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(5/19/15) Public Workshop- Item 6  
Model Criteria for Groundwater Monitoring  
Deadline: 5/29/15 by 12:00 noon

May 29, 2015

Jeanine Townsend  
Clerk to the Board  
State Water Resources Control Board  
1001 I Street, 24th Floor  
Sacramento, CA 95814  
(Submitted electronically to [commentletters@waterboards.ca.gov](mailto:commentletters@waterboards.ca.gov))



**COMMENTS ON APRIL 29, 2015 STATE WATER RESOURCES CONTROL BOARD (SWRCB) "DRAFT MODEL CRITERIA FOR GROUNDWATER MONITORING IN AREAS OF OIL AND GAS WELL STIMULATION" (DRAFT CRITERIA)**

Dear Ms. Townsend and Board Members:

Thank you for the opportunity to comment on the Draft Criteria. Groundwater monitoring addressed by the Draft Criteria for oil and gas field stimulation sites is essentially Detection Monitoring, with the monitoring program intended to reliably detect possible groundwater quality impacts from oil and gas well stimulation. Having overseen groundwater monitoring programs at a variety of California polluted and potentially polluted sites for decades, I am familiar with many components and standards of a successful (and unsuccessful) groundwater monitoring program.

The Draft Criteria contains sections titled "1.0 Introduction", "2.0 Area-Specific Groundwater Monitoring", "3.0 Requirements for Designated Contractor Sampling and Testing" and "4.0 Regional Groundwater Monitoring Program". The section "2.0 Area-Specific Groundwater Monitoring" contains subsections "2.1 Groundwater Monitoring Where Protected Water is Present" and "2.2 Requests for Exclusion from Area-Specific Groundwater Monitoring Requirement". Specific comments below apply to Draft Criteria "2.1 Groundwater Monitoring Where Protected Water is Present". Other Draft Criteria sections are not specifically addressed herein.

GENERAL COMMENTS

Oil and gas well stimulation is sometimes conducted over large areas (square miles) and at great depths (miles), in rock with multiple aquifer zones, variable stratigraphy and structure, and oil and gas deposits, and where well stimulation has been conducted for many years. Monitoring cubic miles of subsurface involving multiple aquifer zones possibly already polluted by previous activities and with pressure gradients varying through time, for confident early detection of pollution from current well stimulation, is a major undertaking. For example, detection groundwater monitoring at well stimulation sites is far beyond the scope of detection groundwater monitoring at surface point sources such as waste impoundments or landfills where tens of monitoring wells might be necessary and monitoring costs can be tens or hundreds of thousands of dollars annually.

Groundwater monitoring terms specified by the Draft Criteria are coarse and rudimentary, and generally would not be considered capable of providing reliable early detection of pollution at sites much smaller and less complex than many oil and gas well stimulation sites. The proposed one upgradient and two downgradient wells with 50+ foot screen intervals and supply wells possibly substituting as monitoring wells hearken back to the 1970s infancy of groundwater monitoring at waste management unit sites. Those standards were far surpassed decades ago at even those surficial waste management unit sites that are relatively small and simple compared to subject oil and gas well stimulation sites.

In fact, one might infer the Draft Criteria rudimentary monitoring terms are an expression of the infeasibility of implementing an adequate monitoring program at most oil and gas well stimulation sites. That is, because it may be prohibitively expensive and difficult to properly monitor cubic miles of subsurface with multiple and variable aquifer

zones, variable stratigraphy and structure, variable pollution sources, variable pressure gradients and possible pre-existing pollution, the Draft Criteria apply little more than a façade of reliable groundwater detection monitoring.

That is not to say reliable groundwater monitoring at well stimulation sites is necessarily impossible or futile. Assuming technological and other obstacles could be overcome, reliable groundwater detection monitoring could theoretically be done everywhere stimulation fluids threaten groundwater: at the surface, in transport to and from the stimulation zone, and at the stimulation zone. All surface units with pollution potential, such as produced water ponds, could be monitored in the manner typical for waste management units, with multiple monitoring wells horizontally close to the unit and screened in uppermost groundwater and other saturated zones threatened by the unit. Groundwater penetrated by a pipe transporting stimulation fluid from the surface to the stimulation zone could be monitored by wells with multiple depth-discrete sampling devices. At a given elevation along a transport pipe, possibly only one sampling point would be needed, if close enough to the transport pipe to be impacted by any leakage. A dense array of monitoring wells could be placed just outside the stimulation zone (vertically and horizontally) to detect any fluid migration away from the zone. For a single stimulation site, this entire monitoring network might consist of ten or more wells at each surface pollution source, ten or more depth-discrete sampling points in each protected aquifer, and tens or more monitoring wells just outside the stimulation zone. This could total hundreds or more wells or sampling points per stimulation site, producing hundreds or more discrete samples per sampling event.

