January 30, 2005

Mr. Craig J. Wilson
Chief, Water Quality Assessment Unit
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814

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303 (d) Deadline: 1/31/06

Subject: **Comments on the 2006 303(d) List**

Dear Mr. Wilson,

As representatives of the Turlock Irrigation District (TID), we are presenting comments on the *Staff Report – Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments*, dated September 2005 (Staff Report), specifically regarding 303(d) listings for Harding Drain and Don Pedro Reservoir. Our comments are based on new data and on the SWRCBs *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy)[1].

Water quality in the Harding Drain has improved considerably over the last several years. Application of the new Policy and new data supports delisting the Harding Drain for ammonia, diazinon and chlorpyrifos because water quality objectives are now being met. As noted in Section 4.1 of the Policy, "waters shall be removed from the section 303(d) list if the number of measured exceedances supports rejection of the null hypothesis [the hypothesis that the water is impaired] as presented in Table 4.1." Application of the Table 4.1 delisting criteria to data collected recently in the Harding Drain demonstrate that water quality objectives are not exceeded frequently for ammonia, diazinon, chlorpyrifos, or additive toxicity for the two pesticides. The data show that Harding Drain is not impaired for these constituents and the drain should be delisted accordingly.

The Policy also calls for delisting Don Pedro Reservoir for mercury because the original listing was based on faulty data. As noted in Section 4 of the Policy, "listings of water segments shall be removed from the section 303(d) list if the listing was based on faulty data, and it is demonstrated that the listing would not have occurred in the absence of faulty data." The Policy goes on to define faulty data to include "improper quality assurance/quality control procedures, or limitations related to the analytical methods that would lead to improper conclusions regarding water quality status of the segment." The data used to list Don Pedro Reservoir for mercury is faulty because it is based on outdated analytical techniques, it is not spatially representative, and was incorrectly applied to compare

[1] As the SWRCB is likely aware, there have been ongoing discussions at the RWQCB level regarding the beneficial uses of agricultural canals and drains generally throughout the Central Valley. Although TID is not raising these issues as a basis for delisting the Harding Drain at this time, neither does it intend that its discussion here inadvertently waive its views on the issues before the RWQCB. Rather, TID here shows that the data supports delisting the Harding Drain based on the beneficial use that drove the original listing, a WARM freshwater fishery beneficial use, without regard to whether that beneficial use was properly applied to the Harding Drain.

against the USEPA criterion. As such, the Policy requires that the listing be removed. New, more complete data should be collected on Don Pedro Reservoir to assess any potential impairment and to determine if a listing is warranted.

An overview of our comments on the listings for Harding Drain and Don Pedro Reservoir is presented below. More detailed Fact Sheets, including raw data (Attachments A, B, C, and D), and QA/QC information (Attachment E) are presented in several attachments to this letter.

Harding Drain

Harding Drain, which is often incorrectly referred to as TID Lateral 5, is currently listed as impaired for ammonia, chlorpyrifos, diazinon, and unknown toxicity. The Harding Drain is approximately 5.25 miles in length and is located at the downstream end of TID's Ceres Main Canal (Figure 1). As shown, Lateral 5 spills to the Ceres Main Canal where the canal turns to the west. The Ceres Main Canal spills to the Harding Drain at CMD32 – Hodges (or the Ceres Main, Drop 32 also known as Hodges Drop). It should also be noted that the 303(d) listing currently refers to an 8.3-mile distance of impaired water in the Harding Drain, which appears to be an error in the measured distance or inappropriately includes the Ceres Main and Lateral 5 canals.

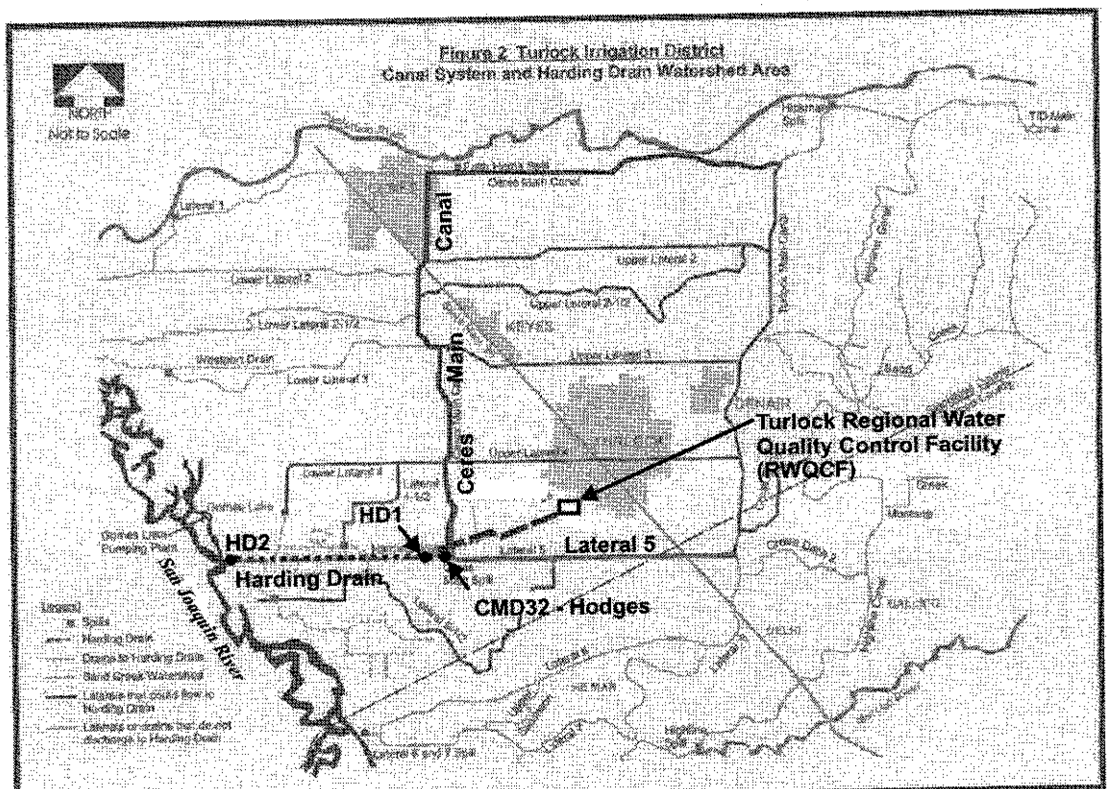

Figure 1. Map of the Harding Drain Watershed

Improving Water Quality in the Harding Drain

Recent data from the Harding Drain reflect water quality improvements that have resulted from actions taken by many over the last several years in the Harding Drain watershed. In 2001, Central Valley Regional Water Quality Control Board (CVRWQCB) staff initiated a joint cooperative project with the Department of Fish and Game, the Turlock Irrigation District, and dairy owners to remove dairy discharges and associated ammonia from the Harding Drain (CVRWQCB, 2005a). These joint efforts were successful in eradicating dairy discharges by the end of 2001. The City of Turlock also implemented improvements at the Turlock Regional Water Quality Control Facility (RWQCF) in May 2002, providing nitrification and removing much of the ammonia from its effluent. As a result, ammonia discharges from the City into the upper end of Harding Drain have decreased substantially. The RWQCF is regulated by an NPDES permit issued by the CVRWQCB.

The Regional Board recently adopted a TMDL Basin Plan Amendment *(Public Review Draft Staff Report for the San Joaquin River Basin Plan Amendments)* to address organophosphate pesticides in the San Joaquin River (CVWRCB, 2005b), with a 5-year compliance schedule. Even before the TMDL, agricultural and urban uses of organophosphate pesticides in the area were declining. Data on pesticide application demonstrate that agricultural use of chlorpyrifos and diazinon within Stanislaus County and the rest of the Central Valley has been reduced significantly since 1995 (DPR 2003a, DPR 2003b, CVRWQCB 2005b). Other recent actions will further reduce the potential for chlorpyrifos and diazinon to occur in urban discharges to the TID system. As noted recently by Regional Board staff - "The ban on residential urban use of chlorpyrifos, and the phase-out of urban use of diazinon should eventually reduce the potential for water quality impacts from these pesticides in urban areas" (CVRWQCB 2005b).

The results of existing data are the basis for the recommended delisting of the Harding Drain. Factors contributing to the conditions of the drain have changed since the original listing. Additional actions currently being taken will further benefit the conditions of the drain; however, such actions are not the basis for the proposed delisting.

To further improve water quality in the Harding Drain (Figure 2), the TID is now in the midst of implementing two grant-funded projects, administered by the State Water Resources Control Board (SWRCB). A Proposition 50 project is underway to perform detailed monitoring of water quality in the Harding Drain and tributary sources, perform a watershed assessment, develop a watershed management plan, and perform education and outreach. This Proposition 50 project is to be completed by March 31, 2008. In addition, a Proposition 13 project, which is anticipated to run through March 2007, is in process to identify agricultural discharges within the TID service area (including the Harding Drain watershed) and to install positive shut-off devices on tailwater discharges, providing growers with the tools needed to control the quantity and quality of runoff leaving their land.

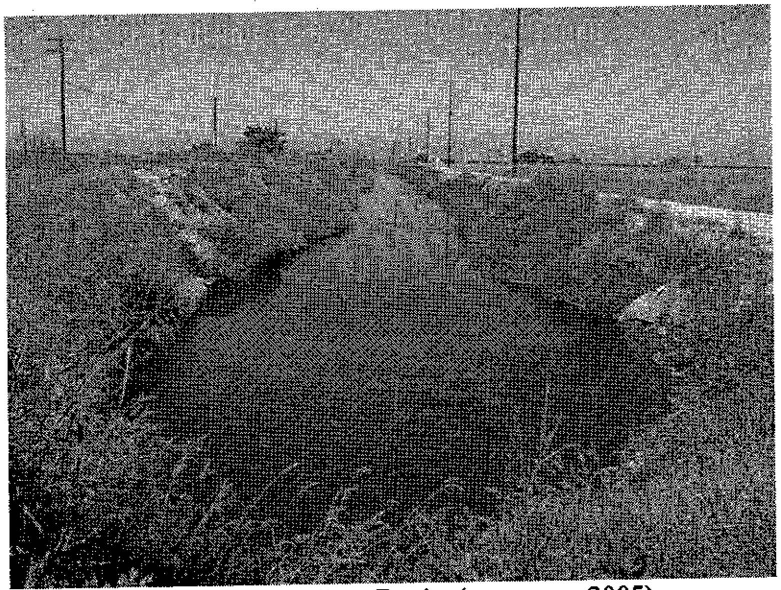

Figure 2. Harding Drain (summer, 2005)

New Harding Drain Data Support Delisting

As noted in the *Internal Draft CVRWQCB Staff Assessment* (Attachment G), much of the data used to support the original 303(d) listing of the Harding Drain were collected between 1985 and 1999 (Grober 2001). More recent data for ammonia (along with pH and temperature), chlorpyrifos, and diazinon have been collected by the Turlock Irrigation District, U.S. Geological Survey (USGS), Department of Pesticide Regulation (DPR), and the City of Turlock. These new data reflect improved water quality within the drain and support delisting, as described below. Further detail is presented in the attachments to this letter.

The TID performed extensive water quality monitoring, collecting two samples a month between September 2001 and September 2004, including locations in the Ceres Main Canal just upstream of the Harding Drain (CMD32 – Hodges), and at the upstream (HD1) and downstream ends (HD2) of the Harding Drain. The TID monitoring program included a detailed sampling and analysis plan and QA/QC program, which are described in Attachment E and are compliant with the data quality assessment process requirements outlined in Section 6 of the Policy. Applying the delisting criteria (Table 4.1), to data from these sites, both individually and collectively, demonstrate that the Harding Drain is not impaired for ammonia, chlorpyrifos or diazinon.

Ammonia. Ammonia data were compared to chronic criteria, or Criteria Continuous Concentration (CCC), 30-day average concentrations with fish early life stages present. Based on the recently completed UAA for the Harding Drain (Tetra Tech 2004), reproduction and/or early development uses are not applicable to the drain. Though the CCC 30-day average without early life stages would actually be most applicable and slightly less restrictive, the more restrictive CCC 30-day average concentrations with early life stages present were used to evaluate data. Thus, the analysis of data is conservative.

For ammonia, the TID data show a substantial improvement in water quality after the implementation of improvements at the City of Turlock RWQCF (summer, 2002). The data from the Ceres Main Canal at CMD32 -Hodges, which is upstream of the City of Turlock RWQCF discharge, show only one exceedance of chronic ammonia criteria out of 72 samples collected. The delisting criteria in the Policy (Table 4.1) would allow for as many as six total exceedances over that sample size and still reject the null hypothesis (that the site is impaired for ammonia). Data from the Harding Drain, collected after the RWQCF improvements, show two exceedances of chronic criteria at HD1 and no exceedances at HD2 out of 55 samples collected at each site. These data more than meet the delisting criteria, which would allow for as many as four exceedances at each site and still support delisting. Taken collectively, the data for the three sites together also meet the delisting criteria, with a total of three exceedances out of 182 samples collected since the City of Turlock RWQCF improvements, when up to 13 exceedances would be allowable according to Table 4.1 of the Policy.

Other available sources of data for ammonia were also assessed. Data collected by the City of Turlock were compared against chronic ammonia criteria and the delisting criteria in the Policy. The City's data were evaluated for time periods before and after the RWQCF upgrades. Of the 131 City of Turlock samples collected prior to the upgrades, a total of 58 ammonia exceedances were observed, indicating impairment. Historic data collected by the USGS between 1992 and 1995 as part of the National Water Quality Assessment (NAWQA) Phase I monitoring program also showed ammonia impairment prior to the RWQCF improvements. A total of 20 out of 58 USGS ammonia samples exceeded chronic ammonia criteria prior to summer 2002. After the RWQCF improvements, only three samples collected by the City of Turlock exceeded the chronic ammonia criteria out of 163 samples collected. These data meet the delisting criteria, which would allow for up to 22 exceedances and still support delisting. No QA/QC data for the City's monitoring program were assessed for the purposes of this letter.

Chlorpyrifos and Diazinon. Chlorpyrifos and diazinon data were compared to water quality guidelines included in the Staff Report (SWRCB 2005a), which are based on California Department of Fish and Game (CDFG) Hazard Assessment Criteria of 0.014 ug/L for chlorpyrifos and 0.10 ug/L for diazinon, 4-day average (chronic) concentrations (Siepmann and Finlayson, 2000; Finlayson 2004). These chronic 4-day criteria are more restrictive than the acute 1-hour maximum concentration criteria; thus, the data evaluation is conservative, given that some segments (e.g., Lower Feather River, Morrison Creek, and Sutter Bypass) have been delisted on the basis of less restrictive acute evaluation guidelines (SWRCB 2005b).

Data collected by TID for chlorpyrifos and diazinon also support delisting. Chlorpyrifos data, collected from September 2001 through September 2004, show two exceedances of the chronic limit (0.014 ug/L) out of 71 samples collected at CMD32-Hodges, two out of 74 samples collected at HD1, and five out of 74 samples collected at HD2. The delisting criteria would allow for up to five exceedances at CMD32 and up to six exceedances at HD1 and HD2. Taken together, the data also support delisting, with a total of nine exceedances out of 219 samples, when the delisting criteria would allow up to 18 exceedances to support delisting. Diazinon data collected by TID show a similar result, with four exceedances of the chronic limit (0.10 ug/L) at CMD32, and two each at HD1 and HD2, or a total of eight at all three sites versus 18 allowed. Additive toxicity for chlorpyrifos and diazinon was also calculated for each of the sampling events and compared to the additive toxicity limit presented in the Basin Plan Amendment (CVRWQCB, 2005b). The additive toxicity results also indicate that delisting is appropriate. Of the 219 samples assessed, a total of 14 had additive toxicity that exceeded the additive toxicity limit, when the delisting criteria would allow for up to 18 exceedances.

Other available data for chlorpyrifos and diazinon were also assessed for Harding Drain. Historic data from the USGS and DPR (pre-1995) indicate impairment, but more recent data show a substantial improvement in water quality. USGS data collected between 1992 and 1994 had a total of 18 out of 23 chlorpyrifos samples and one out of 23 diazinon samples that exceeded limits. Historic DPR data for chlorpyrifos and diazinon from 1991 to 1993 showed 12 chlorpyrifos exceedances and 9 diazinon exceedances out of 49 samples collected. More recent data collected by the USGS between 1999 and 2001 at HD2 showed no exceedances of limits for either chlorpyrifos or diazinon. Data collected by the City of Turlock for chlorpyrifos and diazinon data between 2001 and 2005 showed no exceedances out of 15 samples total.

In summary, data collected by TID and by others (City of Turlock and USGS) indicate that the Harding Drain is no longer impaired for chlorpyrifos and/or diazinon and support delisting the Harding Drain for these constituents.

Timing for TMDL Completion

As noted above, many local efforts have been underway to address water quality issues in the Harding Drain over the last several years. The TMDL schedule should recognize these efforts and provide time for them to work before a regulatory process is imposed. In this manner, limited resources can be focused on the water quality impairments that are the most significant or are not already being addressed by other means. A major aim of State grant-funded projects is to support local initiatives to improve water quality. Developing the TMDLs before local initiatives can be completed would undermine these efforts, rather than enabling and encouraging local watershed stakeholders to "do the right thing", to take positive actions to restore water quality and address historic impairments.

Given that new data for the Harding Drain support delisting, there should be no reason to proceed with TMDLs currently proposed for completion in 2007 (ammonia) and 2008 (chlorpyrifos and diazinon).

Don Pedro Reservoir

In the past, TID has submitted extensive comments highlighting several concerns with the listing of Don Pedro Reservoir for mercury (summarized most recently in a June 14, 2004 letter to Craig Wilson, SWRCB). To date, TID has not seen any detailed response to those comments. Two principle issues support the delisting of Don Pedro Reservoir. As previously noted, the new Policy does not allow the use of "faulty" data to support listing waters, and specifically where limitations related to the analytical methods would lead to improper conclusions regarding the water quality status. The data for mercury in Don Pedro Reservoir are faulty when compared to quality assurance standards associated with current analytical techniques, given that they were collected decades ago, prior to the development of "clean" and "ultra-clean" metals techniques. The data are also spatially confined to the northernmost arms of the lake and do not provide adequate spatial coverage to represent the entire 12,960 acres of waterbody that is currently listed.

In addition, the USEPA criterion for mercury concentrations in fish tissue was misapplied to the data from Don Pedro Reservoir. The USEPA fish tissue residue criterion was developed based on a "weighted consumption" of fish from three trophic levels (USEPA 2001), while the fish tissue data used to list Don Pedro Reservoir considered only the highest trophic level. Applying a weighted average equation (as described in USEPA 2003) to all the available historic data for Don Pedro Reservoir results in a mercury fish tissue concentration of 0.38 mg/kg, as compared to the USEPA criterion of 0.30 mg/kg[2]. Given that the data were collected prior to "clean" and "ultra-clean" metals techniques, it is very likely that the data were faulty and overstated actual mercury levels in Don Pedro Reservoir, which incorrectly led to a 303(d) listing. Under the Policy, "All listings of water segments shall be removed from the section 303(d) list if the listing was based on faulty data, and it is demonstrated that the listing would not have occurred in the absence of such faulty data." Don Pedro Reservoir should be delisted until collection and analysis of additional data using accurate analytical techniques can be performed to assess the actual, current state of mercury. Details supporting the delisting of Don Pedro Reservoir are included in Attachment F.

Summary and Recommendations

Water quality in the Harding Drain has improved considerably since the original 303(d) listing. TID strongly encourages the SWRCB to recognize water quality improvements and make several changes to the proposed 303(d) list, as follows:

- Delist Harding Drain for ammonia to reflect improvements in water quality due to recent City of Turlock RWQCF upgrades and other improvements within the Harding Drain watershed.
- Delist Harding Drain for diazinon and chlorpyrifos, based on new data and information that indicate reduced use of these organophosphate pesticides and reduced levels in Harding Drain.
- Modify the length of the Harding Drain listing to accurately reflect the length of the Drain (i.e. 5.25 miles).
- Delist Don Pedro Reservoir until sufficient data can be collected to assess whether any impairment from mercury exists. Existing data are insufficient to support a listing.

[2] Regarding the weighted average for mercury concentrations in Don Pedro Reservoir, it should be noted that there is a slight difference between the value presented in this analysis and the value included in previously submitted comments. Within previous 303(d) list reviews, comments were made that non-detect results from Don Pedro Reservoir fish sampling were not considered in the SWRCB's analysis of mercury concentrations. In further review, it was determined that the excluded values were actually "unmeasured" values (rather than non-detect results); thus, the exclusion of such values is appropriate.

The TID has spent a significant amount of time and resources over the last several years collecting and analyzing data from the Harding Drain. As observed by Dr. Peter Kozelka of USEPA Region 9 at the Public Workshop on December 6th, the state "is compelled to consider new data" in the process of updating the 303(d) list. We understand the staff workload issues the CVRWQCB and SWRCB face; so the TID has presented the data (attached) in a form that can be readily evaluated by CVRWQCB or SWRCB staff. As described above, delisting waterbodies that are no longer impaired or were inappropriately listed is consistent with the recently adopted listing policy (SWRCB 2004). By delisting these waterways now, valuable state and local resources can be focused in the coming years on addressing the current impairments, rather than expending valuable resources on problems that do not exist.

Thank you for your consideration. We very much appreciate the opportunity to provide comments and would be happy to answer any questions or discuss the data and analysis presented here at any time (925-210-2477).

Very truly yours,

BROWN AND CALDWELL

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Senior Vice President

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Project Engineer

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Project Engineer

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USEPA 2003. *Total Maximum Daily Load [Draft] for Total Mercury in Fish Residue in Spring Creek (including Listed Segment).* Etowah River Tributary (Floyd County, GA). USEPA May 2003.

Attachment A
Harding Drain Ammonia Fact Sheet

Water Segment: Harding Drain (Turlock Irrigation District Lateral #5)

Pollutant: Ammonia

Decision: **Delist** (To be confirmed by SWRCB staff)

Weight of Evidence: This pollutant is being considered for removal from the section 303(d) list under section 4.1 of the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy). Under section 4.1 a single line of evidence is necessary to assess delisting status.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification in favor of removing this water segment-pollutant combination from the section 303(d) list.

This conclusion is based on the findings that:

1. The data used (collected by the Turlock Irrigation District)satisfy the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfy the data quantity requirements of section 6.1.5 of the Policy.
3. Three of the 182 samples exceeded Criteria Continuous Concentration (CCC) with fish early life stages present, and this does not exceed the allowable frequency listed in Table 4.1 of the Policy.
4. Pursuant to section 4.11 of the Policy, additional data and information on current conditions available from the City of Turlock support the decision.

SWRCB Staff Recommendation (Proposed – to be confirmed): After review of the available data and information, SWRCB staff concludes that the water body-pollutant combination should be removed from the section 303(d) list because applicable water quality standards for the pollutant are not exceeded.

Lines of Evidence:

Numeric Line of Evidence Pollutant – Water

Beneficial Use: WARM – Warm Freshwater Habitat (pertinent to listing).

Matrix: Water

Water Quality Objective/ Water Quality Criterion: The Basin Plan narrative water quality objective for toxicity states that all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.

Evaluation Guideline: For the warm freshwater habitat use, the following limit was used in this evaluation: USEPA National Recommended Water Quality Criteria to Protect Freshwater Aquatic Life, Fish Early Life Stages Present, Criteria Continuous Concentration (CCC), 30-day average total ammonia nitrogen (in mg N/L), as calculated by the following equation:

$$CCC = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) \times MIN\left(2.85, 1.45 \times 10^{0.028\times(25-T)}\right)$$

where T = temperature in degrees C

Data Used to Assess Water Quality: Out of 182 samples, three were exceedances (see below for more detail).

Spatial Representation: Three sites, including two locations on Harding Drain (about four miles apart, representing the upper and lower ends of the drain) and one location immediately upstream of the drain, were sampled.

Temporal Representation: Samples were collected twice a month for a period of three years. The monitoring timeframe included both irrigation and non-irrigation seasons. Due to the frequency and duration of monitoring, a number of non-irrigation season sampling events were conducted shortly after precipitation events, representing storm conditions.

Data Quality Assessment:

Quality control samples were analyzed, which included field duplicates, surrogate spikes, matrix spikes (MS) and matrix spike duplicates (MSD), and laboratory blanks. Laboratory results were reviewed after each data package submittal using the established data validation procedures included in the associated sampling and analysis plan.

1.0 Background

As noted in the *Internal Draft CVRWQCB Staff Assessment*,, much of the data used to support the original 303(d) listing of the Harding Drain were collected between 1985 and 1999 (Grober 2001). More recent data for ammonia (along with pH and temperature) were collected by TID during their water quality monitoring program between September 2001 and September 2004 at three sampling locations on or just upstream of the Harding Drain. These new data reflect improved water quality within the drain. A description of the sampling locations follows and more detail about the results at each site is presented below.

- CMD32-Hodges (Ceres Main Drop 32 at Hodges): immediately upstream of the Harding Drain. Lateral 5 spills to the Ceres Main Canal where the canal turns to the west. The Ceres Main Canal spills to the Harding Drain at CMD32-Hodges (or the Ceres Main, Drop 32 also known as Hodges Drop). CMD32-Hodges represents the quality of water within the TID canal immediately prior to spilling into the drain and prior to mixing with effluent from the Turlock Regional Water Quality Control Facility (RWQCF).

- HD1: at the upper end of Harding Drain downstream of where the RWQCF effluent discharges into the Harding Drain. Represents a mixture of flows, including treated effluent.

- HD2: at the lower end of Harding Drain immediately prior to where it flows into the San Joaquin River. Represents the quality of flows to the San Joaquin River.

The City of Turlock RWQCF discharges treated effluent into the upper end of the Harding Drain just downstream of the Ceres Main Drop 32. The Harding Drain was added to the 303(d) list based on high ammonia concentrations and observed fish mortality in samples collected from the drain between 1985 and 1999, as noted in the *Internal Draft CVRWQCB Staff Assessment* (Grober 2001), using data from USGS (1998) and Foe and Conner (1991). During this period, the City's effluent was identified as a primary source of ammonia to the drain (NPDES Permit Study, 1997).

Since the original listing, municipal point source and agricultural improvements have occurred. In May of 2002, the City of Turlock completed an upgrade of the wastewater treatment process at the RWQCF to include nitrification, removing much of the ammonia that was previously discharged to the drain (Berklich 2005). Ammonia discharges coming from dairy related fields were also once a significant source of concern, but the California Department of Fish and Game (CDFG), TID, and dairy owners in conjunction with CVRWQCB staff have worked together to remove dairy discharges to the drain. According to the CVRWQCB, "Early November 2001 was the last recorded discharge into the drain. Joint cooperation and strict enforcement proved successful" (CVRWQCB 2005a). Another published CVRWQCB acknowledgement of the water quality improvement due to eliminated dairy wastes states "An example of the water quality improvement is the Harding Drain, which commonly carried dairy wastes in the past" (CVRWQCB 2005b).

In addition, significant ongoing work by CVRWQCB staff, the East San Joaquin Water Quality Coaltion, TID and others to educate growers regarding water quality issues related to tailwater has resulted in improvements in water quality leaving agricultural fields and entering the drain.

2.0 Water Quality Objectives Attained

Chronic and acute criteria for ammonia, which vary based on pH and temperature, are summarized in the USEPA National Water Quality Criteria to Protect Freshwater Aquatic Life (USEPA 2002). For the purposes of the analysis of recent Harding Drain data, provided below, the most restrictive chronic criteria, also known as the Criteria Continuous Concentration (CCC) with fish early life stages present, were compared to ammonia data (Figures A1 through A3). Based on the recently completed UAA for the Harding Drain (Tetra Tech 2004), reproduction and/or early development uses were dropped for the drain; so the CCC without early life stages would actually be most applicable and slightly less restrictive.

3.0 Evidence of Non-impairment

Based on Section 4.1 of the SWRCB's *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy), "Using the binomial distribution, waters shall be removed from the 303(d) list if the number of measured exceedances supports rejection of the null hypothesis as presented in Table 4.1 (in the Policy)." The null hypothesis that impairment exists can be rejected if the number of samples that exceed criteria (or indicate impairment) are less than a certain number, specified as a function of the sample size based on the binomial distribution.

An analysis of TID ammonia data from three sites (CMD32-Hodges, HD1, and HD2) ranging in spatial distribution from just above Harding Drain to the furthest downstream portions of the drain is presented in Sections 3.1, 3.2, and 3.3. TID ammonia data collected in the drain after the RWQCF upgrade include a total of only 3 CCC exceedances out of 182 samples when the Policy would allow for up to 13 exceedances and still support delisting.

Established quality assurance and quality control (QA/QC) procedures were used in the collection, analysis, and database entry of TID ammonia data. These documented QA/QC procedures are included in Attachment E.

Harding Drain ammonia data collected by the USGS from NAWQA Phase I monitoring and the City of Turlock near the HD2 site were also reviewed as part of this analysis. These data also indicate that Harding Drain is not impaired, providing further weight of evidence to the TID data. Plots of the ammonia data along with the raw data from the USGS and the City of Turlock are provided in Attachment B.

Other potential sources of data were pursued, but no other available data were found for ammonia in the Harding Drain. Although the SWRCB collects water quality data for the

Surface Water Ambient Monitoring Program (SWAMP) on the Harding Drain, the program did not include ammonia[1].

3.1 CMD32-Hodges Ammonia Data

TID Data. Ammonia concentrations at CMD32-Hodges, shown in Figure A1, which are upstream of the RWQCF effluent discharges, show only one exceedance of chronic ammonia criteria out of 72 samples collected. The delisting criteria in the Policy (Table 4.1) would allow for as many as six total exceedances over that sample size and still reject the null hypothesis (that the site is impaired for ammonia). These data more than meet the delisting criteria. Raw TID ammonia data for CMD32-Hodges are available in Section 5.0 of this document.

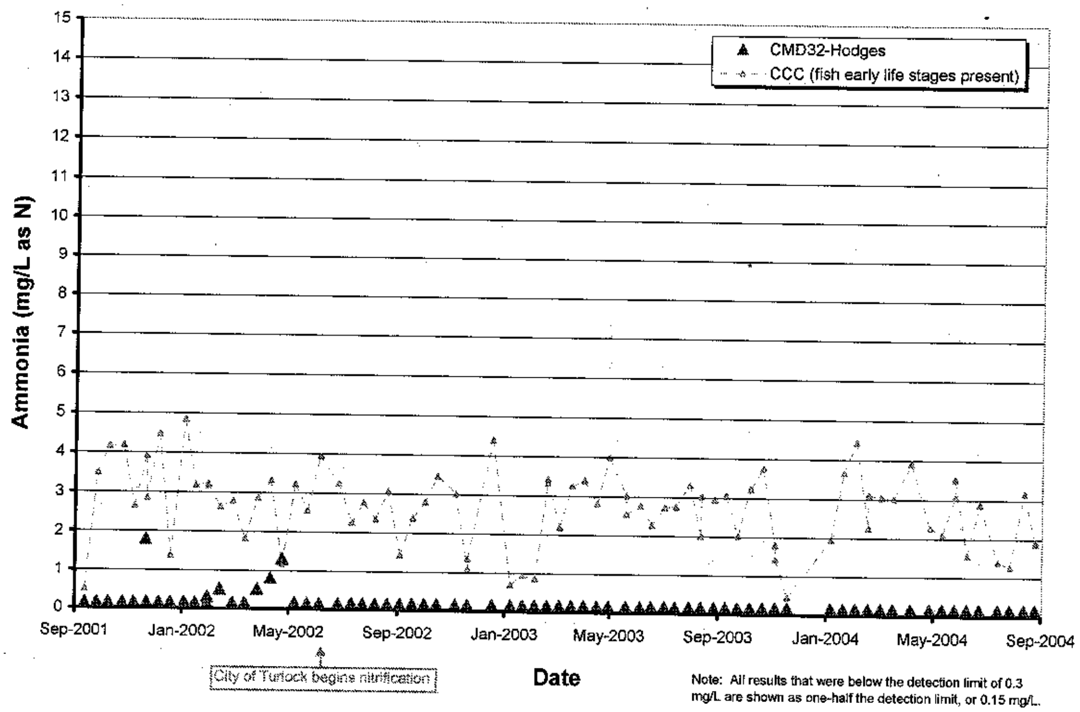

Figure A1. Ammonia in Ceres Main Canal Upstream of Harding Drain (CMD32-Hodges) with CCC Limit.

3.2 HD1 Ammonia Data

TID Data. Ammonia concentrations at HD1, shown in Figure A2, are influenced by the RWQCF effluent. Prior to the RWQCF treatment improvement, a total of 10 out of 19 samples (53%) exceeded the CCC limit at HD1. However, only 2 exceedances out of 55 samples (4%) were observed after the RWQCF upgrade. Data collected after the upgrade more than meet the delisting criteria, which would allow for as many as four exceedances of

[1] This statement was confirmed by CVRWQCB personnel, including Josh Grover and Joe Karkoski (via personal communication on 12/09/05).

the CCC and still support delisting. Raw TID ammonia data for HD1 are available in Section 5.0 of this document.

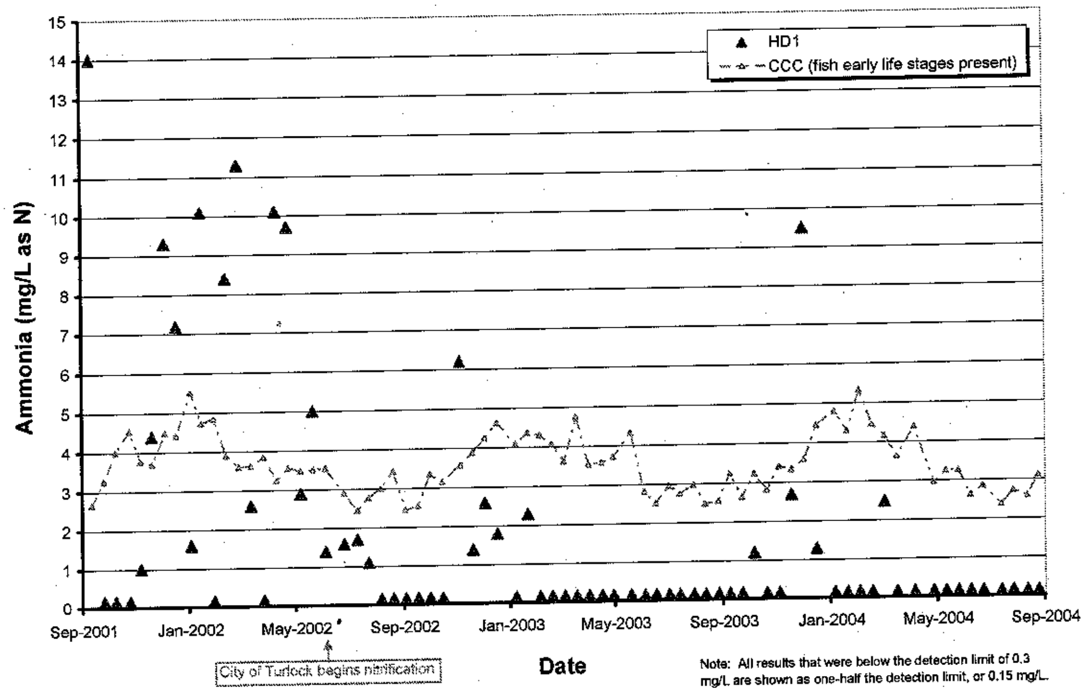

Figure A2. Ammonia at the Upstream End of Harding Drain (HD1) with CCC limit.

