Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation

Reporting Period: January 1, 2020 through December 31, 2020

STATE WATER RESOURCES CONTROL BOARD

April 14, 2021

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GLOSSARY

Area-specific Groundwater Monitoring Plan (GMP) – A groundwater monitoring plan submitted by the oil and gas field operator to characterize baseline water quality conditions and detect potential impacts to protected water from well stimulation treatments. A GMP may be developed for a stimulated well or group of stimulated wells. The GMP should describe the groundwater monitoring design, as well as proposed groundwater sampling and analytical testing. An operator may propose additional wells to stimulate in an area where a GMP has been approved by State Water Board and Regional Water Quality Control Board (collectively Water Boards) staff (addendum).

Axial Dimensional Stimulation Area (ADSA) – The estimated maximum length, width, height, and azimuth of the area(s) stimulated by a well stimulation treatment (WST) (California Geologic Energy Management Division [CalGEM] Well Stimulation Treatment Regulations, July 1, 2015). CalGEM approves or denies the ADSA as part of the well stimulation permitting process. After approval of the ADSA, a well stimulation permit may be issued to an operator; however, stimulation cannot occur until State Water Resources Control Board (State Water Board) staff has approved either a groundwater monitoring plan or request for exclusion from groundwater monitoring associated with the permitted well(s).

Designated Contractors – State Water Board is required to designate one or more qualified independent third-party contractors to perform property owner requested water quality sampling and testing (Pub. Resources Code, §3160, subdivision (d)(7)(B)), which interested parties must submit an application to be approved. The designated contractor must not work for or be affiliated with an oil and gas operator. A list of approved designated contactors is maintained by the State Water Board.

Exempted aquifer – As defined in 40 Code of Federal Regulations (CFR) part 146.4, an aquifer or a portion thereof which meets the criteria for an underground source of drinking water that:

1) 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.

Refer to 40 CFR part 146.4 for regulation specifics.

Groundwater Monitoring – Monitoring of protected water in a specific area to characterize baseline water quality conditions and to assess potential effects to beneficial use waters from well stimulation treatment activities (i.e., monitoring well sampling and gauging of water levels).

Interim Groundwater Monitoring Plan (interim GMP) – GMP approved during the interim period (January 1, 2014 – July 6, 2015) prior to the State Water Board adoption of the Model Criteria.

Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation – Outlines the methods to be used for assessment, sampling, analytical testing, and reporting of water quality associated with oil and gas well stimulation treatments. Adopted by the State Water Board July 7, 2015.

Performance Measures – Performance measures are a means to evaluate the effectiveness and efficiency of the Model Criteria. Five (5) goals were developed through a process of meetings with stakeholder groups. Performance measures are included in the *Model Criteria for Groundwater Monitoring in Areas of Well Stimulation: Summary of Goals, Strategies, Proposed Performance Measures, and Plans for Implementation* (March 1, 2016).

Protected Water – Water with less than 10,000 milligrams per liter of total dissolved solids and located outside an exempt aquifer (meeting the criteria of 40 CFR part 146).

Regional Groundwater Monitoring Program (RMP) – As required by Senate Bill 4 (Statutes of 2013), and detailed in the Model Criteria, the State Water Board is to implement an oil and gas RMP in order to protect all waters designated for any beneficial use, while prioritizing the monitoring of groundwater that is or has the potential to be a source of drinking water. Factors considered for the RMP include well stimulation treatments, among other events or activities that have the potential to contaminate groundwater. The U.S. Geological Survey is the technical lead on the RMP.

Request for Exclusion from Area-Specific Groundwater Monitoring– A document submitted by the oil and gas field operator to request exclusion from groundwater monitoring before proceeding with well stimulation activities. Water Boards staff must provide a written concurrence to the operator for the exclusion from groundwater monitoring. Additionally, operators can submit requests to add wells to an existing exclusion. Specific submission requirements are provided in the Model Criteria.

Well stimulation treatment (WST) – A treatment procedure for a well to enhance production by increasing the permeability of the formation. WSTs include, but are not limited to, hydraulic fracturing treatments and acid well stimulation treatments.

FracFocus – FracFocus is the national hydraulic fracturing chemical registry, which is managed by the Ground Water Protection Council (non-profit organization) and the Interstate Oil and Gas Compact Commission (multi-state government entity)

Submittal Status:

Approved - Submittal was reviewed and has met the requirements of the Model Criteria.

Denied - Submittal did not meet the minimum requirements of the Model Criteria.

Cancelled - Submittal was retracted by the operator or review discontinued by State Water Board.

Review in Progress - Submittal is being reviewed by Water Boards staff.

On Hold - Water Boards staff are not currently reviewing the submittal. Submittals may be put “On Hold” for the following reasons:

- Comments have been forwarded to the operator and the operator is working on a revised submittal.
- Water Boards staff are awaiting approval of the Axial Dimensional Stimulation Area (ADSA) from CalGEM.
- The submittal is on hold at the request of the operator.

ABBREVIATIONS AND ACRONYMS

ADSA	Axial Dimensional Stimulation Area
Annual Model Criteria Performance Report	2020 Annual Performance Report: Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation
bbl	barrel(s) of oil
CalGEM	California Geologic Energy Management Division
Central Valley Water Board	Central Valley Regional Water Quality Control Board
CIPA	California Independent Petroleum Association
COGG	United States Geological Survey California Oil, Gas, and Groundwater Program (see RMP)
GeoTracker	GeoTracker Information System
GMP	Area-specific groundwater monitoring plan
GMR	Area-specific groundwater monitoring report associated with GMPs
MCL	maximum contaminant level
Model Criteria	Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation
neighbor notification	CalGEM Well Stimulation Treatment Neighbor Notification Form
operator	oil and gas field operator
RMP	Regional Monitoring Program (see COGG)
Regional Water Board	Regional Water Quality Control Board
Reporting period	January 1, 2020 - December 31, 2020
State Water Board	State Water Resources Control Board
USGS	United States Geological Survey
Water Boards	State Water Resources Control Board and Regional Water Quality Control Boards
WellSTAR	Well Statewide Tracking and Reporting System
WSPA	Western States Petroleum Association
WST	Well Stimulation Treatment

1.0 INTRODUCTION

This Annual Performance Report summarizes work performed from January 1, 2020 through December 31, 2020 (reporting period) by staff from the State Water Resources Control Board (State Water Board) and associated agencies to implement the *Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation* (Model Criteria).

State Water Board developed the Model Criteria to guide the process for assessing potential effects of well stimulation treatments (WSTs) on California's groundwater resources. It outlines groundwater monitoring requirements for area-specific groundwater monitoring conducted by oil and gas operators (operators), as well as the approach State Water Board staff will take to conduct a Regional Monitoring Program (RMP).

A WST cannot be performed until staff from the State of California Department of Conservation, California Geologic Energy Management Division (CalGEM) issues a WST permit and the State Water Board and the Regional Water Quality Control Board (Water Boards) staff have:

- approved an operator-submitted groundwater monitoring plan (GMP), or
- approved an operator-submitted request for exclusion from groundwater monitoring.

