From: "Jim Fitzpatrick" <prontowash@msn.com>
To: "'James Smith'" <jsmith@waterboards.ca.gov>, "'Ben Neill'" <BNeill@water...
CC: <richard.boon@rdmd.ocgov.com>, "'Jim Fitzpatrick'" <prontowash@msn.com>
Date: 8/20/2009 1:45 PM
Subject: NPDES MS4 Comments
Attachments: IC24 Wastewater Disposal (2).pdf; 2009 FedWay Car Washwater Monitoring Stud y.pdf; Car Wash Run Off Effluent Impact Study - Pudget Sound.pdf; IC24 Wast ewater Disposal (2).pdf; 2009 FedWay Car Washwater Monitoring Study.pdf; Ca r Wash Run Off Effluent Impact Study - Pudget Sound.pdf

Hello, hope all is well. I wanted to share some feedback on the NPDES MS4 Permits for both Region 9 for South Orange County and Region 8 for North Orange County. I will make separate comments to Region 8 for San Bernardino and Riverside Counties.

Every City in an attempt to engage in a discussion about developing BMP's directs me to the County of Orange. The County of Orange has not accepted my requests to meet to discuss BMP development for the Mobile Car Wash and Detailing industry.

BMP's for NPDES MS4 Permit Region 8 North Orange County

I contact the City of Anaheim, received the same direction to contact the County, and received the attached BMP developed as a result of the adoption of the new NPDES MS4 Permit. It appears that my concerns shared in testimony and comments are valid. I have requested the Permit be prescriptive so that BMP's would be consistent with the spirit and intent of the Permit writers. The BMP has lumped all Mobile Businesses together and I believe that there are special practices associated with Wash & Detailing a car that are not addressed.

My primary focus of concern is and has been pollution, not the waste water. Focus on pollution, you solve any and all issues with waste water. This BMP mentions pollution in the beginning, but all other language and Practice recommendations focus on the waste water. This water can be controlled and prohibited from entering the Storm Drain. However, the BMPs do not address the pollution left behind which are picked up in Storm Water Runoff as Non Point Source Pollution.

See Attached BMP

Region 8 North Orange County

What do I or we do? Are we to live with these BMP's for the next

5 + years?

Can you please help me to get a meeting with the County of Orange?

Region 9 South Orange County

You are finalizing your permit

Do you see why I come to very meeting to champion a more prescriptive approach and specifying the standards you expect? You set standards on LID at the 85th percentile, so I know it is possible

With no action, even though you have the word pollution specifically inserted into the relevant section on Mobile businesses . there is valid concern that the County will not alter the BMP's.

There is sufficient evidence that eh Cities will take their direction from the Primary Permitee, the County of Orange.

What can we, you or I do?

Can you please help me to get a meeting with the County of Orange?

Studies that confirm runoff form car washes kill fish

I hope you will not receive and file, or as one Senior Scientist put it " we are building a body of knowledge". Sounds more like a politician than a scientist.

Attached is an older study (Pudget Sound), shared before.

Also attached is a new one (FedWay), again from the state of Washington, who is leading the way on this topic, and not the state of California.

Why discuss Irrigation, and not address Home Car Washing. There are reasonable Practices one can do at home to conserve water and control run off.

Will you act?

Thank you for your time and consideration,

Jim Fitzpatrick

949.257.8448

IC24. DISPOSAL OF WASTEWATER GENERATED BY MOBILE BUSINESSES & OUTDOOR ACTIVITIES

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner.[1] The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Dispose of or wastewater according to the instructions below. No wastewater shall be disposed of into the storm drain system.

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	x
Metals	x
Bacteria	x
Oil & Grease	x
Toxic Organic	x
Pesticides	x
Oxygen Demanding	x

Purpose of this BMP:

Orange County cities and the County of Orange are mandated under NPDES Permits issued by the California Regional Water Quality Control Boards to prohibit the discharge of pollutants and non-storm water runoff into the storm drain system. Therefore, untreated wastewater (including wastewater from mobile detailing, pressure washing, steam cleaning, carpet cleaning, or similar activities) shall **not** be discharged to the storm drain system.

In an effort to help businesses comply with the NPDES Permit, the cities of Orange County, County of Orange, South Orange County Wastewater Authority, Orange County Sanitation District, and Irvine Ranch Water District have developed the following best management practices (BMPs) for the proper disposal of wastewater generated by mobile business operations and outdoor activities.

If you have specific questions regarding any of the BMPs herein, please call your local sewering agency.

1. General Best Management Practices (BMPs) and Preparation of Work Area

What should I do prior to conducting a job?

The BMPs presented below are intended to help you avoid violating local and state regulations by preventing your wastewater from entering the storm drain system. The following BMPs must be followed by all mobile businesses that generate wastewater, regardless of the type of surface to be cleaned or cleaning operation to be performed:

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

- Evaluate the chemicals and compounds used for cleaning and reduce or eliminate the use of those that contain solvents, heavy metals, high levels of phosphates, or very high/very low pH exceeding the applicable sanitation or sewering agency requirements.

- Walk through the area where the cleaning will occur prior to the start of the job and identify all area drains, yard drains, and catch basins where wastewater could potentially enter the storm drain system.

- Block/seal off identified drains or catch basins using sand bags, plugs, rubber mats, or temporary berms.

- Collect all trash and debris from the project area and place them in a trash bin for disposal.

- Sweep all surface areas prior to cleaning to minimize the amount of suspended solids, soil, and grit in wastewater.

- Identify the wastewater disposal option that will be used. Whether you are discharging to landscaping or the sanitary sewer, it is necessary that you meet all the requirements identified below.

- Conduct mobile washing in accordance with all operating instructions provided by the equipment supplier. Maintain equipment in good working order and routinely check and test all safety features.

What methods can be used to collect wastewater at a site?

There is no specific containment method that must be used for wastewater collection/diversion. However, the system must be adequately designed so that the wastewater does not flow into an on-site or off-site storm drain inlet. All mobile businesses should use one of the following methods, regardless of the surface to be cleaned or the type of cleaning operation to be performed:

- Portable containment areas can be made from waterproof tarps, heavy-duty plastic, or rubber matting equipped with berms to prevent wastewater from running into storm drain inlets or off-site. Materials that have been used for berms include sand bags or water-filled tubing. Whatever containment material is used, it must seal tightly to the ground so that none of the wastewater can pass under or over the berms.

- When power washing smaller pieces of equipment, containment devices to use may include portable vinyl swimming pools, plastic 55-gallon drums on casters, and flat metal or plastic containment pads.

- Depending on the volume of wastewater generated, it may be necessary to use a pump system, which may range in size from a wet-dry vacuum to a sump pump. A natural basin from which to pump can also be set up by establishing a slightly sloped containment area.

- Stationary or more permanent containment areas can be constructed with cement. Berms and pump systems may be used to contain wastewater and divert it to a holding tank.

- Commercial wastewater collection systems are also available for power washing. These systems can range from portable wash pits to self-contained water recycling systems. A list of companies selling this type of equipment can usually be found in the telephone book under “Pressure Washing Services and Equipment”.

- Storm drain inlet covers can be made of an impermeable barrier such as a heavy-duty vinyl or plastic secured in place with materials such as concrete blocks, gravel bags, or sand bags. Storm drain inlet covers may also be available though commercial vendors.

Note: Blocking storm drain catch basin inlets in the public right-of-way (i.e. public street, or other publicly owned facility) is prohibited as a method of containment, unless expressly permitted by the municipality typically through an

encroachment permit process. Wastewater should be contained on-site prior to entering the public right-of-way. Contact the local municipality for more information.

2. Wastewater Disposal Options

How can I dispose of my wastewater?

Wastewater generated by mobile businesses is not allowed in the storm drain or street. However, the wastewater may be discharged to landscaping or the sanitary sewer, or it may be picked up and disposed of by a waste hauler. Please note that laboratory analysis may be required to establish the proper disposal method.

Choose one of the three wastewater disposal options listed below based upon the following conditions:

Option 1: Discharge Wastewater to a Landscaped Area

The wastewater must meet the following requirements if discharging to landscaping:

- The pH must be between 6.5 and 8.5. This can be checked quickly and easily through the use of pH paper test strips.
- The wastewater should not contain:
    - Toxic materials.
    - Degreasers.
    -
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel).
    -
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
    -
    - Petroleum oil, or other products of mineral oil origin.
    -
    - Paint.
- In addition, wastewater from cleaning food-related vehicles or areas, vehicle exteriors or engines, and buildings with lead- or mercury-based paint should **not** be discharged to landscaping.
- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- Ensure that the wastewater is fully contained within the landscaped area and will fully infiltrate into the ground prior to leaving the job site.

Option 2: Discharge Wastewater to the Sanitary Sewer

The wastewater must comply with the following conditions if disposed of into the sanitary sewer system:

- The wastewater temperature must be less than 140°F (60°C).

- The pH must be between 6.0 and 12.0. This can be checked quickly and easily through the use of pH paper test strips. Adjust the wastewater to a pH that is between 6.0 and 12.0. Dilution is not an effective or acceptable pretreatment.

- The wastewater quality must comply with the local sanitary sewer district's discharge limits and requirements. The wastewater should not contain:

    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel).
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
    - Petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.
    - Oil based paint.

- No wastewater shall be discharged into any publicly owned sewer manholes without the sewer agency's express authorization.

- Filter the wastewater if it contains debris, fibers, or other suspended solids.

- If chemicals (e.g., solvents or acids) are used during the cleaning process, additional precautions may be needed. Contact your local sanitation district to learn if wastewater containing these chemicals requires pretreatment before discharge to the sanitary sewer or if it needs to be treated as hazardous waste.

- Ensure that the wastewater is released at a flow rate and/or concentration, which will not cause problems, pass through, or interference with the sewerage facilities.

- Utilize an approved discharge point such as:

    - Privately owned cleanout (or sink, toilet or floor drain), oil/water separator, or below ground clarifier at the client's property where the wash water is generated;
    -
    - Privately owned industrial sewer connection at the client's property where the wash water is generated;
    -
    - Waste hauler station at sanitary sewer facility; and
    -
    - Any other disposal points approved by the sanitary sewer facility.

- Maintain a logbook of all discharges.

Option 3: Dispose of Wastewater Using a Professional Hazardous Waste Hauler

Wastewater that can be characterized in any of the following ways must be disposed of using a hazardous waste hauler:

- Is corrosive (as indicated by a pH value of less than 5.5) or caustic (as indicated by a pH value of greater than 10.0).

- Contains a pollutant that may create a fire or explosion hazard (e.g., gasoline, diesel fuel).

- Contains solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
- Contains petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.
- Contains other potential hazardous wastes. Examples of other potential hazardous wastes include:
    - Wastewater generated from power washing old paint off a building. Paint chips need to be collected, evaluated, and disposed of properly. Paint chips cannot be left on the ground at the job site. Old paint stripped off commercial buildings may contain metals (e.g., lead, chromium, cadmium, and mercury), causing it to be a regulated hazardous waste.
    - Wastewater used in conjunction with certain solvents and degreasing agents, which may cause the wastewater to be classified as a listed or characteristic hazardous waste.

You must comply with the following conditions if a hazardous waste hauler is used:

- Ensure that the waste hauler is certified by the appropriate sanitary sewering agency and the Orange County Health Care Agency, is Hazardous Waste DOT certified, and is complying with applicable discharge regulations, which may include obtaining necessary permits and conducting water quality monitoring requirements. Please contact the Orange County Health Care Agency and/or your local fire department for specific requirements.
-
- Identify the wastes involved and determine if a hazardous waste has been generated.

- Maintain a logbook of all discharges and hazardous waste manifests, if applicable.

For additional information contact:

County of Orange Stormwater Program
Resources & Development Management Department
Watershed & Coastal Resources Division
(714) 567-6363
Or Visit:
www.ocwatersheds.com

RESIDENTIAL CAR WASHWATER MONITORING STUDY

July 2009

Public Works Department
Surface Water Management Division

RESIDENTIAL CAR WASHWATER MONITORING STUDY

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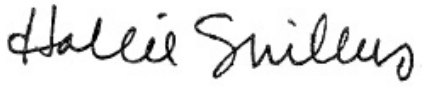

_____
Hollie Shilley, Surface Water Quality Technician
Surface Water Management

CITATION

Smith, Daniel J., Shilley, Hollie. 2009. Residential Car Washwater Monitoring Study. City of Federal Way, Washington, Public Works, Surface Water Management

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ABSTRACT

To better understand the nature of urban stormwater discharges to the City of Federal Way Municipal Separate Storm Sewer System (MS4), the Water Quality section of the Surface Water Management (SWM) Division of Public Works embarked on a small study to illustrate the links between car washing, stormwater, local surface waters, and Puget Sound. Findings from the study will be presented to the public as part of our on-going stormwater pollution prevention education campaign targeting residential activities.

The findings presented herein show that most wash water from residential car washing is a source of stormwater pollution. It also demonstrates that any single uncontrolled residential car wash activity might be inconsequential with respect to its contribution to the pollutant load being delivered to the MS4, however, when extrapolated over the entire City of Federal Way for a year, the pollutant loading becomes significant.

The following are several of the crucial pollutants detected and the calculated annual pollutant loading to the City's MS4:

- Petroleum hydrocarbon waste: gasoline, diesel, and motor oil (estimated 190 gallons of annual mass loading).
- Nutrients: phosphorous and nitrogen (estimated 400 pounds of annual mass loading).
- Ammonia (estimated 60 pounds of annual mass loading).
- Surfactants (estimated 2,200 pounds of annual mass loading
- Solids (estimated 30,000 pounds of annual mass loading).

The results of this study support the findings of the Puget Sound Partnership 2008 Action Agenda declaring that pollution-related water quality problems in the freshwaters and marine waters of Puget Sound include excess nutrients and contamination by toxic chemicals draining from urban areas. The Action Agenda also points out that pollution entering Puget Sound's rivers, lakes, and marine waters does so through a variety of pathways, and that surface water runoff appears to be the primary transportation route, with the most concentrated loads coming from developed lands.

1.0 INTRODUCTION

Stormwater generated in Federal Way drains into Puget Sound. Fed by seasonal freshwater from the Olympic and Cascade Mountain watersheds, Puget Sound is a ninety-mile long saltwater estuary in rapidly growing Western Washington. This water body provides recreation for people, and is home to a diverse, but endangered, ecosystem.

In 2007 the Washington State Legislature created the Puget Sound Partnership (PSP), an effort undertaken to implement a strategic and bold plan to restore the health of this regionally important waterbody by 2020. Released at the end of 2008, the PSP issued an Action Agenda that spells out measurable goals for Puget Sound's recovery by demonstrating the complex connections between the land and water. With a good deal of alarm, the PSP emphasizes, in no uncertain terms, that urban stormwater runoff poses a major threat to Puget Sound's ecosystem.

Often society has been slow to recognize the link between individual behaviors and practices, and the detrimental impacts that they may have on our natural aquatic resources. One of these practices, residential car washing, may give rise to surface water quality impacts that can be felt well beyond the front yards and driveways of the communities where it occurs.

In some instances, car washing is carried out on lawns, in sideyards, or on graveled areas, which all allow for the infiltration of the wash water. However, in most cases, it is performed on impervious surfaces – that is, driveways or streets – where the washwater drains directly into the Municipal Separate Storm Sewer System (MS4).

To better understand the nature of urban stormwater discharges to the City of Federal Way Municipal Separate Storm Sewer System (MS4), the Water Quality section of the Surface Water Management (SWM) Division of Public Works embarked on a small study to illustrate the links between car washing, stormwater, local surface waters, and Puget Sound.

1.1 Regulatory Background

In 1999, the Environmental Protection Agency (EPA) issued the National Pollutant Discharge Elimination System (NPDES) stormwater Phase II program regulations (40 CFR Part 122). The ruling was a Federal mandate established to address discharges from small MS4s in an effort to reduce sources of stormwater pollution that impact the water quality of our natural water bodies.

