Study #115

California Department of Pesticide Regulation

Environmental Monitoring and Pest Management

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Sacramento, CA 95814

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PROTOCOL FOR MONITORING INFILTRATION BASIN DRAINAGE ON HIGHWAY RIGHTS-OF-WAY FOR OFFSITE MOVEMENT OF SOIL-APPLIED HERBICIDES

I. INTRODUCTION

This will be the second cooperative study with the California Department of Transportation (Caltrans) investigating the potential for environmental contamination by herbicides due to rights-of-way (ROW) storm water runoff and runoff disposal practices. The first study, currently underway in Glenn County, is investigating the movement of simazine and diuron applied to ROW; the study involves monitoring storm water runoff from treatment sites and at points of discharge into surface water, and monitoring of soil underlying treatment sites and infiltration areas. This second study will investigate the groundwater contamination potential of ROW infiltration basins in San Joaquin County.

Drainage basins are used to collect ROW storm water runoff in order to provide adequate roadway drainage. The large storage capacity of basins is essential where high intensity rainfall and large volumes of runoff occur, especially in areas of flat terrain and limited natural water

channels. Drainage basins are natural or excavated depressions in the ground surface, designed for either detention or infiltration of surface runoff. Detention basins are used for temporary runoff storage, and once the critical storm period has passed, basin storage can be released into a nearby watercourse. Infiltration basins are designed for storage and underground disposal by soil infiltration.

Because the potential sources of off-site movement are so varied, this study will focus on the infiltration basin as a pathway for groundwater contamination, rather than on the identification of all contributing sources of herbicides in runoff. Two basins will be selected and monitored for the presence of herbicide residues in drainage water.

II. OBJECTIVES

1. Determine concentrations of herbicides carried in water flowing to the basin and in water collected in the basin.

2. Determine concentrations of herbicides and depth of herbicide infiltration in the soil profile underlying the basin floor.

III. PERSONNEL

Project Leader: Sewell Simmons

Senior Scientist: John Troiano

Field Coordinator: Jesse Leyva

Data analyst: Sally Powell

Laboratory: California Department of Food and Agriculture
Chemistry Laboratory Services

EHAP Laboratory Liaison: Nancy Miller

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Caltrans Liaison: Robert Johnson

Caltrans District 10 Liaison: Larry Shields

IV. STUDY DESIGN

Site description

Two basins, located on Caltrans ROW, have been selected as study sites. One site, the Manteca basin, receives runoff only from the adjacent highway ROW. The other site, the Peltier basin, receives runoff conveyed in a concrete-lined drainage canal from a five-square mile agricultural area in addition to the roadway runoff. Both basins were designed for storage and infiltration of storm water runoff. The Peltier basin has three drywells on the basin floor, and the Manteca site has no drywells.

The Manteca basin was constructed in 1980 and lies in the northeast quadrant of the Highway 120/Manteca Road interchange. The basin is approximately two acres in area and receives runoff only from the Caltrans' ROW (approximately 1/2 mile along Highway 120); the grade level allows no runoff onto the ROW from surrounding areas. Caltrans treats the

ROW with a single fall application of soil-applied Krovar (a.i. diuron + bromacil) following the first fall rain. Runoff from the treated roadside drains directly downslope over the soil surface to the basin. The Manteca basin will be monitored only for diuron and bromacil. Water samples will be collected from basin storage water and soil cores will be taken from the basin floor.

The Peltier basin was constructed in 1960 and was deepened in 1987. It lies in the northeast quadrant of the Highway 99/Peltier Road interchange north of Lodi, and is approximately 1 1/2 acres in area. There are three drywells, each 35-feet deep, on the floor of the basin to provide for faster, higher-volume drainage. The basin collects runoff from one mile of Highway 99 ROW to the south of the basin, and from a five-square mile agricultural area to the east of the basin. Caltrans treats the ROW with single fall applications of oxyfluorfen (Goal) and oryzalin (Surflan). Both preemergence herbicides are applied to the soil following the first fall rain. Most of the agricultural area is vineyards. According to the San Joaquin County Agricultural Commissioner, the soil-applied herbicides of greatest use in the vineyards are simazine (Princep), oryzalin (Surflan), sethoxydim (Poast), diuron (Karmex), and norflurazon (Solicam). Simazine is the most widely used soil-applied herbicide in the vineyards. Oxyfluorfen, applied by Caltrans to the ROW, is also used in the vineyards, although not extensively. The Commissioner also reported that the San Joaquin County Public Works treats county roadsides throughout the vineyard area with simazine and, to a much lesser extent, with diuron.

The Peltier basin will be monitored for oryzalin, oxyfluorfen, simazine, diuron, and bromacil, the soil-applied herbicides applied by Caltrans to the ROW as well as those commonly used in vineyards or non-crop sites in the nearby agricultural area. Water samples will be collected from the inflow drainage canal, from concrete pipe discharge into the basin, from basin storage water, and from settling chambers in basin floor drywells. Soil cores will be taken from the basin floor.

