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VIA ELECTRONIC MAIL

June 30, 2015

Subject: Comments on the State Water Resources Control Board's Revised Draft Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation

The Western States Petroleum Association (WSPA) is a trade association that represents the majority of petroleum-related interests in the western United States. These interests include production, transportation, refining, and marketing of petroleum and petroleum-based products.

WSPA appreciates the opportunity to provide comments on the State Water Resources Control Board's (SWRCB's) Revised Draft Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation, dated June 23, 2015.

General Comment 1 – Perimeter groundwater monitoring would provide important benefits

Groundwater monitoring programs typically fall into two categories: compliance monitoring and detection monitoring. Compliance monitoring, which addresses a known release, is performed to evaluate whether a release has resulted in unacceptable impacts to groundwater and whether those impacts are physically spreading or stable.

In the case of compliance monitoring, groundwater monitoring wells are installed close to the known source. By contrast, detection monitoring is performed to evaluate whether a release to groundwater has occurred, and uses wells that are typically installed at an area boundary or perimeter.

As WSPA presented at the SWRCB's public workshop held on December 11, 2014 and included in our comments on February 4, 2015, in the case of WST, detection monitoring would provide a perimeter well network for long-term groundwater monitoring to ensure zonal isolation. Such an approach would be commensurate with the very low risks associated with WST.

Recommendation

WSPA recommends the Board incorporate language into the Model Criteria that allows the use of perimeter monitoring. The final Model Criteria should clearly identify and define the use of a

perimeter monitoring approach that would satisfy the requirements in SB 4. This acknowledgement of perimeter monitoring is critical for areas where there is a large number of WST wells located in proximity to each other and that penetrate the same aquifers, in order to avoid unnecessary monitoring wells. The final Model Criteria should provide flexibility with respect to the placement of monitoring wells around the perimeter of a group of closely co-located WST wells.

General Comment 2 – Concurrence of exclusion based on absence of protected water should not be revisited

Section 2.2 of the Revised Draft Model Criteria states as follows:

Written concurrence issued prior to the date of adoption of the Model Criteria for Groundwater Monitoring by the State Water Board are effective only for well stimulation permits issued by DOGGR prior to that date.

This language indicates that previously granted written concurrences would no longer be valid. Considerable effort by Water Board staff and operators has gone into the preparation and approval of concurrence packages. Starting over on these concurrences is unnecessary because groundwater quality and the absence of protected water would not have not changed.

Confirmation of a proposed well's location within an area with written concurrence should be expected, however preparation and processing of duplicative concurrences will monopolize valuable staff time and resources.

Recommendation

WSPA recommends striking from the Model Criteria the requirement to resubmit previously approved concurrences. The Model Criteria should state that once written concurrence of exclusion due to the absence of protected water is obtained from the Water Board staff for a geographic area, this geographic area will be considered excluded going forward, and that additional application for exclusion is not needed each time a future WST is proposed in the same geographic area.

General Comment 3 – Definition of protected water should include a yield criterion

The previous version of the Draft Model Criteria, dated April 29th, 2015 (“the Draft Model Criteria”) defined protected water as follows:

- Water with less than 10,000 milligrams per liter (mg/L) of total dissolved solids (TDS);
- Within an aquifer of sufficient volume (yields more than 200 gallons per day); and
- Outside an exempt aquifer (pursuant to the Code of Federal Regulations, title 40, part 146.4).

The definition of protected water in the Revised Draft Model Criteria (Section 2.1) was changed relative to the Draft Model Criteria in that the criterion of sufficient yield has been removed. The ability to sustain a reasonable yield of groundwater is a standard and important consideration in the evaluation of groundwater resources.

The SWRCB's Resolution 88-63 established exceptions to groundwater suitability or potential suitability, including a minimum sustained yield criterion of 200 gallons per day for a single well. In the absence of a groundwater yield criterion, aquifers that cannot be reasonably used for water supply would be considered as protected.

Recommendation

WSPA recommends that the final Model Criteria include the minimum yield criterion as a key factor defining protected groundwater.

General Comment 4 – Groundwater monitoring plan review should be concurrent with stimulation permit review

The Revised Draft Model Criteria require certain information in the groundwater monitoring plans that would not be available prior to DOGGR approval of the WST permit application. For example, items 4h and 4j of Section 2.1.2 require the operator to include the "DOGGR-approved ADSA" [axial dimensional stimulation area] for stimulated zones and stages.