EPA's primary role in the NPDES program was to develop the overall regulatory framework. Under the ruling, authorized states (including Washington) were permitted to tailor their stormwater discharge control programs so that water quality needs and objectives could be addressed through a fine-tuning and adjustment of the regulatory process at a state level. In early 2007, the State of Washington Department of Ecology (DOE) issued the Western Washington Phase II Municipal Stormwater Permit. Over 100 jurisdictions are subjected to this permit, including Federal Way.

The Phase II rule requires that all affected municipalities implement a series of individualized programs designed to control non-stormwater discharges, including both a public education track and procedures to detect and eliminate stormwater pollutants (illicit discharges). With some exceptions, the EPA defines an illicit discharge as "any discharge to an MS4 that is not composed entirely of stormwater".

Phase II jurisdictions are to "effectively prohibit through ordinance, or other regulatory mechanism, illicit discharges into the MS4, and implement appropriate enforcement actions as needed". The Western Washington Phase II Municipal Stormwater permit requires Federal Way to develop a regulatory mechanism that effectively prohibits non-stormwater, illegal discharges, and/or dumping into the MS4 to the maximum extent allowable under State and Federal law. An ordinance accomplishing this will go into effect for the City of Federal Way on August 16, 2009.

By definition, residential car washwater is a non-stormwater discharge, however, the EPA ruling sets it and other types of non-stormwater discharges (including water line flushing, landscape irrigation, de-chlorinated swimming pool discharges, etc.) apart. These discharges would only need to be included in the scope of an illicit discharge detection and elimination (IDDE) program if they were identified as *significant contributors of pollutants* to the MS4. In these cases, specific stormwater controls would need to be implemented. If deemed to be ineffective, an affected municipality would have the authority to prohibit the discharge completely.

1.2 Recent Permit Clarifications

In September of 2008, the Department of Ecology began recommending that permitted municipalities implement a public education approach when attempting to obtain compliance with residential car wash discharges. These recommendations were included in a number of DOE-issued correspondences, including news releases, a fact sheet, and a guidance document to cities and counties clarifying the recommended response actions. DOE recommendations include a learning phase period to allow for behavior change, letting each permitted entity to decide which group of actions would be effective enough to eliminate "significant" prohibited discharges (Howard, 2009).

2.0 STUDY DESIGN

Attempting to sample and quantify stormwater contaminants generated by common residential activities can be difficult. These elusive constituents, many of which are which are invisible to the naked eye, include bacterial loadings produced by poor pet waste management practices, fertilizers, herbicides and or pesticides dissolved in surface runoff from lawns. Depending on the frequency and volume of stormwater flows, concentrations of these pollutants can be highly variable. These type of contaminant loadings are classified as non-point discharges.

Conversely, car washwater streaming into neighborhood stormwater structures presents a more simplified sampling opportunity. It offers a much easier target to examine: the flow stream is often foamy and visible; it can be readily captured as it drops into a catch basin; the concentration of contaminants is relatively consistent; the discharges occur predictably (on nice

days); and the transport of pollutants generated by the activity is not dependant upon fluctuating stormwater runoff. Accordingly, discrete flows of residential car washwater are point source discharges to the MS4.

Sampling multiple individual driveway or street locations around the city in an effort to examine the issue for this study was found to be difficult with respect to timing, coordination, and potentially uneasy interactions with the public. Therefore, washwater grab samples were instead collected at five distinct weekend car wash fund raising events (see Section 4.1), which was considered to be representative of pollutants typically generated by individual car washing activities (See Section 4.2).

3.0 GOALS AND OBJECTIVES

The following were the goals and objectives of the Federal Way Residential Car Washwater Monitoring Study:

- Collect and analyze representative residential car washwater samples in accordance with procedures outlined in Standard Methods for the Examination of Water and Wastewater, 20th Edition.
- Estimate the annual mass loading of select individual pollutants to the MS4.

4.0 VEHICLE WASHWATER TESTING METHODS

4.1 Location of Sampling

The study utilized car washwater from five distinct weekend fund raising functions in the City of Federal Way during the summers of 2007 and 2008. The events were typical, and included groups washing cars and trucks for donations at settings such as commercial business locations and church parking lots. No significant precipitation events occurred before or during any event.

Due to the large number of vehicles washed, and the volume of washwater generated, event organizers were required to install a car wash kit to divert the flow away from the stormwater system. The kit, supplied by the City at no cost, includes power cords, hoses, a small submersible pump, and a plastic insert which fits into catch basin structures that receive the soapy flow.

By means of this set-up (Figure 1), discrete grab samples of the washwater were easily retrieved from the car wash kit discharge hose during the mid-point of each scheduled event. All water flowing across the pavement in the car washing area was collected within the catch basin insert. Collected washwater was delivered as effluent through a hose to either a sanitary clean out, sanitary sewer manhole, or pervious area at the site.

4.2 List of Parameters

It is known that washwater generated from car washing may contain many types of contaminants including high amounts of petroleum hydrocarbons, heavy metals and nutrients. In addition, data provided by the International Carwash Association (ICA) representing wastewater discharged to publicly owned treatment works from various commercial facilities indicates a similar inventory of pollutants generated by car washing activity (ICA, 2002).

Based upon this information, a list of constituents to be analyzed for was developed. The constituents tested are shown in Table 1. The following presents a brief description of the general pollutant categories that were selected to be tested:

- Petroleum hydrocarbons (gasoline, diesel fuel, motor oil, fluids and lubricants) from automobile engines, leaks, and fuel combustion processes.
- Heavy metals resulting from normal wear of auto brake linings (copper), tires, exhaust, and fluid leaks.
- Phosphorous- and nitrogen-containing detergents contained in wash water from cleaning vehicles.
- Surfactants in detergents and cleaning formulations (both synthetic and organic agents) that lower the surface tension of water, allowing dirt or grease to be washed off of cars.

4.3 Sample Collection, Containers, Preservation, and Storage

Laboratory guidance was used to determine the number and type of sample containers used, the correct sample volume, and the proper sample preservative required for each parameter analyzed. Before each sampling event, the following supplies were prepared:

- Sampling bottles, labels, and chain-of-custody forms from the laboratory.
- Powder-free disposable latex gloves.
- Coolers and ice.
- Field notebook to keep records concerning sampling.

The following describes the sampling method:

- Samples of car washwater were collected directly into the sample bottles without transferring into another container to prevent unnecessary contamination.
- Bottles were filled to within two inches of the top to allow for thermal expansion (unless sample analysis requires that no air space be left)

- The samples were placed immediately into a cooler with ice (and then refrigerator) to maintain a 4°C environment until delivery to the laboratory. Samples were delivered within the shortest holding time of the water parameter need to be analyzed.
- No replicates or field blanks were collected.

4.4 Chain of Custody Procedures

The chain-of-custody (COC) refers to the documented account of changes in possession that occur for a particular sample or set of samples. The COC record allows an accurate step-by-step recreation of the sampling path, from origin through analysis. With the COC documentation, there exists confidence that samples have not been tampered with and that they are representative of the car wash water collected from that particular site. Information recorded on the COC includes:

- Name of the persons collecting the sample
- Sample ID number
- Date and time of the sample collection
- Location of the sample collection
- Names and signature of all persons handling the samples in the field and in the laboratory

4.5 Field Records

The following sampling information was submitted on the COC to the laboratory ensuring proper sample handling and analysis by the laboratory:

- A unique identification number assigned to all samples.
- The date and time of sample collection
- The source of the sample.
- The name of sampling personnel.
- Specific analysis required.

5.0 SAMPLE ANALYSIS

5.1 Methods

Analytical methods followed the procedures outlined in Standard Methods for the Examination of Water and Wastewater, 20th Edition. Table 1 describes each parameter analyzed, the analytical method used, and the proper sample preservatives required.

Test America Laboratories prepared written narratives assessing the quality of the data collected for this project. These reviews include a description of analytical methods and assessments of holding times, initial and continuing calibration and degradation checks, method blanks, surrogate recoveries, matrix spike recoveries, laboratory control samples, and laboratory duplicates. No significant problems were encountered in the conventional water quality analyses.

6.0 PREDICTED CONTAMINANT LOADING

The following series of steps were conducted to estimate annual pollutant loadings to the MS4:

1. An average concentration value was calculated for each parameter tested during the five individual sampling events.

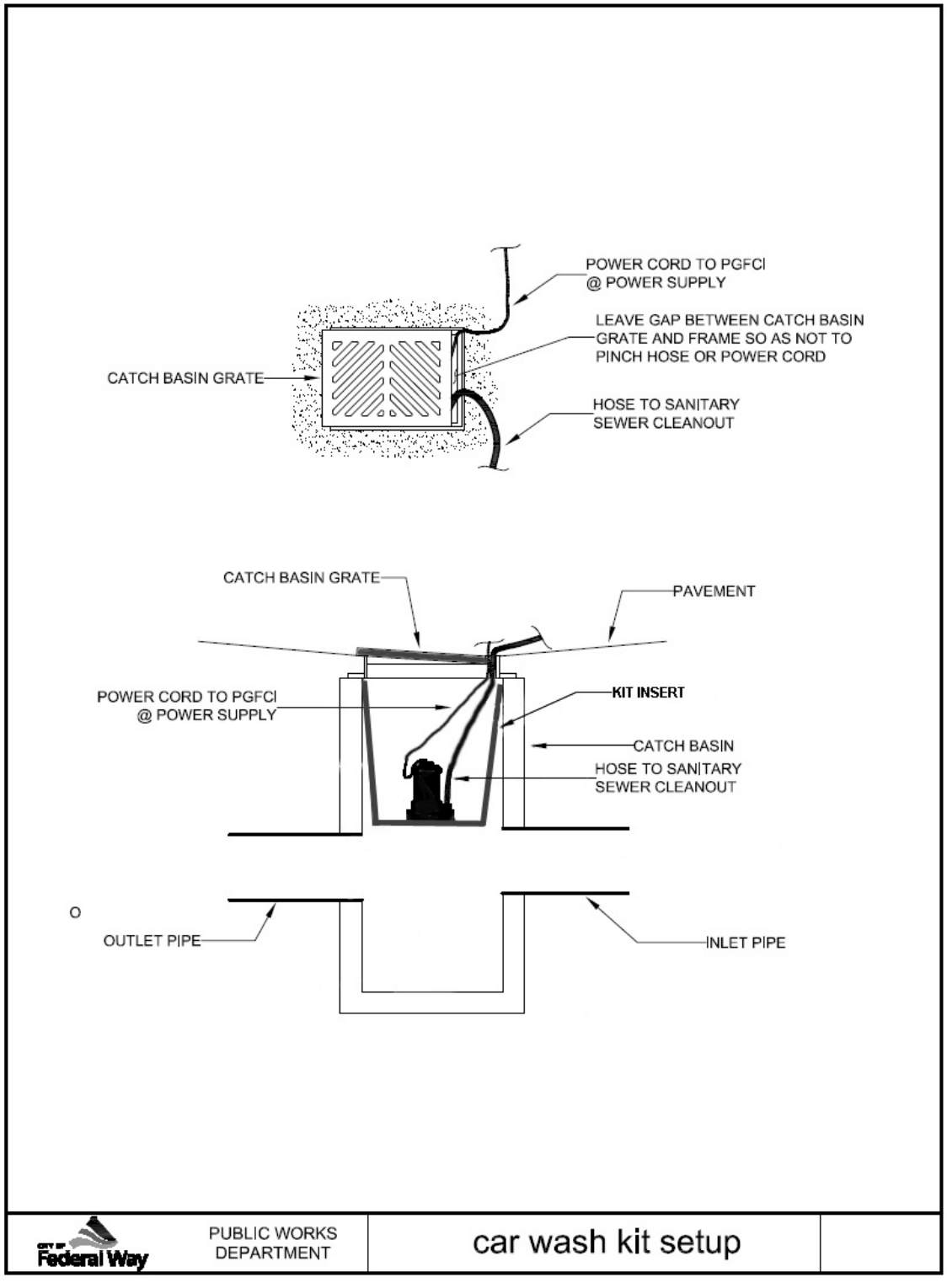
2. The average values were converted into an appropriate volume or mass quantity (either gallons or pounds).

3. Total annual MS4 pollutant loadings were calculated based upon the amount of residential car washing estimated to be carried out in Federal Way.

6.1 Laboratory Results

Table 2 provides a summary of laboratory results for each of the five separate sampling events and the calculated average concentration for each parameter.

Figure 1. Car wash kit set up diagram



6.2 Conversion Factors

The final study figures hinged upon the following key referenced statistics and conversion factors:

- There are an estimated 62,000 passenger cars and trucks registered in Federal Way (WDOL, 2009).
- Thirty-eight percent (38%) of car owners wash their cars in the driveway (ICA, 2005).
- The average frequency of residential car washing in the Puget Sound region is once every two weeks (Hardwick, 1997).
- Twenty (20) gallons is the average amount of water used to wash a vehicle (based upon field observations and simulations using a low-flow nozzle).
- Assumed that 80% of driveway car washing effluent drains to MS4.
- The average weight of used motor oil is 7.0 lbs/gal, (USEPA, 1993).
- The average weight of gasoline is 6.1 lbs/gal, (USDOE, 2009).
- The average weight of #2 diesel fuel is 7.0 lbs/gal, (USDOE, 2009).
- The weight of ammonia is 5.15 lbs/gal at 60°F, (USDOL, 2009).

Table 1. Analytical methodology and preservation methods, residential car washing in Federal Way, WA, 2007-2008

Parameter	Analytical Methodology	Container/Preservative
Gasoline	NWTPH-Gx, SW846 5030B	40 ml VOA vials (3), HCl
Motor Oil	NWTPH-Dx, SW846 3510C	1 liter amber glass, HCl
#2 Diesel	NWTPH-Dx, SW846 3510C	1 liter amber glass, HCl
Surfactants (MBAS)	SM5540 C	250 ml poly, unpreserved
Total recoverable metals	6010B ICP (3005A)	250 ml poly, HNO3
Dissolved metals	6010B ICP	250 ml poly, HNO3
Total dissolved solids	EPA 160.1	1 liter poly, unpreserved
Total suspended solids	EPA 160.2	1 liter poly, unpreserved
Oil and grease (HEM)	EPA 1664A	1 liter amber glass, H2SO4
Ammonia	EPA 350.1	250 ml poly, H2SO4
Nitrate + Nitrite	EPA 300.0	250 ml poly, H2SO4
Total Phosphorous	EPA 365.1	250 ml poly, H2SO4

6.3 Final Results

By converting sample concentration to mass or volume, hypothetical annual pollutant loading estimates to the MS4 could be calculated. Significant findings are summarized in Table 3 that lists select contaminants tested and their average annual estimated mass loading to the City of Federal Way MS4 from residential car washing.

7.0 DISCUSSION OF STUDY RESULTS

The following is a brief discussion concerning several of the crucial pollutants detected, the calculated annual pollutant loading, impacts to the City's MS4, potential effects on downstream water quality:

Petroleum hydrocarbon waste: gasoline, diesel, and motor oil (estimated 190 gallons of annual mass loading). Compounds in petroleum hydrocarbons are highly toxic, and in the surface water environment, they can cause harm to wildlife through direct physical contact, contamination by ingestion, and the destruction of food sources and habitats.

Bottom-dwelling or bottom-feeding aquatic organisms may ingest petroleum contaminants and transmit them up through the food chain until they accumulate in dangerous concentrations in fish. Hydrocarbons also harm fish directly, and damaged fish eggs may not develop properly (EPA, 2003). Additionally, oil can be particularly problematic because a single spilled cup can contaminate the surface area of a waterbody the size of a football field (EPA, 2003).

Dissolved copper (estimated 14 pounds of annual mass loading). Exposure to dissolved copper may be sufficient to impair the sensory biology (olfactory system) of coho salmon (*Oncorhynchus kisutch*), listed as an ESA Species of Concern. Coho and other salmonids rely on their sense of smell for critical behaviors such as homing, foraging, and predator avoidance. Sub-lethal impacts on olfactory function may reduce the chances of survival or reproduction of individual salmon and, therefore, are a concern for the survival of salmon populations within the Pacific Northwest (Baldwin, et al, 2003). Dissolved copper is also toxic to phytoplankton, the base of the aquatic food chain (National Research Council, 2008).