If the operator proposes WST for additional wells in an area where an GMP or exclusion was previously approved, an addendum to the GMP (hereafter referred to as addendum) or a request to add wells to an existing exclusion is required.

The requirement for a GMP is limited to areas where protected water is present. Protected water is defined as:

- Water with less than 10,000 milligrams per liter (mg/L) of total dissolved solids, and
- Water located outside of an exempt aquifer (meeting the criteria of 40 Code of Federal Regulations (CFR) part 146.4).

Efforts performed by Water Boards staff for implementation of the Model Criteria during the reporting period are presented in six sections of this report. Please note that URLs for hyperlinks can be found in the Web Link Glossary (Appendix A).

1.1 Background

Senate Bill 4 (Pavley, statutes of 2013) required the State Water Board to establish and implement a comprehensive regulatory groundwater monitoring and oversight program for WSTs (including hydraulic fracturing) in areas of oil and gas operations (California Water Code section 10783). The State Water Board was also required to develop a "model criteria" for groundwater monitoring to assess potential effects of WSTs on California's groundwater resources. The Model Criteria was adopted by the State Water Board on July 7, 2015 (Resolution No. 2015-0047). It outlines requirements for groundwater monitoring conducted by operators, as well as the approach the State Water Board will take to conduct the RMP.

Prior to the Model Criteria CalGEM developed Emergency Interim Regulations which included groundwater monitoring requirements. The interim regulations were effective from January 1, 2014 to June 30, 2015, operators were required to submit either an approved groundwater monitoring plan (interim GMP) or a letter from State Water Board staff concurring that the well(s) planned for WST does not penetrate protected water. If no additional WSTs were planned in an area with an approved interim GMP, the operator continued monitoring under the interim GMP. Several interim and Model Criteria GMPs were active during this reporting period. Data from both are uploaded to the State Water Board's GeoTracker information system (GeoTracker).

The performance measures were presented to the State Water Board on March 1, 2016 and included goals, strategies, and plans for implementing the Model Criteria and are found in Appendix B. The State Water Board *Model Criteria for Groundwater Monitoring in Areas of Well Stimulation: Summary of Goals, Strategies, Proposed Performance Measures, and Plans for Implementation* (Performance Measures) specifies that the State Water Board prepare and make publicly available an "Annual Model Criteria Performance Report."

Five performance measures were identified, as provided below:

1. Provide transparent and availability of online information and documentation
2. Provide clear milestones and timely deliverables
3. Understand and mitigate impacts of well stimulation on water quality and public health
4. Provide region-specific or localized flexibility, where possible
5. Assess implementation costs

2.0 AREA-SPECIFIC GROUNDWATER MONITORING

Well stimulation permits are required prior to performing WSTs. The number and status of well stimulation permits can be found on the CalGEM Well Statewide Tracking and Reporting (WellSTAR) website. Effective December 17, 2019, the public can use WellSTAR to find information about WST permits and disclosures.

A GMP is required where protected water is present. If the operator proposes WST for additional wells in an area where a GMP is approved, then an addendum to the GMP is required. A GMP is required unless an operator can make a technical demonstration that the wells to be stimulated do not penetrate protected water. An exclusion from groundwater monitoring requirements may be granted if Water Boards staff concur with the absence of protected water. Operators must obtain approval for additional WST wells to be stimulated in an existing exclusion from groundwater monitoring. Process flowcharts for Water Board staff review of Area Specific Monitoring Program submittals can be found on the Additional Resources webpage.

Operators are required to submit groundwater monitoring data from groundwater monitoring wells sampled as part of GMPs to GeoTracker as Groundwater Monitoring Reports (GMRs) once a GMP is approved. Water Boards staff review GMRs and provide comments to operators

via comment letters that are also archived in GeoTracker. A summary table of the 2020 information is provided below:

2020 Summary Table: Submittals and Review Timeline Milestones

Type of Submittal	Approved	Denied	Review in Progress / On Hold	Cancelled	Total	Average Review Time (days)	*Total No. of Approved WST Wells*
GMPs	2	0	1	1	**4**	**122**	**10**
Addenda	7	0	3	0	**10**	**198**	***60***
Requests for Exclusions	1	0	2	0	**3**	**41**	**-**
Requests to Add Wells to an Existing Exclusion	20	0	3	0	**23**	**50**	***60***
Note – Approved requests for exclusion do not include specific WST wells							

2.1 Groundwater Monitoring Plans

Water Boards staff reviewed four GMPs and ten addenda during the reporting period. The status of GMPs and addenda and Water Boards staff timeline of review are summarized in Appendix C Tables 1 and 2, which provide details of review timeline milestones and all submittals reviewed. The locations of GMPs and addenda submitted, and wells stimulated in 2020 are shown in Figure 1. GMP and addenda reviewed during the reporting period were in the following counties and oil fields:

- Kern County – Elk Hills, Lost Hills, Buena Vista (Nose), and South Belridge
- Kings County – Kettleman North Dome

Process and Timeline for Reviewing Groundwater Monitoring Plans

Water Boards staff conduct a completeness check to verify all required information once a GMP or addendum has been uploaded to GeoTracker. The document is then accepted into GeoTracker and the review is initiated. Water Boards staff develop comments to obtain additional information from the operator. If Water Boards staff provide comments or deny a GMP and the operator chooses to pursue WST, the operator is required to submit a revised GMP or addendum. The Axial Dimensional Stimulation Area (ADSA) must be approved by CalGEM before a GMP or addendum can be approved. When submittals are placed “On Hold”, that time is not included in the calculation of total review time. The time for Water Boards staff to complete review of operator submittals of GMPs and addenda during the reporting period is summarized in Tables 1 and 2.

Groundwater Monitoring Plans Submitted that Propose Alternative Methods

The Model Criteria allows Water Boards staff to consider proposed alternatives and modifications to the methods for GMPs based on factors such as site-specific conditions (e.g., terrain, geology, access), number and depth of aquifers containing protected water, potential

pathways, and risk to receptors (e.g., groundwater resources). Water Boards staff shall provide at least fifteen days notice and an opportunity for public comment on the proposal prior to approving a proposed alternative or modification.

State Water Board staff did not receive an alternative proposal for groundwater monitoring in 2020.

2.2 Requests for Exclusion and Added Wells

Water Boards staff reviewed three requests for exclusion and 23 requests to add wells to an existing exclusion (added wells). The status of requests for exclusion and added wells are summarized Appendix C, Tables 3 and 4 which provide details of review timeline milestones and all submittals reviewed. The locations of these submittals, as well as wells stimulated in 2020 are shown in Figure 2. Locations for requests for exclusion and added wells are from GeoTracker while locations of wells stimulated are from WellSTAR. All requests for exclusion and added wells reviewed were in the following county and oil fields:

- Kern County – South Belridge, North Belridge, McKittrick, and Elk Hills

Process and Timeline for Reviewing Requests for Exclusion

Water Boards staff conduct a completeness check to verify all required information once a request for exclusion or added wells has been uploaded to GeoTracker. Then the document is accepted into GeoTracker and the initial review is initiated. Comments are developed to obtain additional information from the operator. After staff have completed their review, initial comments are forwarded to the operator, the request for exclusion may be approved, or the request for exclusion may be denied. When submittals are placed “On Hold”, that time is not included in the calculation of total review time. Request for exclusion approval does not depend on CalGEM approving an ADSA but is based solely on whether sufficient technical information was submitted to clearly demonstrate the absence of protected water. The time for Water Boards staff to review of requests for exclusion and added wells submittals during the reporting period is summarized in Appendix C, Tables 3 and 4.

