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Summary of Substantial Evidence of Potentially Significant Water and Air Quality Impacts from Fireworks Displays in the City of San Diego

Exhibit A **San Diego Regional Water Quality Control Board (draft) Tentative Order No. R9-2011-0022, NPDES NO. CAG999002; General NPDES Permit for Residual Fireworks Pollutant Waste Discharges to Waters of the United States in the San Diego Region form the Public Display of Fireworks.**

- Draft Clean Water Act (Federal and State) permit contains numerous findings supporting contention that fireworks discharges over water have the potential to cause significant environmental harm. Relevant language includes, but is not limited to, the following:

- "Public displays of fireworks (also referred to as a fireworks show or event) are conducted throughout the year at various locations within the San Diego Region as part of national and community celebrations and other special events."

- "Typical firework constituents include, but are not limited to, aluminum, antimony, barium, carbon, calcium, chlorine, cesium, copper, iron, potassium, lithium, magnesium, oxidizers including nitrates, chlorates and perchlorates, phosphorus, sodium sulfur, strontium, titanium, and zinc. The chemical constituents burn at high temperatures when the firework is detonated which promotes incineration. The chemical constituents within the fireworks are scattered by the burst charge which separates them from the fireworks casing and internal shell components. A firework combustion residue is produced in the form of smoke, airborne particulates, chemical pollutants, and debris including paper, cardboard, wires and fuses. This combustion residue can fall into surface waters. In addition un-ignited pyrotechnic material including duds and misfires can also fall into surface waters. The receiving water fallout area affected by the fireworks residue can vary depending on wind speed and direction, size of the shells, the angle of mortar placement, the type and height of firework explosions and other environmental factors. Once the fireworks residue enters a water body it can be transported to waters and shorelines outside the fallout area due to wind shear and tidal effects."

- "...discharges from the public display of fireworks contain pollutants that have a potential to cause excursions of applicable water and sediment quality objectives."

- "One of the main constituents of concern in firework discharges is perchlorate. The detonation of fireworks can result in the release of perchlorate into the environment and surface waters. Perchlorate is a chemical that is both manufactured and naturally-occurring. Most commonly found in the form of perchloric acid and salts, perchlorate is highly soluble, mobile in groundwater and surface water, and persistent in the environment. Most fireworks are believed to contain potassium perchlorate, an inorganic salt that is a strong oxidizer. The manufacturers of fireworks use potassium perchlorate in the compositions that produce colored smokes and bursts. Its presence in the environment has been attributed to past waste handling practices at facilities that manufacture or use perchlorate and materials containing the chemical. It may also be present in the environment as a consequence of using perchlorate-containing products such as solid rocket propellant, flares, fireworks, pyrotechnic devices including fireworks, and explosives. Perchlorate can greatly impact human health by interfering with iodide uptake into the thyroid gland. In adults, the thyroid gland helps regulate the metabolism by releasing hormones, while in children, the thyroid helps in proper development. Although research has found that perchlorate at high levels can limit the uptake of iodide by the thyroid gland, studies have not directly measured the impact of perchlorate on human metabolism and growth."

  "Perchlorate effects on the thyroid gland are the basis of the 6 ug/L public health goal (PHG) for drinking water established in 2004. A PHG is a level of a contaminant in drinking water that does not pose a significant short-term or long-term health risk. A PHG is not a regulatory requirement. Instead, it is a goal for drinking water that California's public water suppliers and regulators should strive to meet if it is feasible to do so. In January 2011, OEHHA released a draft technical support report document proposing the establishment of a 1 ug/L PHG for perchlorate."

  "Monitoring by the California Department of Public Health and operators of public water systems have shown perchlorate to be a wide spread drinking water contaminant occurring in several hundred wells, mostly in Southern California. Perchlorate was also found in the Colorado River, an important source of water for drinking and irrigation, where its presence resulted from contamination from ammonium perchlorate manufacturing facilities in Nevada. Based on all of these considerations the California Department of Public Health took action in October 2007 to regulate perchlorate as a drinking water contaminant with a maximum contaminant level (MCL) of 6 micrograms per liter. On the Federal level the US EPA issued a notice in the federal register on February 2, 2011 that it is initiating a process to develop and establish a national primary drinking water regulation for perchlorate."

- Regarding water quality monitoring after larger Sea World fireworks shows, "Water chemistry sampling following these dates found receiving waters in the fireworks fallout area to exceed both water quality criteria and levels documented

at the reference sites. Pollutants such as arsenic, copper, mercury, tin, zinc and phosphorous were detected at levels above water quality criteria or at elevated levels compared to the reference sites."

- Regarding impacts to sediment quality following larger Sea World fireworks shows, "SeaWorld's sediment monitoring in Mission Bay found enrichment of 11 metals within the fireworks zone when compared to one reference site (barium, chromium, cobalt, copper, molybdenum, potassium, selenium, silver, thallium, titanium and vanadium) and 4 metals (barium, cobalt, copper, and vanadium) when compared to both reference sites. Alternatively, sediment grain size and concentration analysis found correlations for barium, cobalt, chromium, copper, titanium and vanadium. The data provides an indication of an accumulation of pollutants over time within the fireworks fallout area when compared to the reference sites."

- "SeaWorld's sediment monitoring in Mission Bay found enrichment of 11 metals within the fireworks zone when compared to one reference site (barium, chromium, cobalt, copper, molybdenum, potassium, selenium, silver, thallium, titanium and vanadium) and 4 metals (barium, cobalt, copper, and vanadium) when compared to both reference sites. Alternatively, sediment grain size and concentration analysis found correlations for barium, cobalt, chromium, copper, titanium and vanadium. The data provides an indication of an accumulation of pollutants over time within the fireworks fallout area when compared to the reference sites."

- "Thus, while sampling documented increased pollutant levels, the monitoring conducted to date is insufficient to discern if there are benthic impacts within the fireworks fallout area attributable solely to the discharge of residual fireworks pollutant waste. However, the increase in pollutant levels within the sediment in the fireworks fallback area shows that the discharge of pollutants associated with larger fireworks events has the reasonable potential to cause or contribute to an exceedance of the narrative sediment quality objectives stated in section VI.A.3.c of the Order."

- The language quoted herein is not credibly in dispute. While dischargers may disagree with the policies to be enacted as a result of these facts, they are nonetheless the current state of scientific knowledge regarding large fireworks shows in the region. To the extent the City seeks to declare the individual 4th of July shows it permits as smaller than the Sea World shows deemed to have the stated impacts, there is not substantial evidence to support such assertion. Please also see CERF's comment letter regarding this draft permit for additional arguments in this regard.

The draft permit will be considered for adoption on May 11, 2011. Thus, it is highly likely the final document, with the language quoted above left intact, will qualify for augmentation to the administrative record for any lawsuit brought to

challenge the proposed City action. At the very least, the City is on notice that there is a substantial likelihood that larger fireworks shows have the potential to cause significant environmental effects. Please also note, the exemption proposed in the Special Events Ordinance does not indicate any limit in size or scope of exempted show. Therefore, the City must be able to state with certainty that significant effects could not be possible even if all other shows were increased in duration and fireworks type to equal or even exceed the largest of Sea World's shows. This cannot be done without substantially more environmental review than conducted by the City thus far.

Exhibit A-1 CERF's April 20, 2011 Comment Letter to San Diego Regional Water Quality Control Board Regarding Tentative Order No. R9-2011-0022.

- Letter provides arguments and data to suggest the Regional Board arbitrarily established a difference between the size of Sea World's largest fireworks shows and those conducted elsewhere in the City of San Diego (esp. La Jolla) on the 4th of July.

- To the extent any evidence provided by the City relies upon the draft permit purportedly to establish with certainty the unlikelihood of significant environmental impacts from smaller fireworks shows, CERF's comment letter raises legitimate questions regarding the validity of the draft permit's findings for such purpose.

Exhibit B San Diego Regional Water Quality Control Board Executive Officer's Report, December 12, 2007, Regarding Sea World NPDES Permit Amendment to Establish Waste Discharge Requirements for Discharge of Waste from Aerial Fireworks Displays to Mission Bay.

- "There have been concerns over the possible environmental effects of fireworks displays on sediment and water quality. Constituents of concern include aluminum, magnesium, strontium, barium, sodium, potassium, iron, copper, sulfate, nitrate and perchlorate. These fireworks constituents have a potential to adversely impact and/or contribute to degradation of water and sediment quality within Mission Bay. In addition, debris from unexploded shells as well as paper, cardboard, wires and fuses from exploded shells can also adversely impact the quality within Mission Bay. The area affected by these debris can vary depending on wind speed and direction, size of the shells, height of the explosion, and other environmental and anthropogenic factors."

- Coupled with the findings in the draft Tentative Order and the more recent Sea World reports themselves, this documents indicates the data regarding water quality impacts from fireworks displays is far from conclusive. The City cannot thus claim with certainty that the Municipal Code exemptions will not result in significant environmental effects.

Exhibit C **San Diego Regional Water Quality Control Board Conditional Waiver No. 11 - Aerially Discharged Wastes Over Land.**

- "For waste discharges related to fireworks displays, available studies suggest annual or infrequent fireworks displays present a low threat to groundwater quality. However, there may be potential water quality impacts that are cumulative for shallow groundwaters used as drinking water sources with recurring fireworks displays."

- This document indicates there is uncertainty regarding potential impacts from fireworks over land to significantly effect groundwater used as drinking water. The City has not addressed this issue at all, and therefore cannot claim with certainty there would be no cumulative significant effects from shows throughout the City.

Exhibit D ***Perchlorate Behavior in a Municipal Lake Following Fireworks Displays*, Environ. Sci. Technol. 2007, 41, 3966-3971.**

- Peer reviewed scientific journal article establishes that fireworks displays over water can result in perchlorate concentration spikes of 24 to 1028 times the mean baseline value. "After the fireworks displays, perchlorate concentrations decreased toward the background level within 20 to 80 days, with the rate of attenuation correlating to surface water temperature. Adsorption tests indicate that sediments underlying the water column have limited (<100 nmol/g) capacity to remove perchlorate via chemical adsorption." "Results from this study highlight the need for additional studies of perchlorate behavior following fireworks displays in relation to surface water and groundwater quality, particularly in urban areas."

- This document represents the most in-depth review of the impacts of perchlorate discharges from fireworks shows. Based on this document alone, the City cannot claim with any certainty either (a) that perchlorate cannot cause environmental impact; (b) that perchlorate is unlikely to be discharged into water bodies from fireworks over them; and ©) that the state of science regarding perchlorate impacts from fireworks is such that the significance of potential impacts can be established without additional monitoring and studies. This document specifically calls into question the potential for significant impacts to Lake Murray and the San Diego River from 4th of July and periodic Qualcomm fireworks shows.

Exhibit E **Legislative Counsel Digest, AB 826 (Jackson), The Perchlorate Contamination Prevention Act, Approved by Governor September, 2003.**

- The Act contains legislative findings regarding the potential negative impacts from perchlorate contamination. Establishes that, "Perchlorate materials and wastes are associated with, among other things, solid rocket propellants, explosives, fireworks, flares, airbags, and some fertilizers." Also notes that, "The discharge of perchlorate waste into the environment through air, surface and

subsurface soils, surface water and groundwater media is a threat to water supply and to wildlife habitat, such as wetlands."

- In light of the State's express recognition that perchlorate contamination is such a problem that a state law addressing it is required, coupled with the finding that fireworks are a contributor to such contamination, and that such contamination is a threat to water supply and wildlife habitat, it is impossible for the City to say with certainty that the discharge of fireworks meets the common sense exemption.

Exhibit F ***The Fallout from Fireworks: Perchlorate in Total Deposition,*** **Water Air Soil Pollution, Vol. 198, Issue 1, p.149.**

- Peer reviewed scientific journal article establishing likelihood of perchlorate spikes in aerial deposition attributable to 4th of July fireworks shows. The study also suggests that wind properties and storm direction affect the extent of the particulate matter fallout zone, with perchlorate impacts noted "a few km from known displays."

- "The Massachusetts Dept. of Environmental Protection has determined that historic fireworks displays are the likely source of perchlorate contamination in two of the nine public water supply systems showing levels above 1 microgram L^{-1} (Mass. DEP 2006). Although little information is available on the perchlorate content in fireworks their model predicts that groundwater should be contaminated to the tens of micrograms ClO_4 L^{-1} within 100 meters of the fireworks display."

- "The effects of atmospheric pollution from fireworks have been reported by other studies noting increases in SO2, NO2, suspended particles and metallic elements (Moreno et al. 2007; Ravindra et al. 2003)."

- "Our study showed that precipitation concentrations after Fourth of July fireworks displays can be 18 times as much as background levels confirming that, "fireworks constitute a potential source of increasing importance, as fireworks use is rising exponentially with average consumption at 4.5 × 107 kg per year" (Dasgupta et al. 2006). As a result we need to be concerned about the potential impact on our groundwater of increased perchlorate in precipitation associated with fireworks."

- Study confirms that aerial deposition of pollutants from fireworks displays may cause significant environmental effects. This is particularly applicable to San Diego as historically some of the largest fireworks shows have occurred on New Year's Eve on San Diego and Mission Bays. But, because the City's exemption does not restrict fireworks shows during the rainy season, the City must also establish with certainty such shows would not occur when the chance for precipitation would occur during or immediately following a show. This has not been done. The study also relates the likelihood that air quality impacts from

fireworks, while an issue not focused on by CERF, would also have to be studied and refuted in order for the City to take advantage of the common sense exception.

Exhibit G **Exceptional Event Request; Fireworks Display Impact, Granite City, Illinois, Site 17-119-1007, July 5, 2008 $PM_{2.5}$ Sample**.

- Clean Air Act compliance notification of exceedences of National Ambient Air Quality Standards (NAAQS) directly attributable to fireworks. ""But for" the July 5th measurement that was significantly impacted by fireworks displays emissions, the Granite City site would have complied with the $PM_{2.5}$ daily NAAQS.

- The City of San Diego, to CERF's knowledge, has not studied the issue of potentially significant environmental effects to air quality from fireworks shows. Thus, it cannot say with certainty that fireworks cannot possibly cause impacts to air quality.

Exhibit H ***The Impact of Fireworks on Airborne Particles*, Author's Accepted Manuscript, by Vecchi, Bernardoni, et al.; Atmospheric Environment (2007) doi:10.1016/j.atmosenv.2007.10.047.**

- Study indicates fireworks are responsible for transient high concentrations of particles (especially metals and organic compounds) and gases.

- The City of San Diego, to CERF's knowledge, has not studied the issue of potentially significant environmental effects to air quality from fireworks shows. Thus, it cannot say with certainty that fireworks cannot possibly cause impacts to air quality.

Exhibit I ***Effect of Fireworks Events on Urban Background Trace Metal Aerosol Concentrations: Is the Cocktail Worth the Show?*, by Moreno, Querol, et al.; Journal of Hazardous Materials 183 (2010) 945-949.**

- Abstract of scientific journal article reads, "We report on the effect of a major firework event on urban background atmospheric $PM_{2.5}$ chemistry, using 24-h data collected over 8 weeks at two sites in Girona, Spain. The firework pollution episode (Sant Joan fiesta on 23rd June 2008) measured in city centre parkland increased local background $PM_{2.5}$ concentrations as follows: Sr (x86), K (x26), Ba (x11), Co (x9), Pb (x7), Cu (x5), Zn (x4), Bi (x4), Mg (x4), Rb (x4), Sb (x3), P (x3), Ga (x2), Mn (x2), As (x2), Ti (x2) and SO4 2- (x2). Marked increases in these elements were also measured outside the park as the pollution cloud drifted over the city centre, and levels of some metals remained elevated above background for days after the event as a reservoir of metalliferous dust persisted within the urban area. Transient high-PM pollution episodes are a proven health hazard, made worse in the case of firework combustion because many of the elements released are both toxic and finely respirable, and because displays

commonly take place in an already polluted urban atmosphere.

- *The City of San Diego, to CERF's knowledge, has not studied the issue of potentially significant environmental effects to air quality from fireworks shows. Thus, it cannot say with certainty that fireworks cannot possibly cause impacts to air quality.*

Exhibit A

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

SAN DIEGO REGION

Linda S. Adams
Acting Secretary for
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Edmund G. Brown Jr.
Governor

TENTATIVE ORDER NO. R9-2011-0022
NPDES NO. CAG999002

GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL FIREWORK POLLUTANT WASTE DISCHARGES TO WATERS OF THE UNITED STATES IN THE SAN DIEGO REGION FROM THE PUBLIC DISPLAY OF FIREWORKS

The following Dischargers, as described in the following table, may apply for coverage under this General Permit (also referred to herein as Order) and are subject to waste discharge requirements as set forth in this Order:

Table 1. Discharger Information

Discharger	Any person discharging pollutant wastes associated with the public display of fireworks to surface waters of the United States (U.S.) in the San Diego Region.
The U.S. Environmental Protection Agency and the California Regional Water Quality Control Board, San Diego Region, have classified these discharges as minor discharges. In accordance with Section 2200, Title 23 of the California Code of Regulations, discharges regulated by this Order are determined to be Category 3. The threat to water quality and complexity of the discharge is determined to be category 3C.	

Discharges of residual firework pollutant wastes by persons identified in Table 1 above from the discharge points identified in Table 2 below are subject to waste discharge requirements as set forth in this Order. Administrative information is contained in Table 3 below.

Table 2. Discharge Location

Discharge Point(s)	Discharge Description	Discharge Point Latitude(s)	Discharge Point Longitude(s)	Receiving Water(s)
Various Locations throughout San Diego Region	Residual Firework Pollutant Waste Discharges to Waters of the United States	Various	Various	Inland Surface Waters, Enclosed Bays and Estuaries, Harbors, Lagoons, Pacific Ocean

Table 3. Administrative Information

This Order was adopted by the California Water Quality Control Board, San Diego Region, on:	**May 11, 2011**
This Order shall become effective on:	**June 1, 2011**
This Order shall expire on:	**May 31, 2016**
Dischargers (also referred to as Enrollees) covered under this Order at the time of expiration will continue to be covered until coverage becomes effective under a reissued permit. Upon reissuance of this Order by the San Diego Water Board, Dischargers may need to seek re-enrollment under the revised Order.	

I, David W. Gibson, Executive Officer, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Diego Region, on May 11, 2011.

TENTATIVE

David W. Gibson
Executive Officer

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I. DISCHARGE INFORMATION

This Order is intended to regulate residual pollutant waste discharges associated with the public display of fireworks to various receiving surface waters of the United States (Surface Waters) within the jurisdiction of the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board). The San Diego Region covers a large portion of San Diego County, portions of South Orange County, and the southwestern portion of Riverside County based on hydrologic drainage areas. In this Order the public display of fireworks refers to an entertainment feature where the public or a private group is admitted to, or permitted to, view the display or discharge of fireworks.

Public displays of fireworks (also referred to as a fireworks show or event) are conducted throughout the year at various locations within the San Diego Region as part of national and community celebrations and other special events. Located within the San Diego Region are entertainment theme parks and two major league stadiums for football and baseball that use firework displays during regular activities and special events. Additionally, fireworks displays and pyrotechnics special effects are periodically used in other venues such as business grand openings and special events, public and private school homecoming & graduation events, various sporting events and local fairs. The most significant and widespread use of fireworks displays for celebrations in the San Diego Region are for annual Fourth of July and New Year's Eve public and private events Firework display sites on or adjacent to urban shorelines are often the preferred setting to provide public access and avoid the fire hazards associated with terrestrial display sites.

Professional pyrotechnic devices used in fireworks displays can be grouped into three general categories: 1) aerial shells (paper and cardboard spheres or cylinders filled with pyrotechnic materials), 2) low-level comet and multi-shot devices such as roman candles, and 3) set piece displays mounted on the ground. Typical firework constituents include, but are not limited to, aluminum, antimony, barium, carbon, calcium, chlorine, cesium, copper, iron, potassium, lithium, magnesium, oxidizers including nitrates, chlorates and perchlorates, phosphorus, sodium sulfur, strontium, titanium, and zinc. The chemical constituents burn at high temperatures when the firework is detonated which promotes incineration. The chemical constituents within the fireworks are scattered by the burst charge which separates them from the fireworks casing and internal shell components. A firework combustion residue is produced in the form of smoke, airborne particulates, chemical pollutants, and debris including paper, cardboard, wires and fuses. This combustion residue can fall into surface waters. In addition un-ignited pyrotechnic material including duds and misfires can also fall into surface waters. The receiving water fallout area affected by the fireworks residue can vary depending on wind speed and direction, size of the shells, the angle of mortar placement, the type and height of firework explosions and other environmental factors. Once the fireworks residue enters a water body it can be transported to

waters and shorelines outside the fallout area due to wind shear and tidal effects. The Clean Water Act (CWA), at section 301(a), broadly prohibits the discharge of any pollutant to waters of the United States, except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Residual firework pollutant waste discharged into surface waters constitutes discharge of a pollutant from a point source within the meaning of the CWA. Therefore, coverage under an NPDES permit is required before residual firework pollutant waste can be lawfully discharged.

This Order requires implementation of Best Management Practices (BMPs) described in Section V.B of this Order to ensure the pollutant waste discharges associated with the public display of fireworks do not cause pollution or nuisance conditions in surface waters within the San Diego Region. This Order also requires post firework event monitoring and reporting as well as receiving water monitoring and reporting for discharges meeting certain specific criteria described under specific conditions in Attachment E of this Order.

II. PERMIT COVERAGE AND APPLICATION REQUIREMENTS

A. General Permit Coverage

This General Permit covers the point source discharge of residual firework pollutant waste to surface waters resulting from the public display of fireworks, including but not limited to fireworks using aluminum, antimony, barium, carbon, calcium, chlorine, cesium, copper, iron, potassium, lithium, magnesium, oxidizers including nitrates, chlorates and perchlorates, phosphorus, sodium sulfur, strontium, titanium, and zinc.

Users of fireworks containing these and other pollutant wastes for public shows or events are required to obtain coverage under this General Permit prior to the public display of fireworks.

B. Discharger Eligibility Criteria

Any person who proposes to discharge pollutant waste from the public display of fireworks to surface waters of the U.S. in the San Diego Region may submit a Notice of Intent (NOI) for coverage under this Order. The NOI may address multiple fireworks events at different locations throughout the San Diego Region. When a fireworks event(s) is hosted by one person but is operated or conducted by another person, it is the host person's duty to submit an NOI and obtain coverage under this Order. The San Diego Water Board may require the joint submission of an NOI from both the host person and the person operating the fireworks event on a case-by-case basis.

C. General Permit Application

To obtain coverage under this Order, Dischargers must submit a complete application containing the items below to the San Diego Water Board no later than 60 days prior to a fireworks event. During the period of May 11, 2011 through June 10, 2011 Dischargers must submit the complete application no later than 24 days prior to a fireworks event. The application must contain the following items:

1. A completed Notice of Intent (NOI) form shown as Attachment B signed in accordance with the signatory requirements of the Standard Provisions in Attachment D, Section V.B.1. Signatory and Certification Requirements;

2. Payment of the annual application fee, equal to the first annual fee, made payable to State Water Resources Control Board or "SWRCB"; and

3. A Fireworks Best Management Practices Plan.

The NOI, including, the application fee, and other attachments must be submitted to the following address:

CRWQCB – San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Attn: Fireworks General NPDES Order
NOTICE OF INTENT

D. Notice of Enrollment

The San Diego Water Board will review the application package for completeness and applicability to this Order. Notice of Enrollment (NOE) under this Order will be provided to the Discharger by the San Diego Water Board upon receipt of a complete NOI, Fireworks Best Management Practices Plan, and application fee. The NOE may include specific conditions not stated in this Order, including but not limited to receiving water and sediment monitoring. Any such specific conditions and requirements shall be enforceable. The effective enrollment date will be specified in the NOE and the Discharger is authorized to discharge residual firework pollutant waste starting on the date specified in the NOE. General Permit coverage will be effective when all of the following have occurred:

1. The Discharger has submitted a complete permit application;

2. The Fireworks Best Management Practices Plan has been accepted by the San Diego Water Board; and

3. The San Diego Water Board has issued a Notice of Enrollment (NOE).

E. Notice of Exclusion (NOEX)

The San Diego Water Board may issue a Notice of Exclusion (NOEX), which either terminates the permit coverage or requires submittal of an application for an individual permit. An NOEX is a one-page notice that indicates that the proposed Discharger is not eligible for coverage under this General Permit and states the reason why. This justification can include, but is not limited to, necessity to comply with a total maximum daily load or to protect sensitive water bodies.

F. Fees

Under this General Permit, fireworks discharges require no treatment systems to meet the terms and conditions of this Order and pose no significant threat to water quality. As such, they are eligible for Category 3 in section 2200(b) (8) of Title 23, California Code of Regulations (CCR). This category is appropriate because regulation of firework discharge under this Order incorporates best management practices (BMPs) to control potential adverse effects to beneficial uses, and this General Permit prohibits residual firework pollutant waste from causing excursions of water quality objectives. The annual fee associated with this rating can be found in section 2200(b) (8) of Title 23, CCR, which is available at **http://www.waterboards.ca.gov/resources/fees/**.

G. Terminating Coverage

To terminate permit coverage, a Discharger must submit a complete and accurate Notice of Termination (NOT). The Discharger's coverage under this General Permit terminates on the date specified in the coverage termination letter issued by the San Diego Water Board. Prior to the termination effective date, the Discharger is subject to the terms and conditions of this General Permit and is responsible for submitting the annual fee and all reports associated with this General Permit. The Discharger must submit an NOT when one of the following conditions occurs:

1. A new sponsor has taken over responsibility of the Discharger's fireworks display activities covered under an existing NOI; or

2. The Discharger has ceased all discharges of residual firework pollutant waste for which it obtained General Permit coverage and does not expect to discharge during the remainder of this General Permit term; or

3. The Discharger has obtained coverage under an individual permit for all residual firework pollutant waste discharges to waters of the U.S. required to be covered by an NPDES permit.

III. FINDINGS

The San Diego Water Board finds:

A. Background. In 1972, the Federal Water Pollution Control Act [33 U.S.C. §1251 et seq. (1972)], currently referred to as the Clean Water Act (CWA), was amended to provide that the discharge of pollutants to waters of the United States from any point source is prohibited, unless the discharge is in compliance with an NPDES permit. The federal regulations allow either the United States Environmental Protection Agency (USEPA) or states with USEPA-approved programs to issue either general NPDES permits or individual NPDES permits to regulate discharges of pollutants to waters of the United States. California has an approved program.

Public displays of fireworks are conducted throughout the year at various locations within the San Diego Region. Although this Order does not precisely specify the point(s) at which fireworks residue becomes a pollutant waste, discharges from the public display of fireworks contain pollutants that have a potential to cause excursions of applicable water and sediment quality objectives. Residual firework pollutant waste discharged into surface waters constitutes discharge of a pollutant from a point source within the meaning of the CWA. Therefore, coverage under an NPDES permit is required.

With the exception of SeaWorld San Diego, discharges associated with public fireworks events have previously been unregulated in the San Diego Region by the San Diego Water Board. The Fact Sheet of this Order contains an assessment of firework event monitoring data collected in Mission Bay by SeaWorld.

For the purposes of this Order, references to the “discharger” or “permittee” in applicable federal and state laws, regulations, plans, or policies are held to be equivalent to references to the Discharger herein.

B. Discharge Description. Public displays of fireworks are typically conducted over or adjacent to surface water bodies throughout the San Diego Region, including but not limited to, the San Diego River, San Diego Bay, Mission Bay, and the Pacific Ocean. Typical firework constituents include but are not limited to aluminum, antimony, barium, carbon, calcium, chlorine, cesium, copper, iron, potassium, lithium, magnesium, oxidizers including nitrates, chlorates and perchlorates, phosphorus, sodium sulfur, strontium, titanium, and zinc. The chemical constituents burn at high temperatures when the firework is detonated which promotes incineration. The chemical constituents within the fireworks are scattered by the burst charge, which separates them from the fireworks casing and internal shell components. A firework combustion residue is produced in the form of smoke, airborne particulates, chemical pollutants, and debris including paper, cardboard, wires and fuses. This combustion residue can fall into surface

waters. In addition, un-ignited pyrotechnic material including duds and misfires can also fall into surface waters. The receiving water fallout area affected by the fireworks residue can vary depending on wind speed and direction, size of the shells, the angle of mortar placement, the type and height of firework explosions and other environmental factors. Once the fireworks residue enters a water body it can be transported to waters and shorelines outside the fallout area due to wind shear and tidal effects.

C. Legal Authorities. This Order is issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (USEPA) and chapter 5.5, division 7 of the California Water Code (commencing with section 13370). Section 122.28(a)(1) of Title 40 of the Code of Federal Regulations [40 C.F.R. §122.28(a)(1)] allows NPDES permits to be written to cover a category of discharges within the State political boundaries as a general NPDES permit. USEPA Region 9 has granted the San Diego Water Board the authority to issue general NPDES permits.

This Order shall serve as a General NPDES permit for point source discharges of residual firework pollutant waste from public firework events. This Order also serves as general Waste Discharge Requirements (WDRs) pursuant to article 4, chapter 4, division 7 of the Water Code (commencing with section 13260).

D. Background and Rationale for Requirements. The San Diego Water Board developed the requirements in this Order based on available monitoring data and other available information related to the effects, characteristics, and regulation of firework pollutant waste discharges. The Fact Sheet (Attachment F), which contains background information and rationale for Order requirements, is hereby incorporated into this Order and constitutes part of the Findings for this Order. Attachments A through F are also incorporated into this Order

E. California Environmental Quality Act (CEQA). Under Water Code section 13389, this action to adopt an NPDES permit is exempt from the provisions of CEQA, Public Resources Code section 21000 et seq.

F. Technology-based Effluent Limitations. Section 301(b) of the CWA and implementing USEPA permit regulations at section 122.44, title 40 of the Code of Federal Regulations[1], require that permits include conditions meeting applicable technology-based requirements at a minimum, and any more stringent effluent limitations necessary to meet applicable water quality standards. This Order does not contain technology based effluent limitations. There are currently no applicable Effluent Limitation Guidelines (technology based requirements established by USEPA) for discharges associated with public displays of fireworks. The provisions of this Order require implementation of BMPs to control and abate the discharge of pollutants to surface waters. Dischargers

[1] All further statutory references are to title 40 of the Code of Federal Regulations unless otherwise indicated.

enrolled under this Order are expected to comply with all water and sediment quality objectives through implementation of BMPs.

G. Water Quality-Based Effluent Limitations (WQBELs). Section 301(b) of the CWA and section 122.44(d) require that permits include limitations more stringent than applicable federal technology-based requirements where necessary to achieve applicable water quality standards.

Section 122.44(d)(1)(i) of 40 CFR mandates that permits include effluent limitations for all pollutants that are or may be discharged at levels that have the reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. Section 122.44(k)(3) of 40 CFR allows the use of other requirements such as BMPs in lieu of numeric effluent limits if the latter are infeasible. The San Diego Water Board finds that numeric effluent limits for fireworks residual pollutant waste discharges are infeasible because:

1. This General Permit regulates discharges of residual pollutant wastes which are firework constituents or breakdown products that are present after the use of the fireworks for public display. Therefore, the exact residual pollutant waste levels in the discharge are immeasurable and undefined; and

2. It would be impractical to provide effective treatment, given the numerous short duration intermittent residual firework pollutant releases to surface waters at many different locations.

The discharge specifications contained in this General Permit are narrative and include requirements to develop and implement a Firework Best Management Practices Plan that describes appropriate BMPs, as well as requirements to comply with receiving water limitations.

The BMPs required herein constitute Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) and are intended to: 1) minimize the area and duration of adverse effects caused by the discharge of firework pollutant wastes in the firing range and adjacent surface water(s) and 2) allow for restoration of water quality and protection of beneficial uses of the receiving waters to pre-fireworks discharge quality following completion of a public fireworks display event.

H. Water Quality Control Plans. The San Diego Water Board adopted a Water Quality Control Plan for the San Diego Basin (hereinafter Basin Plan) on September 8, 1994, which was subsequently approved by the State Water Board on December 13, 1994, that designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve those objectives in all receiving waters addressed through the plan. In addition, the Basin Plan implements State Water Resources Control Board (State Water Board) Resolution No. 88-63, which established state policy that all waters, with

certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply. Beneficial uses applicable to the receiving waters within the San Diego Region are listed in Table 4. Requirements of this Order implement the Basin Plan.

Table 4. Basin Plan Beneficial Uses

Discharge Point	Receiving Water Name	Beneficial Use(s)
Various	Coastal Waters (Pacific Ocean, Enclosed Bays and Estuaries, Harbors, and Lagoons)	Industrial service supply (IND), navigation (NAV), contact water recreation (REC1), non-contact water recreation (REC2), commercial and sport fishing (COMM), biological habitats of special significance (BIOL), estuarine habitats (EST)wildlife habitat (WILD), preservation of rare, threatened or endangered species (RARE), marine habitat (MAR), Aquaculture (AQUA), migration of aquatic organisms (MIGR), spawning (SPWN), and shellfish harvesting (SHELL).
Various	Inland Surface Waters	Municipal and domestic supply (MUN), agricultural supply (AGR), industrial service supply (IND), industrial process supply (PROC), ground water recharge (GWR), hydropower generation (POW), contact water recreation (REC1), non-contact water recreation (REC2), biological habitats of special significance (BIOL), warm freshwater habitat (WARM), cold freshwater habitat (COLD), wildlife habitat (WILD), preservation of rare, threatened or endangered species (RARE), spawning (SPWN).

I. California Ocean Plan. The State Water Board adopted the *Water Quality Control Plan for Ocean Waters of California, California Ocean Plan* (Ocean Plan) in 1972 and amended it in 1978, 1983, 1988, 1990, 1997, 2000, and 2005. The State Water Board adopted the latest amendment on April 21, 2005 and it became effective on February 14, 2006. The Ocean Plan is applicable, in its entirety, to point source discharges to the ocean. The Ocean Plan identifies beneficial uses of ocean waters of the State to be protected as summarized below:

Table 5. Ocean Plan Beneficial Uses

Discharge Point	Receiving Water	Beneficial Uses
Various	Pacific Ocean	Industrial water supply; water contact and non-contact recreation, including aesthetic enjoyment; navigation; commercial and sport fishing; mariculture; preservation and enhancement of designated Areas of Special Biological Significance (ASBS); rare and endangered species; marine habitat; fish spawning and shellfish harvesting

Section III.E.1 of the Ocean Plan provides that waste shall not be discharged to areas designated as being of special biological significance (ASBS). Section III.E.2. provides that the Regional Water Boards may, however, approve waste discharge requirements or recommend certification for limited-term (i.e. weeks or months) activities in ASBS. Limited term activities may result in temporary and

short-term changes in existing water quality. Water quality degradation shall be limited to the shortest possible time. The activities must not permanently degrade water quality or result in water quality lower than that necessary to protect existing uses, and all practical means of minimizing such degradation shall be implemented.

This Order establishes requirements for the continued discharge of residual firework pollutant waste by the La Jolla Community Fireworks Foundation into the Pacific Ocean offshore of Scripps Park approximately one-quarter mile south from the La Jolla ASBS in San Diego County and the City of Laguna Beach into the Heisler Park ASBS in Orange County.

In order to protect the beneficial uses, the Ocean Plan establishes water quality objectives and a program of implementation. Requirements of this Order implement the Ocean Plan.

J. National Toxics Rule (NTR) and California Toxics Rule (CTR). USEPA adopted the NTR on December 22, 1992, and later amended it on May 4, 1995 and November 9, 1999. About forty criteria in the NTR applied in California. On May 18, 2000, USEPA adopted the CTR. The CTR promulgated new toxics criteria for California and, in addition, incorporated the previously adopted NTR criteria that were applicable in the state. The CTR was amended on February 13, 2001. These rules contain water quality criteria for priority pollutants.

K. State Implementation Policy. On March 2, 2000, the State Water Board adopted the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Policy or SIP). The SIP became effective on April 28, 2000 with respect to the priority pollutant criteria promulgated for California by the USEPA through the NTR and to the priority pollutant objectives established by the San Diego Water Board in the Basin Plan. The SIP became effective on May 18, 2000 with respect to the priority pollutant criteria promulgated by the USEPA through the CTR. The State Water Board adopted amendments to the SIP on February 24, 2005 that became effective on July 13, 2005. The SIP establishes implementation provisions for priority pollutant criteria and objectives and provisions for chronic toxicity control. Requirements of this Order implement the SIP.

L. Sediment Quality Objectives. On September 16, 2008 the State Water Board adopted the *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (SWRCB Sediment Quality Control Plan). The SWRCB Sediment Quality Control Plan became effective on August 25, 2009. The SWRCB Sediment Quality Control Plan establishes 1) narrative sediment quality objectives for benthic community protection from exposure to contaminants in sediment and to protect human health, and 2) a program of implementation using a multiple lines of evidence approach to interpret the narrative sediment quality objectives.

M. Compliance Schedules and Interim Requirements. Section 2.1 of the SIP provides that, based on a Discharger's request and demonstration that it is infeasible for an existing Discharger to achieve immediate compliance with an effluent limitation derived from a CTR criterion, compliance schedules may be allowed in an NPDES permit. Unless an exception has been granted under section 5.3 of the SIP, a compliance schedule may not exceed 5 years from the date that the permit is issued or reissued, nor may it extend beyond 10 years from the effective date of the SIP (or May 18, 2010) to establish and comply with CTR criterion-based effluent limitations. Where a compliance schedule for a final effluent limitation exceeds 1 year, the Order must include interim numeric limitations for that constituent or parameter. Where allowed by the Basin Plan, compliance schedules and interim effluent limitations or discharge specifications may also be granted to allow time to implement a new or revised water quality objective. This Order does not include compliance schedules and interim effluent limitations and/or discharge specifications.

N. Alaska Rule. On March 30, 2000, USEPA revised its regulation that specifies when new and revised state and tribal water quality standards (WQS) become effective for CWA purposes. (40 C.F.R. § 131.21; 65 Fed. Reg. 24641 (April 27, 2000).) Under the revised regulation (also known as the Alaska rule), new and revised standards submitted to USEPA after May 30, 2000, must be approved by USEPA before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to USEPA by May 30, 2000 may be used for CWA purposes, whether or not approved by USEPA.

O. Stringency of Requirements for Individual Pollutants. This Order requires the implementation of BMPs to protect water quality and beneficial uses.

P. Antidegradation Policy. Section 131.12 requires that the state water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16. Resolution No. 68-16 incorporates the federal antidegradation policy where the federal policy applies under federal law. Resolution No. 68-16 requires that existing quality of waters be maintained unless degradation is justified based on specific findings. The San Diego Water Board's Basin Plan implements, and incorporates by reference, both the state and federal antidegradation policies. As discussed in detail in the Fact Sheet the permitted discharge is consistent with the antidegradation provision of section 131.12 and State Water Board Resolution No. 68-16.

Q. Anti-Backsliding Requirements. Sections 402(o)(2) and 303(d)(4) of the CWA and federal regulations at title 40, Code of Federal Regulations section 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require effluent limitations in a reissued permit to be as stringent as those in the previous permit, with some exceptions where limitations may be relaxed.

R. Endangered Species Act. This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the Federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). This Order requires compliance with effluent limits, receiving water limits, and other requirements to protect the beneficial uses of waters of the state. The discharger is responsible for meeting all requirements of the applicable Endangered Species Act.

S. Monitoring and Reporting. Section 122.48 requires that all NPDES permits specify requirements for recording and reporting monitoring results. Water Code sections 13267 and 13383 authorizes the Regional Water Boards to require technical and monitoring reports. The Monitoring and Reporting Program establishes monitoring and reporting requirements to implement federal and State requirements. This Monitoring and Reporting Program is provided in Attachment E.

T. Standard and Special Provisions. Standard Provisions, which apply to all NPDES permits in accordance with section 122.41, and additional conditions applicable to specified categories of permits in accordance with section 122.42, are provided in Attachment D. The San Diego Water Board has also included in this Order special provisions applicable to the Discharger. A rationale for the special provisions contained in this Order is provided in the attached Fact Sheet.

U. Provisions and Requirements Implementing State Law. Certain provisions/requirements of this Order are included to implement state law only. These provisions/requirements are not required or authorized under the federal CWA; consequently, violations of these provisions/requirements are not subject to the enforcement remedies that are available for NPDES violations.

V. Executive Officer Delegation of Authority. The San Diego Water Board by prior resolution has delegated all matters that may legally be delegated to its Executive Officer to act on its behalf pursuant to Water Code section13223. Therefore, the Executive Officer is authorized to act on the San Diego Water Board's behalf on any matter within this Order unless such delegation is unlawful under Water Code section 13223 or this Order explicitly states otherwise.

W. Notification of Interested Parties. The San Diego Water Board has notified interested agencies and persons of its intent to prescribe Waste Discharge Requirements for the discharge and has provided them with an opportunity to submit their written comments and recommendations. Details of notification are provided in the Fact Sheet of this Order.

X. Consideration of Public Comment. The San Diego Water Board, in a public meeting, heard and considered all comments pertaining to the discharge. Details of the Public Hearing are provided in the Fact Sheet of this Order.

THEREFORE, IT IS HEREBY ORDERED, that in order to meet the provisions contained in division 7 of the Water Code (commencing with section 13000) and regulations adopted thereunder and the provisions of the federal Clean Water Act (CWA) and regulations and guidelines adopted thereunder, the Discharger shall comply with the requirements in this Order.

IV. DISCHARGE PROHIBITIONS

A. The discharge of residual firework pollutant waste to waters of the state in a manner causing, or threatening to cause a condition of pollution, contamination or nuisance as defined in Water Code section 13050, is prohibited.

B. The discharge of residual firework pollutant waste shall not cause, have a reasonable potential to cause, or contribute to exceedances of any applicable criterion promulgated by USEPA pursuant to section 303 of the CWA, or water quality objective adopted by the State Water Board or San Diego Regional Water Board.

C. The discharge of residual firework pollutant waste to designated Areas of Special Biological Significance (ASBS), is prohibited except as provided in 1) Section VII.C.2, *Special Provisions for Discharges into La Jolla and Heisler Park ASBS* of this Order or 2) an exception issued by the State Water Board pursuant to the provisions of the Ocean Plan.

D. The discharge of residual firework pollutant waste to waters of the United States within the San Diego Region is prohibited unless an NOI has been submitted, and the San Diego Water Board has provided the Discharger with a written Notice of Enrollment identifying the discharge subject to waste discharge requirements.

E. Compliance with Discharge Prohibitions contained in the Basin Plan is required as a condition of this Order.

F. Discharges of residual firework pollutant waste in a manner, or to a location which have not been specifically regulated by waste discharge requirements of this Order are prohibited.

V. DISCHARGE SPECIFICATIONS

A. Effluent Limitations – Not Applicable

B. Fireworks Best Management Practices Plan (FBMPP)

The Discharger shall prepare and implement a Fireworks Best Management Practices Plan (FBMPP) to prevent or reduce the discharge of pollutants associated with the public display of fireworks. The FBMPP shall address, at a minimum, the following elements:

1. Whenever practicable and economically feasible, the Discharger shall consider the use of alternative fireworks produced with new pyrotechnic formulas that replace perchlorate with other oxidizers and propellants that burn cleaner, produce less smoke and reduce pollutant waste loading to surface waters.

2. Whenever practicable and feasible, the Discharger shall design the firing range, or consider alternative firing ranges, to eliminate or reduce residual firework pollutant waste discharges to waters of the United States.

3. As soon as practicable, and no later than 24 hours following a public display of fireworks, the Discharger, in addition to complying with title 19 of the California Code of Regulations, section 1003, shall, to the extent practical, collect, remove, and manage particulate matter and debris from ignited and un-ignited pyrotechnic material including aerial shells, stars (small pellets of composition that produce color pyrotechnic effects), paper, cardboard, wires and fuses found during inspection of the entire firing range and adjacent affected surface water(s).

4. If the fireworks are launched or ignited on barges or floating platforms , the fireworks and fireworks equipment shall be setup, discharged and taken down in accordance with the laws and regulations applying to that display by a public display operator licensed by the State of California. All required permits, licenses and approvals shall be obtained from the authorities having jurisdiction over the fireworks display, and the parties responsible under applicable law and regulation shall comply with the requirements and conditions of those permits and licenses. All equipment used to hold and launch the fireworks shall be secured properly in accordance with applicable laws and regulations and in such a way as to minimize the risk that the equipment and fireworks would fall into the water. Barges and floating platforms shall be inspected for leaks and other potential safety issues. Other than system firing cables and common or grounding wires intended to be recovered after the display, electric igniter wires used to trigger the fireworks shall be secured to minimize the risk that the wires would fall into the water during or after the discharge. As soon as practicable, and no later than 24

hours following a public display of fireworks, the decks of each barge or floating platform that contained fireworks shall be raked or swept to gather fireworks debris and prevent it from being deposited into the water.

5. Immediately following a public display of fireworks, all hazardous fireworks waste, including duds, resulting from the set-up, firing, and strike of the public display, including live pyrotechnics waste, shall be handled and managed in accordance with applicable fireworks and hazardous waste laws and regulations.

6. All non-hazardous solid waste resulting from the set-up, firing, and strike of the public display, including wires, boxes, and packaging, shall be collected to the extent practicable and properly disposed of.

7. Fireworks shall be packaged, transported, stored, set-up, and handled in accordance with California Code of Regulations, Title 19, Division1, Chapter 6, *Fireworks* and Title 22, Chapter 33, *Best Management Practices for Perchlorate Materials* in order to prevent or minimize firework pollutant wastes from entering surface waters.

8. Residual firework pollutant waste discharges shall be located a sufficient distance from areas designated ASBS to assure maintenance of natural water quality conditions in these areas, except as provided in Section VII.C.2, *Special Provisions for Discharges into La Jolla and Heisler Park ASBS* of this Order.

C. Public Fireworks Display Log

The Discharger shall maintain a written log for each public fireworks display event. The log shall be completed within 5 days following each public fireworks event and shall be made available to the San Diego Water Board upon request. The log shall contain the following information:

1. The name of the organization sponsoring the fireworks event, together with the names and license numbers of the pyrotechnic operators actually in charge of the display;

2. The date, time, and duration of the public fireworks event;

3. The location of the public fireworks event;

4. The affected receiving waters;

5. Certification that the FBMPP was fully implemented; and

6. The amounts of fireworks debris collected, the dates, times and visual monitoring observations noted from after event firing range inspections and any other pertinent information

VI. RECEIVING WATER LIMITATIONS

A. Surface Waters

The discharge shall at all times be in conformance with applicable water quality standards and shall not cause an excursion above any applicable narrative or numeric water quality objective, including but not limited to all applicable provisions contained in:

1. The San Diego Water Board's *Water Quality Control Plan for the San Diego Basin* (Basin Plan), including beneficial uses, water quality objectives, and implementation plans;

2. State Water Board plans for water quality control including the:

   a) Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries (Thermal Plan), and

   b) The *California Ocean Plan* (Ocean Plan), including beneficial uses, water quality objectives, and implementation plans*;*

3. State Water Board policies for water and sediment quality control including the

   a) Water Quality Control Policy for the Enclosed Bays and Estuaries of California,

   b) Policy for Implementation of Toxics Standards for Inland Surface Waters, and Enclosed Bays, and Estuaries of California;

   c) State Water Board's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality which includes the following narrative objectives:

      (1) Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities; and

      (2) Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health.

   d) The *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (State Water Board Resolution No. 68-16) *and*

4. Priority pollutant criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA) through the:

   a) *National Toxics Rule* (NTR)[2] (promulgated on December 22, 1992 and amended on May 4, 1995) and

   b) *California Toxics Rule* (CTR) [3], [4]

B. Groundwater - Not Applicable

VII. PROVISIONS

A. Standard Provisions

1. The Discharger shall comply with all Standard Provisions included in Attachment D of this Order.

2. San Diego Water Board Standard Provisions. The Discharger shall comply with the following provisions:

   a. The Discharger shall comply with all requirements and conditions of this Order. Any permit non-compliance constitutes a violation of the Clean Water Act (CWA) or the California Water Code (CWC) and is grounds for enforcement action, permit termination, revocation and reissuance, or modification, or for denial of an application for permit renewal, modification, or reissuance.

   b. The Discharger shall comply with all applicable federal, state, and local laws and regulations for handling, transport, treatment, or disposal of waste or the discharge of waste to waters of the state in a manner which causes or threatens to cause a condition of pollution, contamination or nuisance as those terms are defined in CWC 13050.

   c. No discharge of waste into waters of the state, whether or not the discharge is made pursuant to waste discharge requirements (WDR) , shall create a vested right to continue the discharge. All discharges of waste into waters of the state are privileges, not rights.

   d. For the purposes of this Order, the term “permittee” used in parts of 40 CFR incorporated into this Order by reference and/or applicable to this Order shall have the same meaning as the term “Discharger” or “Enrollee” used elsewhere in this Order.

[2] 40 CFR 131.36
[3] 65 Federal Register 31682-31719 (May 18, 2000), adding Section 131.38 to 40 CFR
[4] If a water quality objective and a CTR criterion are in effect for the same priority pollutant, the more stringent of the two applies

e. This Order expires on May 31, 2016, after which, the terms and conditions of this Order are automatically continued pending issuance of a new WDR, provided that all requirements of USEPA's NPDES regulations at 40 CFR 122.6 and the State's regulations at CCR Title 23, Section 2235.4 regarding the continuation of expired Orders and waste discharge requirements are met.

f. A copy of this Order shall be made available to all personnel/staff (including field staff) involved with the compliance of this Order.

g. The Discharger shall comply with any interim limitations established by addendum, enforcement action, or revised waste discharge requirements that have been or may be adopted by the San Diego Water Board.

h. Failure to comply with provisions or requirements of this Order, or violation of other applicable laws or regulations governing discharges of fireworks pollutant wastes, may subject the Discharger to administrative or civil liabilities, criminal penalties, and/or other enforcement remedies to ensure compliance. Additionally, certain violations may subject the Discharger to civil or criminal enforcement from appropriate local, state, or federal law enforcement entities.

i. In the event the Discharger does not comply or will be unable to comply for any reason, with any prohibition, effluent limitation, discharge specification, or receiving water limitation of this Order, the Discharger shall notify the San Diego Water Board by telephone at (858) 467-2952 within 24 hours of having knowledge of such noncompliance, and shall confirm this notification in writing within five days, unless the San Diego Water Board waives confirmation. The written notification shall contain a description of the noncompliance and its cause; the period of non-compliance including exact dates and times, and if noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

j. The Discharger is required to retain records, including all monitoring information and copies of all reports required by this Order, for five years unless directed otherwise by the San Diego Water Board.

k. This Order may be modified, revoked and reissued, or terminated for cause due to promulgation of amended regulations, receipt of USEPA guidance concerning regulated activities, judicial decision, or in accordance with 40 Code of Federal Regulations (CFR) 122.62, 122.63, 122.64, and 124.5.

l. Enrollment in this Order is temporary. Dischargers enrolled in this Order planning to discharge fireworks related waste after the expiration date of

June 16, 2016 may be subject to new prohibitions or requirements based on the re-issuance of this Order after June 16, 2016.

m. The enrollee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this Order and the Notice of Enrollment from the San Diego Water Board, including such accelerated or additional monitoring as may be necessary to determine the nature, and effect of the non-complying discharge.

n. This Order or the Notice of Enrollment from the San Diego Water Board, may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

   (1) Violation of any terms or conditions of this Order or the Notice of Enrollment from the San Diego Water Board;

   (2) Obtaining enrollment under this Order, or a Notice of Enrollment from the San Diego Water Board, by misrepresentation or failure to disclose fully all relevant facts;

   (3) A change in any condition that requires either a temporary or permanent reduction or elimination of the discharge subject to waste discharge requirements; or

   (4) A finding that monitoring "indicator" pollutants listed in this Order do not ensure compliance with water quality criteria or objectives for the pollutants expected to be represented by the "indicator" pollutants.

o. The filing of a request by the Discharger for modification, revocation and reissuance, or termination of this Order or an associated discharge Notice of Enrollment from the San Diego Water Board, or a notification of planned change in or anticipated noncompliance with this Order or discharge Notice of Enrollment does not stay any condition of this Order or the Notice of Enrollment from the San Diego Water Board.

p. Notwithstanding Provision 2.k. above, if any applicable toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant and that standard or prohibition is more stringent than any limitation on the pollutant in this Order, the San Diego Water Board may institute proceedings under these regulations to modify or revoke and reissue this Order to conform to the toxic effluent standard or prohibition.

q. In addition to any other grounds specified herein, this Order or a Notice of Enrollment from the San Diego Water Board shall be modified or revoked at any time if, on the basis of any data, the San Diego Water Board determines that continued discharges may cause unreasonable degradation of the aquatic environment.

r. The San Diego Water Board or the Director of the USEPA may require any person requesting enrollment under this Order or subject to waste discharge requirements under this Order to apply for and obtain an individual NPDES permit. Cases where an individual NPDES permit may be required include but are not limited to those described in 40 CFR 122.28 (b) (3).

s. It shall not be a defense for the enrollee in an enforcement action that effluent limitation violations are a result of analytical variability rendering the results inaccurate. The validity of the testing results, whether or not the enrollee has monitored or sampled more frequently than required by this Order, shall not be a defense to an enforcement action.

t. The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of this Order which has a reasonable likelihood of adversely affecting human health or the environment.

u. For the purposes of this Order, the term permit, general permit, and WDR, shall have the same meaning as the term Order used elsewhere in this Order.

B. Monitoring and Reporting Program (MRP) Requirements

The Discharger shall comply with the MRP and future revisions thereto in Attachment E of this Order.

C. Special Provisions

1. Reopener Provisions

Order No. R9-2011-0022 may be re-opened and modified, revoked, and reissued or terminated in accordance with the provisions of 40 CFR 122, 123, 124, and 125. The San Diego Water Board may reopen the permit to modify permit conditions and requirements. Causes for modifications include the promulgation of new regulations or adoption of new regulations by the State Water Board or San Diego Water Board, including revisions to the Basin Plan.

2. Special Provisions for Discharges into La Jolla and Heisler Park ASBS

Discharges of residual fireworks pollutant waste by the La Jolla Community Fireworks Foundation Foundation into the Pacific Ocean offshore of Scripps

Park approximately one-quarter mile south from the La Jolla ASBS, and by the City of Laguna Beach into the Heisler Park ASBS may continue subject to the following conditions:

a. The residual firework pollutant waste discharges shall be limited to those resulting from one Fourth of July celebration public fireworks display event per calendar year.

b. The net explosive weight of fireworks used in the public fireworks display event shall not exceed1,000 pounds of pyrotechnic material.

c. The areal extent of the firing range in the ASBS shall be limited to the maximum extent practicable to prevent or reduce residual firework pollutant waste discharges in the ASBS.

d. The residual firework pollutant waste discharges shall not permanently alter natural water quality conditions[5] in the ASBS receiving waters. Temporary excursions from natural ocean water quality conditions resulting from residual firework pollutant waste discharges within any portion of the firing range located in the ASBS are permissible if beneficial uses are protected.

e. The residual firework pollutant waste discharges shall comply with all other applicable provisions, including water quality standards, of the Ocean Plan.

3. Special Provisions for SeaWorld San Diego Discharges

a. The October 15, 2009 Report of Waste Discharge submitted by Sea World Inc. is deemed complete for the purpose of enrollment under this Order. The enrollment date will be effective upon the effective date of this Order and SeaWorld San Diego is authorized to discharge residual firework pollutant waste starting on this date pursuant to the requirements of this Order. The requirements of this Order will supersede the requirements of SeaWorld San Diego's Order No. R9-2005-0091, NPDES No. CA0107336, for residual firework pollutant waste discharges upon the effective date of this Order.

b. SeaWorld San Diego shall submit the filing fee for coverage under this Order, specified in Section II.F of this Order, no later than June 1, 2011.

c. SeaWorld San Diego shall prepare and submit a Fireworks Best Management Practices Plan containing the information specified in

[5] Natural ocean water quality will be determined by the Southern California Water Research Project (SCCWRP) ASBS Monitoring Program which is designed to define natural water quality in ASBS areas at selected reference sites.

Section V.B. of this Order no later than September 1, 2011.

4. **Special Studies, Technical Reports and Additional Monitoring Requirements – Not Applicable**

5. **Construction, Operation and Maintenance Specifications- Not Applicable**

6. **Special Provisions for Municipal Facilities (POTWs Only) – Not Applicable**

7. **Other Special Provisions – Not Applicable**

8. **Compliance Schedules – Not Applicable**

VIII. COMPLIANCE DETERMINATION

This Order requires the use of minimum stipulated BMPs to control and abate the discharge of pollutant wastes from public fireworks events to surface waters in the San Diego Region. Proper implementation of the BMPs will assure the protection of water and sediment quality within the receiving waters. Dischargers enrolled under this Order are expected to comply with all water and sediment quality objectives through the implementation of BMPs. Compliance will be determined by evaluating the proper implementation of the minimum stipulated BMPs and their effectiveness in preventing and minimizing pollutant waste loading from public fireworks events to surface waters. Compliance will also be evaluated using information obtained under the monitoring and reporting program of this Order.

ATTACHMENT A – DEFINITIONS

Acute Toxicity

Acute Toxicity (TUa)

Expressed in Toxic Units Acute (TUa)

$$Tua = \frac{100}{\text{96-hr LC}_{50\%}}$$

Lethal Concentration 50% (LC 50)

LC 50 (percent waste giving 50% survival of test organisms) shall be determined by static or continuous flow bioassay techniques using standard marine test species as specified in Ocean Plan Appendix III. If specific identifiable substances in wastewater can be demonstrated by the discharger as being rapidly rendered harmless upon discharge to the marine environment, but not as a result of dilution, the LC 50 may be determined after the test samples are adjusted to remove the influence of those substances.

When it is not possible to measure the 96-hour LC 50 due to greater than 50 percent survival of the test species in 100 percent waste, the toxicity concentration shall be calculated by the expression:

$$TUa = \frac{\log (100 - S)}{1.7}$$

where:

S = percentage survival in 100% waste. If S > 99, TUa shall be reported as zero.

Aerial Shell
A cylinder or spherical cartridge containing a burst charge and pyrotechnic or non-pyrotechnic effects, a fuse, a black powder lift charge and is fired from a mortar. [19 CCR § 980 (a)]

Areas of Special Biological Significance (ASBS)
Those areas designated by the State Water Board as ocean areas requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable. All Areas of Special Biological Significance are also classified as a subset of STATE WATER QUALITY PROTECTION AREAS.

Barge
Water vessel from which fireworks are launched or fired.

Break
An individual burst from an aerial shell, producing either a visible or audible effect or both, and may consist of a single burst or multiple effects. [19 CCR § 980 (b) (7)]

Carcinogenic
Pollutants are substances that are known to cause cancer in living organisms.

Category 1 Discharger
A Discharger that discharges fireworks containing a net explosive weight of 1,000 pounds or more, in any calendar year, from a single event to Mission Bay or San Diego Bay. SeaWorld San Diego is also considered a Category 1 Discharger.

Category 2 Discharger
A Discharger that either 1) discharges fireworks containing a net explosive weight less than 1,000 pounds, in any calendar year, from a single event to Mission Bay or San Diego Bay or 2) discharges fireworks of any net explosive weight from a single event or multiple events to any other Surface Water of the U.S. within the San Diego Region.

Chronic Toxicity
This parameter shall be used to measure the acceptability of waters for supporting a healthy marine biota until improved methods are developed to evaluate biological response.

