by any considerations under the SDWA, except excessive contaminant loading or toxic contaminant level, should be reviewed under CEQA.

Sole Source Aquifers, Pacific NW, Region 10
As of December, 1997, EPA had designated 69 sole source aquifers nationwide. Fifteen of these are in Region 10 (Alaska which has zero, Idaho, Oregon, and Washington).

Sole Source Aquifers
The Safe Drinking Water Act Sole Source Aquifer Protection Program in California

Sole Source Aquifers, Pacific Southwest, Region 9
Serving: Arizona, California, Hawaii, Nevada, Pacific Islands, Tribal Nations
http://www.epa.gov/region9/water/groundwater/ssa.html

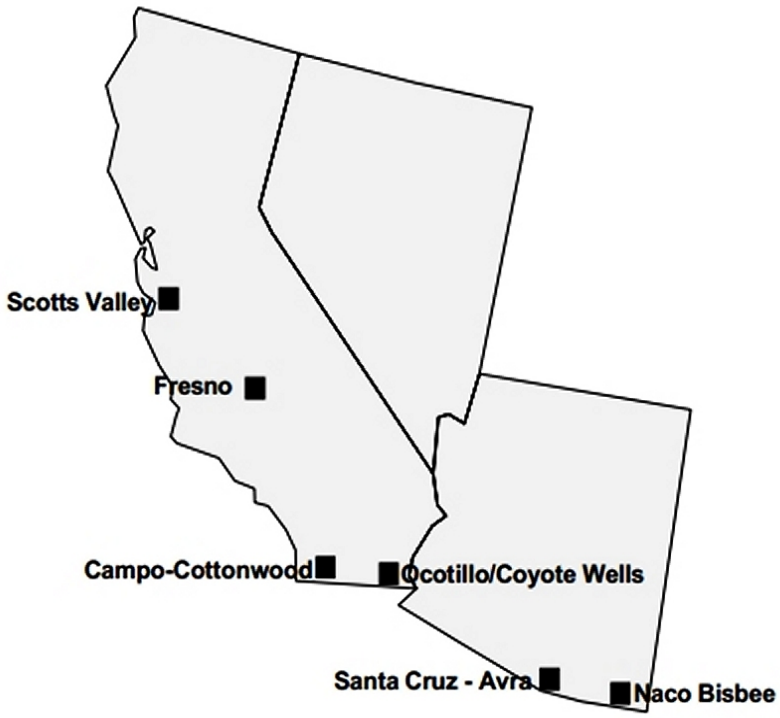
The EPA's Sole Source Aquifer (SSA) Program was established under Section 1424(e) of the Safe Drinking Water Act (SDWA.) Since 1977, it has been used by communities to help prevent contamination of groundwater from federally-funded projects. It has increased public awareness of the vulnerability of groundwater resources. The SSA program allows for EPA environmental review (PDF) (1pg, 34K) of any project which is financially assisted by federal

grants or federal loan guarantees. These projects are evaluated to determine whether they have the potential to contaminate a sole source aquifer.

Groundwater is a valuable resource both in the United States and throughout the world. http://ga.water.usgs.gov/edu/gwdepletion.html

Where surface water, such as lakes and rivers, are scarce or inaccessible, groundwater supplies many of the hydrologic needs of people everywhere. In the United States. It is the source of drinking water for about half the total population and nearly all of the rural population, and it provides over 50 billion gallons per day for agricultural needs.

6 California Sole Source Aquifers, Southern California



Where Water Can Migrate, So Can Contaminants

All of the water in the ground of course is not fresh water. Much of the very deep groundwater and water below oceans is saline. Under natural conditions the boundary between the freshwater and saltwater tends to be relatively stable, but pumping can cause saltwater to migrate inland and upward, resulting in saltwater contamination of the water supply.

Some hazardous substances dissolve very slowly in water. When these substances seep into groundwater faster than they can dissolve, some of the contaminants will stay in liquid form. If the liquid is less dense than water, it will float on top of the water table, like oil on water.

Pollutants in this form are called **light non-aqueous phase liquids (LNAPLs)**. If the liquid is more dense than water, the pollutants are called **dense non-aqueous phase liquids (DNAPLs)**. DNAPLs sink to form pools at the bottom of an aquifer.

These pools continue to contaminate the aquifer as they slowly dissolve and are carried away by moving groundwater. As DNAPLs flow downward through an aquifer, tiny globs of liquid become trapped in the spaces between soil particles. This form of groundwater contamination is called **residual contamination.**

Many processes can affect how contamination spreads and what happens to it in the groundwater, potentially making the contaminant more or less harmful, or toxic. Cumulative sub-seismic events in the Northern part of the State, whether natural tectonic displacement (or induced) by the moment of a well fracture stimulation, the duration of progression of induced fractures through the formation, or multistage frac stimulations can cause groundwater to move into a production zone and well as documented in the Eel River Basin, and by way of traveling through natural faults enter new areas/levels of the geologic strata. *(Jere Jay INNEX/ Foothills Inc, Eel River Basin, Grizzly Bluff Gas Field)*

EIR Scoping Concerns: Wastewater
California Department of Conservation, DOC
Division of Oil, Gas, and Geothermal Resources, DOGGR

7) Under SB 4 reporting procedures, tabulated sub-seismic events, (2.0 and greater) are logged. Will they be analyzed for cumulative impacts analysis over the lifetime of the well or well pad if multiple bores from a single pad are employed? What levels are acceptable and what levels would trigger a risk characterization assessment?

Fracquakes

8) Are the SB 4 reporting procedures, for tabulated sub-seismic events, bound by end points within the parameters laid out in 1780 Definitions, wherein “For purposes of this article, a well stimulation treatment commences when well stimulation fluid is pumped into the well, and ends when the well stimulation treatment equipment is disconnected from the well”?

