Comments on
DRAFT STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED AND PEST CONTROL IN WATERS OF THE UNITED STATES

Comments Submitted by

G. Fred Lee, PhD, DEE
G. Fred Lee & Associates, El Macero, California
gfredlee@aol.com - www.gfredlee.com

March 10, 2004

The State Water Resources Control Board (SWRCB) is charged with the development of a general NPDES permit covering the addition of pesticides/herbicides for the control of aquatic weeds. This permit requires that pesticide (herbicide) residues not cause or contribute to exceedances of applicable California Toxics Rule criteria and State Water Resources Control Board (State Board) or Regional Water Quality Control Board water quality objectives outside the Treatment Area (the area needs aquatic weed and pest control) any time after pesticide application has started and inside the Treatment Area after completion of the project.

In response to the request for comments on the draft general NPDES permit for the application of herbicides for the control of aquatic weeds, I wish to make the following comments. These comments are a follow-up to the December 23, 2003, comments that I submitted to the SWRCB on the November 26, 2003, preliminary draft general aquatic herbicide NPDES permit. Those comments are appended to these comments as background information.

Overall, the revised draft NPDES aquatic herbicide permit is significantly improved over the initial draft. There are still several areas that need major revision. Of particular concern is inadequate toxicity and bioassessment monitoring. These are discussed below.

Comments on
STATE WATER RESOURCES CONTROL BOARD MONITORING AND REPORTING PROGRAM (MRP) WATER QUALITY ORDER NO 2004-__-DWQ STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED AND PEST CONTROL IN WATERS OF THE UNITED STATES GENERAL PERMIT NO. CAG_____

Section B. RECEIVING WATER MONITORING states,

> *"1. The discharger shall choose, for each type of aquatic pesticide used, one representative monitoring site for each type of site."*

The wording for this section should be changed to:

"The discharger shall choose, for each type of aquatic pesticide used, an appropriate number of monitoring sites for each type of site where application occurs."

A single monitoring site will not be adequate for some aquatic weed control situations.

Section c. Post-Event Monitoring states,

> *"Post-event samples shall be collected within the Treatment Area and immediately adjacent to the Treatment Area within one week of the application event."*

Since one sample obtained a week after treatment may not be protective against non-target organism toxicity, this section needs to be changed to require sampling on the first day of treatment, two days later and one week after treatment.

Table 1 indicates that composite samples should be collected for certain parameters. Composite samples are not appropriate for assessing water quality impacts of pesticides and other chemicals. Composite samples do not represent what the organisms are exposed to. Separate discrete samples should be analyzed.

The statement in section 3. Evaluation of Receiving Water Toxicity,

> *"If chronic toxicity is detected in treated waters, and upstream or untreated waters do not exhibit chronic toxicity for a sampling event, the discharger shall begin increased toxicity monitoring as described below. If upstream untreated chronic toxicity sampling exhibits toxicity, the sampling event is inconclusive and no additional monitoring is required."*

is not technically valid for assessing the water quality impacts of aquatic herbicides. It is inappropriate to give a blanket exception from toxicity monitoring if upstream toxicity occurs. The toxicity of the herbicide could be to different organisms and/or could be enhanced by the upstream toxicity, etc. Upstream toxicity should be considered in evaluating the water quality impacts of the herbicide.

Section "D. Sediment Toxicity" is not adequate. Sediment toxicity should be assessed with each herbicide application to determine its impact within and outside the Treatment Area. Also of concern is the persistence of this toxicity. In addition to the herbicide and its degradation products, the toxicity in sediments can be due to the decay of the killed vegetation, where ammonia accumulates in the sediments in the area where the dead vegetation accumulates. This type of secondary toxicity should also be evaluated.

The approach set forth in Section E. Bioassessment, of linking the bioassessment to reference sites, is not necessary to evaluate the impact of the herbicide on benthic organisms. The Treatment Area prior to treatment is the most appropriate reference site. Significant changes of the benthic organism assemblages associated with treatment need to be evaluated. Bioassessment measurements should be made before treatment, shortly after treatment and a few weeks after treatment in the Treatment Area and at selected locations outside the Treatment Area.

One of the major problems with issuing a general NPDES permit for aquatic herbicide application is that there is no specific requirement that the proposed application be reviewed by the Regional Board. This should be incorporated into the general permit. Failure to adopt this approach could readily lead to significant adverse impacts on the beneficial uses of the State's waters associated with the aquatic herbicide application.

Those who use aquatic herbicides, both public and private entities, should be required to pay sufficient funds to the State to support the Regional Board's appropriate review of the proposed treatment and review of the reports that are generated on the treatment.

Comments on
FACT SHEET
WATER QUALITY ORDER NO. 2004-__-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED AND PEST CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG_____

Overall, the Fact Sheet is written in such a way as to support the use of aquatic pesticides/ herbicides without appropriate safeguards to insure that the waters of the State are protected from the adverse impacts of the use of aquatic pesticides to non-target organisms. Examples of this situation are provided below. The Fact Sheet needs to be rewritten so that the focus is on protecting the beneficial uses of the waters of the State from the application of pesticides to these waters or to waters that could influence these waters.

The Fact Sheet, on page 3, states,

> *"Based on these results, this General Permit will require toxicity monitoring only for copper-based aquatic pesticides."*

It would be highly inappropriate to conclude, based on a limited-scope study, that no other aquatic herbicide/pesticide could directly or indirectly cause toxicity outside the zone of application in the waters treated. There can readily be toxicity that is not manifested in the current studies, which develops in the future due to combinations of chemicals that were not experienced during the limited-scope study period. Toxicity measurements must be a standard, ongoing requirement for all aquatic herbicide applications.