Chronic Toxicity (TUc)

Expressed as Toxic Units Chronic (TUc)

$$TUc = \frac{100}{NOEL}$$

No Observed Effect Level (NOEL)

The NOEL is expressed as the maximum percent effluent or receiving water that causes no observable effect on a test organism, as determined by the result of a critical life stage toxicity test listed in Ocean Plan Appendix II.

Contamination
"Contamination" means an impairment of the quality of the waters of the state by waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" includes any equivalent effect resulting from the disposal of waste, whether or not waters of the state are affected. [CWC § 13050(k)]

Daily Discharge
Daily Discharge is defined as either: (1) the total mass of the constituent discharged over the calendar day (12:00 am through 11:59 pm) or any 24-hour period that reasonably represents a calendar day for purposes of sampling (as specified in the permit), for a constituent with limitations expressed in units of mass or; (2) the unweighted arithmetic mean measurement of the constituent over the day for a constituent with limitations expressed in other units of measurement (e.g., concentration).

The daily discharge may be determined by the analytical results of a composite sample taken over the course of one day (a calendar day or other 24-hour period defined as a day) or by the arithmetic mean of analytical results from one or more grab samples taken over the course of the day.

For composite sampling, if 1 day is defined as a 24-hour period other than a calendar day, the analytical result for the 24-hour period will be considered as the result for the calendar day in which the 24-hour period ends.

Degrade
Degradation shall be determined by comparison of the waste field and reference site(s) for characteristic species diversity, population density, contamination, growth anomalies, debility, or supplanting of normal species by undesirable plant and animal species. Degradation occurs if there are significant differences in any of three major biotic groups, namely, demersal fish, benthic invertebrates, or attached algae. Other groups may be evaluated where benthic species are not affected, or are not the only ones affected.

Detected, but Not Quantified (DNQ)
Sample results that are less than the reported Minimum Level, but greater than or equal to the laboratory's MDL.

Downstream Ocean Waters
Waters downstream with respect to ocean currents.

Dud
A pyrotechnic item which leaves the mortar and returns to earth without producing the intended burst or effect. [19 CCR § 980 (d) (4)]

Enclosed Bays
Indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes but is not limited to Mission Bay, and San Diego Bay.

Estuaries
Estuaries means waters, including coastal lagoons, located at the mouths of streams that serve as areas of mixing for fresh and ocean waters. Coastal lagoons and mouths of streams that are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall be considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and seawater. Estuaries do not include inland surface waters or ocean waters.

Fallout Area
The area in which firework debris and pollutants fall after a pyrotechnic device is detonated. The extent of the fallout area depends on the wind and the angle of mortar placement.

Fireworks
"Fireworks" means any device containing chemical elements and chemical compounds capable of burning independently of the oxygen of the atmosphere and producing audible, visual, mechanical, or thermal effects which are useful as pyrotechnic devices or for entertainment.

The term "fireworks" includes, but is not limited to, devices designated by the manufacturer as fireworks, torpedoes, skyrockets, roman candles, rockets, Daygo bombs, sparklers, party poppers, paper caps, chasers, fountains, smoke sparks, aerial bombs, and fireworks kits. (California Health and Safety Code *§* 12511)

Fireworks Event (also referred to as Public Display of Fireworks)
Fireworks event means an entertainment feature where the public or a private group is admitted or permitted to view the display or discharge of fireworks. (22 CCR § 67384.3)

Firing Range
The firing range is that area over which fireworks may travel by design or accident and upon which firework pollutant waste may fall. It includes the fireworks launching area and adjacent shorelines, quays, docks and the fireworks fallout area.

Ground Display Piece
A pyrotechnic device that functions on the ground (as opposed to an aerial shell that functions in the air) and that includes fountains, wheels, and set pieces.

Inland Surface Waters
All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

Kelp Beds
For purposes of the bacteriological standards of the Ocean Plan, are significant aggregations of marine algae of the genera Macrocystis and Nereocystis. Kelp beds

include the total foliage canopy of Macrocystis and Nereocystis plants throughout the water column.

Mariculture
The culture of plants and animals in marine waters independent of any pollution source.

Method Detection Limit (MDL)
The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, as defined in title 40 of the Code of Federal Regulations, Part 136, Attachment B.

Minimum Level (ML)
The concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

Misfire
A pyrotechnic item which fails to function as designed after initiation. [19 CCR § 980 (m) (5)]

Mortar
A cylinder that is used to hold and fire public display or special effects pyrotechnic items or compositions. [19 CCR § 980 (m) (8)]

Multiple Break
Aerial shell which has two or more breaks. [19 CCR § 980 (m) (11)]

Natural Light
Reduction of natural light may be determined by the San Diego Water Board by measurement of light transmissivity or total irradiance, or both, according to the monitoring needs of the San Diego Water Board.

Net Explosive Weight
Net explosive weight" means the weight of all pyrotechnic compositions, explosives material, and fuse only. (22 CCR § 67384.3)

Not Detected (ND)
Those sample results less than the laboratory's MDL.

Nuisance
"Nuisance" means anything which meets all of the following requirements: (1) Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property. (2) Affects at the same time an entire community or neighborhood, or any considerable

number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal. [CWC § 13050(m)]

Ocean Waters
The territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. If a discharge outside the territorial waters of the state could affect the quality of the waters of the state, the discharge may be regulated to assure no violation of the Ocean Plan will occur in ocean waters.

Person
Person includes any city, county, district, the state, and the United States, to the extent authorized by federal law. [CWC 13050(c)]. Person also includes any citizen, domiciliary, political agency, or entity of California. [CWC 13050(o)].

Pollutant
"Pollutant" means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. It does not mean: (a) Sewage from vessels; or (b) Water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil and gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if the State determines that the injection or disposal will not result in the degradation of ground or surface water resources. NOTE: Radioactive materials covered by the Atomic Energy Act are those encompassed in its definition of source, byproduct, or special nuclear materials. Examples of materials not covered include radium and accelerator-produced isotopes. See Train v. Colorado Public Interest Research Group, Inc., 426 U.S. 1 (1976). (40 CFR 122.2)

Pollution
"Pollution" means an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either of the following: (A) The waters for beneficial uses. (B) Facilities which serve these beneficial uses. "Pollution" may include "contamination." [CWC § 13050(l)]

Pyrotechnic operator
Pyrotechnic operator means any licensed pyrotechnic operator, who by examination, experience, and training, has demonstrated the required skill and ability in the use and discharge of fireworks as authorized by the license granted. (22 CCR § 67384.3)

Pyrotechnic Compositions
Pyrotechnic compositions means any combination of chemical elements or chemical compounds capable of burning independently of the oxygen of the atmosphere. (California Health and Safety Code *§* 12525)

Pollutant Minimization Program (PMP)
PMP means waste minimization and pollution prevention actions that include, but are not limited to, product substitution, waste stream recycling, alternative waste management methods, and education of the public and businesses. The goal of the PMP shall be to reduce all potential sources of Ocean Plan Table B pollutants through pollutant minimization (control) strategies, including pollution prevention measures as appropriate, to maintain the effluent concentration at or below the water quality-based effluent limitation. Pollution prevention measures may be particularly appropriate for persistent bioaccumulative priority pollutants where there is evidence that beneficial uses are being impacted. The San Diego Water Board may consider cost effectiveness when establishing the requirements of a PMP. The completion and implementation of a Pollution Prevention Plan, if required pursuant to Water Code section 13263.3(d), shall be considered to fulfill the PMP requirements.

Reported Minimum Level
The ML (and its associated analytical method) chosen by the Discharger for reporting and compliance determination from the MLs included in this Order. The MLs included in this Order correspond to approved analytical methods for reporting a sample result that are selected by the San Diego Water Board either from Appendix II of the Ocean Plan in accordance with section III.C.5.a. of the Ocean Plan or established in accordance with section III.C.5.b. of the Ocean Plan. The ML is based on the proper application of method-based analytical procedures for sample preparation and the absence of any matrix interferences. Other factors may be applied to the ML depending on the specific sample preparation steps employed. For example, the treatment typically applied in cases where there are matrix-effects is to dilute the sample or sample aliquot by a factor of ten. In such cases, this additional factor must be applied to the ML in the computation of the reported ML.

Roman Candle
A heavy paper or cardboard tube containing pellets of pyrotechnic composition which, when ignited, are expelled into the air at several second intervals. (19 CCR §980 (r) (3))

Salute
An aerial shell as well as other pyrotechnic items whose primary effects are detonation and flash of light. [19 CCR § 980 (s) (1)]

San Diego Water Board
As used in this document the term "San Diego Water Board" is synonymous with the term "Regional Board" as defined in Water Code section 13050(b) and is intended to

refer to the California Regional Water Quality Control Board for the San Diego Region as specified in Water Code Section 13200.

Shellfish
Organisms identified by the California Department of Health Services as shellfish for public health purposes (i.e., mussels, clams and oysters).

Significant Difference
Defined as a statistically significant difference in the means of two distributions of sampling results at the 95 percent confidence level.

Star
"Star" means a small pellet of composition that produces a pyrotechnic effect. A single aerial firework shell could contain several hundred stars (22 CCR § 67384.3)

State Water Quality Protection Areas (SWQPAs)
Non-terrestrial marine or estuarine areas designated to protect marine species or biological communities from an undesirable alteration in natural water quality. All AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE (ASBS) that were previously designated by the State Water Board in Resolution Nos. 74-28, 74-32, and 75-61 are now also classified as a subset of State Water Quality Protection Areas and require special protections afforded by the Ocean Plan.

Toxicity Reduction Evaluation (TRE)
A study conducted in a step-wise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices, and best management practices. A Toxicity Identification Evaluation (TIE) may be required as part of the TRE, if appropriate. (A TIE is a set of procedures to identify the specific chemical(s) responsible for toxicity. These procedures are performed in three phases (characterization, identification, and confirmation) using aquatic organism toxicity tests.)

Waste
CWC section 13050(d) provides that "Waste" includes sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation, including waste placed within containers of whatever nature prior to, and for purposes of, disposal.

Waters of the State
Any water, surface or underground, including saline waters within the boundaries of the State (CWC section 13050 (e)). The definition of the Waters of the State is broader than that for the Waters of the United States in that all water in the State is considered to be

a Waters of the State regardless of circumstances or condition. Under this definition, a MS4 is always considered to be a Waters of the State.

Waters of the United States

Waters of the United States are defined as: "(a) All waters, which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (b) All interstate waters, including interstate "wetlands;" (c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, "wetlands," sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation or destruction of which would affect or could affect interstate or foreign commerce including any such waters: (1) Which are or could be used by interstate or foreign travelers for recreational or other purposes; (2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (3) Which are used or could be used for industrial purpose by industries in interstate commerce; (d) All impoundments of waters otherwise defined as waters of the United States under this definition: (e) Tributaries of waters identified in paragraphs (a) through (d) of this definition; (f) The territorial seas; and (g) "Wetlands" adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with the EPA." (40 CFR 122.2)

ATTACHMENT B – NOTICE OF INTENT

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

NOTICE OF INTENT

ORDER NO. R9-2011- 0022
NPDES NO. CAG999002

GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL FIREWORKS POLLUTANT WASTE DISCHARGES TO WATERS OF THE UNITED STATES IN THE SAN DIEGO REGION FROM THE PUBLIC DISPLAY OF FIREWORKS

I. NOTICE OF INTENT STATUS

Mark only one Item:: ☐ New Application ☐ Change of Information:
WDID#_____

☐ Change of Discharger or Responsibility WDID#_____

II. STIPULATION OF APPLICABILITY

☐ **Discharger Name** has reviewed the eligibility criteria of the subject Order as stated below and hereby certifies that the criteria is met.

Eligibility Criteria
Any person who proposes to discharge pollutant waste from the public display of fireworks to surface waters in the San Diego Region may submit a Notice of Intent (NOI) for coverage under this Order. When a fireworks event is sponsored by one person but is operated or conducted by another person, it is the sponsor's duty to submit an NOI and obtain coverage under the Order. The San Diego Water Board may require the joint submission of an NOI from both the sponsor and the person operating the fireworks event on a case-by-case basis.

☐ **Discharger Name** has reviewed the Order and hereby certifies that:

1. **Discharger Name** understands the requirements of the Order; and

2. **Discharger Name** will comply with all terms, conditions, and requirements of the Order.

III. DISCHARGER INFORMATION

Discharger Name:			
Mailing Address			
City	County	State	ZIP
Contact Person Name and Title			
Contact Person e-mail		Contact Person Phone	

IV. BILLING INFORMATION

☐ Same as Discharger Information (Enter information only if different from Section III above)			
Discharger Name:			
Mailing Address			
City	County	State	ZIP
Contact Person Name and Title			
Contact Person e-mail		Contact Person Phone	

V. FIREWORKS BEST MANAGEMENT PRACTICES PLAN

Has a Fireworks Best Management Practices Plan been prepared pursuant to the requirements of this Order? ☐ Yes ☐ No

☐ If yes, check the box and attach a copy of the Fireworks Best Management Practices Plan to this form.

VI. APPLICATION FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?

☐ Yes ☐ No

The initial fee and annual fee are based upon the type of pollutants to be discharged or potentially discharged.

Make checks payable to "**State Water Resources Control Board**" and include "Fireworks General NPDES Order" in the check memo field.

Category 3 Lowest Threat to Water Quality
Discharges that require minimal or no treatment systems to meet limits and pose no significant threat to the environment in accordance with California Code Of Regulations Title 23. Division 3. Chapter 9. Waste Discharge Reports And Requirements Article 1. Fees. (Fees amounts are subject to change. The fee for enrollment under this Order as of September 23, 2010 is $1,200 plus $252 surcharge = $1,452)

VII. CERTIFICATION

I certify under penalty of law that the information provided in this application and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those directly responsible for gathering the information, the information submitted is true, accurate, and complete to the best of my knowledge and belief. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. In addition, I certify that the provisions of the permit, including the criteria for eligibility will be complied with.
Printed Name:
Signature*: Date:
Title:

* The appropriate person must sign the application form. See Standard Provision V.B.1 Signatory and Certification Requirements. Acceptable signatures are:
1. for a corporation, a principal executive officer of at least the level of senior vice-president;
2. for a partnership or individual (sole proprietorship), a general partner or the proprietor;
3. for a governmental or public agency, either a principal executive officer or ranking elected/appointed official.

Submit the NOI and application fee to the following address:

CRWQCB – San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Attn: Fireworks General NPDES Order
NOTICE OF INTENT

SAN DIEGO WATER BOARD USE ONLY

WDID:	Staff Initials:	Status: ☐ Complete ☐ Incomplete ☐ Withdrawn ☐ Pending Additional Information
Date NOI Received:	Check No.:	
Date NOI Processed:	Fee Amount Received: $	
CIWQS Place ID:	CIWQS Reg. Meas. ID:	
Comments:		

INSTRUCTIONS FOR COMPLETING THE NOTICE OF INTENT

WATER QUALITY ORDER NO. R9-2011- 0022
NPDES NO. CAG999002

GENERAL NPDES PERMIT FOR RESIDUAL FIREWORKS POLLUTANT WASTE DISHCARGES TO WATERS OF THE UNITED STATES IN THE SAN DIEGO REGION FROM PUBLIC DISPLAY OF FIREWORKS

These instructions are intended to help you, the Discharger, to complete the Notice of Intent (NOI) form for the General National Pollutant Discharge Elimination System (NPDES) permit. **Please type or print clearly when completing the NOI form**. For any field, if more space is needed, submit a supplemental letter with the NOI.

Send the completed and signed form along with the filing fee and supporting documentation to the California Regional Water Quality Control Board, San Diego Region.

Section I – Notice of Intent Status

Indicate whether this request is for the first time coverage under this General Permit or a change of information for the discharge already covered under this General Permit. For a change of information or ownership, please supply the eleven-digit Waste Discharge Identification (WDID) number for the discharge.

Section II – Stipulation of Applicability

The Discharger must review the eligibility criteria for enrollment under the Order and certify that the Discharger meets the qualifications for enrollment. The Discharger must acknowledge that they have reviewed, understand, and will comply with the terms, conditions, and requirements of the Order. Fill in all of the Discharger Name and check the appropriate boxes to certify that the Discharger understands and accepts these stipulations.

Section III – Discharger Information

A. Enter the name of the Discharger.
B. Enter the mailing address, including street number and street name, where correspondence should be sent (P.O. Box is acceptable).
C. Enter the city that applies to the mailing address given.
D. Enter the county that applies to the mailing address given.
E. Enter the state that applies to the mailing address given.
F. Enter the zip code that applies to the mailing address given.
G. Enter the name (first and last) and title of the contact person.
H. Enter the email address of the contact person.

I. Enter the daytime telephone number of the contact person.

Section IV – Billing Address

Check the box if the Billing Information is the same as the Discharger Information. Enter other information **only** if it is different from Section III above.

A. Enter the name (first and last) of the person who will be responsible for the billing.
B. Enter the billing address, including street number and street name, where the billing should be sent (P.O. Box is acceptable).
C. Enter the city that applies to the billing address.
D. Enter the county that applies to the billing address.
E. Enter the state that applies to the billing address.
F. Enter the zip code that applies to the billing address.
G. Enter the name and title of the person responsible for billing.
H. Enter the email address of the person responsible for billing.
I. Enter the daytime telephone number of the person responsible for billing.

Section V – Fireworks Best Management Practices Plan

The Discharger must prepare and complete a Fireworks Best Management Practices Plan (FBMPP). The minimum contents of FBMPP are specified in the permit under item V.B of the Order. The Discharger must ensure that the sponsor, operator(s), and all other appropriate personnel are familiar with the FBMPP contents before conducting a public display of fireworks covered under this Order.

Section VI – Application Fee

The amount of Annual fee shall be based on Category 3 discharge specified in Section 2200(b)(8) of Title 23, California Code of Regulations. Fee information can be found at http://www.waterboards.ca.gov/resources/fees/. Check the YES box if you have included payment of the annual fee. Check the NO box if you have not included this payment.

NOTE: You will be billed annually and payment is required to enroll or continue coverage.

Section VII– Certification

A. Print the name of the appropriate official. For a municipality, State, federal, or other public agency, this would be a principal executive officer, ranking elected official, or duly authorized representative. The principal executive officer of a federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of USEPA).
B. The person whose name is printed above must sign and date the NOI.
C. Enter the title of the person signing the NOI.

ATTACHMENT C – PUBLIC DISPLAY OF FIREWORKS POST EVENT REPORT FORM

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION

POST FIREWORKS DISPLAY REPORT

This form shall be completed no later than ten (10) days following a public display of fireworks event and made available to the San Diego Water Board upon request. Reports shall be submitted to the San Diego Water Board in accordance with the schedule outlined in Section X.B.3 of the Monitoring and Reporting Program.

Completed forms may be submitted electronically on compact disk or by hard copy to the San Diego Water Board office. The San Diego Water Board may accept electronic submission of this form (Check with the San Diego Water Board before submitting electronically).

<table>
<tr><td colspan="2">Name of Organization Sponsoring the Event</td><td>WDID No.</td></tr>
<tr><td colspan="3">Contact Person for Organization Sponsoring the Event:
Name:
Phone Number:
Email:</td></tr>
<tr><td colspan="2">Location of Event – Address and GPS Coordinates</td><td>Name of Receiving Water(s)</td></tr>
<tr><td>Date of Display</td><td colspan="2">Time of Display
FROM .M to .M</td></tr>
<tr><td colspan="3">Map. Attach a map or diagram identifying the firing range, adjacent shorelines, quays, and docks, any other appropriate features of the firing range and adjacent affected surface water(s). The firing range is that area over which fireworks may travel by design or accident and upon which firework pollutant waste may fall. It includes the fireworks launching area and adjacent shorelines, quays, docks and the fireworks fallout area.</td></tr>
<tr><td colspan="3">Name and License No. of Pyrotechnic Operators</td></tr>
<tr><td colspan="3">1.</td></tr>
<tr><td colspan="3">2.</td></tr>
<tr><td colspan="3">3.</td></tr>
</table>

Particulars of Display*						Low Level Items*		Ground Displays*	
Shell Size	No. Single Breaks	No. Multi Breaks	Shell Size	No. Single Breaks	No. Multi Breaks	Type	Qty	Type	Qty
25 mm			7”			MINES		SETS	
80 mm			8”			ROMANS		DEVICES	
2”			9”			COMETS			
3”			10”			CAKES			
4”			11”						
5”			12”						
6”									

Net Explosive Weight:

Solid Rocket Motor Gross Weight:

Were alternative fireworks used? If so, indicate which fireworks were environmentally friendly.

Defective Shells - List Manufacturer's Name, Size Of Shell, And Malfunction.*

Were the entire firing range (including the fireworks launching area, adjacent shorelines, quays, docks and the fireworks fallout area), barge(s) (if used) and adjacent surface water(s) inspected and cleaned of particulate matter and debris from ignited and un-ignited pyrotechnic material within 24 hours following the display?

☐ Yes Date _____ Time _____

☐ No

If no, explain:

Amount of debris collected from the firing range:_____lbs dry weight

Amount of floating debris collected from adjacent surface water(s):_____lbs wet weight

_____lbs dry weight (if known)

I certify under penalty of law that the information provided in this application and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those directly responsible for gathering the information, the information submitted is true,

accurate, and complete to the best of my knowledge and belief. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. In addition, I certify that the provisions of the permit, including the criteria for eligibility will be complied with.	
Printed Name:	
Signature:	Date:
Title:	

*May attach a copy of the Pyrotechnic Operator Post Display Report submitted to the Office of the State Fire Marshall to satisfy this requirement.

ATTACHMENT D – STANDARD PROVISIONS

I. STANDARD PROVISIONS – PERMIT COMPLIANCE

A. Duty to Comply

1. The Discharger shall comply with all of the conditions of this Order. Any noncompliance constitutes a violation of the Clean Water Act (CWA) and the California Water Code and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. (40 C.F.R. § 122.41(a).)

2. The Discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions, even if this Order has not yet been modified to incorporate the requirement. (40 C.F.R. § 122.41(a)(1).)

B. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a Discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order. (40 C.F.R. § 122.41l.)

C. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this Order that has a reasonable likelihood of adversely affecting human health or the environment. (40 C.F.R. § 122.41(d).)

D. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Discharger to achieve compliance with the conditions of this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by a Discharger only when necessary to achieve compliance with the conditions of this Order. (40 C.F.R. § 122.41(e).)

E. Property Rights

1. This Order does not convey any property rights of any sort or any exclusive privileges. (40 C.F.R. § 122.41(g).)

2. The issuance of this Order does not authorize any injury to persons or property or invasion of other private rights, or any infringement of state or local law or regulations. (40 C.F.R. § 122.5l.)

F. Inspection and Entry

The Discharger shall allow the San Diego Water Board, State Water Board, United States Environmental Protection Agency (USEPA), and/or their authorized representatives (including an authorized contractor acting as their representative), upon the presentation of credentials and other documents, as may be required by law, to (40 C.F.R. § 122.41(i); Water Code, § 13383):

1. Enter upon the Discharger's premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order (40 C.F.R. § 122.41(i)(1));

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order (40 C.F.R. § 122.41(i)(2));

3. Inspect and photograph, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order (40 C.F.R. § 122.41(i)(3)); and

4. Sample or monitor, at reasonable times, for the purposes of assuring Order compliance or as otherwise authorized by the CWA or the Water Code, any substances or parameters at any location. (40 C.F.R. § 122.41(i)(4).)

G. Bypass

1. Definitions

   a. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. (40 C.F.R. § 122.41(m)(1)(i).)

   b. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities, which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production. (40 C.F.R. § 122.41(m)(1)(ii).)

2. Bypass not exceeding limitations. The Discharger may allow any bypass to occur which does not cause exceedances of effluent limitations, but only if it is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions listed in Standard Provisions – Permit Compliance I.G.3, I.G.4, and I.G.5 below. (40 C.F.R. § 122.41(m)(2).)

3. Prohibition of bypass. Bypass is prohibited, and the San Diego Water Board may take enforcement action against a Discharger for bypass, unless (40 C.F.R. § 122.41(m)(4)(i)):

   a. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage (40 C.F.R. § 122.41(m)(4)(i)(A));

   b. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance (40 C.F.R. § 122.41(m)(4)(i)(B)); and

   c. The Discharger submitted notice to the San Diego Water Board as required under Standard Provisions – Permit Compliance I.G.5 below. (40 C.F.R. § 122.41(m)(4)(i)I.)

4. The San Diego Water Board may approve an anticipated bypass, after considering its adverse effects, if the San Diego Water Board determines that it will meet the three conditions listed in Standard Provisions – Permit Compliance I.G.3 above. (40 C.F.R. § 122.41(m)(4)(ii).)

5. Notice

   a. Anticipated bypass. If the Discharger knows in advance of the need for a bypass, it shall submit a notice, if possible at least 10 days before the date of the bypass. (40 C.F.R. § 122.41(m)(3)(i).)

   b. Unanticipated bypass. The Discharger shall submit notice of an unanticipated bypass as required in Standard Provisions – Reporting V.E below (24-hour notice). (40 C.F.R. § 122.41(m)(3)(ii).)

H. Upset

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the Discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. (40 C.F.R. § 122.41(n)(1).)

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Standard Provisions – Permit Compliance

I.H.2 below are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review. (40 C.F.R. § 122.41(n)(2).)

2. Conditions necessary for a demonstration of upset. A Discharger who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that (40 C.F.R. § 122.41(n)(3)):

   a. An upset occurred and that the Discharger can identify the cause(s) of the upset (40 C.F.R. § 122.41(n)(3)(i));

   b. The permitted facility was, at the time, being properly operated (40 C.F.R. § 122.41(n)(3)(ii));

   c. The Discharger submitted notice of the upset as required in Standard Provisions – Reporting V.E.2.b below (24-hour notice) (40 C.F.R. § 122.41(n)(3)(iii)); and

   d. The Discharger complied with any remedial measures required under Standard Provisions – Permit Compliance I.C above. (40 C.F.R. § 122.41(n)(3)(iv).)

3. Burden of proof. In any enforcement proceeding, the Discharger seeking to establish the occurrence of an upset has the burden of proof. (40 C.F.R. § 122.41(n)(4).)

II. STANDARD PROVISIONS – PERMIT ACTION

A. General

This Order may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any Order condition. (40 C.F.R. § 122.41(f).)

B. Duty to Reapply

If the Discharger wishes to continue an activity regulated by this Order after the expiration date of this Order, the Discharger must apply for and obtain a new permit. (40 C.F.R. § 122.41(b).)

C. Transfers

This Order is not transferable to any person except after notice to the San Diego Water Board. The San Diego Water Board may require modification or revocation and reissuance of the Order to change the name of the Discharger

and incorporate such other requirements as may be necessary under the CWA and the Water Code. (40 C.F.R. § 122.41(l)(3); § 122.61.)

III. STANDARD PROVISIONS – MONITORING

A. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. (40 C.F.R. § 122.41(j)(1).)

B. Monitoring results must be conducted according to test procedures under Part 136 or, in the case of sludge use or disposal, approved under Part 136 unless otherwise specified in Part 503 unless other test procedures have been specified in this Order. (40 C.F.R. § 122.41(j)(4); § 122.44(i)(1)(iv).)

IV. STANDARD PROVISIONS – RECORDS

A. Except for records of monitoring information required by this Order related to the Discharger's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by Part 503), the Discharger shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this Order, and records of all data used to complete the application for this Order, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the San Diego Water Board Executive Officer at any time. (40 C.F.R. § 122.41(j)(2).)

B. **Records of monitoring information shall include:**

1. The date, exact place, and time of sampling or measurements (40 C.F.R. § 122.41(j)(3)(i));

2. The individual(s) who performed the sampling or measurements (40 C.F.R. § 122.41(j)(3)(ii));

3. The date(s) analyses were performed (40 C.F.R. § 122.41(j)(3)(iii));

4. The individual(s) who performed the analyses (40 C.F.R. § 122.41(j)(3)(iv));

5. The analytical techniques or methods used (40 C.F.R. § 122.41(j)(3)(v)); and

6. The results of such analyses. (40 C.F.R. § 122.41(j)(3)(vi).)

C. **Claims of confidentiality for the following information will be denied (40 C.F.R. § 122.7(b)):**

1. The name and address of any permit applicant or Discharger (40 C.F.R. § 122.7(b)(1)); and

2. Permit applications and attachments, permits and effluent data. (40 C.F.R. § 122.7(b)(2).)

V. STANDARD PROVISIONS – REPORTING

A. Duty to Provide Information

The Discharger shall furnish to the San Diego Water Board, State Water Board, or USEPA within a reasonable time, any information which the San Diego Water Board, State Water Board, or USEPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order or to determine compliance with this Order. Upon request, the Discharger shall also furnish to the San Diego Water Board, State Water Board, or USEPA copies of records required to be kept by this Order. (40 C.F.R. § 122.41(h); Water Code, § 13267.)

B. Signatory and Certification Requirements

1. All applications, reports, or information submitted to the San Diego Water Board, State Water Board, and/or USEPA shall be signed and certified in accordance with Standard Provisions – Reporting V.B.1.a, V.B.1.b, V.B.1.c, V.B.2, V.B.3, and V.B.4 below. (40 C.F.R. § 122.41(k).)

   a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. (40 C.F.R. § 122.22(a)(1).)

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively. (40 C.F.R. § 122.22(a)(2).)

   c. For a municipality, State, federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this provision, a principal executive officer of a federal agency includes: (i) the chief executive officer of the agency, or (ii) a senior executive officer

having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of USEPA). (40 C.F.R. § 122.22(a)(3).).

2. All reports required by this Order and other information requested by the San Diego Water Board, State Water Board, or USEPA shall be signed by a person described in Standard Provisions – Reporting V.B.2 above, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described in Standard Provisions – Reporting V.B.2 above (40 C.F.R. § 122.22(b)(1));

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) (40 C.F.R. § 122.22(b)(2)); and

   c. The written authorization is submitted to the San Diego Water Board and State Water Board. (40 C.F.R. § 122.22(b)(3).)

3. If an authorization under Standard Provisions – Reporting V.B.3 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Standard Provisions – Reporting V.B.3 above must be submitted to the San Diego Water Board and State Water Board prior to or together with any reports, information, or applications, to be signed by an authorized representative. (40 C.F.R. § 122.22I.)

4. Any person signing a document under Standard Provisions – Reporting V.B.2 or V.B.3 above shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." (40 C.F.R. § 122.22(d).)

C. Monitoring Reports

1. Monitoring results shall be reported at the intervals specified in the Monitoring and Reporting Program (Attachment E) in this Order. (40 C.F.R. § 122.22(l)(4).)

2. Monitoring results must be reported on a Discharge Monitoring Report (DMR) form or forms provided or specified by the San Diego Water Board or State Water Board for reporting results of monitoring of sludge use or disposal practices. (40 C.F.R. § 122.41(l)(4)(i).)

3. If the Discharger monitors any pollutant more frequently than required by this Order using test procedures approved under Part 136 or, in the case of sludge use or disposal, approved under Part 136 unless otherwise specified in Part 503, or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the San Diego Water Board. (40 C.F.R. § 122.41(l)(4)(ii).)

4. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this Order. (40 C.F.R. § 122.41(l)(4)(iii).)

D. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this Order, shall be submitted no later than 14 days following each schedule date. (40 C.F.R. § 122.41(l)(5).)

E. Twenty-Four Hour Reporting

1. The Discharger shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the Discharger becomes aware of the circumstances. A written submission shall also be provided within five (5) days of the time the Discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. (40 C.F.R. § 122.41(l)(6)(i).)

2. The following shall be included as information that must be reported within 24 hours under this paragraph (40 C.F.R. § 122.41(l)(6)(ii)):

    a. Any unanticipated bypass that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(A).)

b. Any upset that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(B).)

3. The San Diego Water Board may waive the above-required written report under this provision on a case-by-case basis if an oral report has been received within 24 hours. (40 C.F.R. § 122.41(l)(6)(iii).)

F. Planned Changes

The Discharger shall give notice to the San Diego Water Board as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required under this provision only when (40 C.F.R. § 122.41(l)(1)):

1. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in section 122.29(b) (40 C.F.R. § 122.41(l)(1)(i)); or

2. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are not subject to effluent limitations in this Order. (40 C.F.R. § 122.41(l)(1)(ii).)

3. The alteration or addition results in a significant change in the Discharger's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan. (40 C.F.R.§ 122.41(l)(1)(iii).)

G. Anticipated Noncompliance

The Discharger shall give advance notice to the San Diego Water Board or State Water Board of any planned changes in the permitted facility or activity that may result in noncompliance with General Order requirements. (40 C.F.R. § 122.41(l)(2).)

H. Other Noncompliance

The Discharger shall report all instances of noncompliance not reported under Standard Provisions – Reporting V.C, V.D, and V.E above at the time monitoring reports are submitted. The reports shall contain the information listed in Standard Provision – Reporting V.E above. (40 C.F.R. § 122.41(l)(7).)

I. Other Information

When the Discharger becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the San Diego Water Board, State Water Board, or USEPA, the

Discharger shall promptly submit such facts or information. (40 C.F.R. § 122.41(l)(8).)

VI. STANDARD PROVISIONS – ENFORCEMENT

A. The San Diego Water Board is authorized to enforce the terms of this permit under several provisions of the Water Code, including, but not limited to, sections 13385, 13386, and 13387

VII. ADDITIONAL PROVISIONS – NOTIFICATION LEVELS

A. Non-Municipal Facilities – Not Applicable

ATTACHMENT E – MONITORING AND REPORTING PROGRAM

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ATTACHMENT E – MONITORING AND REPORTING PROGRAM (MRP)

Section 122.48 of Title 40 of the Code of Federal Regulations (40 CFR 122.48) requires that all NPDES permits specify monitoring and reporting requirements. Water Code Sections 13267 and 13383 also authorize the San Diego Water Board to require technical and monitoring reports. This MRP establishes monitoring and reporting requirements, which implement the federal and California laws and regulations.

This Monitoring and Reporting Program is designed to address the two key questions shown below. It also encourages Dischargers to establish or join monitoring coalitions for residual firework pollutant discharges to Mission Bay and San Diego Bay with the regulated community discharging to these water bodies.

Question No. 1: Is the Discharger adequately implementing BMPs specified in this Order and in the approved Firework Best Management Practices Plan?

Question No. 2: For discharges to Mission Bay and San Diego Bay, are the BMPs specified in this Order and the Discharger's approved Firework Best Management Practices Plan adequate to prevent an exceedance of the receiving water and sediment quality limitations of this Order?

I. GENERAL MONITORING PROVISIONS

A. Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. Another waste stream, body of water, or substance shall not dilute the monitored discharge.

B. Water monitoring must be conducted according to USEPA test procedures approved under 40 CFR section 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act as amended, unless other test procedures are specified in this Order or by the San Diego Water Board. Monitoring for total residual chlorine, total dissolved solids, temperature, and pH may be done using an appropriate field measurement device.

C. Sediment monitoring must be conducted according to the State Water Resources Control Board's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Effective August 25, 2009), Section V, Benthic Community Protection (SWRCB Sediment Quality Control Plan).

D. If the Discharger monitors any pollutant more frequently than required by this Order using test procedures approved under 40 CFR section 136, or as specified in this Order or by the appropriate San Diego Water Board, the results of the monitoring shall be included in the calculation and reporting of the data submitted in the Discharger's Annual Report. The increased frequency of monitoring shall also be reported.

E. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this Order.

F. Use of flow measurement devices and methods shall be consistent with industry practices. All monitoring instruments and devices used by the Discharger to fulfill the monitoring program shall be properly maintained and calibrated to ensure reliability and accuracy.

G. If laboratory services are used, records and monitoring information shall include:

1. The date, exact location, and time of sampling or measurements;
2. The name(s) of individual(s) who performed the sampling or measurements;
3. The date(s) analysis were performed;
4. The name(s) of the laboratory and individual(s) who performed the analyses;
5. The analytical techniques or methods used; and
6. The results of such analyses.

II. MONITORING LOCATIONS

Each Discharger shall establish monitoring locations within the public firework event firing range and adjacent affected surface waters to demonstrate adequate implementation of the BMPs specified in this Order and in the approved Firework Best Management Practices Plan. For discharges to Mission Bay or San Diego Bay each Discharger, classified as a Category 1 Discharger under this Order, or Coalition shall also establish receiving water and sediment monitoring locations to demonstrate compliance with the receiving water limitations of this Order.

III. FIREWORKS BEST MANAGEMENT PRACTICES PLAN (FBMPP)

A. Public Fireworks Display Event Log. The Discharger shall maintain a written log for each public fireworks display event containing the information as described in Section V.C. of this Order. The log shall be completed within 5 days following each public fireworks event and shall be made available to the San Diego Water Board upon request.

B. Post Firework Display Event Reporting. No later than ten (10) calendar days following each public display of fireworks event, the Discharger shall complete *Attachment C - Public Display of Fireworks Post Event Report Form* of this Order and make it available to the San Diego Water Board upon request. With the exception of the Fourth of July Post Event report, completed reports shall also be submitted to the San Diego Water Board quarterly in accordance with Section X.B.2 below. Fourth of July Post Event Reports shall be submitted to the San Diego Water Board by August 1.

IV. INFLUENT MONITORING REQUIREMENTS – NOT APPLICABLE

V. EFFLUENT MONITORING REQUIREMENTS- NOT APPLICABLE

VI. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS – NOT APPLICABLE

VII. LAND DISCHARGE MONITORING REQUIREMENTS – NOT APPLICABLE

VIII. RECLAMATION MONITORING REQUIREMENTS – NOT APPLICABLE

IX. RECEIVING WATER MONITORING REQUIREMENTS – SURFACE WATER

A. Category 1 Discharger Monitoring Requirements

1. ***Category 1 Discharger Criteria.*** A Category 1 Discharger is a Discharger that meets any one of the following criteria:

   a. Discharges fireworks containing a net explosive weight of 1,000 pounds or more, in any calendar year, from a single event to Mission Bay or San Diego Bay; or

   b. Discharges fireworks from SeaWorld San Diego to Mission Bay.

   Receiving water body monitoring shall be performed by all Category 1 Dischargers to assess compliance with receiving water limits. The monitoring may be performed either by individual Dischargers to assess compliance with receiving water limits, or through participation in a San Diego Bay or Mission Bay water body monitoring coalition or both as determined by the San Diego Water Board.

2. ***Monitoring Coalitions***. To achieve maximum efficiency and economy of resources, the San Diego Water Board encourages Category 1 Dischargers in coordination to establish or join a San Diego Bay or Mission Bay water body-monitoring coalition. Monitoring coalitions enable the sharing of technical resources, trained personnel, and associated costs and create an integrated water and sediment monitoring program within each water body. Focusing resources on water body issues and developing a broader understanding of pollutants effects in these water bodies enables the development of more rapid and efficient response strategies and facilitates better management of water and sediment quality.

   a. If a San Diego Bay or Mission Bay monitoring coalition is established, the coalition shall be responsible for water and sediment quality assessment within the designated water body and for ensuring that appropriate studies and reports required under this Order are completed in a timely manner.

b. The Coalitions shall coordinate with the San Diego Water Board to ensure that all coalition participants are proactive and responsive to potential water and sediment quality related issues as they arise during monitoring and assessment.

3. ***Water and Sediment Monitoring Plan.*** The Discharger or water body monitoring coalition shall prepare and submit a Water and Sediment Monitoring Plan to assess compliance with Receiving Water Limitations of this Order. The Water and Sediment Monitoring Plan shall be submitted within twelve (12) months of the effective enrollment date specified in the Notice of Enrollment under this Order and shall contain the following elements:

a. *Quality Assurance Project Plan*. A Quality Assurance Project Plan (QAPP) describing the project objectives and organization, functional activities, and quality assurance/quality control protocols for the water and sediment monitoring.

b. *Sampling and Analysis Plan*. A Sampling and Analysis Plan must be proposed based on methods or metrics described in 40 CFR 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act* and the SWRCB Sediment Quality Control Plan. The plan shall include a list of chemical analytes for the water column and sediment.

i. Water Column Sampling

1. Frequency: The Sampling and Analysis Plan must propose the frequency and timing for water column sampling for Category 1 discharges. The proposed sampling must be based upon results on the fate and transport of pollutants from the conceptual model (see c, below).

2. Pollutants: The Sampling and Analysis Plan must propose what pollutants will be monitored. At a minimum, monitoring must include the pollutants in Table 1 below:

Table 1. Water Chemistry Analytical Testing for San Diego and Mission Bay

Conventional, Nutrients	Semivolatile Organic Compounds	Metals (Total and Dissolved)
Total Phosphorous Perchlorate	bis-phthalate	Arsenic Barium Cadmium Chromium Cobalt Copper Lead Mercury Molybdenum Nickel Potassium Selenium Silver Thallium Tin Titanium Vanadium Zinc

ii. Sediment Sampling

1. Frequency: Sediment chemistry, toxicity and benthic organism monitoring shall be done, at a minimum, once every three years.

2. Sediment Chemistry, Toxicity and Benthic Community Condition: Sediment chemistry, toxicity and benthic community monitoring shall be done in accordance with, at a minimum, the requirements under the SWRCB Sediment Quality Control Plan. The proposal must also include the following:

   a. Sediment Chemistry: In addition to those metals listed in Attachment A of the SWRCB Sediment Quality Control Plan, sediment chemistry must monitor for those metals listed in Table 1.

   b. Benthic Community: An analysis of the subtidal habitat of the receiving waters. For discharges to unvegetated subtidal, the benthic community shall be evaluated using the line of evidence approach in Section V.G of the SWRCB Sediment Quality Control Plan. For discharges to vegetated subtidal (*Zostera marina*), the proposed benthic community monitoring must be conducted in accordance with Section V.J of the

SWRCB Sediment Quality Control Plan and utilize a reference site approach to assess the benthic invertebrate community and impacts to *Zostera marina* as a line of evidence. Assessment of *Zostera marina* must be done in accordance with the Southern California Eelgrass Mitigation Policy.

c. *Conceptual Model***.** A Conceptual Model identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the water and sediment. The Conceptual Model will serve as the basis for assessing the appropriateness of the Water and Sediment Monitoring Plan design. The Conceptual Model shall consider:

- Points of discharge into the segment of the water body or region of interest;
- Tidal flow and/or direction of predominant currents;
- Historic or legacy conditions in the vicinity;
- Nearby land and marine uses or actions;
- Beneficial Uses;
- Potential receptors of concern;
- Change in grain size salinity water depth and organic matter; and
- Other sources or discharges in the immediate vicinity.

d. *Spatial Representation*. The Water and Sediment Monitoring Plan shall be designed to ensure that the sample stations are spatially representative of the sediment within the water body segment or region of interest.

e. *Existing Data and Information*. The Water and Sediment Monitoring Plan design shall take into consideration existing data and information of appropriate quality.

f. *Strata***.** Identification of appropriate strata shall consider characteristics of the water body including sediment transport, hydrodynamics, depth, salinity, land uses, inputs (both natural and anthropogenic) and other factors that could affect the physical, chemical, or biological condition of the sediment.

g. *Index Period*. All stations shall be sampled between the months of June through September to correspond with the benthic community index period.

h. *Report Completion Schedule*. The Water and Sediment Monitoring Plan shall include a schedule for completion of all sample collection and analysis activities and submission of a final Water and Sediment Monitoring Report described in Reporting Requirement VIII. C.

4. ***Water and Sediment Monitoring Plan Implementation***. The Discharger or water body monitoring coalition shall implement the Water and Sediment Monitoring Plan in accordance with the schedule contained in the Water and Sediment Monitoring Plan unless otherwise directed in writing by the San Diego Water Board. Before beginning sample collection activities, the Discharger or water body monitoring coalition shall:

   a. Notify the San Diego Water Board at least fourteen days in advance of the beginning of sample collection activities.; and

   b. Comply with any conditions set by the San Diego Water Board with respect to sample collection methods such as providing split samples.

5. ***Water and Sediment Monitoring Report*****.** The Discharger or water body monitoring coalition shall submit a Water and Sediment Monitoring Report in accordance with the schedule contained in the Water and Sediment Monitoring Plan unless otherwise directed in writing by the San Diego Water Board. The Water and Sediment Monitoring Report shall contain the following information:

   a. *Analysis****.*** An evaluation, interpretation and tabulation of the water and sediment monitoring data including interpretations and conclusions as to whether applicable Receiving Water Limitations in this Order have been attained at each sample station.

   b. *Sample Location Map*. The locations, type, and number of samples shall be identified and shown on a site map.

   c. *California Environmental Data Exchange Network.* A statement certifying that the monitoring data and results have been uploaded into the California Environmental Data Exchange Network (CEDEN[1]).

6. ***Additional Sediment Investigations***. Based on the Water and Sediment Monitoring Report conclusions the San Diego Water Board may require a human health risk assessment to determine if the human health objective contained in Receiving Water Limitations V.A.3.c)(2) has been attained at each sample station. In conducting a risk assessment, the Discharger or regional water body monitoring coalition shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and USEPA Human Health Risk Assessment policies.

[1] http://ceden.org/

B. Category 2 Discharger Monitoring Requirements

1. ***Category 2 Discharger Criteria.*** A Category 2 Discharger is a Discharger that meets any one of the following criteria:

   a. Discharges fireworks containing a net explosive weight less than 1,000 pounds, in any calendar year, from a single event to Mission Bay or San Diego Bay; or

   b. Discharges fireworks of any net explosive weight from a single event or multiple events to any other Surface Water of the U.S. within the San Diego Region.

2. ***Permitted Discharges***. Monitoring performed by Category 2 Dischargers is not required unless otherwise determined by the San Diego Water Board based on the following considerations:

   a. Receiving water body characteristics including circulation, depth, assimilative capacity; CWA 303(d) listed impairments, and beneficial uses;
   b. The frequency of firework events in the receiving water including those at or near the same firework fallout area;
   c. The estimated firework pollutant loading from an individual or repeated firework event(s) affecting the same water body or segment thereof;
   d. Accumulative effects from repeat firework events in the same location or other firework events affecting the same water body or segment thereof;
   e. Proximity of the firework event to existing or proposed State Water Quality Protection Areas, inclusive of Areas of Special Biological Significance (ASBS) or other environmental sensitive receiving waters; or
   f. Any other relevant water quality factors

3. ***Monitoring Coalition.*** If monitoring is required, the monitoring shall be performed by individual Dischargers to assess compliance with receiving water limits, or through participation in a water body monitoring coalition meeting the criteria for a coalition described in Section IX.A.2., or both as determined by the San Diego Water Board.

4. ***Water and Sediment Monitoring Plan.*** If monitoring is required, the Discharger or water body monitoring coalition shall prepare and submit a Water and Sediment Monitoring Plan to assess compliance with Receiving Water Limitations of this Order. The Water and Sediment Monitoring Plan shall be prepared and implemented in conformance with the requirements described in Sections IX.A.3 through Sections IX.A.6.

X. REPORTING REQUIREMENTS

A. General Monitoring and Reporting Requirements

1. The Discharger shall comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping.

B. Self Monitoring Reports (SMRs)

1. At any time during the term of this permit, the State or San Diego Water Board may notify the Discharger to electronically submit Self-Monitoring Reports (SMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). Until such notification is given, the Discharger shall submit hard copy SMRs. The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal.

2. The Discharger shall report in the SMR the results for all monitoring specified in this MRP under sections III through IX. The Discharger shall submit annual SMRs including the results of all required monitoring using USEPA-approved test methods or other test methods specified in this Order. If the Discharger monitors any pollutant more frequently than required by this Order, the results of this monitoring shall be included in the calculations and reporting of the data submitted in the SMR.

3. Monitoring periods and reporting for all required monitoring shall be completed according to the following schedule:

Table 2. Monitoring and Reporting Schedule for Post Event Reports.

Reporting Period(s)	Report Due Date(s)
January-March April-June July-September October-December .	May 1: August 1: November 1: February 1.
July 4	August 1

4. **Reporting Protocols.** The Discharger shall report with each analytical sample result the applicable reported Minimum Level (ML) and the current Method Detection Limit (MDL), as determined by the procedure in Part 136.

   The Discharger shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

a. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

b. Sample results less than the RL, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

   For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (+ a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

c. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

d. Dischargers are to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Discharger to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

5. **Compliance Determination.** This Order requires the use of minimum stipulated BMPs to control and abate the discharge of pollutant wastes from public fireworks events to surface waters in the San Diego Region. Proper implementation of the BMPs will assure the protection of water and sediment quality within the receiving waters. Dischargers enrolled under this Order are expected to comply with all water and sediment quality objectives through the implementation of BMPs. Compliance will be determined by evaluating the proper implementation of the minimum stipulated BMPs and their effectiveness in preventing and minimizing pollutant waste loading from public fireworks events to surface waters. Compliance will also be evaluated using information obtained under the monitoring and reporting program of this Order.

6. **Multiple Sample Data.** When determining compliance with a measure of central tendency (arithmetic mean, geometric mean, median, etc.) of multiple sample analyses and the data set contains one or more reported determinations of "Detected, but Not Quantified" (DNQ) or "Not Detected" (ND), the Discharger shall compute the median in place of the arithmetic mean in accordance with the following procedure:

a. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

b. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

7. The Discharger shall submit SMRs in accordance with the following requirements:

   a. The Discharger shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the facility is operating in compliance with interim and/or final effluent limitations. The Discharger is not required to duplicate the submittal of data that is entered in a tabular format within CIWQS. When electronic submittal of data is required and CIWQS does not provide for entry into a tabular format within the system, the Discharger shall electronically submit the data in a tabular format as an attachment.

   b. The Discharger shall attach a cover letter to the SMR. The information contained in the cover letter shall clearly identify violations of the WDRs; discuss corrective actions taken or planned; and the proposed time schedule for corrective actions. Identified violations must include a description of the requirement that was violated and a description of the violation.

   c. SMRs must be submitted to the San Diego Water Board, signed and certified as required by the Standard Provisions (Attachment D), to the address listed below:

California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

C. **Discharge Monitoring Reports (DMRs)**

1. As described in Section X.B.1 above, at any time during the term of this permit, the State or San Diego Water Board may notify the Discharger to electronically submit SMRs that will satisfy federal requirements for submittal of Discharge Monitoring Reports (DMRs). Until such notification is given, the

Discharger shall submit DMRs in accordance with the requirements described below.

2. DMRs must be signed and certified as required by the standard provisions (Attachment D). The Discharger shall submit the original DMR and one copy of the DMR to the address listed below:

STANDARD MAIL	**FEDEX/UPS/ OTHER PRIVATE CARRIERS**
State Water Resources Control Board Division of Water Quality c/o DMR Processing Center PO Box 100 Sacramento, CA 95812-1000	State Water Resources Control Board Division of Water Quality c/o DMR Processing Center 1001 I Street, 15th Floor Sacramento, CA 95814

3. All discharge monitoring results must be reported on the official USEPA pre-printed DMR forms (EPA Form 3320-1). Forms that are self-generated will not be accepted unless they follow the exact same format of EPA Form 3320-1.

ATTACHMENT F – FACT SHEET

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ATTACHMENT F – FACT SHEET

As described in section II of this Order, this Fact Sheet includes the legal requirements and technical rationale that serve as the basis for the requirements of this Order.

This Order has been prepared under a standardized format to accommodate a broad range of discharge requirements for Dischargers in the San Diego Region. Only those sections or subsections of this Order that are specifically identified as "not applicable" have been determined not to apply to the Discharger. Sections or subsections of this Order not specifically identified as "not applicable" are fully applicable to the Discharger.

I. DISCHARGE INFORMATION

A. Introduction

This Order is intended to regulate residual pollutant waste discharges associated with the public display of fireworks to receiving surface waters of the United States within the jurisdiction of the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board). The San Diego Region covers a large portion of San Diego County, portions of South Orange County, and the southwestern portion of Riverside County based on hydrologic drainage areas. In this Order the public display of fireworks refers to an entertainment feature where the public or a private group is admitted to or permitted to view the display or discharge of fireworks.

Public displays of fireworks (also referred to as a fireworks show or event) are conducted throughout the year at various locations within the San Diego Region as part of national and community celebrations and other special events. Located within the San Diego Region are entertainment theme parks and two major league stadiums for football and baseball that use firework displays during regular activities and special events. Additionally, fireworks displays and pyrotechnics special effects are periodically used in other venues such as business grand openings and special events, public and private school homecoming & graduation events, various sporting events and local fairs. The most significant and widespread use of fireworks displays for celebrations in the San Diego Region are for annual Fourth of July and New Year's Eve public and private events Firework display sites on or adjacent to urban shorelines are often the preferred setting to provide public access and avoid the fire hazards associated with terrestrial display sites.

Typical fireworks constituents include, but are not limited to, aluminum, antimony, barium, carbon, calcium, chlorine, cesium, copper, iron, potassium, lithium, magnesium, oxidizers including nitrates, chlorates and perchlorates, phosphorus, sodium sulfur, strontium, titanium, and zinc. The chemical constituents burn at high temperatures when the firework is detonated which promotes incineration. The chemical constituents within the fireworks are scattered by the burst charge,

which separates them from the fireworks casing and internal shell components. A firework combustion residue is produced in the form of smoke, airborne particulates, chemical pollutants, and debris including paper, cardboard, wires and fuses. This combustion residue can fall into surface waters. In addition un-ignited pyrotechnic material including duds and misfires can also fall into surface waters.

The receiving water fallout area affected by the fireworks residue can vary depending on wind speed and direction, size of the shells, the angle of mortar placement, the type and height of firework explosions and other environmental factors. Once the fireworks residue enters a water body it can be transported to waters and shorelines outside the fallout area due to wind shear and tidal effects. The Clean Water Act (CWA), at section 301(a), broadly prohibits the discharge of any pollutant to waters of the United States, except in compliance with an NPDES permit. Fireworks residue waste discharged into surface waters constitutes discharge of a pollutant from a point source within the meaning of the CWA. Therefore, coverage under an NPDES permit is required before residual firework pollutant waste can be lawfully discharged.

This Order requires implementation of Best Management Practices (BMPs) to ensure the pollutant waste discharges associated with the public display of fireworks do not cause pollution or nuisance conditions in surface waters within the San Diego Region.

B. Background- NPDES Permit Program

The Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA)[1] was enacted in 1972. The CWA established the National Pollutant Discharge Elimination System (NPDES) permit program to regulate the discharge of pollutants from point sources[2], such as pipes, to waters of the United States. The NPDES program is designed to control toxic discharges, implement water quality standards, and restore and maintain "fishable and swimmable" designated beneficial uses in waters of the United States. Point sources that discharge pollutants to waters of the United States are authorized by obtaining and complying e with the terms and conditions of NPDES permits. [3] NPDES Permits are effective for fixed terms not to exceed 5 years. [4] Either the United States Environmental Protection Agency (USEPA) or states with USEPA-

[1] 33 U.S.C. § 1251 et seq. (CWA § 101, et seq.)

[2] A point source is "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged." Id. § 1362(14); (CWA § 502(14).)

[3] See *id.* §§ 1311, 1342, (CWA §§ 301, 402).
[4] *See id. §* 1342(b)(1)(B), (CWA § 402(b)(1)(B).)

approved programs are authorized to issue NPDES permits. California has an approved program.

NPDES permits commonly contain numerical effluent limits on the amounts of specified pollutants that may be discharged and specified best management practices (BMPs) designed to minimize water quality impacts. Federal regulations allow the use of other requirements such as BMPs in lieu of numerical effluent limits if the latter are infeasible.[5] These numerical effluent limitations and BMPs or other non-numerical effluent limitations implement both technology-based and water quality based requirements of the Act. Technology-based limitations represent the degree of control that can be achieved by point sources using various levels of pollution control technology. If necessary to achieve compliance with applicable water quality standards.[6] NPDES permits must contain water quality-based limitations more stringent than the applicable technology-based standards

Water quality standards, as defined in CWA Section 303(c), consist of the beneficial uses of a water body and criteria (referred to as water quality objectives in California) to protect those uses and an anti-degradation policy.[7] The criteria can be either narrative or numeric.[8] A typical narrative criterion, for example, prohibits "the discharge of toxic pollutants in toxic amounts." Numeric criteria establish pollutant concentrations or levels in water that protect beneficial uses. An example of a numeric saltwater criterion for copper to protect aquatic life is 3.1 micrograms per liter (µg/l) as a monthly average.

The states are primarily responsible for the adoption of water quality standards, although EPA has oversight and promulgation authority, as well. [9] In California water quality standards are found in statewide and regional water quality control plans.[10] Water quality control plans contain beneficial use designations, water quality objectives to protect those uses, and a program to implement the objectives.[11] Water quality objectives are the state equivalent of federal criteria

[5] See 40 CFR 122.44(k)(3)

[6] Under state law, the water boards establish beneficial uses and water quality objectives in their water quality control or basin plans. Together with an anti-degradation policy, these beneficial uses and water quality objectives serve as water quality standards under the Clean Water Act. In Clean Water Act parlance, state beneficial uses are called "designated uses" and state water quality objectives are called "criteria." Throughout this order, we use the relevant term depending on the statutory scheme.

[7] See 40 C.F.R. § 131.6.

[8] See 40 CFR § 131.3(b) ("*Criteria* are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use.")

[9] See 33 U.S.C. § 1313(c), CWA § 303(c).

[10] See California Water Code (CWC) §§ 13170, 13170.2, 13240-13247.

[11] Compare CWC §13050(h) with 40 CFR §131.3(b).

under CWA Section 303(c).[12]

In California the State Water Board and nine Regional Water Quality Control Boards (Regional Water Boards) issue and administer NPDES permits under a program approved by the USEPA.[13] To maintain program approval, state and federal law require that permits ensure consistency with the Clean Water Act and implementing USEPA regulations.[14] State statutory authority for the NPDES permit program is found in Chapter 5.5, Division 2 of the California Water Code which ensures consistency with the Clean Water Act requirements for state permit programs. The permits must "apply and ensure compliance with" all applicable provisions of the Clean Water Act and "with any more stringent effluent standards or limitations necessary to implement water quality control plans."[15] In addition, permits must be issued and administered in accordance with the applicable EPA permit regulations.[16] The provisions of Chapter 5.5 prevail over other Water Code provisions to the extent of any inconsistency.

C. Discharge Description

1. Firework Categories

Fireworks are a class of low explosive pyrotechnic devices used for aesthetic or entertainment purposes. Firework devices take many forms to produce four primary effects: noise, light, smoke, and floating materials (confetti for example). Fireworks may be designed to burn with colored flames and sparks including red, orange, yellow, green, blue, purple, and silver.

Professional pyrotechnic devices used in fireworks displays can be grouped into three general categories: 1) aerial shells (paper and cardboard spheres or cylinders filled with pyrotechnic materials), 2) low-level comet and multi-shot devices such as roman candles, and 3) set piece displays mounted on the ground.

Aerial fireworks typically either provide their own propulsion (e.g. a skyrocket using a solid rocket motor) or are shot into the air in an aerial shell by a mortar using a black powder lifting charge or propellant. Most of the incendiary elements and shell casings burn up in the atmosphere; however, portions of the casings and some internal structural components and chemical residue fall back to the ground or receiving water bodies. The aerial shell typically consists of a cylinder or spherical cartridge, usually constructed of paper, plastic or cardboard and may include some plastic or paper internal components used to compartmentalize chemicals within in the shell. The

[12] Compare CWC § 13050(h) with 40 CFR 131.3(b).
[13] See *id.* § 1342(b) and CWC § 13377.
[14] *Ibid.*; 40 CFR 123; CWC §§ 13372, 13377.
[15] See CWC § 13377.
[16] California Code of Regulations (CCR), Title 23, § 2235.2.

shell casing contains a burst charge, pyrotechnic material that emits prescribed colors when detonated, a fuse and a black powder lift charge. Aerial shells are often combined so as to make, when detonated, a great variety of sparkling shapes, often variously colored.