Preferred timescale: From initial drilling, cementing, through stimulation of the well and/or the formation, any post-wash, flow back periods, the wellhead's completion and entire production life cycle, and afterward, re-stimulation, or it's abandonment, and possible re-drilling, well stimulation treatment, re-completion, and potential for use as a waste disposal well?

9) Will the data be aggregated by lease operator, or (lease) ownership for cumulative analysis of tabulated sub-seismic events for multiple well bores, and multiple pads in a 'Township Drainage', or 'gas field' aggregation of wells? (as for the purposes of the EIR per the directive by Governor Jerry Brown)

10) Section 1788 uses the terms 'source, volume, and specific composition and disposition of all

water', is that to be taken as being broadly inclusive? (If delivered, or recycled, recycled and treatment technologies or locations (pond vs tank), and if drawn from aquifer or surface water, and if recycling and treatment happened offsite then final waste disposal method and location? Where disposal injection wells are employed, particularly onsite will any permitted exempted aquifers be delineated by both surface boundaries and sub-surface basin boundaries?

Post-Fracking Disclosures and Reporting. Within 60 days after fracking a well, the operator is required to post information about the well and the fracking activity to the Chemical Disclosure Registry. This of course should read 60 days before.

1788. Required Public Disclosures.
(12) The source, volume, and specific composition and disposition of all water associated with the well stimulation treatment, including, but not limited to, water used as base fluid and water recovered from the well following the well stimulation treatment that is not otherwise reported as produced water pursuant to Section 3227;

Toxic Migrations, Aquifer Contamination; How Overdrafting Concentrates Toxins

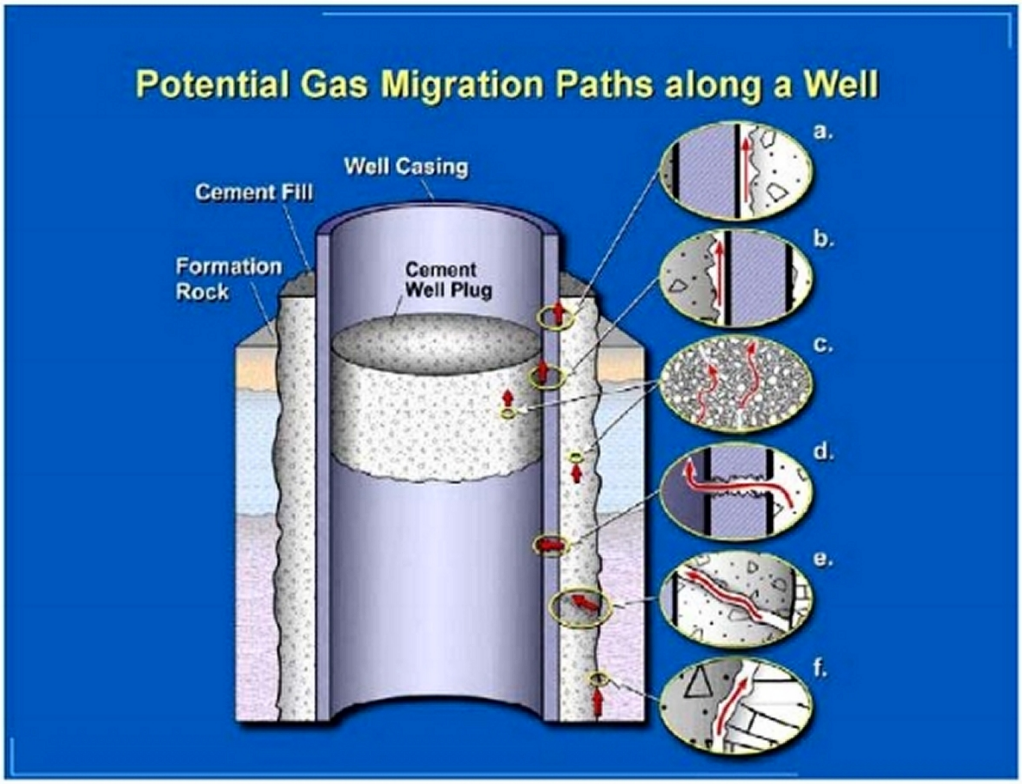
Some of the most important processes affecting hazardous substances in groundwater are advection, sorption, and biological degradation.
1) Advection occurs when contaminants move with the groundwater. This is the main form of contaminant migration in groundwater.
2) Sorption occurs when contaminants attach themselves to soil particles. Sorption slows the movement of contaminants in groundwater, but also makes it harder to clean up contamination.
3)Biological degradation happens when microorganisms, such as bacteria and fungi, use hazardous substances as a food and energy source. In the process, contaminants break down and hazardous substances often become less harmful.

Pathways Of Migration Surround The Well

“It’s a complex job in horizontal wells, many with horizontal bores running up to three miles long. The problem is that each time you re-pressurize the wellbore for a frack job, it puts the cement at risk. The industry already knows that cement that has been stressed frequently has a higher failure rate.”

Data on frequency of occurrence of sustained casing vent flow (SCVF) or gas Migration (GM). show that in the statistical analysis of information on nearly 315,000 onshore oil and gas wells: “Low cement top or exposed casing was found to be the most important indicator for SCVF/GM.

