DRAFT
GROUNDWATER INFORMATION SHEET

N-Nitrosodimethylamine (NDMA)

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Revised:
October 23, 2002

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of sources and data relates mainly to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	N-Nitrosodimethylamine (NDMA)
Aliases	Dimethylnitrosamine; N,N-Dimethylnitrosamine; DMNA; N-Methyl-N-nitroso-methanamine; N-Nitroso-N,N-dimethylamine;
Chemical Formula	$(CH_3)_2N_2O$
CAS No.	62-75-9
Storet No.	34438
Summary	Currently, public water supply monitoring for NDMA is not required. However, the California Department of Health Services (DHS) has established an advisory action level of 0.01 μg/L. Though used primarily in research, NDMA has been used in the production of 1,1-dimethylhydrazine for liquid rocket fuel, and a variety of other industrial uses. It has also been reported to be present in foods, beverages, drugs, and tobacco smoke and to be an air and water contaminant. Based on DHS data through 2000, 3 public drinking water wells have had detections of NDMA, with those detections occurring in Los Angeles. However, it is not known how many public water systems have been sampled for NDMA.

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal MCL	US EPA, Region 9	N/A
State MCL	DHS	N/A
Action Level	DHS	0.01 μg/L
Detection Limit for Purposes of Reporting (DLR)	DHS	N/A
Others: Cancer Potency Factor ($1/10^6$ Cancer Risk) Preliminary Remediation Goal – Tap Water	 OEHHA US EPA	 .0022 μg/L .0013 μg/L

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see A Compilation of Water Quality Goals (Marshack, 2000).

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[2]	
Detection Type	**Number of Groundwater Sources**
Number of active and standby public drinking water wells[3] with concentration ≥ 0.01 μg/L.	3 (unknown number sampled)
County having public drinking water wells[3] with NDMA detections.	Los Angeles

[2]Based on DHS data collected from 1984-2000 (Geotracker). See Figure 1.
[3]In general, drinking water from active and standby wells is treated or blended so consumers are not exposed to water exceeding MCLs. Individual wells and wells for small water systems not regulated by DHS are not included in these figures.

ANALYTICAL INFORMATION	
Analytical Test Methods	Several approaches are available for analysis of NDMA at levels at or below 0.002 μg/L, including high resolution Gas Chromatography/Mass Spectrometry (GC/MS), low resolution GC/MS with chemical ionization (using ammonia or methanol) and electron ionization methods. Several other methods are being developed due to the high costs of existing analytical methods.
Detection Limit	0.002 μg/L
Known Limitations to Analytical Methods	Analytical methods able to detect NDMA at very low levels are not readily available; only a few laboratories are capable of detecting NDMA at very low concentrations. Further, certain aspects of collection, such as holding and preservation of samples, may influence NDMA analyses. This, too, adds uncertainties to the interpretation of analytical results at very

	low NDMA concentrations. DHS is working with laboratories to improve the reliability and reproducibility of analytical results for NDMA at these low levels.
Testing Requirements	Currently, monitoring for NDMA in public water systems is not required by DHS. However, DHS has established an advisory action level of 0.01 µg/L.

NDMA OCCURRENCE	
Anthropogenic Sources	NDMA's use is primarily in research, but it was also used in the production of 1,1-dimethylhydrazine for liquid rocket fuel. Other industrial uses include: a nematocide, a plasticizer for rubber, in polymers and copolymers, a component of batteries, a solvent, an antioxidant, and a lubricant additive. NDMA was reported to be present in: a variety of foods, beverages and drugs; in tobacco smoke; it has been detected as an air pollutant; in treated industrial wastewater; treated sewage (in proximity to a 1,1-dimethylhydrazine manufacturing facility); deionized water (reportedly as result of deionization process); high nitrate well water; and chlorinated drinking water (NTP, 2000).
Natural Sources	No known natural sources of NDMA.
History of Occurrence	In 1998, concern about NDMA contamination at a Sacramento County aerospace facility (Aerojet) prompted investigations in nearby drinking water sources. Samples collected in February and March 1998 from a drinking water well in eastern Sacramento County confirmed the presence of NDMA at approximately 0.15 µg/L. In southern California, NDMA was detected in three drinking water wells in the San Gabriel Basin that were sampled in May 1998. Two wells with NDMA at concentrations of 0.07 µg/L were removed from service. The third well, already out of service because of trichloroethylene and perchlorate contamination, contained NDMA at 3 µg/L. In spring of 1999, as interest in NDMA monitoring increased in the water treatment community, DHS was informed of NDMA findings in treated waste water. From the standpoint of protecting drinking water consumers and sources, DHS considered this finding important in the evaluation of proposed recycled water projects involving wastewater discharges and groundwater recharge.