Colors in fireworks are usually generated by pyrotechnic stars—usually just called stars—which produce intense light when ignited. Stars contain five basic types of ingredients.

- A fuel which allows the star to burn
- An oxidizer—a compound which produces (usually) oxygen to support the combustion of the fuel
- Color-producing chemicals
- A binder which holds the pellet together.
- A chlorine donor which provides chlorine to strengthen the color of the flame. Sometimes the oxidizer can serve this purpose.

Attached to the bottom of an aerial shell is a lift charge of black powder. The lift charge and shell are placed at the bottom of a mortar buried in earth/sand or affixed to a wooden rack. A fuse attached to the lift charge is ignited with an electric charge or heat source, the lift charge explodes, and propels the shell through the mortar tube and into the air to a height determined by the amount of powder in the lift charge and the weight of the shell. As the shell travels skyward, a time-delay secondary fuse is burning that eventually ignites the burst charge within the shell at peak altitude. The burst charge detonates, igniting and scattering the stars, which may, in turn, have small secondary explosions. Shells can be launched one at a time or in a barrage of simultaneous or quick succession launches and are typically designed to detonate between 200 and 1000 feet above ground level.

Low-level firework devices consist of stars packed linearly within a tube. When ignited, the stars exit the tube in succession producing a fountain effect of single or multi-colored light as the stars incinerate through the course of their flight. Typically, the stars burn rather than explode, thus producing a ball or trail of sparkling light to a prescribed altitude where they simply extinguish. Sometimes they may terminate with a small explosion similar to a firecracker. Other low-level devices emit a projected hail of colored sparks or perform erratic low-level flight while emitting a high-pitched whistle. Some emit a pulsing light pattern or crackling or popping sound effects. In general, low-level launch devices and encasements remain on the ground or attached to a fixed structure and can be removed upon completion of the display. Common low-level devices are multi-shot devices, mines, comets, meteors, candles, strobe pots and gerbs. They are designed to produce effects between 0 and 200 feet above ground level.

Set piece or ground level fireworks are primarily static in nature and remain

close to the ground. They are usually attached to a framework that may be crafted in the design of a logo or familiar shape, illuminated by pyrotechnic devices such as flares, sparklers and strobes. These fireworks typically employ bright flares and sparkling effects that may also emit limited sound effects such as cracking, popping, or whistling. Set pieces are usually used in concert with low-level effects or an aerial show and sometimes act as a centerpiece for the display. It may have some moving parts, but typically does not launch devices into the air. Set piece displays are typically designed to produce effects between 0 and 50 feet above ground level.

2. Firework Chemical Constituents

A partial list of chemicals used in fireworks as fuels, oxidizers, binding agents, coloration effects and sound effects is provided in Table1 below. The detonation of fireworks over or adjacent to surface waters may result in the discharge of these and other pollutants to surface waters:

Table 1. Fireworks Chemical Constituents

Symbol	Name	Fireworks Usage
Al	Aluminum	Aluminum is used to produce silver and white flames and sparks. It is a common component of sparklers.
Ba	Barium	Barium is used to create green colors in fireworks, and it can also help stabilize other volatile elements.
C	Carbon	Carbon is one of the main components of black powder, which is used as a propellant in fireworks. Carbon provides the fuel for a firework. Common forms include carbon black, sugar, or starch.
Ca	Calcium	Calcium is used to deepen firework colors. Calcium salts produce orange fireworks.
Cl	Chlorine	Chlorine is an important component of many oxidizers in fireworks. Several of the metal salts that produce colors contain chlorine.
Cs	Cesium	Cesium compounds produce indigo color in fireworks.
Cu	Copper	Copper compounds produce blue colors in fireworks.
Fe	Iron	Iron is used to produce sparks. The heat of the metal determines the color of the sparks.
K	Potassium	Potassium compounds help to oxidize firework mixtures. Potassium nitrate, potassium chlorate, and potassium perchlorate are all important oxidizers. The potassium content can impart a violet color to the sparks.

Symbol	Name	Fireworks Usage
Li	Lithium	Lithium is a metal that is used to impart a red color to fireworks. Lithium carbonate, in particular, is a common colorant.
Mg	Magnesium	Magnesium burns a very bright white, so it is used to add white sparks or improve the overall brilliance of a firework.
Na	Sodium	Sodium imparts a gold or yellow color to fireworks, however, the color is often so bright that it frequently masks other, less intense colors.
O	Oxygen	Fireworks include oxidizers, which are substances that produce oxygen in order for burning to occur. The oxidizers are usually nitrates, chlorates, or perchlorates. Sometimes the same substance is used to provide oxygen and color.
P	Phosphorus	Phosphorus burns spontaneously in air and is also responsible for some glow in the dark effects. It may be a component of a firework's fuel.
S	Sulfur	Sulfur is a component of black powder, and as such, it is found in a firework's propellant/fuel.
Sb	Antimony	Antimony is used to create firework glitter effects.
Sr	Strontium	Strontium salts impart a red color to fireworks. Strontium compounds are also important for stabilizing fireworks mixtures.
Ti	Titanium	Titanium metal can be burned as powder or flakes to produce silver sparks.
Zn	Zinc	Zinc is a bluish white metal that is used to create smoke effects for fireworks and other pyrotechnic devices.

The chemical constituents burn at high temperatures when the firework is detonated which promotes incineration. The chemical constituents within the fireworks are scattered by the burst charge, separating them from the fireworks casing and internal shell components. A firework combustion residue is produced in the form of smoke, airborne particulates, chemical pollutants, and debris including paper, cardboard, wires and fuses. This combustion residue can fall into surface waters. In addition un-ignited pyrotechnic material including duds and misfires can also fall into surface waters. The receiving water fallout area affected by the fireworks residue can vary depending on wind speed and direction, size of the shells, the angle of mortar placement, the type and height of firework explosions and other environmental factors. Once the fireworks residue enters a water body it can be transported to waters and shorelines outside the fallout area due to wind

shear and tidal effects.

Various factors can affect the levels of firework chemical residues in surface waters adjacent to fireworks displays, such as the frequency of firework events, the overall amount of ignited fireworks per event, efficiency of perchlorate oxidation which controls the mass of perchlorate introduced to the environment, wind direction and velocity which controls the dispersion and fall-out of firework particles. All of these factors associated with the detonation of fireworks have a potential to adversely effect or contribute to degradation of water and sediment quality within the receiving waters.

3. Perchlorate Considerations

One of the main constituents of concern in firework discharges is perchlorate. The detonation of fireworks can result in the release of perchlorate into the environment and surface waters. Perchlorate is a chemical that is both manufactured and naturally-occurring. Most commonly found in the form of perchloric acid and salts, perchlorate is highly soluble, mobile in groundwater and surface water, and persistent in the environment. Most fireworks are believed to contain potassium perchlorate, an inorganic salt that is a strong oxidizer. The manufacturers of fireworks use potassium perchlorate in the compositions that produce colored smokes and bursts. Its presence in the environment has been attributed to past waste handling practices at facilities that manufacture or use perchlorate and materials containing the chemical. It may also be present in the environment as a consequence of using perchlorate-containing products such as solid rocket propellant, flares, fireworks, pyrotechnic devices including fireworks, and explosives. Perchlorate can greatly impact human health by interfering with iodide uptake into the thyroid gland. In adults, the thyroid gland helps regulate the metabolism by releasing hormones, while in children, the thyroid helps in proper development. Although research has found that perchlorate at high levels can limit the uptake of iodide by the thyroid gland, studies have not directly measured the impact of perchlorate on human metabolism and growth.

Perchlorate effects on the thyroid gland are the basis of the 6 ug/L public health goal (PHG) for drinking water established in 2004. A PHG is a level of a contaminant in drinking water that does not pose a significant short-term or long-term health risk. A PHG is not a regulatory requirement. Instead, it is a goal for drinking water that California's public water suppliers and regulators should strive to meet if it is feasible to do so. In January 2011, OEHHA released a draft technical support report document proposing the establishment of a 1 ug/L PHG for perchlorate. .

Monitoring by the California Department of Public Health and operators of public water systems have shown perchlorate to be a wide spread drinking

water contaminant occurring in several hundred wells, mostly in Southern California. Perchlorate was also found in the Colorado River, an important source of water for drinking and irrigation, where its presence resulted from contamination from ammonium perchlorate manufacturing facilities in Nevada.

Based on all of these considerations the California Department of Public Health took action in October 2007 to regulate perchlorate as a drinking water contaminant with a maximum contaminant level (MCL) of 6 micrograms per liter. On the Federal level the US EPA issued a notice in the federal register on February 2, 2011 that it is initiating a process to develop and establish a national primary drinking water regulation for perchlorate.

D. Summary and Analysis of Existing Data

With the exception of SeaWorld San Diego, discharges associated with public fireworks events have previously been unregulated in the San Diego Region by the San Diego Water Board. SeaWorld has conducted annual fireworks related monitoring for sediment and water quality parameters since 2001 in accordance with its NPDES permit. In 2007 monitoring requirements to determine effects on benthic infauna were also added by the San Diego Water Board.

On December 17, 2007, the San Diego Water Board made revisions to the NPDES permit for SeaWorld San Diego (Order No. R9-2005-0091, NPDES No. CA0107336) to incorporate requirements for the discharge of pollutant waste associated with the public display of fireworks to Mission Bay. SeaWorld has conducted nightly displays of fireworks over many years during the summer months between April and September and other times during the year. Under the current SeaWorld Master Plan update, approved by the California Coastal Commission in 2001, SeaWorld may present up to 150 fireworks events per year, with an anticipated average between 110 and 120 events per year. SeaWorld's firework events have occurred at the same general location in Mission Bay and thus would be expected to represent the maximum firework pollutant loading conditions and cumulative effects on a surface water body. Accordingly discharges from SeaWorld's public fireworks events likely represent the maximum firework pollutant loading conditions and cumulative effects due to a combination of 1) the restricted circulation of waters within Mission Bay, 2) the shallow depth of the bay in the vicinity of the fireworks events, and 3) the high frequency of repeat fireworks events throughout the year at the same location. Other water bodies however can exhibit different and unique effects from firework event discharges due to site specific factors.

With the exception of perchlorate and bis-phthalate, water chemistry sampling of regular SeaWorld events (typically involving the detonation of approximately 200 pounds of net explosive weight) to date showed little evidence of pollutants within the receiving water column at levels above applicable water quality

criteria or detected reference site levels.[17] Comparison of instantaneous and average concentrations of dissolved metals in water samples taken after SeaWorld's typical fireworks displays to California Toxics Rule (CTR) saltwater criteria shows that the instantaneous and average dissolved concentrations of metals fall below both continuous exposure and maximum exposure concentrations.

SeaWorld also conducted water chemistry monitoring following two Labor Day events and one Fourth of July fireworks event.[18] These 3 events have a larger discharge, with approximately 1000 pounds of net explosive weight used per event. Water chemistry sampling following these dates found receiving waters in the fireworks fallout area to exceed both water quality criteria and levels documented at the reference sites. Pollutants such as arsenic, copper, mercury, tin, zinc and phosphorous were detected at levels above water quality criteria or at elevated levels compared to the reference sites. However, only phosphorous exceeded instantaneous water quality criteria.

While dissolved water chemistry during major events showed one exceedance and elevated levels of some pollutants, it is important to note that the dissolved form may not be representative of fireworks discharges. The June 2010 Sea World Aerial Fireworks Displays NPDES Permit Addendum Summary Report suggests that the lack of exceedances of water quality criteria may be due to a number of factors, including settling and a short residence time in the water. It is also important to note that CTR criteria for metals is in the dissolved form. However, all NPDES permit effluent limitations for metals are required to be expressed in the 'total recoverable metal' (see 40 CFR 122.45 and 136). Based upon the potential nature of the discharge form (particulate) and pertinent federal regulations, the data was also examined for differences in total metals between the fireworks discharge zone and the reference sites. The sampling showed increased total concentrations in the fireworks discharge zone relative to the reference site(s) for aluminum, cadmium, chromium, copper, lead, nickel, selenium, thallium, vanadium and zinc. This indicates that the dominant form of the discharge is in particulate form. However, the only metals whose levels in the discharge zone were at or above instantaneous dissolved CTR criteria were copper and zinc.

While the water chemistry sampling to date shows elevated levels of pollutants within the fireworks fallout area relative to reference sites, the elevated levels are primarily following large events and below applicable water quality criteria. Monitoring of SeaWorld's major firework events was typically conducted approximately 12 hours following the event, and for the Fourth of July event, approximately 36 hours following the event. The representativeness of the sampling is likely influenced by a number of factors including the form of the discharge (dissolved or particulate form), tidal magnitude and timing, and

[17] There are currently no applicable water quality criteria for perchlorate and bis-phthalate.
[18] The sampling following the July 4th event was delayed until the morning of July 6.

salinity. Again, the unknown variability in these factors is reflected within the June 2010 Sea World Aerial Fireworks Displays NPDES Permit Addendum Summary Report which lists factors such as "currents and tidal mixing, the short residence time of fireworks debris in the water of the FDZ, adsorption, and settling, and the fact that the majority of the fireworks chemicals are incinerated upon detonation" as potential contributing factors to the documented results. Thus, the accuracy of the sampling methodology may be limiting the accuracy of water column sampling for pollutants. However, it remains clear that water chemistry sampling found elevated pollutant levels relative to the reference sites after major events.

It is important to note that the Water and Sediment Monitoring Plan required under this Order must include a conceptual model developed by dischargers to dictate the design of the sediment monitoring program. The model is required to consider the physical and chemical fate and transport of pollutants. This effort is expected to better define the nature of residual firework pollutant waste discharges into receiving waters, and may result in a more representative sampling methodology for water chemistry following fireworks discharges. Thus, the documentation of elevated levels of certain pollutants in the water column and sediment relative to the reference sites, as well as the unknown nature of the discharge, warrant further sampling for water chemistry following conceptual model development.

SeaWorld's sediment monitoring in Mission Bay found enrichment of 11 metals within the fireworks zone when compared to one reference site (barium, chromium, cobalt, copper, molybdenum, potassium, selenium, silver, thallium, titanium and vanadium) and 4 metals (barium, cobalt, copper, and vanadium) when compared to both reference sites. Alternatively, sediment grain size and concentration analysis found correlations for barium, cobalt, chromium, copper, titanium and vanadium. The data provides an indication of an accumulation of pollutants over time within the fireworks fallout area when compared to the reference sites.

Based on SeaWorld's sediment toxicity and benthic community analysis, it was difficult to draw any conclusions regarding the benthic effects of fireworks displays to the differences found between the reference stations and the fireworks fallout area. Additional monitoring may be necessary to separate possible effects associated with fireworks displays and effects from other pollutant sources to Mission Bay, such as storm water discharges. The results for the short-term survival sediment toxicity sampling were highly variable spatially and temporally within the fireworks deposition zone and temporally within the reference sites. Sediment toxicity test results for both reference sites and the fireworks fallout area ranged from non-toxic to highly toxic. Thus, it was difficult to detect any difference in short term toxicity between and among the sites. All sites did appear to exhibit decreased survival rates when compared to laboratory control samples. While the sediment toxicity sampling

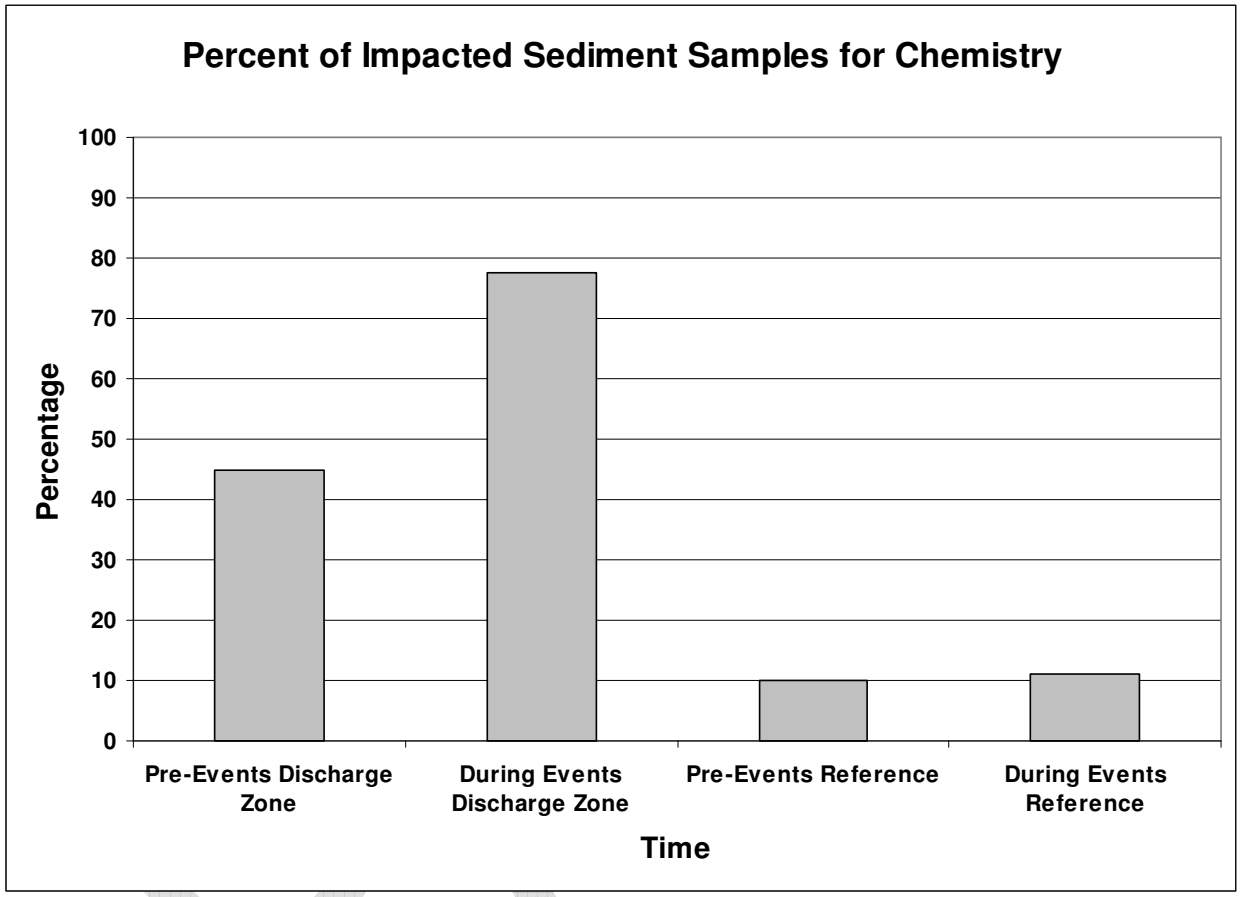
conducted by SeaWorld utilized a methodology consistent with the SWRCB Sediment Quality Control Plan, sampling done to determine compliance with Sediment Quality Objectives must include both a short-term survival toxicity test and a sublethal sediment toxicity test. The benthic infaunal sampling found the reference sites and fireworks fallout area to have communities with a different species composition. The fireworks fallout sampling area consists of vegetated (*Zostera marina*) soft-bottom subtidal habitat while the reference sites were documented in sampling datasheets to be unvegetated soft-bottom. The differing habitat types made it difficult to compare benthic communities between the reference sites and fireworks fallout area. Thus, detecting or determining any benthic community impacts in the fireworks fallout area is not feasible with the data collected.

The data collected by SeaWorld under their NPDES permit for SeaWorld San Diego was collected from August 2008 to March 2010. Although the data collected is insufficient for a full determination based upon the SWRCB Sediment Quality Control Plan, the current Sediment Quality Objectives Line of Evidence Evaluation Tool (SQO LOE Tool) allows for the input of collected data in order to access the likelihood of biological exposure and effects from each line of evidence. For the data collected by SeaWorld, a number of chemical constituents required by the SWRCB Sediment Quality Plan were not collected, and only one of the required two toxicity tests was done. However, the data collected was entered into the SQO LOE Tool and evaluated for toxicity and chemical exposure. The fireworks fallout area could not be evaluated for benthic community condition as the SQO LOE Tool is specific to unvegetated subtidal. A total of 6 events were sampled by SeaWorld as follows: 2 spring pre-fireworks events, 3 major fireworks events, and 1 minor fireworks event. An additional 7 reference sites in Mission Bay were sampled in 2006 and 2007. The total number of samples collected was as follows: 19 reference samples and 60 fireworks fallback area samples. 10 samples per event were taken within the fireworks fallback area.

The results for sediment chemistry showed a moderate number of impacted[19] sediment samples (45 percent) in the fireworks fallout area prior to the beginning of SeaWorld's summer fireworks events (see Figure 1). For sediment samples collected during the fireworks season (August and September 2008, July and September 2009), the number of impacted sediment samples increased, with almost 80 percent of samples qualifying as impacted (see Figure 1). The number of qualified sediment samples at reference sites remained low during both periods, with pre-events sampling showing 10 percent of sediment samples as impacted. During the SeaWorld fireworks season this number increased slightly to 11.1 percent.

[19] Sediment samples with a moderate or high exposure risk to benthic communities (integrated chemistry indicator).

Figure 1. Percent of Impacted Sediment Chemistry Samples Before and During Fireworks.

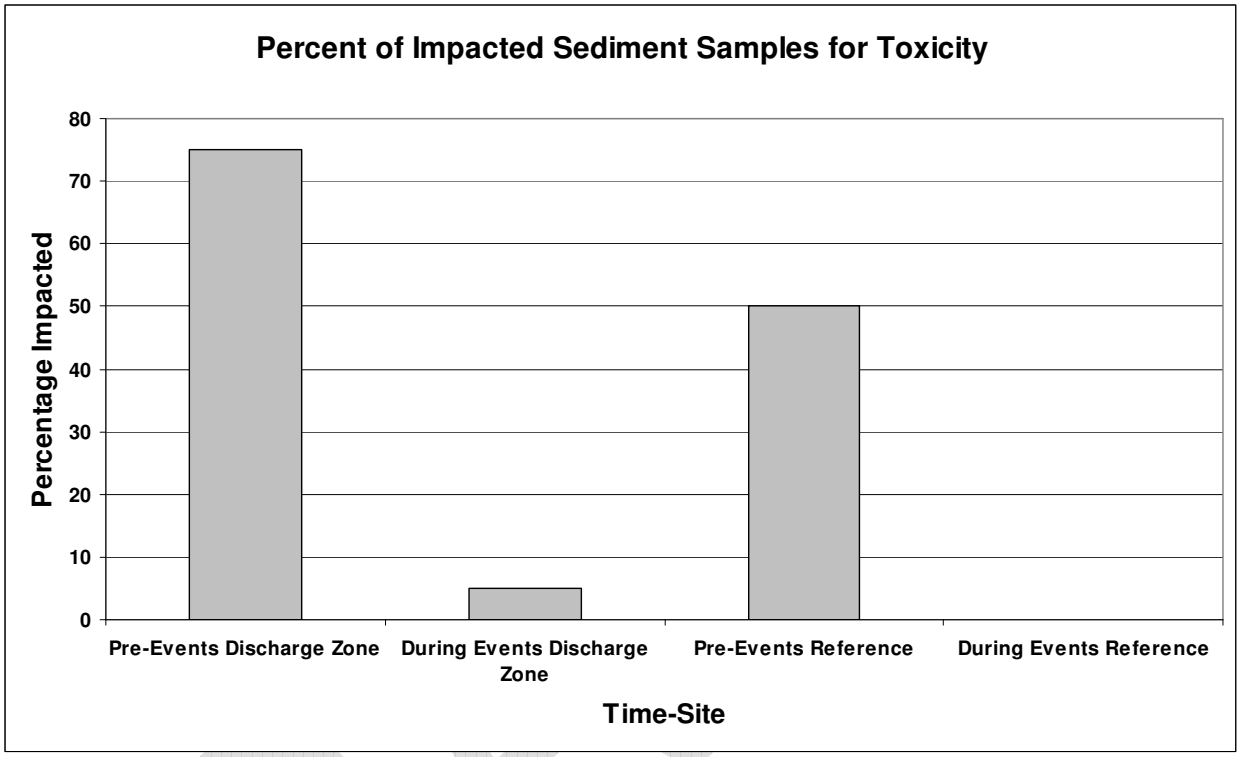


The results for sediment acute toxicity differed from the sediment chemistry results. The reference sites and the SeaWorld fireworks fallout area had more samples that were considered toxic[20] during pre-events sampling than for samples collected during the fireworks season. Acute toxicity during the fireworks season was low, with less than 10 percent of samples and 0 percent of samples defined as toxic in the SeaWorld fireworks fallout area and reference sites, respectively (see Figure 2). Presumably a factor external to the fireworks discharge resulted in acute toxicity in both areas. The June 2010, SeaWorld Aerial Fireworks Displays NPDES Permit Addendum Summary Report suggest that storm water runoff may be a possible source of the acute toxicity. This is a likely possibility, as rainfall records show 0.18" and 0.68" of rainfall occurring in March 2009 and 2010, respectively[21]. These rainfall events occurred prior to the pre-event sample collection. It is important to note that while the sampling indicates the fireworks discharge did not cause acute

[20] Samples classified as nontoxic or low toxicity were not considered "toxic."
[21] http://www.wrh.noaa.gov/sgx/

toxicity, no sublethal toxicity testing was conducted. Therefore, sublethal effects from chemical exposure is unknown.

Figure 2. Percent of Toxic Sediment Toxicity Samples Before and During Fireworks.

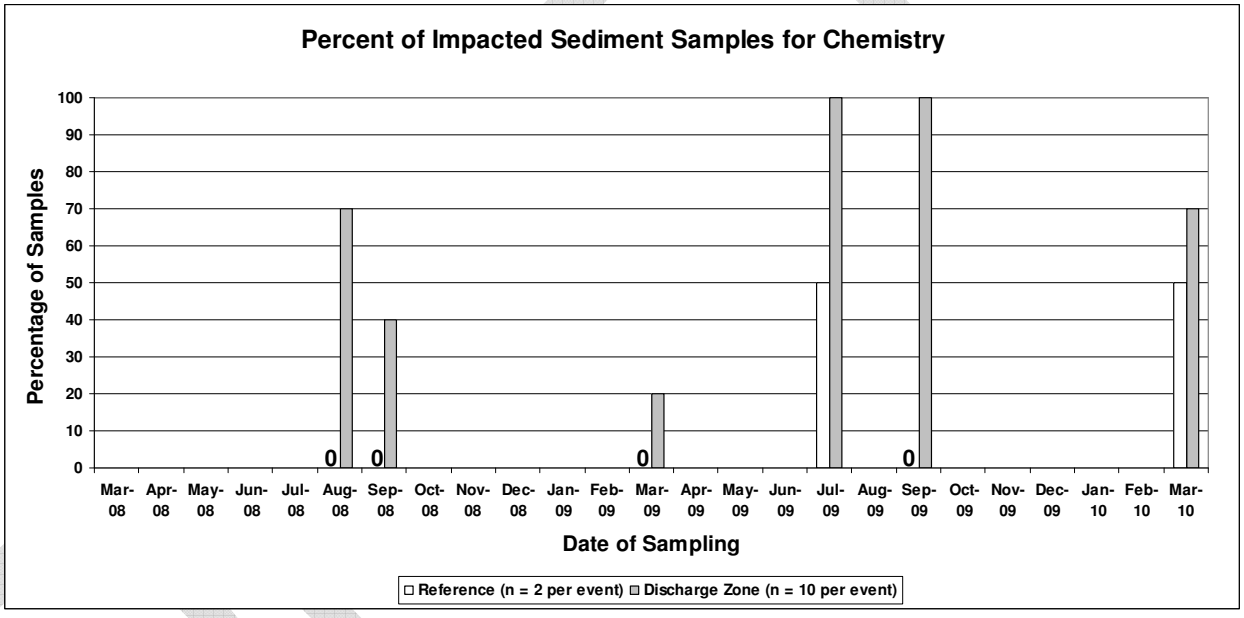


In summary, sediment monitoring at SeaWorld to date shows elevated pollutants within the sediment, but toxicity testing results are inconclusive, and the benthic community results cannot reasonably be evaluated. As discussed in the SWRCB Sediment Quality Control Plan, none of the individual lines of evidence is sufficiently reliable when used alone to assess sediment quality impacts due to toxic pollutants. Within a given site, individual lines of evidence may underestimate or overestimate the risk to benthic communities and do not indicate causality of specific chemicals. Thus, while sampling documented increased pollutant levels, the monitoring conducted to date is insufficient to discern if there are benthic impacts within the fireworks fallout area attributable solely to the discharge of residual fireworks pollutant waste. However, the increase in pollutant levels within the sediment in the fireworks fallback area shows that the discharge of pollutants associated with larger fireworks events has the reasonable potential to cause or contribute to an exceedance of the narrative sediment quality objectives stated in section VI.A.3.c of the Order.

Based on water quality data obtained to date, it is unlikely that single fireworks events of a smaller size than SeaWorld's Fourth of July and Labor Day events would cause exceedances of applicable water quality criteria in the water column of receiving waters. However, the continuous discharge of pollutant waste from large fireworks events and the cumulative discharges of smaller

events may result in longer-term pollutant accumulation in bay sediments, similar to the enrichment observed in the in the SeaWorld fireworks fallback area data.. The water column monitoring documented an increased level of total metal concentrations in the SeaWorld fireworks fallback area relative to the reference site(s) for aluminum, cadmium, chromium, copper, lead, nickel, selenium, thallium, vanadium and zinc. The dominance of pollutants in the particulate form after major events provides evidence that single fireworks event greater than 1000 pounds has the reasonable potential to contribute pollutants to sediment in an enclosed bay or estuary. While sampling in the SeaWorld fireworks fallback area clearly documented an accumulation of metals within the fallback area sediment, the data on cumulative effects is too limited to discern differences in accumulation between and among events, nor determine rates of accumulation or attenuation (see Figure 3).

Figure 3. Percent of Impacted Sediment Chemistry Samples By Event.



Although site specific information is not available for all receiving waters in the San Diego Region subject to this type of discharge, and each water body can exhibit different effects as a result of the discharge, it is anticipated that proper implementation of BMPs required under this Order would adequately control and abate the discharge of pollutant wastes from public fireworks events to surface waters in the San Diego Region.

The San Diego Water Board's review of sampling conducted under Order No. R9-2005-0091 focused on quantitative data from water column and sediment sampling, with the review looking primarily for differences in water column and sediment chemistry results between the discharge zone and reference sites, and by further comparing discharge zone results to applicable water quality criteria. As stated in section I.C.2 of this Order, the fireworks discharge form may also include wires, cardboard, fuses and duds that fall back into the

discharge zone. Order No. R9-2005-0091 did include a finding regarding the amount of surface debris collected by SeaWorld following fireworks events, with an average of 11 pounds of fireworks related wet debris collected each evening and 8 pounds the following morning. Furthermore, the diving logs for sample collection under Order No. R9-2005-0091 provided additional documentation of fireworks debris on the benthos of the discharge zone. It is likely that firework duds, the incomplete combustion of fireworks, and post-fragmentation debris (wires, cardboard, etc…) contributes equal, if not greater, loads of pollutants to the benthos of receiving waters than particulate fallout. However, the proportion of pollutants from particulate fallout in relation to duds, debris or incomplete combustion has not been tested or quantified.

E. Related Fireworks Regulation

1. Office of the California State Fire Marshall (OSM).

California's Fireworks Law, passed in 1938, established the Office of the State Fire Marshal (SFM) as the fireworks classification authority in California. Fireworks are classified through laboratory analysis, field examinations and test firing of items. As part of the program, SFM requires the licensing of all pyrotechnic operators, fireworks manufacturers, importer-exporters, wholesalers, retailers, and public display companies. Pyrotechnic Operators, who discharge fireworks at public displays or launch high powered and experimental rockets, must also pass a written examination and provide proof of experience. The State's Explosives Law authorizes the California State Fire Marshal to adopt regulations for the safe use, handling, storage and transportation of fireworks in California. The laws and regulations governing the transportation, use and storage of fireworks in California are contained in:

a) State Fireworks Law, California Health and Safety Code, Section 12500 – 12728;

b) State Fireworks Regulations, Title 19, California Code of Regulations, Chapter 6;

c) Storage, Title 27, Code of Federal Regulations part 55, Sub-part K; and

d) Hazardous Materials Transportation, Title 13, California Code of Regulations,

2. California State Department of Toxic Substances Control.

In light of the risks to public health and the environment posed by perchlorate releases, the California Legislature adopted the Perchlorate Contamination Prevention Act of 2003, amending Chapter 6.5 of Division 20 of, the Health and Safety Code and requiring the California Department of

Toxic Substances Control (DTSC) to adopt regulations specifying best management practices for perchlorate and perchlorate-containing substances. The perchlorate BMP regulations were adopted on December 31, 2005 and are contained in California Code of Regulations (CCR), Title 22. Social Security Division 4.5. Environmental Health Standards for the Management of Hazardous Waste Chapter 33. Best Management Practices for Perchlorate Materials Article 1, § 67384.1 - § 67384.11. These regulations provide at §67384.8 (c). Special Best Management Practices for Flares and Pyrotechnic Perchlorate Materials, that:

"Within twenty-four (24) hours of a public display of fireworks or the use of dangerous fireworks, the pyrotechnics operator, in addition to complying with title 19 of the California Code of Regulations, section 1003, shall, to the extent practical, collect any stars and un-ignited pyrotechnic material found during the required inspection of the entire firing range."

3. U.S. Coast Guard.

The U.S. Coast Guard (USCG), pursuant to 33 CFR 100, implements a Marine Safety Program designed to ensure the safety of vessels and recreational boaters on navigable U.S. waters during firework display events. The USCG issues Marine Event permits to sponsors of public firework display events marine events that have the potential to endanger marine safety. An Application for Approval of Marine Event must be submitted to the USCG or approval no later than 135 days prior to the event if the applicant does not meet criteria specified in 33 CFR 100.15 (c), or 60 days prior to the event if the applicant does meet the criteria. After approving plans for the holding of a fireworks display event, the USCG is authorized to promulgate special local regulations as necessary to insure public safety on navigable waters immediately prior to, during, and immediately after the approved fireworks event. Such regulations may include a restriction on, or control of, the movement of vessels through a specified fireworks display area.

4. San Diego Air Pollution Control District.

The San Diego Air Pollution Control District (APCD) is the air pollution control agency for all of San Diego County. San Diego Air Pollution Control District Rule 101-Burnng Control was established to require that open burning in San Diego County be conducted in a manner that minimizes emissions and smoke, and is managed consistently with state and federal law. The provisions of Rule 101 specifically exempt fireworks displays and pyrotechnics used for creation of special effects [Sections (b)(1)(iii) and (b)(1)(iv)].

5. South Coast Air Quality Management District.

The South Coast Air Quality Management District (AQMD) is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino Counties. The AQMD historically has not required permits for equipment associated with fireworks displays at theme park activities or annual celebrations. AQMD Rule 219- Exemptions From Written Permit Requirements, specifically exempts pyrotechnic equipment from written permit requirements. AQMD prohibitory Rule 444 - Open Burning, also provides exemption from rule provisions for various fire works and pyrotechnics activities. However, AQMD Rules 401 - Visible Emissions, and 402 – Nuisance, do not provide exemption for emissions from fireworks displays or pyrotechnics used in the creation of special effects at theme parks.

6. U.S. Department of Transportation (DOT).

Prior to transportation into and within the U.S., all explosives, including fireworks, must be classed and approved by DOT. Federal hazardous materials (hazmat) transportation law (Federal hazmat law; 49 U.S.C., 5101 et seq.) authorizes DOT to issue classification documents—EX Approvals—in accordance with the Hazardous Materials Regulations (HMR; 49 CFR, Parts 100 -185). All fireworks must be in compliance with, and meet the terms and conditions of, the American Pyrotechnic Association (APA) Standard 87-11 (, which is incorporated by reference as part of the HMR, or be submitted to a DOT-approved laboratory for examination and classification (See 49 CFR 173.56(b)). If approved, fireworks are assigned an explosives classification number by the Associate Administrator of Hazardous Materials Safety. Approval holders also must comply with the rules set forth by the U.S. Coast Guard; U.S. Customs and Border Protection; Bureau of Alcohol, Tobacco, and Firearms; as well as the Consumer Product Safety Commission.

II. PERMIT INFORMATION

The following table summarizes administrative information related to the discharge.

Table 2. Facility Information

Discharger	Any person discharging pollutant wastes associated with the public display of fireworks to surface waters in the San Diego Region
Type of Facility	Amusement and Recreation Services (SIC Code: 7999)
Major or Minor Facility	Minor
Threat to Water Quality	3
Complexity	C
Pretreatment Program	No
Watershed	various
Receiving Water	All receiving surface waters within the San Diego Region

Receiving Water Type	Ocean waters, enclosed bay, estuary, and inland surface water

A. Discharger Eligibility Criteria

Any person who proposes to discharge pollutant waste from the public display of fireworks to surface waters in the San Diego Region may submit a Notice of Intent (NOI) for coverage under this Order. The NOI may address multiple fireworks events at different locations throughout the San Diego Region. When a fireworks event is hosted by one person but is operated or conducted by another person, it is the person's hosting the event duty to submit an NOI and obtain coverage under this Order. The San Diego Water Board may require the joint submission of an NOI from both the host person and the person operating the fireworks event on a case-by-case basis.

B. General Permit Application

To obtain coverage under this Order Dischargers must submit a complete application containing the following items to the San Diego Water Board:

1. A completed Notice of Intent (NOI) form shown as Attachment B signed in accordance with the signatory requirements of the Standard Provisions in Attachment D, Section V.B.1. Signatory and Certification Requirements, no later than 60 days prior to a fireworks event. During the period of May 11, 2011 through June 10, 2011, Dischargers may submit the complete application no later than 24 days prior to a fireworks event. The NOI may address multiple fireworks events at different locations throughout the San Diego Region;

2. Payment of the annual application fee, equal to the first annual fee, made payable to State Water Resources Control Board or "SWRCB;" and

3. A Fireworks Best Management Practices Plan.

The NOI, including, the application fee, and other attachments must be submitted to the following address:

CRWQCB – San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Attn: Fireworks General NPDES Order
NOTICE OF INTENT

C. Notice of Enrollment

The San Diego Water Board will review the application package for completeness and applicability to this Order. Notice of Enrollment (NOE) under this Order will be provided to the Discharger by the San Diego Water Board upon receipt of a complete NOI and application fee. The NOE may include specific conditions not stated in the Order, including but not limited to receiving water and sediment monitoring. Any such specific conditions and requirements shall be enforceable. The effective enrollment date will be specified in the NOE and the Discharger is authorized to discharge fireworks pollutant waste starting on the date specified in the NOE. General Permit coverage will be effective when all of the following have occurred:

1. The Discharger has submitted a complete permit application;

2. The Fireworks Best Management Practices Plan has been accepted by the San Diego Water Board; and

The San Diego Water Board has issued a Notice of Enrollment (NOE).

D. Notice of Exclusion (NOEX)

The San Diego Water Board may issue a Notice of Exclusion (NOEX), which either terminates the permit coverage or requires submittal of an application for an individual permit. An NOEX is a one-page notice that indicates that the Discharger or proposed Discharger is not eligible for coverage under this General Permit and states the reason why. This justification can include, but is not limited to, necessity to comply with a total maximum daily load or to protect sensitive water bodies).

E. Fees

Under this General Permit, fireworks discharges require no treatment systems to meet the terms and conditions of this Order and pose no significant threat to water quality. As such, they are eligible for Category 3 in section 2200(b)(8) of Title 23, California Code of Regulations (CCR). This category is appropriate because firework discharges incorporate best management practices (BMPs) to control potential impacts to beneficial uses, and this General Permit prohibits firework residual pollutant waste from causing excursions of water quality objectives. The annual fee associated with this rating can be found in section 2200(b)(8) of Title 23, CCR, which is available at http://www.waterboards.ca.gov/resources/fees/.

F. Terminating Coverage

To terminate permit coverage, a Discharger must submit a complete and accurate Notice of Termination (NOT). The Discharger's coverage under this General Permit terminates on the day of the coverage termination letter issued by the San Diego Water Board. Prior to the termination effective date, the Discharger is subject to the terms and conditions of this General Permit and is responsible for submitting the annual fee and all reports associated with this General Permit. Discharger must submit an NOT when one of the following conditions occurs:

1. A new sponsor has taken over responsibility of the Discharger's fireworks display activities covered under an existing NOI;
2. The Discharger has ceased all discharges from the application of pesticides for which it obtained General Permit coverage and does not expect to discharge during the remainder of this General Permit term; or
3. The Discharger has obtained coverage under an individual permit for all discharges required to be covered by an NPDES permit.

III. APPLICABLE PLANS, POLICIES, AND REGULATIONS

The requirements contained in the proposed Order are based on the requirements and authorities described in this section.

A. Legal Authorities

This Order is issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (USEPA) and chapter 5.5, division 7 of the California Water Code (commencing with section 13370). It shall serve as a NPDES permit for point source discharges from this facility to surface waters. This Order also serves as Waste Discharge Requirements (WDRs) pursuant to article 4, chapter 4, division 7 of the Water Code (commencing with section 13260). Section 122.28(a)(1) of Title 40 of the Code of Federal Regulations [40 C.F.R. §122.28(a)(1)] allows NPDES permits to be written to cover a category of discharges within the State political boundaries as a general NPDES permit. USEPA Region 9 has granted the San Diego Water Board the authority to issue general NPDES permits.

B. California Environmental Quality Act (CEQA)

Under Water Code section 13389, this action to adopt an NPDES permit is exempt from the provisions of CEQA, Public Resources Code sections 21100 through 21177.

C. State and Federal Regulations, Policies, and Plans

Water Quality Control Plans. The Regional Water Quality Control Board, San Diego Region (San Diego Water Board) adopted a Water Quality Control Plan for the San Diego Basin (hereinafter Basin Plan) on September 8, 1994 that designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve those objectives in all receiving waters addressed through the plan. In addition, the Basin Plan implements State Water Resources Control Board (State Water Board) Resolution No. 88-63, which established state policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply.

Beneficial uses applicable to receiving waters within the San Diego Region are as follows:

Table 3. Basin Plan Beneficial Uses

Discharge Point(S)	Receiving Water Name	Beneficial Use(s)
Various	Coastal Waters (Pacific Ocean, Enclosed Bays and Estuaries, Harbors, and Lagoons)	Industrial service supply (IND), navigation (NAV), contact water recreation (REC1), non-contact water recreation (REC2), commercial and sport fishing (COMM), biological habitats of special significance (BIOL), estuarine habitats (EST)wildlife habitat (WILD), preservation of rare, threatened or endangered species (RARE), marine habitat (MAR), Aquaculture (AQUA), migration of aquatic organisms (MIGR), spawning (SPWN), and shellfish harvesting (SHELL).
Various	Inland Surface Waters	Municipal and domestic supply (MUN), agricultural supply (AGR), industrial service supply (IND), industrial process supply (PROC), ground water recharge (GWR), hydropower generation (POW), contact water recreation (REC1), non-contact water recreation (REC2), biological habitats of special significance (BIOL), warm freshwater habitat (WARM), cold freshwater habitat (COLD), wildlife habitat (WILD), preservation of rare, threatened or endangered species (RARE), spawning (SPWN).

Requirements of this Order implement the Basin Plan.

California Ocean Plan. The State Water Board adopted the Water Quality Control Plan for Ocean Waters of California, California Ocean Plan (Ocean Plan) in 1972 and amended it in 1978, 1983, 1988, 1990, 1997, 2000, and 2005. The State Water Board adopted the latest amendment on April 21. 2005 and it became effective on February 14, 2006. The Ocean Plan is applicable, in its entirety, to point source discharges to the ocean. The Ocean Plan identifies beneficial uses of ocean waters of the State to be protected as summarized below

Table 4. Ocean Plan Beneficial Uses

Discharge Point	Receiving Water	Beneficial Uses
Outfall 001	**Pacific Ocean**	**Industrial water supply; water contact and non-contact recreation, including aesthetic enjoyment; navigation; commercial and sport fishing; mariculture; preservation and enhancement of designated Areas of Special Biological Significance (ASBS); rare and endangered species; marine habitat; fish spawning and shellfish harvesting**

Section III.E of the Ocean Plan specifies that waste shall not be discharged to areas designated as being of special biological significance (ASBS). Section III.E.2 provides that the Regional Water Boards may, however, approve waste discharge requirements or recommend certification for limited-term (i.e. weeks or months) activities in ASBS. Limited term activities may result in temporary and short-term changes in existing water quality. Water quality degradation shall be limited to the shortest possible time. The activities must not permanently degrade water quality or result in water quality lower than that necessary to protect existing uses, and all practical means of minimizing such degradation shall be implemented. This Order establishes requirements for discharges of residual pollutants waste into the La Jolla ASBS and the Heisler Park ASBS.

In order to protect the beneficial uses, the Ocean Plan establishes water quality objectives and a program of implementation. Requirements of this Order implement the Ocean Plan.

Alaska Rule. On March 30, 2000, USEPA revised its regulation that specifies when new and revised state and tribal water quality standards (WQS) become effective for CWA purposes (40 C.F.R. § 131.21, 65 Fed. Reg. 24641 (April 27, 2000)). Under the revised regulation (also known as the Alaska rule), new and revised standards submitted to USEPA after May 30, 2000, must be approved by USEPA before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to USEPA by May 30, 2000, may be used for CWA purposes, whether or not approved by USEPA.

Antidegradation Policy. Section 131.12 requires that the state water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16. Resolution No. 68-16 incorporates the federal antidegradation policy where the federal policy applies under federal law. Resolution No. 68-16 requires that existing water quality be maintained unless degradation is justified based on specific findings. The San Diego Water Board's Basin Plan implements, and incorporates by reference, both the State and federal antidegradation policies. The permitted discharge must be consistent with the antidegradation provision of section 131.12 and State Water Board Resolution No. 68-16.

Anti-Backsliding Requirements. Sections 402(o)(2) and 303(d)(4) of the CWA and federal regulations at title 40, Code of Federal Regulations[22] section 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require that effluent limitations in a reissued permit must be as stringent as those in the previous permit, with some exceptions in which limitations may be relaxed.

D. Impaired Water Bodies on CWA 303(d) List

The federal Clean Water Act requires States to identify and make a list of surface water bodies that are polluted. These water bodies, referred to in law as "water quality limited segments," do not meet water quality standards even after discharges of wastes from point sources have been treated by the minimum required levels of pollution control technology. Wastewater treatment plants, a city's storm drain system, or a boat yard, are a few examples of point sources that discharge wastes to surface waters. States are required to compile the water bodies into a list, referred to as the "Clean Water Act Section 303(d) List of Water Quality Limited Segments" (303(d) List). States must also prioritize the water bodies on the list and develop action plans, called total maximum daily loads (TMDLs) to improve the water quality.

The State Board updated the 2004-2006 303(d) List for California on October 25, 2006, and EPA approved it on November 30, 2006.

There are approximately 100 impaired water bodies on the 303(d) List in the San Diego Region. Most TMDLs for water bodies within the San Diego Region are under development or have not been started. However, four TMDLs for the San Diego Region need only State Board approval to be complete, and three are already complete. Of the three completed TMDLs, two impact the water quality of San Diego Bay and the third impacts the water quality of Rainbow Creek.

E. Other Plans, Polices and Regulations – Not Applicable

IV. RATIONALE FOR EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

The CWA requires point source dischargers to control the amount of conventional, non-conventional, and toxic pollutants that are discharged into the waters of the United States. The control of pollutants discharged is established through effluent limitations and other requirements in NPDES permits. There are two principal bases for effluent limitations in the Code of Federal Regulations: section 122.44(a) requires that permits include applicable technology-based limitations and standards; and section 122.44(d) requires that permits include water quality-based effluent

[22] All further statutory references are to title 40 of the Code of Federal Regulations unless otherwise indicated.

limitations to attain and maintain applicable numeric and narrative water quality criteria to protect the beneficial uses of the receiving water.

A. Discharge Prohibitions

Discharges under this Order are required to be nontoxic. Toxicity is the adverse response of organisms to chemicals or physical agents. This prohibition is based on the Basin Plan, which requires that all waters be maintained free of toxic substances in concentrations that are lethal or produce other detrimental responses in aquatic organisms. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species. The Basin Plan also requires waters to be free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, or animal life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

B. Technology-Based Effluent Limitations

1. Scope and Authority

Section 301 (b) of the CWA and implementing USEPA permit regulations (40 CFR 122.44) require that permits include conditions meeting the applicable technology-based requirements at a minimum, and any more stringent effluent limitations necessary to meet applicable water quality standards.

The CWA requires that technology-based effluent limitations be established based on several levels of controls:

Best practicable treatment control technology (BPT) represents the average of the best performance by plants within an industrial category or subcategory. BPT standards apply to toxic, conventional, and non-conventional pollutants.

Best available technology economically achievable (BAT) represents the best existing performance of treatment technologies that are economically achievable within an industrial point source category. BAT standards apply to toxic and non-conventional pollutants.

Best conventional pollutant control technology (BCT) represents the control from existing industrial point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, and oil and grease. The BCT standard is established after considering the “cost reasonableness” of the relationship between the cost of attaining a reduction in effluent discharge and the benefits that would result, and also the cost effectiveness of additional industrial treatment beyond BPT.

New source performance standards (NSPS) represent the best available demonstrated control technology standards. The intent of NSPS guidelines is to set limitations that represent state-of-the-art treatment technology for new sources.

The CWA requires USEPA to develop effluent limitations, guidelines and standards (ELGs) representing application of BPT, BAT, BCT, and NSPS. Section 402(a)(1) of the CWA and section 125.3 of the Code of Federal Regulations authorize the use of best professional judgment (BPJ) to derive technology-based effluent limitations on a case-by-case basis where ELGs are not available for certain industrial categories and/or pollutants of concern. Where BPJ is used, the permit writer must consider specific factors outlined in section 125.3. This General Permit requires the use of BMPs to control and abate the discharge of pollutants from public fireworks event to surface waters within the San Diego Region.

2. Applicable Technology-Based Effluent Limitations

This General Permit will authorize the discharge of residual firework pollutant waste that may pose a threat to water quality and beneficial uses of the receiving waters. The primary mechanism for regulating such discharges will be through the development and implementation of BMPs as required by section VI.C.3. of this Order.

NPDES regulations [40 CFR 122.44(k)] allows for the use of BMPs to control or abate the discharge of pollutants under certain circumstances, including when numeric effluent limitations are infeasible. Proper implementation of BMPs will assure the protection of water quality within the receiving waters. Dischargers enrolled under this General Permit are expected to comply with all water quality objectives through the implementation of BMPs.

C. Water Quality-Based Effluent Limitations (WQBELs)

1. Scope and Authority

Section 301(b) of the CWA and section 122.44(d) require that permits include limitations more stringent than applicable federal technology-based requirements where necessary to achieve applicable water quality standards.

Section 122.44(d)(1)(i) mandates that permits include effluent limitations for all pollutants that are or may be discharged at levels that have the reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. Where reasonable potential has been established for a pollutant, but there is no numeric criterion or objective for the pollutant, water quality-based effluent limitations (WQBELs) must be established using: (1) USEPA criteria guidance under CWA section 304(a), supplemented where necessary by

other relevant information; (2) an indicator parameter for the pollutant of concern; or (3) a calculated numeric water quality criterion, such as a proposed state criterion or policy interpreting the state's narrative criterion, supplemented with other relevant information, as provided in section 122.44(d)(1)(vi).

The process for determining reasonable potential and calculating WQBELs when necessary is intended to protect the designated uses of the receiving water as specified in the Basin Plan, and achieve applicable water quality objectives and criteria that are contained in other state plans and policies, or any applicable water quality criteria contained in the Ocean Plan and CTR.

2. Applicable Beneficial Uses and Water Quality Criteria and Objectives

The designated beneficial uses of surface waters throughout the State may include municipal, domestic, industrial, and agricultural supply; water contact and non-contact recreation; navigation; groundwater recharge and freshwater replenishment; hydropower generation; wildlife habitat; cold freshwater and warm freshwater habitat; fish migration and fish spawning; marine habitat; estuarine habitat; shellfish harvesting; ocean commercial and sport fishing; areas of special biological significance; and preservation of rare and endangered species. To the extent that the Basin Plan designates additional or different beneficial uses, the Basin Plan shall control.

3. Determining the Need for WQBELs

This Order does not contain WQBELs. The San Diego Water Board finds that numeric effluent limitations are infeasible because it is impracticable to determine actual concentrations of pollutants in the fireworks waste prior to entering the receiving water. This Order requires the use of BMPs to control and abate the discharge of pollutants from public fireworks events to surface waters in the San Diego Region.

CWA section 301 (b)(1) and section 122.44(d) require NPDES permits to include effluent limitations that achieve technology-based standards and any more stringent limitations necessary to meet water quality standards. Where numeric effluent limitations for a pollutant or pollutant parameter have not been established in the applicable state water quality control plan, 40 CFR section 122.44(d)(1)(vi) specifies that water quality-based effluent limitations (WQBELs) may be set based on USEPA criteria, and may be supplemented where necessary by other relevant information to attain and maintain narrative water quality criteria, and to fully protect designated beneficial uses.

NPDES regulations [section 122.44(k)] acknowledge that BMPs shall be included as permit conditions (when applicable) where they are authorized under section 304(e) of the CWA when (1) numeric effluent limitations are

infeasible or(2) necessary to achieve limitations or carry out the purpose and intent of the CWA.

4. WQBEL Calculations – Not Applicable

5. Whole Effluent Toxicity (WET) – Not Applicable

D. Final Effluent Limitations

1. Satisfaction of Anti-Backsliding Requirements – Not Applicable

2. Satisfaction of Antidegradation Policy

The San Diego Water Board has determined that discharges authorized under the General Permit will be consistent with applicable antidegradation requirements of State Water Board Resolution No. 68-16, as well as USEPA policy established at 40 CFR 131.12. These provisions require that, at a minimum, existing instream water uses and the level of water quality necessary to protect those existing uses must be maintained. Where the existing water quality is better than the water quality objectives set to protect existing and potential beneficial uses, that quality must be maintained, unless specific findings are made.

3. Stringency of Requirements for Individual Pollutants

This Order requires the Discharger to develop and implement BMPs to regulate and control the discharge of waste associated with public fireworks events.

The requirements established by this Order are no more stringent than necessary to implement the mandates of the CWA.

E. Fireworks Best Management Practices Plan (FBMPP)

The Discharger shall prepare and implement a Fireworks Best Management Practices Plan (FBMPP) to prevent or reduce the discharge of pollutants associated with the public display of fireworks. The FBMPP shall address, at a minimum, the following elements:

1. Whenever practicable and economically feasible, the Discharger shall consider the use of alternative fireworks produced with new pyrotechnic formulas that replace perchlorate with other oxidizers and propellants that burn cleaner, produce less smoke and reduce pollutant waste loading to surface waters.

2. Whenever practicable and feasible, the Discharger shall design the firing range, or consider alternative firing ranges, to eliminate or reduce residual

firework pollutant waste discharges to waters of the United States.

3. As soon as practicable, and no later than 24 hours following a public display of fireworks, the Discharger, in addition to complying with title 19 of the California Code of Regulations, section 1003, shall, to the extent practical, collect, remove, and manage particulate matter and debris from ignited and un-ignited pyrotechnic material including aerial shells, stars (small pellets of composition that produce color pyrotechnic effects), paper, cardboard, wires and fuses found during inspection of the entire firing range, , and adjacent affected surface water(s).

4. If the fireworks are launched or ignited on barges or floating platforms, the fireworks and fireworks equipment shall be set- up, discharged and taken down in accordance with the laws and regulations applying to that display by a public display operator licensed by the State of California. All required permits, licenses and approvals shall be obtained from the authorities having jurisdiction over the fireworks display, and the parties responsible under applicable law and regulation shall comply with the requirements and conditions of those permits. All equipment used to hold and launch the fireworks shall be secured properly in accordance with applicable laws and regulations and is such a way as to minimize the risk that they would fall into the water. Barges and floating platforms shall be inspected for leaks and other potential safety issues. Other than system firing cables and common or grounding wires intended to be recovered after the display, electric igniter wires used to trigger the fireworks shall be secured to minimize the risk that the wires would fall into the water during or after discharge. As soon as practicable, and no later than 24 hours following a public display of fireworks, the decks of each barge or floating platform that contained fireworks shall be raked or swept to gather fireworks debris and prevent it from being deposited into the water. The barges shall be returned to the loading or setup area to be further cleaned and to have the mortars removed.

5. Immediately following a public display of fireworks, all hazardous fireworks waste, including duds, resulting from the set-up, firing, and strike of the public display, including live pyrotechnics waste, shall be handled and managed in accordance with applicable fireworks and hazardous waste laws and regulations.

6. All non-hazardous solid waste resulting from the set-up, firing, and strike of the public display, including wires, boxes, and packaging, shall be collected to the extent practicable and properly disposed of.

7. Fireworks shall be packaged, transported, stored, set-up, and handled in accordance with California Code of Regulations, Title 19, Division1, Chapter 6, Fireworks and Title 22, Chapter 33, Best Management Practices for

Perchlorate Materials in order to prevent or minimize firework pollutant wastes from entering surface waters.

8. Residual firework pollutant waste discharges shall be located a sufficient distance from areas designated ASBS to assure maintenance of natural water quality conditions in these areas, except as provided in Section VII.C.2, *Special Provisions for Discharges into La Jolla and Heisler Park ASBS* of this Order.

F. Public Fireworks Display Log

The Discharger shall maintain a written log for each public fireworks display event. The log shall be completed within 5 days following each public fireworks event and shall be made available to the San Diego Water Board upon request. The log shall contain the following information:

1. The name of the organization sponsoring the fireworks event, together with the names and license numbers of the pyrotechnic operators actually in charge of the display;

2. The date, time, and duration of the public fireworks event;

3. The location of the public fireworks event;

4. The affected receiving waters;

5. Certification that the FBMPP was fully implemented; and

6. The amounts of fireworks debris collected, the dates, times and visual monitoring observations noted from after event firing range inspections and any other pertinent information

G. Interim Effluent Limitations – Not Applicable

H. Land Discharge Specifications- Not Applicable

I. Reclamation Specifications – Not Applicable

V. RATIONALE FOR RECEIVING WATER LIMITATIONS

A. Surface Water

The discharge shall at all times be in conformance with applicable water quality standards and shall not cause an excursion above any applicable narrative or numeric water quality objective, including but not limited to all applicable provisions contained in:

1. The San Diego Water Board's *Water Quality Control Plan for the San Diego Basin* (Basin Plan), including beneficial uses, water quality objectives, and implementation plans;

2. State Water Board plans for water quality control including the:

   a) Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries (Thermal Plan), and

   b) The *California Ocean Plan* (Ocean Plan)*,* including beneficial uses, water quality objectives, and implementation plans*;*

3. State Water Board policies for water quality control including the

   a) Water Quality Control Policy for the Enclosed Bays and Estuaries of California,

   b) Policy for Implementation of Toxics Standards for Inland Surface Waters, and Enclosed Bays, and Estuaries of California;

   c) State Water Resources Control Board's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality which includes the following narrative objectives

      (1) Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities; and

      (2) Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health.

   d) Resources Control Board's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality; and

   e) The Statement of Policy with Respect to Maintaining High Quality of Waters in California (State Water Board Resolution No. 68-16)

4. Priority pollutant criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA) through the:

   a) National Toxics Rule (NTR)[23] (promulgated on December 22, 1992 and amended on May 4, 1995) and

   b) California Toxics Rule (CTR) [24]. [25]

[23] 40 CFR 131.36
[24] 65 Federal Register 31682-31719 (May 18, 2000), adding Section 131.38 to 40 CFR

B. Groundwater – Not Applicable

VI. RATIONALE FOR MONITORING AND REPORTING REQUIREMENTS

Section 122.48 requires that all NPDES permits specify requirements for recording and reporting monitoring results. Water Code sections 13267 and 13383 authorizes the San Diego Water Board to require technical and monitoring reports. The Monitoring and Reporting Program (MRP), Attachment E of this Order, establishes monitoring and reporting requirements to implement federal and state requirements. The following provides the rationale for the monitoring and reporting requirements contained in the MRP for this facility.

