

# Health Consultation

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EVALUATION OF POTENTIAL EXPOSURE TO CONTAMINANTS  
IN PRIVATE WELL WATER

CLOVERDALE, SONOMA COUNTY, CALIFORNIA

**Prepared by the  
California Department of Public Health**

DECEMBER 10, 2009

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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## **Background**

On October 20, 2008, the California Department of Public Health (CDPH), Environmental Health Investigation Branch, was asked by the California Regional Water Quality Control Board (RWQCB), North Coast Region, to provide technical assistance regarding a community member's concern about potential exposure to contamination from a private well located in Cloverdale, California. Cloverdale is located in the northern portion of Sonoma County, approximately 85 miles north of the city of San Francisco, California.

This health consultation is based on a letter between CDPH and the community member (see letter in Appendix A). CDPH works under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR), and this health consultation is being forwarded to ATSDR for their concurrence.

The community member contacted RWQCB about concerns that a number of health issues in their family could be potentially related to environmental exposure. Of particular concern was the family's drinking water, which originates from their private well. The family's residence and private well are located in a mixed residential, agricultural, and industrial area of Cloverdale. The family has been using the well for approximately 7 years.

On November 6, 2008, RWQCB collected samples to explore if chemicals from nearby industrial and agricultural practices have contaminated their private well. Water samples were collected from both the well head and tap water. The samples were taken to a state certified laboratory and analyzed for inorganic substances, petroleum hydrocarbons, pesticides, and chlorinated organic compounds. In total, approximately 188 substances related to industrial and agricultural practices were analyzed.

The community member also contacted the Sonoma County Department of Health Services and requested a cancer statics review of the Cloverdale area. An epidemiologist from Sonoma County contacted the California Cancer Registry (CCR) and requested a cancer statics review of adult leukemia and adult lymphoma incidences in the locality of the community members. The review is being conducted by the CCR and results will be communicated to the community member from CCR.

This health consultation is an evaluation of the sample data collected from the community member's private well.

## **Discussion**

On December 11, 2008, RWQCB forwarded the lab data to CDPH for evaluation. The analytical results are presented in Appendix A.

Out of the 188 substances analyzed, 22 were detected. CDPH compared the concentrations of each substance detected to health-based water comparison values (CVs): Environmental Media Evaluation Guide (EMEG) and Reference Dose Media Evaluation Guide (RMEG). RMEGs and EMEGs are based on conservative assumptions about exposure and represent concentrations of

substances in water, soil, and air to which daily human exposure is unlikely to result in adverse health effects. CDPH used the RMEGs and EMEGs to select which detected substances should be further reviewed for possible public health implications.

In addition to EMEG and RMEG values, Maximum Contaminant Levels (MCLs) have been included as a reference. MCLs, developed by the U.S. Environmental Protection Agency (EPA), are the highest level of a contaminant the federal government allows in drinking water. MCLs, which are legally enforceable standards, are based on human health and the economic costs of applying clean-up treatment technologies.

Copper was the only contaminant exceeding CVs and thus was evaluated further. On the basis of limited data, the amount of copper reported at the well head (57.3 parts per billion (ppb)) is considered in the normal range for copper found in drinking water [1]. The total copper reported in the tap was 165 ppb, which exceeds the child EMEG of 100 ppb. The source of copper appears to be located after the water is pumped from the well head. This could be due to aged copper piping or old brass water fixtures.

Motor oil, gasoline, and xylenes were detected at very low levels at the well head. Gasoline, toluene, and xylenes were detected at very low levels at the tap. Their presence shows that a petroleum source exists near the well that has released petroleum product into the water column. However, concentrations are not at levels of health concern. The release could be from the transfer pump leaking into cracked or broken pipe seals.

## **Exposure Pathways**

CDPH identifies exposure pathways to determine if and how individuals might be exposed to the contaminants. There are five elements considered in the evaluation of an exposure pathway [2]:

- A source of contamination.
- Transport through an environment medium (air, soil, or water).
- A point of exposure.
- A route of exposure (inhalation, dermal absorption, or ingestion).
- A receptor population.

