IN THE PITS

Oil and Gas Wastewater Disposal into Open Unlined Pits and the Threat to California's Water and Air

November 2014

CLEAN WATER **ACTION** • CLEAN WATER **FUND**

Acknowledgements

This report was written by Andrew Grinberg, Clean Water Action/Clean Water Fund.

Tom Frantz, farmer from Shafter, first told Clean Water Action about the McKittrick pits and has been critical in helping us investigate and understand the local threats of the oil industry in Kern County.

We would like to thank Earthworks for partnering with us on our work in Kern County, especially Jhon Arbelaez for his help in investigating unlined pits.

Bill Allayaud of Environmental Working Group, deserves much credit for his work on oil and gas issues in California, bringing the issue of unlined pits to our attention.

The following people provided review and comment on this report:

Bill Allayaud, Environmental Working Group
Jhon Arbelaez, Earthworks
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Miriam Gordon, Clean Water Action
Lynn Thorp, Clean Water Action
John Noel, Clean Water Action

Clean Water Fund is grateful to the following funders for supporting this work:

The Broad Reach Fund
The California Wellness Foundation
Patagonia

Clean Water Action thanks The Tides Advocacy Fund for supporting this work.

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Clean Water Fund is a national 501(c)(3) research and education organization that has been promoting the public interest since 1978. Clean Water Fund supports protection of natural resources, with an emphasis on water quality and quantity issues. Clean Water Fund's organizing has empowered citizen leaders, organizations and coalitions to improve conditions of hundreds of communities, and to strengthen policies at all levels of government. **www.CleanWaterFund.org**

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TABLE OF CONTENTS

Executive Summary 1

I. Introduction: A Broken System 4

II. Oil and Gas Development Produces a Massive Waste Stream in California 6

Flowback versus Produced Water 6

Wastewater Disposal Methods Used in California 7

Lack of Federal Oversight 7

III. Disposal into Open Pits or Sumps 8

Extent of Use of Unlined Pits in the Central Valley 8

Legal Mandate to Take Action to Protect Water Quality 11

Precedent for Prohibiting Unlined Pits in Other States and Industry Best Practices 13

IV. McKittrick 1 and 1-3 pits: Examples of Inadequate Oversight and Threats to Groundwater and Air Quality 14

History of Inadequate Oversight 15

Increased Scrutiny 17

Documented Air Quality Threats 18

V. Conclusion 20

Actions and Policy Recommendations 22

Endnotes 25

Appendix A: Health Impacts 28

Executive Summary

As the fourth largest oil producing state in the country, California must responsibly manage the massive waste stream generated by the oil and gas sector. This report examines the risks to California water and air quality associated with just one part of this waste stream: oil and gas wastewater disposal into open-air and unlined pits. The investigation that preceded this report found a long-term ongoing failure on the part of regulatory entities tasked with protecting public health and the environment to properly monitor and restrict the use of these pits, despite demonstrated threats to public health and the environment.

In 2013, industry produced 8 billion gallons of oil in California, and 130 billion gallons of wastewater, or approximately 15 barrels of wastewater for every barrel of oil that is produced. Oil and gas wastewater contains both naturally occurring and added contaminants, including carcinogens, heavy metals, radioactive materials and salts. In California, oil and gas wastewater is disposed of in four different ways: underground injection into class II disposal wells; reinjection for enhanced oil recovery (EOR); irrigation of crops; or disposal into unlined pits, also known as sumps. Each presents its own unique challenges and threats to water quality, health and the environment, but unlined and open-air pits are especially troubling because they are designed to percolate and evaporate toxic chemicals into the environment.

Unlined pits are a commonly used disposal method for an unknown, yet potentially significant, portion of the 130 billion gallons of wastewater produced annually from oil and gas operations. According to Division of Oil, Gas and Geothermal Resources (DOGGR) records, at least 432 unlined pits are currently being used for disposal of oil and gas wastewater in the Central Valley, and most have been operating with significantly

Image A: Unlined wastewater disposal pit in Kern County, CA.

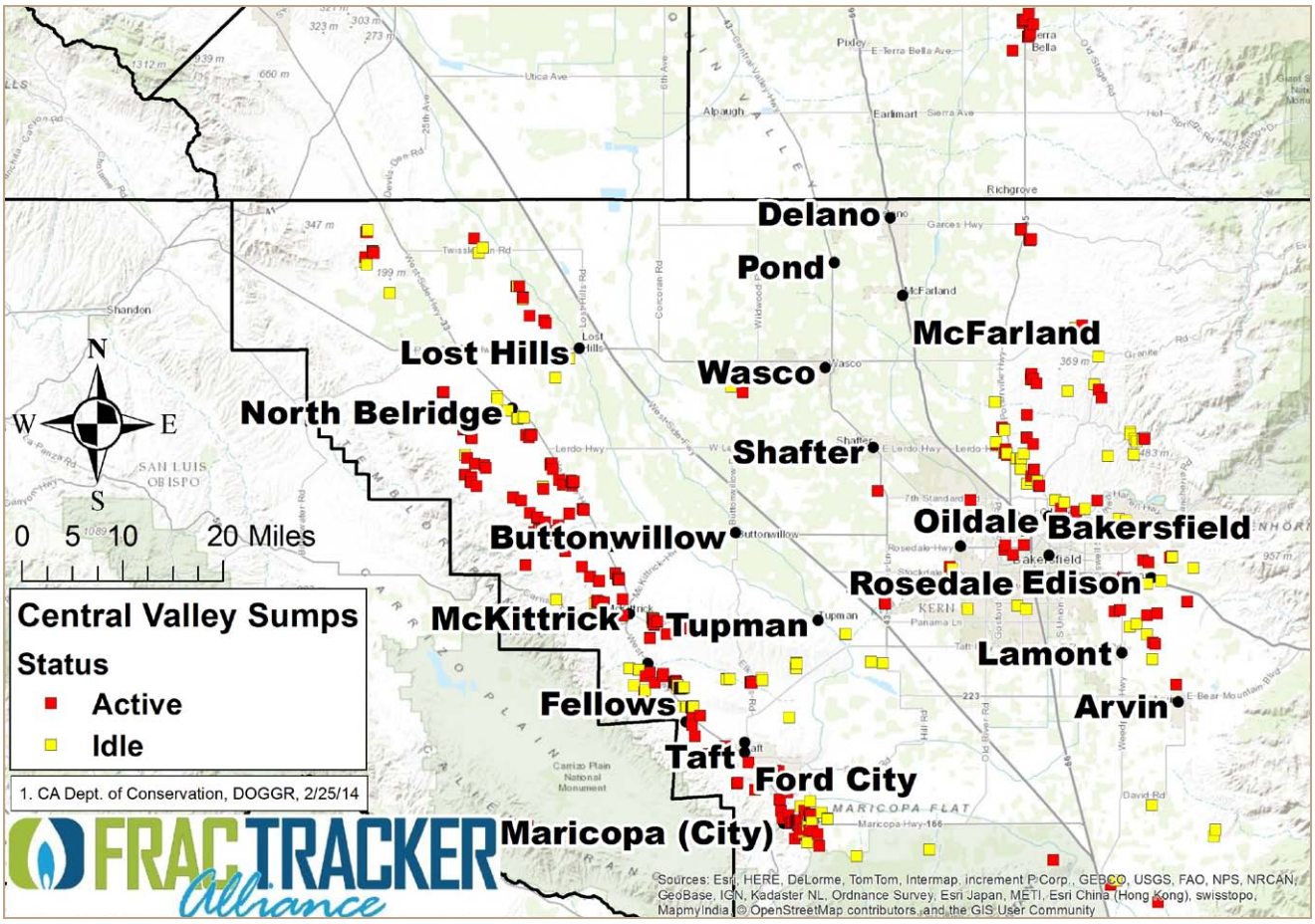

Image B: Central Valley oil and gas wastewater sumps. Courtesy Kyle Ferrar, FracTracker Alliance.

out-of-date waste discharge permits, or no permits at all. The discharge of wastewater into unlined pits threatens water resources, including potential sources of drinking and irrigation water, and impacts air quality due to the off-gassing of chemicals from the wastewater. The majority of these pits are near waterways, increasing the likelihood that spills and surface-to-groundwater migration will impact water resources. There has been no comprehensive review of locations of pits in relation to high quality groundwater.

