

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

Technical Memorandum Report



State of California
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Cover photos

Clockwise from top left: Westlands Water District turn-in structure; view of Pool 30, drained during the lining repairs of January 2016; low water levels in San Luis Reservoir July 28, 2016.

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Daniel Wisheropp, Environmental Scientist



**Division of Operations and Maintenance
State Water Project Operations Support Office
Environmental Assessment Branch
Sacramento, California**

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Acronyms and Abbreviations

µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
AEWSD	Arvin-Edison Water Storage District
af	acre-foot, acre-feet
Aqueduct	Edmond G. Brown California Aqueduct
AVEK	Antelope Valley-East Kern Water Agency
BVPP	Buena Vista Pumping Plant
cfs	cubic feet per second
COC	constituents of concern
CVC	Cross Valley Canal
DAPP	Dos Amigos Pumping Plant
Delta	Sacramento-San Joaquin Delta
DMC	Delta-Mendota Canal
DOC	dissolved organic carbon
DWR	California Department of Water Resources
EC	electrical conductivity
EPP	Edmonston Pumping Plant
IRWD	Irvine Ranch Water District
KCWA	Kern County Water Agency
KDWD	Kern Delta Water District
KWBA	Kern Water Bank Authority
KWBC	Kern Water Bank Canal
maf	million acre-feet
MCL	maximum contaminant level
mg/L	milligrams per liter
MP	milepost: distance in miles down the California Aqueduct from the northernmost feature at the Clifton Court Forebay Gates
<MRL, >MRL	below method reporting limit, above method reporting limit
NO ₃	nitrate
pCi/L	picoCuries per liter
NTU	nephelometric turbidity units
POA	percentage-of-Aqueduct, the percentage of Aqueduct flow composed of turn-in water
PP	pumping plant
PPP	Pearblossom Pumping Plant
pump-ins	groundwater pumped directly into the Aqueduct
Reclamation	U.S. Bureau of Reclamation
Rosedale	Rosedale Rio-Bravo Water Storage District
SFD	Southern Field Division
SJFD	San Joaquin Field Division
SLC	San Luis Canal: segment of the California Aqueduct that is part of the Joint-Use Facilities

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SLFD	San Luis Field Division
SO ₄	sulfate
SRIBP	Strand Ranch Integrated Banking Project
SWP	State Water Project
SWSD	Semitropic Water Storage District
taf	thousand acre-feet
TDS	total dissolved solids
TOC	total organic carbon
turn-ins	groundwater conveyed to the Aqueduct passively through bidirectional inflow/outflow structures and actively through pump-ins
us/ds	upstream/downstream
WKWD	West Kern Water District
WRMWSD	Wheeler Ridge-Maricopa Water Storage District
WWD	Westlands Water District

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I. Executive Summary

A total of 199,980 acre-feet (af) of non-State Water Project (or non-Project) turn-in water was admitted to the Edmund G. Brown California Aqueduct (Aqueduct) during 2016. Non-Project water originates from sources other than the Sacramento-San Joaquin Delta and can aid in supplying water to areas experiencing shortages, such as during periods of drought or years with below-normal snowpack runoff. The majority of non-Project water provided in 2016 originated as groundwater pumping in the San Joaquin Field Division (SJFD), with 86 percent of the total, followed by surface and/or groundwater inflows in the San Luis Field Division (SLFD) and Southern Field Division (SFD). Monitoring showed water quality in the Aqueduct was affected, both positively and negatively, but the effects were sometimes inconsistent and depended on a variety of factors, such as water quality parameter, turn-in source, and relative flows. Yet, the overall range of concentration changes observed downstream of a given turn-in for nearly all constituents was small relative to the variation observed in the Aqueduct upstream of that turn-in.

In the SLFD, 26,621 af of groundwater was pumped into the Aqueduct from Westlands Water District (WWD) during April–August. Consistent increases between upstream/downstream (us/ds) stations in the Aqueduct were reported for sulfate. This parameter can cause consumer acceptance problems in drinking water, but is not considered to be a human health threat. Deviations between us/ds stations were less consistent for other parameters. In some instances, us/ds changes coincided with expected results, based on turn-in wellhead concentrations, as seen with minor increases for arsenic, manganese, and nitrate. But other us/ds changes contradicted expected results. Examples included minor us/ds decreases in bromide, conductivity, and total dissolved solids (TDS), as well as, minor-to-no downstream deviations in boron and selenium, despite higher-than-Aqueduct concentrations in turn-in samples. Manganese was the only parameter in the SLFD with samples exceeding the maximum contaminant level (MCL) for drinking water. Exceedances occurred in two samples downstream of the turn-ins.

