



# Attention to Protocol

## How a State/Federal Partnership Defused Tensions over Perchlorate

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**Effective environmental remediation** relies on established regulatory standards, processes, risk science, and source characterization to decide on an appropriate course of action. When an “emerging contaminant” like perchlorate is involved, environmental professionals often lack such protocols and touchstones. Emerging contaminants are defined as chemicals or materials that have pathways to enter the environment and present potential, unacceptable human health or environmental risks. They either do not have regulatory peer-reviewed human health standards or the regulatory standards are evolving due to new science, detection capabilities, or pathways.

In the case of perchlorate, improved analytical capabilities, the perception of a definitive source, and conflicting risk messages have combined to create a groundswell of concern among the public, media outlets, and elected representatives, which created challenges for everyone involved.

In 2002, California regulators and the U.S. Department of Defense (DoD) faced this confluence of factors over perchlorate, a chemical relied upon by DoD as a stable oxidizer in propellants, munitions, and pyrotechnics. The circumstances led to the launch of a partnership in August 2003 to screen potential risks posed by DoD sites to California’s drinking water wells.

### Why a Protocol Was Needed

By late 2002, perchlorate had been observed in excess of 4 parts per billion (ppb) in more than 350 drinking water wells throughout California. At this point, perchlorate was attracting attention throughout the country due to detections in water supplies in over 25 states. Adding to the challenge, the analytical capability to detect perchlorate improved from the hundreds of ppb range down to just 4 ppb, maturing more quickly than agreement among scientists about which toxicological studies should become the basis for regulatory standards for drinking water and site cleanups. Nevertheless, some California water purveyors were shutting down drinking water wells or blending their sources to reduce concentrations of perchlorate. In a water-strapped region, this drew the attention and involvement of state and federal legislators, who demanded not only an explanation but also immediate action.

Moreover, a systematic evaluation of potential perchlorate sources in California had not been conducted. Neither the extent of perchlorate contamination in drinking water sources on or near DoD facilities, nor the potential role DoD facilities may have played in such contamination had been characterized. Although hints that other anthropogenic and natural sources could be contributing were emerging, DoD was perceived to be a major source of the problem because of its known use of perchlorate.

The California Regional Water Quality Control Boards, acting on behalf of the California Environmental Protection Agency (Cal/EPA), issued letters in June 2003 to all DoD facilities and formerly used defense sites (FUDS), requesting they investigate the sources of six emerging chemicals at their facilities, including perchlorate, and report that information back to the regulatory agencies. Meanwhile, DoD and the California regulatory agencies began to address the perchlorate issue, by establishing an interagency workgroup to formulate an appropriate approach to the perchlorate situation. DoD and the California regulatory agencies agreed to limit the scope of the interagency workgroup to perchlorate, leaving the other five emergent chemicals to be addressed separately.

In fall 2003, an interagency team of representatives from the state and each of the military services formed the California Perchlorate Working Group (CA PWG). Staff from Cal/EPA, the Department of Toxic Substances Control

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(DTSC), the State Water Resources Control Board, and some of the nine Regional Water Quality Control Boards made up the state's participants. DoD was represented by regional environmental coordinators from each service, in addition to a representative from the Corps of Engineers to address FUDS. Together, they looked for an expeditious and efficient way to focus limited resources in evaluating DoD facilities that posed the greatest potential for perchlorate releases.

Given the general lack of site characterization data and the dual realities of limited funding and competing sampling requirements, the CA PWG members recognized that an efficient screening tool was needed to identify and prioritize sites for investigation.

### The Perchlorate Protocol

The Prioritization Protocol for Perchlorate Impacts to Drinking Water from Department of Defense Facilities in California was published on August 25, 2004. The protocol was thoroughly vetted through the military services, the Office of the Secretary of Defense, and the Secretary of the Cal/EPA, and was designed as a simple proximity analysis using mapped data of drinking water wells