The effect of low or poor cement was evaluated on the basis of the location
of the SCVF/GM compared to the cement top... the vast majority of sustained casing vent flow gas migration originates from formations not isolated by cement.” Watson and Bachu (2009)



As contaminates migrate into aquifers, and overdrafting depletes the aquifer, TDS increases, and toxins accumulate. Water levels in wells throughout drought affected States show that aquifers are being significantly depleted in many areas as more water is drained out than seeps back into the ground. Many California aquifers are declining, and calls grow for more oversight of groundwater: January 3, 2014
http://www.thecalifornian.com/article/20140104/NEWS01/301040025/With-many-Californiaaquifers-declining-calls-grow-more-oversight-groundwater

An analysis of groundwater data provided by the U.S. Geological Survey and two other agencies has found that, of 3,394 wells across California, water levels declined in about 62 percent of the wells between 2000 and 2013.

Unconventional Gas From Shale Plays:
"Myths and Realities Related To Human Health Impacts" *Dr. Anthony Ingraffea*

"Dr. Anthony Ingraffea has been speaking all over the world about the process and impacts of shale gas extraction. As Dwight C. Baum Professor of Engineering at Cornell, Dr. Ingraffea has taught fracture mechanics, finite element methods, and structural mechanics at Cornell for 35 years. Dr. Ingraffea's research concentrates on computer simulation and physical testing of complex fracturing processes. He and his students have authored more than 250 papers on this research, and he has twice won the National Research Council/U.S. National Committee for Rock Mechanics Award for Research in Rock Mechanics (1978, 1991). He is Co-Editor-in-Chief

of the premier journal in his field, Engineering Fracture Mechanics. Dr. Ingraffea was named one of TIME Magazine's "People Who Mattered" in 2011."

Unconventional Gas From Shale Plays:
Myths and Realities Related To Human Health Impacts
Public education series on un-conventional gas drilling sponsored by the Town of Enfield.

Part 1 – one hour
http://www.youtube.com/watch?v=EbrHD789eu8

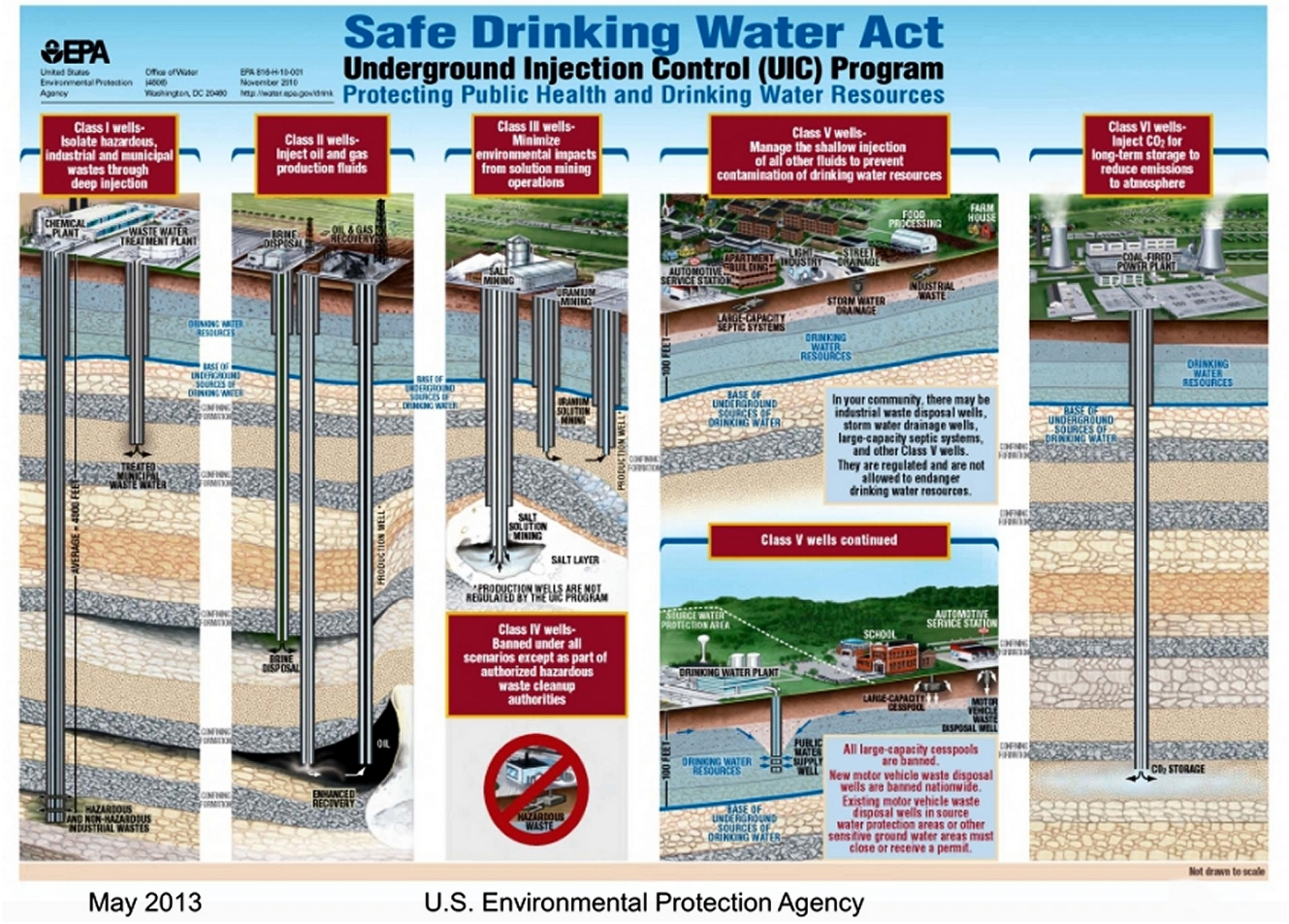
Part 2 – one hour
http://www.youtube.com/watch?v=cSZCdAtXu38

Part 3 Q&A – 40 minutes
http://www.youtube.com/watch?v=Re5E-0l-MK4

Industrial Disposal Well Types And Aquifer Safe Drinking Water Protections (Exemptions)
Underground Injection Control Program (UIC) Safe Drinking Water Act (SDWA)

Class II and III well operations may be taking place in aquifers containing less than 10,000 mg/l TDS. These aquifers must be exempted in accordance with 40 CFR §146.04 in order for these operations to remain legal. and will not in the future serve as a source of drinking water. All information necessary for EPA to approve the exemptions should be included in the applications. This includes a demonstration that the aquifer is not currently used and that it meets one of the criteria of §146.04(b). The aquifer must also be identified in terms of areal extent and depth.

