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Contaminated Water Supplies at Camp Lejeune — Assessing Potential Health Effects

Testimony of

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and

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Good morning Mr. Chairman and members of the committee. My name is John Nuckols. I am a professor in the Department of Environmental and Radiological Health Sciences at Colorado State University. I was a member of the Committee on Contaminated Drinking Water at Camp Lejeune, a committee of the National Research Council. The Research Council is the operating arm of the National Academy of Sciences and the National Academy of Engineering.

I'm pleased to appear before you today to discuss our committee's recent report Contaminated Water Supplies at Camp Lejeune – Assessing Potential Health Effects.

At the request of Congress, the Navy sponsored a study by a committee of the Research Council to review the scientific evidence on associations between adverse health effects and historical data on prenatal, childhood, and adult exposures to contaminated drinking water at Camp Lejeune. For each health effect reviewed, the committee was asked to evaluate the available scientific literature concerning evidence of a statistical association between contaminants found or likely to have been in the water supply at Camp Lejeune and adverse health effects. The committee was also asked to review whether there was any evidence to suggest any causal relationships between the exposures and health outcomes.

Let me begin with the Research Council study process. As you are aware, the Research Council is a non-governmental institution originally chartered by President Lincoln to provide independent scientific advice to the nation. That scientific advice is usually in the form of

consensus reports produced by expert, unpaid committees. In the case of the Camp Lejeune study, the committee was comprised of 13 members with expertise in epidemiology, toxicology, exposure assessment, environmental engineering, clinical medicine, biostatistics, and risk assessment. The committee's report was developed through an established study process designed to ensure the committee and the report were free from actual or potential conflicts of interests, were balanced for any biases, and were independent of oversight from the sponsoring agency.

Our committee reviewed the relevant scientific literature, heard from experts, met with former residents and workers to hear their concerns, and deliberated for two years. Once the committee reached its consensus, but prior to the report being released, the draft report was subjected to a formal, peer-review process overseen by the National Academies Report Review Committee. The report was released only after the Review Committee was satisfied that all review comments had been appropriately considered and addressed.

Copies of the final report were sent to the sponsor immediately prior to public release. The sponsor was not provided an opportunity to review the report or any portions of the report, or to suggest changes to the NRC report prior to its release.

To address the specific charge of the Camp Lejeune study, our committee divided the review into two major categories: (1) evaluating the potential for exposure of former residents and workers to contaminants in the water supply source and distribution systems at Camp Lejeune, in particular the Tarawa Terrace and Hadnot Point water-supply systems, and (2) evaluating the potential health effects associated with these water contaminants based on epidemiological and toxicological evidence. The two assessments were then considered together to ascertain whether conclusions could be drawn about whether any adverse health outcomes could be attributed to the water contamination.

In reviewing the available exposure information, the committee agreed with previous assessments that the primary contaminant of the Tarawa Terrace water system was perchloroethylene (PCE), a solvent that was improperly disposed of by an off-base dry-cleaner. Other contaminants were also identified as being of concern, including trichloroethylene (TCE), dichloroethylene, benzene, toluene, and vinyl chloride. Sophisticated computer modeling techniques were used by the Agency for Toxic Substances and Disease Registry (ATSDR) to make predictions about the monthly concentrations of PCE to which residents of Tarawa Terrace were exposed. The committee questioned the degree of accuracy that could be achieved from the modeling because no contaminant measurements were available for the first 30 years of the contamination, so it was not possible to verify model predictions. In addition, assumptions had to be made about how the water system was operating over the potential exposure period, as no records were available at the time of the development of the model reviewed by the NRC committee. Given these uncertainties, the committee concluded that the Tarawa Terrace modeling predictions should only be used to provide general estimates of the timeframe and magnitude of exposure.

The contamination of the Hadnot Point water system was more complex than Tarawa Terrace. There were multiple sources of pollutants from on-base activities, such as storage and disposal practices. To date, no groundwater modeling has been performed for this water system. Based

on the records the committee reviewed, trichloroethylene appeared to be the primary contaminant of concern, but other contaminants were also detected in the water supply, including dichloroethylene, methylene chloride, and vinyl chloride. Because groundwater modeling of the Hadnot Point system will be fraught with considerable difficulties and uncertainties (similar to, but much more complex than those associated with the Tarawa Terrace models), the committee recommended that simpler models be used to assess the extent of water supply contamination and potential exposures. Simpler models will not reduce the uncertainty associated with the estimates, but they have the advantage of providing a broad picture of the timeframe and magnitude of exposure with less resources than complex modeling exercises. More complex predictive models for exposure assessment should be used only if justified by more straightforward analytical methods.

To evaluate the potential health effects to exposed residents, the committee undertook four kinds of reviews to determine what kinds of diseases or disorders have been found to result from exposure to TCE and PCE. The first was a review of epidemiologic studies of solvents and their effects, including studies in occupational and industrial settings and community studies. The second was a review of epidemiologic studies of other communities with solvent-contaminated water supplies. The third was a review of toxicologic studies conducted in animals and humans to test for health effects. And the fourth was a review of studies conducted specifically on the Camp Lejeune population.