Nutrients: phosphorous and nitrogen (estimated 400 pounds of annual mass loading). An increase in nutrient loading to a surface water body leads to excessive plant growth and decay. This creates low dissolved oxygen levels, changes in animal populations, and an overall degradation of water quality and aquatic habitat. This process is known as eutrophication. In the 2008 Water Quality Assessment, DOE found numerous locations in South Puget Sound impaired due to a lack of dissolved oxygen caused by excess sources of nitrogen from human-related pollution.

Table 2. Analytical summary and concentration averages for select contaminants from residential car washing in Federal Way, WA, 2007-2008

Parameter	Date	Date	Date	Date	Date	Average Concentration
	6/23/2007	*5/17/2008*	*6/28/2008*	*7/12/2008*	*7/26/2008*	
Gasoline (mg/L)	0.12	0.071	0.12	0.062	0.084	0.091
Motor Oil (mg/L)	8.2	2.8	12	9.4	10	8.5
#2 Diesel (mg/L)	5.8	3.2	13	3.9	3.7	5.9
Total Metals (mg/L)						
Arsenic	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Cadmium	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Chromium	Non Detect	Non Detect	0.025	0.030	Non Detect	0.028
Copper	0.83	0.15	0.71	0.59	0.38	0.532
Lead	0.054		0.034	0.061	0.056	0.051
Nickel	0.021		0.056	0.19	ND	0.089
Zinc	0.74	0.14	0.62	0.57	0.44	0.502
Dissolved Metals (mg/L)						
Arsenic	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Cadmium	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Chromium	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Copper	0.21	0.11	0.23	0.16	0.13	0.168
Lead	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect	Non Detect
Nickel	Non Detect	Non Detect	0.027	0.023	Non Detect	0.025
Zinc	0.32	0.092	0.22	0.24	0.16	0.206
Nitrate + Nitrite (mg/L)	Non Detect	0.96	0.77	0.73		0.82
pH (Ph)	6.09	7.01	6.5	7.16	6.99	6.75
Hardness (mg/L)	45	95	75	75	35	65
Total Dissolved Solids (mg/L)	210	300	180	230	150	214
Total Suspended Solids (mg/L)	82	Non Detect	280	230	200	198
Oil & Grease (mg/L)	21		45	11	8.8	21.5
Turbidity (NTU)	180	27	270	220	100	159
Total Phosphorus (mg/L)	0.75	0.73	5.8	6.1	6.3	3.94
Surfactants MBAS (mg/L)	30	12	35	40	19	27
Ammonia (mg/L)		0.61	0.65	0.97	0.73	0.74

Table 3. Select contaminant annual pollutant concentrations and estimated annual pollutant loading from residential car washing in Federal Way, WA, 2007-2008

Parameter	Analytical Methodology	Estimated annual mass pollutant discharge
Fuel (Gasoline, #2 Diesel)	NWTPH-Gx, SW846 5030B, NWTPH-Dx, SW846 3510C	492 lbs (70 gals)
Motor Oil	NWTPH-Dx, SW846 3510C	695 lbs (120 gals)
Surfactants (MBAS)	SM5540 C	2,200 lbs
Chromium, total recoverable	6010B ICP (3005A)	2 lbs
Copper, total recoverable	6010B ICP (3005A)	44 lbs
Lead, total recoverable	6010B ICP (3005A)	4 lbs
Nickel, total recoverable	6010B ICP (3005A)	7 lbs
Zinc, total recoverable	6010B ICP (3005A)	41 lbs
Copper, dissolved	6010B ICP	14 lbs
Total dissolved solids	EPA 160.1	17,500 lbs
Total suspended solids	EPA 160.2	16,200 lbs
Oil and grease (HEM)	EPA 1664A	1,400 lbs
Ammonia	EPA 350.1	60 lbs
Nitrate-Nitrite	EPA 300.0	67 lbs
Phosphorous	EPA 365.1	320 lbs

Nutrient availability also impacts the formation of hazardous algal blooms (HABs) which can produce high concentrations of nerve or liver toxins in the water column at levels that pose human health concerns (WDOE, 2009). HABs in Washington ponds, lakes, and reservoirs (including Federal Way) have been documented at an increasing rate over the past 25 years (WDOH, 2008).

Ammonia (estimated 60 pounds of annual mass loading). Forms of nitrogen (ammonium), in combination with pH and temperature variations, can be toxic to fish. When this toxic combination occurs, large amounts of oxygen in the water is consumed, subsequently stressing or killing fish and other aquatic organisms (King County, 2009).

Surfactants (estimated 2,200 pounds of annual mass loading. In surface water environments, surfactants are acutely toxic to aquatic life, stripping fish gills of natural oils, thereby interrupting the normal transfer of oxygen.

Solids (estimated 30,000 pounds of annual mass loading). Sediment, the most common pollutant in stormwater runoff by volume and weight, makes streams and lakes less suitable for recreation, fish life, and plant growth. Sediment is of particular concern in fish-bearing streams where it can smother trout and salmon eggs, destroy habitat for insects (a food source for fish), and cover prime spawning areas. Uncontrolled sediment can also clog storm drains, leading to increased private and public maintenance costs and flooding problems (King County, 2009).

8.0 CONCLUSION

The purpose of this study was to quantify the pollutant loading to the MS4 from residential car washing activities in areas upstream of in-flow treatment structures such as catch basin sumps, oil/water separators, ditches and retention/detention ponds.

While many of the known contaminants in car wash water were tested for, there are many other chemicals that were not. Some of these compounds include degreasers, metal brighteners, waxes and other potentially toxic components, and are more extensively addressed by recent studies investigating the overall aquatic toxicity of car wash effluent and synthetic detergents (Abel, 2006) (Brasino, et al, 2007).

Given both the nature and concentration of the pollutants found in the car washwater tested, it is apparent that significant quantities of stormwater contaminants are generated annually from residential car washing activity in Federal Way. Stormwater carries these pollutants – soapy water and all – to storm drains in urban areas, which then flow to surface waters with little or no water quality treatment (WDOE, 2009). This study demonstrates that while any single residential car wash might be considered inconsequential with respect to its contribution to the pollutant load being delivered to the MS4, however, when extrapolated over the entire City of Federal Way for a year, the pollutant loadings becomes more significant.

The City of Federal Way recognizes the challenges faced by the average homeowner as they struggle to implement car wash stormwater pollution prevention best management practices in their own driveway or neighborhood street. Solving these challenges becomes more urgent when considering the population growth trends developed for Washington's ten central Puget Sound counties. Currently, there are approximately 4.2 million people residing here, but the figure is expected to swell 1.3 million more by 2020 (WSOFM, 2009). These census predictions show us how powerful and effective incremental behavioral changes by people can be, and how small changes – when they benefit the environment – can translate into larger and more geographically significant water quality improvements.

Even though professional car washing facilities employ water treatment systems, and in many cases recycle the wastewater, surveys conducted by the International Carwash Industry from 1999 to 2008 indicate that the majority of home washers consistently feel that residential car washing is better for the environment than commercial car washes (ICA, 2008). From this information, it appears that more effective public education efforts will be needed to affect

sufficient behavior changes to reduce prohibited discharges caused by residential car washing activity.

Other survey data indicates that people will act more environmentally responsible as more accurate information is attained (NEETF, 2005). The City of Federal Way's public education program continues to embrace this concept, and will follow the DOE lead in utilizing the results of this study to craft more meaningful, effective, and accurate educational tools that describe the overall magnitude of stormwater pollution created by all home-based activities, including residential car washing.

For the average resident, we hope that this study will bring to view the amount of car washing contamination produced in their own community, causing them to be concerned by the prospects of pollutant loadings to our local salmon streams and Puget Sound when the sum of discharges from the entire Western Washington region are considered.

References

Abel, P.D. 2006. "Toxicity of Synthetic Detergents to Fish and Aquatic Invertebrates." *Journal of Fish Biology, Vol.6, No 3.*

Baldwin, David H., Sandahl, Jason F., Labenia, Jana S., and Scholz, Nathaniel L. 2003. "Sublethal Effects of Copper on Coho Salmon: Impacts on Nonoverlapping Receptor Pathways in the Peripheral Olfactory Nervous System." *Environmental Toxicology and Chemistry, Vol.22, No.10.*

Brasino, J. and Dengler, J. 2007. Practical Fish Toxicity Test Report. Environmental Partners, Inc.

Hardwick, N. 1997. Lake Sammamish Watershed Water Quality Survey, Water and Land Resources Division, King County, Washington.

Howard, Sandy. 2009. Washington Department of Ecology Communications Manager-Water Quality and Environmental Assessment Programs. Personal Communication.

International Car Wash Association. 2002. Water Effluent and Solid waste Characteristics in the Professional Car Wash Industry

International Car Wash Association. 2005. ICA Study of Consumer Car Washing Attitudes and Habits.

International Car Wash Association. 2008. ICA Study of Consumer Car Washing Attitudes and Habits.

King County, Washington. 2009. http://www.kingcounty.gov/environment/waterandland/stormwater/introduction/science.aspx#nutrients

The National Environmental Education & Training Foundation (NEETF). 2005. What Ten Tears of NEETF/Roper Research and Related Studies Say About Environmental Literacy in America.

National Research Council. 2008. Urban Stormwater Management in the United States.

Puget Sound Partnership. 2009. http://www.psp.wa.gov/

U.S. Department of Energy, Oakridge National Laboratory. 2009. Bioengineering Conversion Factors.

U.S. Department of Labor, Occupational Safety and Health Administration. Safety and Health Topics: Properties of Ammonia. 2009.

U.S. Environmental Protection Agency. 1993. USEPA Business Guide for Reducing Solid Waste, EPA/530-K-92-004.

U.S. Environmental Protection Agency. 2003. *Shipshape Shores and Waters,* A Handbook for Marina Operators and Recreational Boaters.

Washington State Department of Ecology. 2009. Algae Control Program. http://www.ecy.wa.gov/programs/wq/plants/algae/publichealth/GeneralCyanobacteria.html

Washington State Department of Ecology. 2009. Car Washing and Stormwater Permits, http://www.ecy.wa.gov/programs/wq/stormwater/CarWash.html

Washington State Department of Health. 2008. Washington State Recreational Guidance for Microcystins (Provisional) and Anatoxin-a (Interim/Provisional)

Washington State Department of Licensing. 2009.

Washington State Office of Financial Management. 2009. Final Projections of the Total Resident Population for Growth Management High Series: 2000 to 2030.

ENVIRONMENTAL PARTNERS INC

"Practical" Fish Toxicity Test Report

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There is little, if any, reliable data available to assess the storm water loading of a typical curbside car wash event. This study is sponsored by Brown Bear Car Wash to develop a more reliable empirical data set to help evaluate storm water impacts. Brown Bear did not dictate the test procedures or otherwise influence the design or outcome of the study.

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1.0 TEST DESCRIPTION

Two "practical" fish toxicity tests were run. The first test was conducted from August 28 to September 1, 2006 and used effluent water collected from a fund-raiser car wash event at a commercial automotive service location on August 26, 2006. The second test was conducted from November 29 to December 3, 2006 and used a simulated effluent solution containing a consumer car wash detergent. The simulated effluent solution was formulated according to the product label directions with dilution that mimicked a car wash effluent.

The same detergent concentrate was used in water samples for both tests. Juvenile rainbow trout were used in both tests and both tests were conducted according to standard protocols specified in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA-821-R-02-012). The tests were performed by an experienced, certified laboratory.

The tests produced similar results. The first test indicated a percent concentration that was lethal to 50% of the test organisms (LC50) of 3.1%. The second test indicated an LC50 of 3.0%.

There were significant differences in the way the stock water solutions for the two tests were prepared. For the first test, runoff water was collected from the parking lot of an automotive service facility during a fund-raising event. This water ran across approximately 30 feet of asphalt before collection and likely included contact with petroleum hydrocarbons and the grit and grime typically associated with a heavily traveled asphalt lot. Approximately 15 gallons of this water was sampled and delivered "as collected" to the laboratory. Figure 1 presents an overall view of the car wash event location and Figure 2 is a photograph showing a view of the storm drain water collection device. (Note: The youth organization used a car wash kit supplied by King County that prevented the effluent water from entering the storm drain. Effluent water was collected by a storm drain catch basin, shown in the background of Figure 1, and pumped to a sanitary sewer drain, shown in the foreground of Figure 1.)

For the second test, the same detergent concentrate that was used for the car wash event was used by the laboratory to prepare a simulated effluent for testing. This simulated effluent was mixed according to instructions on the product container and was further diluted to simulate addition of rinse water. All water used in the second test was potable.

These tests are termed "practical" fish toxicity tests because the effluent solutions for both were collected or prepared such that each represented the actual runoff water that would be expected to enter into storm water drains and,

eventually, the streams and rivers of Puget Sound. The tests were not run to simply determine the lethal concentration of a pure chemical or to satisfy a discharge permit requirement. As such, the results of these tests represent one piece of evidence that points directly to the impact of wash water from residential driveway or fund-raiser car washes that enters storm drains emptying into water bodies containing threatened and endangered salmon.

2.0 DISCUSSION OF CAR WASH EFFFLUENT FISH TOXICITY TEST

A 96-hour acute effluent toxicity bioassay test (EPA-821-R-02-012) was performed using juvenile Rainbow Trout (Oncorhynchus mykiss) exposed to a standard 0.5 dilution series. The concentration series consisted of 6.25, 12.5, 25, 50, and 100 percent car wash effluent water diluted with potable water. Four replicates of each concentration were run. Potable water was also used to run a laboratory control test.

Prior to test start, dissolved oxygen, pH, conductivity, and temperature of the test waters were measured in each test chamber to ensure parameters were within acceptable limits (prescribed by Environmental Protection Agency (EPA) method guidance). Water quality measurements and survival observations were made daily.

The car wash effluent water caused 100 percent mortality in all concentration steps tested. Complete mortality occurred within 24 hours of test start. Survival of the laboratory control was 100 percent. Results are presented in Table 1 below.

Table 1. Car Wash Effluent Fish Toxicity Test Results

Test Solution Concentration (%)	Live Organisms at Start of Test	Live Organisms at 96 Hours	Percent Survival
0 (control)	40	40	100
6.25	40	0	0
12.5	40	0	0
25	40	0	0
50	40	0	0
100	40	0	0

The calculated LC50, the concentration of sample that is expected to cause mortality in 50 percent of the select population of organisms, was 3.125 percent due to the complete mortality observed in the lowest concentration tested (6.25 percent) and the 100 percent survival observed in the laboratory control (0 percent). Another measure of toxicity is called Toxic Units (TU = 100/LC50). TU

measurement is typically a specified criterion for discharge monitoring permits. For this case, the Acute Toxic Unit (TUa) result was calculated to be 32, meaning that the tested effluent is 32 times more toxic than an acceptable effluent.

The test was aerated at initiation due to low dissolved oxygen levels (4.3 milligrams per liter (mg/L)) in the received sample car wash water. Dissolved oxygen levels remained within protocol limits for the duration of the test. The results of an associated reference toxicant solution using copper sulfate fell outside the 95% confidence limits of the historical laboratory mean. This indicated that the organisms tested might have been less sensitive to concentrations of copper than typical populations. Since complete mortality was observed in all concentrations of car wash effluent, this reference toxicant deviation had no impact on test results.

Listed below are average test solution physical and chemical data. All parameters were held within acceptable limits during the test period.

Dissolved oxygen:	7.6 mg/L
Temperature:	15.0 +/- 0.1 ^{o}C
Conductivity:	0.23 mS/cm
pH:	7.5
Hardness:	99 mg/L (as calcium carbonate)
Alkalinity:	90 mg/L (as calcium carbonate)
Total chlorine:	0 mg/L

(^{o}C = degrees Celsius and mS/cm = milliSiemens per centimeter)

The complete laboratory test report is included in Appendix A.

