

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

STAFF REPORT FOR REGULAR MEETING OF DECEMBER 1, 2006

Prepared on October 20, 2006

ITEM NO: 15

SUBJECT: Response Actions To E. Coli Bacterial Outbreak

INTRODUCTION

Spinach grown and processed in the Central Coast Region has been implicated in an outbreak of *E. coli* O157:H7 infections. The first illness associated with this outbreak occurred on August 2, 2006, although most illnesses reported to date cluster with onsets from August 26 to September 12, 2006. To date, 204 cases of illness have been reported to the Centers for Disease Control and Prevention (CDC), including 31 cases involving a type of kidney failure called Hemolytic Uremic Syndrome (HUS), 104 hospitalizations, and three deaths. The first death was an elderly woman in Wisconsin; the second death, a two-year-old in Idaho; and the third death, an elderly woman in Nebraska.

The 26 affected states and numbers of illnesses in each state are: Arizona (8), California (2), Colorado (1), Connecticut (3), Idaho (8), Illinois (2), Indiana (10), Kentucky (8), Maine (3), Maryland (5), Michigan (4), Minnesota (2), Nebraska (11), Nevada (2), New Mexico (5), New York (11), Ohio (26), Oregon (6), Pennsylvania (10), Tennessee (1), Utah (19), Virginia (2), Washington (3), West Virginia (1), Wisconsin (50), and Wyoming (1). In addition, Canada has one confirmed case.

On Oct. 4, 2006, the U.S. Attorney of the Northern District of California issued a statement on the execution of two search warrants on Growers Express in Salinas,

and Natural Selection Foods in San Bautista, in connection with the outbreak. US Food and Drug Administration (FDA), the California Department of Health Services (DHS), the CDC, and the US Department of Agriculture (USDA) continue to investigate the cause of this outbreak. This includes continued inspections and sample collection in facilities, the environment and water, as well as studies of animal management, water use, and the environment. FDA announced on Sept. 29, 2006, that all spinach implicated in the current outbreak has traced back to Natural Selection Foods. This determination is based on epidemiological and laboratory evidence obtained by multiple states and coordinated by CDC. Natural Selection Foods issued a recall of all implicated products on Sept. 15, 2006. Four other companies have issued secondary recalls because they received the recalled product from Natural Selections.

FDA and DHS announced October 12 that samples of cattle feces on one of the implicated ranches tested positive based on matching genetic fingerprints for the same strain of *E. coli* O157:H7 that sickened 204 people. The trace back investigation has narrowed to four implicated fields on four ranches. The outbreak strain of *E. coli* O157:H7 from cattle feces was identified on one of these four ranches. At this time, testing of other environmental samples from all four ranches that supplied the implicated lot of

contaminated spinach is in progress. The O157:H7 positive test result is a significant finding, but is just one aspect of this investigation. More information may come forward as the investigation continues. These four fields, located in Monterey and San Benito counties, are not currently being used to grow any fresh produce. Further testing by these agencies, reportedly, identified the strain in a wild boar's gut.

While the focus of this outbreak has narrowed to these four fields, the history of *E. coli* O157:H7 outbreaks linked to leafy greens indicates an ongoing problem.

This report discusses steps Water Board staff has taken to investigate the occurrence of *E. coli* in the Salinas Valley and measures staff has taken or will take to address the problem.

Summary of Data findings

Indicator Bacteria—Coliform bacteria include a number of different species that occur widely in the environment: in water, soil, decaying organic material and in the guts of warm-blooded animals. Fecal coliform are a thermo-tolerant subset of coliform bacteria species that commonly occur in warm-blooded animals. One of the common species included in the fecal coliform group is *E. coli*. Most fecal coliform species, including most strains of *E. coli*, are not pathogenic. However, there are some, including *E. coli* O157:H7, that produce a very toxic substance, called shiga toxin.

The Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP) and other monitoring efforts in the Region sample for pathogen indicators, including total and fecal coliform, and *E. coli*. Many monitoring programs, including CCAMP, use the Colilert method to test for *E. coli*. Colilert does not readily detect the O157:H7 strain. Indicators are measures of potential contamination, but are typically not pathogenic themselves. Basin Plan

standards are based on these indicator concentrations, not on concentrations of actual pathogens.

