Conditional Waiver for Rice and Rice Pesticides Program

2007 Annual Monitoring Report Sacramento River Drainage Basin

Volume 1

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CH2MHILL

Contents

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Appendix B: CWFR Data
Appendix C: RPP Data

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Acronyms and Abbreviations

ACP	agricultural civil penalties
BOD	biological oxygen demand
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CWFR	Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands for Rice
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
CRC	California Rice Commission
CTR	California Toxics Rule
CVRWQCB	Central Valley Regional Water Quality Control Board
COC	chain of custody
COD	chemical oxygen demand
CWFR	Conditional Waiver for Rice
CAC	County Agricultural Commissioner
DOC	dissolved organic carbon
DO	dissolved oxygen
EC	electrical conductivity
gpm	gallons per minute
LCS	lab control spike
MS/MSD	Matrix spike and matrix spike duplicate
MCLs	maximum contaminant levels
MDL	minimum detection limit
MRL	minimum reportable limit
MRP	Monitoring and Reporting Program
MRP Order	Monitoring and Reporting Program Order No. R5-2003-0826

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NOA	Notice of Applicability or Notice of Application
NOI	Notice of Intent
ppb	parts per billion
QAO	Quality assurance objectives
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
RPD	relative percent difference
RPP	Rice Pesticides Program
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
TIE	toxicity identification evaluation
USEPA	U.S. Environmental Protection Administration
UCCE	University of California Cooperative Extension
UC IPM	University of California Integrated Pest Management
WQO	water quality objective
WET	whole effluent toxicity

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CHAPTER 1

Introduction

The California Rice Commission (CRC) is a statutory organization representing about 2,500 rice farmers who farm approximately 500,000 acres of California farmland. Rice is one of the top 20 crops produced in California, and adds nearly a half billion dollars in revenue and thousands of jobs vital to the state's economy. The California rice industry contributes significantly to the foundation of many rural economies and the positive balance of international trade. Rice produced in the United States provides 1.5 to 2 percent of global production, competes in the global market, and constitutes a large proportion of internationally traded medium-grain (north Asian) rice.

The CRC implements water quality monitoring and reporting activities in compliance with two programs of the Central Valley Regional Water Quality Control Board (CVRWQCB). The CRC implements Conditional Waiver for Rice (CWFR) monitoring and reporting, pursuant to the Monitoring and Reporting Program (MRP) issued under the CVRWQCB's *Conditional Waiver of Waste Discharges Requirements for Discharges from Irrigated Lands*. The CRC also implements the Rice Pesticides Program (RPP), pursuant to the Conditional Prohibition of Discharge requirements specified in the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* (Basin Plan).

This report serves as the 2007 Annual Monitoring Report (AMR) for both the CWFR and RPP efforts, and describes the CRC-conducted CWFR program activities for the calendar year 2007. Key CWFR activities include the following:

- Reporting of rice acreage information
- Reporting of rice pesticide use information
- Water quality monitoring
- Toxicity testing and follow-up toxicity identification evaluations
- Laboratory coordination
- Laboratory analysis and reporting
- Data validation and review
- Coordination of early-season data submittals between the County Agricultural Commissioners (CACs) and the California Department of Pesticide Regulation (DPR)
- Interaction with pesticide registrants to support the development of reduced risk pesticides
- Annual reporting and review

In addition, the CRC implemented activities in compliance with the RPP for calendar year 2007. Key RPP activities include the following:

- Reporting of rice acreage information
- Reporting of rice pesticide use information
- Water quality monitoring
- Laboratory coordination
- Laboratory analysis and reporting
- Data validation and review

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- Coordination of early season data submittals between the CACs and the DPR
- Pesticide use compliance inspections and enforcement
- Communications with the City of Sacramento and City of West Sacramento, enhanced through the activities of the Storm Event Work Group
- Interaction with pesticide registrants to support the development of reduced risk pesticides
- Triennial reporting and review

Program Administration

The CRC has long been recognized by the CVRWQCB as an entity with the authority and capacity to implement RPP activities to achieve water quality protection. The CRC is a statutory organization with authorities and restrictions as established in the California Food and Agricultural Code. In July 2003 the CRC was issued a Notice of Applicability (NOA) as a watershed Coalition under the CVRWQCB's Conditional Waiver for Discharges from Irrigated Lands and has implemented rice-specific program activities since then.

Kleinfelder was contracted by the CRC to collect water samples at specified sites to obtain data that would help characterize water quality. CH2M HILL prepared this AMR under contract to the CRC.

California Rice

Rice is grown in nine Sacramento Valley counties (Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Tehama, Yolo, and Yuba). Rice is also farmed in counties outside the Sacramento Valley; however, the acreages are generally small and are not the dominant crops in these areas. For the purposes of the rice-specific MRP, the monitoring area is defined as the nine rice producing counties in the Sacramento Valley.

Rice fields provide a number of environmental and commercial advantages that no alternative land use would, including a variety of upland and shallow aquatic habitat. In their quest to reduce rice straw burning and to improve wildlife habitat, rice farmers routinely flood their fields in the winter (when no rice is present) to degrade the straw and reduce the need for rice straw burning.

Rice farming requires flooded field conditions that contribute to favorable habitat conditions. More than 235 species of wildlife and millions of migratory waterfowl thrive in California rice fields. In 2003, California rice lands were designated as shorebird habitat of international significance by the Manomet Center for Conservation Sciences in partnership with the Western Hemisphere Shorebird Reserve Network.

In 2007, the nine rice growing counties of the Sacramento Valley farmed about 522,000 acres of rice, as shown on Figure 1-1.

Rice Farming's Influence on Water Quality

Because rice is farmed in standing water, the importance of good farming practices to water quality is evident. However, water quality problems associated with other crops and locales,

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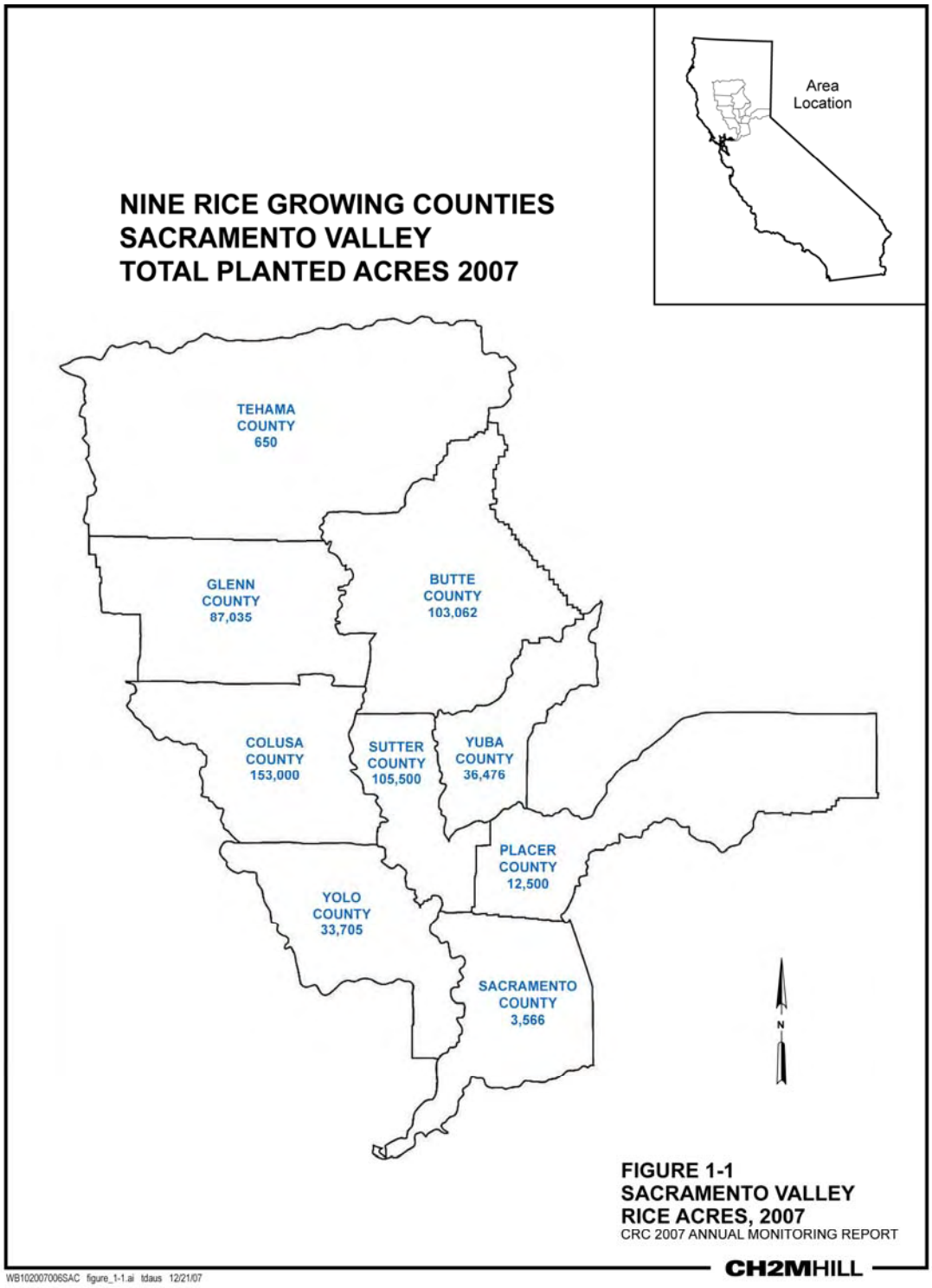

FIGURE 1-1
SACRAMENTO VALLEY
RICE ACRES, 2007
CRC 2007 ANNUAL MONITORING REPORT

WB102007006SAC figure_1-1.ai ldaus 12/21/07

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such as soil erosion and sediment transport, saline drainage waters, and high concentrations of trace elements in subsurface drainage, are typically not problems associated with rice drainage. The generally slow rate of flow through rice fields and the controlled rate of water release tend to minimize significant soil erosion. With regard to salinity, much of the water used to irrigate rice fields initially has a low salt concentration, and there is little possibility for salt accumulation in a continuously flooded system, so salt concentration in return flows is usually relatively low.

History of Rice Water Quality Efforts

The CRC has undertaken water quality management activities since the 1980s. The efforts began under the RPP and, beginning in 2004, included efforts under the CWFR. A description of the historical context of rice water quality management efforts in the Sacramento Valley follows.

RPP

A rice pesticide regulatory program has been in place since the 1980s. Implementation of the program included a proactive, industry-led effort to meet water quality objectives. The rice industry not only met the challenge, but also created an example for other commodity groups and coalitions to follow.

Beginning in May 1980, and on a yearly basis through 1983, over 65,000 carp, catfish, black bass, and crappie died in Sacramento Valley agricultural drains dominated by rice drainage. At approximately the same time, monitoring studies found that thiobencarb concentrations as low as 1 µg/L resulted in increases in water taste complaints from people whose drinking water was supplied by the Sacramento River downstream of agricultural drain inputs.

As a result of the fish kill events in the early 1980s, the California Department of Fish and Game (CDFG) conducted investigations that indicated molinate poisoning caused the fish losses. In response, increased in-field holding times for irrigation waters containing molinate were implemented, and no additional fish losses have been documented since June 1983.

CVRWQCB monitoring studies in the early 1980s determined that molinate, carbofuran, malathion, and methyl parathion were present in agricultural drains dominated by rice drainage. The concentrations of these chemicals were determined to pose a threat to aquatic life. As a result of the fish kills and the chemical monitoring through the early 1980s, the California Department of Food and Agriculture (now DPR) initiated the Rice Pesticide Control program, the precursor to today's RPP, in 1984 to manage and regulate the discharge of pesticides from rice fields.

Findings by CDFG and the CVRWQCB further moved the State Water Resources Control Board (SWRCB) to contract for scientific studies to develop a toxicity database and to suggest limits for pesticide levels in the Valley's rivers and agricultural drains.

A review of information on toxicity of molinate and thiobencarb was conducted by the SWRCB (1990). This review was used to developed specific water quality criteria and performance goals for those pesticides. In 1990, the CVRWQCB amendment the Basin Plan

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for the Central Valley Region to include a conditional prohibition of discharge for irrigation return flows containing molinate, thiobencarb, carbofuran, malathion, and methyl parathion unless a CVRWQCB-approved management practice is followed. Proposed management practices are intended to control pesticide contractions in return flows from rice fields so that specific performance goals are met.

Environmental monitoring in the RPP has been among the most intense ever undertaken by California's agricultural producers, and has resulted in a substantial knowledge base regarding the movement of rice pesticides in the Sacramento Valley. Through the implementation of industry-wide Best Management Practices (BMPs), the rice industry has been very successful in meeting water quality performance goals set by the RWQCB.

The RPP undergoes annual RWQCB review, at which time the RWQCB considers re-certifying the program. Annual reports are due to the RWQCB each December.

This year is the first that the CRC has submitted a single report combining information for the CWFR and RPP programs.

Conditional Waiver of Waste Discharge Requirements for Rice

The CRC was granted a NOA to serve as a watershed coalition group under the CVRWQCB Resolution R5-2003-0105, *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Central Valley* (Irrigated Lands Conditional Waiver) and Monitoring and Reporting Program Order No. R5-2003-0826 (MRP Order).

In October 2004, the CRC submitted a technical report entitled *Basis for Water Quality Monitoring Program: Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands for Rice* (CWFR) to the CVRWQCB. The report served as the basis for the CVRWQCB's rice-specific MRP. The report presented mapping information, including subwatersheds and drainages, rice acreage, and hydrography (lakes, reservoirs, rivers, creeks, canals, and drains); an overview of rice cultural practices; information on the usage and a review of historical data for pesticides and nutrients; a discussion of other potential constituents of concern; a proposed future rice-specific sampling program, including sample locations, sample parameters, and sample timing; and a discussion of the framework for future program review. The geographic and historic data are analyzed and employed to select appropriate water quality monitoring sites. Specifically, the report included information on the following subjects:

- Study area
- Rice pesticide use and water quality data
- Nutrient use and water quality data
- Copper use and water quality data
- Proposed future sampling
- Framework for program review and update

AMR Requirements

The AMR for the CWFR program is to be submitted by December 31 of each year. The AMR is to include the following components:

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1. Title page
2. Table of contents
3. Description of the watershed
4. Monitoring objectives
5. Sample site descriptions
6. Location map of sampling sites and land use
7. Tabulated results of analyses
8. Sampling and analytical methods used
9. Copy of chains of custody
10. Associated laboratory and field quality control samples results
11. Summary of precision and accuracy
12. Pesticide use information
13. Data interpretation including and assessment of data quality objectives
14. Summary of management practices used
15. Actions take to address water quality impacts identified, including but not limited to, revised or additional management practices to be implemented
16. Communications reports
17. Conclusions and recommendations

Table 1-1 shows the location of each piece of the required above listed information within this report.

TABLE 1-1
Location of Required AMR Information in This Report

Required Information	Location in This Report
Table of contents	Page iii
Description of the watershed	Chapter 2
Monitoring objectives	Chapter 4
Sample site descriptions	Chapter 4
Location map of sampling sites and land use	Appendix A
Tabulated results of analyses	Chapter 5
Sampling and analytical methods used	Chapter 4
Copies of chains of custody	Appendixes B and C
Associated laboratory and field quality control samples results	Appendixes B and C
Summary of precision and accuracy	Chapter 6
Pesticide use information	Chapter 2
Data interpretation including and assessment of data quality objectives	Chapter 5
Summary of management practices used	Chapter 3
Actions take to address water quality impacts identified, including but not limited to, revised or additional management practices to be implemented	Chapter 3
Communications reports	The information herein supersedes the communication reports.

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TABLE 1-1
Location of Required AMR Information in This Report

Required Information	Location in This Report
Conclusions and recommendations	Chapter 6
Field documentation	Appendixes B and C
Laboratory original data	Appendixes B and C
Perspective on field conditions including a description of the weather, rainfall, stream flow, color of the water, odor, and other relevant inform that can help in data interpretation	Chapter 2

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CHAPTER 2

Growing Season, Hydrology, and Applied Materials

The rice water quality monitoring programs are based on a thorough understanding of how rice is grown in the Sacramento Valley, including key events such as irrigation, drainage, and runoff, and an understanding of when and how products such as pesticides and nutrients are applied. Hydrological conditions during the year can also influence the timing of key events. This chapter includes descriptions of the "typical" Sacramento Valley rice farming calendar and the 2007 rice growing season (including Sacramento River 2007 hydrology), and includes data on the materials applied to rice during the 2007 growing season.

Rice Farming in the Sacramento Valley

Most California rice is produced by direct seeding into standing water, and a continuous flood is maintained for most of the season. Limited acreage is drill seeded (planted with ground equipment) and also uses permanent flood after stand establishment. These are key events in the rice farming cycle:

- Field preparation
- Planting
- Fertilizer application
- Pesticide application
- Irrigation
- Drainage
- Harvest
- Winter flood-up
- Winter drainage

Figure 2-1 illustrates the timeline for these key events.

Hydrology

Seasonal rainfall and weather conditions influence rice planting and rice pesticide application. The 2007 rice farming year was relatively typical. Fields were planted in mid-April, and fall drainage occurred during August and September. Due to earlier-than-normal rains beginning in early October, some harvest operations were delayed until late October through early November. Flow data for the Sacramento River and Butte Slough were acquired from the California Data Exchange Center (CDEC), and precipitation data for a sensor in Colusa were obtained from the University of California Integrated Pest Management (UC IPM) California Weather Database. Data were collected beginning January 1, 2007, through September 30, 2007.

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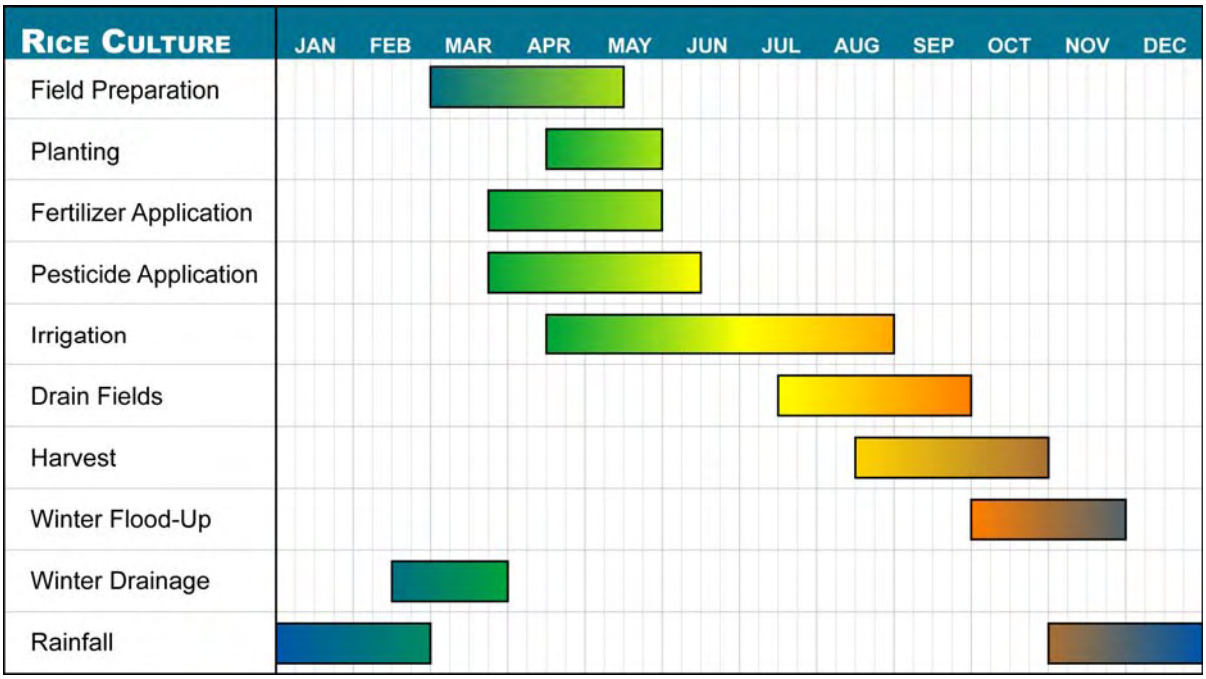

FIGURE 2-1
Key Events in a Typical Rice Year
Source: University of California Cooperative Extension and grower input

The Department of Water Resources (DWR) provides flow data (station COL) and the UC IPM California Weather Database provides precipitation and air temperature data for a station near the Sacramento River at Colusa (station COL.A). Flow and precipitation data for the 2007 growing season are shown in Figure 2-2, and minimum and maximum air temperatures are shown in Figure 2-3.

Applied Materials

Agricultural use of pesticides in California is regulated by DPR. Growers, pesticide applicators, pest control advisors, and pest control operators report pesticide use to CACs for inclusion in the DPR Pesticide Use Report (PUR). DPR provides the CRC with early review/draft PUR data and enforcement data for inclusion in the CRC's annual report. Data presented in the following discussions of pesticide use and nutrient application are usage data for the Sacramento Valley rice growing counties (excluding Tehama, where rice is has traditionally been exclusively organic).

Pesticide Use

The pesticides with acreage increases were clomazone (23,574), diflubenzuron (303), lambda cyhalothrin (11,219), and malathion (145).

The pesticides with acreage decreases were bensulfuron-methyl (4,201), bispyribac-sodium (6,759), carfentrazone-ethyl (19,331), cyhalofop-butyl (9,091), (s)-cypermethrin (2,124), molinate (16,265), penoxsulam (1,579), propanil (62,357), thiobencarb (13,602), triclopyr TEA (39,587).

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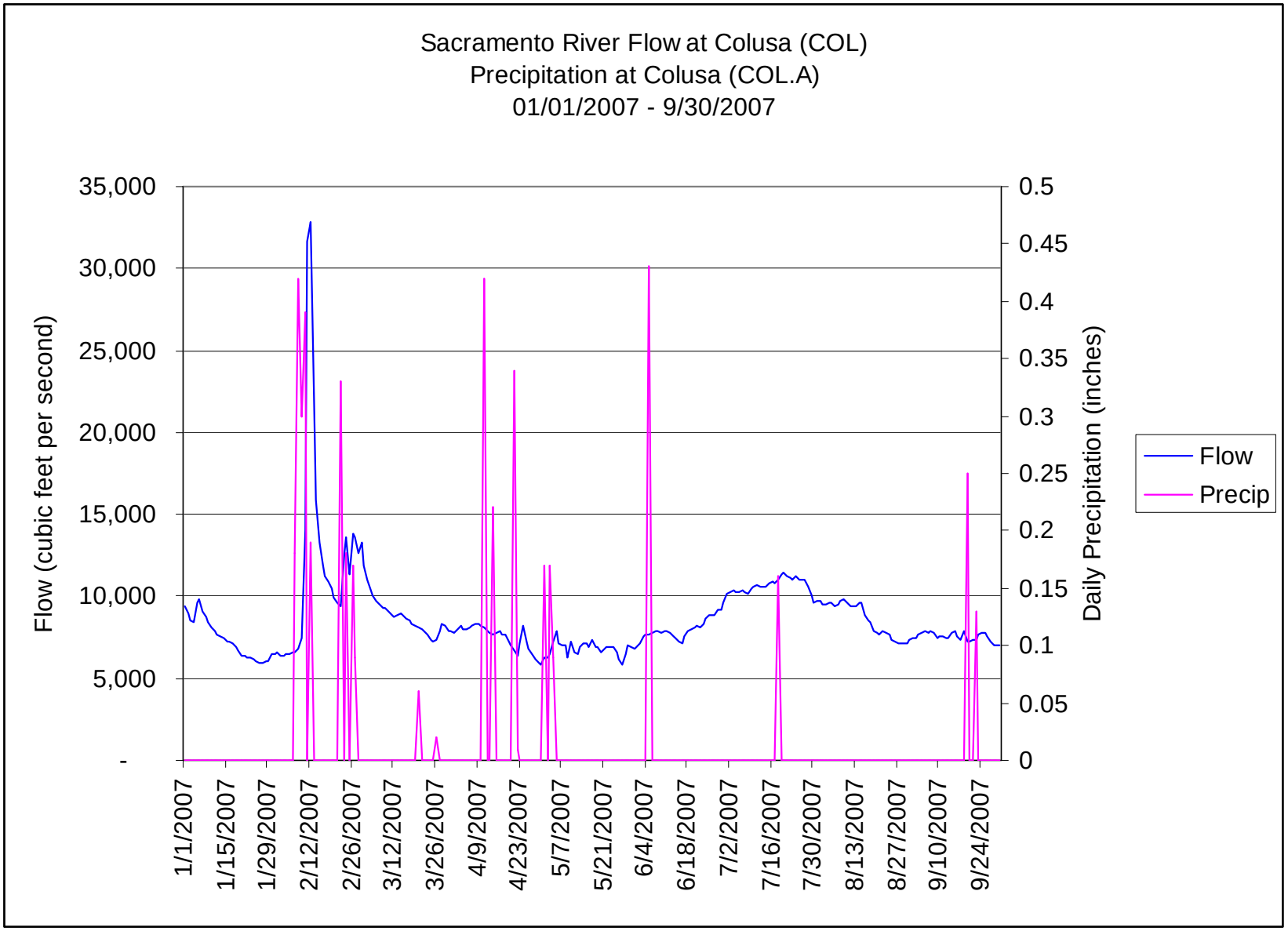

FIGURE 2-2
2007 Flow and Precipitation Data

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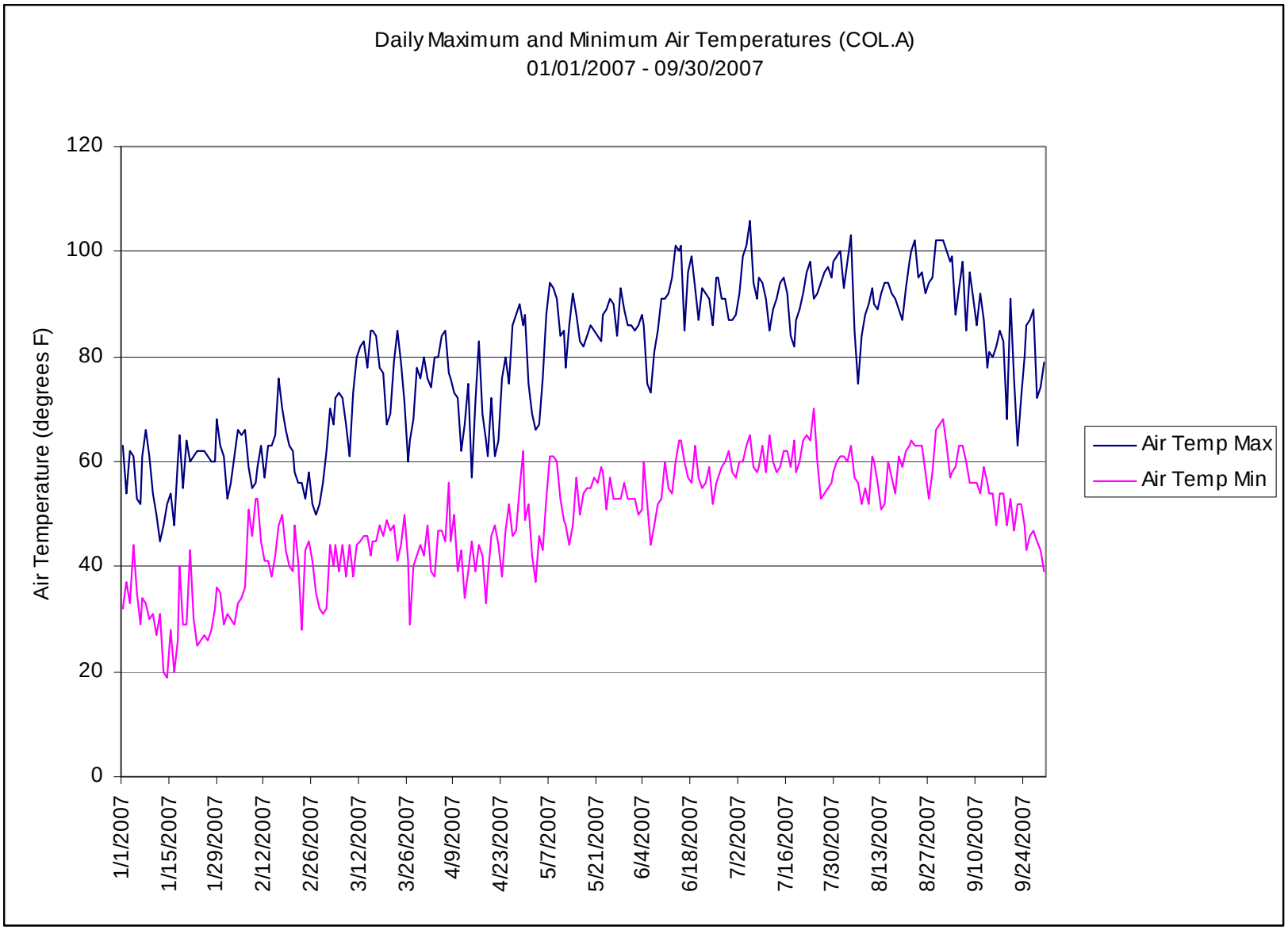

FIGURE 2-3
2007 Daily Maximum and Minimum Air Temperatures

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Treated acreage has a direct correlation to pounds of active ingredient applied. Planted acreage in 2007 (522,000 acres) decreased only slightly from 2006 (526,000 acres). Total pounds of active ingredient, however, decreased by nearly 50 percent. This is likely because the higher-application-rate products decreased in use. The rice industry is experiencing an expansion of reduced-risk products with lower per acre use rates.[1]

Tables 2-1 and 2-2 show the Sacramento County rice acres treated and pounds applied, respectively, with herbicides. Tables 2-3 and2-4 show the Sacramento County rice acres treated and pounds applied, respectively, with insecticides. Tables 2-5 and 2-6 show the Sacramento County rice acres treated and pounds applied, respectively, with fungicides. Sacramento County acres of molinate and thiobencarb treated for the time period 2005 through 2007 are listed in Table 2-7, and pounds of molinate thiobencarb applied during this same time are listed in Table 2-8. Tables 2-9 and 2-10 show the San Joaquin County rice acres treated and pounds applied, respectively, with herbicides.

