**Appendix 1-10: Summary of Chlorpyrifos Monitoring Data**

**1. General Monitoring Data**

Examination of the EPA 303(d)[[1]](#footnote-1) list of impaired waters indicates 95 impairments are caused by chlorpyrifos as of January 2015. These waters are located in California, Idaho, Oklahoma, Oregon and Washington. Chlorpyrifos-impaired waters in California include 1559.76 stream miles and 277,200 acres of estuary or lakes. The full list of 303(d) chlorpyrifos impaired waters are provided in **Table B 1-10.1**.

**Table B 1-10.1. 303(d) list of chlorpyrifos impaired waters**

| State | Waterbody Name | Location |
| --- | --- | --- |
| CA | [ALAMO RIVER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR7231000019990205093023&p_cycle=&p_report_type=) | COLORADO RIVER BASIN |
| CA | [ARANA GULCH](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3041205119990222133711&p_cycle=&p_report_type=) |  |
| CA | [ASH SLOUGH (MADERA COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5452000020081113235605&p_cycle=&p_report_type=) |  |
| CA | [BEAR RIVER, LOWER (BELOW CAMP FAR WEST RESERVOIR)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5151000020000208113114&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [BERENDA CREEK (MADERA COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5453002020081113235146&p_cycle=&p_report_type=) |  |
| CA | [BERENDA SLOUGH (MADERA COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5452000020081113234637&p_cycle=&p_report_type=) |  |
| CA | [BLANCO DRAIN](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091101019981209161509&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [BRADLEY CHANNEL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3121003020021002233532&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [BRANCIFORTE CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3041205119990223104548&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [CARPINTERIA CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3153402019980825112405&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [CHUALAR CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091900020080604161337&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [COON CREEK, LOWER (FROM PACIFIC AVENUE TO MAIN CANAL, SUTTER COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5192200020080623174531&p_cycle=&p_report_type=) |  |
| CA | [DEADMAN CREEK (MERCED COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5357000020080806144342&p_cycle=&p_report_type=) |  |
| CA | [DEL PUERTO CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5411000020011212111305&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [DELTA WATERWAYS (CENTRAL PORTION)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAE5440000020041014185830&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [DRY CREEK (TRIBUTARY TO TUOLUMNE RIVER AT MODESTO, E STANISLAUS COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5354001120080623180014&p_cycle=&p_report_type=) |  |
| CA | [DUCK CREEK (SAN JOAQUIN COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5314000020080803214539&p_cycle=&p_report_type=) |  |
| CA | [DUCK SLOUGH (IN DELTA WATERWAYS, NORTHERN PORTION)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5100000020080623183037&p_cycle=&p_report_type=) |  |
| CA | [DUCK SLOUGH (MERCED COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5357000020080808202452&p_cycle=&p_report_type=) |  |
| CA | [ELBOW CREEK (FROM MATHEWS DITCH TO COTTONWOOD CREEK, TULARE COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5581000020070511151618&p_cycle=&p_report_type=) |  |
| CA | [ELK BAYOU (TULARE COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5581000020080808204645&p_cycle=&p_report_type=) |  |
| CA | [ESPINOSA LAKE](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAL3091900020020117151744&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [FEATHER RIVER, LOWER (LAKE OROVILLE DAM TO CONFLUENCE WITH SACRAMENTO RIVER)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5192200019980817161057&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [FRANKLIN CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3153402019990225134357&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [FRENCH CAMP SLOUGH (CONFLUENCE OF LITTLEJOHNS AND LONE TREE CREEKS TO SAN JOAQUIN RIVER, SAN JOAQUIN CO; PARTLY IN DELTA WATERWAYS, EASTERN PORTION)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5314000020020702142222&p_cycle=&p_report_type=) |  |
| CA | [FRESNO SLOUGH (FROM GRAHAM ROAD TO JAMES BYPASS, FRESNO COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5518000020080623182154&p_cycle=&p_report_type=) |  |
| CA | [FURLONG CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3053002019990222111932&p_cycle=&p_report_type=) |  |
| CA | [GREENE VALLEY CREEK (SANTA BARBARA COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3121003020080611165954&p_cycle=&p_report_type=) |  |
| CA | [HARDING DRAIN (TURLOCK IRRIGATION DISTRICT LATERAL #5)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5355000019980813181351&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [HIGHLINE CANAL (FROM MUSTANG CREEK TO LATERAL NO 8, MERCED AND STANISLAUS COUNTIES)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5356000020080707125417&p_cycle=&p_report_type=) |  |
| CA | [INGRAM CREEK (FROM CONFLUENCE WITH SAN JOAQUIN RIVER TO CONFLUENCE WITH HOSPITAL CREEK)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5411000020011211113332&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [KINGS RIVER, LOWER (PINE FLAT RESERVOIR TO ISLAND WEIR)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5518000020090112105219&p_cycle=&p_report_type=) |  |
| CA | [LLAGAS CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3053002020020319075726&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [LONE TREE CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5314000019980814105503&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [LONG CANYON CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9028300020011025112509&p_cycle=&p_report_type=) | SAN DIEGO |
| CA | [MAIN STREET CANAL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3121003020020819110803&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [MERCED RIVER, LOWER (MCSWAIN RESERVOIR TO SAN JOAQUIN RIVER)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5357000019980817154245&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [MILLERS CANAL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3053002020080603171000&p_cycle=&p_report_type=) |  |
| CA | [MOKELUMNE RIVER, LOWER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5440000019980818095133&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [MORMON SLOUGH (FROM STOCKTON DIVERTING CANAL TO BELLOTA WEIR--CALAVERAS RIVER)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5313000020050622171527&p_cycle=&p_report_type=) |  |
| CA | [MOSS LANDING HARBOR](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAB3060001419981214121135&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [MURRIETA CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9023200020010924152136&p_cycle=&p_report_type=) | SAN DIEGO |
| CA | [MUSTANG CREEK (MERCED COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5356000020080808193633&p_cycle=&p_report_type=) |  |
| CA | [NEW RIVER (IMPERIAL COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR7231000019990205102948&p_cycle=&p_report_type=) | COLORADO RIVER BASIN |