An exposure pathway is classified as either complete, potential, or eliminated. A completed pathway exist when the five elements are present; they indicate that exposure to a contaminant has occurred in the past or is occurring. A potential exposure pathway is either not currently complete (but could become complete in the future) or indeterminate due to lack of information. A pathway is eliminated from further assessment if one or more elements are missing and never likely to exist. A completed and potential exposure pathway may be eliminated if it is unlikely to have public health significance.

For the family members drinking, showering, and cooking from their private well in Cloverdale, a completed exposure pathway exists.

## **Health Effects Evaluation**

Copper is readily found in drinking water at ranges of 25 ppb to 75 ppb and is considered to be an essential element for humans at low levels. Studies have shown that the health effects of drinking high levels of copper are similar in children and adults. The most common symptoms are gastrointestinal in nature—mostly in the form of nausea and vomiting. Symptoms do not persist but rather are felt immediately after ingestion, and then diminish [1].

To evaluate whether the level of copper detected in the family's tap water poses a health risk, CDPH estimated a daily dose based on the make-up of the family: a 1-year old female child, a 12-year old male adolescent, and a female adult would receive the estimated dose of 165 ppb copper from drinking from their private well water. Each dose was estimated by factoring in the approximate time the family has been utilizing the private well, high-end assumptions for the amount of water ingested per day, and the average body weight based on age and sex [3] (see letter in Appendix A).

CDPH compared the estimated doses to ATSDR's Minimal Risk Level (MRL) for copper. The MRL value is an estimate of a daily human exposure to a substance below which adverse health effects are unlikely to occur. MRLs are used to determine if an estimated daily dose needs to be evaluated further as a potential health risk to an individual. The MRL for copper is 10 micrograms of copper per kilogram of body weight per day ( $\mu\text{g/kg/day}$ ).

The estimated doses from exposure to drinking water containing copper at 165 ppb for a 12-year old male adolescent ( $7.2 \mu\text{g/kg/day}$ ) and female adult ( $5.6 \mu\text{g/kg/day}$ ) do not exceed the MRL ( $10 \mu\text{g/kg/day}$ ). However, the estimated daily dose from exposure to drinking water containing copper at 165 ppb for a 1-year old female child ( $15.8 \mu\text{g/kg/day}$ ) does exceed the MRL. To determine if the estimated daily dose of  $15.8 \mu\text{g/kg/day}$  presents a health risk, CDPH reviewed the available ATSDR toxicological data regarding copper. Toxicological information indicates that the lowest-observed-adverse-effect level (LOAEL) for copper is  $91 \mu\text{g/kg/day}$  [1]. The LOAEL is the lowest tested dose of a substance that has been reported to cause harmful health effects in people or animals. According to one study, the effects observed were gastrointestinal symptoms in men and women ingesting copper sulfate in drinking water for 2 months. The researchers found no changes in copper status or liver impacts in the study participants. The no-observed-adverse-effect level (NOAEL) reported in the same drinking water study is  $42 \mu\text{g/kg/day}$  [1]. The NOAEL is the highest tested dose of a substance that has been reported to have no harmful health effects on people or animals. Based on the NOAEL of  $42 \mu\text{g/kg/day}$ , it is unlikely that the dose estimated for a 1-year old female child ( $15.8 \mu\text{g/kg/day}$ ) will cause adverse health effects.

## **ATSDR Child Health Issues**

CDPH and ATSDR recognize that, in communities with contaminated water, soil, air, or food (or all of these combined, depending on the substances and exposure situation), infants and children can be more sensitive than adults to chemical exposures. This sensitivity results from several factors: 1) children might have higher exposures to environmental toxins than adults because, pound for pound of body weight, children drink more water, eat more food and breath more air

than adults; 2) children play outdoors close to the ground, which increases their exposure to toxins in dust, soil, surface water, and ambient air; 3) children have tendency to put their hands in their mouths, thus potentially ingesting contaminated soil particles at higher rates than adults; some children even exhibit an abnormal behavior trait known as “pica”, which causes them to ingest non-food items, such as soil; 4) children are shorter than adults, which means they can breathe dust, soil, and vapors that settle close to the ground; 5) children’s bodies are growing and developing, thus they can sustain permanent damage if toxic exposures occur during critical growth stages; and 6) children and teenagers more readily than adults can disregard no trespassing signs and wander onto restricted property. Because children depend completely on adults for risk identification and management decisions, CDPH was committed in evaluating children’s special interests to the highest degree possible for the private well as part of the CDPH and ATSDR Child Health Initiative.