A. Influent Monitoring – Not Applicable

B. Effluent Monitoring – Not Applicable

C. Whole Effluent Toxicity Testing Requirements – Not Applicable

D. Receiving Water Monitoring

1. Surface Water

a. General Water Quality Effects on Surface Waters

The effects of fireworks pollutant waste on the environment are relatively unknown at this time. The infrequence of fireworks displays at most locations, coupled with the wide dispersion of constituents make detection of residual firework pollutant waste difficult. In addition, pollution from other sources makes it difficult to measure the amount of pollution and subsequent effects that specifically comes from fireworks. The possible toxicity of any fallout may also be affected by the amount of black powder used, type of oxidizer, colors produced and launch method.

A study[26] was conducted on a small lake located at EPCOT Center, a theme park at the Walt Disney World Resort in Lake Buena Vista, Florida, between 1982 and 1992, to evaluate the impact of repeat fireworks displays (2,000 shows over a decade). Sampling of both water-column and sediments was conducted intermittently over the ten year period. The testing revealed higher than normal concentrations of antimony, barium, and strontium, three common ingredients of fireworks, demonstrating that residual firework pollutant waste does accumulate over time.

A team led by the U. S. Environmental Protection Agency's Richard Wilkin,

[25] If a water quality objective and a CTR criterion are in effect for the same priority pollutant, the more stringent of the two applies

[26] Thomas A. Debusk, Jeffrey J. Keaffaber, Benedict R. Schwegler, Jr., John Repoff, Environmental Effects of Fireworks on Bodies of Water,

have conducted research on the use of pyrotechnic devices over bodies of water noting concerns over the effects of environmental perchlorate on human health and wildlife. Sources of perchlorate range from lightning and certain fertilizers to the perchlorate compounds in rocket fuel and explosives. It had been long suspected that community fireworks displays were another source, but few studies had been done on the topic. Wilkin's group has now established fireworks displays as a source of perchlorate contamination by analyzing water in an Oklahoma lake before and after annual Fourth of July fireworks displays in 2004, 2005 and 2006.[27] Within 14 hours after the fireworks, perchlorate levels rose 24 to 1,028 times above background levels. Levels peaked about 24 hours after the display, and then decreased to the pre-fireworks background within 20 to 80 days.

The San Diego Water Board has reviewed monitoring conducted to date by SeaWorld San Diego. As described in greater detail in Section I.D above, SeaWorld has conducted annual fireworks related monitoring for sediment and water quality parameters since 2001. Water chemistry sampling documented elevated levels of pollutants within the fireworks discharge zone, with some pollutants exceeding water quality criteria. Sediment monitoring showed enrichment of metals within the fireworks fallback area, though short-term sediment toxicity testing was inconclusive and toxicity testing for sublethal effects, a requirement under the SWRCB Sediment Quality Control Plan, was not conducted or required. For benthic communities, differing benthic communities were documented, though the reference sites and fallback area had differing habitat types.

b. **Net Explosive Weight Threshold**

Based on the above considerations, the San Diego Water Board has established a specific firework threshold (expressed in pounds of net explosive weight) that would trigger requirements for receiving water monitoring in San Diego Bay or Mission Bay. The threshold was calculated based on data provided by SeaWorld and summarized in Table 5 below. SeaWorld conducts nightly fireworks displays during the summer months between April and September and averages between 110 and 120 shows per year. The data in Table 5 indicates that the firework displays vary in length from approximately 6 minutes to 20 minutes depending on the number of firework aerial shells ignited during the displays. The maximum residual firework pollutant loading on the receiving water occurs on the Fourth of July event when up to 1750 aerial shells are ignited with an estimated net explosive weight of 961 pounds. .

Based on the Table 5 data the San Diego Water Board has determined that the discharge of fireworks containing a net explosive weight of 1000 pounds

[27] Wilkin, R.T., D.D. Fine, and N.G. Burnett. (2007). "Perchlorate Behavior in a Municipal Lake Following Fireworks Displays." *Environmental Science and Technology*, 41: 3966–3971.

is the estimated threshold at which water quality effects from residual firework pollutant discharges may be detected in the receiving water and/or sediment.

Table 5. SeaWorld Fireworks Events

Fireworks Display Type	Approximate Show Length	Aerial Shells Fired (Average)	Estimated Net Explosive Weight (in pounds)
Typical	6 minutes	Up to 250	216
Special	12 minutes	Up to 1000	Not Reported
Major	20 minutes	Up to 1750	961

c. **Receiving Waters With Required Monitoring Under this Order**

The majority of public fireworks displays in the San Diego Region occur over or within the vicinity of Mission Bay or San Diego Bay, therefore it is reasonable to mandate and concentrate receiving water monitoring activities in these two water bodies. Between June 2010 and December 2010 there were approximately 66 Marine Event Permits for fireworks events issued by the U.S. Coast Guard for Mission Bay and San Diego Bay. Approximately 11 of the Marine Event Permits issued were for fireworks shows over Mission Bay and approximately 55 were for fireworks shows over San Diego Bay.

The San Diego Water Board currently does not have any information regarding additional fireworks events discharging to other surface water bodies within the region, with the exception of the Pacific Ocean. While the San Diego Water Board has received some documentation regarding the occurrence of fireworks events over the Pacific Ocean, no monitoring data has been provided to the San Diego Water Board for these discharges. This Order does not require receiving water monitoring for fireworks displays over the Pacific Ocean.

The Southern California Coastal Water Research Project (SCCWRP) routinely conducts a comprehensive assessment of the ecological condition of the Pacific Ocean at hundreds of sampling locations along the Southern California Bight. [28] The Bight Monitoring Program has several components including coastal ecology and offshore water quality to assess conditions of marine resources in the Bight and evaluate effects of their exposure to pollutants. The monitoring and assessment is conducted by SCCWRP at

[28] The Southern California bight is the 400 miles of recessed coastline between Point Conception, in Santa Barbara County, and Cabo Colnett, south of Ensenada in Mexico.

regular intervals. The current monitoring survey called Bight 2008 is the fourth in a series of regional surveys in the Southern California Bight that began in 1994. Receiving water monitoring for public fireworks events over the Pacific Ocean in the San Diego Region may be conducted as part of the regular SCCWRP Bight Monitoring Surveys. These surveys are funded in part by the Surface Water Ambient Monitoring Surcharge paid by the Dischargers as part of the annual fee for coverage under this Order. Utilizing a regional approach is expected to provide baseline information to assess water quality conditions in Pacific Ocean areas located at or near firework events and evaluate the effects of firework residual pollutant waste discharges. In 2004 the SWRCB adopted Resolution No. 2004-0052 which, in part, established an ASBS Natural Water Quality Committee (NWQC). The NWQC's purpose and role is to provide guidance on determining "natural water quality" and provide scientific advice regarding assessing impacts in ASBS. The NWQC produced a Summation of Findings (SCCWRP Technical Report 625) in September 2010. Additionally, the voters of California approved bond measures for Proposition 84 that provides funding to responsible parties to assist responsible parties to comply with the discharge prohibition into ASBS. An estimated $1,000,000 of funds will be set aside to conduct monitoring, including a regional water quality assessment in accordance with BMP monitoring. This effort is expected to better characterize the receiving water condition of ASBS across the state, including those which may receive discharges from fireworks.

d. **Discharger Categories**

The San Diego Water Board has established a methodology for classifying Dischargers as either Category 1 or Category 2 to identify the Dischargers who are required to conduct or participate in receiving water monitoring under this Order. Category 1 is a Discharger that discharges fireworks containing a net explosive weight of 1,000 pounds or more, in any calendar year, from a single event to Mission Bay or San Diego Bay. Category 1 also includes fireworks discharges from SeaWorld San Diego to Mission Bay. Dischargers classified as Category 1 Dischargers are required to conduct or participate in receiving water monitoring in accordance with Section IX.A. of the Monitoring and Reporting Program.

Category 2 is a Discharger that either 1) discharges fireworks containing a net explosive weight less than 1,000 pounds, in any calendar year, from a single event to Mission Bay or San Diego Bay, or 2) discharges fireworks of any net explosive weight from a single event or multiple events to any other surface water of the U.S. within the San Diego Region. Dischargers classified as Category 2 Dischargers are not required to conduct or participate in receiving water monitoring unless the San Diego Water Board determines monitoring is needed based on the considerations listed in Section IX.B of the Monitoring and Reporting Program.

e. **Category 1 Discharger Monitoring**

Category 1 Dischargers are required to monitor in accordance with Section IX.A. of the Monitoring and Reporting Program. Monitoring is required for discharges of 1,000 pounds or more of pyrotechnic weight in any calendar year from any single event into Mission Bay or San Diego Bay. SeaWorld San Diego is also considered a Category 1 discharger. This monitoring is needed to ensure compliance with receiving water limitations. Both of these enclosed bays are listed on the CWA section 303(d) list for constituents that are commonly found in fireworks.

Mission Bay and the mouth of the San Diego River form a 4,000 acre aquatic park. Water quality within Mission Bay generally is lower than that of the coastal ocean water due to the poor flushing characteristics of the bay and the input of nutrient material from storm runoff.

San Diego Bay is approximately 13 miles long and varies from ½ to 1 ½ miles in width. It is surrounded by metropolitan San Diego and most of the shoreline has been heavily developed for recreational, residential, military, and industrial use.

The receiving water monitoring requirements for San Diego and Mission Bay contain water chemistry, sediment chemistry, sediment toxicity and benthic community components.

f. **Water Chemistry**

Water chemistry monitoring requirements were developed based on the results obtained from the SeaWorld San Diego monitoring, which are discussed in section I.D of the fact sheet. The required list of pollutants to be monitored is considered a minimum list, and Discharger(s) may elect to monitor for additional constituents of concern. Additionally, the ultimate fate and transport of pollutants from the discharge is required to be addressed by a conceptual model, which is a component of the SWRCB Sediment Quality Control Plan. It is expected that the development of a conceptual model will enable the discharger(s) to determine, and subsequently propose, a sampling frequency and timing that is representative of the discharge.

g. **Sediment Monitoring**

The Order requires sampling of sediment chemistry, toxicity and the benthic community. The basis for sediment monitoring under the Order is based on the requirements in the SWRCB Sediment Quality Control Plan. Sediment chemistry sampling has been expanded to include metals the San Diego Water Board determined to be at elevated levels in reviewing the SeaWorld

San Diego monitoring data. It is important to note that the required sediment chemistry list includes constituents that are not included in fireworks discharges. This data collected will enable proper stressor identification to be conducted if sediments fail to meet the Sediment Quality Objective. Sediment toxicity must be conducted pursuant to the SWRCB Sediment Quality Control Plan, which requires a short-term and sublethal toxicity test.

The benthic community assessment has been modified to require monitoring that reflects the benthic habitat subject to the discharge. For unvegetated subtidal habitats the monitoring must be done in accordance with the line of evidence approach described in Section V.G of the SWRCB Sediment Quality Control Plan. Where the subtidal habitat is vegetated (*Zostera marina,* eelgrass), the line of evidence tool under Section V.G does not accurately portray impacts to benthic communities, as the tool was developed specifically for unvegetated subtidal habitat. However, the SWRCB Sediment Quality Control Plan does provide guidance under Section V.J for situations when a particular line of evidence may not be suitable. This alternative approach, which calls for utilization of a reference site for statistical comparison, is required under the Order. The Order requires the same chemistry and toxicity testing be utilized as in found Section V of the SWRCB Sediment Quality Control Plan, but requires a line of evidence for the benthic community which utilizes invertebrates and pertinent regulatory guidance to protect receiving waters, which for vegetated subtidal includes the Southern California Eelgrass Mitigation Policy from the National Marine Fisheries Service[29]. It is expected that the benthic community assessment can utilize invertebrates and eelgrass in the line of evidence approach to estimate levels of impacts, consist with the SWRCB Sediment Quality Control Plan requirements under Section V.J.

Monitoring Frequency and Discussion: The monitoring requirements under the Order do not specify a required frequency of monitoring for water chemistry, and require a minimum number of one sediment monitoring event (using all lines of evidence) every 3 years. The frequency of sediment monitoring is based upon the guidelines from the SWRCB Sediment Quality Control Plan, which specifies a minimum frequency for minor discharges and regional monitoring groups (see Section VII.D of the SWRCB Sediment Quality Control Plan). The proposed frequency of water chemistry monitoring is expected to be based upon results from the conceptual model required under the Water and Sediment Monitoring Plan required under this Order.

h. **Category 2 Discharge Monitoring**

Category 2 is a Discharger that either 1) discharges fireworks containing a

[29] http://swr.nmfs.noaa.gov/hcd/HCD_webContent/aboutus/policies.htm

net explosive weight less than 1,000 pounds, in any calendar year, from a single event to Mission Bay or San Diego Bay or 2) discharges fireworks of any net explosive weight from a single event or multiple events to any other Surface Water of the U.S. within the San Diego Region. Category 2 Dischargers would not be required to conduct monitoring at this time, unless the San Diego Water Board determines monitoring is needed based on the following considerations described in Section IX.B. of this Order:

(i) Receiving water body characteristics including circulation, depth, assimilative capacity; CWA 303(d) listed impairments, and beneficial uses;

(ii) Receiving water body characteristics including circulation, depth, assimilative capacity; CWA 303(d) listed impairments, and beneficial uses;

(iii) The frequency of firework events in the receiving water including those at or near the same firework fallout area;

(iv) The estimated firework pollutant loading from an individual or repeated firework event(s) affecting the same water body or segment thereof;

(v) Accumulative effects from repeat firework events in the same location or other firework events affecting the same water body or segment thereof;

(vi) Proximity of the firework event to existing or proposed State Water Quality Protection Areas, inclusive of Areas of Special Biological Significance (ASBS) or other environmental sensitive receiving waters; or

(vii) Any other relevant water quality factors

2. Groundwater

Discharges of wastes from public fireworks events to land are subject to regulation under the San Diego Water Board's Conditional Waiver No. 11 and are not subject to regulation under this Order. Additional information on the San Diego Water Board Conditional Waivers can be found at the San Diego Water Board website: http://www.waterboards.ca.gov/sandiego/

E. Other Monitoring Requirements – Not Applicable

VII. RATIONALE FOR PROVISIONS

A. Standard Provisions

Standard Provisions, which apply to all NPDES permits in accordance with section 122.41, and additional conditions applicable to specified categories of permits in accordance with section 122.42, are provided in Attachment D to the order.

Section 122.41(a)(1) and (b) through (n) establish conditions that apply to all State-issued NPDES permits. These conditions must be incorporated into the permits either expressly or by reference. If incorporated by reference, a specific citation to the regulations must be included in the Order. Section 123.25(a)(12) allows the state to omit or modify conditions to impose more stringent requirements. In accordance with section 123.25, this Order omits federal conditions that address enforcement authority specified in sections 122.41(j)(5) and (k)(2) because the enforcement authority under the Water Code is more stringent. In lieu of these conditions, this Order incorporates by reference Water Code section 13387(e).

B. Special Provisions

1. Reopener Provisions

This Order may be re-opened and modified, revoked, and reissued or terminated in accordance with the provisions of 40 CFR Parts 122, 123, 124, and 125. The San Diego Water Board may reopen the permit to modify permit conditions and requirements. Causes for modifications include the promulgation of new regulations or adoption of new regulations by the State Water Board or San Diego Water Board, including revisions to the Basin Plan.

2. Special Provisions for Discharges into La Jolla and Heisler Park ASBS

Public displays of fireworks are conducted every Fourth of July by the La Jolla Community Fireworks Foundation at the Scripps Park near the La Jolla ASBS in San Diego County and by the City of Laguna Beach over the Heisler Park ASBS in Orange County. These events result in the discharge of residual firework pollutant waste to these ASBS areas.

Public firework display events have been occurring near the La Jolla ASBS since 1984. The annual Fourth of July event conducted at Scripps Park by the La Jolla Community Fireworks Foundation is located approximately one-quarter mile from the La Jolla ASBS. The fireworks fallout area may extend into portions of the ASBS. The event typically runs 20-25 minutes. The number and size of shells launched are unknown at this time. It is estimated

that, in 2010, less than 500 pounds net weight of pyrotechnics material is discharged into the air over or adjacent to the La Jolla ASBS during this single event.

Public firework display events have been occurring over the Heisler Park ASBS in Orange County since approximately 2001. The annual Fourth of July event conducted by the City of Laguna Beach typically runs approximately 15 minutes and during that time approximately 667 aerial shells are ignited and launched. The aerial shells range in size from 2.5 inches to 5 inches. It is estimated that 600 pounds of pyrotechnic material is discharged into the air over or adjacent to the Heisler Park ASBS during this single event. The City of Laguna Beach estimates that between 20 to 46 percent of the firing range is over land. Beach clean-up is mandatory after the event and additional clean-up is conducted the morning after each event.

The Ocean Plan explicitly prohibits discharges into an ASBS unless an exception has been granted by the State Water Resources Control Board. The Ocean Plan does, however, allow the Regional Water Board's may approve waste discharge requirements for limited term activities in ASBS as described in Section III.E. subject to the following restrictions:

- Limited term activities may result in temporary and short term changes in existing water quality;

- Water quality degradation shall be limited to the shortest possible time; and

- The activities may not permanently degrade water quality or result in water quality lower than that necessary to protect existing uses, and all practicable means of minimizing such degradations shall be implemented.

A once per year fireworks event of less than 1000 pounds net explosive weight that complies will all the provisions specified in this Order and meets the specifications below is not likely to permanently degrade water quality or result in water quality lower than that necessary to protect existing beneficial uses of the La Jolla ASBS or Heisler Park ASBS. Proper implementation of the minimum specified BMPs required under this Order will also minimize residual firework pollutant waste discharges into the ASBS and water quality degradation of the ASBS.

The San Diego Water Board has determined that the annual Fourth of July public firework displays near the La Jolla ASBS and in the Heisler Park ASBS are limited–term short duration activities and are eligible for approval of waste discharge requirements under Ocean Plan Section III.E. The San Diego Water Board has established the following special conditions in section VII.C. of this Order to assure maintenance of natural ocean water quality conditions

and protection of beneficial uses in the ASBS while allowing continued discharges of residual firework pollutant waste discharges to the ASBS at the annual Fourth of July public firework display events. Discharges of residual fireworks pollutant waste by the La Jolla Community Fireworks Foundation near the La Jolla ASBS and by the City of Laguna Beach into the Heisler Park ASBS may continue subject to the following conditions:

a. The residual firework pollutant waste discharges shall be limited to those resulting from one Fourth of July celebration public fireworks display event per calendar year.

b. The net explosive weight of fireworks used in the public fireworks display event shall not exceed1,000 pounds of pyrotechnic material.

c. The areal extent of the firing range in the ASBS shall be limited to the maximum extent practicable to prevent or reduce residual firework pollutant waste discharges into the ASBS.

d. The residual firework pollutant waste discharges shall not permanently alter natural water quality conditions[30] in the ASBS receiving waters. Temporary excursions from natural ocean water quality conditions resulting from residual firework pollutant waste discharges within any portion of the firing range located in the ASBS are permissible if beneficial uses are protected.

e. The residual firework pollutant waste discharges shall comply with all other applicable provisions, including water quality standards, of the Ocean Plan.

3. Special Provisions for SeaWorld San Diego Discharges

On December 17, 2007, the San Diego Water Board made revisions to the NPDES permit for SeaWorld San Diego (Order No. R9-2005-0091, NPDES No. CA0107336) to incorporate requirements for the discharge of pollutant waste associated with the public display of fireworks to Mission Bay. Sea World Inc. has submitted a Report of Waste Discharge dated October 15, 2009 and applied for a NPDES permit renewal of Order No. R9-2005-0091 for 1) the discharge of up to 9.36 million gallons per day of treated wastewater from SeaWorld, San Diego and 2) the discharge of waste from public fireworks displays to Mission Bay. The October 15, 2009 Report of Waste Discharge submitted by Sea World Inc. is deemed complete for the purpose of enrollment under this Order. The enrollment date will be effective upon the effective date of this Order and SeaWorld San Diego is authorized to

[30] Natural ocean water quality will be determined by the Southern California Water Research Project (SCCWRP) ASBS Monitoring Program which is designed to define natural water quality in ASBS areas at selected reference sites.

discharge residual firework pollutant waste starting on this date pursuant to the requirements of this Order. The requirements of this Order will supersede the requirements of Order No. R9-2005-0091 for residual firework pollutant waste discharges upon the effective date of this Order.

4. **Special Studies and Additional Monitoring Requirements – Not Applicable**

5. **Construction, Operation, and Maintenance Specifications – Not Applicable**

6. **Special Provisions for Municipal Facilities (POTWs Only) – Not Applicable**

7. **Other Special Provisions – Not Applicable**

8. **Compliance Schedules – Not Applicable**

VIII. PUBLIC PARTICIPATION

The San Diego Water Board is considering the issuance of waste discharge requirements (WDRs) that will serve as a General National Pollutant Discharge Elimination System (NPDES) permit for discharges of waste associated with public display of fireworks. As a step in the WDR adoption process, the San Diego Water Board staff has developed tentative WDRs. The San Diego Water Board encourages public participation in the WDR adoption process.

A. Notification of Interested Parties

The San Diego Water Board has notified interested agencies and persons of its intent to prescribe waste discharge requirements for the discharge and has provided them with an opportunity to submit their written comments and recommendations. The draft tentative Order was electronically e-mailed to all known interested persons on March 21, 2011, posted on the San Diego Water Board's webpage shortly thereafter. Notification was published in the San Diego Union Tribune, the Orange County Register and the (Riverside) Press-Enterprise on March 21, 2011.

B. Written Comments

Interested persons were invited to submit written comments concerning this Order prior to its adoption by the San Diego Water Board. Comments were required to be submitted either in person or by mail to the Executive Office at the San Diego Water Board at the address above on the cover page of this Order.

C. Public Hearing

The San Diego Water Board held a public hearing on this Order during its regular Board meeting on the following date and time and at the following location:

Date: **May 11, 2011**
Time: **9:00 AM**
Location: **Regional Water Quality Control Board**
Regional Board Meeting Room
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Interested persons were invited to attend. At the public hearing, the San Diego Water Board heard testimony, if any, pertinent to the discharge and this Order.

D. Waste Discharge Requirements Petitions

Any person affected by adoption of this Order of the San Diego Water Board may petition the State Water Board to review the action in accordance with California Water Code section 13320 and California Code of Regulations Title 23 section 2050. The petition must be received by the State Water Board (Office of Chief Counsel, P.O. Box 100, Sacramento, California 95812) within 30 days of the date of adoption of this Order. Copies of the laws and regulations applicable to filing petitions will be provided upon request.

E. Information and Copying

Documents related to this Order, comments received, and other information are on file and may be inspected at the address above at any time between 8:30 a.m. and 4:45 p.m., Monday through Friday. Copying of documents may be arranged through the San Diego Water Board by calling (858) 467-2952.

F. Register of Interested Persons

Any person interested in being placed on the mailing list for information regarding this Order should contact the San Diego Water Board, reference this facility, and provide a name, address, and phone number.

Exhibit A-1

COAST LAW GROUP LLP

1140 S. Coast Highway 101
Encinitas, CA 92024

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April 20, 2011

Michelle Mata
San Diego Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Via Electronic Mail
mmata@waterboards.ca.gov

Re: Tentative Order No.R9-2011-0022, NPDES Permit No. CAG999002
General Waste Discharge Requirements For Discharges Associated With Public Displays of Fireworks To Surface Waters In The San Diego Region

Dear Ms. Mata and Regional Board members:

Please accept these comments on behalf of the Coastal Environmental Rights Foundation (CERF) in opposition to Tentative Order No. R9-2011-0022 (Fireworks Permit) by the Regional Water Quality Control Board (Regional Board). CERF is a nonprofit environmental organization founded by surfers in North San Diego County and active throughout California's coastal communities. CERF was established to aggressively advocate, including through litigation, for the protection and enhancement of coastal natural resources and the quality of life for coastal residents.

Unfortunately, as written, the Fireworks Permit is unsupportable. The revisions to the Permit since its first release have largely undermined the goals of the Clean Water Act and California Water Code, in some instances in direct violation of these laws. While, CERF appreciates the tremendous pressure the Regional Board faces as the first agency to regulate these discharges, a permit that is not truly protective of water quality, nor focused on closing information gaps, falls short of its purpose.

Admittedly, the information available to date has largely come from Sea World, and has been of limited usefulness in drafting a general permit for so varied firework events discharging into numerous water bodies. Though this reality has been candidly expressed by the Regional Board, it has not been reflected in the Fireworks Permit itself. In highlighting the shortcomings of the current draft, CERF hopes to provide suggestions that will enable the Regional Board to modify and adopt a scientifically sound Fireworks Permit which meets the two goals of gathering information currently lacking and ensuring water quality protection in the interim.

I. The Permit Categorical Thresholds Are Arbitrary

The current Fireworks Permit divides dischargers into two categories. Category 1 dischargers are distinguished from Category 2 dischargers by (1) receiving water body and (2) a threshold net explosive weight of 1000 lbs. However, the Board's reasoning for the "net explosive weight" distinction is not explained in any level of detail. Indeed, it is undermined by staff's analysis of the available monitoring data.

> Furthermore, the diving logs for sample collection under Order No. R9-2005-0091 provided additional documentation of fireworks debris on the benthos of the discharge zone. **It is likely that firework duds, the incomplete combustion of fireworks, and post-fragmentation debris (wires, cardboard, etc…) contributes equal, if not greater, loads of pollutants to the benthos of receiving waters**

> **than particulate fallout**. However, the proportion of pollutants from particulate fallout in relation to duds, debris or incomplete combustion has not been tested or quantified. (Permit, Fact Sheet, p. F-18, emphasis added).

The net explosive weight, as defined in Appendix A, includes the "weight of all pyrotechnic compositions, explosives material, and fuse only." (Permit, Definitions, p. A-5). Excluded from this definition, and thereby made irrelevant to the categorical threshold issue, is paper and paste. Such an approach cannot be reconciled with the above-quoted language, which clearly indicates duds, and post and incomplete combustion debris, including paper and paste, likely contribute equal *if not greater* pollutant loads to receiving waters.

As highlighted in the Fireworks Permit, diving logs at Sea World clearly evidence the deposition of duds and other firework debris in the fallout area, eventually on the bay floor. (Permit , Fact Sheet, p. F-18). Sea World has reported an average of 11 lbs nightly and 8 lbs the next morning are picked up along the surface of the water and at Fiesta Island. (*Id*.). However, this debris is unaccounted for in the Regional Board's threshold, which only considers "net explosive weight".[1] In light of the Board's "discharge description", which clearly reflects all firework components reach surface waters, such an approach is unsupportable.

> The chemical constituents within the fireworks are scattered by the burst charge, which separates them from the fireworks casing and internal shell components. A firework **combustion residue** is produced in the form of smoke, airborne particulates, chemical pollutants, and **debris including paper, cardboard**, wires and fuses. This combustion residue can fall into surface waters. In addition, **un-ignited pyrotechnic material** including duds and misfires can also fall into surface waters. (Permit, pp. 10-11).

Although it is unclear how dischargers would estimate their "net explosive weight", available figures show it is not a simple calculation. A cursory review of 2010 fireworks events in the City of San Diego has shown the following *shell numbers* for events:

Event	Waterbody	Total # of Shells
Big Bay Boom	San Diego Bay	18,040
Paradise Point	Mission Bay (Paradise Point)	986
La Jolla Cove	Pacific Ocean (La Jolla Cove)	804
Sea World	Mission Bay (Fiesta Island)	520
Mira Mesa Community 4th of July	n/a	463
Ocean Beach Main Street	Pacific Ocean (OB Pier)	416
Rancho Bernardo Spirit of the 4th	n/a/	382
Lake Murray	Lake Murray	364
La Jolla Country Club	n/a	328
Mission Bay Yacht Club	Mission Bay (Sail Bay)	143

[1] One FBMP requires dischargers to remove and manage particulate matter and debris from the firing range and affected surface waters, but this is only to be done to the "extent practical" and can be delayed a full 24 hours after the public display – at which point much of the pollutants will have settled or been carried away by prevailing winds and currents. (Permit, p. 19).

The event with by far the largest number of fireworks shells is the Big Bay Boom[2]. The second largest is Paradise Point, adjacent to the Sea World show, and within the same 303(d) listed waterbody, Mission Bay. The third largest show is La Jolla Cove, adjacent to the La Jolla ASBS. As currently written, the Fireworks Permit does not account for shell number.[3] Indeed, as explained below, the La Jolla Cove fireworks show adjacent to the ASBS enjoys an exemption in the current draft of the permit without any mention of the number of shells used.

Sea World's January 2007 Report, prepared by Dr. Conkling, estimated firework weights and composition based on firework vendor representations and Department of Transportation applications. (An Analysis of the Fireworks Used at Sea World/San Diego, John A. Conkling, January 2007 ("Conkling Report")). These number have not been independently verified, and the analysis below is merely illustrative of the oversimplification used in determining categorical thresholds.

Based on these figures, it appears the relationship between chemical composition and number of shells is not linear. This is actually evident in the Regional Board's own analysis, as 6 minute shows, consisting of up to 250 shells are estimated to weigh 216 pounds of the total 284 pounds. (Fireworks Permit, Fact Sheet p. F-36; Conkling Report, Appendix C). Major shows (such as 4th of July shows) last 20 minutes, consist of up to 1750 shells, and reportedly weigh 961 pounds of the total 1313 pounds. (*Id*; Conkling Report, Appendix D). Dr. Conkling's report states 4th of July shows comprise of 1,418 shells (not 1,750). However, even assuming the 1,750 figure is accurate, it is clear the relationship between number of shells and net explosive weight is not linear. For the 6 minute shows, net explosive weight is 75 percent of the total weight, and each shell is assumed to weigh .864 lbs. For 20 minute shows, net explosive weight is only 73 percent of the total weight. Using the 1750 figure, shells are assumed to weight .55 lbs each, and .68 lbs using the 1418 shell figure.

Also evident in Dr. Conkling's analysis is the fact that total shell number is not as important as shell size. As shell size goes up, the chemical constituents, as a percentage of the total firework composition, goes up (ie. explosive weight increases). Mr. Conkling's figures have been used to create the table below.

[2] Sea World data shows 1,418 shells are used during 4th of July events. Its application to the City of San Diego states only 520 shells are used. It may be the case that the figures for 4th of July in Dr. Conkling's study are now out of date and inaccurate. CERF suggests the Regional Board obtain clarification as to this discrepancy. Another discrepancy exists regarding the total weight of 4th of July fireworks (previously cited in the Permit as 2185lbs). This figure is also cited in Sea World monitoring reports.

[3] Event organizers, including those of the Big Bay Boom, always speak of bigger and better shows. In all likelihood, these numbers will only increase in future years.

Firework Composition by Shell Size

		Weight (g)	% Weight
3 INCH	Break/lift	65	25
	stars	100	38
	paper/paste	96	37
	Total	261	
4 INCH	Break/lift	120	25
	stars	255	54
	paper/paste	96	20
	Total	471	
5 INCH	Break/lift	265	29
	stars	510	56
	paper/paste	141	15
	Total	916	
6 INCH	Break/lift	390	26
	stars	850	56
	paper/paste	279	18
	Total	1519	

Simply counting the number of shells used does not give an accurate "net explosive weight". It is also evident that it does not capture the full extent of pollutants actually reaching the receiving waters, which would be more accurately captured by total weight for each show. More importantly this exercise still does not accurately characterize those discharges which are likely to adversely impact water quality. This is because the Regional Board does not have sufficient data – nor do firework event sponsors – to determine the threshold at which firework events are unlikely to cause impacts to water quality.

It appears staff relied upon the only data available (which as explained below is highly suspect) to set the threshold between Category 1 and 2 dischargers. Though staff acknowledge the limited usefulness of the monitoring data, the Fireworks Permit nonetheless sets an arbitrary threshold based entirely on this data. After looking at *six sampling events*, this conclusion is reached regarding the potential of certain categories of fireworks events to negatively impact water quality.

> The water column monitoring documented an increased level of total metal concentrations in the SeaWorld fireworks fallback area relative to the reference site(s) for aluminum, cadmium, chromium, copper, lead, nickel, selenium, thallium, vanadium and zinc. The dominance of pollutants in the particulate form after major events provides evidence that single fireworks event greater than 1000 pounds has the reasonable potential to contribute pollutants to sediment in an enclosed bay or estuary. While sampling in the SeaWorld fireworks fallback area **clearly**

> **documented an accumulation of metals** within the fallback area sediment, the data on cumulative effects is too limited to discern differences in accumulation between and among events, nor determine rates of accumulation or attenuation (see Figure 3). (Permit, Fact Sheet, p. F-17 (emphasis added)).

Thus, based entirely on an increased percentage of impacted sediment samples after two major fireworks shows at Sea World (4th of July and Labor Day), the Regional Board has determined shows that are not major are not likely to impact water quality. However, this syllogism does not hold true.

What can be said is that after the two major events, more sediments were impacted and water quality likely impacted as well. What cannot be said is that absent major events the sediment is not impacted. Indeed, two other sampling events were conducted outside of the fireworks season, one of which showed a higher percentage of impacted sediments, another which showed a low percentage of impact. As for the remaining two sampling events, they were also conducted during fireworks season, and they both showed elevated impacts to sediment. However, one of these sampling events was not related to a major event. Thus, the only thing that can actually be gleaned from this data is that fireworks cause impacts.

Further, *even if* major fireworks shows were the *only ones* associated with water quality or sediment impacts, the threshold would properly be set to capture the major shows, **not above them**.[4] The estimated net weight associated with major shows is 961 lbs. Thus, at the threshold level of 1000 lbs, even these shows would not be captured in Category 1.

Therefore, the threshold – set entirely based on a net explosive weight associated with major events – is not supported by the Sea World data, or logic. Major fireworks shows cause impacts, and smaller ones cause impacts as well.

A more rational approach to distinguishing between fireworks shows would take into account a number of factors, including: the number and size of shells used in the event; proximity to other events in the same waterbody or upstream/downstream waterbodies; whether the receiving water is 303(d) listed; special protections and designations for the receiving water; and frequency of events.

CERF urges the Regional Board to return to the approach taken in the first draft of the Fireworks Permit, which did not distinguish between categories of dischargers. Rather, monitoring should be required in at least one location for each water body where fireworks are discharged, and all 303(d) listed waterbodies. In addition, all discharges into or near an ASBS should be prohibited.

II. Sea World Monitoring Is of Limited Value

In the 2005 four-year monitoring report, SAIC chose three reference sites in Mission Bay Channel, Mariner's Basin, and Quivira Basin, "generally upwind" from the Sea World fireworks barge, and "therefore, expected to be unaffected by the fireworks displays." (SAIC, Impacts From SeaWorld San Diego Fireworks Displays to Mission Bay Sediment and Water Quality, Year 4 Monitoring Final Report). This did not, however, take into account the other fireworks shows also conducted within Mission Bay.

In reviewing fireworks permits issued by the City of San Diego, CERF became aware of two

[4] Indeed, one would also expect a reasonable margin of safety.

4th of July fireworks shows conducted in Mission Bay, in addition to the Sea World show: Paradise Point and Mission Bay Yacht Club. As shown in the table provided in section I, *infra*, Paradise Point actually has the second largest show (in terms of the number of shells). Although it is unclear how long these events have been held, an internet search reveals the history of the events dates at least as far back as 2001.[5]

Unfortunately, either Sea World representatives did not feel this was relevant or were unaware of this in designating sampling locations for monitoring background areas and reference sites, which were largely directly within the deposition or fallout zone for these two shows. Depending on circulation within Mission Bay and prevailing winds, it is also possible firework residue and debris from these two locations impacted other parts of Mission Bay not within their respective anticipated fallback areas. (See Enclosed Figure)

Monitoring conducted later, under the 2005 Addendum to Sea World's NPDES Permit also failed to account for these other shows, taking background samples and reference samples directly within the fallout zone for the Paradise Point and Mission Bay Yacht Club fireworks. This may explain the general toxicity of all sediment samples taken with Mission Bay.

> Based on SeaWorld's sediment toxicity and benthic community analysis, it was difficult to draw any conclusions regarding the benthic effects of fireworks displays to the differences found between the reference stations and the fireworks fallout area. Additional monitoring may be necessary to separate possible effects associated with fireworks displays and effects from other pollutant sources to Mission Bay, such as storm water discharges. The results for the short-term survival sediment toxicity sampling were highly variable spatially and temporally within the fireworks deposition zone and temporally within the reference sites. **Sampling in Sediment toxicity test results for both reference sites and the deposition zone fireworks fallout area ranged from non-toxic to highly toxic**. Thus, it was difficult to detect any difference in short term toxicity between and among the sites. **All sites** did appear to exhibit decreased survival rates when compared to laboratory control samples. (Permit, Fact Sheet, pp. F-13-14 (emphasis added)).

Though the Regional Board seems to have relied on Sea World monitoring for little more than establishing that larger shows (or the accumulation of many small shows) has the potential to cause impacts, the failure to consider other nearby firework shows within the same water body evidences the shortcomings of the current monitoring.

Therefore, CERF urges the Regional Board not to rely heavily on the monitoring results, either as an indication that certain firework shows are less problematic (ie. smaller daily shows) or to establish a threshold. Indeed, the only conclusion staff could reach from Sea World monitoring data is that an increase in the level of total metals concentration was observed in the water column, and that pollutants in particulate form were documented, after fireworks events. (Permit, Fact Sheet, p. 17 and Figure 3). Reliance on the Sea World monitoring data to actually set a specific threshold between Category 1 and 2 dischargers is therefore unwise. The highly suspect nature of the monitoring data, coupled with the arbitrary nature of the threshold, requires elimination of the threshold altogether and further underscores the need for more robust and accurate monitoring data.

[5] http://www.laprensa-sandiego.org/archieve/june29/firework.htm

III. The ASBS Temporary Event Exceptions Are in Violation of the Ocean Plan

The current version of the Fireworks Permit allows direct discharge into the Laguna Beach ASBS and discharge directly adjacent to the La Jolla ASBS. (Permit, p. 25). The fact sheet explains:

> Public firework display events have been occurring over or adjacent to near the La Jolla ASBS since 1984. The annual Fourth of July event conducted at Scripps Park by the La Jolla Community Fireworks Foundation is located approximately one-quarter mile from the La Jolla ASBS. The fireworks fallout area may extend *into portions of the ASBS*. The event typically runs 20-25 minutes. The number and size of shells launched are **unknown** at this time. It is **estimated** that, in 2010, less than 500 pounds net weight of pyrotechnics material is discharged into the air over or adjacent to the La Jolla ASBS during this single event. (Permit, Fact Sheet, pp. F-42-43 (emphasis added)).

In previous iterations of the Fireworks Permit, the Regional Board wrote in the exception for the La Jolla and Laguna ASBS events, without supporting figures for the La Jolla Cove show.

> Public firework display events have been occurring over or adjacent to the La Jolla ASBS since 19__. The annual Fourth of July event conducted by the La Jolla Community Fireworks Foundation typically runs approximately _____ minutes and during that time approximately ____ aerial shells are ignited and launched. The aerial shells range in size from ___ to ___ inches. It is estimated that ___ pounds of pyrotechnic material is discharged into the air over or adjacent to the La Jolla ASBS during this single event. (Draft Fireworks Permit Strikeout/Underline, version 2/8/2011, Fact Sheet, pp. 40-41 (highlight added)).

Clearly, the Board made a decision to allow the discharge without supporting rationale. Though the Fireworks Permit now contains some (but not all) of the missing figures, the result was seemingly predeterimined: the fireworks discharges qualify for the "limited-term activity" exception.

Still unknown, according to the Permit, is the number and size of shells. This data is actually readily available – in fact it was provided to the Regional Board by CERF representatives at the workshop on March 11th: 804 shells for 2009 and 2010 shows, consisting of 10-3inch, 100-2.5inch, 200-3inch, 218-4inch, 176-5inch shells, and 100 salutes.[6] La Jolla Community Fireworks Foundation, on the other hand, after providing the information now found in the current permit fact sheet, flippantly responded to Regional Board inquiry stating "[t]he rest of the requested information [the number and size of shells] calls for such a level of detail...that it cannot be confirmed at this juncture and is not necessary to the findings in the Tentative Order." (Latham & Watkins Comment Letter, March 7, 2011, p. 4).

The Regional Board nonetheless carved out an exception to this strict ASBS discharge prohibition in the Ocean Plan: "Waste **shall not be discharged** to areas designated as being of

[6] La Jolla Community Fireworks Foundation and previous sponsors routinely provide this information to the City of San Diego in their applications for Single Event Permits from the City's Fire-Rescue Department. Using Dr. Conkling's figures, the La Jolla Cove event fireworks weigh 411lbs in "net explosive weight" and 819 lbs total. Though this is below the arbitrary 1000 lb threshold, no other discharger would simply be allowed to discharge 411-819 lbs of pollutants directly adjacent to or above the ASBS.

special biological significance. Discharges shall be located a sufficient distance from such designated areas to assure maintenance of natural water quality conditions in these areas." (Ocean Plan, p. 20 (emphasis added)).

The Regional Board allows for these discharges by inappropriately invoking a limited term activity exception to the prohibition.

> Regional Boards may approve waste discharge requirements or recommend certification for limited-term (i.e. weeks or months) activities in ASBS. Limited-term activities include, but are not limited to, **activities such as maintenance/repair of existing boat facilities, restoration of sea walls, repair of existing storm water pipes, and replacement/repair of existing bridges**. Limited-term activities may result in temporary and short-term changes in existing water quality. Water quality degradation shall be limited to the shortest possible time. The activities must not permanently degrade water quality or result in water quality lower than that necessary to protect existing uses, and all practical means of minimizing such degradation shall be implemented. (Ocean Plan, pp. 20-21(emphasis added)).

CERF representatives have previously commented on the limited purpose of this exception; it is for repair or maintenance type activities. This exception has, in the past, been used to allow repair for bridges or storm drains, but is not meant to be a general catch-all exception for discharges that simply are of short duration. State Board representatives have confirmed, this exception is only to be applied to true maintenance and repair activities.[7] Surely no other discharger attempting to "temporarily" discharge 819 lbs of pollutant adjacent to the ASBS would be given such leeway.

Not only does the Regional Board's new (unsupported) reading of the Ocean Plan exception set a terrible precedent, it allows a continued, long-term discharge into ASBS under the auspices of a limited term activity. The fireworks shows are annual, by their very nature they repeatedly occur. The La Jolla Cove fireworks show has been ongoing for *26 years*. (Permit, Fact Sheet, p. F-42). As a matter of public policy, it is truly illogical to create a carve-out for pollution simply because it is tradition.

Underscoring the truly arbitrary nature of the ASBS exceptions, one of the Fireworks Best Management Practices (FBMP) is to locate firework discharges "a sufficient distance from areas designated ASBS to assure maintenance of natural water quality conditions in these areas". (Permit, p. 19). Another FBMP requires the discharger to design the firing range, or consider alternative firing ranges, to eliminate or reduce residual firework pollutant waste discharges to waters of the US. (*Id*.). There is no attempt to ascertain the feasibility of application of the FBMPs to the ASBS shows. It is difficult to reconcile these FBMP, the Ocean Plan's clear directive that "all practical means of minimizing such degradation shall be implemented", and the Regional Board's silence on the issue of location of the fireworks. (Ocean Plan, p. 21).

Clearly, firework events can be held at a variety of locations, whether over water or land. To simply allow an inherently mobile discharger to locate discharges either directly over or adjacent to an ASBS, without any mention of alternative locations, surely does not meet the mandatory Ocean Plan dictate to implement "all practical means of minimizing such degradation". (*Id*.).

The State Water Resources Control Board is currently undertaking a long, comprehensive

[7] Personal communication with Dominic Gregorio.

review of requested exceptions to the Ocean Plan for permanent exemptions to the ASBS discharge prohibition. The State Board's six-year-long process has culminated with the pending California Environmental Quality Act (CEQA) review. The EIR for the State Board's exemption process details the statewide attempt at defining "natural water quality" for ASBS. (ASBS Program Draft Environmental Report, January 18, 2011, pp. 43-44). The State Board's Natural Water Quality Committee (NWQC) had a three-year mission to define natural water quality at the La Jolla ASBS. (*Id*.). The Committee's September 2010 final report[8] defined natural water quality as:

> That water quality (based on selected physical chemical and biological characteristics) that is required to sustain marine ecosystems, and which is without apparent human influence, i.e., an absence of significant amounts of:
>
> a) man-made constituents (e.g., DDT);
>
> b) other chemical (e.g., trace metals), physical (temperature/thermal pollution, sediment burial) and biological (e.g., bacteria) constituents at levels that have been elevated due to man's activities above those resulting from the naturally occurring processes that affect the area in question; and
>
> c) non-indigenous biota (e.g., invasive algal bloom species) that have been introduced either deliberately or accidentally by man.

(*Id*; *see* NWQC Summation of Findings). Thus, in order to protect or prevent degradation of natural water quality, we should strive to reduce the introduction of man-made constituents and other chemicals into the ASBS. There is no indication the Regional Board has even considered the ramifications of the fireworks shows on natural water quality by introducing a plethora of man-made constituents and chemicals into the ASBS.

Also highlighted in the NWQC Summation of Findings is Scripps Institute of Oceanography biological monitoring results (NWQC Summation of Findings, pp. 6-7). Two of the four stated results indicate that: (1) certain pollutants were elevated in transplanted mussels near SIO Pier (Chromium, Nickel, Iron, and Manganese) and at the south end of the adjoining La Jolla ASBS relative to other sites within the study area; and (2) certain pollutants were elevated in transplanted mussels near the SIO pier (Chromium and Nickel) relative to historical statewide Mussel Watch results. Manganese is used as a catalyst in fireworks.[9] Iron is used to produce sparks[10] and chromium is also used in fireworks.[11] (Permit, p. 5). Nickel is used in fireworks as nichromium as well.[12] All four of these metals were found in solid waste samples, in water and in sediment samples, collected after Sea World fireworks shows, as reported in Sea World's 2006 Report of Waste Discharge. (Sea World 2006 RWD, pp. 3-8-9, 3-11).

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[8] http://www.waterboards.ca.gov/water_issues/programs/ocean/docs/asbs/asbspeir_apx08_2011jan.pdf

[9] http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_ARTICLEMAIN&node_id=841&content_id=WPCP_010292&use_sec=true&sec_url_var=region1&__uuid=1e6435fc-c42f-4c9d-8576-84019102b849

[10] http://chemistry.about.com/od/fireworkspyrotechnics/a/fireworkelement.htm

[11] http://toxtown.nlm.nih.gov/text_version/chemicals.php?id=10

[12] Nickel and Chromium were found in elevated levels in the fallback area in Sea World 2008-2010 monitoring. (Permit, Fact Sheet, p. F-12, 17); http://www.buzzle.com/articles/nickel-the-element.html

Interestingly, the Fireworks Permit now calls for natural water quality to be defined, as outlined in the NWQC final report, by monitoring reference sites. However, the ASBS is likely the best indicator of natural water quality itself. Not surprisingly, the NWQC report acknowledges that today's natural water quality is unlikely the same as it was 35 years ago when the Ocean Plan was adopted. In other words, "[t]ruly natural water quality probably does not now exist in California's coastal ocean, and may be rare throughout the world." (NWQC Summation of Findings, preface). The NWQC ultimately found it "should be possible to define a reference area or areas for each ASBS that currently approximate natural water quality and that are expected to exhibit the likely natural variability that would be found in that ASBS." (*Id*.). This bleak outlook is also reflected in the NWQC's recommendation that regulatory agencies now consider how to deal with a shifting baseline as human activities will continue to impact ASBS and potential reference sites. (*Id*. at 19).

Thus, the beneficial use of the ASBS of "preservation and enhancement of designated" ASBS is already an impaired use. (Ocean Plan, p. 3). Our inability to define truly natural water quality, and the reality that water quality at ASBS and reference sites will only deteriorate with population growth, is a truly compelling reason to strictly enforce the Ocean Plan discharge prohibition. It is at the very least a reason to prohibit unnecessary pollutant discharge directly adjacent to or within an ASBS. The Ocean Plan's narrow exception for limited-term maintenance and repair activities for facilities essential to public service should not and cannot be abused to allow for fireworks displays where they should clearly be prohibited.

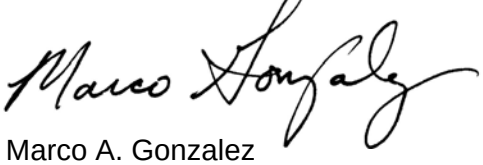
IV. Conclusion

CERF representatives have been active participants in the Regional Board's firework permitting process, particularly through this general Fireworks Permit, and since its inception when Sea World's NPDES permit was first amended to account for fireworks discharges. This Regional Board has more experience with permitting of fireworks discharges than arguably any other agency nationwide. CERF applauds the Regional Board for paving the way for future agencies, and its efforts to regulate these widespread and frequent discharges. However, we cannot support a permit that is not scientifically defensible and protective of water quality and beneficial uses, and which fails to incorporate monitoring requirements that will inform the Regional Board in future decisions and iterations of this permit. We strongly urge the Board to: (i) eliminate the threshold for category 1 and 2 dischargers; (ii) prohibit discharges into and adjacent to the ASBS; and (iii) require at least one representative monitoring location within every receiving water to which firework pollutants are discharged.

Thank you for your consideration of these comments, and for addressing this important water quality issue.

Sincerely,

COAST LAW GROUP LLP



Marco A. Gonzalez
Legal Director

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Paradise Point Resort 7/3/05 & Mission Bay Yacht Club 7/4/05
Barge Locations

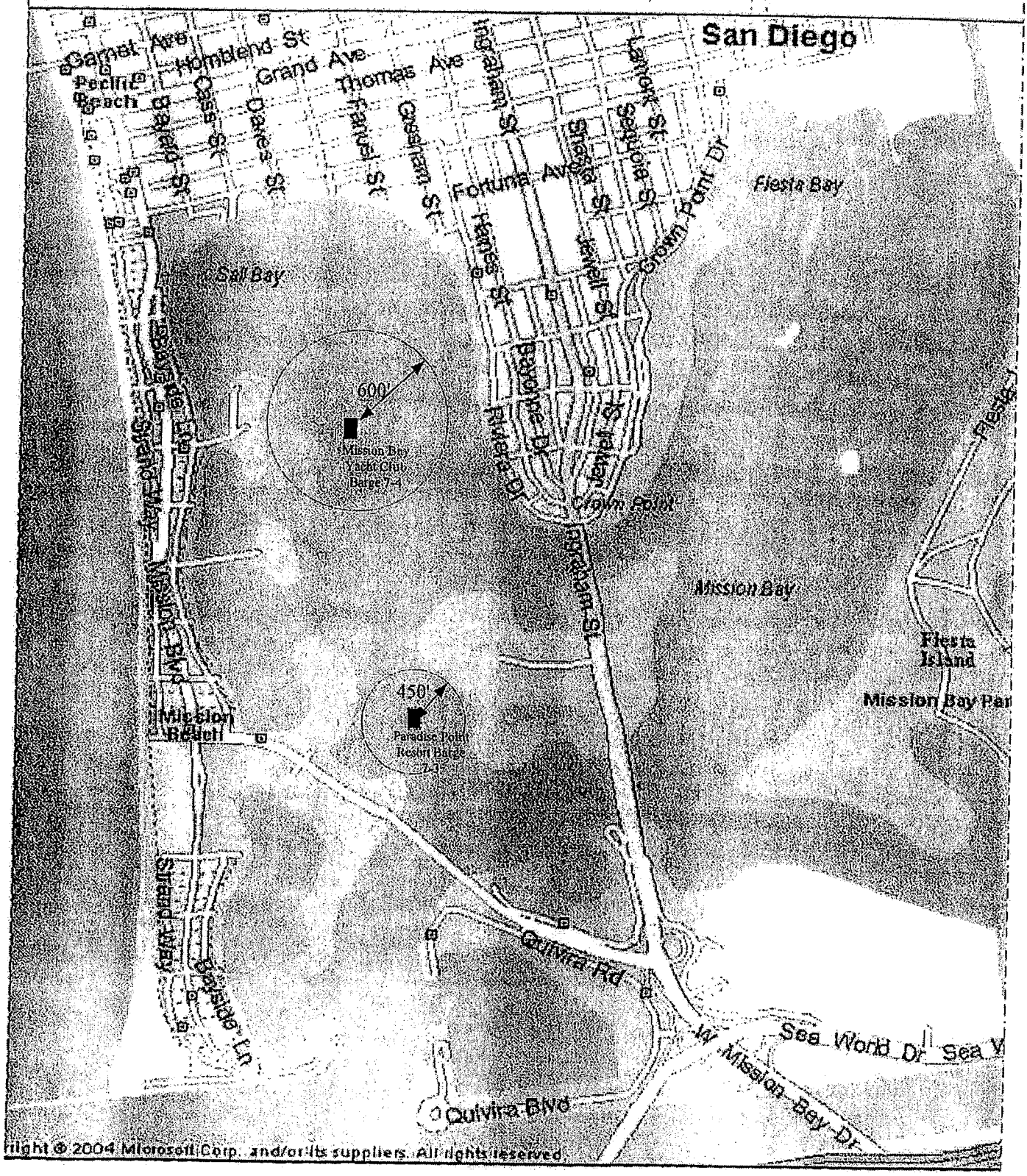

Exhibit B

State of California
Regional Water Quality Control Board
San Diego Region

EXECUTIVE OFFICER SUMMARY REPORT
(December 12, 2007)

ITEM: 10

SUBJECT: NPDES Permit Revision: SeaWorld San Diego. The Regional Board will consider amending SeaWorld's existing NPDES permit to establish waste discharge requirements for discharges of waste from SeaWorld's aerial fireworks displays to Mission Bay, San Diego. (Tentative Addendum No. 1 to Order No. 2005-0091, NPDES No. CA0107336) (Michelle Mata)

PURPOSE: Tentative Addendum No. 1 to Order No R9-2005-0091 NPDES No. CA0107336 would, if adopted, amend Order No. R9-2005-0091 for SeaWorld San Diego to establish waste discharge and monitoring requirements for their aerial fireworks displays over Mission Bay.

PUBLIC NOTICE: A Public Notice of this agenda item was published in the San Diego Union Tribune on November 8, 2007, for the Board Meeting scheduled for December 12, 2007. Copies of the tentative Addendum No. 1 were mailed out on November 2, 2007 to SeaWorld and to all known interested parties and agencies. The tentative Addendum was made available for public review via the Regional Board web page on November 5, 2007.

DISCUSSION: On October 23, 2007, SeaWorld San Diego submitted a Report of Waste Discharge (RWD), prepared by Brown and Caldwell, for an Amendment to Order No. R9-2005-0091, NPDES Permit No. CA0107336 for the discharge of wastes from SeaWorld's aerial fireworks displays over Mission Bay.

Fireworks displays have been a part of SeaWorld entertainment since 1968. From 1968 to 1985, fireworks were used for special events. In 1985, the frequency of fireworks displays increased to nightly from mid-June through Labor Day, and since 1997, the schedule has expanded to include three additional weekends starting Memorial Day weekend. Fireworks displays are also conducted for special events, private parties and

celebrations. The SeaWorld Master Plan Update, which was approved by the Coastal Commission in 2001, allows up to 150 shows per year. Currently the park averages between 110 and 120 shows per year.

The average fireworks show lasts 5 to 6 minutes and dispenses approximately 250 shells; special events, such as the 4th of July and New Year's Eve, may dispense between 1,000 and 1,750 shells. Fireworks are launched from a barge moored in the Pacific passage Zone of Mission Bay, between Fiesta Island and the SeaWorld shorelines. SeaWorld subcontracts the logistics of fireworks, operations, transportation, setup, ignition and cleanup to Fireworks America, a licensed pyrotechnics company based in Lakeside, CA.

There have been concerns over the possible environmental effects of fireworks displays on sediment and water quality. Constituents of concern include aluminum, magnesium, strontium, barium, sodium, potassium, iron, copper, sulfate, nitrate and perchlorate. These fireworks constituents have a potential to adversely impact and/or contribute to degradation of water and sediment quality within Mission Bay. In addition, debris from unexploded shells as well as paper, cardboard, wires and fuses from exploded shells can also adversely impact the quality within Mission Bay. The area affected by these debris can vary depending on wind speed and direction, size of the shells, height of the explosion, and other environmental and anthropogenic factors.

SeaWorld conducted annual fireworks related monitoring of sediment and water quality parameters between 2001-2006 as part of a Coastal Commission permit requirement. The final monitoring report prepared for SeaWorld, by Science Applications International Corporation, concluded that there were no significant spatial or temporal patterns in concentrations of critical metals in sea water or sediments in Mission Bay. It was also concluded that there is no indication of fireworks residue accumulation in the water or sediment of Mission Bay.

If adopted, Addendum No. 1 would establish waste discharge requirements (WDRs) for discharges of waste from SeaWorld's aerial fireworks displays to Mission Bay, San Diego. The WDRs include monitoring of water quality,

sediment and benthic infauna for fireworks related constituents.

Comments have been received from SeaWorld San Diego. A written Responses to Comments document and an Errata sheet will be included in the Supplemental Agenda Package.

KEY ISSUE:

1. Although the tentative Addendum includes a monitoring and reporting program designed to assess the potential adverse effects of fireworks related constituents on water quality, sediment and benthic infauna, the monitoring requirements may need to be revised after review of the data submitted to ensure that the program is adequate.

2. It is uncertain whether the current BMP's are sufficient in reducing impacts of fireworks related debris on water quality, sediment and benthic infauna. The BMP's will be reviewed periodically to evaluate their effectiveness and to determine if additional measures or changes to the current measures are needed.

LEGAL CONCERNS: None.

SUPPORTING DOCUMENTS:

1. Map
2. Transmittal letter for Tentative Addendum No. 1 to Order No. R9-2005-0091, NPDES No. CA0107336.
3. Tentative Addendum No. 1 No. R9-2005-0091, NPDES No. CA 0107336.
4. Order No. R9-2005-0091, NPDES No. CA0107336
5. Comment letter from SeaWorld San Diego dated November 28, 2007.

SIGNIFICANT CHANGES: The tentative Addendum would establish requirements for the SeaWorld aerial fireworks which were previously not regulated by the Regional Board.

COMPLIANCE RECORD: N/A – The discharge of fireworks wastes from SeaWorld has not previously been regulated by the Regional Board and, therefore, no compliance record has been established.

RECOMMENDATION(S): Adoption of Tentative Addendum No. 1 to Order No. 2005-0091, NPDES No. CA 0107336 is recommended.

Exhibit C

Conditional Waiver No. 11 – Aerially Discharged Wastes Over Land

Conditional Waiver No. 11 is for wastes that have been discharged aerially over land, which may be a source of pollutants that can adversely affect the quality of waters of the state.