Nutrient Use

Like most other farmland, rice acreage is fertilized annually. Fertilizer suppliers are the best source of information regarding the rates of fertilizer application. Suppliers were consulted to determine the range of fertilizer rates commonly applied to rice in the Sacramento Valley. The information obtained from the suppliers is summarized in Table 2-11. The table shows that fertilizer may be applied to rice before planting (granular starter, aqua ammonia, zinc) and later in the season (topdressing). The total for the high and low ends of the reported range are shown for each element in the lower section of Table 2-11.

Nitrogen (N) is essential for all commercial rice production in California. The general rate is 120 to 150 pounds per acre. Specific N requirements vary with soil type, variety, cropping history, planting date, herbicide used, and the kind and amount of crop residue incorporated during seedbed preparation. Winter flooding for straw decomposition and waterfowl management has greatly reduced N use in some rice fields. Most N is applied preplant and either soil incorporated or injected 2 to 4 inches before flooding. Some N may be topdressed mid-season (panicle differentiation) to correct deficiencies and maintain plant growth and yield.

Phosphorus (P) is applied 18 to 26 pounds per acres and incorporated into the seedbed before flooding. Most rice fields are above a critical need for P and do not require repeated use of this fertilizer. Phosphate fertilizer may also be topdressed when a deficiency occurs, usually in the early seedling stage.

Potassium (K) is generally unnecessary in California.

Zinc (Zn) deficiency or "alkali disease" is common in alkaline soils and areas where topsoil has been removed. If Zn is used, the rate is 2 to 16 pounds per acre at preflood, and it is not incorporated into the soil. Zinc deficiencies most commonly occur in cool weather during stand establishment (early season).

Iron deficiency is rare in California and can usually be corrected by lowering the soil pH.

[1] The USEPA designates pesticides as reduced-risk based the following criteria: low impact on human health, low toxicity to non-target organisms (birds, fish, and plants), low potential for groundwater contamination, lower use rates, low pest resistance potential, and compatibility with Integrated Pest Management.

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TABLE 2-1
Herbicides: Acres Treated, Sacramento County, 2007

	Acres Treated									
County	Bensulfuron-methyl	Bispyribac-sodium	Carfentrazone-ethyl	Clomazone	Cyhalofop-butyl	Molinate	Penoxsulam	Propanil	Thiobencarb	Triclopyr TEA
Butte	2,081	6,523	5,371	44,663	14,592	10,965	6,500	22,049	13,099	17,357
Colusa	820	16,024	123	20,084	42,897	340	9,889	49,574	24,094	52,063
Glenn	277	4,499	1,318	26,695	1,624	701	2,013	41,026	1,140	30,727
Placer	0	320	642	3,108	471	437	1,565	4,810	813	2,933
Sacramento	0	0	0	0	0	0	0	0	0	0
Sutter	3,624	10,739	3,334	22,090	22,180	2,036	28,943	72,810	13,018	55,657
Tehama	148	0	0	0	0	148	0	0	148	0
Yolo	1,017	2,238	648	1,010	7,183	666	8,469	27,110	8,321	25,115
Yuba	220	2,002	1,223	15,622	4,135	0	10,855	15,833	1,194	9,830
Total acres	8,187	42,345	12,659	133,272	93,082	15,293	68,234	233,212	61,827	193,682

TABLE 2-2
Herbicides: Pounds Applied, Sacramento County, 2007

	Pounds Applied									
County	Bensulfuron-methyl	Bispyribac-sodium	Carfentrazone-ethyl	Clomazone	Cyhalofop-butyl	Molinate	Penoxsulam	Propanil	Thiobencarb	Triclopyr TEA
Butte	104	321	1,042	21,678	4,502	47,730	227	103,957	51,149	2,628
Colusa	73	425	2	10,097	12,643	1,467	307	253,442	95,684	8,951
Glenn	12	68	52	14,861	530	2,839	47	206,632	4,201	4,987
Placer	0	11	8	1,450	141	1,690	58	22,573	2,694	527
Sacramento	0	0	0	0	0	0	0	0	0	0
Sutter	380	266	451	10,301	7,335	9,188	1,232	336,111	49,199	10,066
Tehama	8	0	0	0	0	525	0	0	450	0
Yolo	51	150	65	453	2,150	2,937	308	125,953	33,315	4,754
Yuba	13	64	184	7,058	1,327	0	381	70,992	4,483	1,527
Total pounds	641	1,305	1,804	65,898	28,628	66,376	2,560	1,119,660	241,175	33,440

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TABLE 2-3
Insecticides, Acres Treated, Sacramento County, 2007

	Acres Treated			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	381	7,148	7,424	0
Colusa	247	7,945	13,765	0
Glenn	37	2,460	1,142	0
Placer	0	1,695	1,869	0
Sacramento	0	0	0	0
Sutter	16	12,954	13,584	0
Tehama	0	33	0	0
Yolo	60	217	6,604	145
Yuba	821	3,548	6,072	0
Total pounds	1,562	36,000	50,460	145

TABLE 2-4
Insecticides, Pounds Applied, Sacramento County, 2007

	Pounds Applied			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	53	333	211	0
Colusa	34	363	390	0
Glenn	4	119	36	0
Placer	0	81	55	0
Sacramento	0	0	0	0
Sutter	2	563	385	0
Tehama	0	2	0	0
Yolo	10	11	191	253
Yuba	166	211	144	0
Total pounds	269	1,683	1,412	253

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TABLE 2-5
Fungicides: Acres Treated Applied, Sacramento County, 2007

County	Acres Treated		
	Azoxystrobin	Propiconazole*	Trifloxystrobin
Butte	1,427	0	0
Colusa	75	0	0
Glenn	19,726	17	17
Placer	2,154	0	0
Sacramento	0	0	0
Sutter	15,319	92	92
Tehama	0	0	0
Yolo	4,850	0	0
Yuba	2,956	25	25
Total pounds	46,507	134	134

*Propiconazole and trifloxystrobin constitute the product Stratego

TABLE 2-6
Fungicides: Pounds Applied, Sacramento County, 2007

County	Pounds Applied		
	Azoxystrobin	Propiconazole*	Trifloxystrobin
Butte	268	0	0
Colusa	15	0	0
Glenn	3,111	3	3
Placer	247	0	0
Sacramento	0	0	0
Sutter	2,607	13	13
Tehama	0	0	0
Yolo	847	0	0
Yuba	603	4	4
Total pounds	7,698	20	20

*Propiconazole and trifloxystrobin constitute the product Stratego

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TABLE 2-7
Acres Treated with Molinate and Thiobencarb, 2005 through 2007

	Acres Treated					
	Molinate			Thiobencarb		
County	2005	2006	2007	2005	2006	2007
Butte	16,479	21,571	10,965	34,749	20,353	13,099
Colusa	1,084	880	340	18,510	24,384	24,094
Glenn	4,059	1,845	701	6,847	4,952	1,140
Placer	3,498	2,173	437	767	367	813
Sacramento	0	0	0	4,316	1,158	0
Sutter	8,668	4,675	2,036	26,427	17,359	13,018
Tehama	0	0	148	0	0	148
Yolo	707	414	666	6,067	6,200	8,321
Yuba	4,060	0	0	2,888	656	1,194
Total pounds	38,555	31,588	15,293	100,571	75,429	61,827
Total planted acres	533,648	526,000	522,000	533,648	526,000	522,000

TABLE 2-8
Pounds of Molinate and Thiobencarb Applied, 2005 through 2007

	Pounds Applied					
	Molinate			Thiobencarb		
County	2005	2006	2007	2005	2006	2007
Butte	69,136	92,930	47,730	127,796	81,722	51,149
Colusa	4,466	3,551	1,467	72,891	96,106	95,684
Glenn	17,994	7,631	2,839	25,992	18,611	4,201
Placer	14,930	9,978	1,690	2,342	1,114	2,694
Sacramento	0	0	0	15,774	4,243	0
Sutter	36,784	20,545	9,188	98,755	66,765	49,199
Tehama	0	0	525	0	0	450
Yolo	2,943	1,561	2,937	23,457	24,761	33,315
Yuba	17,568	0	0	8,334	2,480	4,483
Total pounds	163,821	136,196	66,376	375,341	295,802	241,175
Total planted acres	533,648	526,000	522,000	533,648	526,000	522,000

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TABLE 2-9
Herbicides: Acres Treated, San Joaquin County, 2007

	Acres Treated									
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Molinate**	**Penoxsulam**	**Propanil**	**Thiobencarb**	**Triclopyr TEA**
Fresno		431	0							
Madera						6			5	
San Joaquin		138	135							
Total acres		569	135			6			5	

TABLE 2-10
Herbicides: Pounds Applied, San Joaquin County, 2007

	Acres Treated									
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Molinate**	**Penoxsulam**	**Propanil**	**Thiobencarb**	**Triclopyr TEA**
Fresno		14	0							
Madera						30			200	
San Joaquin		4	4							
Total acres		18	4			30			200	

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TABLE 2-11
Range of Fertilizer Components Applied to Rice

Material/Element	Pounds per Acre		Form and Method
	Low	High	
N	80	120	Injected aqua
16-20	150	200	
N	24	32	Solid 16-20-0-13 starter
P	30	40	Solid 16-20-0-13 starter
K	0	0	Solid 16-20-0-13 starter
S	19.5	26	Solid 16-20-0-13 starter
Zn	1	5	Metallic
NH4SO4	0	200	Topdressed
N	0	42	Topdressed
S	0	49	Topdressed
Totals			
N	104	194	Total for all application methods
P	30	40	Total for all application methods
K	0	0	Total for all application methods
S	20	75	Total for all application methods
Zn*	1	5	Total for all application methods

*Seldom applied

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CHAPTER 3

Management Practices

Management practices are a key component of the rice water quality programs. During the early phases of the RPP, management practices were developed to protect water quality. The cornerstone of rice management practices is a thorough understanding of the rice calendar, including the application methods and timing of pesticide use.

Management practices include field-level management of rice pesticides and discharges, CAC enforcement programs, grower education efforts, and communications programs. This chapter includes the pesticide use calendar, general information on rice water quality management practices, and specific 2007 enforcement data.

Pesticide Use Calendar

The following tables depict the season or timing of pesticide applications to rice. Included are separate tables for herbicide applications (Table 3-1), insecticide applications (Table 3-2), tank mix combinations (Table 3-3), and sequential herbicide applications (Table 3-4). A "sequential" is the application of an herbicide followed by another herbicide with a different mode of action. Sequential applications are used to achieve better coverage and efficacy for weed control. The second application usually occurs in the next growth stage of the rice plant. For example, clomazone is applied at germination. A sequential application of bispyribac-sodium is applied at tiller initiation. Figure 3-1 provides illustrations of rice's growth stages.

Rice pesticide applications are timed for specific growth stages of the rice plant. To simplify the rice growth schedule, the following tables group pre-flood and germination into early season; tiller initiation and tillering are mid-season, and panicle initiation and flower are late season.

This calendar of applications provides information that is useful for understanding potential water quality concerns relative to particular times during the year.

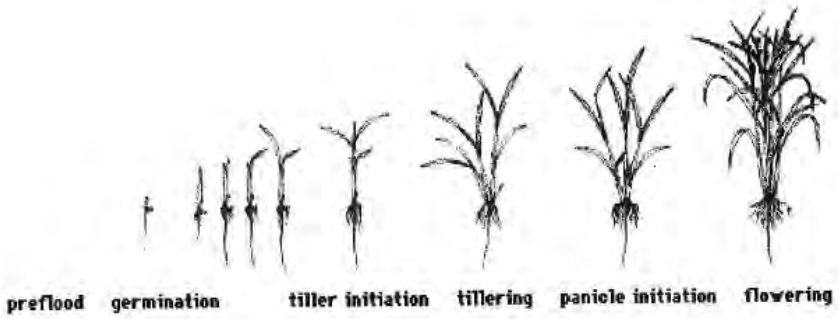

FIGURE 3-1
Rice Growth Stages

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TABLE 3-1
Timing of Specific Rice Herbicide Applications

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Bensulfuron-methyl Permanent flood 7-day water hold				
		Bensulfuron-methyl Pinpoint flood 7-day water hold			
		Bispyribac-sodium Pinpoint flood			
	Carfentrazone-ethyl Permanent flood 5-day static; 30-day release				
	Clomazone Permanent flood 14-day water hold				
		Cyhalofop-butyl Pinpoint flood 7-day water hold			
	Molinate Permanent flood 28-day water hold				
		Propanil Pin-point flood			
	Thiobencarb (Bolero and Abolish) Permanent flood Bolero 30-day/Abolish 19-day				
		Triclopyr TEA Pinpoint flood 20-day water hold			

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TABLE 3-2
Timing of Herbicide Tank Mix Combinations

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
		Bispyribac-sodium/Thiobencarb (Abolish) Pinpoint flood 19-day water hold Propanil/Thiobencarb (Abolish) Permanent flood 19-day water hold			

TABLE 3-3
Timing of Specific Rice Insecticide Applications

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Lambda cyhalothrin Border treatment 7-day water hold (s)-cypermethrin Border treatment 7-day water hold				Lambda cyhalothrin Boarder treatment 7-day water hold (s)-cypermethrin Boarder treatment 7-day water hold

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TABLE 3-4
Timing of Sequential Rice Herbicide Applications

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Bispyribac-sodium, Thiobencarb (Bolero) 30-day water hold Permanent Flood				
		Bispyribac-sodium, Propanil Pinpoint flood			
	Clomazone, Bensulfuron-methyl 14-day water old Permanent flood				
	Clomazone, Bispyribac-sodium 14-day water hold Permanent flood				
	Clomazone, Carfentrazone-ethyl up to 30-day water hold Permanent flood				
	Clomazone, Propanil 14-day water hold Permanent flood				
	Clomazone, Propanil/Triclopyr TEA 20-day water hold				
		Cyhalofop-butyl, Bensulfuron-methyl 7-day water hold Pinpoint flood			
		Cyhalofop-butyl, Bispyribac-sodium 7-day water hold Pinpoint flood			
		Cyhalofop-butyl, Propanil 7-day water hold Pinpoint flood			
		Propanil, Cyhalofop-butyl 7-day water hold Pinpoint flood			
	Carfentrazone-ethyl, Cyhalofop-butyl 30-day water hold, 7-day water hold Pinpoint flood				

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Role of Management Practices in Attaining Water Quality Protection

Over the years, BMPs such as water-hold requirements, grower information meetings, and inspection/enforcement were implemented to ensure compliance with performance goals and attainment of water quality objectives and maximum contaminant level (MCLs). The water holds, which are specified on pesticide use labels and through permit conditions, were developed to provide for in-field degradation of pesticides prior to the release of treated water to drains and other surface waters. For 2007, all required water holds were the same as required during the 2005 and 2006 growing seasons.

Water Holds

The primary field-level water quality management practice is the water hold. The nature of rice farming, which requires standing water during the growing season, provides rice farmers with a unique opportunity to manage water quality. The water holds, which are specified on pesticide-use labels and through permit conditions, were developed to provide for in-field degradation of pesticides prior to the release of treated water to drains and other surface waters. Water-hold durations vary based on the persistence of specific registered rice pesticides in the environment, and are used to provide time for the applied product to degrade in the field. The goal of this strategy is to discharge rice drainage water that meets Basin Plan Performance Goals or other benchmarks.

The management practices developed under the RPP have been the foundation for development and implementation of water-hold requirements for other pesticides. Over the years, water holds have become standard practice to address aquatic toxicity, taste complaints, environmental fate, and product efficacy. Water holds were developed with the input of technical resources such as the University of California Cooperative Extension (UCCE) and pesticide registrants. In the early 1980s, when the RPP began, water holds were generally not a pesticide-use label requirement. Over time, rice-specific registrations of pesticides were developed to require specified water holds as a condition of the permitted use of these products. In addition, DPR and the CACs have the authority to impose additional water hold requirements necessary to be protective of water quality.

Water-holding requirements for thiobencarb and molinate are pesticide-use permit conditions under the RPP. Table 3-5 specifies the water hold requirements for the four currently registered pesticides regulated under the CVRWQCB's RPP Conditional Prohibition of Discharge. These water hold requirements are the same as those required during the 2005 and 2006 growing seasons. Table 3-6 lists the water holds for other products registered for use on rice.

Actions Taken to Address Identified Water Quality Impacts

The CACs are the local enforcement agencies working with DPR to enforce the California Food and Agricultural Code and the California Code of Regulations pertinent to pesticide use. CACs issue restricted materials permits to growers purchasing and using California-restricted materials in their respective counties. Molinate and thiobencarb are restricted materials with additional use restrictions (permit conditions) not found on the registered product label. The most common permit conditions for molinate and thiobencarb

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TABLE 3-5
Water Hold Requirements in Days for Molinate, Thiobencarb, Methyl Parathion, and Malathion (RPP Pesticides)

	Molinate		Thiobencarb			
Release Type	**Ordram® 15-GM**	**Ordram® 8-E**	**Bolero® 15-G**	**Abolish™ 8EC**	**Methyl Parathion**	**Mala-thion**
Single field	28	4	30	19	24	4[a]
Single field southern area only[b]	—	—	19	—	—	—
Release into tailwater recovery system or pond onto fallow field (except southern area)[b]	28	4	14[c]	14[c]	—	—
Multi-growers and district release onto closed recirculating systems	8	4	6	6	—	—
Multi-growers and district release onto closed recirculating systems in southern area	—	—	6	—	—	—
Release into area that discharge negligible amounts to perennial streams	12	4	19	6[d]	—	—
Pre-flood application: release onto tailwater recovery system	4	4	—	—	—	—
Emergency release of tailwater	11	—	19	19	—	—
Commissioner verifies the hydrologic isolation of the fields	—	—	6	6	—	—

[a]Voluntary hold
[b]Sacramento–San Joaquin Valley defined as south of the line defined by Roads E10 and 116 in Yolo County and the American River in Sacramento County
[c]Thiobencarb permit condition allowed Bolero® 15-G label hold period of 14 days.
[d]See hydrologically isolated fields.

are water holds. The thiobencarb permit conditions for 2003 remained in place during 2004, 2005, 2006, and 2007. Since 2003, the CVRWQCB RPP authorizing resolutions have included thiobencarb permit conditions that required increased inspections for seepage control; buffer zones during application; a pre-season mandatory meeting for growers, pest control advisors, and applicators; and formation of a Storm Event Work Group.

The restricted materials permits require the CACs in rice growing counties of the Sacramento Valley Basin to keep records of specific pesticides applied to rice acreage. The CACs meet the notification requirements by utilizing the Notices of Intent (NOIs) and

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TABLE 3-6
Hold Times (Days) for Insecticides, Fungicides, and Herbicides Not Covered by RPP

Active Ingredient	Trade Name	Water-hold Time	Provisions
Insecticides			
Diflubenzuron	Dimlin® Insect Growth Regulator	14 days	None
(s)-cypermethrin	Mustang® 1.5 EW Insecticide	7 days	None
Lambda-cyhalothrin	Warrior® Insecticide	7 days	None
Fungicides			
Azoxystrobin	Quadris® Flowable Fungicide	14 days	None
Herbicides			
Carfentrazone-ethyl	Shark®	5-day static 30-day release	None
Clomazone	Cerano™	14 days	Less if closed system
Cyhalofop-butyl	Clincher™	7 days	None
Propanil	Stam™ 80 EDF	7 days	None
Triclopyr TEA	Grandsand™ CA Herbicide	20 days	Less if closed system

Notices of Application (NOAs) process. Rice growers or pest control operators submit NOIs to the CACs at least 24 hours prior to application so that CAC staff can observe applications. NOAs are reported 24 hours after an application occurs so that water-holding times can be recorded, inspected, and tracked.

Compliance with pesticide-use restrictions is a critical component of the RPP's ability to achieve water quality protection. A range of label restrictions and permit conditions apply to the use of rice pesticides, including mix/load, application, and water-hold requirements. CACs perform inspections to enhance compliance with each of the label restrictions and permit conditions. Mix/load inspections are performed primarily for worker protection and to evaluate whether proper handling and containment of pesticides is being implemented to prevent releases to the environment. Application inspections are performed to evaluate label and permit condition application restrictions such as buffer zones, adherence to rate and wind speed and other local requirements, and water management. Seepage inspections evaluate the efficacy of farm water management levees to hold water in-field throughout the duration of water holds.

Release Inquiries and Emergency Releases

In 2007, there was one release inquiry and one reported emergency release. The inquiry and reported emergency release occurred in Yolo County.

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Seepage Control and Inspections

Seepage is a concern because rice field water can move laterally through levees bordering rice fields, especially when levees are constructed in a manner that does prevent water seepage. Often, levee borrow pits, commonly called "sweat ditches," are used to contain this water. When water becomes high enough, it can flow into local agricultural drainage conveyances. The CVRWQCB expressed concern that seepage was a contributing factor to past increased thiobencarb concentrations in the Sacramento River.

Current program recommendations require securing weir boxes in rice fields with a soil barrier to a depth higher than the water level. At rice pesticide permit issuance, the CACs provide rice growers with a handout entitled *Closed Rice Water Management Systems*, prepared by the USDA and the UCCE. Another brochure the CACs provide to rice growers, entitled *Seepage Water Management – Voluntary Guidelines for Good Stewardship in Rice Production*, was cooperatively developed by the UCD Department of Agronomy and Range Science, DPR, and UCCE. This brochure is also distributed at the thiobencarb mandatory meetings. The brochure explains the causes of seepage and identifies voluntary management activities that growers should use to minimize and prevent seepage.

For several years, the CRC has contracted with the CACs to fund CAC "off duty" inspections for rice growing activities in an effort to accommodate grower's operational needs and the RPP's need to maintain diligent monitoring and reporting practices. Consequently, weekend and holiday seepage and pre-flood inspections that were historically not funded have been funded for the past several years. The CRC continued this practice during the 2007 growing season.

In 1998 DPR and the CACs implemented a Prioritization Plan and a Negotiated Work Plan. One component of both plans was to negotiate a number of water-hold inspections. The plans allow the counties to set priorities within the standard enforcement guidelines. All rice pesticide water-holding requirements are ranked as high-priority inspections when rice pesticides are used as restricted materials.

Some pre-flood inspections were per grower request, while most inspections were in response to an NOI filed at the CAC office. Some permits were denied due to seepage conditions upon inspection. Tables 3-7 through 3-8 present enforcement activities in 2007. Information was gathered from the CACs on number of inspections, types of inspections, violations, agricultural civil penalties (ACP), and water seepage inspections. The CRC provided the CAC offices with weekly updates of the rice herbicide monitoring results in order to coordinate water quality protection activities.

CACs conducted seepage inspections, as summarized in Table 3-7. Based on the inspection data provided to the DPR by the CAC, 965 molinate and thiobencarb use sites were inspected. Of these inspected sites, 953 sites reported no discharge, and 9 had reported discharges of less than 5 gallons per minute (gpm). These 9 sites constitute less than 1 percent of inspected sites. Of the 965 sites inspected, 3 had reported discharges of greater than 5 gpm. These 3 sites constituted 0.3 percent of inspected sites. Two enforcement actions were issued.

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TABLE 3-7
Molinate and Thiobencarb Water Seepage Inspections in 2007

County	Chemical	Seepage Inspections	Sites with No Seepage	Sites w/ Less than 5 gpm Seepage	Sites w/ More than 5 gpm Seepage	Enforcement Actions
Butte	Molinate	55	54	1	0	0
	Thiobencarb	224	220	4	0	0
Colusa	Molinate	0	0	0	0	0
	Thiobencarb	224	223	0	1	1
Glenn	Molinate	18	18	0	0	0
	Thiobencarb	34	30	2	2	0
Placer	Molinate	2	2	0	0	0
	Thiobencarb	2	2	0	0	0
Sacramento	Molinate	0	0	0	0	0
	Thiobencarb	26	26	0	0	0
Sutter	Molinate	23	23	0	0	0
	Thiobencarb	282	282	0	0	0
Tehama	Molinate	1	1	0	0	0
	Thiobencarb	1	1	0	0	0
Yolo	Molinate	4	4	0	0	0
	Thiobencarb	24	22	2	0	0
Yuba	Molinate	23	23	0	0	0
	Thiobencarb	22	22	0	0	1
Totals		965	953	9	3	2

Application and Mix/Load Inspections

CACs conducted application and mix/load inspections, as summarized in Table 3-8. Based on the inspection data the CACs provided to the DPR, a total of 19 mix/load events were inspected. The CACs performed 36 application inspections. On enforcement action was issued.