3.3 HD2 Ammonia Data

TID Data. Ammonia concentrations at HD2, shown in Figure A3, are generally lower than HD1, due to a variety of factors including dilution from other inputs and uptake or conversion. Prior to the City of Turlock's RWQCF upgrades, a total of 6 out of 20 samples (30%) exceeded the CCC limit at HD2. However, out of 55 samples collected after the RWQCF upgrade, no exceedances were observed, which supports delisting. Raw TID ammonia data for HD2 are available in Section 5.0 of this document.

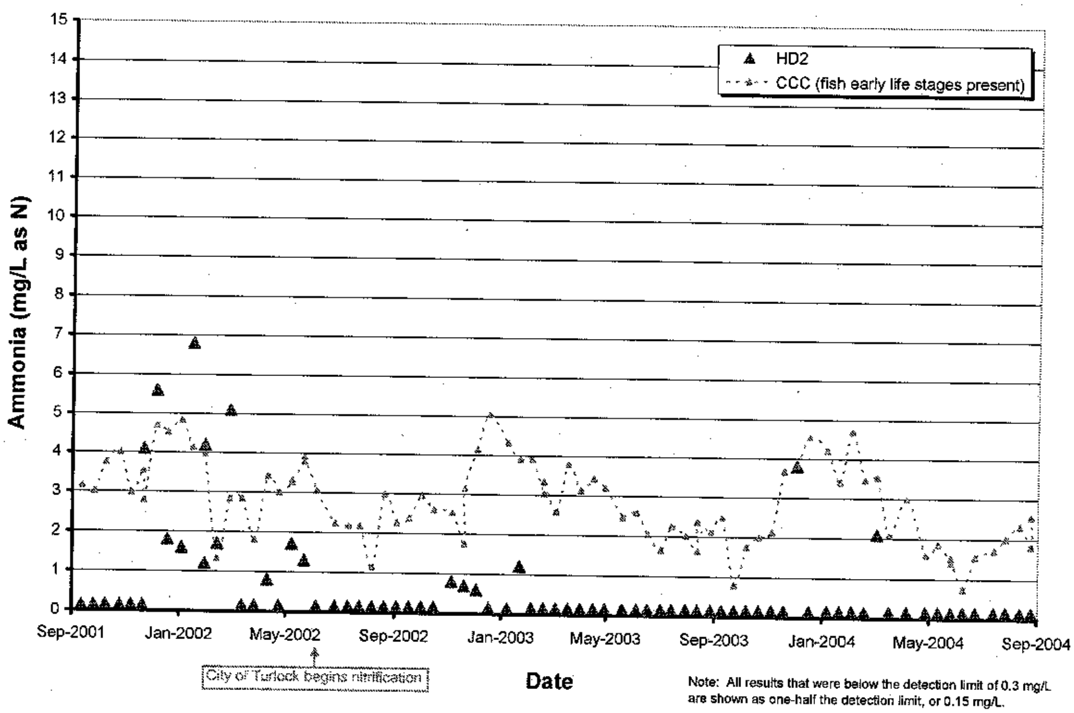

Figure A3. Ammonia at Downstream End of Harding Drain (HD2) with CCC.

USGS NAWQA Phase I Data. The USGS collected ammonia data for Harding Drain near HD2 between 1992 and 1995 as part of NAWQA Phase I monitoring. These data indicate water quality impairment that was present prior to the City of Turlock upgrade of the RWQCF, with 20 out of 58 ammonia samples exceeding the CCC (see Attachment B for data and plots).

City of Turlock Data. The City of Turlock collects ammonia data at three locations on Harding Drain for NPDES permitting. Ammonia samples are collected at R1 (which is the same location as TID site CMD32-Hodges), R2 (which is located in between TID sites CMD32-Hodges and HD1), and R8 (which is the same location as TID site HD2). The City also collects data for other sites, including R3 through R7; however, those sites and/or data collected for those sites are not relevant for this evaluation. Sites R3 and R4 are located on the San Joaquin River. Site R5 is the effluent wastewater pipeline, located 200 feet prior to confluence with Lateral 5. Though sites R6 and R7 are located on the Harding Drain, the City does not have ammonia data at those sites. No QA/QC data for the City's monitoring program were assessed for the purposes of this analysis.

Data for sites R1, R2, and R8 are presented in Attachment B. A very limited amount of ammonia data were collected at R1 and R2 and results of those data were all non-detect values. City of Turlock data from the downstream end of Harding Drain (R8 or HD2) show only 3 exceedances out of 169 samples that exceeded the CCC for data collected after the RWQCF upgrade. According to Section 4.1 of the Policy, these results support delisting of Harding Drain for ammonia.

4.0 Summary of Ammonia Analysis

Based on available recent data from September 2001 through September 2004, the Harding Drain meets the criteria to delist ammonia for each of the three sites analyzed individually (CMD32-Hodges, HD1 and HD2). When data from the three sites are considered together, the delisting criteria in the Policy (SWRCB 2004) are also met, with only 3 exceedances out of the 182 samples collected by the TID since the City of Turlock RWQCF treatment modification; whereas the binomial distribution delisting criteria would allow up to 13 exceedances. Data collected by the City of Turlock, after the RWQCF upgrade, also show that water quality objectives are being met and meet the delisting criteria of the Policy.

5.0 TID Ammonia Data

TID ammonia data for CMD32-Hodges, HD1, and HD2 are included in Tables A1, A2, and A3, respectively. Bold lines in Tables A1, A2, and A3 indicate the timeframe that the RWQCF upgrade occurred.

Table A1. TID Ammonia Data for CMD32-Hodges

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
9/12/2001	8.7	69	20.6	< 0.3	0.49	No
9/26/2001	7.4	66	19.0	< 0.3	3.5	No
10/9/2001	7.2	65	18.2	< 0.3	4.2	No
10/25/2001	7.5	60	15.7	< 0.3	4.2	No
11/7/2001	7.9	59	15.0	< 0.3	2.6	No
11/20/2001	7.4	64	17.7	1.8	3.9	No
11/21/2001	7.7	64	18.0	< 0.3	2.9	No
12/5/2001	7.5	55	12.7	< 0.3	4.5	No
12/18/2001	8.4	47	8.3	< 0.3	1.4	No
1/3/2002	7.4	54	12.1	< 0.3	4.8	No
1/15/2002	7.8	51	10.8	< 0.3	3.2	No
1/29/2002	7.8	52	11.3	< 0.3	3.2	No
1/29/2002	*7.8*	*52*	*11.3*	*0.3*	*3.2*	*No*
2/12/2002	7.9	59	15.0	0.5	2.6	No
2/26/2002	7.8	60	15.8	< 0.3	2.8	No
3/12/2002	8.2	58	14.5	< 0.3	1.8	No
3/26/2002	7.8	60	15.5	0.5	2.9	No
4/10/2002	7.7	62	16.5	0.8	3.3	No
4/23/2002	8.3	64	17.6	1.3	1.2	**Yes**
5/7/2002	7.6	64	18.0	< 0.3	3.2	No
5/21/2002	7.8	63	17.2	< 0.3	2.6	No
6/4/2002	7.1	68	19.9	< 0.3	3.9	No
6/25/2002	7.5	67	19.2	< 0.3	3.2	No
7/10/2002	7.7	71	21.5	< 0.3	2.3	No
7/23/2002	7.6	68	20.0	< 0.3	2.8	No
8/6/2002	7.8	67	19.2	< 0.3	2.4	No
8/20/2002	7.6	67	19.3	< 0.3	3.1	No
9/3/2002	8.1	71	21.5	< 0.3	1.4	No
9/17/2002	7.8	67	19.6	< 0.3	2.4	No
10/1/2002	7.7	64	17.6	< 0.3	2.8	No
10/15/2002	7.5	64	17.5	< 0.3	3.5	No
11/5/2002	7.8	50	10.2	< 0.3	3.0	No
11/19/2002	8.5	51	10.7	< 0.3	1.1	No
11/19/2002	*8.4*	*51*	*10.7*	*< 0.3*	*1.4*	*No*
12/3/2002	NS/NF	NS/NF	NS/NF	NS/NF	- -	- -
12/17/2002	7.5	58	14.5	< 0.3	4.4	No
1/7/2003	8.8	45	7.5	< 0.3	0.68	No

RWQCF improvements

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
1/21/2003	8.6	47	8.3	< 0.3	0.94	No
2/4/2003	8.7	42	5.5	< 0.3	0.85	No
2/18/2003	7.6	63	17.3	< 0.3	3.3	No
2/18/2003	*7.6*	*63*	*17.3*	*< 0.3*	*3.4*	*No*
3/4/2003	7.9	66	18.8	< 0.3	2.2	No
3/18/2003	7.8	54	12.4	< 0.3	3.3	No
4/1/2003	7.6	64	17.5	< 0.3	3.4	No
4/16/2003	7.8	62	16.4	< 0.3	2.8	No
4/29/2003	7.4	63	17.0	< 0.3	4.0	No
5/19/2003	7.7	63	17.1	< 0.3	3.0	No
5/19/2003	*7.8*	*63*	*17.1*	*< 0.3*	*2.6*	*No*
6/4/2003	7.5	70	21.3	< 0.3	2.8	No
6/17/2003	7.7	71	21.6	< 0.3	2.3	No
7/2/2003	7.6	68	20.2	< 0.3	2.7	No
7/14/2003	7.6	68	19.8	< 0.3	2.7	No
7/30/2003	7.2	72	22.3	< 0.3	3.3	No
8/12/2003	7.9	67	19.7	< 0.3	2.0	No
8/12/2003	*7.5*	*67*	*19.7*	*< 0.3*	*3.0*	*No*
8/27/2003	7.5	69	20.5	< 0.3	2.9	No
9/9/2003	7.5	67	19.7	< 0.3	3.0	No
9/23/2003	7.8	72	22.1	< 0.3	2.0	No
10/7/2003	7.5	68	19.8	< 0.3	3.2	No
10/21/2003	7.4	65	18.1	< 0.3	3.8	No
11/4/2003	8.2	48	9.2	< 0.3	1.8	No
11/4/2003	*8.3*	*48*	*9.2*	*< 0.3*	*1.4*	*No*
11/18/2003	9.1	54	12.4	< 0.3	0.43	No
12/2/2003	NS/NF	NS/NF	NS/NF	NS/NF	- -	- -
12/15/2003	NS/NF	NS/NF	NS/NF	NS/NF	- -	- -
1/6/2004	8.2	52	11.1	< 0.3	1.9	No
1/20/2004	7.6	60	15.4	< 0.3	3.7	No
2/3/2004	7.5	55	12.5	< 0.3	4.4	No
2/17/2004	8.0	60	15.7	< 0.3	2.3	No
2/17/2004	*7.8*	*60*	*15.7*	*< 0.3*	*3.1*	*No*
3/2/2004	7.8	61	16.0	< 0.3	3.0	No
3/16/2004	7.7	63	17.2	< 0.3	3.0	No
4/5/2004	7.5	61	16.1	< 0.3	3.9	No
4/27/2004	7.8	67	19.6	< 0.3	2.3	No
5/11/2004	7.9	65	18.5	< 0.3	2.1	No
5/25/2004	7.6	65	18.6	< 0.3	3.1	No
5/25/2004	*7.4*	*65*	*18.6*	*< 0.3*	*3.5*	*No*
6/8/2004	8.1	68	19.8	< 0.3	1.6	No
6/22/2004	7.5	70	21.1	< 0.3	2.9	No
7/13/2004	8.1	71	21.5	< 0.3	1.4	No
7/27/2004	8.1	72	22.4	< 0.3	1.3	No

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
8/12/2004	7.4	70	20.9	< 0.3	3.2	No
8/25/2004	7.9	69	20.7	< 0.3	1.9	No
8/25/2004	*7.9*	*69*	*20.7*	*< 0.3*	*1.9*	*No*

NS/NF = Not sampled due to no flow.
Italics indicate duplicate samples.

Table A2. TID Ammonia Data for HD1

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
9/12/2001	7.3	76	24.5	14	2.7	**Yes**
9/26/2001	7.4	69	20.4	< 0.3	3.3	No
10/9/2001	7.2	67	19.4	< 0.3	4.0	No
10/25/2001	7.2	63	17.0	< 0.3	4.5	No
11/7/2001	7.3	67	19.2	1	3.8	No
11/20/2001	7.1	71	21.5	4.4	3.7	**Yes**
11/21/2001	NS	NS	NS	NS	- -	- -
12/5/2001	7.2	63	17.2	9.3	4.5	**Yes**
12/18/2001	7.1	65	18.2	7.2	4.4	**Yes**
1/3/2002	7.2	57	13.7	1.6	5.5	No
1/15/2002	7.2	62	16.6	10.1	4.7	**Yes**
1/29/2002	7.2	62	16.4	< 0.3	4.8	No
2/12/2002	7.3	65	18.2	8.4	3.9	**Yes**
2/26/2002	7.3	68	19.7	11.3	3.6	**Yes**
3/12/2002	7.4	66	18.9	2.6	3.6	No
3/26/2002	7.4	65	18.3	< 0.3	3.8	No
4/10/2002	7.3	71	21.8	10.1	3.3	**Yes**
4/23/2002	7.1	72	22.1	9.7	3.6	**Yes**
5/7/2002	7.4	67	19.7	2.9	3.5	No
5/21/2002	7.4	67	19.4	5	3.5	**Yes**
6/4/2002	7.0	72	22.2	1.4	3.5	No
6/25/2002	7.0	78	25.6	1.6	2.9	No
7/10/2002	7.2	80	26.5	1.7	2.5	No
7/23/2002	7.0	79	26.4	1.1	2.8	No
8/6/2002	6.9	78	25.7	< 0.3	3.0	No
8/20/2002	7.2	70	21.3	< 0.3	3.4	No
9/3/2002	7.5	74	23.6	< 0.3	2.5	No
9/17/2002	7.3	78	25.4	< 0.3	2.5	No
10/1/2002	7.3	70	21.4	< 0.3	3.3	No
10/15/2002	7.1	75	23.8	< 0.3	3.2	No
11/5/2002	7.0	72	22.2	6.2	3.6	**Yes**
11/19/2002	7.0	70	21.2	1.4	3.9	No
12/3/2002	6.9	68	19.9	2.6	4.3	No
12/17/2002	7.0	65	18.5	1.8	4.6	No

RWQCF improvements

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
1/7/2003	7.1	67	19.4	< 0.3	4.1	No
1/21/2003	7.0	66	19.1	2.3	4.4	No
2/4/2003	7.0	67	19.4	< 0.3	4.3	No
2/18/2003	7.1	67	19.6	< 0.3	4.1	No
3/4/2003	7.2	69	20.6	< 0.3	3.6	No
3/18/2003	7.2	62	16.8	< 0.3	4.8	No
4/1/2003	7.2	69	20.8	< 0.3	3.5	No
4/16/2003	7.3	68	20.0	< 0.3	3.6	No
4/29/2003	7.3	66	19.2	< 0.3	3.7	No
5/19/2003	7.1	66	18.7	< 0.3	4.3	No
6/4/2003	7.1	78	25.5	< 0.3	2.8	No
6/17/2003	7.3	78	25.8	< 0.3	2.5	No
7/2/2003	7.4	71	21.8	< 0.3	3.0	No
7/14/2003	7.5	72	22.0	< 0.3	2.8	No
7/30/2003	7.1	76	24.5	< 0.3	3.0	No
8/12/2003	7.5	75	23.8	< 0.3	2.5	No
8/27/2003	7.2	78	25.7	< 0.3	2.6	No
9/9/2003	7.2	72	22.5	< 0.3	3.3	No
9/23/2003	7.0	80	26.9	< 0.3	2.6	No
10/7/2003	7.1	73	23.0	1.2	3.2	No
10/21/2003	7.3	75	24.1	< 0.3	2.8	No
11/4/2003	7.2	71	21.5	< 0.3	3.4	No
11/18/2003	7.3	71	21.5	2.7	3.3	No
12/2/2003	7.2	70	21.0	9.5	3.6	**Yes**
12/16/2003	6.9	67	19.4	1.3	4.5	No
1/6/2004	7.1	63	17.2	< 0.3	4.8	No
1/20/2004	7.2	65	18.3	< 0.3	4.3	No
2/3/2004	6.9	62	16.6	< 0.3	5.3	No
2/17/2004	7.1	64	18.0	< 0.3	4.5	No
3/2/2004	7.3	64	17.9	2.5	4.2	No
3/16/2004	7.2	69	20.6	< 0.3	3.6	No
4/5/2004	7.3	63	17.1	< 0.3	4.4	No
4/27/2004	7.4	70	21.3	< 0.3	3.0	No
5/11/2004	7.5	67	19.6	< 0.3	3.3	No
5/25/2004	7.0	75	23.7	< 0.3	3.3	No
6/8/2004	7.5	71	21.8	< 0.3	2.6	No
6/22/2004	7.3	74	23.2	< 0.3	2.9	No
7/13/2004	7.3	79	26.0	< 0.3	2.4	No
7/27/2004	7.3	75	23.9	< 0.3	2.7	No
8/12/2004	7.0	81	27.3	< 0.3	2.6	No
8/25/2004	7.3	72	22.1	< 0.3	3.1	No

NS = Not sampled.
Italics indicate duplicate samples.

Table A3. TID Ammonia Data for HD2

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
9/12/2001	7.3	71	21.7	< 0.3	3.2	No
9/26/2001	7.5	69	20.4	< 0.3	3.0	No
10/9/2001	7.4	64	17.8	< 0.3	3.8	No
10/25/2001	7.4	62	16.8	< 0.3	4.0	No
11/7/2001	7.7	62	16.9	< 0.3	3.0	No
11/20/2001	7.5	64	17.5	< 0.3	3.5	No
11/21/2001	7.7	65	18.4	4.1	2.8	**Yes**
12/5/2001	7.4	56	13.1	5.6	4.7	**Yes**
12/18/2001	7.5	57	14.1	1.8	4.5	No
1/3/2002	7.4	56	13.3	1.6	4.8	No
1/15/2002	7.6	55	13.0	6.8	4.1	**Yes**
1/29/2002	7.6	54	12.5	1.2	4.2	No
1/29/2002	*7.6*	*54*	*12.5*	*4.2*	*4.0*	***Yes***
2/12/2002	8.2	66	18.7	1.7	1.3	**Yes**
2/26/2002	7.8	62	16.7	5.1	2.8	**Yes**
3/12/2002	7.8	63	17.2	< 0.3	2.8	No
3/26/2002	8.1	63	17.5	< 0.3	1.8	No
4/10/2002	7.4	67	19.7	0.8	3.4	No
4/23/2002	7.5	70	20.9	< 0.3	3.0	No
5/7/2002	7.4	69	20.4	1.7	3.2	No
5/7/2002	*7.4*	*69*	*20.4*	*1.7*	*3.3*	*No*
5/21/2002	7.4	64	18.0	1.3	3.8	No
5/21/2002	*7.4*	*64*	*18.0*	*1.3*	*3.9*	*No*
6/4/2002	7.3	72	22.0	< 0.3	3.1	No
6/25/2002	7.7	73	22.7	< 0.3	2.2	No
7/10/2002	7.7	73	22.7	< 0.3	2.2	No
7/23/2002	7.6	75	23.9	< 0.3	2.2	No
8/6/2002	8.2	71	21.4	< 0.3	1.1	No
8/20/2002	7.4	71	21.6	< 0.3	3.0	No
9/3/2002	7.6	75	24.0	< 0.3	2.3	No
9/17/2002	7.6	72	22.1	< 0.3	2.4	No
10/1/2002	7.7	63	17.4	< 0.3	2.9	No
10/15/2002	7.7	66	19.0	< 0.3	2.6	No
11/5/2002	7.9	60	15.5	0.8	2.5	No
11/19/2002	8.2	59	14.9	0.7	1.8	No
11/19/2002	*7.8*	*59*	*14.9*	*0.7*	*3.1*	*No*
12/3/2002	7.5	59	15.2	0.6	4.2	No
12/17/2002	7.3	57	13.8	< 0.3	5.0	No
1/7/2003	7.5	58	14.4	< 0.3	4.3	No
1/21/2003	7.6	58	14.5	1.2	3.9	No
2/4/2003	7.6	59	14.8	< 0.3	3.9	No
2/18/2003	7.8	59	15.3	< 0.3	3.0	No

RWQCF improvements

Date	pH	Temp (°F)	Temp (°C)	Ammonia Nitrogen	CCC (fish early life stages present)	Exceeds CCC limit?
2/18/2003	*7.7*	*59*	*15.3*	*< 0.3*	*3.3*	*No*
3/4/2003	7.8	63	17.4	< 0.3	2.6	No
3/18/2003	7.6	59	15.1	< 0.3	3.8	No
4/1/2003	7.6	66	19.0	< 0.3	3.1	No
4/16/2003	7.5	65	18.5	< 0.3	3.4	No
4/29/2003	7.5	66	19.1	< 0.3	3.2	No
5/19/2003	7.8	65	18.6	< 0.3	2.4	No
5/19/2003	*7.8*	*65*	*18.6*	*< 0.3*	*2.5*	*No*
6/4/2003	7.5	72	22.4	< 0.3	2.6	No
6/17/2003	7.7	74	23.3	< 0.3	2.0	No
7/2/2003	7.9	75	23.7	< 0.3	1.7	No
7/14/2003	7.6	73	22.8	< 0.3	2.2	No
7/30/2003	7.7	75	24.1	< 0.3	2.0	No
8/12/2003	7.9	73	22.9	< 0.3	1.6	No
8/12/2003	*7.6*	*73*	*22.9*	*< 0.3*	*2.4*	*No*
8/27/2003	7.6	77	24.9	< 0.3	2.1	No
9/9/2003	7.5	73	22.8	< 0.3	2.5	No
9/23/2003	8.3	76	24.3	< 0.3	0.80	No
10/7/2003	7.9	70	21.1	< 0.3	1.8	No
10/21/2003	7.9	67	19.6	< 0.3	2.0	No
11/4/2003	8.0	62	16.6	< 0.3	2.1	No
11/18/2003	7.4	64	18.0	< 0.3	3.7	No
12/2/2003	7.5	61	16.3	3.8	3.8	No
12/16/2003	7.5	58	14.4	< 0.3	4.6	No
1/6/2004	7.5	56	13.4	< 0.3	4.2	No
1/20/2004	7.7	60	15.8	< 0.3	3.4	No
2/3/2004	7.4	58	14.4	< 0.3	4.7	No
2/17/2004	7.6	61	16.3	< 0.3	3.5	No
3/2/2004	7.6	61	16.1	2.1	3.5	No
3/16/2004	7.9	65	18.5	< 0.3	2.1	No
4/5/2004	7.7	63	17.1	< 0.3	3.0	No
4/27/2004	8.0	71	21.8	< 0.3	1.6	No
5/11/2004	8.0	68	19.8	< 0.3	1.9	No
5/25/2004	8.1	69	20.8	< 0.3	1.4	No
5/25/2004	*8.0*	*69*	*20.8*	*< 0.3*	*1.5*	*No*
6/8/2004	8.4	72	22.0	< 0.3	0.75	No
6/22/2004	7.9	73	22.8	< 0.3	1.6	No
7/13/2004	7.8	76	24.4	< 0.3	1.7	No
7/27/2004	7.6	77	24.8	< 0.3	2.0	No
8/12/2004	7.5	77	25.0	< 0.3	2.3	No
8/25/2004	7.8	74	23.2	< 0.3	1.8	No
8/25/2004	*7.5*	*74*	*23.2*	*< 0.3*	*2.6*	*No*

Italics indicate duplicate samples.

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Attachment B
Additional Data for Ammonia in Harding Drain

Ammonia data and plots from the USGS NAQWA Phase I monitoring are included in Table B1 and Figure B1, and data and plots from the City of Turlock data are provided in Tables B2, B3, and B4 and Figure B2. A bold line in Table B4 indicates the timeframe that the RWQCF upgrade occurred.

Table B1. USGS Data for Harding Drain at Carpenter Road (HD2) (before RWQCF upgrades)

USGS Identifier	Date	Date (formatted)	Time	Nitrogen, Ammonia Dissolved (mg/L as N)[1]	pH Water Whole Field[1]	Temperature Water (°C)[1]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
11274560	19920422	4/22/1992	1151	2.1	7.8	18.5	2.5	No
11274560	19920429	4/29/1992	1215	1.4	8.1	20.0	1.5	No
11274560	19920506	5/6/1992	1130	0.68	8.3	22.0	0.9	No
11274560	19920513	5/13/1992	1200	0.62	7.9	21.0	1.8	No
11274560	19920520	5/20/1992	1100	1.6	7.8	19.5	2.3	No
11274560	19920527	5/27/1992	945	0.69	7.8	21.5	2.0	No
11274560	19920603	6/3/1992	1015	3.2	7.9	22.5	1.7	Yes
11274560	19920610	6/10/1992	930	0.5	7.7	21.0	2.4	No
11274560	19920617	6/17/1992	1140	0.39	7.5	20.5	3.0	No
11274560	19920624	6/24/1992	1130	0.3	7.4	22.0	2.9	No
11274560	19920702	7/2/1992	800	2.3	9.0	22.0	0.3	Yes
11274560	19920708	7/8/1992	1115	0.6	7.7	21.5	2.3	No
11274560	19920715	7/15/1992	845	1.5	8.0	22.5	1.5	Yes
11274560	19920722	7/22/1992	835	0.49	7.8	20.5	2.2	No
11274560	19920729	7/29/1992	1125	0.66	7.8	23.5	1.8	No
11274560	19920805	8/5/1992	1635	1.3	7.9	27.0	1.3	Yes
11274560	19920812	8/12/1992	900	0.86	7.9	22.0	1.7	No
11274560	19920819	8/19/1992	940	0.99	7.7	22.5	2.1	No
11274560	19920826	8/26/1992	915	2.1	7.8	21.0	2.1	Yes
11274560	19921215	12/15/1992	1430	20	7.8	12.2	3.2	Yes
11274560	19921222	12/22/1992	930	20	7.7	10.2	3.6	Yes
11274560	19930106	1/6/1993	1030	25	7.8	10.0	3.2	Yes
11274560	19930113	1/13/1993	1230	14	7.8	9.5	3.2	Yes
11274560	19930120	1/20/1993	1110	13	7.7	13.0	3.6	Yes
11274560	19930526	5/26/1993	1400	0.03	7.6	21.9	2.5	No
11274560	19930622	6/22/1993	1545	1.6	8.0	24.5	1.3	Yes
11274560	19930727	7/27/1993	1330	2.1	7.8	25.0	1.6	Yes
11274560	19930826	8/26/1993	1905	2.6	7.7	25.8	1.7	Yes
11274560	19930930	9/30/1993	1020	1.7	7.2	20.0	3.8	No
11274560	19931028	10/28/1993	1350	0.99	7.5	17.3	3.6	No
11274560	19931118	11/18/1993	1450	3.6	7.9	16.2	2.5	Yes
11274560	19931229	12/29/1993	1205	7.4	7.7	--	--	No

[1]Data are presented in Table B1 in the form they were received from the USGS NAWQA website (http://ca.water.usgs.gov/sanj/sw_cycle1.html#Basic-Fixed%20Site).

USGS Identifier	Date	Date (formatted)	Time	Nitrogen, Ammonia Dissolved (mg/L as N)[1]	pH Water Whole Field[1]	Temperature Water (°C)[1]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
11274560	19940202	2/2/1994	1145	18	7.6	12.0	4.0	Yes
11274560	19940302	3/2/1994	1205	8	7.8	19.9	2.2	Yes
11274560	19940322	3/22/1994	1030	9	7.8	14.0	3.2	Yes
11274560	19940426	4/26/1994	1300	0.64	7.5	16.7	3.8	No
11274560	19940527	5/27/1994	1030	2.3	7.8	18.4	2.5	No
11274560	19940628	6/28/1994	1015	1.7	7.6	22.2	2.4	No
11274560	19940727	7/27/1994	1030	0.49	7.6	21.8	2.5	No
11274560	19940824	8/24/1994	850	2.3	7.4	20.5	3.2	No
11274560	19940928	9/28/1994	1015	1.6	7.6	19.8	2.8	No
11274560	19941027	10/27/1994	1140	3.5	7.8	17.0	2.7	Yes
11274560	19941130	11/30/1994	1140	11	7.4	12.0	4.7	Yes
11274538	19950110	1/10/1995	900	--	--	--	--	No
11274538	19950110	1/10/1995	950	--	--	--	--	No
11274538	19950110	1/10/1995	1055	--	--	--	--	No
11303500	19950110	1/10/1995	1100	--	--	--	--	No
11274538	19950110	1/10/1995	1400	--	--	--	--	No
11274538	19950110	1/10/1995	2145	--	--	--	--	No
11290000	19950124	1/24/1995	1030	0.03	6.3	10.8	6.8	No
11274538	19950124	1/24/1995	1315	0.09	7.7	12.8	3.6	No
11303500	19950124	1/24/1995	1600	0.63	7.4	11	4.7	No
11274538	19950302	3/2/1995	1100	6.2	7.8	15	3.1	Yes
11303500	19950302	3/2/1995	1320	0.05	7.4	14	4.7	No
11290000	19950302	3/2/1995	1615	0.04	7.0	--	--	No
11290000	19950321	3/21/1995	1130	0.02	7.0	10.9	5.9	No
11274538	19950321	3/21/1995	1530	0.06	8.2	14.5	1.8	No
11303500	19950321	3/21/1995	1830	0.13	7.0	13.6	5.9	No

[1]Data are presented in Table B1 in the form they were received from the USGS NAWQA website (http://ca.water.usgs.gov/sanj/sw_cycle1.html#Basic-Fixed%20Site).

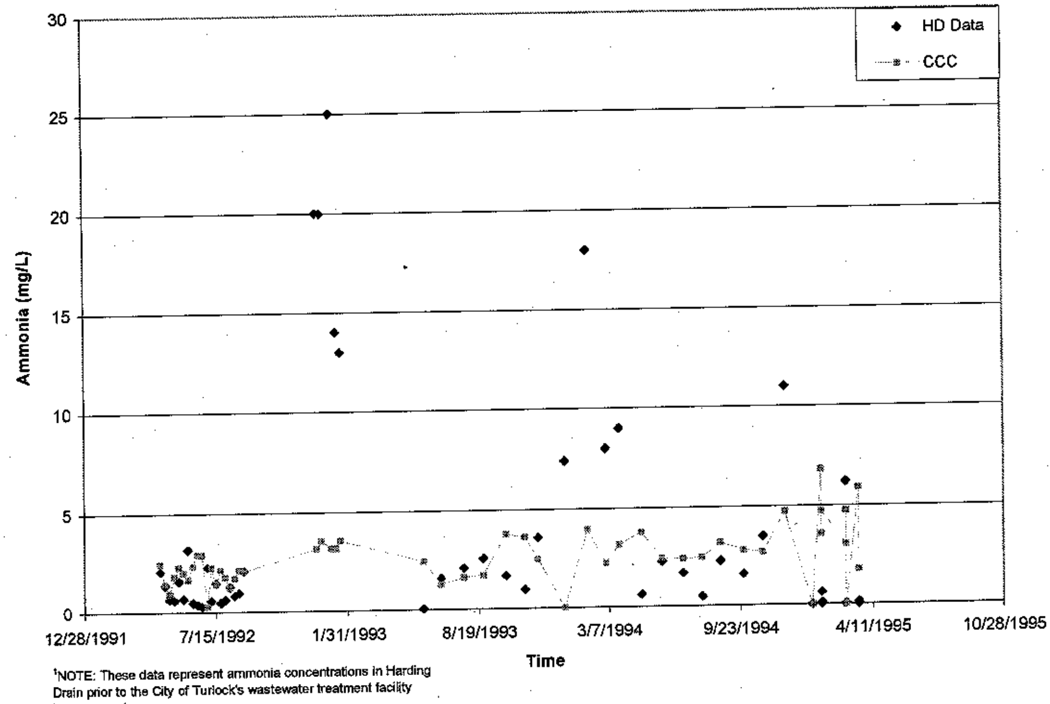

Figure B1. USGS NAWQA Phase I Ammonia Data and CCC Limit for Harding Drain at Carpenter Road (before RWQCF upgrades)

Table B2. City of Turlock Ammonia Data for Harding Drain at R1 (Prairie Flower Road, CMD32-Hodges)

Date	NH3-N mg/l Method 4500-E
6/10/02	ND
10/21/02	ND

The reporting limit for NH_3 is 0.5 mg/L.

Table B3. City of Turlock Ammonia Data for Harding Drain at R2 (between Prairie Flower and Mitchell Roads, between CMD32-Hodges and HD2)

Date	NH3-N mg/l Method 4500-E
10/21/02	ND
6/10/02	ND

The reporting limit for NH_3 was 0.5 mg/L on 6/10/02 and 1.0 mg/L on 10/21/02.