The following types of discharge not regulated or authorized under WDRs may be eligible for Conditional Waiver No. 11:

- Discharges of wastes related to fireworks displays over land
- Other wastes discharged aerially over land that may adversely affect the quality of the groundwaters of the state, but determined to be "low threat" by the San Diego Water Board

These types of discharge can have similar environmental settings and potential threat to water quality. Therefore, wastes discharged aerially over land were grouped into one discharge classification. Wastes discharged aerially over land that comply with the waiver conditions are not expected to pose a threat to the quality of waters of the state.

For waste discharges related to fireworks displays, available studies suggest annual or infrequent fireworks displays present a low threat to groundwater quality. However, there may be potential water quality impacts that are cumulative for shallow groundwaters used as drinking water sources with recurring fireworks displays. With proper planning and management, the potential treat to groundwater quality from wastes related to fireworks discharged over to land can be eliminated. Therefore, waiver conditions must require proper planning and management of fireworks displays over land to minimize or eliminate the discharge of pollutants to waters of the state.

There may be other aerially discharged wastes in the San Diego Region that are determined to pose a low threat to the quality of groundwaters of the state. These aerially discharged wastes would likely require the same minimum conditions to be protective of the quality of groundwaters of the state.

The permitting process and permits issued by other public agencies (e.g., air pollution control districts, municipalities, fire departments) can provide preliminary information and data to the San Diego Water Board to determine compliance with conditions of a waiver for aerially discharged wastes. Obtaining the proper permits, licenses, or certifications from appropriate public agencies can be a waiver condition that serves as the method of enrollment for a conditional waiver.

However, waiver conditions should be developed in order for members of the public, cities, counties, local agencies and organizations, and/or the San Diego Water Board to determine if aerially discharged wastes are in conformance with the conditional waiver, or causing significant adverse effects on the waters of the state. Significant adverse effects include, but are not limited to, one-time observations of exceedences of drinking water maximum contaminant levels in reservoirs and groundwater source water wells,

persistent pollutant concentrations in the water column that exceed water quality objectives for surface waters, and persistent pollutant concentrations in the sediments of surface water bodies that exceed sediment screening levels or sediment criteria.

If dischargers are not in compliance with waiver conditions, they can be issued a Notice of Violation and required to correct deficiencies in order to be eligible for Conditional Waiver No. 11. If dischargers violate any waiver conditions, the San Diego Water Board has the option to terminate the conditional waiver for the discharge and begin regulating the discharge with individual WDRs and/or take other enforcement actions.

In order to be eligible for Conditional Waiver No. 11, discharges must comply with certain conditions to be protective of water quality. The waiver conditions applicable to wastes discharged aerially over land include the following:

11.I.A. General Waiver Conditions for Aerially Discharged Wastes Over Land

11.II.A. Specific Waiver Conditions for Discharges of Waste Related to Fireworks Displays Over Land

Wastes discharged aerially over land that comply with the general and specific waiver conditions in Conditional Waiver No. 11 are not expected to pose a threat to the quality of waters of the state.

11.I.A. General Waiver Conditions for Aerially Discharged Wastes Over Land

1. Aerially discharged wastes cannot be discharged directly over and/or into surface waters of the state (including ephemeral streams and vernal pools).
2. Aerially discharged wastes must not cause or threaten to cause a condition of contamination, pollution, or nuisance.
3. Aerially discharged wastes must not impact the quality of groundwater in any water wells or surface water in any drinking water reservoirs.
4. Dischargers must comply with any local, state, and federal ordinances and regulations and obtain any required approvals, permits, certifications, and/or licenses from authorized local agencies.
5. Discharger must submit a Notice of Intent or technical and/or monitoring program reports when directed by the San Diego Water Board.

11.II.A. Specific Waiver Conditions for Discharges of Waste Related to Fireworks Displays Over Land

1. No more than one fireworks display may be conducted from a launch site or within 1.0 mile of another launch site within a 48-hour period.[1] If the organizer will have more than one fireworks display within a 48-hour period, the organizer must file a Notice of Intent containing information about the fireworks to be used, location of launch area and nearby water bodies and groundwater basins, surrounding land uses, planned period of and frequency

[1] This condition is intended to alleviate spatial and temporal accumulation of fireworks-related chemical contaminants.

of discharge, copies of any permits obtained from other public agencies, and measures that will be taken to minimize or eliminate the discharge of pollutants that might affect surface water and groundwater quality. Sufficient information must be submitted before the discharge may begin.

2. All fireworks-related debris must be cleaned up from land surface areas.
3. Launch areas and deposition areas of fireworks displays may not be located within areas designated as Zone A for groundwater source area protection, as defined by the California Department of Public Health's Drinking Water Source Assessment Protection Program. This condition may be waived if the owner or operator of a groundwater drinking water source, through a permit, specifically allows the fireworks display launch area and/or deposition area within an area designated as Zone A for groundwater source area protection.
4. Launch areas and deposition areas of fireworks displays may not be located within areas designated as Zone A for surface water source protection, as defined by the California Department of Public Health's Drinking Water Source Assessment Protection Program. This condition may be waived if the owner or operator of a surface water source reservoir or intake structure, through a permit, specifically allows the fireworks display launch area and/or deposition area within an area designated as Zone A for surface water protection.
5. The fireworks display must be permitted by all relevant public agencies that require permits for fireworks displays (e.g., fire departments, municipal governments, law enforcement, water supply agencies). Copies of any permits must be available on site for inspection.
6. The San Diego Water Board and/or other local regulatory agencies must be allowed reasonable access to the site in order to perform inspections and conduct monitoring

Exhibit D

Environ. Sci. Technol. **2007**, *41,* 3966−3971

Perchlorate Behavior in a Municipal Lake Following Fireworks Displays

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Perchlorate salts of potassium and ammonium are the primary oxidants in pyrotechnic mixtures, yet insufficient information is available regarding the relationship between fireworks displays and the environmental occurrence of perchlorate. Here we document changes in perchlorate concentrations in surface water adjacent to a site of fireworks displays from 2004 to 2006. Preceding fireworks displays, perchlorate concentrations in surface water ranged from 0.005 to 0.081 μg/L, with a mean value of 0.043 μg/L. Within 14 h after the fireworks, perchlorate concentrations spiked to values ranging from 24 to 1028× the mean baseline value. A maximum perchlorate concentration of 44.2 μg/L was determined following the July 4th event in 2006. After the fireworks displays, perchlorate concentrations decreased toward the background level within 20 to 80 days, with the rate of attenuation correlating to surface water temperature. Adsorption tests indicate that sediments underlying the water column have limited (<100 nmol/g) capacity to remove perchlorate via chemical adsorption. Microcosms showed comparatively rapid intrinsic perchlorate degradation in the absence of nitrate consistent with the observed disappearance of perchlorate from the study site. This suggests that at sites with appropriate biogeochemical conditions, natural attenuation may be an important factor affecting the fate of perchlorate following fireworks displays.

Introduction

Detection of perchlorate in groundwater and surface water around the United States has fueled recent evaluations of the source, distribution, and biogeochemical processes governing perchlorate behavior in aquatic environments. Much of the current concern over this anion stems from the fact that perchlorate ingestion may pose an adverse human health risk because perchlorate interferes with the production of thyroid hormones required for normal metabolism and the development of mental function (*1*, *2*). Elevated perchlorate concentrations may also pose a risk to aquatic ecosystems. Fish from contaminated sites have been found to contain several thousands of parts per billion (ppb) of perchlorate in the head area and hundreds of ppb in the fillets (*3*). In addition, recent histological assessments show that fish from perchlorate-contaminated sites have increased thyroid follicular hyperplasia, hypertrophy, and colloid depletion at perchlorate concentrations as low as 100 μg/L and exposure times of 30 d (*4*, *5*).

The potential impact of perchlorate on human and ecosystem health is directly tied to its mobility and attenuation in the environment. Perchlorate salts are highly soluble in water and perchlorate ions weakly adhere to mineral and organic surfaces (*6*−*9*); thus, abiotic attenuation pathways of perchlorate are frequently considered to be unimportant. Attenuation of perchlorate in the environment, however, can be effectively mediated by microaerophilic or anaerobic microorganisms that transform ClO_4^- to Cl^- following the pathway $ClO_4^- \rightarrow ClO_3^- \rightarrow ClO_2^- \rightarrow Cl^- + O_2$ (*10*−*13*). Perchlorate-reducing organisms can use a variety of organic carbon substrates as electron donors, such as glucose, acetate, vegetable oils, and natural organic carbon compounds present in soils and sediments (*6*, *8*, *14*, *15*). Biological transformation of perchlorate has been successfully utilized for drinking water treatment (*16*−*17*) and for in situ groundwater remediation (*18*−*21*).

Occurrences of perchlorate in groundwater and surface water stem from both anthropogenic and natural sources. Anthropogenic sources of perchlorate include ammonium perchlorate, a major ingredient of rocket fuel that powers the space shuttle and the U.S. nuclear missile arsenal. In addition, potassium perchlorate is a key ingredient in the production of fireworks, explosives, road flares, and other minor uses (*22*). Natural sources of perchlorate were generally thought to be restricted to fertilizers mined from Chilean caliche deposits (*23*). However, recent studies suggest a possible atmospheric origin for background levels of perchlorate, formed from chloride or hypochlorite during atmospheric lightning discharges or from reactions involving ozone, solar energy, and chloride (*24*−*26*). Other work proposes multiple possible sources of perchlorate to subsurface and surface environments such as mineralogical impurities, agricultural fertilizers, or in situ formation via electrochemical processes (*27*). Although fireworks are commonly referred to as a source of perchlorate to the environment (*28*−*29*), few data are available to evaluate impacts to groundwater or surface water resources (*30*). For example, Dasgupta et al. (*29*) note, in their recent examination of sources of perchlorate to the environment, that a knowledge gap exists regarding the relationship between fireworks displays and the environmental occurrence of perchlorate. This paper documents the time-dependent concentrations of perchlorate observed in a municipal lake following four fireworks displays from 2004 to 2006.

Materials and Methods

Sample Collection, Handling, and Analysis. Surface water samples were collected along the shoreline of a small lake (62 000 m^2) located in Ada, OK. The site is a park with no known source of perchlorate contamination. Sample collection times were centered on fireworks displays in July 2004, July 2005, November 2005, and July 2006. Figure 1 shows an aerial photograph of the lake, locations of sampling sites, and the location of the fireworks ignition site. Samples for perchlorate analyses were syringe-filtered (0.2 μm pore size) in the field into plastic bottles and kept refrigerated at 4 °C until analysis. Measurements in the field were made for pH,

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Published on Web 05/02/2007

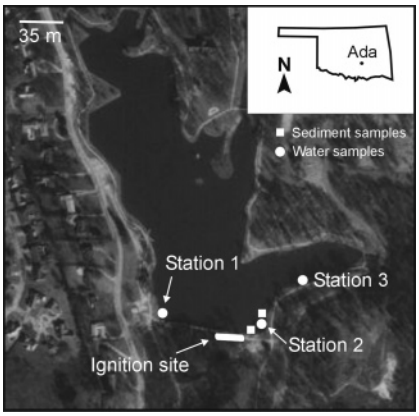

FIGURE 1. Study area, sampling locations, and fireworks ignition site.

specific conductance, and temperature. Samples for stable hydrogen and oxygen isotopic compositions were collected into 20-mL glass vials and sealed to prevent evaporation that can potentially alter $^{18}O/^{16}O$ and $^{2}H/^{1}H$ ratios. Oxygen- and hydrogen-isotopic ratios of H_2O were analyzed using a high-temperature conversion elemental analyzer linked to a continuous flow isotope ratio mass spectrometer (IRMS, Finnigan Delta plus XP). Filtered samples were also collected for element analysis by inductively coupled plasma optical emission spectroscopy (ICP-OES, Perkin-Elmer Optima 3300DV) and anion analysis by capillary electrophoresis (CE, Waters). Sediment samples were collected from the top 10 cm of the bottom sediments at locations near the surface water sampling sites. Sediments were stored at 4 °C in nitrogen-gas purged containers. Sample splits were used for solid-phase characterization, adsorption tests, and microcosm experiments.

Reagents and Standards. Water and acetonitrile (both LC/MS grade manufactured by Riedel-de Haen, Seelze, Germany), sodium perchlorate (minimum 99% purity), and 40% w/w methylamine in water were purchased from Sigma-Aldrich (Milwaukee, WI). Oxygen-18-enriched sodium perchlorate, $NaCl^{18}O_4$, was obtained from Isotec (Miamisburg, OH) and was diluted with reagent water to a concentration of 40 μg/L $Cl^{18}O_4$. The liquid chromatography (LC) mobile phase (200 mM methylamine) was prepared by adding 10 mL of 40% w/w methylamine to 490 mL of LC/MS water. Certified second source standards of perchlorate were purchased from Environmental Resource Associates (Arvada, CO).

Perchlorate Analysis. The determination of perchlorate in water was done using a liquid chromatography tandem mass spectrometry (LC/MS/MS) method based on EPA method 331.0 (*31*, *32*). An Agilent 1100 liquid chromatograph and a Finnigan TSQ Quantum Ultra triple-quadrupole mass spectrometer were used for the analysis. Sample volumes of 40 μL were injected, via an Agilent autosampler, onto a Dionex IonPac AS21 column (250 mm × 2 mm) (Dionex, Millford, MA). The flow rate of the mobile phase, 200 mM methylamine, was 350 μL/min. This allowed the perchlorate anion to elute from the column in ~8 min. All PEEK coated fused silica connecting tubing in the liquid chromatograph was replaced with PEEK tubing. Similarly, all Vespel graphite rotor seals in valves and the Vespel graphite injector seat in the LC injector were replaced with parts made of PEEK material. A postcolumn flow of 300 μL/min acetonitrile was added via a tee before the column flow entered the electrospray source. Optimization of the MS parameters was done using infusion of perchlorate into the mobile phase (further details are provided in the Supporting Information).

A value for the lowest concentration minimum reporting level (LCMRL) for this method, 0.011 μg/L, was calculated using the procedure described elsewhere (*33*). The method detection limit (MDL) was determined by analyzing seven samples prepared separately at the 0.010 μg/L level, calculating the standard deviation of the determined concentration, and multiplying the standard deviation by 3.15 (the 97% Student t value) (*32*). The MDL for the method was determined to be 0.003 μg/L (0.03 nmol/L). The quality control data for this study were collated from sample queues run between July 2004 and August 2006. Over this period, continuing calibration check standards of 0.025 and 0.100 μg/L had average recoveries of 109% (RSD = 9.2%, $n = 4$) and 103% (RSD = 5%, $n = 13$), respectively. Secondary source standards with certified concentrations at 0.151 and 1.51 μg/L had average recoveries of 99% (RSD 3.6%, $n = 6$) and 101% (RSD 2.6%, $n = 11$), respectively. During this study fifteen samples were spiked with perchlorate at concentrations between 0.100 and 10 μg/L. The average matrix spike recovery for these samples was 101% (RSD = 11%). The concentration of perchlorate in the samples that were spiked ranged from 0.017 to 11.9 μg/L.

Adsorption and Microcosm Experiments. Precautions were taken to minimize the alteration of sediment samples prior to use in batch adsorption and microcosm experiments. Fresh sediments (wet) were added to 50 mL bottles along with oxygen-saturated deionized water, and aliquots of a stock sodium perchlorate solution. Oxygen-saturated water was used in batch adsorption tests to inhibit potential microbial degradation of perchlorate. The bottles were sealed with screw caps and their contents were mixed on a mechanical shaker for 2 d. All samples were filtered through 0.2-μm syringe filters and analyzed for perchlorate by LC/MS/MS.

Microcosm experiments were conducted in 45 mL glass serum bottles. Duplicate experiments were established containing 1 g of wet sediment, plus solution containing 5 mg/L NO_3^--N, 1 mg/L ClO_4^-, or a mixture of 1 mg/L ClO_4^- and 5 mg/L NO_3^--N. All solutions were purged with nitrogen gas to remove dissolved oxygen. Sterile control experiments were set up with $HgCl_2$ and container controls were prepared by spiking sterile water in serum bottles with the stock nitrate and perchlorate solutions. At selected time intervals, samples were collected from the serum bottles and filtered through 0.2 μm syringe filters prior to sample storage and analysis. An analysis of holding times indicated that perchlorate concentrations were stable for time periods of at least 6 months in filtered solutions (see Supporting Information, Figure S1).

Results and Discussion

Method Improvement. One important modification to the reported LC/MS/MS method (*31*) that increased the overall method sensitivity of perchlorate determinations was to add acetonitrile postcolumn before the aqueous LC solvent entered the electrospray source. The addition of organic solvents to an aqueous mobile phase can help reduce the effects of surface tension, viscosity, and heat of vaporation (*34*). An increase in perchlorate response of 170% occurred immediately with as little as 50 μL/min addition of acetonitrile and continued with acetonitrile flows of up to 500 μL/min (Figure 2). For this analysis, a postcolumn flow of 350 μL/min of acetonitrile was used. This resulted in an 8-fold increase in the response of perchlorate and isotopically labeled perchlorate.

Perchlorate Background, Spiking, and Attenuation. Temporal trends in perchlorate concentrations show significant variations centered on the timing of fireworks displays (Figure 3). Perchlorate concentrations preceding fireworks displays, by up to 6 days in July 2005, November 2005, and

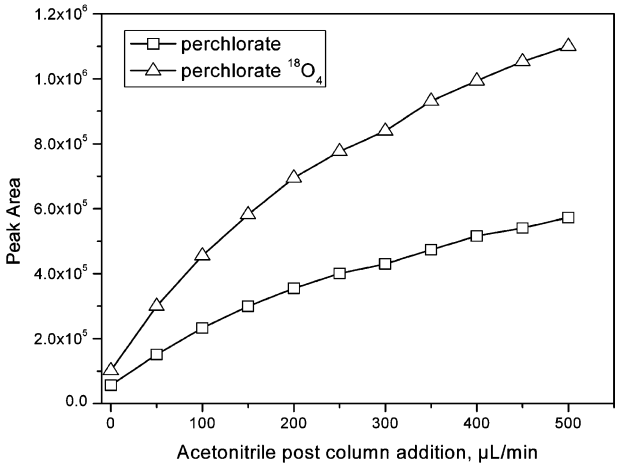

FIGURE 2. Increase in LC/MS/MS peak area response for replicate injections of 0.50 μg/L perchlorate and 1.0 μg/L labeled perchlorate as the flow rate of postcolumn acetonitrile increases.

July 2006, ranged from 0.005 to 0.081 μg/L (0.05 to 0.81 nmol/L), with a mean value of 0.043 μg/L (0.43 nmol/L; $n =$ 15). Prior to fireworks displays, the ClO_4^-/Cl^- mole ratio in Wintersmith Park surface water was 5.4×10^{-7}. This baseline ClO_4^-/Cl^- mole ratio is lower by a factor of 256× compared to the ratio estimated for modern bulk atmospheric deposition, approximately $1.4 \pm 0.1 \times 10^{-4}$ in New Mexico (*26*), suggesting perchlorate depletion in Wintersmith Lake surface water relative to chloride due to biological processes or chloride enrichment from other sources.

Sampling events within 14 h after the fireworks showed spikes in perchlorate values ranging from 24 to 1028× the mean baseline value. A maximum perchlorate concentration of 44.2 μg/L (444 nmol/L) was determined following the July 2006 display (Figure 3). These trends show significant increases in perchlorate levels that can be reasonably attributed to fireworks sources. Rainfall events do not obviously correlate with perchlorate concentrations which would indicate perchlorate inputs from surface runoff (Figure 3). Various factors potentially impact the absolute increase of perchlorate levels in surface water bodies adjacent to fireworks displays, such as the overall amount of ignited fireworks and efficiency of perchlorate oxidation which controls the mass of perchlorate introduced to the environment, wind direction and velocity which controls the dispersion and fallout of perchlorate-enriched particles, and sampling locations relative to the site of fireworks detonation. About 2−3× more fireworks were ignited during the July 2005 display as compared to the November 2005 display (city of Ada, personal communication), which is generally consistent with the observed perchlorate response in surface water (Figure 3).

In a previous study, Canadian surface waters in the Great Lakes Basin were analyzed for the presence of perchlorate (*35*). Sampling sites included Hamilton Harbor, Niagara River, Lake Huron, and Lake Erie. Surface water samples were analyzed by HPLC/MS/MS using isotopically labeled perchlorate. Perchlorate was detected at several sites at concentrations close to the reported method detection limit of 0.2 μg/L (2.0 nmol/L). Interestingly, perchlorate was detected in Hamilton Harbor, the location of Canada Day fireworks (July 2004). Perchlorate was detected 4 days after the event; a week later perchlorate was undetected at the same site (*35*).

In each of the fireworks events examined in this study, perchlorate concentrations attained a maximum level within 1 d following the display. Subsequently, concentrations decreased and reached the background level after 20−80 d

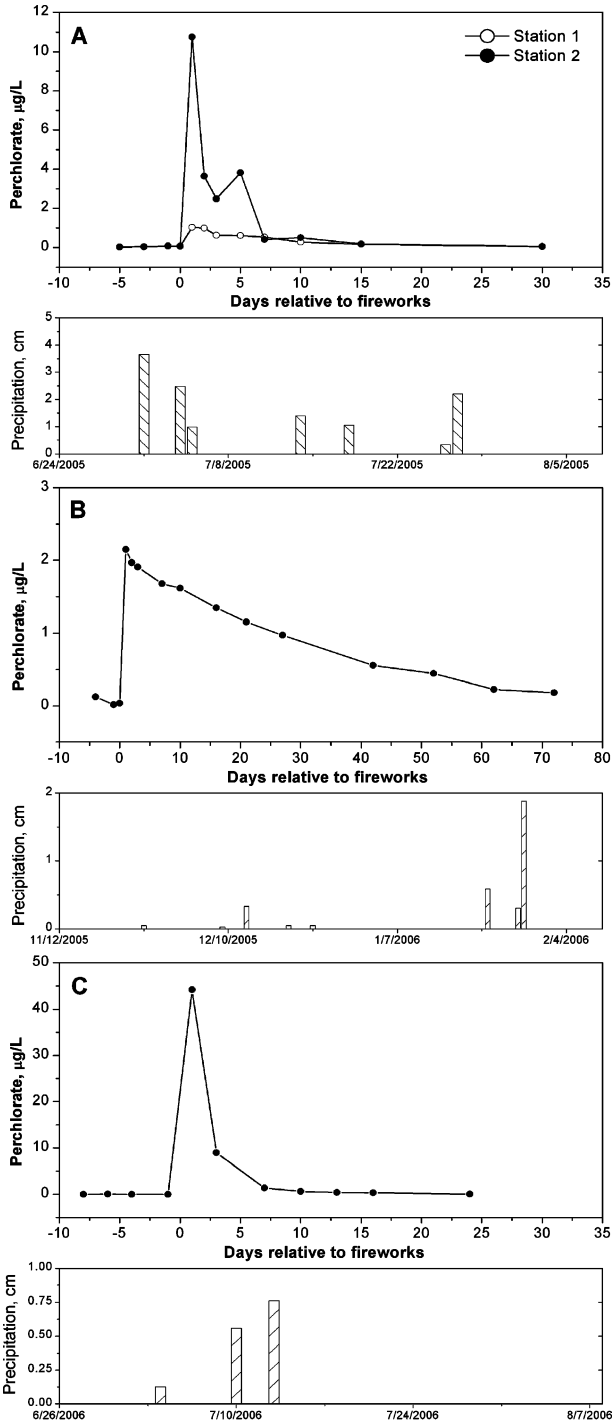

FIGURE 3. Perchlorate concentration trends and precipitation data centered on fireworks displays in (A) July 2005, (B) November 2005, and (C) July 2006. Samples taken from Station 3 before and after the 2004 July 4th display indicated perchlorate concentrations had changed from 0.08 (on July 2, 2004) to 6.42 μg/L (on July 5, 2004). Station 1 was sampled only in July 2005. Data for all sampling events are presented in the Supporting Information (Table S1).

(Figure 3). The reaction kinetics of perchlorate disappearance from the aqueous phase was modeled with a pseudo-first-order rate equation

$$dC/dt = -k_{obs}C$$

where C is the concentration of perchlorate in the aqueous phase (μg/L), k_{obs} is the observed first-order rate constant (d^{-1}), and t is time (d). Linear regression analysis of plots of

the natural logarithm of perchlorate concentration versus time gave straight-line results with R^2 values ranging from 0.81 to 0.99 (see Supporting Information Figure S2). Values of k_{obs} ranged between 0.03 and 0.28 d^{-1}. Rates of perchlorate removal observed in Wintersmith surface waters are similar to a microbial degradation rate, 0.14 d^{-1}, measured in sediment porewaters from a contaminated site (*15*). Perchlorate removal rates in Wintersmith Lake correlate with temperature. The fastest rate of perchlorate removal was observed in surface water with a mean temperature of 33.4 °C (July 2006, see Supporting Information Table S1); whereas, the slowest apparent rate occurred in surface water with a mean temperature of 12.4 °C (November 2005). The apparent activation energy (E_a) of the perchlorate removal process was estimated using the equation

$$E_a = -R\frac{d\ln k_{obs}}{d(1/T)}$$

where E_a is the apparent activation energy (kJ/mol), R is the gas constant (8.314×10^{-3} kJ/mol K), and T is temperature (K). Regression analysis yields an apparent activation energy of 60.5 ± 5.0 kJ/mol (see Supporting Information Figure S3), consistent with cellular and life-related reactions, mineral precipitation−dissolution reactions, but not with adsorption or diffusion processes (*36*).

Other Components in Pyrotechnics. White (*28*) lists over 53 organic and inorganic chemicals important in fireworks as fuels, oxidizers, binding agents, and for various coloration and sound effects. Perchlorate salts of potassium and ammonium are the most common oxidizers in modern fireworks displays, and presumably unreacted perchlorate salts are the compounds that lead to spikes in soluble perchlorate concentrations discussed above. Detonation of fireworks is expected to lead to the quantitative conversion of perchlorate to chloride following, for example, the decomposition reaction for potassium perchlorate:

$$KClO_4 \rightarrow KCl + 2O_{2(g)}$$

Thus, complete efficiency in perchlorate oxidation reactions during pyrotechnical displays should result in no remaining perchlorate (*37*). Not surprisingly, spikes in chloride concentrations were consistently observed after the fireworks displays, but were delayed relative to the timing of perchlorate spikes by 3−5 days (see Supporting Information Figure S4). Chloride concentrations were observed to increase by about 5−7 mg/L compared to pre-fireworks values or by about 25%. Only a small fraction (maximum of 0.3%) of this chloride could have been derived from degrading perchlorate that was present in the lake water; the main source of this chloride is apparently from the dissolution of combustion residues.

Other compounds containing strontium, barium, calcium, sodium, copper, antimony, aluminum, and magnesium are essential color-emitters used in pyrotechnical displays (*37*). Spikes in the concentrations of these other elements were not detected in Wintersmith Lake. The reasons for this are uncertain but may have to do with the more limited sensitivity of the analytical technique employed for these elements (ICP-OES) coupled in some cases with relatively high background concentrations (Ca, Na, K, Mg) and their lower mass abundance compared to perchlorate in the fireworks. Also the final chemical form, water solubility, and reactivity of metals associated with the remains of detonated fireworks have not been studied in detail.

Oxygen and Hydrogen Isotopes. Stable oxygen and hydrogen isotope ratios are valuable for hydrologic investigations, especially for water-balance evaluations in groundwater and surface water systems. Wintersmith Lake surface water had stable isotope ratios of oxygen and hydrogen that showed seasonal variations of about 1.5‰ and 8‰, respectively (Figure 4). Isotopic data show the effects of evaporation in that the meteoric water trend is not observed; rather data follow along a trajectory below the meteoric water trend having a slope of about 5 instead of 8. Ratios of $^{18}O/^{16}O$ and $^{2}H/^{1}H$ are more variable in the summer, because of greater precipitation and generally more intense evaporation compared to the late fall and winter. Considering the limited rainfall that occurred over the period that perchlorate concentrations were decreasing in Wintersmith Lake (Figure 3) and the overall evaporitic trend indicated by the isotopic data (Figure 4), dilution is not expected to be an important factor in lowering perchlorate levels in this system. Dilution of perchlorate concentrations via mixing of the lake water, however, is a possibility that was not assessed during this study.

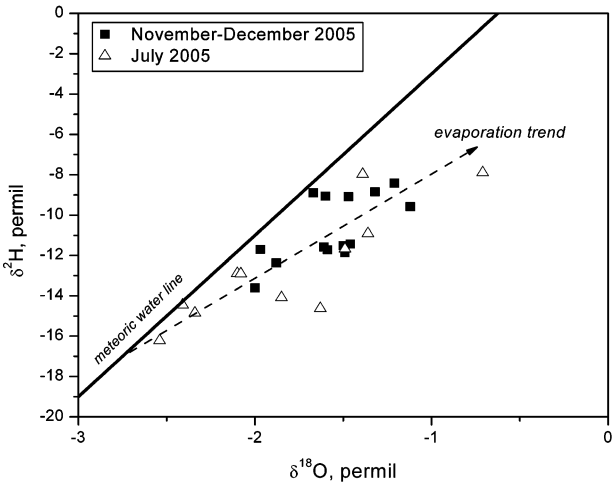

FIGURE 4. Plot of $\delta^{18}O$ versus $\delta^{2}H$ of samples collected from Wintersmith Lake.

TABLE 1. Selected Chemical Characteristics for Two Core Sections (0−10 cm Depth) from Wintersmith Lake in Ada, OK

core	% clay	% silt	% sand	sediment pH	TOC,[a] g kg^{-1}	TIC,[a] g kg^{-1}	TS,[b] g kg^{-1}
NBWR	15	12	73	8.46	35.2	4.1	0.16
NBWL	10	8	82	8.03	1.82	0.43	1.2

[a] Measured by carbon coulometry. Total carbon (TC) determined by combustion at 950 °C. Total inorganic carbon (TIC) determined by acid extraction using 2 N perchloric acid. Total organic carbon (TOC) is equal to TC − TIC. Total sulfur (TS) measured by sulfur coulometry via combustion at 1100 °C.

Adsorption. It is widely accepted that perchlorate does not appreciably sorb to solids and that its mobility and fate in the environment are largely influenced by hydrological and biological factors (*9*). Core samples retrieved from the bottom of Wintersmith Lake were composed predominately of sand-sized particles and the sediment pH for each core was between 8.0 and 8.5 (Table 1), similar to the mean pH of the overlying water column (8.51 ± 0.44; $n = 50$). Core section NBWR was ~20× more enriched in organic matter compared to core section NBWL (Table 1). Also the fraction of clay-sized particles is somewhat higher in the NBWR sample.

Constant-pH sorption tests were conducted with perchlorate loadings from about 10 to 450 μg perchlorate per g of sediment. Core section NBWL showed no potential to remove perchlorate from solution, as 96−102% of the spiked perchlorate was recovered in the aqueous phase (Figure 5). However, core section NBWR removed up to about 10 μg of perchlorate per g of sediment (100 nmol g^{-1}) (Figure 5). The measurable sorption capacity for this material may be related to a higher abundance of organic carbon and an overall finer

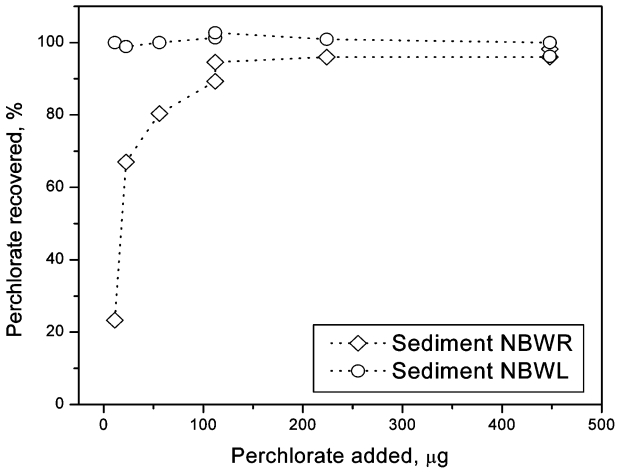

FIGURE 5. Results of sediment adsorption tests. Perchlorate recovered as a function of perchlorate loading to 1 g of sediment, pH 7.5 ± 0.3, and 2 day exposure time.

grain size (Table 1). As noted in previous studies, it can be difficult to discern between chemical adsorption and microbial degradation in batch experiments with perchlorate (*8*, *9*). The batch adsorption experiments were conducted over 48 h with initial aerobic conditions that should have prevented any microbial perchlorate degradation. The results of the adsorption tests suggest that sediments underlying Wintersmith Lake have only a minor capacity to remove perchlorate via sorption. However, this mechanism of removal cannot be completely discounted. More detailed assessments of the spatial distribution of organic carbon content and perchlorate adsorption capacity may allow for a better estimate of perchlorate adsorption and desorption.

Microcosms. Microcosm experiments show that Wintersmith Lake sediments contain microbial communities capable of reducing both nitrate and perchlorate, with nitrate reduction being favored (Figure 6). In nitrate-free microcosms, perchlorate was degraded from 1 mg/L after 18 d to at or below 0.05 μg/L; whereas, in microcosms with both perchlorate and nitrate present the start of perchlorate reduction lagged several days behind nitrate reduction, and up to 35 d was needed for perchlorate concentrations to decrease below 0.05 μg/L. Note that the mean value of nitrate in Wintersmith Lake was determined to be 40 μg/L. Interestingly, the lowest perchlorate concentrations obtained in the microcosms fall within range of the observed pre-fireworks background levels in Wintersmith Lake (Figure 6a), perhaps suggesting that microbial perchlorate reduction becomes unfavorable at very low concentrations (*38*). Simultaneous reduction of perchlorate and nitrate was observed. However, perchlorate reduction was clearly favored only after nitrate concentrations were reduced to below 200 μg N/L. Note that a transient period of ammonia production, perhaps due to dissimilatory nitrate reduction to ammonia, occurred prior to dentrification. Pseudo-first-order rate constants were determined by fitting perchlorate data in the initial nonlinear decay period. Rate constants ranged from 0.39 to 0.59 d^{-1} and are comparable to rates observed in previous microcosm studies on sediments from contaminated sites (*15*, *39*). Additional studies to examine the effects of initial concentrations of perchlorate and nitrate have not been conducted, but the results indicate that microbial perchlorate reduction can occur at initial perchlorate levels much greater than are observed resulting from several fireworks displays.

Implications. Spikes in perchlorate concentrations significantly above background levels were noted after four separate fireworks displays, and in one case concentrations in Wintersmith Lake reached 44 μg/L. Maximum concentrations observed in this study following fireworks displays exceed current action levels for drinking water (e.g., 6 μg/L State of California; 4 μg/L State of Texas, and 1 μg/L State of Massachusetts). It is unclear if aquatic organisms are affected at these concentration levels, although previous work indicates thyroid impacts in fish at perchlorate concentrations as low as 100 μg/L and exposure times of 30 d (*4*). Microcosm tests showed comparatively rapid intrinsic perchlorate degradation in the absence of nitrate consistent with the observed disappearance of perchlorate from Wintersmith Lake, indicating that natural attenuation may be an important factor affecting the fate of perchlorate in the environment following fireworks displays. The availability of organic carbon to provide energy for perchlorate reducing bacteria may be a key factor governing perchlorate attenuation rates in the environment. Results from this study highlight the need for additional studies of perchlorate behavior following fireworks displays in relation to surface water and groundwater quality, particularly in urban areas.

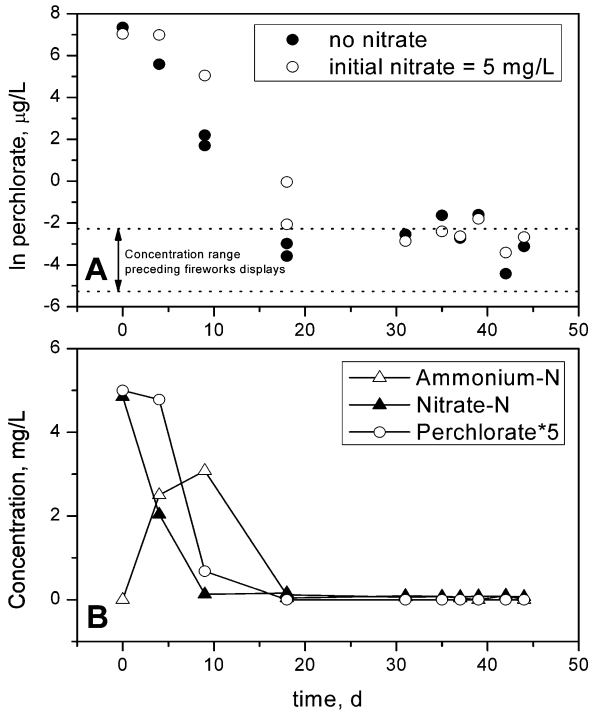

FIGURE 6. Results of microcosm studies showing degradation of perchlorate and nitrate as a function of time (sediment sample NBWR). (A) Perchlorate concentration change with and without nitrate with respect to time. (B) Microcosm concentration of ammonia-N, nitrate-N, and perchlorate with respect to time. Perchlorate concentrations were multiplied by 5 to make trends more apparent.

Acknowledgments

The U.S. Environmental Protection Agency through its Office of Research and Development funded the research described here. It has not been subjected to Agency review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. We gratefully acknowledge the analytical support provided by Shaw Environmental (Contract #68-C-03-097), E. Hoskin for field work, and D. Walters for supporting data.

Supporting Information Available

Additional information, data, and figures as noted in the text. This material is available free of charge via the Internet at http://pubs.acs.org.

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ES0700698

Exhibit E

Assembly Bill No. 826

CHAPTER 608

An act to amend Section 25404 of, to add Section 25504.1 to, and to add Article 10.01 (commencing with Section 25210.5) and Article 12.5 (commencing with Section 25249.1) to Chapter 6.5 of Division 20 of, the Health and Safety Code, relating to hazardous waste.

[Approved by Governor September 29, 2003. Filed with Secretary of State September 29, 2003.]

LEGISLATIVE COUNSEL'S DIGEST

AB 826, Jackson. The Perchlorate Contamination Prevention Act: perchlorate materials: statewide database.

(1) Existing law, administered by the Department of Toxic Substances Control, prohibits the management of hazardous waste, except in accordance with the hazardous waste laws or in the regulations adopted by the department. A violation of the hazardous waste control law is a crime.

This bill would enact the Perchlorate Contamination Prevention Act and would require the department to adopt regulations, by December 31, 2005, specifying best management practices for managing perchlorate materials. The bill would prohibit a person from managing perchlorate materials after the effective date of those regulations, except in compliance with the best management practices specified in those regulations.

The bill would require the owner or operator of a perchlorate facility, as defined, located within a 5-mile radius of a public drinking water well that has been found by a state or local agency to be contaminated with perchlorate to submit to the Environmental Protection Agency, on or before July 1, 2004, a summary of any subsurface and any groundwater monitoring, investigation, or remediation work that has been performed at the facility.

Because a violation of the bill's requirements would be a crime, the bill would impose a state-mandated local program.

(2) Existing law requires the Secretary for Environmental Protection to adopt regulations and implement a unified hazardous waste and hazardous materials management regulatory program. Existing law authorizes a city or local agency that meets specified requirements to apply to the secretary to implement the unified program, and requires every county to apply to the secretary to be certified to implement the unified program. The secretary is required to establish standards

specifying the data to be collected and submitted by unified program agencies in administering the unified program.

This bill would additionally include, in the unified program, a person managing perchlorate materials, thereby creating a state-mandated local program by imposing new duties upon local agencies.

The bill would require the secretary to establish a statewide database and to work with the certified unified program agencies to develop a phased-in schedule for the electronic collection and submittal of information to be included in the statewide data base.

(3) Existing law generally requires a business that handles specified amounts of a hazardous material to establish and implement a business plan for emergency response to a release or threatened release of the hazardous material, as specified. Existing law specifies the contents of the business plan, including an inventory, and requires it to be submitted to the administering agency, as defined. Under existing law, violations related to business plans are a crime.

This bill would require a business that handles any amount of perchlorate materials to prepare and submit a business plan and an inventory. By changing the definition of a crime, this bill would impose a state-mandated local program.

(4) The bill would incorporate changes to Section 25404 of the Health and Safety Code proposed by both this bill and AB 1640, which would become operative only if both bills are enacted and become effective on or before January 1, 2004, and this bill is enacted after AB 1640.

(5) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for specified reasons.

The people of the State of California do enact as follows:

SECTION 1. This act shall be known, and may be cited, as the Perchlorate Contamination Prevention Act.

SEC. 2. (a) The Legislature finds and declares all of the following:

(1) The State Department of Health Services, in the year 2000, reported detections of perchlorate in 44 public drinking water systems, with 23 systems indicating levels greater than 18 part per billion.

(2) This perchlorate contamination has been found statewide, including areas in Los Angeles, Pasadena, Riverside, Sacramento, San Bernardino, and Santa Clarita.

(3) Perchlorate can persist for many years in ground and surface water, and it is difficult to remove perchlorate with standard water treatment processes.

(4) Perchlorate has been found in scientific studies to disrupt thyroid hormone production, which hinders the body's ability to regulate its metabolism and physical growth.

(5) Pregnant women and their developing fetuses may suffer the most serious health effects from perchlorate contamination in drinking water, including improper thyroid functioning and inhibition of iodine intake.

(6) The Office of Environmental Health Hazard Assessment is proposing a public health goal within the range of 2 to 6 parts per billion of perchlorate in water.

(7) An awareness of the problem caused by perchlorate materials and wastes has increased and information has become available from investigation of groundwater contamination at various sites.

(8) Perchlorate materials and wastes are associated with, among other things, solid rocket propellants, explosives, fireworks, flares, airbags, and some fertilizers.

(9) The discharge of perchlorate waste into the environment through air, surface and subsurface soils, surface water and groundwater media is a threat to water supply and to wildlife habitat, such as wetlands.

(10) In light of the serious risks to public health and the environment posed by perchlorate releases resulting from the mismanagement of perchlorate and perchlorate-containing materials, the Department of Toxic Substances Control has indicated that it will reprioritize its existing regulatory resources to enable the expeditious assessment of existing standards, and the adoption of any additional standards determined to be necessary, for the management of waste perchlorate and perchlorate-containing wastes. The Department of Toxic Substances Control has also indicated that, should legislation be enacted requiring that nonwaste perchlorate and perchlorate-containing materials also be addressed as part of this assessment and regulations adoption process, this can be accomplished without additional resources.

(b) It is the intent of the Legislature to enact legislation to establish a continuing program for the purpose of preventing contamination from management of perchlorate material and from generation, storage, treatment, and disposal of perchlorate or perchlorate-containing waste relative to emissions into the air and subsequent deposition and runoff into surface water or groundwater, and direct or indirect discharge to surface soils, subsurface soils, surface water, or groundwater of the State of California.

SEC. 3. Article 10.01 (commencing with Section 25210.5) is added to Chapter 6.5 of Division 20 of the Health and Safety Code, to read:

Article 10.01. Management of Perchlorate

25210.5. For purposes of this article, the following definitions shall apply:

(a) Notwithstanding Section 25117.2, ‘‘management’’ means disposal, storage, packaging, processing, pumping, recovery, recycling, transportation, transfer, treatment, use, and reuse.

(b) ‘‘Perchlorate’’ means all perchlorate-containing compounds.

(c) ‘‘Perchlorate material’’ means perchlorate and all perchlorate-containing substances, including, but not limited to, waste perchlorate and perchlorate-containing waste.

25210.6. (a) On or before December 31, 2005, the department shall adopt regulations specifying best management practices for a person managing perchlorate materials. These practices may include, but are not limited to, all of the following:

(1) Procedures for documenting the amount of perchlorate materials managed by the facility.

(2) Management practices necessary to prevent releases of perchlorate materials, including, but not limited to, containment standards, usage, processing and transferring practices, and spill response procedures.

(b) (1) The department shall consult with the State Air Resources Board, the Office of Environmental Health Hazard Assessment, the State Water Resources Control Board, the Office of Emergency Services, the State Fire Marshal, and the California certified unified program agencies forum before adopting regulations pursuant to subdivision (a).

(2) The department shall also, before adopting regulations pursuant to subdivision (a), review existing federal, state, and local laws governing the management of perchlorate materials to determine the degree to which uniform and adequate requirements already exist, so as to avoid any unnecessary duplication of, or interference with the application of, those existing requirements.

(3) In adopting regulations pursuant to subdivision (a), the department shall ensure that those regulations are at least as stringent as, and to the extent practical consistent with, the existing requirements of Chapter 6.95 (commencing with Section 25500) and the Uniform Fire Code governing the management of perchlorate materials.

(c) The regulations adopted by the department pursuant to this section shall be adopted as emergency regulations in accordance with Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, and for the purposes of that chapter, including Section 11349.6 of the Government Code, the adoption of these

regulations is an emergency and shall be considered by the Office of Administrative Law as necessary for the immediate preservation of the public peace, health and safety, and general welfare. Notwithstanding Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, including subdivision (e) of Section 11349.1 of the Government Code, any emergency regulations adopted pursuant to this section shall be filed with, but not be repealed by, the Office of Administrative Law and shall remain in effect until revised by the department.

(d) The department may implement an outreach effort to educate persons who manage perchlorate materials concerning the regulations promulgated pursuant to subdivision (a).

25210.7. On and after the effective date of the regulations adopted by the department pursuant to Section 25210.6, a person may not manage perchlorate materials unless the management complies with the best management practices specified in the regulations adopted by the department.

SEC. 4. Article 12.5 (commencing with Section 25249.1) is added to Chapter 6.5 of Division 20 of the Health and Safety Code, to read:

Article 12.5. The Perchlorate Contamination Prevention Program

25249.1. For the purposes of this article, the following definitions shall apply:

(a) ''Management'' means disposal, storage, packaging, processing, pumping, recovery, recycling, transportation, transfer, treatment, use, and reuse.

(b) ''Perchlorate'' means all perchlorate-containing compounds.

(c) ''Perchlorate facility'' means all contiguous land, and the structures, appurtenances and improvements on the land, that has been used for the management of perchlorate material. A perchlorate facility may consist of one or more units, or combination of units, that is or has been used for the management of perchlorate material.

(d) ''Perchlorate material'' means perchlorate and all perchlorate-containing substances, including, but not limited to, waste perchlorate and perchlorate-containing waste.

(e) ''Public drinking water well'' has the same meaning as defined in paragraph (1) of subdivision (a) of Section 25299.97.

25249.2. On or before July 1, 2004, the owner or operator of a perchlorate facility, located within a 5-mile radius of a public drinking water well that has been found by any state or local agency to be contaminated with perchlorate, shall submit to the Environmental Protection Agency a summary of any subsurface and any groundwater

monitoring, investigation, or remediation work that has been performed at the facility. The owner or operator shall submit the information electronically, if it is available in electronic format.

SEC. 5. Section 25404 of the Health and Safety Code, as amended by Section 53 of Chapter 999 of the Statutes of 2002, is amended to read:

25404. (a) For purposes of this chapter, the following terms shall have the following meanings:

(1) (A) ''Certified Unified Program Agency'' or ''CUPA'' means the agency certified by the secretary to implement the unified program specified in this chapter within a jurisdiction.

(B) ''Participating Agency'' or ''PA'' means a state or local agency that has a written agreement with the CUPA pursuant to subdivision (d) of Section 25404.3, and is approved by the secretary, to implement or enforce one or more of the unified program elements specified in subdivision (c), in accordance with Sections 25404.1 and 25404.2.

(C) ''Unified Program Agency'' or ''UPA'' means the CUPA, or its participating agencies to the extent each PA has been designated by the CUPA, pursuant to a written agreement, to implement or enforce a particular unified program element specified in subdivision (c). The UPAs have the responsibility and authority to implement and enforce the requirements listed in subdivision (c), and the regulations adopted to implement the requirements listed in subdivision (c), to the extent provided by Chapter 6.5 (commencing with Section 25100), Chapter 6.67 (commencing with Section 25270), Chapter 6.7 (commencing with Section 25280), Chapter 6.95 (commencing with Section 25500), and Sections 25404.1 and 25404.2. After a CUPA has been certified by the secretary, the unified program agencies and the state agencies carrying out responsibilities under this chapter shall be the only agencies authorized to enforce the requirements listed in subdivision (c) within the jurisdiction of the CUPA.

(2) ''Department'' means the Department of Toxic Substances Control.

(3) ''Minor violation'' means the failure of a person to comply with any requirement or condition of any applicable law, regulation, permit, information request, order, variance, or other requirement, whether procedural or substantive, of the unified program that the UPA is authorized to implement or enforce pursuant to this chapter, and that does not otherwise include any of the following:

(A) A violation that results in injury to persons or property, or that presents a significant threat to human health or the environment.

(B) A knowing willful or intentional violation.

(C) A violation that is a chronic violation, or that is committed by a recalcitrant violator. In determining whether a violation is chronic or a

violator is recalcitrant, the UPA shall consider whether there is evidence indicating that the violator has engaged in a pattern of neglect or disregard with respect to applicable regulatory requirements.

(D) A violation that results in an emergency response from a public safety agency.

(E) A violation that enables the violator to benefit economically from the noncompliance, either by reduced costs or competitive advantage.

(F) A class I violation as provided in Section 25117.6.

(G) A class II violation committed by a chronic or a recalcitrant violator, as provided in Section 25117.6.

(H) A violation that hinders the ability of the UPA to determine compliance with any other applicable local, state, or federal rule, regulation, information request, order, variance, permit, or other requirement.

(4) ''Secretary'' means the Secretary for Environmental Protection.

(5) ''Unified program facility'' means all contiguous land and structures, other appurtenances, and improvements on the land that are subject to the requirements listed in subdivision (c).

(6) ''Unified program facility permit'' means a permit issued pursuant to this chapter. For the purposes of this chapter, a unified program facility permit encompasses the permitting requirements of Section 25284, and any permit or authorization requirements under any local ordinance or regulation relating to the generation or handling of hazardous waste or hazardous materials, but does not encompass the permitting requirements of a local ordinance that incorporates provisions of the Uniform Fire Code or the Uniform Building Code.

(b) The secretary shall adopt implementing regulations and implement a unified hazardous waste and hazardous materials management regulatory program, which shall be known as the unified program, after holding an appropriate number of public hearings throughout the state. The unified program shall be developed in close consultation with the director, the Director of the Office of Emergency Services, the State Fire Marshal, the executive officers and chairpersons of the State Water Resources Control Board and the California regional water quality control boards, the local health officers, local fire services, and other appropriate officers of interested local agencies, and affected businesses and interested members of the public, including environmental organizations.

(c) The unified program shall consolidate the administration of the following requirements, and shall, to the maximum extent feasible within statutory constraints, ensure the coordination and consistency of any regulations adopted pursuant to those requirements:

(1) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to hazardous waste generators, persons operating pursuant to a permit-by-rule, conditional authorization, or conditional exemption, pursuant to Chapter 6.5 (commencing with Section 25100) or the regulations adopted by the department, and persons managing perchlorate materials.

(B) The unified program shall not include the requirements of paragraph (3) of subdivision (c) of Section 25200.3, the requirements of Sections 25200.10 and 25200.14, and the authority to issue an order under Sections 25187 and 25187.1, with regard to those portions of a unified program facility that are subject to one of the following:

(i) A corrective action order issued by the department pursuant to Section 25187.

(ii) An order issued by the department pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iii) A remedial action plan approved pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iv) A cleanup and abatement order issued by a California regional water quality control board pursuant to Section 13304 of the Water Code, to the extent that the cleanup and abatement order addresses the requirements of the applicable section or sections listed in this subparagraph.

(v) Corrective action required under subsection (u) of Section 6924 of Title 42 of the United States Code or subsection (h) of Section 6928 of Title 42 of the United States Code.

(vi) An environmental assessment pursuant to Section 25200.14 or a corrective action pursuant to Section 25200.10 or paragraph (3) of subdivision (c) of Section 25200.3, that is being overseen by the department.

(C) The unified program shall not include the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to persons operating transportable treatment units, except that any required notice regarding transportable treatment units shall also be provided to the CUPAs.

(2) The requirement of subdivision (c) of Section 25270.5 for owners and operators of aboveground storage tanks to prepare a spill prevention control and countermeasure plan.

(3) The requirements of Chapter 6.7 (commencing with Section 25280) concerning underground storage tanks, except for the responsibilities assigned to the State Water Resources Control Board pursuant to Section 25297.1, and the requirements of any underground storage tank ordinance adopted by a city or county.

(4) The requirements of Article 1 (commencing with Section 25500) of Chapter 6.95 concerning hazardous material release response plans and inventories.

(5) The requirements of Article 2 (commencing with Section 25531) of Chapter 6.95, concerning the accidental release prevention program.

(6) The requirements of subdivisions (b) and (c) of Section 80.103 of the Uniform Fire Code, as adopted by the State Fire Marshal pursuant to Section 13143.9 of the Health and Safety Code, concerning hazardous material management plans and inventories.

(d) To the maximum extent feasible within statutory constraints, the secretary shall consolidate, coordinate, and make consistent these requirements of the unified program with other requirements imposed by other federal, state, regional, or local agencies upon facilities regulated by the unified program.

(e) (1) The secretary shall establish standards applicable to CUPAs, participating agencies, state agencies, and businesses specifying the data to be collected and submitted by unified program agencies in administering the programs listed in subdivision (c). Those standards shall incorporate any standard developed under Section 25503.3.

(2) The secretary shall establish an electronic geographic information management system capable of receiving all data collected by the unified program agencies pursuant to this subdivision and Section 25504.1. The secretary shall make all nonconfidential data available on the Internet.

(3) (A) As funding becomes available, the secretary shall establish, consistent with paragraph (2), and thereafter maintain, a statewide database.

(B) The secretary, or one or more of the boards, departments, or offices within the California Environmental Protection Agency, shall seek available federal funding for purposes of implementing this subdivision.

(4) Once the statewide database is established, the secretary shall work with the CUPAs to develop a phased-in schedule for the electronic collection and submittal of information to be included in the statewide database, giving first priority to information relating to those chemicals determined by the secretary to be of greatest concern. The secretary, in making this determination shall consult with the CUPAs, the Office of Emergency Services, the State Fire Marshal, and the boards,

departments, and offices within the California Environmental Protection Agency. The information initially included in the statewide database shall include, but is not limited to, the hazardous materials inventory information required to be submitted pursuant to Section 25504.1 for perchlorate materials.

(f) This section shall remain in effect only until January 1, 2006, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2006, deletes or extends that date.

SEC. 5.5. Section 25404 of the Health and Safety Code, as amended by Section 53 of Chapter 999 of the Statutes of 2002, is amended to read:

25404. (a) For purposes of this chapter, the following terms shall have the following meanings:

(1) (A) ''Certified Unified Program Agency'' or ''CUPA'' means the agency certified by the secretary to implement the unified program specified in this chapter within a jurisdiction.

(B) ''Participating Agency'' or ''PA'' means a state or local agency that has a written agreement with the CUPA pursuant to subdivision (d) of Section 25404.3, and is approved by the secretary, to implement or enforce one or more of the unified program elements specified in subdivision (c), in accordance with Sections 25404.1 and 25404.2.

(C) ''Unified Program Agency'' or ''UPA'' means the CUPA, or its participating agencies to the extent each PA has been designated by the CUPA, pursuant to a written agreement, to implement or enforce a particular unified program element specified in subdivision (c). The UPAs have the responsibility and authority to implement and enforce the requirements listed in subdivision (c), and the regulations adopted to implement the requirements listed in subdivision (c), to the extent provided by Chapter 6.5 (commencing with Section 25100), Chapter 6.67 (commencing with Section 25270), Chapter 6.7 (commencing with Section 25280), Chapter 6.95 (commencing with Section 25500), and Sections 25404.1 and 25404.2. After a CUPA has been certified by the secretary, the unified program agencies and the state agencies carrying out responsibilities under this chapter shall be the only agencies authorized to enforce the requirements listed in subdivision (c) within the jurisdiction of the CUPA.

(2) ''Department'' means the Department of Toxic Substances Control.

(3) ''Minor violation'' means the failure of a person to comply with any requirement or condition of any applicable law, regulation, permit, information request, order, variance, or other requirement, whether procedural or substantive, of the unified program that the UPA is authorized to implement or enforce pursuant to this chapter, and that does not otherwise include any of the following:

(A) A violation that results in injury to persons or property, or that presents a significant threat to human health or the environment.

(B) A knowing willful or intentional violation.

(C) A violation that is a chronic violation, or that is committed by a recalcitrant violator. In determining whether a violation is chronic or a violator is recalcitrant, the UPA shall consider whether there is evidence indicating that the violator has engaged in a pattern of neglect or disregard with respect to applicable regulatory requirements.

(D) A violation that results in an emergency response from a public safety agency.

(E) A violation that enables the violator to benefit economically from the noncompliance, either by reduced costs or competitive advantage.

(F) A class I violation as provided in Section 25117.6.

(G) A class II violation committed by a chronic or a recalcitrant violator, as provided in Section 25117.6.

(H) A violation that hinders the ability of the UPA to determine compliance with any other applicable local, state, or federal rule, regulation, information request, order, variance, permit, or other requirement.

(4) ''Secretary'' means the Secretary for Environmental Protection.

(5) ''Unified program facility'' means all contiguous land and structures, other appurtenances, and improvements on the land that are subject to the requirements listed in subdivision (c).

(6) ''Unified program facility permit'' means a permit issued pursuant to this chapter. For the purposes of this chapter, a unified program facility permit encompasses the permitting requirements of Section 25284, and any permit or authorization requirements under any local ordinance or regulation relating to the generation or handling of hazardous waste or hazardous materials, but does not encompass the permitting requirements of a local ordinance that incorporates provisions of the Uniform Fire Code or the Uniform Building Code.

(b) The secretary shall adopt implementing regulations and implement a unified hazardous waste and hazardous materials management regulatory program, which shall be known as the unified program, after holding an appropriate number of public hearings throughout the state. The unified program shall be developed in close consultation with the director, the Director of the Office of Emergency Services, the State Fire Marshal, the executive officers and chairpersons of the State Water Resources Control Board and the California regional water quality control boards, the local health officers, local fire services, and other appropriate officers of interested local agencies, and affected businesses and interested members of the public, including environmental organizations.

(c) The unified program shall consolidate the administration of the following requirements, and shall, to the maximum extent feasible within statutory constraints, ensure the coordination and consistency of any regulations adopted pursuant to those requirements:

(1) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to hazardous waste generators, persons operating pursuant to a permit-by-rule, conditional authorization, or conditional exemption, pursuant to Chapter 6.5 (commencing with Section 25100) or the regulations adopted by the department, and persons managing perchlorate materials.

(B) The unified program shall not include the requirements of paragraph (3) of subdivision (c) of Section 25200.3, the requirements of Sections 25200.10 and 25200.14, and the authority to issue an order under Sections 25187 and 25187.1, with regard to those portions of a unified program facility that are subject to one of the following:

(i) A corrective action order issued by the department pursuant to Section 25187.

(ii) An order issued by the department pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iii) A remedial action plan approved pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iv) A cleanup and abatement order issued by a California regional water quality control board pursuant to Section 13304 of the Water Code, to the extent that the cleanup and abatement order addresses the requirements of the applicable section or sections listed in this subparagraph.

(v) Corrective action required under subsection (u) of Section 6924 of Title 42 of the United States Code or subsection (h) of Section 6928 of Title 42 of the United States Code.

(vi) An environmental assessment pursuant to Section 25200.14 or a corrective action pursuant to Section 25200.10 or paragraph (3) of subdivision (c) of Section 25200.3, that is being overseen by the department.