Water-Hold Inspections

CACs conduct water-hold inspections, as summarized in Table 3-8. A total of 965 molinate and thiobencarb use sites were inspected. Reporting was recorded for two formulations of each product. Of the 965 sites inspected, 2 were issued enforcement actions.

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TABLE 3-8
Molinate and Thiobencarb Water Hold, Application, and Mix-Load Inspections in 2007

County	Chemical	Water-Hold Inspections	Release Inquires	Emerg. Releases	ACPs	Appl. Insp.	Mix-Load Insp.	ACPs
Butte	Ordram 15GM	55	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	197	0	0	0	4	0	0
	Abolish EC	27	0	0	0	3	2	0
	County total	279	0	0	0	7	2	0
Colusa	Ordram 15GM	0	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	219	0	0	1	5	3	0
	Abolish EC	5	0	0	0	3	3	0
	County total	224	0	0	1	8	6	0
Glenn	Ordram 15GM	18	0	0	0	0	1	1
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	34	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	52	0	0	0	0	1	1
Placer	Ordram 15GM	2	0	0	0	3	0	0
	Ordram 8E	0	0	0	0	2	0	0
	Bolero 15G	1	0	0	0	3	0	0
	Abolish EC	1	0	0	0	1	0	0
	County total	4	0	0	0	9	0	0
Sacramento	Ordram 15GM	0	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	26	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	26	0	0	0	0	0	0
Sutter	Ordram 15GM	22	0	0	0	0	0	0
	Ordram 8E	1	0	0	0	0	0	0
	Bolero 15G	262	2	0	0	5	6	0
	Abolish EC	20	1	0	0	1	1	0
	County total	305	3	0	0	6	7	0

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TABLE 3-8
Molinate and Thiobencarb Water Hold, Application, and Mix-Load Inspections in 2007

County	Chemical	Water-Hold Inspections	Release Inquires	Emerg. Releases	ACPs	Appl. Insp.	Mix-Load Insp.	ACPs
Tehama	Ordram 15GM	1	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	1	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	2	0	0	0	0	0	0
Yolo	Ordram 15GM	4	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	24	1	1	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	28	1	1	0	0	0	0
Yuba	Ordram 15GM	23	0	0	0	1	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	11	0	0	1	3	2	0
	Abolish EC	11	0	0	0	2	1	0
	County total	45	0	0	1	6	3	0
Total		965	4	1	2	36	19	1

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CHAPTER 4

Monitoring and Reporting Requirements

The monitoring and reporting requirements for the CWFR are specified in the MRP Order R5-2005-0833. Monitoring and reporting requirements for the 2007 RPP are specified in CVRWQCB Resolution No. R5-2007-001. This chapter provides an overview of the monitoring and reporting requirements of each program, including the overall purpose and objectives, the sites, the program administration, sampling procedures, and analytical labs and methods utilized to assess water quality.

Monitoring Purpose and Objectives

Although similar, the CWFR and RPP programs each have different purposes and objectives for monitoring and reporting.

CWFR

The purpose of the MRP is to monitor the discharge of wastes in irrigation return flows and stormwater from irrigated rice lands. As specified Part (I) of the MRP, the purposes of monitoring conducted under the MRP are as follows:

a. Assess the impacts of waste discharges from irrigated lands to surface water

b. Determine the degree of implementation of management practices to reduce discharges of waste that impact water quality

c. Determine the effectives of management practices and strategies to reduce discharge of wastes that impact water quality

d. Determine concentration and load of waste in these discharges to surface waters

e. Evaluate compliance with existing narrative and numeric water quality objectives to determine if additional implementation of management practices is necessary to improve and/or protect water quality

The monitoring and reporting requirements of the 2007 (Year 3) CWFR program are specified in CVRWQCB Monitoring and Reporting Program Order No. R5-2004-0839 under Resolution No. R5-2003-0105. Additional requirements and guidance are provided in Executive Order letters, issued under the authority granted in the Resolution.

RPP

The purpose of the RPP is to achieve attainment of Performance Goals established in the Basin Plan. Monitoring is conducted under the RPP for the purposes of determining attainment of those Performance Goals. Similar to the CWFR, though not specifically stated in regulatory documents, the purposes of the monitoring under the RPP are as follows:

a. Assess the impacts of the rice pesticides regulated under the Basin Plan Conditional

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b. Determine the degree of implementation of rice pesticides management practices

c. Monitor the effectives of management practices and strategies to attain Performance Goals

d. Determine concentration of Basin Plan rice pesticides at specific sites

e. Evaluate compliance with Performance Goals to determine if additional implementation of management practices is necessary to improve and/or protect water quality

Overview of Requirements

The CWFR and RPP programs have different requirements. The CWFR requirements are specified in the rice-specific MRP. The RPP requirements are specified in CVRWQCB Resolution R5-2007-0018.

CWFR

The MRP requires that the following types of monitoring and evaluation be conducted:

- Toxicity testing. The stated purpose of the toxicity testing is to evaluate compliance with the Basin Plan's narrative toxicity objective, to identify the causes of observed toxicity, and to determine the sources of identified toxicants.
- Water quality and flow monitoring. The stated purpose of the water quality and flow monitoring is to assess the sources of wastes and loads in discharges from irrigated lands to surface waters, and to evaluate the performance of management practice implementation efforts. Monitoring data is to be compared to existing numeric and narrative water quality objectives.
- Pesticide use evaluation. The stated purpose of the pesticide use evaluation is to provide information regarding the usage of pesticide relative to monitoring sites, including changes in pesticide use.
- Management Practice Evaluation. Evaluation of the effectiveness of management practices and tracking levels of implementation in the watershed.

RPP

The RPP requires that the following types of monitoring and evaluation be conducted:

- Field water quality monitoring
- Molinate and thiobencarb water quality monitoring
- Pesticide use reporting

Monitoring Sites

Monitoring under both the CWFR and RPP is conducted at specific sites. Table 4-1 lists site names, locations, and drainage area for each of the sites under the CWFR and RPP monitoring programs.

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TABLE 4-1
CWFR and RPP 2007 Monitoring Sites

Site Code	Site Name	Latitude	Longitude	Estimated Rice Area Captured by Station (acres)	Program(s)	Site Type
CBD1	Colusa Basin Drain above Knights Landing	38.8125 N	-121.7731 W	171,165	CWFR, RPP	Main
CBD5	Colusa Basin Drain #5	39.1833 N	-122.0500 W	156,000	CWFR, RPP	Main
BS1	Butte Slough at Lower Pass Road	39.1875 N	-121.9000 W	183,617	CWFR, RPP	Main
SSB	Sacramento Slough Bridge near Karnak	38.7850 N	-121.6533 W	24,549	CWFR, RPP	Main
JS	Jack Slough at Jack Slough Road (near Kimball Lane)	39.1804 N	-121.5711 W	27,741	CWFR	Rotating, Year 1 and Year 3
LCC	Coon Creek at Striplin Road (west of Power Line Road)	38.8715 N	-121.5808 W	20,764	CWFR	Rotating, Year 2
SR1	Sacramento River 1	38.6039 N	-121.5189 W	~500,000	RPP	River

CWFR Sites

The MRP requires that the CRC perform water quality and flow monitoring at six sites per year. Each year, monitoring must be conducted at four main sites and one rotating site. In 2007, the rotating site was JS.

The five sites were selected because, collectively, they are estimated to capture drainage from 90 percent of the acres planted in rice. BS1, CBD1, CBD5, and SSB are historical sites. Figure 4-1 shows the five CWFR monitoring sites.

RPP Sites

Under the RPP, the CRC performs water quality and flow monitoring at five sites. Four of these sites, CBD1, CBD5, BS1, and SSB, are monitored under the CWFR, while the fifth site, SR1, is monitored only under the RPP. Figure 4-2 shows the five RPP monitoring sites.

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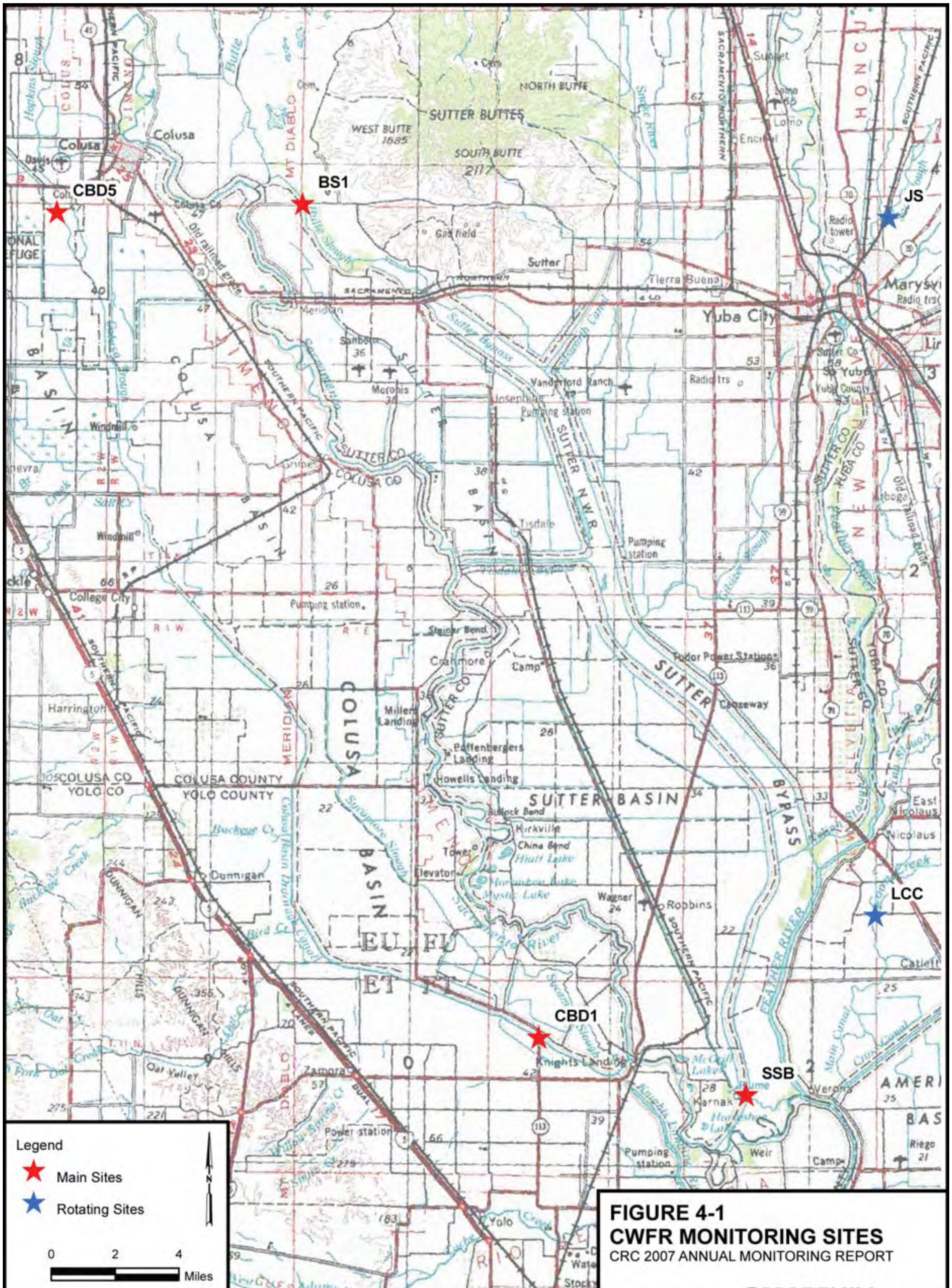

FIGURE 4-1
CWFR MONITORING SITES
CRC 2007 ANNUAL MONITORING REPORT

WB102007006SAC figure_4-1.ai tdaus 12/21/07

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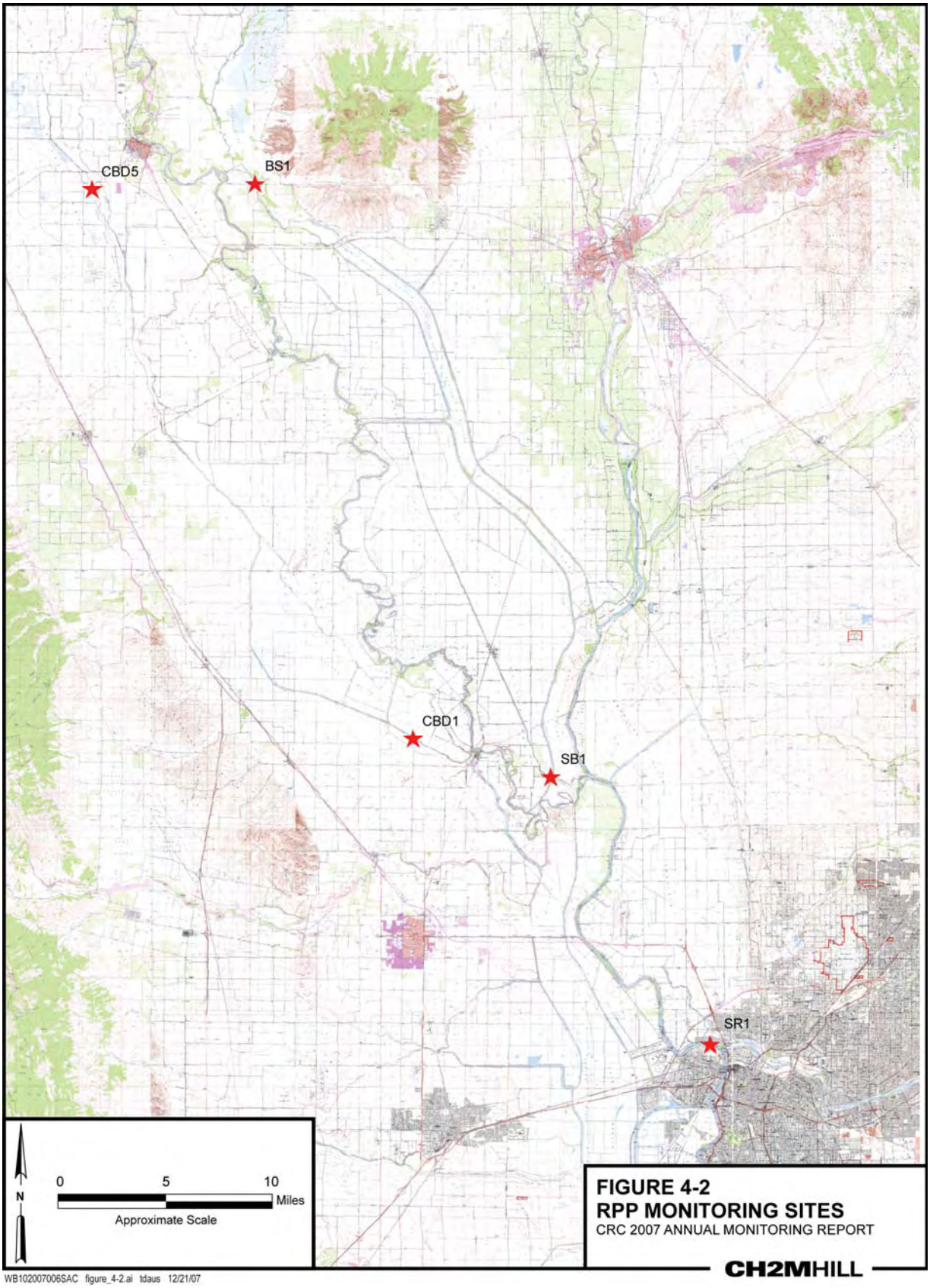

FIGURE 4-2
RPP MONITORING SITES
CRC 2007 ANNUAL MONITORING REPORT

CH2MHILL

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CBD1

CBD1 is located on the Colusa Basin Drain. Water samples at CBD1 were collected from the middle of the bridge along Road 99E as it crosses Colusa Basin Drainage Canal near Road 108 west of Knights Landing. CBD1 is monitored under both the CWFR and RPP.

PHOTO 1
CBD1: Colusa Basin Drain #1

CBD5

CBD5 is located on the Colusa Basin Drain within the Colusa National Wildlife Refuge. Water samples at CBD5 were collected from the middle of the second bridge at the Colusa National Wildlife Refuge south of Highway 20. CBD5 is monitored under both the CWFR and RPP.

PHOTO 2
CBD5: Colusa Basin Drain #5

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BS1

BS1 is located on Butte Slough. Water samples at BS1 were collected from the middle of the bridge along Lower Pass Road that crosses Butte Sough northeast of Meridian. In 1995 and 1996, samples were previously collected at the west end of the washed out bridge. Sampling at the new bridge site started in 1997. BS1 is monitored under both the CWFR and RPP.

PHOTO 3
BS1: Butte Slough #1

SSB

The RPP historically monitored Sacramento Slough at a location known as Sacramento Slough 1 (SS1), which was located at the DWR gauging station downstream of the Karnak pumps. Beginning in 2006, the monitoring site for Sacramento Slough was moved slightly upstream to a location named Sacramento Slough Bridge (SSB) in order to provide improved safety for field technicians accessing the site. This year, during Weeks 1 through 3, the bridge was inundated was not accessible so sampling was conducted from the gauging station upstream of the Karnak pumps. Beginning in Week 4, sampling was conducted from the bridge location, SSB. SSB is monitored under both the CWFR and RPP.

PHOTO 4
SSB: Sacramento Slough Bridge

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LCC

LLC is located on Lower Coon Creek. Water samples at LCC were collected from the middle of the Striplin Road Bridge. LCC is monitored under only the CWFR.

PHOTO 5
LCC: Lower Loon Creek

JS

Water samples at JS were collected from the middle of the bridge along Jack Slough Road near Kimball Lane, north of Marysville. JS1 is monitored under only the CWFR.

PHOTO 6
JS: Jack Slough

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SR1

SR1 is located on the Sacramento River. Water samples at SR1 were collected from the Sacramento River at the Village Marina along the Garden Highway in Sacramento. The SR1 water samples were collected from the edge of a floating dock near the entrance of a restaurant along the east bank of the Sacramento River. Kleinfelder noted the river level on a staff gauge located along a middle dock between the sampling point and the riverbank. SR1 is monitored under only the RPP.

PHOTO 7
SR1: Sacramento River Village Marina

Constituents

CWFR

The MRP specifies the constituents for which field monitoring and laboratory analysis are to be conducted. Table 4-2 presents the constituents for which monitoring was required during 2007, which is considered Year 3 of the CWFR program.

The irrigation season for this monitoring program is defined as April through September. In an effort to evaluate the impacts of rice field discharges during the irrigation season, the CRC monitors throughout the defined irrigation season. In addition to monitoring for the purpose of characterizing irrigation season drainage, the MRP also requires monitoring to evaluate water quality during February and October, which are considered the two most significant periods of discharge outside of irrigation season. In February, rice growers drain their fields in preparation for the rice planting season. Unlike farming methods used for field, row, and tree crops, rice fields can capture and hold rainfall in the field, and drainage throughout the valley can be a controlled/managed event. Typically, in October rice growers flood their fields to begin winter straw decomposition.

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TABLE 4-2
CWFR Monitoring and Reporting Requirements, 2007

Constituent	Units	Sample Type	Irrigation Season Sampling Frequency (April–Sept.)	Non-irrigation Season Sampling Frequency	Reporting Frequency
Flow	cfs	Field[a]	Monthly	February, October	Annually
pH	pH units	Field	Monthly	February, October	Annually
Electrical conductivity	µmhos/cm	Field	Monthly	February, October	Annually
Dissolved oxygen	mg/L	Field	Monthly	February, October	Annually
Temperature	degrees C	Field	Monthly	February, October	Annually
Color	ADMI	Field	Monthly	February, October	Annually
Turbidity	NTUs	Field	Monthly	February, October	Annually
Total dissolved solids[b]	mg/L	Field	Monthly	February, October	Annually
Aquatic toxicity[c]	% survival[d]	Grab	Monthly	February, October	Annually
Sediment toxicity	% survival[d]	Grab	July, September	February[e]	Annually
Specified pesticides[f]	µg/L	Grab	Monthly	NA	Annually
Hardness	mg/L as CaCO3	Grab	Monthly	February, October	Annually
Copper	µg/L	Grab	See note g	See note[g]	Annually

[a]Flow may also be obtained from Department of Water Resources (DWR) monitoring stations, where available.

[b]Calculated from electrical conductivity field measurements.

[c]Acute toxicity testing shall be conducted using the invertebrate, *Ceriodaphnia dubia*, and the larval fathead minnow, *Pimephales promelas*, according to standard U.S. Environmental Protection Administration (USEPA) acute toxicity test methods. In addition, to identify toxicity caused by herbicides, 96-hour toxicity tests with the green algae *selanastrum capricornutum* shall be conducted.

[d]To be reported as percent survival, as compared to the control.

[e]Sediment toxicity required in February only if toxicity is found in both of the previous irrigation season's sampling events (July and September).

[f]Specified pesticides are determined annually based on available water quality data, current usage trends, and aquatic toxicity considerations. These pesticides are formally included in the CRC's MRP requirement through Executive Officer communication or Board Resolution.
Start-up Monitoring (2004): specified pesticides were: Lambda cyhalothrin, s-cypermethrin
Year 1 (2005) specified pesticides were: Lambda cyhalothrin, s-cypermethrin
Year 2 (2006) specified pesticides were: Carfentrazone-ethyl, bispyribac-sodium
Year 3 (2007) specified pesticides were: Cyhalofop-butyl, azoxystrobin, propiconazole, and trifloxystrobin

[g]For Year 3, copper monitoring is required in conjunction with *selanastrum* studies. Specifically, copper analysis was performed at CBD1 in July and at BS1, CBD5, and SSB in September.

RPP

Monitoring for the RPP is conducted during the 10-week period of peak rice pesticide use. Monitoring is conducted once per week for the first three weeks, then is increased to twice per week for the following four weeks (corresponding with peak usage), and is then decreased to once per week for the final three weeks. Field parameters are recorded, and samples are taken for molinate and thiobencarb analysis. The constituents and their monitoring requirements are shown in Table 4-3.

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TABLE 4-3
RPP Monitoring and Reporting Requirements, 2007

Constituent	Units	Sample Type	Sampling Frequency			Reporting Frequency
			Weeks 1–3	Weeks 4–7	Weeks 8–10	
pH	pH units	Field	Weekly	Biweekly	Weekly	Annually
Electrical conductivity	µmhos/cm	Field	Weekly	Biweekly	Weekly	Annually
Dissolved oxygen	mg/L	Field	Weekly	Biweekly	Weekly	Annually
Temperature	degrees C	Field	Weekly	Biweekly	Weekly	Annually
Turbidity	NTUs	Field	Weekly	Biweekly	Weekly	Annually
Molinate	µg/L	Grab	Weekly	Biweekly	Weekly	Annually
Thiobencarb	µg/L	Grab	Weekly	Biweekly	Weekly	Annually

Administration and Execution

For both the CWFR and the RPP, the CRC contracted with Kleinfelder to collect water samples and coordinate with laboratories. Following each monitoring event, field data sheets, chain-of-custody (COC) forms, and calibration logs were scanned and e-mailed to CH2M HILL. Kleinfelder was the primary contact for all laboratory services. Labs submitted data to Kleinfelder, which then forwarded the data to CH2M HILL for review and analysis.

Sampling Procedures

Sampling was conducted pursuant to the procedures described in the CWFR Quality Assurance Project Plan (Kleinfelder, 2004) and RPP Quality Assurance Project Plan (CRC, 2006) unless otherwise noted.

Field Measurements

Field water quality parameters for the CWFR and RPP, listed in Table 4-2 and 4-3, respectively, were measured prior to sample collection at each site, and flow was measured after samples were collected. At each site, a water quality sheet was completed; this documented the surface water level, width of the waterway, sample depth at the middle of the water column, total depth to sediment, general weather observations, time arrived on site, and field water quality measurements. Unless otherwise noted, field measurements were taken at a depth equal to approximately half the water column.

Flow

Flow is measured only under the CWFR. Measurements are taken at 10 cross-sections at each site. The wetted width of the waterbody was measured, recorded, and divided by 10 to determine the width of each cross-section. The midpoint of each cross-section was

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calculated by dividing the cross-section width in half. Velocity was measured at the midpoint of each cross-section at 0.2 and 0.8 of the total depth from the water surface, and then averaged. Flow was then calculated using the following equation:

$$Q = \sum_{n=1}^{10} W_n D_n V_n$$

Where:

Q	=	estimated flow at the site (cfs)
W	=	section width (feet)
D	=	depth of measurement (feet)
V	=	velocity (feet per second)

Electrical Conductivity, Dissolved Oxygen, Temperature, and pH

EC, DO, temperature, and pH measurements are taken for both the CWFR and RPP monitoring programs. These parameters were measured using a multiprobe instrument that was lowered directly into the water column. The meter was allowed to equilibrate for at least 90 seconds before data were recorded. The meter was calibrated at the beginning of the sampling day. Calibration logs for the CWFR monitoring events are included in Appendix B-1 and the logs for the RPP monitoring events are included in Appendix C-1.

Turbidity

Turbidity was measured using a turbidity meter. Turbidity measurements were recorded for both the CWFR and the RPP.

Total Dissolved Solids

EC is measured in the field using the multiprobe instrument as described above. These measurements are then converted to a TDS result by using the following equation:

$$TDS = 0.77 \times EC + 36.46$$

Where:

TDS	=	Total dissolved solids (mg/L)
EC	=	electrical conductivity measurement (µmhos/cm)

Grab Samples

For both the CWFR and RPP, grab samples were collected by a qualified and trained crew of Kleinfelder technicians. The water grab samples were collected using a Kemmerer water sampler (stainless steel and Teflon model, approximately 1.5 liter volume) at a depth equal to one-half the water column. The sample was transferred from the Kemmerer to a stainless steel container; collection continued until approximately 13 liters of sample were collected. This composite sample was homogenized and then split, using a stainless steel funnel, into the following:

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- Ten 1-L amber glass bottles for toxicity analysis (CWFR only)
- Two 1-L amber glass bottles for pesticide analysis (CWFR and RPP)
- One 1-L amber glass bottle for the color analysis (RPP only)

Non-disposable equipment used in sample collection was cleaned after each use by rinsing with distilled water. At each site before sample collection, sampling equipment was rinsed with water from the middle of the water column. Clean sampling equipment was not allowed to touch the ground, and field personnel wore clean, disposable gloves. New, clean sample bottles and jars were provided by the analytical laboratories or purchased from a supply company.

Sample containers were labeled at the time of sample collection with a unique sample ID number. The label also contained the following information:

- Sample ID
- Sample location
- Date and time of sample collection
- Kleinfelder project number
- Sampling technician identification

Samples were held on wet or blue ice at 4°C until delivered to the laboratory for analysis.

Sample Custody and Documentation

For both the CWFR and RPP, custody of samples was maintained and documented from the time of sample collection to completion of analysis. Each sample was considered to be in the sampler's custody, and the sampler was responsible for the care and custody of the samples until they were delivered to the laboratory. Field data sheets and copies of COC forms were maintained in the project file for samples collected during each event.

