

# MEMORANDUM



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SUBJECT: **EVALUATION OF ADDITIONAL PESTICIDE MONITORING DATA**

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The purpose of this memorandum is to evaluate chlorpyrifos and diazinon monitoring data collected by the Permittees at six additional monitoring locations to determine if concentrations of these two constituents at these sites are adequately characterized by monitoring at any of the "long term" monitoring locations. If the additional pesticide locations can be shown to be "represented" by these other longer term monitoring locations, the additional monitoring would not be required based on § 2.E. of the Monitoring and Reporting Program (MRP) of the National Pollutant Elimination System (NPDES) discharge permit (Permit).

Three sample-events in 2003-04 and four sample-events in 2004-05 were monitored at the following additional monitoring locations:

- Chicken Ranch Slough at Hurley (CRS) – 2004-05 only
- Elk Grove Creek at Laguna (EGCK01)
- Elder Creek at Morrison Creek (ELDERCK01)
- Morrison Creek at Sunrise (MC02) – upstream of urban development
- Natomas East Main Drain at Elkhorn Road (NEMD01)
- Natomas East Main Drain at San Juan Road (NEMD02) – upstream of urban development

When possible, data were also synoptically collected at the urban runoff, urban tributary, and the Coordinated Monitoring Program (CMP) sites on the Sacramento and American Rivers. Long-term urban runoff (a.k.a. discharge characterization) data and

CMP data exist for approximately the last ten years for organophosphate (OP) pesticides, including diazinon and chlorpyrifos. Urban runoff monitoring was not required in the Permit in 2004-05, and will resume in 2005-06. Urban tributary data have been collected for the last two seasons, however, these locations are considered long-term as it is anticipated that monitoring will be required in future permits.

### *Diazinon and Chlorpyrifos Sacramento Urban Creek TMDL*

The Central Valley Regional Water Quality Control Board (Water Board) adopted the Sacramento Urban Creek Pesticide TMDL<sup>1</sup> for those creeks listed as impaired due to diazinon or chlorpyrifos concentrations in the California 2002 303(d) list. The TMDL does not specifically require monitoring of the additional sites outside of the requirements in the Permit.

### *Characterizing the Pesticide Concentrations in Urban Runoff*

Concentrations of OP pesticides in Sacramento area urban tributaries have been characterized through a number of different studies performed by the Permittees. The MRP requires pesticide monitoring of Natomas East Main Drain because it is 303(d) listed for diazinon, although it is not discussed extensively in the TMDL document. Strong Ranch Slough, is a required discharge monitoring location, and is monitored according to that MRP schedule (2 of every 3 years). Monitoring is required in the MRP for Arcade Creek, Morrison Creek, and Willow Creek as long-term urban tributary locations. These sites are all downstream of urbanized areas.

The six additional pesticide locations of interest in this analysis are shown and the urban tributary locations in Table 1 along with summary statistics for data collected in the current permit-required (MRP) monitoring. All results related to the additional pesticide monitoring are shown in Table 2 for chlorpyrifos and Table 3 for diazinon.

Although the reported quantitation limit (reporting limit or RL) for both constituents is generally listed as 0.05 µg/L, the analytical lab was able to report detected values down to a method detection limit (MDL) of 0.012 µg/L for diazinon and 0.018 µg/L for chlorpyrifos. Values reported between the MDL and RL include the “J” qualifier indicating an estimated value that cannot be quantified accurately.

The Water Board has cited water quality criteria from California Department of Fish and Game (DFG) objectives in both the MRP and the TMDL. The DFG diazinon criteria are 0.08 µg/L (acute, 1-hour) and 0.05 µg/L (chronic, 4-day). The DFG chlorpyrifos criteria are 0.02 µg/L (acute, 1-hour) and 0.014 µg/L (chronic, 4-day).