After learning about an unlined pit site, Clean Water Action began to investigate one pair of pits located near McKittrick in Kern County. By reviewing public documents, and using citizen collected air quality samples, the investigation found documentation of a plume of wastewater containing heavy metals such as boron, high salinity, and other constituents of concern, that has migrated towards high quality, useable groundwater resources. The Central Valley Regional Water Quality Control Board (CVRWQCB or Central Valley Board) has required groundwater testing near the site since 2004. The test results — all public documents — indicate that a plume of wastewater, matching the characteristics of the wastewater in the pits, extends close to a mile to the northeast of the pits. It extends towards the Kern River Flood Channel, the California Aqueduct and high quality groundwater used for significant agricultural activity. The public documents

also indicate a complete lack of enforcement of regulations by the Central Valley Board, which has allowed discharge into these pits since the 1950s, despite its own records indicating industry non-compliance with state and regional water quality laws.

Air quality sampling (analyzed by an independent lab) at the pits identified health-threatening and climate-changing pollution. Samples showed the presence of 24 volatile organic compounds (VOC's), and methane, as well as Benzene and 2-Hexanone, above the Long Term Effects Screening Levels.* After receiving a complaint of noxious odors at the pits, the San Joaquin Valley Air Pollution Control District (the District) responded with a claim of "no threat," based on self-reported sampling by the operator of the pits. The District did not conduct independent air or water sampling.

This report focuses on addressing the threats of unlined pits for wastewater disposal and recommends the following policies:

- DOGGR and the State Water Board should immediately prohibit discharge of oil and gas waste to unlined pits.
- These agencies should also investigate and ensure remediation of impacts associated with past discharges into these pits by:
  - → Developing an inventory of historic wastewater disposal locations into unlined pits;
  - → Investigating whether groundwater quality has been degraded by currently operating and historic unlined pits;
  - → Identifying responsible parties and requiring remediation of groundwater degradation that has occurred due to disposal into unlined pits; and
  - → Developing a plan for remediation of groundwater for which no responsible party can be identified.
- The California Air Resources Board and the San Joaquin Valley Air Pollution Control District should increase oversight of open pits by:
  - → Enforcing existing laws such as District Rule 4402, by conducting independent sampling of water and air quality instead of data that is self-reported by operators;
  - → Conducting inventories of emissions from open pits; and
  - → Exploring whether a statewide rule is needed for limiting emissions from pits.

On September 5, 2014, Clean Water Action made a formal request to the Central Valley Water Board to prohibit the discharge of oil and gas wastewater to unlined pits. The

*Long Term Effects Screening Levels (ESL's) are chemical specific air concentration levels based on data concerning health and vegetation effects.

Central Valley Board responded on September 29 by denying the request and stating that staff would continue to investigate pits on a case-by-case basis. This response does not address the numerous concerns outlined in the request for closure and this report, and represents a failure to provide adequate protections for Central Valley groundwater.

This report contributes to a mounting body of evidence of California's failure to regulate adequately the oil and gas industry. This evidence calls into question the state's ability to withstand industry influence and meet its statutory mandate to protect public health, private property, and public trust resources.

I. Introduction: A Broken System

On April 26, 2014, Clean Water Action and other interested parties conducted a tour of oil and gas industry sites throughout Kern County, California. Towards the end of the tour, the group headed toward the western side of Kern County, home to the Belridge, Elk Hills, Lost Hills and many other large oil fields.

Driving north along Highway 33 — nicknamed the "Petroleum Highway" — the group turned off to the east, down a narrow, unmarked and publicly accessible dirt road. A large tanker truck was visible in the distance. It appeared to be dumping water into the ground. Minutes later, the tour approached a gate with a sign reading "Danger H2S May Be Present." Tour members stepped out of the vehicles and were immediately hit with a noxious odor. Several tied bandanas around their mouths and noses to block the fumes. In less than five minutes, many in the group complained of nausea and headaches.

The site consisted of a few dozen long narrow ponds, some with standing liquids of different shades of green, brown and black, some dry and empty. The closest pond contained two thick pipes that were discharging steaming black and green fluids to the pond, while vapors visibly rose off the surface of the ponds. A thick black ring of what

Images C and D: McKittrick Waste Pits, Kern County, CA.

appeared to be oil rimmed the bank and a shimmering black layer floated on the surface. Pipes connected the first pond receiving the discharge to other, larger ponds stretching out hundreds of yards into the distance.

Clean Water Action staff left the tour with many questions, including:

- What are the impacts on groundwater and air from these ponds?
- Why is industry allowed to operate a disposal site that is so visibly toxic?
- Was the State of California aware of the existence of these pits, and if not, why not?
- Are there other pits like this in California?

The following pages detail Clean Water Action's investigation into these specific pits, the broader use and risks of unlined pits (also known as sumps) for oil and gas waste disposal in California, and what the investigation revealed about the failure of California's current regulatory system to address those risks.

As a major oil producing state, California policies regarding oil and gas have far-reaching ramifications for health, quality of life, and natural resources. In the context of the extreme drought impacting most of California, addressing threats to water quality and supply should be an especially high priority. The vast majority of oil production occurs in areas with limited water supplies that are highly dependent upon imported water, such as Kern County and Los Angeles. Therefore, water impacts by the oil and gas industry affects the state as a whole. Additionally, the majority of oil production occurs in areas with some of the worst air quality in the country, such as Bakersfield and Los Angeles, which topped the American Lung Association's list of worst cities for ozone (Los Angeles), year round, and short term particle pollution (Bakersfield-Delano).[1]

Industry-projected increases in oil extraction using hydraulic fracturing ("fracking") in the Monterey Shale has placed California's oil and gas industry under greater scrutiny than perhaps at any time in its history. Community and environmental concerns about fracking have launched California into a period of major policy development around well stimulation treatments, including hydraulic fracturing and acidizing, and air emission regulations for all oil and gas production. As the state develops policies to address the impacts of fracking and acidizing, as mandated by Senate Bill 4 (Pavley), a closer look at other aspects of the oil industry is also needed. The massive wastestream resulting from drilling, stimulation, and production is one of the most significant and threatening aspects of oil and gas operations in terms of potential impacts to public health and environmental resources.

The most significant water quality related shortcoming of the Division of Oil Gas and Geothermal Resources' (DOGGR) oversight of well stimulation and the oil and gas industry in general, is that the agency does not comprehensively address oil and gas

wastewater disposal. The draft SB 4 regulations for well stimulation, which are set to become final by January 2015, address some aspects of wastewater storage and disposal, but only for wells that have undergone a stimulation treatment. Since wastewater with harmful constituents is produced whether or not a well has been stimulated, the SB 4 regulations will not address the entirety of wastewater disposal by the oil and gas industry in California. Without a more comprehensive focus, state regulators are failing to address a significant threat to public health.

II. Oil and Gas Development Produces a Massive Waste Stream in California

California is the fourth largest oil producing state in the country. Significant oil development activities have occurred across the state for over 130 years. Oil development in California produces massive volumes of wastewater, creating a waste stream that the state must regulate.

Flowback versus Produced Water

Oil and gas wastewater is comprised of flowback and produced water. Flowback is the fluid that returns to the surface after well treatments, such as hydraulic fracturing or acidizing, are completed, but before oil and gas is production begins. Produced water is primarily composed of the fluids present in geologic formations that come to the surface during the production phase. Produced water is associated with all forms of oil and gas production, regardless of the use of fracking, well stimulation or other treatments.

Both flowback and produced water often contain health-harming chemicals added to fracking (or other stimulation) fluids, as well as naturally occurring contaminants (radioactive materials, salts, and heavy metals) that are dissolved in the fluids that rise up from the rock formation. Produced water is typically very saline and can contain heavy metals such as lead, as well as organic contaminants such as benzene and toluene. It can also contain naturally occurring radioactive materials (NORMs) from deep in the formation. These various contaminants make treatment and recycling difficult and pose threats to drinking and irrigation water quality if any contamination or degradation of useable water resources occurs.[2] These characteristics can vary widely, depending on the formation.