A COC form, sample labels, and field documentation were crosschecked to verify sample identification, type of analyses, sample volume, and number and type of containers.

Field data sheets, COC forms, and calibration forms were scanned by Kleinfelder and submitted to CH2M HILL. CWFR and RPP COC forms are included in Appendixes B-1 and C-1, respectively.

Sample Delivery and Analysis

For both the CWFR and RPP, after each sampling event, Kleinfelder submitted the samples under COC to the laboratories. Sample shipments were accompanied by the original COC form, which identified contents. Samples were transports after sample collection to the lab for analysis within the sample holding time. The laboratories performing analysis are provided in Table 4-4.

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TABLE 4-4
Analytical Laboratories and Methods, 2007

Laboratory	Analytes/Analytical Method(s)	Analytical Method(s) Standard Operating Procedures	Notes
AQUA-Science 17 Arboretum Dr. Davis, CA 95616 aquasci@aol.com 530-753-5456	Fathead Minnow 5th edition Screen	Acute 96-Hour Percent Survival Static non-renewal, static renewal, or LC50 Test (EPA 821-R-02-012) SOP #503.3	AQUA-Science performed aquatic toxicity tests and TIEs (when required) on samples collected July through October. AQUA-Science also coordinated shipment of sediment samples to Nautilus.
	c. dubia 5th ed. Screen	Acute 96-Hour Percent Survival Static non-renewal, static renewal, or LC50 Test (EPA 821-R-02-012) SOP #503.3	
	Algae Chronic Screen	Chronic Freshwater Algae (*selanastrum capricornutum)* Static non-renewal Growth Test SOP #510	
Nautilus Environmental San Diego Bioassay Laboratory 5550 Morehouse Drive, Suite 150 San Diego, CA 92121	Sediment Toxicity	10-Day Freshwater Sediment Invertebrate (*Hyalella azteca*) Survival Test SOP #518	Nautilus Environmental performed sediment toxicity tests on samples collected in July and September.
Environmental Micro Analysis, Inc. (EMA) 40 N. East Street, Suite E Woodland, CA 95776	EPA 8081A (w)	EPA 8081A (w)	See Appendix B-4 for list of analytes included in 8081A (w) scan. Tested as part of algae toxicity study plan.
	EPA 8141A (w) ONs	EPA 8141A (w)	See Appendix B-4 for list of analytes included in 8041A (w) scan. Tested as part of algae toxicity study plan.
	Triclopyr (Garlon)	EPA 8151A (w) (RL = 0.05 µg/L)	Specified Pesticide
	Penoxsulam	EPA 632 (w) (RL = 5 µg/L)	
	Diuron	EPA 632 (w) (RL = 0.50 µg/L)	Not a rice pesticide. Tested as part of algae toxicity study plan.
	Glyphosate	EPA 547 (RL = 10 µg/L)	Used on rice only as pre-plant treatment for borders. Tested as part of algae toxicity study plan. Subcontracted to North Coast Labs.

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TABLE 4-4
Analytical Laboratories and Methods, 2007

Laboratory	Analytes/Analytical Method(s)	Analytical Method(s) Standard Operating Procedures	Notes
Environmental Micro Analysis, Inc. (EMA) 40 N. East Street, Suite E Woodland, CA 95776	Thiobencarb	EPA 619(w)	Analyzed under the RPP.
	Molinate	EPA 619(w)	Analyzed under the RPP.
California Laboratory Services (CLS) 3249 Fitzgerald Road Rancho Cordova, CA 95742	Copper	EPA 200.7 (RL = 20 µg/L)	
	Hardness	SM 2340B	
	Color	EPA 110.2	
Valent Dublin Laboratory (Registrant Laboratory) 6560 Trinity Court Dublin, CA 94568	Thiobencarb	Registrant method	Analyzed under the RPP.
Syngenta Crop Protection, Inc. (Registrant Laboratory) 410 Swing Road Greensboro, NC 27419	Molinate	Registrant method	Analyzed under the RPP.

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CHAPTER 5

2007 Monitoring

The CWFR and RPP 2007 monitoring season details and results are provided separately according to the relevant required information for each program. CWFR monitoring information is provided in the following manner:

- Sampling schedule
- Field parameter results
- Copper and hardness results
- Toxicity testing results
- Pesticides results
- Flow data
- UC Davis edge-of-field monitoring

RPP monitoring information is provided in this manner:

- RPP Performance Goals
- Water holds
- Pesticides monitored
- Sampling schedule
- Sampling collection, delivery, and analysis
- Results

CWFR Monitoring

Monitoring is conducted under the CWFR according to the MRP. Monitoring at the five sites includes measurement of general field parameters, and laboratory analysis of aquatic toxicity, sediment toxicity, and specified pesticides. The 2007 CWFR monitoring requirements and the results follow.

Sampling Schedule

The MRP specifies the general calendar for monitoring. Based on the understanding of the rice growing season, a rice-specific monitoring calendar was developed to characterize the April through September "irrigation season," and two "storm events," which include an event in February or March (to characterize spring drainage) and an event in October (to characterize a potential storm event). In 2007, sampling was conducted as shown in Table 5-1, which lists regularly scheduled monitoring and any necessary resampling.

Field Parameters

The following field parameters were measured as part of the 2007 sampling effort: temperature, dissolved oxygen (DO), pH, electrical conductivity (EC), and turbidity.

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TABLE 5-1
2007 Sampling and Resampling Calendar

Event Type	Month	Date	Field	Copper	Hardness and Color	Specified Pesticides[a]	*C. dubia* Toxicity Tests	Minnow Toxicity Tests	*Selenastrum* Toxicity Tests	Additional Pesticides Under *Selenastrum* Study[b]	*H. azteca* Toxicity Tests	QC Samples
Winter drainage	Feb	2/27/07	✓		✓		✓	✓	✓			
Irrigation	Apr	4/24/07	✓		✓	✓	✓	✓	✓			Yes
Irrigation	May	5/08/07	✓		✓	✓	✓	✓	✓			
May resample[c]	May	5/15/07	✓									
Irrigation	June	6/05/07	✓		✓	✓	✓	✓	✓			Yes
June resample[c]	June	6/12/07	✓									
Irrigation/drainage	July	7/10/07	✓	CBD1	✓	✓	✓	✓	✓	CBD1	✓	
Irrigation/drainage	Aug	8/21/07	✓		✓	✓	✓	✓	✓			Yes
Irrigation/drainage	Sept	9/18/07	✓	BS1, CBD5, SSB	✓	✓	✓	✓	✓	BS1, CBD5, SSB	✓	
September resample[c]	Sept	9/21/07	✓									
Winter flood-up	Oct	10/23/07	✓		✓		✓	✓	✓			

[a]Year 3 (2007) specified pesticides were cyhalofop-butyl, azoxystrobin, propiconazole, and trifloxystrobin.
[b]Additional pesticides analyzed under *Selenastrum* effort.
[c]Resample requirements are based on the outcome of toxicity tests performed on sample collected during regularly scheduled monthly monitoring events.

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Temperature Measurements

Temperature measurements were taken during field sampling using the multiprobe instrument. Figure 5-1 shows the field temperature measurements. Temperature in the waterbodies is typically lowest in the winter and highest in the summer. This year, peak temperatures were observed during the July sampling event and reached 80°F, essentially tracking with ambient air temperatures. During this time of the year, these waterbodies are clearly not coldwater fisheries, though they may provide coldwater habitat during other times of the year.

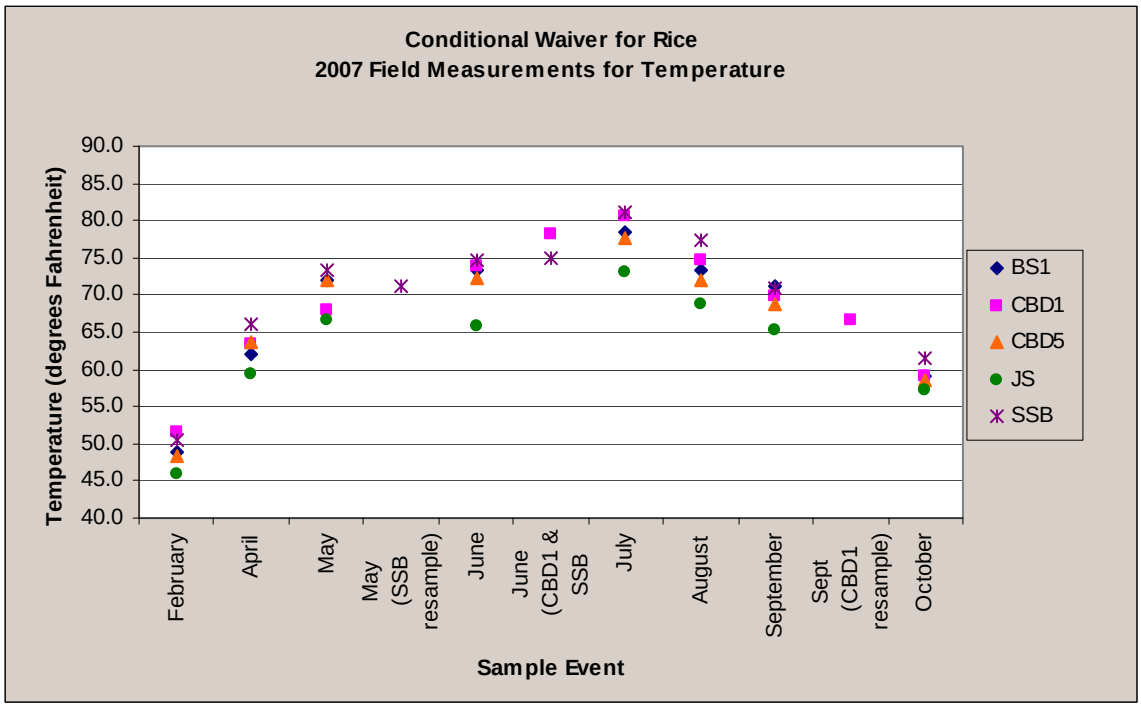

FIGURE 5-1
Field Temperature Measurements, 2007

Table 5-2 presents tabulated temperature results and basic summary information, including site minimum, maximum, mean, and median observed temperature, as well as event minimum, maximum, mean, and median observed temperature. Table 5-2 also includes an evaluation of the number of times and the frequency with which the observed field temperature exceeded 68°F, which is the Basin Plan water quality objective for the lower Sacramento River.

DO Measurements

The multiprobe instrument was used to take DO measurements in the field. Figure 5-2 shows the results of all DO measurements taken during 2007. Table 5-3 presents tabulated DO results and basic summary information, including site minimum, maximum, mean, and median observed DO, as well as event minimum, maximum, mean, and median observed DO Table 5-3 also includes an evaluation of the number of times and the frequency with which the observed field DO exceeded 5 mg/L, 6 mg/L, and 7 mg/L.

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DO values of less than 6 mg/L were observed at the BS1 and CBD1 sites. Both sites also had at least one DO reading of less than 5 mg/L during the 2007 sampling season.

Low DO (<6 mg/L) was consistently observed at the BS1 and CBD1 sites beginning in May. Low DO at CBD1 persisted through August; low DO at BS1 persisted through October. The mean DO concentration at the CBD1 site was 6.37 mg/L, and mean at the BS1 site was 6.48 mg/L. Site CBD1 experienced its lowest DO concentration during the July sampling event (3.46 mg/L), and BSI experienced its lowest DO concentration during the August sampling event (2.84 mg/L).

The multiprobe instrument is suspected of being incorrect in one sampling event (August). The values from that event are provided at the bottom of Table 5-3 as a reference; however, they were not used for site analysis.

Factors that may contribute to low DO include instream biological oxygen demand from high organic loads and productive algal communities (resulting from available nutrients) and the resulting diurnal oxygen depletion resulting from nighttime algae uptake, and/or uniform channel character that limits natural aeration.

Warm water temperatures can also contribute to low DO values. As temperature increases, oxygen solubility decreases and approaches the water quality objective (WQO) of 7 mg/L DO. This means that biological activity (such as from microorganisms breaking down detritus or other organic matter) can easily consume enough oxygen to depress DO below the WQO, particularly under warmer conditions. Figure 5-3 shows oxygen solubility as a function of temperature. Oxygen solubilities on the graph are approximate because additional factors, such as salinity, influence oxygen solubility.

After completion of the August sampling event, field staff from Kleinfelder contacted representatives from CH2M HILL and the CRC to alert them of DO testing concerns. The values for DO at all of the sites for this sampling event were very low. It was determined that the multiprobe instrument used in field testing had just been serviced, and had its sensors recently replaced. Although the instrument calibrated correctly, the values it produced were extremely low. Because low values were reported for all sites, it was assumed that the multiprobe instrument may be functioning incorrectly. AQUA-Science, the aquatic toxicity testing laboratory processing the water samples, was contacted to determine the DO content of the samples from this event. They reported that the readings were above 8 mg/L; lab personnel expressed concern about using the lab values because the samples had been on ice (cooler water typically has a higher DO) and had been mixed when transferred into the sample bottle.

As another form of check, the CRC elected to perform additional laboratory analysis for both chemical oxygen demand (COD) and biological oxygen demand (BOD). AQUA-Science sent portions of the field samples to CalTest for COD and BOD analysis on all five samples. All of the samples yielded non-detect, indicating that there was no oxygen demand in the water, suggesting that the field-acquired results were likely false. The field-recorded values from this sampling even are reported in Table 5-3 as a record of this event; however, they were not utilized in site characterization. The results of the COD and BOD analysis are included in AQUA-Science's August toxicity report, included in Appendix B-3.

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TABLE 5-2

Field Temperature Measurements Tabulated Results, 2007

		Temperature (degrees F)											
Event	**Date**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**	**Event Low**	**Event Mean**	**Event Median**	**Event High**	**Event Variance**	**Event Std. Deviation**	**N**
February	02/27/07	48.8	51.4	48.5	46.0	50.5	46.00	49.05	48.79	51.44	4.41	2.10	5
April	04/24/07	62.1	63.4	63.6	59.3	66.1	59.27	62.90	63.39	66.11	6.24	2.50	5
May	05/08/07	71.9	68.1	72.0	66.6	73.4	66.61	70.39	71.89	73.38	8.34	2.89	5
May (SSB resample)	05/15/07					71.1	71.08	71.08	71.08	71.08			1
June	06/05/07	73.4	74.0	72.3	65.8	74.7	65.77	72.02	73.36	74.68	12.98	3.60	5
June (CBD1 and SSB resample)	06/12/07		78.2			74.9	74.89	76.52	76.52	78.15	5.31	2.30	2
July	07/10/07	78.4	80.7	77.5	73.1	81.1	73.08	78.13	78.37	81.05	10.22	3.20	5
August	08/21/07	73.2	74.7	72.1	68.9	77.4	68.88	73.25	73.24	77.38	9.90	3.15	5
September	09/18/07	71.1	69.8	68.8	65.3	71.0	65.34	69.20	69.76	71.13	5.55	2.36	5
Sept (CBD1 resample)	09/21/07		66.5				66.52	66.52	66.52	66.52			1
October	10/23/07	59.1	59.2	58.4	57.3	61.6	57.29	59.12	59.13	61.56	2.44	1.56	5
	Site Low	48.79	51.44	48.45	46.00	50.54							
	Site Mean	67.25	68.59	66.65	62.78	70.16							
	Site Median	71.51	68.92	70.40	65.55	72.23							
	Site High	78.37	80.65	77.52	73.08	81.05							
	Site Variance	95.26	79.80	88.62	71.04	77.86							
	Site Std. Deviation	9.76	8.93	9.41	8.43	8.82							
	N	8	10	8	8	10							
	Number of Obs. Temp >68F	5	6	5	2	7							
	Number of Obs. Temp <68F	3	4	3	6	3							
	% of obs. Where Temp >68F	63%	60%	63%	25%	70%							
	% of obs. Where Temp <68F	38%	40%	38%	75%	30%							

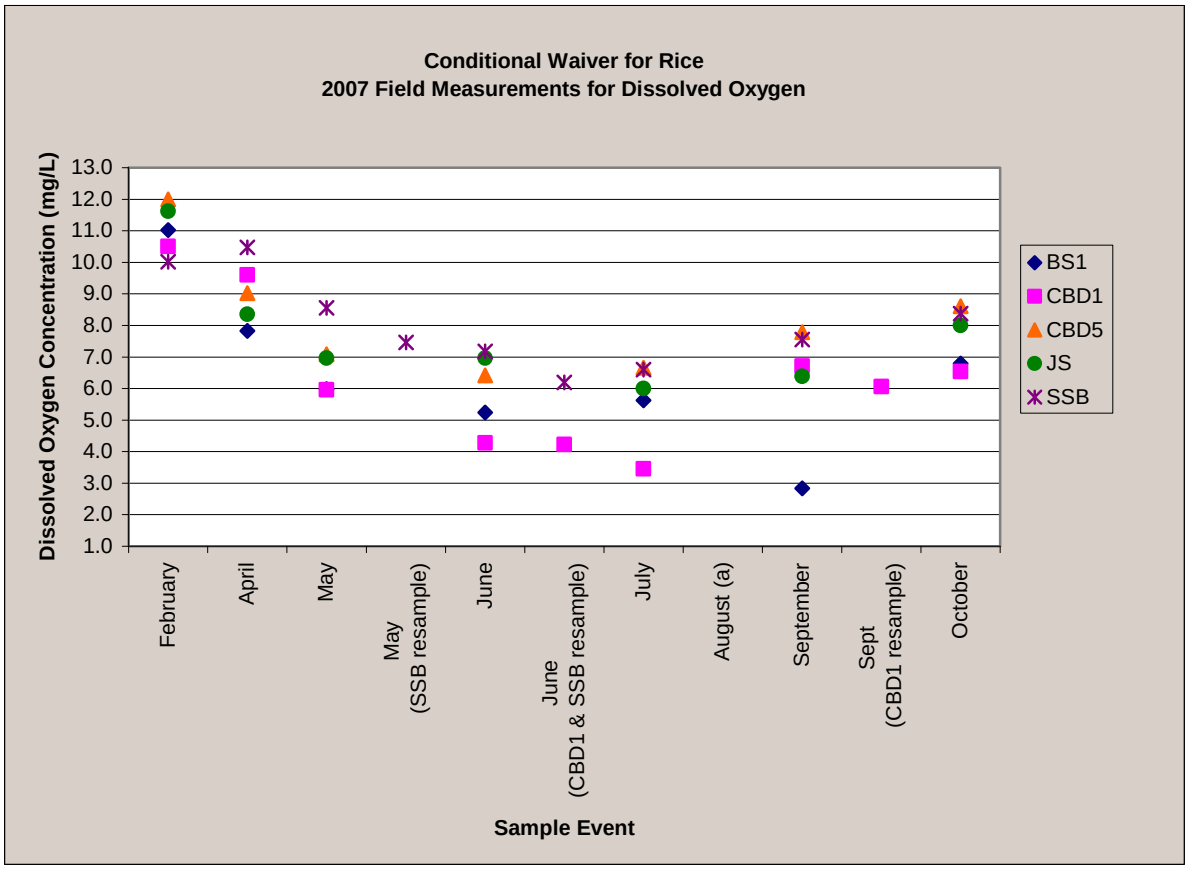

FIGURE 5-2
Dissolved Oxygen Field Measurements, 2007

pH

The multiprobe instrument was used to take pH measurements in the field. Figure 5-4 shows the results of all pH measurements taken during 2007. Table 5-4 presents tabulated pH results and basic summary information, including site minimum, maximum, mean, and median observed pH, as well as event minimum, maximum, mean, and median observed pH. Table 5-4 also includes an evaluation of the number of times and the frequency with which the observed field pH exceeded 6.5 and 8.5. There were no observations that exceeded a pH of 6.5 or 8.5 in 2007.

EC/TDS Measurements

The multiprobe instrument was used to take EC measurements in the field. Figure 5-5 shows the results of all EC measurements taken during 2007. Table 5-5 presents tabulated EC results and basic summary information, including site minimum, maximum, mean, and median observed EC, as well as event minimum, maximum, mean, and median observed EC. Table 5 5 also includes an evaluation of the number of times and the frequency with which the observed field EC exceeded 700 µmhos/cm, which has been cited by CVRWQCB as a threshold for reporting. This threshold is based on the citation in Recommended Numerical Limits to Translate Water Quality Objectives, 19 May 2004, and is an agricultural water

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quality value (Ayers and Wescot, 1985). Inclusion of this reference value is for screening purposes only and does not imply that the CRC recognizes this value as an adopted salinity WQO. Management of salinity with the Sacramento Valley should be undertaken in the context of the CALFED ROD. The 2007 sampling season yielded two samples with an EC of greater than 700 µmhos/cm. Both samples were collected during the February storm sampling event, an event that is not considered to be representative of rice drainage.

Turbidity

Turbidity measurements are taken in the field using the multiprobe instrument. Figure 5-6 shows the results of all turbidity measurements taken during 2007 sampling. Table 5-6 presents tabulated turbidity results and basic summary information, including site minimum, maximum, mean, and median observed turbidity, as well as event minimum, maximum, mean, and median observed turbidity.

Copper and Hardness Analysis

Selected samples collected in July (CBD1) and September (BS1, CBD5, and SSB) were analyzed for copper by using EPA method 200.7. All sites on both dates had a non-detect result.

Aquatic Toxicity Testing

Aquatic toxicity and sediment toxicity analyses were conducted in accordance with MRP requirements. Acute and chronic aquatic toxicity tests were performed on three test species:

- Fathead minnow (*Pimephales promelas*)
- Water flea (*Ceriodaphnia dubia*)
- Green algae (*Selenastrum capricornutum*)

The aquatic toxicity tests are performed on samples collected at each station and are performed concurrent with tests on control samples.

Sediment toxicity tests were performed on the test species *H. azteca* using samples collected at each site during July and September.

The following discussion explains the methodology used to perform the required test, and then provides details and summary results for each species-specific toxicity test.

Whole Effluent Test Methodology

Whole effluent toxicity (WET) tests, or bioassays, are one approach for evaluating the quality of discharged water and its potential to adversely affect biota in receiving waters. WET tests are laboratory toxicity studies in which standard test species are exposed to field-collected water samples by using standardized protocols, and the resulting toxicity (or absence of toxicity) is observed. Suter et al. (2000) identified strengths and weaknesses of bioassays. Strengths of bioassays include the following:

- Realistic representation of the form and bioavailability of the contaminants.
- Effects due to multiple contaminants or contaminants that lack toxicity data may be evaluated.
- The spatial distribution of toxicity can be determined by testing multiple locations

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TABLE 5-3

Dissolved Oxygen Field Measurements Tabulated Results, 2007

Event	Date	Dissolved Oxygen Concentration (mg/L) BS1	CBD1	CBD5	JS	SSB	Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N	Number of Obs. DO<7	Number of Obs. DO<6	Number of Obs. DO<5	% of Obs. Where DO<7	% of Obs. Where DO<6	% of Obs. Where DO<5
February	02/27/07	11.02	10.5	12.0	11.62	10.02	10.02	11.03	11.02	12.00	0.65	0.80	5	0	0	0	0%	0%	0%
April	04/24/07	7.83	9.60	9.02	8.35	10.47	7.83	9.05	9.02	10.47	1.07	1.04	5	0	0	0	0%	0%	0%
May	05/08/07	5.99	5.97	7.09	6.96	8.56	5.97	6.91	6.96	8.56	1.13	1.06	5	3	2	0	60%	40%	0%
May (SSB resample)	05/15/07					7.46	7.46	7.46	7.46	7.46			1	0	0	0	0%	0%	0%
June	06/05/07	5.25	4.28	6.42	6.96	7.18	4.28	6.02	6.42	7.18	1.51	1.23	5	4	2	1	80%	40%	20%
June (CBD1 and SSB resample)	06/12/07		4.23			6.19	4.23	5.21	5.21	6.19	1.93	1.39	2	2	1	1	100%	50%	50%
July	07/10/07	5.63	3.46	6.67	6.01	6.60	3.46	5.67	6.01	6.67	1.72	1.31	5	5	2	1	100%	40%	20%
August (a)	08/21/07									0.00			0	0	0	0			
September	09/18/07	2.84	6.71	7.79	6.39	7.56	2.84	6.25	6.71	7.79	3.99	2.00	5	3	1	1	60%	20%	20%
Sept (CBD1 resample)	09/21/07		6.07				6.07	6.07	6.07	6.07			1	1	0	0	100%	0%	0%
October	10/23/07	6.79	6.54	8.61	8.00	8.38	6.54	7.66	8.00	8.61	0.89	0.94	5	2	0	0	40%	0%	0%
	Site Low	2.84	3.46	6.42	6.01	6.19													
	Site Mean	6.48	6.37	8.23	7.75	8.05													
	Site Median	5.99	6.07	7.79	6.96	7.56													
	Site High	11.02	10.50	12.00	11.62	10.47													
	Site Variance	6.39	5.67	3.70	3.59	2.13													
	Site Std. Deviation	2.53	2.38	1.92	1.90	1.46													
	N	7	9	7	7	9													
	Number of Obs DO <7	5	7	2	4	2													
	Number of Obs DO <6	4	4	0	0	0													
	Number of Obs DO <5	1	3	0	0	0													
	% of Obs. Where DO <7	71%	78%	29%	57%	22%													
	% of Obs. Where DO <6	57%	44%	0%	0%	0%													
	% of Obs. Where DO <5	14%	33%	0%	0%	0%													

(a) DO results for the August sampling event are considered suspicious, and are therefore not included in the main table. They are provided below.