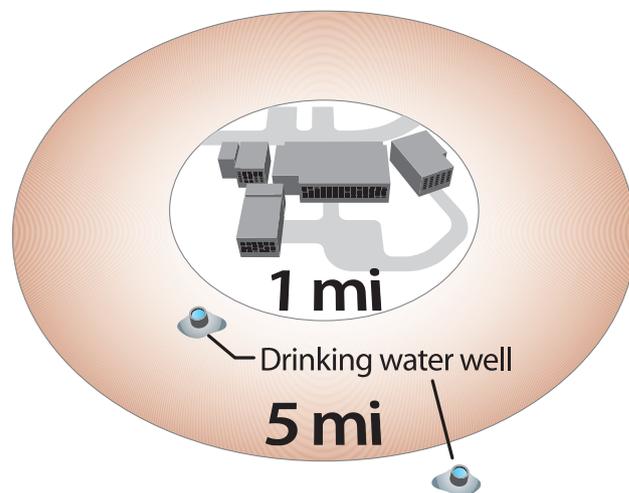


Figure 1. Illustration of boundaries for protocol.

obtained from the California Department of Public Health (DPH) (see Figure 1). The three prioritization criteria were: sites within five miles of a drinking water source; reported detections of perchlorate in those proximate drinking water wells at concentrations above the analytical detection limit of 4 ppb; and whether perchlorate-related activities may have occurred at the installation or site. This latter criterion required that the DoD contingent of the CA PWG first inventory all categories of historic and current military activities to establish where and how perchlorate-containing materials were used. Ease of mapping and agreement among the group led to the selection of the five-mile range. The inventory then informed site-specific reviews to determine whether perchlorate had been used in that location. The prioritization scheme is depicted in Figure 2, and is defined as:

- reported detections of 4 ppb of perchlorate or higher in public drinking water wells (yes, no, unknown);
- whether perchlorate-related activities may have caused a release at the installation or site (yes, no, unknown); and
- site proximity relative to a drinking water wells (less than one mile; or greater than one and less than five miles).

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Priority	Drinking Water Supply Impact? *			Perchlorate Release Area?			Distance Between Perchlorate Release Area (or Installation or Site Boundary) and Drinking Water Supply Source *	
	Yes	Unknown	No*	Yes	Unknown	No**	Within 1 mile	1 < miles < 5
HIGHEST ↑	a	●			●		●	
	b	●			●			●
	c	●				●	●	
	d	●				●		●
	e		●		●		●	
	f		●		●			●
	g			●	●		●	
	h			●	●			●
	i		●			●	●	
	j		●			●		●
	k			●		●	●	
LOWEST ↓	l			●	●			●
	m	●				●	●	
	n	●				●		●
	o		●			●	●	
	p		●			●		●

Figure 2. Prioritization method.

As can be seen from the matrix in Figure 2, the highest priority was given to DoD installations and FUDS sites that have a drinking water well located within one mile with detections of  $\geq 4$  ppb perchlorate, and with a known perchlorate use within the installation's fenceline. As illustrated in Figure 1, DoD facilities greater than five miles from a drinking water well were excluded from the effort, as well as operational ranges, which have yet to report sampling results and fell under DoD's ongoing Range Assessment Program.

A training workshop cochaired by the state and DoD was held in July 2004 to explain the protocol to users, such as state and DoD project managers. The workshop served to ensure consistent implementation. Feedback provided to the CA PWG also helped ensure understanding and buy-in from the field. A questions-and-answers document was generated as a reference for implementation of the protocol. The CA PWG also assisted and guided field implementers as the prioritization was taking place, following up with bases and regulatory agencies to ensure progress.

## Protocol Implementation and Findings

The protocol and an action plan for implementation were distributed to the DoD components and the Cal/EPA agencies in September 2004. Memoranda signed by the Assistant Deputy Under Secretary of Defense and the Cal/EPA Secretary, directed DoD personnel and state regulators to jointly determine the priority assigned to each facility and its individual sites within the relative ranking system. Implementation of the protocol was completed for each facility in three steps: planning, prioritization, and investigation.

### Planning

The planning phase consisted of a DoD review of existing records for information regarding the history of perchlorate use and disposal to assess the potential for releases of perchlorate to the environment. Concurrently, participating

state agencies conducted an evaluation of water supply wells within one and five miles of each site, and reviewed any available perchlorate sampling data.