3.0 DISCUSSION OF SIMULATED EFFLUENT FISH TOXICITY TEST

A 96-hour acute effluent toxicity bioassay test (EPA-821-R-02-012) was performed using juvenile Rainbow Trout (Oncorhynchus mykiss) exposed to a concentration series of 0.01, 0.05, 0.1, 0.5, 1, and 10 percent simulated effluent (laboratory-prepared effluent sample) solution diluted with potable water. Four replicates of each concentration were run. Potable water was also used to run a laboratory control test.

Prior to test start, dissolved oxygen, pH, conductivity, and temperature of the test waters were measured in each test chamber to ensure parameters were within acceptable limits (prescribed by EPA method guidance). Water quality measurements and survival observations were made daily.

The simulated effluent solution caused 100 percent mortality in the 10 percent concentration solution and 2.5 percent mortality in the 1 percent concentration solution. All mortality at the 10 percent concentration occurred with 24 hours. Survival rates were 100 percent for all other series concentrations. Survival of the laboratory control was 100 percent. Results are presented in Table 2 below.

Table 2. Simulated Effluent Fish Toxicity Test Results

Test Solution Concentration (%)	Detergent Concentrate Concentration (ppm)	Live Organisms at Start of Test	Live Organisms at 96 Hours	Percent Survival
0 (control)	0	40	40	100
0.01	0.005	40	40	100
0.05	0.027	40	40	100
0.1	0.053	40	40	100
0.5	0.265	40	40	100
1	0.530	40	39	97.5
10	5.300	40	0	0

The calculated LC50 was 3.046 percent, which equates to a detergent concentrate concentration of approximately 1.6 parts per million (ppm).

The test was aerated at initiation and during its duration due to low dissolved oxygen. Dissolved oxygen levels remained within protocol limits for the duration of the test. The results of an associated reference toxicant solution using copper sulfate fell within the test 95% confidence limits of the historical laboratory mean.

Listed below are average test solution physical and chemical data. All parameters were held within acceptable limits during the test period.

Dissolved oxygen:	10.2 mg/L
Temperature:	11.1 +/- 0.1 ^{o}C
Conductivity:	0.32 mS/cm
pH:	8.3
Hardness:	62 mg/L (as calcium carbonate)
Alkalinity:	140 mg/L (as calcium carbonate)
Total chlorine:	0 mg/L

(^{o}C = degrees Celsius and mS/cm = milliSiemens per centimeter)

The complete laboratory test report is included in Appendix B.

4.0 TOXICITY TEST WATER SAMPLES

The car wash effluent water obtained from the fund-raiser event was a true blind sample and can be considered a typical car wash event effluent. Inquiries were made at local newspapers, schools, service stations, and of individuals who work with youth groups to try to locate a fund-raiser event. The sampler arrived after the event had started and had no input into how the car washing was performed. The location of the event, the type and amount of detergent used, its dilution in a bucket, and the amount of rinse water used was uncontrolled. This car wash event effluent water was used to prepare the dilution series for the first fish toxicity test (i.e., 100, 50, 25, 12.5, and 6.25 percent of the effluent sample).

Cars were washed on an asphalt surface at an oil change service facility. The asphalt condition was typical of a parking lot; its surface had numerous dark spots indicating leaks of petroleum product, as shown in Figure 3. Wash and rinse water that dropped to the asphalt ran about 30 feet across the asphalt to a storm drain grate. The 30-foot traverse was across a driveway of the facility. The event was held on a sunny September day.

The people running the event were using a King County-supplied car wash kit that consisted of an impervious plastic tub, small electric pump, and hose. The plastic tub fit into the storm drain opening and prevented water from going down the drain. It collected the wash water, which was pumped through a hose to an on-site sanitary sewer drain. The car wash effluent water sample was collected from the hose prior to discharge to the sewer. The sample was cooled to 4^{o}C and delivered to the test laboratory the following day.

The simulated effluent solution for the second fish toxicity test used the same detergent that was used during the car wash event. The solution was prepared using directions printed on the product container and was further diluted to simulate the addition of rinse water. All water used in the second test was potable.

Based on product label directions, approximately 16 milliliters (mL) of detergent concentrate was mixed with 4 gallons of water to make the wash solution. This wash solution was diluted by a factor of 20 to mimic the addition of rinse water to produce a concentration of approximately 53 parts per million (ppm) that was the simulated effluent solution used to prepare the dilutions series for the second fish toxicity test (i.e., 10, 1, 0.5, 0.1, 0.05, and 0.01 percent of the effluent sample).

An analysis was made of summertime stream flows for several small creeks and streams in King County that flow into Puget Sound, Lake Washington, and Lake Sammamish. Although flows were highly variable depending on stream size and

recent weather, a typical range of summertime flow was about 2 to 10 cubic feet per second (cfs), equivalent to 900 to 4,500 gpm. This range of stream flow rates was compared to an assumed flow of water from two hoses running at 5 gpm each that was assumed to be typical of a fund-raiser car wash event. The ratio of car wash effluent to stream flow was about 1/100 (0.01 or 1%) to 1/1,000 (0.001 or 0.1%).

This analysis was used to bracket the range of the dilution series performed by the laboratory for the second fish toxicity test. Thus, the concentration of the simulated effluent and the dilution series used for this toxicity test represent realistic conditions. Organisms living and swimming in small creeks and streams around northwest lakes and flowing into Puget Sound would likely be exposed to car wash detergent concentrations that were used in both fish toxicity tests reported here.

5.0 DISCUSSION OF FISH TOXICITY TEST RESULTS

Table 3 presents a comparison of the LC50 results for the two fish toxicity tests. The two tests were identical in all respects except for the source of the test water. The reported LC50 values are the percent concentrations of the two dilution series at which mortality was estimated for half of the rainbow trout specimens tested.

Table 3. Fish Toxicity Test Results Summary

Test	Description	LC50	Concentration	Comments
1st	Real car wash event effluent tested	3.125%	Unknown	5-step dilution series, identical to 2nd test in all other respects
2nd	Laboratory-prepared simulated effluent tested	3.046%	1.6 ppm	6-step dilution series, identical to 1st test in all other respects

Because the car wash effluent used in the first toxicity test was generated in an uncontrolled manner it is not possible to make conclusive remarks about the LC50 results of the toxicity test. This is because the amount of detergent and water used was not measured; hence, detergent concentrations in the dilution series were not known. Also, no chemical analyses were performed to determine petroleum hydrocarbon or metals concentrations in the effluent. Nevertheless, the effluent water sample was collected from an actual fund-raising car wash event and the effluent water represented an actual potential impact to a local stream.

On the other hand, the laboratory-prepared simulated effluent solution used in the second fish toxicity test used measured quantities of detergent and water, which allowed exact calculation of detergent concentrations in the dilution series water. Uncertainties associated with this test include lack of exposure to a petroleum-contaminated asphalt parking lot and lack of exposure to grime from a dirty car.

The similarity of LC50 results is unexpected. There is no way to know if this similarity indicates true replicability or is merely coincidental. The common feature between the two tests was the use of the same car wash detergent concentrate. This concentrate is a commercially available product marketed specifically as a car wash detergent. As indicated by the second test results, a detergent concentration of approximately 1.6 ppm is sufficient to kill one-half of a population of juvenile rainbow trout. In the first toxicity test the car wash effluent solution was fatal to all specimens tested within 24 hours down to the minimum dilution tested of 6.25 percent.

Because the simulated effluent solution for the second test was prepared in the laboratory it is reasonable to assume that the fish mortality was due solely to the effect of the chemicals in the car wash concentrate. The most likely chemical that could be found in such a product that would be toxic to fish is a surfactant or mix of surfactants. The exact physiological impact of a surfactant chemical on the fish is unknown in this case. The chemical could be toxic by simple ingestion, could affect the surface chemistry of fish gills and thereby asphyxiate fish, could disrupt or destroy cell membranes, or produce some other lethal effect.

Other research in this area has indicated that detergents as a rule will destroy fish mucus membranes and gills to varying degrees. Natural oils may be washed away affecting oxygen uptake by the gills. The damaged mucus membranes make fish more susceptible to organic chemicals such as petroleum and pesticides and inorganic chemicals found in fertilizers. Thus, smaller concentrations than predicted of these chemicals may become toxic to fish. Some surfactant chemicals in detergents have been shown to break down into more toxic compounds and to mimic natural hormones in fish causing abnormal growth and development, and therefore lowering survival rates.

Material Safety Data Sheets (MSDSs) for the detergent concentrate were obtained but revealed little about the chemical constituents of the product. The MSDS for the product tested listed only the constituents "water" and "surfactant (mixture)." The surfactant was indicated to be at a concentration between 5 and 20 percent. No ecological information was presented in the MSDS. The only precautions listed were to avoid eye contact ("May Cause Eye Irritation"), likely due to a listed pH of 9.

MSDSs for similar car wash products marketed by the same vendor indicated a few chemical compounds. Among those listed for similar products were the following:

- sodium dodecylbenzene sulfonate (CAS 025155-30-0, also known as sodium laurylbenzene sulfonate);
- alcohol ethoxylate, sulfated, sodium salt (CAS 068585-34-2); and
- unsaturated alkyl carboxylic acid diethanolamide (CAS 068155-07-7).

Ecotoxicity information for the first of these chemicals indicates moderate toxicity to fish, high toxicity to nematodes and flatworms, and slight toxicity to crustaceans and zooplankton. The chemical use is listed as microbiocide, adjuvant, fungicide, and insecticide.

6.0 PUGET SOUND SETTING

Puget Sound is home to 3.8 million people, two-thirds of the state's population. By 2020, another 1.4 million people are expected to settle around the Sound. There are approximately 1.8 million people currently living in King County.

Puget Sound is the second largest estuary in the United States. It has 2,300 miles of shoreline. The Puget Sound watershed covers nearly 16,500 square miles and consists of over ten thousand rivers and streams that drain into the Sound. All but a tiny fraction of storm water that falls on developed areas enters storm drains and flows untreated into the Sound.

Over 80% of the surface water flowing into Puget Sound comes from the following major river drainages: Cedar River (Lake Washington), Green/Duwamish, Elwha, Nisqually, Nooksack, Puyallup (White), Skagit, Skokomish, Snohomish, and Stillaguamish. In King County, the major river drainage systems are the White (Puyallup) River, Green/Duwamish River, Cedar River (Lake Washington), Sammamish River, and the Skykomish/Snoqualimie Rivers.

As of 2006, the number of registered vehicles in Washington was approximately 5.6 million. There are approximately 3.7 million vehicles in the Puget Sound area and about 1.7 million of those are in King County.

7.0 TEST RESULT HYPOTHETICAL IMPLICATIONS

Assumptions were made and calculations performed for a hypothetical urban or suburban Puget Sound setting in which a small stream is subjected to car wash effluent input. The calculations were done to try to bracket certain parameters that are typical and would be expected to apply in a real life situation. The scenario, which is hypothetical, is presented below. The spreadsheet developed to perform these calculations is presented in Appendix C.

The setting is a small stream watershed that empties into Lake Washington. The stream is about 10 to 20 miles long and during the summer and fall season ranges in flow from about 2 to 20 cubic feet per second (cfs), depending on recent weather. These flows are typical of many small Puget Sound area streams during summer. A time period of 48 hours during a dry August weekend is assumed.

Approximately 100,000 people are assumed to live in the watershed area. Storm drains serving this population feed to the stream. One percent of the cars of the population are washed in driveways during the time period. A consumer car wash detergent is used to wash the cars and 75 gallons of water flows to the storm drain and, subsequently, to the small stream for each car washed.

Calculations indicate that within this watershed approximately 1,000 vehicles will be washed in driveways during the weekend. The 75 gallons of car wash effluent per vehicle will contain 53 parts per million (ppm) of detergent.

A simple "bathtub" calculation was performed in which all the stream flow and all car wash effluent were pooled and the resulting detergent concentration calculated. The calculated detergent concentration ranged from 0.2 ppm to 1.5 ppm for high and low stream flow conditions, respectively. These detergent concentrations are similar to the 1.6 ppm value that was found to be lethal to 50 percent of juvenile rainbow trout tested. Thus, some fish in the stream could be killed and it would be likely that the detergent would wash protective mucus from the gills of some surviving fish. The surviving fish would, thus, be more susceptible to other contaminants that may exist or be introduced into the stream. It is also possible that oxygen uptake necessary for fish survival may be impaired and that other physiological impacts to fish survival may occur. Other freshwater organisms living in the stream would also likely be affected depending on individual species sensitivities.

Minor changes to the assumptions made in the above analysis drive the calculated detergent concentration to much higher values and make significant impacts to fish and other freshwater organisms more likely. For instance, increasing the percentage of cars washed from one percent to 1.5 percent

increases the total amount of detergent flushed to the stream by 50 percent and raises the calculated detergent concentration in the stream to 2.2 ppm for the low flow situation (i.e., 2 cfs). Calculated detergent concentrations skyrocket when the hypothetical stream flow rate is decreased, because dilution by the stream is the most important factor in the calculated detergent concentration.

8.0 CONCLUSION

September and October, when most salmon are returning to Puget Sound area streams to spawn the next generation, typically represents the lowest stream flow time of the year. Although adult fish are found in the streams, they have been severely stressed by the long return migration and are likely more susceptible to deleterious impacts of detergents and pollutants in stream water. A case can be made that during this pivotal time of the year driveway car washing effluent that reaches streams via storm drains is a real detriment to salmon survival.

Figure 1 – Overall View of Car Wash Event Location

Figure 2 – View of Storm Drain and Water Effluent Collection Device

Figure 3 – View of Typical Car Wash Event Asphalt Surface

APPENDIX A

Laboratory Report –
Car Wash Effluent Fish Toxicity Test

WESTON SOLUTIONS, INC.
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Port Gamble, WA 98364
(360) 297-6903 / (360) 297-6905 FAX
www.westonsolutions.com

October 4, 2006

Dr. Jeff Dengler
Environmental Partners, Inc.
295 NE Gilman Blvd., Suite 201
Issaquah, Washington 98027

Re: 96-Hour Rainbow Trout Toxicity Testing Results – Car Wash Water

Dear Dr. Dengler:

Enclosed, please find the report for the acute toxicity test performed on one sample of Car Wash effluent, received on the 28th of August. Toxicity testing was conducted using juvenile Rainbow Trout between the 28th of August and 1st of September, 2006. The results of this test are listed in the table below.

Test	Sample ID	Control Survival	100% Test Substance Survival	LC_{50}	TUa
Rainbow Trout 96-Hour Survival	Car Wash	100%	0%	3.125%	>32

Methods: This testing investigated the survival of juvenile Rainbow Trout exposed to a dilution series of sample Car Wash over a 96-Hour period. The concentration series tested consisted of 6.25, 12.5, 25, 50, and 100 percent test substance diluted with laboratory water. This series is a standard 0.5 dilution used to statistically estimate the level of toxicity an effluent may have on aquatic organisms. The water used for the sample diluent and the Laboratory Control consisted of Evian™ mineral water diluted with deionized water to a hardness of 99 mg/L $CaCO_3$ (moderately hard water). The exposure chambers utilized for this test were 8-Liter square tubs to which 4-Liters of test solution was added to each. Each concentration was run in replicates of four. Prior to test initiation, dissolved oxygen, pH, conductivity, and temperature was measured in each chamber to ensure parameters were within acceptable limits for the survival of Rainbow Trout. These limits are defined by standardized Environmental Protection Agency (EPA) method guidance and appropriate Weston Solutions standard operating procedures (SOP). Ten juvenile

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Rainbow Trout were randomly added to each chamber. Water quality measurements and survival observations were then performed daily. Fish were not fed during the course of the test.