	In addition, in 1999, limited sampling indicated that NDMA appeared to be present at very low levels (<0.01 µg/L) in treated drinking water. Preliminary analyses suggested that NDMA's presence in drinking water was related to disinfection processes, but very limited data were available, and often they appeared to be inconclusive. In November 1999, DHS initiated studies with drinking water utilities to investigate the occurrence of NDMA in raw, treated and distributed water, the role water quality and treatment processes may play in the production of NDMA, and the possible extent of NDMA production at various steps in the water treatment process. In April 2000, the American Water Works Association Research Foundation and the Water Environment Foundation released a Request for Proposal for the study of factors affecting the formation of NDMA in water and occurrence. In May 2000, two wells in Orange County had NDMA at concentrations of approximately 0.03 to 0.04 µg/L, and were taken out of service. A nearby groundwater recharge operation involving injection of treated wastewater contained NDMA in its injected water. DHS informed the wastewater treatment plant that its activities were impairing groundwater, and directed them to reduce the levels of NDMA accordingly. In May 2000, a system in Los Angeles County found NDMA in its groundwater sources at concentrations of 0.032 to 0.076 µg/L, apparently associated with chemicals formerly produced in the aerospace industry. In June 2000, a system in Los Angeles County found NDMA at about 0.03 µg/L, apparently related to resins used in water treatment for nitrate removal. In June 2000, also in Los Angeles County, NDMA at concentrations of 0.049 and 0.074 µg/L (duplicates) and 0.091 µg/L was found in treated wastewater that was blended for use as groundwater recharge.
Contaminant Transport Characteristics	Laboratory studies are currently being conducted to better understand how NDMA is formed and how it can be removed. NDMA has a high water solubility indicating that NDMA detected in groundwater is likely completely dissolved. Volatilization to air from water is expected because NDMA has a moderately high vapor pressure. Currently, there are not enough data to determine the Henry's Law Constant or organic carbon partition coefficient. The tendency for NDMA to volatilize from water or adhere to soil, therefore, is unclear.

	NDMA, however, could be expected to move with groundwater flow based on its high water solubility. Initial research shows that NDMA can form through a reaction between monochloramine (a form of chlorine commonly found during disinfection) and simple amines, such as dimethylamine. Precursors of NDMA in recycled water are being identified to develop methods for conventional and advanced treatment.

REMEDIATION & TREATMENT TECHNOLOGIES

UV/Oxidation technology: Ultraviolet light technology has been used successfully for the destruction of NDMA to levels below drinking water standards. UV can be coupled with the use of hydrogen peroxide in an advanced oxidation system application for NDMA destruction.

HEALTH EFFECT INFORMATION

NDMA causes cancer in laboratory animals such as /rats and mice when they are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in people who are exposed over long periods of time.

NDMA is identified as a carcinogen under California's Health and Safety Code Section 25249.5, et seq., the Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65"). In addition, the US EPA identifies NDMA as a "probable human carcinogen" (US EPA, 1997), and the National Toxicology Program lists NDMA as "reasonably anticipated to be a human carcinogen" (NTP, 2000).

KEY REFERENCES

1. Agency for Toxic Substances and Disease Registry. Public Health Assessment: Air Force Plant PJKS, Waterton, Jefferson County, Colorado. March 29, 2000. http://www.atsdr.cdc.gov/HAC/PHA/pjks/pjk_p4b.html#appd (Sept. 2002)

2. California Department of Health Services. California Drinking Water: NDMA-Related Activities http://www.dhs.ca.gov/ps/ddwem/chemicals/NDMA/NDMAindex.htm (Sept. 2002)

3. California Environmental Protection Agency / Regional Water Quality Control Board,

Central Valley Region. August 2000. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marshack.
http://www.swrcb.ca.gov/rwqcb5/available_documents/wq_goals/wq_goals.pdf

4. Online NIOSH Pocket Guide to Chemical Hazard.
http://www.cdc.gov/niosh/npg/npgd0000.html (Sept. 2002)

5. National Toxicology Program (NTP), 2000, *"N-Nitrosodimethylamine CAS No. 62-75-9," Ninth Report on Carcinogens*, Public Health Service, US Department of Health and Human Services.

