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United States Government Accountability Office
Washington, DC 20548

July 20, 2007

The Honorable Joe Barton
Ranking Member
Committee on Energy and Commerce
House of Representatives

Dear Mr. Barton:

We appreciate the opportunity to appear before the Subcommittee on Environment and Hazardous Materials on April 25, 2007 to speak about GAO's work related to the health and environmental impacts of exposure to perchlorate.

Enclosed is GAO's response to questions that you submitted for the hearing record in response to our testimony, *Perchlorate: EPA Does Not Systematically Track Incidents of Contamination,* (GAO-07-797T). If you or your staff have any questions about our responses, please contact me at (202) 512-3841 or stephensonj@gao.gov.

Sincerely yours,

John B. Stephenson
Director, Natural Resources
and Environment

Enclosure

cc: The Honorable John Dingell, Chairman
Committee on Energy and Commerce

The Honorable Albert Wynn, Chairman
Subcommittee on Environment and Hazardous Materials

The Honorable John Shimkus, Ranking Member
Subcommittee on Environment and Hazardous Materials

GAO Response to Questions

1. Your report on perchlorate mentioned that you reviewed 92 studies that examined the health effects of perchlorate and only 44 offered conclusions or observations about whether perchlorate had an adverse health effect, and 25 of these studies suggested an adverse health effect. What did these other 48 studies conclude then? Why, in your assessment, is there such a wide range of numbers and conclusions?

As we reported in May 2005, GAO identified and summarized 90 peer-reviewed studies published between 1998 and 2005 that examined the health effects of perchlorate exposure.[1] The 90 studies used a variety of methodologies, study populations, and health outcomes, which helps to account for their differing conclusions (or lack thereof) about whether perchlorate has adverse health effects. Of those studies, 44 offered findings or conclusions about the effects of perchlorate on health, and 46 did not.[2] Many of the latter studies focused on particular physiological processes, and did not seek to specifically establish conclusions regarding perchlorate's health effects. For example, one study that did not draw conclusions examined perchlorate's effects on iodide transport across the gut and skin in frogs.

With regard to the wide range of methodologies, some of the studies used experimental design methods that exposed subjects to different amounts of perchlorate; some used field study methods that compared subjects in contaminated areas with subjects in uncontaminated areas; and some analyzed data from previous studies to determine the highest perchlorate exposure level that does not adversely affect humans. With regard to study populations, some studies examined men and/or women, whereas others looked at other mammals, fish, or amphibians. The studies also examined different health outcomes, including enlarged thyroid and cancer.

Of the 44 studies that offered conclusions about health, 26 indicated that perchlorate had an adverse effect on thyroid function and human health. Of those, 18 studies found adverse effects on development resulting from maternal exposure to perchlorate. Most studies on adult populations were unable to determine whether the thyroid was affected because adverse effects of perchlorate on the adult thyroid, such as cancer, may happen over longer time periods than are generally observed in a research study. In contrast, the adverse effects of perchlorate on prenatal development can be more easily studied and measured within typical study time frames.

[1]GAO, *Perchlorate: A System to Track Sampling and Cleanup Results is Needed*, GAO-05-462 (Washington, D.C.: May 20, 2005).

[2]Appendix I of our report provides details of the methodology that we used to review the scientific literature, and appendix III provides details about the studies we reviewed, including their sponsor, the methodologies used by the authors, and the authors' findings or conclusions about the effects of perchlorate, where given.

EPA officials told us, at the time of our review, that the most sensitive population for perchlorate exposure is the fetus of a pregnant woman who is nearly iodine-deficient. About 36 percent of U.S. women have these lower iodine levels. However, none of the studies that we identified had considered this population. The National Academy of Sciences recommended in their 2005 review that additional research be conducted on perchlorate exposure and its effect on children and pregnant women. As we discussed in our April 2007 testimony before the Subcommittee, CDC researchers recently published the results of the first large study to examine the relationship between low-level perchlorate exposure and thyroid function in women with low iodine levels.[3] The study found decreases in a thyroid hormone that helps regulate the body's metabolism and is needed for proper fetal neural development in pregnant women.

One conclusion has become clearer since our 2005 review—perchlorate exposure can reduce iodine uptake in the adult thyroid, and iodide is critical for making thyroid hormones that help control metabolism and development, particularly for fetuses of pregnant women. In part as a result of advances in the scientific understanding of perchlorate's effects on human health, the American Water Works Association—which represents public and private drinking water utilities—and the Association of Metropolitan Water Agencies—which represents drinking water utilities in large cities—recently called on EPA to set a Maximum Contaminant Level (MCL) for perchlorate because they believe EPA now has enough information to make a "positive regulatory determination."

2. In your assessment of perchlorate contamination found by site, you mention that while 28% of contamination stems from DOD and NASA industries, 27% is naturally occurring. Can you further expand on how perchlorate is naturally occurring and what you estimate this means to cleanup efforts?

Of those 395 contaminated sites we identified, 105 (28 percent) were from natural sources in the Texas high plains region.[4] Perchlorate, much like arsenic, is naturally occurring, and human activity can mobilize or concentrate it in the environment. GAO has not evaluated the impacts of naturally-occurring perchlorate on cleanup efforts. However, naturally-occurring perchlorate is widely dispersed and readily dissolves in surface and groundwater sources and may pose a cleanup challenge when those sources are used for drinking water or irrigation. If

[3]GAO, *Perchlorate: EPA Does Not Systematically Track Incidents of Contamination*, GAO-07-797T (Washington, D.C.: April 25, 2007).