CCAMP screens for fecal coliform in surface waters by determining the rate of exceedance of the fecal coliform standard for water body contact (no more than 10% of samples exceeding 400 MPN/100 ml). CCAMP also evaluates the fecal coliform geometric mean for exceedance of 200 MPN/10 ml and screens for *E. coli* problems using the EPA recommended single sample maximum (235 MPN/100 ml at public swimming areas or 409 MPN/100 ml in lightly used water body contact areas).

In addition to routine CCAMP sampling, staff has sampled both the Salinas and Santa Maria watersheds over the last several years for *E. coli* to support Total Maximum Daily Load (TMDL) development. Other programs have also collected *E. coli* data in recent years. We summarize data from CCAMP regional collections and other efforts below.

Regionwide findings—CCAMP has routinely collected fecal coliform data since 1998 and has generated a number of new 303(d) listings for pathogen indicators. We have found elevated levels of fecal coliform to be widespread in our Region, particularly at the lower ends of developed watersheds. There are some areas of the Region that routinely do not exceed standards, such as the Big Sur coastline, and sites in some upper watershed areas. However, as shown in Figure 1, most sites in lower watersheds, where urban and agricultural activities are plentiful, have elevated geometric means.

CCAMP monitoring for *E. coli* began more recently, in 2005, with the startup of the second watershed rotation through our five watershed areas. CCAMP sampled the Pajaro and north coast watersheds in 2005 and is currently sampling in the Salinas watershed.

E. coli data from the CCAMP program commonly exceeds the EPA recommended standard for light water body contact. Percent exceedance in waterbodies sampled to date are shown in Figure 2. Magnitudes range widely, with many of the sites with the highest exceedance rates also showing higher magnitudes and site geometric means. Gabilan Creek, discussed in more detail below relative to *E. coli* 0157:H7, exceeds *E. coli* standards less frequently than other waterbodies in the Region.

Salinas Sampling—In 2004 to 2006, staff sampled the main stem of the Salinas River, Gabilan Creek, the Alisal/Reclamation Canal/Tembladero system, and Chualar Creek during both wet and dry seasons, as summarized in the Preliminary Project Report for the Salinas fecal coliform TMDL. All river and creek sites in the lower Salinas River system exceeded either fecal coliform or *E. coli* criteria, except in the Arroyo Seco River. We found that rate of exceedance and overall magnitude was lowest on the main stem of the Salinas River and in Blanco Drain. Most other locations exceeded standards 50% or more of the time. We discuss *E. coli* 0157:H7 results associated with this sampling effort in more detail below.

A Monterey Bay National Marine Sanctuary Citizens Monitoring Network grant, in place since 2005, has funded monthly volunteer *E. coli* sampling in the Salinas Reclamation Ditch, Santa Rita Creek, and storm water outfalls draining to these water bodies. Sampling results are similar to other studies, with all sites violating the EPA single sample maximum, usually between 60 and 90% of the time. Some of the outfalls had very high documented levels, exceeding 240,000 MPN/100 ml in one case.

California State University Monterey Bay researchers collected total, fecal and *E. coli* samples from Chualar Creek as part of a larger sampling effort between March 2001

and December 2002. Data findings were similar to CCAMP findings throughout the lower Salinas. *E. coli* values ranges from 2-220,000 MPN/100 mL.

The Preliminary Project Report for the Santa Maria fecal coliform TMDL utilizes CCAMP data as well as additional data collected during the wet season to examine agricultural and urban sources. TMDL sampling activities point to urban runoff as a large contributor to the problem. Though *E. coli* samples from irrigated agricultural areas also frequently exceeded standards, the concentrations were typically not as high as in runoff from urban areas. Rangeland was shown at some sites to be the primary source of concern. Eight samples were also tested for *E. coli* 0157:H7. None of these samples were positive.

Staff has relied on CCAMP and other special TMDL monitoring for source investigations for TMDLs developed in other watersheds throughout the region, as described above for the Santa Maria River watershed. The Central Coast Water Board establishes implementation requirements and strategies to control discharges of bacteria for sources identified by TMDL assessments.