Results: The Car Wash effluent caused 100 percent mortality in all treatments tested with complete mortality occurred within 24-Hours of test initiation. Survival in the Laboratory Control was 100 percent. A standard aquatic toxicity test endpoint is the LC_{50}, which is the concentration of sample that is expected to cause mortality in 50 percent of a select population of organisms. The calculated LC_{50} for test substance Car Wash was 3.125 percent. Due to the complete mortality observed in the lowest concentration tested (6.25% sample) and the 100 percent survival observed in the Laboratory Control (0 % sample), the LC_{50} is calculated to be half of the 6.25 percent value (3.125%). Additional testing with a concentration series more closely bracketing the estimated LC_{50} may provide better resolution on the actual value; however, this test confidently indicates that the LC_{50} value lies between the 6.25 percent test substance and the Laboratory Control.

Another toxicity test endpoint tool used in compliance monitoring is called Toxic Units, and is used for both chronic and acute testing. In this case, the Acute Toxic Unit (TUa) was calculated to be 32. This value is calculated as being $100/LC_{50}$. Many discharge monitoring programs do not allow a TUa of greater than 1 for effluent dischargers. This is usually after taking into consideration the mixing zone concentration as an effluent enters a specific waterbody. A TUa value of 32 indicates that the Car Wash effluent is 32 times more toxic than an acceptable discharged effluent under common EPA National Pollutant Discharge Elimination System (NPDES) permitted discharges.

All testing was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Weston Solutions is not responsible for use of less than the complete report. Results apply only to the sample tested.

If you have any questions regarding these results, or require additional testing, please call me at (360) 297-6070. Thank you for using the aquatic testing services of Weston Solutions, Inc.

Sincerely,

Brian Hester
Laboratory Manger

Enclosed: 1 toxicity report, raw data sheets for 1 toxicity report; reference toxicity data sheets, statistical analysis and control chart; sample receipt log; 1 chain of custody

MEC Analytical Systems, Inc.

Analytical Report

Client	Environmental Partners, Inc.	Date Received:	28 Aug 06
Project:	Car Wash	Date Test Started:	28 Aug 06
Client Sample ID:	Car Wash 1, 2, 3	Date Test Ended:	01 Sep 06
MEC Test ID:	P060828.01a, b, c	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No. BIO012
EPA-821-R-02-012

Test Organism: ***Oncorhynchus mykiss***
Age: 22 day(s) old

Test Solution mg/L	Number of Test Organisms at Start of Test	Number of Test Organisms at End of Test	Percent Survival
Control	40	40	100
6.25	40	0	0
12.5	40	0	0
25	40	0	0
50	40	0	0
100	40	0	0

Acute Toxicity Statement for Sample Car Wash 1, 2, 3

Distribution Method	Result	Variance Method	Result
Shapiro-Wilk's Test	Normal; p > 0.01	N/A	Cannot Be Confirmed

Hypothesis Method	LOEC	NOEC	TUa	Point Estimation Method	LC_{50}
Steel's Many-One Rank Test	<6.25	6.25	32	Linear Interpolation	3.125

Acute Toxicity Statement: Test substance Car Wash expressed a toxic effect on the survival of juvenile Rainbow Trout exposed for 96-hours. Survival in 100 percect test material was 0 percent after 96 hours. The calculated LC_{50} of the Car Wash sample was 3.125 percent.

Protocol Deviations: The test was aerated initiation due to low dissolved oxygen levels in sample Car Wash at receipt (4.3 mg/L) and continued to test termination. Dissolved oxygen level remained within protocol limits for the duration of the test. The associated reference toxicant LC_{50} of 183.26 ppb Cu^{2+} falls outside the 95% confidence limits of the historical laboratory mean (68.45± 92.7 ppb Cu^{2+}). The results of this test may indicate that the organisms used in these tests may be less sensitive to concentrations of copper as typical populations. This may reduce the ability of the toxicity test to determine toxic effects; however, since complete mortallity was observed in all the test treatments of sample Car Wash, this deviation does not impact the significance of the test results.

QA Officer — Date: 10.4.06

Approved — Date: 10.4.06

MEC Analytical Systems, Inc.

Analytical Report

Client	Environmental Partners, Inc.	Date Received:	28 Aug 06
Project:	Car Wash	Date Test Started:	28 Aug 06
Client Sample ID:	Car Wash 1, 2, 3	Date Test Ended:	01 Sep 06
MEC Test ID:	P060828.01a, b, c	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No.: BIO012
EPA-821-R-02-012

Test Organism: ***Oncorhynchus mykiss***

Test Solution Physical and Chemical Data

Analyte:	Alkalinity as $CaCO_3$	Conductivity	Dissolved Oxygen	Hardness as $CaCO_3$	pH	Chlorinity
EPA Method:	310.1	120.1	360.1	130.2	150.1	330.5
Method Reporting Limit:	2 mg/L	0.02 mS/cm	1% sat.	5 mg/L	---	0.2 mg/L

Concentration (mg/L)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)
Control	99	90
100	*	*

Total Chlorine (mg/L)			
Concentration (mg/L)	Initial	Renewal	Final
Control	0.0	N/A	N/A
100	*	*	*

* Test solution too dark for colorimetric analyses.
N/A = Chlorine not present at initiation. Subsequent analyses not required.

Concentration (mg/L)	Statistic	D.O. (% Saturation)	Temp.(°C)	Cond. (mS/cm)	pH
Control	Mean	7.3	14.7	0.19	7.3
	Minimum	6.1	14.2	0.19	6.7
	Maximum	8.3	15.1	0.20	7.9
6.25	Mean	8.3	15.1	0.20	8.0
	Minimum	8.2	14.2	0.20	7.7
	Maximum	8.4	16.0	0.20	8.3
12.5	Mean	7.5	14.6	0.21	7.6
	Minimum	7.3	14.1	0.21	7.5
	Maximum	7.7	15.0	0.21	7.7
25	Mean	7.2	15.1	0.23	7.5
	Minimum	7.2	14.2	0.23	7.4
	Maximum	7.2	16.0	0.23	7.5
50	Mean	6.5	14.6	0.25	7.5
	Minimum	6.5	14.1	0.25	7.5
	Maximum	6.5	15.0	0.26	7.5
100	Mean	6.1	14.6	0.32	7.6
	Minimum	5.2	14.2	0.32	7.5
	Maximum	6.9	15.0	0.33	7.7

MEC Analytical Systems, Inc.

Analytical Report

Client:	Environmental Partners, Inc.	Date Received:	28 Aug 06
Project:	Car Wash	Date Test Started:	28 Aug 06
Client Sample ID:	Car Wash 1, 2, 3	Date Test Ended:	01 Sep 06
MEC Test ID:	P060828.01a, b, c	Matrix:	Liquid

APPENDIX

Pertinent Test Data

TEST: 96 Hour Acute Effluent Toxicity Bioassay, Weston Testing Protocol BIO012, EPA-821-R-02-012

LAB CONTROL WATER: diluted mineral water

Dissolved Oxygen	7.6% Saturation
Temperature	15°C
pH	7.0
Hardness	99 mg/L $CaCO_3$
Alkalinity	90 mg/L $CaCO_3$

TEST ORGANISM: Rainbow Trout, *Oncorhynchus mykiss* Age: 22 day(s) old
Supplier: Thomas Fish Co.
Feeding: Fed Tetramin® flake food *ad libitum* daily prior to testing.

TEST CHAMBER: 8000-mL containers, 4 replicate controls and 4 replicate samples at concentrations of 6.25, 12.5, 25, 50, and 100 percent test substance, brought to a 4000-mL final volume.

EXPERIMENTAL DESIGN:

1. Environmental Partners, Inc. personnel collected a sample at 1210-1230 hours on August 27, 2006. The product sample was delivered by Environmental Partners, Inc. at 0800 hours the following day. Sample temperature upon receipt was 4°C.
2. The temperature of the sample was adjusted to 15 ± 1°C.
3. Ten test organisms were placed in each test container.
4. Test chambers were randomized and held at 15 ± 1 °C for 96 hours with a photoperiod of 16 hours light: 8 hours darkness.
5. Test solution was renewed at 48 hours.

MORTALITY CRITERIA: Lack of respiratory movement and lack of reaction to gentle prodding

ACCEPTIBILITY CRITERIA: ≥ 90% survival in controls. Evaluation of the concentration-response relationship indicated that the data presented in this report are reliable.

REFERENCE TOXICITY: (Control Chart Included)
Toxicant: CuSO4, Lot No.: 5117-14, Received: 11/30/04, Opened: 12/14/04, Expires: 6/2/06.

96 Hour LC50:	183.26 ppb	
Laboratory Mean:	68.45 ppb	
Test Date:	8.28/06	Outside 95 % Confidence Limits*

* See protocol deviations

STUDY DIRECTOR: B. Hester
INVESTIGATORS: T. Schuh, J. Word, G. Zandpoor, C. Word

Weston Solutions BIO012C

96 Hour Acute Toxicity Test for Rainbow Trout

Client	EPI
Project:	Car Wash
Client Sample ID:	Car Wash 1, 2, 3
Weston Sample ID:	P060828.01a, b, c
Weston Protocol:	BIO 012
Study Director:	BH

Date Received:	8/28/06
Date Test Started:	8/28/06
Date Test Ended:	9.1.06
Matrix:	Liquid
Species:	O. mykiss
Organisms / Chamber:	10

	Conc.	D.O. (mg/L) Meter #		Temp (°C) Meter #		Cond. (mS/cm) Meter #		pH Meter #		Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Total chlorine mg/L
Day 0 (0 Hours)	Control	1	7.6	1	15	1	0.191	1	7.0	99	90	0.0
Date: 8/28/06 (BH)	6.25		8.4		16		0.198		8.3			
Replicate: 1	12.5		7.7		15		0.207		7.7			
Time: 1700	25		7.2		16		0.232		7.4			
Technician: JW	50		6.5		15		0.253		7.5			
Sample ID: P060828.01A+B	100		5.2		15		0.321		7.5	③ →		
24 Hours	Control	5	6.1	5	15.1	1	0.192	5	6.65			
Date: 8/29/06	6.25		8.2		14.2		0.200		7.67			
Replicate: 2	12.5		7.3		14.1		0.210		7.54			
Time: 1510	25		7.2		14.2		0.233		7.5			
Technician: CW	50		6.5		14.1		0.256		7.5			
	100		6.9		14.2		0.325		7.7			
48 Hours	Control	1	8.3	1	14.2	1	0.195	1	7.3	99	90	0.0
Date: 8/30/06												
Replicate: 3												
Time: 1706												
Technician: JW												
Sample ID: NA										③ →		
72 Hours	Control	1	8.3	1	14.3	1	0.198	1	7.5			
Date: 8/31/06												
Replicate: 4												
Time: GZ												
Technician: N/A												
96 Hours	Control	1	6.4	1	14.8	1	0.199	1	7.9			
Date: 9/1/06												
Replicate: 1												
Time: 1400												
Technician: JW												

Start Time:	1600
End Time:	1535
Supplier:	Thomas Fish Co.
Organism Batch:	TFC 5482 Age: 22 days
Hobo Temp. No.:	N/A
Test Location:	Bath 10

Dilution Water Batch:	DMW 001
pH: 7.0	DO: 7.6 Temp: 15
Ref Tox:	P.05102772 Lot No.: 5117-14
LC50: 183.26	Test Date: 8.28.06
Lab Mean: 68.45	
Test Acceptability: X	≥ 90% Control Survival

① Very slow aeration initiated Due to low DO on arrival. 8/28/06 BH
② i.e. 8/29/06 CW ③ Test solution too dark for colorimetric analysis 8.28.06 BH

Weston Solutions

BIO012C

96 Hour Acute Toxicity Test for Rainbow Trout

Client	EPI
Project:	CAR WASH
Client Sample ID:	Car Wash 1,2,3
Weston Sample ID:	P060828.01a,b,c
Weston Protocol:	0 BIO 012
Study Director:	BH

Date Received:	8/28/06
Date Test Started:	8/28/06
Date Test Ended:	9.1.06
Matrix:	L
Species:	O. mykiss
Organisms/Chamber:	10

Conc.	Rep	24 Hours Date: 8/29/06 Time: 1515		48 Hours Date: 8/30/06 Time: GZ		72 Hours Date: 8/31/06 Time: GZ		96 Hours Date: 9/1/06 Time: [illegible]	
		# Alive	# Dead	# Alive	# Dead	# Alive	# Dead	# Alive	# Dead
Control	1	10	0	10	0	10	0	10	Ø
	2	10	0	10	0	10	0	10	Ø
	3	10	0	10	0	10	0	10	Ø
	4	10	0	10	0	10	0	10	Ø
6.25	1	0	10	—	—	—	—	—	—
	2	0	10	—	—	—	—	—	—
	3	0	10	—	—	—	—	—	—
	4	0	10	—	—	—	—	—	—
12.5	1	0	10	—	—	—	—	—	—
	2	0	10	—	—	—	—	—	—
	3	0	10	—	—	—	—	—	—
	4	0	10	—	—	—	—	—	—
25.0	1	0	10	—	—	—	—	—	—
	2	0	10	—	—	—	—	—	—
	3	0	10	—	—	—	—	—	—
	4	0	10	—	—	—	—	—	—
50	1	0	10	—	—	—	—	—	—
	2	0	10	—	—	—	—	—	—
	3	0	10	—	—	—	—	—	—
	4	0	10	—	—	—	—	—	—
100	1	0	10	—	—	—	—	—	—
	2	0	10	—	—	—	—	—	—
	3	0	10	—	—	—	—	—	—
	4	0	10	—	—	—	—	—	—
	Initials:	CW		GZ					

Date / Time:			Technician:		
	Length (mm)	Weight (g)		Length (mm)	Weight (g)
1)			6)		
2)			7)		
3)			8)		
4)			9)		
5)			10)		
Average Length (mm):			Average Weight (g):		

Total Volume (L) per Replicate:		Total Grams of Fish Flesh per Liter:	

Note: All fish taken from Control Rep 1 unless otherwise specified.

Acute Fish Test-96 Hour

Start Date:	8/28/2006 16:00	Test ID:	P060828.01a, b, c	Sample ID:	Car Wash 1, 2, 3
End Date:	9/1/2006 15:35	Lab ID:	PGL- Port Gamble Laborator	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	EPAA 02-EPA Acute	Test Species:	OM-Oncorhynchus mykiss
Comments:					

Conc-%	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
6.25	0.0000	0.0000	0.0000	0.0000
12.5	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4			1.0000	1.0000
*6.25	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000
*12.5	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000
*25	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000
*50	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000
*100	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000

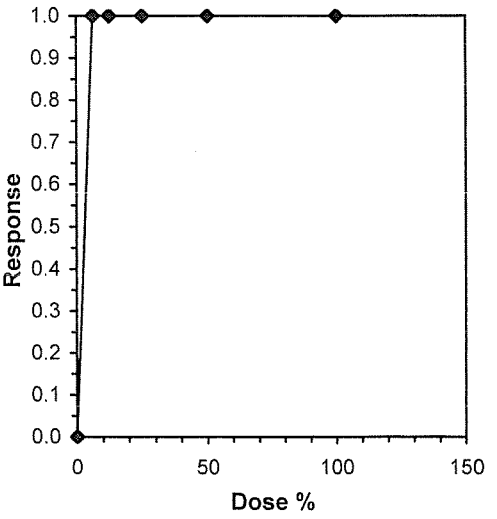
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	1	0.884		
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	<6.25	6.25		
Treatments vs Control				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05*	0.3125	0.0000	0.3125	0.3125	1.0076
IC10*	0.6250	0.0000	0.6250	0.6250	#DIV/0!
IC15*	0.9375	0.0000	0.9375	0.9375	#DIV/0!
IC20*	1.2500	0.0000	1.2500	1.2500	#DIV/0!
IC25*	1.5625	0.0000	1.5625	1.5625	#DIV/0!
IC40*	2.5000	0.0000	2.5000	2.5000	#DIV/0!
IC50*	3.1250	0.0000	3.1250	3.1250	#DIV/0!