| CA | [NEWMAN WASTEWAY](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5412000020011211151440&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [OLD SALINAS RIVER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091101020080611145518&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [ORCUTT CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3121003020011129154708&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [ORESTIMBA CREEK (ABOVE KILBURN ROAD)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5422003219990126113826&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [PAJARO RIVER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3051003019980826115152&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [PIXLEY SLOUGH (SAN JOAQUIN COUNTY; PARTLY IN DELTA WATERWAYS, EASTERN PORTION)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5312000020080803212723&p_cycle=&p_report_type=) |  |
| CA | [QUAIL CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091900020011227140647&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [REDHAWK CHANNEL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9025100020080904171327&p_cycle=&p_report_type=) |  |
| CA | [SACRAMENTO SLOUGH](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5192200019980814113208&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [SALINAS RECLAMATION CANAL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091101019980828112229&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SALINAS RIVER (LOWER, ESTUARY TO NEAR GONZALES RD CROSSING, WATERSHEDS 30910 AND 30920)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091101020021007193102&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SALTON SEA](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAS7280000019990205133504&p_cycle=&p_report_type=) | COLORADO RIVER BASIN |
| CA | [SAN ANTONIO CREEK (SAN ANTONIO WATERSHED, RANCHO DEL LAS FLORES BRIDGE AT HWY 135 TO DOWNSTREAM AT RAILROAD BRIDGE)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3130001020020918211049&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SAN LORENZO RIVER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3041202219980827084709&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SAN LUIS OBISPO CREEK (BELOW W MARSH STREET)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3102402119980828115513&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SAND CREEK (TRIBUTARY TO MARSH CREEK, CONTRA COSTA COUNTY; PARTLY IN DELTA WATERWAYS, WESTERN PORTION)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5430001120080808191800&p_cycle=&p_report_type=) |  |
| CA | [SANTA CLARA RIVER REACH 6 (W PIER HWY 99 TO BOUQUET CYN RD) (WAS NAMED SANTA CLARA RIVER REACH 8 ON 2002 303(D) LIST)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR4035100019990204123459&p_cycle=&p_report_type=) | LOS ANGELES |
| CA | [SANTA GERTRUDIS CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9024200020080825001546&p_cycle=&p_report_type=) |  |
| CA | [SANTA MARIA RIVER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3121003020011228103528&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [SPRING CREEK (COLUSA COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5612002020070510165737&p_cycle=&p_report_type=) |  |
| CA | [STANISLAUS RIVER, LOWER](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5353000019980817151834&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [STONY CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5202100020020701133119&p_cycle=&p_report_type=) |  |
| CA | [TEMBLADERO SLOUGH](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3091101019981209131830&p_cycle=&p_report_type=) | CENTRAL COAST |
| CA | [TEMECULA CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9025100020011025111323&p_cycle=&p_report_type=) | SAN DIEGO |
| CA | [TUOLUMNE RIVER, LOWER (DON PEDRO RESERVOIR TO SAN JOAQUIN RIVER)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5355000019980817143435&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [ULATIS CREEK (SOLANO COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5601001220080801154307&p_cycle=&p_report_type=) |  |
| CA | [WADSWORTH CANAL](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5203000020041130173733&p_cycle=&p_report_type=) | CENTRAL VALLEY |
| CA | [WARM SPRINGS CREEK (RIVERSIDE COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR9023300020080825005933&p_cycle=&p_report_type=) |  |
| CA | [WESTLEY WASTEWAY (STANISLAUS COUNTY)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5411000020080808192151&p_cycle=&p_report_type=) |  |
| CA | [YANKEE SLOUGH (PLACER AND SUTTER COUNTIES)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR5151000020080731221832&p_cycle=&p_report_type=) |  |
| CA | [ZAYANTE CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=CAR3041202220020124155410&p_cycle=&p_report_type=) | CENTRAL COAST |
| ID | [Fifteenmile Creek - 4th order (Fivemile Creek to mouth)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=ID17050114SW007_04&p_cycle=&p_report_type=) |  |
| ID | [Fivemile Creek - 3rd order](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=ID17050114SW010_03&p_cycle=&p_report_type=) |  |
| ID | [Jenkins Creek - entire watershed](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=ID17050201SW005_02&p_cycle=&p_report_type=) |  |
| ID | [Mason Creek - entire watershed](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=ID17050114SW006_02&p_cycle=&p_report_type=) |  |
| ID | [Tenmile Creek - 3rd order below Blacks Creek Reservoir](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=ID17050114SW008_03&p_cycle=&p_report_type=) |  |
| OK | [Bishop Creek](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OK520610010180_00&p_cycle=&p_report_type=) |  |
| OK | [Coon Creek](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OK520710010030_00&p_cycle=&p_report_type=) |  |
| OK | [Deer Creek](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OK620910040120_00&p_cycle=&p_report_type=) |  |
| OK | [Willow Creek](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OK520610010080_00&p_cycle=&p_report_type=) |  |
| OR | [INDIAN CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OR1215104457009_0_7%2E8&p_cycle=&p_report_type=) | MIDDLE COLUMBIA-HOOD |
| OR | [LENZ CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OR1215146456436_0_1%2E5&p_cycle=&p_report_type=) | MIDDLE COLUMBIA-HOOD |
| OR | [NEAL CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OR1215257456640_0_5%2E6&p_cycle=&p_report_type=) | MIDDLE COLUMBIA-HOOD |
| OR | [WEST FORK PALMER CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=OR1230779452146_0_5%2E2&p_cycle=&p_report_type=) | YAMHILL |
| WA | [BLUE SLOUGH](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1204148465502_0%2E156&p_cycle=&p_report_type=) |  |
| WA | [GRAYS HARBOR COUNTY DRAINAGE DITCH NO. 1 (GHCDD-1)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1240884468222_0%2E052&p_cycle=&p_report_type=) |  |
| WA | [MARION DRAIN](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1201939463324_0%2E357&p_cycle=&p_report_type=) |  |
| WA | [PACIFIC COUNTY DRAINAGE DITCH NO. 1 (PCDD-1)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1240478467266_0%2E998&p_cycle=&p_report_type=) |  |
| WA | [PACIFIC COUNTY DRAINAGE DITCH NO. 1 (PCDD-1)](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1240478467266_2%2E768&p_cycle=&p_report_type=) |  |
| WA | [SPRING CREEK](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1196766462331_0%2E624&p_cycle=&p_report_type=) |  |
| WA | [SULPHUR CREEK WASTEWAY](http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_list_id=WA1199778463247_0%2E55&p_cycle=&p_report_type=) |  |