(C) The unified program shall not include the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to persons operating transportable treatment units, except that any required notice regarding transportable treatment units shall also be provided to the CUPAs.

(2) The requirement of subdivision (c) of Section 25270.5 for owners and operators of aboveground storage tanks to prepare a spill prevention control and countermeasure plan.

(3) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.7 (commencing with Section 25280) concerning underground storage tanks and the requirements of any underground storage tank ordinance adopted by a city or county.

(B) The unified program may not include the responsibilities assigned to the State Water Resources Control Board pursuant to Section 25297.1.

(C) The unified program may not include the corrective action requirements of Sections 25296.10 to 25296.40, inclusive.

(4) The requirements of Article 1 (commencing with Section 25500) of Chapter 6.95 concerning hazardous material release response plans and inventories.

(5) The requirements of Article 2 (commencing with Section 25531) of Chapter 6.95, concerning the accidental release prevention program.

(6) The requirements of subdivisions (b) and (c) of Section 80.103 of the Uniform Fire Code, as adopted by the State Fire Marshal pursuant to Section 13143.9 of the Health and Safety Code, concerning hazardous material management plans and inventories.

(d) To the maximum extent feasible within statutory constraints, the secretary shall consolidate, coordinate, and make consistent these requirements of the unified program with other requirements imposed by other federal, state, regional, or local agencies upon facilities regulated by the unified program.

(e) (1) The secretary shall establish standards applicable to CUPAs, participating agencies, state agencies, and businesses specifying the data to be collected and submitted by unified program agencies in administering the programs listed in subdivision (c). Those standards shall incorporate any standard developed under Section 25503.3.

(2) The secretary shall establish an electronic geographic information management system capable of receiving all data collected by the unified program agencies pursuant to this subdivision and Section 25504.1. The secretary shall make all nonconfidential data available on the Internet.

(3) (A) As funding becomes available, the secretary shall establish, consistent with paragraph (2), and thereafter maintain, a statewide database.

(B) The secretary, or one or more of the boards, departments, or offices within the California Environmental Protection Agency, shall seek available federal funding for purposes of implementing this subdivision.

(4) Once the statewide database is established, the secretary shall work with the CUPAs to develop a phased-in schedule for the electronic collection and submittal of information to be included in the statewide database, giving first priority to information relating to those chemicals determined by the secretary to be of greatest concern. The secretary, in making this determination shall consult with the CUPAs, the Office of Emergency Services, the State Fire Marshal, and the boards, departments, and offices within the California Environmental Protection Agency. The information initially included in the statewide database shall include, but is not limited to, the hazardous materials inventory information required to be submitted pursuant to Section 25504.1 for perchlorate materials.

(f) This section shall remain in effect only until January 1, 2006, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2006, deletes or extends that date.

SEC. 6. Section 25404 of the Health and Safety Code, as added by Section 54 of Chapter 999 of the Statutes of 2002, is amended to read:

25404. (a) For purposes of this chapter, the following terms shall have the following meanings:

(1) (A) ''Certified Unified Program Agency'' or ''CUPA'' means the agency certified by the secretary to implement the unified program specified in this chapter within a jurisdiction.

(B) ''Participating Agency'' or ''PA'' means a state or local agency that has a written agreement with the CUPA pursuant to subdivision (d) of Section 25404.3, and is approved by the secretary, to implement or enforce one or more of the unified program elements specified in subdivision (c), in accordance with Sections 25404.1 and 25404.2.

(C) ''Unified Program Agency'' or ''UPA'' means the CUPA, or its participating agencies to the extent each PA has been designated by the CUPA, pursuant to a written agreement, to implement or enforce a particular unified program element specified in subdivision (c). The UPAs have the responsibility and authority to implement and enforce the requirements listed in subdivision (c), and the regulations adopted to implement the requirements listed in subdivision (c), to the extent provided by Chapter 6.5 (commencing with Section 25100), Chapter 6.67 (commencing with Section 25270), Chapter 6.7 (commencing with Section 25280), Chapter 6.95 (commencing with Section 25500), and Sections 25404.1 and 25404.2. After a CUPA has been certified by the secretary, the unified program agencies and the state agencies carrying out responsibilities under this chapter shall be the only agencies authorized to enforce the requirements listed in subdivision (c) within the jurisdiction of the CUPA.

(2) ‘‘Department’’ means the Department of Toxic Substances Control.

(3) ‘‘Secretary’’ means the Secretary for Environmental Protection.

(4) ‘‘Unified program facility’’ means all contiguous land and structures, other appurtenances, and improvements on the land that are subject to the requirements listed in subdivision (c).

(5) ‘‘Unified program facility permit’’ means a permit issued pursuant to this chapter. For the purposes of this chapter, a unified program facility permit encompasses the permitting requirements of Section 25284, and any permit or authorization requirements under any local ordinance or regulation relating to the generation or handling of hazardous waste or hazardous materials, but does not encompass the permitting requirements of a local ordinance that incorporates provisions of the Uniform Fire Code or the Uniform Building Code.

(b) The secretary shall adopt implementing regulations and implement a unified hazardous waste and hazardous materials management regulatory program, which shall be known as the unified program, after holding an appropriate number of public hearings throughout the state. The unified program shall be developed in close consultation with the director, the Director of the Office of Emergency Services, the State Fire Marshal, the executive officers and chairpersons of the State Water Resources Control Board and the California regional water quality control boards, the local health officers, local fire services, and other appropriate officers of interested local agencies, and affected businesses and interested members of the public, including environmental organizations.

(c) The unified program shall consolidate the administration of the following requirements, and shall, to the maximum extent feasible within statutory constraints, ensure the coordination and consistency of any regulations adopted pursuant to those requirements:

(1) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to hazardous waste generators, persons operating pursuant to a permit-by-rule, conditional authorization, or conditional exemption, pursuant to Chapter 6.5 (commencing with Section 25100) or the regulations adopted by the department, and persons managing perchlorate materials.

(B) The unified program shall not include the requirements of paragraph (3) of subdivision (c) of Section 25200.3, the requirements of Sections 25200.10 and 25200.14, and the authority to issue an order under Sections 25187 and 25187.1, with regard to those portions of a unified program facility that are subject to one of the following:

(i) A corrective action order issued by the department pursuant to Section 25187.

(ii) An order issued by the department pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iii) A remedial action plan approved pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iv) A cleanup and abatement order issued by a California regional water quality control board pursuant to Section 13304 of the Water Code, to the extent that the cleanup and abatement order addresses the requirements of the applicable section or sections listed in this subparagraph.

(v) Corrective action required under subsection (u) of Section 6924 of Title 42 of the United States Code or subsection (h) of Section 6928 of Title 42 of the United States Code.

(vi) An environmental assessment pursuant to Section 25200.14 or a corrective action pursuant to Section 25200.10 or paragraph (3) of subdivision (c) of Section 25200.3, that is being overseen by the department.

(C) The unified program shall not include the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to persons operating transportable treatment units, except that any required notice regarding transportable treatment units shall also be provided to the CUPAs.

(2) The requirement of subdivision (c) of Section 25270.5 for owners and operators of aboveground storage tanks to prepare a spill prevention control and countermeasure plan.

(3) The requirements of Chapter 6.7 (commencing with Section 25280) concerning underground storage tanks, except for the responsibilities assigned to the State Water Resources Control Board pursuant to Section 25297.1, and the requirements of any underground storage tank ordinance adopted by a city or county.

(4) The requirements of Article 1 (commencing with Section 25501) of Chapter 6.95 concerning hazardous material release response plans and inventories.

(5) The requirements of Article 2 (commencing with Section 25531) of Chapter 6.95, concerning the accidental release prevention program.

(6) The requirements of subdivisions (b) and (c) of Section 80.103 of the Uniform Fire Code, as adopted by the State Fire Marshal pursuant to Section 13143.9 of the Health and Safety Code, concerning hazardous material management plans and inventories.

(d) To the maximum extent feasible within statutory constraints, the secretary shall consolidate, coordinate, and make consistent these requirements of the unified program with other requirements imposed by other federal, state, regional, or local agencies upon facilities regulated by the unified program.

(e) (1) The secretary shall establish standards applicable to CUPAs, participating agencies, state agencies, and businesses specifying the data to be collected and submitted by unified program agencies in administering the programs listed in subdivision (c). Those standards shall incorporate any standard developed under Section 25503.3.

(2) The secretary shall establish an electronic geographic information management system capable of receiving all data collected by the unified program agencies pursuant to this subdivision and Section 25504.1. The secretary shall make all nonconfidential data available on the Internet.

(3) (A) As funding becomes available, the secretary shall establish, consistent with paragraph (2), and thereafter maintain, a statewide database.

(B) The secretary, or one or more of the boards, departments, or offices within the California Environmental Protection Agency, shall seek available federal funding for purposes of implementing this subdivision.

(4) Once the statewide database is established, the secretary shall work with the CUPAs to develop a phased-in schedule for the electronic collection and submittal of information to be included in the statewide database, giving first priority to information relating to those chemicals determined by the secretary to be of greatest concern. The secretary in making this determination shall consult with the CUPAs, the Office of Emergency Services, the State Fire Marshal, and the boards, departments, and offices within the California Environmental Protection Agency. The information initially included in the statewide database shall include, but is not limited to, the hazardous materials inventory information required to be submitted pursuant to Section 25504.1 for perchlorate materials.

(f) This section shall become operative January 1, 2006.

SEC. 6.5. Section 25404 of the Health and Safety Code, as added by Section 54 of Chapter 999 of the Statutes of 2002, is amended to read:

25404. (a) For purposes of this chapter, the following terms shall have the following meanings:

(1) (A) ''Certified Unified Program Agency'' or ''CUPA'' means the agency certified by the secretary to implement the unified program specified in this chapter within a jurisdiction.

(B) ‘‘Participating Agency’’ or ‘‘PA’’ means a state or local agency that has a written agreement with the CUPA pursuant to subdivision (d) of Section 25404.3, and is approved by the secretary, to implement or enforce one or more of the unified program elements specified in subdivision (c), in accordance with Sections 25404.1 and 25404.2.

(C) ‘‘Unified Program Agency’’ or ‘‘UPA’’ means the CUPA, or its participating agencies to the extent each PA has been designated by the CUPA, pursuant to a written agreement, to implement or enforce a particular unified program element specified in subdivision (c). The UPAs have the responsibility and authority to implement and enforce the requirements listed in subdivision (c), and the regulations adopted to implement the requirements listed in subdivision (c), to the extent provided by Chapter 6.5 (commencing with Section 25100), Chapter 6.67 (commencing with Section 25270), Chapter 6.7 (commencing with Section 25280), Chapter 6.95 (commencing with Section 25500), and Sections 25404.1 and 25404.2. After a CUPA has been certified by the secretary, the unified program agencies and the state agencies carrying out responsibilities under this chapter shall be the only agencies authorized to enforce the requirements listed in subdivision (c) within the jurisdiction of the CUPA.

(2) ‘‘Department’’ means the Department of Toxic Substances Control.

(3) ‘‘Secretary’’ means the Secretary for Environmental Protection.

(4) ‘‘Unified program facility’’ means all contiguous land and structures, other appurtenances, and improvements on the land that are subject to the requirements listed in subdivision (c).

(5) ‘‘Unified program facility permit’’ means a permit issued pursuant to this chapter. For the purposes of this chapter, a unified program facility permit encompasses the permitting requirements of Section 25284, and any permit or authorization requirements under any local ordinance or regulation relating to the generation or handling of hazardous waste or hazardous materials, but does not encompass the permitting requirements of a local ordinance that incorporates provisions of the Uniform Fire Code or the Uniform Building Code.

(b) The secretary shall adopt implementing regulations and implement a unified hazardous waste and hazardous materials management regulatory program, which shall be known as the unified program, after holding an appropriate number of public hearings throughout the state. The unified program shall be developed in close consultation with the director, the Director of the Office of Emergency Services, the State Fire Marshal, the executive officers and chairpersons of the State Water Resources Control Board and the California regional water quality control boards, the local health officers, local fire services,

and other appropriate officers of interested local agencies, and affected businesses and interested members of the public, including environmental organizations.

(c) The unified program shall consolidate the administration of the following requirements, and shall, to the maximum extent feasible within statutory constraints, ensure the coordination and consistency of any regulations adopted pursuant to those requirements:

(1) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to hazardous waste generators, persons operating pursuant to a permit-by-rule, conditional authorization, or conditional exemption, pursuant to Chapter 6.5 (commencing with Section 25100) or the regulations adopted by the department, and persons managing perchlorate materials.

(B) The unified program shall not include the requirements of paragraph (3) of subdivision (c) of Section 25200.3, the requirements of Sections 25200.10 and 25200.14, and the authority to issue an order under Sections 25187 and 25187.1, with regard to those portions of a unified program facility that are subject to one of the following:

(i) A corrective action order issued by the department pursuant to Section 25187.

(ii) An order issued by the department pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iii) A remedial action plan approved pursuant to Chapter 6.8 (commencing with Section 25300) or Chapter 6.85 (commencing with Section 25396).

(iv) A cleanup and abatement order issued by a California regional water quality control board pursuant to Section 13304 of the Water Code, to the extent that the cleanup and abatement order addresses the requirements of the applicable section or sections listed in this subparagraph.

(v) Corrective action required under subsection (u) of Section 6924 of Title 42 of the United States Code or subsection (h) of Section 6928 of Title 42 of the United States Code.

(vi) An environmental assessment pursuant to Section 25200.14 or a corrective action pursuant to Section 25200.10 or paragraph (3) of subdivision (c) of Section 25200.3, that is being overseen by the department.

(C) The unified program shall not include the requirements of Chapter 6.5 (commencing with Section 25100), and the regulations adopted by the department pursuant thereto, applicable to persons

operating transportable treatment units, except that any required notice regarding transportable treatment units shall also be provided to the CUPAs.

(2) The requirement of subdivision (c) of Section 25270.5 for owners and operators of aboveground storage tanks to prepare a spill prevention control and countermeasure plan.

(3) (A) Except as provided in subparagraphs (B) and (C), the requirements of Chapter 6.7 (commencing with Section 25280) concerning underground storage tanks and the requirements of any underground storage tank ordinance adopted by a city or county.

(B) The unified program may not include the responsibilities assigned to the State Water Resources Control Board pursuant to Section 25297.1.

(C) The unified program may not include the corrective action requirements of Sections 25296.10 to 25296.40, inclusive.

(4) The requirements of Article 1 (commencing with Section 25501) of Chapter 6.95 concerning hazardous material release response plans and inventories.

(5) The requirements of Article 2 (commencing with Section 25531) of Chapter 6.95, concerning the accidental release prevention program.

(6) The requirements of subdivisions (b) and (c) of Section 80.103 of the Uniform Fire Code, as adopted by the State Fire Marshal pursuant to Section 13143.9 of the Health and Safety Code, concerning hazardous material management plans and inventories.

(d) To the maximum extent feasible within statutory constraints, the secretary shall consolidate, coordinate, and make consistent these requirements of the unified program with other requirements imposed by other federal, state, regional, or local agencies upon facilities regulated by the unified program.

(e) (1) The secretary shall establish standards applicable to CUPAs, participating agencies, state agencies, and businesses specifying the data to be collected and submitted by unified program agencies in administering the programs listed in subdivision (c). Those standards shall incorporate any standard developed under Section 25503.3.

(2) The secretary shall establish an electronic geographic information management system capable of receiving all data collected by the unified program agencies pursuant to this subdivision and Section 25504.1. The secretary shall make all nonconfidential data available on the Internet.

(3) (A) As funding becomes available, the secretary shall establish, consistent with paragraph (2), and thereafter maintain, a statewide database.

(B) The secretary, or one or more of the boards, departments, or offices within the California Environmental Protection Agency, shall seek available federal funding for purposes of implementing this subdivision.

(4) Once the statewide database is established, the secretary shall work with the CUPAs to develop a phased-in schedule for the electronic collection and submittal of information to be included in the statewide database, giving first priority to information relating to those chemicals determined by the secretary to be of greatest concern. The secretary in making this determination shall consult with the CUPAs, the Office of Emergency Services, the State Fire Marshal, and the boards, departments, and offices within the California Environmental Protection Agency. The information initially included in the statewide database shall include, but is not limited to, the hazardous materials inventory information required to be submitted pursuant to Section 25504.1 for perchlorate materials.

(f) This section shall become operative January 1, 2006.

SEC. 7. Section 25504.1 is added to the Health and Safety Code, to read:

25504.1. Notwithstanding any other law, including, but not limited to, the quantity limitations and exemptions specified in Section 25503.5, a business that handles any amount of perchlorate material, as defined in subdivision (c) of Section 25210.5, shall prepare and submit to the administering agency a business plan pursuant to Section 25503.5 and an inventory form pursuant to Section 25509, both of which shall address all perchlorate materials handled by that business.

SEC. 8. Sections 5.5 and 6.5 of this bill incorporate amendments to Section 25404 of the Health and Safety Code proposed by both this bill and AB 1640. Sections 5.5 and 6.5 shall only become operative if (1) both bills are enacted and become effective on or before January 1, 2004, (2) each bill amends Section 25404 of the Health and Safety Code, and (3) this bill is enacted after AB 1640, in which case Sections 5 and 6 of this bill shall not become operative.

SEC. 9. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because the only costs that may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, eliminates a crime or infraction, or changes the penalty for a crime or infraction, within the meaning of Section 17556 of the Government Code, or changes the definition of a crime within the meaning of Section 6 of Article XIII B of the California Constitution or because a local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service

mandated by this act, within the meaning of Section 17556 of the Government Code.

O

Exhibit F

Water Air Soil Pollut
DOI 10.1007/s11270-008-9833-6

The Fallout from Fireworks: Perchlorate in Total Deposition

Jennie Munster · Gilbert N. Hanson · W. Andrew Jackson · Srinath Rajagopalan

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Abstract Recent studies have shown that natural perchlorate may be an important component to the general population exposure. These studies indicate that natural perchlorate is likely deposited by atmospheric deposition. Perchlorate concentration of total (dry + wet) deposition is relatively unstudied yet these measurements will aid in understanding natural levels in the environment. We sampled total deposition monthly at six sites in Suffolk County, Long Island, NY from November 30, 2005 until July 5, 2007. The mean perchlorate concentration is 0.21±0.04 (standard error) μg L^{-1} with a maximum value of 2.78 μg L^{-1}. Here we show up to an 18-fold increase above the mean concentration in July 2006 and July 2007 samples. It appears that this increase in perchlorate in total deposition is associated with Fourth of July fireworks.

Keywords Fireworks · Groundwater · New York · Perchlorate · Precipitation

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1 Introduction

While perchlorate is known to inhibit iodide uptake of the thyroid gland, whether low microgram levels of perchlorate in drinking water are a health concern is still highly debated (Blount and Valentin-Blasini 2006). The US Environmental Protection Agency has yet to establish a national drinking water standard, while many states have set advisory levels. New York State has implemented advisory levels of 18 μg L^{-1} ClO_4 for the public notification level and 5 μg L^{-1} ClO_4 for the drinking water planning level in groundwater. Advisory levels are as low as 1 μg L^{-1} in Massachusetts, Maryland and New Mexico (EPA 2005). Establishing background concentration of perchlorate in precipitation and groundwater, and determining whether the perchlorate is natural or anthropogenic is a prerequisite for determining drinking water standards.

Since the presence of perchlorate in precipitation has only recently been measured (Dasgupta et al. 2005; Barron et al. 2006), the sources of perchlorate in precipitation are not well known. A major source could be the formation of perchlorate in the atmosphere from chlorine species (Dasgupta et al. 2005). Perchlorate in the atmosphere may also be from sea spray since perchlorate is present in seawater (Martinelango et al. 2006). Perchlorate is present in surface soils of the southwest (Rao et al. 2007), thus it is conceivable that perchlorate in dust is picked up by wind, transported and deposited as dry deposition. An anthropogenic source of perchlorate in the atmosphere may be

fireworks. Atmospheric fallout from fireworks consists of fine particles of burnt black powder, paper debris and residue. Perchlorate in paper debris ranges from 302 to 34,200 μg kg^{-1} (DEP 2006). Two studies (Backus et al. 2005; Wilkin et al. 2007) show direct perchlorate contamination of lake water from fireworks displays.

The Massachusetts Dept. of Environmental Protection has determined that historic fireworks displays are the likely source of perchlorate contamination in two of the nine public water supply systems showing levels above 1 μg L^{-1} (Mass. DEP 2006). Although little information is available on the perchlorate content in fireworks their model predicts that groundwater should be contaminated to the tens of μg ClO_4 L^{-1} within 100 meters of the fireworks display. This assumes 1,000–2,000 aerial shells weighing a total of 1,361 kg, of which 40% is ClO_4 and the contaminated area (fireworks fallout area) is equal to 3,600 m^2.

To establish a perchlorate contribution from the atmosphere we collected monthly samples of total deposition at six sites in Suffolk County, Long Island, NY from November 2005 to July 2007 (Fig. 1). We analyzed samples for ClO_4 and also NO_3, NH_4, Cl, Br, I, SO_4, Na, Mg, K, Ca, Sr and B.

2 Methods

One hundred and eight total (wet plus dry) deposition samples were collected monthly for 20 months between November 30, 2005 and July 5, 2007 at six sites in Suffolk County, NY. Suffolk County is the eastern most county on Long Island, which extends east from Queens and Brooklyn. All sample sites are in or near urban areas (Fig. 1).

Samples were collected using All-Weather Precipitation Gauges purchased from Fisher Scientific. These gauges sample both wet and dry (total) deposition since they are not covered during dry periods. The sampling area of the gauge is 10 cm in diameter. The inner sampling device, used to determine rainfall, is 26 cm in height and 3.2 cm in diameter. Evaporation from these samplers is minimal due to the small opening at the top of the gauge. For example, annual rainfall totals for 2006 at our sites ranged from 110 to 130 cm which are only slightly less than the 137.4 cm value for 2006 reported by The National Weather Service for Islip, NY which is in the center of Long Island (http://www.weather.gov/climate). The variation between our sites and Islip, NY could be due to spatial differences as wet

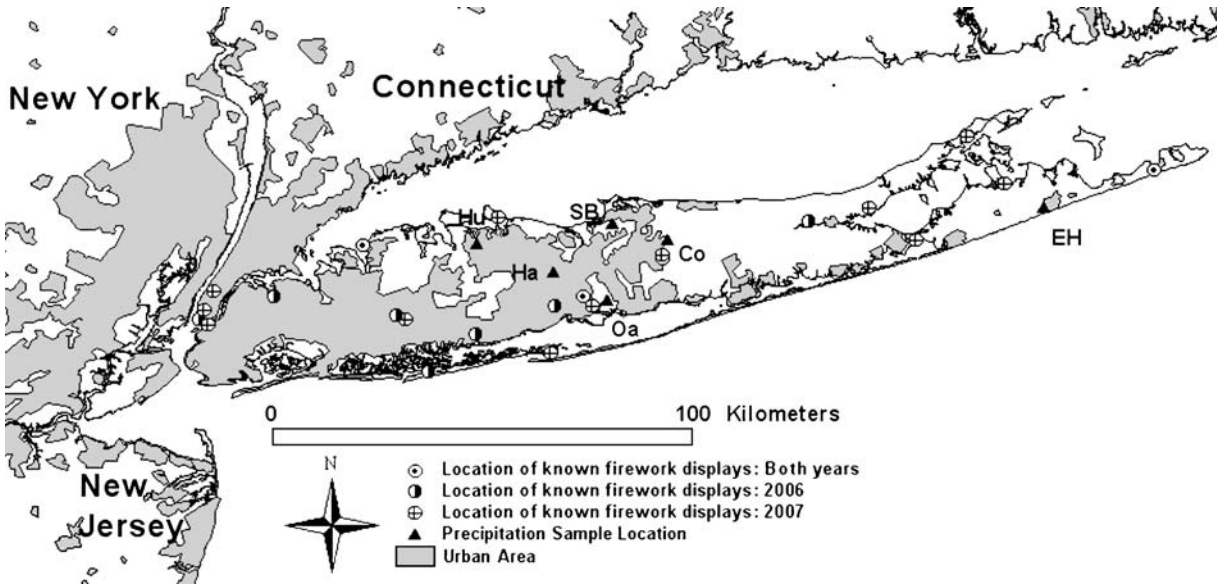

Fig. 1 Location of sample gauges in Suffolk County, Long Island, NY. Site names are abbreviated; *Hu* Huntington, *Ha* Hauppauge, *SB* Stony Brook, *Co* Coram, *Oa* Oakdale, and *EH* East Hampton. *Gray areas* are urban as mapped by the US Geological Survey according to the Digital Chart of the World, revised version of 1998 data. In general, urban areas are a concentration of at least 5,000 persons in continuous collection of houses where the community sense is well developed and the community maintains public utilities, such as, roads, street lighting, water supply, sanitary arrangements etc. Note that two firework display locations overlap near the Coram site. The covered symbol had firework displays both years

precipitation can vary as much as 20 cm (8 in.) across Long Island (Busciolano 2004).

Samples were filtered in the field using a 0.2-μm surfactant-free cellulose acetate (SFCA) filter for perchlorate analysis and 0.45 μm glass fiber filters for all other analysis. Samples were stored in sample rinsed, polypropylene vials untreated for all samples except nitrogen. Vials for nitrogen were acid rinsed with a 10% HCl solution before sample collection. Samples were stored in a cooler while in the field and then at 4°C until analyzed. Samples for nitrogen, once in the laboratory, were frozen until analyzed.

Perchlorate was analyzed using a sequential ion chromatography-mass spectroscopy/mass spectroscopy (IC-MS/MS) technique (Koester et al. 2000) with a method detection limit of 0.005 μg L^{-1}. To account for matrix effects, all samples were spiked with an oxygen-isotope (^{18}O) labeled ClO_4 internal standard. Each sample was measured in duplicate or triplicate and the precision was on average ±5%. B, Br, I, Mg, Na, Ca, K, Sr, Cl, N–NO_3, NH_4 and SO_4, were also analyzed using standard methods.

We used the program Minitab to perform One-way analysis of variance (ANOVA, unstacked) Turkey tests, with a 95% confidence interval. A one-way analysis of variance is a way to test the equality of three or more means at one time by using variances.

The HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model was used to model simple air parcel trajectories from known firework displays for 24 h, in 1 h spacing, from July 4, 2006 and July 4, 2007 at 50 m height (Draxler and Rolph 2003).

3 Results

The mean monthly perchlorate concentration of total deposition samples is 0.21±0.04 (standard error) μg L^{-1}. The maximum monthly value is 2.78 μg L^{-1}. The mean value is similar to that reported from Lubbock, TX, 0.20 μg L^{-1} (Dasgupta et al. 2005), while the maximum is similar to the highest value reported in Ireland, 2.82 μg L^{-1} (Barron et al. 2006). What is striking about our data set is the large peak in perchlorate concentrations in the July samples for both 2006 and 2007 collected after the Fourth of July (Fig. 2). Many communities in and around the Metropolitan New York area, which includes Long Island, have large firework celebrations on the evening

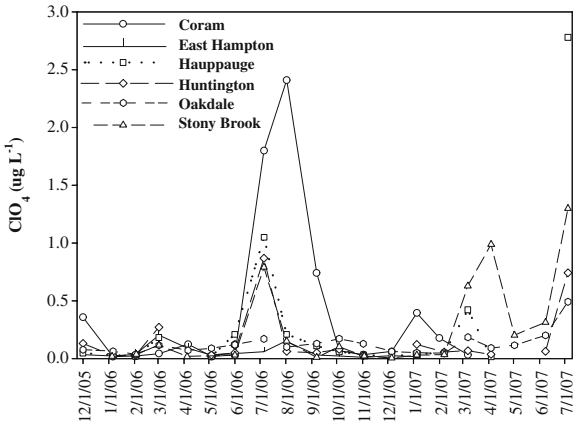

Fig. 2 Monthly perchlorate concentrations for total deposition samples. Collection at Coram was discontinued after March 2007 and discontinued at East Hampton after January 2007

of, and leading up to the Fourth of July. Although fireworks are illegal in New York State, residents also set off fireworks in their neighborhoods. We have located (Fig. 1) known displays during the Fourth of July celebrations reported in Newsday (July 2, 2006 and July 4, 2007), using oral communication with local town clerks, from information on a local fireworks company's website (http://www.grucci.com) and other sources (http://hamptons.plumtv.com; http://www.sagharboryc.com). We have not located all the firework displays, but we believe that we have located the larger ones. Modeled air trajectories, using HYSPLIT, in western Suffolk County, NY, and Atlantic City, NJ, travel in a north to northeast pattern that pass over the rain gauges in Suffolk County. Modeled air trajectories in New York City travel in a similar pattern but do not pass over Suffolk County.

Excluding the samples from July the mean concentration of perchlorate in precipitation is 0.12±0.03 (standard error) μg L^{-1}. Perchlorate concentrations are significantly higher in July compared to all months except August ($p<0.05$). Mean values vary between the six sites, although there was no statistical difference ($p<0.05$). Coram has the highest mean value of 0.40± 0.70 (standard deviation) μg L^{-1}. East Hampton has the lowest mean of 0.06±0.06 μg L^{-1}. Hauppauge has a mean value of 0.27±0.14 μg L^{-1}, Huntington a value of 0.14±0.06 μg L^{-1}, and Stony Brook a mean value of 0.25±0.09 μg L^{-1}. There was no significant correlation (defined as $R^2>0.5$) between ClO_4 and the other ion analyzed.

4 Discussion

In our study area, wet deposition occurred between the Fourth of July and the time of sample collection for both years of this study (http://www.weather.gov/climate). These three storms originated inland and progressed in a west to east direction, moving slightly north during the 2006 events, as noted on NOAA archived radar images (http://www4.ncdc.noaa.gov). The timing of wet deposition combined with modeled air trajectories indicates a high probability that firework fallout is the cause of increased perchlorate concentration in the July samples. The effects of atmospheric pollution from fireworks have been reported by other studies noting increases in SO_2, NO_2, suspended particles and metallic elements (Moreno et al. 2007; Ravindra et al. 2003). Precipitation scavenging can effectively remove pollutants from the atmosphere, with wet deposition being more effective than dry deposition (Loosmore and Cederwall 2004).

Two studies (Backus et al. 2005; Wilkin et al. 2007) which show direct contamination of lake water from firework displays measured perchlorate concentration adjacent to the displays. Our rain gauges are, at the closest, a few km from known displays (Fig. 1). Thus wind properties and storm direction play a role in where the firework fallout eventually settles. Our rain gauges are mostly in areas zoned for business, except for Stony Brook which is on a university campus and Coram, which is in a residential neighborhood. Coram, coincidentally, had the highest concentration in July 2006. Sampling at that site was discontinued after March 2007. Coram is also very near known public firework displays (approximately 1.5 km). Oakdale, which is also near known firework displays, has relatively low concentrations with a value of 0.17 μg L^{-1} on July 6, 2006 and 0.49 μg L^{-1} on July 5, 2007. It is likely that the wind and storm direction did not carry fireworks contamination towards the Oakdale study site in 2006 but that some contamination was received in 2007. Hauppauge measured 2.78 μg L^{-1} on July 5, 2007. There are no known fireworks displays near Hauppauge, yet fireworks fallout from the south is likely influencing Hauppauge rain water. Additionally, there may have been fireworks near Hauppauge that we are unaware of. It is likely that the perchlorate from fireworks in our precipitation samples have traveled some distance in the atmosphere and perchlorate concentrations of precipitation adjacent to large fireworks displays may be much higher than we report.

Our study showed that precipitation concentrations after Fourth of July fireworks displays can be 18 times as much as background levels confirming that, "fireworks constitute a potential source of increasing importance, as fireworks use is rising exponentially with average consumption at 4.5×10^7 kg per year" (Dasgupta et al. 2006). As a result we need to be concerned about the potential impact on our groundwater of increased perchlorate in precipitation associated with fireworks.

Acknowledgment This study was funded by the Suffolk County Water Authority and by a Department of Education GAANN Fellowship to JM.

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Exhibit G

EXCEPTIONAL EVENT REQUEST

FIREWORKS DISPLAY IMPACT

GRANITE CITY, ILLINOIS

Site 17-119-1007

July 5, 2008 $PM_{2.5}$ Sample

submitted by

Illinois Environmental Protection Agency

March, 2009

Background

Some national and/or cultural traditions, such as July 4th Independence Day and the Chinese New Year, have long included fireworks displays as important elements of their observances. While this issue is not specifically covered in the Clean Air Act Section 319, the United States Environmental Protection Agency (US EPA) has stated that they believe Congress did not intend to require US EPA to consider air quality violations associated with such cultural traditions in regulatory determinations. In that regard , US EPA has adopted rules governing the review and handling of air quality measurements that have been unduly influenced by fireworks displays as exceptional events.

In the Code of Federal Regulations at 40 CFR Part 50.14(b)(2), it states that US EPA shall exclude data from use in determinations of exceedances and violation of a National Ambient Air Quality Standard (NAAQS) where a state demonstrates to US EPA's satisfaction that emissions from fireworks displays caused a specific air pollutant concentration to be in excess of one or more NAAQS at a particular monitoring location. Such data is to be treated as an exceptional event under the rule, provided that the state demonstrates that the violation would not have occurred "but for" the event, that is, absent the impact of fireworks display emissions, the critical value would have been below the NAAQS.

Exceptional Event - July 5, 2008

The Illinois EPA has determined that such an exceptional event did occur on July 5, 2008 at the Granite City (17-119-1007) monitoring site location. The site recorded a value of 41.8 micrograms per cubic meter (ug/m3) on July 5, 2008 that was significantly influenced by fireworks display emissions that lingered in the area after the events on the late evening of July 4th. The 41.8 ug/m3 measurement resulted in the site recording a 98th percentile value of 36.0 ug/m3 for 2008 and that in turn, provided an average 98 percentile value for 2006-2008 of 36.1 ug/m3, thus a violation of 35 ug/m3 daily $PM_{2.5}$ NAAQS. Absent the 41.8 ug/m3 value, the Granite City results would provide a 98 percentile value of 31.9 ug/m3 in 2008 and an average 98 percentile value for 2006-2008 of 34.7 ug/m3, below the daily $PM_{2.5}$ NAAQS. "But for" the July 5th measurement that was significantly impacted by fireworks displays emissions, the Granite City site would have complied with the $PM_{2.5}$ daily NAAQS.

In order to substantiate the significance of the fireworks emissions impacts, Illinois EPA analyzed air quality, chemical speciation and meteorological data for July 5th. That analysis clearly shows that "but for" the contribution from fireworks emissions, the Granite City measurement would have been from 11.4 to 17 ug/m3 lower. This would have resulted in a daily value of only 25 to 30 ug/m3 and a value well below the $PM_{2.5}$ NAAQS. The Illinois EPA data analysis was based upon:

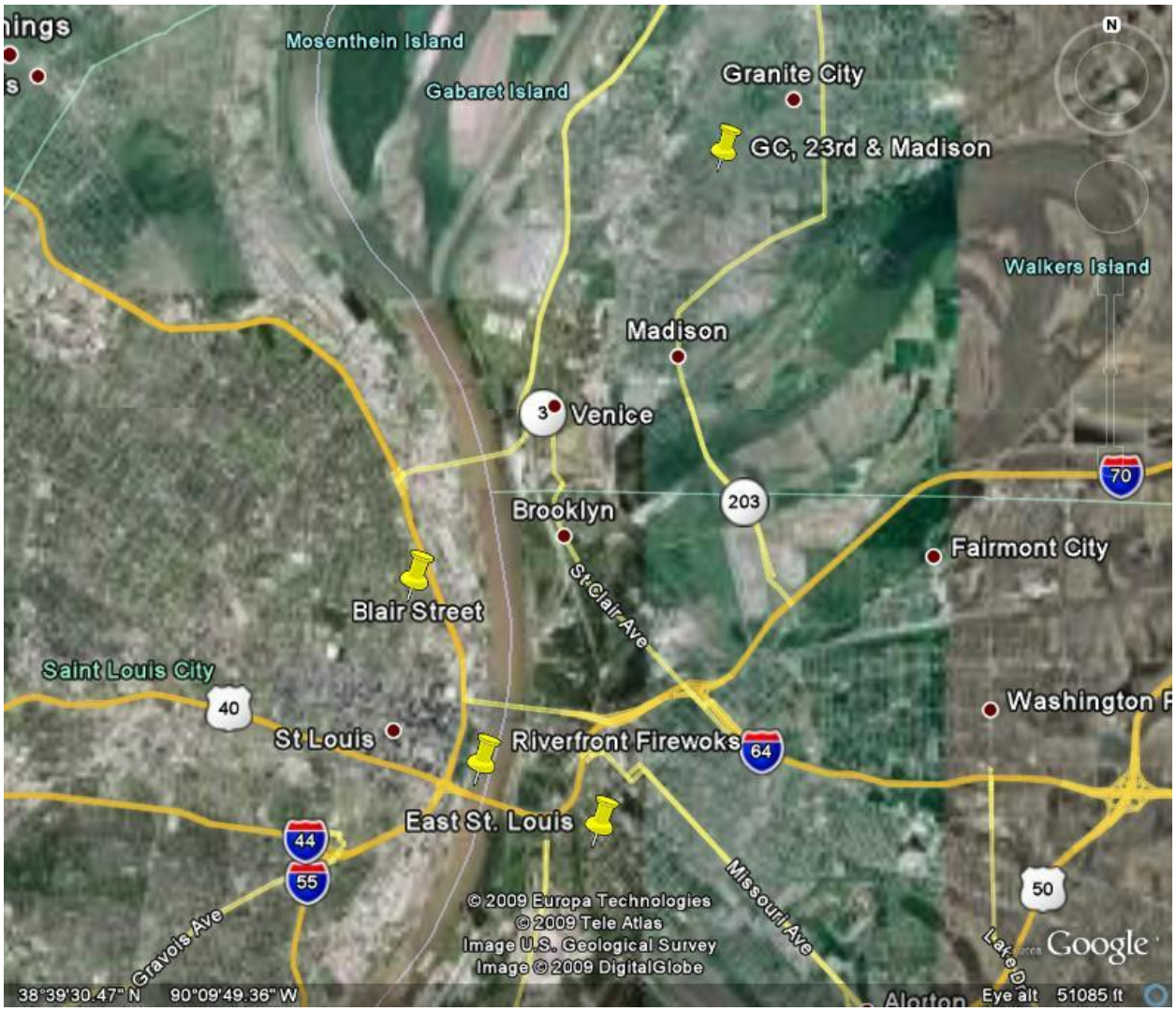
1) Real-time PM monitoring data. Histograms of hourly continuous data.
2) Chemical speciation data. Measured concentrations of metals associated with fireworks.
3) Meteorological observations. Illinois EPA and National Weather Service wind and visibility data.

The following sections provide discussion of these data and an interpretation of the results as they pertain to the significant influence of fireworks display emissions on July 4th and 5th.

Real-time Monitoring Results

As shown on the map displayed in Figure 1, there are three continuous PM monitoring stations in and around Granite City, a PM_{10} monitor in Granite City (17-119-1007), a $PM_{2.5}$ monitor at E. St. Louis (17-163-0010) located 4 miles South of Granite City, and a $PM_{2.5}$ monitor at St. Louis- Blair St (25-510-0085) 4 miles Southwest of Granite City. The St. Louis Riverfront (Arch) July 4th fireworks display is a massive event and is the main event in the St. Louis area Independence Day celebration. The location of the fireworks discharge as shown on the map was along the riverfront just west of the E. St. Louis air monitoring site. All three monitoring sites were in close proximity to the fireworks display.

Figure 1



The hourly data from the three monitoring sites for the period of July 3rd through July 6th has been displayed in Figures 2-4. As can be seen from the graphs, beginning at 9:00 pm (2100) PM levels begin to spike dramatically. This coincides with the beginning of the fireworks displays and clearly shows their impact across the area. For the hours during with the fireworks display (July 4th 2100-2200), hourly $PM_{2.5}$ concentrations reached 188 ug/m3 at St. Louis- Blair St. and 146 ug/m3 at E. St. Louis and 120

Figure 2
East St. Louis Continuous $PM_{2.5}$
July 3 - 6, 2008

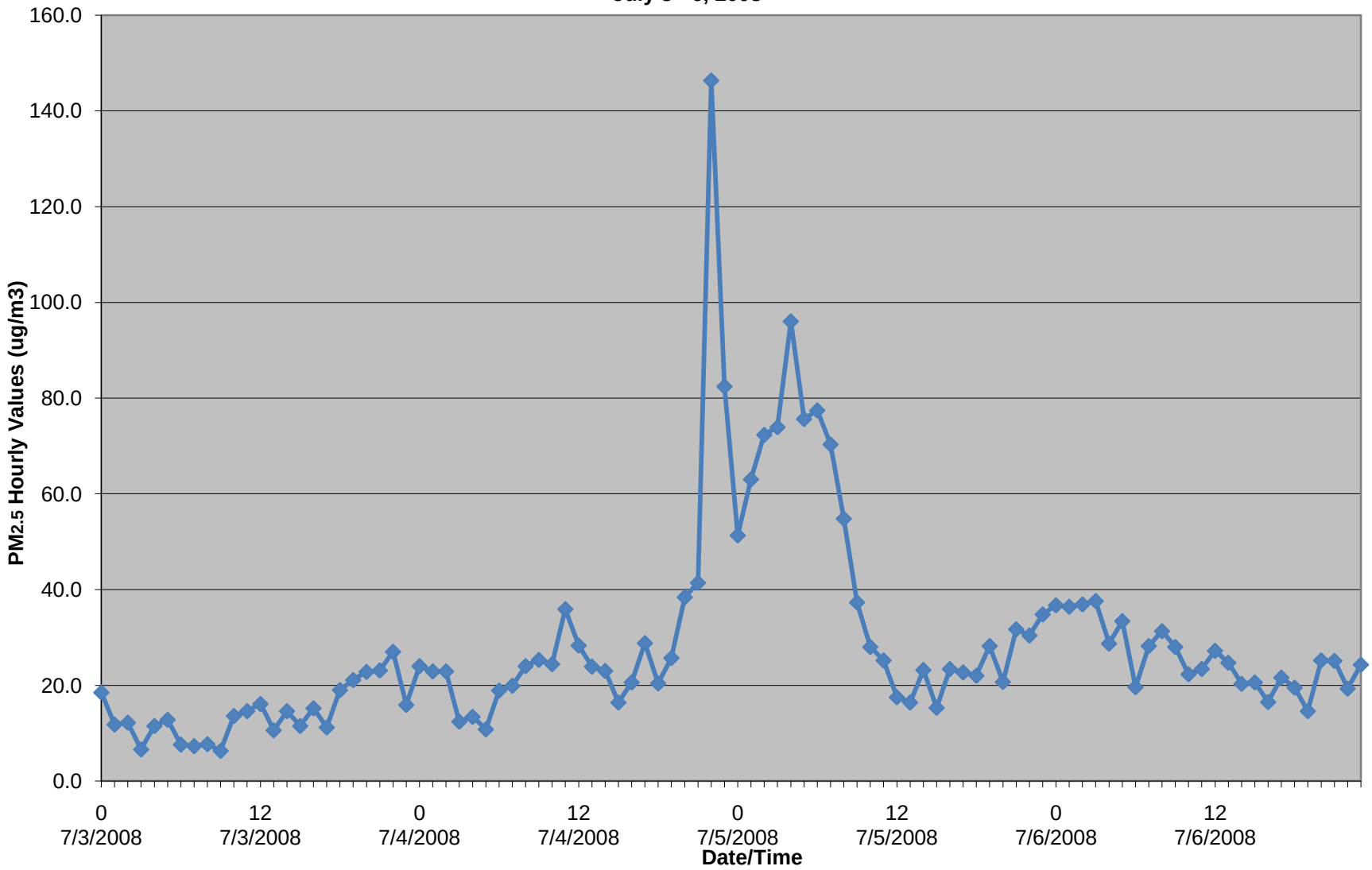


Figure 3
Blair Street St. Louis, MO Continuous $PM_{2.5}$
July 3 - 6, 2008

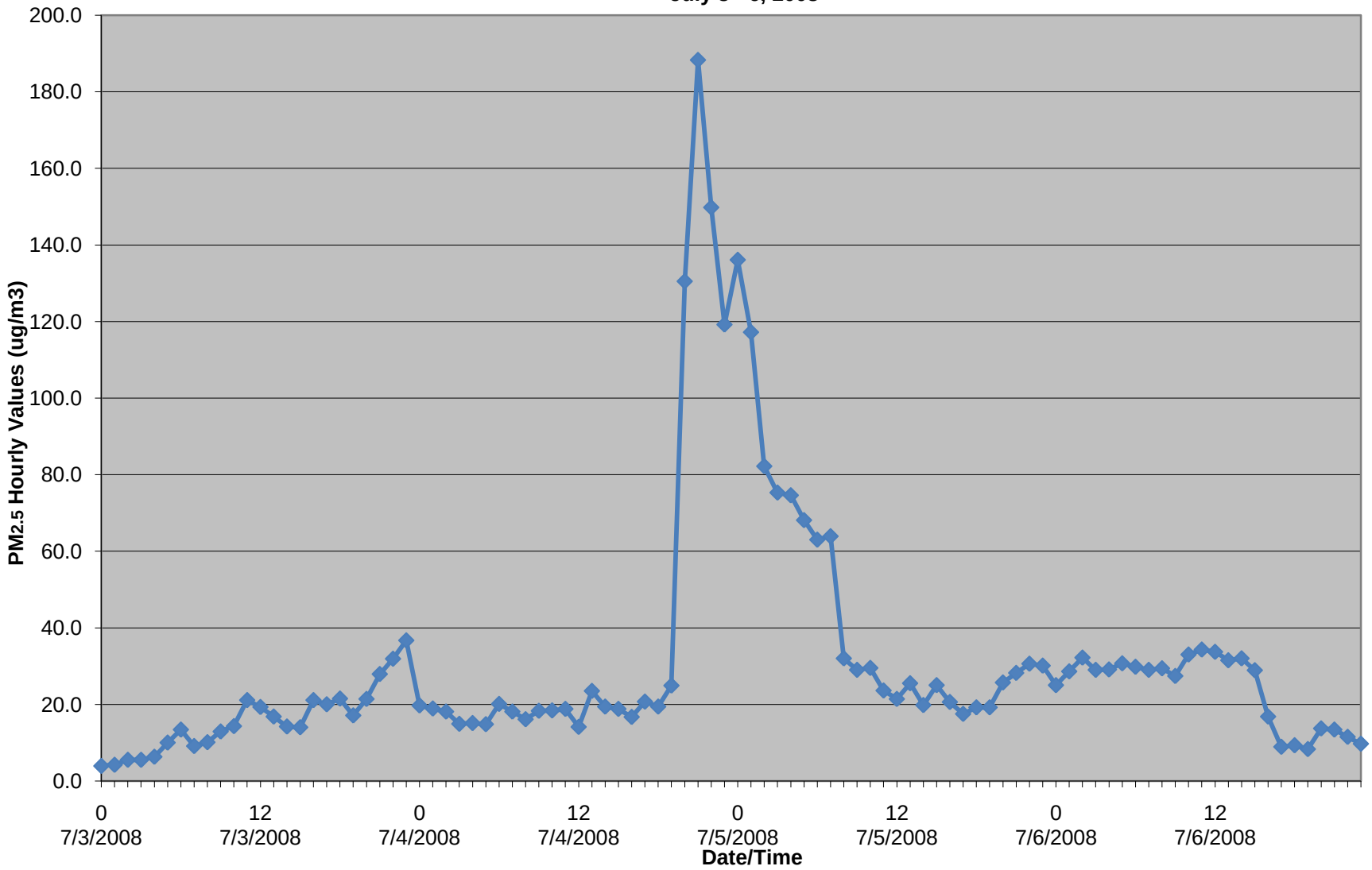
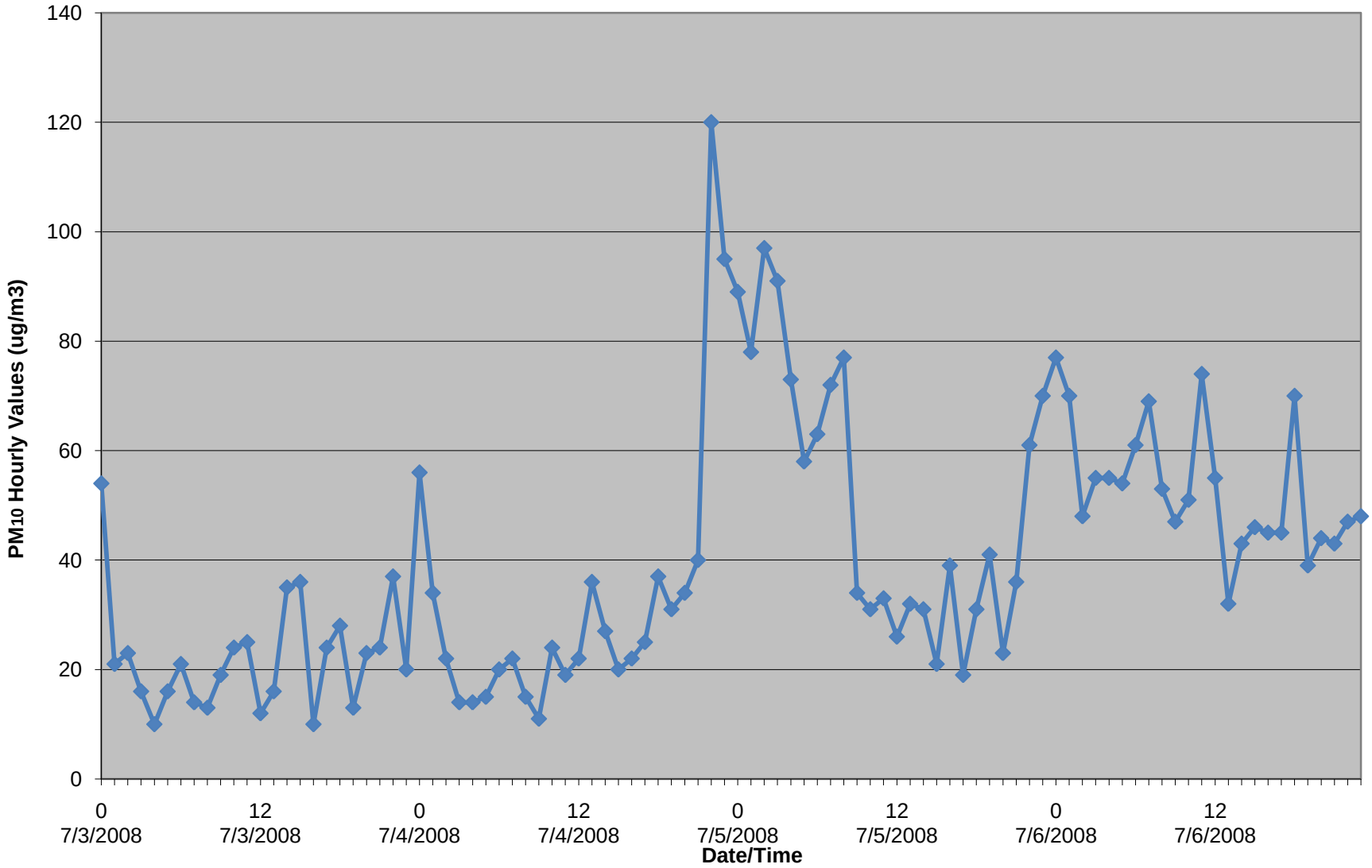


Figure 4
Granite City - 23rd & Madison Continuous PM_{10}
July 3 - 6, 2008



ug/m3 of PM_{10} measured at Granite City. As the fireworks associated emissions lingered in the area due to light winds, the $PM_{2.5}$ levels remained elevated at all three sites until 0800 on July 5th. During the early morning hours on July 5th, the St. Louis- Blair St. recorded $PM_{2.5}$ hourly values of 138 and 118 ug/m3 and E. St. Louis site recorded a $PM_{2.5}$ hourly value of 96 ug/m3. As Figures 2-4 illustrate, the concentrations of PM dropped dramatically after 0800 on July 5th when area winds increased and PM levels dispersed. The daily (Midnight to Midnight) PM values measured at the three sites on July 5th were as follows:

E. St. Louis (17-163-0010) $PM_{2.5}$ - 42.1 ug/m3

St. Louis Blair St. (25-510-0085) $PM_{2.5}$ - 44.9 ug/m3

Granite City PM (17-119-1007) PM_{10} - 51.0 ug/m3

These three values agree closely with the 41.8 ug/m3 value recorded on July 5th by the FRM sampler located at Granite City (17-119-1007) and the subject of this exceptional event request.

While the fireworks impacts are obvious from Figures 2-4, an analysis was conducted to estimate the contribution of the fireworks displays emissions to area PM2.5 levels. Both St. Louis- Blair St. and E. St. Louis monitors recorded levels at 25 ug/m3 for extended periods before and after the fireworks event. Using 25 ug/m3 as a baseline for July 5th, the mass concentrations of $PM_{2.5}$ measured from hours 0000 through 0800 were adjusted by subtracting 25 ug/m3 and the remaining total mass totaled. This adjusted mass was then compared to the total mass for the day to estimate the per cent contribution of hours 0000-0800 (fireworks) to the July 5th measurements. The analysis results found St. Louis- Blair St. to have 44% and E. St. Louis to have 40.5% of their July 5th mass directly associated to the fireworks display emissions. Using the more conservative number of 40.5% to estimate the fireworks impact to the 41.8 ug/m3 FRM measurement at Granite City, an impact of 16.9 ug/m3 was projected. The analysis concludes that absent the fireworks display impact (16.9 ug/m3), the Granite City FRM value for July 5th would have been only 24.9 ug/m3 and provides supportive evidence that no violation would have occurred but for the fireworks event.

Those sites outside of the downtown E. St. Louis area were found to have recorded significantly lower $PM_{2.5}$ values on July 5th. The Houston site located in a rural area south of the St. Louis area (Randolph County) recorded a value of only 18.8 ug/m3 and the Alton and Wood River sites located 10 miles north of Granite City recorded values of 25.5 and 24.0 ug/m3 respectively. These data indicate that the regional air mass (background) concentration on July 5th was well below the level of the NAAQS. A review of historical $PM_{2.5}$ data for the Granite City (17-119-1007) site for the period of 2006 through 2008 found that the 41.8 ug/m3 value on July 5, 2008 was the highest of the 322 daily measurements reported. The second highest daily value was 40.0 ug/m3 reported on February 28, 2006. Clearly, as the 100 percentile value, the 41.8 ug/m3 value on July 5, 2008 would meet the criteria of being in excess of normal historical values. These results would serve to confirm an incrementally significant impact of fireworks emissions on July 5th.

Chemical Speciation Results

The Granite City (17-119-1024) site includes a special sampler to provide information on the chemical composition of collected $PM_{2.5}$ mass. The site is one of US EPA's national trend sites for chemical speciation and samples collected from Granite City are submitted to US EPA's national contract laboratory for analysis and reporting. A valid sample was collected at Granite City on July 5, 2008 and the results were available for analysis to confirm impacts from fireworks displays emissions.

Previous requests to US EPA for the approval of a sample as an exceptional event impacted by fireworks emissions have included supporting chemical speciation data. Fireworks emissions are particularly rich in certain compounds and elements that are not normally found in high concentration in $PM_{2.5}$ mass. The presence of these compounds/elements then serve as a tracer for fireworks emissions and can indicate a level at which a particular sample has been impacted. Fireworks tracers that have been identified are barium, copper, potassium, strontium, ammonium, nitrates, sulfates and organic carbon.

A review of the Granite City sample for July 5, 2008 revealed significantly high concentrations of all of these fireworks tracers. The following data tables summarize the July 5th results and provides the site average for each fireworks tracer compound/element .

As can be seen from Tables 1 and 2, significantly higher than normal levels of potassium, barium and strontium (which is almost never detected) were present in the July 5th sample. Sulfates, nitrates and organic carbon were also well above normal values. These results clearly substantiate a significant impact of fireworks emissions on the July 5th Granite City sample. By using the difference between the July 5th sample results and the average values recorded at the Granite City site over the previous year, an approximation of mass associated with the fireworks impact can be determined. The tables provide the these compound/element differences to total up to 11.4 ug/m3. While lower that the 16.9 ug/m3 impact projected from the real-time data, the 11.4 ug/m3 impact projected from the speciation data is significant. Subtracting that amount from the July 5th value of 41.8 ug/m3, a Granite City $PM_{2.5}$ concentration of only 30.3 ug/m3 would have been projected.

Table 1.

Granite City Gateway Medical - Speciation Data (ug/m3)						
Period	**Elements Total**	**Ammonium**	**Nitrate**	**Sulfate**	**Elemental Carbon**	**Organic Carbon**
7/5/2008	2.7	2.4	2.0	8.0	0.8	5.6
Site Average	1.4	1.4	0.8*	3.1	0.6	2.8
Difference	**1.3**	**1.0**	**1.2**	**4.9**	**0.2**	**2.8**
Difference Sum	**11.4**					

*Nitrate uses May through October average.

Table 2.

Element	Element Concentrations 7/5/2008	Site Average
Aluminum	0.06	0.03
Barium	0.08	0.01
Copper	0.04	0.01
Magnesium	0.13	0.02
Potassium	1.87	0.12
Strontium	0.03	0.00
Sum	**2.21**	**0.19**

As with the real-time monitoring data, the chemical speciation data for July 5th provides supportive evidence that no violation at Granite City would have occurred but for the fireworks event of July 4-5, 2008. The range of projected fireworks related mass contribution of 11.4 to 16.9 ug/m3, derived from chemical speciation and real-time monitoring data respectively, provides an estimated July 5th $PM_{2.5}$ value of only 25 to 30 ug/m3. This analysis provides convincing evidence that no violation of the NAAQS would have occurred but for the July 5th fireworks event.

Meteorological Data and Observations

A detailed summary of the meteorological conditions present on July 4-5, 2008 was prepared and is presented in Attachment 1. The evening of July 4th experienced light, variable winds which dropped to calm at Midnight. The calm conditions persisted until 0900 on July 5th. In effect , these meteorological conditions hindered the dispersion of the fireworks emissions to the extent that smoke and haze blanketed the downtown riverfront area during the late hours of July 4th and into the morning hours of July 5th. These conditions are reflected in the National Weather Service (NWS) observations at St. Louis Airport (Lambert Field). Prior to the fireworks displays, the NWS reported visibility as 10 miles (best conditions for St. Louis) and no other special observations. The Midnight report indicated visibility at 10 miles dropping to 6 miles at 0300 and to 4 miles at 0600. Along with the dropping visibility, the NWS weather observers reported haze at the 0300 and 0600 hours. This reduced visibility and reported haze coincide with calm winds and the time period of recorded elevated $PM_{2.5}$ concentrations at all three real-time monitoring stations.

The NWS data and observations provide additional corroboration of the earlier analysis findings that fireworks displays emissions lingered into the early morning hours of July 5th. These independent data and observations coincide with the time periods of elevated PM measurements reported by the area monitoring stations and further support the technical analysis findings.

Summary

The Illinois EPA has determined that on July 5, 2008 the Granite City (17-119-1007) monitoring site recorded a value of 41.8 micrograms per cubic meter (ug/m3) that was significantly influenced by fireworks display emissions that lingered in the area after the events on the late evening of July 4th. In order to substantiate the significance of the fireworks emissions impacts, Illinois EPA analyzed air quality, chemical speciation and meteorological data for July 5th. The analysis clearly showed that "but for" the contribution from fireworks emissions, the Granite City measurement would have been from 11.4 to 17 ug/m3 lower. Absent the contribution from the fireworks emissions, the July 5th $PM_{2.5}$ measurement at Granite City would have been only 25 to 30 ug/m3 and a value well below the $PM_{2.5}$ NAAQS.