Flowback volumes depend on the volume of well stimulation treatment fluids injected into the well. The oil industry's reporting of volumes of well stimulation fluids used has historically been limited in California, though voluntary reporting since 2011 indicates that hundreds of thousands of gallons are injected in most frack jobs. In some instances — where fracking has occurred in deeper formations — operators have used up to 1.5 million gallons of well stimulation fluid.[3] Produced water can reach millions of gallons over the lifetime of the well.[4] In 2013, along with close to 200

million barrels (over 8 billion gallons) of oil produced in California, 3.1 billion barrels (130 billion gallons) of produced water flowed from oil and gas wells.[5] For every barrel of oil produced, roughly 15 barrels of wastewater are generated and require disposal.

Wastewater disposal methods used in California

In California, industry primarily disposes of oil and gas wastewater in four different ways: underground injection into class II disposal wells,* reinjection for enhanced oil recovery (EOR),** irrigation of crops, or disposal into unlined pits, also known as sumps. Each method presents its own unique challenges and threats to water quality, health and the environment. Currently, no comprehensive reporting of oil and gas waste disposal methods and locations is made to DOGGR, or any other state or federal agency. In August 2014, the Legislature passed SB 1281 (Senator Fran Pavley), which will require reporting of wastewater disposal beginning in 2015.[6]

California's oil and gas industry is working to expand unconventional oil production in the Monterey Shale, a series of shale formations in the San Joaquin Valley, parts of the Central Coast and the Los Angeles basin.[7] Despite the recent downgrade by the Energy Information Administration (EIA) of technically recoverable oil in the Monterey by 96 percent — from 13.7 billion barrels to 600 million barrels — industry is still planning to exploit those reserves with new techniques such as hydraulic fracturing, acidizing and as yet undeveloped technologies. If the oil and gas industry is successful, the state will see a major spike in the volume of wastewater it must manage.

Lack of Federal Oversight

The federal government has largely exempted oil and gas wastes from the Resources Conservation and Recovery Act (RCRA),*** leaving each state to regulate its own oil and gas waste. This exemption also allows oil and gas waste disposal into class II wells, rather than the more tightly regulated class I injection wells that must meet more stringent construction and siting standards. Without direct federal oversight, California regulators are solely responsible for ensuring oil and gas wastes are handled in a manner that does not threaten water or air quality.

This report focuses on the potential and currently occurring impacts on Kern County, where the vast majority of California's oil production takes place, and regulatory inadequacies have been observed.

*EPA regulates six classes of underground injection wells. Class II wells are used to inject brines and other fluids associated with oil and gas production, as well as hydrocarbons for storage.

**Enhanced oil recovery (EOR) techniques are used to increase oil production through the injection of fluids or gases. Common EOR techniques in California that use oilfield wastewater include: water flooding, steam flooding and cyclic steam injection.

*** The Resources Conservation and Recovery Act (RCRA), signed into law in 1976, is the primary federal law regulating the disposal of solid and hazardous waste. The oil and gas industry was exempted so that most of its waste, even when exhibiting hazardous characteristics, is exempt from the strict federal requirements for hazardous waste transport and disposal that all other industries must comply with.

Known Contamination from Open Pits

The most well-known example of oil and gas related contamination in California is the contamination of the Starrh almond farm. Aera Energy was ordered to pay $8.5 million in damages after improper disposal of produced water from the Belridge Oil field into an unlined pit polluted the local aquifer, and destroyed Starrh's almond orchard when he used that aquifer for irrigation.[8] Wastewater sumps have been the source of contamination in numerous cases across the country. In other states, damage and contamination from produced water is common, and often associated with surface discharges into pits. One of the most recent examples occurred in Washington County, Pennsylvania, which resulted in a $4.15 million fine on September 18, 2014, after Range Resources contaminated groundwater when six impoundments leaked Marcellus Shale wastewater into the aquifer.[9]

III. Disposal into Open Pits or Sumps

Extent of Use of Unlined Pits in the Central Valley

In California, the use of unlined sumps has been historically common for a wide range of industrial discharges. According to public data provided to Central Valley Board staff from DOGGR, and presented at the June 6, 2014 Central Valley Board meeting, the use of unlined pits by the oil industry is common but on the decline. As recently as 1990, over 2,000 unlined pits were listed as active or idle in the Central Valley. Currently 432 pits in the Central Valley (mostly in Kern County) have been identified as actively in use for the disposal of oil and gas wastewater, while 198 are idle but may potentially be used in the future.[10] It is possible that there are pits which DOGGR and the Water Boards are not aware of. In fact, in its initial investigation of 20 pits, the Central Valley Board identified at least one idle pit that was not on DOGGR's list.[11] The volume of waste disposed into unlined pits is unknown because there were no reporting requirements prior to the implementation of SB 1281 (Pavley) set to take effect in January 2015.

After reviewing 20 of the 432 active pits in the Valley, Central Valley Board staff concluded that some pits are operating without permits and lack any regulatory oversight, and many others are operating with outdated discharge permits and insufficient monitoring. Because only a small portion (4.6%) of the pits listed as active have been inspected, the state does not know how many are out of compliance.[12] Of the active pits, the vast majority are in close proximity to surface waterways *(Table 1)*. Close proximity to waterways increases risk that harmful spills, seepage, or improper use will contribute to water quality degradation either above or below ground. Proximity of pits to groundwater of beneficial use has not been analyzed on a regional or statewide scale. However, according to Board staff, some of the pits that have been reviewed are directly adjacent to or above high quality groundwater.[13]

TABLE #1: ***432 Central Valley Active Unlined Pits and Proximity to Waterways***[14]

Within 1500'	Within 1/2 Mile	Within 1 Mile
268 (62%)	326 (75%)	366 (85%)

Wastewater Disposal by Underground Injection

Regulatory failures in the Underground Injection Control (UIC) program highlight problems that may impact the state's ability to regulate other forms of disposal, including unlined pits. Recent enforcement orders, issued in July and August 2014 by DOGGR and the Board to oil and gas operators injecting produced water into potential sources of drinking water, show that there is a major data and enforcement gap concerning which aquifers are suitable for the discharge of produced water. This is the core tenet of the regulation of injection wells. US EPA can exempt aquifers from protection, allowing injection of oil and gas waste, under the federal Safe Drinking Water Act (SDWA), based on criteria provided in Title 40 CFR 146.4.

However, state and federal regulators, as well as the public, appear to lack a good understanding of which aquifers have been exempted, and the boundaries and locations of these aquifers. In some cases, documentation on exempted aquifers was unavailable to the public for decades.[15] In July and August 2014, DOGGR shut down injection wells that it has previously permitted to inject into aquifers that had specifically been denied exemptions by EPA in 1982, violating SDWA, and putting potential sources of drinking water at risk.[16] The State Water Resources Control Board (SWRCB), in its initial investigation following these shutdowns, has indicated that injection of oil and gas wastewater has occurred into aquifers currently used as irrigation and drinking water sources and within 1 mile of over 250 public water supply wells.[17]

This example of regulatory confusion and improper implementation shows that the Federal Exempt Aquifer status is an unreliable, unclear, and unenforced guide as to which aquifers are appropriate for produced water disposal. DOGGR is currently reviewing its entire UIC program, and its initial work plan indicates that the aquifer exemption program may need to be updated. This indicates that the current scheme for determining where disposal of oil and gas waste is appropriate is entirely inadequate.[18] While the exempt aquifer and UIC failings are covered by a separate regulatory program than unlined pits, and administered by a different agency (DOGGR), this recent experience with a regulatory lapse should act as a lesson that additional caution is needed to protect aquifers from oil and gas operations.