Because a reliable detection monitoring program at well stimulation sites is such an extensive and expensive undertaking, groundwater monitoring might not be the most effective and efficient means of detecting water pollution from well stimulation. Nevertheless, as stated repeatedly by the Draft Criteria, the legislature has mandated groundwater monitoring at well stimulation sites. Draft Criteria, page 4, bottom, states “*Area-specific groundwater monitoring shall be designed for early detection of potential impacts to protected water from well stimulation treatments.*” Thus, the question of whether groundwater monitoring at well stimulation sites is an efficient and effective means of detecting pollution is not discussed further herein, and it is given that the Draft Criteria is intended to provide reliable early detection of groundwater pollution from well stimulation.

#### SPECIFIC COMMENTS

1. The Draft Criteria does not appear to factor volumes and pressures of injected fluids into determinations of the number and locations of monitoring wells required.
2. The Draft Criteria does not clearly address or require site-specific monitoring for individual well stimulation sites (other than to mention it generally).
3. The Draft Criteria does not clearly address or require groundwater monitoring for potential release from surface impoundments or other surface features associated with well stimulation sites.
4. The Draft Criteria does not clearly address or require monitoring of surface water that could be polluted by recharge from groundwater polluted by well stimulation sites.
5. The Draft Criteria page 4 definition of “*Protected water for current and future beneficial use*” is not consistent with some beneficial use designations made by the State Water Resources Control Board and Regional Water Quality Control Boards, the entities mandated to make such designations in California. For example, the Central Coast Regional Water Quality Control Board designated all groundwater throughout the Central Coastal Basin, except the Soda Lake Sub-basin, as suitable for agricultural water supply, municipal and domestic water supply, and industrial use. This includes water with greater than 10,000 milligrams per liter (mg/L) Total Dissolved Solids (TDS), which the Draft Criteria excludes as protected water for current and future beneficial use, contrary to the Water Board designation. Also, as a practical matter, water with greater than 10,000 mg/L TDS can be, and in places is, desalinated to produce drinking water, so it also warrants protection from well stimulation pollution.

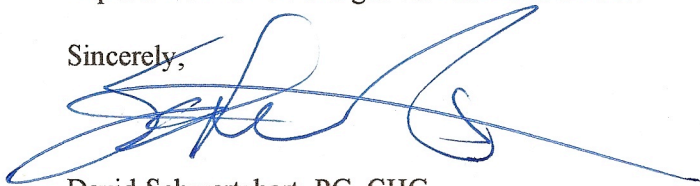
6. The Draft Criteria is not clear on how to differentiate a zone targeted for well stimulation from a protected water zone.
7. Draft Criteria, page 4, Section 2.1, second paragraph, last sentence statement "*The ASDA... of the subsurface area...*" (emphasis added) refers to a volume, not an area, and should state "volume" rather than "area".
8. Draft Criteria, page 5, top, discusses how to establish baseline water quality conditions, but is unclear how to establish baseline where well stimulation was done prior to current proposed well stimulation.
9. Draft Criteria, page 5, third paragraph states "*Water Board staff will evaluate data and statistical test results...*", however it is unclear how Water Board staff will get involved, particularly because well stimulation permits are issued by DOGGR.
10. Draft Criteria, page 5, fourth paragraph states water supply wells may be used as monitoring wells. For a variety of well established reasons, supply wells are generally unsuitable as monitoring wells, for example because the relatively high volume of water produced by a supply well might be comprised of enough unpolluted water to dilute and mask any polluted water present.
11. Draft Criteria, page 5, "*Number and Locations of Monitoring Wells*" states each protected aquifer penetrated by a stimulated well (or group of stimulated wells) shall be monitored by at least one upgradient and two downgradient wells. It is unlikely that three wells will be capable of reliable, early detection of pollutants because of the variability and complexity of all relevant factors and because of the great horizontal, and more importantly, vertical, extent of many protected aquifers. One of the reasons the three well minimum was adopted decades ago was because at least three points are necessary to define a plane, and thus grossly define flow direction. Also decades ago, though, the three well strategy was realized to be usually incapable of providing reliable, early detection of pollutants from relatively small, surface point sources such as waste management units, and current waste management unit groundwater detection monitoring programs almost invariably include many more than three wells. Well stimulation sites are generally much more complex and variable, and much more extensive horizontally and vertically, than waste management unit sites, and thus require much more extensive monitoring networks.
12. Draft Criteria, page 5, "*Number and Locations of Monitoring Wells*" states the three monitoring wells in a protected aquifer may be located up to 0.5 horizontal miles from the surface projection of the stimulation zone. Again, this is very coarse, does not consider many relevant factors such as pollutant migration paths from the stimulation zone to the protected aquifer, and does not consider leakage from stimulation well blank casing passing through the protected aquifer. Consider the scenario of a protected aquifer at 100 feet depth and a stimulation zone at 10,500 feet depth over a horizontal area of possibly a square mile. Locating two downgradient monitoring wells 0.5 mile downgradient of the stimulation zone surface projection and one upgradient well 0.5 miles upgradient of that square mile surface projection would result in three monitoring wells located up to 2 miles apart, a very coarse monitoring network indeed. Compound this with unknown migration paths from the stimulation zone through two vertical miles of variable stratigraphy and structure to the protected aquifer, and the failure to even consider monitoring well proximity to potentially leaking blank casing passing through the protected aquifer, and the three monitoring wells miles apart will have little more than incidental likelihood of detecting pollution from stimulation fluids, and certainly will not provide early detection.
13. Draft Criteria, page 5, "*Number and Locations of Monitoring Wells*" states monitoring wells may contain screen lengths "*preferably less than 50 feet*". 50+ foot screens generally do not provide depth discrete samples and can allow unpolluted water to dilute and mask small polluted zones. Ten foot screens (or less) are generally the current monitoring well standard.