Table B4. City of Turlock Ammonia Data for Harding Drain at R8 (Carpenter Road, HD2)

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
1/13/1999	7.8	41.0	5.0	7.6	3.2	Yes
1/27/1999	7.8	44.0	6.7	5.9	3.2	Yes
2/10/1999	8.3	45.0	7.2	2.7	1.5	Yes
2/24/1999	8.0	48.0	8.9	4.9	2.4	Yes
3/10/1999	8.2	50.0	10.0	4.8	1.8	Yes
3/24/1999	7.2	47.0	8.3	1.9	5.4	No
4/7/1999	7.4	52.0	11.1	2.8	4.7	No
4/21/1999	7.2	60.0	15.6	2.3	5.0	No
5/5/1999	7.2	59.0	15.0	2.1	5.2	No
5/19/1999	7.3	64.0	17.8	0.6	4.1	No
6/2/1999	7.2	66.0	18.9	0.5	4.1	No
6/16/1999	7.1	70.0	21.1	0.8	3.7	No
6/30/1999	7.1	71.0	21.7	3.5	3.6	No
7/7/1999	7.1	66.0	18.9	1.0	4.3	No
7/14/1999	7.2	74.0	23.3	1.2	3.1	No
7/21/1999	7.3	70.0	21.1	0.9	3.3	No
7/28/1999	7.1	69.0	20.6	2.1	3.8	No
8/4/1999	7.3	74.0	23.3	3.0	2.9	Yes
8/11/1999	7.4	66.0	18.9	2.7	3.6	No
8/18/1999	7.3	71.0	21.7	1.4	3.2	No
8/25/1999	7.3	76.0	24.4	3.0	2.7	Yes
9/1/1999	7.5	67.0	19.4	2.7	3.2	No
9/8/1999	7.4	69.0	20.6	2.0	3.2	No
9/15/1999	7.4	71.0	21.7	2.0	3.0	No
9/22/1999	7.3	71.0	21.7	0.6	3.2	No
9/29/1999	7.2	66.0	18.9	0.6	4.1	No
10/6/1999	7.4	65.0	18.3	0.4	3.7	No
10/13/1999	7.5	63.0	17.2	2.4	3.7	No
10/20/1999	7.6	59.0	15.0	0.9	3.9	No
10/27/1999	7.8	59.0	15.0	1.4	3.1	No
11/3/1999	7.8	58.0	14.4	1.9	3.2	No
11/17/1999	7.8	56.0	13.3	5.4	3.2	Yes
12/1/1999	7.9	59.0	15.0	5.7	2.7	Yes
12/15/1999	8.1	49.0	9.4	7.8	2.1	Yes
12/29/1999	7.9	54.0	12.2	10.8	2.8	Yes
1/12/2000	7.7	58.0	14.4	10.6	3.6	Yes
1/26/2000	7.9	58.0	14.4	0.7	2.8	No
2/9/2000	6.8	60.0	15.6	6.9	5.9	Yes
2/23/2000	7.1	56.0	13.3	3.5	5.7	No
3/8/2000	6.5	58.0	14.4	0.6	6.7	No
3/22/2000	7.2	62.0	16.7	0.8	4.7	No

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
4/5/2000	7.0	60.0	15.6	2.1	5.5	No
4/19/2000	7.8	59.0	15.0	5.4	3.1	Yes
5/3/2000	7.7	63.0	17.2	0.8	3.0	No
5/17/2000	7.6	62.0	16.7	0.6	3.5	No
5/31/2000	7.6	66.0	18.9	0.9	3.0	No
6/28/2000	7.6	73.0	22.8	2.7	2.3	Yes
7/5/2000	7.3	68.0	20.0	0.5	3.6	No
7/12/2000	7.6	70.0	21.1	1.1	2.6	No
7/19/2000	7.5	65.0	18.3	1.3	3.4	No
7/26/2000	7.5	72.0	22.2	1.2	2.7	No
8/2/2000	7.6	80.0	26.7	0.9	1.8	No
8/9/2000	7.1	71.0	21.7	0.6	3.6	No
8/16/2000	7.5	73.0	22.8	1.1	2.6	No
8/23/2000	7.5	69.0	20.6	4.0	3.0	Yes
8/30/2000	7.7	71.0	21.7	0.5	2.3	No
9/6/2000	7.4	67.0	19.4	1.5	3.4	No
9/13/2000	7.4	68.0	20.0	2.8	3.3	No
9/20/2000	7.1	72.0	22.2	1.6	3.4	No
9/27/2000	7.5	70.0	21.1	2.9	2.9	Yes
10/4/2000	7.3	67.0	19.4	2.8	3.7	No
10/11/2000	7.3	63.0	17.2	7.5	4.3	Yes
10/18/2000	7.2	64.0	17.8	2.2	4.4	No
10/25/2000	7.4	62.0	16.7	4.0	4.1	No
11/1/2000	7.5	59.0	15.0	6.0	4.2	Yes
11/15/2000	7.9	56.0	13.3	7.0	2.8	Yes
11/29/2000	7.5	56.0	13.3	3.0	4.4	No
12/13/2000	8.0	55.0	12.8	15.0	2.4	Yes
12/27/2000	7.6	49.0	9.4	6.1	4.0	Yes
1/10/2001	7.4	56.0	13.3	13.5	4.7	Yes
1/24/2001	6.9	55.0	12.8	12.4	6.1	Yes
2/7/2001	7.5	50.0	10.0	12.0	4.4	Yes
2/21/2001	7.6	58.0	14.4	9.0	4.0	Yes
3/7/2001	7.6	55.0	12.8	5.9	4.0	Yes
3/21/2001	7.5	63.0	17.2	7.5	3.7	Yes
4/4/2001	7.5	55.0	12.8	7.2	4.4	Yes
4/18/2001	7.1	62.0	16.7	2.0	4.9	No
5/2/2001	7.5	60.0	15.6	2.4	4.1	No
5/16/2001	7.5	68.0	20.0	1.8	3.1	No
5/30/2001	7.2	70.0	21.1	2.8	3.5	No
6/13/2001	7.3	70.0	21.1	5.5	3.3	Yes
6/27/2001	7.3	70.0	21.1	5.0	3.3	Yes
7/3/2001	7.3	74.0	23.3	1.8	2.9	No
7/11/2001	7.3	70.0	21.1	2.4	3.3	No

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
7/18/2001	7.3	70.0	21.1	2.8	3.3	No
7/25/2001	7.5	71.0	21.7	1.7	2.8	No
8/1/2001	6.8	71.0	21.7	3.0	4.0	No
8/8/2001	7.1	77.0	25.0	4.0	2.9	Yes
8/15/2001	7.4	70.0	21.1	4.0	3.1	Yes
8/22/2001	7.4	69.0	20.6	2.3	3.2	No
8/29/2001	6.9	72.0	22.2	0.8	3.7	No
9/5/2001	7.4	72.0	22.2	2.5	2.9	No
9/12/2001	7.3	70.0	21.1	10.0	3.3	Yes
9/19/2001	7.3	72.0	22.2	6.0	3.1	Yes
9/26/2001	7.5	71.0	21.7	3.3	2.8	Yes
10/3/2001	7.5	72.0	22.2	7.2	2.7	Yes
10/10/2001	7.4	64.0	17.8	1.3	3.8	No
10/17/2001	7.5	68.0	20.0	5.6	3.1	Yes
10/24/2001	7.4	64.0	17.8	2.5	3.8	No
10/31/2001	7.5	66.0	18.9	5.0	3.3	Yes
11/7/2001	7.5	62.0	16.7	1.0	3.8	No
11/14/2001	7.5	64.0	17.8	2.8	3.5	No
11/21/2001	7.5	68.0	20.0	5.0	3.1	Yes
12/5/2001	7.5	56.0	13.3	7.3	4.4	Yes
12/12/2001	7.7	59.0	15.0	10.1	3.5	Yes
12/19/2001	7.6	62.0	16.7	11.2	3.5	Yes
12/26/2001	7.5	56.0	13.3	8.4	4.4	Yes
1/2/2002	7.4	58.0	14.4	5.3	4.7	Yes
1/9/2002	7.6	61.7	16.5	6.3	3.5	Yes
1/16/2002	7.7	53.8	12.1	6.9	3.6	Yes
1/23/2002	7.7	50.0	10.0	10.9	3.6	Yes
1/30/2002	7.8	47.0	8.3	7.0	3.2	Yes
2/6/2002	7.7	50.7	10.4	6.2	3.6	Yes
2/13/2002	7.7	56.1	13.4	4.8	3.6	Yes
2/20/2002	7.7	60.0	15.6	5.6	3.3	Yes
2/27/2002	7.5	60.4	15.8	8.1	4.0	Yes
3/6/2002	7.5	60.8	16.0	12.0	4.0	Yes
3/13/2002	7.5	55.8	13.2	6.3	4.4	Yes
3/20/2002	7.4	55.8	13.2	5.0	4.7	Yes
3/27/2002	7.1	60.0	15.6	3.5	5.3	No
4/3/2002	7.1	62.8	17.1	2.9	4.8	No
4/10/2002	6.9	62.4	16.9	0.9	5.3	No
4/17/2002	7.1	59.4	15.2	3.6	5.4	No
4/24/2002	7.1	62.9	17.2	1.9	4.8	No
5/1/2002	7.3	60.6	15.9	4.1	4.6	No
5/8/2002	7.4	68.0	20.0	2.2	3.3	No
5/15/2002	7.4	69.0	20.6	4.8	3.2	Yes

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
5/22/2002	7.3	64.4	18.0	4.8	4.1	**Yes**
5/29/2002	7.4	72.1	22.3	1.7	2.9	No
6/5/2002	7.5	73.4	23.0	2.7	2.5	**Yes**
6/12/2002	7.4	71.0	21.7	1.4	3.0	No
6/19/2002	7.3	72.3	22.4	2.1	3.1	No
6/26/2002	7.0	71.2	21.8	0.2	3.7	No
7/3/2002	7.9	71.6	22.0	4.5	1.7	**Yes**
7/10/2002	7.1	76.1	24.5	0.7	3.0	No
7/17/2002	7.3	70.0	21.1	<0.1	3.3	No
7/24/2002	7.2	72.0	22.2	1.4	3.4	No
7/31/2002	7.3	71.0	21.7	0.3	3.2	No
8/7/2002	7.2	67.5	19.7	<0.5	3.9	No
8/14/2002	7.2	72.5	22.5	0.4	3.2	No
8/21/2002	7.1	66.0	18.9	0.3	4.3	No
8/28/2002	7.1	72.5	22.5	0.1	3.4	No
9/4/2002	7.2	70.2	21.2	0.3	3.5	No
9/11/2002	7.2	71.8	22.1	3.3	3.3	No
9/18/2002	7.5	69.0	20.6	0.1	3.0	No
9/25/2002	7.1	68.7	20.4	0.3	3.9	No
10/2/2002	7.3	59.0	15.0	0.2	4.9	No
10/9/2002	7.3	68.4	20.2	0.2	3.5	No
10/16/2002	7.0	63.9	17.7	0.3	4.8	No
10/23/2002	7.1	57.0	13.9	0.1	5.7	No
10/30/2002	7.6	59.9	15.5	0.6	3.7	No
11/6/2002	7.2	56.3	13.5	2.1	5.4	No
11/13/2002	7.1	61.7	16.5	2.0	5.0	No
11/20/2002	7.5	57.0	13.9	3.7	4.4	No
11/27/2002	7.3	52.0	11.1	0.4	5.1	No
12/4/2002	7.0	59.0	15.0	0.6	5.7	No
12/11/2002	7.2	55.0	12.8	0.7	5.4	No
12/18/2002	7.1	51.0	10.6	<0.1	5.7	No
12/23/2002	7.1	55.0	12.8	1.8	5.7	No
12/30/2002	7.2	54.3	12.4	0.3	5.4	No
1/8/2003	7.4	52.7	11.5	0.1	4.7	No
1/15/2003	7.2	58.6	14.8	<0.2	5.3	No
1/22/2003	7.3	55.0	12.8	0.3	5.1	No
1/29/2003	7.1	56.0	13.3	0.9	5.7	No
2/5/2003	7.2	52.2	11.2	0.1	5.4	No
2/12/2003	7.3	56.0	13.3	0.4	5.1	No
2/19/2003	7.6	54.9	12.7	<.2	4.0	No
2/26/2003	7.2	55.4	13.0	0.2	5.4	No
3/5/2003	7.3	55.2	12.9	0.3	5.1	No
3/12/2003	7.0	61.3	16.3	0.4	5.3	No

RWQCF improvements

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
3/19/2003	7.3	57.0	13.9	0.2	5.1	No
3/26/2003	7.5	62.8	17.1	0.7	3.7	No
4/2/2003	6.8	57.0	13.9	0.2	6.3	No
4/9/2003	7.1	61.0	16.1	0.3	5.1	No
4/16/2003	6.8	60.8	16.0	0.3	5.7	No
4/23/2003	6.7	64.0	17.8	0.2	5.2	No
4/30/2003	7.2	57.4	14.1	0.1	5.4	No
5/7/2003	7.0	58.0	14.4	1.1	5.9	No
5/14/2003	7.1	66.7	19.3	1.1	4.2	No
5/21/2003	6.9	69.9	21.1	1.8	4.0	No
5/28/2003	6.8	73.6	23.1	0.3	3.6	No
6/4/2003	7.1	69.1	20.6	0.6	3.8	No
6/11/2003	7.2	68.4	20.2	0.2	3.7	No
6/18/2003	7.1	71.1	21.7	0.3	3.6	No
6/25/2003	6.9	73.8	23.2	0.4	3.5	No
7/2/2003	6.9	73.4	23.0	0.5	3.5	No
7/9/2003	7.1	71.2	21.8	0.1	3.5	No
7/16/2003	7.6	71.1	21.7	0.2	2.5	No
7/23/2003	7.7	77.0	25.0	0.3	1.8	No
7/30/2003	7.0	79.0	26.1	0.2	2.8	No
8/6/2003	7.5	68.9	20.5	<0.2	3.0	No
8/13/2003	7.6	70.3	21.3	0.3	2.6	No
8/20/2003	7.7	69.9	21.1	0.1	2.3	No
8/27/2003	7.6	71.8	22.1	0.2	2.4	No
9/3/2003	7.8	73.9	23.3	0.5	1.8	No
9/10/2003	7.9	68.0	20.0	0.2	2.0	No
9/17/2003	7.7	67.3	19.6	<0.1	2.6	No
9/24/2003	7.8	70.0	21.1	<0.1	2.1	No
10/1/2003	7.6	67.8	19.9	0.3	2.8	No
10/8/2003	7.7	67.6	19.8	0.8	2.5	No
10/15/2003	7.8	63.0	17.2	<0.1	2.7	No
10/22/2003	7.5	67.0	19.4	<0.1	3.2	No
10/29/2003	7.8	67.0	19.4	<0.1	2.3	No
11/5/2003	7.9	59.9	15.5	<0.1	2.6	No
11/12/2003	7.9	58.5	14.7	<0.1	2.8	No
11/19/2003	7.6	61.0	16.1	1.8	3.6	No
11/26/2003	7.8	55.0	12.8	8.1	3.2	**Yes**
12/3/2003	7.6	60.0	15.6	3.5	3.7	No
12/10/2003	7.8	57.0	13.9	<0.1	3.2	No
12/17/2003	7.8	53.4	11.9	0.8	3.2	No
12/24/2003	8.0	58.3	14.6	0.4	2.4	No
12/31/2003	7.6	56.3	13.5	0.1	4.0	No
1/7/2004	7.8	56.0	13.3	<0.2	3.2	No

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
1/14/2004	7.9	56.8	13.8	<0.1	2.8	No
1/21/2004	7.9	54.0	12.2	<0.1	2.8	No
1/28/2004	7.6	57.7	14.3	<0.1	4.0	No
2/4/2004	7.6	56.5	13.6	0.3	4.0	No
2/11/2004	7.7	54.5	12.5	0.6	3.6	No
2/18/2004	7.5	58.6	14.8	0.6	4.3	No
2/25/2004	7.8	58.0	14.4	0.2	3.2	No
3/3/2004	7.6	58.8	14.9	2.6	3.9	No
3/10/2004	7.7	63.1	17.3	0.3	3.0	No
3/17/2004	7.8	63.7	17.6	<0.1	2.6	No
3/24/2004	7.9	62.1	16.7	<0.1	2.4	No
3/31/2004	7.7	60.8	16.0	<0.1	3.3	No
4/7/2004	8.0	58.8	14.9	0.1	2.4	No
4/14/2004	7.9	61.9	16.6	0.5	2.4	No
4/21/2004	7.8	63.0	17.2	0.2	2.7	No
4/26/2004	7.9	68.4	20.2	<0.1	1.9	No
5/5/2004	7.3	66.7	19.3	<0.1	3.7	No
5/12/2004	7.8	63.7	17.6	<0.1	2.6	No
5/19/2004	7.6	63.5	17.5	0.7	3.3	No
5/26/2004	7.8	68.2	20.1	<0.1	2.2	No
6/2/2004	7.7	71.8	22.1	<0.1	2.2	No
6/9/2004	7.5	68.9	20.5	<0.2	3.0	No
6/16/2004	7.4	73.4	23.0	0.3	2.7	No
6/23/2004	7.3	69.6	20.9	<0.2	3.4	No
6/30/2004	7.2	71.9	22.2	0.3	3.3	No
7/7/2004	7.2	72.9	22.7	0.4	3.2	No
7/14/2004	7.3	71.4	21.9	0.3	3.2	No
7/21/2004	7.6	72.7	22.6	1.2	2.4	No
7/28/2004	7.2	71.9	22.2	0.2	3.3	No
8/4/2004	7.2	70.7	21.5	0.3	3.4	No
8/11/2004	7.2	72.1	22.3	<0.2	3.3	No
8/18/2004	7.2	72.1	22.3	0.2	3.3	No
8/25/2004	7.3	68.9	20.5	<0.2	3.5	No
9/1/2004	7.3	71.1	21.7	<0.2	3.2	No
9/8/2004	7.5	73.0	22.8	<0.2	2.6	No
9/15/2004	7.5	69.3	20.7	<0.2	2.9	No
9/22/2004	7.5	68.0	20.0	0.9	3.1	No
9/29/2004	7.6	65.0	18.3	2.2	3.1	No
10/6/2004	7.5	66.5	19.2	<0.2	3.2	No
10/13/2004	7.8	64.9	18.3	<0.2	2.5	No
10/20/2004	7.7	59.5	15.3	<0.2	3.4	No
10/27/2004	7.6	57.7	14.3	<0.2	4.0	No
11/3/2004	8.0	61.7	16.5	<0.2	2.1	No

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

DATE	pH (Method 4500-B)[2]	TEMP °F (Method 2550-B)[2]	TEMP (°C)	NH3-N (mg/L) (Method 4500-E)[2]	Ammonia CCC for early life stages present (mg/L)	Exceeds CCC for early life stages present
11/10/2004	8.1	63.0	17.2	0.7	1.8	No
11/17/2004	7.8	63.7	17.6	0.2	2.6	No
11/22/2004	8.2	54.7	12.6	0.2	1.8	No
12/1/2004	7.9	54.0	12.2	<0.2	2.8	No
12/8/2004	8.0	58.5	14.7	0.3	2.4	No
12/15/2004	8.0	68.5	20.3	0.3	1.7	No
12/22/2004	7.9	55.6	13.1	<0.2	2.8	No
12/29/2004	8.1	62.0	16.7	<0.2	1.8	No
1/5/2005	8.1	65.0	18.3	0.3	1.6	No
1/12/2005	8.0	54.5	12.5	0.7	2.4	No
1/19/2005	8.0	58.8	14.9	<0.2	2.4	No
1/26/2005	7.8	61.7	16.5	0.2	2.8	No
2/2/2005	7.6	52.7	11.5	0.2	4.0	No
2/9/2005	7.6	60.0	15.6	0.2	3.7	No
2/16/2005	7.5	60.0	15.6	0.6	4.1	No
2/23/2005	7.4	60.0	15.6	<1.0	4.4	No
3/2/2005	7.6	62.0	16.7	<1.0	3.5	No
3/9/2005	7.6	63.0	17.2	<1.0	3.3	No
3/16/2005	7.7	62.0	16.7	3.1	3.3	No
3/23/2005	7.6	60.0	15.6	<1.0	3.7	No
3/30/2005	7.4	60.0	15.6	<1.0	4.4	No
4/6/2005	7.5	62.0	16.7	<1.0	3.8	No
4/13/2005	7.6	60.0	15.6	<1.0	3.7	No
4/20/2005	7.5	61.0	16.1	<1.0	3.9	No
4/27/2005	7.6	64.0	17.8	<1.0	3.2	No
5/4/2005	7.5	64.0	17.8	<1.0	3.5	No
5/11/2005	7.6	64.0	17.8	<1.0	3.2	No
5/18/2005	7.6	68.0	20.0	<1.0	2.8	No
5/25/2005	7.6	75.0	23.9	<1.0	2.2	No
6/1/2005	7.4	72.0	22.2	<1.0	2.9	No
6/8/2005	7.6	66.0	18.9	<1.0	3.1	No
6/15/2005	7.6	74.0	23.3	<1.0	2.3	No
6/22/2005	7.7	70.0	21.1	<1.0	2.3	No
6/29/2005	7.5	74.0	23.3	<1.0	2.6	No
7/6/2005	7.4	75.0	23.9	<1.0	2.6	No
7/13/2005	7.7	76.0	24.4	<1.0	1.9	No

[2]Data are presented in Table B4 in the form they were received from the City of Turlock.

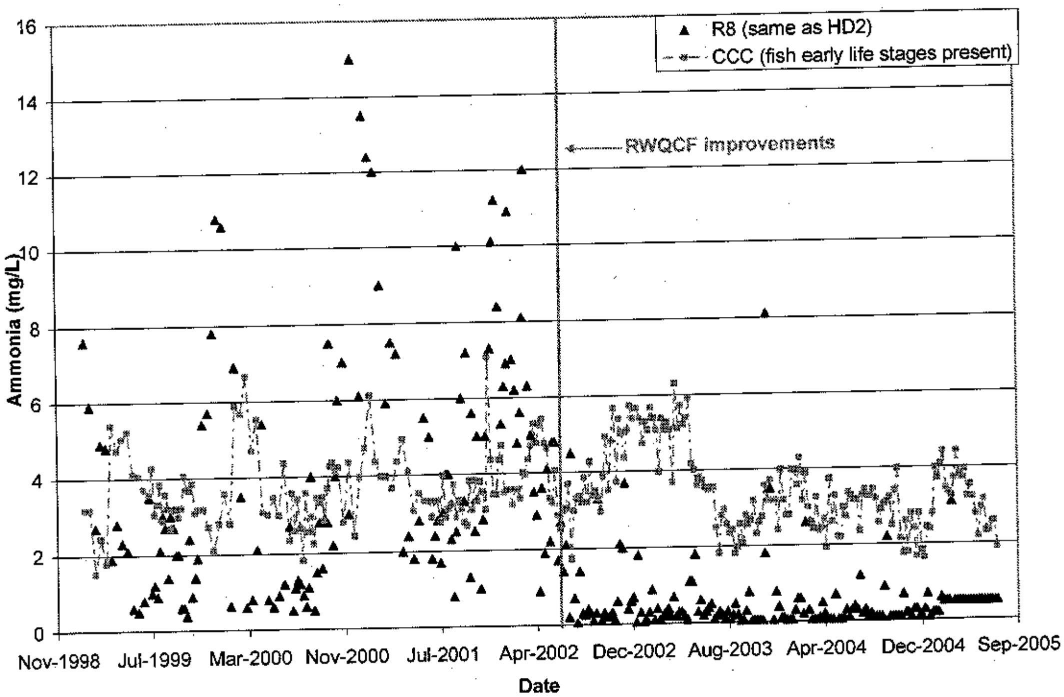

Figure B2. City of Turlock Ammonia Data for Harding Drain at Carpenter Road (HD2)

Attachment C
Harding Drain Chlorpyrifos and Diazinon Fact Sheet

Water Segment: Harding Drain (Turlock Irrigation District Lateral #5)

Pollutant: Chlorpyrifos and Diazinon

Decision: **Delist** (To be confirmed by SWRCB staff)

Weight of Evidence: These pollutants are being considered for removal from the section 303(d) list under section 4.1 of the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy). Under section 4.1 a single line of evidence is necessary to assess delisting status.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification in favor of removing these water segment-pollutant combinations from the section 303(d) list.

This conclusion is based on the findings that:

1. The data used (collected by the Turlock Irrigation District) satisfy the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfy the data quantity requirements of section 6.1.5 of the Policy.
3. Three of the 182 samples exceeded Criteria Continuous Concentration (CCC) with fish early life stages present, and this does not exceed the allowable frequency listed in Table 4.1 of the Policy.
4. Pursuant to section 4.11 of the Policy, additional data and information on current conditions available from the USGS and City of Turlock support the decision.

SWRCB Staff Recommendation (Proposed – to be confirmed): After review of the available data and information, SWRCB staff concludes that the water body-pollutant combinations should be removed from the section 303(d) list because applicable water quality standards for the pollutants are not exceeded.

Lines of Evidence:

Numeric Line of Evidence Pollutant – Water

Beneficial Use: WARM – Warm Freshwater Habitat (pertinent to listing).

Matrix: Water

Water Quality Objective/ Water Quality Criterion: The narrative pesticide objectives state, in part:

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses;
- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.
- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies, and
- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

The Basin Plan narrative water quality objective for toxicity states that all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.

Evaluation Guideline: For the freshwater habitat use, the following limits were used in this evaluation: CDFG Hazard Assessment Criteria for chlorpyrifos of 0.014 ug/L and 0.10 ug/L for diazinon, 4-day average (chronic) (Siepmann and Finlayson, 2000; Finlayson 2004).

Data Used to Assess Water Quality: Out of 219 chlorpyrifos samples, nine were exceedances and out of 219 diazinon samples, eight were exceedances (see below for more detail).

Spatial Representation: Three sites, including two locations on Harding Drain (about four miles apart, representing the upper and lower ends of the drain) and one location immediately upstream of the drain, were sampled.

Temporal Representation: Samples were collected twice a month for a period of three years. The monitoring timeframe included both irrigation and non-irrigation seasons. Due to the frequency and duration of monitoring, a number of non-irrigation season sampling events were conducted shortly after precipitation events representing storm conditions.

Data Quality Assessment: Quality control samples were analyzed, which included field duplicates, surrogate spikes, matrix spikes (MS) and matrix spike duplicates (MSD), and laboratory blanks. Laboratory results were reviewed after each data package submittal using the established data validation procedures included in the associated sampling and analysis plan.

1.0 Background

The Harding Drain was added to the 303(d) list for chlorpyrifos and diazinon impairment based on water quality and toxicity data collected primarily during the early 1990's (Foe 1995). Since 1995, chlorpyrifos and diazinon agricultural use within Stanislaus County and the rest of the Central Valley has declined significantly (DPR 2003a, DPR 2003b, CVRWQCB 2005). Additionally, chlorpyrifos and diazinon have been banned for sale to the public.

Monthly data for chlorpyrifos and diazinon were collected by TID during their water quality monitoring program between September 2001 and September 2004 at three sampling locations on or just upstream of the Harding Drain. These new data indicate improved water quality within the drain. A description of the sampling locations follows and more detail about the results at each site is presented below.

- CMD32-Hodges (Ceres Main Drop 32 at Hodges): immediately upstream of the Harding Drain. Lateral 5 spills to the Ceres Main Canal where the canal turns to the west. The Ceres Main Canal spills to the Harding Drain at CMD32-Hodges (or the Ceres Main, Drop 32 also known as Hodges Drop). CMD32-Hodges represents the quality of water within the TID canal immediately prior to spilling into the drain and prior to mixing with effluent from the Turlock Regional Water Quality Control Facility (RWQCF).

- HD1: at the upper end of Harding Drain downstream of where the City of Turlock effluent discharges into the Harding Drain. Represents a mixture of flows, including treated effluent.

- HD2: at the lower end of Harding Drain immediately prior to where it flows into the San Joaquin River. Represents the quality of flows to the San Joaquin River.

2.0 Water Quality Objectives Attained

Chronic and acute criteria for chlorpyrifos and diazinon are summarized in the *Staff Report – Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments*, dated September 2005 (Staff Report). The Staff Report identifies water quality evaluation guidelines for TMDL listing in Table 4, including chronic 4-day average values for chlorpyrifos and diazinon[1] of 0.014 ug/L and 0.10 ug/L, respectively, which are based on CDFG Aquatic Life Criteria for freshwater (SWRCB 2005a). These chronic 4-day criteria are more restrictive than the acute 1-hour maximum concentration criteria; therefore, the data analysis approach is conservative, given that some segments (e.g., Lower Feather River, Morrison Creek, and Sutter Bypass) have been delisted on the basis of less restrictive acute evaluation guidelines (SWRCB 2005b).

[1] Note that the recently adopted Basin Plan Amendment also included 4-day average (chronic) water quality goal of 0.10 ug/L for diazinon and stated "Regional Board staff calculations based on CDFG data set, using US EPA method" (CVRWQCB 2005).

3.0 Evidence of Non-Impairment

Based on Section 4.1 of the SWRCB's *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy), "Using the binomial distribution, waters shall be removed from the 303(d) list if the number of measured exceedances supports rejection of the null hypothesis as presented in Table 4.1 (in the Policy)." The null hypothesis that impairment exists can be rejected if the number of samples that exceed criteria (or indicate impairment) are less than a certain number, specified as a function of the sample size based on the binomial distribution.

Chlorpyrifos and diazinon data from three sites (CMD32-Hodges, HD1, and HD2) ranging in spatial distribution from just above the Harding Drain to the furthest downstream portions of the drain were compared to chronic criteria (Sections 3.1 and 3.2) and additive toxicity was also assessed (Section 3.3). The sampling and analysis plan and QA/QC procedures used to collect TID data are included in Attachment E.

Chlorpyrifos and diazinon were also monitored in Harding Drain by the USGS for the NAWQA Phase I project, the Department of Pesticide Regulation (DPR), and the City of Turlock. Historic data from the USGS and DPR (pre-1995) indicate impairment, but more recent data show a substantial improvement in water quality and support delisting.

3.1 Chlorpyrifos Data

TID Data. As shown in Figure C1, chlorpyrifos data, collected by TID from September 2001 through September 2004, show two exceedances of the chronic limit (0.014 ug/L) out of 71 samples collected at CMD32-Hodges, two out of 74 samples collected at HD1, and five out of 74 samples collected at HD2. The delisting criteria would allow for up to five exceedances at CMD32 and up to six exceedances at HD1 and HD2. Taken together, data from all three sites also support delisting, with a total of nine exceedances out of 219 samples, when the delisting criteria would allow up to 18 exceedances to support delisting. TID chlorpyrifos data for CMD32-Hodges, HD1, and HD2 are included in Tables C1, C2, and C3, respectively, in Section 5.0 of this document.

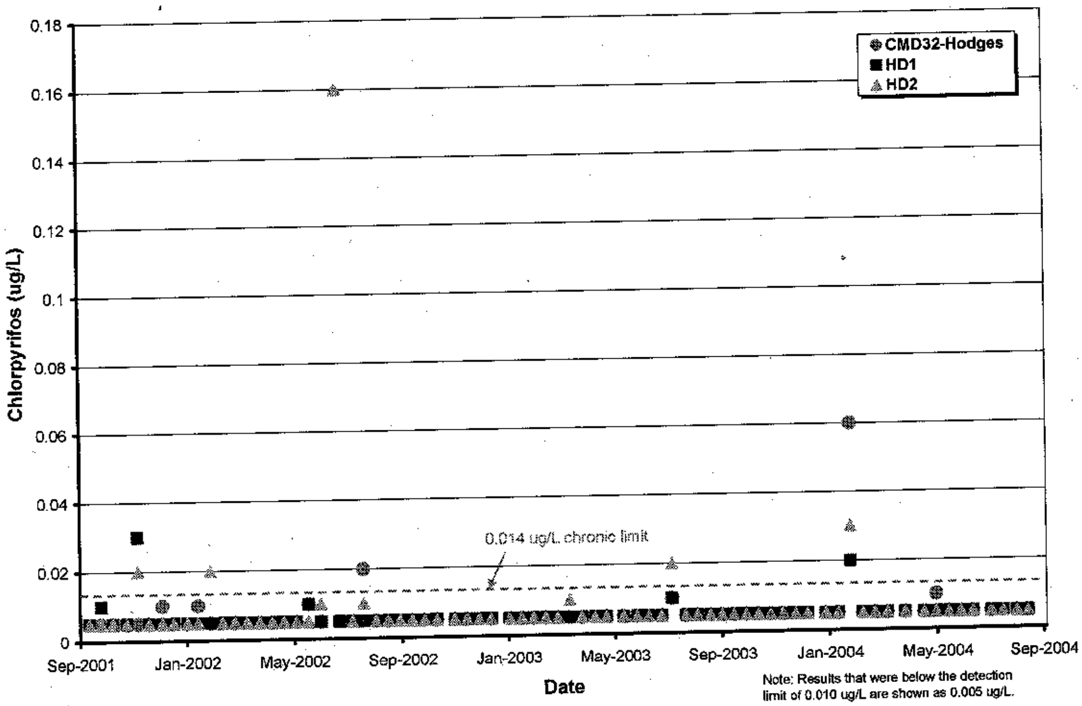

Figure C1. Chlorpyrifos in Ceres Main Canal and the Harding Drain with Numerical Limit of 0.014 ug/L

USGS NAWQA Phase I Data. The USGS also collected chlorpyrifos data for the Harding Drain near Carpenter Road between 1992-1994 and 2000-2001 as part of the National Water Quality Assessment (NAWQA). Historic USGS data (1992 to 1994) showed 18 exceedances of the chronic limit out of 23 chlorpyrifos samples. Of 11 more recent samples (2000-2001) collected by the USGS, no exceedances were observed. These data and plots of the data are provided in Attachment D.

DPR Data. DPR also collected historic chlorpyrifos data from 1991 to 1993. The 1991 to 1993 data are illustrative of the impairment that was present before recent improvements. (More recent Harding Drain data have not been collected by DPR.) Of the 49 DPR samples collected, a total of 12 chlorpyrifos exceedances were observed. DPR chlorpyrifos data and plots are included in Attachment D.

City of Turlock Data. The City of Turlock collects chlorpyrifos data at two locations on Harding Drain. Samples are collected at R1 (which is the same location as TID site CMD32-Hodges) and R2 (which is located in between TID sites CMD32-Hodges and HD1). No exceedances were observed of the 15 samples collected by the City, as all sample results were non-detect. Data for sites R1 and R2 collected between 2001 and 2005 are included in Attachment D.

3.2 Diazinon Data

TID Data. Diazinon data collected by TID at CMD32-Hodges, HD1, and HD2 are presented in Figure C2. The diazinon data show four exceedances of the chronic limit (0.10 ug/L) at CMD32, and two each at HD1 and HD2, which meet delisting criteria. The delisting criteria in the Policy (Table 4.2) would allow for up to five exceedances at CMD32 and up to six exceedances at HD1 and HD2. Taken together, data from all three sites also support delisting; though 18 exeedances would be allowable under the Policy, a total of only eight exceedances out of 219 samples were observed.