Central Valley Board staff has begun to inventory pits and update permits and monitoring. These are steps in the right direction to understanding the scope of the problem and moving towards better protection of groundwater. However a more robust effort is required to ensure adequate protection of water resources. To date, according to Central Valley Board staff, only 20 of the 432 pits (4.6%) classified as active have been inspected. Further investigations are currently on hold until additional staff are added.[19]

In the initial investigation, the Central Valley Board found one pit operating without a Waste Discharge Requirement (WDR) permit, and ordered the operator to cease disposal on June 30, 2014.[20] While shutting down non-compliant pits as they are investigated is a positive step, the current pace is insufficient. Without the resources to investigate all 432 active pits in a timely manner, the Central Valley Board is unlikely to examine some of the largest pits in Kern County in the near future. Staff has prioritized the investigation of pits near the Edison Field on east side of Kern County because they are located directly above known high quality groundwater. Pits in other parts of the Central Valley have not been prioritized, as they are not directly adjacent to or above aquifers with known beneficial uses. Nevertheless, these pits present threats to groundwater as underground migration of fluids can occur over large distances and can threaten surrounding water resources.

On September 5, 2014, Clean Water Action submitted a formal request for closure and prohibition of all unlined pits for the disposal of oil and gas wastewater.[21] The letter referenced the Board's legal authority over surface discharges and the threats posed by oil and gas wastewater to the Central Valley. On September 29, the Central Valley Board responded by denying the request for closure of all sumps.[22] Citing the need for more resources and stating that current activities are sufficient to address potential threats, the Central Valley Board indicated that it will continue to review individual sumps and update permits as needed. The letter states that a total prohibition on unlined pits is not needed since groundwater quality in the Central Valley varies significantly and certain areas have poor quality groundwater that does not warrant protection. However, it is unclear what criteria the Board is using to determine where unlined pits are appropriate, or what level of groundwater quality deserves protection. It is also unclear, in cases where wastewater discharge to unlined pits is occurring, whether the Board has made a determination that high quality groundwater will not be impacted. Since only a small portion of the pits have been investigated, many pits are likely operating without the oversight needed to ensure that groundwater will not be degraded. In short, the Central Valley Board's response does not address adequately the concerns outlined in Clean Water Action's request and in this report, nor does it reflect the urgency needed to protect scarce water resources in the Central Valley.

On October 7, 2014 the Central Valley Water Board announced in a press release that two oil companies, Vintage Production LLC and Occidental of Elk Hills, had reached settlement agreements with the Board "for administrative civil liability penalties totaling $476,784. The penalties are for discharging oilfield fluids into unlined pits in violation of a Central Valley Water Board order that permitted discharges of only specific types of fluids."[23] The Central Valley Board issued these enforcement actions because the operators discharged produced water — and potentially other fluids — into sumps permitted only for drilling muds. These sumps were identified as part of a separate investigation regarding the use of sumps for drilling muds and falls outside the scope of the Board's work to inventory and investigate wastewater disposal sumps.

These enforcement actions demonstrate that the use of unlined pits, regardless of their designation (wastewater or drilling muds), are a threat to Central Valley groundwater quality. The Board should be commended for taking action in these cases where its investigations have shown problems and illegal discharge. However, this limited review is not adequate to provide full protection of water resources as there are hundreds of unlined pits that are not receiving adequate oversight or review.

Additionally, these pits, which were determined to threaten groundwater, were permitted for other activities and further investigation found the pits were being used for non-permitted wastewater disposal. Prohibiting the use of unlined pits would ensure that this type of illegal discharge does not occur and make enforcement much simpler and efficient by clarifying that discharge cannot occur into unlined pits of any kind. Additionally, since these drilling mud pits are not a part of the known list of sumps

Image E: Oil and wastewater in an unlined pit.

provided by DOGGR, this raises the question of the extent of other types of unlined pits in use by the oil industry, the extent of co-mingling of wastes in sumps permitted for specific wastes, and whether there is adequate regulatory oversight and enforcement.

Legal Mandate to Take Action to Protect Water Quality

The State Water Quality Control Board's anti-degradation policy (Resolution No. 68-16) requires that that high-quality waters (that is, waters of a quality suitable for one or more beneficial uses) be maintained "to the maximum extent possible."[24] In order for degradation to be authorized by the State or Regional Board, an analysis of the potential degradation must be conducted. The Board, in order to approve **any** degradation of high quality waters, must make an affirmative finding that such degradation is in the best interest of the people of the State of California. Even if some level of degradation is approved by the Board, under no circumstances is it permissible to pollute waters of the state unless those waters have been exempted from beneficial use protections.

California's Porter–Cologne Water Quality Control Act requires the State and Regional Boards to ensure the protection of the "waters of the state," including groundwater, from waste disposal. Under that law, the State and Regional Boards have both the authority and the responsibility to prevent surface discharge of oil and gas waste.[25] At a minimum, the Central Valley Board, with the authority granted in Water Code Section 13301,

may issue cease and desist orders to halt discharges to any unlined pit where Waste Discharge Requirements (WDRs) are not adequate, or where a threat to groundwater quality exists.

Section 13127 of the California Water Code requires that groundwater be protected and grants authority to the Board, "To ensure adequate protection of water quality and statewide uniformity in the siting, operation, and closure of waste disposal sites." Disposal of oil and gas waste is inconsistent with this statute, as unlined pits are designed specifically to percolate waste into the ground, and the resultant threat to groundwater quality is inherently high.

The primary vehicle for implementation of the state's water quality laws are the basin plans prepared for each hydrologic region of the state. The region discussed in this report is covered by the Tulare Lake Basin Plan ("Basin Plan").[26] The Basin Plan includes rules for the regulation of oil and gas waste discharge to unlined sumps. It states:

- Maximum salinity limits for wastewaters in unlined sumps overlying ground water with existing and future probable beneficial uses are, 1,000 µmhos/cm EC, 200 mg/l chlorides, and 1 mg/l boron, except in the White Wolf subarea, where more or less restrictive limits apply.
- Discharges of oil field wastewater that exceed the above maximum salinity limits may be permitted to unlined sumps, stream channels, or surface waters if the discharger successfully demonstrates to the Regional Water Board in a public hearing that the proposed discharge will not substantially affect water quality nor cause a violation of water quality objectives.[27]

The Central Valley Board has not properly implemented these provisions of the Basin Plan. It has acknowledged publicly in inspection reports (detailed below) that the discharge fluids at certain pits (including the McKittrick pits, described below) violate the standards set in the Basin Plan, and that some discharges do not have permits to discharge at all. In short, the Central Valley Board has failed to properly implement its own Basin Plan, first by allowing discharge of produced water that violates the water quality objectives in that plan, and second by allowing unpermitted discharges to occur.

While the Basin Plan provisions serve as a regulatory floor, its effectiveness in protecting groundwater quality from degradation from oil and gas wastewater should also be examined. The Plan's provision requiring that "discharge not substantially affect water quality, nor cause a violation of water quality objectives," is vague and undefined and could lead to the conclusion that degradation up to the water quality objective is appropriate. In addition, in order to comply with the state's anti-degradation policy, each facility should conduct an anti-degradation analysis prior to the issuance of a WDR in order to determine where and to what degree degradation may be expected to occur and what impact that degradation would have on identified beneficial uses. The Central Valley Board has historically failed to require such analysis for groundwater, and does not

appear to have done so at the McKittrick, and other pits in the Central Valley, indicating another failure to implement the Basin Plan properly, and highlighting a deficiency in the Basin Plan's provisions.

The intended use of unlined pits is to percolate low quality water into the ground, a practice that inherently presents a risk of degrading any nearby and connected water resources. Unless isolation from any potentially beneficial use waters can be proven and ensured, the discharge of contaminated wastewater must be prohibited. The case of the McKittrick pits (below) demonstrates the difficulty of proving isolation and ensuring no migration of wastewater out of an intended area, or degradation of groundwater. In light of the interconnected nature of underground and surface hydrological systems, waste discharges into open pits must be presumed to be a threat to surface and groundwater resources unless sufficient information is provided to show that it is not.