### Prioritization

Each site was then prioritized by consensus among the DoD and state remedial project managers using the method described in the protocol. A letter rank was assigned to each site with "A" being the highest priority and "P" the lowest. During the priority-setting process, a "not applicable" (N/A) category was added to address sites where state and DoD representatives agreed that assigning a priority was not warranted or appropriate at the time. It is important to note that

this N/A designation was developed for screening sites using this protocol and is not equivalent to a state agency regulatory decision of "no further action." If the DOD component and the state regulatory agency staff could not reach agreement on the ranking of a site, it was referred to the CA PWG for discussion.

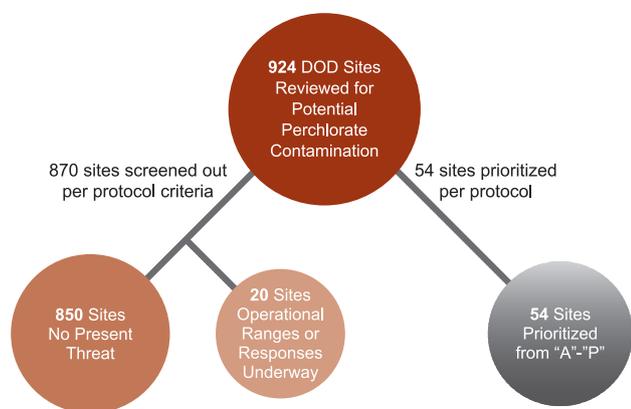
### Investigation

A total of 924 DoD sites were screened using the protocol (see Figure 3). Five sites were ranked as highest priority (Category A–D) for the third step of investigation and sampling. The potential universe of sites is mapped in Figure 3, showing the status of the 924 sites. The results of implementing the protocol are illustrated in Figure 4, which depicts the findings as of October 2008.

To put the California protocol findings into a national context, by the end of 2007, the results of more than 47,500 samples collected by DoD at 309 locations across the nation (including California) told a similar story. DoD's nationwide survey showed that the vast majority of perchlorate samples were below 4 ppb. The data showed that 56 installations/FUDS detected perchlorate—at some point in time in some media—in excess of 24 ppb, DoD's level of concern for managing perchlorate. (For a summary of DoD's perchlorate sampling results, see the references at the conclusion of this article.<sup>1,2</sup>)

**A site was determined to be not applicable to the protocol if any of the following conditions were met:**

- Operational ranges
- Ongoing perchlorate investigation or remediation
- Greater than five miles from a drinking water supply
- Know hydrologic conditions indicate it is not a source
- Consensus between state and DoD project managers that the site is not a source based on site history of perchlorate use, and/or disposal
- No impacted drinking water supply within five miles



**Figure 3.** Evaluation of the potential universe of sites in California.

Of the 56 locations, 41 were taking appropriate action in consultation with regulators, while the remaining 15 had either completed appropriate action or did not require any action. There were no exceedances above 24 ppb at DoD drinking water wells—although several wells with potable uses have been shut down to avoid potential exposures. The Commonwealth of Massachusetts also investigated perchlorate and concluded in a March 14, 2005, letter to the U.S. Environmental Protection Agency (EPA), “None of the nine water supplies that have tested positive for perchlorate in Massachusetts appear to have any connection to military bases or activities.”

### California Regulatory Status

The State of California was among the first to act, establishing a nonregulatory guidance of 6 ppb for perchlorate in March 2004. Several significant events have changed the regulatory landscape for perchlorate in California since the finalization of the protocol in 2004. Of greatest public interest and impact was the California DPH’s establishment of a drinking water maximum contaminant level of 6 ppb on October, 18, 2007. For California, this effectively resolved the “unregulated contaminant” issues surrounding perchlorate investigation and remediation.

The Perchlorate Contamination Prevention Act of 2003,<sup>3</sup> required that the California DTSC adopt regulations specifying best management practices (BMPs)<sup>4</sup> for the management of perchlorate-containing materials to

prevent future releases to the environment. As a result of DoD and California’s partnership in developing the protocol, DTSC received DoD input on handling practices and even determined that in some instances DoD’s requirements were equivalent or more stringent than the BMPs proposed by DTSC. BMP requirements were adopted for packaging, labeling, secondary containment, recordkeeping, reporting, notification, disposal, and discharge of perchlorate-containing materials, and became effective on July 1, 2006.