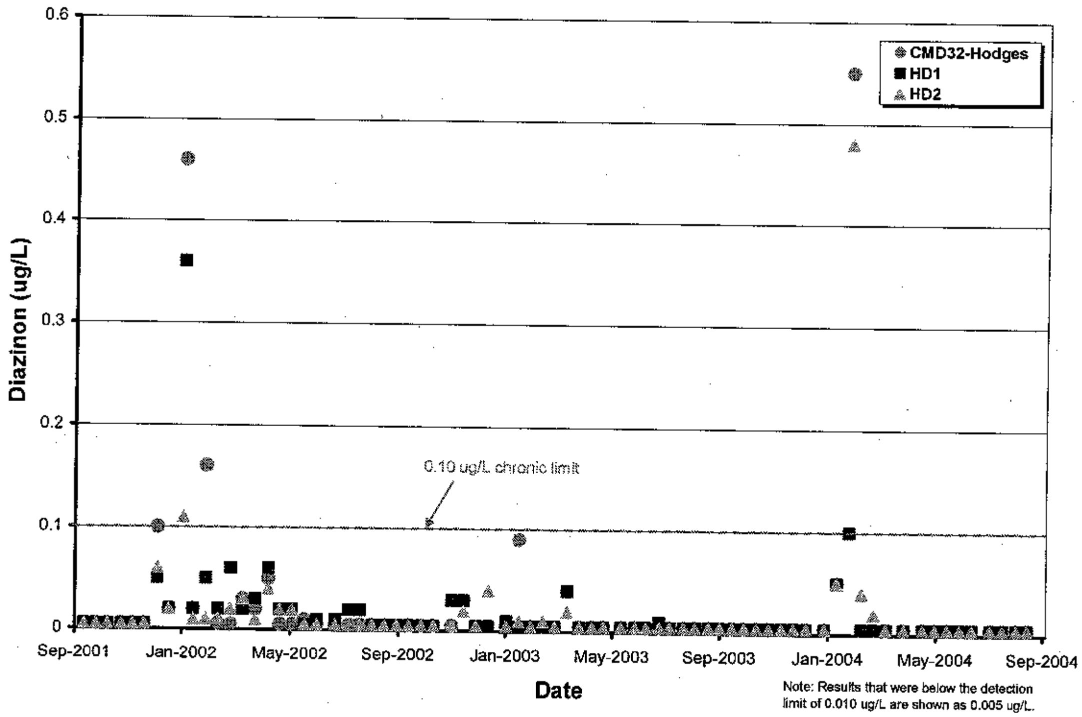

Figure C2. Diazinon in Ceres Main Canal and the Harding Drain with Numerical Limit of 0.10 ug/L

USGS NAWQA Phase I Data. Historic USGS data (1992 to 1994) from near Carpenter Road had one out of 23 diazinon samples that exceeded water quality goals. Recent USGS data (1999 to 2001) at the same site had no exceedances of diazinon, further supporting delisting. USGS diazinon data and plots are included in Attachment D.

DPR Data. Additionally, DPR collected historic diazinon data from 1991 to 1993. The 1991 to 1993 data are illustrative of the impairment that was present before recent improvements. (More recent Harding Drain data have not been collected by DPR.) Of the 49 DPR samples collected, a total of 9 diazinon exceedances were observed. DPR diazinon data and plots are included in Attachment D.

City of Turlock Data. The City of Turlock collects diazinon data at two locations on Harding Drain. Like chlorpyrifos monitoring, diazinon samples are collected at R1 and R2. No diazinon exceedances were observed of the 15 samples collected by the City, as all sample results were non-detect. Data for sites R1 and R2 collected between 2001 and 2005 are presented in Attachment D.

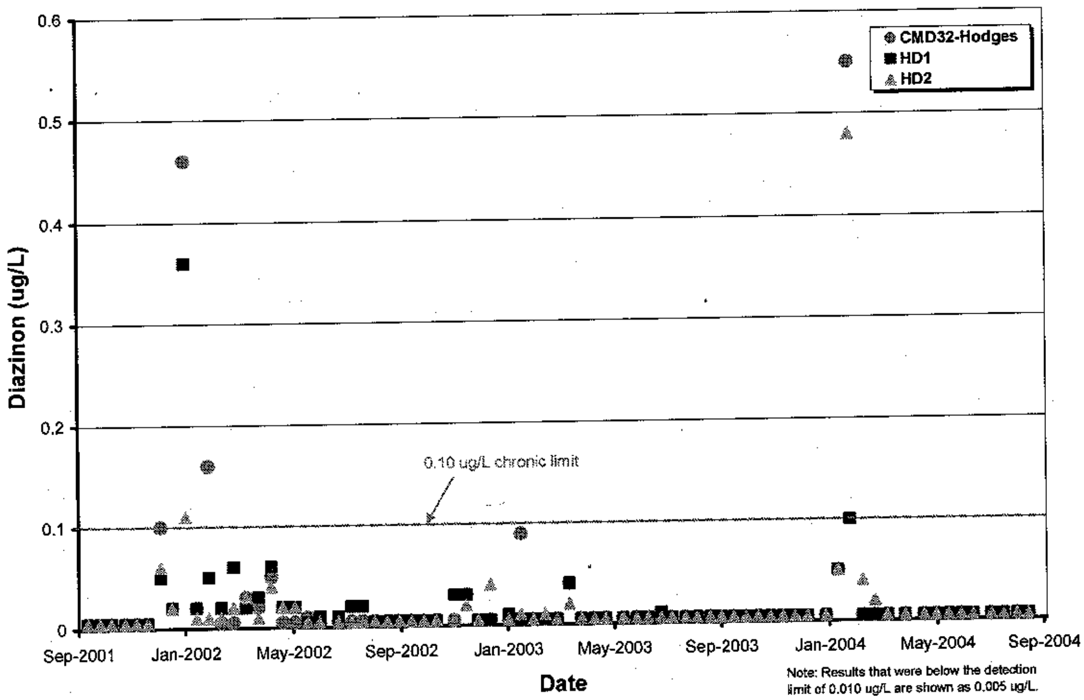

Figure C2. Diazinon in Ceres Main Canal and the Harding Drain with Numerical Limit of 0.10 ug/L

3.3 Additive Toxicity of Chlorpyrifos and Diazinon

In addition to the numeric water quality evaluation guidelines for chlorpyrifos and diazinon presented in the Staff Report, the CVRWQCB recently adopted a Basin Plan Amendment (CVRWQCB 2005) that includes a calculation for additive toxicity of both chemicals, using the following equation:

$$\frac{C_{chlorpyrifos}}{WQO_{chlorpyrifos}} + \frac{C_{diazinon}}{WQO_{diazinon}} \leq 1.0$$

Where

$C_{chlorpyrifos}$ = chlorpyrifos concentration in ug/L

$C_{diazinon}$ = diazinon concentration in ug/L

$WQO_{chlorpyrifos}$ = acute or chronic chlorpyrifos water quality objective in ug/L

$WQO_{diazinon}$ = acute or chronic diazinon water quality objective in ug/L

Additive toxicity was calculated for each of the three sampling locations using the chlorpyrifos and diazinon data collected by TID (Figure C3). Five of the 71 samples collected at CMD32-Hodges, 3 of the 74 samples collected at HD1, and 6 of the 74 samples collected at HD2 exceeded the additive toxicity limit. Though additive toxicity is not listed as a 303(d) impairment, these data meet the criteria for delisting chlorpyrifos and diazinon collectively. Of the 219 samples assessed for the three sites, a total of 14 had additive toxicity that exceeded the additive toxicity limit, when the delisting criteria would allow for up to 18 exceedances

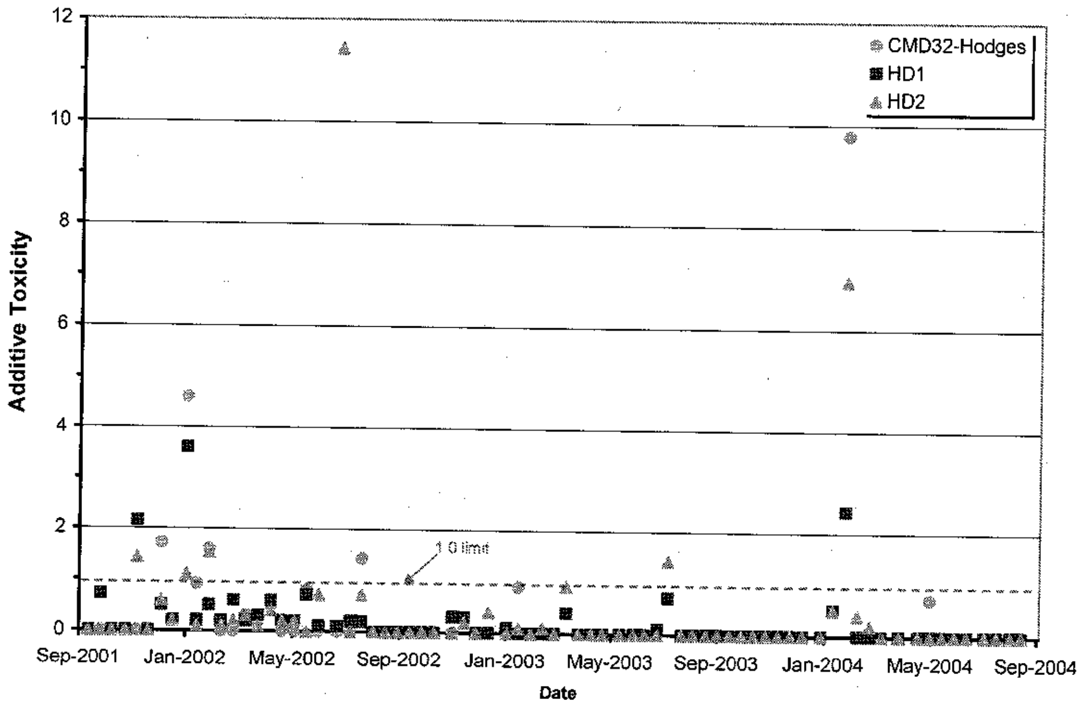

Figure C3. Additive toxicity of Chlorpyrifos and Diazinon in Ceres Main Canal and the Harding Drain

The CVRWQCB also assessed acute toxicity for diazinon and chlorpyrifos and additive toxicity for both in the Harding Drain (CVRWQCB 2005). The analysis, summarized in Attachment D, appears to be based on USGS NAWQA Phase I and DPR data, though there are some inconsistencies. The data presented within the Basin Plan Amendments show no exceedances of the water quality limits or additive toxicity limits for more recent data (1999 to 2001).

4.0 Summary of Chlorpyrifos and Diazinon Analysis

Data collected by TID for chlorpyrifos, diazinon, and additive toxicity support delisting the Harding Drain for these constituents. Though exceedances were observed in the historic USGS and DPR data, the results of the recent USGS and City of Turlock data show no exceedances of chronic criteria, reflecting improvement in chlorpyrifos and diazinon within Harding Drain since the early to mid-1990s.

5.0 TID Chlorpyrifos and Diazinon Data

TID chlorpyrifos and diazinon data for CMD32-Hodges, HD1, and HD2 are included in Tables C1, C2, and C3, respectively.

Table C1. TID Chlorpyrifos and Diazinon Data for CMD32-Hodges

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
9/12/2001	<0.01	0.005	No	<0.01	0.005	No
9/26/2001	<0.01	0.005	No	<0.01	0.005	No
10/9/2001	<0.01	0.005	No	<0.01	0.005	No
10/25/2001	<0.01	0.005	No	<0.01	0.005	No
11/7/2001	<0.01	0.005	No	<0.01	0.005	No
11/20/2001	<0.01	0.005	No	<0.01	0.005	No
12/5/2001	0.01	0.01	No	0.1	0.1	No
12/18/2001	<0.01	0.005	No	0.02	0.02	No
1/3/2002	<0.01	0.005	No	0.46	0.46	**Yes**
1/15/2002	0.01	0.01	No	0.02	0.02	No
1/29/2002	<0.01	0.005	No	0.16	0.16	**Yes**
2/12/2002	<0.01	0.005	No	<0.01	0.005	No
2/26/2002	<0.01	0.005	No	<0.01	0.005	No
3/12/2002	<0.01	0.005	No	0.03	0.03	No
3/26/2002	<0.01	0.005	No	0.02	0.02	No
4/10/2002	<0.01	0.005	No	0.05	0.05	No
4/23/2002	<0.01	0.005	No	<0.01	0.005	No
5/7/2002	<0.01	0.005	No	<0.01	0.005	No
5/21/2002	0.01	0.01	No	0.01	0.01	No
6/4/2002	<0.01	0.005	No	<0.01	0.005	No
6/25/2002	<0.01	0.005	No	<0.01	0.005	No
7/10/2002	<0.01	0.005	No	<0.01	0.005	No
7/23/2002	0.02	0.02	**Yes**	<0.01	0.005	No
8/6/2002	<0.01	0.005	No	<0.01	0.005	No
8/20/2002	<0.01	0.005	No	<0.01	0.005	No
9/3/2002	<0.01	0.005	No	<0.01	0.005	No
9/17/2002	<0.01	0.005	No	<0.01	0.005	No
10/1/2002	<0.01	0.005	No	<0.01	0.005	No
10/15/2002	<0.01	0.005	No	<0.01	0.005	No
11/5/2002	<0.01	0.005	No	<0.01	0.005	No
11/19/2002	<0.01	0.005	No	0.03	0.03	No
12/17/2002	<0.01	0.005	No	<0.01	0.005	No
1/7/2003	<0.01	0.005	No	<0.01	0.005	No
1/21/2003	<0.01	0.005	No	0.09	0.09	No
2/4/2003	<0.01	0.005	No	<0.01	0.005	No
2/18/2003	<0.01	0.005	No	<0.01	0.005	No
3/4/2003	<0.01	0.005	No	<0.01	0.005	No
3/18/2003	<0.01	0.005	No	0.04	0.04	No

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
4/1/2003	<0.01	0.005	No	<0.01	0.005	No
4/16/2003	<0.01	0.005	No	<0.01	0.005	No
4/29/2003	<0.01	0.005	No	<0.01	0.005	No
5/19/2003	<0.01	0.005	No	<0.01	0.005	No
6/4/2003	<0.01	0.005	No	<0.01	0.005	No
6/17/2003	<0.01	0.005	No	<0.01	0.005	No
7/2/2003	<0.01	0.005	No	<0.01	0.005	No
7/14/2003	0.01	0.01	No	<0.01	0.005	No
7/30/2003	<0.01	0.005	No	<0.01	0.005	No
8/12/2003	<0.01	0.005	No	<0.01	0.005	No
8/27/2003	<0.01	0.005	No	<0.01	0.005	No
9/9/2003	<0.01	0.005	No	<0.01	0.005	No
9/23/2003	<0.01	0.005	No	<0.01	0.005	No
10/7/2003	<0.01	0.005	No	<0.01	0.005	No
10/21/2003	<0.01	0.005	No	<0.01	0.005	No
11/4/2003	<0.01	0.005	No	<0.01	0.005	No
11/18/2003	<0.01	0.005	No	<0.01	0.005	No
1/6/2004	<0.01	0.005	No	<0.01	0.005	No
1/20/2004	<0.01	0.005	No	0.05	0.05	No
2/3/2004	0.06	0.06	Yes	0.55	0.55	Yes
2/17/2004	<0.01	0.005	No	<0.01	0.005	No
3/2/2004	<0.01	0.005	No	<0.01	0.005	No
3/16/2004	<0.01	0.005	No	<0.01	0.005	No
4/5/2004	<0.01	0.005	No	<0.01	0.005	No
4/27/2004	<0.01	0.005	No	<0.01	0.005	No
5/11/2004	0.01	0.01	No	<0.01	0.005	No
5/25/2004	<0.01	0.005	No	<0.01	0.005	No
6/8/2004	<0.01	0.005	No	<0.01	0.005	No
6/22/2004	<0.01	0.005	No	<0.01	0.005	No
7/13/2004	<0.01	0.005	No	<0.01	0.005	No
7/27/2004	<0.01	0.005	No	<0.01	0.005	No
8/12/2004	<0.01	0.005	No	<0.01	0.005	No
8/25/2004	<0.01	0.005	No	<0.01	0.005	No

Table C2. TID Chlorpyrifos and Diazinon Data for HD1

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
9/12/2001	<0.01	0.005	No	<0.01	0.005	No
9/26/2001	0.01	0.01	No	<0.01	0.005	No

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
10/9/2001	<0.01	0.005	No	<0.01	0.005	No
10/25/2001	<0.01	0.005	No	<0.01	0.005	No
11/7/2001	0.03	0.03	**Yes**	<0.01	0.005	No
11/20/2001	<0.01	0.005	No	<0.01	0.005	No
12/5/2001	<0.01	0.005	No	0.05	0.05	No
12/18/2001	<0.01	0.005	No	0.02	0.02	No
1/3/2002	<0.01	0.005	No	0.36	0.36	**Yes**
1/15/2002	<0.01	0.005	No	0.02	0.02	No
1/29/2002	<0.01	0.005	No	0.05	0.05	No
2/12/2002	<0.01	0.005	No	0.02	0.02	No
2/26/2002	<0.01	0.005	No	0.06	0.06	No
3/12/2002	<0.01	0.005	No	0.02	0.02	No
3/26/2002	<0.01	0.005	No	0.03	0.03	No
4/10/2002	<0.01	0.005	No	0.06	0.06	No
4/23/2002	<0.01	0.005	No	0.02	0.02	No
5/7/2002	<0.01	0.005	No	0.02	0.02	No
5/21/2002	0.01	0.01	No	<0.01	0.005	No
6/4/2002	<0.01	0.005	No	0.01	0.01	No
6/25/2002	<0.01	0.005	No	0.01	0.01	No
7/10/2002	<0.01	0.005	No	0.02	0.02	No
7/23/2002	<0.01	0.005	No	0.02	0.02	No
8/6/2002	<0.01	0.005	No	<0.01	0.005	No
8/20/2002	<0.01	0.005	No	<0.01	0.005	No
9/3/2002	<0.01	0.005	No	<0.01	0.005	No
9/17/2002	<0.01	0.005	No	<0.01	0.005	No
10/1/2002	<0.01	0.005	No	<0.01	0.005	No
10/15/2002	<0.01	0.005	No	<0.01	0.005	No
11/5/2002	<0.01	0.005	No	0.03	0.03	No
11/19/2002	<0.01	0.005	No	0.03	0.03	No
12/3/2002	<0.01	0.005	No	<0.01	0.005	No
12/17/2002	<0.01	0.005	No	<0.01	0.005	No
1/7/2003	<0.01	0.005	No	0.01	0.01	No
1/21/2003	<0.01	0.005	No	<0.01	0.005	No
2/4/2003	<0.01	0.005	No	<0.01	0.005	No
2/18/2003	<0.01	0.005	No	<0.01	0.005	No
3/4/2003	<0.01	0.005	No	<0.01	0.005	No
3/18/2003	<0.01	0.005	No	0.04	0.04	No
4/1/2003	<0.01	0.005	No	<0.01	0.005	No
4/16/2003	<0.01	0.005	No	<0.01	0.005	No
4/29/2003	<0.01	0.005	No	<0.01	0.005	No
5/19/2003	<0.01	0.005	No	<0.01	0.005	No
6/4/2003	<0.01	0.005	No	<0.01	0.005	No
6/17/2003	<0.01	0.005	No	<0.01	0.005	No
7/2/2003	<0.01	0.005	No	0.01	0.01	No

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
7/14/2003	0.01	0.01	No	<0.01	0.005	No
7/30/2003	<0.01	0.005	No	<0.01	0.005	No
8/12/2003	<0.01	0.005	No	<0.01	0.005	No
8/27/2003	<0.01	0.005	No	<0.01	0.005	No
9/9/2003	<0.01	0.005	No	<0.01	0.005	No
9/23/2003	<0.01	0.005	No	<0.01	0.005	No
10/7/2003	<0.01	0.005	No	<0.01	0.005	No
10/21/2003	<0.01	0.005	No	<0.01	0.005	No
11/4/2003	<0.01	0.005	No	<0.01	0.005	No
11/18/2003	<0.01	0.005	No	<0.01	0.005	No
12/2/2003	<0.01	0.005	No	<0.01	0.005	No
12/16/2003	<0.01	0.005	No	<0.01	0.005	No
1/6/2004	<0.01	0.005	No	<0.01	0.005	No
1/20/2004	<0.01	0.005	No	0.05	0.05	No
2/3/2004	0.02	0.02	**Yes**	0.1	0.1	No
2/17/2004	<0.01	0.005	No	<0.01	0.005	No
3/2/2004	<0.01	0.005	No	<0.01	0.005	No
3/16/2004	<0.01	0.005	No	<0.01	0.005	No
4/5/2004	<0.01	0.005	No	<0.01	0.005	No
4/27/2004	<0.01	0.005	No	<0.01	0.005	No
5/11/2004	<0.01	0.005	No	<0.01	0.005	No
5/25/2004	<0.01	0.005	No	<0.01	0.005	No
6/8/2004	<0.01	0.005	No	<0.01	0.005	No
6/22/2004	<0.01	0.005	No	<0.01	0.005	No
7/13/2004	<0.01	0.005	No	<0.01	0.005	No
7/27/2004	<0.01	0.005	No	<0.01	0.005	No
8/12/2004	<0.01	0.005	No	<0.01	0.005	No
8/25/2004	<0.01	0.005	No	<0.01	0.005	No

Table C3. TID Chlorpyrifos and Diazinon Data for HD2

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
9/12/2001	<0.01	0.005	No	<0.01	0.005	No
9/26/2001	<0.01	0.005	No	<0.01	0.005	No
10/9/2001	<0.01	0.005	No	<0.01	0.005	No
10/25/2001	<0.01	0.005	No	<0.01	0.005	No
11/7/2001	0.02	0.02	**Yes**	<0.01	0.005	No
11/20/2001	<0.01	0.005	No	<0.01	0.005	No
12/5/2001	<0.01	0.005	No	0.06	0.06	No

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
12/18/2001	<0.01	0.005	No	0.02	0.02	No
1/3/2002	<0.01	0.005	No	0.11	0.11	**Yes**
1/15/2002	<0.01	0.005	No	0.01	0.01	No
1/29/2002	0.02	0.02	**Yes**	0.01	0.01	No
2/12/2002	<0.01	0.005	No	0.01	0.01	No
2/26/2002	<0.01	0.005	No	0.02	0.02	No
3/12/2002	<0.01	0.005	No	0.03	0.03	No
3/26/2002	<0.01	0.005	No	0.01	0.01	No
4/10/2002	<0.01	0.005	No	0.04	0.04	No
4/23/2002	<0.01	0.005	No	0.02	0.02	No
5/7/2002	<0.01	0.005	No	0.02	0.02	No
5/21/2002	<0.01	0.005	No	<0.01	0.005	No
5/21/2002	<0.01	0.005	No	<0.01	0.005	No
6/4/2002	0.01	0.01	No	<0.01	0.005	No
6/25/2002	0.16	0.16	**Yes**	<0.01	0.005	No
7/10/2002	<0.01	0.005	No	<0.01	0.005	No
7/23/2002	0.01	0.01	No	<0.01	0.005	No
8/6/2002	<0.01	0.005	No	<0.01	0.005	No
8/20/2002	<0.01	0.005	No	<0.01	0.005	No
9/3/2002	<0.01	0.005	No	<0.01	0.005	No
9/17/2002	<0.01	0.005	No	<0.01	0.005	No
10/1/2002	<0.01	0.005	No	<0.01	0.005	No
10/15/2002	<0.01	0.005	No	<0.01	0.005	No
11/5/2002	<0.01	0.005	No	<0.01	0.005	No
11/19/2002	<0.01	0.005	No	0.02	0.02	No
12/3/2002	<0.01	0.005	No	<0.01	0.005	No
12/17/2002	<0.01	0.005	No	0.04	0.04	No
1/7/2003	<0.01	0.005	No	<0.01	0.005	No
1/21/2003	<0.01	0.005	No	0.01	0.01	No
2/4/2003	<0.01	0.005	No	<0.01	0.005	No
2/18/2003	<0.01	0.005	No	0.01	0.01	No
3/4/2003	<0.01	0.005	No	<0.01	0.005	No
3/18/2003	0.01	0.01	No	0.02	0.02	No
4/1/2003	<0.01	0.005	No	<0.01	0.005	No
4/16/2003	<0.01	0.005	No	<0.01	0.005	No
4/29/2003	<0.01	0.005	No	<0.01	0.005	No
5/19/2003	<0.01	0.005	No	<0.01	0.005	No
6/4/2003	<0.01	0.005	No	<0.01	0.005	No
6/17/2003	<0.01	0.005	No	<0.01	0.005	No
7/2/2003	<0.01	0.005	No	<0.01	0.005	No
7/14/2003	0.02	0.02	**Yes**	<0.01	0.005	No
7/30/2003	<0.01	0.005	No	<0.01	0.005	No
8/12/2003	<0.01	0.005	No	<0.01	0.005	No
8/27/2003	<0.01	0.005	No	<0.01	0.005	No

Date	Chlorpyrifos			Diazinon		
	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?	Result (ug/L)	Plotted Result (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
9/9/2003	<0.01	0.005	No	<0.01	0.005	No
9/23/2003	<0.01	0.005	No	<0.01	0.005	No
10/7/2003	<0.01	0.005	No	<0.01	0.005	No
10/21/2003	<0.01	0.005	No	<0.01	0.005	No
11/4/2003	<0.01	0.005	No	<0.01	0.005	No
11/18/2003	<0.01	0.005	No	<0.01	0.005	No
12/2/2003	<0.01	0.005	No	<0.01	0.005	No
12/16/2003	<0.01	0.005	No	<0.01	0.005	No
1/6/2004	<0.01	0.005	No	<0.01	0.005	No
1/20/2004	<0.01	0.005	No	0.05	0.05	No
2/3/2004	0.03	0.03	**Yes**	0.48	0.48	**Yes**
2/17/2004	<0.01	0.005	No	0.04	0.04	No
3/2/2004	<0.01	0.005	No	0.02	0.02	No
3/16/2004	<0.01	0.005	No	<0.01	0.005	No
4/5/2004	<0.01	0.005	No	<0.01	0.005	No
4/27/2004	<0.01	0.005	No	<0.01	0.005	No
5/11/2004	<0.01	0.005	No	<0.01	0.005	No
5/25/2004	<0.01	0.005	No	<0.01	0.005	No
6/8/2004	<0.01	0.005	No	<0.01	0.005	No
6/22/2004	<0.01	0.005	No	<0.01	0.005	No
7/13/2004	<0.01	0.005	No	<0.01	0.005	No
7/27/2004	<0.01	0.005	No	<0.01	0.005	No
8/12/2004	<0.01	0.005	No	<0.01	0.005	No
8/25/2004	<0.01	0.005	No	<0.01	0.005	No

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Attachment D
Additional Data for Chlorpyrifos and Diazinon in Harding Drain

Chlorpyrifos and diazinon data from NAWQA Phase I monitoring are included in Tables D1 and D2 and are plotted in Figure D1 and D2. Bold lines in Tables D1 and D2 indicate the timeframe before and after observed water quality improvements; data included below the bold lines represent recent chlorpyrifos and diazinon data and reflect current conditions of the Harding Drain. DPR chlorpyrifos and diazinon data are included in Tables D3 and D4 and are plotted in Figures D3 and D4, while Tables D5 and D6 include data from the City of Turlock. Data presented in the CVRWQCB Basin Plan Amendments are summarized in Table D7; these data are seemingly based on USGS and DPR data, though there are some inconsistencies.

Table D1. USGS NAWQA Chlorpyrifos Data Harding Drain at Carpenter Rd Near Patterson (HD2)[1]

Sample Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?
4/22/1992	0.035		Yes
4/29/1992	0.039		Yes
5/6/1992	0.02		Yes
5/13/1992	0.06		Yes
5/20/1992	0.037		Yes
5/27/1992	0.032		Yes
6/3/1992	0.026		Yes
6/10/1992	0.019		Yes
6/17/1992	0.01		No
6/24/1992	0.009		No
7/2/1992	0.014		No
7/8/1992	0.04		Yes
7/15/1992	0.024		Yes
7/22/1992	0.026		Yes
7/29/1992	0.017		Yes
8/5/1992	0.055		Yes
8/12/1992	0.015		Yes
8/19/1992	0.018		Yes
8/26/1992	0.015		Yes
12/15/1992	0.019		Yes
12/22/1992	0	0.004	No
1/6/1993	0.029		Yes
6/22/1994	0.014		No
9/21/1999	0.0049		No
1/6/2000	0.0072		No
1/12/2000	0.0074		No
1/19/2000	0.0109		No
2/4/2000	0.0062		No
2/9/2000	0.0048		No

Sample Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?
2/13/2000	0	0.008	No
2/14/2000	0.0126		No
2/14/2000	0.0096		No
2/14/2000	0.009		No
6/21/2001	0.0121		No
8/2/2001	0.0076		No

[1]Site code is 100; Site latitude (decimal degrees): 37.46446; Site longitude(decimal degrees): -121.031.
[2]LOQ = limit of quantification

Table D2. USGS NAWQA Diazinon Data Harding Drain at Carpenter Rd Near Patterson (HD2)[1]

Sample Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
4/22/1992	0.041		No
4/29/1992	0.025		No
5/6/1992	0.023		No
5/13/1992	0.021		No
5/20/1992	0.058		No
5/27/1992	0.009		No
6/3/1992	0.023		No
6/10/1992	0.02		No
6/17/1992	0.006		No
6/24/1992	0.004		No
7/2/1992	0.024		No
7/8/1992	0.014		No
7/15/1992	0.005		No
7/22/1992	0.021		No
7/29/1992	0.017		No
8/5/1992	0.072		No
8/12/1992	0.017		No
8/19/1992	0.021		No
8/26/1992	0.016		No
12/15/1992	0.071		No
12/22/1992	0.13		**Yes**
1/6/1993	0.085		No
6/22/1994	0.03		No
9/21/1999	0.0122		No
1/6/2000	0.0182		No
1/12/2000	0.0291		No
1/19/2000	0.0338		No
2/4/2000	0.056		No
2/9/2000	0.0293		No
2/13/2000	0	0.06	No
2/14/2000	0.0686		No

Sample Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
2/14/2000	0.0602		No
2/14/2000	0.0457		No
6/21/2001	0.038		No
8/2/2001	0.0125		No

[1]Site code is 100; Site latitude (decimal degrees): 37.46446; Site longitude(decimal degrees): -121.031.
[2]LOQ = limit of quantification

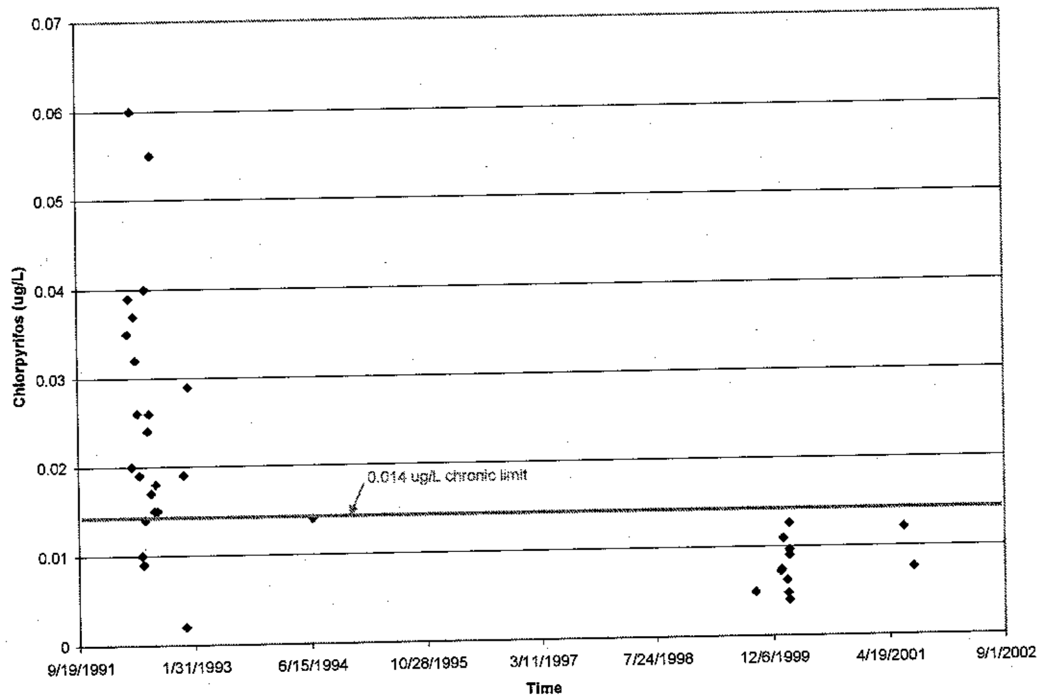


Figure D1. USGS NAWQA Chlorpyrifos Data Harding Drain at Carpenter Rd Near Patterson (HD2)

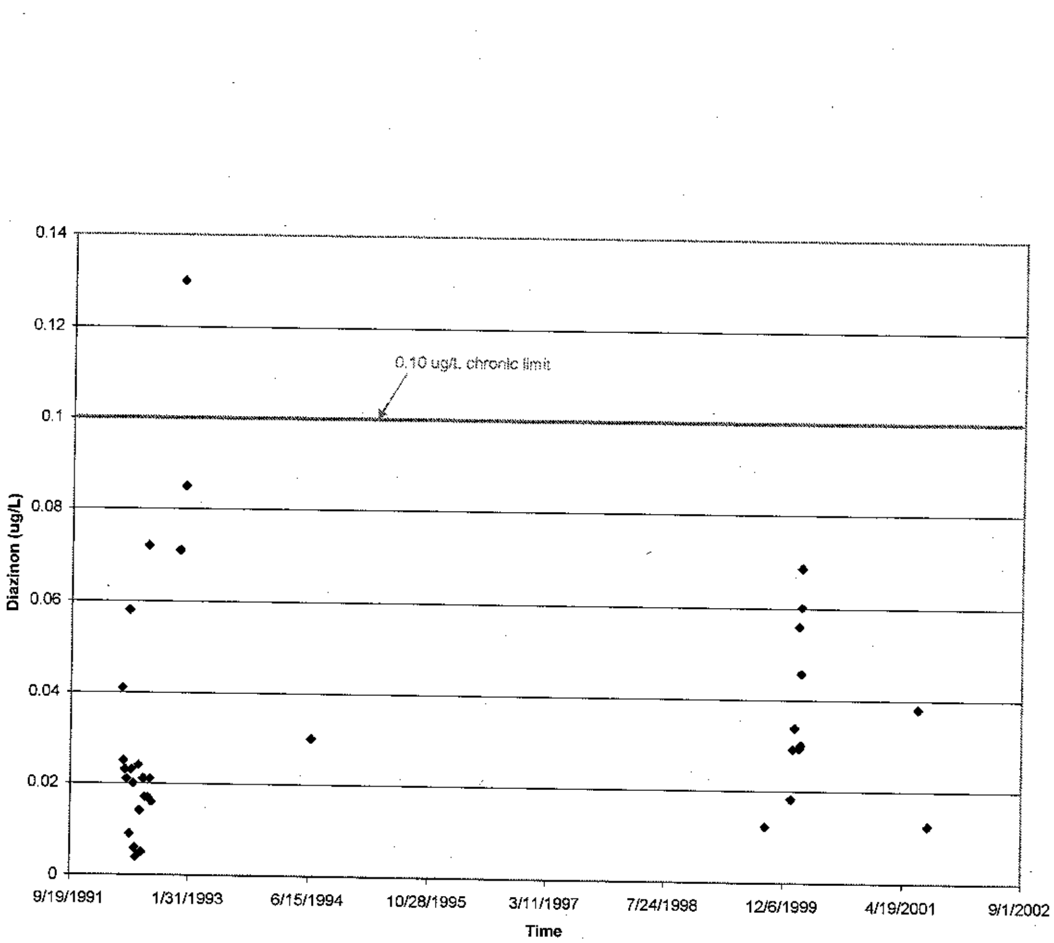


Figure D2. USGS NAWQA Diazinon Data Harding Drain at Carpenter Rd Near Patterson (HD2)