**2. Surface Water**

Water monitoring data from the USGS National Water-Quality Assessment Program (NAWQA), USEPA/USGS Pilot Reservoir Monitoring Program, USDA Pesticide Data Program (PDP; focused on raw water samples), California Department of Pesticide Regulation (CDPR), Washington State Department of Ecology and Agriculture (WSDE/WSDA) Cooperative Surface Water Monitoring Program[[2]](#footnote-2),[[3]](#footnote-3), Dow AgroSciences (MRID 44711601), Oregon Department of Environmental Quality, and Califronia Environmental Data Exchange Network (CEDEN) were evaluated for chlorpyrifos and chlorpyrifos-oxon.

In general, the surface water monitoring data include sampling sites that represent a range of aquatic environments including small and large water bodies, rivers, reservoirs, and urban and agricultural locations, but are limited for some areas of the United States where chlorpyrifos use occurs. Also, the sampling sites, as well as the number of samples, vary by year. The vulnerability of the sampling site to chlorpyrifos contamination varies substantially due to use, soil characteristics, weather and agronomic practices. None of the monitoring programs examined to date were specifically designed to target chlorpyrifos use,except the Registrant Monitoring Program (MRID 44711601) conducted in California which is discussed in greater detail below. Therefore, peak concentrations of chlorpyrifos and chlorpyrifos-oxon likely went undetected in these programs. Chlorpyrifos detections generally did not exceed 0.5 µg/L. For example, USGS NAWQA, which contains an extensive monitoring dataset for chlorpyrifos and chlorpyrifos-oxon, reports a peak chlorpyrifos detection of 0.57 µg/L in surface water with a detection frequency of approximately 15%. CDPR has detected chlorpyrifos concentrations greater than 1 µg/L in surface water on several occasions, with an observed peak chlorpyrifos concentration of 14.7 µg/L. Sampling frequencies in these monitoring programs were sporadic and generally range from once per year to twice per month. The chlorpyrifos monitoring data evaluated thus far also show that as sampling frequency increases, so does the detection frequency. This is evident in the registrant-submitted monitoring data, as well as examination of individual sampling sites within the various datasets.

Therefore, while there are many individual samples collected and analyzed for chlorpyrifos (or chlorpyrifos-oxon) across the United States, it would not be appropriate to combine these data sources to generate exposure estimates or to use these datasets to represent exposure on a national or even regional basis. While these data demonstrate exposure, using the measured concentrations as an upperbound exposure estimate would not be a reasonable approach for the reasons given above, including limited sample frequency, limited use information, and sampling site variability, on a national or even a regional basis. Model estimated concentrations should be considered a suitable upper bound concentrations for chlorpyrifos and chlorpyrifos-oxon.

All evaluated monitoring data are summarized in **Environmental Fate and Transport** section of the Biological Evaluation. A brief discussion of each of the individual programs is provided below.

**2.1. USGS NAWQA**

The NAWQA is a national-scale ambient water quality monitoring program that contains monitoring data for pesticides in streams. The database includes an extensive amount of data for both chlorpyrifos and chlorpyrifos-oxon; however, the NAWQA monitoring program was not designed to specifically target chlorpyrifos use. Specifically, the sample timing and frequency were not designed to correspond with chlorpyrifos applications. The monitoring sites were not selected based on known chlorpyrifos treatment areas, although there are some sampling locations in high chlorpyrifos use areas. In general, sample frequencies are sporadic and range from once per year to a couple times per month depending on the site and year. For these reasons, the data included in the NAWQA dataset are expected to underestimate chlorpyrifos and chlorpyrifos-oxon concentrations. The magnitude of this underestimation is unknown. NAWQA monitoring data from 1991 to 2010 were evaluated for this assessment and the results are summarized below.

The highest detected concentration of chlorpyrifos in surface water is 0.57 µg/L. This peak concentration was observed in 2003 at an urban location in Las Vegas, Nevada. Chlorpyrifos detection frequencies in surface water are 14.76% nationwide. The range of limit of detections (LODs) for chlorpyrifos is 0.004 – 0.5 µg/L.

Although the peak detection for chlorpyrifos-oxon in surface water reported as <0.34 µg/L for a mixed use area in Maryland in 2008, the maximum qualified (actual or estimated) detection of chlorpyrifos-oxon is 0.04 µg/L. This detection was made in 2008 at a Mississippi crop land location. Chlorpyrifos-oxon detection frequency is 0.33% nationwide. The range of LODs for chlorpyrifos-oxon is 0.013 - 0.33 µg/L.

NAWQA data for chlorpyrifos and chlorpyrifos-oxon in surface water are highlighted in **Table B 1-10.2**.