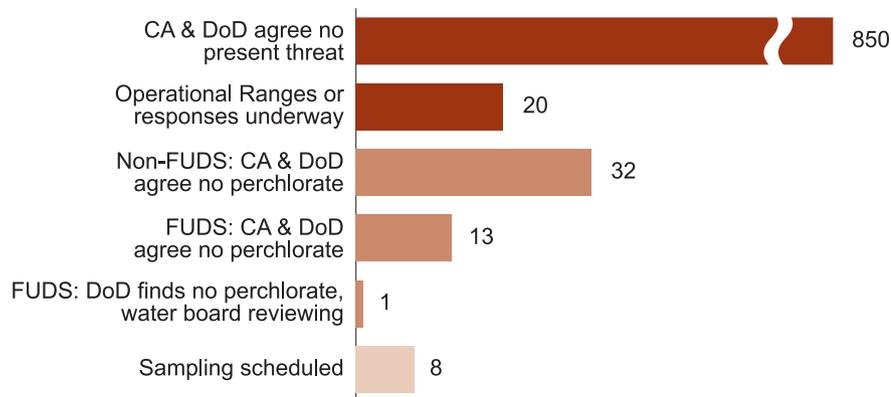
Another state law, SB 1004,<sup>5</sup> amended the California water code to require a party responsible for perchlorate contamination of water supplies to provide replacement water for each user. SB 1004, passed in 2003, also requires owners of perchlorate facilities to notify the State Water Board about where, how much, and the manner in which they stored perchlorate from 1950 to the present, and required the State Water Board to establish a database for reporting on the storage and releases of perchlorate. Finally, the law requires persons who discharge 10 lb or more of perchlorate into any waters of the state to immediately notify the State Office of Emergency Services and the appropriate Regional Water Board.

### DoD Sampling Policy Status

DoD’s policies regarding sampling of, and response to, perchlorate were clarified over the 2002–2007 timeframe as information evolved: the first policy was issued on November 13, 2002, a second on September 29, 2003, and a third on January 6, 2006. DoD’s 2006 policy reflects both perchlorate risk assessment and management actions, applies to all DoD property and FUDS, and is based on the EPA’s chronic reference dose for perchlorate of 0.7 µg/kg/day. It established 24 ppb as the “level of concern” and also integrates other applicable state or federal standards. The policy refers to sampling DoD-owned drinking water systems, groundwater, wastewater, and soil, and notes that response actions may be taken based on site-specific risk assessments.

### Next Steps

After the review and identification of sites through the implementation of the protocol, the DoD and state remedial project managers have been cooperating to develop sampling plans and schedules for each prioritized site. For sites where insufficient information was available, sampling was conducted, or is now scheduled to be conducted, to fill data gaps. The State Water Resources Control Board has requested that the California DPH’s Division of Drinking Water and Environmental Management work with water purveyors to sample untested public drinking water wells within five miles of DoD sites. Where perchlorate releases are confirmed, the DoD



**Figure 4.** Protocol results.

# Perchlorate Guidance: Remediation Technologies for Perchlorate Contamination in Water and Soil

The Interstate Technology & Regulatory Council (ITRC) Perchlorate Team was formed in 2004 to address technical issues associated with perchlorate remediation. The Perchlorate Team is composed of representatives from environmental agencies, federal agencies, private consulting and vendor companies, academia, and public stakeholders.

In March 2008, the ITRC Perchlorate Team published, *Remediation Technologies for Perchlorate Contamination in Water and Soil*. The purpose of this document is to conduct a review of technologies applicable to the remediation of perchlorate in groundwater and/or soil. In addition, the social, political, and regulatory barriers to the deployment of these technologies are examined. The expected outcome is that industry, responsible parties, and state and federal environmental regulators will have reliable guidance that will streamline the review and approval process for perchlorate treatment technologies. This document is intended to serve as a technical and regulatory reference for state and federal regulators, consultants, project managers, and other stakeholders when selection of a cleanup technology for perchlorate is necessary. Where possible, this document identifies important regulatory issues to consider during site characterization, design, construction, and monitoring. Case studies are included to highlight various applications and potential complicating issues when implementing particular technologies.