Central Coast Water Board staff has been implementing actions to reduce bacteria discharges in the Morro Bay Watershed pursuant to a TMDL implementation plan for several years. The TMDL for bacteria for the Morro Bay Watershed was approved by USEPA on January 20, 2004. Central Coast Water Board staff partners with the Volunteer Monitoring Program for the Morro Bay National Estuary to collect bacteria data in the creeks and the Bay. The Central Coast Water Board also regulates storm water and septic system discharges, and staff manages grants that implement measures to control bacteria discharges from rangeland. The Central Coast Water Board approved the Watsonville Sloughs Bacteria TMDLs and

Implementation Plans in March 2006 and the State Water Board approved them in September 2006. These TMDLs include a conditional discharge prohibition for livestock and manure applications that may contact runoff, and require management measures to control bacteria discharges in storm water.

Central Coast Water Board staff has completed a preliminary TMDL assessment of bacteria sources in Aptos, Corralitos, and Valencia Creeks watersheds and the San Lorenzo River Estuary and Soquel Lagoon watersheds. Staff also initiated the assessment to determine sources of bacteria impairment in the Pajaro River watershed, which includes San Benito River and Llagas Creek, and will complete the assessment for that watershed by December 2006. Livestock, urban runoff, and homeless encampments appear to be the main sources of bacteria in most of these watersheds.

The source investigations for Morro Bay and Watsonville Sloughs included genetic studies to determine the origins of the bacteria. Central Coast Water Board staff evaluated the results and applicability of these studies to other similar watersheds and determined the following:

- Sources (e.g., bovine, human) can originate from watersheds draining multiple land uses and are likely originating from more than one land use.
- While sources are not well correlated with land use data, all land uses are associated with exceedances of water quality objectives.
- Seasonality, meaning different bacteria concentrations during wet weather compared to dry weather, is watershed-specific.

- Watersheds with larger rangeland components contribute more bovine sources.
- Exceedances of water quality objectives can be solely caused from natural sources (e.g., birds).

Central Coast Water Board staff has been challenged to determine the extent to which natural sources are causing the exceedances of water quality standards relative to controllable, anthropogenic sources, and to clearly identify which anthropogenic sources are the main sources. To date, the Central Coast Water Board has required controls on anthropogenic sources of bacteria¹ even when natural sources are known to be present and significant contributors of bacteria.

The City of Santa Maria has collected several years of runoff data associated with its storm water permit. All of the fecal coliform samples exceeded the criterion, and pointed both to urban areas and agriculture as sources. All site geomeans exceeded 1000 MPN/100 mL, with one site as high as 8,666 MPN/100 mL. The County's Project Clean Water had similar findings from storm water monitoring on Orcutt-Soloman Creek (a tributary to the Santa Maria River); *E. coli* sample geomeans ranged from 1,474 to 9,453 MPN/100 mL.

***E. coli* 0157:H7 in the Salinas Watershed**

Water Board staff has documented *E. coli* 0157:H7 in various stream locations in the Salinas River Watershed, in collaborative monitoring with DHS and USDA. This sampling has been conducted both as part of the source analysis for development of the Salinas River Watershed Fecal Coliform TMDL, and as follow-up to determine sources associated with the recent *E. coli* 0157:H7 outbreak. Water

¹ Anthropogenic sources include livestock grazing land.

Board staff released a Preliminary Project Report for the TMDL Project, containing this data, earlier this year.

Water Board staff collected data for the TMDL Project from November 2004 to April 2006. Staff collected water quality samples from streams, rivers and sloughs in the Project Area. DHS analyzed the samples for *E. coli* concentrations. Beginning in February 2005, USDA also analyzed the samples for the presence or absence of *E. coli* O157:H7.

Sampling locations were located within various land uses, including forested areas, grasslands, residential areas, and areas flanked by irrigated agricultural activities. There were few opportunities to sample from undeveloped sites, although some sampling was done from these areas.

E. coli O157:H7 was identified in all the land uses described above, with the exception of the undeveloped area. Samples positive for the O157:H7 strain were more prevalent during wet weather sampling, although some positives were also identified during dry weather.

Figure 3 illustrates the monitoring sites where *E. coli* O157:H7 has been identified and the land uses flanking these sites. Note from the figure that forested and grassland areas flank the upper reaches of the Gabilan Creek watershed. Although this area is somewhat undeveloped, this area does support rural residential areas, grazing lands, as well as areas where wildlife have access to stream systems.