Class I wells – Technologically sophisticated wells that inject wastes into deep, isolated rock formations below the lowermost USDW. Class I wells may inject hazardous waste, non-hazardous industrial waste, or municipal wastewater.
Class II wells – Wells that inject brines and other fluids associated with oil and gas production, or storage of hydrocarbons. Class II well types include salt water disposal wells, enhanced recovery wells, and hydrocarbon storage wells.
Class III wells – Wells that inject fluids associated with solution mining of minerals. Mining practices that use Class III wells include salt solution mining, in-situ leaching of uranium, and sulfur mining using the Frasch process.
Class IV wells – Wells that inject hazardous or radioactive wastes into or above a USDW. These wells are banned unless authorized under a federal or state groundwater remediation project.
Class V wells – Wells not included in Classes I to IV and Class VI. Class V wells inject non-hazardous fluids into or above a USDW and are typically shallow, on-site disposal systems; however, this class also includes some deeper injection operations. There are approximately 20 subtypes of Class V wells.
Class VI wells – Wells that inject carbon dioxide for the purposes of long-term storage, also known as CO2 geologic sequestration.



UIC wells, and Steam Injection stimulation techniques were excluded from the SB 4 Well Stimulation Regulations (limited to frac oversight, and permitting for hydroflouric acid).

Well Failures And Groundwater Conditions, Reporting, Under SB 4 Language

(SB 4) 1783.4. Groundwater Sampling, Testing, and Monitoring (Protections)
(6) A contingency plan for reporting information in the event of a well failure, or any other unintended event that has the potential to affect groundwater quality, such as the detection of a fracture beyond the intended zone or into protected waters. A "well failure" means instances where the well casing has been compromised producing a subsurface leak into water bearing zones and is a potential threat to groundwater quality.
(D) An estimate of the volume of fluid lost during well failure, or unintended event.
(c) Well-specific and area-specific groundwater monitoring should be designed to assess whether protected waters have been impacted by well stimulation treatment. Groundwater wells to be used for groundwater monitoring should be located within reasonable proximity of the oil or gas well(s) undergoing stimulation treatment. Groundwater wells to be used for groundwater monitoring should be screened at depths in the aquifer where existing groundwater supply wells are screened.

(SB 4 continued) Additional groundwater wells to be used for ground water monitoring should be screened near the base of protected waters. The number of new and existing groundwater wells to be used for groundwater monitoring, their locations, depths, screened intervals, and justification for their use shall be included in the groundwater monitoring plan. If any groundwater wells identified in accordance with subsection (b)(3) are not to be used for groundwater monitoring, a justification for their exclusion shall be included in the groundwater monitoring plan.

- The Division shall not approve as complete an Interim Well Stimulation Treatment Notice submitted on or after January 1, 2014 that asserts the absence of protected water as the basis for not conducting groundwater monitoring unless the submittal includes written concurrence by the Water Boards with the operator's determination of the absence of protected water.

SB 4 Interim Well Stimulation Treatment Regulations Public Notices (Notification)

Text of Proposed Regulations 1783.2. Copy of Interim Well Stimulation Treatment Notice; Notice of Availability for Water Testing, Sampling; Request for Water Testing.
(a) At least 30 days in advance of commencing well stimulation treatment, the operator of the well subject to well stimulation treatment is required to provide to surface property owners and tenants of legally recognized parcels of land situated within a 1500-foot radius of the wellhead of any such well, or within 500 feet of the horizontal projection of the subsurface parts of any such well.

OFFSHORE, State Waters, State Bottom Lands, Outer Continental Shelf

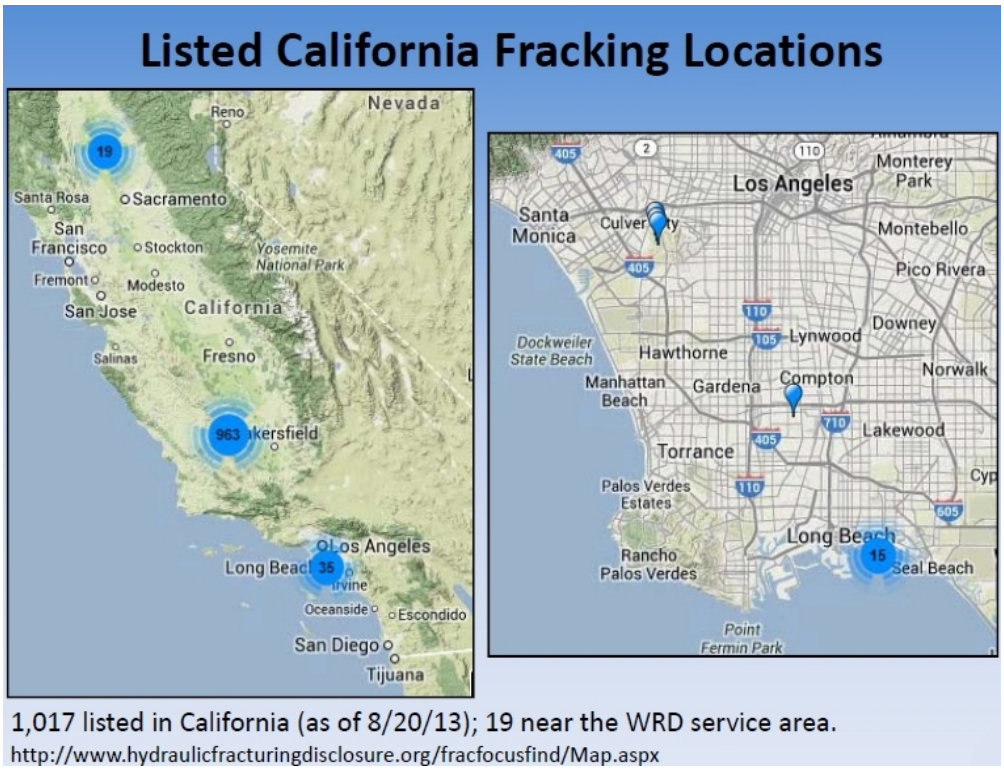
At the very least, any drilling heading towards offshore reserves whether under State Bottom Lands or the OCS, should file Public Notifications with the California Coastal Commission.