In the SJFD, 170,303 af of groundwater was pumped into the Aqueduct during January–December. Cross Valley Canal (CVC) accounted for 48 percent of the total turn-in volume, followed by Arvin-Edison Water Storage District (AEWSD) with 18 percent, Kern Water Bank Authority (KWBA) with 15 percent, Wheeler Ridge-Maricopa Water Storage District (WRMWSD) with 9.9 percent, Semitropic Water Storage District (SWSD) with 8.6 percent, and West Kern Water District (WKWD) with 1.3 percent. Turn-ins comprised 8.3 percent of water entering the Aqueduct in the SJFD from turn-ins and flows at Check 21. This was less than the same statistic (37 percent) in 2015.

Arsenic, dissolved chromium, hexavalent chromium, and sulfate consistently increased in the Aqueduct downstream of SJFD turn-ins. These parameters are undesirable in drinking water,

because they pose a potential threat to human health or potentially produce unpleasant tastes and odors. Arsenic and other co-occurring contaminants can also be undesirable for reasons beyond the threat to human health. Rising concentrations of constituents, like arsenic, are a concern to State Water Project (SWP) contractors, because they can accumulate in sludge as a byproduct of drinking water production and, as a result, increase disposal costs. No drinking water MCLs were exceeded in the Aqueduct.

Bromide and dissolved organic carbon (DOC) decreased in the Aqueduct downstream of SJFD turn-ins. This provided a net benefit to SWP contractors, because these parameters can increase both the cost of producing drinking water and the potential for creating carcinogenic trihalomethanes, which are regulated by the State Water Resources Control Board's Division of Drinking Water. Chloride and salinity also decreased downstream of the turn-ins, providing a benefit to Aqueduct water quality, because of the potential for these increased parameters to cause consumer-acceptance problems in drinking water. There are other benefits of lower concentrations of salt and salt-related parameters. Salinity in treated or reclaimed wastewater must meet regulatory limits upon discharge and can become a constraining factor for groundwater recharge if certain thresholds are exceeded. Although these issues were not investigated in this report, users of Aqueduct water consider them ongoing concerns.

In the SFD, 1,056 af of groundwater was pumped into the Aqueduct from Antelope Valley-East Kern Water Agency (AVEK). This turn-in had very little influence on Aqueduct water quality because of its small relative inflows and good water quality. All parameters reported in at least one wellhead sample greater than concurrent Aqueduct concentrations, except arsenic and chloride. But no significant us/ds deviations were reported during the turn-in period and those deviations that occurred showed poor relationship with concurrent turn-in concentration and inflow percentages.

II. Introduction

Groundwater and other non-State Water Project (or non-Project) waters admitted to the State Water Project (SWP) can alter the chemical composition of water used for drinking or agricultural applications. Any inputs to the SWP that are not diverted directly from the Sacramento-San Joaquin Delta (Delta) are referred to as non-Project waters. These waters usually replace a portion of Delta-surface supplies that have been depleted during periods of drought or reduced allocation. Non-Project waters from aquifers or, secondarily, from other available surface-water sources can contain water quality parameters that are either desirable or undesirable to various water users. This report documents water quality changes to the Edmund G. Brown California Aqueduct (Aqueduct) resulting from non-Project inputs in 2016.

During periods of reduced water allocations, such as periods of drought or years with below-normal snowpack runoff, non-Project groundwater can be pumped into the Aqueduct and transferred to areas where water is in short supply. According to California Water Code Section 1810, no agency may deny a transferor of water the use of a water conveyance, which has unused capacity, if fair compensation is paid. Participants of an approved program can use available Aqueduct capacity to move candidate waters from a point of availability to a point of need. This water is used for local redistribution or transfer to other water contractors. Further, surface-water diversions outside of the Aqueduct can be replaced with a similar amount of non-Project water, allowing these diversions to be transferred to other users with reduced allocations. The Aqueduct has been used routinely as a conveyance for non-Project groundwater during the recent drought.

Non-Project waters may be conveyed into the Aqueduct at bidirectional inflow/outflow structures, referred to as turn-ins. These structures serve as turn-ins when water is admitted to the Aqueduct, and serve as turn-outs when water is diverted out of the Aqueduct for delivery to contractual recipients. Non-Project water can either flow passively into the Aqueduct from some bidirectional canals, or it can be pumped directly into the Aqueduct through unidirectional inflow structures from groundwater wells or collection pipelines that have plumbed connections with several wells. Passive and pumped inflows have been collectively termed as turn-ins to encompass water pumped directly into the Aqueduct (pump-ins) and water passively conveyed into the Aqueduct via bidirectional turn-in/out structures.