Table D3. DPR Chlorpyrifos Data for Turlock Irrigation District Drain #5 (HD2)[1]

Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?
3/4/1991	0	0.01	No
3/4/1991	0	0.01	No
3/19/1991	0.05	0.01	Yes
3/19/1991	0	0.01	No
4/3/1991	0	0.05	No
4/4/1991	0.02	0.01	Yes
4/4/1991	0	0.01	No
4/25/1991	0.23	0.05	Yes
4/26/1991	0.19	0.01	Yes
4/26/1991	0.23	0.01	Yes
12/18/1991	0.01	0.01	No
12/18/1991	0	0.01	No
1/5/1992	0.01	0.01	No
1/5/1992	0	0.01	No
1/13/1992	0.01	0.01	No
1/13/1992	0	0.01	No
1/20/1992	0.01	0.01	No

Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.014 ug/L)?
1/20/1992	0	0.01	No
1/29/1992	0	0.05	No
2/3/1992	0.01	0.01	No
2/3/1992	0	0.01	No
2/10/1992	0.04	0.01	**Yes**
2/10/1992	0	0.01	No
2/17/1992	0.08	0.01	**Yes**
2/17/1992	0	0.01	No
2/18/1992	0	0.05	No
2/24/1992	0.02	0.01	**Yes**
2/24/1992	0	0.01	No
3/9/1992	0.08	0.01	**Yes**
3/9/1992	0	0.01	No
4/15/1992	0	0.05	No
4/27/1992	0.02	0.01	**Yes**
4/27/1992	0	0.01	No
5/4/1992	0.01	0.01	No
5/4/1992	0	0.01	No
5/11/1992	0.05	0.01	**Yes**
5/11/1992	0	0.01	No
5/25/1992	0.01	0.01	No
5/25/1992	0	0.01	No
6/1/1992	0.01	0.01	No
6/1/1992	0	0.01	No
6/15/1992	0	0.01	No
6/15/1992	0	0.01	No
6/22/1992	0	0.01	No
6/22/1992	0	0.01	No
7/29/1992	0	0.05	No
8/26/1992	0	0.05	No
1/16/1993	0	0.05	No
2/9/1993	0.07	0.05	**Yes**

[1]This site is mis-named and is consistent with HD2. Site latitude (decimal degrees): 37.4644; Site longitude (decimal degrees): -121.03
[2]LOQ = limit of quantification

Table D4. DPR Diazinon Data for Turlock Irrigation District Drain #5 (HD2)[1]

Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
3/4/1991	0	0.01	No
3/4/1991	0	0.01	No
3/19/1991	0.03	0.01	No
3/19/1991	0	0.01	No
4/3/1991	0	0.05	No
4/4/1991	0.04	0.01	No
4/4/1991	0	0.01	No

Date	Concentration (ug/L)	LOQ[2] (ug/L)	Exceeds Chronic Limit (0.10 ug/L)?
4/25/1991	0	0.05	No
4/26/1991	0.02	0.01	No
4/26/1991	0	0.01	No
12/18/1991	0	0.01	No
12/18/1991	0.08	0.01	No
1/5/1992	0	0.01	No
1/5/1992	0.05	0.01	No
1/13/1992	0	0.01	No
1/13/1992	0.17	0.01	**Yes**
1/20/1992	0	0.01	No
1/20/1992	0.09	0.01	No
1/29/1992	0.45	0.05	**Yes**
2/3/1992	0.26	0.01	**Yes**
2/3/1992	0	0.01	No
2/10/1992	0.29	0.01	**Yes**
2/10/1992	0	0.01	No
2/17/1992	0.5	0.01	**Yes**
2/17/1992	0	0.01	No
2/18/1992	0.28	0.05	**Yes**
2/24/1992	0.45	0.01	**Yes**
2/24/1992	0	0.01	No
3/9/1992	0	0.01	No
3/9/1992	0.08	0.01	No
4/15/1992	0	0.05	No
4/27/1992	0	0.01	No
4/27/1992	0.01	0.01	No
5/4/1992	0	0.01	No
5/4/1992	0.01	0.01	No
5/11/1992	0	0.01	No
5/11/1992	0.01	0.01	No
5/25/1992	0	0.01	No
5/25/1992	0	0.01	No
6/1/1992	0	0.01	No
6/1/1992	0	0.01	No
6/15/1992	0	0.01	No
6/15/1992	0	0.01	No
6/22/1992	0.01	0.01	No
6/22/1992	0	0.01	No
7/29/1992	0	0.05	No
8/26/1992	0	0.05	No
1/16/1993	0.12	0.05	**Yes**
2/9/1993	1.69	0.05	**Yes**

[1]This site is mis-named and is consistent with HD2. Site latitude (decimal degrees): 37.4644; Site longitude(decimal degrees): -121.03.
[2]LOQ = limit of quantification

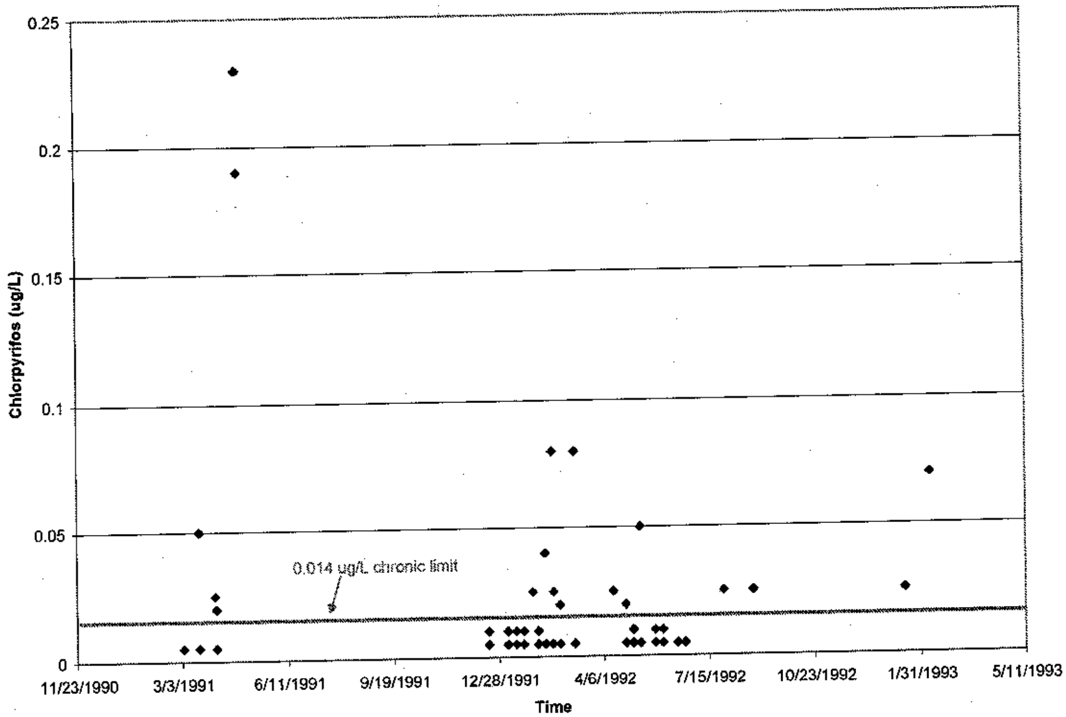


Figure D3. DPR Chlorpyrifos Data for Turlock Irrigation District Drain #5 (HD2)

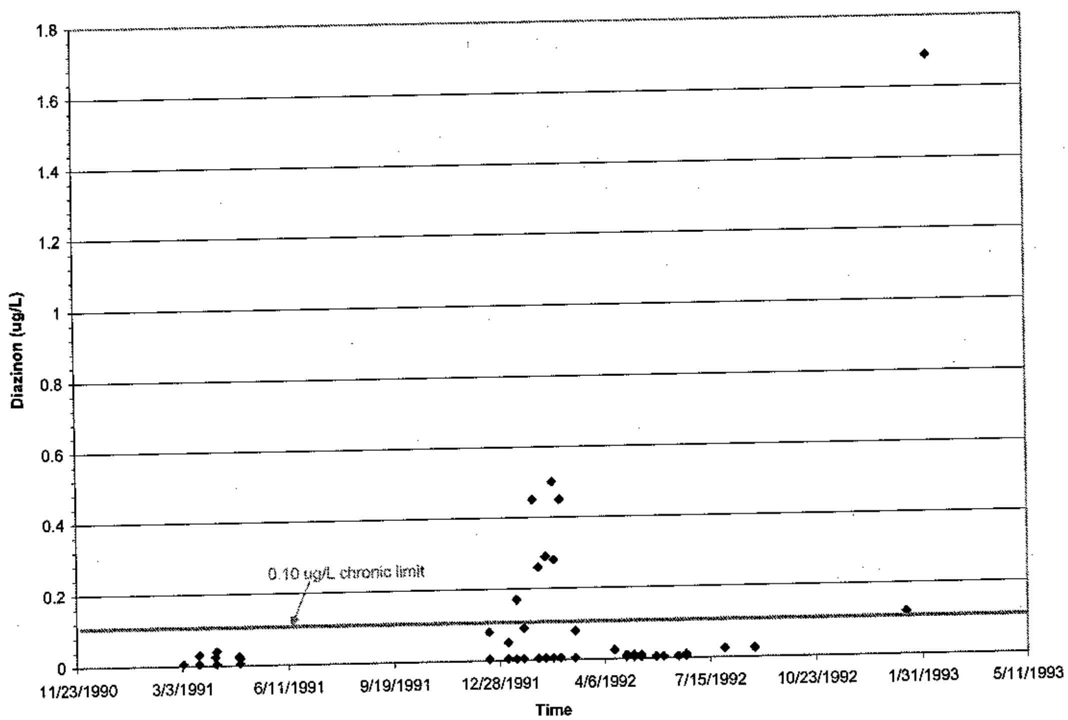


Figure D4. DPR Diazinon Data for Turlock Irrigation District Drain #5 (HD2)

Table D5. City of Turlock Chlorpyrifos and Diazinon Data for Harding Drain at R1 (Prairie Flower Road, CMD32-Hodges)

Date	Diazinon µg/L Method 622	Chlorpyriphos µg/L Method 622	Diazinon µg/L Method 507	Chlorpyriphos µg/L Method 507
12/17/01	<0.08	<0.08		
3/25/02	<0.08	<0.08		
6/10/02			<0.25	<1.0
10/21/02			<0.25	<1.0
10/23/02	<0.08	<0.08		
3/17/03	<0.08	<0.08	<0.25	
6/2/03	<0.08	<0.08		
9/15/03	<0.08	<0.08		
10/15/03	<0.08	<0.08		
3/15/04	<0.08	<0.08		
5/10/04	<0.08	<0.08		
8/17/04	<0.08	<0.08		
10/11/04	<0.08	<0.08		
3/14/05	<0.08	<0.08		
5/23/05	<0.5	<0.5		

The reporting limit for diazinon and chlorpyriphos for Method 622 is 0.08 µg/L, however on 5/23/05 the reporting limit was 0.5 µg/L.

The reporting limit for Method 507 is 0.25 µg/L for diazinon and 1.0 µg/L for chlorpyriphos.

Table D6. City of Turlock Chlorpyrifos and Diazinon Data for Harding Drain at R2 (between Prairie Flower and Mitchell Roads, between CMD32-Hodges and HD2)

Date	Diazinon µg/L Method 622	Chlorpyriphos µg/L Method 622	Diazinon µg/L Method 507	Chlorpyriphos µg/L Method 507
12/17/01	<0.08	<0.08		
3/25/02	<0.08	<0.08		
6/10/02			<0.25	<1.0
10/21/02			<0.25	<1.0
10/23/02	<0.08	<0.08		
3/17/03	<0.08	<0.08	<0.25	
6/2/03	<0.08	<0.08		
9/15/03	<0.08	<0.08		
10/15/03	<0.08	<0.08		
3/15/04	<0.08	<0.08		
5/10/04	<0.08	<0.08		
8/17/04	<0.08	<0.08		
10/11/04	<0.08	<0.08		
5/23/05	<0.5	<0.5		

The reporting limit for diazinon and chlorpyriphos for Method 622 is 0.08 µg/L, however on 5/23/05 the reporting limit was 0.5 µg/L.

The reporting limit for Method 507 is 0.25 µg/L for diazinon and 1.0 µg/L for chlorpyriphos.

Table D7. Assessment of DPR and USGS Data for Diazinon, Chlorpyrifos, and Additive Toxicity in Harding Drain (from Basin Plan Amendment, CVRWQCB, 2005)

Constituent	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diazinon Acute Toxicity	0%[a] 7[b]	17%[a] 41[b]	60%[a] 5[b]	0%[a] 1[b]	NS[c]	NS[c]	NS[c]	NS[c]	NS[c]	0%[a] 11[b]	0%[a] 2[b]	NS[c]	NS[c]	NS[c]	NS[c]
Chlorpyrifos Acute Toxicity	57%[d] 7[e]	32%[d] 40[e]	28%[d] 7[e]	0%[d] 1[e]	NS[c]	NS[c]	NS[c]	NS[c]	NS[c]	0%[d] 9[e]	0%[d] 2[e]	NS[c]	NS[c]	NS[c]	NS[c]
Additive Toxicity[f]	57%[g] 7[h]	46%[g] 41[g]	80%[g] 5[h]	0%[g] 1[h]	NS[c]	NS[c]	NS[c]	NS[c]	0%[g] 1[h]	0%[g] 9[h]	0%[g] 2[h]	NS[c]	NS[c]	NS[c]	NS[c]

Proposed Diazinon Acute Toxicity Target = 0.16 ug/L

Proposed Chlorpyrifos Acute Toxicity Water Quality Objective = 0.025 ug/L

[a]Percent of samples for the year that exceed the proposed diazinon acute toxicity target value.

[b]Total number of samples analyzed for diazinon during the year.

[c]NS = No samples analyzed during the year.

[d]Percent of samples for the year that exceed the proposed chlorpyrifos acute toxicity water quality objective value.

[e]Total number of samples analyzed for chlorpyrifos during the year.

[f]Additive toxicity is defined in the Basin Plan Amendment (CVRWQCB 2005) by the following equation:.

$$\frac{C_{chlorpyrifos}}{WQO_{chlorpyrifos}} + \frac{C_{diazinon}}{WQO_{diazinon}} \leq 1.0$$

Where

$C_{chlorpyrifos}$ = chlorpyrifos concentration in ug/L

$C_{diazinon}$ = diazinon concentration in ug/L

$WQO_{chlorpyrifos}$ = acute or chronic chlorpyrifos water quality objective in ug/L

$WQO_{diazinon}$ = acute or chronic diazinon water quality objective in ug/L

[g]Percent of samples for the year for which the combined (additive) toxicity value equals or exceeds 1.0.

[h]Total number of samples analyzed for chlorpyrifos and/or diazinon during the year.

Attachment E
TID Sampling and Analysis Plan and
Quality Assurance and Quality Control Procedures

1.0 Background

The TID Sampling and Analysis Plan (SAP) guided the collection of ammonia, chlorpyrifos, and diazinon data presented in Attachments A and C. The original version of the SAP was developed in 2001, and the document was most recently revised in 2003. This revision is included in Section 3.0 of this document. The SAP and its appendices comply with the QA/QC elements of Section 6.1.4 of the Policy, as follows:

- *Objectives of the monitoring program* (SAP Section I);
- *Methods used for sample collection and handling* (SAP Section IV, under "Sampling Techniques," "Flow Measurement," and "Sample Documentation and Delivery." Also included in SAP Appendix B and Appendix C)
- *Field and laboratory measurement and analysis* (SAP Section IV, under "Field Parameters" and "Sampling Constituents and Analytical Methods." Also included in Appendix F);
- *Data management, validation, and recordkeeping (including proper chain of custody) procedures* (SAP Section V, under "Data Validation Procedures" and "Reporting." Also included in Appendix G);
- *Quality assurance and quality control requirements* (SAP Section V, under "Precision," "Accuracy," "Representativeness," "Comparability," "Completeness," and "Reporting." Also included in Appendix F);
- *A statement certifying the adequacy of the QAPP (plus name of person certifying the document)* is included as follows:
  - The SAP meets the requirements of a QAPP and was reviewed by senior staff at Brown and Caldwell (Cindy Paulson, PhD, and Greg Cole) and TID staff (Keith Larson).
- *A description of personnel training* (SAP Section III, under "Sampling Team");
- *Data quality objectives of the project* (SAP Section V. Also included in Appendix G.)
- *A statement that the data quality objectives were achieved.* A quantitative summary of QA/QC results, including a statement that data quality objectives were achieved is included in Section 2.0 of this document.
- *Rationale for:*
  - *the selection of sampling sites* (SAP Section III, Table 3-1);
  - *water quality parameters* (SAP Section IV, under "Sampling Constituents and Analytical Methods"),
  - *sampling frequency and methods that assure the samples are spatially and temporally representative of the surface water and representative of conditions within the targeted sampling timeframe* (SAP Section III under "Sampling Locations" and "Timing and Scheduling");
- *Documentation to support the conclusion that results are reproducible* (Section 2.0 and SAP Appendix F). A quantitative summary of QA/QC results is included in Section 2.0 of this document.

2.0 Summary of QA/QC Results

As described in the SAP (See Section 3.0), quality assurance and quality control procedures were employed to ensure the accuracy and precision of the collected data. Quality control samples were analyzed, which included field duplicates, surrogate spikes, matrix spikes (MS) and matrix spike duplicates (MSD), and laboratory blanks. Laboratory results were reviewed after each data package submittal using the Data Validation Procedure described in Appendix G of the SAP. Additionally, sampling locations were selected for this monitoring program to ensure that the data collected adequately represent the study area. Specifically, data collected at the three sampling locations (CMD32-Hodges, HD1, and HD2) adequately represent the general water quality throughout the extent of the Harding Drain.

Chlorpyrifos and Diazinon Data Assessment
The accuracy of the chlorpyrifos and diazinon data was verified by examining recoveries from spiked samples (surrogate, MS, and MSD) and results from the analysis of laboratory blanks. Spiked sample recoveries consistently were within the control limits of 70 to 130%, and laboratory blanks repeatedly showed no detectable amount of contamination. Instances where recoveries of spiked samples deviated from the control range or where laboratory blanks indicated the presence of contamination are summarized in Table E1. Although the QC results did not meet the data quality objectives for these few sampling events, it is unlikely that the quality of the collected data was compromised.

Precision and reproducibility of the data were verified by examining the relative percent difference (RPD) between field samples and field duplicates, the RPD between MS and MSD samples, and the RPD between laboratory split samples; all of which were consistently less than 20%. Instances where the RPD between duplicates was greater than 20% are summarized in Table E1. Similar to the discussion of accuracy above, although the QC results did not meet the data quality objectives for these few sampling events, it is unlikely that the quality of the collected data was compromised. The RPD between MS/MSD pairs and the RPD between laboratory split samples were always less than 20%.

Ammonia Data Assessment
For the purposes of the 303(d) evaluation, the primary interest is in assessing the quality of ammonia data collected after May of 2002, when the Turlock Regional Water Quality Control Facility (RWQCF) completed its treatment process upgrade. Quality assurance and quality control (QA/QC) reports for the ammonia analyses were not included as part of the data package submittal to TID until January of 2003, although the laboratory did consistently analyze these QC samples during this period as part of the certification and method requirements. QA/QC reports prior to January of 2003 are available upon request. The accuracy of the ammonia data since January of 2003 was verified by examining recoveries from MS and MSD samples and evaluating the results of laboratory blanks. Spiked sample recoveries were consistently within the control limits of 95 to 105%, except for one instance in March of 2003, where the reported matrix spike recovery was 109%. Laboratory blanks repeatedly showed no detectable amount of contamination.

Precision and reproducibility of the data were verified by examining the relative percent difference (RPD) between field samples and field duplicates, the RPD between MS and

MSD samples, and the RPD between laboratory split samples; all of which were consistently less than 20%. Of the more than 25 field sample and duplicate pairs collected after May of 2002, only one pair showed differing results; a field sample from HD1 collected in June of 2002 showed 1.6 mg/L of ammonia, whereas a duplicate was reported as non-detect. The RPD between MS/MSD pairs and the RPD between laboratory split samples were always less than 20%.

Achievement of Data Quality Objectives

Based on the data quality assessment presented above, the data quality objectives for chlorpyrifos, diazinon, and ammonia data were achieved during this project (See Section V of SAP), and the data are accurate, precise, representative, comparable, and complete.

Table E1. Diazinon and Chlorpyrifos Data Assessment - QA/QC Issues

QA/QC Issue	Date	Description of QA/QC Issue	Notes
>130% recovery of surrogates in sample	4/27/2004	133% recovery of surrogate from HD1	No corrective action taken because target compounds were not detected.
	3/13/2003	141% recovery of surrogate from CMD32-Hodges	No corrective action taken because target compounds were not detected.
	10/15/2002	146% recovery of surrogate from HD2	No corrective action taken because target compounds were not detected.
	8/20/2002	132% recovery of surrogate from CMD32-Hodges	No corrective action taken because target compounds were not detected.
	7/10/2002	134% recovery of surrogate from CMD32-Hodges	No corrective action taken because target compounds were not detected.
	5/7/2002	139% recovery of surrogate from CMD32-Hodges	No corrective action taken because target compounds were not detected.
	5/7/2002	134% recovery of surrogate from HD2	Diazinon was detected at 0.02 ug/L. Reanalysis confirmed the result.
	11/7/2001	131% recovery of surrogate from HD1	Chlorpyrifos was detected at 0.03 ug/L. No corrective action (reanalysis) was taken by mistake.
Low Recovery (< 60%)	10/10/2002	65.6% recovery of diazinon in MS.	No corrective action taken, as MSD was within appropriate range. Diazinon was not detected in any samples in this batch.
	5/1/2002	65.5% recovery of chlorpyrifos in MS.	No corrective action taken, as MSD was within appropriate range. Chlorpyrifos was not detected in any samples in this batch.
	8/28/2002	69.2 % recovery of diazinon in MS.	No corrective action taken, as MSD was within appropriate range. Diazinon was detected in one sample (SJ2) in this batch.
	4/10/2002	68.5% recovery of surrogate from HD2.	Diazinon was detected at 0.04 ug/L at HD2. Some sample was lost in final extraction, leading to low surrogate recovery.
Contaminated blank	3/11/2002	Blank showed 0.03 ug/L chlorpyrifos.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
>20% RPD in MS/MSD	6/5/2004	42% RPD between MS and MSD recoveries for chlorpyrifos, however both recoveries were within 70 to 130% range.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
	5/19/2004	21% RPD between MS and MSD recoveries for diazinon, however both recoveries were within 70 to 130% range.	Chlorpyrifos was detected at CMD32-Hodges at 0.01 ug/L but was not detected at HD1 or HD2; diazinon was not detected at any of the three sites. All surrogate recoveries were within appropriate range.
	3/25/2004	27% and 42% RPD between MS and MSD for diazinon and chlorpyrifos, respectively; however both recoveries were within 70 to 130% range.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
	2/11/2004	33% and 30% RPD between MS and MSD for diazinon and chlorpyrifos, respectively; however both recoveries were within 70 to 130% range.	Diazinon was detected at HD1, HD2, and CMD32-Hodges at 0.10, 0.48, and 0.55 ug/L, respectively. Chlorpyrifos was detected at the same sites at 0.02, 0.03, and 0.06 ug/L, respectively. All surrogate recoveries were within appropriate range.
	1/26/2004	28% and 31% RPD between MS and MSD for diazinon and chlorpyrifos, respectively; however both recoveries were within 70 to 130% range.	Diazinon was detected in samples HD1, HD2, and CMD32-Hodges at 0.05 ug/L; chlorpyrifos was not detected. All surrogate recoveries were within appropriate range.
	3/8/2003	29% and 31% RPD between MS and MSD for diazinon and chlorpyrifos, respectively; however both recoveries were within 70 to 130% range.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
	10/10/2002	36% RPD between MS and MSD recoveries for diazinon; low recovery (65.6%) in MS, but MSD was within appropriate range.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
	8/28/2002	27% RPD between MS and MSD recoveries for diazinon; slighly low recovery (69.2%) in MS, but MSD was within appropriate range.	Diazinon and chlorpyrifos were not detected at HD1, HD2, or CMD32-Hodges.
	5/1/2002	35% and 29% RPD between MS and MSD for diazinon and chlorpyrifos, respectively; low recovery (65.5%) in MS; but MSD was within appropriate range.	Diazinon was detected in samples HD1 and HD2 at 0.02 ug/L, chlorpyrifos was not detected at any of the three sites. All surrogate recoveries were within appropriate range.
> 20% RPD in recovery of sample and field duplicate	10/7/2003	29% RPD in surrogate recoveries of CMD32-Hodges and duplicate	No detectable amounts of chlorpyrifos or diazinon in either sample.
	11/19/2002	23% RPD in surrogate recoveries of HD1 and duplicate	Diazinon was detected at 0.03 ug/L in both HD1 and duplicate.
	8/6/2002	41% RPD in surrogate recoveries of HD2 and duplicate	No detectable amounts of chlorpyrifos or diazinon in either sample.
	2/12/2002	42% RPD in surrogate recoveries of HD2 and duplicate	Diazinon was detected in HD2 at the detection level of 0.01 ug/L, but not detecedt in field duplicate
	10/10/2001	25% RPD in surrogate recoveries of HD1 and duplicate	No detectable amounts of chlorpyrifos or diazinon in either sample.

MS = Matrix Spike
MSD = Matrix Spike Duplicate
RPD = Relative Percent Difference

3.0 Sampling and Analysis Plan

The most recently revised version of the SAP and associated appendices, including quality assurance and quality control procedures, follow.

TURLOCK IRRIGATION DISTRICT
SAMPLING AND ANALYSIS PLAN
REVISED APRIL 2003

I. INTRODUCTION AND DATA COLLECTION OBJECTIVES

In May 2001, Brown and Caldwell and Baker & Hostetler, in conjunction with the Turlock Irrigation District (TID), developed an Action Plan to respond to upcoming water quality issues. The Action Plan explains the need for more site-specific data to support TID in this process. Since the original Action Plan, changes have been made to the scope of water quality information needs, which are reflected in this Sampling and Analysis Plan (SAP). This water quality SAP outlines the steps to be followed for surface water sampling and analysis. The SAP provides procedures and methodologies for obtaining ammonia, organic nitrogen, nitrate, nitrite, diazinon, chlorpyrifos, ag panel constituents, and field data. The objective of collecting such scientifically sound site-specific data is the analysis of water quality on TID's drains, the San Joaquin River, and Mustang and Sand Creeks. Other benefits may include:

- evaluating beneficial uses
- measuring compliance with water quality objectives
- identifying major sources of constituents and their impacts
- documenting the change in water quality on the San Joaquin River above and below the Harding Drain
- characterizing conditions in the Harding Drain and in the other drains and laterals of the TID system
- supporting appropriate application of water quality objectives
- developing appropriate TMDL load allocations for the Harding Drain

II. OVERVIEW

Brown and Caldwell developed this SAP, which is executed by TID personnel, to collect data that are representative and scientifically defensible. The monitoring effort includes active review of collected data to evaluate the effectiveness of the plan in meeting project goals.

Each sampling event requires approximately two days to collect and record water column samples, measure field parameters, prepare samples for transport, and deliver and mail samples for overnight delivery to the respective laboratories. Samples are collected at eight sites including the Ceres Main Extension, Harding Drain, Prairie Flower Drain, Mustang Creek, Sand Creek, and the San Joaquin River. Sampling sites at Westport Spill, Lateral 2 Spill, Lateral 6&7 Spill, Lower Stevinson Spill, and Highline Spill were added in April 2002. Samples are taken twice per month at each site. The initial sampling effort began in September 2001 and continued through December 2001. Based on the results of the analyses, s ampling continues to better document conditions in the TID. Laboratory analyses included ammonia, diazinon, chlorpyrifos, organic nitrogen, nitrate, and nitrite from September 2001 through April 2002. In

April 2002, analysis of the ag panel constituents was added on a quarterly basis to several sites as noted in Table 3-1. Field parameters are collected at all sites and include pH, dissolved oxygen (DO), temperature, conductivity, and flow and will require the use of a field probe and flow meter during sampling to take the measurements. Based on the field conditions, the program may be modified by the project team during the sampling event to provide for field safety and make the collection accurate and thorough.

TID personnel are responsible for coordinating and performing the sampling events, including providing sampling equipment, obtaining sample bottles from the lab, taking field notes, and ensuring delivery of the samples to the analytical laboratories. The following sections provide details of the SAP, including sample locations, schedule, analytes, sampling analyses, documentation, quality assurance/ quality control (QA/QC) and reporting.

III. WATER QUALITY SAMPLING LOCATIONS AND SCHEDULE

This section details the locations for water quality sampling and the scheduled timing of each sampling event. As the project progresses, there may be a need to add or remove sampling sites and to adjust the timing of the sampling events. This SAP will be updated with changes to the locations and schedule as needed.

Sampling Locations

The sampling locations were selected to assure accessibility by foot or vehicle under all weather conditions, a well-mixed water column across the transect that is representative of stream conditions, minimal impact from other inflows and drainages, and an accurate mass balance.

The location of each sampling station is identified on Figure 3-1. Final site selection was made by TID personnel. Specific site selection criteria included safe access, bridge crossings, flow and staff gages, and the location of mixed conditions below discharges and inflows. Descriptions and purpose of sample locations are summarized in Table 3-1.

Table 3-1. TID Sampling Locations

Sample Site Designation	Sample Site Location	Purpose
TUOLUMNE RIVER		
Hickman Spill	Main Canal at Hall Road where Main Canal spills into the Tuolumne River.	Documenting constituent loads (ag panel only) to the Tuolumne River from the Main Canal. Added April 2002.
Faith Home Spill	Ceres Main Canal at Faith Home Road where it spills into the Tuolumne River.	Documenting constituent loads (ag panel only) to the Tuolumne River from Ceres Main Canal. Added April 2002.
L 1 Spill	Lateral 1 west of Vivian Road where it spills to the Tuolumne River.	Documenting flow to the Tuolumne River from Lateral 1. Added April 2002.

Sample Site Designation	Sample Site Location	Purpose
LATERAL 2 SPILL		
LL 2 Spill	Lower Lateral 2 spill located 250 feet downstream from where LL2 crosses Grayson Road.	Documenting constituent loads (ag panel only) from Lower Lateral 2 to the San Joaquin River. Added April 2002.
WESTPORT SPILL		
LL 3 Spill	Lower Lateral 3 above Jennings Road upstream of where it spills to the Westport Drain.	Documenting constituent loads (ag panel only) to Westport Drain from Lateral 3. Added April 2002.
LL 2 ½ Spill	Lower Lateral 2½ located 0.5 miles downstream from Quiesenberry Road and 0.25 miles north of the Westport Drain.	Documenting constituent loads (ag panel only) from Lower Lateral 2 ½ to the San Joaquin River. Added April 2002.
WPS	Westport Drain where it merges with the LL2½ spill. This location is about 2.5 miles upstream from where it joins the San Joaquin River.	Documenting constituent loads to the San Joaquin River from Westport Drain. Added April 2002.
HARDING DRAIN		
CMD32-Hodges	Ceres Main Extension just upstream of the Ceres Main outfall at the footbridge (approx. 5.25 miles upstream of HD2).	Documenting impact of RWQCF outfall on Harding Drain water quality.
HD1	Harding Drain downstream of the Turlock Regional Water Quality Control Facility (RWQCF) effluent outfall from the west side of Mitchell Road (approx. 4.75 miles upstream of HD2).	
L 5½ Upper Spill	Lateral 5½ at Drop 16, upstream of where it spills into the Harding Drain, between Morgan Road and South Blaker Road.	Documenting constituent loads (ag panel only) to Harding Drain from Lateral 5½. Added April 2002.
L 5½ Lower Spill	Lateral 5½ upstream of where it spills to the Prairie Flower Drain east of Crows Landing Road.	Documenting constituent loads (ag panel only) to Prairie Flower Drain from Lower Lateral 5½. Added April 2002.
L 4½ Spill	Lateral 4½ Canal upstream of where it spills to Lateral 4½ Drain at Morgan Road.	Documenting constituent loads (ag panel only) to Lateral 4½ Drain (and eventually to Harding Drain) from Lateral 4½. Added April 2002.
LL 4 Spill	Lower Lateral 4 Canal just north of Linwood Road upstream of where it spills into the Lateral 4 Drain.	Documenting constituent loads (ag panel only) to Harding Drain from Lower Lateral 4. Added April 2002.
PFS	Above Lateral 5½ spill into the Prairie Flower Drain upstream of the access road (approx. 1.1 miles upstream of the outfall to Harding Drain).	Documenting constituent loads to the Harding Drain from the Prairie Flower Drain.
HD2	Harding Drain on the east side of the Carpenter Road bridge, upstream of the outfall into the San Joaquin River.	Documenting constituent loads to the San Joaquin River from Harding Drain.
SAN JOAQUIN RIVER		
SJ1	San Joaquin River just upstream of the Harding Drain outfall.	Documenting impact of Harding Drain outfall on water quality conditions in the San Joaquin River.
SJ2	San Joaquin River just downstream of the Harding Drain outfall.	

Sample Site Designation	Sample Site Location	Purpose
LATERAL 6&7		
L 6 Spill	Lateral 6 Canal at Central Avenue upstream of where it spills to the combined 6&7 Drain.	Documenting constituent loads (ag panel only) from Lateral 6 to the combined 6&7 Drain, which discharges to the San Joaquin River. Added April 2002.
L 7 Spill	Lateral 7 at Central Avenue upstream of where it spills to the combined 6&7 Drain.	Documenting constituent loads (ag panel only) from Lateral 7 to the combined 6&7 Drain, which discharges to the San Joaquin River. Added April 2002.
L 6&7 Spill	Lateral 6&7 Drain upstream of where it spills as a tributary to the San Joaquin River.	Documenting constituent loads to the San Joaquin River from Lateral 6&7. Added April 2002.
MERCED RIVER		
HLS	Highline Canal at Williams Avenue upstream of where it spills into the Merced River.	Documenting constituent loads to the Merced River from Highline Canal. Added April 2002.
LSS	Lower Stevinson Spill, 0.5 mile downstream from Faith Home Road, upstream of where it spills into the Merced River.	Documenting constituent loads to the Merced River from Lower Stevinson. Added April 2002.
CREEKS		
Mustang Creek	Mustang Creek upstream of confluence with Highline Canal.	Documenting water quality conditions in Mustang Creek. May be flowing only after precipitation events.
Sand Creek	Sand Creek upstream of confluence with Turlock Main Canal.	Documenting water quality conditions in Sand Creek. May be flowing only after precipitation events.