Objective 1: Water flowing to the basin (inflow) and collected in the basin (stored)

Inflow water will be sampled only at the Peltier site; stored water will be sampled in both the Manteca and Peltier basins; drywells will be sampled only in the Peltier basin.

Inflow

The Peltier basin lies in the northeast quadrant of the Highway 99/Peltier Road interchange. Drainage to the basin is collected in a concrete-lined canal, 3/4 of a mile in length, which extends south of the Peltier Road overpass ramp. Drainage flows north in the canal to the ramp, and is conveyed under the ramp to the basin by concrete pipe. Three sampling sites will be selected in the canal. Water entering the basin will be sampled at the concrete pipe discharge to determine herbicide transport into the basin during fall/winter 1991/92. (Herbicide found in stored water may in part be redissolved residues from previous years.) Distinguishing the 1991/92 fall/winter inflow will enable correlation of

Pesticide Use Report data for the agricultural area with sampling results for simazine, diuron, and bromacil (applied in the agricultural area but not on the ROW).

Inflow sampling will begin when rainfall produces substantial runoff flow in the inflow canal, and during rain events at approximately 4-week intervals throughout the rainy season.

Stored water

Herbicide concentrations found in basin storage water may be affected by repartitioning of residue in basin floor soil from previous years' runoff. These concentrations should, however, represent the water available for infiltration into the soil.

Water samples will be collected from stored water in both basins during peak water storage. This period is normally during January and February. This allows sufficient time for runoff from the entire drainage area to reach the basin following herbicide treatments. Communication with Caltrans district personnel regarding water levels in the basins will enable timely sampling. Samples will be collected from the deepest area of the basins. All sample concentrations will be corrected for extraction efficiency.

Basin floor drywells

There are no drywells in the Manteca basin. The Peltier basin has three drywells, located in the lowest level of the basin floor. Samples will be taken from water collected in the settling chambers of each drywell. In

addition to the immediate hazard to groundwater that would be demonstrated by herbicides found in drywells, the water pooled in settling chambers may be the only available source for sampling within the basin until large storms provide standing water in the basin. Because drywells collect the earliest inflow, herbicide concentrations from drywells may include that contributed by soil repartitioning from inflow movement across the basin floor to the drywells.

Metal grates over the drywell openings must be removed for sampling. Sampling will begin following the completion of herbicide treatment on the ROW, and continue at 4-week intervals throughout the rainy season. The sampling schedule may vary according to timing of rainfall events and the depth of storage water on the floor of the basin; drywell samples will only be collected when the grated openings are not submerged.

Objective 2: Soil infiltration

Herbicide concentrations and depth of herbicide infiltration will be determined from 10-foot soil cores taken from both basins. Two background soil cores will be taken from the Manteca basin prior to Caltrans' herbicide application on the adjacent road shoulder, which is the only source of herbicide movement to the basin. Backround cores will not be taken from the Peltier basin because soil-herbicide applications are well underway in the agricultural area which provides runoff to the basin. Cores will be taken at the end of the rainy season from both basins, following final basin floor drainage. All cores will be collected from the lowest areas of the basin floor. The background cores will be split for soil texture analysis. All sample concentrations will be corrected

for extraction efficiency. Bulk density measurements will be used to convert soil concentrations to mass of herbicide per volume of soil at each depth.

Table 1. Total number of samples

Type of sample		Number of samples
Basin inflow water		
Inflow canal	Peltier	
3 samples x 4 months		12
Basin perimeter inflow pipe	Peltier	
1 sample x 4 months		4
Basin storage water		
2 samples x 2 months	Peltier	4
2 samples x 2 months	Manteca	4
Basin floor drywells		
Settling chamber water	Peltier	
3 drywells x 1 sample x 4 months		12
Soil cores		
Background soil (10-foot cores)	Manteca	
2 cores x 11 depths		22
Final soil (10-foot cores)	Peltier	
2 cores x 11 depths		22
Final soil (10-foot cores)	Manteca	
2 cores x 11 depths		22

Note: Each Peltier sample will be analyzed for oryzalin, oxyfluorfen, simazine, diuron, and bromacil. Each Manteca sample will be analyzed for diuron and bromacil. Four soil samples will have accompanying samples to be analyzed for soil texture.

V. SAMPLING METHODS

An Encroachment Permit must be issued by Caltrans before project activites may begin on Caltrans' ROW. Application for this permit has been initiated to allow sufficient time for approval.

Underground utilities must be marked at each project site before soil cores are taken. USA Underground provides this service upon request.

Basin inflow water

Sampling sites will be selected where water depth allows sampling with minimum sediment. One-liter sample bottles will be immersed (cap remaining on) 12 to 18 inches below the water surface. The bottle cap will be removed underwater and the bottle allowed to fill. The cap will be replaced before the bottle is removed from the water. If the water body is too shallow to immerse a bottle, a second clean glass container will be used to fill the sample bottles.