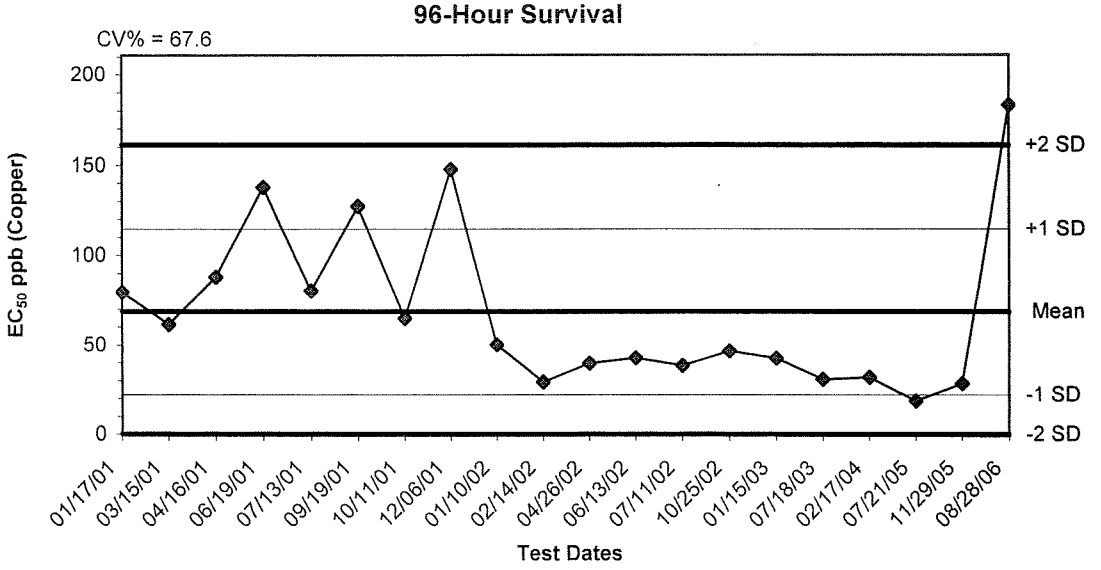
* indicates IC estimate less than the lowest concentration



Test: AC-Acute Fish Test					Test ID: P060828.01				
Species: OM-Oncorhynchus mykiss					Protocol: EPAA 02-EPA Acute				
Sample ID: Car Wash 1, 2, 3					Sample Type: DMR-Discharge Monitoring Report				
Start Date: 8/28/2006 16:00				End Date: 9/1/2006 15::	Lab ID: PGL- Port Gamble Laboratory				
Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	3	Control	10				10	
	4	4	Control	10				10	
	5	1	6.250	10				0	
	6	2	6.250	10				0	
	7	3	6.250	10				0	
	8	4	6.250	10				0	
	9	1	12.500	10				0	
	10	2	12.500	10				0	
	11	3	12.500	10				0	
	12	4	12.500	10				0	
	13	1	25.000	10				0	
	14	2	25.000	10				0	
	15	3	25.000	10				0	
	16	4	25.000	10				0	
	17	1	50.000	10				0	
	18	2	50.000	10				0	
	19	3	50.000	10				0	
	20	4	50.000	10				0	
	21	1	100.000	10				0	
	22	2	100.000	10				0	
	23	3	100.000	10				0	
	24	4	100.000	10				0	

Comments:

Oncorhynchus mykiss Reference Toxicant Control Chart: 96-Hour Survival



Dates	Values	Mean	-1 SD	-2 SD	+1 SD	+2 SD
01/17/01	79.4878	68.4472	22.1628	0.0000	114.7315	161.0158
03/15/01	61.4720	68.4472	22.1628	0.0000	114.7315	161.0158
04/16/01	87.9825	68.4472	22.1628	0.0000	114.7315	161.0158
06/19/01	137.7600	68.4472	22.1628	0.0000	114.7315	161.0158
07/13/01	80.1567	68.4472	22.1628	0.0000	114.7315	161.0158
09/19/01	127.2790	68.4472	22.1628	0.0000	114.7315	161.0158
10/11/01	64.7289	68.4472	22.1628	0.0000	114.7315	161.0158
12/06/01	147.8140	68.4472	22.1628	0.0000	114.7315	161.0158
01/10/02	50.1660	68.4472	22.1628	0.0000	114.7315	161.0158
02/14/02	29.1790	68.4472	22.1628	0.0000	114.7315	161.0158
04/26/02	39.7384	68.4472	22.1628	0.0000	114.7315	161.0158
06/13/02	42.6380	68.4472	22.1628	0.0000	114.7315	161.0158
07/11/02	38.3651	68.4472	22.1628	0.0000	114.7315	161.0158
10/25/02	46.5870	68.4472	22.1628	0.0000	114.7315	161.0158
01/15/03	42.5565	68.4472	22.1628	0.0000	114.7315	161.0158
07/18/03	30.7498	68.4472	22.1628	0.0000	114.7315	161.0158
02/17/04	31.8198	68.4472	22.1628	0.0000	114.7315	161.0158
07/21/05	18.7500	68.4472	22.1628	0.0000	114.7315	161.0158
11/29/05	28.4485	68.4472	22.1628	0.0000	114.7315	161.0158
08/28/06	183.2640	68.4472	22.1628	0.0000	114.7315	161.0158

Updated 9/26/06 BH

Acute Fish Test-96 Hour

Start Date:	8/28/2006 16:30	Test ID:	P051027.72	Sample ID:	REF-Ref Toxicant
End Date:	9/1/2006 14:10	Lab ID:	PGL- Port Gamble Laborator	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	EPAA 02-EPA Acute	Test Species:	OM-Oncorhynchus mykiss
Comments:					

Conc-ppb	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
22.5	1.0000	1.0000	1.0000	0.9000
45	1.0000	1.0000	1.0000	1.0000
90	1.0000	1.0000	0.8000	1.0000
180	0.5000	0.5000	0.6000	0.5000
360	0.0000	0.0000	0.0000	0.1000

			Transform: Untransformed					Rank	1-Tailed		
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4			1.0000	0.0000
22.5	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	16.00	10.00	0.9750	0.0250
45	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	18.00	10.00	1.0000	0.0000
90	0.9500	0.9500	0.9500	0.8000	1.0000	10.526	4	16.00	10.00	0.9500	0.0500
*180	0.5250	0.5250	0.5250	0.5000	0.6000	9.524	4	10.00	10.00	0.5250	0.4750
*360	0.0250	0.0250	0.0250	0.0000	0.1000	200.000	4	10.00	10.00	0.0250	0.9750

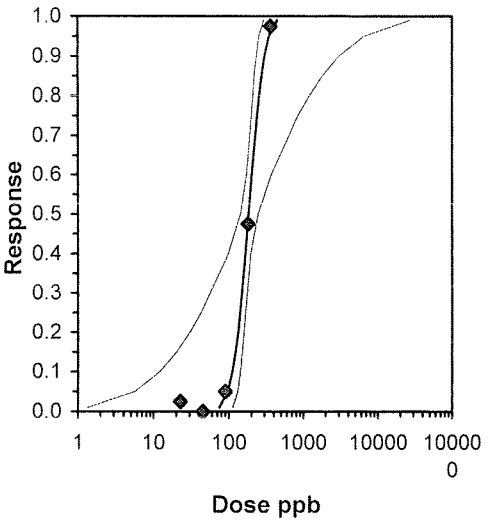
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.88152	0.884	-1.1417	3.32127
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	90	180	127.279	
Treatments vs Control				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.97692	2.49772	1.08139	10.8724	0	0.1671	7.81473	0.98	2.26308	0.16731	6
Intercept	-8.5262	5.64594	-19.592	2.53982							
TSCR											

Point	Probits	ppb	95% Fiducial Limits	
EC01	2.674	74.7919	1.32853	113.327
EC05	3.355	97.2469	5.63162	131.811
EC10	3.718	111.856	12.1272	143.285
EC15	3.964	122.934	20.2964	151.969
EC20	4.158	132.515	30.4771	159.687
EC25	4.326	141.328	43.0423	167.213
EC40	4.747	166.222	98.1868	196.469
EC50	5.000	183.264	142.671	244.676
EC60	5.253	202.053	172.153	366.938
EC75	5.674	237.643	199.869	847.115
EC80	5.842	253.448	209.04	1197.8
EC85	6.036	273.201	219.484	1800.02
EC90	6.282	300.257	232.659	3014.22
EC95	6.645	345.365	252.805	6493.55
EC99	7.326	449.054	293.942	27535.3



Test: AC-Acute Fish Test — Test ID: P051027.72
Species: OM-Oncorhynchus mykiss — Protocol: EPAA 02-EPA Acute
Sample ID: REF-Ref Toxicant — Sample Type: CUSO-Copper sulfate
Start Date: 8/28/2006 16:30 — End Date: 9/1/2006 14:[illegible] — Lab ID: PGL- Port Gamble Laboratory

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	3	Control	10				10	
	4	4	Control	10				10	
	5	1	22.500	10				10	
	6	2	22.500	10				10	
	7	3	22.500	10				10	
	8	4	22.500	10				9	
	9	1	45.000	10				10	
	10	2	45.000	10				10	
	11	3	45.000	10				10	
	12	4	45.000	10				10	
	13	1	90.000	10				10	
	14	2	90.000	10				10	
	15	3	90.000	10				8	
	16	4	90.000	10				10	
	17	1	180.000	10				5	
	18	2	180.000	10				5	
	19	3	180.000	10				6	
	20	4	180.000	10				5	
	21	1	360.000	10				0	
	22	2	360.000	10				0	
	23	3	360.000	10				0	
	24	4	360.000	10				1	

Comments:

96 Hour Rainbow Trout (with Renewal)
Reference Toxicant Test

Test ID: P051027.72	Replicates: 4	Study Director: BH	Location: BATH 10
Dilution Water Batch: DMW 001	Organism Batch: TFC 5482	Associated Test(s): EPL	No. of Organisms: 10

Toxicant: Copper Sulfate (0.509gCu/LCuSO$_4$)	Date Prepared: 8/28/06	Initials: GZ
Lot Number: 5117-14		

Target Concentrations: 360, 180, 90, 45, 22.5 ppb	Quantity of Stock Toxicant:					Quantity of Diluent:				
	Target	Actual				Target	Actual			
		R1	R2	R3	R4		R1	R2	R3	R4
360 ppb	2.829 mL	2.82872	2.82889	2.82907	2.82970	4 L	4000.0	4000.0	4000.0	4000.0
180 ppb	1.415 mL	1.41500	1.41523	1.41531	1.41500	4 L	4000.0	4000.0	4000.4	4000.0
90 ppb	0.707 mL	0.70697	0.70723	0.70731	0.70731	4 L	4000.0	4000.0	4000.0	4000.0
45 ppb	0.354 mL	0.35422	0.35424	0.35438	0.35432	4 L	4000.0	4000.1	4000.0	4000.0
22.5 ppb	0.177 mL	0.17704	0.17740	0.17691	0.17691	4 L	4000.0	4000.0	4000.0	4000.0

0 Hours Date: 8/28/06 WQ Time: 1710 Start Time: 1630 Initials: [illegible]

STOCK

	Control	22.5	45	90	180	360
D.O. (mg/L)	~~7.5~~ 9.1	9.0	8.9	12.1	9.8	10.0
Temperature	15	14	16	15	15	15
Conductivity	0.185	0.184	0.184	0.178	0.175	0.175
pH	~~9.1~~ 7.5	~~9.0~~ 7.2	7.2	7.2	7.2	7.1

Survival Data

24 Hours Date: 8/29/06 Time: 1550 Initials: CW

	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	10	10	3 (7)
No. Alive Rep 2	10	10	10	10	8 (2)	4 (6)
No. Alive Rep 3	10	10	10	10	10	3 (7)
No. Alive Rep 4	10	10	10	10	8 (2)	6 (4)

① WC 8/28/06 [illegible]

96 Hour Rainbow Trout (with Renewal)
Reference Toxicant Test

48 Hour Renewal Information		Date: 8/30/06 Initials: GZ
Concentration	Toxicant Amount	Diluent Amount
360 ppb	2.82889	4000.0
180 ppb	1.41487	4000.0
90 ppb	0.70721	↓
45 ppb	0.35409	↓
22.5 ppb	0.17728	↓

2.829
1.415
0.707
0.354
0.177

48 Hour Survival	Date: 8/30/06	Time: 1705	Initials: [illegible]			
	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	10	5(5)	Ø(3)
No. Alive Rep 2	10	10	10	10	5(3)	Ø(4)
No. Alive Rep 3	10	10	10	8(2)	7(3)	Ø(3)
No. Alive Rep 4	10	9(1)	10	10	5(3)	1(5)

72 Hours	Date: 8/31	Time: 1000	Initials: GZ			
	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	10	5	—
No. Alive Rep 2	10	10	10	10	5	—
No. Alive Rep 3	10	10	10	8	7	—
No. Alive Rep 4	10	9	10	10	5	1

96 Hours	Date: 9/1/06	WQ Time: 1400 STOCK	Replicate: 4	Initials: [illegible]	
	Control	22.5	45	90	180	360
D.O. (mg/L)	8.2	8.1	7.8	7.8	8.2	8.5
Temperature	14.6	14.4	14.3	14.5	14.6	14.8
Conductivity						
pH	8.3	8.2	8.2	8.1	8.0	7.9

96 Hour Survival Data	End Time: 1410	Initials: [illegible]			
	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	10	5	—
No. Alive Rep 2	10	10	10	10	5	—
No. Alive Rep 3	10	10	10	8	6(1)	—
No. Alive Rep 4	10	9	10	10	5	* 1

APPENDIX B

Laboratory Report –
Simulated Effluent Fish Toxicity Test

WESTON SOLUTIONS, INC.
4729 NE View Dr.
P.O. Box 216
Port Gamble, WA 98364
(360) 297-6903 / (360) 297-6905 FAX
www.westonsolutions.com

December 21, 2006

Dr. Jeff Dengler
Environmental Partners, Inc.
295 NE Gilman Blvd., Suite 201
Issaquah, Washington 98027

Re: 96-Hour Rainbow Trout Toxicity Testing Results – Blue Coral Concentrate

Dear Dr. Dengler:

Enclosed, please find the report for the acute toxicity test performed on the Blue Coral brand car wash detergent, received on the 21st of November. Toxicity testing was conducted using juvenile Rainbow Trout between the 29th of November and 3rd of December, 2006. The results of this test are listed in the table below.

Test	Sample ID	Control Survival	LC_{50}
Rainbow Trout 96-Hour Survival	Blue Coral Concentrate	100%	1614.41 µg/L

Methods: This testing investigated the survival of juvenile Rainbow Trout exposed to a concentration series of the Blue Coral product over a 96-Hour period. Previous testing with Car Wash effluent (comprised of the same product) resulted in a calculated LC_{50} of 3.125 percent. Due to the complete mortality observed in the lowest concentration tested (6.25% sample) and the 100 percent survival observed in the Laboratory Control (0 % sample), the LC_{50} was calculated to be half of the 6.25 percent value (3.125%). This additional testing included a concentration series that more closely bracketed the estimated LC_{50} in order to provide increased resolution of the actual value. Because additional samples of Car Wash effluent were not available, the preparation of a mock effluent was proposed. This mock effluent was prepared in the laboratory with the Blue Coral product and laboratory water to simulate the Car Wash effluent. The proposed concentrations of mock effluent to be tested were 10, 1, 0.5, 0.1, 0.05, and 0.01 percent effluent. Calculations for the concentration series utilized the prescribed recipe for creating a batch of the Blue Coral wash water and included an estimation of dilution after rinsing [1]. This information was utilized to estimate the actual concentration of Blue Coral

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product contained in a "mock" effluent. The equivalent concentrations of the proposed mock effluent above were 5300, 530, 265, 53, 26.5, and 5.25µg/L (parts per billion) test substance diluted with laboratory water.