In October 2013, California coastal waters 'ocean fracking' was in the news.
http://www.fishsniffer.com/blogs/details/feds-urged-to-halt-fracking-off-the-california-coast/
The Center for Biological Diversity filed a notice letter with two federal agencies in charge of regulating offshore oil development, the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement.

Oil companies are fracking California's beautiful coastal waters with dangerous chemicals, and federal officials seem barely aware, we need an immediate halt to offshore fracking before chemical pollution or a spill poisons California's rich coastal waters.
http://www.biologicaldiversity.org/news/press_releases/2013/fracking-10-03-2013.html

The facts constituting an urgency and immediate threat to the public health, safety and welfare are these: considerable uncertainty exists as to whether new technology operations engaged in oil and or gas exploration and development within the unincorporated area of Mendocino County would be in conformance with the General Plan and whether they may be hazardous to the public health, safety and welfare. Under the Coastal Zone Management Act (CZMA) this

would apply to the offshore as well. Until the Mendocino County General Plan is amended, and updated, this uncertainty will remain.



Northern Sacramento Basin: Non-Associated Natural Gas Fields

Un-associated or Non-associated

Gas Fields North Sacramento Basin

Geologic Formation Age/Name

From Lighter Color To Darker Color,

Younger To Older Geologic Time Scale

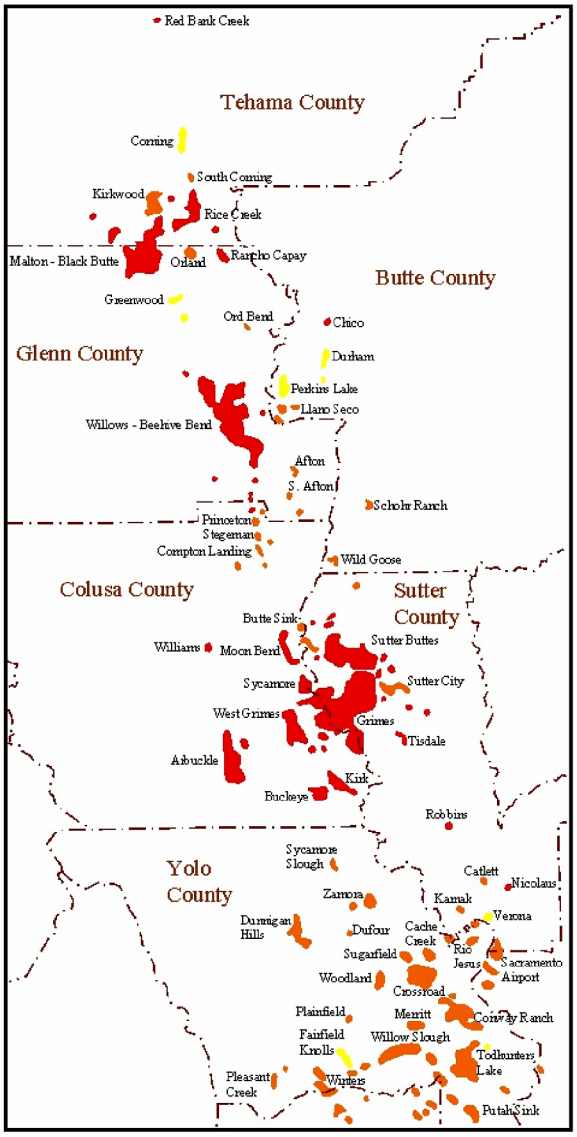
(Yellow) Eocene, (Red) Cretaceous Forbes and older

In Butte and Tehama Counties, production depths

are in the older Lovejoy, and Chico Formations.

The youngest being the Tuscan Formation.

Natural gas production in the Sacramento Valley comes from formations ranging from Cretaceous to Pliocene in age. Eocene and younger reservoirs: Capay, the Domengine, the Nortonville, various gorge fills, and the Tehama Formation. Paleocene reservoirs: Meganos and Martinez Formations. The younger Cretaceous includes the Kione, the Winters, and the Starkey, as well as the Blewett and Tracy sands south of the delta. The Forbes is grouped with the older Dobbins and Guinda.