The footnote on page 6 of the Fact Sheet states,

> *"'Residue' is defined as chemicals or by-products caused by the application of aquatic pesticides that persist in the receiving waters after a specified treatment period."*

"Residue" should apply to any constituent derived from the applied pesticide that occurs outside of the treatment area from the initiation of treatment, not **after** treatment.

Page 9 of the Fact Sheet states,

> *"For those Control Agencies that have been granted a section 5.3 exception, the event may result in 'short-term or seasonal' exceedance of water quality standards for priority pollutants inside and outside the Treatment Area. Again, there is no discrete definition of short-term but the intent is to allow the exception to apply for some period of time, such as the summer months (June, July, and August) and in some years extending through September due to weather. We do not intend for the exception to apply all year."*

Great caution should be exercised in granting exceptions to compliance with water quality objectives. This should only be done under rare, highly unusual conditions, and for very limited periods of time – no more than a few days to a week, certainly not a season (i.e., summer).

Page 9 further states,

> *"The Control Agency may apply aquatic pesticides longer than would be considered short-term or seasonal. However, it must demonstrate that exceedances of priority pollutant standards occur only during the defined short-term or season. It is up to the discharger to make this demonstration."*

This demonstration needs to be critically reviewed by the Regional Board to be certain it is appropriate and protective of the beneficial uses of the waterbody outside of the Treatment Area during treatment and a week or so following treatment.

Page 14 of the Fact Sheet states,

> *"The boards of each public entity, as the lead agencies under CEQA, approved the Final ND/MND and determined that the discharge of aquatic pesticides in their respective projects would not have significant effect on the environment. Those public entities have determined that the water quality or related water quality impacts identified in the environmental assessments of the ND/MND are less than significant. The boards of each public entity, as the lead agencies under CEQA, approved the Final ND/MND and are not required to meet priority pollutant criteria until after completion of the application event."*

This approach is not protective. Those responsible for application of aquatic pesticides, whether public or private, should be required to meet CTR criteria and water quality objectives outside of the Treatment Area during treatment and inside the Treatment Area within a week after treatment has been completed. To grant blanket "less than significant" water quality impacts, without a demonstration of this situation, is inappropriate.

Page 14 of the Fact Sheet states,

> *"The California Department of Food and Agriculture (CDFA) has determined that its ongoing projects to eradicate hydrilla are exempt from the requirements of CEQA because the activities are necessary to prevent or mitigate an emergency …"*

This exemption could readily lead to application of aquatic pesticides where there will not be appropriate review of CDFA's activities. It is very difficult to envision an "emergency" situation where the control of hydrilla should not be subject to CEQA review.

Page 15 of the Fact Sheet states,

> *"The MRP requires dischargers to choose one representative site for each type of aquatic pesticide used. Each representative site will be monitored for the active ingredient and other water quality parameters before, immediately after, and one week after each treatment. Toxicity monitoring is required with application of copper and rotenone-based aquatic pesticides. Dischargers must sample at least 20 percent of application events."*

As discussed in the comments on the MRP presented above, selecting a single sampling point will generally be inadequate for monitoring of the adverse impacts of aquatic pesticide application. Further, sampling only 20 percent of the application events could readily be inadequate to properly define adverse impacts. The approach for establishing the monitoring program should be based on intensive, comprehensive monitoring of each application situation. After a few years of application of the same chemical at the same locations, using the same approaches, it may be possible, with appropriate regulatory review, to reduce the amount of monitoring. Even this should be done cautiously, however, since other chemicals can be present in the waters in the future that would act additively or synergistically with the applied pesticide to cause problems for the beneficial uses of the waterbody that were not present during previous applications.

Comments on
WASTE DISCHARGE REQUIREMENTS
WATER QUALITY ORDER NO. 2004-__-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED AND PEST CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG_____

A footnote on page 2 of the Waste Discharge Requirements for this permit states,

> *"Inert ingredients are additional ingredients that are not toxic to target organisms."*

While this statement is true by definition, it is also true that "inert" ingredients can have an adverse impact on non-target organisms. This will need to be investigated for each aquatic pesticide/herbicide formulation that is proposed to be applied.

Page 4, number 23 states,

> *"This General Permit requires dischargers to evaluate BMPs that may include alternative control options, procedures to determine that water quality impacts have been*

minimized, and a determination that there are no feasible alternatives to the selected resource or pest management measures."

This evaluation must also include dischargers **implementing** BMPs that will be protective of the beneficial uses of the waterbodies that could be adversely impacted by the aquatic pesticide.

Page 7 of the Waste Discharge Requirements states,

> ***"C. Receiving Water Limitations:***
> *1. Discharge of treated water from the Treatment Area shall not exceed the following limitations.*
> *a. All Aquatic Pesticide Applications:*
>
Parameter	***Limitation***
Chronic Toxicity	*Aquatic pesticide applications shall not cause or contribute to toxicity in receiving waters.*

> *"*

As discussed in my previous comments, it is important that the toxicity tests that are used are matched to the duration of exposure at the test site. Failure to conduct appropriate toxicity tests could overestimate toxicity that occurs during and following treatment.

The footnote on page 7 states,

> *"Public entities listed in attachment E are not required to meet this limitation* [the receiving water limitation for applications of copper-based herbicides/pesticides] *during treatment."*

While it may be desirable to allow some public agencies, such as water utilities that need to control algae in their water supply reservoirs, to be exempt from receiving water limitations for applications of copper-based herbicides/pesticides, these utilities should be required to determine the adverse impacts to the designated beneficial uses of the waterbody as a result of this application. The information gained from this evaluation would be used to determine the appropriateness of continued use of copper-based herbicides in waterbodies that have aquatic-life-related designated beneficial uses.