Event	Date	BS1	CBD1	CBD5	JS	SSB
August	08/21/07	1.79	0.05	0.13	4.39	1.60

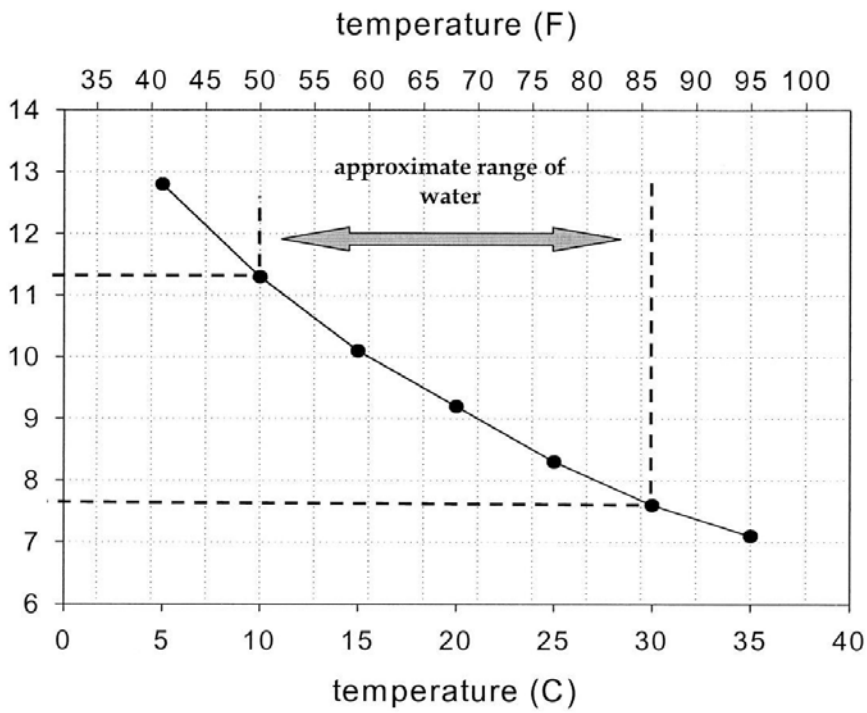

FIGURE 5-3
Oxygen Solubility as a Function of Temperature

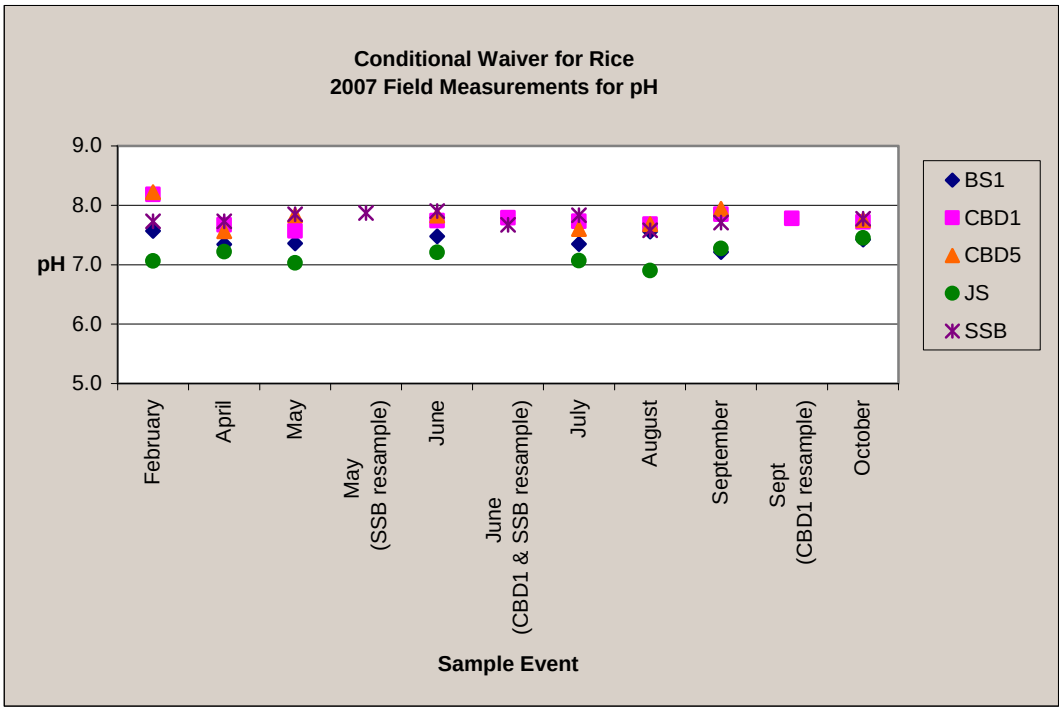

FIGURE 5-4
pH Field Measurements, 2007

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Weaknesses of bioassays include the following:

- Test media may be modified by collection and preparation for toxicity testing.
- Forms and concentrations of chemicals may be modified by sample collection and processing.
- Samples may be unrepresentative.
- Most media toxicity tests have short durations and test species may not adequately represent species in the field.
- If toxicity is observed, the cause of the toxicity is unknown.

These limitations do not negate the considerable advantages of media toxicity testing. The first three limitations can be avoided to a considerable degree by exercising care in the collection and handling of samples and in the conduct of the tests. The fourth limitation requires analysis and interpretation of the results. The fifth limitation requires additional testing to identify which components of the contaminant mixture are responsible, a process called toxicity identification evaluation (TIE) (EPA 1991a; EPA 1993f). In the TIE process, the toxic components of a mixture are identified by removing components of a mixture and testing the residue, fractionating the mixture and testing the fractions, or adding components of the mixture to background medium and testing the artificially contaminated medium.

Control and reference media both should be tested along with the contaminated media. Control media are laboratory media known to be appropriate for the test species. That is, control media support the maximal rates of survival, growth, and reproduction of the test species. The characteristics of control media are usually prescribed in standard test protocols. Reference media are media that come from near the site, and are physically and chemically similar to the test media except that they do not contain the site contaminants. The control tests determine whether the test was conducted properly using healthy organisms. The local reference tests provide the basis for determining how much toxicity the site adds to proximate media. If a separate clean reference is used, it provides the basis for determining whether the differences from controls are due to contaminants or to properties of the media, such as pH.

Standard toxicity tests have been developed for determining the acceptability of aqueous effluents and are widely used in effluent permitting in the United States. These tests are unique in the extent to which they have been validated against biosurvey data (Dickson et al., 1992; Grothe et al., 1996). In a number of studies, the 7-day fathead minnow and *Ceriodaphnia dubia* tests have been found to be predictive of reductions in the species richness of aquatic communities. As a result of this intensive development and validation, these tests are widely used.

In accordance with the MRP Order, acute and chronic toxicity tests were performed on three test species:

- Fathead minnow, *Pimephales promelas*
- Water flea, *Ceriodaphnia dubia*
- Green algae, *Selenastrum capricornutum*

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TABLE 5-4

pH Field Measurements Tabulated Results, 2007

Event	Date	pH BS1	pH CBD1	pH CBD5	pH JS	pH SSB	Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N	Number of Obs. pH<6.5	Number of Obs. pH>8.5	% of Obs. Where pH<6.5	% of Obs. Where pH>8.5
February	02/27/07	7.57	8.18	8.22	7.06	7.73	7.06	7.75	7.73	8.22	0.23	0.48	5	0	0	0	0%
April	04/24/07	7.34	7.67	7.56	7.22	7.73	7.22	7.50	7.56	7.73	0.05	0.22	5	0	0	0	0%
May	05/08/07	7.36	7.57	7.83	7.03	7.85	7.03	7.53	7.57	7.85	0.12	0.34	5	0	0	0	0%
May (SSB resample)	05/15/07					7.87	7.87	7.87	7.87	7.87			1	0	0	0	0%
June	06/05/07	7.48	7.74	7.83	7.21	7.9	7.21	7.63	7.74	7.90	0.08	0.29	5	0	0	0	0%
June (CBD1 and SSB resample)	06/12/07		7.79			7.67	7.67	7.73	7.73	7.79	0.01	0.08	2	0	0	0	0%
July	07/10/07	7.35	7.73	7.60	7.07	7.83	7.07	7.51	7.60	7.83	0.10	0.31	5	0	0	0	0%
August	08/21/07	7.56	7.68	7.68	6.90	7.58	6.90	7.48	7.58	7.68	0.11	0.33	5	0	0	0	0%
September	09/18/07	7.22	7.85	7.94	7.27	7.71	7.22	7.60	7.71	7.94	0.11	0.33	5	0	0	0	0%
Sept (CBD1 resample)	09/21/07		7.78				7.78	7.78	7.78	7.78			1	0	0	0	0%
October	10/23/07	7.42	7.72	7.75	7.45	7.77	7.42	7.62	7.72	7.77	0.03	0.17	5	0	0	0	0%
	Site Low	7.22	7.57	7.56	6.90	7.58											
	Site Mean	7.41	7.77	7.80	7.15	7.76											
	Site Median	7.39	7.74	7.79	7.14	7.75											
	Site High	7.57	8.18	8.22	7.45	7.90											
	Site Variance	0.01	0.03	0.04	0.03	0.01											
	Site Std. Deviation	0.12	0.16	0.21	0.17	0.10											
	N	8	10	8	8	10											
	Number of Obs. pH <6.5	0	0	0	0	0											
	Number of Obs. pH >8.5	0	0	0	0	0											
	% of Obs. Where pH <6.5	0%	0%	0%	0%	0%											
	% of Obs. Where pH >8.5	0%	0%	0%	0%	0%											

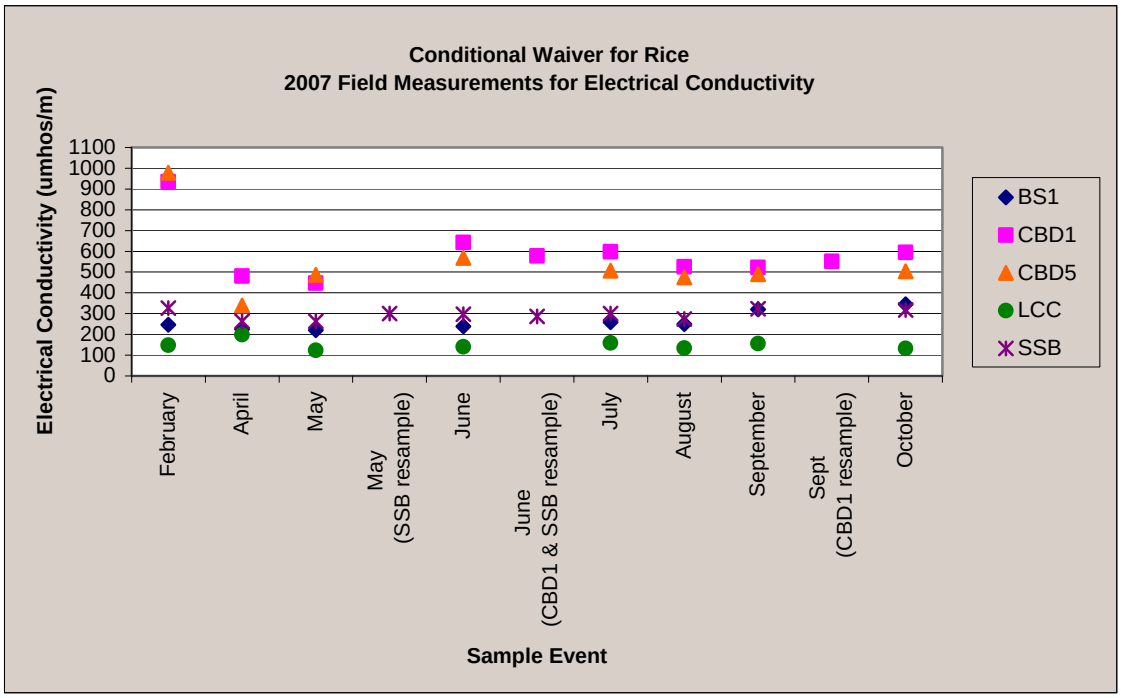

FIGURE 5-5
EC Field Measurements, 2007

Tests are performed on samples collected at each station and are performed concurrent with tests on control samples.

Fathead Minnow (*Pimephales promelas*)

The MRP includes toxicity tests using the test species *Pimephales promelas* to detect toxicity to fish species. This minnow is considered a sensitive test species, and toxicity to *P. promelas* can indicate a water quality concern.

2007 P. *promelas* Toxicity Testing. The AQUA-Science laboratory performed *P. promelas* toxicity tests. The detailed results of these tests are shown in Table 5-7. These tabulated results provide the sample date (or resample date), the lab report that summarizes the test results, and the test organisms' percent survival (as compared to the control). For all of the analyses conducted during Year 3, there was no statistically significant observed toxicity to fathead minnow. No resampling was triggered and no TIEs were required. These results indicate that sampled waters were not toxic to fish species.

Water Flea (*Ceriodaphnia dubia*). The MRP includes toxicity tests using the test species *Ceriodaphnia dubia* in order to detect toxicity to invertebrates. *C. dubia* is considered a sensitive test species, and toxicity to *C. dubia* can indicate a water quality concern.

2007 *C. dubia* Toxicity Testing. The AQUA-Science laboratory performed *C. dubia* toxicity tests. The detailed results of the daphnia toxicity tests are shown in Table 5-8. These tabulated results provide the sample date (or resample date), the lab report that summarizes the test results, the test organisms' percent survival (as compared to the control), whether resampling was triggered, and the results of any resampling. The results of the 2007 CWFR *C. dubia* toxicity testing are summarized as follows:

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- Analysis conducted in September 2007 resulted in 0 percent survival of the test organism *C. dubia* for the CBD1 sample. As a result, resampling was triggered, and a Phase I TIE was performed. The results of the TIE indicated that a non-polar organic chemical(s) contributed to the toxicity. Inorganic chemicals and cationic metals were determined not be contributing to the observed toxicity. The resample did not result in statistically significant toxicity to *C. dubia*.
- Analysis conducted in February and April through October showed no statistically significant observed toxicity to *C. dubia.* No resampling was triggered, and no TIEs were required.

Green Algae (*Selenastrum capricornutum*)

The MRP includes toxicity tests using the test species *Selenastrum capricornutum* in order to detect toxicity to aquatic plants. *Selenastrum* is a green algae species and is considered the most sensitive test species. Toxicity to *Selenastrum* can indicate a water quality concern.

Background. Monitoring conducted in Year 1 and Year 2 of the CWFR monitoring program identified *Selenastrum* reductions as on an ongoing occurrence. TIEs performed in Year 1 and Year 2 were not conclusive in determining the causal agents contributing to toxicity, although "short-lived non-polar organic herbicides" were often indicated based on the effectiveness of SPE-18 treatments in removing the toxicity. Follow-on chemistry conducted on elute derived from the SPE-18 columns resulted in a series of non-detects for various rice herbicides and non-rice products.

In 2007, an alternative study plan was proposed by the CRC and was endorsed by CVRWQCB staff. In an effort to improve the effectiveness of the study plan in determining the causal agent contributing to the *Selenastrum* reductions, the CRC proposed, in lieu of TIEs, to submit samples for herbicides and copper analysis concurrent with the initiation of the *Selenastrum* toxicity tests. This additional herbicide and copper analysis was conducted on samples collected at CBD1 in July and at BS1, CBD5, and SSB in September.

This approach provided the benefit of including immediate analysis of original samples (the prior approach involved waiting for determination of toxicity prior to submitting samples for herbicide analysis). In addition, since previous TIEs had been unsuccessful in advancing the understanding of the causal agent beyond the determination of "short-lived non-polar organic herbicides," this approach was deemed more economical because it would provide up-front chemistry aimed at assessing specific herbicides and it would provide numeric results for detected pesticides.

In addition to the additional herbicide analysis, resampling is required at any site with an observed toxicity reduction of 50 percent or more (less than 50 percent survival as compared to the control).

Based on a review of previous *Selenastrum* toxicity studies conducted by the CRC and by UC Davis and the RWQCB, the RWQCB staff, CH2M HILL, and the CRC consulted on the list of herbicides to be analyzed in 2007. These herbicides are listed in Table 5-9. In addition, the lab reported the results of the full scan of the EPA 8081A (w) method, as well as many of the analytes included under the EPA 8041A (w) method. These results are included in Appendix B-4.

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TABLE 5-5

EC Field Measurements Tabulated Results, 2007

		Electrical Conductivity (umhos/cm)													
Event	Date	BS1	CBD1	CBD5	LCC	SSB	Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N	Number of Obs. EC>700	% of Obs. Where EC>700
February	02/27/07	246	935	978	148	326	148.00	526.60	326.00	978.00	158216.80	397.76	5	2	40%
April	04/24/07	225	480	339	198	263	198.00	301.00	263.00	480.00	12828.50	113.26	5	0	0%
May	05/08/07	221	447	487	124	264	124.00	308.60	264.00	487.00	23680.30	153.88	5	0	0%
May (SSB resample)	05/15/07					301	301.00	301.00	301.00	301.00			1	0	0%
June	06/05/07	239	643	568	140	298	140.00	377.60	298.00	643.00	47172.30	217.19	5	0	0%
June (CBD1 and SSB resample)	06/12/07		578			286	286.00	432.00	432.00	578.00	42632.00	206.48	2	0	0%
July	07/10/07	259	598	507	158	300	158.00	364.40	300.00	598.00	33190.30	182.18	5	0	0%
August	08/21/07	249	525	475	133	274	133.40	331.28	274.00	525.00	26847.59	163.85	5	0	0%
September	09/18/07	321	522	490	155	324	155.00	362.40	324.00	522.00	21989.30	148.29	5	0	0%
Sept (CBD1 resample)	09/21/07		552				552.00	552.00	552.00	552.00			1	0	0%
October	10/23/07	345	595	504	132	318	132.00	378.80	345.00	595.00	32041.70	179.00	5	0	0%
	Site Low	221.00	447.00	339.00	124.00	263.00									
	Site Mean	263.13	587.50	543.50	148.55	295.40									
	Site Median	247.50	565.00	497.00	144.00	299.00									
	Site High	345.00	935.00	978.00	198.00	326.00									
	Site Variance	2053.27	18316.28	34978.57	536.53	545.16									
	Site Std. Seviation	45.31	135.34	187.03	23.16	23.35									
	N	8	10	8	8	10									
	Number of Obs. EC >700	0	1	1	0	0									
	% of Obs. Where EC >700	0%	10%	13%	0%	0%									

		Total Dissolved Solids (mg/L)													
Event	Date	BS1	CBD1	CBD5	LCC	SSB	Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N	Number of Obs. EC>700	% of Obs. Where EC>700
February	02/27/07	226	756	790	150	287	150.42	441.94	287.48	789.52	93806.74	306.28	5	2	40%
April	04/24/07	210	406	297	189	239	188.92	268.23	238.97	406.06	7606.02	87.21	5	0	0%
May	05/08/07	207	381	411	132	240	131.94	274.08	239.74	411.45	14040.05	118.49	5	0	0%
May (SSB resample)	05/15/07					268	268.23	268.23	268.23	268.23			1	0	0%
June	06/05/07	220	532	474	144	266	144.26	327.21	265.92	531.57	27968.46	167.24	5	0	0%
June (CBD1 and SSB resample)	06/12/07		482			257	256.68	369.10	369.10	481.52	25276.51	158.99	2	0	0%
July	07/10/07	236	497	427	158	267	158.12	317.05	267.46	496.92	19678.53	140.28	5	0	0%
August	08/21/07	228	441	402	139	247	139.18	291.55	247.44	440.71	15917.94	126.17	5	0	0%
September	09/18/07	284	438	414	156	286	155.81	315.51	285.94	438.40	13037.46	114.18	5	0	0%
Sept (CBD1 resample)	09/21/07		462				461.50	461.50	461.50	461.50			1	0	0%
October	10/23/07	302	495	425	138	281	138.10	328.14	302.11	494.61	18997.52	137.83	5	0	0%
	Site Low	206.63	380.65	297.49	131.94	238.97									
	Site Mean	239.07	488.84	454.96	150.84	263.92									
	Site Median	227.04	471.51	419.15	147.34	266.69									
	Site High	302.11	756.41	789.52	188.92	287.48									
	Site Variance	1217.38	10859.72	20738.79	318.11	323.22									
	Site Std. Seviation	34.89	104.21	144.01	17.84	17.98									
	N	8	10	8	8	10									
	Number of Obs. EC >700	0	1	1	0	0									
	% of Obs. Where EC >700	0%	10%	13%	0%	0%									

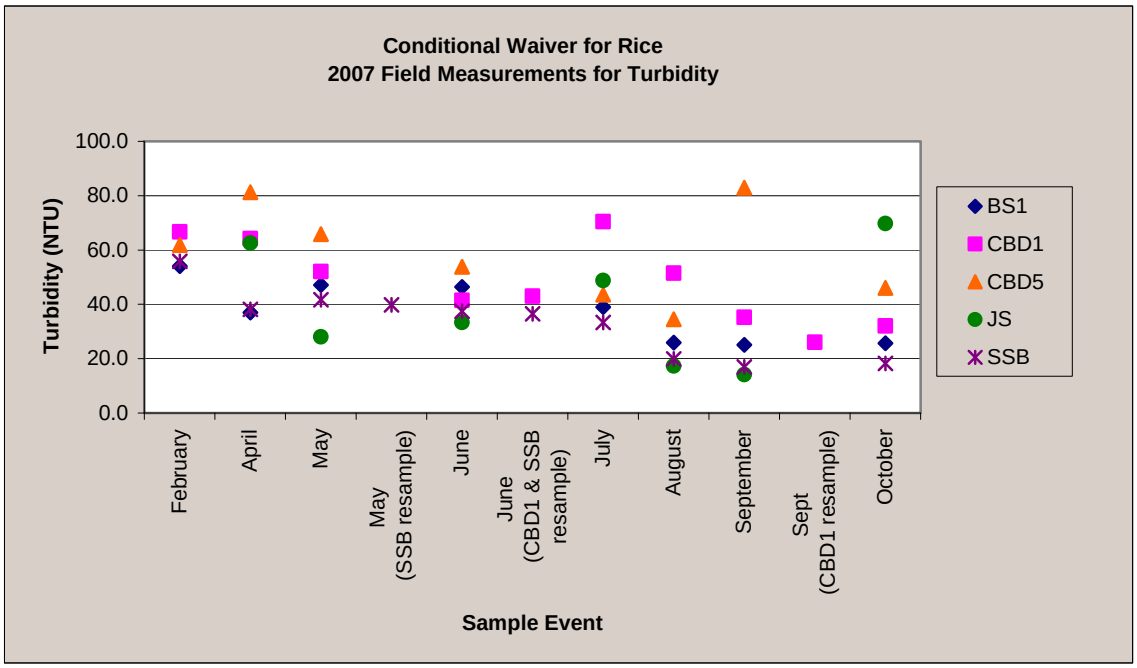

FIGURE 5-6
Turbidity Field Measurements, 2007

2007 *Selenastrum* Testing

Selenastrum toxicity tests were performed by the laboratory AQUA-Science on samples. The detailed results of the *Selenastrum* toxicity tests are shown in Table 5-10. These tabulated results provide the sample date (or resample date), the lab report that summarizes the results of the tests, the test organisms' percent survival (as compared to the control), whether resampling was triggered, and the results of any resampling. The results of the 2007 CWFR *Selenastrum* toxicity testing are summarized as follows:

February

- All samples showed 100 percent survival as compared to the control.

April

- Statistically significant toxicity was observed at BS1 (86 percent) and CBD1 (85 percent).
- Samples analyzed at CBD5, JS, and SSB showed no statistically significant observed toxicity.
- No resampling was triggered.

May

- Statistically significant toxicity was observed at BS1 (84 percent), CBD1 (67 percent), and SSB (28 percent).
- Samples analyzed at CBD5 and JS showed no statistically significant observed toxicity.
- Resampling was triggered at SSB. Resampling was performed 7 days following the original sampling event. The results of the resampling showed 105 percent survival as compared to the control, indicating that that the previously observed toxicity did not persist.

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June

- Statistically significant toxicity was observed at all sites: BS1, 86 percent; CBD1, 25 percent; CBD5, 79 percent; JS, 66 percent; and SSB, 8 percent.
- Resampling was triggered at CBD1 and SSB. The results of the resampling at CBD1 showed 8 percent survival, and results at SSB showed 36 percent survival, both of which were determined to be statistically significant. These results indicate that the previously observed toxicity did persist at CBD1 and SSB.

July

- Statistically significant toxicity was observed at CBD1 (86 percent), JS (80 percent), and SSB (74 percent).
- Results observed at BS1 and CBD5 showed 100 percent survival.
- No resampling was triggered.
- Results for additional herbicides analyzed performed on the CBD1 sample as part of the CRC's Selenastrum study plan were all non-detect. These results are included in Appendix B-4.

August

- All samples showed greater than 100 percent survival as compared to the control.

September

- Statistically significant toxicity was observed at SSB (70 percent).
- Samples analyzed at BS1, CBD1, CBD5, and JS showed no statistically significant observed toxicity.
- No resampling was triggered.
- Results for additional herbicides analyzed performed on the BS1, CBD5, and SSB samples as part of the CRC's Selenastrum study plan were all non-detect. These results are included in Appendix B-4.

October

- All samples showed equal to or greater than 100 percent survival as compared to the control.

Sediment Toxicity Testing

The MRP requires sediment toxicity tests using the test species *Hyalella azteca* to detect toxicity to benthic organisms. A small amphipod common in aquatic systems, *H. azteca* is considered a sensitive test species, and toxicity to *H. azteca* can indicate a sediment quality concern. As required, sediment toxicity tests were performed on samples collected in July and September.

July 2007 Testing

H. azteca toxicity tests performed on samples collected in July showed no statistically significant effects (87 percent to 96 percent survival, as compared to the control). No resampling was required. July *Hyalella* results are detailed in Table 5-11.

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TABLE 5-6

Turbidity Field Results Tabulated Results, 2007

		Turbidity (NTU)											
Event	**Date**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**	**Event Low**	**Event Mean**	**Event Median**	**Event High**	**Event Variance**	**Event Std. Deviation**	**N**
February	02/27/07	54.03	66.68	61.83	308.5	55.81	54.03	109.37	61.83	308.50	12416.61	111.43	5
April	04/24/07	37.03	64.24	81.27	62.54	38.19	37.03	56.65	62.54	81.27	356.04	18.87	5
May	05/08/07	47.08	52.08	65.89	28.09	41.64	28.09	46.96	47.08	65.89	192.24	13.87	5
May (SSB resample)	05/15/07					39.76	39.76	39.76	39.76	39.76			1
June	06/05/07	46.46	41.41	53.83	33.36	37.42	33.36	42.50	41.41	53.83	63.65	7.98	5
June (CBD1 and SSB resample)	06/12/07		43.03			36.48	36.48	39.76	39.76	43.03	21.45	4.63	2
July	07/10/07	38.93	70.42	43.54	48.73	33.31	33.31	46.99	43.54	70.42	204.00	14.28	5
August	08/21/07	25.91	51.47	34.46	17.27	19.89	17.27	29.80	25.91	51.47	190.41	13.80	5
September	09/18/07	25.08	35.17	82.92	14.13	17.01	14.13	34.86	25.08	82.92	788.47	28.08	5
Sept (CBD1 resample)	09/21/07		26.00				26.00	26.00	26.00	26.00			1
October	10/23/07	25.64	32.04	46.10	69.72	18.23	18.23	38.35	32.04	69.72	412.58	20.31	5
	Site Low	25.08	26.00	34.46	14.13	17.01							
	Site Mean	37.52	48.25	58.73	72.79	33.77							
	Site Median	37.98	47.25	57.83	41.05	36.95							
	Site High	54.03	70.42	82.92	308.50	55.81							
	Site Variance	125.26	234.98	308.20	9475.55	148.78							
	Site Std. Deviation	11.19	15.33	17.56	97.34	12.20							
	N	8	10	8	8	10							

TABLE 5-7

Minnow Toxicity Test Summary Results

Month	Event	Sample Date	Appendix Reference	Minnow 96-Hour % Survival as Compared to Control (Control Survival)					Resample Triggered?				
				BS1	CBD1	CBD5	JS	SSB	BS1	CBD1	CBD5	JS	SSB
February	Original	02/27/07	March 6, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N
April	Original	04/24/07	May 1, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N
	Resample												
May	Original	05/08/07	May 29, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N
June	Original	06/05/07	July 2, 2007; AQUA-Science	100%	100%	97.5%	100%	100%	N	N	N	N	N
July	Original	07/10/07	July 30, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N
August	Original	08/21/07	Sept 13, 2007; AQUA-Science	100%	100%	100%	97.5%	97.5%	N	N	N	N	N
	Resample								N	N	N	N	N
September	Original	09/18/07	Oct 9, 2007; AQUA-Science	100%	100%	100%	97.5%	100%	N	N	N	N	N
October	Original	10/23/07	Nov 2, 2007; AQUA-Science	100%	97.5%	100%	100.0%	100%	N	N	N	N	N

Note: N indicates that a resample was not triggered.