3.0 PROPERTY-OWNER NOTIFICATIONS AND REQUESTED WATER SAMPLING

Operators are required to hire an independent third-party to notify property owners, or tenants of a property, located within 1,500 feet of the well to be stimulated or within 500 feet of the surface representation of the horizontal path of the area of stimulation. CalGEM is responsible for maintaining records regarding the third-party notification process. The third party sends the property owners or tenants a Well Stimulation Treatment Neighbor Notification Form (neighbor notifications), which includes information such as the earliest date the well may be stimulated and how the property owner may request water quality testing on an existing water well or surface water suitable for drinking. Additional information regarding this process can be found on the CalGEM Well Stimulation Treatment Neighbor Notification and Water Sampling webpage. As of October 29, 2019, neighbor notification forms must be submitted through the WellSTAR electronic database. CalGEM staff provided the count of neighbor notifications sent

to property owners by operators on January 27, 2021. Historical notification counts are found in Appendix C, Table 5 and the 2020 notifications are summarized below:

- Aera Energy, LLC – 73
- Chevron USA, Inc – 27

State Water Board staff maintain a List of Designated Contractors for Water Sampling (designated contractor) to perform property owner requested water quality sampling. Once a property owner has received a notification regarding WST from an operator, the property owner may choose a designated contractor to perform water quality sampling. Designated contractors are required to notify State Water Board staff prior to sampling and upload the results to GeoTracker after analysis. During 2020, State Water Board staff did not receive any notifications of water sampling requests.

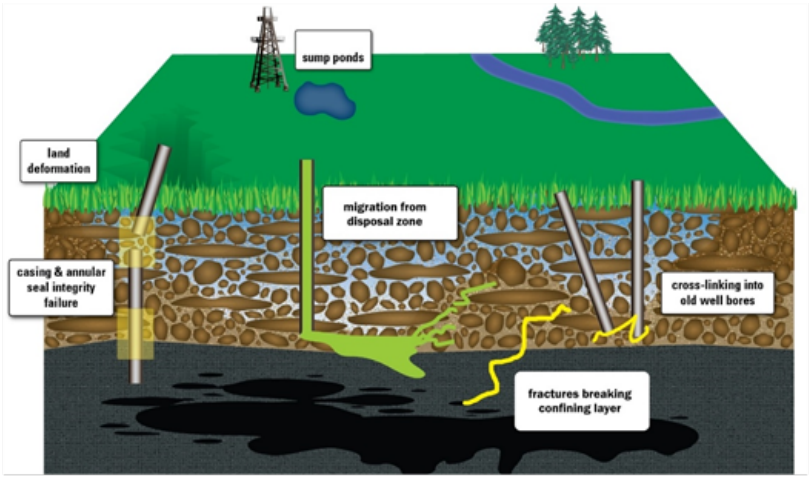
4.0 ASSESS IMPLEMENTATION COSTS

State Water Board staff, in cooperation with operators and representatives, from California Independent Petroleum Association (CIPA) and Western States Petroleum Association (WSPA), developed a list of information needed to assess operator costs. CIPA, in collaboration with WSPA, used a third-party aggregator to collect and report operator costs associated with the implementation of the Model Criteria. In 2020, the estimated cost for operators to perform tasks associated area-specific monitoring and the Regional Monitoring Program was $1,092,140 and $135,700, respectively. These costs are described in detail in Appendix C, Table 6.

Water Boards have a total of 14 staff positions dedicated to WST activities budgeted at $2.45 million per year; the RMP has a budget of $7.4 million per year. Both are funded through the Oil, Gas, and Geothermal Administrative Fund.

5.0 REGIONAL MONITORING PROGRAM

The goal of the RMP is to evaluate potential impacts from WST and oil field operations, and to characterize the risk to water designated for any beneficial use (e.g., drinking water), while prioritizing the highest areas of risks to be monitored. The RMP evaluates pathways (see illustration below) by determining which WSTs and other oil and gas operations have the potential to contaminate groundwater. Potential pathways include the injection of water and/or steam during enhanced oil recovery practices, underground oilfield water injection, leakage along improperly constructed and/or compromised wells, surface disposal ponds, or natural geologic sources.



Potential Pathways between Oil & Gas Activities and Protected Groundwater
(Source: USGS, https://ca.water.usgs.gov/projects/oil-gas-groundwater/science/pathways/)

The United States Geological Survey (USGS) is the technical lead of the RMP, which the USGS refers to as the California Oil, Gas, and Groundwater (COGG) Program. The approach used by the USGS includes: 1) mapping groundwater salinity, 2) characterizing and monitoring groundwater in wells near oil fields, and 3) characterizing oilfield fluids. Together, with site-specific information about the local geology, hydrology, and historic disposal areas, this approach helps to systematically and comprehensively collect and interpret information that will help support the protection of beneficial use water in California.

USGS and State Water Board staff selected study areas using results from the prioritization analysis (Davis and others, 2018, Appendix D). Well depth and water chemistry data were compiled into numerical databases for use in the regional analyses. Work then began in each of these study fields on one or more of four major tasks and a summary of tasks conducted as of 2020 for each oil field is presented in Appendix D:

1) Salinity mapping
2) Groundwater sampling
3) Oilfield fluid sampling
4) Interpretative analysis of the collected data from tasks 1 through 3 in each of these selected fields.

For tasks 2 and 3, the USGS identified suitable locations of groundwater wells, as well as oil production wells and injection well sites that met water and fluid sample criteria for the RMP. Once the well locations were determined, the USGS worked with oilfield operators to obtain access to collect samples. Samples collected include thirty-eight water supply and monitoring wells in five study areas and fifteen oil-field fluid sample sites in two study areas. Additional groundwater and oilfield fluid sampling planned in 2020 had to be rescheduled for 2021 due to the COVID-19 pandemic. State Water Board staff hosted a public meeting on August 12, 2020, where USGS presented an update on RMP activities and findings.

5.1 Regional Monitoring Program Published Results and Findings-2020

A focus of RMP efforts in 2020 was a USGS publication of results from the Lost Hills and Belridge oilfield study area. Complete references to USGS publications are available in Appendix D. The observations below summarize results from publications in 2020.