Rather than examining the potential for threats to water resources at each individual pit as resources and time allow, as the Board has been doing since May of this year, **categorically prohibiting discharge into these high-risk pits is a more efficient and effective way to regulate disposal**. This would ensure compliance with the Basin Plan water quality objectives and protection of the region's scarce groundwater resources. The Central Valley Water Board has already ceased to issue permits for new pits, an action that we fully support. The Board also recently took an enforcement action and issued a fine to Vintage Production LLC for dumping wastewater from oil and gas operations into an unlined pit, citing Water Code Section 13350 for unpermitted discharges to land.[28] Shutting down existing pits is consistent with previously stated and acted upon policy decisions and water quality goals.

Precedent for Prohibiting Unlined Pits in Other States and Industry Best Practices

The use of unlined pits is a largely outdated method for wastewater disposal. Some states do not allow surface discharge of oil and gas waste into unlined pits. Pennsylvania requires, at a minimum, lining on all waste pits. If a liner is breached, all fluids must be prevented from leaking from the pit.[29] Colorado, prohibits the use of unlined pits where communication with groundwater is likely, and prohibits the disposal of untreated produced water into unlined pits.[30] New Mexico also requires lining for all new pits.[31]

The oil and gas industry's own best management practices commonly advise against surface discharge of produced water into unlined pits. The Center for Sustainable Shale Development (CSSD), an independent organization with representation from oil and gas producers such as Shell, Chevron, and Consol Energy, is adopting a zero surface discharge performance standard in 2014. CSSD's current standards require that any new pits be double-lined.[32] While double-lined pits do not fully eliminate threats to water quality, lined pits are preferable to unlined pits, such as those found in Kern County. The industry-funded oversight body, *Investor and Environmental Health Network and Interfaith Center on Corporate Responsibility*, identifies utilizing covered tanks for storing wastewater

as the number one best practice for preventing contamination from wastewater. The report cites companies like Encana, who have moved to closing pits containing drilling and production wastes.[33]

Prohibiting discharge of wastewater to unlined pits is technically feasible. Claims by industry that this would shut down operations should be viewed skeptically as the majority of operations in California do not use unlined pits. Additionally, closed loop waste systems have the potential to reduce liability risk associated with potential spills and contamination; protecting operators from potential clean up costs and damages. Decreasing the risk of contamination and the need for remediation may benefit operators in the long term.

Prohibiting the surface discharge of oil and gas waste to unlined pits is well within achievable industry standards already in use by many operators in California and nationally. This prohibition would not place undue burden on operators and could even provide economic benefits for industry. Additionally, other states have moved ahead of California in implementing regulations that do not allow this discharge method. In light of California's drought and the decreasing availability of groundwater and surface water for irrigation and drinking water, and the fact that 90% of drinking water in the Central Valley is provided by groundwater, California should look to any and all opportunities to protect water resources. At the very least, California should follow the lead of states that are already prohibiting the disposal of oil and gas wastewater into unlined open-air pits.

IV. McKittrick 1 and 1-3 pits: Examples of Inadequate Oversight and Threats to Groundwater and Air Quality

The McKittrick pits are a striking example of a known, long-time threat to water quality, and the inadequate oversight and enforcement of the law meant to prevent such threats. The Central Valley Board should not only address this case with individual enforcement action, it must consider the larger problem of waste pits and their threats to water resources. The scale of the problem (i.e. the hundreds of pits across Kern County and elsewhere in the state), makes it unlikely and impractical to expect that the State and Regional Boards can provide a regulatory response in the timely manner needed to prevent contamination. At current staffing levels, it will take years to examine all wastewater sumps in the Central Valley, let alone go through the process of amending or revoking their permits and issue enforcement actions for remediation of polluted discharges.

The McKittrick 1 and 1-3 pits, operated by Valley Water Management Company ("Valley"), near the South Belridge, Cymric and Elk Hills oil fields are situated just a few miles from the Kern River Flood Channel, the State Water Project, fertile farmland, and high quality groundwater. The Central Valley Water Board's process for reviewing permit compliance prioritizes sumps directly above or adjacent to water with known beneficial uses, leaving low priority pits such as the McKittrick pits, without adequate oversight.

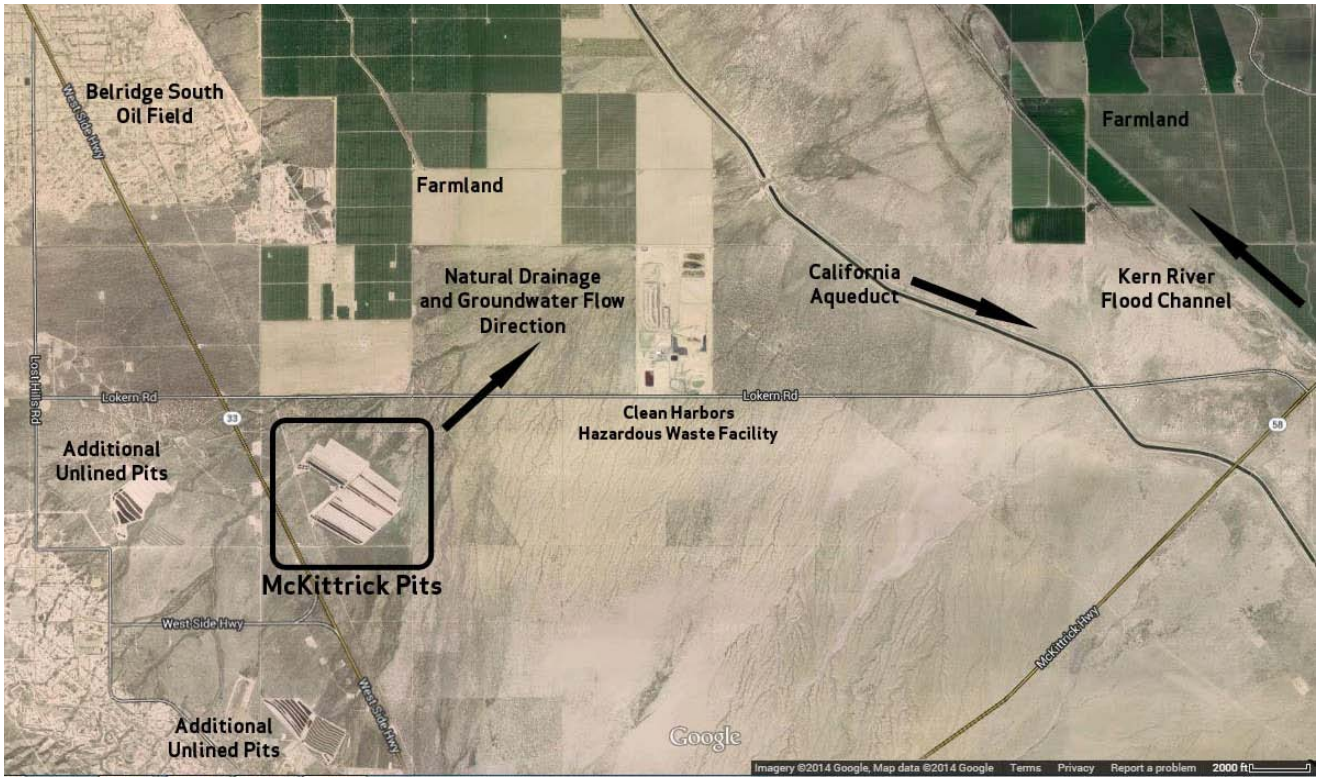

Image F: Aerial photo showing McKittrick waste pits in relation to water resources. Photo courtesy of Google Earth.