Page 10 states,

> *"Upon completion of an aquatic pesticide project, public entities listed in Attachment E to this General Permit shall provide certification by a qualified biologist that beneficial uses of receiving waters accepting aquatic pesticides have been restored."*

Adequate detailed information on the technical basis for the certification must be submitted to the Regional Board for review and approval.

G. Fred Lee & Associates

27298 E. El Macero Dr.
El Macero, California 95618-1005
Tel. (530) 753-9630 • Fax (530) 753-9956
e-mail: gfredlee@aol.com
web site: http://www.gfredlee.com

Comments on SWRCB November 26, 2003, Preliminary Draft Water Quality Order No. 2004-__-DWQ Statewide General National Pollutant Discharge Elimination System Permit for Discharge of Aquatic Pesticides for Aquatic Weed Control in Irrigation Systems, Drinking Water Canals, and Surface Water Impoundments that are Waters of the United States

Comments Submitted by
G. Fred Lee, PhD, DEE

December 23, 2003

In response to the SWRCB staff's request for comments on the SWRCB staff November 26, 2003, draft Water Quality Order No. 2004-__-DWQ Statewide General National Pollutant Discharge Elimination System Permit for Discharge of Aquatic Pesticides for Aquatic Weed Control in Irrigation Systems, Drinking Water Canals, and Surface Water Impoundments that are Waters of the United States, I have reviewed this draft permit and found a number of significant deficiencies in it. The major problem areas with the draft aquatic pesticide NPDES permit are summarized below.

These comments are based on my having been involved in research on fate, transport and impact evaluation of aquatic pesticides on waterbodies' water quality-beneficial uses since the mid-1960s. A summary of my work in these areas is appended to these comments.

Previously I have provided to the State Water Resources Control Board and the Aquatic Pesticide Monitoring Program (APMP) some comments on unreliable information provided at the October 24, 2003, APMP Steering Committee meeting regarding potential problem areas with respect to aquatic pesticide applications that result in adverse impacts. I have attached those comments to these comments, since they provide additional background information on the issues summarized below.

Inadequate Registration of Pesticides

On page 2 of the Draft Order, last paragraph, it is stated,

> *"As part of the pesticide registration process, USEPA and DPR evaluate data submitted by registrants to ensure that a product used according to label instructions will cause no harm (or "adverse impact") on non-target organisms that cannot be reduced (or "mitigated") with protective measures or use restrictions."*

It is my experience that the key component of this statement – the mitigation and use restrictions – is not adequately and reliably applied to label allowed uses, with the result that there are significant adverse impacts to non-target organisms associated with the use of pesticides according to the label instructions.

On page 6, the second paragraph states,

> *"The USEPA and DPR require that aquatic pesticides undergo toxicity testing and meet specific toxicity requirements before registering the pesticide for application to surface waters. USEPA has found that the application of properly registered aquatic pesticides pose a minimum threat to people and the environment."*

Further, on page 6, in the fourth paragraph, the statement is made that,

> *"In this General Permit, inert ingredients are not considered on constituent-by-constituent basis because the aquatic pesticides have been through USEPA and DPR registration processes where toxic effects of active ingredients and entire formulations have been analyzed (USEPA regulates pesticide use through strict labeling requirements in order to mitigate negative impacts to human health and the environment, and DPR environmental and medical toxicologists review toxicity data on formulations and can deny registration or work with registrants or CACs to impose additional requirements in order to protect human health or the environment)."*

These statements could lead someone not familiar with how pesticides are used to believe that pesticide use in accordance with label instructions does not cause significant environmental problems. A critical review of the process used by the US EPA Office of Pesticide Programs (OPP) in registering pesticides shows that, while the US EPA requires that pesticides be evaluated with respect to their toxicity to some forms of aquatic and terrestrial life, there is no requirement to evaluate the fate, transport and impacts on non-target organisms associated with pesticides used in accordance with the label restrictions. Further, the US EPA OPP includes a variety of factors in its registration of pesticides, such as economic considerations and their assessment of the benefits of using the pesticide, versus not using it. The US EPA OPP allows for adverse impacts to non-target organisms, provided that this impact is considered by the OPP to be of acceptable significance. This approach is in direct violation of the US EPA Clean Water Act requirements of controlling toxicity and other adverse impacts to non-target organisms in stormwater runoff, as well as outside the treatment area (zone of application) for a pesticide.

It is important to understand that a registered pesticide for aquatic application is not adequately evaluated as part of registration with respect to its potential to be adverse to non-target aquatic life outside of the zone of application (treatment area). This situation mandates that the local agency (in California, the Regional Boards) responsible for protection of water quality from the adverse impacts of registered pesticides used in accordance with the label requirements, require evaluation of the pesticide's impacts on water quality and beneficial uses with respect to the site-specific conditions of the use. This evaluation requires a comprehensive, detailed monitoring program associated with each application, to determine whether the application causes violations of Clean Water Act requirements for the control of toxicity and other adverse impacts on the

beneficial uses of the waterbody receiving the pesticide application and other waterbodies connected to this waterbody.

As discussed below, I find that the draft aquatic pesticide NPDES permit is significantly deficient in several areas with respect to requiring an adequate monitoring/evaluation program associated with a particular aquatic pesticide application. In June 2003, based on a request by the DeltaKeeper/BayKeeper, I prepared guidance on the characteristics of the monitoring/evaluation program that should be conducted associated with each aquatic pesticide application. This guidance is attached.

Inadequate Monitoring Requirements

The proposed monitoring/evaluation program associated with this draft permit is significantly deficient from several points of view.

