RECEIVED
DEC 03 2013
DIVISION OF WATER QUALITY

Attachment E – Notice of Intent

WATER QUALITY ORDER NO. 2013-0002-DWQ
GENERAL PERMIT NO. CAG990005

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL AQUATIC PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM ALGAE AND AQUATIC WEED CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item A. New Applicator B. X Change of Information: WDID# 3 44 206022

C. ☐ Change of ownership or responsibility: WDID# _____

II. DISCHARGER INFORMATION

A. Name: Santa Cruz Water Department			
B. Mailing Address: 715 Graham Hill Road			
C. City: Santa Cruz	D. County: Santa Cruz	E. State: CA	F. Zip: 95060
G. Contact Person: Hugh Dalton	H. E-mail address: hdalton@cityofsantacruz.com	I. Title: Water Quality Manager	J. Phone: (831) 420-5484

III. BILLING ADDRESS (Enter Information ***only*** if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip
G. E-mail address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. Algaecide and aquatic herbicides are used to treat (check all that apply):

1. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   Name of the conveyance system: _____
2. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   Owner's name: _____
   Name of the conveyance system: _____
3. X Directly to river, lake, creek, stream, bay, ocean, etc.
   Name of water body: Loch Lomond Reservoir

B. Regional Water Quality Control Board(s) where treatment areas are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 3
(List all regions where algaecide and aquatic herbicide application is proposed.)

V. ALGAECIDE AND AQUATIC HERBICIDE APPLICATION INFORMATION

A. Target Organisms: X Algae

B. Algaecide and Aquatic Herbicide Used: List Name and Active ingredients
Cutrine-Plus (chelated Copper)
Captain (chelated Copper)
PAK-27 (Sodium Carbonate Peroxhydrate)

C. Period of Application: Start Date April 1 End Date October 31

D. Types of Adjuvants Used: None

VI. AQUATIC PESTICIDE APPLICATION PLAN

Has an Aquatic Pesticide Application Plan been prepared and is the applicator familiar with its contents?
☒ Yes ☐ No

If not, when will it be prepared? _____

VII. NOTIFICATION

Have potentially affected public and governmental agencies been notified? ☒ Yes ☐ No

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?
☐ YES ☐ NO ☒ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. **Printed Name:** Hugh Dalton

B. **Signature:** Hugh Dalton **Date:** November 27, 2013

C. **Title:** Water Quality Manager

XI. FOR STATE WATER BOARD STAFF USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** $	**Check #:**
☐ **Lyris List Notification of Posting of APAP**	**Date** _____	**Confirmation Sent** _____

RECEIVED
DEC 03 2013
DIVISION OF WATER QUALITY

City of Santa Cruz
Water System No. 410010
Aquatic Pesticides Application Plan
For
Loch Lomond Reservoir
2013 Revision

This Aquatic Pesticide Application Plan (APAP) has been prepared in compliance with Water Quality Order No. 2013-0002-DWQ for Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States, General Permit No. CAG990005.

Water Quality Order No. 2013-0002-DWQ, Section VIII.C, specifies eleven elements that are to be included in the APAP. These elements, along with our discussion are listed below:

1. Description of the water system to which algaecides and aquatic herbicides are being applied;

Loch Lomond Reservoir, on Newell Creek in the Santa Cruz Mountains, provides drinking water for the population of the City of Santa Cruz and outlying areas served by the City's Water Department. Water from the reservoir is treated at the City's Graham Hill Water Treatment Plant (GHWTP).

Loch Lomond Reservoir is located near the town of Ben Lomond in the Santa Cruz Mountains; this reservoir was constructed in 1960 and has a maximum capacity of 2,810 million gallons (MG). The land owned by the City of Santa Cruz is 2760 acres, the total drainage area of the Loch Lomond watershed upstream of the dam is 8.95 square miles and the surface area of the lake is approximately 175 acres. Flow into Newell Creek below the dam is controlled to ensure that a minimum flow of 1 cubic-foot/second is maintained. During the rainy season the lake level generally rises to flow over the spillway. During drought years there may not be any such spill.

In addition to providing surface water storage, the reservoir and surrounding watershed are used for public recreation purposes, including fishing, boating, hiking and picnicking. The area of the Newell Creek watershed above the reservoir is about eight square miles. In addition to the City, the San Lorenzo Valley Water District is entitled to receive a portion of the water stored in Loch Lomond.

2. Description of the treatment area in the water system;

The application area may include the entire reservoir surface that is accessible by boat. This leaves a strip 4'-10' wide along the shore where the pesticide is not applied directly. The treatment area is the entire reservoir surface as the near shore waters do receive some copper by mixing. Generally, it has been necessary to treat the entire lake as blooms have been

widespread rather than localized. However, as a way to minimize pesticide use, limited areas may be treated when bloom conditions make this an option; e.g. when a bloom is limited to a cove or smaller portion of the lake.