As a result, the Granite City (17-119-1007) $PM_{2.5}$ value of 41.8 ug/m3 reported for July 5, 2008 has been flagged as an exceptional event by the Illinois EPA. Concurrence of this event by US EPA is requested.

Attachment 1.

Meteorology on July 4th and 5th, 2008

On the morning of July 4th, 2008 areas of high pressure were located in the Lake Michigan vicinity. A 1021 mb high was centered of southern Wisconsin and a second 1021 mb high was centered over northern lower Michigan. An area of low pressure was located in southern Illinois along a stationary front that stretched from just off the New England coastline southwestward to the boot heel of Missouri and northwestward over the Eastern Rockies. Shower and thunderstorm activity was occurring along this boundary just south of the St. Louis, Missouri area. Winds were from the north and northeast at just under 10 mph through the mid afternoon time period. Reference to Figure 1 shows by 7 p.m. on July 4th high pressure had expanded over the entire Great Lakes region with a lightening surface wind pattern. The stationary front was still located from New England into the Missouri boot heel. Chart 1 shows wind speeds under 10 mph going calm just before midnight.

Figure 1.

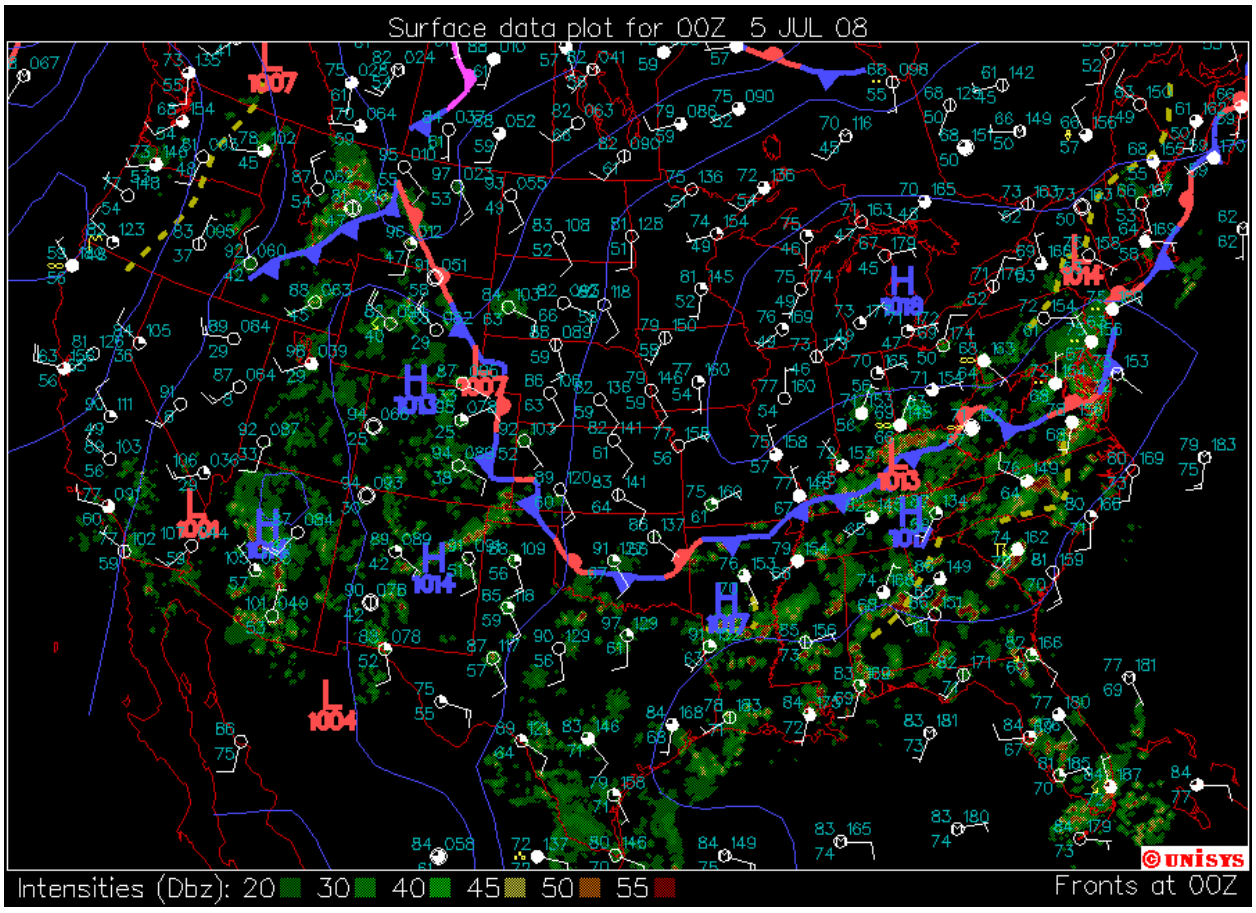


Chart 1.

NWS Monitoring Site: St. Louis, MO					
Date	Hour Ending	Visibiltiy (Miles)	Wind Direction (deg)	Wind Speed (mph)	Weather Remarks
7/4/08	03:00	9.00	50	7.0	
	06:00	10.00	30	9.0	
	09:00	10.00	350	8.0	
	12:00	10.00	340	8.0	
	15:00	10.00	320	7.0	
	18:00	10.00	350	7.0	
	21:00	10.00	320	7.0	
	24:00	10.00	0	0.0	

During the morning hours of July 5th, 2008 the stationary front was still located near southern Missouri with light winds throughout the area. Figure 2 shows the surface set-up at 7 a.m. local time. The St. Louis, Missouri weather station was reporting haze at the time indicated with the ∞ symbol to the left of the station plot. Chart 2 also indicates haze in the area through at least the 6 a.m. report. Visibilities during this time frame dropped significantly. The midnight report indicated visibility up to 10 miles dropping down to 6 miles at 3 a.m. and 4 miles at 6 a.m. By the afternoon, visibilities increased back towards 10 miles and wind speed increased from calm up to near 10 mph.

Figure 2.

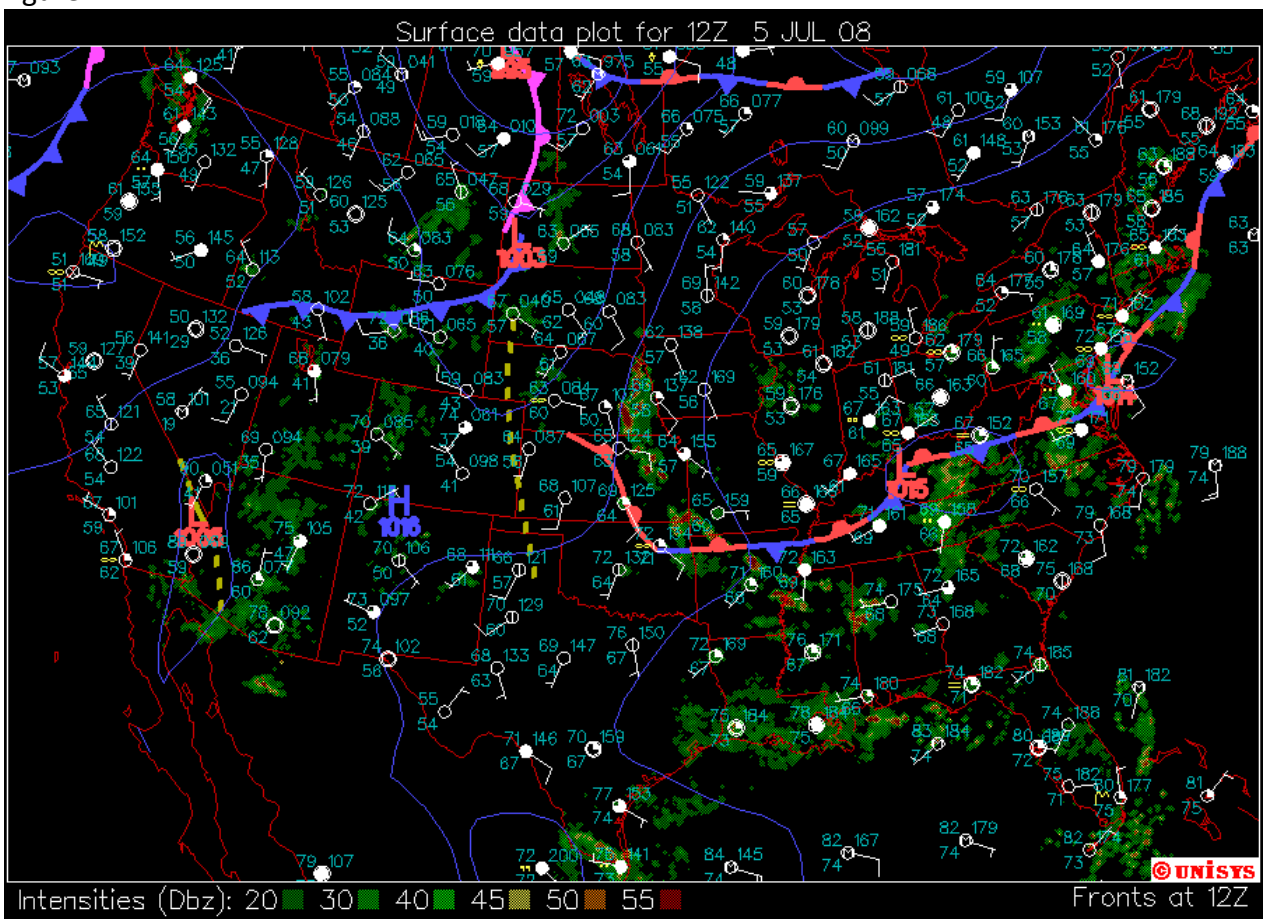


Chart 2.

NWS Monitoring Site: St. Louis, MO					
Date	Hour Ending	Visibiltiy (Miles)	Wind Direction (deg)	Wind Speed (mph)	Weather Remarks
7/5/08	03:00	6.00	0	0.0	Haze
	06:00	4.00	0	0.0	Haze
	09:00	7.00	110	7.0	
	12:00	9.00	0	0.0	
	15:00	10.00	150	6.0	
	18:00	10.00	120	6.0	
	21:00	8.00	110	6.0	
	24:00	9.00	150	7.0	

Granite City (17-119-1007) July 5, 2008 Exceptional Event

ADDITIONAL INFORMATION

Submitted July 13, 2009

Granite City Festival and July 4th Fireworks Display at Wilson Park

Wilson Park is located just five blocks Northeast of the Granite City Fire Station and each year hosts a weekend festival and July 4th fireworks display. The fireworks display is impressive as can be seen on the YouTube videos of the July 4, 2006 Grand Finale at (http://www.youtube.com/watch?v=uVfivc-sAjs) and the July 4, 2008 Grand Finale at (http://www.youtube.com/watch?v=e9ceRvLmNXc&NR=1) . The July 4-5, 2008 wind direction/speed in Granite City (as measured at the nearby Illinois EPA meteorological site at Poag, IL) during and shortly after the fireworks display (10-12 pm) was from the Northeast (58-76 degrees) with light winds (less than 1 mph). See the attached wind data from Edwardsville/Poag. These wind conditions would have taken the locally heavy concentrations of fireworks emissions directly to the Granite City Fire Station and then on to the Gateway Medical Center. See attached map. As described later in the discussion of chemical analysis data, fireworks emissions significantly contributed to the $PM_{2.5}$ exceedance measured at the Granite City Fire Station on July 5, 2008 and to elevated levels at the Gateway site. The Wilson Park, St. Louis Riverfront and many other fireworks displays all contributed emissions which resided in the area due to light winds and which impacted many of the $PM_{2.5}$ measurements on July 5, 2008.

Additional Chemical Analyses of PM2.5 FRM Filters

The FRM filters collected on July 5, 2008 from both the Granite City Gateway and Fire Station sites were submitted for chemical analysis to confirm the fireworks impacts at the Fire Station site. US EPA's national contract laboratory, Research Triangle Institute (RTI), performed the same XRF analyses for metals as that conducted on samples for the Chemical Speciation Network. The results are presented on attached RTI Analysis Summary. As can be seen from the following summary table of elements associated with fireworks, the FRM filter analysis results agree closely, are somewhat higher than the results obtained from the Chemical Speciation (SASS) sampler on July 5, 2008 and are significantly higher than the annual average data obtained from the Gateway site.

Chemical Analysis Summary for 7/5/08 Samples (ug/m3)

Element	SASS Concentration	Fire Station FRM	Gateway FRM	Gateway Average
Aluminum	0.06	0.18	0.08	0.03
Barium	0.08	0.16	0.20	0.01
Copper	0.04	0.06	0.08	0.01
Magnesium	0.13	0.25	0.26	0.02
Potassium	1.87	2.56	3.12	0.12
Strontium	0.03	0.05	0.06	0.00
Sum	2.21	3.26	3.80	0.19

These results clearly show that fireworks emissions significantly impacted both Granite City sites on July 5, 2008. In addition, using the analysis of sulfur which is an excellent surrogate for sulfate, the RTI sulfur results projected sulfate concentrations in good agreement with that found in the July 5, 2008 SASS data and illustrated that both Granite City sites showed much higher than normal sulfate concentrations on July 5.

Element	SASS Concentration	Fire Station FRM	Gateway FRM	Gateway Average
Sulfate	8.0	8.7 (sulfur 2.89)	8.6 (sulfur 2.86)	3.1

The RTI FRM filter results showed higher mass concentration impacts from the fireworks than the SASS data. Since the FRM filters results are used for the NAAQS compliance, the chemical analysis results provided in the Illinois Exceptional Event Request have been updated with the recent RTI metals and sulfates data. The results follow and would represent what Illinois EPA believes is the best estimate of fireworks emissions impact on at the Granite City Fire Station on July 5, 2008.

Granite City Chemical Analysis Data (ug/m3) for 7/5/08

Period	Fireworks Elements	Ammonium	Nitrates	Sulfates	Elemental Carbon	Organic Carbon
7/5/08	3.26	2.4	2.0	8.7	0.8	5.6
Average	0.19	1.4	0.8	3.1	0.6	2.8
Difference	3.07	1.0	1.2	5.6	0.1	2.8

Total Difference 13.77 ug/m3

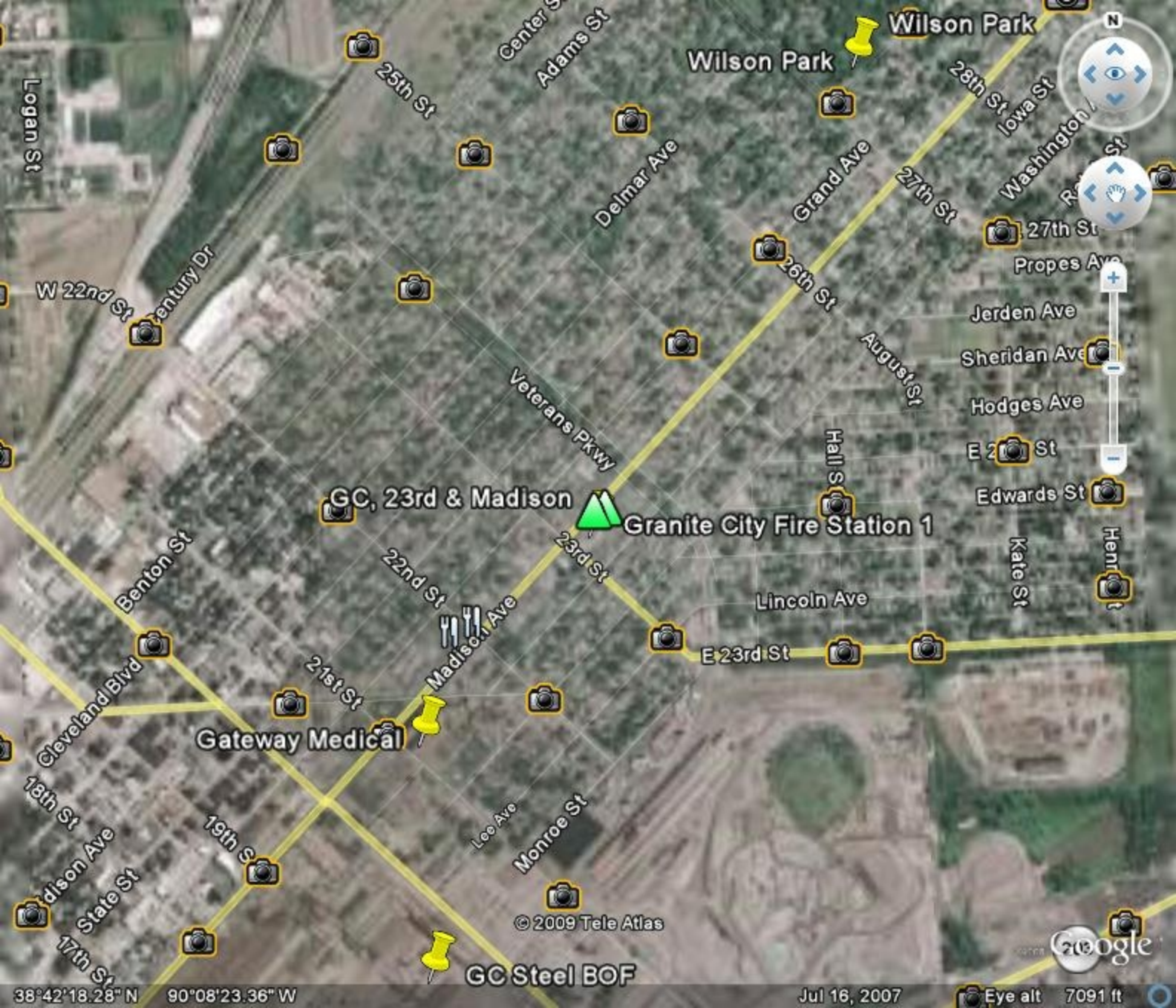
The chemical analysis data show significantly higher than normal levels of fireworks related metals and elevated concentrations of sulfates, nitrates and elemental/organic carbons all of which are also associated with fireworks emissions. The accumulated mass attributed to these fireworks related compounds was correspondingly estimated to be 13-14 ug/m3, thereby providing convincing evidence that absent the fireworks, the 41.7 ug/m3 $PM_{2.5}$ concentration measured at the Fire Station on July 5, 2008 would have been well below the 35 ug/m3 daily NAAQS. But not for the fireworks display events, no violation of the $PM_{2.5}$ NAAQS would have occurred.

Granite City Fire Station and Gateway Monitoring Sites

While the Granite City Fire Station measured a NAAQS exceedance (41.7 ug/m3) on July 5, 2008 the Gateway site did not, measuring a $PM_{2.5}$ value of 30.7 ug/m3. Comments have been received pointing to the difference in these values. The Illinois EPA believes that these differences are due to local conditions around the sites. The Gateway site is located just 2 city blocks from the Fire Station site but is exposed to local emission sources in differing ways. The Gateway site is 2 blocks closer to Granite City Steel's basic oxygen furnace (BOF), the predominant source in the immediate area. The Fire Station is located along a section of Madison Avenue that carries significantly more traffic (14,000 compared to 10,000 ADT at Gateway), has more truck traffic and lies along the city bus (diesel) routes. The Gateway site has 270 degrees of clear exposure, thus meeting the 40 CFR 58 Appendix E probe siting criteria, but is obstructed to the easterly direction by a much taller Medical Center building. The Fire Station has

clear exposure in 360 degrees. These locally variant sources of $PM_{2.5}$ emissions, site probe exposure differences and the differences associated to $PM_{2.5}$ measurement precision would potentially account for concentration differences when comparing daily data between the two sites.

A comparison of recent Gateway and Fire Station $PM_{2.5}$ data was prepared to illustrate the data variation. See the attached. The data comparison shows that concentration differences between the two sites of 7 to 10 ug/m3 are not uncommon. On 11/11/08, the Fire Station recorded a value 10.8 ug/m3 higher than Gateway, while on 12/20/08, the Gateway site was 10.9 ug/m3 higher than the Fire Station. Over the 62 day comparison, six days (10%) were found have a difference greater than 7 ug/m3. The data comparison also shows that on average, the two sites are very comparable as the 62 day averages were 11.1 ug/m3 at the Fire Station and 11.0 ug/m3 at Gateway. Illinois EPA believes the varying data from these two sites simply reflects differing source impacts on some days and similar impacts on most days.


Wilson Park
Wilson Park
25th St
Center St
Adams St
Logan St
Delmar Ave
Grand Ave
27th St
28th St
Iowa St
Washington
27th St
26th St
Propes Ave
Jerden Ave
Sheridan Ave
August St
Hodges Ave
Edwards St
W 22nd St
Century Dr
Veterans Pkwy
GC, 23rd & Madison
Granite City Fire Station 1
Hall St
Kate St
Benton St
22nd St
23rd St
Lincoln Ave
E 23rd St
Madison Ave
21st St
Cleveland Blvd
Gateway Medical
18th St
19th St
Lee Ave
Monroe St
State St
17th St
© 2009 Tele Atlas
GC Steel BOF
Google
38°42'18.28" N
90°08'23.36" W
Jul 16, 2007
Eye alt 7091 ft

Date	Madison	Gateway	Concentration Difference	Madison from Gateway Percent Difference
10/03/08	12.9	13	-0.1	-1%
10/09/08	14	13.4	0.6	4%
10/15/08	8.1	11.8	-3.7	-46%
10/18/08	18	10.1	7.9	44%
10/21/08	6.3	11.3	-5	-79%
10/24/08	5.7	5.8	-0.1	-2%
11/02/08	23.8	26.5	-2.7	-11%
11/08/08	4.8	6.6	-1.8	-38%
11/11/08	19.8	9	10.8	55%
11/14/08	13	14.3	-1.3	-10%
11/20/08	9.7	10.7	-1	-10%
11/26/08	27.2	29.8	-2.6	-10%
11/30/08	11.4	13	-1.6	-14%
12/02/08	12.1	12.1	0	0%
12/08/08	7.1	10.1	-3	-42%
12/14/08	6.5	6.9	-0.4	-6%
12/20/08	6.8	17.7	-10.9	-160%
12/26/08	9.5	6.2	3.3	35%
01/01/09	9.8	9.5	0.3	3%
01/06/09	16.5	15.1	1.4	8%
01/07/09	11.6	11.9	-0.3	-3%
01/13/09	9.8	8.8	1	10%
01/17/09	8.4	9.2	-0.8	-10%
01/18/09	10.5	9.4	1.1	10%
01/20/09	11.9	12.9	-1	-8%
01/22/09	14.9	20.8	-5.9	-40%
01/25/09	8.8	8.7	0.1	1%
01/30/09	10	10.6	-0.6	-6%
01/31/09	15.2	14.2	1	7%
02/06/09	12.4	14.2	-1.8	-15%
02/09/09	20.4	16.7	3.7	18%
02/12/09	10.9	11.2	-0.3	-3%
02/18/09	15.1	12.9	2.2	15%
02/24/09	8.5	13.4	-4.9	-58%
02/27/09	13.3	12.8	0.5	4%
03/02/09	5.9	7.1	-1.2	-20%
03/05/09	13.1	14.2	-1.1	-8%
03/08/09	8.3	8.8	-0.5	-6%
03/12/09	7	7.5	-0.5	-7%
03/14/09	15.9	18.1	-2.2	-14%
03/17/09	24.1	16.8	7.3	30%
03/26/09	13.9	6.2	7.7	55%
03/29/09	6.5	5.7	0.8	12%
04/01/09	9.4	6.9	2.5	27%
04/04/09	7.3	9.9	-2.6	-36%
04/07/09	4.8	5.8	-1	-21%
04/11/09	6.3	10.5	-4.2	-67%
04/13/09	9.7	8.8	0.9	9%
04/16/09	12	12.1	-0.1	-1%
04/19/09	11.8	2.8	9	76%
04/22/09	10.2	2.4	7.8	76%
04/25/09	12.1	12	0.1	1%
04/28/09	8.1	8	0.1	1%
05/01/09	5.3	5	0.3	6%
05/07/09	10.5	10.9	-0.4	-4%
05/13/09	13.9	13.9	0	0%
05/16/09	5.1	5.1	0	0%
05/19/09	7	9.1	-2.1	-30%
05/22/09	14.9	15.4	-0.5	-3%
05/25/09	9.5	9	0.5	5%
05/28/09	5.3	4.4	0.9	17%
05/31/09	7.5	6.9	0.6	8%
Average	**11.1**	**11.0**	**-0.1**	**1%**
Madison > Gateway		26		42%
Madison < Gateway		33		53%
Madison = Gateway		3		5%
Madison,Gateway +/-5%		19		31%
Madison,Gateway +/-10%		34		55%
Madison,Gateway +/-15%		40		65%

SITE	RUN DATE	AIRS	ELAPSED	VOLUME	AVGFLOW	FLOW CV	INITIAL WT	FINAL WT	UG/M3
MADISON 1-23rd	05/06/08	17119100711203	24:00:00	24.000	16.67	0.20	139.796	140.300	21.00
GRANITE CITY GATEWAY	05/06/08	17119002411203	24:00:00	23.989	16.66	0.40	143.486	144.158	28.01
GRANITE CITY GATEWAY	05/30/08	17119002411203	23:58:47	23.973	16.66	0.34	144.603	145.200	24.90
MADISON 1-23rd	05/30/08	17119100711203	24:00:00	24.000	16.67	0.00	145.817	146.558	30.87
GRANITE CITY GATEWAY	07/11/08	17119002411203	24:00:00	24.001	16.67	0.55	144.888	145.296	17.00
MADISON 1-23rd	07/11/08	17119100711203	24:00:00	24.000	16.60	0.00	142.430	142.791	15.04
GRANITE CITY GATEWAY	08/04/08	17119002411203	23:59:00	24.000	16.69	0.12	145.451	146.209	31.58
MADISON 1-23rd	08/04/08	17119100711203	24:00:00	24.000	9.99	9.99	141.489	142.352	35.96

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #43 GATEWAY	11.3	Ag	0.06782	0.16963	0.142	ug/filter
GC #43 GATEWAY	11.3	Al	4.66539	0.43741	0.122	ug/filter
GC #43 GATEWAY	11.3	As	0.63196	0.06527	0.016	ug/filter
GC #43 GATEWAY	11.3	Ba	0.21485	0.05445	0.099	ug/filter
GC #43 GATEWAY	11.3	Br	0.15960	0.02134	0.017	ug/filter
GC #43 GATEWAY	11.3	Ca	11.38796	0.80652	0.046	ug/filter
GC #43 GATEWAY	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #43 GATEWAY	11.3	Ce	0.00000	0.06155	0.066	ug/filter
GC #43 GATEWAY	11.3	Cl	0.24529	0.04089	0.048	ug/filter
GC #43 GATEWAY	11.3	Co	0.24244	0.04320	0.011	ug/filter
GC #43 GATEWAY	11.3	Cr	0.15318	0.02312	0.021	ug/filter
GC #43 GATEWAY	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #43 GATEWAY	11.3	Cu	1.46911	0.10527	0.013	ug/filter
GC #43 GATEWAY	11.3	Fe	164.98396	11.67142	0.014	ug/filter
GC #43 GATEWAY	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #43 GATEWAY	11.3	K	4.95929	0.35276	0.038	ug/filter
GC #43 GATEWAY	11.3	Mg	1.64637	0.15593	0.11	ug/filter
GC #43 GATEWAY	11.3	Mn	1.86069	0.13483	0.017	ug/filter
GC #43 GATEWAY	11.3	Na	3.14540	0.36113	0.386	ug/filter
GC #43 GATEWAY	11.3	Ni	0.15896	0.01438	0.011	ug/filter
GC #43 GATEWAY	11.3	P	0.38691	0.09123	0.098	ug/filter
GC #43 GATEWAY	11.3	Pb	2.85390	0.21982	0.047	ug/filter
GC #43 GATEWAY	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #43 GATEWAY	11.3	S	20.45834	1.45216	0.071	ug/filter
GC #43 GATEWAY	11.3	Sb	0.00000	0.13433	0.403	ug/filter
GC #43 GATEWAY	11.3	Se	0.00000	0.00894	0.019	ug/filter
GC #43 GATEWAY	11.3	Si	10.51900	0.87987	0.108	ug/filter
GC #43 GATEWAY	11.3	Sn	0.73470	0.39900	0.307	ug/filter
GC #43 GATEWAY	11.3	Sr	0.03620	0.01604	0.022	ug/filter
GC #43 GATEWAY	11.3	Ti	0.00000	0.03639	0.042	ug/filter
GC #43 GATEWAY	11.3	V	0.04316	0.02517	0.029	ug/filter
GC #43 GATEWAY	11.3	Zn	3.05546	0.21713	0.034	ug/filter
GC #43 GATEWAY	11.3	Zr	0.00000	0.08120	0.044	ug/filter
GC #43 MAD	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #43 MAD	11.3	Al	3.60355	0.34507	0.122	ug/filter
GC #43 MAD	11.3	As	0.13803	0.02992	0.016	ug/filter
GC #43 MAD	11.3	Ba	0.84757	0.07657	0.099	ug/filter
GC #43 MAD	11.3	Br	0.14138	0.01873	0.017	ug/filter
GC #43 MAD	11.3	Ca	10.00018	0.70832	0.046	ug/filter
GC #43 MAD	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #43 MAD	11.3	Ce	0.00000	0.05340	0.066	ug/filter
GC #43 MAD	11.3	Cl	0.35498	0.04080	0.048	ug/filter
GC #43 MAD	11.3	Co	0.08715	0.02896	0.011	ug/filter
GC #43 MAD	11.3	Cr	0.08159	0.01688	0.021	ug/filter
GC #43 MAD	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #43 MAD	11.3	Cu	0.43551	0.03274	0.013	ug/filter
GC #43 MAD	11.3	Fe	82.20738	5.81613	0.014	ug/filter
GC #43 MAD	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #43 MAD	11.3	K	3.83218	0.27289	0.038	ug/filter
GC #43 MAD	11.3	Mg	1.51331	0.14329	0.11	ug/filter
GC #43 MAD	11.3	Mn	1.18469	0.08678	0.017	ug/filter

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #43 MAD	11.3	Na	2.63999	0.30610	0.386	ug/filter
GC #43 MAD	11.3	Ni	0.03151	0.00673	0.011	ug/filter
GC #43 MAD	11.3	P	0.04065	0.07786	0.098	ug/filter
GC #43 MAD	11.3	Pb	0.70356	0.07037	0.047	ug/filter
GC #43 MAD	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #43 MAD	11.3	S	18.87088	1.33949	0.071	ug/filter
GC #43 MAD	11.3	Sb	0.14692	0.42958	0.403	ug/filter
GC #43 MAD	11.3	Se	0.01131	0.01247	0.019	ug/filter
GC #43 MAD	11.3	Si	9.93441	0.82983	0.108	ug/filter
GC #43 MAD	11.3	Sn	0.29384	0.35097	0.307	ug/filter
GC #43 MAD	11.3	Sr	0.05541	0.01521	0.022	ug/filter
GC #43 MAD	11.3	Ti	0.00000	0.03291	0.042	ug/filter
GC #43 MAD	11.3	V	0.03968	0.02285	0.029	ug/filter
GC #43 MAD	11.3	Zn	2.13712	0.15220	0.034	ug/filter
GC #43 MAD	11.3	Zr	0.00000	0.08117	0.044	ug/filter
GC #51 GATEWAY	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #51 GATEWAY	11.3	Al	2.33626	0.26642	0.122	ug/filter
GC #51 GATEWAY	11.3	As	0.23878	0.03103	0.016	ug/filter
GC #51 GATEWAY	11.3	Ba	0.32481	0.07840	0.099	ug/filter
GC #51 GATEWAY	11.3	Br	0.04525	0.01505	0.017	ug/filter
GC #51 GATEWAY	11.3	Ca	8.19681	0.58082	0.046	ug/filter
GC #51 GATEWAY	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #51 GATEWAY	11.3	Ce	0.00000	0.04902	0.066	ug/filter
GC #51 GATEWAY	11.3	Cl	0.31166	0.04203	0.048	ug/filter
GC #51 GATEWAY	11.3	Co	0.11662	0.03166	0.011	ug/filter
GC #51 GATEWAY	11.3	Cr	0.11338	0.01880	0.021	ug/filter
GC #51 GATEWAY	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #51 GATEWAY	11.3	Cu	0.82178	0.05968	0.013	ug/filter
GC #51 GATEWAY	11.3	Fe	95.91173	6.78577	0.014	ug/filter
GC #51 GATEWAY	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #51 GATEWAY	11.3	K	2.85216	0.20389	0.038	ug/filter
GC #51 GATEWAY	11.3	Mg	1.14213	0.11978	0.11	ug/filter
GC #51 GATEWAY	11.3	Mn	0.72295	0.05504	0.017	ug/filter
GC #51 GATEWAY	11.3	Na	3.17457	0.36676	0.386	ug/filter
GC #51 GATEWAY	11.3	Ni	0.06260	0.00841	0.011	ug/filter
GC #51 GATEWAY	11.3	P	0.00000	0.09205	0.098	ug/filter
GC #51 GATEWAY	11.3	Pb	0.40728	0.05269	0.047	ug/filter
GC #51 GATEWAY	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #51 GATEWAY	11.3	S	48.14971	3.41173	0.071	ug/filter
GC #51 GATEWAY	11.3	Sb	0.00000	0.13433	0.403	ug/filter
GC #51 GATEWAY	11.3	Se	0.02037	0.01478	0.019	ug/filter
GC #51 GATEWAY	11.3	Si	4.13688	0.35895	0.108	ug/filter
GC #51 GATEWAY	11.3	Sn	1.01717	0.40205	0.307	ug/filter
GC #51 GATEWAY	11.3	Sr	0.02714	0.01595	0.022	ug/filter
GC #51 GATEWAY	11.3	Ti	0.00000	0.02919	0.042	ug/filter
GC #51 GATEWAY	11.3	V	0.00227	0.02156	0.029	ug/filter
GC #51 GATEWAY	11.3	Zn	2.02921	0.14463	0.034	ug/filter
GC #51 GATEWAY	11.3	Zr	0.00000	0.08117	0.044	ug/filter
GC #51 MAD	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #51 MAD	11.3	Al	4.36894	0.42089	0.122	ug/filter
GC #51 MAD	11.3	As	0.08035	0.02664	0.016	ug/filter

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #51 MAD	11.3	Ba	0.70291	0.10871	0.099	ug/filter
GC #51 MAD	11.3	Br	0.09276	0.01610	0.017	ug/filter
GC #51 MAD	11.3	Ca	29.56447	2.09205	0.046	ug/filter
GC #51 MAD	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #51 MAD	11.3	Ce	0.00000	0.04908	0.066	ug/filter
GC #51 MAD	11.3	Cl	1.37870	0.10797	0.048	ug/filter
GC #51 MAD	11.3	Co	0.10309	0.02815	0.011	ug/filter
GC #51 MAD	11.3	Cr	0.18840	0.02162	0.021	ug/filter
GC #51 MAD	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #51 MAD	11.3	Cu	0.43862	0.03302	0.013	ug/filter
GC #51 MAD	11.3	Fe	69.23549	4.89864	0.014	ug/filter
GC #51 MAD	11.3	In	0.13562	0.24883	0.213	ug/filter
GC #51 MAD	11.3	K	4.27378	0.30447	0.038	ug/filter
GC #51 MAD	11.3	Mg	3.08033	0.27394	0.11	ug/filter
GC #51 MAD	11.3	Mn	2.07414	0.14917	0.017	ug/filter
GC #51 MAD	11.3	Na	6.93609	0.71330	0.386	ug/filter
GC #51 MAD	11.3	Ni	0.04479	0.00730	0.011	ug/filter
GC #51 MAD	11.3	P	0.58656	0.11565	0.098	ug/filter
GC #51 MAD	11.3	Pb	0.58602	0.06305	0.047	ug/filter
GC #51 MAD	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #51 MAD	11.3	S	46.43425	3.29103	0.071	ug/filter
GC #51 MAD	11.3	Sb	0.00000	0.13433	0.403	ug/filter
GC #51 MAD	11.3	Se	0.03507	0.01380	0.019	ug/filter
GC #51 MAD	11.3	Si	13.73143	1.14506	0.108	ug/filter
GC #51 MAD	11.3	Sn	0.00000	0.10233	0.307	ug/filter
GC #51 MAD	11.3	Sr	0.08481	0.01799	0.022	ug/filter
GC #51 MAD	11.3	Ti	0.17748	0.03637	0.042	ug/filter
GC #51 MAD	11.3	V	0.02840	0.02281	0.029	ug/filter
GC #51 MAD	11.3	Zn	5.73702	0.40666	0.034	ug/filter
GC #51 MAD	11.3	Zr	0.16958	0.14746	0.044	ug/filter
GC #65 GATEWAY	11.3	Ag	0.03390	0.15824	0.142	ug/filter
GC #65 GATEWAY	11.3	Al	2.31953	0.25480	0.122	ug/filter
GC #65 GATEWAY	11.3	As	0.15042	0.02706	0.016	ug/filter
GC #65 GATEWAY	11.3	Ba	0.14399	0.07889	0.099	ug/filter
GC #65 GATEWAY	11.3	Br	0.05314	0.01299	0.017	ug/filter
GC #65 GATEWAY	11.3	Ca	5.16089	0.36626	0.046	ug/filter
GC #65 GATEWAY	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #65 GATEWAY	11.3	Ce	0.00000	0.04396	0.066	ug/filter
GC #65 GATEWAY	11.3	Cl	0.25449	0.03680	0.048	ug/filter
GC #65 GATEWAY	11.3	Co	0.04865	0.02289	0.011	ug/filter
GC #65 GATEWAY	11.3	Cr	0.06002	0.01424	0.021	ug/filter
GC #65 GATEWAY	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #65 GATEWAY	11.3	Cu	0.43966	0.03305	0.013	ug/filter
GC #65 GATEWAY	11.3	Fe	47.91660	3.39050	0.014	ug/filter
GC #65 GATEWAY	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #65 GATEWAY	11.3	K	2.91332	0.20799	0.038	ug/filter
GC #65 GATEWAY	11.3	Mg	0.77666	0.09194	0.11	ug/filter
GC #65 GATEWAY	11.3	Mn	0.68490	0.05171	0.017	ug/filter
GC #65 GATEWAY	11.3	Na	2.84588	0.32638	0.386	ug/filter
GC #65 GATEWAY	11.3	Ni	0.03782	0.00657	0.011	ug/filter
GC #65 GATEWAY	11.3	P	0.01268	0.08533	0.098	ug/filter

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #65 GATEWAY	11.3	Pb	0.45343	0.05452	0.047	ug/filter
GC #65 GATEWAY	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #65 GATEWAY	11.3	S	34.75265	2.46312	0.071	ug/filter
GC #65 GATEWAY	11.3	Sb	0.00000	0.13433	0.403	ug/filter
GC #65 GATEWAY	11.3	Se	0.00000	0.00645	0.019	ug/filter
GC #65 GATEWAY	11.3	Si	5.07148	0.43160	0.108	ug/filter
GC #65 GATEWAY	11.3	Sn	0.00000	0.10233	0.307	ug/filter
GC #65 GATEWAY	11.3	Sr	0.04070	0.01498	0.022	ug/filter
GC #65 GATEWAY	11.3	Ti	0.02495	0.02727	0.042	ug/filter
GC #65 GATEWAY	11.3	V	0.03513	0.01942	0.029	ug/filter
GC #65 GATEWAY	11.3	Zn	1.73263	0.12369	0.034	ug/filter
GC #65 GATEWAY	11.3	Zr	0.00000	0.08116	0.044	ug/filter
GC #65 MAD	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #65 MAD	11.3	Al	2.35925	0.24920	0.122	ug/filter
GC #65 MAD	11.3	As	0.06783	0.02422	0.016	ug/filter
GC #65 MAD	11.3	Ba	0.00000	0.04635	0.099	ug/filter
GC #65 MAD	11.3	Br	0.04748	0.01288	0.017	ug/filter
GC #65 MAD	11.3	Ca	6.19192	0.43912	0.046	ug/filter
GC #65 MAD	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #65 MAD	11.3	Ce	0.00000	0.03828	0.066	ug/filter
GC #65 MAD	11.3	Cl	0.42903	0.04412	0.048	ug/filter
GC #65 MAD	11.3	Co	0.01131	0.01586	0.011	ug/filter
GC #65 MAD	11.3	Cr	0.04381	0.01141	0.021	ug/filter
GC #65 MAD	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #65 MAD	11.3	Cu	0.17466	0.01518	0.013	ug/filter
GC #65 MAD	11.3	Fe	19.27706	1.36478	0.014	ug/filter
GC #65 MAD	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #65 MAD	11.3	K	2.62537	0.18766	0.038	ug/filter
GC #65 MAD	11.3	Mg	0.92204	0.10050	0.11	ug/filter
GC #65 MAD	11.3	Mn	0.78768	0.05823	0.017	ug/filter
GC #65 MAD	11.3	Na	2.24682	0.27724	0.386	ug/filter
GC #65 MAD	11.3	Ni	0.01392	0.00530	0.011	ug/filter
GC #65 MAD	11.3	P	0.00000	0.07881	0.098	ug/filter
GC #65 MAD	11.3	Pb	0.51436	0.05715	0.047	ug/filter
GC #65 MAD	11.3	Rb	0.00000	0.00567	0.017	ug/filter
GC #65 MAD	11.3	S	34.46561	2.44280	0.071	ug/filter
GC #65 MAD	11.3	Sb	0.07910	0.42946	0.403	ug/filter
GC #65 MAD	11.3	Se	0.01696	0.01249	0.019	ug/filter
GC #65 MAD	11.3	Si	5.58011	0.47268	0.108	ug/filter
GC #65 MAD	11.3	Sn	0.23731	0.35072	0.307	ug/filter
GC #65 MAD	11.3	Sr	0.01808	0.01475	0.022	ug/filter
GC #65 MAD	11.3	Ti	0.13148	0.02555	0.042	ug/filter
GC #65 MAD	11.3	V	0.01926	0.01592	0.029	ug/filter
GC #65 MAD	11.3	Zn	1.07336	0.07710	0.034	ug/filter
GC #65 MAD	11.3	Zr	0.04521	0.12436	0.044	ug/filter
GC #73 GATEWAY	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #73 GATEWAY	11.3	Al	2.12105	0.27229	0.122	ug/filter
GC #73 GATEWAY	11.3	As	0.11539	0.02512	0.016	ug/filter
GC #73 GATEWAY	11.3	Ba	0.27967	0.06993	0.099	ug/filter
GC #73 GATEWAY	11.3	Br	0.07125	0.01554	0.017	ug/filter
GC #73 GATEWAY	11.3	Ca	12.82625	0.90824	0.046	ug/filter

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #73 GATEWAY	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #73 GATEWAY	11.3	Ce	0.00000	0.04406	0.066	ug/filter
GC #73 GATEWAY	11.3	Cl	0.38381	0.04883	0.048	ug/filter
GC #73 GATEWAY	11.3	Co	0.03624	0.02280	0.011	ug/filter
GC #73 GATEWAY	11.3	Cr	0.04538	0.01399	0.021	ug/filter
GC #73 GATEWAY	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #73 GATEWAY	11.3	Cu	0.40516	0.03060	0.013	ug/filter
GC #73 GATEWAY	11.3	Fe	45.88670	3.24708	0.014	ug/filter
GC #73 GATEWAY	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #73 GATEWAY	11.3	K	7.22177	0.51250	0.038	ug/filter
GC #73 GATEWAY	11.3	Mg	2.05174	0.19364	0.11	ug/filter
GC #73 GATEWAY	11.3	Mn	0.83437	0.06207	0.017	ug/filter
GC #73 GATEWAY	11.3	Na	4.18759	0.46893	0.386	ug/filter
GC #73 GATEWAY	11.3	Ni	0.05043	0.00738	0.011	ug/filter
GC #73 GATEWAY	11.3	P	0.28867	0.11750	0.098	ug/filter
GC #73 GATEWAY	11.3	Pb	0.38681	0.04999	0.047	ug/filter
GC #73 GATEWAY	11.3	Rb	0.00045	0.01085	0.017	ug/filter
GC #73 GATEWAY	11.3	S	76.03199	5.38650	0.071	ug/filter
GC #73 GATEWAY	11.3	Sb	0.00000	0.13433	0.403	ug/filter
GC #73 GATEWAY	11.3	Se	0.02601	0.01370	0.019	ug/filter
GC #73 GATEWAY	11.3	Si	5.28472	0.45310	0.108	ug/filter
GC #73 GATEWAY	11.3	Sn	0.05651	0.35037	0.307	ug/filter
GC #73 GATEWAY	11.3	Sr	0.02035	0.01477	0.022	ug/filter
GC #73 GATEWAY	11.3	Ti	0.00000	0.02490	0.042	ug/filter
GC #73 GATEWAY	11.3	V	0.12606	0.02126	0.029	ug/filter
GC #73 GATEWAY	11.3	Zn	2.94961	0.20956	0.034	ug/filter
GC #73 GATEWAY	11.3	Zr	0.00000	0.08116	0.044	ug/filter
GC #73 MAD	11.3	Ag	0.00000	0.04733	0.142	ug/filter
GC #73 MAD	11.3	Al	5.76929	0.54266	0.122	ug/filter
GC #73 MAD	11.3	As	0.11880	0.02520	0.016	ug/filter
GC #73 MAD	11.3	Ba	0.48625	0.09951	0.099	ug/filter
GC #73 MAD	11.3	Br	0.05655	0.01415	0.017	ug/filter
GC #73 MAD	11.3	Ca	32.99736	2.33488	0.046	ug/filter
GC #73 MAD	11.3	Cd	0.00000	0.06000	0.18	ug/filter
GC #73 MAD	11.3	Ce	0.00000	0.04912	0.066	ug/filter
GC #73 MAD	11.3	Cl	0.57437	0.06183	0.048	ug/filter
GC #73 MAD	11.3	Co	0.08839	0.02242	0.011	ug/filter
GC #73 MAD	11.3	Cr	0.07610	0.01571	0.021	ug/filter
GC #73 MAD	11.3	Cs	0.00000	0.11033	0.331	ug/filter
GC #73 MAD	11.3	Cu	0.31939	0.02502	0.013	ug/filter
GC #73 MAD	11.3	Fe	38.73786	2.74135	0.014	ug/filter
GC #73 MAD	11.3	In	0.00000	0.07100	0.213	ug/filter
GC #73 MAD	11.3	K	5.76676	0.40995	0.038	ug/filter
GC #73 MAD	11.3	Mg	3.10692	0.28121	0.11	ug/filter
GC #73 MAD	11.3	Mn	1.53179	0.11067	0.017	ug/filter
GC #73 MAD	11.3	Na	5.28932	0.58020	0.386	ug/filter
GC #73 MAD	11.3	Ni	0.03911	0.00682	0.011	ug/filter
GC #73 MAD	11.3	P	1.08196	0.15037	0.098	ug/filter
GC #73 MAD	11.3	Pb	0.32350	0.04869	0.047	ug/filter
GC #73 MAD	11.3	Rb	0.01357	0.01248	0.017	ug/filter
GC #73 MAD	11.3	S	86.36012	6.11828	0.071	ug/filter

Sample_ID	Deposit_Area	Analyte	Filter_Result	Filter_Uncertainty	MDL	Units
GC #73 MAD	11.3	Sb	0.04521	0.46337	0.403	ug/filter
GC #73 MAD	11.3	Se	0.05543	0.01522	0.019	ug/filter
GC #73 MAD	11.3	Si	15.06355	1.25805	0.108	ug/filter
GC #73 MAD	11.3	Sn	0.38426	0.36267	0.307	ug/filter
GC #73 MAD	11.3	Sr	0.05880	0.01746	0.022	ug/filter
GC #73 MAD	11.3	Ti	0.29276	0.03899	0.042	ug/filter
GC #73 MAD	11.3	V	0.19219	0.02650	0.029	ug/filter
GC #73 MAD	11.3	Zn	3.18478	0.22622	0.034	ug/filter
GC #73 MAD	11.3	Zr	0.00000	0.08117	0.044	ug/filter

Sample_ID	Date_Analyzed	Flags	Invalid	Comment
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
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GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 GATEWAY	7/16/2009		FALSE	Illinois 2nd Set
GC #43 MAD	7/16/2009		FALSE	Illinois 2nd Set
GC #43 MAD	7/16/2009		FALSE	Illinois 2nd Set
GC #43 MAD	7/16/2009		FALSE	Illinois 2nd Set
GC #43 MAD	7/16/2009		FALSE	Illinois 2nd Set
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Exhibit H

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The impact of fireworks on airborne particles

Roberta Vecchi, Vera Bernardoni, Diana Cricchio, Alessandra D'Alessandro, Paola Fermo, Franco Lucarelli, Silvia Nava, Andrea Piazzalunga, Gianluigi Valli

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The impact of fireworks on airborne particles

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Abstract

Fireworks are one of the most unusual sources of pollution in atmosphere; although transient, these pollution episodes are responsible for high concentrations of particles (especially metals and organic compounds) and gases. In this paper, results of a study on chemical-physical properties of airborne particles (elements, ions, organic and elemental carbon and particles size distributions) collected during a fireworks episode in Milan (Italy) are reported. Elements typically emitted during pyrotechnic displays increased in one hour as follows: Sr (120 times), Mg (22), Ba (12), K (11), and Cu (6). In our case study, Sr was recognised as the best fireworks tracer because its concentration was very high during the event and lower than, or comparable with, minimum detection limits during other time intervals, suggesting that it was mainly due to pyrotechnic displays. In addition, particles number concentrations increased significantly during the episode (up to 6.7 times in one hour for the $0.5<d<1$ μm size bin). Contributions (e.g. Cu, elemental carbon and nitrogen oxides) to air pollution due to the large traffic volume registered during the same night were also singled out.

The original application of Positive Matrix Factorization and Multiple Linear Regression allowed, as far as we know, here for the first time, the quantification of the fireworks contribution to atmospheric particulate matter and the resolution of their chemical profile. The contribution of fireworks to the local environment in terms of PM10 mass, elements and chemical components was assessed with 4-hour time resolution. PM10 mass apportioned by fireworks was up to 33.6 μg m^{-3} (about 50% of the total PM10 mass). Major contributors were elemental and organic carbon (2.8 and 8.1 μg m^{-3}, respectively) as well as metals like Mg, K, Sr, Ba, and Cu (0.4, 0.7, 0.07, 0.1, and 0.1 μg m^{-3}, respectively).

Keywords: fireworks, chemical composition, number size distribution, PMF

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1. Introduction

In recent years concern for air pollution effects both on short-term and on long term has increased (Pope and Dockery, 2006; and therein literature). Therefore, many studies are currently carried out to characterise anthropogenic emissions especially in urban areas where large populations live.

One of the most unusual sources of pollution in atmosphere is the displacement of fireworks to celebrate festivities worldwide as well as specific events. The burning of fireworks is a huge source of gaseous pollutants such as ozone, sulphur dioxide, and nitrogen oxides (Attri et al., 2001; Ravindra et al., 2003) as well as of suspended particles. The aerosol particles emitted by fireworks are generally composed of metals (e.g. potassium, magnesium, strontium, barium, and copper), elemental carbon and secondary compounds like nitrate and organic substances (Kulshrestha et al., 2004; Drewnick et al., 2006; Moreno et al., 2007; Wang et al., 2007). The issue of exposure to elevated particle concentrations during celebrations with fireworks has implications in many countries of the world where pyrotechnic exhibitions often last for several hours/days (e.g. during Diwali Festival in India, Las Fallas in Spain, Lantern Festival in Beijing and New Year's celebration world-wide). The complex nature of particles emitted during fireworks may cause adverse health effects as reported in Ravindra et al. (2001). Nevertheless, some authors (Perry, 1999; Dutcher et al., 1999) concluded that fireworks unlikely pose a significant public health hazard, as they are relatively rare, detonate at altitudes well above the ground and generally burn outdoors, where the emitted pollutants can be dispersed in a large volume of air.

An additional effect of fireworks is the visibility reduction due to the generation of a dense cloud of smoke that drifts downwind and slowly disperses. The impact of fireworks on visibility and human health is particularly evident when the pyrotechnic exhibition is performed during stable meteorological conditions (Clark, 1997).

In this paper, we report on the chemical-physical characteristics of ambient aerosol measured during fireworks burnt in Milan (Italy) to celebrate the win of the football World Cup; due to the short duration of the fireworks exhibition, we considered it as a case study. The main goal of this paper is the assessment of the fireworks emissions environmental impact through the aerosol characterisation in terms of number (10 min resolution), mass and chemical composition (4-hour time resolution) as well as 1-hour resolution elemental data. In addition to particulate matter, trace gases concentrations, meteorological parameters, and atmospheric stability conditions were taken into account. Owing to the occurrence of this episode during a longer monitoring campaign, the apportionment of the fireworks source was possible applying Positive Matrix Factorization (PMF) and Multiple Linear Regression (MLR) to the whole dataset; as far as we know, this is the first attempt to identify and quantify the fireworks source contribution using a receptor model.

2. Experimental

The effect of pyrotechnic displays on air quality was studied in Milan (Italy) in July 2006, during the night between 9th and 10th, when the Italian team was celebrated for the win of the 2006 FIFA World Cup.

2.1 Site and sampling

Major pyrotechnic displays were located in the Cathedral's square downtown Milan; additional celebrations with many minor fireworks displays and a huge amount of crackers and sparkles were burnt everywhere in the town, starting soon after the end of the football match (at about 10:45 p.m.). Due to the peculiarity of the episode, the duration of the celebrations is not easy to assess (a reasonable estimate might be approximately 1 - 2 hours). The samplings were carried out at the University campus on the roof of the Institute of Physics, at about 10 m a.g.l.. The monitoring station was about 3 km far from the city centre so that the measurement related to the advected and diffused smoke cloud (as generally done in literature studies on this topic).

PM10 was sampled starting at 12 a.m., local time, from July 9th to 11th, every 4 hours. Samplings were carried out in parallel on PTFE filters (diameter: 47 mm, pore size: 2 μm) and quartz fibre filters (diameter: 47 mm, pre-fired at 700°C for 1 hour) using CEN-equivalent samplers operating at a flow rate of 2.3 m^3 h^{-1}.

Fine (d_{ae}<2.5 μm) and coarse (2.5<d_{ae}<10 μm) PM fractions were also collected with hourly resolution, using a streaker sampler. The streaker sampler separates particles in two different stages using a pre-impactor (which removes particles with d_{ae}>10μm) and an impactor. The latter is made of a Kapton foil on which coarse particles are collected. The fine fraction is then sampled on a Nuclepore filter (0.4 μm pore diameter). The Kapton foil and Nuclepore filter are paired in a cartridge rotating at constant angular speed (1.8° h^{-1}); this produces a circular continuous deposition on both stages. It should be noted that mass concentration in streaker samples is not available. Further details on the sampler, its cut-off diameters, and its control unit can be found elsewhere (Prati et al. 1998); it should be noticed that mass concentration in streaker samples is not available.

2.2 Laboratory analyses

Before and after the samplings the filters were exposed for 48 hours on open but dust-protected sieve-trays in an air-conditioned weighing room (T = 20 ∂ 1 °C and R.H. = 50 ∂ 5 %). The gravimetric determination of the mass was carried out using an analytical microbalance (precision 1 σg), which was installed and operated in the weighing room. Calibration procedures checked the microbalance performance.

PTFE filters were analysed for elemental composition by Energy Dispersive X-Ray Fluorescence technique (details can be found in Marcazzan et al., 2004), obtaining concentration values for Mg, Al, Si, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Br, Sr, Ba, Pb. Other elements (i.e. V, As, Se, Zr, and Mo) were in principle detectable, but they often resulted below the minimum detection limit (MDL), which was in the range 2 – 20 ng m^{-3} for most elements. Experimental overall uncertainties were in the range 10-15 %.

One half of the quartz fibre filters was analysed for water-soluble major components (SO_4^{2-}, NO_3^-, and NH_4^+) by ion chromatography (IC). A special care was used in IC analyses of particulate matter collected on quartz fibre filters due to

high blank levels (minimum detection limits: 167, 359 e 46 ng m^{-3} for SO_4^{2-}, NO_3^-, and NH_4^+, respectively); information about extraction procedures and blanks correction can be found in Fermo et al. (2006). The overall uncertainty for ionic concentrations was estimated in 10 %.

One punch (area: 1.5 cm^2) cut from the quartz fibre filter was analysed by TOT (Thermal-Optical Transmittance) method (Birch and Cary, 1996) to quantify elemental and organic carbon. The technique detection limit was 0.2 σgC m^{-3} and the precision was 5%.

Nuclepore and Kapton substrates from the streaker sampler were analysed by Particle Induced X-ray Emission analysis (PIXE) at the LABEC-INFN accelerator facility in Florence, Italy, whose set up is described in Calzolai et al. (2006). The concentration of 19 elements (Na, Mg, Al, Si, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Br, Sr, Ba, Pb) was obtained. As for ED-XRF analysis, other elements were in principle detectable, but they often were below the minimum detection limit (lower than 10 ng m^{-3} for V, As, Se, Zr, Rb, Mo). The accuracy of hourly elemental concentrations was in the range 2% - 20%.

2.3 Additional measurements

An Optical Particle Counter (Grimm, mod.1.107) measured number size distributions in the 0.25-32 σm range (31 size bins).

To evaluate atmospheric dispersion conditions, ^{222}Rn short-lived decay products measurements were performed using the experimental methodology reported in Marcazzan et al. (2003). Mixing layer heights (MLH) with hourly resolution were obtained by means of a box model suitably set up by the group of the Institute of Physics using ^{222}Rn concentration measurements as input data (Pacifico, 2005). MLH evaluations by our box-model were in good agreement with thermal inversions heights from radio-soundings data by the nearby Milan-Linate airport as well as with other modelling studies based on thermodynamic variables (Casadei et al., 2006).

Meteorological parameters (wind speed and direction, relative humidity, pressure, temperature, solar radiation and precipitation) were also measured at the Institute of Physics monitoring station.

Trace gases data recorded at monitoring stations of the Regional Environmental Protection Agency were also available (Figure 1): NO_2 and NO at the 1-J station (near the University campus and the motor-way) and NO_2, NO and CO at the 2-V station (city centre) and 3-L (on the ring-round). Moreover, hourly traffic volumes in the city centre were recorded at the station 4-S (city centre).

2.4 Receptor model

The fireworks episode occurred during a longer field campaign, which was performed during two weeks in summer and two weeks in winter 2006, with the same characteristics as those described in paragraphs 2.1, 2.2, and 2.3. The complete

PM10 data set (180 samples) was analysed by PMF to identify and apportion (by MLR) major aerosol sources. PMF resolved seven sources (re-suspended soil, construction works, industry, traffic, secondary sulphates, secondary nitrates and fireworks). In this paper, only results on the fireworks source will be described and discussed (another paper in preparation deals with the other six sources).

PMF is an advanced factor analysis technique computing a weighted, non-negative constrained least squares fit. It imposes non-negativity constraints to the factors and uses realistic error estimates from data standard deviations, as described in Paatero (1997). Data values and errors, missing values and below detection limit data were calculated according to Polissar et al. (1998) and used in this work as inputs for the PMF.