Page 10, under Toxicity, first paragraph mentions the chronic toxicity. The last sentence states, *"This General Permit requires that aquatic pesticide applications not cause or contribute to chronic toxicity outside the Treatment Area."* The assessment of chronic toxicity, as opposed to acute toxicity, is an issue that needs to be evaluated on a site-specific basis. There will be situations where it will not be possible to have a sufficient exposure to a pesticide or its transformation products to achieve chronic toxicity. Under these conditions, the appropriate toxicity assessment should be based on acute toxicity. Requiring that there be no chronic toxicity, as measured in a laboratory test, as proposed, could unnecessarily restrict the use of an aquatic pesticide in certain applications.

Page 12, under Monitoring Requirements, in the second paragraph, the statement is made that,

> *"Chronic toxicity monitoring will enable the Regional Boards to evaluate compliance with this General Permit's receiving water limitation and also yield important information regarding the toxicity of residual aquatic pesticides post application."*

It is important to also monitor for the primary toxicant in the pesticide formulation, since aquatic life testing of toxicity is not sufficiently sensitive to measure toxicity that can occur in ambient water systems. A comparison between the measured concentration and about one-tenth of the LC_{50} for the most sensitive organism that was tested in the pesticide registration process should be used as an indication of potential toxicity that could be present that would be below the measurable toxicity threshold in the standard US EPA toxicity test.

Another significant deficiency in the monitoring/evaluation program is that the toxicity measurements are restricted to the water column. A number of the aquatic pesticides attach strongly to sediments. There is a potential for these pesticides to cause toxicity to sediment organisms, both within and outside of the treatment area. The monitoring program should include assessing toxicity to *Hyalella azteca* for fresh waters, in accordance with the US EPA standard sediment toxicity test procedure (US EPA, 2000) within and just outside of the zone of treatment. For marine waters, the US EPA (1994) methods should be used.

Justification for including sediment toxicity testing within the zone of treatment is that some of the pesticides could quickly become incorporated into sediments within the area of treatment, leading to toxic conditions in the sediments that can persist for considerable periods of time. It will be important, in evaluating the potential impact of aquatic pesticides, to determine if this is a problem with a particular pesticide at a particular location. An issue that needs to be addressed is whether it is appropriate and allowable under Clean Water Act requirements to have sediment toxicity in the zone of treatment at the time and shortly after treatment. It certainly would be inappropriate to allow this toxicity to occur for considerable periods of time (i.e., a few days) after the treatment has been completed.

Another deficiency in the draft monitoring program is the failure to include bioassessment of the macroinvertebrates in the sediments within and outside of the treatment area. This should be a standard part of the aquatic pesticide monitoring/ evaluation.

Defining the Size of the Treatment Area (Zone of Application)

The aquatic pesticide permit should provide detailed information on how to define the magnitude of the area that is considered to be the treatment area (zone of application), where there can be violations of water quality objectives arising from the treatment and its impacts on aquatic life and other beneficial uses of the waterbody. This area should be limited to the maximum extent possible, to allow effective aquatic weed control without significant adverse impact on the beneficial uses of the waterbody.

Secondary Impacts of Aquatic Vegetation Control

The application of aquatic pesticides to a waterbody can have not only primary impacts associated with the toxicity to water column and sediment organisms, but also secondary impacts due to the decomposition and decay of the aquatic vegetation. Any permit issued for aquatic vegetation control must include comprehensive monitoring of the potential for low DO, excessive ammonia, or other adverse secondary impacts to the beneficial uses of the waterbody receiving the pesticide application.

References

US EPA, "Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods," EPA-600/R-94/025, US Environmental Protection Agency, Env. Research Laboratory, Narragansett, RI (1994).

US EPA, "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates," Second Edition, US Environmental Protection Agency, EPA/600/R-99/064, Washington, D.C. (2000).

Developing Water Quality Monitoring Programs Associated with the Use of Herbicides in the Control of Aquatic Weeds

G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
G. Fred Lee & Associates
El Macero, CA 95618
Ph (530)753-9630 Fx (530)753-9956 em gfredlee@aol.com
www.gfredlee.com

June 14, 2003
References Updated December 2003

The California Statewide General NPDES Permit for Discharges of Aquatic Pesticides to Waters of the United States requires that the agency that is conducting an aquatic weed control program monitor the impacts of this program on the water-quality-related beneficial uses of the waterbodies that could be impacted by the control program. Of particular concern is the impact of the herbicides used for weed control on aquatic life toxicity, bioaccumulation of the herbicide chemical that represents a threat to higher trophic level organisms, as well as the impacts of the chemicals released from the decay of the killed vegetation such as oxygen demand and ammonia. Presented herein is guidance on the characteristics of the monitoring program that should be conducted as part of an aquatic weed control program.

Overall Approach

The overall approach that should guide the development of a water quality monitoring program has been presented by Lee and Jones-Lee (2002). They discuss a number of components of a technically valid water quality monitoring program. Each of the components of the monitoring program should be critically examined, including

- Clearly establish the objectives of the monitoring program.
- Understand the nature of "water quality," water quality concerns, beneficial uses, and their assessment for the waterbodies of concern.
- Select the parameters to be measured and justify potential significance of each parameter selected.
- Examine previous studies to understand variability in each area of the waterbody to be monitored.
- List factors that can influence results of the monitoring program and how they may influence the results.
- Determine the level of confidence at which the objective is to be achieved.
- For each area of each waterbody to be monitored, determine the number and location of samples to be collected.
- If no data are available from previous studies or if existing data are inadequate to define variability and other characteristics needed to establish a reliable monitoring program, conduct a pilot study of representative areas to define the characteristics of the area that are needed to develop a reliable water quality monitoring program.
- Select sampling techniques and methods of analysis to meet the objectives and level of confidence desired.