**Table B 1-10.2. USGS NAWQA surface water monitoring data for chlorpyrifos and chlorpyrifos-oxon**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Chlorpyrifos** | **Chlorpyrifos-oxon** |
| Sampling Years | 1991-2014 | 1999-2014 |
| Number of Samples | 30,542 | 8778 |
| Sample Frequency | varied | varied |
| Qualified Detections |  |  |
| Frequency of Detections | 15% | <1% |
| Maximum Detection  (concentration, year, location) | 0.57 µg/L  2003  Las Vegas, NV (urban) | 0.0543 µg/L  2008  Washington, MS (cropland) |
| LOD | 0.004 – 0.5 µg/L | 0.013 - 0.33 µg/L |

**2.2. USGS-Sample Runoff from Urban Drain**

The USGS performed a sampling of runoff from an urban drain during one storm period. In which it was sampled every hour for 8 hours collecting 9 samples showing a maximum concentration of chlorpyrifos at 0.035 µg/L, with a concentration range being 0.018 – 0.033 µg/L.[[4]](#footnote-4)

**2.3. USGS-EPA Pilot Reservoir Monitoring Program**

The USGS pilot reservoir monitoring program was designed to examine pesticide concentrations in twelve water-supply reservoirs and subsequent Community Water Systems (CWS). The reservoirs sampled ranged in size from 120 to 92,600 acre-foot normal capacity within watersheds ranging from about 3 to 785 square miles. The sites were located in California, Indiana, Louisiana, Missouri, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, and Texas. Samples were collected from the raw-water intake and the finished-water tap located at the entry point to the distribution system. The program took place during 1999 and 2000. While sample timing and frequency were designed to target pesticide usage, the program was not specifically designed to correspond with chlorpyrifos applications. The monitoring sites were also not selected based on known chlorpyrifos treatment areas, but rather areas where pesticides are generally applied and runoff is likely. For these reasons, the data included in the USGS-EPA Pilot program are expected to underestimate chlorpyrifos and chlorpyrifos-oxon concentrations in aquatic environments. The magnitude of this underestimation is unknown. For the purposes of this assessment only raw water samples are considered.

The highest concentration of chlorpyrifos detected was 0.0341 µg/L. This was observed for intake water. There are 21 reported detections of chlorpyrifos. The peak detection for chlorpyrifos-oxon was reported as <0.016 µg/L, which is the reported LOD for chlorpyrifos-oxon. This is higher than the detection limit for chlorpyrifos. All less than values were reported for intake water. The findings are summarized in **Table B 1-10.3**.

**Table B 1-10.3. USGS-EPA Pilot Reservoir Monitoring Program data for chlorpyrifos and chlorpyrifos-oxon**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Chlorpyrifos** | **Chlorpyrifos-oxon** |
| Sampling Years | 1999-2000 | 1999-2000 |
| Number of Samples | 323 | -- |
| Sample Frequency | bimonthly | bimonthly |
| Qualified Detections | 21 | 0 |
| Frequency of Detections | 6.5% | 0% |
| Maximum Detection | 0.0341 µg/L | < LOD |
| LOD | 0.004 µg/L | 0.016 µg/L |

**2.4. USDA Pesticide Data Program**

The USDA Pesticide Data Program (PDP) Water Monitoring Survey is designed to collect monitoring data on pesticide residues in drinking water. This is an ambient water monitoring program. For the purposes of this assessment only raw water samples are considered. PDP began testing for pesticide residues in drinking water sources in 2001. Samples have been collected from 82 locations in 28 states and the District of Columbia; however, only a subset of these sampling locations were sampled each year. In 2013, all PDP water monitoring ceased. While both chlorpyrifos and chlorpyrifos-oxon were monitored for as part of the PDP, the program was not designed to specifically target chlorpyrifos—the sample timing and frequency were not designed to correspond with chlorpyrifos applications. Although there are some sampling locations in chlorpyrifos use areas, the monitoring sites were not selected based on known chlorpyrifos use areas. For these reasons, the data included in the PDP program are expected to underestimate chlorpyrifos and chlorpyrifos-oxon concentrations. The magnitude of this underestimation is unknown. The range of LODs for chlorpyrifos and chlorpyrifos-oxon are 0.006 – 0.027 and 0.012 – 0.510 µg/L, respectively. PDP does not report any detections of chlorpyrifos or chlorpyrifos-oxon. Results are summarized in **Table B 1-10.4**.

**Table B 1-10.4. USDA Pesticide Data Program Monitoring data for chlorpyrifos and chlorpyrifos-oxon**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Chlorpyrifos** | **Chlorpyrifos-oxon** |
| Source | Raw Intake  Water | Raw Intake  Water |
| Sampling Years | 2004-2013 | 2004-2013 |
| Number of Samples | 1691 | 773 |
| Sample Frequency | bimonthly | bimonthly |
| Qualified Detections | 0 | 0 |
| Frequency of Detections | 0 | 0 |
| Maximum Detection | na | na |
| LOD | 0.006 – 0.027 µg/L | 0.059 – 0.510 µg/L |

#### **2.5. California Department of Pesticide Regulation**

The California Department of Pesticide Regulation (CDPR) maintains a surface water database of pesticide detections in surface waters (large and small water bodies) for the entire state. This is an ambient water monitoring program. In general, sample frequencies are sporadic and range from once per year to twice per month depending on the site and year. The sampling frequency and timing represented in the dataset do not specifically target chlorpyrifos applications; however, there are some sampling sites located within areas known to have high chlorpyrifos use. Because the sampling was not designed to monitor for chlorpyrifos, it is expected that the CDPR data underestimate chlorpyrifos concentrations. The magnitude of this underestimation is unknown.

The maximum detection was 3.96 µg/L in 2003 from a sample taken from Quail Creek in Monterey County. Overall, 10 samples had concentrations greater than 1 µg/L; however, most of these samples were collected prior to 2000. Only three of the samples greater than 1 µg/L were collected post 2000, with most of the highest detections occurring in Monterey and Stanislaus counties. The samples with the highest concentrations typically occur in the spring and summer. CDPR data for chlorpyrifos in surface water are highlighted in **Table B 1-10.5**.