- Ball et al., 2020. "Probabilistic categorical groundwater salinity mapping from airborne electromagnetic data adjacent to California's Lost Hills and Belridge oil fields"
    - Airborne electromagnetic surveys near the Lost Hills and Belridge oil fields show a layered salinity structure with shallow saline water overlying the fresher Tulare aquifer separated by a clay layer. Study results showed zones of saline water downgradient of produced water disposal ponds and other areas affected by natural or unknown sources. Downgradient of unlined surface water canals, there is fresher groundwater. This study did not investigate the cause(s) of the saline groundwater.
- Everett, et al., 2020. "Multiple-well monitoring site adjacent to the Lost Hills oil field, Kern County, California"
    - USGS installed a multiple-well monitoring site near Lost Hills Oil Field. Groundwater level and historic pressure profiles indicate aquifer clay layers can restrict vertical groundwater flow in some areas.
- Everett, et al., 2020. "Multiple-well monitoring site adjacent to the North and South Belridge Oil Fields, Kern County, California"
    - USGS installed a multiple-well monitoring site near the North and South Belridge Oil Fields. Flow gradients are downward through the entire aquifer system at this site and vertical groundwater flow is likely to be restricted by clay layers based on differences in water level elevation between layers. Salinity values exceeded 10,000 mg/L below 1,200 feet, close to the depth estimated in a regional study by Gillespie and others (2019).

6.0 LESSONS LEARNED FROM IMPLEMENTATION OF THE MODEL CRITERIA

A summary of opportunities identified by ongoing program evaluation based on performance measures is provided below with highlights of actions completed in 2020 and actions planned for 2021:

- Provide transparent and available information online:
    - New groundwater monitoring data was uploaded to GeoTracker and updates were made to the State Water Board Oil and Gas program webpage to include recent USGS publications. Staff also developed a GIS layer in the GeoTracker system to display RMP data.
    - In 2021, Staff will continue to evaluate data sharing strategies and opportunities to reduce duplication as new phases of WellSTAR are released.

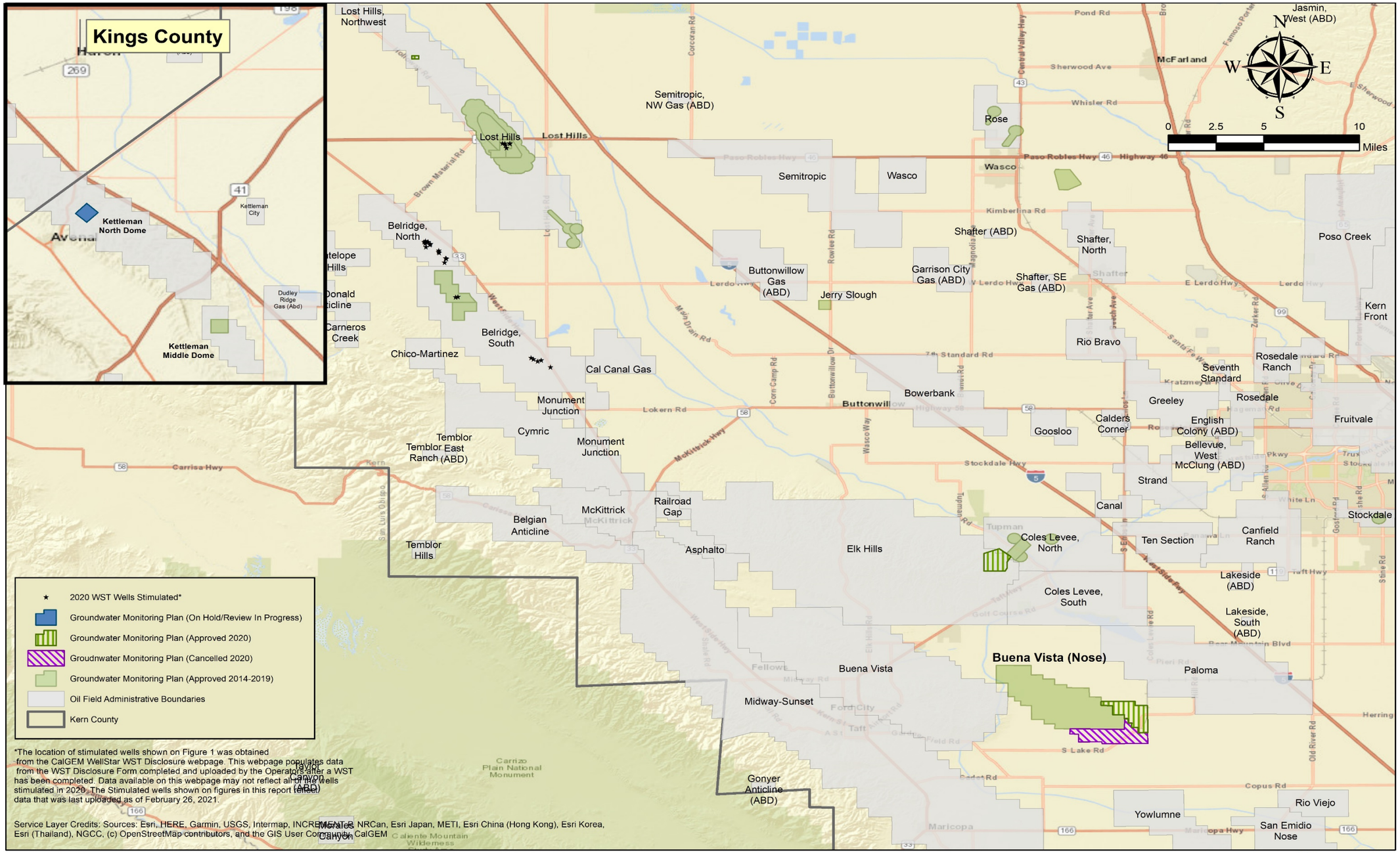
- Provide clear milestones and timely deliverables:
    - Staff met with operators to discuss project and review status to ensure comments are resolved in a timely manner.
    - In 2021, Staff plan to evaluate its use of tracking tools to monitor the status of operator submittals. The use of these tracking tools will help staff refine processes and increase review efficiency.

- Understand and mitigate impacts of well stimulation on water quality and public health:
    - State Water Board staff hosted public briefings on RMP activities and facilitated kick off meetings with the USGS and operators prior to sampling. Additionally, GMR review comments were sent to operators to ensure compliance with the Model Criteria.
    - In 2021, State Water Board staff will continue its evaluation of the Model Criteria by seeking input from technical experts at the Regional Water Boards, CalGEM, USGS, and selected operators. Finally, public meeting(s) will be held to present technical findings following RMP publications.

- Provide region-specific or localized flexibility:
    - No alternative proposals for groundwater monitoring were received during the reporting period.

- Assess implementation costs:
    - In 2020, operators spent approximately $1.1 million on groundwater monitoring sampling and reporting and $5,400 for requests for exclusion from groundwater monitoring requirement.