3. Description of types of weed(s) and algae are being controlled and why;

Blue-green algae cause the water to become discolored and unpleasantly odorous. These algae can produce cyanotoxins, which are harmful to humans, fish and other animals. Further, metabolic products released by the algae react with chlorine during the treatment process to produce potentially carcinogenic disinfection by-products (DBPs). When a large algae population dies off, the decomposition can deplete the available oxygen and lead to fish kills, further damaging water quality. In order to prevent these problems and to insure that the water customers receive an adequate supply of water that meets drinking water requirements, an aquatic pesticide is applied when a blue-green algae bloom is imminent.

4. Algaecide and aquatic herbicide products or types of algaecides and aquatic herbicides expected to be used and if known their degradation byproducts, the method in which they are applied, and if applicable, the adjuvants and surfactants used;

Two algaecide options are considered at this time:

Historically, algaecides containing copper as the active ingredient have been successfully used. Cutrine-Plus has been effective at carefully controlled low doses. Cutrine-Plus ingredients are 9.0% copper and 91.0% inert ingredients. The copper is from mixed copper-ethanolamine complexes. The algaecide is applied directly to the water from a boat. A typical application takes one day to complete. The application dose is 0.6 gallons per acre-foot. The target copper concentration is 0.2 mg/L in the top 10 feet of the reservoir. The Curtrine-Plus is dosed at a controlled rate while the boat sweeps the reservoir using GPS navigation. Adjuvants are not used. An equivalent chelated-copper containing algaecide, such as Captain may be used if Cutrine-Plus is not available.

Sodium carbonate peroxyhydrate is a more recently approved product by the California Department of Pesticide Regulation for the treatment of algae. One formulation is marketed as PAK-27 by Solvay Chemicals. The active component which selectively controls blue-green algae is hydrogen peroxide (H_2O_2). PAK-27 is 85% sodium carbonate peroxyhydrate which corresponds to 27.6% H_2O_2. PAK-27 is applied directly to the water from a boat by broadcasting the granules over the surface while the boat sweeps the reservoir using GPS navigation. The product specifications advise application doses in the range of 3.0 to 16.9 lbs/acre-foot of water to give 0.3 to 1.7 ppm H_2O_2. Adjuvants are not used.

5. Discussion of the factors influencing the decision to select algaecide and aquatic herbicide applications for algae and weed control;

In general, actions to control blue-green algae blooms are most effective when taken at the earliest possible indications of a bloom. Early treatment of a bloom minimizes the algaecide dose required as well as preventing negative algae impacts on beneficial uses and water quality.

In order to catch an algae bloom at an early stage, Loch Lomond Reservoir is monitored weekly year-round with additional monitoring during warmer months when algae blooms are most likely. The table below shows the routine weekly monitoring schedule.

Typical Loch Lomond Reservoir Monitoring Schedule

	Sampling Locations		
Depth	**Site 2**	**Site 4**	***Sites 1, 3, 5**
Surface	Analytes A & B, Chlorophyll(a), Secchi Depth	Analytes A & B, Chlorophyll(a), Secchi Depth	*Analytes B, *Secchi Depth
GHWTP Intakes	Analytes A & B	*Analytes B	
Between GHWTP Intakes	Analytes B	*Analytes B	
Surface, 550', 530'	Phytoplankton		
	*Seasonal monitoring - when algae blooms are anticipated		

Analytes A: pH, Turbidity, Color, Odor, Specific Conductance
Analytes B: Temperature, Dissolved Oxygen,

GHWTP Intake Depths: 550', 530', 510', 490', 470' AMSL
Between GHWTP Intake Depths: 540', 520', 500', 480' AMSL

When a bloom is imminent, i.e. data begins to show early signs of algae growth, additional monitoring may be conducted to verify the bloom and monitor its growth. Additional monitoring, as described in the appendices of this APAP, is conducted in the event of a pesticide application to monitor the pesticide dosage and its effectiveness. In addition to the monitoring, Water Department Ranger staff is on the lake daily making observations of conditions.

The monitored parameters that indicate an algae bloom are:

1. Phytoplankton Counts: Blue-green algae of concern, as well as other phytoplankton, can be seen under a microscope and quantified. In addition to the counts of the "natural units" of algae, the size and overall strength of those units is an indication of the bloom strength. During a strong bloom, the species that is blooming dominates and other species may not be present at all. The objective of pesticide applications is to minimize or eliminate blue-green algae blooms.
2. Visual Inspection: Water Department staff is on the lake daily and observe the visual presence of algae, e.g. submerged algae visible in the water; floating mats of algae; algae clumps in the coves; algal scum. Visual algae are an indication of an advanced bloom of some type of algae. Such indications dictate the need for microscopic examination of the algae to determine which algae are present.
3. Chlorophyll a: Chlorophyll a measurements may be indicative of the size of the algae mass. Because blue-greens are not the only algae containing chlorophyll a, this cannot be seen as an exclusive indicator of blue-green algae mass. However, if the phytoplankton counts identify a blue-green algae bloom and a low level of other

algae, the chlorophyll a concentrations may give indications of changes in the blue-green algae biomass.