- Verify that analytical methods are appropriate for each area of the waterbody, with particular reference to the time of aquatic weed control program implementation.
- Conduct studies to evaluate precision of sampling and analytical procedures and technique, reliability of preservation, and variability of the system.
- Critically examine the relationship between present and past studies.
- Determine how the data will be analyzed, with respect to compliance with water quality standards, using existing data or synthetic data that are expected to be representative of the site.
- Screen/evaluate data as they are collected.
- Analyze, interpret and store data, and report on the results of the analysis and interpretation.

Aquatic Life Toxicity

One of the issues of primary concern in the use of herbicides for aquatic weed control is the toxicity of the herbicide and its associated chemicals to non-target organisms. A common error made by those who conduct aquatic weed control programs is the assumption that the application of a US EPA Office of Pesticide Programs (OPP) registered herbicide for aquatic weed control in accordance with the label restrictions will not cause adverse impacts to other aquatic life. US EPA OPP registration of a herbicide and its use in accordance with the label does not mean that there will be no adverse impacts to other forms of aquatic life. The US EPA OPP allows a significantly different degree of protection of non-target aquatic life than the Clean Water Act. The Clean Water Act dictates that there shall be no toxicity, while the US EPA OPP allows toxicity if it is not "significant," and the evaluation of significance can include economic considerations and other factors.

Further, the US EPA OPP does not necessarily include the interaction of other chemicals used with the herbicide such as surfactants, colorants as well as other chemicals that may be in the water being treated. The interaction of the herbicide with other chemicals can cause additive and synergistic effects which can enhance toxicity to non-target organisms. While it is impossible to predict or even measure all potential problems of this type, a reasonable effort should be made to screen for these types of problems, through conducting a comprehensive water quality monitoring program associated with the aquatic weed control program.

Further, the weed control program should be conducted in phases, so that an evaluation can be made of potential impacts discerned by the monitoring program during the early phases, and appropriate adjustments can be made in further control efforts. Since mechanical and other means of controlling aquatic weeds also will have adverse impacts on water quality/beneficial uses, it will be important to monitor their impacts, as well.

In addition to testing the water column for aquatic life toxicity, there is also need to conduct toxicity tests on the sediments, especially for those herbicides that tend to become strongly attached to sediment particles. Pesticides that have been characterized as being strongly adsorbed to particles are being found to be absorbed by benthic organisms into their tissues through their intestinal tract (see Weston, 2002; Weston and Lydy, 2003). The toxicological effects of this absorption are not understood at this time.

In reviewing the potential for aquatic life toxicity of the herbicide(s), it is appropriate to review the US EPA OPP Ecotoxicity Database for information on toxicity to various types of aquatic organisms. The information in this Database is derived from registrants as part of conducting the required testing for registration of the pesticide. It has been reviewed by an expert in the field. For example, the Database contains about 90 entries for the herbicide glyphosate. It shows that there are zooplankton and some fish that have 48-hour or 96-hour LC_{50}s on the order of a few milligrams per liter. However, no information is provided in the US EPA OPP Ecotoxicity Database on the toxicity of glyphosate in combination with other chemicals.

One of the issues that should be addressed in developing the monitoring program is a plausible worst-case scenario evaluation of the concentration of the herbicide(s) that could occur when applied in accordance with label instructions, and when the applied chemical is assumed to be dispersed evenly in the water column at the time of application. The monitoring program should be developed around measuring the worst-case conditions, where there is the greatest potential for aquatic life toxicity to non-target organisms to occur.

Selection of Monitoring Parameters

All constituents that are used in the chemical treatment for control of aquatic weeds should be monitored, independent of whether their monitoring is required by the Statewide General Permit. It is possible that in combination with other chemicals they could be adverse to the beneficial uses of the waters in the area of treatment. Table 1 presents the parameters that should be monitored as part of the aquatic weed control program.

The toxicity testing should include sensitive fish larvae and zooplankton. For San Francisco Bay marine systems, Ogle (2003) recommends that the zooplankton *Americamysis bahia* (Opossum shrimp, formerly *Mysidopsis bahia*) and the fish larvae *Atherinops affinis* (topsmelt) or *Menidia beryllina* (Inland Silversides) should be used. Standard US EPA (1994a) testing procedures using these organisms should be used. For freshwater systems, the zooplankton *Ceriodaphnia dubia* (water flea) and the fish larvae *Pimephales promelas* (fathead minnow) should be used following the procedures described by US EPA (2002a,b,c).

There is need to test the sediments for toxicity to sensitive species. For San Francisco Bay marine systems, it is recommended by Ogle (2003) that the amphipods *Eohaustorius estuarius* and *Ampelisca abdita* be tested using US EPA (1994b) testing procedures. *Eohaustorius estuarius* is less sensitive to sediment grain size. Freshwater sediment toxicity should be evaluated to *Hyalella azteca* (amphipod) using procedures described in US EPA (2000). Other organisms may be used than those recommended above. They should, however, be considered "sensitive" organisms.

The total concentration of the herbicide in the sediments should be measured, and the DO concentrations should be monitored in the waters in the treated area over several weeks to determine if the DO is decreased to critical levels due to the decay of aquatic vegetation.

The transport/fate of the killed aquatic weeds should be determined. If the killed species are carried by the tide/current to an area where they are deposited on the sediments, monitoring should also be conducted in this area for all the parameters to be certain that the dead aquatic

Table 1
Monitoring Parameters

Visual
- Site description (channel/marsh depth or width, estimate of percent cover by vegetation, etc.)
- Appearance of waterway (sheen, color, clarity, etc.)
- Weather conditions (fog, rain, wind, etc.) just prior to the time of application, at the time of application and for the next few days

Physical
- Temperature
- Turbidity
- Electrical conductivity/salinity
- Total suspended solids (TSS)

Chemical
- pH
- Dissolved oxygen (DO)
- Herbicides and associated chemicals such as surfactants, colorants, and transformation products etc.
- Total Kjeldahl nitrogen (TKN) and ammonia
- Nitrate
- Total and dissolved phosphorus
- Biochemical oxygen demand (BOD)
- Total organic carbon (TOC) in the water column and sediments

Toxicity
- Fish larvae and zooplankton
- Algae (?)
- Sediment organisms

Bioaccumulation
- Benthic organism uptake

weeds do not transport the hazardous chemicals from the point of application to another location where the chemicals and vegetation decay products (including elevated ammonia and low DO) are adverse to aquatic-life-related beneficial uses in the water column or sediments.