Sampling Team

The sampling team is composed of two TID personnel that collect samples, measure field parameters, and take flow measurements. There may be times when the conditions are safe enough to necessitate only one sampler for an event. This decision will be made by TID personnel based on flows, antecedent precipitation, and sampling site characteristics. However, having only one sampler may significantly slow the sampling process. Debra Liebersbach from TID provides project oversight and the sampling team is comprised of Paul Posson and Keith Larson from TID. Brown and Caldwell personnel, Sarah Reeves and Amanda Withrow, provided training before monitoring began and participated in the first sampling event on September 12, 2001. Brown and Caldwell also provides technical assistance as needed during implementation of the sampling plan.

Timing and Scheduling

Water samples, field parameters, and flow measurements are collected twice per month. Both dry weather and wet-weather sampling is anticipated for this sampling program. It is anticipated that 2 of the sampling events will be taken during storm events. Anticipated sampling dates are listed below in Table 3-2; however, unexpected circumstances or heavy rain events may require that a sampling date be rescheduled. The SAP will be updated with any changes.

Table 3-2. Monthly Water Column Sampling Schedule

	Sampling Dates*
September 2001	9/12/01 9/25/01 through 9/26/01
October 2001	10/8/01 through 10/9/01 10/25/01
November 2001	11/7/01 11/20/01
December 2001	12/3/01 and 12/5/01 12/18/01 and 12/21/01
January 2002	1/2/02 through 1/3/02 1/15/02 1/29/02 through 1/30/02
February 2002	2/12/02 2/26/02
March 2002	3/11/02 through 3/12/02 3/18/02
April 2002	4/10/02 4/22/02 through 4/23/02 and 4/25/02
May 2002	5/7/02 through 5/8/02 5/21/02 through 5/22/02
June 2002	6/3/02 through 6/5/02 6/25/02 through 6/26/02
July 2002	7/9/02 through 7/10/02 7/22/02 through 7/24/02
August 2002	8/6/02 through 8/7/02 8/20/02 through 8/21/02
September 2002	9/3/02 through 9/4/02 9/17/02 through 9/18/02
October 2002	9/30/02 through 10/2/02 10/15/02 through 10/16/02
November 2002	11/5/02 through 11/6/02 11/19/02 through 11/20/02
December 2002	12/3/02 through 12/4/02 12/16/02 through 12/18/02
January 2003	1/7/03 through 1/8/03 1/20/03 through 1/22/03
February 2003	2/4/03 through 2/5/03 2/18/03 through 2/19/03
March 2003	3/4/03 through 3/5/03 3/18/03 through 3/19/03
April 2003	4/1/03 through 4/2/03 4/15/03 through 4/16/03
May 2003	5/5/03 through 5/6/03 5/26/03 through 5/27/03

June 2003	6/3/03 through 6/4/03 6/17/03 through 6/18/03
July 2003	7/1/03 through 7/2/03 7/14/03 through 7/15/03 7/29/03 through 7/30/03
August 2003	8/11/03 through 8/12/03 8/26/03 through 8/27/03
September 2003	9/9/03 through 9/10/03 9/23/03 through 9/24/03
October 2003	10/7/03 through 10/8/03 10/21/03 through 10/22/03
November 2003	11/4/03 through 11/5/03 11/18/03 through 11/19/03
December 2003	12/2/03 through 12/3/03 12/16/03 through 12/17/03

*Sampling events generally require 2 full days to complete, with the Harding Drain sites sampled on the first day and remaining sites sampled on the second day.

IV. WATER COLUMN SAMPLING PROCEDURES AND ANALYSIS

To ensure consistency, it is important that each sampling team member be familiar with the techniques and protocols outlined in this section of the SAP. A supply checklist to aid in preparation for each sampling event is included in Appendix A. This checklist should be copied so that a fresh checklist is ready for each event.

Sampling Techniques

Since the banks on the Drains and Laterals are steep, samples from the drains and laterals will be taken from the bank, a bridge, or other similar structure at all times. This method is appropriate for these sites as drain and lateral sites will be located in an area where the water is expected to be well mixed. The San Joaquin River, Mustang Creek, and Sand Creek under low wadeable flow may not be mixed. Therefore, it will be important to collect composite samples from across the width of these waterbodies. During high non-wadeable flow, it will be assumed that the San Joaquin River and Mustang and Sand Creek are mixed from increased turbulence and flow. The actual method and location of sample collection are documented in Appendix B.

Drain and Lateral Sampling. The exact location of each sampling site was determined prior to the initial sampling event and documented in Appendix B. Sampling locations were determined on a site-specific basis depending on access and mixing of upstream discharges or inputs (e.g., distance downstream, turbulence, and flow). For example, HD1 was located far enough downstream of RWQCF such that the RWQCF discharge is fully mixed with the receiving water.

Samples are taken from bridges (or similar structures) at each of the sites where a bridge exists or from the bank where there is no bridge available. Where samples can be collected from a bridge, 5 grab samples are taken at equal intervals across the drain or lateral and then composited in a carboy. If no bridge is located at the site, the samples are a composite of two grab samples, one from each bank of the drain or lateral. Variations of these compositing scenarios may be used, and depend on site conditions. The manner in which samples are collected (if different from Appendix B) is documented thoroughly in the field notebook.

It is assumed that the water in the drains and laterals at the sampling sites is well mixed so that the composited grab samples are representative of the stream cross-section. Individual grab samples are of equal volume and collected using a pre-cleaned metal sampling bucket and rope or an extendable pole and glass sampling bottle. The sampler rinses the sampling apparatus three times with site water, and then collects the grab samples and composites the samples in a glass or metal carboy, which has been rinsed three times.

Chemical laboratory sample bottles are filled from the compositing carboy. The carboy is swirled to keep the water mixed immediately before filling each sample bottle. All sample bottles collected in the field are labeled and placed in a cooler with ice for transit to the appropriate laboratory.

Mustang and Sand Creek Sampling. The subsections below outline methods for sampling under differing conditions. Proper sampling and handling procedures are essential to ensure that reliable data are being collected. Since sampling may take place throughout the year, it is possible that during spring runoff, in-stream sampling may not be safe at Mustang and Sand Creeks. The sampling team members are responsible for determining whether the turbidity, visual and gage flow, and previous precipitation events represent hazardous conditions for sampling in stream. It is also possible that during dry periods, there may be no flowing water in Mustang or Sand Creek. Water quality samples will only be collected in flowing water.

Since Mustang and Sand Creek are highly influenced by stormwater, and often do not flow and cannot be sampled unless there has been a storm, it may be useful to collect samples from these creeks during rainfall events and not necessarily in conjunction with a full sampling event. By taking samples of Mustang and Sand Creek during runoff events, the amount of pesticides and nutrients contributed to the Harding Drain system can be determined. TID staff will check both creeks for flow during storm events and take samples as needed to characterize these streams.

The preference for sampling from Mustang and Sand Creek is wadeable sampling to collect flow and composite water column samples across the transect of the creek. If flow and weather conditions do not allow wadeable sampling, a composite sample will be collected from a bridge. If there is no bridge, two grab samples will be collected, one from each side of the river or creek, and then composited. Variations of these compositing scenarios may be used, and will depend on site conditions. The manner in which samples are collected will be documented thoroughly in the field notebook.

Wadeable Sampling. Under low-flow wadeable conditions, it is assumed that the stream is not mixed so that a composite sample is necessary to be representative of the stream cross-section. For Mustang and Sand Creek, grab samples are collected in a glass sampling container at intervals of 20 percent of the width. For example, if the creek is 20 feet wide, individual samples are collected at 4-foot intervals and composited in a metal or glass carboy.

Prior to taking the sample, rinse the glass container and the compositing carboy three times with stream water. To take each grab sample, the glass sampling container is submerged in the middle of the stream upstream of the sampling team member such that the mouth of the container is facing downstream and is completely below the surface of the water. Grab samples are composited in the pre-cleaned metal or glass carboy.

Chemical laboratory sample bottles are filled from the carboy. The carboy is swirled to keep the water mixed immediately before filling the sample bottle. All sample bottles collected in the field are labeled then placed in a cooler with ice for transit to the appropriate laboratory.

Non-Wadeable Sampling. Non-wadeable conditions may exist with higher flows. Sampling under these conditions is conducted from bridges at each of the sites where a bridge exists. For Mustang and Sand Creek, grab samples are collected using a glass sampling container attached to an extendable pole at intervals of 20 percent of the width. For example, if the river is 20 feet wide, individual samples are collected at 4-foot intervals. Equal amounts of sample from each grab are composited in a carboy. If there is no bridge located near the sampling site, two grab samples are collected, one from each bank in a mixed region of the stream, and then composited in a carboy.

Prior to taking the sample, the glass sampling container and the metal or glass compositing carboy are rinsed three times with stream water. Equal volumes of each grab sample are composited in the pre-cleaned carboy.

Chemical laboratory sample bottles are filled from the carboy. The carboy is swirled to keep the water mixed immediately before filling the sample bottle. All sample bottles collected in the field are labeled then placed in a cooler with ice for transit to the appropriate laboratory.

San Joaquin River Sampling. The San Joaquin River is sampled at all times by boat or canoe, as the water is generally turbid and it is difficult to see the bottom when wading.

When sampling from a boat on the San Joaquin River, the cross-section is staked on both banks and a temporary buoy will be deployed in the middle of the river. The width of the river is measured by stretching a measuring tape across the river from bank to bank and then retracting the tape promptly to avoid boating hazards on the river. The stream is divided into tenths by estimating the divisions between the buoy and the banks of the river. An anchor is used to steady the boat so that grab samples can be taken at intervals of 10 percent of the width. For example, if the river is 100 feet wide, individual samples are collected at 10-foot intervals and composited in a metal or glass carboy.

Prior to taking the sample, the glass container and the compositing carboy are rinsed three times with stream water. To take each grab sample, the glass sampling container is submerged in the middle of the stream such that the mouth of the container is facing downstream and is completely below the surface of the water. Grab samples are composited in the pre-cleaned metal or glass carboy. Variations of these compositing scenarios may be used, and will depend on site conditions. The manner in which samples are collected is documented thoroughly in the field notebook.

Chemical laboratory sample bottles are filled from the carboy. The carboy is swirled to keep the water mixed immediately before filling the sample bottle. All sample bottles collected in the field are labeled then placed in a cooler with ice for transit to the appropriate laboratory.

Wet-Weather Sampling. It is anticipated that two of the sampling events will take place during storm events in order to characterize the water quality associated with stormwater runoff to the TID system. Stormwater may carry a pesticide or nutrient load that is not measured under normal sampling conditions. As a result, it is important to capture a stormwater event in order to characterize its impact on water quality of the TID system. To facilitate this, a storm event protocol is outlined below.

Identifying a storm event. TID personnel will track weather predictions and activity in the Turlock area in order to identify candidate storm events. The storm criteria is an estimated rainfall of 0.5 inches (enough precipitation to cause runoff). The final decision to sample during a storm event will be made by TID staff. The decision to sample a given storm event will be based on local weather forecasts of the size and intensity of the storm. Careful attention to the National Weather Service forecast should give at least 2 days notice of a possible sampling event. Once a storm is targeted for possible sampling, equipment should be gathered and loaded into the appropriate vehicles, and possibly taken to a sampler's home overnight, if needed. TID staff will track the weather forecasts before the candidate storm to confirm expected rainfall and estimated time that the storm will begin. Once the precipitation begins and the decision is made to sample, all appropriate sampling personnel will be notified by the sampling leader.

Wet-weather sampling considerations. The steps for sampling during wet weather are the same as those for a normal sampling event. However, there are several additional considerations that must be included in a wet weather event since the timing of sampling depends on the start of the storm event and sampling takes place during the storm.

- Water quality meters will need to be calibrated upon arrival at the first sampling site during a storm event. Documentation of the calibration should be recorded in the field notebooks.
- Once the decision is made to sample an event, the sampling team will go to the field and begin sampling at each location in the order in which the locations are normally sampled.

- It is likely that during storm events, the banks of the drains, laterals, and streams could become very slippery. In addition, water levels could rise rapidly, especially during flash flood events. Safety of the samplers is of utmost importance and should be considered at all times. Therefore, it is assumed that any wet weather sampling will utilize non-wadeable techniques, as discussed above.
- After the storm event, the lead sampler will confirm the storm rainfall and record it in the field book.
- A false start or no runoff should be noted in the field book and data recorded in the database should be qualified.

Flow Measurement

Flows in the San Joaquin River and Mustang and Sand Creeks are calculated by velocity and stream cross-sectional area measurements at all in-stream sample locations where USGS, California Data Exchange Center (CDEC), or calibrated discharge data are unavailable. It is possible that stream cross-sections will be developed at some locations by a TID survey crew so that cross-section measurements during each event will be unnecessary. Excessive flow velocities and flow depth may impede the measurement of flow at some stations. In this case, the nearest USGS stream gage at Hills Ferry and Crows Landing, and the CDEC stream gage near Patterson Bridge, discharges, and a flow balance would be used to estimate flow at the sampling location. When access is not feasible but a staff gage and bridge are near the site, flow is obtained by using the staff gage for depth and measuring the velocity at 5 locations along the transect of the stream with a portable flow meter. When access is prohibited and no staff gage is located at the sampling site, the sampling teams take depth and velocity readings at each bank.

Where access is feasible, velocity measurements are obtained using a portable flow meter and flow is determined using the USGS method (Buchanan and Somers 1969) as described below and in Appendix C. Average velocity readings are recorded at the center of intervals that are ten percent of the width of the stream along the cross-section transect at each sample site (see Figure 3-2 and Appendix C worksheet).

When sampling from a boat on the San Joaquin River, the cross-section is staked on both banks and a temporary buoy is deployed in the middle of the river. The width of the river is measured by stretching a measuring tape across the river from bank to bank and then retracting the tape promptly to avoid boating hazards on the river. The stream is divided into tenths by estimating the divisions between the buoy and the banks of the river. An anchor is used to steady the boat so that flow and depth measurements can be taken as described in this section.

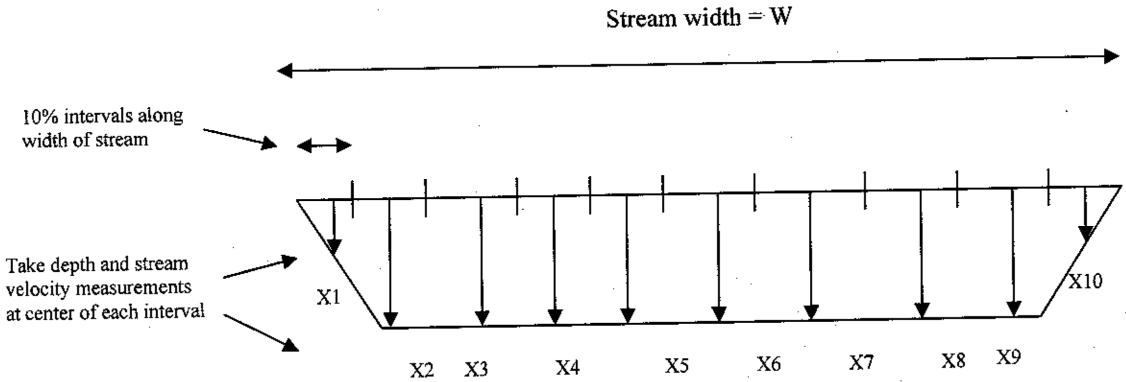


Figure 3-2. Example of stream cross-sectional area measurements

Where X1 measured at W/20
X2 measured at X1 + W/10
X3 measured at X2 + W/10
...on through to X10.

A velocity profile is measured by smoothly moving the probe vertically from surface to bottom. A flow (Q) for each section of the transect is then calculated by multiplying the velocity (V) by the area of the individual transect cross-section (see equations below). Flows for each transect section are then summed to determine an overall flow rate.

Flows for individual cross-sectional areas

Q1* = V1*(X1*W/10)/2
Q2 = V2*(X2*W/10)
Q3 = V3*(X3*W/10)
Q4 = V4*(X4*W/10)
Q5 = V5*(X5*W/10)
Q6 = V6*(X6*W/10)
Q7 = V7*(X7*W/10)
Q8 = V8*(X8*W/10)
Q9 = V9*(X9*W/10)
Q10* = V10*(X10*W/10)/2

*Note that the flow for Q1 and Q10 are divided by 2 because the cross-sectional areas are triangular in shape rather than rectangular.

Overall flow rate
Q(total) = Q1+Q2+Q3+Q4+Q5+Q6+Q7+Q8+Q9+Q10

Field Parameters

Field parameters are measured at all stations directly in the water column at the midpoint of each transect and at mid-depth. Under non-wadeable conditions, field measurements are taken from the water collected to rinse collection equipment. All field sampling measurements along with sample date, time, location, sampler name, weather conditions, and any other pertinent information or visual observations are noted in a dedicated hard-bound field book. Equipment calibration is performed on the day of sampling before sample collection, and calibration recorded in the multi-meter (YSI) notebook.

Field measurements are taken using portable in-stream meters (YSI or comparable) following EPA-approved standard techniques and equipment calibration procedures. The meters measure pH, DO, conductivity, and temperature. Calibration is completed at the start of each day of sampling for pH, DO, and conductivity, using the specific water quality meter instructions.

Sampling Constituents and Analytical Methods

The proposed constituents to be monitored are necessary to further characterize the water quality of the TID system and the San Joaquin River. In addition, the constituents will provide data required for water quality modeling, if needed in the future, and comparison to site-specific model results. Table 4-1 summarizes the constituents and analytical methods for this SAP. Sampling constituents and sampling frequency vary between sampling sites as shown in Table 4-2.

Table 4-1. Sampling Constituents and Analytical Methods

Constituent	Container Type	Detection Limit	Holding Time	Analytical Method
Field Parameters				
Flow/Velocity	NA	NA	NA	Varies by site
Temperature (T)	NA	NA	NA	YSI Multiparameter probe
pH	NA	NA	NA	YSI Multiparameter probe
Specific Conductance/ Electrical Conductivity (SC/EC)	NA	NA	NA	YSI Multiparameter probe
Dissolved Oxygen (DO)	NA	NA	NA	YSI Multiparameter probe
Laboratory Analyses				
Ammonia	2 - 500 mL plastic bottles, no preservation	0.3 mg/L	7 days	SM4500-NH3B/EPA 350.2
Organic Nitrogen		0.3 mg/L	2 days	SM4500-NH3B/EPA 350.2

Constituent	Container Type	Detection Limit	Holding Time	Analytical Method
Nitrate and Nitrite		2 mg/L	7 days	SM4500-NO3F
Chlorpyrifos Diazinon	2 – 1 Liter amber glass bottles with Teflon lid, no preservation	10 ng/L	7 days	EPA Method 8141 Modified

Table 4-2. Water Quality Constituents and Monitoring Frequency for Each Sampling Site

Sample Site Designation	Constituents	
	Twice Per Month	Quarterly
TUOLUMNE RIVER		
Hickman Spill	Field Parameters, Flow	Ag Panel
Faith Home Spill	Field Parameters, Flow	Ag Panel
L 1 Spill	Field Parameters, Flow	
LATERAL 2 SPILL		
LL 2 Spill	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
WESTPORT SPILL		
LL 3 Spill	Field Parameters, Flow	Ag Panel
LL 2½ Spill	Field Parameters, Flow	Ag Panel
WPS	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
HARDING DRAIN		
CMD32-Hodges	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	
HD1	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	
L 5½ Upper Spill	Field Parameters, Flow	Ag Panel
L 5½ Lower Spill	Field Parameters, Flow	Ag Panel
L 4½ Spill	Field Parameters, Flow	Ag Panel
LL 4 Spill	Field Parameters, Flow	Ag Panel
PFS	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	
HD2	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
SAN JOAQUIN RIVER		
SJ1	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	
SJ2	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	
LATERAL 6&7		
L 6 Spill	Field Parameters, Flow	Ag Panel

Sample Site	Constituents	
L 7 Spill	Field Parameters, Flow	Ag Panel
L 6&7 Spill	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
MERCED RIVER		
HLS	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
LSS	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
CREEKS		
Mustang Creek	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel
Sand Creek	Field Parameters, Flow, OP Pesticides, Organic Nitrogen, Nitrate, Nitrite, Ammonia	Ag Panel

Sample Documentation and Delivery

Field sampling personnel are responsible for collecting all water samples, completing all labeling, field notes, and chain of custody (COC) documentation, and coordinating the delivery of all samples to the appropriate analytical laboratory (also see Appendix D). It is important that samples are packaged on ice in coolers for transport immediately after sampling is completed. Ammonia, organic nitrogen, nitrate, and nitrite samples are delivered directly to A&L Western Agricultural Laboratories (A&L Laboratories) and OP pesticide samples are mailed the day of the sampling event for overnight delivery to Environmental Micro Analysis, Inc. Laboratory (EMA).

Field Notebook. Field notes are taken for all sampling sites and recorded in a bound field notebook (Appendix D provides a sample field notebook entry). It is important that all observations and sampling methods be recorded while at the sampling site to reduce confusion of conditions or unusual events at different sites. Information recorded includes: identification of the monitoring site; date and time of sampling; identity of the sampler(s); description of the type of samples taken; identification of QA/QC samples; method of sampling; results of any field analyses; description of the weather, including percent cloud cover and air temperature; description of the site appearance; and any unusual conditions observed. The sampling team also records information on precipitation that occurred in the days preceding each sampling event, which can be obtained from the nearest rain gage.

Sample Bottle Labeling. Collected samples are designated by sample location (e.g., SJ1, HD1). Each sample container is individually labeled with the label affixed directly to the bottle itself and analysis to be performed printed on the label. Some analytical methods require preservative in the field, although none of the analyses being performed at this time require preservation in the field. Additional sampling information including date, time, location, sampling medium, and sampler initials, is also written on the label with indelible ink (Appendix D provides an example completed sample bottle label).

Chain of Custody Documentation. COC documentation identifies sample containers, provides a complete inventory of all containers in a sample set, and provides an audit trail identifying the persons who have custody of a sample in order, and the exact date and time when custody was relinquished from one person to the next (Appendix D provides an example completed COC form). COC forms will be obtained from the analytical laboratory with the sample bottles.

Sample Containment for Transport. All sample bottles collected in the field are thoroughly labeled, double-bagged, and placed in a plastic re-useable cooler with double-bagged ice for transit to the appropriate laboratory. Samples are kept chilled to 4 degrees Celsius in a cooler from the time of collection through delivery to the analytical laboratory. Bubble wrap packing and air-filled baggies are used to fill the entire space in the cooler to minimize the chance for movement and damage of the sample bottles inside the cooler.

Each cooler being shipped to EMA. is taped shut with packing tape or zip tied shut to ensure that it does not open during transit. The shipping label for EMA is clearly displayed on the outside of each cooler. A completed chain of custody form accompanies each cooler, sealed in a plastic bag inside the cooler. All of the coolers for a sampling day are hand-delivered to the laboratory or shipping company. Samples going to EMA are sent out the day of the sampling event to be delivered over night. Delivery of samples will be coordinated with the analytical laboratory's work schedule to ensure that the samples can be properly received, logged in, and analyzed within the specified holding times.

The analytical laboratory receives samples in a designated control area of the laboratory. The sample custodian unpacks the samples and checks the shipping container to make sure that there are no broken bottles and that the samples remained cool during shipping. The sample custodian verifies the arrival of all samples against the COC record.

In addition, the sample custodian makes sure that the proper containers and preservatives for the parameters of interest have been used. The sample custodian immediately notifies the TID project manager or his/her designate of any problems that may affect the sample integrity or any discrepancies between the samples and the COC record.

The laboratory is instructed to retain all samples until the holding times have expired. EMA holds samples for 30 days after the report is sent out and A & L Laboratories hold samples for one month total. This allows for the opportunity to reanalyze samples if initial results seem anomalous and holding times have not been exceeded.

V. DATA QUALITY OBJECTIVES AND QUALITY CONTROL PROCEDURES

This section discusses how the specific quality objectives of. precision, accuracy, representativeness, comparability, and completeness will be addressed in this study. Field QA/QC includes thorough sample collection, cleaning of sampling equipment, use of appropriate sample containers, and maintaining COC procedures. QA/QC measures are also followed by the contracted laboratories and include equipment blanks and spikes. QA/QC results will be provided by both laboratories.

Precision

Precision is a measure of the agreement between multiple measurements made on the same sample. Precision is determined by the characteristics of the instrument or method, and by the operator's technique. Precision is checked by evaluating multiple measurements at the same time and location (called duplicate samples), or performing multiple analyses on the same sample (called split samples)

This study quantifies precision using duplicate and split samples. Duplicate field measurements of all parameters (temp, pH, conductivity, and DO) were made at one of the eight sites during each sampling trip until April 2002. After April 2002, field duplicates are measured at four of the 24 sites during each event. The required precision for each field parameter in this study is shown in Table 5-1.

Table 5-1. Accuracy and Precision Required for Data Quality

	Temperature	PH	Dissolved oxygen	Conductivity
Accuracy	± 0.5 °C	± 0.2	± 0.3 mg/l	± 7% of std. value
Precision	± 1.0 °C	± 0.3	± 0.5 mg/l	± 2%

In addition, duplicates of water samples are collected and analyzed for four of the following constituents: ammonia, nitrate, nitrite, chlorpyrifos, or diazinon. Field duplicates analyzed by the laboratories are labeled as separate samples to avoid confusion and to provide an unbiased blind evaluation. Duplicate QC samples are identified as D1, D2, etc., with the number designating the order in which duplicate samples were collected and will not represent the sample site location (e.g., D1 would not designate a duplicate sample collected at site SJ1). Designation of the sampling location where the duplicate sample was taken is recorded in the bound field notebook for reference when reviewing sample results. Although the laboratory knows the sample is a duplicate, it does not know what sample has been duplicated and has no basis upon which to modify results. See Appendix E for a list of the field duplicates to be taken for laboratory analysis during the sampling program.

In September of 2002, split water samples were collected at a number of stations and analyzed for ammonia, nitrate, nitrite, organic nitrogen, chlorpyrifos, or diazinon. As with duplicate samples, field splits were labeled as separate samples to avoid confusion and to provide an unbiased blind evaluation. Split QC samples were identified as S1, S2 with the number designating the order in which split samples were collected and not the sample site location.

Accuracy

Accuracy is a measure of the error between the reported value and the true value. Accuracy is assured by proper instrument calibration. Over time, some instruments tend to drift away from their calibration. Different types of instruments are affected by drift to different degrees. In order to make sure that instruments are not drifting too *far from their calibration, periodic accuracy checks are performed by observing the instrument reading solution of known concentration.*

This study uses a system of frequent calibration and accuracy checks to insure the accuracy of the results. Frequent communication and ongoing data review insures that any deficiencies in accuracy are caught quickly so that the appropriate corrective action can be taken.

- The pH, DO, and conductivity probes are calibrated before every sampling event, and accuracy checked upon returning from the field each day (see Table 5-1).
- Calibration and accuracy check data are recorded in logbooks kept with each instrument.

Representativeness

Representativeness is a measure of how closely the sample reflects the actual site conditions. Representativeness is assured by choosing good sampling sites and using proper sampling technique.

Sampling sites and procedures used in this study have been designed to insure that the resulting data are representative of the conditions in the river. Samples are taken from the center of the channel, where possible and where the water is well mixed. Stagnant areas such as eddies behind bridge abutments are avoided.

Comparability

Comparability is a measure of how well data from one study are comparable to data in other studies and to applicable criteria. Comparability is assured by using standard sampling protocols.

The monitoring program for this project ensures comparability with similar projects by following the standardized sampling protocols developed by state agencies (e.g., Surface Water Ambient Monitoring Program developed in response to AB 982), and by using high quality equipment. Where possible, the sampling sites are the same as those used in previous studies.

Completeness

Completeness is a measure of the amount of data obtained compared to the amount of data that was expected to be obtained. Completeness is assured by planning ahead and using good sampling technique to avoid data loss.

This study insures completeness by anticipating and preparing for problems that could cause data loss. Frequent calibration, accuracy checks, and data review by TID and Brown and Caldwell staff allows equipment malfunctions or procedural problems to be caught and corrected promptly in order to keep invalid data to a minimum. Despite these preparations, there are some circumstances such as weather events or safety issues that may prevent sampling.

Data Validation Procedures

Data validation procedures are used to review laboratory reports and field notebooks to ensure that the data are complete, consistent, and correct. Proper data validation helps to identify errors and allow for correction of any problems in data collection and analysis for future sample collection. Data are checked by the designated quality control review person at Brown and Caldwell upon receipt from the laboratories. The review person will fill out a QA/QC Checklist (Appendix G) for each laboratory report within a week of receipt of the report. The QA/QC Checklist is then submitted to TID. If there are problems with the report, Brown and Caldwell staff in collaboration with TID staff, will resolve the problem prior to submitting the QA/QC Checklist. Field notebooks and COCs are checked by TID Staff to confirm that the field notes reflect the proper date, time, and sample identification noted on the COC and in the laboratory report. The notebooks and laboratory reports are also compared by TID Staff to confirm that duplicates and splits are identified and analyzed as indicated in the field notebook.

Reporting

For data validation and storage, TID transfers all of the data collected, including recorded field parameters, to a computerized database (Access) after being validated. This facilitates data validation, reporting, graphic demonstration, and statistical analysis.

VI. REFERENCES

Buchanan, T.J. and W.P. Somers. 1969. Discharge measurements at gaging stations. Techniques of Water-Resources Investigations of the United States Geological Survey; Chapter A8 of Book 3: Applications of Hydraulics.

APPENDIX A.

FIELD EQUIPMENT AND SUPPLIES

CHECK	QUANTITY	SUPPLIES
	1	Site location map
	1	Sampling Plan and Field Work Safety Plan
	1	Field book
	3	Coolers (large)
	1	Cooler full of ice
	• 2 – 1 Liter amber glass bottles with teflon lid for each site (26 total) • 1 – 500 mL plastic bottle for each site (13 total) • 1 – 500 mL bottle for each ag panel site (18 total).	Sample bottles and chain of custody forms
	1	Compositing carboy (glass or metal)
	1	YSI meter
	1	Roll duct tape
	8	Wooden stakes
	1	Mallet hammer
	1	Measuring tape (to span San Joaquin River)
	1	Metal bucket
	1	Rope (cotton clothesline rope is fine) and/or extendable pole
	2	Glass sampling containers (milk bottle is fine)
	Many	Ziploc bags for ice and bagging bottles
	2	FedEx labels and directions for drop off
	1	Flow meter
	1	Depth stick (or surveyors rod)
	Many	Sharpies and pencils
	2 pair	Waders (hip and chest)
	1	Calculator
	1	Ruler
	1	Metal clip board
	2 rolls	Clear packing tape

Appendix B. Surface Water Sampling Methods and Flow Measurement Methods at Each TID Sampling Site

Sample Site Designation	Sample Site Location	Surface Water Sampling Method	Flow Measurement/Estimation
SJ1	San Joaquin River just upstream of the Harding Drain outfall approximately 100 feet. After January 2, 2002 sampling event, this site was moved upstream (approximately 700 feet upstream of the Harding Drain outfall) in order to obtain better flow measurements.	From a boat, 9 grab samples are collected at evenly spaced intervals across the river. Three quarters of a bottle are collected at each of the 9 locations to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow is measured on a cross-section of the river at equal intervals, measuring depth and velocity at each interval. Overall width of the stream is also measured and the method described on page 8 of the Water Quality Sampling Plan is used to calculate the flow. Flow is also measured at the Crows Landing USGS station upstream of SJ1. This flow is used when conditions do not allow for measurement of flow by boat.
SJ2	San Joaquin River just downstream of the Harding Drain outfall approximately 400 feet.	From a boat, 9 grab samples are collected at evenly spaced intervals across the river. Three quarters of a bottle are collected at each of the 9 locations to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow is calculated as the flow at SJ1 plus the flow at HD2.
CMD32-Hodges	Ceres Main Drop 32 at Prairie Flower Road just upstream of the Ceres Main outfall (app. 5.25 miles upstream of HD2). Specifically on the downstream side of the footbridge just before water falls over the drop structure.	From the footbridge with an extension, take five grab samples using a glass milk bottle. The grab samples are taken at handrail uprights at equal intervals, starting at one bank and working to the other. One and one half bottles full of sample are taken at each of the five locations in order to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	An overpour weir with a staff gage is used at this site.
HD1	Harding Drain downstream of the RWQCF effluent outfall from the west side of Mitchell Road (app. 4.75 miles upstream of HD2).	From the metal culvert or from the road in high flow with an extension, take three grab samples using a glass milk bottle. The grab samples are taken from about 6 inches in from each edge and one from the center of the flow. Two and one half bottles full of sample are taken at each of the three locations in order to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow is measured as it comes out of the pipe. The pipe is 4 feet in diameter and water depth in the pipe is measured with a measuring rod. Flow velocity is also recorded using a hand-held meter.

Sample Site Designation	Sample Site Location	Surface Water Sampling Method	Flow Measurement/Estimation
L 5½ Upper Spill	Lateral 5½ where it spills into the Harding Drain, between Morgan Road and South Blaker Road.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
L 5½ Lower Spill	Lateral 5½ Lower spill where it spills to the Prairie Flower Drain west of Crows Landing Road.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
L 4½ Spill	Lateral 4½ where it spills to Lateral 4½ Drain at Morgan Road.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
LL 4 Spill	Lower Lateral 4 just north of Linwood Road where it spills into a drain that is tributary to the Harding Drain.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
PFS	Above Lateral 5.1/2 spill into the Prairie Flower Drain upstream of the access road (app. 1.1 miles upstream of the outfall to Harding Drain).	From the metal culvert or from the road in high flow with an extension, take three grab samples using a glass milk bottle. The grab samples are taken from about 6 inches in from each edge and one from the center of the flow. Two and one half bottles full of sample are taken at each of the three locations in order to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow is measured as it enters into the pipe. The pipe is 2.4 feet in diameter and water depth in the pipe is measured with a measuring rod. Flow velocity is also recorded using a hand-held meter.
HD2	Harding Drain on the east side (upstream side) of the Carpenter Road bridge, upstream of the outfall into the San Joaquin River.	From the bridge with an extension, take five grab samples using a glass milk bottle. The grab samples are taken at handrail uprights at equal intervals, starting 3 uprights in from the edge of the bridge and taking samples at every sixth upright. One and one half bottles full of sample are taken at each of the five locations in order to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow is measured using a weir and a staff gage. Because of technical difficulties throughout most of the fall of 2001, flow is measured coming out of the culvert pipe. The pipe is 6 feet in diameter and water depth in the pipe is measured with a measuring rod. Flow velocity is also recorded using a hand-held meter.
L1 Spill	Lateral 1 west of Vivian Road where it spills to the Tuolumne River.	Field Parameters only are taken at this location.	An overpour weir with a staff gauge is used at this site.
LL 2½ Spill	Spill is located 0.5 miles downstream from Quiesenberry Rd. and 0.25 miles north of the Westport Drain.	Field parameters only are taken at this location.	A Replogle flume with a staff gauge is used at this site.