4. Temperature and Light: Warm water and sunlight can promote algae blooms. The likelihood of algae blooms is heightened during summer months when the weather is warm and longer days provide more sunlight. During these times the frequency of phytoplankton counts may be increased to watch for blue-greens.
5. Dissolved oxygen: By photosynthesis, algae raise the dissolved oxygen concentration of the water. Elevated oxygen concentrations may indicate blue-green algae activity or other chlorophyll containing algae.
6. Secchi Depth and Turbidity: These are indicators of clarity of the water. Blue-greens and other algae float in the water as small particulates and reduce the clarity.
7. pH: By photosynthesis, blue-green as well as other algae may cause an elevation in the pH of the reservoir water. This is a gradual change and not a sharp indicator of algae bloom.
8. Odor: Algae produce odors that are detectable in the water. Increasing odor levels may indicate blue-green or other algae.

High counts of blue-green algae, such as 500 NU or more would be sufficient to call for treatment without review of the other considerations. This is especially true if algae counts are noted as increasing at a high rate, such as doubling in a day. Higher counts and rapid growth indicate that a strong bloom is occurring.

Less obvious blooms, such as a count of 75 NU with a moderate growth rate, doubling the count in three days to a week, or a widespread distribution of algae throughout the lake and depths, are algae levels that call for careful monitoring or perhaps treatment with an algaecide.

An important objective in the management of the reservoir water quality is to minimize the use of algaecides. This makes it crucial to treat the algae blooms at the earliest possible point. Therefore, low levels of algae along with other indicators, such as warm water and long sunny days in August, may trigger a decision to treat with algaecide. The same algae counts may not call for treatment in late fall when there are fewer daylight hours, more clouds, temperatures are lower and nutrients needed by the algae have been used up by previous blooms.

Many factors need to be monitored and considered when trying to make treatment determinations early in the cycle of a bloom or even just before the bloom begins. A registered Pest Control Advisor must make the decision to apply a pesticide. The factors supporting the decision shall be documented and reported as required.

Loch Lomond Reservoir is a critical source of water for the City of Santa Cruz water customers. There are no adequate alternative water supplies during the summer months when conditions are optimal for the blooms of blue-green algae. Detrimental impacts of algae growth can include:

a. color and odor that exceed MCLs in the treated water,
b. DBPs that exceed MCLs in the treated water,
c. clogged filters at the GHWTP,
d. poisonous cyanotoxins produced by the algae,
e. fish kills due to toxins and oxygen depletion in the lake, and
f. loss of beneficial recreational use of lake due to color, odor, toxins and oxygen depletion.

For these reasons it is necessary to control excessive algae growth at Loch Lomond. Treatment of reservoir water at the GHWTP after the algae growth is neither economically feasible nor would it address problems in the lake itself.

A few blue-green algae may be present in the reservoir at any time. The timing of treatment of blue-green algae with algaecide is critical both to the success in preventing the undesirable effects of the algae and in minimizing the algaecide dosage.

6. If applicable, list the gates or control structures to be used to control the extent of receiving waters potentially affected by algaecide and aquatic herbicide application and provide an inspection schedule of those gates or control structures to ensure they are not leaking;

Discharges from Loch Lomond Reservoir occur through three routes:

1. There is a constant release of water (fish water release) below the dam to provide water to Newell Creek. The release is controlled to ensure that a minimum flow of 1 cubic-foot/second is maintained. This outflow is inspected at least weekly when Ranger staff reads the flow meter.
2. There is a deluge valve at the base of the dam to release water from the reservoir during an emergency. The deluge valve is tested annually.
3. During the rainy season the lake level usually rises to flow over the spillway and into Newell Creek. During drought years there may not be any such spill over. Undesirable algaecide releases to Newell Creek could occur if there is spillway flow during or shortly after an algaecide treatment. It is very rare that water would be flowing over the spillway by late spring when the earliest algae blooms may occur. However, if the spillway is flowing and an algae bloom treatment is imminent, it is possible to prevent water from going over the spillway by opening the deluge valve to reduce the lake level prior to treatment.

There are four functional inlet/outlet gates on the front side of the dam located at twenty foot vertical intervals from 490' to 550' elevation above sea level, on a sloped concrete intake structure. In the summer of 2012: Gate 1 (550'EL), Gate 2 (530'EL), Gate 3 (510'EL) and Gate 4 (490'EL) were replaced in kind, including new fish screen trash rack assemblies. Gate 5 (470'EL) was modified to facilitate extension (at a later date, if desired) of the inlet/outlet

beyond the original inlet area that experiences high material buildup. Gate 5 (470'EL) is not available to use at this time.