TABLE 5-8

C. Dubia Toxicity Test Summary Results

				C. Dubia 96-Hour % Survival as Compared to Control (Control Survival)					Resample Triggered?					TIE Performed (O = original sample, R = resample)				
Month	**Event**	**Sample Date**	**Appendix Reference**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**
February	Original	02/27/07	March 6, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N	—	—	—	—	—
April	Original	04/24/07	May 1, 2007; AQUA-Science	95%	100%	100%	100%	100%	N	N	N	N	N	—	—	—	—	—
May	Original	05/08/07	May 29, 2007; AQUA-Science	100%	100%	100%	100%	95%	N	N	N	N	N	—	—	—	—	—
	Resample	05/15/07																
June	Original	06/05/07	July 2, 2007; AQUA-Science	100%	100%	100%	95%	100%	N	N	N	N	N	—	—	—	—	—
	Resample	06/12/07																
July	Original	07/10/07	July 30, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N	—	—	—	—	—
August	Original	08/21/07	Sept 13, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N	—	—	—	—	—
September	Original	09/18/07	Oct 9, 2007; AQUA-Science	100%	0%	100%	100%	95%	N	Y	N	N	N	—	—	—	—	—
	Resample	09/21/07		—	95%	—	—	—	NA	NA	NA	NA	NA	—	O	—	—	—
October	Original	10/23/07	Nov 2, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N	—	—	—	—	—

Resample Triggered

N indicates that a resample was not triggered.

Y indicates that a resample was triggered.

NA indicates that resample requirements are not applicable based on resample results.

— indicates that no TIE was required.

O indicates that a TIE was performed on original sample.

R indicates that a TIE was performed on resample.

TABLE 5-9
Herbicides Identified for Analysis as Part of the *Selenastrum* Study Plan, 2007

Herbicide	EPA Method[a]	Detection (MRL)[b]	Application Period	Sequential Application	Water-hold Period	Use
Atrazine	8141A	0.5 µg/L	—	NA	NA	Non-rice herbicide
Bensulfuron-methyl	8081A	20 µg/L	April, May–June	Yes	7 day (static)	Herbicide
Bispyribac sodium	8151A(m)	1.0 µg/L	April–May or May–June	Yes	7 day	Herbicide
Carfentrazone	8081A	20 µg/L	April–June	Yes	5-day static, 30-day release	Herbicide
Clomazone	8141A	100 µg/L	April–May	No, 120-day PHI	14 day	Herbicide
Diuron	632	1.0 µg/L	—	NA	NA	Non-rice herbicide
Glyphosate	547	10.0 µg/L	March, if rice preplant	NA	None (preplant)	Non-rice herbicide
Halosulfuron	8081A	50 µg/L	April–May	No	None	Herbicide
Molinate	8141A	1 µg/L	April–May	No	28 day	Herbicide
Pendimethalin	8081A	20 µg/L	March–April	No	None (preplant)	Herbicide
Penoxsulam	632	30 µg/L[c]	April–June	No	None	Herbicide
Propanil	8081A	0.5 µg/L	May–July	Yes	7 day	Herbicide
Simazine	8141A	0.5 µg/L	—	NA	NA	Non-rice herbicide
Thiobencarb	8141A	5 µg/L	April–May	No	19 day	Herbicide
Triclopyr TEA	8151A	0.25 µg/L	May–June	Yes	20 day	Herbicide

[a]Modified or new EPA lab method for herbicide as specified by Environmental Micro Analysis, Inc. (CRC-contracted lab) as noted on the laboratory's Web site.
[b]Estimated minimum reportable limit (MRL). The actual detection and reportable limits are to be provided by the analytical laboratory as part of QA/QC.
[c]Proprietary method used by Environmental Micro Analysis, Inc. The reported MRL is based on the laboratory results included in Appendix B.

October 2007 Testing

H. azteca toxicity tests performed on samples collected in July showed no statistically significant effects (98 percent to 104 percent survival, as compared to the control). No resampling was required. October *H. azteca* results are detailed in Table 5-12.

As noted in the report from the laboratory, included in Appendix B-5, due to an error in shipment by the delivery service, though shipped for overnight delivery service on September 20th, the samples were not received by the sediment testing laboratory

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(Nautilus) until September 24th. The temperature of the samples was 23.8°C. As a result, Nautilus contacted AQUA-Science, which shipped a duplicate set of samples to Nautilus. The duplicate set of samples was received and met temperature thresholds and was analyzed.

Specified Pesticides

Four "specified pesticides" were monitored during Year 3: cyhalofop-butyl azoxystrobin propiconazole and trifloxystrobin. Samples collected April through September were analyzed for the specified pesticides. Table 5-13 shows the chemical that were analyzed, the EPA methods, method reporting limits, and additional information regarding the usage of these products on rice.

Results for the entire year for all sites were non-detect (below the MRL). The raw lab results are included in the Appendix B-4.

2007 Flow Data

Table 5-14 contains the flow data collected under the 2007 Conditional Waiver for Rice Program. These flow estimates are calculated based on field cross-section and velocity measurements collected at the time of water quality sample collection. Field measurements are documented on field sheets contained in Appendix B-1.

UC Davis Edge-of-Field Monitoring

The MRP requirements incorporate monitoring conducted under UC Davis CALFED grant 384. The grant was approved for funding by the SWRCB on June 17, 2004 (Resolution No. 2004-0035) and contains four study components producing data to be submitted by UC Davis to the CVRWQCB. The grant contract is entitled "The Regents of the University of California, University of California Davis - State Water Resources Control Board Grant Agreement No. 04-183-555-0." UC Davis, with significant input and oversight by CVRWQCB staff, developed a monitoring plan that specifies the parameters of monitoring activities to be conducted under the grant. On behalf of the SWRCB, the grant is managed by a CVRWQCB staff person. Descriptions of each study component's purpose and parameters follow.

Study Component 1

Study Component #1 is focused on the evaluation of Total Organic Carbon and Dissolved Organic Carbon (TOC/DOC), TDS and EC, and turbidity of outflows from rice fields cultivated under differing straw decomposition and winter flood practices. This component includes the evaluation of a minimum of four fields with two plots per field. The MRP specifies the Study Component 1 monitoring.

Study Component 2

Study Component 2 is designed to measure the amount and transport of TOC and DOC, TDS and EC, and turbidity in rice field peripheral drains. Peripheral drain sites are to be

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TABLE 5-10

Selanastrum Toxicity Test Summary Results

				Selanastrum 96-Hour % Survival as Compared to Control (Control Survival)					Resample Triggered?				
Month	**Event**	**Sample Date**	**Appendix Reference**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**
February	Original	02/27/07	March 6, 2007; AQUA-Science	100%	100%	100%	100%	100%	N	N	N	N	N
April	Original	04/24/07	May 1, 2007; AQUA-Science	86%	85%	91%	97%	96%	N	N	N	N	N
May	Original	05/08/07	May 29, 2007; AQUA-Science	84%	67%	99%	98%	28%	**Y**	N	N	N	N
	Resample	05/15/07						106%					
June	Original	06/05/07	July 2, 2007; AQUA-Science	86%	25%	79%	66%	8%	N	**Y**	N	N	**Y**
	Resample	06/12/07			8%			36%					
July	Original	07/10/07	July 30, 2007; AQUA-Science	100%	86%	100%	80%	74%	N	N	N	N	N
	Resample												
August	Original	08/21/07	Sept 13, 2007; AQUA-Science	125%	109%	118%	105%	115%	N	N	N	N	N
September	Original	09/18/07	Oct 9, 2007; AQUA-Science	88%	89%	94%	95%	70%	N	N	N	N	N
October	Original	10/23/07	Nov 2, 2007; AQUA-Science	100%	105%	115%	102%	104%	N	N	N	N	N

Statistically Significant Toxicity Observed

Resample Triggered

N indicates that a resample was not triggered

Y indicates that a resample was triggered

TABLE 5-11
July *H. azteca* Sediment Toxicity Results, 2007

Site	Percent Survival	Percent Reduction Compared to Control	Percent Survival Compared to Control
Control	98%	—	—
BS1	92%	6%	94%
CBD1	89%	10%	90%
CBD5	94%	4%	96%
JS	86%	13%	87%
SSB	90%	9%	91%

TABLE 5-12
October *H. azteca* Sediment Toxicity Results, 2007

Site	Percent Survival	Percent Reduction Compared to Control	Percent Survival Compared to Control
Control	92	—	—
BS1	90	2%	98%
CBD1	90	2%	98%
CBD5	87	5%	95%
JS	96	—	104%
SSB	97	—	104%

TABLE 5-13
Pesticides Analyzed, 2007

Chemical	EPA Method	Method Reporting Limit (MRL)[b]	Application Period	Sequential Application	Water-hold period	Use
Azoxystrobin	8141A	0.5 µg/L	May–June	Yes	14 day	Fungicide
Cyhalofop-butyl	8081A	50 µg/L	May–June	Yes	7 day	Herbicide
Propiconazole[a]	8141A	1.0 µg/L	May–June	Yes	7 day	Fungicide
Trifloxystrobin[a]	8151A	0.2 µg/L	May–June	Yes	7 day	Fungicide

[a]The rice pesticide Stratego® is comprised of the two active ingredients propiconazole and trifloxystrobin.

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TABLE 5-14
2007 Flow Data

Month	Sample Date	Estimated Flow(cubic feet per second)				
		BS1	CBD1	CBD5	JS	SSB
February	2/27/2007	491	0	151	85	0
April	4/24/2007	59	0	522	0	533
May	5/8/2007	231	16	195	23	496
June	6/5/2007	139	35	625	39	364
July	7/10/2007	140	97	730	21	102
August	8/21/2007	66	1031	1191	52	556
September	9/18/2007	16	200	518	0	231
October	10/23/2007	122	201	246	36	274

located downstream of the fields used in Study Component 1. Monitoring as specified in the MRP is to be conducted as part of Study Component 2.

Study Component 3

Study Component 3 is designed to determine the impact of alternative seeding methods on pest management and pesticide outflows from rice fields, including a water-seeded and conventionally farmed field, and a dry-seeded and conventionally farmed rice field. Monitoring for Study Component 3 is to be conducted as specified in the MRP.

Study Component 4

Study Component 4 is to measure the impact of alternative rice-seeding methods and irrigation management on nitrogen and phosphorus outflows from rice fields, including outflows from a water-seeded and conventionally farmed field, and a dry-seeded and conventionally farmed rice field. Monitoring for Study Component 4 is to be conducted as specified in the MRP.

Study Findings

The monitoring being conducted under components 1, 3, and 4 is being compiled by UC Davis and will be submitted to the CVRWQCB under the requirements of the grant reporting. In addition, the results will be reviewed in accordance with a DO and pH Management Plan, which is being developed by the CRC and CVRWQCB and is anticipated to be approved in early 2008.

The initial results for Component 2, focused on peripheral drain monitoring, are included in Table 5-15. The results include DO, pH, EC, and temperature monitoring data for several sites associated with four rice fields. These results will be analyzed in the contact of the overall grant by UC Davis and in accordance with the aforementioned DO and pH Management Plan.

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TABLE 5-15
UC Davis Field Data, Component 4, 2007

Monitoring Point	Date	Time	DO (mg/L)	pH	EC (µmhos)	Temp °C	Comments
MATHEWS							
MAT-3 INLET	8/15/2007	820	10.86	8.1	not stabile	12.79	clr, no flo
MAT-3	8/15/2007	830	4.45	7.47	112	17.79	muddy no flo
MAT-BRIDGE	8/15/2007	850	6.23	7.34	183	19.11	grn, turbid, slo flo
MAT-11 INLET	8/15/2007	905	10.99	7.86	not stabile	13.79	clr, grn, flowing
MAT-11	8/15/2007	920	6.31	7.38	183	19.26	grn, turbid, flowing
OUTLETS(S)	ok						
MEYERS							
M 6 CANAL INLET	8/15/2007	1050	10.95	7.91	91	17.23	grn, turbid, flowing
MF6U	8/15/2007	1140	9.04	7.49	131	20.43	grn/brn, trbd, slo flo
MF6D	8/15/2007	1150	9.07	7.41	135	20.77	grn, trbd, slo flo
M 5 CANAL INLET	8/15/2007	1105	7.01	7.74	97	21.89	grn, trbd, no flo
MF5U	8/15/2007	1115	4.06	7.39	288	18.95	brn, trbd, no flo
MF5D	8/15/2007	1130	6.26	7.35	231	20.45	muddy, slo flo
OUTLETS(S)	ok						
MABEN							
M10 CHECK 4	8/15/2007	1230	1.43	7	484	20.51	murkey, algae, no flo
M10 CHECK 2	8/15/2007	1245	1.23	7.02	390	19.21	murkey, algae, no flo
M10 CHECK1	8/15/2007	1240	2.02	6.92	346	20.65	murkey, algae, no flo
M10 INLET	8/15/2007	1255	7.2	7.48	340	22.51	grn/brn, trbd, flowing
M9 INLET	8/15/2007	1310	9.18	7.71	343	24.46	brn, stagnet, bubbles
M9 CHECK 2	8/15/2007	1320	1.54	7.21	341	20.67	murkey, algae, no flo
M9 CHECK5	8/15/2007	1330	0.69	7.06	364	19.3	murkey, algae, no flo
M9 CHECK 6	8/15/2007	1345	1.24	7.3	731	18.98	murkey, algae, no flo
OUTLETS(S)	ok						
TIBBITTS							
T12 INLET	8/15/2007	1500	7.81	7.84	525	27.31	grn, trbd, slo flo
T12DE	8/15/2007	1510	7.49	7.95	2759	26.39	murkey, slime, no flo
T12DW	8/15/2007	1520	10.33	8.03	3466	26.45	grn, trbd, no flo
T8 INLET	8/15/2007	1530	10.07	8.95	509	33.5	*grn, trbd, no flo
T8E	8/15/2007	1550	9.64	8.27	810	30.52	grn, trbd, no flo
T8W	8/15/2007	1600	8.87	8.35	858	30.43	grn/brn, trbd, no flo
OUTLETS(S)	ok						

Notes:
Technician: M Lee
Weather: Sunny, warm
*Water level very low

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RPP Monitoring

Monitoring is conducted under the RPP according the CVRWQCB Resolution No. R5-2007-0018, Approval of the 2007 Rice Pesticides Program, March 15, 2007. Monitoring at the five RPP sites includes measurement of general field parameters and laboratory analysis of the chemicals molinate and thiobencarb.

The RPP is reviewed triennially by the CVRWQCB, which has authority to authorize the program or use another regulatory approach to achieve water quality protection, including attainment of Performance Goals established in the Basin Plan. The RPP has achieved substantial improvements in water quality and an increased understanding of rice water quality concerns and serves as a model of grower engagement and follow-through.

RPP Performance Goals

Since 1990, Sacramento Valley rice farmers have operated pursuant to water quality regulations that prohibit the discharge of irrigation return flows containing carbofuran, malathion, methyl parathion, molinate and thiobencarb unless the discharger is following management practices approved by the CVRWQCB. The Basin Plan requires that practices only be approved if implementation of such practices can be expected to result in compliance with adopted numeric performance goals and narrative toxicity standards. The Basin Plan was amended to establish performance goals for the five pesticides. The goals were established to be protective of the aquatic ecosystem. The established performance goals for the five pesticides regulated under the conditional prohibition of discharge are shown in Table 5-16.

TABLE 5-16
Basin Plan Performance Goals for the Five RPP Pesticides

Pesticide	Basin Plan Performance Goal
Molinate	10.0 ppb
Thiobencarb	1.5 ppb
Malathion	0.1 ppb
Methyl parathion	0.13 ppb
Carbofuran	0.4 ppb

ppb: parts per billion

In addition to achieving the Basin Plan performance goals, molinate and thiobencarb levels in drinking water delivered to municipal customers must meet enforceable MCLs. MCLs are enforceable drinking water standards set by the USEPA and the California Department of Public Health (CDPH, formerly the California Department of Health Services). Primary MCLs are health-based standards, and secondary MCLs are based on aesthetic properties such as taste, color, odor, and appearance. The primary MCL for thiobencarb is 70.0 ppb (toxicity), and the secondary MCL is 1.0 ppb (off-taste). The MCL for molinate is 20.0 ppb.

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Water Holds

Over the years, best management practices such as water-hold requirements, grower information meetings, and inspection and enforcement were implemented to ensure compliance with performance goals and attainment of water quality objectives and MCLs. The water-holds, which are specified in the DPR permit conditions, were developed to provide for in-field degradation of pesticides prior to the release of treated water to drains and other surface waters. For 2007, all required water-hold requirements were the same as during the 2005 and 2006 growing seasons. The water holds for rice pesticides, including the four registered pesticides regulated under the Basin Plan's conditional prohibition of discharge, are listed in Chapter 3.

Pesticides Monitored

RPP laboratory analysis in 2007 included thiobencarb and molinate. The monitoring program continued to *not* include analysis for carbofuran, malathion, and methyl-parathion because of registration cancellation, decrease in use, and no reportable applications to rice. Carbofuran is no longer registered on rice with no reportable use since 2000. Malathion was not monitored in 2003, 2004, 2005, 2006, or 2007 because of a dramatic decrease in its use. Historical information indicates that the maximum rice acreage treated with malathion was 9,278 acres in 1991. Annual malathion use on rice has been less than 1,000 acres since 2001. The preliminary DPR PUR documented no 2007 usage of methyl parathion In 2007, based on the draft pesticide use reporting data provided by DPR, only 145 acres were treated with malathion; this small area of application is too small to be significant to warrant water quality monitoring under RPP monitoring program.

Sampling Schedule

The sampling calendar was developed based on historical data, rice pesticide use and drainage patterns, and actual 2007 conditions. Sampling was conducted for 10 weeks according to the schedule listed in Table 5-17. On 4/24/2007, Kleinfelder initiated sampling at sites CBD5, BS1, CBD1, SSB and SR1.

The weekly samples were collected on Tuesdays. During Weeks 4, 5, 6, and 7, a second round of samples was collected from each of the five sites on Thursdays. The CVRWQCB requested this sampling frequency to monitor attainment of water quality performance goals established for rice pesticides; this sampling frequency provides a sound technical basis for screening for water quality concerns in order to inform prompt follow-up

Sample Collection, Delivery, and Analysis

Sample analysis is conducted by registrant laboratories, with additional samples collected and analyzed by a third-party laboratory. Kleinfelder collected water samples to detect whether water quality performance goals were being attained. Performance goals are established in the Basin Plan and additional conditions in CVRWQCB Resolution No. R5-2007-0018.

Water samples were collected from specified surface water locations within the Sacramento River Basin. Each site serves as an end-of-basin drainage point designed to trigger further

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TABLE 5-17
RPP Sampling Schedule, 2007

Date	Event
4/24/07	W1
5/1/07	W2
5/8/07	W3
5/15/07	W4D1
5/17/07	W4D2
5/22/07	W5D1
5/24/07	W5D2
5/29/07	W6D1
5/31/07	W6D2
6/5/07	W7D1
6/7/07	W7D2
6/12/07	W8D1
6/19/07	W9
6/26/07	W10

study and potential scrutiny, should measured conditions indicate an impact to existing (non-toxic event) in-stream habitat suitability.

Kleinfelder collected water samples from the five sites: one river and four drain sites, as shown on Figure 4-2. Kleinfelder collected the samples and submitted them directly to the analytical laboratories for thiobencarb and molinate analysis. Detailed maps of each station are included in Appendix A, and field sheets and COCs are included in Appendix C-1.

After each sampling event at the five sites, Kleinfelder split the samples and submitted the samples under chain-of-custody to the analytical laboratories. The primary laboratory for thiobencarb was Valent, and the primary laboratory for molinate was Syngenta. EMA, Inc. was used as a secondary laboratory and analyzed samples for thiobencarb and molinate. Thiobencarb analyses were performed by the registrant laboratory Valent Dublin Laboratory and Environmental Micro Analysis (EMA, Inc.) laboratory. Molinate analyses were performed by the registrant laboratory Syngenta Crop Protection, Inc. and EMA, Inc. The contact information for these laboratories is included in Chapter 4, and the results from the laboratories are included in Appendixes C-1 through C-4.

Results

The 2007 RPP water quality results and City results are summarized in Table 5-18. In 2007 there were no measured exceedances of thiobencarb or molinate performance goals or MCLs at either the five primary monitoring locations or the City drinking water intakes. Field data sheets and COC forms are presented in Appendix C-1, and laboratory data sheets are presented in Appendix C-2 through C-4.

RPP Thiobencarb Results

During the 10 weeks of sampling, thiobencarb was observed a total of 24 times (includes City sampling). No detections above the 1.5 µg/L performance goal were observed. The

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TABLE 5-18
Summary of Detections (RPP and City Monitoring), 2007

	Molinate			Thiobencarb		
Site	Detections	Detections Greater than Performance Goal	Range of Detected Concentrations	Detections	Detections Greater than Performance Goal	Range of Detected Concentrations
CBD5[a]	0	0	ND	5	0	ND–0.54 μg/L
BS1[a]	5[d]	0	ND–1.92 μg/L	5	0	ND–0.23 μg/L
CBD1[a]	1	0	ND–0.77 μg/L	9[e]	0	ND–0.76 μg/L
SSB[a]	2	0	ND–1.8 μg/L	3	0	ND–0.17 μg/L
SR1[a]	0	0	ND	1	0	ND–0.13 μg/L
SRR[b]	0	0	ND	0	0	ND
WSR[c]	0	0	ND	1	0	ND–0.19 μg/L
Totals	8	0	–	24	0	–

[a]RPP site
[b]City of Sacramento intake site
[c]City of West Sacramento intake site
[d]Syngenta analysis and the EMA duplicate sample showed a detection for this event. Both results are counted as a single detection.
[e]Valent analysis and the EMA duplicate sample showed a detection for this event. Both results are counted as a single detection.
ND: non-detect (below the method reporting limit)

highest measured concentration, which occurred at CBD1 on 5/22/2007, was 0.76 μg/L. The average concentration (not including City data, and assuming non-detects are equivalent to zero) was 0.09 μg/L for the period of monitoring. Graphed results are shown in Figure 5-7, and tabulated results are shown in Table 5-19.

RPP Molinate Results

During the 10 weeks of sampling, molinate detections were far below the 10.0 μg/L water quality performance goal. The highest measured concentration, which occurred at BS1 on 22 May 2007, was 1.92 μg/L. The average concentration (assuming non-detects are equivalent to zero) was 0.14 μg/L for the period of monitoring. Graphed results are shown in Figure 5-8, and tabulated results are shown in Table 5-20.

City Intake Results

The City of Sacramento provided the CRC with analytical results for the drinking water intake sampling for Sacramento and West Sacramento. The cities of Sacramento and West Sacramento monitor at two separate locations:

- **SRR:** Sacramento River at the intake to the water treatment facility in Sacramento, California, and approximately 0.3 kilometers downstream from the confluence with the American River in Sacramento County.
- **WRS:** Sacramento River at the intake to the water treatment facility in West Sacramento, California, approximately 100 yards west of Bryte Bend Bridge in West Sacramento.

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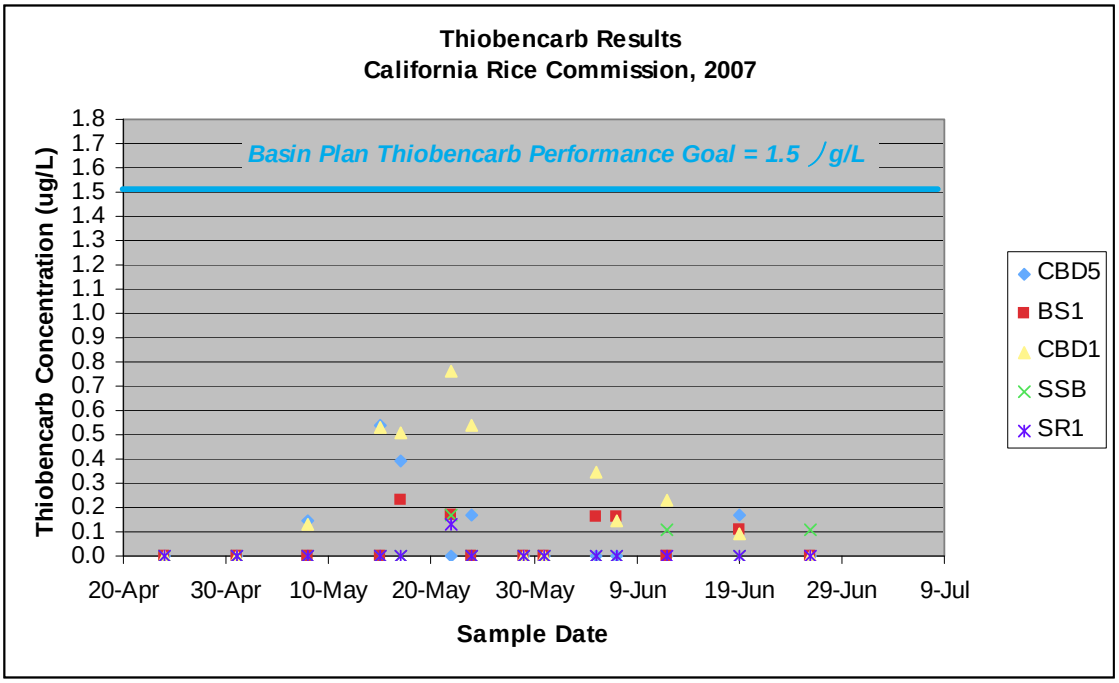

FIGURE 5-7
Thiobencarb Results, RPP, 2007
Non-detects are shown as zero (0) on the graph, and only the highest value of a reported duplicate sample is shown.

City sampling was performed from April 18 through June 12, 2007. The intake results for thiobencarb and molinate, as provided to the CRC, are detailed in Table 5-21.

SRR Results

Prior to the City of Sacramento drinking water intake, some water mixing occurs from the American River at the Sacramento River confluence. Concentrations of thiobencarb and molinate continued to be low at SRR. Of the nine SRR sampling events, there were no molinate or thiobencarb detections. These results demonstrate achievement of both the RPP Basin Plan Performance Goals and the drinking water MCLs.

WRS Results

WRS is located upstream from the confluence of the American River, so the mixing and dilution prior to the drinking water intake that occurs at the City of Sacramento water intake (SRR) does not occur at WRS. Concentrations of thiobencarb and molinate continued to be low at the City of West Sacramento drinking water intake. Of the nine sampling events, no molinate detections were measured, and one thiobencarb detection was measured. The highest measured concentration of thiobencarb was 0.19 µg/L. These results demonstrate achievement of both the RPP Basin Plan Performance Goals and the drinking water MCLs.

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TABLE 5-19
Thiobencarb Monitoring Results, RPP 2007

Sampling Dates	Concentration at each Monitoring Site µg/L (ppb)				
	CBD5	BS1	CBD1	SSB	SR1
April 24	ND	ND	ND	ND	ND
May 1	ND	ND	ND	ND	ND (Valent) ND (EMA)
May 8	0.15	ND	0.13	ND	ND
May 15	0.54	ND	0.53	ND	ND
May 17	0.39	0.23	0.51(Valent) 0.50 (EMA)	ND	ND
May 22	ND	0.17	0.41(Valent) 0.76 (EMA)	0.17	0.13
May 24	0.17	ND	0.54	ND	ND
May 29	ND (Valent) ND (EMA)	ND	ND	ND (Valent) ND (EMA)	ND
May 31	ND	ND	ND	ND	ND
June 5	ND	0.16 (Valent) ND (EMA)	0.35	ND	ND
June 7	ND	0.16	0.15	ND	ND
June 12	ND	ND	0.23	0.11	ND
June 19	0.17	0.11 (Valent) ND (EMA)	0.09	ND	ND
June 26	ND	ND (Valent) ND (EMA)	ND	0.11	ND (Valent) ND (EMA)

Notes:

If a sample was tested at the primary and secondary laboratories, each result is provided with the respective laboratory's name.