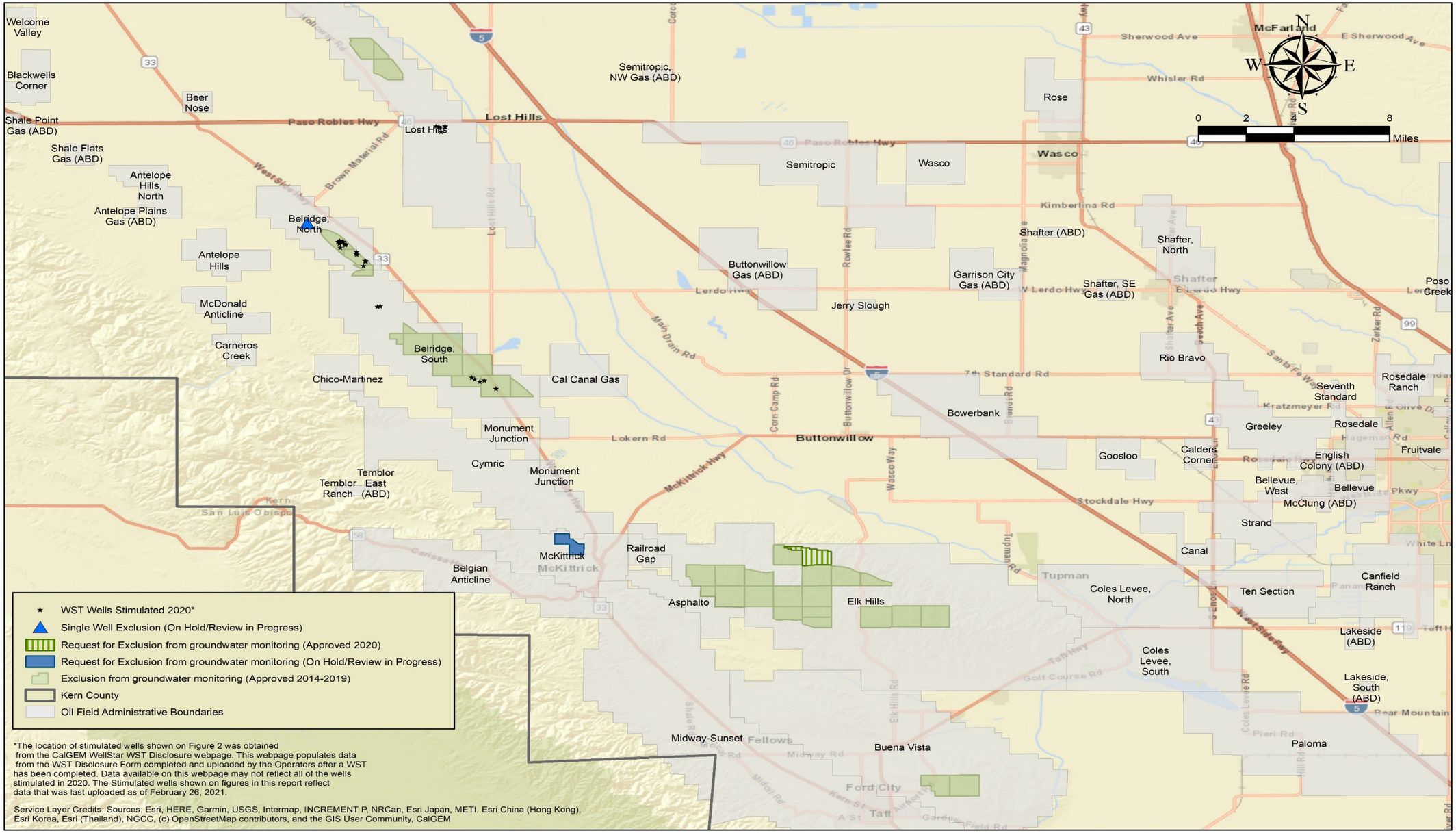
FIGURES



*The location of stimulated wells shown on Figure 1 was obtained from the CalGEM WellStar WST Disclosure webpage. This webpage populates data from the WST Disclosure Form completed and uploaded by the Operators after a WST has been completed. Data available on this webpage may not reflect all of the wells stimulated in 2020. The Stimulated wells shown on figures in this report (where) data that was last uploaded as of February 26, 2021.

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community, CalGEM

Figure 1. Groundwater Monitoring Plans and Wells Stimulated (January 1, 2020 - December 31, 2020)



*The location of stimulated wells shown on Figure 2 was obtained from the CalGEM WellStar WST Disclosure webpage. This webpage populates data from the WST Disclosure Form completed and uploaded by the Operators after a WST has been completed. Data available on this webpage may not reflect all of the wells stimulated in 2020. The Stimulated wells shown on figures in this report reflect data that was last uploaded as of February 26, 2021.

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Figure 2. Requests for Exclusion from Groundwater Monitoring and Wells Stimulated (January 1, 2020 - December 31, 2020)

Appendix A - WEB LINK GLOSSARY

LINK TEXT	URL ADDRESS	SECTION
MODEL CRITERIA FOR GROUNDWATER MONITORING IN AREAS OF OIL AND GAS WELL STIMULATION	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/well_stimulation/index.shtml	1
40 CODE OF FEDERAL REGULATIONS (CFR) PART 146.4	https://www.waterboards.ca.gov/rwqcb3/board_info/agendas/2017/january/item9/item9_att1.pdf	1
RESOLUTION NO. 2015-0047	https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0047.pdf	1
EMERGENCY INTERIM REGULATIONS	https://www.conservation.ca.gov/index/Pages/prpsregs.aspx	1
GEOTRACKER	https://geotracker.waterboards.ca.gov/	1
MODEL CRITERIA FOR GROUNDWATER MONITORING IN AREAS OF WELL STIMULATION: SUMMARY OF GOALS, STRATEGIES, PROPOSED PERFORMANCE MEASURES, AND PLANS FOR IMPLEMENTATION	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/performance_measures/index.shtml	1
WELLSTAR	https://wellstar-public.conservation.ca.gov/	2
ADDITIONAL RESOURCES	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/additional_resources/	2
CALGEM WELL STIMULATION TREATMENT NEIGHBOR NOTIFICATION AND WATER SAMPLING MCLS FOR DRINKING WATER	https://www.conservation.ca.gov/calgem/Pages/WSTNeighborNotificationAndWaterSampling.aspxhttps://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.shtml	3
STATE WATER BOARD LIST OF DESIGNATED CONTRACTORS FOR WATER SAMPLINGCALGEM WELL STIMULATION TREATMENT NEIGHBOR NOTIFICATION AND WATER SAMPLING	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/docs/list_of_designated_contractors_sept_2019.pdfhttps://www.conservation.ca.gov/calgem/Pages/WSTNeighborNotificationAndWaterSampling.aspx	3

EVERETT, ET AL., 2020. “MULTIPLE-WELL MONITORING SITE ADJACENT TO THE LOST HILLS OIL FIELD, KERN COUNTY, CALIFORNIA”	https://pubs.er.usgs.gov/publication/ofr20191114	5
EVERETT, ET AL., 2020. “MULTIPLE-WELL MONITORING SITE ADJACENT TO THE NORTH AND SOUTH BELRIDGE OIL FIELDS, KERN COUNTY, CALIFORNIA”	https://pubs.er.usgs.gov/publication/ofr20201116	5