In PMF studies, a weak variable (according to signal to noise ratio criterion, as in Paatero and Hopke, 2003) can sometimes be inserted in the fit with the normal variables if it represents a tracer of a specific source (Qin et al., 2006). This approach was here adopted for Sr, considered the best tracer of the fireworks source in our case study (see paragraph 3.3). It was not really a weak variable but it had a much lower signal to noise ratio respect to other variables. In this work, instead of reducing the weights of Sr, we doubled them to highlight the role of this fireworks tracer in the fit. At the same time, it was necessary to down-weight some variables by increasing their uncertainties by a factor from 2 to 4 to obtain a better distribution of their scaled residuals (Kim et al., 2003). The coefficients of adjustment for the weights were determined with trial and error method until the model resolved the fireworks source, together with the same six sources found in a previous analysis where Sr was not used as input for PMF.

Rotational ambiguity is always a problem in factor analysis (Paatero et al., 2002); in this work, after a systematic study of the rotational range of the solution, FPEAK=0 was chosen. MLR was performed to regress the total mass against the factor scores; the regression coefficients were then used to transform the factor profiles given in arbitrary units in parts per million ones and to quantitatively apportion the mass contributions among the resolved sources.

3. Results and discussion

3.1 Mass concentration and meteorological conditions

During the case study period, meteorological conditions were quite stable. The wind speed was about 1 m s^{-1} as average value between 10:30 p.m. and 12 a.m. on the fireworks night and the prevalent wind direction was changing from south-westerly to westerly direction.

During the fireworks night a ^{222}Rn strong accumulation was registered (Figure 2); the variation of Radon concentration between the minimum (8.6 Bq m^{-3}) on July 9th afternoon and the maximum (26.4 Bq m^{-3}) in the following day was a good indicator of the nocturnal mixing layer depth, which was lower than 100 m.

In Figure 2, PM10 mass and ^{222}Rn concentration on 9th-10th July 2006 are shown. On 10th July, PM10 concentration increased up to 63.9 μg m^{-3} in the time interval between 12 a.m. and 4 a.m., when the pyrotechnical displays contribution

was maximum at our monitoring station, as singled out by the chemical markers analysis (see paragraph 3.3). However, fireworks were not likely the only cause of PM10 growth during that night; indeed, the concomitant strong accumulation of ^{222}Rn concentration suggests that this increase was likely due both to sources emissions and to the strong atmospheric stability.

As far as we know, currently in the literature there is no quantification of the fireworks contribution to the PM mass, as this estimation is difficult and not straightforward. With the aim of apportioning the fireworks source, in this paper the receptor model approach has been possible owing to the availability of a large number of chemically characterised PM samples with 4-hours temporal resolution. According to the PMF source apportionment the fireworks contribution began to be remarkable in the 8 p.m. – 12 a.m. time interval, accounting for 13.1 μg $m^{-3}$of the PM10 mass (27 %), reached its maximum at 33.6 μg m^{-3} (53 %) in the 4 hours after midnight and decreased to 4.2 μg m^{-3} (8 %) from 4 a.m. to 8 a.m.

3.2 Gaseous pollutants

CO concentration and traffic volumes increased soon after the end of the match (10:45 p.m.) at the monitoring stations 2-V and 4-S near the Cathedral's Square, as shown in Figure 3a. A similar pattern in CO concentration, i.e. maximum value between 11 p.m. and 12 a.m. with a 3-fold increase in one hour, was also recorded at the station 3-L, located next to the city ring-road (see Figure 1) and about 1.5 km far from major pyrotechnic displays. In Figure 3b NO_2 temporal patterns recorded at the stations 2-V, 3-L and 1-J are reported. At the 2-V and 3-L stations the concentration increase was recorded simultaneously with the CO increase while at the station 1-J (near University Campus) a delay in the maximum concentration occurred.

Ravindra et al. (2003) observed NO_2 increases during the pyrotechnic displays. On the contrary, in our case the experimental results indicate that the increase in trace gases concentration was mainly due to the high number of vehicles circulating soon after the end of the match to celebrate the national team more than to fireworks emissions. Indeed, it is important to observe that the location of the 3-L monitoring station compared to the city centre and the prevalent wind direction (see paragraph 3.1) suggest that fireworks unlikely affect air quality in that area. Moreover, the NO_2 temporal trend observed at the station near major pyrotechnic displays (2-V) and at the 3-L station are comparable, indicating that no significant NO_2 emissions can be ascribed to fireworks in our case study. The NO_2 peak occurring at 2 a.m. in the 1-J station was explained by traffic flows, likely due to people going back home, as also confirmed by Cu temporal pattern (another traffic tracer) represented in Figure 4.

3.3 Chemical composition

On 9th July, starting from 11 p.m., the hourly concentrations of some elements in the fine fraction strongly increased. Similar results were also found PM10 elemental data with 4-hour resolution (in Table 1 mass and chemical components

concentrations are given for the episode); nevertheless, for sake of brevity, the data with the highest time resolution are represented in Figure 4. At our monitoring station, the highest values were registered on 10th July between 1 a.m. and 2 a.m.; this is consistent with the location of major fireworks considering wind speed and direction. To quantify the elements concentration increase during the episode, the maximum concentration was compared to the value of the day before (9th July, not affected by fireworks), averaged between 12 a.m. and 10 p.m. In case of below MDL hourly data, one-half of the MDL value was used. Remarkable increases in Sr (120 times), Mg (22 times), K (12 times), Ba (11 times), and Cu (6 times) concentration were observed. No increases were detected in the coarse fraction elemental concentrations and Sr, Mg, K, Ba, and Cu concentrations were below or comparable to MDL (not shown), indicating that ambient aerosol after the fireworks event was preferably confined in the fine fraction.

Sr, Ba, and Cu compounds are used to give red, green, and blue fireworks, respectively (Kulshrestha et al., 2004; Wang et al., 2007; Moreno et al., 2007). Different Ba compounds can give the green colour, but the increase in chlorine concentration measured during the fireworks night and the nitrate concentration comparable or lower than other nights one, suggested that $Ba(ClO_3)_2$ was more likely used (Perry, 1999). K is one of the major components of fireworks (Liu et al., 1997; Dutcher et al., 1999; Perry, 1999; Kulshrestha et al., 2004; Drewnick et al., 2006): 74% of black powder consists of KNO_3, which provides the main oxidizer to the burning. Also potassium perchlorate or, less commonly, chlorate can be used in the black powder. Mg gives origin to bright electric white fireworks and it is used as metallic fuel (Moreno et al., 2007; Wang et al. 2007).

In this work, Sr was recognised as the best fireworks tracer because its concentration was very high during the event and lower than, or comparable with, MDL during other time intervals, suggesting that it was mainly due to pyrotechnic displays (see also PMF results in Table 2). On the contrary, Cu and Ba can also have a contribution coming from traffic (Vecchi et al., 2007 and therein literature) and K and Mg are widespread elements emitted by many sources (e.g. biomass burning for K and soil dust for Mg).

From 4-hours resolution PM10 data, the concentration ratios between levels registered in the 12 a.m. - 4 a.m. time interval and the average values of the day before (during the period free from the event, i.e. between 12 a.m. and 8 p.m.) were calculated; results for elements, organic and elemental carbon, and ions are reported in Figure 5. As expected, the most significant increases were observed for Sr, Mg, Ba, K, and Cu (elements ratios were smaller than those reported for 1-hour resolution elemental data because the longer sampling time included periods with lower concentrations). Indeed, these elements can be all considered fireworks tracers.

The nitrate concentration ratio was comparable to the one measured during other summer nights at the same sampling site (as an example, see the comparison with 6th July night, in Figure 5) because of the lower night-time temperature, which limited losses due to volatilisation. In agreement with results by Drewnick et al. (2006), in our case study no nitrate increase due to fireworks was observed.

The EC ratios (3.1) found in this work are in good agreement with black carbon increases reported by Babu and Moorthy (2001) and by Wang et al. (2007).

Opposite to what found by Wang et al (2007), no anomalous growth in secondary components was observed the day after the pyrotechnical displacement: the increases in sulphate and ammonium were similar to the ones measured during other summer afternoons at the same sampling site. However, it should be taken into account that secondary compounds formation may change in relation to local meteorological condition, pollutants mixture and duration and strength of the episode.

In Figure 6, the fireworks chemical profile obtained by PMF is also reported as an original contribution to the characterisation of fireworks emissions. Major components are carbon compounds (both EC and OC) and metals. The fireworks source profile confirms Sr as the best tracer in our case study as, contrarily to other fireworks indicators, it was found only in this chemical profile while, for example, Ba was also detected in the traffic profile, and K was found in a number of sources (not shown here). In Table 2 the PMF apportionment for major PM10 components detected during pyrotechnic displays is reported. As already reported for PM10 mass concentrations, also elements, ions, and carbon components peaked in the 12 a.m. - 4 a.m. time interval. Total carbon (TC = EC+OC) due to fireworks accounted for 11 μg m^{-3} of the PM10 mass (i.e. about 50-55 % of the measured total carbon). Major elemental contributions apportioned by PMF and due to the pyrotechnic displays were Mg (0.4 μg m^{-3}), K (0.7 μg m^{-3}), Cu (0.07 μg m^{-3}), Sr (0.1 μg m^{-3}), and Ba (0.1 μg m^{-3}) corresponding to 81%, 77%, 68%, 100% and 91% of their measured concentration, respectively. These results are in very good agreement with experimental observations discussed so far.

3.4 Number size distribution

During the fireworks night, starting from 11 p.m., the number concentration in all size ranges increased. The growths were different for each size bin, but the maximum concentration was always found on 12:10 a.m.. The ratios between the number of particles measured on 12:10 a.m. and 11 p.m. were as follows: 6.7 for particles in the range 0.5<d<1 μm, 2.8 for particles in the range 2.5<d<10 μm, 2.6 for particles in the range 1 <d<2.5 μm and 1.7 for particles with d<0.5 μm.

The delay (about 1.5 hours) in the occurrence of the maximum concentration compared to end of the match may be explained considering the distance of our sampling site from the city centre (where the major fireworks exhibition was performed and the largest traffic volume observed) together with the low wind speed, the wind direction and the atmospheric stability conditions. From 12:10 a.m. to 1:40 a.m. the particles number concentration in all size ranges decreased as follows: -20% for particles with d<0.5 μm, -70% for particles in the range 0.5<d<1 μm, -50% for particles in the 1<d<2.5 μm range and -35% for particles in 2.5<d<10 μm range. Between 1:40 a.m. and 3 a.m. another increase was observed in all size bins, and particularly in particles with diameters smaller than 0.4 μm. It is interesting to note that a growth in Cu hourly concentration (fine fraction) and in NO_2 concentration (at 1-J monitoring station near the University

campus) was also measured between 2 a.m. and 3 a.m. (see Figures 3b and 4). As these increases were contemporary, the growth in particle number concentration might be ascribed to traffic (contributing to Cu, NO_2, and fine particles), because of people going back home after celebrations. Moreover, these results suggested that traffic emissions were mainly in the finest fractions. After 3 a.m., particles number concentrations definitively decreased until the next morning, when the number of particles increased again because of typical working day's activities.

Particles number temporal pattern in each size range was compared to Sr concentration (taken here as fireworks tracer). The correlation coefficients between Sr (fine fraction) and number concentration were calculated using hourly-resolved data between 10 p.m. on 9th July and 10 a.m. on 10th July. The highest correlation coefficients (R>0.95) were registered in the 0.45 – 1 μm, and particularly in the 0.70 - 0.80 μm, size bin (R=0.98). The high correlation between Sr and the 0.7-0.8 μm size range is consistent with what found by Perry (1999), who reported 0.7 μm as mass mean diameter of potassium (in that work considered the indicator for fireworks) observed after fireworks emissions transport.

In Figure 7, Sr temporal pattern (1-hour resolution) and particles number concentrations (10-minutes resolution) in the 0.25-0.3 μm, 0.70 - 0.80 μm, and 8.5-10 μm size intervals are shown, as examples. A very good agreement between Sr and particle number in the 0.70 - 0.80 μm size range in the increase phase and in the first part of the decrease phase was evident, while differences can be noticed after 2 a.m. However, it must be considered that, in this case study, fireworks display was the only source of Sr while airborne particles in general can be originated by different sources. In Figure 7 can also be noted that, even if particles in the 0.25-0.3 μm and 8.5-10 μm size ranges increased during the fireworks period, a poorer correlation (R=0.72 and R=-0.13, respectively) was found with Sr concentration.

Taking into account the good correlation between Sr and particles in 0.4-1μm size range during the increase phase, and evaluating the time necessary to Sr to reach values similar to those presented before fireworks, a rough estimate of the time necessary to particles in this size-range to diffuse (with low wind speed conditions) can be evaluated in about 12 hours.

4. Conclusions

The fireworks exhibition was used to study the chemical composition and the size distribution of airborne particles observed during such events. The influence of additional emissions due to the traffic registered just after the football match was also discussed.

Atmospheric aerosols originated by fireworks had a typical signature as singled out by the few works on this topic (see references given in the text). Results obtained by hourly elemental analysis showed that in the fine fraction many metals (i.e. Sr, Mg, K, Ba and Cu) increased significantly during the celebrations (e.g. Sr up to 120 times in one hour) while no differences were observed in the coarse fraction concentrations. It is worth noting that, although fireworks cause short-lived air pollution events, fine particles are responsible for adverse health effects, and the bioreactivity of fine metal aerosols is of particular concern (Moreno et al, 2007; and therein cited literature).

The availability of a large number of chemically characterised samples allowed the PM10 and major chemical components apportionment during the pyrotechnic displays. Although our fireworks event had short duration, the PM10 concentration ascribed by PMF to the fireworks source was not negligible (up to 33.6 μg m^{-3}). In addition, fireworks accounted for a large part of the metal concentrations (e.g. up to 70-100% of the measured values for Mg, K, Cu, Sr, and Ba). Obviously, the impact of this source type can vary considerably in relation to fireworks duration and type, being more serious when stable atmospheric conditions occur (Clark, 1997). The assessment of the fireworks source chemical profile and of the contribution of fireworks to local environment gives an original contribution towards understanding the aerosol characteristics and burden during fireworks displays.

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Figure captions

Figure 1: map of the monitoring stations.

Figure 2: PM10 mass (in σg m^{-3}) and ^{222}Rn concentration (in Bq m^{-3}) on 9^{th}-10^{th} July 2006 in Milan.

Figure 3: a) CO (in mg m^{-3}) and traffic volume (number of vehicles); b) NO_2 (in σg m^{-3}) concentrations at three different monitoring stations on 9^{th}-10^{th} July 2006 in Milan.

Figure 4: fireworks elemental markers, fine fraction data with hourly resolution (in ng m^{-3})

Figure 5: Ratios between the concentration of different chemical components registered in the time interval 12 a.m. - 4 a.m. (fireworks displays) on 9^{th}-10^{th} July night and the average value measured for the same species during the day before (grey). Similar ratios (white) calculated for the night between 6^{th} and 7^{th} July (free from fireworks) are given for comparison.

Figure 6: fireworks source profile (in mg mg^{-1}) as resolved by PMF

Figure 7: Sr hourly temporal pattern (in ng m^{-3}) together with particles number concentration (particles m^{-3}) in the 0.25-0.30 σm, 0.70-0.80 σm and 8.5-10 σm size intervals

Table captions

Table 1: 4-hour resolution chemical components and elemental concentrations (in ng m^{-3}) during the fireworks episode

Table 2: Contribution to PM10 mass and major chemical components concentration (in ng m^{-3} and as percentage of their measured concentration) due to the fireworks source obtained by PMF. By convention, concentration values lower than experimental minimum detection limits have been labelled as <MDL.

Table 1

Date	9/7	9/7	10/7	10/7	10/7	10/7
Time interval	**4 p.m. - 8 p.m.**	**8 p.m. - 12 a.m.**	**12 a.m. - 4 a.m.**	**4 a.m. - 8 a.m.**	**8 a.m. - 12 p.m.**	**12 p.m. - 4 p.m.**
PM10 mass	46 400	48 200	63 900	51 400	71 100	55 500
SO_4^{2-}	4 232	3 130	3 622	2 687	2 830	5 147
NO_3^-	<360	1 115	4 499	2 326	2 326	3 683
NH_4^+	1 169	1 102	1 575	868	1 644	2 548
OC	7 870	9 806	13 491	11 672	12 071	10 490
EC	1 293	1 959	5 372	4 070	4 694	1 748
Mg	<100	183	598	246	127	182
Al	355	519	680	451	720	609
Si	802	1 023	1 368	967	1 790	1 344
S	1 303	803	1 176	1 276	1 024	1 759
Cl	<70	<70	233	98	115	121
K	158	369	991	369	364	267
Ca	308	369	645	723	1 475	744
Ti	28	32	46	37	53	34
V	<6	<6	<6	<6	<6	<6
Cr	<4	<4	11	10	<4	<4
Mn	7	16	30	35	30	20
Fe	468	847	1 731	1 581	1 374	586
Ni	4	2	5	7	6	5
Cu	20	43	105	56	65	25
Zn	82	85	190	270	276	90
Br	5	6	9	12	6	4
Pb	9	16	57	25	41	14
Sr	<3	55	139	18	11	<3
Ba	<20	41	156	22	31	24

Table 2

		9/7 4 p.m. - 8 p.m.	9/7 8 p.m. - 12 a.m.	10/7 12 a.m. - 4 a.m.	10/7 4 a.m. - 8 a.m.	10/7 8 a.m. - 12 p.m.	10/7 12 p.m. - 4 p.m.
EC	*ng m^{-3}*	<MDL	1 101	2 827	357	211	<MDL
	(%)		(56)	(54)	(9)	(6)	
OC	*ng m^{-3}*	<MDL	3 144	8 075	1 019	601	<MDL
	(%)		(39)	(52)	(9)	(5)	
Mg	*ng m^{-3}*	<MDL	168	433	<MDL	<MDL	<MDL
	(%)		(62)	(81)			
Al	*ng m^{-3}*	<MDL	102	262	<MDL	<MDL	<MDL
	(%)		(20)	(38)			
Si	*ng m^{-3}*	<MDL	151	387	49	29	<MDL
	(%)		(15)	(29)	(5)	(2)	
K	*ng m^{-3}*	<MDL	269	692	87	52	<MDL
	(%)		(64)	(77)	(27)	(13)	
Ca	*ng m^{-3}*	<MDL	111	284	36	21	<MDL
	(%)		(30)	(44)	(5)	(1)	
Mn	*ng m^{-3}*	<MDL	5.2	13	<MDL	<MDL	<MDL
	(%)		(33)	(44)			
Fe	*ng m^{-3}*	10.3	400	1 028	130	77	10
	(%)	(2)	(48)	(57)	(10)	(5)	(1)
Cu	*ng m^{-3}*	<MDL	27	70	9	5	<MDL
	(%)		(66)	(68)	(14)	(9)	
Zn	*ng m^{-3}*	<MDL	38	98	12	7	<MDL
	(%)		(45)	(52)	(5)	(3)	
Sr	*ng m^{-3}*	<MDL	54	140	18	10	<MDL
	(%)		(100)	(100)	(99)	(98)	
Ba	*ng m^{-3}*	<MDL	51	130	16	<MDL	<MDL
	(%)		(90)	(91)	(47)		
PM10 mass	*ng m^{-3}*	<MDL	13 087	33 610	4 240	<MDL	<MDL
	(%)		(27)	(53)	(8)		

Figure 1

Figure 2

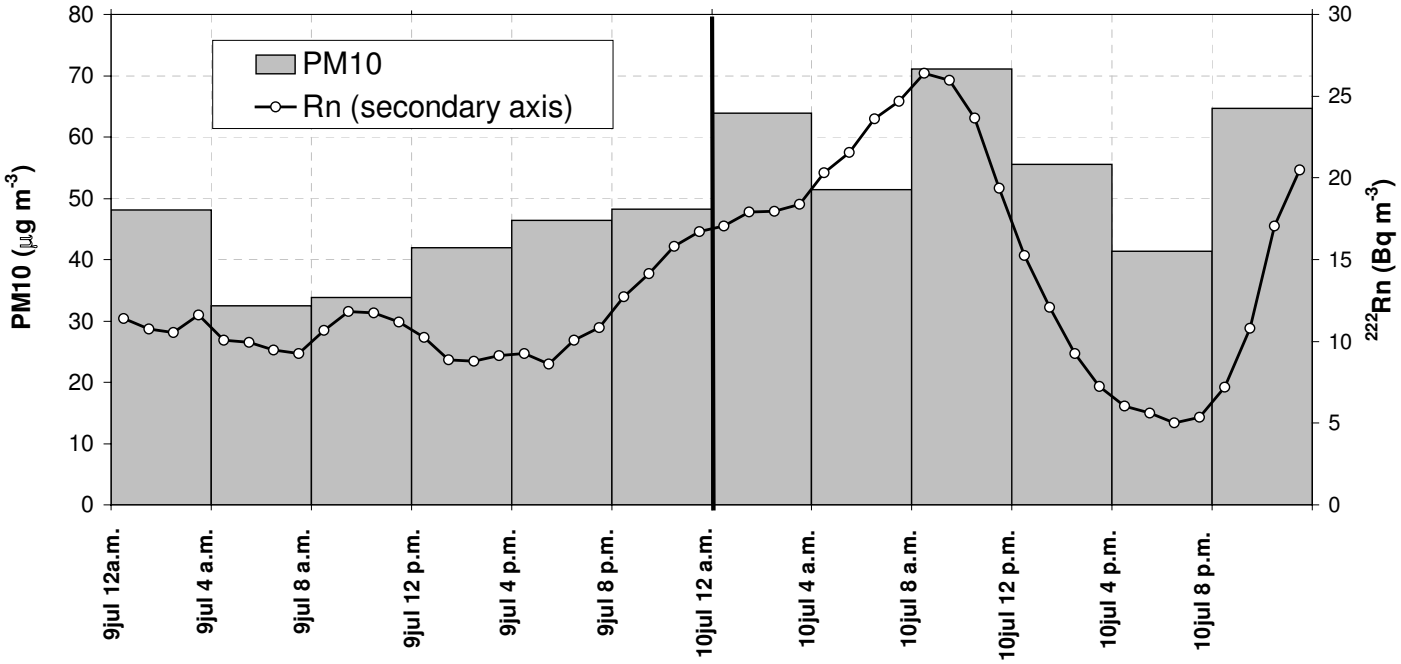

Figure 3

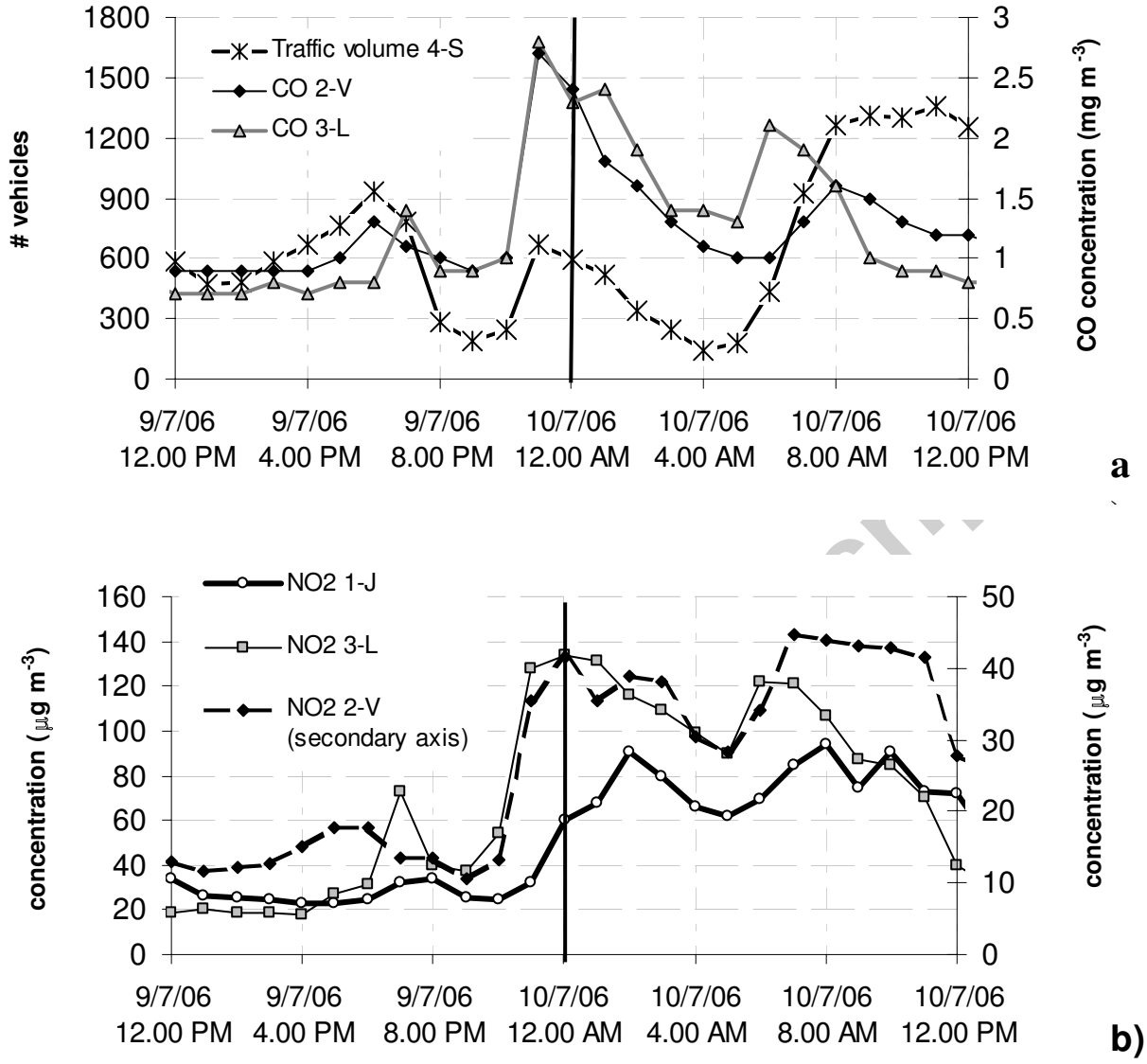

Figure 4

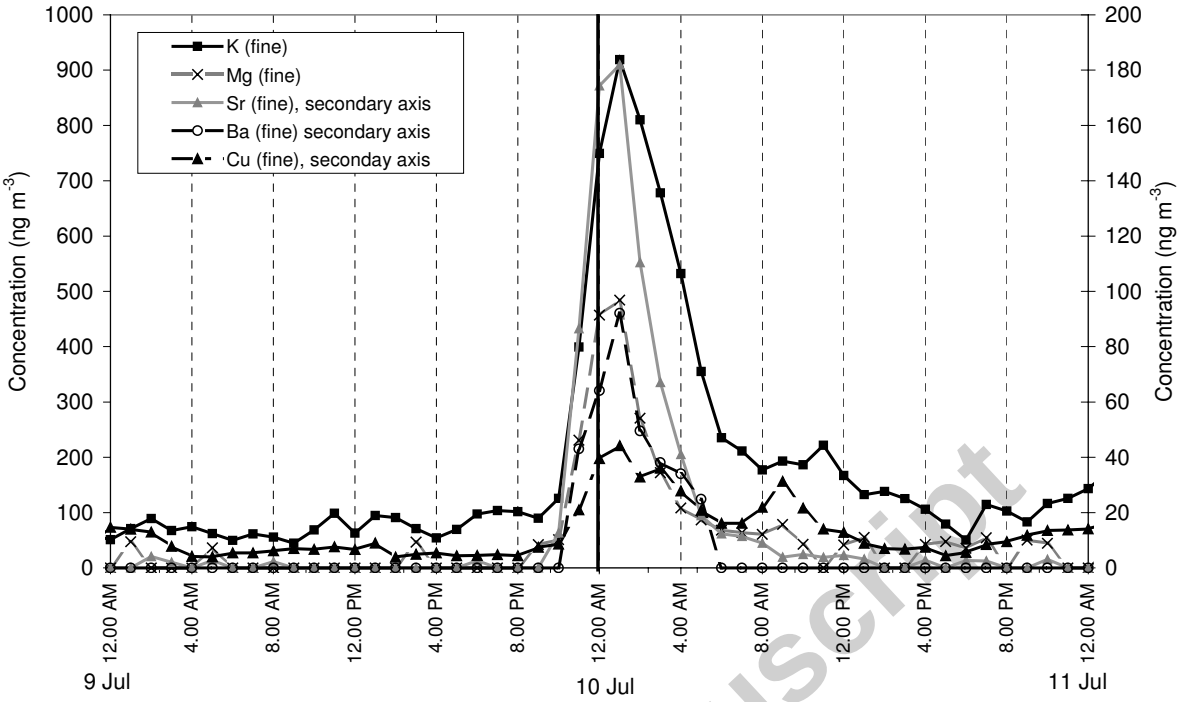

Figure 5

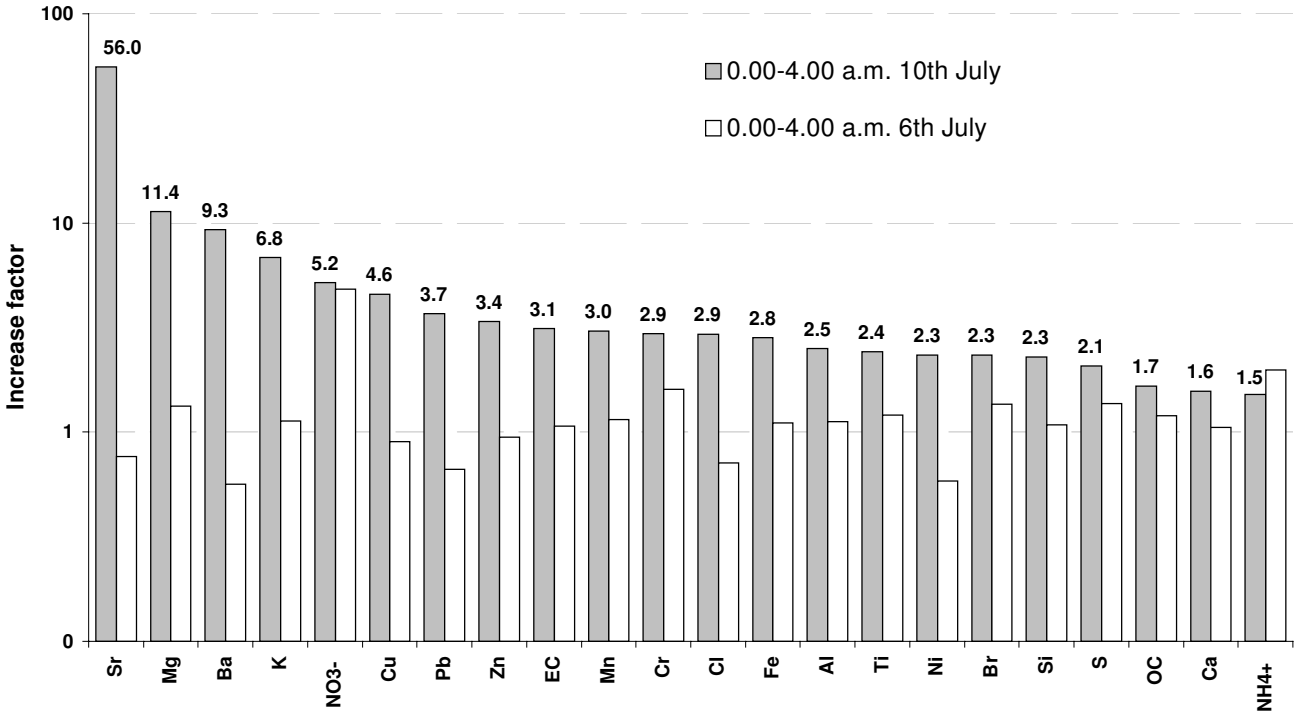

Figure 6

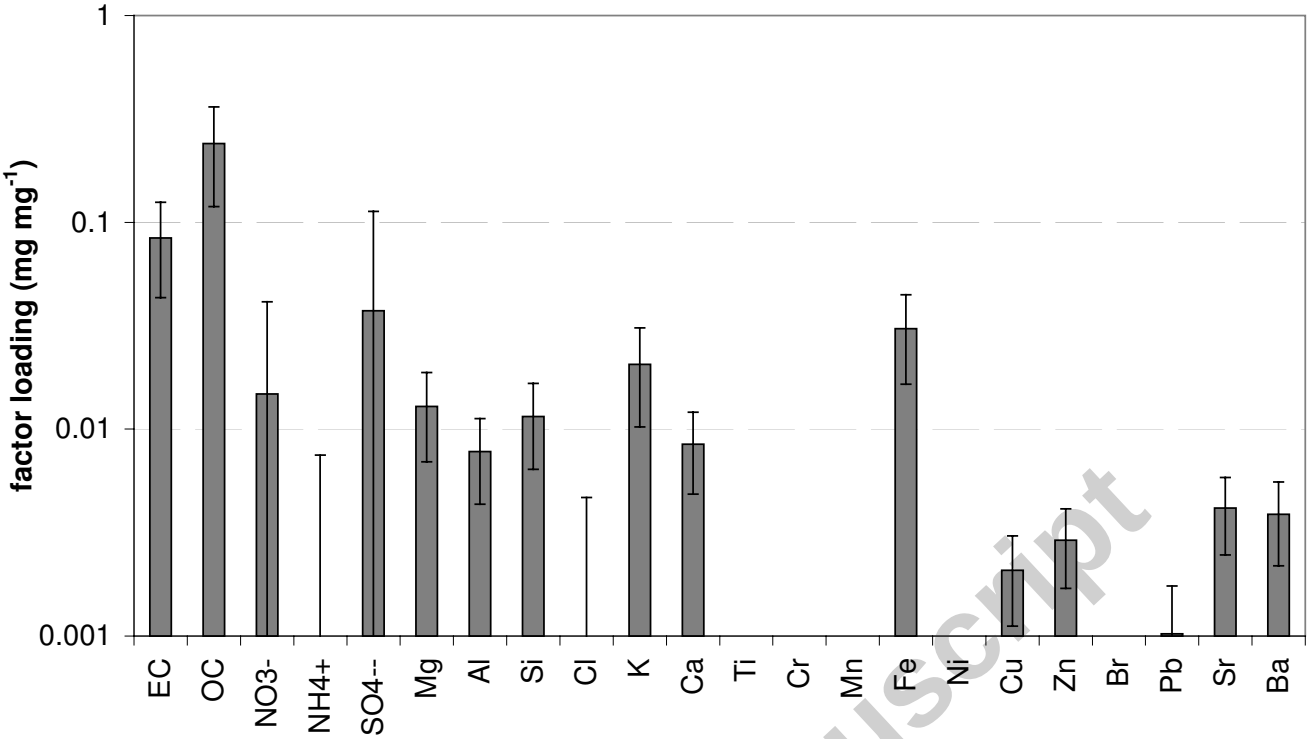

Figure 7

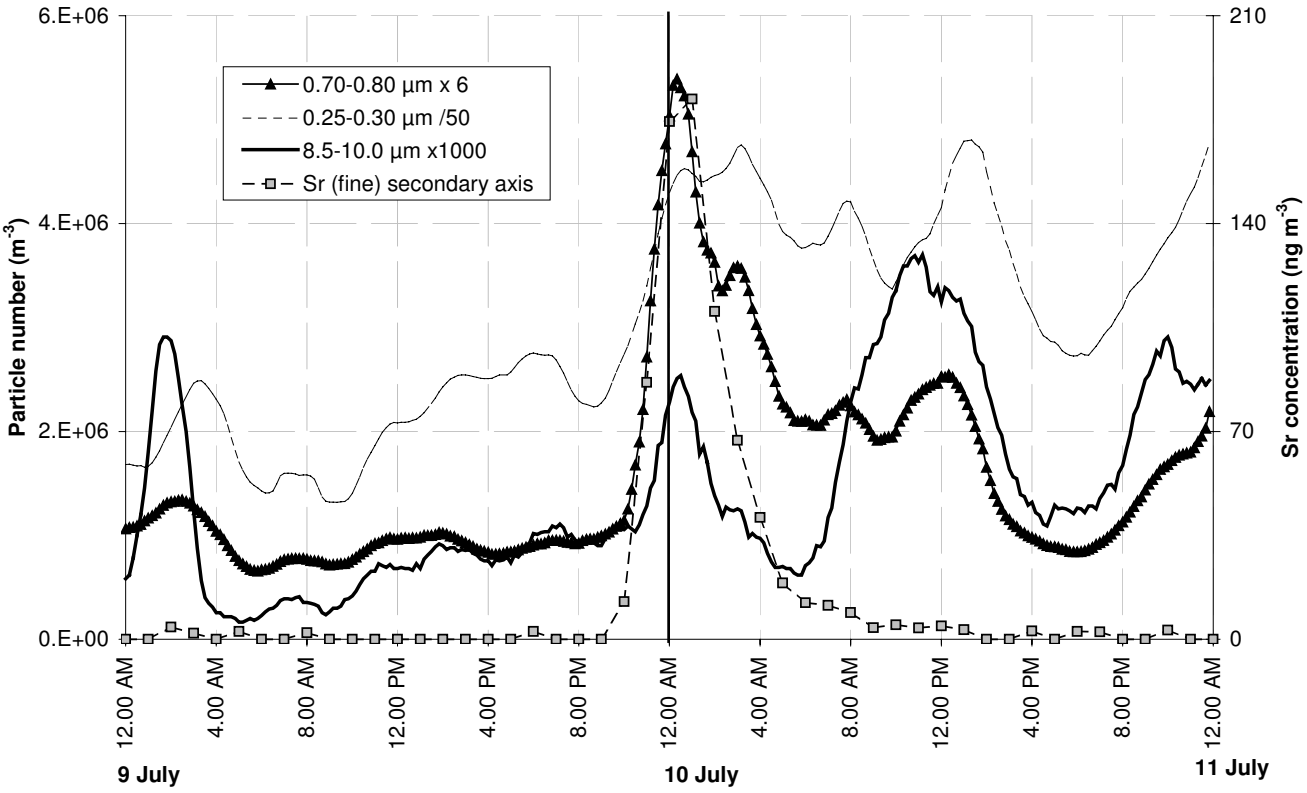

Exhibit I

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Short communication

Effect of fireworks events on urban background trace metal aerosol concentrations: Is the cocktail worth the show?

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ABSTRACT

We report on the effect of a major firework event on urban background atmospheric $PM_{2.5}$ chemistry, using 24-h data collected over 8 weeks at two sites in Girona, Spain. The firework pollution episode (*Sant Joan* fiesta on 23rd June 2008) measured in city centre parkland increased local background $PM_{2.5}$ concentrations as follows: Sr (x86), K (x26), Ba (x11), Co (x9), Pb (x7), Cu (x5), Zn (x4), Bi (x4), Mg (x4), Rb (x4), Sb (x3), P (x3), Ga (x2), Mn (x2), As (x2), Ti (x2) and SO_4^{2-} (x2). Marked increases in these elements were also measured outside the park as the pollution cloud drifted over the city centre, and levels of some metals remained elevated above background for days after the event as a reservoir of metalliferous dust persisted within the urban area. Transient high-PM pollution episodes are a proven health hazard, made worse in the case of firework combustion because many of the elements released are both toxic and finely respirable, and because displays commonly take place in an already polluted urban atmosphere.

1. Introduction

The polluting nature of the smoke plumes arising from firework displays has recently received considerable scientific attention, with published studies reporting mainly on specific events such as Independence Day in the USA [1], European World Cup football celebrations [2], Lantern festival in China [3], Diwali in India [4], Las Fallas in Spain [5], and New Year's Day [e.g. [6]]. The smoke plumes arising from such events can raise atmospheric particulate matter (PM) levels from tens to thousands of $\mu g\,m^{-3}$ [7], with most particles being fine (1–2 μm) and therefore potentially respirable [1]. The chemistry of these plumes is complex, but is always characterised by a high metal content due to presence of K in the black powder propellent and a range of other metals/metalloids used as oxidisers, stabilisers, and to add colour and other special effects.

The inhalation of smoke loaded with metalliferous particles small enough to enter the lung alveoli causes negative health effects in humans [e.g. [8]], especially among vulnerable individuals such as asthmatics [9]. However, demonstrating toxicological responses to the inhalation of fireworks smoke is hampered by a continuing lack of detail about the exact nature of the inorganic chemical cocktail being inhaled. Most publications to date have published only partial chemical analyses, and/or have measured materials also contaminated by sources other than fireworks. Furthermore, focussing only on the specific fireworks event fails to provide the longer term context of urban atmospheric PM chemistry normally present in a given urban area. In this short communication we summarise new chemical data from filters collected daily over a 7-week period prior to a major summer fireworks festival in Mediterranean Spain (*Sant Joan*), and compare them with data collected during and 1 week after the event. The primary aim of the study was to characterise the concentrations and chemistry of urban background levels of $PM_{2.5}$ in Girona, compare these with more traffic-polluted sites within the city, and to identify unusual spikes in air pollution such as, in this case, a fireworks festival. Our data include analyses of trace elements (using ICP-AES and ICP-MS) in 107 24 h filter samples: such a comprehensive database on the effect of fireworks emissions on urban background atmospheric chemistry has not previously been published.

2. Methodology

Filter samples for this study were collected during a monitoring campaign in May–June 2008 from two locations in the city of Girona (population 96,000) in NE Spain, including an urban background and a more traffic-polluted site in the city centre. The traffic site lies

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Table 1
Concentrations, detection limits and uncertainty of selected elements at the *Parc Migdia* and *Escola Musica* monitoring sites before, during and after the *Sant Joan* fireworks event. See text for details.

	Parc Migdia			*Escola Musica*			DL ($\mu g\,m^{-3}$)	Uncertainty (%)
	Before 05/05–22/06	During 23/06	After 24/06–30/06	Before 05/05–22/06	During 23/06	After 24/06–30/06		
$\mu g\,m^{-3}$								
$PM_{2.5}$	16.3	25.3	22.1	22.1	30.8	20.1		
OM + EC	5.7	7.9	7.3	13.6	11.9	14.4	0.58558	15–20
CO_3^{2-}	0.3	0.3	0.5	0.5	0.4	0.5	0.06008	4–5
SiO_2	2.1	2.7	2.1	1.9	2.1	1.9	0.11739	3–4
Al_2O_3	0.7	0.9	0.7	0.6	0.7	0.6	0.03913	3–4
Ca	0.2	0.2	0.3	0.3	0.3	0.3	0.04005	4–5
Fe	0.1	0.1	0.1	0.1	0.1	0.2	0.02017	3–4
K	0.1	2.6	0.2	0.1	1.3	0.2	0.02075	3–4
Na	0.2	0.2	0.2	0.3	0.3	0.4	0.10293	4–6
Mg	<0.1	0.2	0.1	0.1	0.2	0.1	0.01697	3–5
SO_4^{2-}	2.5	5.7	3.7	2.8	5.5	4.0	0.12572	5
NO_3-	0.4	0.2	0.1	0.5	0.1	0.1	0.07476	6–15
Cl^-	0.3	0.3	0.4	0.3	0.4	0.4	0.18700	15–28
NH_4^+	1.0	0.8	1.3	1.0	1.5	1.4	0.01793	14
$ng\,m^{-3}$								
P	10.3	26.9	25.7	15.2	15.8	23.8	0.00579	3–4
Ti	10.3	15.5	16.0	8.6	14.0	13.0	0.00218	3–4
V	4.1	4.5	3.7	3.8	4.6	3.8	0.00020	4
Mn	3.9	7.2	5.3	4.3	5.4	5.3	0.00079	4–6
Co	0.1	0.9	0.1	0.2	0.2	0.1	0.00004	5–6
Ni	2.9	3.2	3.1	3.6	4.5	3.6	0.00118	5
Cu	4.0	20.2	5.1	12.8	17.5	11.5	0.00278	4
Zn	18.3	71.3	64.3	39.8	74.6	86.8	0.03073	7–10
Ga	0.1	0.2	0.1	0.1	0.1	0.1	0.00004	8–10
Ge	1.1	1.1	0.9	0.8	0.9	0.7	0.00057	9–12
As	0.3	0.6	0.3	0.3	0.6	0.4	0.00007	4–5
Se	0.3	0.2	0.3	0.2	0.1	0.3	0.00008	4–5
Rb	0.2	0.8	0.4	0.3	0.6	0.4	0.00005	5–7
Sr	1.4	120.5	2.1	1.5	106.8	2.1	0.00043	6–8
Cd	0.1	0.2	0.1	0.1	0.2	0.2	0.00009	7–9
Sn	0.9	1.2	1.1	1.4	1.4	1.6	0.00201	4–5
Sb	0.4	1.4	0.7	0.9	1.7	1.0	0.00010	4–5
Ba	29.4	321.7	131.0	47.0	261.1	165.3	0.03708	10–18
La	0.2	0.3	0.2	0.2	0.2	0.2	0.00013	6–8
Ce	0.6	0.7	0.5	0.4	0.5	0.5	0.00032	6–7
Pb	4.2	29.1	4.9	4.4	22.8	5.8	0.00060	4
Bi	0.1	0.4	0.1	0.1	0.4	0.1	0.00004	6–10

in the southern city centre (*Escola Musica* 41°58′69″N/2°49′31″E: adjacent to the busy main road feeding north into the centre), whereas the background site lies in urban parkland (*Parc Migdia* 41°58′10″N/2°49′28″E) 350 metres to the SE (150°). Data from both stations were obtained from 5 May to 30 June 2008, with 24-h $PM_{2.5}$ sampling being carried out by means of MCV CAV-A and DIGITEL DH80 high volume samplers ($30\,m^3\,h^{-1}$) equipped with quartz fibre filters (Munktell). Filters were treated and analyzed following the procedure described by Pey et al. [10]. This is based on the daily sampling of PM and subsequent analysis of major and trace elements by ICP-AES and ICP-MS (of acidic digestions of 1/2 of each filter), soluble anions and cations by ion chromatography, ammonium by colorimetry-FIA (water leached, 1/4 of each filter) and carbon by thermo-optical methods. Contents of Si and CO_3^{2-} were indirectly determined from the contents of Al, Ca and Mg, on the basis of prior experimental equations ($2Al_2O_3 = SiO_2$; $1.5Ca + 2.5Mg = CO_3^{2-}$). Blank field filters were used for every stock purchased for sampling and analyzed in the same batches of their respective filter samples. The corresponding blank concentrations were subtracted for each sample. For analysis control, reference material NIST 1633b was added to a fraction of a blank filter to check the accuracy of the analysis of the acidic digestions. The individual uncertainty of daily measurements due to analytical techniques was estimated following the method described by Amato et al. [11] and expressed as % (interquartile range) of species concentration (Table 1). An estimate of detection limit (DL) was performed for the *j*th analyte based on the following formula:

$$DL^j = \frac{\sqrt{\sigma_0^{2j} + \sigma_{BLK}^{2j}}}{V}$$

which combines estimates of the two uncertainties linked to the instrument σ_0 (ICP-MS, ICP-AES, HPLC, etc.) and the blank subtraction σ_{BLK} [12]; V is an average value of air volume sampled in 24 h. Additional measurements were made every 15 min for SO_2 (ultraviolet fluorescence), and atmospheric conditions (wind velocity and direction, precipitation, relative humidity and ambient temperature) were supplied by the local site in the meteorological network of the Generalitat of Catalonia.

3. Results

The *Sant Joan* fireworks fiesta is celebrated late in the evening of 23rd June, and is recorded on an hourly scale by our SO_2 data at *Parc Migdia* which show a sudden rise after 20:00 to a transient peak at 22:00 UTC time (from 2.0 to 6.8 $\mu g\,m^{-3}$), followed by rapid subsidence to background levels after midnight (Fig. 1 inset). In contrast, neither aerosol nitrate nor ammonium levels were significantly affected by fireworks combustion, as also noted in previous work during New Year celebrations in Germany [6]. Mass concentrations of $PM_{2.5}$ (averaged over 24 h) rose from 14 $\mu g\,m^{-3}$ on the 22nd June to 25 $\mu g\,m^{-3}$ on the 23rd June. The influence of fireworks

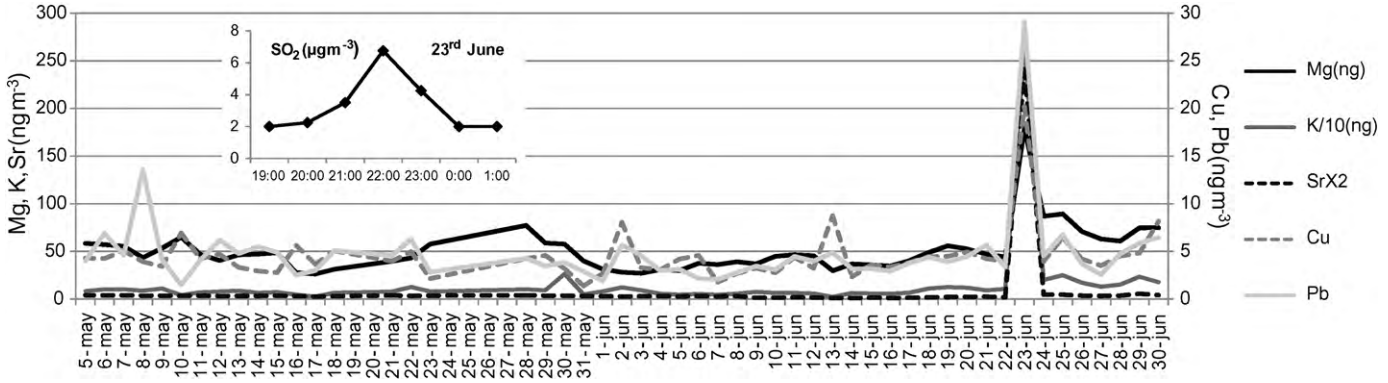

Fig. 1. Daily concentrations of Sr (x2), Mg, Cu, Pb and K (/10) at *Parc Migdia* urban background monitoring station, Girona. The prominent fireworks-related peak on 23rd June is followed by an aftermath of elevated levels compared to pre-fireworks background. Inset: hourly SO_2 levels registered on the 23rd of June.

on the PM content of filter samples for 23rd June in *Parc Migdia* is clear: they are unusually rich in metals, with K, Ba, Mg, Sr, Cu, Pb, Sn, Al, Bi, and Ga all rising suddenly to their highest value during the 8 week sampling campaign. The elemental increases relative to pre-fireworks background levels measured over the preceding weeks are, in decreasing order, Sr (x86), K (x26), Ba (x11), Co (x9), Pb (x7), Cu (x5), Zn (x4), Bi (x4), Mg (x4), Rb (x4), Sb (x3), P (x3), Ga (x2), Mn (x2), As (x2), Ti (x2) and SO_4^{2-} (x2).

Fig. 1 illustrates the scale of the fireworks metals peak at *Parc Migdia* on 23rd June, using five metals which best define the event, namely Sr, K, Mg, Cu and Pb. Interestingly, ambient concentrations of these and other metals during the week after the firework show do not fall back to pre-fireworks background levels but instead remain relatively elevated (Fig. 1). During this time the weather in Girona remained very hot and dry, with above average $PM_{2.5}$ concentrations (except after an early morning storm on 27th June). This observation of a post-fireworks concentration anomaly suggests that the transient but intense smoke event on the 23rd June created a reservoir of metalliferous particles which continued to contaminate the area days after the initial pollution episode. We envisage much of this reservoir as fine metalliferous PM attached to surface deposited particles later subject to daytime resuspension by wind, traffic and other activities. Further study is needed to ascertain for how long this "reservoir effect" can be detected within an urban area.

During the fireworks event light winds blew the main body of the dispersing smoke plume generally northwards over the city centre. The distinctive metalliferous fingerprint of fireworks emissions at the *Escola Musica* site was therefore again obvious, but with correspondingly reduced concentrations and a slightly different chemical mix. Once again pronounced increases were shown by Sr (x71), Ba (x6), Pb (x5), Bi (x4) although K levels dropped considerably (from x26 at *Parc Migdia* to x13 at *Escola Musica*), presumably due to less intense levels of black powder smoke close to ground level. Table 1 compares metal aerosol concentrations at the two monitoring sites averaging the 24-h values before, during and after the fireworks event.

The data from *Escola Musica* again show a post-fireworks aftermath of continued contamination, although as this site was less of a main focus of firework activity the effect is weaker (Table 1). Furthermore, there is a more obvious PM contribution from road vehicles at *Escola Musica*, as reflected by higher levels of background pre- and post-fireworks metals such as Ba, Zn, Cu, and Sb concentrations (Table 1), these elements being well established tracers not only for fireworks events but also for other anthropogenic emissions such as those from road traffic [13 and references therein]. The usefulness of these four metals in highlighting fireworks events is therefore somewhat compromised in sites with heavy traffic. In contrast, the element Sr is not only an excellent tracer for fireworks emissions, but also is unaffected by high traffic flows, with similar pre-fireworks background concentrations at both *Parc Migdia* and *Escola Musica* (Table 1).

In general, and with the obvious exception of 23rd June, background levels of trace metals at the two monitoring sites are controlled primarily by weather conditions and traffic density. Ambient PM concentration reach peaks during dry, mid-week periods and fall to prominent troughs during rainy spells, especially if these coincide with weekends. The first four rainy periods during this summer campaign period occurred at weekends, when daytime traffic flows were at their lowest, and each of these periods is

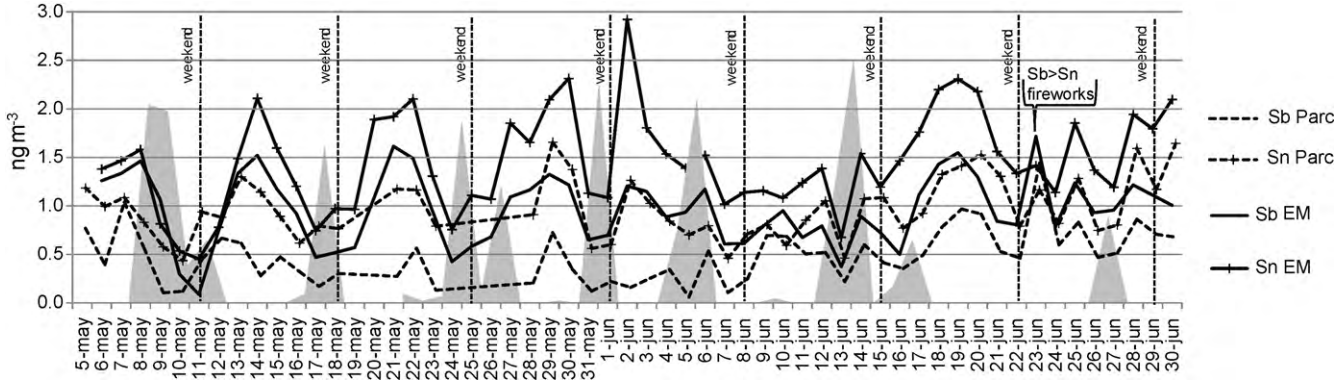

Fig. 2. Concentrations of the trace metals Sb and Sn in ambient air at *Parc Migdia* (Parc, urban background) and *Escola Musica* (EM, heavy traffic) monitoring sites in Girona. The repeated pattern of higher weekday and lower weekend levels is overprinted by cleansing rainfall (grey) events. During the *Sant Joan* fireworks event on 23 June Sb concentrations rise anomalously, exceeding those of Sn, making Sb a useful fireworks marker.

correspondingly marked by a prominent fall in PM concentrations. In contrast, the weekly PM maxima over this period consistently occurred between Tuesday and Thursday under dry conditions. Fig. 2 illustrates how trace metals record this fluctuation in PM concentrations, comparing levels of Sb and Sn, two trace metals with contrasting behaviours with respect to fireworks emissions. The obvious exception to a generally concordant pattern between Sb and Sn occurs over the *Sant Joan* fiesta, when Sb levels more than triple their pre-fireworks average whereas Sn levels, unaffected by fireworks, stay well below their average (Table 1 and Fig. 2). Fig. 2 therefore demonstrates that although contaminants such as Sb derive from mixed sources (in this case traffic and fireworks), comparing this metalloid with trace elements not present in fireworks (in this case Sn) can be a useful way to identify a fireworks event. Overviewing the chemistry of both sites leads us to conclude that the best firework elemental tracers in our study were Sr, K, SO_4^{2-}, Pb, and Bi, with Ba, Zn, Cu, and Sb also clearly showing firework peaks additional to those associated with traffic.

4. Discussion and conclusions

Most previous publications dealing with atmospheric PM emissions from fireworks have emphasised Sr, Ba, and K as especially typical tracers of firework emissions. With regard to other metals and metalloids there is less agreement, with different papers variously identifying some combination of Cu, Ti, Al, Ni, Cr, Zn, Cd, Mg, Co, Pb, Bi, and As [1–7,14–16]. It is clear that different fireworks vary enormously in the cocktail of metals they contain. Although K, as the black powder fuel and combined with S, is dominant, the main "special effects" trace additive can include a variety of other metals such as Al, Cu, Ti, or even Pb [17]. The case of Pb is of especial interest, given the high toxicity of this metal, as it is one of the few metals/metalloids for which legal atmospheric concentration limits exist (along with As, Hg, Ni, and Cd), although only for PM_{10} rather than $PM_{2.5}$. Despite this awareness, it is clear that in many countries any legal requirement for avoiding use of Pb in fireworks manufacture and combustion is being thwarted by imports from manufacturing countries less concerned with potential health implications. Some fireworks continue to contain Pb levels measurable in decigrams [17], and the effect of this on the chemistry of the resulting combustion plume is obvious. In both this current study in Girona, as well as in our study of Las Fallas smoke clouds in Valencia [5], Pb was a prominent component of the firework pollution plume, with average daily levels in Girona rising an order of magnitude higher following the display.

Despite the lack of legal controls on PM emissions emanating from firework combustion, the severity of the impact of such events on urban background atmospheric chemistry provides reasonable cause for concern [18]. There is already abundant published evidence that short-lived fluctuations in pollutants can induce changes in both lung and heart function [8,19–23]. Asthma symptoms, perhaps the most obvious risk factor, have been linked to 1-h PM_{10} and NO_2 concentrations rising from background values of 20–30 $\mu g\,m^{-3}$ to brief peaks at 40–70 $\mu g\,m^{-3}$ [24]. Similarly, 1-h exposure to elevated traffic levels has been associated with the onset of myocardial infarction [25], and hourly increases in $PM_{2.5}$ linked to myocardial ischaemia [26]. In the specific case of fireworks emissions it is the metalliferous component of atmospheric aerosols which is additionally implicated in negative health effects, not only with acute responses but also in their possible contribution to long term degenerative conditions such as Parkinson's and Alzheimer's diseases [e.g. [27,28]]. Presumably, those most immediately at risk from exposure to dense smoke clouds are people already debilitated by pre-existing illness, notably severe asthma or coronary heart disease, but the metalliferous and highly respirable nature of fireworks emissions makes them *per se* hazardous to the general population.

Finally, we emphasise that it is the additional burden of smoke emissions on already contaminated urban air which makes many fireworks events especially polluting. In the case of Girona, a fireworks event lasting an hour or two contributed to raising the daily average $PM_{2.5}$ mass from 13 $\mu g\,m^{-3}$ on 22nd June to 25 $\mu g\,m^{-3}$ on 23rd June. City centre concentrations of metals and metalloids such as Pb, Co, Ni, Zn, As, Al all increased markedly due to the fireworks display. All of these elements are listed in the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA) Priority List of Hazardous Substances published by the US Agency for Toxic Substances and Disease Registry. The health effects of inhaling such a concentrated and complex chemical cocktail of different toxic substances in the form of micron sized particles remain unknown. Furthermore, our observation of a continued "reservoir effect" enhancement of ambient metal PM levels persisting for days after the fireworks event indicates that the effect on urban background PM is less transient than might be supposed.

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