This document includes childhood exposures dose estimation, which incorporate exposure assumptions that reflect a child’s greater intake of water relative to body weight. All conclusions about drinking water from the private well are based on characteristics of this sensitive population.

## **Conclusion**

CDPH concludes that drinking, cooking, or bathing with water from the private well is not expected to harm the resident’s health. The reason for this is that substances detected are below levels of health concern. However, it should be noted that one test does not provide sufficient information regarding any previous condition the well may have been in over the last 7 years and thus is only a snapshot of current conditions.

## **Actions Completed**

- CDPH responded to the RWQCB’s request to evaluate the potential health risk to community members from exposure to contaminated water originating from a private drinking well.
- On January 6, 2009, CDPH sent a letter to the private well owner and to RWQCB outlining their evaluation and analyses.
- On January 12, 2009, a cancer epidemiologist from the CCR examined the incidence of adult leukemia and adult lymphoma. CCR did not find higher than normal rates of either cancer from 1986 to 2006.

## **Ongoing Action**

- According to RWQCB, a new private well will be drilled on the property. The well will be drilled to a greater depth than the current well and will include new leak proof sealants, brass fixtures, and new copper piping.

## References

1. Agency for Toxic Substances and Disease Registry. Toxicological profile for copper. Atlanta: U.S. Department of Health and Human Services; 2004 Sep. Available online at <http://www.atsdr.cdc.gov/toxprofiles/tp132.html>.
2. Agency for Toxic Substances and Disease Registry. Public health assessment guidance manual (update). Atlanta (GA): U.S. Department of Health and Human Services; 2005 Jan. Available online at <http://www.atsdr.cdc.gov/HAC/PHAManual/>.
3. U.S. Environmental Protection Agency. Exposure factors handbook. 1997. Available online at <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=12464>.



## **Preparers of Report**

### **California Department of Public Health**

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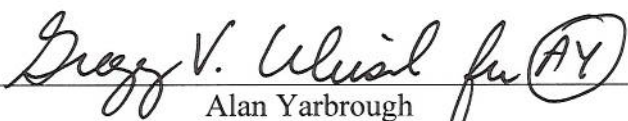
## Certification

This evaluation of potential exposure to contaminants in private well water, Cloverdale, Sonoma County, California, was prepared by the California Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Editorial review was conducted by the cooperative agreement partner.

  
Charisse Walcott, M.S.  
Technical Project Officer, Cooperative Agreement Team  
Division of Public Health Assessment and Consultation  
ATSDR

The Division of Public Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with the findings.

  
Alan Yarbrough  
Lead Environmental Health Scientist  
Division of Public Health Assessment and Consultation  
ATSDR

## **Appendix A**

### **Letter from CDPH to Family in Cloverdale Regarding the Evaluation of their Private Well Water**



MARK B HORTON, MD, MSPH  
*Director*

State of California—Health and Human Services Agency  
California Department of Public Health



ARNOLD SCHWARZENEGGER  
*Governor*

February 3, 2009



Dear [REDACTED],

The Environmental Health Investigations Branch (EHIB) of the California Department of Public Health (CDPH) is writing you this letter to present our evaluation of water data collected from the private well that provides water to your residence. CDPH works under a cooperative agreement with the federal Agency for Toxic Substance and Disease Registry (ATSDR). ATSDR provides CDPH with appropriate resources to respond to public health issues related to human exposure to hazardous substances in the environment.