Item 9 of Section 2.1.2 requires information about the WST well(s), such as American Petroleum Institute (API) identification numbers, geophysical logs, casing diagrams, wellbore paths, etc.

These requirements seem to indicate that the WST application will need to be approved by DOGGR, and WST wells will have to be installed, prior to the preparation and submittal of a groundwater monitoring plan. This requirement is impractical and burdensome. Sequential approval by DOGGR and the Water Boards would result in substantial delays in the planning and implementation of WST projects.

Recommendation

WSPA recommends that the Board incorporate language into the Model Criteria that allows the parallel submittal and concurrent processing of a WST permit application to DOGGR and a groundwater monitoring plan to the Water Board for a given WST project. The operator should be able to submit a groundwater monitoring plan with a proposed ADSA, pending approval of the proposed ADSA by DOGGR.

General Comment 5 – Real-time monitoring of WST wells should be used to evaluate monitoring needs

The parameters monitored during a WST are the best indicators of the potential for loss of fluid containment related to WST, and therefore the best predictor of potential fluid migration to a protected aquifer. As such, they should be used as criteria for frequency, location/depth, and duration of monitoring. DOGGR regulations require the monitoring of the stimulation well during WST.

A stimulation stage takes place over a short duration. Detailed, real-time measurements of pressure, volume, and flow rate of the WST fluid during the time that the well is being stimulated will be collected and reported for every stimulation performed in California.

In the event that anomalous conditions, such as a pressure drop or an unexpected increase in WST fluid flow rate are detected, the operator is required to immediately discontinue the injection. In most cases, an automatic shut-off occurs, significantly limiting fluid volumes that are

pumped after the event. The operator can detect and locate a well casing breach in real time, and to within a few vertical feet.

Therefore, real-time monitoring of the WST well provides by far the best indication of a potential release of WST fluids through a casing breach and can provide a direct indication of the need for additional groundwater monitoring and the depth at which monitoring should take place.

The need for, and the importance of, real-time monitoring of WST wells was stressed by the Groundwater Resources Association of California (GRA) in their May 29, 2015 comment letter on the Draft Model Criteria. The GRA is a highly respected, nonprofit, statewide, volunteer organization with over 1,400 practicing scientists, engineers and other professionals with groundwater expertise.

The GRA helps formulate statewide policy on the development, management, and protection of California's groundwater resources. In their comment letter, the GRA questions the usefulness of a prescriptive, one-size-fits-all monitoring approach, and instead recommends that monitoring be implemented in the event that real-time WST monitoring indicates a release:

We believe a more appropriate method would be to closely monitor the well stimulation activities themselves. If an accident or release occurs, either at the land surface, or in the annular seal or vertical pipe, or in the stimulation zone itself, or through a nearby conduit such as abandoned well or fault zone, then a proper groundwater monitoring program could be designed and implemented around that release point to track the movement of the release and obtain the necessary data to design the most effective remediation or containment system in consultation with the Water Boards.

However, WST well monitoring during injection is not mentioned in the Revised Draft Model Criteria. The Revised Draft Model Criteria do not take advantage of this real-time monitoring. Real-time WST monitoring provides technically sound input to evaluate risk to protected groundwater and the need for additional groundwater monitoring wells, and is also far more effective in determining whether a leak of WST fluids has occurred, hence allowing the operator to respond immediately.

The Revised Draft Model Criteria require that if multiple protected aquifers are penetrated, each aquifer needs to be monitored separately. Depending on the interpretation, the mandate could result in multiple monitoring wells for each WST, without consideration of risk, and without providing any additional environmental protection.

Given that the potential source of contaminants is the zone of stimulation, it would logically follow that the deepest protected aquifer would provide the first indication that there is a lack of zonal isolation, which could trigger additional monitoring. Data from WST wellbore monitoring should be used to evaluate the need for groundwater monitoring in aquifers other than the aquifer nearest to the WST injection.

Recommendation

WSPA recommends that the final Model Criteria incorporate WST wellbore monitoring to evaluate the need for groundwater monitoring. In particular, the need for monitoring of multiple protected water aquifers should be based on WST wellbore monitoring results. The monitoring of multiple aquifers other than the aquifer closest to the WST injection zone, should not be required unless WST wellbore monitoring indicates a release due to casing failure.