Certain conditions must be met before non-Project water can be admitted to the Aqueduct. In accordance with the California Water Code Section 1810, water may be conveyed or transferred via any unused capacity of the Aqueduct, if the comingled water does not result in a diminution of water quality. The transfer must also be made without unreasonably affecting fish, wildlife, or other instream beneficial uses.

The California Department of Water Resources (DWR) established interim procedures and criteria, the *Water Quality Policy and Implementation Process for Acceptance of Non-Project Water into the State Water Project* (California Department of Water Resources 2012), to review turn-in proposals and to determine approval for acceptance into the Aqueduct using a two-tiered approach. This policy is described in Appendix A. According to the policy, the proponent of any turn-in proposal shall demonstrate that the water is of consistent, predictable, and acceptable quality. Prospective turn-in entities are required to submit proposals describing their turn-ins, including detailed water quality monitoring and analyses, source water description, identification of wells, inflow rates, and duration. Tier 1 programs have “no adverse impacts,” which is a conclusion based on historical water quality in the Aqueduct. Programs meeting Tier 1 criteria are generally approved by DWR without referral to the SWP Contractor Facilitation Group for outside review. Proposals are classified as Tier 2 programs when turn-in water quality is generally lower than historical Aqueduct conditions, and the program has the potential to cause adverse impacts. Tier 2 programs are referred to the SWP Contractor Facilitation Group for review. The group consists of DWR staff and representatives from each SWP contractor that chooses to participate. The group reviews Tier 2 proposals based on merits, impacts, mitigation, water quality monitoring, cost/benefits, or other issues. The group then provides recommendations to DWR regarding proposal approval or modification. DWR considers all factors before deciding on any turn-in proposal.

Participants of turn-in programs include both SWP and non-SWP contractors that bank groundwater and routinely convey it into the Aqueduct at various locations. Although most non-Project turn-ins to the Aqueduct originate as groundwater from Kern and Kings counties, other waters include groundwater from individual wells in Fresno County and surrounding counties. In the past, turn-ins have also included surface flows/floodwaters from southern Sierra Nevada watersheds and excess flows in the San Joaquin Valley redirected through the Mendota Pool to the Aqueduct.

Turn-ins can have measurable effects on Aqueduct water quality, depending on such factors as inflow volumes, Aqueduct flows, background concentrations, and participating-well geochemistry. The Aqueduct serves as a source of drinking water, and understanding the significance of any input on Aqueduct water quality is of foremost importance. Groundwater turn-ins have historically exhibited relatively elevated concentrations of certain constituents, such as arsenic, nitrate, and sulfate, which are undesirable for drinking water purposes because of their potential human health threat and/or consumer acceptance problems. Conversely, turn-ins have historically exhibited relatively low bromide and organic carbon, which is beneficial for drinking water because of the reduced potential to form carcinogenic trihalomethanes upon disinfection.

This report uses available data to assess changes in Aqueduct water quality that may be attributed to groundwater turn-ins during 2016. The evaluation of these changes includes flows, turn-in

characteristics, and upstream/downstream (us/ds) analysis of water quality in the Aqueduct. However, factors partially or fully unrelated to turn-ins can magnify or diminish water quality changes between us/ds stations. Comparisons of Aqueduct concentrations can be susceptible to misinterpretation from factors including Aqueduct operations, such as off-peak pumping and check gate closures, or sampling limitations, such as the distance between us/ds water quality sampling stations and downstream migrating parcels of differing water quality; but these factors are often difficult to identify and quantify with periodic sampling. As such, water quality changes, or lack thereof, in the Aqueduct us/ds of a particular turn-in may be erroneously ascribed to that input. There were several instances in this report in which this was possible, and these instances were acknowledged.

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III. San Luis Field Division

Turn-ins administered by Westlands Water District (WWD) admitted 28,621 af of non-Project water in 2016, representing the largest turn-in volume in recent years. Groundwater introductions occurred between Check 13 and Check 21, which is the portion of the Aqueduct commonly referred to as the joint-use stretch or the San Luis Canal (SLC). These turn-ins occurred during April–August under a turn-in agreement similar to the one in effect during the second half of 2015, discussed in that year’s report (California Department of Water Resources 2016). This new agreement was consistent with the DWR turn-in policy (Appendix A).