The team also conducts free online training related to perchlorate. ITRC develops and delivers training courses via the Internet to reach a geographically dispersed audience of regulators, consultants, and other members of the environmental community. These courses create a unique forum for the exchange of technical and regulatory information because they are based on ITRC guidance documents, which reflect the consensus opinion of ITRC members from states and federal environmental agencies, the private sector, and citizen stakeholders.

*Established in 1995, ITRC is a state-led, national coalition of personnel from the environmental regulatory agencies of some 40 states and the District of Columbia, three federal agencies, tribes, and public and industry stakeholders. The organization is devoted to reducing barriers, and speeding interstate deployment of better, more cost-effective, innovative environmental techniques. ITRC operates as a committee of the Environmental Research Institute of the States, a Section 501(c)(3) public charity that supports the Environmental Council of the States through its educational and research activities aimed at improving the environment in the United States and providing a forum for state environmental policy makers. More information about ITRC and its available products and services can be found online at [www.itrcweb.org](http://www.itrcweb.org).*

remedial project managers will address the site using existing response programs.

## Conclusions

The perchlorate prioritization process was used to focus screening efforts on previously unidentified threats to public water wells on or near DoD sites in California. The protocol was a success in that DoD and the State of California were able to conclude that the majority of potential perchlorate releases associated with DoD sites had already been identified through existing environmental programs and were being addressed. The protocol excluded Resource Conservation and Recovery Act sites (i.e., corrective actions, operating facilities, and closure/post-closure activities) and DoD operational ranges, where sampling has yet to be reported. In addition, sites greater than five miles from a public drinking water well, releases that impact media other than drinking water wells, and non-DoD sites, including contractor-owned facilities, were not captured.

Nevertheless, the protocol, when taken together with other DoD sampling and remedial efforts, as well as sampling efforts by other parties, reveals that the sources of perchlorate detections in water wells appears to be far more complicated than originally suspected. Based on the results of the prioritization, the current regulatory standards for perchlorate, sampling results to date, as well as actions taken to manage new releases and remediate known perchlorate releases, it appears that DoD's installations/FUDS are not significantly impacting California

public drinking water wells. Yet, much work remains to be done. Completion of DoD's sampling of its ranges, looking at FUDS further than five miles from drinking water wells, and finding all the other perchlorate sources (both natural and anthropogenic) will be needed before a more complete understanding of the distribution of perchlorate in California is achieved.

The partnership fostered by CA PWG not only provided a framework for public health decision-making focused on the highest concentrations found and careful use of limited fiscal resources, it also served to prepare the parties involved for future communication on key issues. As was evident in the refinements to California's BMPs for handling perchlorate that resulted from the collaboration, the goodwill and trust established between the parties in forging the protocol has led to both a model and a vehicle for addressing future emerging contaminants. **em**

## References

- 1 California drinking water wells with perchlorate. California Department of Public Health, Division of Drinking Water and Environmental Management. See [www.cdph.ca.gov/certlic/drinkingwater/Pages/Perchloratehistory.aspx](http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Perchloratehistory.aspx).
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- 3 California Perchlorate Contamination Prevention Act, 2003. See [http://leginfo.ca.gov/pub/03-04/bill/asm/ab\\_0801-0850/ab\\_826\\_bill\\_20030929\\_chaptered.html](http://leginfo.ca.gov/pub/03-04/bill/asm/ab_0801-0850/ab_826_bill_20030929_chaptered.html).
- 4 Best management practices for perchlorate handling and disposal. California Department of Toxic Substances Control. See [www.dtsc.ca.gov/LawsRegsPolicies/Title22/OEARA\\_REG\\_Title22\\_Ch33.cfm](http://www.dtsc.ca.gov/LawsRegsPolicies/Title22/OEARA_REG_Title22_Ch33.cfm).
- 5 California State Bill (SB) 1004, Introduced by Nell Soto (2204). See [http://info.sen.ca.gov/pub/03-04/bill/sen/sb\\_1001-1050/sb\\_1004\\_bill\\_20030221\\_introduced.pdf](http://info.sen.ca.gov/pub/03-04/bill/sen/sb_1001-1050/sb_1004_bill_20030221_introduced.pdf).