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<sup>1</sup> Central Valley Regional Water Quality Control Board. Total Maximum Daily Load (TMDL) Report for the Pesticides Diazinon and Chlorpyrifos in: Arcade Creek, Elder Creek, Elk Grove Creek, Morrison Creek, Chicken Ranch Slough, and Strong Ranch Slough, July 2004

**Table 1. 2003-05 Summary Statistics for Urban Creek OP Pesticides**

Site Location	Site ID	Chlorpyrifos				Diazinon			
		n	Percent Detected	Max (µg/L)	Median (µg/L)	n	Percent Detected	Max (µg/L)	Median (µg/L)
Urban Tributary Monitoring									
1 Arcade Creek at Watt	AC03	18	5.6%	0.12	<0.05	18	38.9%	0.28	0.16
2 Morrison Creek at Brokfield	MC01	18	11.1%	0.13	<0.05	18	27.8%	0.37	0.2
3 Willow Creek at Blue Ravine	WC01	19	0.0%	<0.05	<0.05	19	0.0%	<0.05	<0.05
Additional Pesticide Monitoring									
1 Chicken Ranch Slough	CRS	3	33.3%	0.21	<0.05	3	33.3%	0.21	<0.05
2 Elk Grove Creek at Laguna	EGCK01	6	16.7%	0.015	<0.05	6	66.7%	0.34	0.12
3 Elder Creek at Morrison Creek	ELDERCK01	7	14.3%	0.023	<0.05	7	57.1%	0.62	0.15
4 Morrison Creek at Sunrise	MC02	6	0.0%	<0.05	<0.05	6	0.0%	<0.05	<0.05
5 Natomas East Main Drain at Elkhorn Road	NEMD01	7	0.0%	<0.05	<0.05	7	0.0%	<0.05	<0.05
6 Natomas East Main Drain at San Juan Road	NEMD02	7	0.0%	<0.05	<0.05	7	0.0%	<0.05	<0.05

**Table 2. Chlorpyrifos Concentrations in Sacramento Urban Creeks**

CHLORPYRIFOS (µg/L)										
EVENT	DATE	Long-Term Monitoring Sites			Additional Pesticide Sites					
		AC03	MC01	WC01	EGCK01	ELDERCK01	MC02	NEMD01	NEMD02	CRS
DW01CRK	13-Apr-04	<0.012	0.03J	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	NS
DW02CRK	06-Oct-04	<0.05	<0.05	<0.05	NS	<0.05	NS	<0.05	<0.05	NS
DW03CRK	12-Apr-05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
WW02CRK	02-Feb-04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NS
WW03CRK	18-Feb-04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NS
WW05CRK	28-Jan-05	0.012J	0.013J	<0.05	0.015J	0.023J	<0.05	<0.05	<0.05	0.017J
WW06CRK	15-Feb-05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

**Note:**

NS = not sampled

J = Detected, but not quantified (DNQ). Estimated value reported between MDL and RL.

**Table 3. Diazinon Concentrations in Sacramento Urban Creeks**

DIAZINON (µg/L)										
EVENT	DATE	Long-Term Monitoring Sites			Additional Pesticide Sites					
		AC03	MC01	WC01	EGCK01	ELDERCK01	MC02	NEMD01	NEMD02	CRS
DW01CRK	13-Apr-04	0.16	<0.018	<0.018	0.2	<0.018	<0.018	<0.018	<0.018	NS
DW02CRK	06-Oct-04	<0.05	<0.05	<0.05	NS	<0.05	NS	<0.05	<0.05	NS
DW03CRK	12-Apr-05	<0.05	<0.05	<0.05	<0.05	0.62	<0.05	<0.05	<0.05	<0.05
WW02CRK	02-Feb-04	0.28	0.32	<0.05	0.34	0.29	<0.05	<0.05	<0.05	NS
WW03CRK	18-Feb-04	0.24	0.2	<0.05	0.27	0.15	<0.05	<0.05	<0.05	NS
WW05CRK	28-Jan-05	0.2	0.25	<0.05	0.12	0.28	<0.05	<0.05	<0.05	0.21
WW06CRK	15-Feb-05	<0.05	0.37	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

**Note:**

NS = not sampled

### *Methodology for Comparing Sites*

Several statistical and general inspection techniques are useful in determining if data and trends between sites are significantly different. Statistical “pair-wise” methods test whether the proposed hypothesis of “site data are the same” is false and generate a probability that differences between data are due to chance alone. Unpaired analyses perform a similar check using “mean” distributional data. This particular analysis is well suited for a pair-wise analysis because the data were collected synoptically at the sites. Finally, a general “inspection” of the data and summary statistics is useful in confirming results of the statistical comparison.