The water used for the sample diluent and the Laboratory Control consisted of carbon filtered tap water with a hardness of 62 mg/L $CaCO_3$ (slightly hard water). The exposure chambers utilized for this test were 8-Liter square tubs to which 4-Liters of test solution was added to each. Each concentration was run in replicates of four. Prior to test initiation, dissolved oxygen, pH, conductivity, and temperature was measured in each chamber to ensure parameters were within acceptable limits for the survival of Rainbow Trout. These limits are defined by standardized Environmental Protection Agency (EPA) method guidance and appropriate Weston Solutions standard operating procedures (SOP). Ten juvenile Rainbow Trout were randomly added to each chamber. Water quality measurements and survival observations were then performed daily. Fish were not fed during the course of the test.

Results: The Blue Coral concentrate caused 100 percent mortality in the highest concentration tested (5300 µg/L). As in the previous study, complete mortality was observed in the first 24 hours of exposure. Survival in the next highest concentration (530 µg/L) was 97.5 percent, with all other treatments, including the laboratory control, having 100 percent survival. The calculated LC_{50} for Blue Coral concentrate was 1614.41 µg/L. This value equates to 3.05 percent of mock effluent, which correlates with the Car Wash effluent LC_{50} of 3.125 percent.

It is important to note that the mock effluent did not take into consideration the chemicals or particulate matter from the washed cars and roads that make up the Car Wash effluent. The effect of the more complex Car Wash effluent interacting with the soap concentrate may increase or decrease the toxicity of the sample when compared to the soap concentrate alone. One must use caution when directly comparing the results of these two tests

All testing was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Weston Solutions is not responsible for use of less than the complete report. Results apply only to the sample tested. If you have any questions regarding these results, or require additional testing, please call me at (360) 297-6070. Thank you for using the aquatic testing services of Weston Solutions, Inc.

Sincerely,

Brian Hester
Laboratory Manger

Enclosed: 1 toxicity report, raw data sheets for 1 toxicity report; reference toxicity data sheets, statistical analysis and control chart; 1 chain of custody

[1] Email communiqué with Jeff Dengler. 26th October 2006.

Weston Solutions, Inc.

Analytical Report

Client	Environmental Partners, Inc.	Date Received:	22 Nov 06
Project:	Coral Blue Product Testing	Date Test Started:	29 Nov 06
Client Sample ID:	Blue Coral (concentrate)	Date Test Ended:	03 Dec 06
MEC Test ID:	P061122.01	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No. BIO012
WDOE WQ-R-95-80

Test Organism: ***Oncorhynchus mykiss***
Age: 16 day(s) old

Test Solution µg/L	Number of Test Organisms at Start of Test	Number of Test Organisms at End of Test	Percent Survival
Control	40	40	100
5.25	40	40	100
26.5	40	40	100
53	40	40	100
265	40	40	100
530	40	39	97.5
5300	40	0	0

Acute Toxicity Statement for Sample Blue Coral (concentrate)

Distribution Method	Result	Variance Method	Result
Shapiro-Wilk's Test	Non-Normal; $p \leq 0.01$	N/A	Cannot Be Confirmed

Hypothesis Method	LOEC	NOEC	TUa	Point Estimation Method	LC_{50}
Steel's Many-One Rank Test	530 µg/L	5300 µg/L	NA	Trimmed Spearman-Karber	1614.41 µg/L

Acute Toxicity Statement: Test substance Blue Coral expressed a toxic effect on the survival of juvenile Rainbow Trout exposed for 96-hours. Survival in 5300µg/L test material was 0 percent after 96 hours. The calculated LC_{50} of the Car Wash sample was 1614.41 percent.

Protocol Deviations: The test was aerated at initiation due to low dissolved oxygen levels in previous testing and continued to test termination. Dissolved oxygen level remained within protocol limits for the duration of the test. The associated reference toxicant LC_{50} of 112.50 ppb Cu^{2+} falls with the 95% confidence limits of the historical laboratory mean (710.10 ± 94.6 ppb Cu^{2+}). The results of this test indicate that the organisms used in these tests are relatively as sensitive to concentrations of copper as previous testing populations.

QA Officer — Date: 12/21/06

Approved — Date: 12/21/06

Weston Solutions, Inc.

Analytical Report

Client	Environmental Partners, Inc.	Date Received:	22 Nov 06
Project:	Coral Blue Product Testing	Date Test Started:	29 Nov 06
Client Sample ID:	Blue Coral (concentrate)	Date Test Ended:	03 Dec 06
MEC Test ID:	P061122.01	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No.: BIO012
WDOE WQ-R-95-80

Test Organism: ***Oncorhynchus mykiss***

Test Solution Physical and Chemical Data

Analyte:	Alkalinity as $CaCO_3$	Conductivity	Dissolved Oxygen	Hardness as $CaCO_3$	pH	Chlorinity
EPA Method:	310.1	120.1	360.1	130.2	150.1	330.5
Method Reporting Limit:	2 mg/L	0.02 mS/cm	1% sat.	5 mg/L	---	0.2 mg/L

Concentration	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)
Control / Diluent	62	140

Total Chlorine (mg/L)			
Concentration	**Initial**	**Renewal**	**Final**
Control / Diluent	0.0	N/A	N/A

N/A = Chlorine not present at initiation. Subsequent analyses not required.

Concentration (µg/L)	Statistic	D.O. (% Saturation)	Temp.(°C)	Cond. (mS/cm)	pH
Control	Mean	10.2	11.1	0.32	8.1
	Minimum	9.1	10.6	0.31	7.6
	Maximum	11.5	11.5	0.33	8.9
5.25	Mean	10.2	11.1	0.32	8.3
	Minimum	9.6	10.6	0.31	7.8
	Maximum	11.5	11.5	0.32	8.8
26.5	Mean	10.2	11.1	0.32	8.3
	Minimum	9.2	10.6	0.31	7.8
	Maximum	11.6	11.5	0.32	8.8
53	Mean	10.4	11.1	0.32	8.2
	Minimum	9.4	10.6	0.31	7.8
	Maximum	11.6	11.7	0.32	8.6
265	Mean	10.1	11.1	0.32	8.2
	Minimum	8.5	10.6	0.31	7.9
	Maximum	11.6	11.4	0.32	8.4
530	Mean	10.2	11.1	0.32	8.2
	Minimum	8.5	10.6	0.31	7.9
	Maximum	11.5	11.1	0.32	8.4
5300	Mean	10.8	10.8	0.33	8.7
	Minimum	10.0	10.7	0.33	8.0
	Maximum	11.6	10.8	0.34	9.3

Weston Solutions, Inc.

Analytical Report

Client:	Environmental Partners, Inc.	Date Received:	22 Nov 06
Project:	Coral Blue Product Testing	Date Test Started:	29 Nov 06
Client Sample ID:	Blue Coral (concentrate)	Date Test Ended:	03 Dec 06
MEC Test ID:	P061122.01	Matrix:	Liquid

APPENDIX

Pertinent Test Data

TEST: 96 Hour Acute Effluent Toxicity Bioassay, Weston Testing Protocol BIO012, WDOE WQ-R-95-80

LAB CONTROL WATER: diluted mineral water

Dissolved Oxygen	11.5% Saturation
Temperature	10.6°C
pH	7.8
Hardness	62 mg/L $CaCO_3$
Alkalinity	140 mg/L $CaCO_3$

TEST ORGANISM: Rainbow Trout, *Oncorhynchus mykiss* Age: 16 day(s) old
Supplier: Thomas Fish Co.
Feeding: Trout chow granular food *ad libitum* daily prior to testing.

TEST CHAMBER: 8000-mL containers, 4 replicate controls and 4 replicate samples at concentrations of 5.25, 25.6, 53, 265, 530, and 5300 µg/L test substance, brought to a 4000-mL final volume.

EXPERIMENTAL DESIGN:

1. Environmental Partners, Inc. personnel collected a sample at 1030 hours on November 20, 2006. The product sample was delivered to Weston Solutions, Inc. at 1200 hours the following day.
2. The temperature of the sample was adjusted to 12 $\pm$ 1°C.
3. Ten test organisms were placed in each test container.
4. Test chambers were randomized and held at 12 $\pm$ 1 °C for 96 hours with a photoperiod of 16 hours light: 8 hours darkness.
5. Test solution was renewed at 48 hours.

MORTALITY CRITERIA: Lack of respiratory movement and lack of reaction to gentle prodding

ACCEPTIBILITY CRITERIA: $\geq$ 90% survival in controls. Evaluation of the concentration-response relationship indicated that the data presented in this report are reliable.

REFERENCE TOXICITY: (Control Chart Included)
Toxicant: CuSO4, Lot No.: 5117-14, Received: 10/27/05, Opened: 11/15/05, Expires: 4/28/07.

96 Hour LC50:	112.5 ppb
Laboratory Mean:	70.1 ppb
Test Date:	11/28/2006

STUDY DIRECTOR: B. Hester
INVESTIGATORS: T. Schuh, J. Word, G. Zandpoor, C. Word

Acute Fish Test-96 Hour

Start Date:	11/29/2006 11:30	Test ID:	P061122.01	Sample ID:	CORAL BLUE
End Date:	12/3/2006 12:00	Lab ID:	PGL- Port Gamble Laborator	Sample Type:	EFF2-Industrial
Sample Date:		Protocol:	WDOE WQ-R95-80	Test Species:	OM-Oncorhynchus mykiss
Comments:					

Conc-ppb	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
5.25	1.0000	1.0000	1.0000	1.0000
26.5	1.0000	1.0000	1.0000	1.0000
53	1.0000	1.0000	1.0000	1.0000
265	1.0000	1.0000	1.0000	1.0000
530	1.0000	1.0000	0.9000	1.0000
5300	0.0000	0.0000	0.0000	0.0000

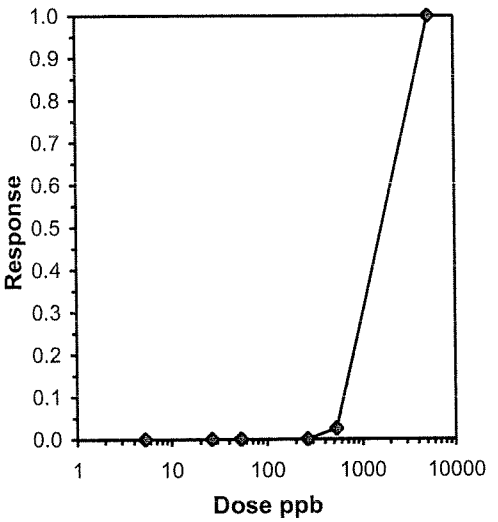
			Transform: Untransformed					Rank	1-Tailed		
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4			1.0000	0.0000
5.25	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	18.00	10.00	1.0000	0.0000
26.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	18.00	10.00	1.0000	0.0000
53	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	18.00	10.00	1.0000	0.0000
265	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	18.00	10.00	1.0000	0.0000
530	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	16.00	10.00	0.9750	0.0250
5300	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4			0.0000	1.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.46508	0.884	-3.0206	13.9892
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	530	5300	1676.01	
Treatments vs Control				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	1614.41	1277.77	2039.74
5.0%	1627.25	1346.91	1965.95
10.0%	1627.25	1346.91	1965.95
20.0%	1627.25	1346.91	1965.95
Auto-0.0%	1614.41	1277.77	2039.74



Test: AC-Acute Fish Test
Species: OM-Oncorhynchus mykiss
Sample ID: Coral Blue
Start Date: 11/29/2006 11:30

Test ID: P061122.01
Protocol: WDOE WQ-R95-80
Sample Type: EFF2-Industrial
End Date: 12/3/2006 1 Lab ID: PGL- Port Gamble Laboratory

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	3	Control	10				10	
	4	4	Control	10				10	
	5	1	5.250	10				10	
	6	2	5.250	10				10	
	7	3	5.250	10				10	
	8	4	5.250	10				10	
	9	1	26.500	10				10	
	10	2	26.500	10				10	
	11	3	26.500	10				10	
	12	4	26.500	10				10	
	13	1	53.000	10				10	
	14	2	53.000	10				10	
	15	3	53.000	10				10	
	16	4	53.000	10				10	
	17	1	265.000	10				10	
	18	2	265.000	10				10	
	19	3	265.000	10				10	
	20	4	265.000	10				10	
	21	1	530.000	10				10	
	22	2	530.000	10				10	
	23	3	530.000	10				9	
	24	4	530.000	10				10	
	25	1	5300.000	10				0	
	26	2	5300.000	10				0	
	27	3	5300.000	10				0	
	28	4	5300.000	10				0	

Comments:

Weston Solutions BIO012C

96 Hour Acute Toxicity Test for Rainbow Trout

Client	EPI
Project:	Coral blue product testing
Client Sample ID:	BLUECORAL CONC.
Weston Sample ID:	P061122.01
Weston Protocol:	BIO 012C
Study Director:	BH

Date Received:	11.28.06
Date Test Started:	11.29.06
Date Test Ended:	12/3/06
Matrix:	L
Species:	O. mykiss
Organisms / Chamber:	10

	Conc.	D.O. (mg/L) Meter #	Temp (°C) Meter #	Cond. (mS/cm) Meter #	pH Meter #	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)
Day 0 (0 Hours)	Control	1 11.5	1 10.6	1 325	1 7.8	62	140
Date: 11.29.06	5.25 ppb	11.5	10.6	323	8.3		
Replicate: 1	26.5	11.6	10.6	322	8.3		
Time: 1100	53	11.6	10.6	323	7.9		
Technician: JW	265	11.6	10.6	323	7.9		
Sample ID:	530	11.5	10.6	324	8.0		
	5300	11.6	10.7	335	8.0	—	—
24 Hours	Control	1 10.0	1 10.8	1 319	1 8.9		
Date: 11.30.06	5.25	10.0	11.3	315	8.8		
Replicate: 2	26.5	10.2	11.0	317	8.8		
Time: 1015	53	10.0	10.9	317	8.6		
Technician: TS	265	10.1	11.2	318	8.5		
	530	10.2	11.1	318	8.4		
	5300	10.0	10.8	331	9.3		
48 Hours	Control	1 10.6	1 11.1	1 307	1 7.6	64	148
Date: 12.1.06	5.25	10.1	11.0	312	8.0		
Replicate: 3	26.5	10.8	10.7	314	8.1		
Time: 1045	53	10.6	11.0	313	8.2		
Technician: TS	265	10.6	11.1	317	8.2		
Sample ID:	530	(BH) 10.69	11.2	308	8.3		
	5300	—	—	—	—	—	—
72 Hours	Control	1 9.8	1 11.5	1 310	1 8.5		
Date: 12/2/06	5.25	9.6	11.2	316	8.4		
Replicate: 4	26.5	9.4	11.5	309	8.4		
Time: 1415	53	10.4	11.7	310	8.4		
Technician: JS	265	9.8	11.4	315	8.4		
	530	9.7	11.3	315	8.4		
	5300	—	—	—	—		
96 Hours	Control	1 9.1	1 11.3	1 318	1 7.7		
Date: 12/3/06	5.25	9.6	11.5	309	7.8		
Replicate: 1	26.5	9.2	11.5	315	7.8		
Time: 1205	53	9.4	11.4	314	7.8		
Technician: TS	265	10.5	11.4	324	7.8		
	530	8.5	11.4	314	7.9		
	5300	—	—	—	—		

Start Time:	1130
End Time:	1200
Supplier:	Thomas Fish Co.
Organism Batch:	TFC 5287 Age: 16 days old
Hobo Temp. No.:	N/A
Test Location:	Room 1

Dilution Water Batch:	CFTW 011
pH: 7.8 DO: 11.5	Temp: 10.6
Ref Tox: P051027.81	Lot No.: 5117-14
LC50: 112.50	Test Date: 11.29.06
Lab Mean:	70.09
Test Acceptability: X	≥ 90% Control Survival

① WC 12.1.06 BH

Weston Solutions

BIO012C

96 Hour Acute Toxicity Test for Rainbow Trout

Client	EPI
Project:	Coral blue product testing
Client Sample ID:	BLUE CORAL CONC.
Weston Sample ID:	P061122.01
Weston Protocol:	BIO 012C
Study Director:	BH

Date Received:	11.22.06
Date Test Started:	11.29.06
Date Test Ended:	12/3/06
Matrix:	L
Species:	O. mykiss
Organisms/Chamber:	10

Conc.	Rep	24 Hours Date: 11.30.06 Time: 1030		48 Hours Date: 12.1.06 Time: 1100		72 Hours Date: 12/2/06 Time: 1420		96 Hours Date: 12/3/06 Time: 1206	
		# Alive	# Dead	# Alive	# Dead	# Alive	# Dead	# Alive	# Dead
Control	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø
5.25 ppb	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø
26.5	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø
53	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø
265	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø
530	1	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	9	1
	4	10	Ø	10	Ø	10	Ø	10	Ø
5300	1	Ø	10						
	2	Ø	10						
	3	Ø	10						
	4	Ø	10						
	Initials:	TS		TS		TS		TS	

Date / Time:			Technician:		
	Length (mm)	Weight (g)		Length (mm)	Weight (g)
1)			6)		
2)			7)		
3)			8)		
4)			9)		
5)			10)		
Average Length (mm):			Average Weight (g):		

Total Volume (L) per Replicate:		Total Grams of Fish Flesh per Liter:	

(1) BH

Note: All fish taken from Control Rep 1 unless otherwise specified.