The Valent ND limit is <0.5 µg/L.

The EMA ND limit is <0.5 µg/L.

The Basin Plan performance goal for thiobencarb is 1.5 µg/L (ppb).

ND: not detected above laboratory reporting limits

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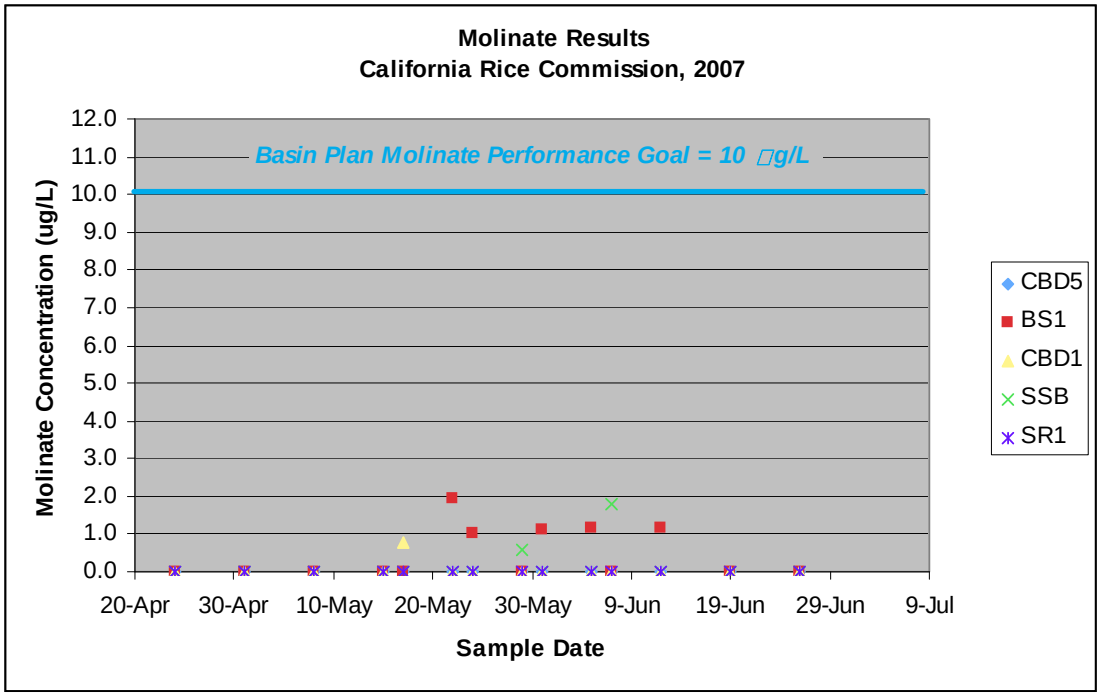

FIGURE 5-8
Molinate Results, RPP 2007
Non-detects are shown as zero (0) on the graph, and only the highest value of a reported duplicate sample is shown.

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TABLE 5-20
Molinate Monitoring Results, RPP 2007

Sampling Dates	Concentration at each Monitoring Site µg/L (ppb)				
	CBD5	BS1	CBD1	SSB	SR1
April 24	ND	ND	ND	ND	ND
May 1	ND	ND	ND	ND	ND (Syngenta) ND (EMA)
May 8	ND	ND	ND	ND	ND
May 15	ND	ND	ND	ND	ND
May 17	ND	ND	ND (Syngenta) 0.77 (EMA)	ND	ND
May 22	ND	1.92	ND (Syngenta) ND (EMA)	ND	ND
May 24	ND	1.03	ND	ND	ND
May 29	ND (Syngenta) ND (EMA)	ND	ND	ND (Syngenta) 0.57 (EMA)	ND
May 31	ND	1.13	ND	ND	ND
June 5	ND	1.15 (Syngenta) 1.04 (EMA)	ND	ND	ND
June 7	ND	ND	ND	1.80	ND
June 12	ND	1.16	ND	ND	ND
June 19	ND	ND (Syngenta) ND (EMA)	ND	ND	ND
June 26	ND	ND (Syngenta) ND (EMA)	ND	ND	ND (Syngenta) ND (EMA)

Notes:

If a sample was tested at the primary and secondary laboratories, each result is provided with the respective laboratory's name.

The Syngenta ND limit is <1.00 µg/L.

The EMA ND limit is <0.5 µg/L.

The Basin Plan performance goal for molinate is 10 µg/L (ppb).

ND: not detected above laboratory reporting limits

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TABLE 5-21
Cities of Sacramento and West Sacramento Molinate and Thiobencarb Results, 2007

Sample Date	Thiobencarb Concentration (µg/L)		Molinate Concentration (µg/L)		Percent Sacramento River Water at SRR[a]
	WSR	SRR	WSR	SRR	
April 18, 2007	<0.10	<0.10	<0.10	<0.10	78.6
April 24, 2007	<0.10	<0.10	<0.10	<0.10	75.7
May 8, 2007	<0.10	<0.10	<0.10	<0.10	81.0
May 16, 2007	<0.10	<0.10	<0.10	<0.10	74.0
May 23, 2007	<0.10	<0.10	0.19	<0.10	83.0
May 28, 2007	<0.10[b]	<0.10	<0.10*	<0.10	82.0
May 29, 2007	<0.10	<0.10	<0.10	<0.10	79.6
June 5, 2007	<0.10	<0.10	<0.10	<0.10	83.6
June 12, 2007	<0.10	<0.10	<0.10	<0.10	76.9

[a]The sampling location SRR, which is located on the Sacramento River at the City of Sacramento's municipal water treatment intake, is downstream of the confluence of the Sacramento River and the American River. Based on the daily flows of the two rivers, the sample taken at SRR will represent varying proportions of Sacramento and American river water. This column represents the City of Sacramento's reported information regarding the blending ration of Sacramento River and American River water on the day of sampling

[b]Sample taken at Crawdads.

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CHAPTER 6

Review of Quality Assurance/Quality Control

The validity of water quality monitoring results relies on defining and rigorously following a Quality Assurance/Quality Control (QA/QC) Program. QA/QC requirements are specified in a Monitoring Quality Assurance Project Plan (QAPP), and the laboratory QA/QC requirements are specified in QA/QC plans for each lab.

QA/QC requirements for the CWFR sampling are specified in a QAPP dated November 3, 2004. QA/QC requirements for the RPP sampling are specified in a QAPP dated 2006. Project schedules (sampling dates, parameters, and sites) specified for each program are revised at the beginning of each monitoring year based on actual weather conditions and grower schedules. The sampling calendars for CWFR and RPP monitoring are included in Chapter 5 (Table 5-1).

The QAPPs were prepared in accordance with EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Operations" (USEPA, 1998); "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (USEPA, 2002); and EPA-540/R-94-012, "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (USEPA, 1999).

Internal QC

Internal QC is achieved by collecting and analyzing a series of duplicate, blank, spike, and spike duplicate samples to check that analytical results are within the specified QC objectives. The QC sample results are used to qualify precision and accuracy, and to identify any problem or limitation in the associated sample results. The internal QC components of a sampling and analysis program ensure that data of known quality are produced and documented. The internal QC samples are described in the following sections.

Field QA/QC Samples

Field QA/QC samples are used to assess the influence of sampling procedures and equipment used in sampling. The results from these samples are examined to ensure that field procedures yield acceptable results. Three types of quality control samples were collected in the field: rinse blanks, field duplicates, and matrix spikes.

Rinse Blanks

Rinse blanks were collected in the field and were analyzed with the environmental samples. Rinse blanks consist of distilled water processed through the sampling equipment using the same procedures used for environmental samples, after decontamination has been performed. Results from these blank samples are examined to ensure that concentrations of constituents of concern are below detection limits. If there are concentrations above the detection limit, then sampling and decontamination procedures will be reevaluated. Results from the rinse blanks represent a total of field and laboratory sources of contamination.

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Field Duplicates

Field duplicates, or split samples, consist of an additional bottle of sample collected at a randomly selected sample location. The results from the duplicate sample are compared to the results from the primary sample; if the relative percent difference (RPD) between the samples is greater than 35 percent, a thorough evaluation of the samples will be performed to determine whether to take corrective action (to either report the data or resample). Duplicate samples provide precision information for the entire measurement system, including sample acquisition, homogeneity, handling, shipping, storage, laboratory sample preparation, and laboratory analysis.

Matrix Spikes and Matrix Spike Duplicates

Matrix spikes and matrix spike duplicate (MS/MSD) samples are collected at the same time as the environmental samples and are spiked at the laboratory with known concentrations of the analyte(s) to be measured. These samples are used to evaluate the effect a particular sample matrix has on the accuracy of the measurement. The MSD sample serves as another check of the accuracy and allows calculation of the analysis method's precision. The difference in the measured concentrations of the original sample and the spiked sample is compared with the spike concentration, and a percent recovery (the concentration that the laboratory measures divided by the known concentration of a spiked sample multiplied by 100) of the spiked concentration is reported.

Laboratory QA/QC Samples

Laboratory QA/QC samples are prepared to ensure that the required level of laboratory accuracy is being achieved. Three types of quality control samples are used to determine laboratory accuracy: method blanks, laboratory control spikes (LCS), and surrogate standards.

Method Blanks

Method blanks consist of deionized water that is run through all of the same steps as the environmental samples at the lab. These samples are used to determine the existence of any laboratory sources of contamination.

LCSs

LCSs consist of known concentrations of a constituent in distilled water. The measured concentrations are compared with the spike concentration, and a percent recovery can be determined. Results are acceptable if the percent recovery falls within a predetermined range.

Surrogate Standards

Surrogate standards are samples that have been spiked with an organic compound that is chemically similar to the analyte of interest, but is not expected to occur in the environmental sample. The recovery of the surrogate standard is used to monitor for errors, unusual effects, and other anomalies. Surrogate recovery is evaluated by comparing the measured concentration with the amount added to the sample.

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QA/QC Objectives

Quality assurance objectives (QAO) are the detailed QC specifications for precision, accuracy, representativeness, comparability, and completeness. The group responsible for collecting data uses the QAOs as comparison criteria during data quality review to evaluate if the minimum requirements have been met and the data can be used as planned. The basis for assessing each element of data quality for this project is discussed in the following subsections.

Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. Precision will be assessed by replicate measurements of field and laboratory duplicate samples. The routine comparison of precision is measured by the RPD between duplicate sample measurements. The overall precision of a sampling event is determined by a sampling component and an analytical component.

The following formula determines the RPD between two samples:

$$RPD = \frac{|D1 - D2|}{(D1 + D2)/2} x100$$

Where:

RPD = relative percent difference
D1 = first sample value
D2 = second sample value (duplicate)

The maximum acceptable RPD for this project is 35 percent.

Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using MS/MSD, LCS, calibration standard, and spiked environmental samples. The accuracy of the data submitted for this project will be assessed in the following manner:

- The percent recovery of LCS, MS/MSD, and spiked surrogates will be calculated and evaluated against established laboratory recovery limits. **Acceptable laboratory recovery limits for this project are 75 through 120 percent.**
- The level of target compounds that are found (if any) in laboratory method blanks will be checked. If a target compound is found above the minimum detection limit (MDL) in the method blank corresponding to a batch of samples, and the same target compound is found in a sample, then the data will not be background subtracted but will be flagged to indicate the result in the blank.

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Accuracy is presented as percent recovery. Since accuracy is often evaluated from spiked samples, laboratories commonly report accuracy using this formula:

$$\% \text{ Recovery} = R / S * 100$$

Where:

S = spiked concentration
R = reported concentration

The laboratory shall monitor accuracy by reviewing MS/MSD, LCS, calibration standard, and surrogate spike recovery results.

Representativeness

Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental conditions. Representativeness is a qualitative parameter that is primarily concerned with the proper design of the sampling program or of the subsampling of a given sample. Representativeness will be assessed by the use of duplicate field and laboratory samples, since they provide information pertaining to both precision and representativeness.

Samples that are not properly preserved or are analyzed beyond acceptable holding times will not be considered to provide representative data. Also, detection limits above applicable MCLs or screening criteria are not considered representative.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples collected under like conditions. This goal is achieved through the use of standard techniques to collect and analyze representative samples and reporting analytical results with appropriate units.

Comparability is limited by other analytical control parameters; therefore, only when precision and accuracy are known can data sets be compared with confidence. Using standard operating procedures (SOPs) promotes comparability.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. To be considered complete, the data set must contain all analytical results and data specified for the project. In addition, all data are compared to project requirements to ensure that specifications are met. Completeness is evaluated by comparing the project objectives to the quality and quantity of the data collected to assess if any deficiencies exist. Missing data can result from any number of circumstances ranging from sample acquisition and accessibility problems to sample breakage and rejection of analytical data because of quality control deficiencies. Completeness is quantitatively assessed as the percent of controlled QC parameters that are within limits.

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Percent completeness for each set of samples for each individual method can be calculated as follows:

$$Completeness = \frac{\text{valid data obtained}}{\text{total data analyzed}} \times 100\%$$

Where:

Valid data are defined as those data points that are not qualified as rejected.

The requirement for completeness is 90 percent for each individual analytical method for all QC parameters except holding times. The QC parameters are as follows:

- Holding time
- Initial calibration
- Continuing calibrations
- LCS percent recovery
- MS/MSD
- Field duplicate RPDs
- Surrogate percent recoveries

The requirement for holding times will be 100 percent. **Any deviations are reported in the report narrative.**

CWFR QA/QC Sample Results and Analysis

The 2007 QA/QC samples for the CWFR were collected during April (Irrigation Sampling Event 1), June (Irrigation Sampling Event 3), and August ("storm" event representing rice drainage). The field CWFR QA/QC samples are shown in Table 6-1. In addition to the field QA/QC samples, analytical laboratories typically perform method blank, laboratory spike, and surrogate standard analyses with each event.

TABLE 6-1
Planned CWFR Field QA/QC Samples, 2007

Date	Event	QA/QC Sample Type(s)
4/24/2007	Irrigation Event 1	Rinse blank at CBD1 Duplicate at CBD1 MS/MSD at CBD1
6/5/2007	Irrigation Event 3	Rinse blank at BS1 Duplicate at BS1 MS/MSD at BS1
8/21/2007	Irrigation Event 5	Rinse blank at CBD5 Duplicate at CBD5 MS/MSD at CBD5

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Field QA/QC Samples

The field QA/QC samples included rinse blank, field duplicate, and MS/MSD samples; the results for each follow.

Rinse Blank

Rinse blank samples were collected and analyzed for azoxystrobin, propiconazole, cyhalofop-butyl, and trifloxystrobin at minimum reporting limits (MRLs) of 0.5 µg/L. The results for the rinse blanks were below the MRLs for these analytes (Table 6-2).

TABLE 6-2
Results of Rinse Blanks Samples, CWFR 2007

Month	Date	Site	Sample Type	Azoxystrobin (µg/L)	Propiconazole (µg/L)	Cyhalofop-butyl (µg/L)	Trifloxystrobin (µg/L)
April	4/24/07	CBD1	Rinse	<0.50	<0.50	<0.50	<0.50
			Primary	<0.50	<0.50	<0.50	<0.50
June	6/5/07	BS1	Rinse	<0.50	<0.50	<0.50	<0.50
			Primary	<0.50	<0.50	<0.50	<0.50
August	8/21/07	CBD5	Rinse	<0.50	<0.50	<0.50	<0.50
			Primary	<0.50	<0.50	<0.50	<0.50

Field Duplicate

Field duplicate samples were collected and analyzed for azoxystrobin, propiconazole, cyhalofop-butyl, and trifloxystrobin using methods with MRLs of 0.5 µg/L. The results for the duplicate samples and for the corresponding samples were below the MRLs for these analytes (Table 6-3).

TABLE 6-3
Results of Duplicate Samples, CWFR 2007

Month	Date	Site	Sample Type	Azoxystrobin (µg/L)	Propiconazole (µg/L)	Cyhalofop-butyl (µg/L)	Trifloxystrobin (µg/L)
April	4/24/07	CBD1	Primary	<0.50	<0.50	<0.50	<0.50
			Duplicate	<0.50	<0.50	<0.50	<0.50
June	6/5/07	BS1	Primary	<0.50	<0.50	<0.50	<0.50
			Duplicate	<0.50	<0.50	<0.50	<0.50
August	8/21/07	CBD5	Primary	<0.50	<0.50	<0.50	<0.50
			Duplicate	<0.50	<0.50	<0.50	<0.50

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MS/MSD

MS and MSD samples were spiked with several analytes and analyzed for those analytes. The results of the matrix (environmental) samples were below the MRL for these analytes (Table 6-4). The RPD for the MS/MSDs for all events were within the acceptable range.

A few of the spike and spike duplicate recovery percentages were outside of the range for recovery limits. Those samples include the June trifloxystrobin analysis and the August propiconazole analysis. The spike recoveries reported for these two events were greater than the acceptable range.

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, LCS, and surrogate standard samples; the results for each follow.

Method Blank

Method blank samples were prepared by the laboratory and tested for the same analytes as the environmental samples. The results of all the method blank samples were below MRL (non-detect) for these analytes (Table 6-5).

It should be noted that the laboratory did not perform a method blank analysis for the 6/5/2007 sampling date, as described in further detail in the summary section.

LCS

LCS samples were analyzed for two sampling dates during the 2007 season: 5/8/2007 and 7/19/2007. The RPD percentages for all samples were within acceptable limits (Table 6-6).

Two of the analytes had recovery limits outside (above) of the acceptable range. These included the propiconazole from the 5/8/2007 sampling event, and the trifloxystrobin from the 7/19/2007 sampling event.

Surrogate Standard

Surrogate standard samples were prepared for analysis with the environmental samples. The majority of the samples were within the required recovery limits, with the exception of three triclopyr samples, one from the 7/18/2007 sampling event, and two from the 9/18/2007 sampling event (Table 6-7). In all three cases, the percent recoveries were less than the acceptable recovery threshold.

Analysis of Precision

A field duplicate sample was collected during the April, June, and August sampling events for each matrix and analyzed for each primary analyte. Duplicate results were found to be consistent with the original matrix results. Field duplicate results are presented in Table 6-3.

An MS/MSD sample was collected for each matrix during the April, June, and August sampling events, and was analyzed for each primary analyte. All of the samples were within the RPD limits for all analytes. MS/MSD results and RPD values are presented in Table 6-4.

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TABLE 6-4
MS/MSD Samples, CWFR 2007

Month	Sample Date	Sample Location	Analyte	Spike Level (µg/L)	Matrix Result (µg/L)	SPK Result (µg/L)	DUP Result (µg/L)	Spike Recovery (%)	Duplicate Recovery (%)	Acceptable Recovery Limits (%)	RPD (%)	RPD Limits
April	4/24/07	CBD1	Azoxystrobin	25	<0.50	25.9	23.7	103.6	94.6	75–120	9.1	35
			Propiconazole	25	<0.50	25.2	25.8	100.6	103.1	75–120	2.5	35
			Trifloxystrobin	2.0	<0.50	1.8	1.9	89.5	97.4	75–120	8.5	35
			Cyhalofop-butyl	20	<0.50	22.8	22.7	114.0	113.6	75–120	0.4	35
June	6/5/07	BS1	Diazinon	2.5	NA	1.9	2.0	76.8	78.9	75–120	2.7	35
			Propiconazole	25	<0.50	28.0	27.9	112.0	111.4	75–120	0.5	35
			Azoxystrobin	25	<0.50	26.0	28.0	104.1	111.8	75–120	7.1	35
			4,4'-DDT	0.5	NA	0.5	0.5	104.9	95.8	75–120	9.1	35
			Trifloxystrobin	0.10	<0.50	0.1	0.1	**133.8**	118.3	75–120	12.3	35
			Cyhalofop-butyl	10	<0.50	8.6	7.8	85.9	77.7	75–120	10.0	35
August	8/21/07	CBD5	Diazinon	2.5	NA	2.0	2.0	80.2	81.7	75–120	1.9	35
			Propiconazole	5.0	<0.50	4.9	6.0	98.9	**120.9**	75–120	20.0	35
			Azoxystrobin	5.0	<0.50	5.7	4.4	114.5	87.7	75–120	26.5	35
			alpha-BHC	0.5	NA	0.5	0.5	93.1	90.4	75–120	2.9	35
			Trifloxystrobin	2.0	<0.50	2.0	1.9	101.0	95.4	75–120	5.7	35
			Cyhalofop-butyl	2.0	<0.50	2.2	2.0	111.5	102.1	75–120	8.8	35

Notes:
The laboratory reported the percent recovery, so SPK and DUP were back-calculated from the spike level and percent recovery
Bold indicates values that do not meet acceptable recovery limits.
NA: not analyzed

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TABLE 6-5
Method Blank Results, CWFR 2007

Associated Sample Dates	Azoxystrobin (MRL = 0.50)	Propiconazole (MRL = 0.50)	Cyhalofop-butyl (MRL = 0.50)	Trifloxystrobin (MRL = 0.50)	Triclopyr (MRL = 0.05)	Penoxsulam (MRL = 5.0)	Diuron (MRL = 0.50)	Glyphosate (MRL = 10.0)
4/24/2007	<0.50	<0.50	<0.50	<0.50	NA	NA	NA	NA
5/8/2007	<0.50	<0.50	<0.50	<0.50	NA	NA	NA	NA
6/5/2007	NBR	NBR	NBR	NBR	NBR	NBR	NBR	NBR
7/10/2007	<0.50	<0.50	<0.50	<0.50	NA	NA	NA	NA
8/21/2007	<0.50	<0.50	<0.50	<0.50	NA	NA	NA	NA
9/18/2007	NA	NA	NA	NA	<0.05	<5.0	<0.50	<10.0

NA: not analyzed
NBR: no blank reported

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TABLE 6-6
LCS and RPD Calculation, CFWR 2007

Sample Date	Analyte	Spike Level (µg/L)	SPK Result (µg/L)	DUP Result (µg/L)	SPK Recovery (%)	DUP Recovery (%)	Recovery Limits	RPD (%)	RPD Limits
5/8/2007	Propiconazole	20.0	25.16	25.54	**125.8**	**127.7**	75–120	1.5	35
	Azoxystrobin	20.0	16.48	16.10	82.4	80.5	75–120	2.3	35
7/19/2007	Propanil	1.0	0.89	0.88	89.2	87.9	75–120	1.5	35
	Halosulfuron-methyl	5.0	5.17	4.75	103.4	95.0	75–120	8.5	35
	Trifloxystrobin	1.0	1.23	1.27	**123.3**	**127.0**	75–120	3.0	35
	Propiconazole	5.00	5.29	5.33	105.8	106.6	75–120	0.8	35
	Clomazone	5.00	4.08	4.14	81.5	82.7	75–120	1.5	35
	Molinate	5.00	4.33	3.61	86.6	72.1	75–120	18.3	35

Note: Bold indicates values that do not meet acceptable recovery limits.

LCS samples were analyzed for two dates: 5/8/2007 and 7/19/2007. All samples from both dates were within the RPD limits for all analytes. LCS sample results and RPD values are presented in Table 6-6.

Analysis of Accuracy

A rinse blank sample was collected during the April, June, and August sampling events and analyzed for each primary analyte. All rinse blank samples were found to have analyte levels below the MRLs. Rinse blank results are presented in Table 6-2.

Method blank samples were run with every batch of analytical samples, with the exception of the 6/5/07 sampling event. All method blank samples were found to have analyte levels below the method reporting limits. Method blank results are presented in Table 6-5.

MS/MSD samples were prepared for the April, June, and August sampling events and were evaluated for each of the spiked analytes. The majority of the samples was within the acceptable recovery limit. The results from two samples fell outside the recovery limits; the percent spike recovery for the trifloxystrobin from June was 133.8 percent, higher than the acceptable recovery limits. For August, the percent duplicate recovery for the propiconazole was 120.9 percent, just slightly above the acceptable recovery limit. MS/MSD results and recovery limits are presented in Table 6-4.

LCS samples were prepared for two sampling dates: 5/8/2007 and 7/19/2007. The majority of the samples was within the acceptable recovery limit. Three samples had results outside the acceptable range: the propiconazole from the 5/8/2007 sampling event, and the trifloxystrobin spike and duplicate spike from the 7/19/2007 sampling event. LCS results and recovery limits are presented in Table 6-6.

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TABLE 6-7
Surrogate Standard Samples, CWFR 2007

		Surrogate Recovery Results (percent)		
Sample Date	**Sample Location**	**Triphenylphosphate[a] (65–135)***	**Dibutylchlordenate (DBC)[b] (65–135)***	**2,4-Dichlorophenylacetic acid (DCAA)[c] (65–135)***
4/24/2007	JS	90.3	90.6	NA
	CBD1	79.5	81.8	NA
	BS1	71.3	78.1	NA
	CBD5	73.9	85.6	NA
	SSB	107	84.5	NA
5/8/2007	JS	94.9	92.4	NA
	CBD1	104	90.5	NA
	BS1	91.0	94.4	NA
	CBD5	115	93.0	NA
	SSB	95.6	102	NA
6/5/2007	JS	112	72.7	NA
	CBD1	105	106	NA
	BS1	125	74.7	NA
	CBD5	114	82.6	NA
	SSB	130	83.5	NA
7/10/2007	JS	112	93.3	NA
	CBD1	109	80.1	58.4
	BS1	99.3	107	NA
	CBD5	102	105	NA
	SSB	87.2	99.0	NA
8/21/2007	JS	103	107	NA
	CBD1	110	104	NA
	BS1	96.5	112	NA
	CBD5	108	85.7	NA
	SSB	111	124	NA
9/18/2007	JS	NA	NA	NA
	CBD1	NA	NA	NA
	BS1	75.7	70.6	66.1
	CBD5	81.3	77.4	61.8
	SSB	74.0	77.3	60.4

[a]Triphenylphosphate at 2.0 μg/L was the laboratory surrogate for EPA method 8141A, which includes cyhalofop-butyl and trifloxystroin. See Appendix B-4 for EMA results.

[b] Dibutylchlordenate (DBC) at was the laboratory surrogate for EPA method 8081A, which includes azoxystrobin and propiconazole. See Appendix B-4 for EMA results.

[c] 2,4-Dichlorophenylacetic acid (DCAA) was the laboratory surrogate for EPA method 8151A, which includes triclopyr. See Appendix B-4, September EMA results, for list of chemicals included in the 8151A analysis. See Appendix B-4 for EMA results.

*Control limits

NA: not analyzed

Bold values indicate that the surrogate recover results were outside of the established control limits.

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Surrogate standards were evaluated with all analytical samples. The majority of the samples was within the acceptable recovery limit, with the exception of three triclopyr samples: one from the 7/18/2007 sampling event, and two from the 9/18/2007 sampling event. Surrogate standard results and recovery limits are presented in Table 6-7.