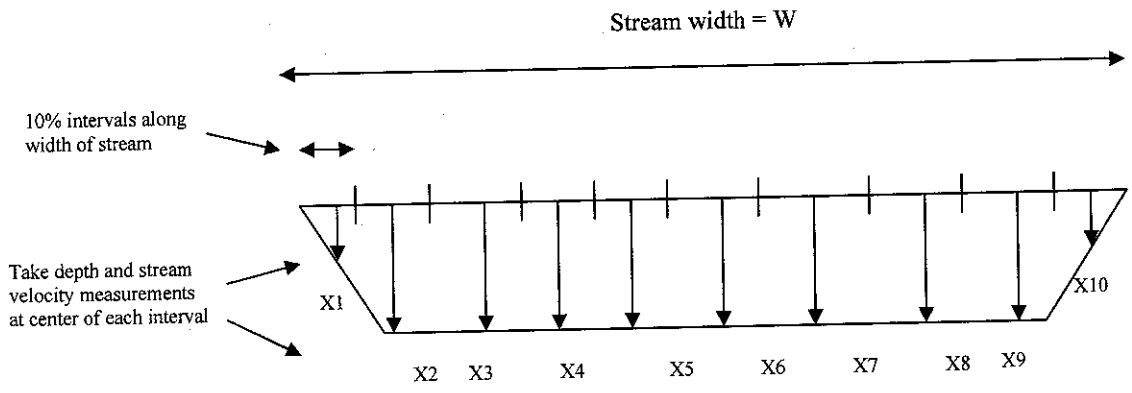
Sample Site Designation	Sample Site Location	Surface Water Sampling Method	Flow Measurement/Estimation
LL 3 Spill	Lower Lateral 3 above Jennings Road where it spills to the Westport Drain.	Field parameters only are taken at this station.	An over pour weir with a staff gauge is used at this site.
WPS	Westport Drain where it merges with the LL 2.5 spill. This location is about 1.5 miles upstream from where it joins into the San Joaquin River.	Using an extension pole samples are taken from three locations, about a foot from each bank and in the middle. Two and one half milk bottles are taken at each location to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	No reasonable or safe method exists at this station to measure the flows. Flows are estimated using the combined flows of LL 2.5 and LL3
LL 2 Spill	Lower lateral 2 Spill is located 250 feet down stream from where LL2 crosses Grayson Road.	From the walkway at the spill sample water is collected using a glass milk bottle. The bottle is fastened to an extension pole and samples are taken from the right and left sides and the middle of the canal. Nine bottles filled three-fourths full are combined in a carboy and mixed to form a composite sample.	An overpour weir with a staff gage is used at this site.
L 6 Spill	Lateral 6 at Central Avenue where it spills to the combined 6&7 Drain.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
L 7 Spill	Lateral 7 at Central Avenue where it spills to the combined 6&7 Drain.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
L 6&7 Spill	Lateral 6&7 Drain where it spills as a tributary to the San Joaquin River.	From a walkway above a trash rack upstream from where the drain passes under the levee samples are collected using an extension pole. Samples are collected from the right, left and middle sections of the drain. Two and one-half milk bottles are collected from each location and combined in a carboy to form a composite sample	No reasonable or safe method exists at this station to measure the flows. Flows are estimated using the combined flows of L6, L7, and the Western States drain.
LSS	Lower Stevinson Spill one-half mile downstream from Faith Home Road where it spills into the Merced River.	From the right and left banks an extension pole is used to collect samples from both banks and the middle. Two and one-half milk bottles are collected from each location and combined in a carboy to form a composite sample.	An overpour weir with a staff gage is used at this site
HLS	Highline Canal at Williams Avenue where it spills into the Merced River.	From the bridge directly over the spill an extension pole is used to collect samples from the right, left and middle sections of the spill. Two and one-half bottles	An overpour weir with a staff gage is used at this site.

Sample Site Designation	Sample Site Location	Surface Water Sampling Method	Flow Measurement/Estimation
		are collected from each site and combined in a carboy to form a composite sample.	
Faith Home Spill	Ceres Main Canal at Faith Home Road where it spills into the Tuolumne River.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
Hickman Spill	Main Canal at Hall Road and the Main Canal where the Main Canal spills into the Tuolumne River.	Field parameters only are taken at this location.	An overpour weir with a staff gage is used at this site.
Mustang Creek	Mustang Creek upstream of confluence with Highline Canal.	Under normal conditions Mustang Creek provides area drainage from precipitation only. During the non-irrigation season three, 36-inch calico gates are left in the open position. Two and one-half bottles are collected from each gate and combined in a carboy to form a composite sample. Should water accumulate behind the closed gates a lift pump is in place to discharge the water into the Highline Canal. Under these conditions sample water would be collected from representative areas.	Flows are measured by rating the depth and velocity of the calico gate discharges.
Sand Creek	Sand Creek upstream of confluence with Turlock Main Canal. Specifically across the stream on west end of the fence that runs along the creek on the south side.	From the bank with an extension or wading in stream, take three grab samples using a glass milk bottle. The grab samples are taken from about 6 inches in from each edge and one from the center of the flow. Three milk bottles full of sample are taken at each of the three locations in order to collect enough water for analysis. These grab samples are combined in a carboy and mixed to form a composite.	Flow was calculated for the September 2001 events using measurements of the width, center depth, and velocity at the center. The creek shape was assumed to be triangular. A survey of the creek cross-section was completed and flow measurement is now done using a center depth and velocity measurement and the cross-section. It has proven difficult to find a consistent location to measure the flows. The fluctuating level of the canal and seasonal aquatic vegetation buildup cause ponding and potential mixing with canal water. During the irrigation season the best location to consistently measure flows is a cement impoundment located about 1000 feet

Sample Site Designation	Sample Site Location	Surface Water Sampling Method	Flow Measurement/Estimation
			upstream from the canal.. This impoundment can be rated like an over pour weir. During the non-irrigation season the free flowing open channel can be rated using the velocity and the area.

APPENDIX C.

CROSS-SECTIONAL FLOW MEASUREMENTS



Where:

X1 (measured at W/20): Depth = ________ Velocity = ________

X2 (measured at X1 + W/10) Depth = ________ Velocity = ________

X3 (measured at X2 + W/10) Depth = ________ Velocity = ________

X4 (measured at X3 + W/10) Depth = ________ Velocity = ________

X5 (measured at X4 + W/10) Depth = ________ Velocity = ________

X6 (measured at X5 + W/10) Depth = ________ Velocity = ________

X7 (measured at X6 + W/10) Depth = ________ Velocity = ________

X8 (measured at X7 + W/10) Depth = ________ Velocity = ________

X9 (measured at X8 + W/10) Depth = ________ Velocity = ________

X10 (measured at X9 + W/10) Depth = ________ Velocity = ________

APPENDIX D

DOCUMENTATION EXAMPLES

BOTTLE LABELS

A & L WESTERN LABORATORIES

Name Paul Posson

Date 9/12/01 Time 1140

Sample ID HD1

Analysis ammonia, Organic N, NO_2 + NO_3

Lab No.

Comment

Surface H_2O - Harding Drain.

EMA

Environmental Micro Analysis, Inc.
40 N. East St., Suite B
WOODLAND, CA 95776

PP

9/12/01 1140

HD1

Chlorpyrifos, diazinon

Surface H_2O - Harding Drain.

CHAIN OF CUSTODY FORMS

A & L WESTERN LABORATORIES, INC.

1311 Woodland Ave. #1 • Modesto, California 95351 • Phone 209-529-4080

CHAIN OF CUSTODY 3720

Client: TID

Address: 833 E. Canal Dr. PO Box 949

Turlock, CA Zip 95381

Phone: (209) 883-8428

CC to: Brown & Caldwell, Griffith, Masuda & Emrick

Signature of person authorizing work under terms stated below*: Paul Poson

*Net 30 days. All accounts past due will be subject to interest charges of 1.5% per month.
*Hazardous materials are the property of the client. The client is responsible for proper disposal of hazardous wastes. Clients not picking up hazardous wastes may be assessed an appropriate fee.

PROJECT ID: TID Surface H2O Sampling

SAMPLED BY: (signature): Paul Poson

Date	Time	Sample Type: Grab	Sample Type: Comp	Sample Location	No. of Containers	Analysis: Ammonia	Analysis: Organic N	Analysis: [illegible]	REMARKS
9/12	0900	X		Sand Creek	2	✓	✓	✓	
↓	0940	X		Mustang Creek	2	✓	✓	✓	
↓	1000	X		CMD32-Hedges	2	✓	✓	✓	
↓	1050	X		PFS	2	✓	✓	✓	
↓	1140	X		HD1	2	✓	✓	✓	
↓	1200	X		HD2	2	✓	✓	✓	
↓	1300		X	SJ1	2	✓	✓	✓	
↓	1320		X	D1	1		✓		
↓	1440		X	SJ2	2	✓	✓	✓	

A & L WESTERN LABORATORIES
Name ______
Date ______ Time ______
Sample ID ______
Analysis ______
Lab No. ______
Comment ______

Relinquished by (signature)	Date	Time	Received by (signature)	Date	Time
Paul Poson	9/12/01	1720			

Site Time: Start: 0830 Finish: 1500 Total Hours: 6.5

Driving Time: Start: 1500 Finish: 1720 Total Hours: 2.3

Dedicated Exclusively to Providing Quality Analytical Services

E.M.A. Inc.
Environmental Micro Analysis

CHAIN OF CUSTODY RECORD

ENVIRONMENTAL MICRO ANALYSIS, INC.
40 N. EAST STREET-SUITE B
WOODLAND, CA 95776
PHONE: (530) 666-6890 FAX: (530) 668-2957

Client: TID   Contact: Debbie Liebersbach
Street Address: 333 E. Canal Dr. PO Box 949
City: Turlock   State: CA   Zip: 95381
Phone: (209) 883-8428   FAX: (209) 656-2180

Project No.:
Project Name: TID Surface H2O Sampling
Samplers: (Signature) Paul Posson

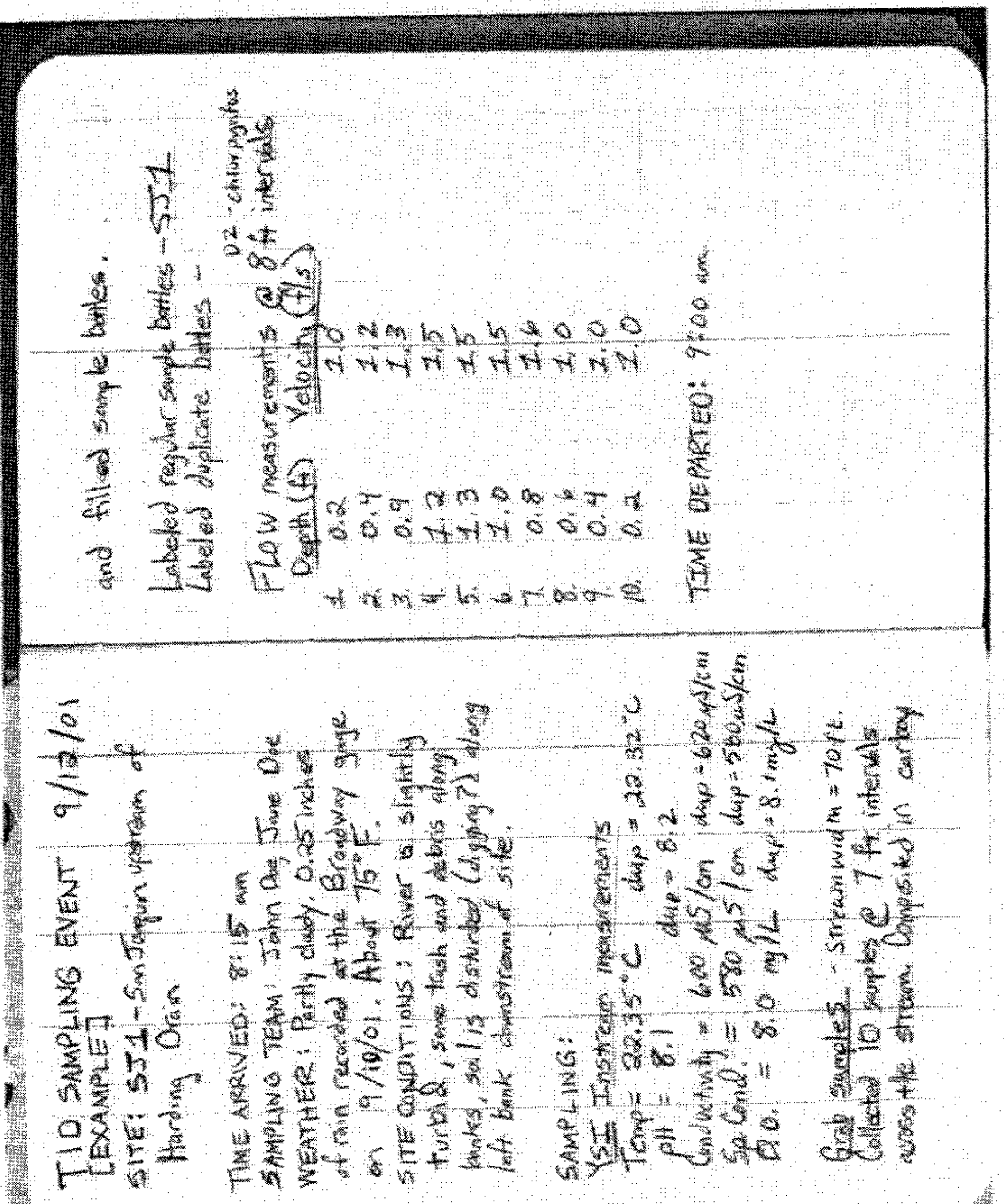
Sample ID	EMA Sample #	Date	Time	Composite	Grab	# Containers & Type	Chlorpyrifos	Diazinon							Remarks
Sand Creek		9/12/01	0900		X	2 Ambr	✓	✓							
Mustang Creek		↓	0940		X	2 ↓	✓	✓							
OM032-Hedges		↓	1000		X	2	✓	✓							
PFS		↓	1030		X	2	✓	✓							
HD1		↓	1140		X	2	✓	✓							
HD2		↓	1200		X	2	✓	✓							
SJ1		↓	1320	X		2	✓	✓							
D2		↓	1320 ~~[illegible]~~	X		1	✓								
SJ2		↓	1440	X		2 ↓	✓	✓							

SIGNATURES

Released By	Received By	Received By	Received By
P. Posson			
Time and Date: 1500 9/12/01	Time and Date	Time and Date	Time and Date
Company: TID	Company	Company	EMA, Inc.
	Released By	Released By	
	Time and Date	Time and Date	

Condition of Samples Upon Receipt At EMA
Intact   Chilled 4 C   Frozen
Comments:

FIELD NOTEBOOK EXAMPLE ENTRY



TID SAMPLING EVENT 9/12/01
[EXAMPLE]
SITE: SJ1 - San Joaquin upstream of Harding Drain

TIME ARRIVED: 8:15 am
SAMPLING TEAM: John Doe, Jane Doe
WEATHER: Partly cloudy. 0.25 inches of rain recorded at the Broadway gage on 9/10/01. About 75°F.
SITE CONDITIONS: River is slightly turbid, some trash and debris along banks, soil is disturbed (digging?) along left bank downstream of site.

SAMPLING:
YSI Instream measurements
Temp = 22.35°C dup = 22.32°C
pH = 8.1 dup = 8.2
Conductivity = 600 µS/cm dup = 620 µS/cm
Sp. Cond. = 580 µS/cm dup = 560 µS/cm
D.O. = 8.0 mg/L dup = 8.1 mg/L

Grab samples - Stream width = 70 ft.
Collected 10 samples @ 7 ft intervals across the stream. Composited in carboy and filled sample bottles.

Labeled regular sample bottles - SJ1
Labeled duplicate bottles - D2 - chlorpyrifos

FLOW measurements @ 8 ft intervals

	Depth (ft)	Velocity (ft/s)
1.	0.2	1.0
2.	0.4	1.2
3.	0.9	1.3
4.	1.2	1.5
5.	1.3	1.5
6.	1.0	1.5
7.	0.8	1.6
8.	0.6	1.0
9.	0.4	1.0
10.	0.2	1.0

TIME DEPARTED: 9:00 am

APPENDIX E.

FIELD DUPLICATES LOCATION AND SCHEDULE

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
9/12/01	SJ1	Organic N Chlorpyrifos Diazinon Field Parameters	1 bottle labeled D1 1 bottle labeled D2
9/26/01	SJ2	Nitrate Nitrite Organic N Ammonia Field Parameters	1 bottle labeled D3
10/9/01	HD1	Diazinon Chlorpyrifos Field Parameters	1 bottle labeled D4
10/25/01	HD2	Ammonia	1 bottle labeled D5
11/7/01	CMD32-Hodges	Diazinon Field Parameters	1 bottle labeled D6
11/20/01	No Duplicates Taken		
12/3/01	No Duplicates Taken		
12/18/01	No Duplicates Taken		
1/3/02	SJ1	Organic N Field Parameters	1 bottle labeled D10
1/15/02	SJ2	Ammonia Field Parameters	1 bottle labeled D11
1/29/02	HD1	Diazinon Field Parameters	1 bottle labeled D12
2/12/02	HD2	Chlorpyrifos Diazinon Field Parameters	1 bottle labeled D13
2/26/02	CMD32-Hodges	Nitrate Field Parameters	1 bottle labeled D14
3/11/02	PFS	Ammonia Field Parameters	1 bottle labeled D15
3/26/02	SJ2	Nitrite Field Parameters	1 bottle labeled D16
4/9/02	No Duplicates Taken		
4/23/02	HD1	Organic N Field Parameters	1 bottle labeled D17
	LSS	Ammonia Field Parameters	1 bottle labeled D18

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
5/7/02	CMD32–Hodges	Nitrate Nitrite	1 bottle labeled D19
	HD1	Diazinon Chlorpyrifos Ammonia Field Parameters	2 bottles labeled D20 Identify in field notebook as D20
5/21/02	CMD32-Hodges	Chlorpyrifos Diazinon Field Parameters	1 bottle labeled D23 Identify in field notebook as D23
	WPS	Organic N Ammonia Field Parameters	1 bottle labeled D24 Identify in field notebook as D24
	L 4½ Spill	Field Parameters	Identify in field notebook as D25
	LL 4 Spill	Field Parameters	Identify in field notebook as D26
6/4/02	CMD32-Hodges	Ammonia Organic N Nitrate Nitrite Field Parameters	1 bottle labeled D27 Identify in field notebook as D27
	L 2 Spill	Chlorpyrifos Diazinon Ammonia Organic N Nitrate Nitrite Field Parameters	2 bottles labeled D28 Identify in field notebook as D28
	L 1 Spill	Field Parameters	Identify in field notebook as D29
	L 2½ Spill	Field Parameters	Identify in field notebook as D30
6/25/02	HD1	Ammonia Organic N Nitrate Nitrite Field Parameters	1 bottle labeled D31 Identify in field notebook as D31
	L 6&7 Spill	Diazinon Ammonia Field Parameters	2 bottles labeled D32 Identify in field notebook as D32
	L 3 Spill	Field Parameters	Identify in field notebook as D33
	L 6 Spill	Field Parameters	Identify in field notebook as D34

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
7/9/02	HD2	Nitrate Nitrite Field Parameters	1 bottle labeled D35 Identify in field notebook as D35
	LSS	Ammonia Organic N Field Parameters	1 bottle labeled D36 Identify in field notebook as D36
	L 7 Spill	Field Parameters	Identify in field notebook as D37
	Faith Home Spill	Field Parameters	Identify in field notebook as D38
7/22/02	SJ1	Nitrate Nitrite Field Parameters	1 bottle labeled D39 Identify in field notebook as D39
	HLS	Nitrate Nitrite Field Parameters	1 bottle labeled D40 Identify in field notebook as D40
	Hickman Spill	Field Parameters	Identify in field notebook as D41
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D42
8/6/02	SJ2	Diazinon Chlorpyrifos Nitrate Ag Panel Field Parameters	4 bottles labeled D43 Identify in field notebook as D43
	HD2	Diazinon Chlorpyrifos Nitrate Ag Panel Field Parameters	4 bottles labeled D44 Identify in field notebook as D44
	L 5½ Lower Spill	Field Parameters	Identify in field notebook as D45
	L 4½ Spill	Ag Panel Field Parameters	1 bottle labeled D46 Identify in field notebook as D46
8/20/02	CMD32-Hodges	Organic N Ammonia Field Parameters	1 bottle labeled D47 Identify in field notebook as D47
	WPS	Diazinon Chlorpyrifos Nitrite Field Parameters	3 bottles labeled D48 Identify in field notebook as D48
	LL 4 Spill	Field Parameters	Identify in field notebook as D49
	L 1 Spill	Field Parameters	Identify in field notebook as D50

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
9/3/02	HD1	Organic N Ammonia Field Parameters	1 bottle labeled D51 Identify in field notebook as D51
	L 2½ Spill	Field Parameters	Identify in field notebook as D53
	L 3 Spill	Field Parameters	Identify in field notebook as D54
9/17/02	SJ1	Diazinon Chlorpyrifos Ammonia Field Parameters	3 bottles labeled D55 Identify in field notebook as D55
	HD2	Organic N Ammonia Field Parameters	1 bottle labeled D56 Identify in field notebook as D56
	L 6 Spill	Field Parameters	Identify in field notebook as D57
	L 7 Spill	Field Parameters	Identify in field notebook as D58
9/30/02	SJ1	Ammonia Nitrate Field Parameters	1 bottle labeled D59 Identify in field notebook as D59
	L 6&7 Spill	Nitrate Nitrite Field Parameters	1 bottle labeled D60 Identify in field notebook as D60
	Faith Home Spill	Field Parameters	Identify in field notebook as D61
	Hickman Spill	Field Parameters	Identify in field notebook as D62
10/15/02	SJ2	Chlorpyrifos Diazinon Nitrate Field Parameters	3 bottles labeled D63 Identify in field notebook as D63
	LSS	Nitrite Diazinon Field Parameters	2 bottle labeled D64 Identify in field notebook as D64
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D65
	L 5½ Lower Spill	Field Parameters	Identify in field notebook as D66
11/5/02	Mustang (Alternate HD2)	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D67 Identify in field notebook as D67
	SJ2	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D68 Identify in field notebook as D68
	L 4½ Spill	Field Parameters	Identify in field notebook as D69

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
11/19/02	HD1	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D71 Identify in field notebook as D71
	CMD32-Hodges	Nitrate Nitrite Ag Panel Field Parameters	2 bottle labeled D72 Identify in field notebook as D72
	WPS	Field Parameters	1 bottle labeled D73 Identify in field notebook as D73
	L 6 Spill	Ag Panel Field Parameters	1 bottle labeled D74 Identify in field notebook as D74
12/3/02	HD1	Organic N Ammonia Field Parameters	1 bottle labeled D75 Identify in field notebook as D75
	LSS	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D76 Identify in field notebook as D76
	WSP	Field Parameters	Identify in field notebook as D77
	L 6 Spill	Field Parameters	Identify in field notebook as D78
12/16/02	HD2	Nitrate Nitrite Organic N Ammonia Field Parameters	1 bottle labeled D79 Identify in field notebook as D79
	WPS	Nitrate Nitrite Field Parameters	1 bottle labeled D80 Identify in field notebook as D80
	L 7 Spill	Field Parameters	Identify in field notebook as D81
	Faith Home Spill (Alternate LSS)	Field Parameters	Identify in field notebook as D82
1/7/03	SJ1	Diazinon Chlorpyrifos Field Parameters	2 bottles labeled D83 Identify in field notebook as D83
	L 2 Spill	Nitrate Nitrite Field Parameters	1 bottle labeled D84 Identify in field notebook as D84
	Hickman Spill and L 6&7 Spill	Field Parameters	Identify in field notebook as D85

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
1/20/03	SJ2	Ammonia Organic N Field Parameters	1 bottle labeled D87 Identify in field notebook as D87
	L 6&7 Spill	Ammonia Organic N Field Parameters	1 bottle labeled D88 Identify in field notebook as D88
	L 5½ Lower Spill	Field Parameters	Identify in field notebook as D89
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D90
2/4/03	HLS (Alternate L 5½ Lower Spill)	Ammonia Organic N Field Parameters	1 bottle labeled D91 Identify in field notebook as D91
	LSS	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D92 Identify in field notebook as D92
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D93
	Hickman Spill (Alternate L 6 Spill)	Field Parameters	Identify in field notebook as D94
2/18/03	HD2	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D95 Identify in field notebook as D95
	HLS (Alternate LSS)	Nitrate Nitrite Field Parameters	1 bottle labeled D96 Identify in field notebook as D96
	Faith Home Spill (Alternate L 6&7 Spill)	Ag Panel* Field Parameters	1 bottle labeled D97 Identify in field notebook as D97
	L 7 Spill	Field Parameters	Identify in field notebook as D98
3/4/03	PFS (Alternate HD1)	Nitrate Nitrite Field Parameters	1 bottle labeled D99 Identify in field notebook as D99
	WPS	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D100 Identify in field notebook as D100
	L 6 Spill	Field Parameters	Identify in field notebook as D101
	L 3 Spill (Alternate L 5½ Upper Spill)	Field Parameters	Identify in field notebook as D102

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
3/18/03	L2 Spill	Nitrate Nitrite Field Parameters	1 bottle labeled D103 Identify in field notebook as D103
	L 6&7 Spill	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D104 Identify in field notebook as D104
	LL 4 Spill	Field Parameters	Identify in field notebook as D105
	L 1 Spill	Field Parameters	Identify in field notebook as D106
4/1/03	Sand Creek (Alternate HD1)	Nitrate Nitrite Field Parameters	1 bottle labeled D107 Identify in field notebook as D107
	HLS	Ammonia Organic N Field Parameters	1 bottle labeled D108 Identify in field notebook as D108
	L 5½ Lower Spill	Field Parameters	Identify in field notebook as D109
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D110
4/15/03	SJ1	Ammonia Organic N Field Parameters	1 bottle labeled D111 Identify in field notebook as D111
	LSS	Nitrate Nitrite Field Parameters	1 bottle labeled D112 Identify in field notebook as D112
	Hickman Spill	Field Parameters	Identify in field notebook as D113
	Faith Home Spill	Field Parameters	Identify in field notebook as D114
4/29/03	PFS (Alternate HD2)	Ammonia Organic N Field Parameters	1 bottle labeled D115 Identify in field notebook as D115
	L 6&7 Spill	Nitrate Nitrite Field Parameters	1 bottle labeled D116 Identify in field notebook as D116
	L 7 Spill	Field Parameters	Identify in field notebook as D117
	L 6 Spill	Field Parameters	Identify in field notebook as D118
5/6/03	SJ2	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D119 Identify in field notebook as D119
	WPS	Ammonia Organic N Field Parameters	1 bottle labeled D120 Identify in field notebook as D120
	L 4½ Spill	Field Parameters	Identify in field notebook as D121
	LL 4 Spill	Field Parameters	Identify in field notebook as D122

Sample Event	Field Duplicate Location	Analyte	Required Sample Bottle Labeling
5/20/03	Sand Creek (Alternate HD2)	Ammonia Organic N Field Parameters	1 bottle labeled D123 Identify in field notebook as D123
	LSS	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D124 Identify in field notebook as D124
	L 1 Spill	Field Parameters	Identify in field notebook as D125
	L 2½ Spill	Ag Panel* Field Parameters	1 bottle labeled D126 Identify in field notebook as D126
6/3/03	L 6&7 Spill	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D127 Identify in field notebook as D127
	LSS	Ammonia Organic N Field Parameters	1 bottle labeled D128 Identify in field notebook as D128
	L 5½ Lower Spill	Field Parameters	Identify in field notebook as D129
	L 5½ Upper Spill	Field Parameters	Identify in field notebook as D130
6/17/03	CMD32-Hodges	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D131 Identify in field notebook as D131
	WPS	Nitrate Nitrite Field Parameters	1 bottle labeled D132 Identify in field notebook as D132
	Hickman Spill	Field Parameters	Identify in field notebook as D133
	Faith Home Spill	Field Parameters	Identify in field notebook as D134
7/1/03	PFS (Alternate SJ1)	Nitrate Nitrite Field Parameters	1 bottle labeled D135 Identify in field notebook as D135
	HLS	Chlorpyrifos Diazinon Field Parameters	2 bottles labeled D136 Identify in field notebook as D136
	L 7 Spill	Field Parameters	Identify in field notebook as D137
	L 6 Spill	Field Parameters	Identify in field notebook as D138

*Ag Panel analyses are part of quarterly sampling. Quarterly sampling is expected to take place within a week of the identified date.

Note: The number of quality assurance samples is based on 5% of the total number of analyses run.

APPENDIX F
ADDITIONAL QUALITY ASSURANCE SAMPLING

To improve the defensibility of TID's water quality dataset, additional quality assurance sampling has been added to the regular field activities described in the Turlock Irrigation District Sampling and Analysis Plan (SAP). Appendix F describes protocols for split sampling and gives a schedule for collection of these quality assurance samples.

Split Sampling

Split samples are a type of replicate sample used to determine analytical precision for chemical constituents between laboratories. A split sample is taken from an already collected, homogenized, processed, and preserved sample. Split samples are prepared by dividing a larger volume of processed sample from one container into equal subsamples. The two samples are then sent to separate laboratories for analysis. Split sampling will be useful to show how results from the current laboratories being used for sample analysis compare to results from laboratories used by the Central Valley Regional Water Quality Control Board (Regional Board).

One round of split samples was included in the sampling protocol for September 17 and 18, 2002.

QA Sample Procedure and Schedule

Split samples will be collected at the same time and in the same manner as all samples collected at each site, following the sampling protocol outlined in the SAP.

For nitrogen compound analyses (at each sampling location):

- Swirl the sampling carboy to mix completely.
- Fill two 500 milliliter bottles with field sample water.
- Label one sample bottle with the site name and analytes indicated in Table 1 for the current sampling event and send to A&L.
- Label a second bottle with the "S-#" sample designation and analytes (see Table 1) and send to Sierra Foothill Laboratory, Inc. Note the sample designation and analytes in the field notebook for the sampling location.

For pesticide analyses (at each sampling location):

- Swirl the sampling carboy to mix completely.
- Fill four 1-liter bottles with field sample water.
- Label two sample bottles with the site name and analytes indicated in Table 1 for the current sampling event and send to EMA.
- Label the remaining two bottles with the "S-#" sample designation and analytes (see Table 1) and send to APPL, Inc. Note the sample designation and analytes in the field notebook for the sampling location.

Table 1. Additional QA Sampling Locations and Schedule

Sample Event	Sample Location	QA Sample Type	Analyte	Laboratory	Required Sample Bottle Labeling
9/17/2002 and 9/18/2002	HD2	Split	Chlorpyrifos	APPL, Inc. (559) 275-2175 Contact: Glen Brown EMA (530) 666-6890 Contact: Don Peterson	4 bottles, 2 labeled HD2 and 2 labeled S-1
			Diazinon		
	CMD-32 Hodges	Split	Chlorpyrifos		4 bottles, 2 labeled CMD-32 Hodges and 2 labeled S-2
			Diazinon		
	WPS	Split	Chlorpyrifos		4 bottles, 2 labeled WPS and 2 labeled S-3
			Diazinon		
	HD1	Split	Nitrate	Sierra Foothill Laboratory, Inc. (209) 223-2800 Contact: Sandy Nurse A&L (209) 529-4080 Contact: Robert Butterfield	2 bottles labeled HD1 and S-4
			Nitrite		
	HD2	Split	Ammonia		2 bottles labeled HD2 and S-5
			Organic Nitrogen		
	SJ1	Split	Nitrate		2 bottles labeled SJ1 and S-6
			Nitrite		
	SJ2	Split	Ammonia		2 bottles labeled SJ2 and S-7
			Organic Nitrogen		
	L 6&7 Spill	Split	Ammonia		2 bottles labeled L6&7 Spill and S-8
			Organic Nitrogen		
	LSS	Split	Nitrate		2 bottles labeled LSS and S-9
			Nitrite		
			Diazinon		

Analytical methods, detection limits, and costs for analyses using APPL, Inc. and Sierra Foothill Laboratory, Inc. are provided in Table 2 below.

Table 2. Analytical Information and Costs for the Split Samples

Laboratory	Analysis	Method	Detection Limit	Cost per sample
APPL, Inc.	Chlorpyrifos	EPA 8141	0.025 ug/L	$150 for both
	Diazinon	EPA 8141	0.025 ug/L	
Sierra Foothill Laboratory, Inc.	Nitrate	EPA 300.0	0.02 mg/L	$22
	Nitrite	EPA 300.0	0.01 mg/L	$22
	Organic N	EPA 310.2	0.62 mg/L	$31
	Ammonia	EPA 350.2	0.24 mg/L	$21

APPENDIX G
DATA VALIDATION PROCEDURES

LABORATORY REPORT

General Report Information

- ☐ **Received data report for sampling event from each laboratory.** If laboratory reports are not received within four weeks from a given event, call the laboratory and request that they send the data with an explanation of why the data were not sent.

- ☐ **"Date sampled" and "time sampled" on lab report matches actual sampling information in field notebook.** Call laboratory if sample date/time are incorrect.

- ☐ **Sample receive date was within one day of sample date.** If samples were received later than one day beyond the sampling date, check with field personnel to see if the sample coolers were sent via overnight mail or if they were held on ice to be sent out the next day. Make changes to shipping procedure as needed to ensure that samples always remain on ice or in a refrigerated environment if it is necessary to hold the samples before they are sent to the laboratory.

- ☐ **Sample IDs, analyses, reporting/detection limits, units, column labels, footnotes, and titles are accurate.** Have lab re-issue report with corrections if there are inconsistencies.