(1) Not required 12.01.06 BH

WESTON SOLUTIONS

- 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
- 98 Main St., Ste. #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
- 1440 Broadway, Ste. 908 • Oakland, CA 94612 • (510) 808-0302, FAX 891-9710
- 152 Sunset View Lane • Sequim, WA 98382 • (360) 582-1758, FAX 582-1679
- [X] 4729 NE View Drive • Port Gamble, WA 98364 • (360) 297-6903, FAX 297-6905

CHAIN OF CUSTODY
13235

DATE 11/20/06 PAGE 1 OF 1

PROJECT NAME / SURVEY / PROJECT NUMBER: CANWASH - FISH TOXICITY 08404.1
PROJECT MANAGER: JOHN BRAGINO
COMPANY: ENVIRONMENTAL PARTNERS, INC.
ADDRESS: 295 NE GILMAN BLVD. SUITE 201
PHONE/FAX: 425-395-0010 425-395-0011

SAMPLE I.D.	DATE	TIME	MATRIX	INITIALS	NUMBER & TYPE OF CONTAINERS	ANALYSIS/TEST REQUESTED: RBT Toxicity	PRESERVED HOW/ COMMENTS	FOR WESTON USE ONLY: SAMPLE TEMP. UPON RECEIPT	FOR WESTON USE ONLY: WESTON LAB ID
CONCENTRATE (BLOE CANAL)	11/20/06	10:30	H2O	JD.	3, 1/2 GA	X	NONE		

SPECIAL INSTRUCTIONS/COMMENTS:
RAW MATERIAL - TO BE DILUTED FOR FISH TOXICITY TEST

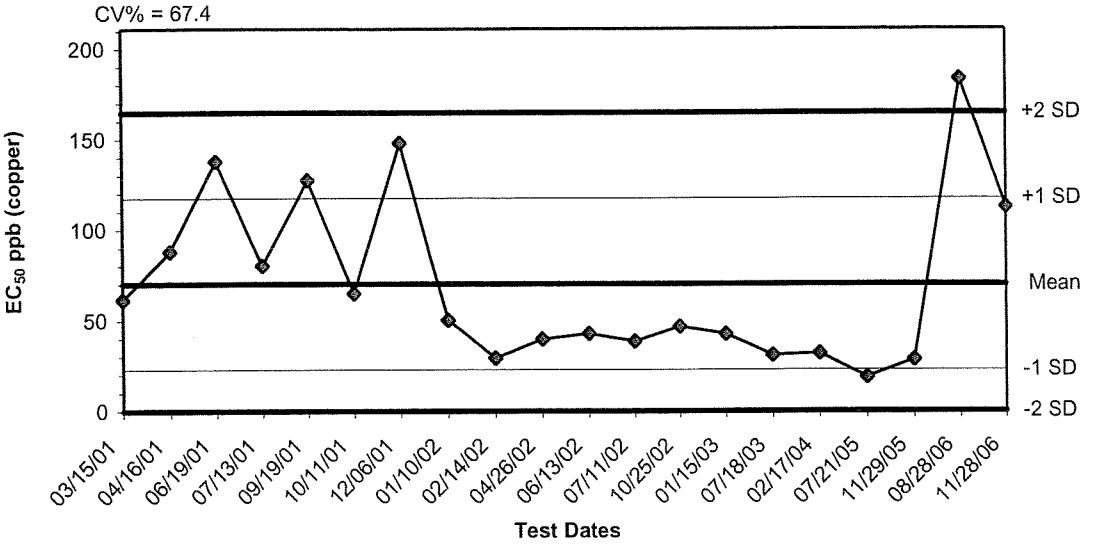
SHIPPING:
Shipping VIA:
Airbill No:

SAMPLE CONDITION UPON RECEIPT (FOR WESTON USE ONLY):

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
JEFF DENGLER					
Signature	Signature Weston	Signature	Signature	Signature	Signature
Firm EPI	Firm 11/20/06	Firm	Firm	Firm	Firm
Date/Time 11/20/06 1415	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

Oncrhynchus mykiss Reference Toxicant Control Chart: 96-Hour Survivial



Dates	Values	Mean	-1 SD	-2 SD	+1 SD	+2 SD
03/15/01	61.4720	70.0978	22.8210	0.0000	117.3746	164.6514
04/16/01	87.9825	70.0978	22.8210	0.0000	117.3746	164.6514
06/19/01	137.7600	70.0978	22.8210	0.0000	117.3746	164.6514
07/13/01	80.1567	70.0978	22.8210	0.0000	117.3746	164.6514
09/19/01	127.2790	70.0978	22.8210	0.0000	117.3746	164.6514
10/11/01	64.7289	70.0978	22.8210	0.0000	117.3746	164.6514
12/06/01	147.8140	70.0978	22.8210	0.0000	117.3746	164.6514
01/10/02	50.1660	70.0978	22.8210	0.0000	117.3746	164.6514
02/14/02	29.1790	70.0978	22.8210	0.0000	117.3746	164.6514
04/26/02	39.7384	70.0978	22.8210	0.0000	117.3746	164.6514
06/13/02	42.6380	70.0978	22.8210	0.0000	117.3746	164.6514
07/11/02	38.3651	70.0978	22.8210	0.0000	117.3746	164.6514
10/25/02	46.5870	70.0978	22.8210	0.0000	117.3746	164.6514
01/15/03	42.5565	70.0978	22.8210	0.0000	117.3746	164.6514
07/18/03	30.7498	70.0978	22.8210	0.0000	117.3746	164.6514
02/17/04	31.8198	70.0978	22.8210	0.0000	117.3746	164.6514
07/21/05	18.7500	70.0978	22.8210	0.0000	117.3746	164.6514
11/29/05	28.4485	70.0978	22.8210	0.0000	117.3746	164.6514
08/28/06	183.2640	70.0978	22.8210	0.0000	117.3746	164.6514
11/28/06	112.5000	70.0978	22.8210	0.0000	117.3746	164.6514

Updated 12/19/06 JW

Acute Fish Test-96 Hour

Start Date:	11/28/2006 12:30	Test ID:	P051027.81	Sample ID:	REF-Ref Toxicant
End Date:	12/3/2006 12:02	Lab ID:	PGL- Port Gamble Laborator	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	WDOE WQ-R95-80	Test Species:	OM-Oncorhynchus mykiss
Comments:					

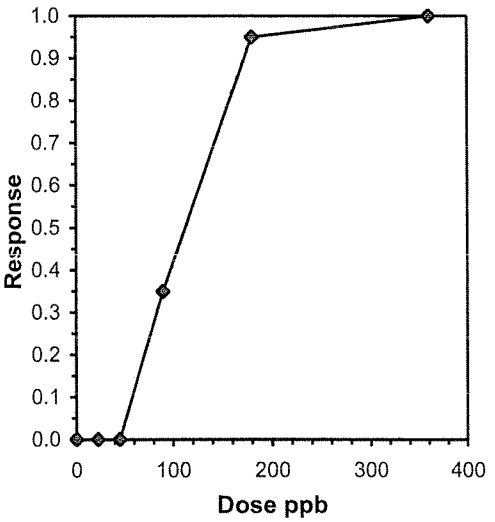
Conc-ppb	1	2
Control	1.0000	1.0000
22.5	1.0000	1.0000
45	1.0000	1.0000
90	0.4000	0.9000
180	0.1000	0.0000
360	0.0000	0.0000

			Transform: Untransformed					Isotonic	
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	2	1.0000	1.0000
22.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	2	1.0000	1.0000
45	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	2	1.0000	1.0000
90	0.6500	0.6500	0.6500	0.4000	0.9000	54.393	2	0.6500	0.6500
180	0.0500	0.0500	0.0500	0.0000	0.1000	141.421	2	0.0500	0.0500
360	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	2	0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Linear Interpolation (200 Resamples)

Point	ppb	SD	95% CL(Exp)		Skew
IC05	51.43	7.60	40.71	115.71	1.0002
IC10	57.86	15.20	36.43	186.43	1.0002
IC15	64.29	15.31	32.14	189.64	0.9107
IC20	70.71	15.50	27.86	192.86	0.7914
IC25	77.14	15.76	23.57	196.07	0.6490
IC40	97.50	16.94	7.50	202.50	0.0616
IC50	112.50	18.24	0.00	202.50	-0.4174



Test: AC-Acute Fish Test					Test ID: 051027.81			
Species: OM-Oncorhynchus mykiss					Protocol: WDOE WQ-R95-80			
Sample ID: REF-Ref Toxicant					Sample Type: CUSO-Copper sulfate			
Start Date: 11/28/2006 12:30			End Date: 12/3/2006 1		Lab ID: PGL- Port Gamble Laboratory			
Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	1	22.500	10				10	
	4	2	22.500	10				10	
	5	1	45.000	10				10	
	6	2	45.000	10				10	
	7	1	90.000	10				4	
	8	2	90.000	10				9	
	9	1	180.000	10				1	
	10	2	180.000	10				0	
	11	1	360.000	10				0	
	12	2	360.000	10				0	

Comments:

96 Hour Rainbow Trout (with Renewal)
Reference Toxicant Test

Test ID: P051027.81	Replicates: 2	Study Director: BH	Location: Room 1
Dilution Water Batch: CFTW 011	Organism Batch: TFC 5287	Associated Test(s): EPI	No. of Organisms: 10

Toxicant: Copper Sulfate (0.509gCu/LCuSO$_4$)	Date Prepared: 11/28/06	Initials: BH
Lot Number: 5117-14		

Target Concentrations:	Quantity of Stock: Target:	Actual: R1	Actual: R2	Quantity of Diluent: Target:	Actual: R1	Actual: R2
360 ppb	2.829 mL	2.829	2.829	4 L	4000.0	4000.0
180 ppb	1.415 mL	1.415	1.415	4 L	4000.0	4000.0
90 ppb	0.707 mL	0.707	0.707	4 L	4000.0	4000.0
45 ppb	0.354 mL	0.354	0.354	4 L	4000.0	4000.0
22.5 ppb	0.177 mL	0.177	0.177	4 L	4000.0	4000.0

0 Hours Date: 11/29/06 WQ Time: 1210 Start Time: 1230 Initials: ✓

STOCK

	Control	22.5	45	90	180	360
D.O. (%)	11.7	11.8	11.6	11.8	11.7	11.8
Temperature	10.5	10.5	10.5	10.5	10.6	10.6
Conductivity	317	316	322	318	316	317
pH	8.0	8.2	8.2	8.1	8.0	8.1

24 Hours Date: 11/30/06 Time: 1045 Initials: TS

	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	10	10	10
No. Alive Rep 2	10	10	10	10	10	10

96 Hour Rainbow Trout (with Renewal)
Reference Toxicant Test

48 Hours	Date: 12/1/06	Time: 1035	Initials: JS

Renewal Information

Target Concentrations:	Quantity of Stock: Target:	Actual: R1	Actual: R2	Quantity of Diluent: Target:	Actual: R1	Actual: R2
360 ppb	2.829 mL	~~2.829~~		4 L	4000.0	
180 ppb	1.415 mL	1.415 (4)		4 L	4000.0 (4)	
90 ppb	0.707 mL	0.707 BH		4 L	4000.0 BH	
45 ppb	0.354 mL	0.354		4 L	4000.0	
22.5 ppb	0.177 mL	~~0.177~~		4 L	~~4000.0~~	

	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	8 (2)	~~3 (2)~~ (1)	6 (4)
No. Alive Rep 2	10	10	10	9 (1)	~~7 (3)~~ (2)	~~3 (7)~~ (3)

72 Hours	Date: 12/2/06	Time: 1415	Initials: TS

	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	5 (3)	3 (4)	Ø (6)
No. Alive Rep 2	10	10	10	9	1 (6)	~~1~~ (2)

96 Hours	Date: 12/3/06	WQ Time: 1153	Replicate: ~~4~~ 1 TS	Initials: TS
		STOCK		

	Control	22.5	45	90	180	360
D.O. (%)	8.6	8.4	8.9	7.5	9.0	8.7
Temperature	11.3	11.3	11.3	11.3	11.3	11.3
Conductivity	309	308	315	308	307	307
pH	7.1	7.2	7.3	7.4	7.5	7.5

96 Hour Survival Data	End Time: 1202	Initials: TS

	Control	22.5	45	90	180	360
No. Alive Rep 1	10	10	10	4 (1)	1 (2)	N/A
No. Alive Rep 2	10	10	10	9	Ø (1)	Ø (1)

(1) WE 12/1/06 TS correct count = 7 (3)
(2) WQ 12/1/06 TS ~~correct count~~ = 7 (3)
(3) WE 12/1/06 TS correct count = 3 (7)
(4) SM 12.1.06 BH

☒ Pass ☐ Fail

Notes:

APPENDIX C

Hypothetical Implications Calculation Spreadsheet

Calculation of Vehicle Washing Impact on Small Stream

gray boxes contain independent variables that may be changed for varying assumptions

Location and Vehicle Facts

100,000	assumed population along a small stream that feeds into Lake Washington
1.00	ratio of vehicles to people (approximately correct according to WA DOT statistics)
100,000	total number of vehicles

Small Stream Facts

15	length of small stream, miles
18	mean width of stream, feet

range of stream flow rates during August

low flow rate (typical of small Puget Sound area stream)		high flow rate (typical of small Puget Sound area stream)
2	low volumetric flow rate, cubic feet/second	20 high volumetric flow rate, cubic feet/second
898	low flow rate, gallons/minute	8,977 high flow rate, gallons/minute
0.25	mean depth of stream at low flow rate, feet	1.25 mean depth of stream at high flow rate, feet
0.44	low flow velocity, feet/second	0.89 high flow velocity, feet per second

Overall Car Washing Estimate

48	time period, August weekend with no rain (hours)
1.50	percent of vehicles washed during time period
1,500	total vehicles washed during time period

Individual Driveway Car Wash Event

5	hose flow rate, gallons/minute
15	time that hose is running, minutes
75	total water to storm drain, gallons
53	detergent concentration to stormdrain, parts per million (ppm)

(Note: detergent concentration derived from car wash product directions)

Bathtub Calculation

calculate total stream flow and detergent concentration for time period, assuming all water is collected in a tub

low flow rate		high flow rate
345,600	total volume of stream, cubic feet	3,456,000 total volume of stream, cubic feet
15,040	total volume of all car wash water, cubic feet	15,040 total volume of all car wash water, cubic feet
2.2	detergent concentration in total volume of water, ppm	0.2297 detergent concentration in total volume of water, ppm

(Note: fish toxicity test indicated 1.6 ppm of detergent lethal to 50 percent of juvenile rainbow trout)

Time and Distance Analysis (assume uniform distribution in time and distance)

100	number of car washes per mile of stream
31	number of car washes per hour of time period