Appendix B - ORIGINAL PERFORMANCE MEASURES

Goals	Strategy
Goal #1: Transparency and availability of online information and documentation.	1.1 Improve and expand upon available datasets and the ability to analyze and manipulate that data.
	1.2 Improve online user experience with simplified and clear messaging to make data easier to access.
	1.3 Create data communication/sharing strategy to optimize data and information sharing between the State Water Board, Regional Water Boards, CalGEM, and other agencies, as appropriate.
Goal #2: Provide clear milestones and timely deliverables.	2.1 Make milestones and deliverables outlined in the Model Criteria and Senate Bill 4 (Chapter 313, Statutes of 2013, including Water Code section 10783), publicly available.
	2.2 Prepare review processes, flowcharts, and timelines for reviewing GMPs and requests for exclusion from groundwater monitoring, including interagency collaboration and program efficiencies.
Goal #3: Understand and mitigate impacts of well stimulation on water quality and public health.	3.1 Provide regular assessments of monitoring data, including pilot study results and identification of any chemicals of concern.
	3.2 Mitigate problems as they occur and share mitigation efforts with stakeholders.
	3.3 Develop a plan to re-evaluate the effectiveness of monitoring. Modify the scope of work and approach based on evaluation of the data collected and evaluated.
	3.4 Coordinate with other agencies to identify risk.
Goal #4: Provide region-specific or localized flexibility where possible.	4.1 Consider local conditions when reviewing groundwater plans.
	4.2 Clearly communicate why region- specific activities are occurring.
	4.3 Use consistent flexibility criteria for monitoring.
Goal #5: Assess implementation costs.	5.1 Assess implementation cost for the State Water Board and stakeholders.

Appendix C - TABLES

LIST OF TABLES

Notes and Acronyms for all tables:

-- = not applicable
ADSA = Axial Dimension Stimulation Area
CalGEM = California Geologic Energy Management Division – Department of Conservation
GMP = Groundwater Monitoring Plan
WST = well stimulation treatment
Bbl = Barrel(s) of oil

1. Located in Kern County, unless otherwise noted.
2. Date of Revised Plan submission to GeoTracker or other action by Operator.
3. On Hold indicates that Water Boards staff are waiting on additional information from the operator or the approved ADSA from CalGEM.
4. Days to complete the process equates to the elapsed time between the "GMP Date Accepted" to "Status/Determination Date". For GMPs (new and addenda) with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Uploading and Reviewing GMPs (new or addenda) on the Additional Resources webpage for the detailed flowchart of the GMP review process.
5. Days to complete the process equates to the elapsed time between the "Request for Exclusion Accepted Date" to "Status/Determination Date". For Requests for Exclusions with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Reviewing Requests for Exclusion from Groundwater Monitoring on the Additional Resources webpage for the detailed flowchart of the Exclusions from Groundwater Monitoring review process.
6. Days to complete the process equates to the elapsed time between the "Date Accepted Request of Additional WST Wells" to "Status/Determination Date". For Requests of Additional WST Wells with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Reviewing Well Stimulation Permit Applications on the Additional Resources webpage for the detailed flowchart of the Exclusions from Groundwater Monitoring review process.

Table 1. Groundwater Monitoring Plans (New) Reviewed (January 1, 2020 - December 31, 2020)

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	GMP Date Accepted	New or Addendum GMP	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination[2]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[3]	Comments
GAOG10009209	Buena Vista (Nose)	T32S, R25E, S13-16 T31S, R25E, S22-24	California Resources Corporation	9/13/2018	New	56	--	Cancelled	6	12/20/2020	57	Southeast expansion. GMP was accepted on 9/13/2018. Water Boards staff held a meeting to discuss comments with the operator on 10/15/2018. Water Board staff sent comments on 11/8/2018.Water Board staff held a meeting to discuss project with the operator on 6/13/2019. Project cancelled by State Water Board management on 12/20/2020 due to inactivity from operator.
GAOG10009209	Buena Vista (Nose)	SECTIONS 1- T32S,R24E, 36- T31S,R24E, 3-11,14-17 T32S,R25E & SECTION 31 - T31S,R25E	California Resources	3/1/2019	New	32	Operator submitted revised GMP (11/12/2019) Operator submitted a second revised GMP (1/9/2020)	Approved	2	1/17/2020	160	Northeast expansion. GMP was accepted on 3/1/2019. A drinking water well survey and new downgradient monitoring well were required as part of this expanded GMP. Water Boards staff discussed comments regarding installation methods proposed for the monitoring well and drinking water well survey results with the operator in coordination meetings on: 3/4/2019, 4/2/2019, 6/3/2019 and 6/24/2019. Water Boards staff sent comment letter to operator on 7/11/2019. Revised GMP accepted on 11/12/2019. A phone meeting was conducted on 11/29/2019 to discuss further comments from Water Boards staff. Water Boards staff contacted operator regarding information submitted within GMP's water well survey on 12/6/2019. Water Boards staff sent a comment letter to operator on 1/7/2020. Operator submitted a revised GMP on 1/9/2020. Issued approval letter on 1/17/2020.

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	GMP Date Accepted	New or Addendum GMP	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination[2]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[3]	Comments
GAOG10011823	Kettleman North Dome	T22S, R17E, S11	California Resources Corporation	7/28/2018	New	85	Operator submitted a revised GMP (2/11/2019) Operator placed the project on hold (4/9/2019)	On Hold	--	--	--	Water Board staff sent comment letter on 10/16/2018. Water Board staff accepted revised GMP on 2/11/2019. Operator placed the project on hold on 4/9/2019.
GAOG10013748	Elk Hills	T30S, R24E, S36	California Resources Corporation	10/31/2019	New	78	Operator submitted a revised GMP (7/20/2020)	Approved	8	9/30/2020	150	Water Board staff sent comment letter to operator on 1/17/2020. Operator submitted a revised GMP on 7/20/2020. Issued approval letter on 9/30/2020.

Table 2. Groundwater Monitoring Plans (Addenda) Reviewed (January 1, 2020 - December 31, 2020)

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	GMP Date Accepted	New or Addendum GMP	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination[2]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[3]	Comments
GAOG10009406	Lost Hills	T27S, R21E, S4, S5	Aera Energy, LLC	5/17/2019	Addendum	60	Operator submitted revised Addendums (8/5/2019, 12/13/2019)	Approved	12	1/24/2020	201	Operator revised bottom hole location for well in addendum on 7/16/2019. A revised addendum was submitted on 8/5/2019. Water Board staff sent comment letter to operator on 11/6/2019. Operator submitted a second revised addendum on 12/13/2019. Issued approval letter on 1/24/2020.
GAOG10009406	Lost Hills	T27S, R21E, S4, S5	Aera Energy, LLC	7/8/2019	Addendum	504	--	Approved	1	11/23/2020	504	CalGEM provided an approved ADSA on 8/10/2020. Issued approval letter 11/23/2020.
GAOG10009406	Lost Hills	T27S, R21E, S4, S5	Aera Energy, LLC	8/15/2019	Addendum	83	Operator submitted revised Addendum (12/17/2019)	Approved	2	11/24/2020	227	Water Board staff sent comment letter to operator on 11/6/2019. Operator submitted a revised addendum on 12/17/2019. Water Board staff informed the operator of the completion of the addendum review, but could not issue approval without receipt of the CalGEM ADSA on 2/7/2020. CalGEM provided an approved ADSA on 8/24/2020. Issued approval letter 11/24/2020.