### *Pairwise Data Comparison*

Data from each additional pesticide monitoring site were compared against the long-term urban tributary monitoring locations using the paired sign test. This non-parametric test is similar to the distributionally based t-test, but does not rely on distributional (parametric) assumptions. The paired sign test also does not rely on the magnitude of the difference between results, which becomes difficult to accurately quantify when data are reported below the reporting limit. Table 4 presents the results of this analysis for the diazinon data. The chlorpyrifos analysis is more difficult to represent because it is less frequently reported and cannot be used for this evaluation.

**Table 4. Paired Sign Test P-values for Diazinon Result Comparison**

Site	AC03	WC01	MC01
ELDERCK01	>0.9999	0.125	>0.9999
EGCK01	0.625	0.125	0.375
MC02	0.125	[a]	0.125
NEMD01	0.125	[a]	0.125
NEMD02	0.125	[a]	0.125
CRS	0.6268	0.513	0.3469

**Notes:**

•p-values indicate the probability that differences between sites are related to something besides random chance. Stated differently, higher p-values indicate more similar sites. A p-value <0.05 is a typical threshold for determining that sites are not alike at a statistically significant level.

[a] All paired results are identical and reported as not detected to MDLs of 0.012 g/L and 0.018 µg/L for diazinon and chlorpyrifos, respectively. Sign test is not possible, but sites cannot be shown to be statistically different.

The diazinon comparisons demonstrate that all of the additional pesticide sites are similar to at least one of the long-term urban tributary sites. The long-term Arcade Creek and Morrison Creek (downstream) sites were generally similar to the same additional pesticide locations (Elder Creek, Elk Grove Creek, and Chicken Ranch Slough). Those additional pesticide sites, which were not similar to the Arcade Creek or Morrison Creek (downstream) sites, did not have detected concentrations of diazinon like the Willow Creek long-term urban tributary site.

No additional pesticide sites demonstrate a statistically significant ( $p$ -value  $<0.05$ ) difference from one of the long term monitoring locations. Elder Creek compared well ( $>0.9999$   $p$ -value) to the downstream Morrison Creek and Arcade Creek locations. Elk Grove Creek and Chicken Ranch Slough had slightly lower  $p$ -values, however, the analysis demonstrates that there are no detectable differences between these three additional pesticide locations and the two long-term sites.

The other three additional pesticide sites (NEMD at Elkhorn, NEMD at San Juan, and Morrison Creek at Sunrise) had no detected concentrations of these two OP pesticides. The Willow Creek long term urban tributary site also had no detected concentrations of these two OP pesticides during the monitoring period. No differences between sites can be determined, and additional monitoring will not likely not provide additional characterization information unless the watersheds change or reporting limits are significantly reduced.

### *Visual Inspection*

Review the data in Tables 2 and 3 confirms the results of the paired comparison tests. For example, chlorpyrifos was detected at more than one site in only one event. (January 28, 2005). During this one event, chlorpyrifos was detected at similar concentrations at Arcade Creek, Morrison Creek (downstream), Elk Grove Creek, Elder Creek, and Chicken Ranch Slough. It was not detected during this event in Willow Creek, Natomas East Main Drain (upstream and downstream), or the upstream Morrison Creek site. This site grouping also follows the paired statistical comparisons for diazinon.

### *Conclusions*

The Elder Creek, Elk Grove Creek, and Chicken Ranch Slough additional pesticide sites are likely sufficiently comparable, for the purpose of general urban watershed monitoring, to the Arcade Creek and Morrison Creek long-term urban tributary sites. The NEMD sites and the upstream Morrison Creek site did not have any reported concentrations of diazinon or chlorpyrifos, which compares well with the Willow Creek long-term urban tributary location.

### *Recommendations*

Continued monitoring of the additional pesticide locations is only necessary if there are changes in (sub-) watershed-specific activities that are anticipated in the specific tributary watersheds that would affect OP pesticide concentrations differently from creek-to-creek. It may also be useful to keep the upstream Morrison Creek location as one long-term upstream monitoring location to characterize general upstream concentrations of pesticides. Based on this analysis, it is recommended that the Permittees formally request that the Water Board waive additional monitoring requirements at these six monitoring locations for the remaining years in the current Permit.