[4]Perchlorate contamination was due undetermined sources at 122 sites (31 percent), activities related to defense and aerospace at 110 sites (28 percent), natural sources at 105 sites (27 percent) in the Texas high plains region, and manufacturing and handling, agriculture, or a variety of commercial activities such as fireworks and flare manufacturing at 58 sites (15 percent).

it is not possible to clean up the perchlorate at a given site or water source, the relevant water treatment plant may have to address the problem.

A recent study, published in June 2007 and funded by the DOD's Strategic Environmental Research and Development Program, identified more naturally-occurring sites than the ones we cataloged in northern Texas. The study found naturally-occurring perchlorate in 5 states across the desert southwest United States—Arizona, Nevada, New Mexico, Texas, and Utah.[5] This discovery may increase pressure on EPA to monitor or regulate the chemical in drinking water.

As the 2007 study observed, perchlorate accumulations in dry unsaturated zones such as the desert southwest are relatively stable while undisturbed, even after accumulating for thousands of years. However, it can be readily flushed into groundwater as a result of human activity. For example, irrigation in the southern High Plains of Texas appears to have completely flushed the naturally-occurring perchlorate from soil into groundwater. The authors concluded that any assessment of potential perchlorate exposure should consider these readily mobilized, naturally-occurring reservoirs of perchlorate, and they recommended that future impacts of agriculture, irrigation, desert urbanization, and even climate change—which may bring increased rainfall to certain parts of the U.S.—should be carefully considered when assessing impacts (and cleanup) from anthropogenic (human) sources. Nonetheless, the study estimated that, while the deserts hold 103 million kilograms, U.S. perchlorate production over the past half-century amounts to 5 *billion* kilograms. Therefore, the vast majority of perchlorate in the environment is from anthropogenic sources, including DOD, NASA, and other manufacturing.

3. How would adopting an MCL affect cleanup of hits from unexplained sources? Who would be responsible for such cleanup, and what funding mechanism would EPA suggest for such cleanup?

An MCL's effect on cleanup activities is indirect. The Safe Drinking Water Act regulates contaminants in drinking water, but it is not an environmental cleanup statute. For contaminants that are known or anticipated to occur in public water systems, and that the EPA Administrator determines may have an adverse impact on health, the Safe Drinking

[5]According to DOD, the Strategic Environmental Research and Development Program (SERDP), the DOD's environmental science and technology program, is planned and executed in partnership with the Department of Energy and the Environmental Protection Agency with participation by numerous other federal and non-federal organizations. To address the highest priority issues confronting the Army, Navy, Air Force, and Marines, SERDP focuses on cross-service requirements and pursues high-risk/high-payoff solutions to the DOD's most intractable environmental problems. The development and application of innovative environmental technologies support the long-term sustainability of DOD's training and testing ranges as well as significantly reduce current and future environmental liabilities.

Water Act requires EPA to set a nonenforceable maximum contaminant level goal (MCLG) at which no known or anticipated adverse health effects occur and that allows an adequate margin of safety. Once the MCLG is established, EPA may set an enforceable standard for water as it leaves the treatment plant—the MCL. The MCL generally must be set as close to the MCLG as is feasible, using the best technology or other means available, and taking costs into consideration. Adopting an MCL would help ensure that public drinking water supplies do not exceed a level of perchlorate shown to adversely affect human health, regardless of the perchlorate source.

Cleanups usually occur under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), the Resource Conservation and Recovery Act (RCRA), or state cleanup programs. Existing standards, such as MCLs under the Safe Drinking Water Act, often serve as cleanup objectives under these programs. Thus, if EPA were to establish an MCL for perchlorate in drinking water, it would also potentially serve as a cleanup standard under one or more of the cleanup programs discussed above.

Parties potentially responsible for perchlorate cleanup costs could include relevant federal agencies (e.g., DOD and NASA), their contractors (e.g., present and former owners and operators of perchlorate manufacturing facilities), and others. DOD has unsuccessfully sought legislative exemptions from environmental cleanup requirements. A recent Supreme Court case will probably make it easier for DOD and NASA contractors to recover cleanup costs from the federal agencies in the event that perchlorate cleanups occur under CERCLA.[6] Both the agencies and their contractors may be able to limit their CERCLA liability at a given perchlorate-contaminated site by establishing that the perchlorate in question was natural rather than anthropogenic, as discussed above.[7] However, potentially responsible parties under CERCLA bear the burden of establishing that natural contamination absolves them of liability for cleanup costs at a site.[8] Notably, DOD recently developed a new technology to distinguish between anthropogenic and naturally-occurring perchlorate.

As we discussed in the previous question, changes in human activity and rainfall patterns may be mobilizing previously-stable, naturally-occurring perchlorate into groundwater that serves as a drinking water source. For any particular contaminated site, the effect of adopting an MCL and the allocation of cleanup responsibilities are dependent on the facts and circumstances associated with that site. For example, some sites with perchlorate contamination that are not likely to be flushed into drinking water sources may not require

[6] United States v. Atlantic Research Corp., 127 S.Ct. 2331 (2007).

[7] E.g., United States v. Alcan, 315 F.3d 179, 184-85 (2d Cir. 2003).

[8] See id. at 185-87.

the same cleanup as sites with a more direct link to drinking water sources. Our report did not attempt to estimate the aggregate responsibility of various parties for cleanups related to perchlorate contamination, but new methods for determining perchlorate sources will likely be used to help assess such responsibility. We suggest that the question about funding for cleanups be directed to EPA.