The new intake gate assemblies (Gates 1-4) consist of stainless steel knife gates and hydraulic operators with proximity switches that were designed to drastically exceed minimum condition requirements to maximize safety, reliability and longevity. The knife gates are 12" A-C valve, type 316 stainless steel with Buna-N bi-directional drip tight resilient seats rated to 150 psi. The hydraulic operators are AWWA C541 type 316 stainless steel RDC Model HC3.25-A8D1MZ with internally mounted GO Model 73-14538-3DD proximity switches UL rated for submerged operation up to 10,000 feet deep. The maximum pressure that the gates could experience in very rare operating conditions is less than 50 psi, so the new gates have a drip tight seal with a safety factor over three. The proximity switches are internally mounted in the hydraulic cylinders to prevent the possibility of switch failure due to fowling and are rated with an internal safety factor over five and external safety factor over 100. The switches are also designed with no moving parts for extended reliable operation.

Quarterly preventative maintenance and annual inspections are performed to maintain system integrity as designed and required by regulatory agencies. During preventative maintenance, each gate is cycled full open and full closed as verified by the proximity switch position indication and rapid increase in hydraulic pressure as the gate reaches the full open or closed positions. If the first two annual inspection results are favorable as expected, subsequent preventative maintenance shall be reduced to bi-annual and inspections shall be reduced to every five years.

Traditional pressure and leakage tests after installation of the new gates were not possible due to system configuration and the deteriorated condition of the pipeline under the Newell Creek Dam. Visual inspection and video documentation ensured that the new gates were not leaking under normal operating conditions and installed correctly per specifications. The gate components were selected with excessive design safety factors to further ensure zero leakage.

7. If the Discharger has been granted a short-term or seasonal exception under State Water Board *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays,* and Estuaries of California* (Policy) section 5.3 from meeting acrolein and copper receiving water limitations, provide the beginning and ending dates of the exception period, and justification for the needed time for the exception. If algaecide and aquatic herbicide applications occur outside of the exception period, describe plans to ensure that receiving water criteria are not exceeded because the Dischargers must comply with the acrolein and copper receiving water limitations for all applications that occur outside of the exception period;

On September 7, 2005 the State Water Resources Control Board adopted Resolution No. 2005-0062 amending Attachment E of Water Quality Order No. 2004-009-DWQ. The Resolution states that the Santa Cruz Water Department (SCWD) has complied with the exception requirements of section 5.3 of the Policy and adds the SCWD to the Attachment G – Exception List, listing public entities with policy Section 5.3 exceptions. The exception period would be the summer and fall when algae blooms appear and include a period thereafter for elevated copper levels to return to water quality standards.

8. Description of monitoring program;

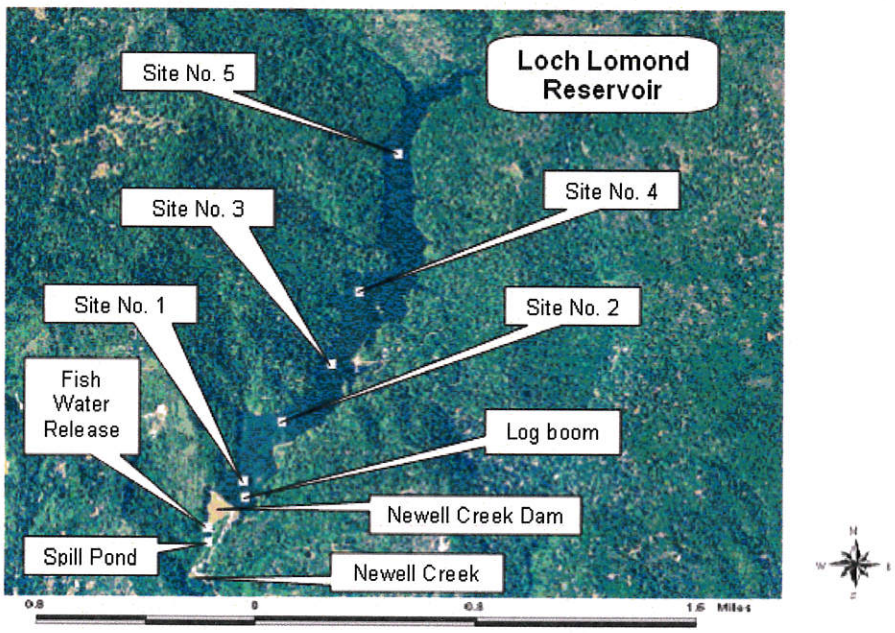
Sampling and analyses are conducted by Santa Cruz Water Department staff from the Water Quality Laboratory (Laboratory Technician, Chemists and Microbiologist), the Loch Lomond Recreation Facility (Park Rangers and Ranger Assistants) and Graham Hill Water Treatment Plant (Water Treatment Operators).