**Table 1-10.5. CDPR Surface Water Monitoring Data for chlorpyrifos and chlorpyrifos-oxon**

| **Parameter** | **Chlorpyrifos** | **Chlorpyrifos-oxon** |
| --- | --- | --- |
| Sampling Years | 1991-2012 | 1991-2012 |
| Number of Samples | 13,212 | 1,059 |
| Sample Frequency | varied | varied |
| Qualified Detections | 2648 | none |
| Frequency of Detections | 20% | 0 |
| Maximum Detection | 3.96 µg/L  2003  Monterey County, CA  Quail Creek (ID # 7929) | No detections |
| LOQ | 0.00005 – 0.02 µg/L | 0.05-0.3 µg/L |

**2.6. California Environmental Data Exchange Network (CEDEN)**

The California Environmental Data Exchange Network (CEDEN) contains information about California’s water bodies, including streams, lakes, rivers, and the coastal ocean. Many groups in California monitor water quality, aquatic habitat, and wildlife health to ensure good stewardship of our ecological resources. CEDEN aggregates this data and makes it accessible to environmental managers and the public. In general, sample frequencies are sporadic. The sampling frequency and timing represented in the dataset do not specifically target chlorpyrifos applications; however, there are some sampling sites located within areas known to have high chlorpyrifos use and use information can be located in California Department of Pesticide Regulation’s Pesticide Usage Reporting database. Because the sampling was not designed to monitor for chlorpyrifos, it is possible that the CEDEN data underestimate chlorpyrifos concentrations. The magnitude of this underestimation is unknown. This dataset includes information for dissolved phase chlorpyrifos as well as chlorpyrifos sorb to particulates (particle phase chlorpyrifos). These data suggest that concentrations of particulate phase chlorpyrifos (max 0.00074 ug/L) are relatively low compared to observed detections of dissolved phase chlorpyrifos (max 0.013 ug/L) and total chlorpyrifos (max 0.013 ug/L).

#### **2.7. STORET Data Warehouse**

STORET Data Warehouse is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others. The sampling frequencies vary by the source of the submitted data and samples collected are not targeted to chlorpyrifos uses, nor does the database contain use information.

The maximum detection reported in STORET (**Table B 1-10.6**) is 14.7 µg/L, which was collected in South Dakota (42.8607, -97.4789) by the US Army Corps of Engineers Omaha District in 2006. The site location is an old oxbow that is cut off from the Missouri river and situated below the dam for Lewis and Clark Lake, a major reservoir. The surrounding watershed is primarily corn and soybean production. The second highest detection reported in the database is 1.73 µg/L, which was collected in Colorado (Dinosaur National Monument; Yampa River) by the National Parks Service Water Resource Division in 2010.

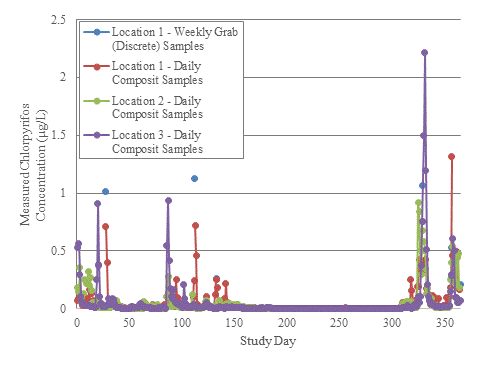
**Table B 1-10.6. STORET DATA Warehouse surface water monitoring data for chlorpyrifos and chlorpyrifos -oxon**

| **Parameter** | **Chlorpyrifos** | **Chlorpyrifos-oxon** |
| --- | --- | --- |
| Sampling Years | 1988-2014 | 2009-2014 |
| Number of Samples | 7580 | 1387 |
| Sample Frequency | varied | Varied |
| Qualified Detections | 2256 | 10 |
| Frequency of Detections | 30% | <1% |
| Maximum Detection | 14.7 µg/L  2006  South Dakota | Present below  quantification |
| LOD | varieda | varieda |
| * 1. The LOD depends on the data submission. | | |

**2.8. California - Registrant Monitoring Program (MRID 44711601)**

Sampling was conducted at three locations on the lower reach of Orestimba Creek for one year (May 1, 1996 to April 30, 1997). This is considered a semi-field water monitoring study meaning that sampling occurred in regions with noted chlorpyrifos use following application and runoff events. Daily time-proportional composite samples[[5]](#footnote-5) were collected, along with weekly samples. The report included chlorpyrifos use information for fields that drained into the creek or had the potential to contribute spray drift[[6]](#footnote-6). All chlorpyrifos applications were made to alfalfa and walnut by aerial equipment and were made during the irrigation season. The total mass of chlorpyrifos applied to all the fields that were identified to have the potential to impact the creek was 2.2 lb a.i./A (1308 kg). Applications occurred throughout the study period (or the day prior to study initiation) with, at most, three fields treated in the study area on the same day. The report suggests that typical chlorpyrifos use occurred during the study period, with the exception of dormant season applications to tree crops, which were limited due to the rainy weather during the study. The measured concentrations at the three sample locations are provided in **Figure B 1-10.1**. The highest measured concentration was 2.2 µg/L and was associated with a chlorpyrifos application to alfalfa followed by flood irrigation.

In several cases, the weekly grab samples were observed to have higher concentrations of chlorpyrifos. This suggests that the composite sampling methodology used in the study for daily samples resulted in the dilution of peak daily concentrations. Thirteen chlorpyrifos peak concentrations could be associated with specific events. The report authors suggest that nine of the events were related to spray drift (peak concentrations occurring within a three day window of application,) and were not linked to an irrigation event. The other four events were linked to irrigation tail water. Flood irrigation was reportedly used in the treated fields. Most of the peak concentrations were observed following chlorpyrifos applications to walnuts. The report noted that many of the walnut orchards are planted adjacent to the creek with an outside row located on the creek bank. This practice was done to maximize drainage from the orchard floor directly into the stream channel. It is unclear if any buffer zones were in place during application, but the observed concentrations suggest that the spray drift occurred during application even in the absence of adverse wind conditions.



**Figure B 1-10.1. Orestimba Creek Water monitoring data (May 1, 1996 to April 30, 1997)**

Not all monitored concentrations were observed shortly after the application event. There is one example where the peak measured concentration (0.32 µg/L) associated with an application event occurred 56 days after application. The detection was associated with an irrigation event. This suggests that chlorpyrifos residues available for transport may persist on the field for several months after application. No detections of chlorpyrifos were observed during the rainy season.