General Comment 6 – The Model Criteria should specify a groundwater monitoring plan review period

The Revised Draft Model Criteria do not specify a regulatory process and schedule for Board review of groundwater monitoring plans. The final Model Criteria should provide a timeframe for a regulatory review process to allow operators to plan stimulation and production activities. This review period should coincide and be bounded within the DOGGR permit review period.

General Comment 7 – Monitoring of aquifers that are not penetrated by the WST well should not be required

The Revised Draft Model Criteria (Item 2, Page 9) require the monitoring of aquifers that are *not* penetrated by the WST well. There is no technical justification for this requirement. This requirement should be struck from the Model Criteria.

SPECIFIC COMMENTS

Specific Comment 1 – Recommended changes to Model Criteria Section 2.1.1

WSPA recommends the following changes to the Revised Draft Model Criteria text in Items 1 and 2 of Section 2.1.1 to address concerns expressed in General Comments (text changes as underline/strikeout):

1. At a minimum, ~~one upgradient and two downgradient~~ monitoring wells will be required for each ~~aquifer containing protected water that is penetrated by the stimulated well, or group of stimulated wells.~~ Monitoring wells shall be installed in the aquifer zone closest to the zone of injection. ~~Monitoring wells completed in each aquifer shall be constructed in similar zones of the aquifer, with similar construction details.~~ Groundwater monitoring wells shall be located within 0.5 mile of the surface projection of zones of stimulation the well 2xADSA or the perimeter of a group of wells being stimulated, provided permission to install and sample wells is granted by the landowner(s). The operator must demonstrate an understanding of the groundwater flow direction in the area of the WST.

2. When multiple protected aquifers are present, ~~each~~ the protected aquifer nearest the WST zone of stimulation activities shall be monitored separately. ~~For each aquifer containing protected water located within 0.5 mile of the surface projection of the zone(s) of stimulation that is not penetrated by the well to undergo well stimulation, at least one monitoring well is required.~~

5. For any drinking water supply well located within one mile and downgradient of the surface projection of the zone(s) of stimulation, a sentry monitoring well shall be located between the stimulated well(s) and the drinking water supply well. The sentry monitoring well shall be located within 0.5 mile of the surface projection of ~~the zone(s) of stimulation~~ the well 2xADSA or the perimeter of a group of wells being stimulated, provided permission to install and sample wells is granted by the landowner(s). If the drinking water supply well is screened across multiple protected water aquifers, then ~~each~~ the protected water aquifer that is at highest potential risk due to WST activities shall have a sentry monitoring well separately. In some cases, one sentry monitoring

well may be used to monitor multiple drinking water supply wells. Monitoring wells, as described above, may act as the sentry well.

Specific Comment 2 – Recommended changes to Model Criteria Section 2.1.2, Item 1, Page 10

WSPA recommends the following changes to the Revised Draft Model Criteria (text changes as underline/strikeout):

1. A map of the oil field area to be covered by the groundwater monitoring plan and with a 0.5 mile buffer surrounding the oil field covered area ~~and any oil and gas wells located outside of the oil field boundary~~, that shows, at a minimum, the following:

This proposed revised language meets the true spirit of an area-specific groundwater monitoring plan. The proposed language greatly reduces the administrative burden on both the State Water Board and the operator, while providing equivalent environmental protection.

Specific Comment 3 – Recommended changes to Model Criteria Section 2.1.2, Addendum to an Approved Groundwater Monitoring Plan, Page 14

WSPA recommends the following changes to the Revised Draft Model Criteria (text changes as underline/strikeout):

An area-specific groundwater monitoring plan applies only to the stimulation well(s) identified by the operator in the areas identified in its proposal and approved by Water Boards staff. Where an operator proposes to stimulate additional wells ~~in an area outside the area~~ that has been approved by the Water Boards staff for area-specific groundwater monitoring based on these Model Criteria, the operator is required to submit an addendum to the approved area-specific groundwater monitoring plan that includes, at a minimum, the following:

This proposed revised language meets the true spirit of an area-specific groundwater monitoring plan, and would measurably reduce the administrative burden on both the State Water Board and the operator, while providing equivalent environmental protection.

Specific Comment 4 – Recommended changes to Model Criteria Section 2.1.3

WSPA recommends the following changes to the Revised Draft Model Criteria (text changes as underline/strikeout):

Collect samples before well stimulation. Following well stimulation, area-specific groundwater monitoring wells shall be placed on a semi-annual monitoring schedule, or an alternate schedule depending on site-specific conditions.