Routine monitoring of the reservoir to detect and respond to blue-green algae blooms is conducted as described in Section 5 above. The frequency of monitoring, particularly the phytoplankton count and the chlorophyll a concentration, is increased during periods when the bloom potential is high.

When the Pest Control Advisor determines that treatment to control an algae bloom is required, monitoring and documentation procedures are implemented. This activity is to monitor the effectiveness of the treatment, the distribution and dissipation of the pesticide and to document impacts of the pesticide application. This treatment-related monitoring is conducted by laboratory staff, ranger staff and water production staff. Details of this treatment-related monitoring are included in *Appendix: Staff Actions During Pesticide Treatments*.

The following map shows the sampling locations discussed in the appendix.

Loch Lomond Reservoir
Sampling Locations



9. Description of procedures used to prevent sample contamination from persons, equipment, and vehicles associated with algaecide and aquatic herbicide application;

Certified algaecide applicator persons from Clean Lakes Inc. or other certified personnel as available will perform algaecide applications at Loch Lomond using their own algaecide application equipment, vehicles, trailers and boat. No Clean Lakes Inc. personnel, equipment, vehicles or boat will be used for any water sampling equipment transportation or sample collections by Santa Cruz Water Department staff. Water samples will be collected using the Loch Lomond patrol boat by Santa Cruz Water Department staff. City of Santa Cruz sampling equipment, ice chests and pre-cleaned sample bottles will be collected using the Loch Lomond patrol boat.

10. Description of the BMPs to be implemented:

Management of algaecide application will be overseen by staff possessing both a Pest Control Advisor's (PCA) license and a Qualified Applicator Certificate (QAC).

The PCA prepares a written Pest Control Recommendation, which includes location and area to be treated, the pesticide to be used, the concentration of the pesticide and total amount of the pesticide to be used, the acreage to be treated, the date, the schedule, and safety precautions. The PCA provides safety training for all involved in the algaecide application.

The QAC oversees the staff performing the application. The QAC maintains records of the pesticide application, reporting to County Agricultural Commissioner (CAC) as required.

Monitoring procedures detailed in Section 8 above will document the application of the pesticide, allowing City of Santa Cruz staff to assess the success of the application and monitor the dissipation of the pesticide.

The creek flow maintenance system (fish water release) draws water from deep within the reservoir (usually elevation 490' or 510' AMSL). After Cutrine-Plus applications, weekly monitoring for copper concentrations in the reservoir at the surface and each 20' intake depth intervals down to elevation 470' AMSL, this gives City staff advance knowledge of the expected copper levels in water diverted for treatment and in the creek flow maintenance water. Water Production staff can change the intake draw to a different depth, to minimize copper concentrations in water leaving the Reservoir. The receiving water limit is determined by calculation:

Maximum Total Copper Conc. [µg/L] = exp[0.8545(ln(hardness, mg/L as CaCO3))-1.702]

However, the 5.3 exception grants a "seasonal" waiver of this limit during treatment periods.

Because of its rapid dissolution, PAK-27 does not remain in the water long enough to reach the depth from which it could be diverted out of the reservoir.

a. Measures to prevent algaecide and aquatic herbicide spill and for spill containment during the event of a spill.

Clean Lakes, Inc. will be responsible for spill containment and communication with Loch Lomond staff in the event of an algaecide spill.

b. Measures to ensure that only an appropriate rate of application consistent with product label requirements is applied for the targeted weeds or algae.

   Comparison of previous algaecide application target dosages and post application algaecide concentrations will be used to verify that appropriate application rates are being correctly applied.

c. The Discharger's plan in educating its staff and algaecide and aquatic herbicide applicators on how to avoid any potential adverse effects from the algaecide and aquatic herbicide applications.

   Clean Lakes, Inc. will be responsible for educating their staff and algaecide applicators on how to avoid any potential adverse effects.

d. Discussion on planning and coordination with nearby farmers and agencies with water rights diversion so that beneficial uses of the water (irrigation, drinking water supply, domestic stock water, etc.) are not impacted during the treatment period; and

   Algaecides are applied by boat using GPS tracking just below the surface of the reservoir: copper algaecides will target the top 10 feet of the reservoir, while PAK-27 algaecide will target the top 3-4 feet of the reservoir.

   Following a copper algaecide application, copper concentrations at the reservoir surface and all intake depths (470' – 550') are measured weekly for a minimum of 8 weeks. A small concentration of copper < 13 ug/L has been measured to exit the Fish Water Release into Newell Creek below the dam. When copper concentrations at the Fish Water Release approach 13 ug/L, pre-selected downstream monitoring sites are monitored for total copper and dissolved copper concentrations until the Fish Water Release is again measured below 13 ug/L.

e. A description of measures that will be used for preventing fish kill when algaecides and aquatic herbicides will be used for algae and aquatic weed controls.