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	GMP Date Accepted	New or Addendum GMP	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination[2]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[3]	Comments
GAOG10010391	Lost Hills	T26S, R21E, S29, S32, S33 T27S, R21E, S4, S5	Chevron USA, Inc	9/13/2018	Addendum	50	Operator submitted revised Addendums (12/15/2018, 5/9/2019)	Approved	24	2/19/2020	155	Water Board staff sent comments to operator on 11/2/2018. Operator submitted a revised addendum on 12/15/2018. Operator placed addendum on hold to revise on 1/24/2019. Operator submitted a revised addendum on 5/9/2019. Water Board staff sent comments to operator on 6/20/2019. Water Boards informed operator of the completion of addendum review, but could not issue approval without receipt of the CalGEM ADSA on 8/20/2019. CalGEM provided an approved ADSA on 2/1/2019. Issued approval letter 2/19/2019.
GAOG10010391	Lost Hills	T26S, R21E, S29, S32, S33 T27S, R21E, S4, S5	Chevron USA, Inc	5/28/2019	Addendum	32	Operator submitted a revised addendum (8/8/2019)	Approved	12	3/2/2020	106	Operator informed Water Board staff of intent to revise addendum on 8/4/2019. Operator submitted a revised addendum on 8/8/2019. Water Board staff informed the operator of the completion of the addendum review, but could not issue approval without receipt of the CalGEM ADSA on 9/9/2019. CalGEM provided an approved ADSA on 2/25/2020. Issued approval letter 3/2/2020.
GAOG10010391	Lost Hills	T26S, R21E, S29, S32, S33 T27S, R21E, S4, S5	Chevron USA, Inc	6/18/2019	Addendum	71	--	On Hold	36	--	--	Water Board staff informed the operator of the completion of addendum review, but could not issue approval without receipt of the CalGEM ADSA on 8/20/2019.

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	GMP Date Accepted	New or Addendum GMP	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination[2]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[3]	Comments
GAOG10010391	Lost Hills	T26S, R21E, S29, S32, S33, and T27S, R21E, S4, S5	Chevron	8/8/2019	Addendum	32	--	Approved	4	2/20/2020	54	Water Board staff informed the operator of the completion of addendum review, but could not issue approval without receipt of the CalGEM ADSA on 9/9/2019. CalGEM provided an approved ADSA on 1/29/2020. Issued approval letter 2/20/2020.
GAOG10010391	Lost Hills	T26S, R21E, S29, S32, S33, and T27S, R21E, S4, S5	Chevron	6/8/2020	Addendum	67	--	On Hold	13	--	--	Water Board staff sent comments to operator on 8/14/2020. Review is on hold waiting for additional operator provided information.
GAOG10009209	Buena Vista (Nose)	T32S, R24E, S1 T31S ,R24E, 36 T32S, R25E, S3-11, S14-17 T31S, R25E, S31	California Resources	6/27/2019	Addendum	83	Operator submitted revised Addendums (4/30/2020, 5/28/2020)	Approved	5	7/2/2020	139	Water Board staff sent comments to the operator on 9/18/2019. Operator submitted a revised addendum on 4/30/2020. Review on hold waiting on additional information of 5/21/2020. Operator submitted a revised addendum on 5/28/2020. Issued approval letter on 7/2/2020.
GAOG10009277	Belridge, South	T28S, R20E, S12, S13, T28S, R21E, S18	Aera Energy LLC	7/8/2019	Addendum	--	--	Review in Progress	2	--	--	Addendum is under Water Board staff review, but cannot be completed without receipt of ADSA narrative.

Table 3 - Requests for Exclusion Reviewed (January 1, 2020 - December 31, 2020)

GeoTracker Global Identification	Oil Field	Township (T), Range (R), Section (S)	Operator	Request for Exclusion Accepted Date	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))	Status/ Determination	Status/ Determination Date	Number of WST Wells	Days to Complete Review Process[1]	Comments
GAOG10011060	McKittrick	T30S,R22E,S7,8,9,16,17,18	Chevron USA Inc	10/31/2017	9	Conference call conducted between Waterboards staff and Operator discussing submitted information. (11/9/2017)	On Hold	--	3	--	Water Board staff conducted a conference call with the Operator on 11/9/2017. Water Board staff review continues to be on hold due to information deficiencies in operator provided documentation.
GAOG10012394	Belridge, North	T27S,R20E,SE 1/4 of S27	Aera Energy, LLC	12/12/2018	51	--	On Hold	--	1	--	Water Board staff and CalGEM reviewed the exempt status of the Mclure Shale unit, and sent comment letter on 2/1/2019. Water Board staff review is on hold due to information deficiencies in operator provided documentation.
GAOG10014266	Elk Hills	T30S, R23E, Portions of S15R,16R, and 22R	California Resources Corporation	4/1/2020	19	Operator submitted a Revised Request for Exclusion (5/18/2020)	Approved	6/9/2020	--	41	Water Board staff sent comment letter on 4/20/2020.Operator submitted a revised Request for Exclusion on 4/20/2020. Approval letter issued on 6/9/2020.

Table 4 - Requests to Add Wells for Stimulated Treatment to Existing Approved Exclusions During Reporting Period (January 1, 2020- December 31, 2020)

GeoTracker Global Identification	Oil Field	Township (T), Range (R), Section (S)	Operator	Date Accepted Request of Additional WST Wells	Days for Initial Response	Status/ Determination	Number of WST Wells added to Approved Exclusion	Status/ Determination Date	Days to Complete Review Process[1]
GAOG10010419	Elk Hills	T30S, R23E, S28R	California Resources	1/3/2020	11	Approved	1	1/14/2020	11
GAOG10010420	Elk Hills	T30S, R22E, S34R	California Resources	1/3/2020	13	Approved	1	1/16/2020	13
GAOG10010422	Elk Hills	T30S, R23E, S33R	California Resources	1/3/2020	94	Approved	2	4/27/2020	94
GAOG10011093	Elk Hills	T30S, R22E, Portion of S29R	California Resources Elk Hills, LLC	12/19/2019	20	Approved	2	1/8/2020	20
GAOG10011834	Elk Hills	T30S, R23E, S36R	California Resources Elk Hills, LLC	1/13/2020	79	Approved	2	4/27/2020	84
GAOG10012808	Elk Hills	T30S, R22E, Portion of S24Z	California Resources Elk Hills, LLC	12/9/2019	60	Approved	7	3/27/2020	78
GAOG10012808	Elk Hills	T30S, R22E, Portion of S24Z	California Resources Elk Hills, LLC	12/12/2019	60	Approved	2	2/10/2020	60
GAOG10012808	Elk Hills	T30S, R23E, S24Z	CREH	1/3/2020	11	Approved	2	1/14/2020	11
GAOG10012808	Elk Hills	T30S, R22E, S24Z	CREH	2/11/2020	58	Approved	1	4/9/2020	58
GAOG10012808	Elk Hills	T30S, R22E, S24Z	CREH	8/21/2020	4	Approved	1	8/25/2020	4

