

**STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION**

STAFF REPORT FOR REGULAR MEETING OF MARCH 20-21, 2008

Prepared on February 27, 2008

ITEM NUMBER: 24

SUBJECT: Perchlorate Cases

DISCUSSION:

Note: *New information concerning the following sites is shown in italics.*

Background

Perchlorate is both a naturally occurring and man-made chemical, although it is rarely found naturally in the United States. One-third of all perchlorate used in the United States is used in California and 90% of California's perchlorate use is related to the aerospace industry. There are three major sources of perchlorate in the United States: ammonium perchlorate has been and continues to be used as an oxidizer in solid rocket propellant, sodium perchlorate is used in slurry explosives, and potassium perchlorate is used in road flares and air bag inflation systems. Wastes from the manufacture and improper disposal of perchlorate-containing chemicals are increasingly being discovered in soil and water.

Health Effects

Perchlorate is known to interfere with the natural function of the thyroid gland by inhibiting the uptake of iodide. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. Such an effect decreases production of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. Potassium perchlorate was used until recently to treat hyperthyroidism related to Graves disease, and is still used diagnostically to test thyroid hormone production in some clinical settings.

Regulatory Standards

Perchlorate is a regulated drinking water contaminant in California, with a maximum contaminant level (MCL) of 6 micrograms per liter ($\mu\text{g/L}$), effective October 18, 2007. Currently there is no federal drinking water MCL for perchlorate. The U.S. Environmental Protection Agency (USEPA) is in the process of studying the occurrence and health effects of perchlorate.

Treatment Methods

Treatment of perchlorate contamination in water is complicated because the perchlorate anion does not respond to typical water treatment techniques because of its fundamental physical and chemical nature. The perchlorate tetrahedron itself is structured such that the four oxygen atoms surround the central chlorine atom, effectively blocking reductants from directly attacking the chlorine. Although perchlorate is thermodynamically a strong oxidizing agent, it is a kinetically sluggish species, making its reduction generally very slow and rendering common reductants ineffective. It can persist in the environment for many decades under typical groundwater and surface water conditions because of its resistance to react with other available constituents.

Perchlorate treatment technologies may be generally classified into categories of destruction or removal technologies. Destructive processes include biological reduction, chemical reduction, and

electrochemical reduction. Physical removal processes include anion exchange, membrane filtration (including reverse osmosis and nanofiltration), and electrodialysis, which all require subsequent disposal of removed perchlorate. The optimum treatment technology for a given perchlorate occurrence may depend on several factors, including perchlorate concentration, the presence and concentration of co-contaminants, other water quality parameters and geochemical parameters. The presence of indigenous perchlorate-reducing microbes and substances inhibitory to their activity will also influence perchlorate treatment technology effectiveness. For in-situ treatment of perchlorate contamination, variables related to the site hydrogeologic setting, such as depth to and distribution of contaminants, soil permeability, groundwater flow velocity, etc. are also additionally important.

Olin Corporation Facility, 425 Tennant Avenue, Morgan Hill, Santa Clara County

Project Manager: Hector Hernandez

Technical Support: Thea Tryon

Background

The former Olin Corporation site is a 13-acre parcel located in southern Morgan Hill. Olin and Standard Fusee used potassium perchlorate in the manufacture of flares from 1956 to 1995. Olin manufactured signal flares at the facility for about 32 years from 1956 to 1988. Standard Fusee leased the site and manufactured signal flares for seven years from 1988 to 1995. Perchlorate was first detected at the site in August 2000 during a due diligence investigation by a potential buyer. Olin made initial contact with Central Coast Water Board staff regarding the perchlorate contamination in February 2001. Perchlorate contamination at the site may have occurred primarily from an unlined evaporation pond that received wastes from the cleaning of the ignition material mixing bowls, on-site incineration of cardboard flare coatings with residues on them, and accidental spills. The Central Coast Water Board never formally regulated waste disposal practices while the facility operated, but facility records do make reference to inspections by Water Board staff.