   Aquatic pesticides applied according to manufacturer's directions will prevent fish kills as long as treatment is performed before the advanced stages of an algal bloom. If an advanced algal bloom needs treatment, then according to manufacturer's directions only one half or a smaller portion of the lake will be treated per day.

11. Examination of Possible Alternatives. Dischargers should examine the alternatives to algaecide and aquatic herbicide use to reduce the need for applying algaecides and herbicides.

No alternatives to algaecides and aquatic herbicides have been identified at this time. Future algaecide applications will be performed using the minimum amount of algaecides that are

necessary to have an effective control program and that are consistent with the algaecide product label requirements.

Reservoir management includes a program to limit nutrient inflows to the lake. Nutrient concentrations in Loch Lomond are not high. The Newell Creek watershed, which drains to Loch Lomond Reservoir, is characterized by timber harvest operations, vineyards and sparse mountain residential development. The City owns nearly 50% of the headwaters of Newell Creek. This property is undeveloped and maintained as watershed lands for the purpose of source water protection, except for a recreational facility that is operated by the City as a requirement of the development of the reservoir. The City is currently in the process of developing a comprehensive plan to guide future management of these lands. The primary goals of this plan are protection of water quality and quantity. While excessive nutrient inflows are not seen as a major contributor to algae blooms, the City of Santa Cruz Water Department includes water resources management staff designated to oversee watershed activities to insure that detrimental water quality impacts are minimized.

From May 2003 through September 2005 the Water Department ran a trial of the Solarbee® Reservoir Circulators. Five Solarbee units were installed for a trial at Loch Lomond Reservoir. The Solarbee® raises water from lower depths to the surface of the reservoir. The mixing raises the dissolved oxygen and pH. This action serves to strip ammonia (N) from the reservoir and to precipitate phosphorus (P) with calcium hardness by formation of hydroxyapatite, a stable non-nutrient which settles to the bottom of the reservoir. In theory, the SolarBee® enables the "good" diatoms and green algae to out-compete the "harmful" blue-green algae for phosphorus. Phosphorus remains the limiting nutrient all season, instead of nitrogen, thus preventing the blue-green algae from taking over. Though the Solarbee® units have been successful in other applications, this approach did not work to control blue-green algae in Loch Lomond Reservoir. After two and a half seasons of testing, repeated blue-green algae blooms and chronically high counts of these algae made it apparent that this method of blue-green algae control was not working. We believe that the depth and complex shape of the lake were factors inhibiting the success of this approach to algae control.

During the summer of 2011, the Water Department ran a trial using an alternative method of algae control. One SonicSolutions® ultrasonic unit was mounted to a floating boat dock utilizing solar power. This ultrasonic device is designed to eliminate algae using ultrasonic waves to burst the cell walls of the algae. SonicSolutions® claims that the device is safe for fish, plants and other aquatic life. Our trial run in 2011 showed no significant change in the color or clarity of the water, algae counts or evidence of any increased blue-green algal die off compared to the other coves without the SonicSolutions® device. Following one trial season, the SonicSolutions® device was removed.

Appendix: Staff Actions During Pesticide Treatments

~Following Pages~

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

24-HOURS PRIOR TO COPPER TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
1	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
2	Collect *Copper* Sample[1] at Site 2			
3	Collect *Copper* Sample[1] at Site 4			
4	Collect *Copper* Sample[1] at Fish Release			
5	Deliver to Lab no later than 1:30PM[2]			
6	Additional miscellaneous samples collected (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Refer to copper sample collection procedure L-4. Do not discard remaining sample from secondary GM container. Please bring remaining sample to WQL to be analyzed for hardness.
[2] Please call the WQL if delayed.

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

DAY OF COPPER TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
WITHIN 2 HRS. PRIOR TO COPPER APPLICATION:				
SITE 2				
1	Collect *Algae* sample[1]			
2	Collect *Chlorophyll* sample[1]			
3	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
SITE 4				
4	Collect *Algae* sample[1]			
5	Collect *Chlorophyll* sample[1]			
6	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
2 HRS. POST COPPER APPLICATION:				
7	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
8	Collect *Copper* Sample[2] at site 2			
9	Collect *Copper* Sample[2] at site 4			
10	Deliver prior and post samples to Lab no later 3:00PM[3]			
11	Additional miscellaneous samples collected (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Refer to L-3 algae and chlorophyll sample collection procedures
[2] Refer to L-4 copper sample collection procedures. Do not discard remaining sample from secondary GM container. Please bring remaining sample to WQL to be analyzed for hardness.
[3] Please call the WQL if delayed