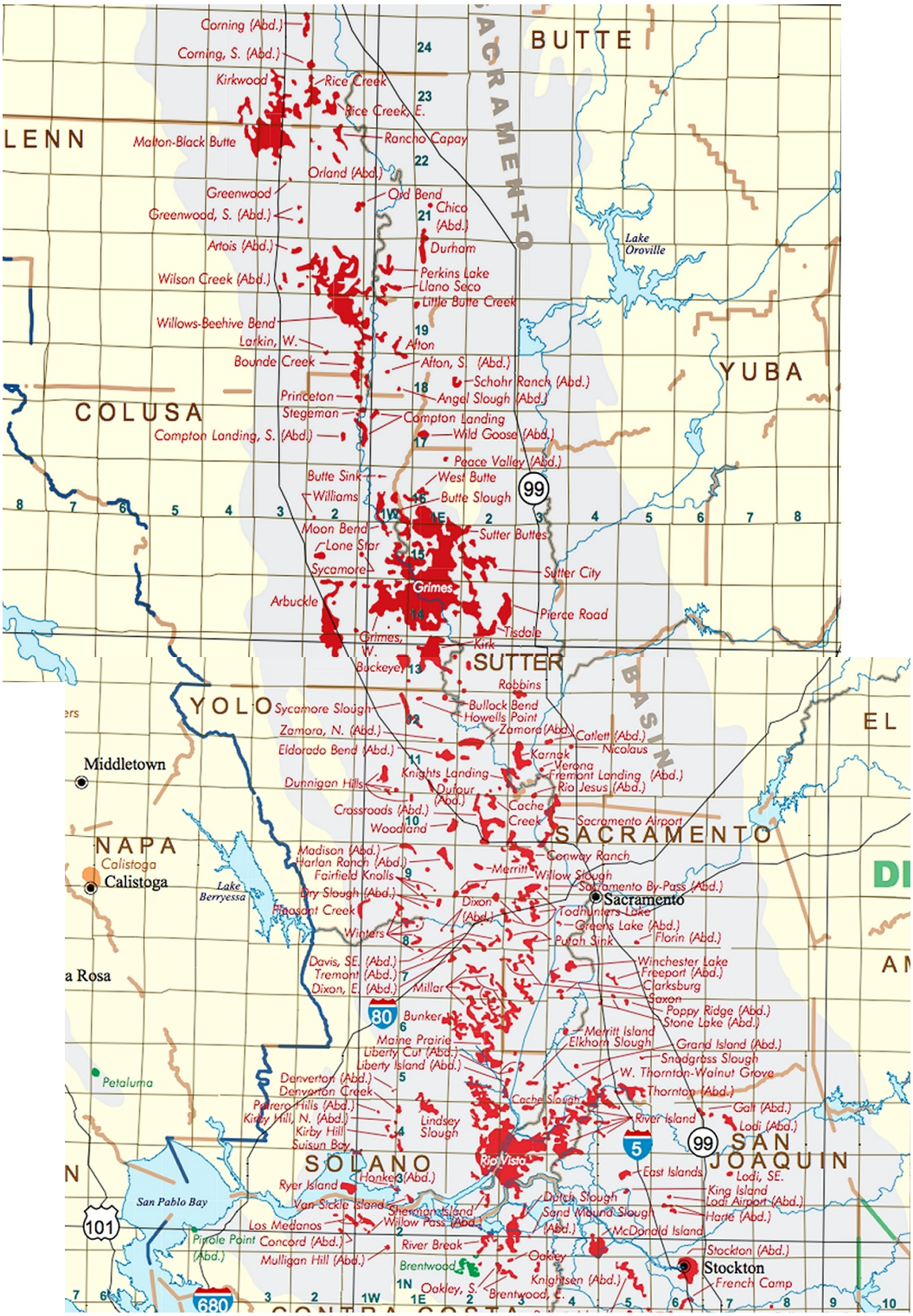


The Willows and Greater Grimes fields are located in Colusa, Glenn and Sutter Counties north of Sacramento, California. Depths range from 2,800 feet in the Willows field to 8,900 feet in the Greater Grimes field. There were 439 producing wells in the fields as of the end of 2008.

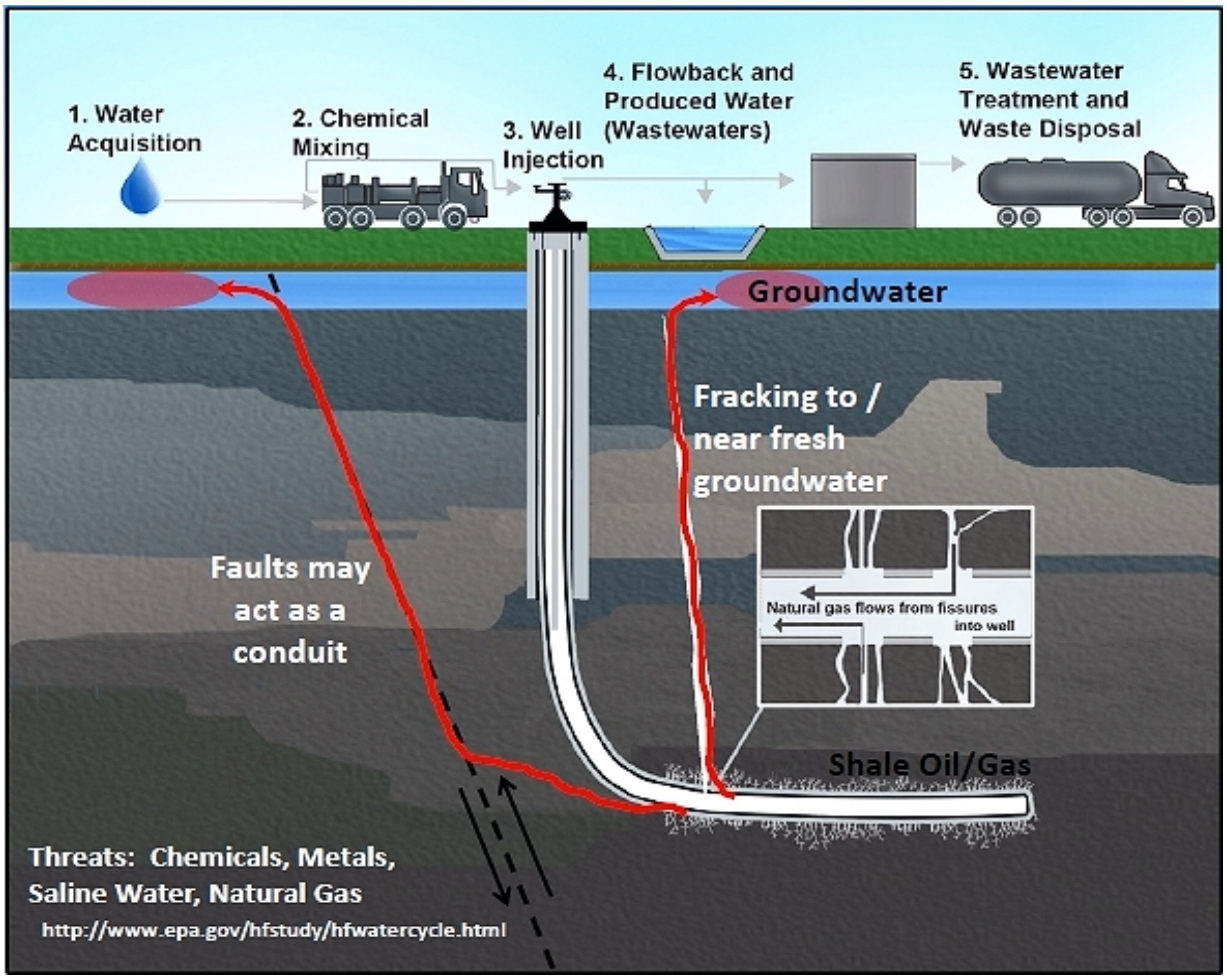
Sacramento Basin UPDATE: Venoco Inc., Denver, (NYSE: VQ) has reported guidance for 2012. http://www.ugcenter.com/US-Shales/Venoco-Devotes-2012-Capex-Californian-Ops_92943