Groundwater in the region typically occurs in alluvial sediments, at depths ranging from 7 to 568 feet below ground surface. The alluvial deposits are composed of heterogeneous layers of clay, silt, sand, and gravel. Interconnected multiple aquifers exist within the area. Groundwater underneath the site is generally unconfined, although there are identified confined zones within the sub-basin to the southeast of the property. The groundwater flow direction is predominantly to the south-southeast with occasional variation to the south and south-southwest. Detailed description of geology and hydrogeologic conditions within the Llagas Subbasin are included in Olin's January 31, 2007, *Llagas Subbasin Characterization – 2006*, Santa Clara County Olin/Standard Fusee, Morgan Hill, California (2006 Characterization Report).

Bottled Water Service Terminations

Central Coast Water Board staff continues to take a conservative approach addressing all issues related to bottled water service termination and monitoring requirements after bottled water service has been terminated. Private domestic supply well users in the Morgan Hill, San Martin, and Gilroy area depend on their well water as their main drinking water source.

Olin continues to provide bottled drinking water to well owners and tenants whose wells have perchlorate concentrations greater than 6.0 µg/L. Olin provides bottled water in accordance with the Central Coast Water Board Cleanup or Abatement Order No. R3-2004-0101, as revised by the State Water Resources Control Board in its Order WQ 2005-0007 (State Water Board Order) and Central Coast Water Board staff's letter dated October 6, 2006. The October 6, 2006 letter provides comments and clarifies all replacement water requirements (e.g., bottled water) and post bottled water termination monitoring.

To date, Central Coast Water Board staff has determined that twelve phases of bottled water service termination have met State Water Board Order criteria. Central Coast Water Board's Executive

Officer has concurred with Olin's request to terminate bottled water service for **560 wells**, in accordance with State Water Board Order requirements. Since July 2006, users of **40 wells** have had bottled water reinstated because perchlorate concentrations above 6 µg/L were detected through post-bottled water termination monitoring. Central Coast Water Board staff will continue to review and evaluate all data submitted by Olin that is associated with bottled water terminations and post-bottled water termination monitoring.

Presently, Olin provides bottled drinking water to owners and tenants at 102 wells that do not meet State Water Board criteria for terminating bottled water service. A total of 153 households are associated with these 102 wells. Thirty-five of 266 domestic supply wells sampled during the fourth quarter of 2007 contained perchlorate concentrations above 6 µg/L. Nine of the 35 wells with perchlorate concentrations above 6 µg/L have ion-exchange systems installed on the wells.

Ion Exchange (IX) System Installations

To date, Olin has installed ion exchange (IX) systems on 15 domestic supply wells. These systems continue to operate as designed. Olin began IX system installation at wells exceeding 10 µg/L, then at wells with concentrations between 8.0-9.9 µg/L. Presently, all domestic supply wells that are actively used as a potable water source with perchlorate concentration above 7.9 µg/L are equipped with IX systems. Fourteen of the 15 ion exchange units installed are operating as designed, system installation remains on hold at one well, and access approval has been received at the other well. Olin has not scheduled installation for one candidate well located on vacant property and another well is not being used as a potable source. Olin continues to evaluate the need to install IX systems on candidate wells that have had greater than 6.0 µg/L perchlorate detections during the past four quarters. Data evaluation continues for the other candidate wells.

Olin will continue providing bottled water to IX wells pending Department of Public Health (DPH) acceptance of the domestic IX systems. In January 2007, Olin submitted its IX system pilot test protocol (Demonstration Protocol) to DPH and provided an update in May 2007. A second Demonstration Protocol report was submitted November 15, 2007. All of the demonstration sites appear to be eliminating perchlorate from groundwater, as expected. MACTEC also conducts monthly inspections of the IX systems. DPH review and approval on the first and second reports remains pending.