GeoTracker Global Identification	Oil Field	Township (T), Range (R), Section (S)	Operator	Date Accepted Request of Additional WST Wells	Days for Initial Response	Status/ Determination	Number of WST Wells added to Approved Exclusion	Status/ Determination Date	Days to Complete Review Process[1]
GAOG10013905	Elk Hills	T30S, R23E, S34R	California Resources Corporation	1/7/2020	90	Approved	1	4/6/2020	90
GAOG10013940	Elk Hills	T30S, R24E, S31S	California Resources Corporation	1/17/2020	52	Approved	2	4/6/2020	79
GAOG10013941	Elk Hills	T30S, R24E, S32S	California Resources Corporation	1/17/2020	21	Approved	1	2/7/2020	21
GAOG10008892	Belridge, South	T28S, R21E, S33	Aera Energy LLC	8/6/2020	15	Approved	2	8/21/2020	15
GAOG10008892	Belridge, South	T28S, R21E, S33	Aera Energy LLC	12/14/2020	--	Review in Progress	9	--	--
GAOG10008913	Belridge, South	T28S, R21E, S28	Aera Energy LLC	8/6/2020	14	Approved	2	11/10/2020	39
GAOG10008915	Belridge, South	T28S, R21E, S34	Aera Energy LLC	12/14/2020	--	Review in Progress	1	--	--
GAOG10009503	Belridge, South	T28S,R21E,S29	Aera Energy, LLC	7/29/2019	179	Approved	3	1/24/2020	179
GAOG10009503	Belridge, South	T28S, R21E, S29	Aera Energy LLC	8/6/2020	15	Approved	11	8/21/2020	15
GAOG10009503	Belridge, South	T28S, R21E, S29	Aera Energy LLC	12/14/2020	26	Approved	3	1/19/2020	26
GAOG10009914	Belridge, South	T28S, R21E, S20	Aera Energy LLC	8/6/2020	14	Approved	2	11/23/2020	90
GAOG10009914	Belridge, South	T28S, R21E, S20	Aera Energy LLC	12/14/2020	--	Review in Progress	1	--	--
GAOG10011107	Belridge, North	T28S, R20E, S1	Aera Energy LLC	7/29/2020	19	Approved	15	8/17/2020	19

Table 5 Neighbor Notifications During Reporting Period (January 1, 2020- December 31, 2020)

Operator	2014	2015	2016	2017	2018	2019	2020
Aera Energy, LLC	818	960	29	138	250	233	**73**
Berry Petroleum Company, LLC	-	-	-	-	160	219	-
Breitburn Energy Co., LLC	18	-	-	-	1	-	-
Central Resources, Inc	19	-	-	-	-	-	-
Chevron USA, Inc	35	6	-	-	42	-	**27**
Crimson Resource Management	194	-	-	-	-	-	-
DCOR, LLC	11	-	-	-	-	-	-
Occidental of Elk Hills, Inc	57	36	-	-	-	-	-
Seneca Resources Corporation	19	4	-	-	-	-	-
Vintage Production California, LLC	108	-	-		-	-	-
California Resources Elk Hills, LLC	-	5	42	2	93	57	-
Linn Operating, Inc	-	273	-	-	-	-	-
Salt Creek Oil, LLC	-	-	2	-	-	-	-
Total	**1,279**	**1,284**	**73**	**140**	**546**	**509**	**100**

Source: State Water Board staff communication with CalGEM staff
January 27, 2021

Table 6 Operator Cost

Operator Cost Category	2014 - 2016 (1)	2017	2018	2019	2020
Number of GMPs Developed	19	7	16	20	1
GMP Cost	$517,250	$207,843	$131,719	$864,872	$17,645
Wells Installed	19	12	8	5	2
Well Installation Cost	$5,806,232	$2,000,673	$351,744	$1,450,014	$514,860
Samples Collected	105	85	106	95	103
Reports Submitted	28	12	12	20	24
Sampling and Reporting Cost	$990,000	$418,702	$273,423	$293,253	$310,615
Samples Analyzed	86	80	106	95	101
Sample Analysis Cost	$172,500	$188,490	$288,345	$243,469	$226,620
Other Subcontractor and Consultant Fees	$111,969	$150,000	$98,601	$20,000	$17,000
Total Cost (Capital + Operating Expenses)	$7,597,951	$2,965,708	$1,143,831	$2,871,608	$1,086,740

Requests for Exclusion	2014 - 2016 (1)	2017	2018	2019	2020
Requests for Exclusion	11	7	29	32	10
Requests for Exclusion Cost	$73,710	$76,075	$46,400	$525,600	$5,400

Regional Monitoring Program	2014 - 2016 (1)	2017	2018	2019	2020
RMP Estimated Total Operators Cost	$15,000	$18,000	$265,525	$0	$135,700

Well Stimulation Treatments and Production	2014 - 2016 (1)	2017	2018	2019	2020
WSTs Performed - GMP	176	34	129	96	**26**
Oil Production from WSTs - GMP (bbl)	1,362,969	451,478	312,501	362,810	**18728**
WSTs Performed - Exclusions	1,089	122	115	70	**34**
Oil Production from WSTs - Exclusions (bbl)	9,438,976	296,336	523,299	166,875	**25903**

Summary	2014 - 2016 (1)	2017	2018	2019	2020
Oil Produced subject to Model Criteria Requirements (bbl)	10,801,945	747,814	835,800	529,685	**44,631**
Estimated Groundwater Monitoring Cost per Sample	$72,361	$34,891	$10,791	$30,227	**$5,381**
Groundwater Monitoring Cost per bbl of oil	$5.57	$6.57	$3.66	$7.91	**$58.03**
Average Cost of Compliance per Monitoring Well	$43,170	$87,227	$8,867	$29,913	**$41,798**

Note: (1) Reporting period equal to 2.5 years.

Appendix D - REGIONAL MONITORING PROGRAM PUBLICATIONS

Appendix D Summary of USGS Studies

Oil Field	County	Salinity Mapping	AEM	Groundwater Sampling	Oilfield Fluid Sampling	Interpretive analysis
Various	Kern, Los Angeles	X		X	X	1, 5, 6, 7
Cal Canal Gas	Kern	X	X			16, 20, 26
Fruitvale	Kern	X		X	X	20, 21, 22, 25
Lost Hills	Kern	X	X	X	X	9, 16, 20, 21, 26, 29
North Belridge	Kern	X	X	X	X	16, 20, 26
Rosedale Ranch	Kern	X				22
South Belridge	Kern	X	X	X	X	16, 20, 21, 26
Elk Hills	Kern	X		X	X	
Montebello	Los Angeles	X		X	X	
North Coles Levee	Kern			X	X	
Orcutt	Santa Barbara			X	X	
Oxnard	Ventura			X	X	37
South Coles Levee	Kern	X				
South Cuyama	Santa Barbara	X				
Buena Vista	Kern			X	X	
Kern River	Kern			X	X	
Midway-Sunset	Kern	X		X	X	
Placerita	Los Angeles			X	X	
San Ardo	Monterey	X		X	X	
Santa Maria Valley	Santa Barbara			X	X	
Yowlumne	Kern County	X				
Cat Canyon	Santa Barbara	X		X	X	
Poso Creek	Kern	X	X	X	X	
Wilmington-Torrance	Los Angeles			X	X	

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