“The company's 2012 exploration, exploitation and development capital expenditures are forecast to be $255 million. Approximately $100 million, or 39% of the capital budget, will be deployed in the company's onshore Monterey Shale play, $110 million or 43% in legacy oil fields in Southern California, and $45 million or 18% in the Sacramento Basin.”

The company plans to drill 15-20 onshore Monterey Shale wells, and drill approximately 20 wells, perform 180 re-completions and 15 fracs in the Sacramento Basin during 2012.



Risk Fractors To Groundwater (GWR)



Graphics or text from US or State Agency publications, are usually linked to web sources/topics.

Those Agencies include the US Environmental Protection Agency, California EPA, Department of the Interior, Bureau of Land Management, US Department of Energy, California Resources Agency, Department of Conservation, Division of Oil Gas and Geothermal Resources, State and Regional Water Quality Control Boards, California Air Quality Management Districts, California Legislative Sessions, Senate Digest, and publications from various Senate or Assembly Bills authors, i.e., press releases. Any 'news stories, or articles' are given proper citation.

All other graphics are from publications in print (some peer reviewed) and all available online at the organizations' website, or the authors' blog and associated websites. These have all been published and are available to the Public Commons for the sake of public discourse and the filing of comments or complaints, and to serve the public good. I have attributed works to their respective authors and/or organizations. All works are source-linked.

Briefing on Offshore Fracking and Other Well Stimulation Treatments,
Alison Dettmer California Coastal Commission http://www.coastal.ca.gov/
Deputy Director Energy, Ocean Resources and Federal Consistency
Watch the archived February 12, 2014 Coastal Commission meeting at Cal-SPAN
http://www.cal-span.org/cgi-bin/media.pl?folder=CCC

PRESENTATION HIGHLIGHTS
State Waters – Jurisdiction New Oil & Gas Drilling Projects
• Require a Coastal Development Permit (CDP)
• Coastal Commission will evaluate potential impacts of well stimulation treatments as part of CDP application review.

State Waters – Jurisdiction Existing Facilities:
• Well stimulation treatments at existing, pre-Coastal Act facilities
– Complex legal issues
– Staff reviews CDP Exemptions
– On-going discussion and coordination with state and local agencies, stakeholders
• Report back to Coastal Commission at future hearing