However, natural groundwater and surface runoff from the McKittrick pits flow directly toward valuable water resources. According to a Central Valley Water Board staff report, these pits are likely some of the largest in the region. They receive an average of 4.6 million gallons of produced water daily, largely from the Belridge Oil Field, the site of the majority of hydraulic fracturing in California.[34]

History of Inadequate Oversight

Constructed in the 1950s, the McKittrick 1 and 1-3 pits received no regulatory oversight until 1969, when the Central Valley Board first issued waste discharge requirements (WDRs) for these sumps. The initial WDR did not require any discharge characterization or groundwater monitoring.[35] Beginning in 1990,* Central Valley Board staff has inspected these pits annually.[36] In 24 years of inspections, no violations have been issued, despite several acknowledgements by inspectors that the pits did not meet waste discharge requirements under the Tulare Lake Basin Plan, originally adopted in 1975.[37] Beginning with the 1990 inspection, the Board "planned to add monitoring and reporting requirements in the future."[38] Inspections in 1990, 1993, and 1997 all reference the need to update the WDR to comply with the Tulare Lake Basin Plan.

Beginning in 1997, Valley (the operator of the pits) began submitting water quality data on the contents of the discharged fluids to the Board. Test results have

*Earliest recorded inspection in public documents provided by CVRWQCB.

Image G: Aerial photo of McKittrick waste pits, Kern County, CA. Courtesy Central Valley Regional Water Quality Control Board.

consistently shown levels exceeding Basin Plan standards for total dissolved solids, chlorides and boron, and the presence of BTEX compounds (benzene, toluene, ethylbenzene, xylene) in the discharged fluids.[39]

Beginning in 2002, at the request of the Central Valley Board, Valley began implementing a groundwater monitoring program, installing three test wells down-gradient of the sumps. *(See Image H for locations of monitoring wells).*[40]

In 2003 (the first year with available monitoring data), migration of wastewater was detected in the two test wells closest to the sumps.[41] The test results from these wells indicate a waste mound, or plume, had migrated at least 4,000 feet to the Northeast of the sumps as of 2004 — as described in an internal letter from the CVRWQCB.[42] The plume has not been detected at the farthest test well. Bi-annual monitoring, conducted by Schlumberger, one of the largest oil field service contractors in the country, as recently as 2013, has shown the presence of the plume at the first two test wells, as shown below, and described in the 2013 Sampling and Analysis documents.[43]

According to the 2003 hydrogeologic characterization, there are two historic agricultural wells approximately 4.5 miles beyond the test wells.[44] The Central Valley Board does not appear to have made a determination that the waste plume will not reach the useable groundwater in these agricultural wells.

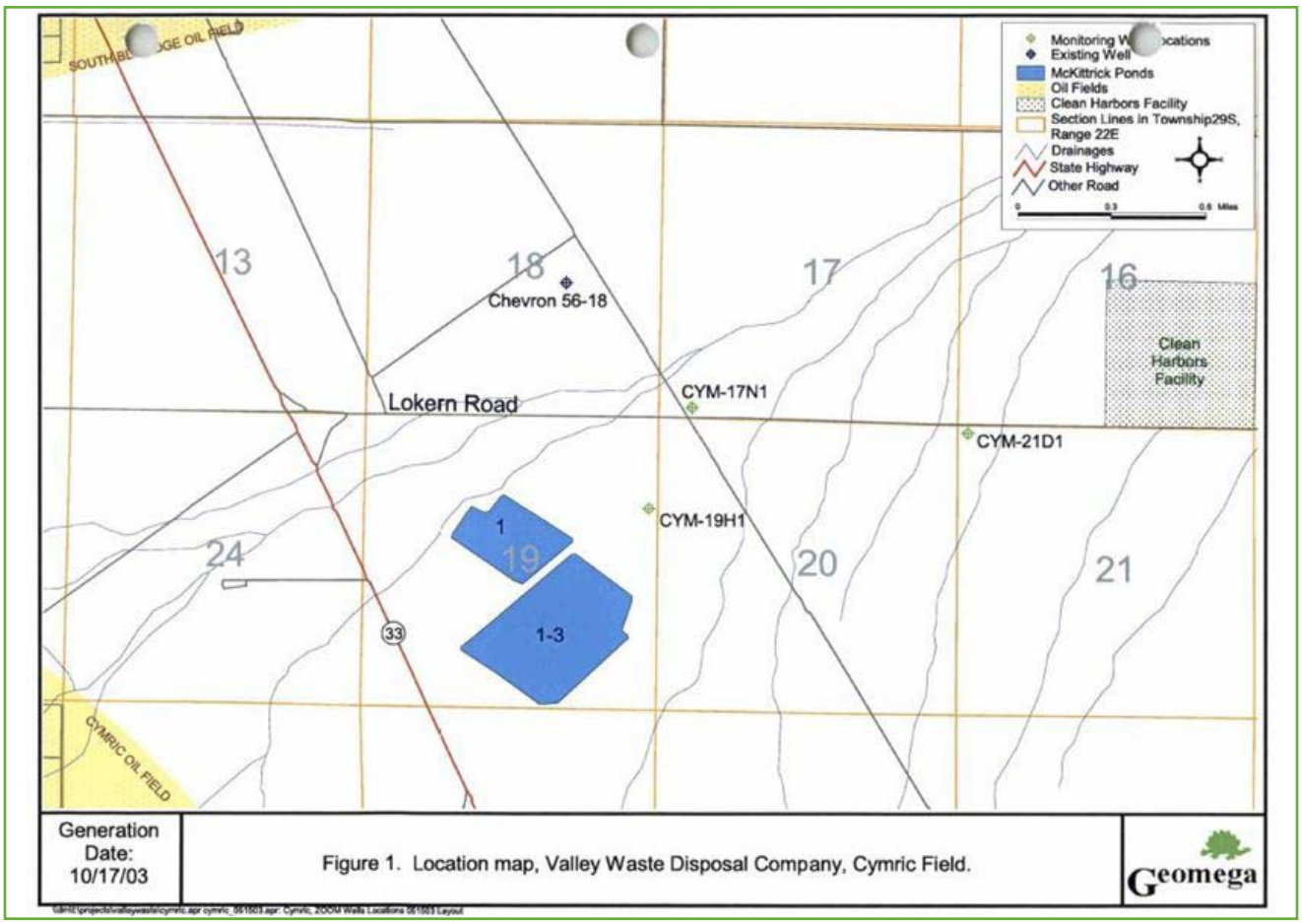

Image H: Map showing monitoring wells near McKittrick 1 and 1-3 pits. Source: 2003 Hydrogeologic Characterization Report p. 43 (See Endnote 41).

Increased Scrutiny

In April, 2014, Clean Water Action first inquired with Central Valley Board staff about the McKittrick 1 and 1-3 sumps. At the time of the inquiry, staff was unaware of these particular pits, or the documentation of the waste plume. In response to concerns raised about potential impacts and whether or not the pits were adequately permitted, the Board conducted their own water quality tests of the discharge fluid. Their results confirmed high levels of hazardous constituents in the wastewater, including boron and chlorides well in excess of permitted levels. These levels do not comply with limits for discharge without a permit under the Tulare Lake Basin Plan. Boron tested at 56mg/L (56 times the permissible limit), and chlorides at 6,000mg/L (30 times the limit).* Testing also confirmed the presence of other hazardous chemicals at dangerous levels, including BTEX compounds (including benzene), naphthalene, and diesel.[45]

In numerous historical inspection reports, Central Valley Board staff noted that the WDR was out of date, and that Valley did not have a discharge plan in compliance with the Tulare Lake Basin Plan. Central Valley Board test results have consistently shown

*The Tulare Lake Basin Plan specifies maximum levels of salinity, chlorides and boron for oil waste discharges.