14. Draft Criteria, page 5, "*Number and Locations of Monitoring Wells*", number 5, states a supply well must be accompanied by a sentry monitoring well. However, that section's introductory paragraph states a supply well might serve as a monitoring well. Those two statements are inconsistent.
15. Draft Criteria, Section 2.1.2 (page 6, et seq.) requires map submittals as part of groundwater monitoring plans. Although not specified, those maps should also include all local waste management units and other potentially polluting surface features (in addition to produced water ponds), existing monitoring wells, if any, and local surface water.
16. Draft Criteria, Section 2.1.2, 3.. i) (page 7) states a groundwater monitoring map must be submitted displaying potentiometric surface contours lines for each protected aquifer. The basis for those contours should also be described.
17. Draft Criteria, Section 2.1.2, 4. (page 7) and 5. (page 8) state at least two cross sections shall be submitted. At these large and variable sites, two cross sections will often be insufficient, and the number and extent of cross sections submitted should be based primarily on the size and heterogeneity of volumes and features depicted.
18. Draft Criteria, Section 2.1.2, 4., j) (page 7) should also include "*folds*".
19. Draft Criteria subsection m) at the top of page 8 states "...*that will function...*", but should state "...*that will or might function...*"
20. Draft Criteria, Section 2.1.2, 4. states required content of submitted cross sections. Those cross sections should also include high permeability zones that could allow pollutant migration, screen intervals of all wells, stratigraphy of all zones present, and extents and configuration of all actual and potential oil and gas deposits and production zones.
21. Draft Criteria, Section 2.1.2, 5. (page 8, et seq.) should also include proppants and all other stimulation fluid constituents not required elsewhere in the Draft Criteria, source and chemistry of water to be used in stimulation fluid, and all planned injection parameters such as pressures, volumes, durations, effects, etc.
22. Draft Criteria, Section 2.1.4 "*Reporting Requirements*" (pages 13 and 14) should also include data analysis (statistical and other methods and results to determine if pollution is detected) and proposed subsequent actions if pollution is detected. Note the top of page 5 requires such data analysis methodology to be included in the groundwater monitoring plan, but the data analysis is not required to be reported and should be.

## CONCLUSION

Reliable groundwater detection monitoring at oil and gas field stimulation sites is a major undertaking that might not be practicable or even technically feasible at many such sites. Many terms of the Draft Criteria are very coarse and rudimentary, and have little to no likelihood of providing reliable, early detection of possible groundwater quality impacts from an oil and gas well stimulation site.

Sincerely,



David Schwartzbart, PG, CHG