**2.9. Washington State**

Sampling focused on salmon-bearing streams in five different basins within Washington (**Table B 1-10.7**). Primarily weekly sampling was conducted during the pesticide use season; however, some daily sampling was also conducted. While the study did not specifically target chlorpyrifos use, nor did the report provide pesticide use information, some pesticide use survey data was obtained from WSDA. In addition, the report included information on the percent cropped area (PCA) for each of the basins included in the report.

The highest chlorpyrifos detections occurred within the Lower Yakima Agricultural Watershed. The highest concentration (0.27 µg/L) was detected in Spring Creek in 2007. Within the Lower Yakima Agricultural Watershed, use of chlorpyrifos includes wine grapes (early dormant spray), tree fruits (early dormant spray), and mint (late season). Chlorpyrifos detection frequencies ranged from 3 to 68% for weekly sampling. Daily samples were collected (mid-May-June) for one year at one location. When daily and weekly sampling frequencies of detection were compared, daily sampling detection frequency was more than 25% higher.

**Table B 1-10.7. WSDA monitoring summary for chlorpyrifos (2006-2011(3))**

|  |  |  |  |
| --- | --- | --- | --- |
| **Location** | **Spring Creek** | **Sulphur Creek Wasteway** | **Marion Drain** |
| **Maximum Detected Chlorpyrifos Concentration** | 0.27 µg/L | 0.28 µg/L | 0.12 µg/L |
| **Sample Yeara** | 2007 | 2009 | 2006 and 2007 |
| **Watershed Size (acres)** | 27,373 | 103,010 | 80,491 |
| 1. The exact sampling date is not provided in the report. 2. Percent cropped area provided for each basin in the report; includes grass, hay, and CRP (Conservation Reserve Program) 3. Survey data from report | | | |

**2.9. Denton, Texas**

The city of Denton, Texas[[7]](#footnote-7) sampled 70 different sites in three different watershed that fall within the city limits. The Cooper Creek watershed is made of mixed rangelands (972 ha), urban development (430 ha) and cropland/pasture (547 ha). The Pecan Creek watershed is a mix of urban (2024 ha), mixed rangeland (1350 ha) and cropland/pasture (1180). The Hickory Creek watershed land use areas were divide between cropland/pasture (3871 ha), mixed rangelands (3855 ha) and forest (977 ha). However, rapid conversions or rural lands to urban land uses was observed. Samples were collected monthly during periods of normal flow from March to August. While all sampling locations were visited on a monthly basis, not all of the stations had sufficient water to provide a sample very month. No information on chlorpyrifos use in the watersheds were provided. Samples were taken from the middle of the waterway at approximately 1 foot below the surface. The highest detection of chlorpyrifos was 0.7 μg/L in 2001. The study did not provide information on the sample site that yielded the highest concentration of chlorpyrifos.

**3. Sediment**

In sediment, the highest concentration of chlorpyrifos observed was 549 μg/kg while chlorpyrifos-oxon was detected at concentrations less than 3 μg/kg (**Table B 1-10.8**). In addition, an open literature articles report chlopryifos detections in sediment7; however, no detection of chlorpyrifos-oxon in sediment were reported.[[8]](#footnote-8) This is consistent with the environmental fate data for both chemicals. Chlorpyrifos is expected to be more persistent and to partition to sediment, while chlorpyrifos-oxon is expected to transform more rapidly and be less likely to partition to sediment.

**Table B 1-10.8. Sediment monitoring data summary for chlorpyrifos and chlorpyrifos-oxon**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Monitoring Data Source** | **Scale** | **Years of Sampling (number of samples)** | **Detection Frequency**  **(%)** | **Maximum Concentration**  **(µg/kg)** | **Years of Sampling (number of samples)** | **Detection Frequency**  **(%)** | **Maximum Concentration**  **(µg/kg)** |
|  | **Chlorpyrifos** | | | **Chlorpyrifos-oxon** | | |
| USGS NAWQA | National | 2002-2013  (177) | 2 | 58.6 | 2010 | 0 | < 3 |
| California Department of Pesticide Regulation | State | 2004  (24) | 38 | 0.019 | No data | | |
| California Central Coast  Region  Irrigated Lands Regulatory Program  (ambient) | Sub-State | 166 | 38 | 549 | No data | | |
|  | 5 | 40 | 0.16 µg/L  (pore water) |
| Los Angeles Region Ventura County  California Irrigated Lands Regulatory Program  (ambient) | Sub-state | 2013-2014  (21) | 81 | 0.026 | No data | | |

**4. Air**

There are 15 available chlorpyrifos air monitoring studies. These include two application site studies done in Tulare and Lompoc Counties, California by the California Air Resources Board (CARB), and 13 ambient air studies in which the particular source of chlorpyrifos within the impacted areas was not identified. Two of these ambient air studies were conducted in the North Central and Yakima Valleys of Washington by the University of Washington Department of Environmental and Occupational Health Sciences. The remaining 11 studies were conducted by Pesticide Action Network North America (PANNA), two in Cowiche and Tieton, Washington, and nine in Lindsay, California. The studies are summarized below.

**4.1. Application Site Monitoring**

Application site air monitoring refers to the collection of air samples around the edges of a treated field during and after a pesticide application. Samples are generally collected for short intervals (*e.g.,* < 8 hours), for at least the first day or two after application with subsequent samples increasing in duration. In this type of study, it is typically known when an application occurred, the equipment used for the application, and the application rate. Application site monitoring data represents an exposure to vapors at or near the field edge resulting from an application.

The Washington Department of Health (WA DOH) Organophosphorus Pesticide Air Monitoring Project employed three sample types (1 application site and 2 ambient) to determine levels of chlorpyrifos and chlorpyrifos oxon in residential communities in 2 regions, North Central and the Yakima Valley. Near-field “perimeter” samples were conducted to determine air concentrations at the edge of an application site. A 4-day sampling schedule was used with samples collected on the pre-spray day, on the spray day and post-spray days 1 and 2.