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

1-DAY POST COPPER TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
1	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
	SITE 2			
2	Collect **10:00AM** *Algae* sample[1]			
3	Collect **10:00AM** *Chlorophyll* Sample[1]			
4	Collect *Copper* Sample[2]			
5	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
	SITE 4			
6	Collect **10:00AM** *Algae* Sample[1]			
7	Collect **10:00AM** *Chlorophyll* Sample[1]			
8	Collect *Copper* Sample[2]			
9	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
10	Deliver to Lab no later than 1:30PM[3]			
11	Additional miscellaneous samples collected (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Refer to L-3 algae and chlorophyll sample collection procedures.
[2] Refer to L-4 copper sample collection procedures. Do not discard remaining sample from secondary GM container. Please bring remaining sample to WQL to be analyzed for hardness.
[3] Please call the WQL if delayed

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

2-DAY POST COPPER TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
	SITE 2			
1	Collect **10:00AM** *Algae* sample[1]			
2	Collect **10:00AM** *Chlorophyll* sample[1]			
3	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
	SITE 4			
4	Collect **10:00AM** *Algae* sample[1]			
5	Collect **10:00AM** *Chlorophyll* sample[1]			
6	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
7	Deliver to Lab no later than 1:30PM[2]			
8	Additional miscellaneous samples collected (please describe below):			
	Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Refer to L-3 algae and chlorophyll sample collection procedures.
[2] Please call the WQL if delayed

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

WEEKLY POST COPPER TREATMENT

WEEK	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
SUNDAYS AND THURSDAYS AFTER COPPER APPLICATION FOR 8 WEEKS				
1	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
2	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
3	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
4	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
5	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
6	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
7	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			
8	Collect *Copper* Sample[1] from Fish Release			
	Collect *Copper* Sample[1] from Fish Release			

[1]Refer to copper sample collection procedure L-4. Do not discard remaining sample from secondary GM container. Please bring remaining sample to WQL to be analyzed for hardness.

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

When the WQ Manager determines that the copper concentration in the fish release is approaching the discharge limit then, copper sampling will be conducted downstream of the dam to monitor for compliance with the copper limit.

Discharge Monitoring
EVERY 2 WEEKS

WEEK	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
FISH RELEASE				
1	Complete: 'NEWELL CREEK SURVEILLANCE FORM'			
2	Collect *Copper* Sample[1]			
3	Collect *Dissolved Copper* Sample[1]			
SPILL POND OUTLET				
1	Complete: 'NEWELL CREEK SURVEILLANCE FORM'			
2	Collect *Copper* Sample[1]			
3	Collect *Dissolved Copper* Sample[1]			
ANADROMOUS LIMIT				
1	Complete: 'NEWELL CREEK SURVEILLANCE FORM'			
2	Collect *Copper* Sample[1]			
3	Collect *Dissolved Copper* Sample[1]			
CONDUCT SAMPLING EVERY 2 WEEKS or AS DIRECTED BY WQM				

[1] Refer to copper sample collection procedure L-4. Do not discard remaining sample from secondary GM container. Please bring remaining sample to WQL to be analyzed for hardness.

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

WEEKLY POST COPPER TREATMENT
WEEKLY AFTER COPPER APPLICATION FOR 8 WEEKS

WEEK		ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
1		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			
2		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

WEEKLY POST COPPER TREATMENT
WEEKLY AFTER COPPER APPLICATION FOR 8 WEEKS

WEEK		ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
3		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			
4		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

WEEKLY POST COPPER TREATMENT
WEEKLY AFTER COPPER APPLICATION FOR 8 WEEKS

WEEK		ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
5		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			
6		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			

Year:_____
Copper Event#_____
LOCH LOMOND TREATMENT CHECKLIST
COPPER APPLICATION DATE:_____

WEEKLY POST COPPER TREATMENT
WEEKLY AFTER COPPER APPLICATION FOR 8 WEEKS

WEEK		ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
7		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			
8		**SITE 2**			
	1	Collect *Algae* Samples at surface and intake depths			
	2	Collect *Copper* Samples at surface and intake depths			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface and intake depths			
		SITE 4			
	1	Collect *Algae* Sample at surface			
	2	Collect *Copper* Sample at surface			
	3	Collect *Chlorophyll* Sample at surface			
	4	Measure DO/Temp at surface			

Year:_____
Pak-27 Event#_____
LOCH LOMOND TREATMENT CHECKLIST
HYDROGEN PEROXIDE (PAK-27) APPLICATION DATE:_____

24-HOURS PRIOR TO PAK-27 TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INTITALS	LAB REC'D
1	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
2	Run HYDROGEN PEROXIDE analysis at site 2[1]			
3	Run HYDROGEN PEROXIDE analysis at site 4[1]			
4	Additional miscellaneous samples (please describe below):			
	Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Use the Hach test Kit Model HYP-1 for hydrogen peroxide (PAK-27) tests.
Record hydrogen peroxide test results on a "Hydrogen Peroxide (PAK-27) Test Record" form and fax results to WQL