6. U.S. Environmental Protection Agency, N-nitrosodimethylamine; CASRN 62-75-9**,** Integrated Risk Information Service (IRIS) Substance File.
http://www.epa.gov/iris/subst/0045.htm (Sept. 2002)

FOR MORE INFORMATION, CONTACT:
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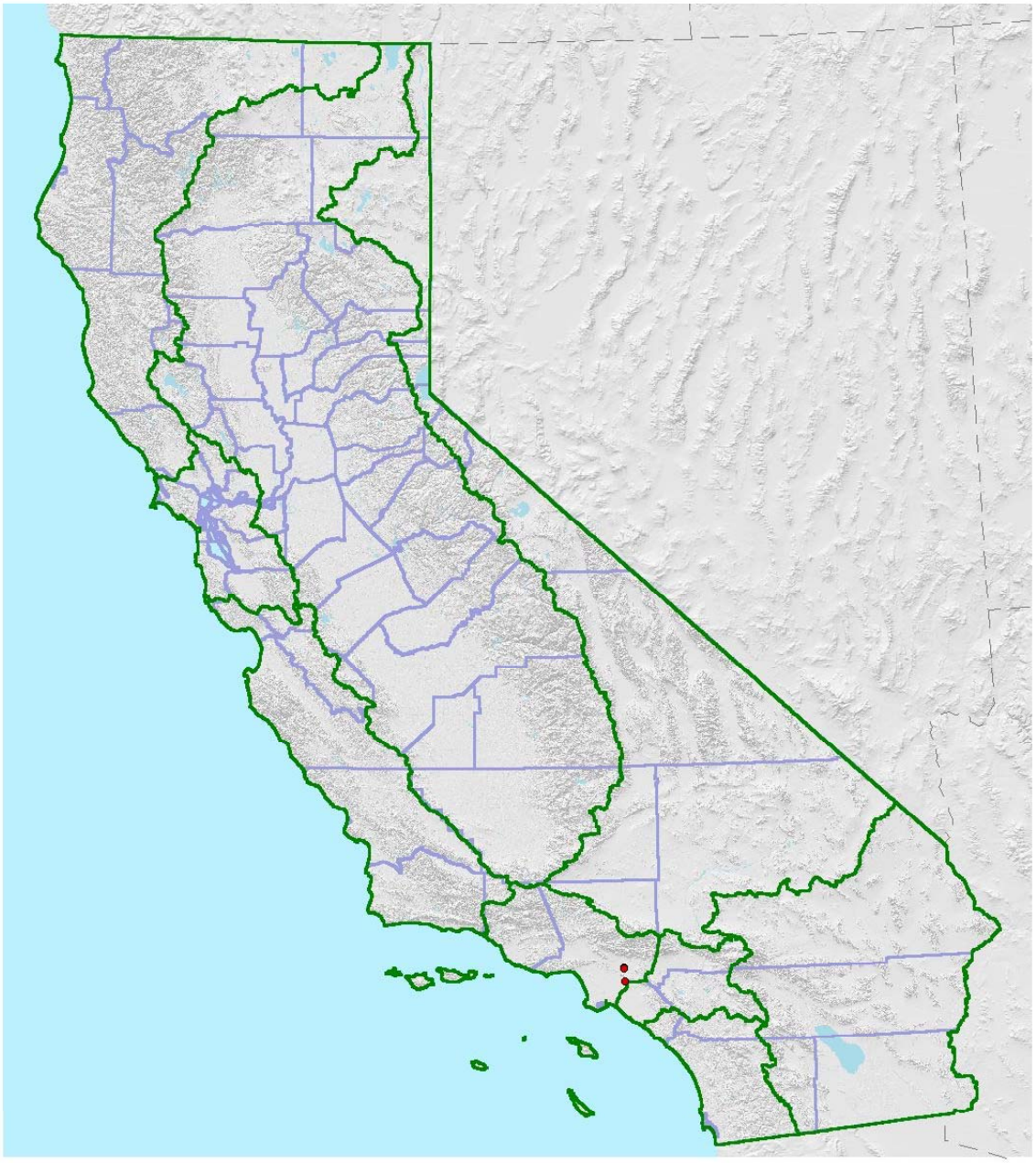
Groundwater Information Sheet: NDMA
Figure 1



Active and Standby DHS Wells (2 Total) with at Least One Detection of N-nitrosodimethylamine (NDMA) >= 0.01 PPB Action Level

Source: 1984 – 2000 DHS Data (Map Revised 10/02/02) **GEOTRACKER**

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