This language would provide flexibility relative to the monitoring frequency based on case-specific conditions.

Specific Comment 5 – Section 2.1.3 Sampling and Testing Requirements

Groundwater monitoring analytes are presented in Appendix B of the Revised Draft Model Criteria. The analyte list, which is extensive, is presented in two parts. The first part (Table B1) requires the analysis of 73 analytes on a routine basis. The second part (Table B2) requires the analysis of additional compounds in the event that concentrations of analytes listed in Table B1 indicate potential impact from WST.

The 73 analytes listed in Table B1 include a wide range of general groundwater parameters, indicators of petroleum hydrocarbons, indicators of WST fluids, and other parameters that are not direct indicators of petroleum hydrocarbons or WST fluids. In their comment letter, the GRA also questions the large number of analytes proposed in the Draft Model Criteria:

*The extensive list of analytes appears **overly broad for the intended monitoring purposes**. In addition, some of the requested analyses are unique, costly and performed at specialty laboratories. **It is suggested that the list of analytes be reduced to key compounds that are persistent, mobile, and associated with the well stimulation program** that will indicate if the stimulation fluids have impacted overlying groundwater aquifers. (Emphasis added.)*

The analyte list for routine monitoring should be substantially reduced and focused on analytes and parameters that will serve as the best indicators of potential impacts from stimulation treatment. The evaluation of analytical results needs to be considerate of the many geochemical changes that can occur naturally (e.g., due to seasonal groundwater fluctuations) or as a result of impacts unrelated to WST.

Recommendation

WSPA recommends the following list of recommended analytes and parameters, and the justification for their selection.

pH – A geochemical master variable and reflects general changes in water composition. The pH of oil formation fluids and brines is likely to differ from the pH of the overlying groundwater. pH is easily measured in the field and can be used as field screening parameter.

Total dissolved solids (TDS) and specific conductance –TDS is the primary drinking water quality parameter. TDS could be used as an indicator of the potential impact from high-TDS WST fluids or formation fluids. TDS is stable and not significantly affected by biological, physical or chemical degradation/attenuation. Specific conductance is a proxy for TDS. It is easily measured in the field and could serve as a field screening parameter during post-WST events to evaluate the need for the analysis of additional parameters.

Total petroleum hydrocarbons (TPH) – TPH is a primary indicator of the presence of crude oil. However, TPH results need to be carefully interpreted because (a) TPH is naturally present in groundwater in certain areas due to seeps or co-occurrence of oil and groundwater, and (b) TPH may be present due to non-WST impacts, such as surface spills of fuel products.

Benzene, toluene, ethylbenzene, and toluene (BTEX) – BTEX includes components of TPH with stringent regulatory drinking water standards. Low BTEX detection limits would allow for early indication of TPH presence but may also indicate the presence of non-WST impacts.

Metals and metalloids – Concentrations of certain metals are elevated in formation brine. Boron, barium and strontium are particularly good indicators. Some metals are indicators of changing redox conditions that may result from the presence of crude oil. However, care should be taken to account for natural geochemical cycles that can affect concentrations of redox-sensitive metals. High background concentrations of metals are present in many areas of California (e.g., arsenic, cadmium) and should be documented in pre-WST sampling.

Major Ions – Flowback and produced water tend to contain higher concentrations of sodium, chloride, and iodide than fresh water. Anion/cation ratios are useful to evaluate potential changes in groundwater composition, and help distinguish natural (e.g., seasonal) fluctuations in groundwater composition. Bromide and iodide are particularly useful in evaluating the potential presence of oil formation water/brine.

Guar gum sugars – Guar gum, a non-toxic food product, is often used as a gelling agent in WST fluids. It is usually included at a relatively high concentration as compared to other WST fluid constituents. Detection of carbohydrates in groundwater may be indicative of the presence of WST fluids.

If concentrations of one or more of the above analytes indicate potential impact from a stimulation treatment, the analytical list would be expanded to include additional compounds that are used in WST. However, the compounds need to be selected on a case-specific basis because the composition of WST fluids varies from stimulation to stimulation.

WSPA appreciates the opportunity to work with the Board and staff on this important issue. We look forward to continuing these efforts, and reviewing staff's response to stakeholder comments.

Sincerely,

A handwritten signature in cursive script that reads "Robert W. Poole".