On October 20, 2008, EHIB was asked by Jan Goebel of the North Coast Regional Water Quality Control Board (RWQCB) to provide technical public health assistance relating to potential concerns regarding possible contamination in a private well that has been the water source to your residence since moving there in 2002. On December 11, 2008, EHIB was forwarded lab data via RWQCB of water samples collected from both the well head and tap water sources of your private well. The samples were taken to a state certified lab and analyzed for inorganic substances, petroleum hydrocarbons, pesticides, and chlorinated organic compounds. Many of these substances are regulated in drinking water because they may affect human health. Some of the compounds that were analyzed from your well water can make water unpleasant (bad taste, odor, or appearance) to drink. In total, approximately 188 substances were analyzed. Of the 188 tested, 22 were detected. Attached with this letter is a table of all substances detected in your well water both at the well head and at the tap. The remainder of this letter will be summarizing the implications of the substances detected.

Each detected substance was compared to a specific value called a health-based water comparison value (CV). CVs are used to select which substances need to be further reviewed for possible public health implications. Several CVs are available; CDPH utilizes the most conservative or health protective values: Environmental Media Evaluation Guide (EMEG) and Reference Dose Media Evaluation Guide (RMEG). CV values have been included for each substance on the attached table.

In addition to the EMEG and RMEG values, we have included Maximum Contaminant Levels (MCLs) as a reference. MCLs are the highest amount the federal or state government will allow

contaminate substances to exist in drinking water. MCLs are based on human health and also factor in the economic costs of applying clean-up treatment technologies.

### **Inorganic Substances**

Fifteen inorganic substances were detected. Many were dissolved in the water, which is not uncommon, since inorganic materials such as metals, which naturally exist in the rock and soil, will regularly mix into groundwater. With the exception of copper, all detected concentrations of inorganics were reported below the CVs. Copper is readily found in drinking water at ranges from 25 parts per billion (ppb) to 75 ppb and is considered to be an essential element for humans at low levels.

Based on the lab results, the amount of copper reported at the well head was 57.3 ppb and considered in the normal range for copper found in drinking water. The total copper in your tap was reported at 165 ppb, which exceeded the CV of 100 ppb for children. The source of the copper appears to be located after the water is pumped from the well head. This could be due to copper plumbing or brass water fixtures used to transport the well water to the tap water.

Although the amount of copper exceeds the health based CV for water, it does not necessarily mean it presents a health risk to you or your family. To evaluate whether the level of copper reported in your tap water posed a health risk to you or your family, CDPH estimated a daily dose that a 1-year old child, a 12-year old male, and an adult female would receive from drinking water containing 165 ppb copper. Each dose was estimated by factoring in the approximate time your family has been residing in your home, a high-end assumption for the amount of water ingested per day, and a body weight based on age and sex. To estimate the daily dose of a one-year old child, the CDPH used a time span of 7 years, a daily intake of 1 liter of water and a 22-pound weight average (10 kilograms). To estimate the dose of a 12-year old male, a time span of 7 years was used with a daily intake of 2 liters of water, and a 97-pound weight average (44 kilograms). To estimate the daily dose of an adult female, a time span of 7 years with a daily intake of 2 liters of water and a 125-pound weight average (57 kilograms) was used. All estimated weights were obtained from the *EPA Exposure Factors Handbook, Volume 1* (08/1997).

Each estimated daily dose was compared to the Minimal Risk Level (MRL) for copper. The MRL value is an estimate of a daily human exposure to a substance below which adverse health effects are unlikely to occur. MRLs are used to determine if an estimated daily dose needs to be reviewed further as potentially creating a possible health risk to an individual. The MRL for copper is 10 micrograms of copper per kilogram of body weight per day ( $\mu\text{g/kg/day}$ ).

The estimated daily doses from exposure to drinking water containing copper at 165 ppb for a 12-year old male ( $7.2 \mu\text{g/kg/day}$ ) and adult female ( $5.6 \mu\text{g/kg/day}$ ) do not exceed the MRL ( $10 \mu\text{g/kg/day}$ ). The estimated daily dose from exposure to drinking water containing copper at 165 ppb for a 1-year old child ( $15.8 \mu\text{g/kg/day}$ ) does exceed the MRL.