Basin storage water

Three subsamples of stored water will be collected from sites selected near the basin inflow. One-liter sample bottles will be immersed (cap remaining on) 12 to 18 inches below the water surface. The bottle cap will be removed underwater and the bottle allowed to fill. If the body of

water is too shallow to immerse a bottle, a second clean glass container will be used to fill the sample bottles. Subsamples will be mixed and a single sample submitted for analysis.

Drywells

Access to sampling of water in the drywell settling chambers is limited by the metal grates on each drywell opening. With Caltrans' permission, the grates will be removed for sampling, and carefully replaced. Water sample handling will be the same as that described for basin inflow water sampling.

Soil cores

All soil cores will be taken using 6-inch stainless steel cylinders inserted into an auger driven by a motorized drilling rig. A stainless steel collar will be placed to prevent surface soil from falling into the hole. The top foot of soil will be sampled in 6-inch increments, the remainder in 1-foot increments, i.e. by combining the contents of two cylinders. After a cylinder (or two, depending on the depth being sampled) is removed from the auger, it will be weighed with the soil in it. The tare weight of the cylinder and the total weight of the cylinder and soil will be recorded for bulk density estimation. The soil will be removed from the cylinder and placed in a plastic bag, where it will be mixed. A 1-pint Mason jar will be filled with soil for chemical analysis. From the remaining soil in the sample, 150 grams will be sealed in a plastic bag for transport to Fresno for textural analysis.

The holes left by drilling will be filled with bentonite. Samples for chemical analysis will be transported on dry ice, and stored frozen until analysis.

According to Larry Shields, Caltrans' District 10 Landscape Specialist, the procedure for identifying the location of underground utilities at coring sites is to notify USA Underground of the exact coring locations. Their representatives will meet with us at the site to mark utility locations with orange paint.

VI. CHEMICAL ANALYSIS/QUALITY CONTROL

All samples from the Manteca site will be analyzed for diuron and bromacil. All samples from the Peltier site will be analyzed for oryzalin, oxyfluorfen, simazine, diuron, and bromacil.

Water will be analyzed for simazine, diuron, and bromacil using the screen developed for CDPR groundwater monitoring. The method uses gas chromatography and has a detection limit of 0.1 ppb for both chemicals. Results will be reported in ppb. One matrix blank and one matrix spike will be analyzed with each extraction set.

Soil will be analyzed for simazine and diuron using the screen developed for CDPR compliance monitoring. The method uses solid phase extraction and gas chromatography and has a detection limit of 4 ppb for simazine and 40 ppb for diuron. Results will be reported in ppb on a dry weight basis. One matrix blank and one matrix spike will be analyzed with each extraction set.

Water and soil samples will be analyzed for oxyfluorfen using gas chromatography. Detection limits are unknown at this time. Method validation will follow protocol approval.

Water and soil samples will be analyzed for oryzalin using liquid chromatography with UV detector. Detection limits are unknown at this time. Method validation will follow protocol approval.

VII. TIMETABLE

Inflow water sampling

Site selection	December
Sampling #1	December
Sampling #2	January
Sampling #3	February
Sampling #4	March
Chemical analysis	December - April

Stored water sampling

Sampling #1	January
Sampling #2	February
Chemical analysis	December - April

Drywell sampling

Sampling #1	December
Sampling #2	January
Sampling #3	February
Sampling #4	March
Chemical analysis	April

Soil coring	
Marking underground utilities	December
Backround soil coring	December
Chemical analysis	January
Soil texture analysis	January
Final soil coring	late March - early April
Chemical analysis	mid-April
Draft report	May
Final Report	May

The sampling conditions, mentioned in the study design, are summarized below:

Inflow water sampling - following completion of all Caltrans' herbicide applications in the area providing runoff to the basin (both basins), and during storm events producing substantial flow in the concrete-lined inflow canal (Peltier basin only)

Stored water sampling - during January and February, the peak storage months (both basins)

Drywell sampling - when standing water is visible in settling chambers, and the grated openings are not submerged (Peltier basin only)

Soil coring

Backround - prior to Caltrans' herbicide application (Manteca basin only)

End-of-season - following final drainage of all stored basin water (both basins)

VIII. REFERENCES

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IX. BUDGET

Soil sampling

Vehicles	2 vehicles x 120 miles x 2 trips	
	x $.25	$ 120
Chemical analysis	66 field samples + 8 QC =	
	74 samples x $200	$14800

Stored water, basin inflow, drywell sampling

Vehicles	1 vehicle x 120 miles x 5 trips	
	x $.25	$ 150
Chemical analysis		
Stored water		
8 field samples + 4 QC =		
12 samples x $200		$ 2400
Basin inflow		
16 field samples + 4 QC =		
20 samples x $200		$ 4000
Drywell		
12 field samples + 4 QC =		
16 samples x $200		$ 3200
	TOTAL	$ 24,670