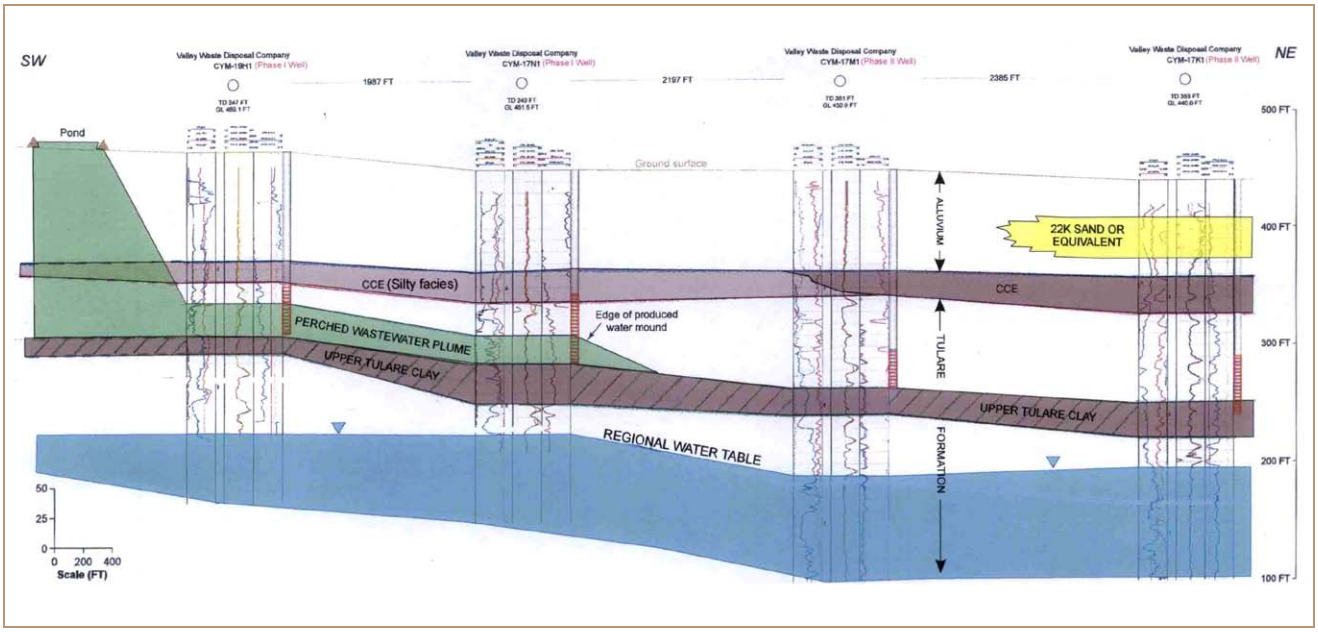

Image I: Detail from 2007 Phase 2 Hydrogeologic Characterization showing plume of wastewater migrating past first two monitoring wells.[46]

levels of contaminants that should trigger the requirement of a permit to ensure that discharge "will not substantially affect water quality nor cause a violation of water quality objectives."[47] However, the Board has not issued a single violation or halted discharge while threats to groundwater are investigated — a violation of the Basin Plan requirements for oil field waste.

Documented Air Quality Threats

In addition to water quality issues, open-air wastewater disposal pits also threaten air quality. The McKittrick pits provide a clear example of the impacts on air quality from open-air disposal of produced water. As noted in the description of the tour of the pits in April 2014, visitors to the site experienced firsthand strong odors and immediate nausea and headaches related to off-gassing of contaminants. Visually noticeable vapors rise off the produced water and from the discharge from the pipes leading into the pits.

In June 2014, a private citizen, filed a complaint with the San Joaquin Valley Air Pollution Control District (District), and turned over documentation of the complaint to Clean Water Action. The complaint reported:[48]

> *On June 15, I was near the above location and noticed noxious odors in the air. On closer inspection I saw multiple large ponds with hot, steaming water pouring into them from several different pipes. I estimated that hundreds of gallons per minute were pouring into the ponds. The color of the water was green in one pipe and black in another. The ponds were steaming and had what looked like oil floating on the surface. A few of the ponds had netting over them. I believe the gases from this water contain Volatile Organic Compounds in excess of what is allowed by law.*

Central Valley Air Regulations on Sumps

San Joaquin Valley Air Pollution Control District Rule 4402 regulates the emissions of Volatile Organic Compounds (VOC's) from crude oil wastewater sumps. The rule specifies that any produced water containing over 35 mg/L of VOC's must have VOC emission controls, such as a covering in place. Only small oil producers and "clean produced water" containing less than 35 mg/L are exempt from the rule.[49] There is no statewide regulation on emissions of VOC's or methane from oil and gas waste pits.

The complaint was processed by the San Joaquin Valley Air Pollution Control District (the District), which on July 9, responded:[50]

> *Conclusions: June 23, 2014; 11:00 AM: Conclusion by Steven Miller: On June 23, 2014 RI conducted a complaint investigation at the Valley Water Management Company (VWMC) located at the southeast corner of Lokern and Hwy 33. During the inspection RI observed several ponds in use but could not detect volatile odors.*
>
> *RI contacted Larry Bright of VWMC and informed him of the complaint and requested samples to make sure they are complying with District Rule 4402. Mr. Bright stated that the water is cleaned produced water from Freeport McMoRan Oil & Gas and that he would collect samples from the first pond in each series to show the water contains less than 35 mg/l.*
>
> *On July 8, 2014 RI received the analytical from Mr. Bright showing the water is well below the clean produced water standard as defined in District Rule 4402. Two ponds were sampled and the result from pond #1 is 1.4 mg/l and pond #2 is 12.2 mg/l. The sumps are compliant with District Rule 4402.*

The District's response to the complaint is not consistent with our own and others' observations and findings. The statement that no odor was detected is highly dubious. Numerous community and advocate organization staff and volunteers have visited the McKittrick pits on multiple occasions, and without exception have reported very strong and noxious odors, often resulting in headaches and nausea.

Perhaps the most concerning aspect of this incident is the fact that the District relied on samples provided by the operator. Not only is there a natural concern about the impartiality of the testing entity, but the sample data provided lacks any confirmation that samples were collected in accordance with the sample collection and testing protocols specified in Rule 4402 Sec. 3.4.

Finally, the District relied solely on water quality testing, and provided no documentation of any air quality testing to support its determination that the pits posed no threats. As the air quality regulator for the San Joaquin Valley, the District should at the very least conduct air sampling as a basic follow-up to a complaint about air quality.

Two sets of air quality samples taken by citizen investigators on May 3 and June 18, 2014 using EPA TO-15[51] air sampling protocols for hydrocarbons and VOCs. The samples found the following air quality results (based on independent analysis by ALS Labs): :

> *Air samples were collected on May 3 and June 18, 2014 in the area of evaporation pits. The air sample collected on May 3 contained 24 detectable Volatile Organic Compounds and Methane. The air sample collected on June 18 contained 12 detectable Volatile Organic Compounds and Methane. The June 18 sample detected Benzene and Hexanone levels that exceed the Long Term Effects Screening Levels (ESL's). Some of the compounds detected do not have established ESL's.*

The results of the air samples are presented below.[52, 53] *(See Table 2a and 2b)*

The variation in test results between the two sample dates is an indication of varying air quality around the pits and demonstrates the need for ongoing monitoring. Furthermore, the variability in air quality demonstrates the difficulty of ensuring that emissions do not negatively impact air quality, even with periodic monitoring. While monitoring results for a particular chemical may fall below threshold levels for enforcement on one day, sampling on a different date and time might yield higher and more actionable levels. Ongoing monitoring is needed to establish longer term average concentrations, as well as detecting spikes in chemical concentrations.

As is the case with water quality concerns, the air quality concerns at the McKittrick pits may be indicative of a more extensive problem at the hundreds of sumps throughout the Central Valley. Since Kern County has some of the worst air pollution in the country, regional air quality regulators must be more proactive. At a minimum, independent monitoring must be conducted, especially in response to citizen complaints. Regulators should also conduct an inventory of VOC emissions from open pits, perform a cumulative analysis on the air impacts of hundreds of sumps on air quality in the Valley, and when appropriate, enforce existing laws by issuing enforcement orders to control emissions.

V. Conclusion

The responsible agencies of the State of California must act immediately to address the numerous threats of oil and gas wastewater, including threats to ground and surface water, and to air quality. Documented environmental threats, inadequate oversight, and the sheer volume of the waste stream call for urgent action to update and reform the regulatory programs that are intended to protect Californians and the environment from oil and gas related impacts.