Another test that should be done is to examine whether the treatment chemicals in the sediments cause problems for germination of non-target species. Ogle (2003) has recommended the use of *Typha latifolia* (cattail) seed germination tests.

Toxicity testing using algae, while sometimes conducted, generally does not lead to information of value. Some herbicides that are used for higher plants are also toxic to algae. This toxicity would be expected to be temporary/short-term, and not be adverse to the overall beneficial uses of the waterbody. At times the destruction of higher-trophic-level plants will lead to an algal bloom associated with the increased light penetration and the release of nutrients from the decaying vegetation.

The analytical methods that will be used should be specified, as well as their detection/ quantitation limits. Further, the QA/QC program that is used should be defined and should be at

least equivalent to the US EPA water quality monitoring QA/QC program. Lee and Jones-Lee (2002) have presented a QA/QC program for water quality monitoring that would be appropriate.

Characteristics of the Monitoring Program

The first sampling should be done in an attempt to collect what would likely be worst-case conditions – i.e., the highest concentration of the herbicide(s) in the water column. If screening for worst-case conditions shows that there is no obvious problem, then the likelihood of other problems occurring will be small.

If potentially toxic concentrations of the herbicide and/or toxicity is found under worst-case conditions, then studies should be conducted to track the movement/fate of the waters that first leave the treated area, using drogues (such as oranges), where measurements are made along the drogue path. This information will give an indication of the potential duration of exposure experienced by planktonic organisms associated with the worst-case waters. Also, samples should be collected just downstream of the treatment area for marine systems on the next tidal cycle at the same stage of the tidal cycle as occurred during and immediately following treatment. For freshwater systems, samples should also be collected just downstream of the treatment area on the day after treatment.

One or more untreated reference areas should be included for similar measurements.

Data Review and Management

The data should be reviewed as soon as possible after collection. This review should occur in the shortest possible timeframe in order to be used to guide monitoring at other treatment sites. The approach that will be used to determine whether there is a potential adverse impact should be specified.

The method of data storage and retrieval should be specified, as well as the timeframe for availability of a draft report for public review.

Provisions and funding for follow-up and/or special studies should be included in the monitoring plan, in the event that the data indicate that there is need for such studies.

Acknowledgment

We wish to acknowledge the assistance of Dr. Scott Ogle of Pacific EcoRisk, Martinez, California, for help in selecting test organisms.

References

Lee, G. F. and Jones-Lee, A., "Issues in Developing a Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Irrigation Water Discharges from Irrigated Agriculture in the Central Valley, CA," California Water Institute Report TP 02-07 to the California Water Resources Control Board/ Central Valley Regional Water Quality Control Board, 157 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/Agwaivermonitoring-dec.pdf

Ogle, S., personal communication, Pacific EcoRisk, Martinez, CA, May (2003).

US EPA, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms, Second Edition," EPA-600-4-91-003, US Environmental Protection Agency, Cincinnati, OH (1994a).

US EPA, "Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods," EPA-600/R-94/025, US Environmental Protection Agency, Env. Research Laboratory, Narragansett, RI (1994b).

US EPA, "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates," Second Edition, US Environmental Protection Agency, EPA/600/R-99/064, Washington, D.C. (2000).

US EPA, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms," US Environmental Protection Agency, Washington, D.C. (2002a). http://www.epa.gov/OST/WET/disk1/

US EPA, "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms," Fifth Edition, US Environmental Protection Agency, Office of Water, Washington, D.C. (2002b). http://www.epa.gov/OST/WET/disk2/

US EPA, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms," EPA-821-R-02-013, US Environmental Protection Agency, Office of Water, Washington, D.C. (2002c). http://www.epa.gov/OST/WET/disk3/

Weston, D. P., "Toxicological Implications of Changing Pesticide Use in the Central Valley, *Norcal SETAC News* 13(1):15-16, March (2002).

Weston, D. P., and Lydy, M. J., "Pyrethroid and Organochlorine Pesticides in Agriculture-Dominated Streams of the Central Valley," In: 6th Bienniel State of the Estuary Conference, "The San Francisco Bay-Delta Estuary: Changes and Challenges," San Francisco Estuary Project, Oakland, California (2003).

Experience of
G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
in
Aquatic Plant Management

Dr. G. Fred Lee became involved in the control of excessive growths of aquatic plants in 1960, while he held a university professorship in water chemistry at the University of Wisconsin, Madison. In this position he developed, and then directed for a period of 13 years, a graduate-level degree program which focused on investigating and managing water quality problems in surface and ground waters. One of his primary areas of research was on the excessive fertilization of waterbodies, focusing on factors influencing and management of algae and other aquatic plants.

In the 1960s Dr. Lee was involved in a number of projects on the control of excessive growths of aquatic plants, including a project sponsored by the Wisconsin Department of Conservation (equivalent to the California Department of Fish and Game) devoted to evaluating the potential impacts of various types of herbicides for control of aquatic plants. The project included adding herbicides to fish hatchery ponds and examining the effects of the herbicides on fish, including their reproduction, growth, etc.