Sources of *E. coli* in the Salinas River Watershed

Water Board staff evaluated the water quality monitoring results along with spatial data that included locations of streams, watershed boundaries, roads and other land uses. We have identified the following probable and confirmed sources of

bacteria in the Salinas Project area, based on investigations to date:

1. Livestock
2. Urban sources, including:
 - a. Sources from regulated stormwater discharges
 - i. Pets
 - ii. Feral animals
 - iii. Humans
 - iv. Illicit connections to municipal storm systems
 - v. Wildlife
 - b. Sources from residential, rural residential, commercial and industrial lands conveyed to surface waters by runoff
 - i. Pets
 - ii. Feral animals
 - iii. Humans
 - iv. Livestock
 - v. Failing septic systems
 - vi. Wildlife
3. Illegal discharges to land
5. Wildlife.

Follow-up Monitoring and Investigations

We recently sent all bacterial data collected by the CCAMP program to DHS for their use relative to the recent *E. coli* incident, and are starting up a new procedure for routine delivery of this information to DHS and to county health agencies. We are also planning the addition of *E. coli* O157:H7 to our routine monitoring activities to screen for its prevalence in other parts of the region. If we begin sampling soon, this will enable us to add this sampling to the last several months of the Salinas watershed rotation, to the Santa Maria rotation area, and to a Pajaro TMDL development project.

Thus, within a year's time we will have data on the three largest agricultural watersheds in our Region. This effort will require approximately \$130,000 in additional monitoring funds. Without new funds, this sampling will not be feasible. On October 20, 2006, the Central Coast Water Board

sent a letter (Attachment 1) to Tam Doduc, State Board Chair, requesting financial assistance to undertake this new sampling, and also expressing opposition to proposed FY 06/07 cuts to regional monitoring to fund new statewide monitoring.

Total Maximum Daily Loads Development and Establishment of Implementation Requirements

Multiple waterbodies in the Central Coast region are already listed as impaired by bacteria. Water Board staff has already completed or initiated source investigations and implementation plans for most of these waterbodies. See Attachment 2 for a list and status of these investigations and Total Maximum Daily Load (TMDL) Projects.

Staff will continue to pursue the TMDL projects currently in progress and will consider recent findings from *E. coli* sampling in evaluating sources in subsequent project analyses.

Recent Regulatory Response to Control Bacteria Discharges

Grazing

In September 2005, the Water Board concurred with a staff recommendation to continue to evaluate regulations and requirements for grazing and livestock operations on a watershed-by-watershed basis. Staff asserted that the results of TMDL investigations would determine the level of impact and need for such regulations or requirements.

In response to current information indicating grazing and livestock operations are a source of *E. coli* O157:H7, Water Board staff is evaluating the need and mechanism for a regional regulatory program for livestock and grazing. Staff is looking into if and how existing and current data support such an action, and the pros and cons of establishing waste discharge

requirements, a waiver of waste discharge requirements, or a Basin Plan prohibition.

Staff sent an informational letter to grazing and livestock industry and landowner representatives. The letter notified them of the recent findings of *E. coli* studies indicating these activities as sources. Additionally, we informed them of Water Board expectations that land managers engaged in such activity operate under plans that ensure they are preventing or minimizing water quality impacts.

Grants

The Regional Water Board is currently managing 55 agricultural-related grants totaling more than \$20 million (including projects from the Avila, Guadalupe, and PG&E settlement funds; Supplemental Environmental Projects, and Grant Programs). Three projects are directly related to food safety and *E. coli*, and are summarized below:

- The Central Coast Agricultural Water Quality Coalition has been awarded \$1,000,000 from the Agricultural Water Quality Grant Program to demonstrate the compatibility of water quality and food safety, through research and implementation of vegetative management practices (including grassed waterways, cover crops, and riparian buffers).
- The Monterey County RCD received \$49,826 from the PG&E fund to address food safety concerns as they pertain to water quality. Widespread concern exists among growers and shippers of fresh produce that vegetation near fields (which we promote) may affect food safety by increasing the risk of contamination. The project will investigate this major barrier to the implementation of vegetative practices by reviewing literature on the topic and assessing field

situations where water quality practices are not implemented as a result of food safety concerns.

- The Monterey Bay Sanctuary Foundation received \$49,874 from the PG&E funds to identify concentrations of *E. coli*, nitrate and orthophosphate in two creeks and six storm drains within Salinas. The goal is to better evaluate the relative impact from urban and agricultural land uses.