Sampling occurred at two locations: North Central Perimeter Site and Yakima Valley Perimeter Site.

The North Central Perimeter Site was monitored from April 6 to April 10, 2008. The site was located in a 4.02 acre study block at the end of a young vertical trellis apple orchard. Sampling stations were located 25 ft out from the perimeter of the block (outside row of trees). A total of 1.5 lbs chlorpyrifos was applied using airblast equipment. The maximum chlorpyrifos air concentration measured was 1,145 ng/m3 and the average was 153 ng/m3 (air concentrations measured for chlorpyrifos included the addition of oxon).

The Yakima Valley Perimeter Site was monitored from March 31 to April 5, 2008. The site was located in a 5.02 acre study block in a mature traditional apple orchard situated near a mix of tree fruit blocks. Sampling stations were located 20 ft out from the perimeter of the block (outside row of trees). A total of 10 lbs chlorpyrifos was applied using airblast equipment. The maximum chlorpyrifos air concentration measured was 1,002 ng/m3 and the average was 294 ng/m3 (air concentrations measured for chlorpyrifos included the addition of oxon).

The California Air Resources Board (CARB) conducted air monitoring at an application site in Tulare County, CA in 1996 (CARB 1998). Application site monitoring was conducted during June 1996 before, during, and for 72 hours after an application to an orange grove in Tulare County. Chlorpyrifos was applied via airblast at the rate of 6 lbs ai/A. Samplers were generally placed on each side of the field, at a distance of about 10 to 20 yards from the edge of the field. The sampling schedule is as follows:

* + A minimum 1-hour background sample within 24 hours prior to application.
  + A combined sample consisting of sampling during and 1 hour after application.
  + A 2-hour sample from 1 to 3 hours after application.
  + A 4-hour sample from 3 to 7 hours after application.
  + Two consecutive 8-hour samples from 7 to 15 and 15 to 23 hours after application.
  + Two consecutive 24-hour samples starting at the end of the second 8-hour sample.

The maximum positive chlorpyrifos detection over the sampling interval was 27,700 ng/m3 and the average chlorpyrifos air concentration detected was 6,448 ng/ m3. All of the application samples, including background samples, were found to be above the LOQ of 0.20 ug per sample for both chlorpyrifos and chlorpyrifos oxon (equivalent to an air concentration of 7 ng/m3 for a 24-hour sample).

**4.2. Ambient Monitoring**

Ambient air monitoring typically is focused on characterizing the airborne pesticide levels within a localized airshed or community structure of some definition (e.g., city, township, or municipality). This type of monitoring effort also can be focused on capturing chronic background levels or other temporal characteristics of interest such as focusing on seasonal pesticide use patterns. Typically, samples are taken for 24 consecutive hours and collected at the same site over an extended period of time (e.g., several weeks or months). In contrast to application site air monitoring, information on the precise timing and location of pesticide applications are rarely collected in ambient air monitoring studies. However, this does not mean that an application did not occur near an ambient sampler during the monitoring period.

The WA DOH, Organophosphorus Pesticide Air Monitoring Project employed three sample types (1 application site and 2 ambient) to determine levels of chlorpyrifos and chlorpyrifos oxon in residential communities in 2 regions, North Central and the Yakima Valley. “Ambient community” data were collected from 4 samplers outside different houses in residential communities. Near-field “receptor" collection sites were located in areas believed to receive relatively high exposure during airblast applications to tree fruit.

The North Central Receptor and Ambient Sites were monitored for 41 days starting March 24, 2008. Samples were collected over 31 days (due to snow the first 10 days) for 24 hours at a time. No orchards were within 1,000 meters of ambient sampling sites. Every receptor site was in close proximity to (bordered by) a conventional apple orchard, ranging from 9 to 276 feet away from the nearest orchards. The maximum chlorpyrifos air concentration measured at the ambient site was 21 ng/m3 and the average was 7 ng/m3. The maximum measured at the receptor sites was 607 ng/m3 and the average was 33 ng/m3 (air concentrations measured for chlorpyrifos included the addition of oxon).

The Yakima Valley Receptor and Ambient Sites were monitored from March 7 to April11, 2008. Sampling periods were 24 hours, with the exception of one 48 hour sample. No orchards were within 1,000 meters of ambient sampling sites. Every receptor site was near conventional apple orchards, ranging from 72 to 1,145 feet away from the nearest orchards. The maximum chlorpyrifos air concentration measured at ambient sites was 30 ng/m3 and the average was 9 ng/m3. The maximum measured at the receptor sites was 243 ng/m3 and the average was 30 ng/m3 (air concentrations measured for chlorpyrifos included the addition of oxon).

From 2004-2005 the Pesticide Action Network (PANNA) Drift Catcher program collected ambient monitoring data in Lindsay, CA (PANNA Drift Catcher report, 2005[[9]](#footnote-9)). The program collected data from 5 samplers in 2004 (July 13 to August 2) and 4 samplers in 2005 (June 13 to July 22). The samplers ranged from 50 to 400 feet away from orange groves. Monitoring was conducted to coincide with summer use of chlorpyrifos as an insecticide on oranges for the control of lepidopterous pests and scale. It is unknown when applications occurred during the monitoring period. 80% of samples were found to be above the LOQ of 30 ng chlorpyrifos per sample (equivalent to an air concentration of 6 ng/m3 for a 24-hour sample).

From 2005-2006 the PANNA Drift Catcher program collected ambient monitoring data in Yakima Valley, WA (PANNA Drift Catcher report, 2006[[10]](#footnote-10)). The program collected data from a sampler located in Tieton, WA in 2005 (April 1 to 21) and from a sampler located in Cowiche, WA in 2006 (April 3 to 23). The Cowiche sampler was set up 57 feet from the orchard and the Tieton sampler was set up 46 feet from the orchard. Monitoring was conducted to coincide with spring use of chlorpyrifos as an insecticide on apples, pears and cherries for the control of coddling moth, leaf roller and other pome-fruit pests. It is unknown when applications occurred during the monitoring period. All 21 samples at both locations were found to be above the LOQ of 20 ng chlorpyrifos per sample (equivalent to an air concentration of 7 ng/m3 for a 24-hour sample).