Cleanup Order No. R3-2007-0077

At the December 7, 2007 Water Board hearing, the Central Coast Water Board authorized the Executive Officer to issue Cleanup and Abatement Order No. R3-2007-0077 (Cleanup Order No. R3-2007-0077). Cleanup Order No. R3-2007-0077 rescinds Cleanup Order No. R3-2005-0014, as amended by Cleanup Order No. R3-2006-0112, but does not remove any requirements of the prior Order.

The Cleanup Order outlines Olin's groundwater cleanup requirements, including the groundwater cleanup approach, strategy, and schedule that are necessary to achieve compliance with groundwater cleanup requirements.

- **Petition** - The City of Morgan Hill (City) filed a petition with the State Water Board requesting review of Cleanup Order No. R3-2007-0077 issued to Olin Corporation. The City further requested to submit supplemental evidence to the State Water Board and a hearing on the supplemental evidence. State Board received the City's petition on January 07, 2008.

On January 23, 2008, the Central Coast Water Board sent a letter to the State Water Board to object to the City's requests and urge the State Water Board to deny both requests.

Water Board staff will be available to provide any updated information concerning the petition at the March meeting.

- **Status of Investigation and Cleanup Activities** - In accordance with Cleanup Order No. R3-2007-0077, Olin has achieved compliance with the following tasks and report submittals:

- **Intermediate Zone:** Olin completed the installation and testing of intermediate aquifer zone extraction well (IEW-01).

Remaining Task - Olin is now required to demonstrate hydraulic containment of Priority Zones A and B (in the intermediate aquifer only) or submit an alternative Priority Zone B containment plan, as required by the Executive Officer.

- **Deep Zone:** Area I deep aquifer characterization efforts are ongoing. During December 2007 and January 2008, Olin completed installation and groundwater development activities at deep aquifer monitoring wells MW-66 and MW-67, respectively. Olin performed perchlorate and hydraulic testing activities at both well locations.

On January 14, 2008, Olin submitted to the Central Coast Water Board an extension request related to installation and testing of a deep aquifer extraction well. As indicated in Olin's formal comments on the draft Cleanup Order No. R3-2007-0077 as presented during the December 7 Hearing, installation and testing of a deep aquifer extraction well by March 28, 2008 is technically unattainable. Central Coast Water Board granted Olin's extension request because it agrees that the request is reasonable and appropriately justified. Olin is required to submit deep aquifer test information by April 15, 2008.

Remaining Tasks - Olin must provide a reasonable implementation schedule in its Feasibility Study Addendum, due April 15, 2008. Olin is also required to complete delineation of perchlorate concentrations within the deep aquifer zone.

- **Onsite Groundwater Treatment and Containment:** The onsite groundwater treatment system continues uninterrupted operation. The treatment system began operation on February 23, 2004. Groundwater is extracted at a rate ranging from 50 to 175 gallons per minute (gpm). Extracted groundwater is filtered, and perchlorate is removed using a perchlorate specific ion-exchange process. The treated groundwater is re-injected onsite into the shallow aquifer. Olin continues to evaluate the effectiveness of the extraction and re-injection system to ensure effective hydraulic control of the perchlorate plume in the shallow and upper intermediate aquifer. During the fourth quarter of 2007, the treatment system extracted and removed perchlorate from approximately 14 million gallons of groundwater. To date, perchlorate has been removed from over 217 million gallons of water and Olin has removed a total of approximately 75 pounds of perchlorate.

- **Status of Monitoring and Reporting Program (MRP) Revisions** - Central Coast Water Board staff is in the process of updating, revising, and consolidating all monitoring requirements (MRP No. 2003-0168 and MRP No. 2001-161) into a new MRP. Central Coast Water Board staff and Olin recognize the need for a revised MRP that updates and incorporates all the monitoring requirements necessary to effectively monitor perchlorate concentrations over time, plume migration, and cleanup progress. The new MRP will include a detailed monitoring network to ensure that perchlorate concentrations are effectively monitored in specific areas of the plume and that increasing trends in groundwater with perchlorate concentrations near 6.0 µg/L can be identified prior to these concentrations reaching domestic supply wells. The MRP will determine the effectiveness of Olin's hydraulic control efforts and their monitored attenuation.