Year:_____

Pak-27 Event#_____

LOCH LOMOND TREATMENT CHECKLIST

HYDROGEN PEROXIDE (PAK-27) APPLICATION DATE:_____

DAY OF PAK-27 TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INTITALS	LAB REC'D
WITHIN 2 HRS. PRIOR TO PAK-27 APPLICATION				
SITE 2				
1	Collect *Algae* sample[1]			
2	Collect *Chlorophyll* sample[1]			
3	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
SITE 4				
4	Collect *Algae* sample[1]			
5	Collect *Chlorophyll* sample[1]			
6	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
WITHIN 2 HRS. POST PAK-27 APPLICATION				
7	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
8	Run HYDROGEN PEROXIDE analysis at site 2[2]			
9	Run HYDROGEN PEROXIDE analysis at site 4[2]			
10	Deliver samples to Lab no later than 3:00PM[3]			
11	Additional miscellaneous samples (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Use sample collection procedure L-3 for algae and chlorophyll.

[2] Use the Hach test Kit Model HYP-1 for hydrogen peroxide (PAK-27) tests.
Record hydrogen peroxide test results on a "Hydrogen Peroxide (PAK-27) Test Record" form and fax to WQL.

[3] Please call the WQL if delayed.

Year:_____
Pak-27 Event#_____
LOCH LOMOND TREATMENT CHECKLIST
HYDROGEN PEROXIDE (PAK-27) APPLICATION DATE:_____

1-DAY POST PAK-27 TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INTITALS	LAB REC'D
1	Complete: 'LOCH LOMOND RESERVOIR SURVEILLANCE FORM'			
	SITE 2			
2	Collect **10:00 AM** *Algae* sample[1]			
3	Collect **10:00 AM** *Chlorophyll* sample[1]			
4	Run HYDROGEN PEROXIDE analysis[2]			
5	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
	SITE 4			
6	Collect **10:00 AM** *Algae* sample[1]			
7	Collect **10:00 AM** *Chlorophyll* sample[1]			
8	Run HYDROGEN PEROXIDE analysis[2]			
9	Complete: *'LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN'*			
10	Deliver to Lab no later than 1:30PM[3]			
11	Additional miscellaneous samples (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Use sample collection procedure L-3 for algae and chlorophyll.
[2] Use the Hach test Kit Model HYP-1 for hydrogen peroxide (PAK-27) tests.
Record hydrogen peroxide test results on a "Hydrogen Peroxide (PAK-27) Test Record" form and fax to WQL.
[3] Please call the WQL if delayed.

Year:_____
Pak-27 Event#_____
LOCH LOMOND TREATMENT CHECKLIST
HYDROGEN PEROXIDE (PAK-27) APPLICATION DATE:_____

2-DAY POST PAK-27 TREATMENT

	ACTION	DATE/TIME COMPLETED	SAMPLER INTITALS	LAB REC'D
	SITE 2			
1	Collect **10:00 AM** *Algae* sample[1]			
2	Collect **10:00 AM** *Chlorophyll* sample[1]			
3	Run HYDROGEN PEROXIDE analysis[2]			
4	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
	SITE 4			
5	Collect **10:00 AM** *Algae* sample[1]			
6	Collect **10:00 AM** *Chlorophyll* sample[1]			
7	Run HYDROGEN PEROXIDE analysis[2]			
8	Complete: '*LOCH LOMOND DEPTH PROFILE DATA FORM FOR TEMPERATURE AND DISSOLVED OXYGEN*'			
9	Deliver to Lab no later than 1:30PM[3]			
10	Additional miscellaneous samples (please describe below): Changes approved by:_____ Deputy Director of Operations or WQM			

[1] Use sample collection procedure L-3 for algae and chlorophyll.
[2] Use the Hach test Kit Model HYP-1 for hydrogen peroxide (PAK-27) tests.
Record hydrogen peroxide test results on a "Hydrogen Peroxide (PAK-27) Test Record" form and fax results to WQL.
[3] Please call the WQL at 420-5480 if delayed.

Year:_____

Pak-27 Event#_____

LOCH LOMOND TREATMENT CHECKLIST

HYDROGEN PEROXIDE (PAK-27) APPLICATION DATE:_____

	ACTION	DATE/TIME COMPLETED	SAMPLER INITIALS	LAB REC'D
COLLECTED BY LABORATORY STAFF WEEKLY AFTER PAK-27 APPLICATION FOR 8 WEEKS				
SITE 2				
1	Collect *Algae* Samples at surface and intake depths			
2	Collect *Chlorophyll* Sample at surface			
3	Measure DO/Temp at surface and intake depths			
SITE 4				
1	Collect *Algae* Sample at surface			
2	Collect *Chlorophyll* Sample at surface			
3	Measure DO/Temp at surface			