- ☐ **Samples have been collected and analyzed at all sites sampled for that event.** There may be some sites that were not sampled as a result of site-specific conditions (e.g.; no flow or too much flow), notes to this effect should have been made in the field notebook on the day of sampling.

- ☐ **Non-detects are always reported in the same manner using consistent notation.** For example, EMA always reports non-detects as "ND" and A&L always reports non-detects as BDL – so there should not be any reported data shown as "<0.01" or any other inconsistent notation.

Data Quality Checks

- ☐ **Duplicates/splits have been identified and analyzed as requested on the Chain of Custody (COC).** Insure that duplicates/splits were submitted to laboratory as called for in the lab quality assurance table (Appendix E to the Sampling Plan). Update table as needed if changes in duplicates/splits were made in the field.

☐ **For EMA pesticide results, all surrogate, matrix spike, and blank spike recoveries are in the acceptable control range specified by the laboratory (70 to 130 percent for all recovery methods).** If not, call the laboratory and request an explanation for the excursion.

☐ **For A&L results, blank and matrix spike recoveries are between acceptable control ranges specified by the laboratory (98 to 102 percent for blank spikes; 95 to 105 percent for matrix spike).** If not, call the laboratory and request an explanation for the excursion.

☐ **Duplicates/splits are within 20 percent of the sample result for that site.** If the duplicate/split result is not within 20 percent, identify cause of the deviation. First, ensure that the duplicate/split is being compared to the proper site sample. Next, for duplicates, check field notes and speak with the sampling personnel to determine if conditions in the field could be the cause of deviation. Finally, for duplicates and splits call the laboratory and speak with the laboratory manager to identify possible issues with laboratory procedure or equipment. Take steps to rectify any identified problems.

☐ **Laboratory blanks do not contain concentrations of analyte above the detection limit.** If there are detections of an analyte in blanks, contact the laboratory to discuss how the lab will take appropriate steps to repair equipment or alleviate blank contamination.

☐ **Samples are analyzed within the required holding times** (see Table 1). Contact the laboratory manager if samples are not analyzed within the proper holding times.

☐ **Reported results are within representative ranges based on range of historical data.** If not within representative range, check results from sites upstream and downstream (does the result fit a range close to values measured upstream or downstream of this site?), field parameters, field notes, previous results at that site, weather, flow changes, current practices within the District, etc. to associate the result with a cause. The laboratory may also be able to explain results that seem out of range. If there does not appear to be a cause for a given result, it may be an anomaly – check data from next sampling event to see if results at this site remain out of range or can be explained.

Table 1. Constituent Quality Assurance Information

Constituent	Detection Limit*	Holding Time
Chlorpyrifos	0.01 ug/L	7 days
Diazinon	0.01 ug/L	7 days
Ammonia	0.3 mg/L	7 days/28 days if preserved with sulfuric acid in the lab
Nitrate	2 mg/L	7 days/28 days if preserved with sulfuric acid in the lab
Nitrite	2 mg/L	2 days
Organic Nitrogen	0.3 mg/L	7 days/28 days if preserved with sulfuric acid in the lab

Constituent	Detection Limit*	Holding Time
Ag Panel		
Sodium	0.04 meq/L Na	14 days
Calcium	0.05 meq/L Ca	14 days
Magnesium	0.08 meq/L Mg	14 days
Carbonate	0 meq/L CO3	14 days
Bicarbonate	0 meq/L HCO3	14 days
Chloride	0.056 meq/L Cl	14 days
Conductivity (EC)	0.01 mmhos/cm	14 days
pH	4 to 10 standard units	14 days
Phosphorus	0.01 ppm	14 days
Potassium	0.0025 meq/L	14 days
Nitrate	2 ppm	14 days
Sulfate	1 ppm	14 days
Boron	0.01 ppm	14 days
TDS	calculated	14 days
SAR	calculated	14 days

***Detection limits are specifically for EMA Laboratories (OP Pesticides) and A&L Laboratories (Ag Panel, ammonia, nitrate, nitrite, organic nitrogen).**

FIELD DATA

General Information

☐ **Field notes include page numbers, date, time of sample collection, field sampling staff, time arrived at site, time left site, site identification, description of site conditions (weather), field parameters, flow information, sample collection procedures, and call out duplicate laboratory/field samples taken.** If mistakes are found in the notebook, changes can be made by crossing out the mistake and marking the change with a date of change, initials, and reason for change.

Duplicate Data

☐ **Duplicate field measurements are collected where called for in Appendix E to the Sampling Plan.** Make changes to Appendix E to account for alterations of the duplicate schedule in the field.

☐ **Field duplicates are within the ranges given below.** If duplicate field measurements are outside of these ranges, the field instrument should be checked to make sure each probe is working properly and was calibrated properly.

- Temperature ± 1.0 °C of measured value at that site.

- pH ± 0.3 standard units of measured value at that site.
- Dissolved oxygen ± 0.5 mg/L of measured value at that site.
- Conductivity ± 2% of measured value at that site.

Flow Measurement

☐ **Flow information is complete for each sampling location such that volume flow measurements (cfs) can be calculated from the information given in the field notebook** (e.g.; flow velocity and cross sectional area).

☐ **Flow measurements generally increase from upstream to downstream.** This is a check that will help identify flow calculations that are erroneous – note that diversions and groundwater flow may affect flow in stream from upstream to downstream.

☐ **Flow measurements at the USGS gage at Crows Landing (obtained from USGS approximately every 2 months) and at SJ1 are similar.** For example, flow at SJ1 on 10/25/01 was measured as 1920 cfs while flow at the Crows Landing USGS gage is reported as 1130 cfs. Differences such as this may indicate that flow measurements taken at SJ1 were not completely accurate for this event. Taking flow at a cross-section from a boat can be difficult and can be skewed by site-specific conditions. In this case, data from the USGS gage should be used in loading calculations for SJ1.

Field Instrument Calibration/Check

☐ **Calibration of field instrument is completed the morning of each field event.** Documentation of calibration should be kept with the instrument in a notebook.

☐ **Equipment calibrates per manufacturer's specifications.** If the field instrument will not calibrate properly there may be a problem with the probe – the field person calibrating the equipment should contact the vendor for assistance.

☐ **Field instrument measures known standards at the end of each sampling day to within the following ranges.** Results of standards check should be recorded in a notebook that is kept with the instrument.

- Temperature ± 0.5 °C of standard value.
- pH ± 0.2 standard units of standard value.
- Dissolved oxygen ± 0.3 mg/L of standard value.

Conductivity ± 7% of standard value.

Attachment F
Don Pedro Mercury Fact Sheet

Water Segment: Don Pedro Lake (Don Pedro Reservoir)

Pollutant: Mercury

Decision: **Delist** (To be confirmed by SWRCB staff)

Weight of Evidence: This pollutant is being considered for removal from the section 303(d) list under section 4.1 of the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy). Under section 4.1 a single line of evidence is necessary to assess delisting status.

The weight of evidence indicates that there is sufficient justification in favor of removing this water segment-pollutant combination from the section 303(d) list.

This conclusion is based on the findings that:

1. Pursuant to section 4.1 of the Policy, the data used to list Don Pedro Reservoir were faulty.
2. The data used did not satisfy the data quality requirements of section 6.1.4 of the Policy.
3. The data used did not satisfy the data quantity requirements of section 6.1.5 of the Policy.

SWRCB Staff Recommendation (Proposed – To be confirmed): After review of the available data and information, SWRCB staff concludes that the water body-pollutant combination should be removed from the section 303(d) list because no credible, applicable data indicate that water quality standards for the pollutant are exceeded.

Lines of Evidence:

Lines of Evidence Pollutant – Water

Beneficial Use: Fish Consumption (pertinent to listing)

Matrix:	Water
Water Quality Objective/ Water Quality Criterion:	The Basin Plan narrative water quality objective for toxicity states that all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Evaluation Guideline:	USEPA Fish Tissue Residue Criterion (*Methylmercury Water Quality Criterion,* 2001. EPA-823-R-01-001) and OEHHA Screening Values (Klassing and Brodberg 2004), 0.3 mg/kg
Data Used to Assess Water Quality:	Data include 67 fish tissue samples from Trophic Levels 3 and 4.
Spatial Representation:	The northern most arms of Don Pedro Lake (total area of reservoir: 12,960 acres).
Temporal Representation:	Data were collected intermittently in 1981 and from 1984 to 1987, during seven sampling events.
Data Quality Assessment:	Unknown.

1.0 Background

The Don Pedro Reservoir was placed on the 303(d) list for mercury based on data collected intermittently in 1981 and from 1984 to 1987 during seven sampling events. A total of 67 fish from Trophic Levels 3 and 4 were analyzed for mercury concentrations; however, the reservoir was listed based only on data from 32 Trophic Level 4 fish. All of the mercury data were collected from the northern most arms of Don Pedro Reservoir (Figure F1).

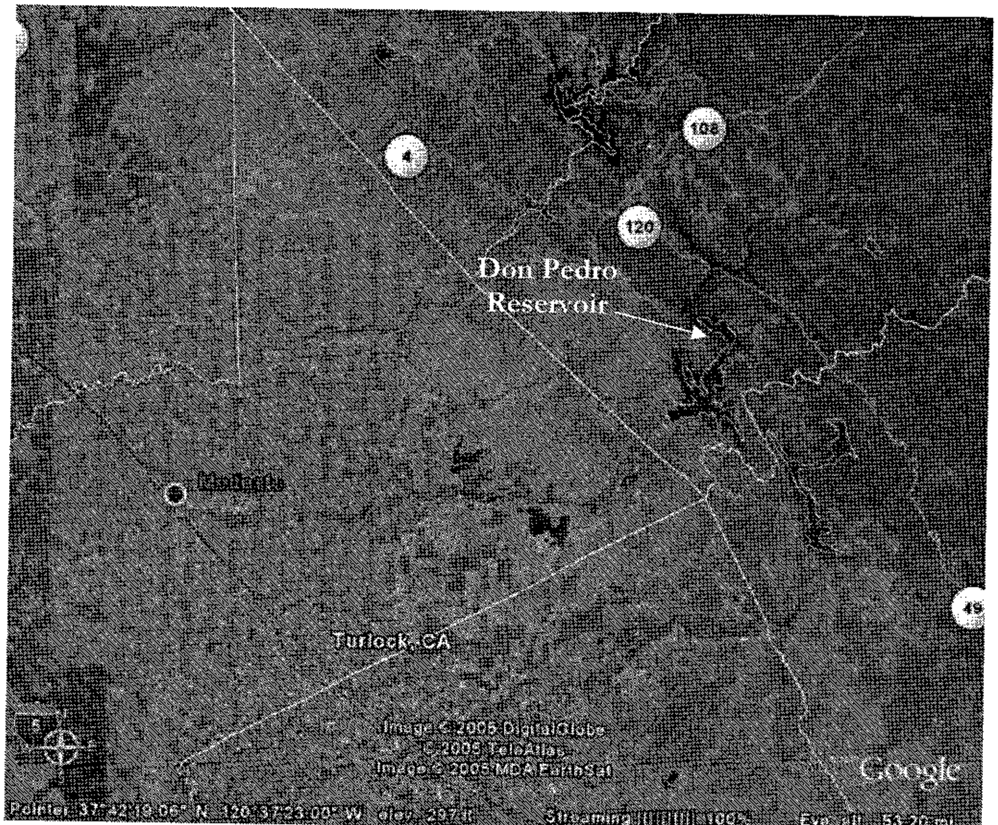


Figure F1. Location of Don Pedro Reservoir

According to Section 4 of the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Policy), "All listings of water segments shall be removed from the section 303(d) list if the listing was based on faulty data, and it is demonstrated that the listing would not have occurred in the absence of such faulty data" (SWRCB 2004a). The Policy continues to state "Faulty data include, but are not limited to, typographical errors, improper quality assurance/quality control procedures, or limitations related to the analytical methods that would lead to improper conclusions regarding the water quality status of the segment" (SWRCB 2004a).

Don Pedro Reservoir should be removed from the 303(d) list for mercury because it was listed inappropriately, based on faulty data and faulty data analysis, as discussed in Sections 2.0 and 3.0.

2.0 Faulty Data

Data used to list Don Pedro Reservoir are faulty due to outdated analytical methods and lack of spatial representativeness.

2.1 Analytical Methods

Mercury data relied on to place Don Pedro Reservoir on the 2002 list is extremely suspect. The data were collected between 18 and 24 years ago (1981, 1984-87) before it was understood that "unclean" collection and analysis techniques may corrupt metals data. Given recent developments in metals analysis techniques ("clean" and "ultra-clean" techniques), particularly for mercury, it is very likely that the historic data are not fully accurate and may have overstated actual mercury levels. Additionally, no information seems to be available describing the sampling and analysis methods and the quality control and quality assurance measures that were implemented during the data collection and/or associated level of accuracy. Based on the data quality assessment requirements set forth in Section 4.1 of the current Policy, the data should not have been used solely to support listing of Don Pedro Reservoir (SWRCB 2004a).

The *Final Functional Equivalent Document* (Final FED) for the Policy includes a detailed description of data quality requirements for listing or delisting a waterbody (SWRCB 2004b). The Final FED states that "In previous section 303(d) listing cycles, a large array of information and data were accepted. The quality of the data and information used was generally unknown. In 2002, if the RWQCB provided information on the quality of the data, it was recorded in the fact sheet" (SWRCB 2004b). The Don Pedro Reservoir fact sheet provided no means of verifying the quality of the data. As such, the Policy and the Final FED do not support this listing.

Frontier Geosciences, an analytical laboratory in Seattle that specializes in ultra-clean methods of sampling trace metals, reports that the use of ultra-clean methods led to a drop in total mercury levels monitored in six Minnesota lakes by three orders of magnitude (Gerads 2002). In the same tests, a change in techniques led to a drop in methylmercury levels of one to two orders of magnitude. It has been reported that the implementation of ultra-clean sampling and analysis methods reduced or eliminated metals discharge violations at three North Carolina wastewater treatment plants (Oakley and Shellenbarger 2002).

Although less work has been done in the area of fish tissue sampling, versus ambient water sampling, substantial metals contamination can also occur with fish tissue sampling, especially given the additional handling that is required (Gerads 2002; Kennard 2002). Contamination can occur when metallic instruments (e.g., razor blades or metal food processor blades) are used for the dissection and homogenization of tissue samples. Only a handful of North American laboratories have documented that their current tissue processing procedures (use of stainless steel blades, thorough cleaning of equipment before and between sample processing) do not result in measurable contamination.

2.2 Spatial Representativeness

The data were also faulty because they are not spatially representative of the entire water body. Data were collected from only the northernmost arms of Don Pedro Reservoir (Moccasin Creek, the Tuolumne River, and Woods Creek). These data were extrapolated and assumed to represent the entire 12,960-acre reservoir. According to the USEPA, "Numerous factors can influence the bioaccumulation of mercury in aquatic biota. These include, but are not limited to, acidity (pH) of the water, length of the aquatic food chain, temperature, and dissolved organic material" (USEPA 2001). Based on the Policy (Section 6.1.5.2 "Spatial Representation"), "Samples should be representative of the water body segment" (SWRCB 2004a).

3.0 Faulty Data Analysis

The data analysis was also faulty because the original listing was based on only mercury concentrations in the highest trophic level (Trophic Level 4) fish instead of considering the data collected for both Trophic Levels 3 and 4 fish. These Trophic Level 4 (TL4) fish (essentially, the top of the aquatic food chain), tend to reflect higher methylmercury accumulations, so comparing tissue concentrations in these fish to the criterion concentration, which is based on a *weighted average* of fish consumption from various trophic levels, is inconsistent.

USEPA guidance (USEPA 2001) includes the following equation for calculating the methylmercury fish tissue residue criterion (TRC) and includes ingestion rates for three trophic levels:

$$TRC = \frac{BW \times (RfD - RSC)}{\sum_{i=2}^{4} FI_i}$$

Where:

TRC = Fish tissue residue criterion (mg methylmercury/kg fish) for freshwater and estuarine fish

RfD = Reference dose (based on noncancer human health effects) of 0.0001 mg methylmercury/kg body weight-day

RSC = Relative source contribution (subtracted from the RfD to account for marine fish consumption) estimated to be 2.7 x 10-5 mg methylmercury/kg body weight-day

BW = Human body weight default value of 70 kg (for adults)

FI = Fish intake at trophic level (TL) i (i = 2, 3, 4); total default intake is 0.0175 kg fish/day for general adult population. Trophic level breakouts for the general population are: TL2 = 0.0038 kg fish/day (21.7%); TL3 = 0.0080 kg fish/day (45.7%); and TL4 = 0.0057 kg fish/day (32.6%).

The result of this equation is a methylmercury TRC value of 0.3 mg methylmercury/kg fish.

Fish consumption patterns within Central Valley waterbodies are not currently well defined and pilot fish consumption surveys are under development (Shilling 2005). As such, assuming that only Trophic Level 4 fish are consumed from Don Pedro Reservoir is not appropriate. A more suitable approach to analyzing mercury fish tissue data is the "Georgia Method" (as used in USEPA Region 4 in Georgia). The Georgia Method is consistent with the USEPA guidance value for the protection of human health from methylmercury, because it is based on a weighted average value. Like the USEPA equation for calculating the methylmercury fish TRC, the Georgia Method also assumes that the population consumes 17.5 grams per day of freshwater fish. The Georgia Method uses a weighted average approach and assumes consumption of Trophic Level 3 fish is 10.2 grams per day (58.4%) and Trophic Level 4 fish is 7.3 grams per day (41.6%) (USEPA 2003). The equation used in the Georgia Method is as follows:

*Weighted Fish Tissue Concentration = (Avg Trophic 3Concentration *58.4%)+(Avg Trophic 4 Concentration.*41.6%)*

4.0 Data Summary

Even with the use of potentially faulty "unclean" analytical techniques, the mercury exceedance used to list Don Pedro Reservoir was not dramatically higher than the USEPA criterion of 0.30 mg/kg. The mercury concentration calculated by the CVRWQCB based on data from only Trophic Level 4 fish is 0.54 mg/L. Utilizing all of the collected data[1] for the two trophic levels in Don Pedro Reservoir (as used in the Georgia Method), the mercury fish tissue concentration is 0.38 mg/kg. The current state of mercury within Don Pedro Reservoir needs to be assessed by additional data collection and analysis using accurate methodology, including "clean" metals techniques. Given the potential analysis contamination issue, the difference between the resultant mercury concentration of 0.38 mg/kg (or even 0.54 mg/kg, which excludes all Trophic Level 3 data) and the USEPA criterion of 0.30 mg/kg is relatively small as compared to the potential error in the analytical results and warrants additional evaluation.

5.0 Situation-Specific Weight of Evidence

If Don Pedro Reservoir had been originally considered under the current Policy, it would not have been included on the 303(d) list. In addition to the aforementioned faulty data and faulty data analysis, there was no situation-specific weight of evidence supporting the listing. In Section 3.11 of the Policy, it is stated that in order to list a waterbody "the RWQCB must justify its recommendation by:

- *Providing any data or information including current conditions supporting the decision;*
- *Describing in fact sheets how the data or information affords substantial basis in fact from which the decision can be reasonably inferred;*
- *Demonstrating that the weight of evidence of the data and information indicate that the water quality standard is not attained;* ***and***
- *Demonstrating that the approach used is scientifically defensible and reproducible.*"

Regarding the Don Pedro Reservoir listing, the RWQCB did not demonstrate that the data afforded substantial basis, that the weight of evidence of the data and information indicated

[1] Raw data used to list Don Pedro Reservoir are provided in Section 7.0 of this document.

that the water quality standard was not attained, or that the approach used to list Don Pedro Reservoir was scientifically defensible.

Also, it should also be noted that the Don Pedro Reservoir listing was not based on any evidence of health impairment or use impairment. Waterbodies may be listed if health advisories are issued (per Section 3.4 of the Policy); however, a fish-consumption advisory has never been issued by a health or environmental agency for the reservoir. Data supporting the original listing were collected under the Toxic Substances Monitoring Program (TSMP). According to a representative from the Office of Environmental Health and Hazard Assessment (OEHHA), TSMP data are not intended to support health risk analysis, and OEHHA had not performed a risk analysis on Don Pedro Reservoir (Brodberg 2001). A representative of the Tuolumne County Health Department indicated that he was aware of the Don Pedro Reservoir 303(d) listing, but was "very surprised" because he did not think that existing data warranted listing (Cruz 2001).

6.0 Summary

Don Pedro Reservoir should be delisted for mercury. The new Policy does not allow the use of "faulty" data to support listing waters, and specifically where limitations related to the analytical methods would lead to improper conclusions regarding the water quality status. The data for mercury in Don Pedro Reservoir do not meet quality assurance standards, given that they were collected decades ago, prior to the development of "clean" and "ultra-clean" metals techniques. The data are also spatially confined to the northernmost arms of the lake and do not provide adequate spatial coverage to represent the entire 12,960 acres of waterbody that is currently listed. Additionally, the data reported in the fact sheet used to originally list Don Pedro Reservoir excluded Trophic Level 3 fish, which falsely increased the reported mercury concentration.

7.0 Don Pedro Mercury Data

Raw mercury data from the Toxic Substance Monitoring Program used to list Don Pedro Reservoir are included in Table F1.

Table F1. Raw Data from Toxic Substance Monitoring Program Website

Station Number	Station Name	Date	Common Name	Trophic Level [inserted]	Number	Age (yrs)	Weight (g)	Length (mm)	Tissue	Hg (mg/kg)
536.31.16	Don Pedro Reservoir/Moccasin Creek	7/13/1984	Largemouth Bass	4	5	4-5	983.7	390.0	Filet	0.870
536.31.16	Don Pedro Reservoir/Moccasin Creek	7/24/1985	Largemouth Bass	4	3	2-4	825.1	373.0	Filet	0.740
536.31.15	Don Pedro Reservoir/Tuolumne River	8/20/1986	Largemouth Bass	4	6	2-3	589.4	325.0	Filet	0.380
536.31.16	Don Pedro Reservoir/Moccasin Creek	8/20/1986	Largemouth Bass	4	5	4-5	1290.5	418.0	Filet	0.690
536.31.15	Don Pedro Reservoir/Tuolumne River	9/2/1987	Largemouth Bass	4	6	1-2	229.2	251.0	Filet	0.280
536.31.16	Don Pedro Reservoir/Moccasin Creek	9/2/1987	Largemouth Bass	4	7	2	355.0	283.0	Filet	0.490
536.31.08	Don Pedro Reservoir/Woods Creek	9/21/1981	Bluegill	3	8	3-4	99.2	166.0	Filet	0.260
536.31.16	Don Pedro Reservoir/Moccasin Creek	7/24/1985	Carp	3	4	3-4	3418.0	570.0	Filet	0.170
536.31.15	Don Pedro Reservoir/Tuolumne River	8/20/1986	Carp	3	6	5-6	4027.0	624.0	Filet	0.130
536.31.16	Don Pedro Reservoir/Moccasin Creek	8/20/1986	Carp	3	6	4	2845.0	543.0	Filet	0.210
536.31.15	Don Pedro Reservoir/Tuolumne River	9/2/1987	Carp	3	5	4-5	2744.0	546.0	Filet	0.200
536.31.16	Don Pedro Reservoir/Moccasin Creek	9/2/1987	Sucker	3	6	6	753.4	399.0	Filet	0.460

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Attachment G
Internal Draft CVRWQCB Staff Assessment

Turlock Irrigation District Lateral No. 5 (TID 5) or Harding Drain

Watershed Characteristics

Harding Drain, also known as Turlock Irrigation District Lateral No. 5 (TID 5), is located in Stanislaus County. The TID5 flows for approximately seven miles, and discharges into the San Joaquin River from the east side. Several laterals-- 4, 4 ½, 5, 5 ½ and 5 ½ Lower-- spill into Harding Drain. It is considered to be a typical east side drain (to the San Joaquin River) and receives inflows that contribute ammonia (the City of Turlock's Wastewater Treatment Plan, dairy runoff), pesticides (from agriculture), and other possible sources contributing other contaminants.

Ammonia

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for ammonia in TID 5. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that, "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for the TID5 by comparing ammonia concentrations measured in TID5 to water quality guidelines and criteria that have been developed for both human health and wildlife protection. The United States Environmental Protection Agency (USEPA) level to protect aquatic life is 0.02 ppb (parts per billion) (USEPA, 1976). The Taste and Odor Threshold for ammonia in drinking water is 500 ug/L (micrograms per liter, or ppb) (Marshack, 2000). The LC50 (lethal concentration at which 50% of an organism is killed) for fish species ranges from 0.1 to 4 mg/L (milligrams per liter, or parts per million) or 100 to 4,000 ppb (McKee and Wolf, 1971). And the USEPA CMC (acute toxicity criteria) to protect freshwater aquatic life, where the water has a pH of 8 and where salmonids are present, is 5.62 mg/L, or 5,620 ppb (USEPA, 1999).

Evidence of Impairment

Samples collected between 1985 and 1999 indicate that TID 5 often contains ammonia in excess of the criteria. Between 1985 and 1988, monthly samples were collected from TID 5. TID 5 contributed concentrated inputs of ammonia, due to a wastewater-treatment plant, especially during non-irrigation season (USGS, 1998).

Between April 1993 and March 1995, ammonia concentrations were collected from TID 5. "Ammonia concentrations in Turlock Irrigation District lateral 5… exceeded the USEPA chronic criteria in 76 … percent… of samples collected between April 1993 and March 1995 (USGS, Circ 1998)." Between October 1993 and November 1994, samples were collected monthly. The samples ranged in dissolved ammonia concentration from 0.490 to 18.0 mg/L (or 490 to 18,000 ug/L) (USGS, 1994 and 1995). At least four, and up to all, of the sample concentrations exceed each of the criteria, including those designed to protect aquatic life (including salmonids and the LC50) and the taste and odor standard for drinking water.

Additionally, in September 1999, a water sample collected from TID 5 contained a dissolved ammonia concentration of 0.85 mg/L, or 850 ppb. This is within the ammonia concentrations seen between October 1993 and November 1994, and is above the USEPA level to protect aquatic life, the taste and odor standard, and some of the LC50s for various fish species (USGS, 1999).

Unknown Toxicity

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained in TID 5. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "Compliance with this objective will be determined by analyses of...biotoxicity tests of appropriate duration..." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

The toxicity objective was evaluated for TID 5 by comparing toxicity test results of ambient water grab samples collected from TID 5 with laboratory control results. These toxicity test procedures estimate the acute and chronic responses of aquatic test species from three phyla (representing three trophic levels) as an assessment of the toxicity of the ambient water samples. The tests include fathead minnow (a fish, *Pimephales promelas*) larval survival (mortality) and growth tests, zooplankton (a cladoceran, *Ceriodaphnia dubia*) survival and reproduction (offspring counts) tests, and algal (*Selenastrum capricornutum*) growth (chlorophyll a production) tests. The test results produced by the ambient river samples were compared to test results of both the laboratory control and Mendota Pool water samples to identify ambient water samples that caused statistically significant test species impairment.

Evidence of Impairment

Nine of 16 ambient water samples collected by the California Regional Water Quality Control Board, Central Valley Region (CRWQCB-CVR) from TID 5 between 1988 and 1990 showed toxicity to Fathead minnows, defined as 30% more death than both the laboratory control and Mendota Pool sample. The toxicity occurred primarily between October and May, and is believed to be the "result, at least in part, from the presence of high concentrations of un-ionized ammonia (Foe and Connor, 1991). One of 16 ambient water samples collected by the CRWQCB-CVR from TID 5 between 1988 and 1990 showed toxicity to Fathead minnows, defined as more than 30 % less tissue growth than the corresponding Mendota Pool and laboratory control samples" (Foe and Connor, 1991). Nine of 12 ambient water samples collected by the CRWQCB-CVR from TID 5 between 1988 and 1990 showed toxicity to *Ceriodaphnia,* defined as 30% more death than both the laboratory control and Mendota Pool sample. Complete (100%) *Ceriodaphnia* mortality was observed on seven occasions and in February and April 1990, ambient water samples collected from TID 5 caused 100% mortality in less than 24 and 120 hours, for each month, respectively (Foe and Connor, 1991). An ambient water sample collected by the CRWQCB-CVR from TID 5 on March 27, 1990, contained 1.3 parts per billion (ppb) demethoate and another ambient water sample collected by the CRWQCB-CVR from TID 5 on April 24, 1990, contained 0.3 ppb carbaryl (a carbamate pesticide) (Foe, 1990). The detected level of carbaryl is 15 times higher that the instantaneous maximum carbaryl criterion for the protection of freshwater aquatic life recommended by the USEPA (NAS, 1973). The cause of the toxicity may be pesticides, "from orchard and row crops," or the additive effects of ammonia and pesticides (Foe and Connor, 1991).

Ambient water samples collected by the CRWQCB-CVR from TID 5 between 1988 and 1990 did not show reduced *Selenastrum* growth (Foe and Connor, 1991).

Diazinon and Chlorpyrifos

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for diazinon and chlorpyrifos in TID5. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider ... numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

The toxicity objective was evaluated for TID5 by toxicity test results using water from TID5 to toxicity test guidelines. In 1985 and 1989, the United States Environmental Protection Agency (USEPA) published protocols for assessing the aquatic toxicity of complex effluents and receiving waters (USEPA, 1991; Horning *et al*, 1985; Weber *et al*, 1989). These bioassay procedures estimate the acute and chronic responses of organisms from three phyla as an assessment of toxicity. The tests include a zooplankton (a cladoceran, Ceriodaphnia dubia) survival and reproductive test. The results for each test date are analyzed by comparing the results of the laboratory to the results produced by the creek sample to identify samples that caused significant organism impairment.

The pesticide objective was evaluated for TID5 by comparing chlorpyrifos and diazinon concentrations measured in TID5 to water quality criteria have been developed for wildlife protection. Chlorpyrifos is an organophosphorus (OP) pesticide-- a group of insecticides that are commonly used by homeowners and on crops (including on orchards) (Bailey at al, 2000). Diazinon and chlorpyrifos are toxic to many organisms and their effects are additive (Bailey et al, 1997). That is, if both compounds are present, their combined toxicity (toxic units, TUs) is the sum of the relative toxicities of each compound.

Diazinon

The United States Environmental Protection Agency (USEPA) Suggested No-Adverse-Response-Level (SNARL) for the protection of drinking water is 0.6 ug/L (micrograms per liter, or parts per billion, ppb) for diazinon (Marshack, 2000). The California Department of Fish and Game (CDFG) has developed acute and chronic criteria (Siepmann and Finlayson, 2000) using methods established by the USEPA for protection of aquatic life (USEPA, 1985) and the USEPA draft acute criterion for the protection of aquatic life. Additionally, the lethal concentration at which 50% mortality of *Ceriodaphnia dubia* is expected (LC50) has been calculated, which can be compared to determine the TUs. Diazinon criteria can be found in table 1.

Chlorpyrifos

The California Department of Fish and Game (CDFG) has developed acute and chronic chlorpyrifos criteria (Siepmann and Finlayson, 2000) using methods established by the U.S. Environmental Protection Agency (USEPA) for protection of aquatic life (USEPA, 1985) and the USEPA draft acute criterion for the protection of aquatic life. Additionally, the lethal concentration at which 50% mortality of *Ceriodaphnia dubia* is expected (LC50) has been calculated, which can be compared to determine the TUs. Chlorpyrifos criteria can be found in table 1.

Table 1. Freshwater Aquatic Life Criteria for Diazinon

Criterion Values	Criterion Type	Criterion Recurrence Period	Criterion Source
0.080 µg/l	Acute	1-hour average; not to be exceeded more than once every 3 years	Siepmann and Finlayson, 2000
0.050 µg/l	Chronic	4-day average; not to be exceeded more than once every 3 years	Siepmann and Finlayson, 2000
0.090 µg/l	Acute	1-hour average; not to be exceeded more than once every 3 years	US EPA (draft), 1998
0.436 µg/l	*Ceriodaphnia dubia* LC50 a	Not applicable	CDFG, 1998

a LC50 is the lethal concentration resulting in 50% mortality in the test species.

Table 2. Freshwater Aquatic Life Chlorpyrifos Criteria

Criterion value	Criterion Type	Criterion Recurrence Period	Source of criterion
0.013 µg/l (micrograms per liter, or parts per billion, ppb)	Chronic	4-day average; not to be exceeded more than once every 3 years	2000 CDFG[1]
0.02 µg/l	Acute	1-hour average; not to be exceeded more than once every 3 years	2000 CDFG[1]
0.041µg/l	Chronic	4-day average; not to be exceeded more than once every 3 years	1986 USEPA[2]
0.083 µg/l	Acute	1-hour average; not to be exceeded more than once every 3 years	1986 USEPA[2]
0.080 µg/l	LC50[3]	Not Applicable	California Department of Fish and Game, 1992

[1]CDFG = California Department of Fish and Game (Siepman and Finlayson, 2000)
[2]US EPA = United States Environmental Protection Agency
[3]LC50 is the lethal concentration resulting in 50% mortality in the test species.

Evidence of Impairment

Water quality and toxicity tests conducted using water from TID5 between 1994 and 2000 indicate that it is impaired by diazinon and chlorpyrifos. Diazinon and chlorpyrifos have been detected in ambient water samples collected from TID5 at concentrations exceeding freshwater aquatic life criteria for these pesticides. Between 1991 and 1992, diazinon concentrations ranged from none detected to 0.54 ppb (Foe, 1995). Chlorpyrifos concentrations ranged from none detected to 0.08 ppb (Foe, 1995). Some of the samples contained diazinon and chlorpyrifos concentrations above or close to the acute and chronic CDFG and USEPA criteria and the USEPA SNARL (diazinon only).

Additionally, between 27 April 1992 and 22 June 1992 the mean baseline concentration of diazinon and chlorpyrifos was calculated for several waterbodies. The mean baseline for diazinon in TID5 was 0.008 ppb; the mean baseline for chlorpyrifos was 0.015 ppb. These concentrations of diazinon and chlorpyrifos were considered "statistically different" from sites with "no pesticide detection (Foe, 1995)," indicating it contained diazinon and chlorpyrifos.

Several tests also indicate that the water from TID5 is toxic to *Ceriodaphnia*. Between 1991 and 1992, several samples approached the LC50 for *Ceriodaphnia*, indicating that the water would result in some death of *Ceriodaphnia*. Biotoxicity tests conducted using water from TID5 resulted in significant *Ceriodaphnia* mortality (up to 100% in 24 hours) in several cases where diazinon was present and in every case where chlorpyrifos concentrations exceeded 0.05 ppb. . In one case, the only toxin detected in TID5 was chlorpyrifos, at 0.8 (80%) an LC50 unit. The study concluded that chlorpyrifos was likely the primary cause of toxicity. In some cases, the cause the toxicity was likely due to both OP pesticides and ammonia concentrations (Foe, 1995).

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