As of the date of this update, Central Coast Water Board staff has initiated coordination efforts with Olin and its consultants to issue the new consolidated MRP. Central Coast Water Board staff anticipates a consolidated MRP will be finalized or very close to being finalized by the date of the Water Board hearing in March.

Reports Under Review

By the date of this update, Central Coast Water Board staff has completed or is in the process of completing its review and preparation of comments concerning the following reports:

- June 15, 2007, Llagas Subbasin Cleanup Work Plan, Olin/Standard Fusee Site, Morgan Hill, California (Cleanup Work Plan).
- January 30, 2008, Fourth Quarter 2007 Groundwater Monitoring Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (4Q Monitoring Report).
- January 30, 2008, Llagas Subbasin Characterization – 2007, Santa Clara County Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (2007 Characterization Report).

Upcoming Reports

- First Quarter 2008, Groundwater Monitoring Report, due by **April 30, 2008**.
- Monthly Progress Reports, due by the **10th of every month**.
- Area I Plume Migration Control FS Addendum, due by **April 15, 2008**.
- Intermediate Aquifer Zone Cleanup Work Plan, due by **April 15, 2008**.
- Area I 45% Engineering Design Package, due by **August 8, 2008**.
- Area I 90% Engineering Design Package, due by **November 28, 2008**.

Status of Groundwater Flow and Mass Transport Model

The Central Coast Water Board has obtained the services of Department of Toxic Substance Control (DTSC) staff member Alice Campbell, to serve as an independent third-party consultant that is currently reviewing and evaluating MACTEC's groundwater flow and transport model. Ms. Campbell will evaluate whether Olin's groundwater flow and transport model is reasonable and appropriate. Central Coast Water Board staff anticipates Ms. Campbell will complete her evaluation of the flow and transport model by May 2008.

Perchlorate Community Advisory Group

The Perchlorate Community Advisory Group (PCAG) meets monthly in San Martin. The advisory group is a forum for public discussion of the perchlorate problem and potential solutions. Central Coast Water Board staff solicits advisory group input at key decision points in the investigation and cleanup process.

Central Coast Water Board staff did not attend the February 1, 2008, PCAG meeting held in San Martin. PCAG Board Chair, Sylvia Hamilton, indicated that the primary topic of discussion during the meeting was the establishment of a PCAG meeting schedule for 2008. Water Board staff provided a proposed meeting calendar based on the most significant milestones concerning the Olin Cleanup case and our Water Board meeting schedule.

The next PCAG meeting will be held at the San Martin Lions Club on Friday, April 4, 2008, at 2pm. Central Coast Water Board staff will attend and be available to address questions from the public concerning the ongoing Olin cleanup issues.

Olin Reports and Significant Correspondence can be accessed on our website at:

<http://www.swrcb.ca.gov/rwqcb3/Facilities/Olin%20Perchlorate/Olinsite.htm>

Whittaker Ordnance Facility, 2751 San Juan Road, Hollister, San Benito County
Project Manager: Kristina Seley: 805-549-3121

Conceptual Site Model

On January 28, 2008, Whittaker submitted the Conceptual Site Model Report. Central Coast Water Board staff requested Whittaker update the conceptual site model because Whittaker has collected additional data and Whittaker has identified possible data gaps in recent years. The Report summarized site history, waste constituent sources, geology, hydrogeologic conditions, and waste constituent distributions including volatile organic compounds (VOCs) and perchlorate. The Report also identified data gaps, which include:

- hydraulic communication across site-scale faults is not fully understood, these faults affect localized groundwater flow paths.*
- the upper groundwater units are laterally discontinuous and heterogeneous, and therefore characterization of soil types is not complete.*
- waste constituents in groundwater south of the site are not well delineated.*
- assessment of bioremediation off-site is a data gap which should be evaluated to assess natural attenuation.*

Central Coast Water Board staff are currently reviewing the Conceptual Site Model Report and anticipate providing comments before the March 21, 2008 Board meeting.