Point Sources

On October 24, 2006, staff sent a letter (Attachment 3) to approximately 20 fruit and vegetable packaging facilities throughout the region. The letter requires packaging facilities that reuse their wastewater for irrigation purposes to initiate bacterial monitoring and reporting of both source and wastewater for multiple bacterial analyses, including *E. coli* 0157:H7. Staff instituted this monitoring requirement because many of these facilities have authorization to reuse their wastewater, but at the time, did not have bacterial monitoring requirements in place.

Because we do not completely understand the fate and transport of *E. coli* 0157:H7, we required all facilities reusing their wastewater to monitor and report on bacterial compounds in both supply and effluent. The letter requires any facility with a positive *E. coli* 0157:H7 detection to immediately report findings to both this Water Board and the DHS Food and Drug Branch Emergency Response Unit. This immediate notification requirement mimics similar reporting requirements for wastewater treatment plants along Santa Barbara County's south coast, relating to bacteria analyses and shellfish harvesting.

As we learn more about individual facility operations and the fate, transport, and habitat of *E. coli* 0157:H7, we will likely modify the requirements imposed by our October 24, 2006 letter. In the near future,

we will also evaluate other food processing facilities, dairies, and wastewater treatment plants to determine if similar monitoring and reporting requirements would be appropriate for these facilities.

As discussed in the Background section above, Natural Selection Foods' San Juan Bautista packaging plant handled the spinach identified as the source of the *E. coli* 0157:H7 outbreak. We regulate waste discharges from this facility through Waste Discharge Requirements Order No. 99-99. Staff's inspections of this facility over the past several months, coupled with review of monitoring reports, identified several violations. Staff issued a notice of violation to Natural Selection Foods on October 17, 2006.² We will continue to review and ensure compliance at food processing facilities.

Agricultural Management Practices

In response to past *E. coli* outbreaks, food safety guidelines were established by FDA and also published by the lettuce industry at the request of FDA. These food safety guidelines are collectively known as Good Agricultural Practices (GAPs). Some guidelines focus on reducing the perceived threat from wildlife. Although the guidelines are stated cautiously, they have been interpreted by local growers and crop buyers to require removal of all wildlife habitat and vegetation anywhere in the vicinity of the crop. Removal of vegetation and habitat has the potential to cause violations of several surface water quality objectives in our Basin Plan and contradict our efforts to ensure healthy watersheds and riparian vegetation.

For certain kinds of pollution control practices, non-crop vegetation is the best method for reducing concentrations of

² Since staff is considering further enforcement action for these violations, a discussion with the Water Board about the factual circumstances of the noted violations is not appropriate at this time.

pesticides and nutrients in nearby surface waters. Riparian buffer zones are essential in maintaining stream channel health and improving water quality. However, market forces are already in place that strongly discourage the presence of non-crop vegetation on or near farms. These market-driven forces conflict with our region's ability to meet water quality objectives and protect beneficial uses.

Industry auditors, who are hired by produce buyers to assess crop food safety, perceive non-crop vegetation as a risk for increased crop contamination. Their rationale is that wildlife using non-crop vegetation could introduce bacteria to the crop or be entrained in the harvesting process. To date, there have been no scientific studies cited to support this assertion; however, it remains as part of the auditing process. Auditors evaluate a farm's food safety risk by assigning points for practices that protect food safety. Points are often deducted for produce grown near non-crop vegetation. In some cases, produce grown near riparian vegetation or other non-crop vegetation will not be purchased by buyers. This is a very strong economic disincentive to installing effective and practicable vegetative pollution treatment practices.

In addition, the most recent *E. coli* outbreak is also having a significant effect on farmers' use of vegetation for pollution prevention purposes. Growers are removing vegetation from their tail water ponds, grass from their roads and any other non-crop vegetation in an effort to reduce the risk of contamination, although we are aware of no scientific study that documents a link between the presence of vegetation and increase in *E. coli*. Several million dollars worth of grants have been awarded by the State and Regional Water Boards to install non-crop vegetation, and to look at the effectiveness of vegetation to reduce pollutants. Staff is now concerned both about project viability and about the

likelihood that these "demonstration projects" will ever result in widespread adoption of such practices.