Analysis Summary

The following summarizes the results of the QA/QC analysis performed on the CWFR data:

- The laboratory did not analyze a method blank for the 6/5/2007 sampling date. Upon review of the results, it was determined that a result for a sample entitled "BLANK" was reported, and the result for the submitted sample "BS1.EM1.0607.RB" was not reported. The laboratory was contacted to clarify these reported results. The laboratory stated that the result report for "BLANK" was in fact the sample BS1.EM1.0607.RB. They further stated that a method blank was not run during this analysis event. The results of MS/MSD (environmental) samples for this event are reported as the laboratory "Quality Control Report." The laboratory provided a revised June pesticides report, dated November 19, 2007. The revised laboratory report is the version included in Appendix B-4.
- Two of the MS/MSD analyses reported results outside of recovery limit ranges: trifloxystrobin in June and propiconazole in August.
- Two of the surrogate standard analyses reported results outside of the control limits; these events were the 7/10/2007 and 9/18/2007 for triclopyr analyses.
- Two of the LCS analyses resulted in recovery limits outside of acceptable range. These events were propiconazole on 5/8/2007 and trifloxystrobin on 7/19/2007.

RPP QA/QC Sample Results and Analysis

As described in Chapter 5, RPP molinate samples are analyzed by the Syngenta Crop Protection, Inc. registrant laboratory, and thiobencarb samples are analyzed by the Valent Dublin Laboratory registrant laboratory. In addition, the CRC submits QA/QC samples to Environmental Micro Analysis Inc. (EMA) throughout the monitoring season.

At each sampling location, two sets of samples are taken. One set was sent to the analyte-specific laboratory (Syngenta or Valent), and the other set was sent to the EMA laboratory for comparison.

The field RPP QA/QC samples are shown in Table 6-8. In addition to the field QA/QC samples, analytical laboratories typically perform method blank, LCS, and surrogate standard analyses with each event.

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TABLE 6-8
Planned RPP QA/QC Samples, RPP 2007

Date	Event	QA/QC Sample Type
5/1/2007	W2D1	Duplicate at SR1
5/8/2007	W3D1	Blind spikes
5/15/2007	W4D1	Duplicate at CBD5
5/17/2007	W4D2	Rinse blank at CBD1
5/17/2007	W4D2	Blind spikes at CBD1
5/22/2007	W5D1	Duplicate at CBD1
5/29/2007	W6D1	Duplicate at SB1
6/5/2007	W7D1	Duplicate at BS1
6/7/2007	W7D2	Rinse blank at CBD1
6/12/2007	W8D1	Rinse blank at CBD5
6/19/2007	W9D1	Duplicate at BS1
6/26/2007	W10D1	Duplicate at SB1

Field QA/QC Samples

The field QA/QC samples included rinse blank, field duplicate, and MS/MSD samples; the results for each follow.

Rinse Blank

Rinse blank samples were collected three times during the sampling season: the W4D2, W7D2, and W8D1 sampling events. The results of all rinse blank samples were below the MDL for thiobencarb and molinate (Table 6-9).

TABLE 6-9
Comparison of Rinse Blank Samples to Primary Samples, RPP 2007

Date	Sample Event	Monitoring Site	Sample Type	Thiobencarb (µg/L)	Molinate (µg/L)
5/17/2007	W4D2	CBD1	Primary*	0.50	<1.00
			Rinse*	<0.50	<0.50
6/7/2007	W7D2	CBD1	Primary*	<0.50	<1.00
			Rinse*	<0.50	<0.50
6/12/2007	W8D1	CBD5	Primary*	<0.50	<1.00
			Rinse*	<0.50	<0.50

*Primary thiobencarb samples analyzed at Valent laboratories, and primary molinate samples analyzed at Syngenta laboratories; rinse samples analyzed at EMA laboratories.

Field Duplicate

Field duplicate samples were collected nearly every week of the RPP sampling, with the exception of weeks 1, 3, and 8 (Table 6-10). The majority of the sample pairs yielded the same results for the primary and duplicate samples.

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TABLE 6-10
Field Duplicate Samples, RPP 2007

Date	Sample Event	Monitoring Site	Sample Type	Thiobencarb (µg/L)	Molinate (µg/L)
5/1/2007	W2D1	SR1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
5/15/2007	W4D1	CBD5	Primary*	0.5	<1.00
			Duplicate*	0.5	0.77
5/22/2007	W5D1	CBD1	Primary*	<0.5	<1.00
			Duplicate*	0.76	<0.5
5/29/2007	W6D1	SSB	Primary*	<0.5	<1.00
			Duplicate*	<0.5	0.57
6/5/2007	W7D1	BS1	Primary*	<0.5	1.15
			Duplicate*	<0.5	1.04
6/19/2007	W9D1	BS1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
6/26/2007	W10D1	SR1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5

*Duplicate samples analyzed at EMA laboratories, primary thiobencarb samples analyzed at Valent laboratories, and primary molinate samples analyzed at Syngenta laboratories.
EMA and Valent reporting limit = 0.5 µg/L
Syngenta reporting limit = 1.0 µg/L

Two sets of samples had values that were slightly different between the primary sample and the duplicate sample. Although the two types of samples were run at different laboratories (primary at Valent or Syngenta and secondary at EMA), RPD values were calculated to quantify the difference. Site CBD1 from sampling event W4D1 had a primary value of <0.5 µg/L, and a duplicate value of 0.76 µg/L for thiobencarb. That yields an estimated RPD of 40 percent, which is above the acceptable limit. Site BS1 from sampling event W7D1 had a primary value of 1.15 µg/L and a duplicate value of 1.04 µg/L for molinate. That yields an RPD of 10 percent, which is considered acceptable under QAPP control limits.

MS/MSD

Matrix (environmental) spike samples were spiked by Kleinfelder and submitted to the laboratory with a fictitious sample site identification. The samples were then analyzed for thiobencarb and molinate (Table 6-11).

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TABLE 6-11
Matrix Spike Sample Results, RPP 2007

Date	Sample Event	Sample Location	Laboratory	Analyte	Spike Level (µg/L)	SPK Result (µg/L)	SPK Recovery (%)	Recovery Limits
5/17/07	W4D2	CRC1*	EMA	Thiobencarb	5	7.41	**148.2**	75–120
			EMA	Molinate	10	11.0	110	75–120
			Valent	Thiobencarb	5	5.3	106	75–120
			Syngenta	Molinate	10	11.1	111	75–120
6/07/07	W7D2	CRC1*	EMA	Thiobencarb	1	1.34	**134**	75–120
			EMA	Molinate	5	5.29	105.8	75–120
			Valent	Thiobencarb	1	0.8	80	75–120
			Syngenta	Molinate	5	5.56	111.2	75–120

Notes:
Bold indicates values that do not meet acceptable recovery limits.
EMA and Valent reporting limit = 0.5 µg/L.
Syngenta reporting limit = 1.0 µg/L.
*CRC1 is a fictitious sample location name given to the spike samples for laboratory analysis.

An RPD value could not be calculated for these samples because the two sets of values for each analyte were spiked by and analyzed at different laboratories.

A few of the spike recovery percentages were outside of the acceptable range for recovery limits. Those samples include the EMA thiobencarb from the W4D2 event and the W7D2 event. Both of these analyses resulted in percent recoveries above the acceptable recovery range.

It is noted that EMA provided a Corrective Action Report for the 5/17/2007 event to clarify the reported results from its initial report. The is provided in Appendix C-4, which includes the EMA results for the RPP analyses.

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, LCS, and surrogate standard samples; the results for each follow.

Method Blank

Method blank samples were prepared and tested for the same analytes as the environmental samples. The values below are for the EMA laboratory analysis. All samples had values below the MRLs for these analytes (Table 6-12).

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TABLE 6-12
Method Blank Results, RPP 2007

Date	Event	Molinate (RL = 0.50)	Thiobencarb (RL = 0.50)
5/1/2007*	W2D1	<0.50	<0.50
5/15/2007	W4D1	<0.50	<0.50
5/17/2007	W4D2	<0.50	<0.50
5/22/2007	W5D1	<0.50	<0.50
5/29/2007	W6D1	<0.50	<0.50
6/5/2007	W7D1	<0.50	<0.50
6/7/2007	W7D2	<0.50	<0.50
6/12/2007	W8D1	<0.50	<0.50
6/19/2007	W9D1	<0.50	<0.50
6/26/2007	W10D1	<0.50	<0.50

*This sample was also tested for several other analytes; all values were below the reporting limit.

LCS

LCS samples were utilized at all three analytical laboratories as an internal QC for the data. The results of all three laboratories' LCS samples are included in Tables 6-13, 6-14, and 6-15.

EMA Laboratories. LCSs were analyzed at EMA laboratories for selected sampling events. The RPD percentages for all samples were within acceptable limits (Table 6-13). Several samples had recovery limits outside the acceptable range, including the benthiocarb from the RPP W6D1 event, and benthiocarb and molinate from the RPP W9D1 event.

Valent Laboratories. LCSs were spiked with thiobencarb and analyzed at Valent laboratories for selected sampling events. The RPD percentages for all samples were within acceptable limits (Table 6-15). The recovery limits for all samples were within acceptable limits.

Syngenta Laboratories. LCSs were spiked with molinate and analyzed at Syngenta laboratories for selected sampling events. The recovery limits for all samples were within acceptable limits (Table 6-15).

Surrogate Standard

Surrogate standard samples were prepared for analysis with the environmental samples. All sample results were within the required recovery limits (Table 6-16).

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TABLE 6-13
LCS Sample Results (EMA), RPP 2007

Sample Event	Analyte	Spike Level (µg/L)	SPK Result (µg/L)	DUP Result (µg/L)	SPK Recovery (%)	DUP Recovery (%)	Recovery Limits	RPD (%)	RPD Limits
W6D1 5/29/2007	Molinate	2	2.01	1.80	100.3	89.8	75–120	11.0	35
	Benthiocarb	2	2.76	2.44	137.8	**122.1**	75–120	12.1	35
W7D1 6/5/2007	Molinate	2	1.94	1.82	96.8	90.9	75–120	6.3	35
	Benthiocarb	2	2.41	2.36	120.6	118.2	75–120	2.0	35
W7D2 6/7/2007	Molinate	2	1.94	1.80	96.8	90.0	75–120	7.3	35
	Benthiocarb	2	2.41	2.36	120.6	118.2	75–120	2.0	35
W9D1 6/19/2007	Molinate	4	2.86	3.04	**71.6**	76.1	75–120	6.1	35
	Benthiocarb	4	2.94	3.68	**73.6**	92.0	75–120	22.2	35

TABLE 6-14
Thiobencarb LCS Sample Results (Valent), RPP 2007

Analysis Date	Spike Level (µg/L)	SPK Result (µg/L)	DUP Result (µg/L)	SPK Recovery (%)	DUP Recovery (%)	Recovery Limits	RPD (%)	RPD Limits
5/3/2007	1.0	0.920	0.929	92.0	92.9	75–120	1.0	35
5/10/2007	1.0	0.956	0.951	95.6	95.1	75–120	0.5	35
5/22/2007	1.0	0.981	1.040	98.1	104.0	75–120	5.8	35
5/29/2007	1.0	0.932	1.000	93.2	100.0	75–120	7.0	35
6/5/2007	1.0	1.004	0.982	100.4	98.2	75–120	2.2	35
6/12/2007	1.0	1.038	1.028	103.8	102.8	75–120	1.0	35
6/19/2007	1.0	0.976	0.965	97.6	96.5	75–120	1.1	35
6/25/2007	1.0	0.924	0.924	92.4	92.4	75–120	0.0	35
6/29/2007	1.0	0.918	0.928	91.8	92.8	75–120	1.1	35

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TABLE 6-15
Molinate LCS Sample Results (Syngenta), RPP 2007

Analysis Date	Spike Level (µg/L)	SPK Result (µg/L)	SPK Recovery (%)	Recovery Limits
4/30/2007	1.0	0.8	80.0	75–120
5/14/2007	1.0	0.9	90.0	75–120
5/23/2007	1.0	1.03	103	75–120
5/31/2007	1.0	0.94	94.0	75–120
6/4/2007	1.0	0.95	95.0	75–120
6/25/2007	1.0	1.14	114	75–120
6/26/2007	1.0	0.96	96.0	75–120
6/28/2007	1.0	1.0	100	75–120
4/30/2007	5.0	4.6	92.0	75–120
5/14/2007	5.0	4.87	97.4	75–120
5/23/2007	5.0	5.25	105	75–120
5/31/2007	5.0	4.88	97.6	75–120
6/4/2007	5.0	4.86	97.2	75–120
6/25/2007	5.0	5.3	106	75–120
6/26/2007	5.0	5.95	119	75–120
6/28/2007	5.0	4.93	98.6	75–120

TABLE 6-16
Surrogate Standard Results, RPP 2007

		Surrogate Recovery Results (%), EMA Laboratories	
Sample Date	Sample Location	Triphenylphosphate (65–135)*	Ethion (65–135)*
5/1/2007	SR1	106	NA
5/15/2007	CBD5	NA	72.4
5/17/2007	CRC1	NA	78.8
5/17/2007	CBD1	NA	73.3
5/22/2007	CBD1	NA	70.4
5/29/2007	SSB	121	NA
6/5/2007	BS1	122	NA
6/7/2007	CRC1	130	NA
6/7/2007	CBD1	116	NA
6/12/2007	CBD5	118	NA
6/19/2007	BS1	124	NA
6/26/2007	SR1	115	NA

Note: Ethion is surrogate for molinate, and triphenylphosphate is surrogate for benthiocarb.
*Control limits
NA: not analyzed

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Analysis of Precision

Duplicates for the RPP sampling were uniquely processed, with the primary and duplicate samples analyzed at different laboratories (primary samples at Valent or Syngenta, duplicate samples at EMA). While this prevents a direct comparison of results from within a site, it allows a comparison of laboratories.

A field duplicate sample was collected nearly every week of sampling, with the exception of weeks 1, 3, and 8. Although the two types of samples (primary versus duplicate) were run at different laboratories, RPD values were calculated to quantify the difference. Site CBD1 from sampling event W4D1 had a primary value of <0.5 µg/L and a duplicate value of 0.76 µg/L for thiobencarb. That yields an estimated RPD of 40 percent, which is above the acceptable limit. Site BS1 from sampling event W7D1 had a primary value of 1.15 µg/L and a duplicate value of 1.04 µg/L for molinate. That yields an RPD of 10 percent, which is considered acceptable under QAPP control limits. Field duplicate results are presented in Table 6-10.

MS samples were analyzed for each matrix during sampling events RPP W4D2 and RPP W7D2. Although two samples for each analyte were taken at each event, they were spiked and analyzed at different laboratories, making an RPD comparison inappropriate. MS results are presented in Table 6-11.

LCS samples for the W6D1, W7D1, W7D2, and W9D1 sampling events were analyzed at EMA laboratories. All samples from all dates were within RPD limits for both analytes. LCS sample results and RPD values are presented in Table 6-13.

LCS samples were analyzed at Valent laboratories for all analysis dates. All samples from all dates were within RPD limits for thiobencarb. LCS samples results and RPD values are presented in Table 6-14.

Analysis of Accuracy

Rinse blank samples were collected at the RPP W4D2, RPP W7D2, and RPP W8D1 sampling events. All rinse blank samples were found to have analyte levels below the method reporting limits. Rinse blank results are presented in Table 6-9.

Method blank samples were run with every batch of analytical samples. All method blank samples were found to have analyte levels below the method reporting limits. Method blank results are presented in Table 6-12.

MS samples were prepared for sampling events W4D2 and W7D2. The majority of the samples were within the acceptable recovery limit. The results from two samples fell outside the recovery limits; the EMA thiobencarb sample from the W4D2 event was 148.2 percent, higher than acceptable recovery limits. For the W7D2 event, the EMA thiobencarb sample was 134 percent, again higher than the acceptable recovery limit. MS results and recovery limits are presented in Table 6-11.

LCS samples were prepared at EMA laboratories for four sampling events, W6D1, W7D1, W7D2, and W9D1. The majority of the samples were within the acceptable recovery limit. Three samples had results outside of the range: the Benthiocarb sample from the RPP W6D1 sampling event had a recovery of 122.1 percent, both the molinate and benthiocarb samples

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from the RPP W9D1 sampling event were outside the range, at 71.6 and 73.6 percent, respectively. LCS results and recovery limits are presented in Table 6-13.

LCS samples for all analysis dates were analyzed at Valent laboratories. All samples from all dates were within the acceptable recovery limits for thiobencarb. LCS sample results and recovery limit values are presented in Table 6-14.

LCS samples for all analysis dates were analyzed at Syngenta laboratories. All samples from all dates were within the acceptable recovery limits for molinate. LCS sample results and recovery limits values are presented in Table 6-15.

Surrogate standards were evaluated with the analytical samples at the EMA laboratory. All of the sample results were within the acceptable recovery limits. Surrogate standard results and recovery limits are presented in Table 6-16.

Analysis Summary

The following summarizes the results of the QA/QC analysis performed on the RPP data:

- Primary and duplicate samples were analyzed at two different laboratories, making a comparison for RPD inappropriate.
- MSD samples were not submitted for analysis to each laboratory in conjunction with MS samples. Rather, the submittal of MS samples to EMA provided an in-lieu MSD for the MS samples submitted to Valent and Syngenta.
- Two MS analyses reported results outside the recovery limit ranges. These analyses were EMA thiobencarb W4D2 and EMA thiobencarb W7D2.
- Three LCS analyses reported results outside the recovery limits. These analyses were EMA benthiocarb W6D1, and EMA benthiocarb and molinate W9D1

Chains of Custody

Chains of custody were utilized to document sample possession from the time of field sampling until the time of laboratory analysis. A chain-of-custody (COC) form was completed after sample collection at each sample event and prior to sample shipment or release. The COC record forms were completed with indelible ink. Unused portions of the form were crossed out and initialed by the sampler. The COC form, sample labels, and field documentation were cross-checked to verify sample identification, type of analyses, sample volume, and number and type of containers.

COC forms for the CWFR and RPP monitoring programs are included in Appendixes B-1 and C-1, respectively.

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CHAPTER 7

Summary and Conclusions

This year was the third full year in which the CRC conducted water quality monitoring and reporting activities under the requirements of the CVRWQCB's *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*. The CRC also conducted monitoring and reporting activities under the requirements of the Rice Pesticides Program as required under the CVRWQCB Resolution No. R5-2007-0018.

During 2007, the CRC continued to invest significant effort and budget to comply with the requirements and intent of the CWFR's MRP and the RPP. Through this investment, the CRC has developed the capacity of its technical consultant resources and continues to refine its monitoring and reporting capabilities.

Summaries of the key successes and challenges faced during 2007 program implementation follow.

CWFR

Specified Pesticides

Four "specified pesticides" were monitored during Year 3: cyhalofop-butyl, azoxystrobin, propiconazole, and trifloxystrobin. Samples collected April through September were analyzed for the specified pesticides. Results for the entire year were non-detect. Samples collected April through September were analyzed for the specified pesticides. The results all analyses were non-detect.

Aquatic Toxicity Testing

In accordance with the MRP, acute and chronic toxicity tests were performed on three test species. Tests are performed on samples collected at each station and are performed concurrent with tests on control samples. The three test species are:

- Fathead minnow (*Pimephales promelas*)
- Water flea (*Ceriodaphnia dubia*)
- Green algae (*Selenastrum capricornutum*)

P. promelas Toxicity Testing

For all of the analyses conducted during Year 3, there was no statistically significant observed toxicity to fathead minnow. No resampling was triggered and no TIEs were required. These results indicate that sampled waters were not toxic to fish species.

C. dubia Toxicity Testing

- Analysis conducted in February and April through October showed no statistically significant observed toxicity to *C. dubia.* No resampling was triggered, and no TIEs were required.

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- Analysis conducted in September 2007 resulted in 0 percent survival of the test organism *C. dubia* for the CBD1 sample. As a result, resampling was triggered, and a Phase I TIE was performed. The results of the TIE indicated that a non-polar organic chemical(s) contributed to the toxicity. Inorganic chemicals and cationic metals were determined not be contributing to the observed toxicity. The resample did not result in statistically significant toxicity to *C. dubia.*

Selenastrum Toxicity Testing

The MRP includes toxicity tests using the test species *Selenastrum capricornutum* to detect toxicity to aquatic plants. *Selenastrum* is a green algae species and is considered the most sensitive test species. Toxicity to *Selenastrum* can indicate a water quality concern. The following summarizes the results of the algae toxicity testing.

February

- All samples showed 100 percent survival as compared to the control.

April

- Statistically significant toxicity was observed at BS1 (86 percent) and CBD1 (85 percent).
- Samples analyzed at CBD5, JS, and SSB showed no statistically significant observed toxicity.
- No resampling was triggered.

May

- Statistically significant toxicity was observed at BS1 (84 percent), CBD1 (67 percent), and SSB (28 percent).
- Samples analyzed at CBD5 and JS showed no statistically significant observed toxicity.
- Resampling was triggered at SSB. Resampling was performed 7 days following the original sampling event. The results of the resampling showed 105 percent survival as compared to the control, indicating that that the previously observed toxicity did not persist.

June

- Statistically significant toxicity was observed at all sites: BS1, 86 percent; CBD1, 25 percent; CBD5, 79 percent; JS, 66 percent; and SSB, 8 percent.
- Resampling was triggered at CBD1 and SSB. The results of the resampling at CBD1 showed 8 percent survival, and results at SSB showed 36 percent survival, both of which were determined to be statistically significant. These results indicate that the previously observed toxicity did persist at CBD1 and SSB.

July

- Statistically significant toxicity was observed at CBD1 (86 percent), JS (80 percent), and SSB (74 percent).
- Results observed at BS1 and CBD5 showed 100 percent survival.
- No resampling was triggered.

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- Results for additional herbicides analyzed performed on the CBD1 sample as part of the CRC's *Selenastrum* study plan were all non-detect. These results are included in Appendix B-4.

August

- All samples showed greater than 100 percent survival as compared to the control.

September

- Statistically significant toxicity was observed at SSB (70 percent).
- Samples analyzed at BS1, CBD1, CBD5, and JS showed no statistically significant observed toxicity.
- No resampling was triggered.
- Results for additional herbicides analyzed performed on the BS1, CBD5, and SSB samples as part of the CRC's *Selenastrum* study plan were all non-detect. These results are included in Appendix B-4.

October

- All samples showed equal to or greater than 100 percent survival as compared to the control.

Sediment Toxicity Testing

The MRP requires sediment toxicity tests using the test species *Hyalella azteca* to detect toxicity to benthic organisms. A small amphipod common in aquatic systems, *H. azteca* is considered a sensitive test species, and toxicity to *H. azteca* can indicate a sediment quality concern. As required, sediment toxicity tests were performed on samples collected in July and September.

H. azteca toxicity tests performed on samples collected in July and September showed no statistically significant effects. No resampling was required.

Field Parameters

pH

In 2007, there were no observations showing pH exceedances.

DO

As compared to the WARM WQO for DO, which is 5 mg/L, there were four observations that did not achieve the WARM WQO:

- September at BS1
- June, June resample, and July at CBD1

As compared to the COLD WQO for DO, which is 7 mg/L, there were twenty observations that did not achieve the COLD WQO. In addition to the four occurrences below 5 mg/L, these occurred at the following times and sites:

- May, June, and July at BS1

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- May, September, September resample, and October at CBD1
- June and July at BD5
- May, June, July, and September at JS
- June resample and July at SSB

Assessment of the 2007 CWFR Program

This year, 2007, represents the third full year of the CWFR program. The key successes and challenges faced during 2006 program implementation are summarized as follows:

- Management practices continued to be implemented, including water-holds, education and outreach (newsletters and grower meetings), enforcement activities, and coordination with the UC Cooperative Extension, UC Davis, and the Rice Research Board. Additionally, the CRC has the ability to directly contact each of its members and is committed to using its outreach capabilities to address water quality concerns when they are identified.

- No new management practices were triggered as a result of the 2007 water quality monitoring results.

- Regularly scheduled sampling was conducted as required under the MRP. This sampling included analysis for field parameters (temperature, DO, pH, electrical conductivity/total dissolved solids, flow), specified pesticides, and toxicity (fathead minnow, water flea, and green algae.

- Low dissolved oxygen, particularly at BS1 and CBD1 sites, was consistently measured. DO was consistently low at BS1 in 2006 as well. Low DO was prevalent during the hot summer months. The CRC implemented DO monitoring in coordination with the UC Davis CALFED grant during 2007 in an effort to increase the understanding of rice discharges and the effects on DO.

- No fathead minnow toxicity was observed.

- C. daphnia toxicity was observed in September (a month in which rice growers do not use pesticides). C. daphnia toxicity was not detected in any other month. A TIE was initiated for this event, as described above.

- Based on the results of *Selenastrum* toxicity tests, resampling was triggered in May (SSB) and June (CBD1 and SSB). The May resample at SSB did not show statistically significant algae reductions. However, both resamples in June showed continued statistically significant algae reductions.

- As required under the 2007 requirements, as part of the algae study plan, additional herbicides and copper were analyzed for samples collected at CBD1 in July and at BS1, CBD5, and SSB in September. The results of all analyzed herbicides and copper were non-detect, including during the SSB September event at which a statistically significant percent reduction (70 percent survival, as compared to the control) was observed.

- The application of the tributary rule to drain sites may not be appropriate, though it is recognized that the protection of existing beneficial uses is an important part of water quality protection.

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- The CRC continues to be engaged in the CVRWQCB's efforts to refine the irrigated lands conditional waiver program through its regular consultation with CVRWQCB staff and through its participation in the CVRWQCB's Technical Issues Committee.

CWFR Recommendations for 2007

- Chemistry analysis for rice herbicides and other herbicides used within the watershed should be continued at the initiation of the toxicity tests for select sites and months at which there is a likelihood of detecting algae toxicity. This may result in an ability to identify the toxicant contributing to *Selenastrum* toxicity. Coordination with the CACs to identify products used during specific months should continue in order to understand other (non-rice) products that may be contributing.
- Chronic concerns such as DO, pH, and algae toxicity should be monitored within the framework of a Management Plan.
- The field samplers should consider using blind naming conventions for spike, duplicate, and rinse blank samples. This would ensure that the laboratories are unaware of expected results.
- Close consultation with CVRWQCB staff regarding the program should continue in an effort to refine the program to focus on identified water quality concerns and appropriate implementation actions, if warranted.

RPP

The RPP continues to be an example of an effective agricultural regulatory program. The RPP implements a monitoring schedule designed to focus sampling activities during the 10 weeks of peak pesticide use, and on high-use products that are regulated under the Basin Plan's Conditional Prohibition of Discharge. Further, the water holds and other management practices implemented by rice growers and the CRC continue to provide water quality protection.

This year saw no exceedances of the Basin Plan Performance Goals for either molinate or thiobencarb. Further, only one detection of thiobencarb was observed at the City of West Sacramento Intake. No detections of either thiobencarb or molinate were observed at the City of Sacramento Intake, and no detections of molinate were observed at the City of West Sacramento Intake.

RPP Recommendations for 2007

It is recommended that the CRC continue to implement RPP water quality monitoring and reporting activities consistent with the program implemented during 2007.

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CHAPTER 8

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