Off-Site Investigation Work Plan

Concurrent with the "Conceptual Site Model Report," Whittaker prepared an "Off-site Investigation Work Plan," dated January 30, 2008. The objective of the off-site investigation is to 1) characterize the groundwater flow, soil type, and extent of constituents of concern to support a long-term remedial strategy; and 2) support ongoing efforts to manage current and future groundwater withdrawals for potable and agricultural uses that prevents exposure and spread of waste constituents in groundwater. Whittaker's scope of work includes completion of a well survey and construction of monitoring wells in both shallow and deep aquifer zones. Staff is currently reviewing the Off-Site Investigation Work Plan, and will complete the review process prior to the March Board meeting in anticipation of Whittaker's field activities on March 17, 2008. Whittaker will submit weekly updates to staff regarding groundwater sampling and well locations until well installation is completed in July 2008.

Groundwater Extraction and Treatment System

The May 2006 "Remedial/Design Remedial Action Work Plan" included design of a groundwater extraction and treatment system. The purpose of the proposed groundwater extraction and treatment system is to contain groundwater migrating from the site to reduce the risk of impacting off-site groundwater beneficial uses. After the on-site groundwater is extracted, Whittaker plans to treat the groundwater with a treatment system consisting of granular activated carbon for VOC removal and a bioreactor for perchlorate and hexavalent chromium remediation.

Whittaker installed seven on-site extraction wells for the groundwater extraction and treatment system. Whittaker has not completed construction of the treatment system. On December 7, 2006, the Central Coast Water Board approved the reissued General NPDES Permit for Discharges of Highly Treated Groundwater. Due to the presence of selenium in concentrations greater than discharge limits included in the General NPDES permit, Whittaker cannot discharge to the San Benito River as originally planned. Whittaker is currently evaluating an option to reinject treated water to a neighboring property pursuant to the Central Coast Water Board Waiver of Waste Discharge Requirements. Also, Whittaker is assessing disposal to the neighboring sanitary sewer, evapotranspiration, and selenium treatment prior to river discharge.

Off-site Agricultural Wells

In the "Remedial Design Remedial Action Work Plan," Whittaker proposed to decommission the Riverside and Christopher agricultural wells to reduce the vertical migration of contaminants. The two neighboring agricultural wells are screened across multiple deep aquifer units. Whittaker's consultants destroyed the Christopher well on August 8, 2007, in accordance with San Benito County Water District and California Well Standards. Whittaker must provide replacement water supply to the Christopher well user. Whittaker drilled a replacement well and found that the water quality does not meet agricultural supply use criteria. Whittaker is currently researching replacement water options including water supply from other off-site sources.

The Riverside well is an agricultural supply well impacted with both VOCs (430 µg/L to 600 µg/L in 2005) and perchlorate (50 µg/L to 100 µg/L in 2005). In 1993, Whittaker voluntarily equipped the well with a VOC treatment system for continued agricultural use and connected the 14 well users to City water for domestic supply. PG&E shut down power to the Riverside well on February 23, 2007. Central Coast Water Board staff is working with the well users and Whittaker to decommission the well. *In an October 11, 2007 letter, Whittaker requested permission from the Riverside Irrigation Company members to abandon the well. Whittaker sent the request to all 14 members of the company and is waiting for a response as of the date of this staff report.*

BAE Systems (former United Defense), 900 John Smith Road, Hollister, San Benito County

Project Manager: Kristina Seley 805-549-3121

Background

BAE Systems has conducted military armor and tracked vehicle testing since 1968. The site, located on approximately 1,200 acres, contains several buildings, former munitions magazines, and two munitions test arenas. Constituents of concern identified in soil and/or groundwater include perchlorate and explosives.