Water Board staff sent a letter to the FDA on October 25, 2006 (Attachment 4), stating our concerns with the conflict between GAPs and our agricultural management practices, and the potential for negative impact to water quality. We have requested a meeting with FDA representatives to discuss the issue of food safety and water quality, and we will follow-up with growers and buyers to emphasize the importance of riparian vegetation and management practices that use vegetation. Additionally, we requested an opportunity to review any future proposed food safety guidelines or suggested farm practices that may affect water quality.

Water Board staff attended the *E. coli* Research Summit convened by Congressman Sam Farr on October 27, 2006. Although there was general agreement that more research is needed to determine the most effective management practices for growers, FDA is proposing to adopt mandatory food safety management guidelines for growers prior to the start of the next planting season in January. Staff raised the concern about removal of vegetation and are requesting to participate in the development of any mandatory practices.

ATTACHMENTS

- Attachment 1 – October 20, 2006 letter to Tam Doduc, State Water Board Chair
- Attachment 2 – List of Surface Water Bodies Impaired by Bacteria
- Attachment 3 – October 24, 2006 letter: Request for Bacterial Analyses
- Attachment 4 – October 25, 2006 letter to U.S. Food and Drug Administration

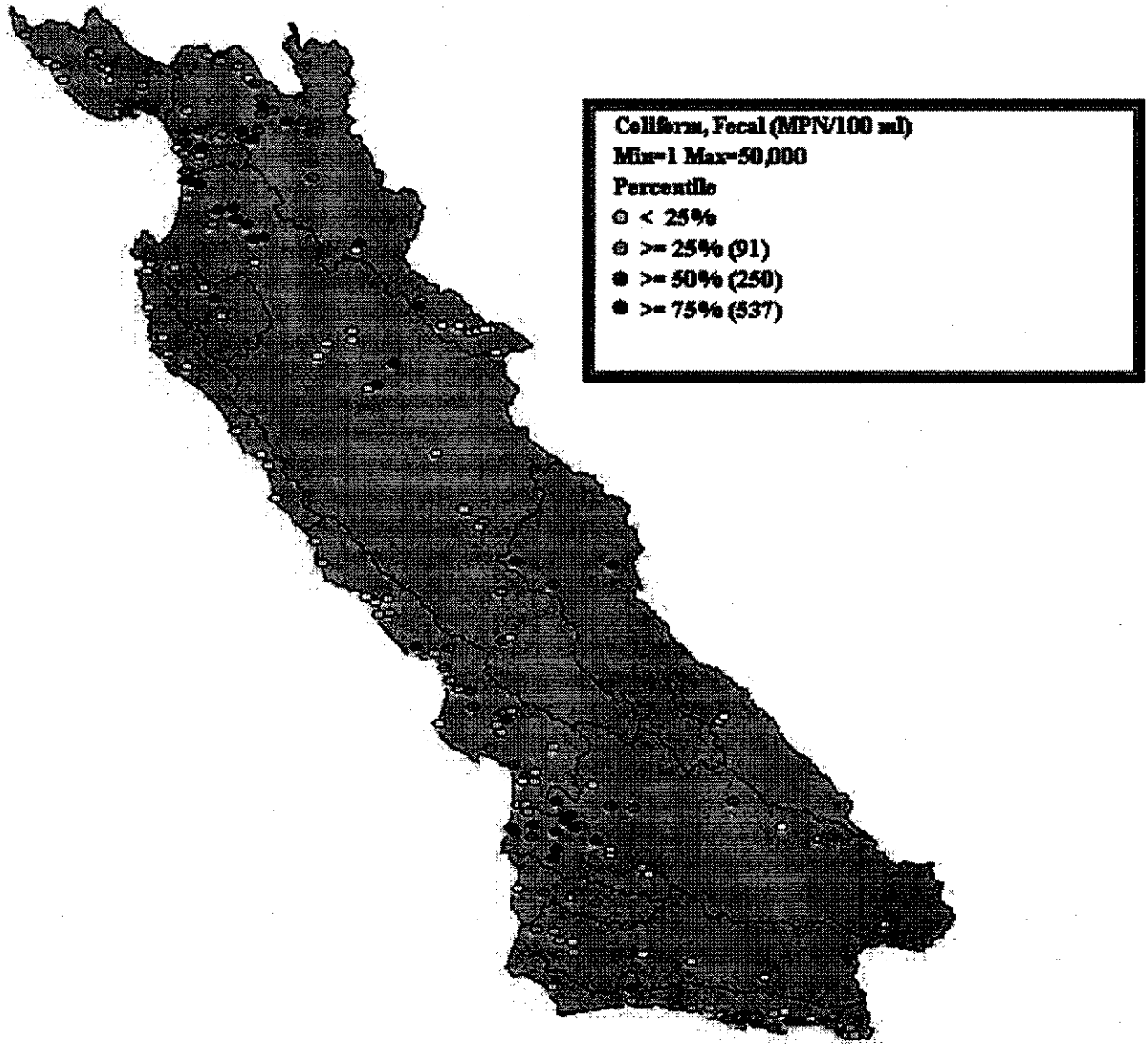


Figure 1. Geometric mean of fecal coliform data from throughout Region 3, expressed in quartiles.

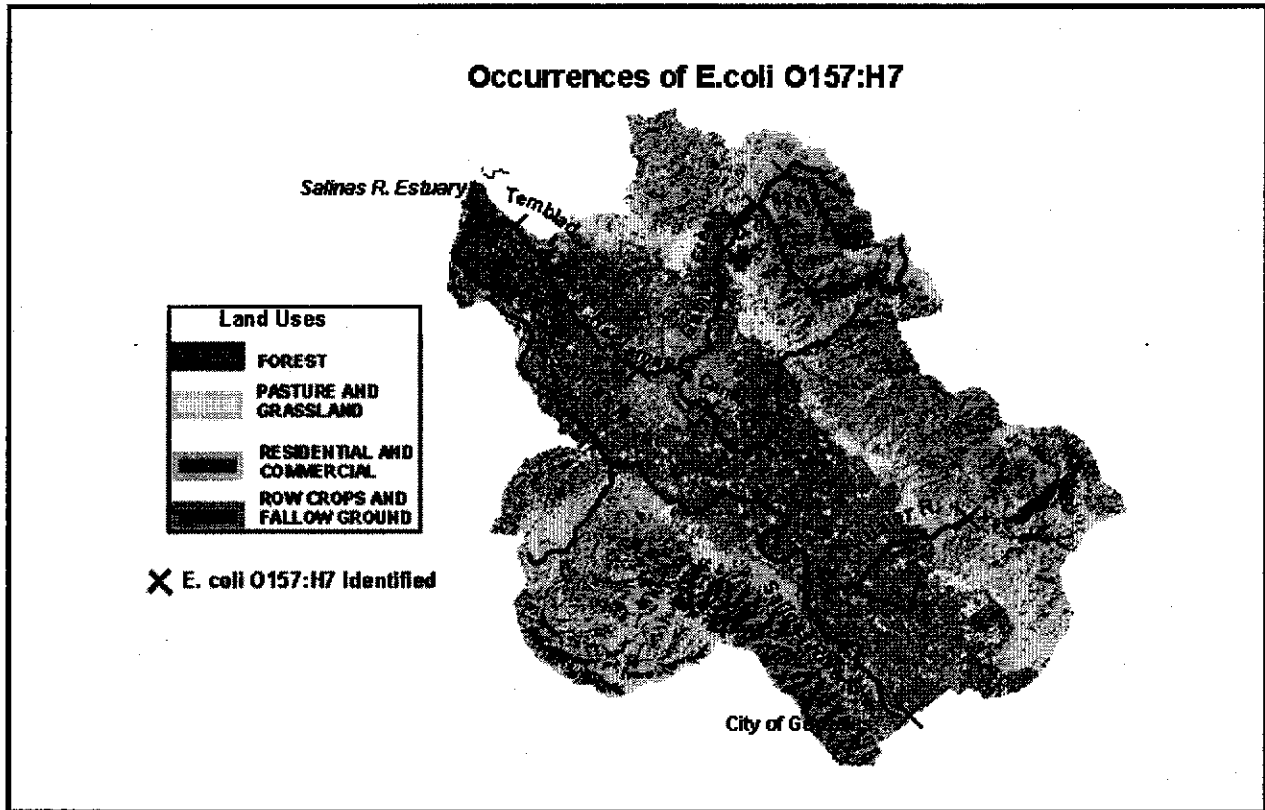


Figure 3. Monitoring sites where E. coli O157:H7 has been identified.