To determine if the estimated daily dose of 15.8 µg/kg/day presented a health risk, CDPH reviewed available ATSDR toxicological data regarding copper.

Studies have shown that the effects of drinking high levels of copper are similar in children and adults. The most common symptoms are gastrointestinal in nature; mostly in the form of nausea and vomiting. Symptoms do not persist, but rather are felt immediately shortly after ingestion and then go away.

A health study conducted on copper exposure showed that the lowest observed adverse effect level (LOAEL) is 91µg/kg/day. The LOAEL is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects on people or animals. The effect observed were gastrointestinal symptoms in men and women ingesting copper sulfate in drinking water for 2 months. The researchers found no changes in copper status or liver impacts in the participants. The no observed adverse effect level (NOAEL) reported in this drinking water study is 42 µg/kg/day. The NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals. Based on the NOAEL (42 µg/kg/day), it is unlikely that the dose estimated for a 1-year old child (15.8µg/kg/day) will cause harmful health effects.

### **Petroleum Hydrocarbons**

Motor oil, gasoline, and xylenes were detected at very low levels above laboratory reporting limits at the well head. Gasoline, toluene and xylenes were detected at very low levels above laboratory reporting limits at the water tap. Their presence does show that a petroleum source exists near your well that has released petroleum product into your water, but the release is not causing adverse health effects. (Perhaps a leaking transfer pump at the well head?)

### **Pesticides**

No pesticides were detected above laboratory reporting limits.

### **Chlorinated Organic Compounds**

Only two chlorinated organic compounds were detected above laboratory reporting limits. Both chloroform and dichloromethane are known to have associations in industrial operations (as solvents) and in pesticide production. The concentrations detected in both the well head and tap were far below their health-based water comparison value.

### **Summary**

The test results indicate that your private well does not currently pose a health hazard for you or your family. However, one test does not provide enough information to fully understand the safety and quality of your water over the last seven years or for future dates.

Dr. Monica Brown, an epidemiologist at the California Cancer Registry, is currently analyzing whether or not there are unusually high numbers of leukemia and lymphoma cases among adults in Cloverdale. She will communicate these results directly to you and Cindy Gardner, the Sonoma County epidemiologist you have been in contact with. You can contact Dr. Brown at (916) 779-2687 with any questions that you have about the cancer statistics review.

CDPH is always available to discuss their results of our evaluation of your private well water. If you have any questions, please do not hesitate to call either Russell Bartlett at (510) 620-3671 or Marilyn Underwood at (510) 620-3610.

Sincerely,



Marilyn C. Underwood, Ph.D., REHS, Chief  
Site Assessment Section  
Environmental Health Investigations Branch

cc. Ms. Jan Goebel  
North Coast Regional Water Quality Control Board  
5550 Skylane Boulevard, Suite A  
Santa Rosa, CA 95403

Monica Brown, MPH, PhD  
Cancer Epidemiologist  
California Cancer Registry  
1825 Bell Street, Suite 102  
Sacramento, CA 95825

Lucinda Gardner, MSPH, Epidemiologist  
Sonoma County Department of Health Services  
3313 Chanate Road  
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**Table 1**  
**Wirt Private Drinking Water Well**