Cleanup Actions

In late September 2005, BAE Systems excavated shallow perchlorate-impacted soils in Arena 1 at concentrations greater than 5.0 milligrams per kilogram (mg/kg). BAE Systems removed approximately 400 cubic yards of soil and installed a 35,000 square foot chip seal cap at Arena 1 to minimize potential mobilization associated with rainfall and runoff infiltration.

Current Investigation

BAE Systems submitted the Phase VII Report with findings and recommendations on October 31, 2007. Three areas of concern were documented in the Report, Building No. 3, Building No. 6, and Arena 1. At Building No. 3, BAE Systems will further evaluate perchlorate in the saturated zone and first encountered groundwater. BAE Systems completed investigation of Building No. 6 and Arena 1, and will continue to monitor groundwater quarterly. The "Remedial Investigation and Feasibility Study" will address future cleanup actions. Central Coast Water Board staff discussed question and comments in a phone conference with BAE Systems' consultant on January 9, 2008. In our January 31, 2008 correspondence, staff generally concurred with the Report recommendations and required BAE Systems to submit an environmental investigation work plan by March 31, 2008 for the next phase of the investigation.

MK Ballistic Systems, 2707 Santa Ana Valley Road, Hollister, San Benito County

Project Manager: Kristina Seley 805-549-3121

Background

The MK Ballistic Systems site is located west of the BAE Systems Test Facility property. Currently, MK Ballistic Systems leases buildings and storage magazines on the five-acre property and

manufactures "less-lethal" explosives and ordnance components and devices. Numerous other tenants have conducted similar operations at the facility and have used perchlorate and other explosive compounds in their manufacturing processes. In 1991, U.S. EPA conducted a time-critical cleanup action when one of the former tenants, Caelus Devices, Inc., went bankrupt and abandoned the facility without proper containment and storage of shock-sensitive explosive chemicals.

Concern

BAE Systems tested all its site wells for chemicals of concern. Perchlorate was detected for three consecutive quarters at about 30 ppb in a windmill well upgradient from all identified soil and groundwater perchlorate impacts. BAE Systems' *Phase IV Environmental Investigation Report* proposed that historical use of perchlorate at the neighboring site, MK Ballistic Systems, may be the cause of contamination. Based on the historical use of perchlorate and explosives at MK Ballistic Systems, and due to the perchlorate detections in the windmill well, staff believe that current or past practices at the MK Ballistics site may have impacted groundwater.

Action

On April 14, 2006, staff received the "MK Ballistic Systems Site Environmental Investigation Work Plan." The work plan summarized historical site operations and proposed a perchlorate soil and groundwater investigation. Central Coast Water Board staff generally concurred with the work plan, and provided comments in a June 23, 2006 letter. MK Ballistic Systems' landowner and lessee are required to submit a summary of their findings and an interpretation of the data in an Environmental Investigation Report.

Central Coast Water Board staff was contacted by the Department of Toxic Substances Control (DTSC) regarding this site. DTSC was investigating the storage and handling of hazardous waste and explosives contained at the site. On February 15, 2007, Central Coast Water Board staff met with DTSC staff and the land owner's representatives in Hollister, CA. DTSC staff provided a copy of the soil sampling results that they conducted as part of their investigation.

In a May 23, 2007 correspondence, the Central Coast Water Board staff directed the responsible party to submit a work plan addendum by June 22, 2007. The directive requires metal analysis in soil at various locations where the DTSC detected elevated surface contamination during their December 2005 site investigation. During July 2007, the consultant obtained additional environmental reports that include information on materials stored, removed, and demolished at the site. In August 2007, the consultant requested a time extension in order to review the new data and optimize the soil and groundwater sampling locations, and to determine if there are additional constituents that should be considered. *Central Coast Water Board staff anticipate receiving the work plan by February 22, 2008 and anticipate providing an approval letter prior to the March Board meeting. The consultant anticipates completing groundwater and soil sampling, following work plan approval, by April 2008.*