Dr. Lee's work on excessive fertilization management included mechanical harvesting of aquatic plants, where he served as an advisor to the predecessor of the US EPA (Federal Water Pollution Control Association) National Eutrophication Research Program on the benefits of mechanical harvesting of aquatic plants on water quality in Lake Sallie in Minnesota. Dr. Lee has been a long-term member of the Aquatic Plant Management Society, and continues to follow closely work that is done on aquatic plant management in various parts of the US.

Dr. Lee received a bachelors degree in environmental health sciences from San Jose State College in 1955, a Master of Science in Public Health degree focusing on water quality issues from University of North Carolina, Chapel Hill, in 1957, and a PhD degree from Harvard University, Cambridge, Massachusetts, in 1960, in environmental engineering with emphasis on aquatic chemistry.

During the 30 years that he held university graduate-level teaching and research positions, Dr. Lee conducted over $5 million in research and published over 500 papers and reports on this work. In addition to holding professorial positions at the University of Wisconsin, Madison, he also held similar positions in the University of Texas system and at Colorado State University.

In 1989, he completed his university teaching and research career as a Distinguished Professor at the New Jersey Institute of Technology. At that time Dr. Anne Jones-Lee, with whom he has worked since the 1970s, and he expanded the part-time consulting that Dr. Lee had been doing while a university professor into a full-time activity, under the name of G. Fred Lee & Associates. Drs. Lee and Jones-Lee are the two principals in the firm.

Dr. Anne Jones-Lee has a bachelors degree in biology from Southern Methodist University, and masters and PhD degrees in environmental sciences, focusing on water quality, from the University of Texas at Dallas. She held university professorial positions for 11 years.

Drs. Lee and Jones-Lee worked on excessive fertilization problems as consultants to a number of countries, including South Africa, Israel, Jordan, Norway, the Netherlands, France, Spain, Japan, Canada, the USSR, Tunisia and Egypt, as well as several of the US states. Their work included completion of a contract for the US EPA devoted to the US part of the Organization for Economic Cooperation and Development (OECD) eutrophication studies that were conducted in the 1970s. In that activity they developed a synthesis report on nutrient load eutrophication response relationships for about 100 waterbodies located throughout the US. The OECD eutrophication study was a five-year, $50-million, 22-country nutrient load eutrophication response investigation which involved the study of 200 waterbodies located in western Europe, North America, Japan and Australia. Dr. Lee was the US representative to the steering committee for the international OECD eutrophication studies. Subsequent to the completion of this work, Drs. Anne Jones-Lee and G. Fred Lee have expanded the database to over 750 waterbodies located throughout the world.

In 1989, when Dr. Lee completed his teaching and research career, he and Dr. Anne Jones-Lee moved to the Sacramento area to provide consulting services to new clients that had developed in California. This work involved examining eutrophication-related water quality issues in the Sacramento-San Joaquin River Delta, as a consultant to Delta Wetlands, Inc. Drs. Lee and Jones-Lee have been active in Central Valley water quality issues since 1989, including most recently serving as the coordinating PI for a $2-million, one-year CALFED project devoted to the low-DO problem in the San Joaquin River Deep Water Ship Channel located near Stockton, California. They have recently completed a 280-page Synthesis Report covering three years of work that has been done on the low-DO problem in the Deep Water Ship Channel. This problem is related to excessive growths of algae in the San Joaquin River watershed. This report is available on their website, as

> Lee, G. F. and Jones-Lee, A., "Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel Near Stockton, CA: Including 2002 Data," Report Submitted to SJR DO TMDL Steering Committee and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003). http://www.gfredlee.com/SynthesisRpt3-21-03.pdf

During the mid- to late 1990s, Dr. Lee was responsible for conducting about $500,000 of 205(j) and 319(h) research on behalf of Orange County, California, and the Santa Ana Regional Water Quality Control Board, concerned with water quality problems (pesticide-caused toxicity) in the Upper Newport Bay watershed. As part of this effort he became familiar with the excessive fertilization problems of Upper Newport Bay and the approaches that need to be taken to control these problems.

During 2002 Drs. Lee and Jones-Lee completed reports for the Central Valley Regional Water Quality Control Board concerned primarily with nonpoint source water quality management issues in the Central Valley. These reports,

Lee, G. F. and Jones-Lee, A., "Review of Management Practices for Controlling the Water Quality Impacts of Potential Pollutants in Irrigated Agriculture Stormwater Runoff and Tailwater Discharges," California Water Institute Report TP 02-05 to California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 128 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/BMP_Rpt.pdf

Lee, G. F. and Jones-Lee, A., "Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance," California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/OClTMDLRpt12-11-02.pdf

Lee, G. F. and Jones-Lee, A., "Issues in Developing a Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Irrigation Water Discharges from Irrigated Agriculture in the Central Valley, CA," California Water Institute Report TP 02-07 to the California Water Resources Control Board/ Central Valley Regional Water Quality Control Board, 157 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/Agwaivermonitoring-dec.pdf

Lee, G. F. and Jones-Lee, A., "City of Stockton Mosher Slough and Five Mile Slough Diazinon and Chlorpyrifos Aquatic Life Toxicity Management Report," California Water Institute Report TP 02-08 to the California State Water Resources Control Board/Central Valley Regional Water Quality Control Board, 44 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/StockDiaTMDL12-14-02.pdf

were funded in part by the US EPA through the State Water Resources Control Board on behalf of the Central Valley Regional Water Quality Control Board. Drs. Lee and Jones-Lee developed these reports as employees of the California Water Institute at California State University, Fresno. One of the key issues that is emphasized in these reports is the development of appropriate nutrient monitoring and management programs to control excessive fertilization of Central Valley waterbodies.