SUBSTANCE	Well Head (ppb)	Tap Water (ppb)	Health-based Water Comparison Value(s) (ppb)
<b>INORGANICS</b>	*(total / dissolved)	*(total / dissolved)	
Antimony	0.1 / 0.2	0.1 / <0.1	6 (MCL) 4 (RMEG child) 10 (RMEG adult)
Arsenic	<0.1 / 0.4	<0.1 / 0.3	10 (MCL) 3 (chronic EMEG child) 10 (chronic EMEG adult)
Barium	342 / 341	330 / 326	2,000 (MCL) 2,000 (chronic EMEG child) 7,000 (chronic EMEG adult )
Cadmium	0.07 / 0.19	0.07 / 0.06	5 (MCL) 5 (chronic EMEG child) 20 (chronic EMEG adult)
Chromium	3.2 / 9	3.5 / 7.7	100 (MCL)
Cobalt	0.2 / 0.1	0.2 / 0.1	100 (EMEG int child) 400 (EMEG int adult)
Copper	38.6 / 57.30	165 / 148	1,300 (MCL) 100 (intermediate EMEG child) 400 (intermediate EMEG adult)
Lead	1.0 / 1.1	0.2 / 0.1	15 (MCL tap water)
Molybdenum	0.3 / 0.4	0.4 / 0.4	50 (RMEG child) 200 (RMEG adult)
Nitrate (as nitrogen) (total dissolved)	1,430	170	10,000 (MCL) 20,000 (RMEG child) 60,000 (RMEG adult)
Nickel	5.4 / 5.0	4.5 / 4.0	200 (RMEG child) 700 (RMEG adult)
Selenium	<0.5 / 0.4	<0.5 / <0.80	50 (MCL) 50 (chronic EMEG child) 200 (chronic EMEG adult)
Silver	<0.1 / <0.1	<0.10 / 0.1	50 (RMEG child) 200 (RMEG adult)
Sulfur	5,540	5,490	**250,000 (MCL-secondary)
Vanadium	<0.1 / 2.1	<0.1 / 1.9	30 (intermediate EMEGchild) 100 (intermediate EMEG adult)
Zinc	36.8 / 66	14.3 / 14	3,000 ( chronic EMEG child) 10,000 (chronic EMEG adult)



SUBSTANCE	Well Head (ppb)	Tap Water (ppb)	Health-based Water Comparison Value(s) and Source (ppb)
<b>Petroleum Hydrocarbons</b>			
Gasoline	3.70	3.90	210 (ESL)
Motor Oil	46	<35	210 (ESL)
Toluene	<0.04	0.08	1,000 (MCL) 800 (RMEG child) 3,000 (RMEG adult)
Xylenes	0.10	0.20	10,000 (MCL) 2,000 (chronic EMEG child) 7,000 (chronic EMEG adult)
<b>Chlorinated Volatile Organic Compounds</b>			
Chloroform	2.31	2.53	80 (MCL) 100 (chronic EMEG child) 400 (chronic EMEG adult)
Dichloromethane	0.37	0.33	5 (MCL) 600 (chronic EMEG child) 2,000 (chronic EMEG adult)

ppb = Parts per billion (1 ppb= 1 µg/L (microgram per Liter))

MCL = Maximum Contaminant Level for drinking water (10/27/2008)

RMEG child = Reference Dose Media Evaluation Guide for child (10/27/2008)

RMEG adult = Reference Dose Media Evaluation Guide for adult (10/27/2008)

chronic EMEG child = chronic Environmental Media Evaluation Guide for child (10/27/2008)

chronic EMEG adult = chronic Environmental Media Evaluation Guide for adult (10/27/2008)

intermediate EMEG adult = intermediate Environmental Media Evaluation Guide for adult (10/27/2008)

intermediate EMEG child = intermediate Environmental Media Evaluation Guide for child (10/27/2008)

EMEGs and RMEGs are estimates of chemical concentrations in air, soil, and water that are *not likely* to cause a risk of harmful, noncancerous health effects for a fixed duration of exposure

RMEGs, are derived by the U.S. Environmental Protection Agency (EPA) and are for exposures that occur for a one year or greater time frame

EMEGs are derived by the ATSDR and are for three exposure times: acute (1-14 days), intermediate (15-364 days) and chronic (365 days or more)

ESL = Environmental Screening Level; California Water Quality Control Board, (05/2008)

\*Variable results due to the total (unfiltered) and dissolved (filtered) samples collected into separate sampling containers

\*\*Secondary MCL has been established for sulfate at 250,000 ppb based on taste, odor, color, corrosivity and staining properties

All samples collected on 11/6/2008