In 2000, CARB collected ambient monitoring data in Lompoc, CA (CARB report, 2003[[11]](#footnote-11)). The program collected data from four samplers located around Lompoc, CA (May 31 to August 3, 2000). Monitoring was conducted around Lompoc because agricultural fields dominate the area between Lompoc and the coast. The five major crops or crop groups grown in this area include cole crops (broccoli, cabbage, and cauliflower), lettuce, dried beans, celery, and flowers. It is unknown when applications occurred during the monitoring period. Approximately 34% of samples were found to have at least trace amounts of chlorpyrifos. Only seven samples were found to be above the estimated quantitation limit.

In 1996, CARB collected ambient monitoring data in Tulare County, CA (CARB report, 1998[[12]](#footnote-12)). The program collected data from four samplers located in Tulare County, CA (May 28 to June 28, 1996). Monitoring was conducted in Tulare County, CA because orange groves are predominant in this area. It is unknown when applications occurred during the monitoring period. Approximately 74% of samples were found to be above the LOQ of 200 ng chlorpyrifos per sample (equivalent to an air concentration of 9.4 ng/m3 for a 24-hour sample). The maximum positive chlorpyrifos detection over the sampling interval was 815 ng/m3 and the average detected was 53 ng/m3.

Based upon review of the available air monitoring studies that measured chlorpyrifos-oxon, all application location sites had measurable quantities. A comparison of average chlorpyrifos and chlorpyrifos-oxon measured (ng/m3) for each site ranged from 4 to 11X below chlorpyrifos for application air monitoring sites and 2 to 8X for ambient sites (2 had no measurable quantity and another only had one measure above the level of detection). It is unclear if the observed detection of oxon are the results of sampling process of if these detections reflect air concentrations of chlorpyrifos-oxon. However, analysis of these studies suggested that some of the oxon measured may be result of the presence of oxon in the air sample and is consistent with the field volatility studies.

1. Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters and report these impaired waters to EPA. Additional information on the program can be found at: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/ [↑](#footnote-ref-1)
2. Sargeant, D, Dugger, D. Newell, E., Anderson, P, Cowles, J. Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams 2006-2008 Triennial Report, **February 2010** (Washington State Department of Ecology and Washington State Department of Agriculture) https://fortress.wa.gov/ecy/publications/summarypages/1003008.html; http://agr.wa.gov/PestFert/natresources/docs/swm/2008\_swm\_report.pdf [↑](#footnote-ref-2)
3. Sargeant, D., Newell, E., Anderson, P., Cook, A. Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams 2009-2011 Triennial Report, **February 2013** (Washington State Department of Ecology and Washington State Department of Agriculture) http://agr.wa.gov/FP/Pubs/docs/377-SWM2009-11Report.pdf [↑](#footnote-ref-3)
4. Zamora, Celia.; Kratzer, Charles R.; Majewski, Michael S.; Knifong, Donna L., “Diazinon and Chlorpyrifos Loads in Precipitation and Urban and Agricultural Storm Runoff during January and February 2001 in the San Joaquin River Basin, California”(2003) USGS [↑](#footnote-ref-4)
5. Hourly samples were collected and composited over a 24-hour period; relatively large fluctuations in stream flow were anticipated during unattended operation of the auto samplers [↑](#footnote-ref-5)
6. Fields within 305 m buffer on either side of the mid-stream line [↑](#footnote-ref-6)
7. Kenneth E. Banks, David H. Hunter, David J. Wachal Chlorpyrifos in Surface Waters Before and After a Federally Mandated Ban Environment International 31 (2005) 351– 356 [↑](#footnote-ref-7)
8. Pait, Anthony S; Whitall, David R; Dieppa, Angel; Newton, Sarah E; Brune, Lia; Caldow, Chris; Mason, Andrew L; Apeti, Dennis a; Christensen, John D, and Pait, Anthony S. Characterization of Organic Chemical Contaminants in Sediments From Jobos Bay, Puerto Rico. 2012 Aug; 184, (8): 5065-5075. [↑](#footnote-ref-8)
9. PANNA Drift Catcher report, 2005: *Air Monitoring for Chlorpyrifos in Lindsay, California Jun-July 2004 and July-August 2005: Technical Report*. Pesticide Action Network North America. July 2006. (http://www.pesticideresearch.com/site/docs/DriftCatcher/Lindsay-chlorpyrifos7\_18\_06wc.pdf) [↑](#footnote-ref-9)
10. PANNA Drift Catcher report, 2006: *Air monitoring for Chlorpyrifos in the Yakima Valley, Washington, April 2006: Technical Report*. Pesticide Action Network North America. December 2006. (http://www.pesticideresearch.com/site/docs/DriftCatcher/FWPP-CP-12-14-06wc.pdf) [↑](#footnote-ref-10)
11. CARB report, 2003: *Ambient Air Monitoring for Pesticides in Lompoc, California, Volume 1: Executive Summary*. State of California Environmental Protection Agency, California Department of Pesticide Regulation, March 2003, EH03-02. (http://www.cdpr.ca.gov/docs/specproj/lompoc/exec\_sum\_march2003.pdf) [↑](#footnote-ref-11)
12. CARB report, 1998: Final Report for the 1996 Monitoring in Tulare Country, California Air Resources Board, California Environmental Protection Agency. Also known as “*Report for the Application and Ambient Air Monitoring of Chlorpyrifos (and the Oxon Analogue) in Tulare County during Spring/Summer 1996*. Project no. C96-041 (ambient), C96-040 (application). April 7, 1998. (http://www.cdpr.ca.gov/docs/emon/pubs/tac/tacpdfs/chlrpfs.pdf) [↑](#footnote-ref-12)