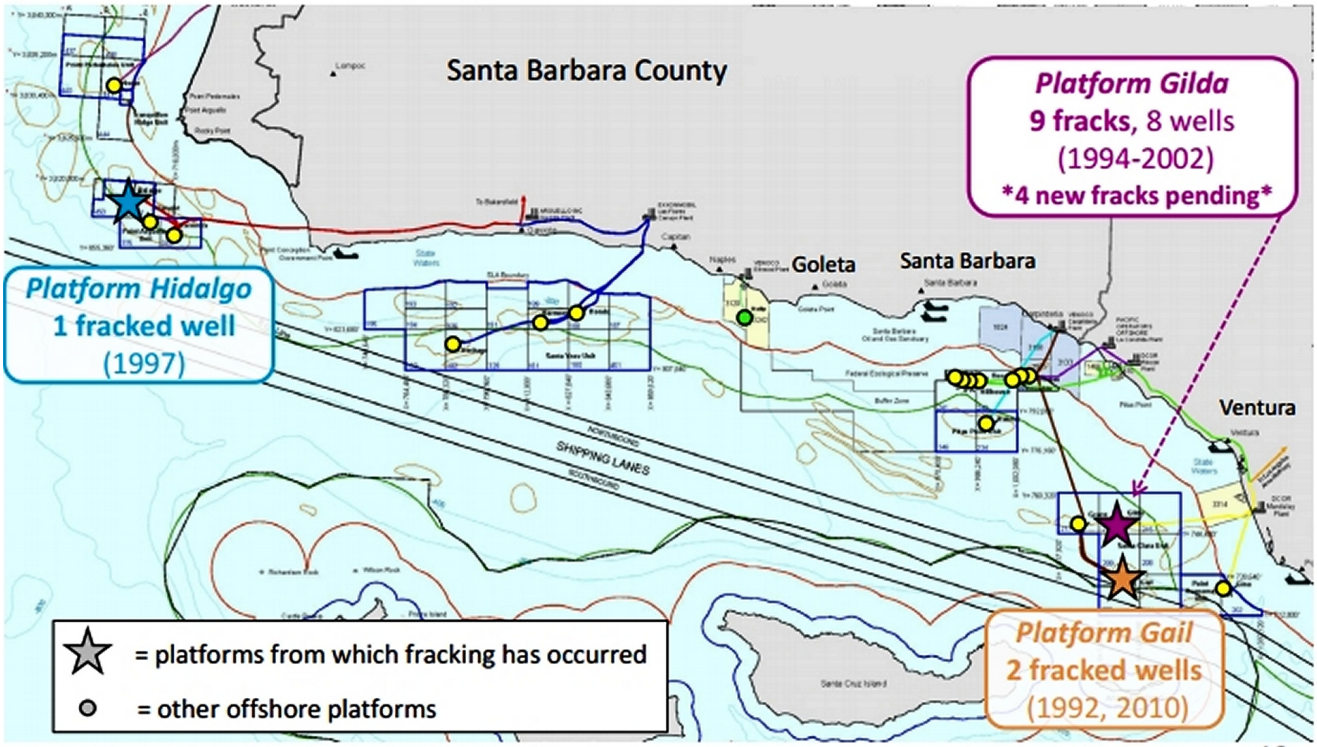
State Waters – Next Steps
• Enter into a Memorandum of Agreement (MOA) with Department of Conservation to delineate respective authorities, responsibilities, notification and reporting requirements associated with well stimulation treatments
• Participate in SB 4 Independent Scientific Study ("SB 4 Science Study")
• Urge that SB 4 Science Study and Statewide EIR analyze potential impacts of offshore well stimulation treatments
• Schedule a Coastal Commission workshop after the release of the SB 4 Science Study to examine results and next steps

State Waters – Discharges Prohibited
• State Law (PRC § 6873(b) & SLC regulations) prohibits the discharge of produced fluids in state waters
• Most waste fluids reinjected into originating reservoir
– Co-located injection & waste disposal wells
– "Closed loop" operations at sites where well stimulation treatments currently occur (Long Beach Unit, Platform Esther, Belmont Field)

Federal Waters: NPDES Permit
• General NPDES permit for oil and gas platforms establishes discharge standards for offshore platforms in federal waters
– Reauthorized every five years
– Applies only to discharges into federal waters
• 13 platforms discharge
• 10 platforms either reinject or comingle wastewater with one of the platforms that does discharge

Hydraulic Fracturing in Federal Waters

- 23 offshore platforms
- 12 confirmed instances of fracking
- 4 approved but pending plans to frack
- Confirmed use of acid stimulation



Source: BSEE/BOEM, 2013

12

By invoking the 'Copyright Disclaimer' Under Section 107 of the Copyright Act 1976, allowance is made for "fair use" for purposes such as criticism, comment, news reporting, teaching, scholarship, and research. Fair use is a use permitted by copyright statute that might otherwise be infringing. Non-profit, educational or personal use tips the balance in favor of fair use."

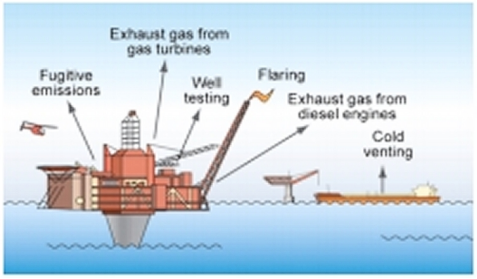
§ 107.Limitations on exclusive rights: Fair use Notwithstanding the provisions of sections 106 and 106A, the fair use of a copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright. In determining whether the use made of a work in any particular case is a fair use, the factors to be considered shall include:
(1) the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes; (2) the nature of the copyrighted work; (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and (4) the effect of the use upon the potential market for or value of the copyrighted work.

If you wish to use copyrighted material from this article for purposes of your own, that go beyond 'fair use', you must obtain permission from the copyright owner.

Potential Environmental Impacts of Offshore Well Stimulation Treatments

- **Discharge of contaminants to the ocean**
- Migration of contaminants into groundwater (onshore, nearshore areas)
- Well integrity, leaks & spills
- Induced seismicity
- Air Quality & GHGs
- Other Impacts

Discharge plume from offshore platform, Gulf of Mexico
(Source: E. Sisskin, Southern Alliance for Clean Energy)



Potential sources of emissions from offshore platforms

Oil spill, Platform A, 1969
(Source: University of California, Santa Barbara)

5

Feb 12, 2014 California Coastal Commisssion Report "Ocean Fracking"

Contaminate Migration Expected Under SB 4 "Well Stimulation Regulations" for California
https://www.indybay.org/newsitems/2014/02/06/18750410.php
by Tomas DiFiore *Thursday Feb 6th, 2014*

Frac ALERT for Coastal and Northern California Basin Aquifers
https://www.indybay.org/newsitems/2014/01/07/18748888.php
by Tomas DiFiore *Tuesday Jan 7th, 2014*

Eel River Basin Natural Gas and Fracking in Humboldt
https://www.indybay.org/newsitems/2013/12/23/18748316.php
by Tomas DiFiore *Monday Dec 23rd, 2013*

Tomas DiFiore POB 612 Little River, CA 95456 email: iamtomas@mcn.org