For the first review of epidemiologic studies, we used a categorization process established by the Institute of Medicine to evaluate risks to veterans of the Vietnam War and Gulf War. The Institute's approach is to evaluate the available epidemiologic literature involving exposures to specific chemicals in any setting, but mainly occupational settings, to determine whether a "statistical association" exists between specific chemicals and diseases and disorders. A statistical association means that people who are exposed to the chemicals are more likely to have or develop the disease or disorder than people who are not exposed. A statistical association, however, does not establish that the chemicals cause the disease or disorders. On the basis of the committee's review, all the health outcomes were placed into one of two categories. The strongest evidence was in the category of limited/suggestive of an association, which means there is some evidence that people who were exposed to TCE or PCE were more likely to have the disease or disorder but that the studies were either few in number or had important limitations. In many cases, the study subjects were exposed to multiple chemicals, so it was not possible to separate out the effects of individual chemicals. Fourteen of the 59 outcomes reviewed by the committee were placed in this category. The other 35 health outcomes reviewed by the committee were placed in the category of inadequate/insufficient evidence to determine whether an association exists, which means that the studies were too few in number, limited in quality, inconsistent, or inclusive in results to make an informed assessment. It also means that such an association cannot be ruled out.

The committee decided to consider the subset of epidemiologic studies that were conducted in communities exposed to solvents in their water supplies in more detail. We felt these studies involved populations and exposure situations that more closely resemble those at Camp Lejeune. Overall, the committee found the evidence from this subset of studies to be inconsistent and that there were a variety of limitations with the studies that did not allow any conclusions to be drawn about what effects might be related to the exposures. Some of the limitations were a lack of data

on the levels of contaminants in the water, lack of adequate information about diseases and disorders in the population, and relatively small populations. These factors limit the capacity of such studies to detect associations.

In animal experiments, a variety of adverse health effects were observed following relatively high exposures to TCE and PCE. It is difficult to determine whether the health effects observed in laboratory animals are predictive of effects in humans. There are differences in how TCE and PCE are handled in the body by rodents and humans that affect biological responses. However, it is clear that TCE and PCE do have toxic effects in laboratory animals and that some of them may be of concern to humans. Similar health effects found in epidemiology and toxicologic studies were kidney cancer, liver and kidney toxicity, neurotoxicity, and immunotoxicity.

Only a few studies have been conducted on the Camp Lejeune population, and these have focused on health effects in people who were exposed as children or while their mothers were pregnant with them. Two studies performed by ATSDR did not find any clear associations between birth outcomes (mean birth weight, preterm birth, or small for gestational age). However, a comparison of subgroups within the Tarawa Terrace population found a weak association between PCE exposure and small for gestational age children of women over the age of 35 or who had prior miscarriages. The findings from these evaluations are no longer valid. After the evaluations were completed, ATSDR discovered that a residential area it classified as unexposed received water from the Hadnot Point system, so the study results must be reanalyzed to correct for this mistake in classification. ATSDR also has a study underway on prenatal exposure to water-supply contaminants and birth defects and childhood cancer. The outcomes in the study are rare, and given the number of study participants, it appears that the statistical power of the study could limit its ability to detect associations.

The committee also looked into the feasibility and utility of future studies of the Camp Lejeune population, including a health survey and epidemiologic studies of mortality and morbidity in the population. The committee noted many difficulties with performing the studies, such as the difficulty with identifying, locating, and recruiting the study participants and obtaining reliable health information on them in an efficient manner. It is questionable whether there will be enough participants to ensure there is adequate statistical power to detect associations, and the committee was concerned about the possibility of bias in the survey and studies, as people who have experienced disease or illness are more likely to participate.

After reviewing the preliminary plans and feasibility assessments, the committee concluded that most questions about whether exposures at Camp Lejeune resulted in adverse health effects cannot be answered definitively with further scientific study. There are two reasons for this. First, it would be extremely difficult, if not impossible, to reliably estimate the historical exposures experienced by people at the base. Second, it will be difficult to detect any increases in the rate of diseases or disorders in the study population. Most of the health effects of concern are relatively rare, which means that very large numbers of people are needed to detect increased cases. Although the total number of people who lived at Camp Lejeune while the Tarawa Terrace and Hadnot Point water supplies were contaminated was sizeable, the population is still unlikely to be large enough to detect effects. Another factor is that the people tended to live on the base for a relatively short period of time, making it difficult to rule out other exposures or

factors that could have contributed to the disease or illness. Most chronic diseases are thought to have a latency period of years, if not decades, which means that exposure needs to be assessed over this same time period. All these factors make it unlikely that the proposed studies, even if the notable uncertainties about feasibility are resolved favorably, will produce a result of sufficient certainty to resolve the question of whether Camp Lejeune residents suffered adverse health effects (especially chronic diseases) from exposure to contaminated water at Camp Lejeune. Thus, our committee's conclusion was that there is no scientific justification for the Navy and Marine Corps to wait for the results of additional health studies before making decisions about how to follow up on the evident solvent exposures on the base and their possible health consequences. The services should undertake the assessments they deem appropriate to determine how to respond in light of the available information.

With that, I would once again like to thank you for inviting me to testify before this committee, and I look forward to your questions.