Additional information on Drs. Lee and Jones-Lee's expertise and experience pertinent to conducting studies on the control of aquatic weeds is available on their website, www.gfredlee.com, or from Dr. Lee at gfredlee@aol.com.

Followup to the October 24, 2003, Aquatic Pesticide Monitoring Program Steering Committee Meeting

Submitted by
G. Fred Lee, PhD, DEE
gfredlee@aol.com www.gfredlee.com

November 20, 2003

There were several statements made at the October 24, 2003, Aquatic Pesticide Monitoring Program Steering Committee meeting that provided unreliable information to the meeting participants. Comments on these issues are provided below.

US EPA OPP Registration of Aquatic Pesticides

A statement was made during the meeting by one of the participants that the US EPA Office of Pesticide Programs (OPP) registration of aquatic pesticides – i.e., those pesticides that are applied to water for the control of pests – includes evaluation of the fate of the pesticide. An issue that has been of concern for some time is the failure of US EPA OPP to include fate evaluation information in the registration of terrestrially applied pesticides. Based on this situation it would not be expected that fate/transport would be included in US EPA OPP registration of aquatic pesticides.

Following the meeting on October 24th, I discussed this matter with Marshall Lee and other DPR staff. It was confirmed that neither US EPA OPP nor DPR include fate information in registering aquatic pesticides. As I understand it, the concern on this issue is that, if these agencies did include evaluation of the fate of the pesticide as part of registration, there might not be need for CEQA evaluation of site-specific applications of the pesticide to a waterbody. It is clear, however, that, since this type of information is not part of the registration, a proper evaluation of the potential adverse impacts of an aquatic pesticide application should include a CEQA evaluation of its impacts, which include fate-persistence information. A Negative Declaration on the need for CEQA is inappropriate under the current information base that exists on the impact of aquatic pesticides in controlling excessive growths of aquatic plants.

Monitoring Requirements

There was discussion about the need to incorporate monitoring into the NPDES permits for the application of aquatic pesticides to waterbodies. It is my understanding that there is need for monitoring based on the ruling by the courts on the inadequate aquatic life protection being provided in connection with the application of pesticides to water. Further, based on my over 40 years of periodic work on fate and effects of pesticides, including aquatic pesticides, the current state of knowledge is such that there is need for highly reliable monitoring programs to be developed and implemented for any pesticide application to waters.

Aquatic Life Toxicity Testing

One of the issues raised at the meeting was the appropriateness of requiring aquatic life toxicity testing. The person who raised this issue made a number of inaccurate statements about the reliability of properly conducted aquatic life toxicity testing. While the person making the

statements may have gained the impression, from some of those with whom she discussed this, that aquatic life toxicity testing is not reliable, such an impression is incorrect with respect to what can be readily achieved with aquatic life toxicity testing.

I have been involved in helping to develop and use aquatic life toxicity testing as a measure of potential water quality impacts of chemicals on the aquatic-life-related beneficial uses of waterbodies for over 30 years. During this period I have repeatedly seen discharger groups attempt to discredit US EPA-based aquatic life toxicity testing as a measure of potential water quality impacts. While there are some laboratories that do not follow the well-defined protocol and have difficulty conducting reliable aquatic life toxicity testing, there are a substantial number of laboratories in the Central Valley and in the Bay region that can do these tests properly and obtain reliable, reproducible results. Any question about the appropriateness of toxicity testing and its reliability in predicting potential water quality problems should be directed to Dr. Val Connor of the State Water Resources Control Board, Karen Larsen of the Central Valley Regional Water Quality Control Board, Dr. Debra Denton of the US EPA Region 9, as well as several laboratories, such as Dr. Scott Ogle and Stephen Clark of Pacific EcoRisk, and Dr. Jeff Miller of AquaScience.

With respect to the statement that it is not possible to interpret toxicity test results, this is another misstatement. Those who are familiar with toxicity testing and how chemicals impact aquatic-life-related and other beneficial uses of waterbodies know how to interpret these results. With respect to the use of pesticides for control of pests in water, it is clear that any toxicity result to the standard three species outside of the treatment area is a violation of the Central Valley Regional Water Quality Control Board's Basin Plan objective (http://www.swrcb.ca.gov/rwqcb5/available_documents/basin_plans/bsnplnab.pdf), which is required to be controlled in any future applications. The San Francisco Bay Region, as well as the other Regional Boards in the State, all have similar requirements for control of toxicity in the water column and sediments.

Credible Monitoring Plan

There was considerable discussion at the October 24, 2003, meeting about the monitoring plan that will be released as part of the SWRCB draft permit, which I understand will be issued in late November. I have been involved in developing, implementing and interpreting the results of monitoring plans for pesticides and other pollutants for over 43 years. On behalf of the CVRWQCB and the SWRCB, Dr. Anne Jones-Lee and I developed a report,

> Lee, G. F. and Jones-Lee, A., "Issues in Developing a Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Irrigation Water Discharges from Irrigated Agriculture in the Central Valley, CA," California Water Institute Report TP 02-07 to the California Water Resources Control Board/ Central Valley Regional Water Quality Control Board, 157 pp, California State University Fresno, Fresno, CA, December (2002). Available at http://www.gfredlee.com/Agwaivermonitoring-dec.pdf

This report provides detailed information on properly developing reliable water quality monitoring programs. Also we have the developed the report,

Lee, G. F., Jones-Lee, A "Developing Water Quality Monitoring Programs Associated with the Use of Herbicides in the Control of Aquatic Weeds," Report of G. Fred Lee & Associates El Macero, CA, June (2003).
Available at http://www.gfredlee.com/AqWeed_Cont_Mon.pdf

This report provides information on the characteristics of monitoring programs that should be conducted associated with the application of aquatic pesticides.

If there are questions on this issues please contact me.

G. Fred Lee

GFL:ds