Based on the findings of this investigation, we believe that continued investigation into the other forms of wastewater disposal utilized by the oil and gas industry is

TABLE #2a: ***Results of Air Monitoring Sample Collected on May 3, 2014 and June 18, 2014 Near McKittrick 1 and 1–3 pits***

Chemical	May 3 Test Results: Concentration (µg/m³)	June 18 Test Results: Concentration (µg/m³)	Long Term Effects Screening Level*[54] Concentration (µg/m³)
Propene	1.4		n/a
CFC 12	1.9	2.0	42
Ethanol		7.1	n/a
Acetone	460	19	4800
Trichlorofluoromethane	1.0	1.0	5600
2-Propanol	23		n/a
2-Butanone (MEK)	340		1300
n-Hexane	3.5	0.69	200
Benzene**	13	1.8	4.5
Cyclohexane	24		340
n-Heptane	3.2	0.80	350
4-Methyl-2-pentanone	7.0		n/a
Toluene	21	3.0	1200
2-Hexanone**	12		4
n-Octane	2.4	0.69	350
Ethyl benzene	8.3		570
m,p-Xylene	11	1.3	180
o-Xylene	6.9	0.69	180
n-Nonane	1.8	0.71	1050
Cumene	2.2		250
n-Propylbenzene	2.3		250
4-Ethyltoluene	1.8		125
1,3,5-Trimethylbenzene	1.9		125
1,2,4-Trimyethybenzene	7.1		125
Naphthalene	7.9		50

*Long Term Effects Screening Levels (ESL's) are chemical specific air concentration levels based on data concerning health and vegetation effects. A discussion of the health impacts of Benzene and 2-Hexanone (the two chemicals testing above the ESL's) appears in Appendix A. In this report we used Texas' ESL's, since it is a more complete list than California's and covers more of the chemicals detected. A number of compounds do not appear on either state's list however.

**Test results exceed ESL.

TABLE #2b: ***Results of Air Monitoring Sample Collected on May 3, 2014 and June 18, 2014r Near McKittrick 1 and 1–3 pits: Tentatively Identified Compounds***

Tentatively Identified Compounds*	May 3 Test Results: Concentration (µg/m³)	June 18 Test Results: Concentration (µg/m³)	Long Term Effects Screening Level Concentration (µg/m³)
Dimethyl Sulfide	16		25
2-Butanol	18		n/s
Methylcyclopentane	39		260
2-Pentanone	57		530
3-Pentanone	22		
Dimethylcyclopentane Isomer	31		350
Dimethylcyclohexane Isomer	23		350
1,1,3-Trimethylcyclohexane	26		n/a
2,4-Dimethylcyclopentanone	16		n/a
1,2,3-Trimethylbenzene	18		25
Decahydronaphthalene Isomer	19		350
n-Dodecane		3.0	350
Methane	3.4 ppmv	2.7 ppmv	

warranted. We applaud DOGGR for its recent commitment to revisit its UIC program and we urge a comprehensive and transparent process to proceed expeditiously, with a particular focus on any injection wells located in basins that also provide water for irrigation and municipal uses. In addition, the use of wastewater for irrigation of crops in California requires additional investigation to ensure that oversight is adequate and wastewater used for irrigation purposes does not contain constituents of concern.

Actions and Policy Recommendations

The state should take immediate steps to prohibit the discharge of oil and gas wastewater into sumps. The Central Valley and State Water Boards have the authority under existing law to prohibit this disposal method. Water regulators must, at a minimum, order all discharge into inadequately permitted sumps to cease immediately. Failure to do so is a clear failure to enforce existing state law.

The State Board must also take steps to identify any degradation and/or pollution that has occurred as a result of decades of discharge into unlined pits. The Board should work to inventory historic sump locations and begin monitoring to detect any contaminated soil or groundwater containing constituents known to be present in the pits. As information becomes available, the Board must also act to require operators to remediate any problems.

*Tentatively Identified Compounds (TIC's) are compounds which can be identified by an analytical method but the concentration cannot be confirmed without additional testing.

The following actions must be taken immediately:

1. The State and Regional Water Boards should immediately issue cease and desist orders to all operators of active open and unlined pits.
2. The Regional Boards should take the following actions to address past and current discharges:
   - → Immediately require all operators that still discharge into sumps to develop a Report of Waste Discharge;
   - → Require all operators that have discharged into sumps conduct adequate monitoring to detect any migration of contaminants from all historic and existing waste disposal pits;
   - → Investigate all sites of produced water discharge in order to determine whether current or historical pits have degraded or contaminated groundwater;
   - → Require remediation by operators in all cases where degradation or contamination has occurred;
   - → Develop a plan for remediation of groundwater for which no responsible party can be identified; and
   - → Prohibit the continued use of unlined and open air pits for produced water.
3. The Central Valley Regional Water Quality Control Board must provide adequate staff and resources needed for proper enforcement and oversight. Given that passing and implementing the needed Budget Change Proposal to increase resources would take considerable time (January 2015 at the earliest), the only appropriate action in the interim would be to issue immediate cease and desist orders to be effective at least until further investigation has occurred at each site.

   Categorically prohibiting discharge into these high-risk pits would be a more efficient and effective way to regulate disposal, rather than examining the potential for threats to water resources at each individual pit.
4. The California Air Resources Board (ARB) should increase state oversight of open-air pits. ARB should consider whether San Joaquin Valley Air Pollution District Rule 4402 is adequate for protecting air quality in the Central Valley. ARB should examine why other districts, such as the South Coast Air Quality Management District (SCAQMD), have more stringent regulations for open sumps and should explore a uniform statewide rule. The SCAQMD (Rule 1176) for example, requires produced water in open pits contain less than 5 mg/L VOC's, compared to the San Joaquin threshold of 35 mg/L. The District should increase attention to the issue by, at a minimum, conducting a VOC and

methane inventory of produced water pits in the Central Valley, and properly enforcing existing District rules. Additionally ARB should prohibit open pits in its upcoming rulemaking to limit methane emissions from oil and gas production activities (expected to begin in 2015).

California is in the midst of one of the worst droughts on record, has a high likelihood of future water shortages, and is home to some of the worst air quality in the country. California water and air quality regulators must make it a top priority to protect all water and air resources from degradation by oil and gas industry practices.

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Appendix A: Health Impacts

Health Impacts of Two Chemicals Detected in Excess of the Long Term Effects Screening Levels

The health impacts of the two chemicals that exceeded the Long Term Effects Screening Levels consisted of:

Benzene

- Known human cancer causing agent
- Known mutagen
- Causes leukemia and damage to blood cells
- Irritates the nose, throat, skin and eyes
- Causes headaches, dizziness, nausea and vomiting

2-Hexanone

- Causes reproductive damage
- Damages the nervous system
- Causes weakness, numbness, tingling
- Irritates the skin, eyes, nose and throat
- Causes headaches, dizziness and lightheadedness

Health Impacts Associated with the Chemicals Detected during the May 3, 2014 Air Monitoring Period

- Known human cancer causing agent
- Probable carcinogen
- Known mutagen
- Causes leukemia , damage to blood cells and affects blood clotting ability
- Damages developing fetus
- Teratogen
- Cancer of the kidneys
- Damages liver, kidneys, larynx, intestines, nervous system and reproductive system
- Irritates the skin, eyes, nose, throat and lungs
- Causes headaches, nausea, vomiting, lightheadedness, dizziness and tremors
- Causes shortness of breath, coughing and wheezing
- Causes abnormal heart rhythm and irregular heart beat
- Causes numbness, tingling, weakness and fatigue
- Results in lack of coordination, reduced memory and personality changes

Health Impacts Associated with the Chemicals Detected during the June 18, 2014 Air Monitoring Period

- Known human cancer causing agent
- Known mutagen
- Causes leukemia and damage to blood cells
- Damages developing fetus
- Teratogen
- Damages liver, kidneys, nervous system and reproductive system
- Irritates the skin, eyes, nose, throat and lungs
- Causes headaches, nausea, vomiting, lightheadedness and tremors
- Cause shortness of breath, coughing and wheezing
- Causes abnormal heart rhythm and irregular health beat
- Causes numbness, tingling, weakness
- Results in lack of coordination, reduced memory and personality changes