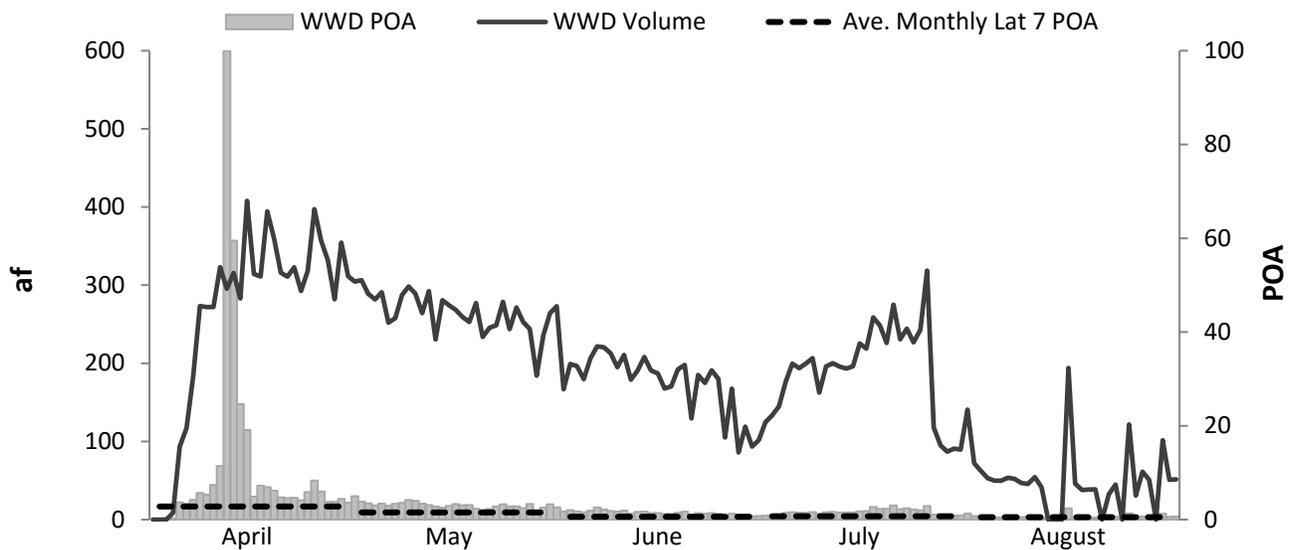
Drought and water-supply issues are the impetus for the increasing WWD turn-in volumes during the past few years. During periods of turn-in operations, the Aqueduct serves as a conveyance facility for WWD, allowing the supply of local water to users within the district. The purpose of the proposed turn-ins is to convey groundwater to areas within WWD “that could not otherwise receive this water, providing greater water management flexibility to the district and their water users” (U.S. Bureau of Reclamation 2015). Water redistribution within the district was necessary because of a 5 percent water allocation for south-of-Delta agricultural contractors. State and federal water officials implemented low water allocations because of a fourth consecutive year of drought. WWD designed its turn-in program to maximize the redistribution of groundwater as a supplemental water source to keep lands in agricultural production that farmers would have otherwise fallowed, given the drought-year allocation (Westlands Water District 2014).

The 2016 WWD turn-in program was the second year of turn-in activity under the 5-year agreement created in 2014 to continue the conveyance of local groundwater into the Aqueduct for disbursement (U.S. Bureau of Reclamation 2015). Under this program, water was admitted to the Aqueduct from WWD’s Lateral 7 facility, which is used to convey local groundwater pumped into Mendota Pool to the Aqueduct, and from individual wells within the WWD service area, which are piped directly to the Aqueduct. In previous years, WWD turn-in programs contained water conveyed through Lateral 7 and from individual wells; but under the 5-year agreement, these sources of WWD groundwater were separated administratively to address the differing water quality concerns posed by each source. The final 5-year agreement among DWR, WWD, and the U.S. Bureau of Reclamation (Reclamation) would allow WWD to admit as much as 30,000 af per year for the 5-year term, depending on Central Valley Project allocations. This agreement also stipulated that Reclamation would serve as the lead agency for this program and would oversee its various components, including water quality.

Westlands Water District Turn-in Volumes

The WWD turn-ins occurred during five months in 2016, exhibiting a wide range of daily and monthly operations. Figure 3-1 provides a graph showing daily trends and a table showing monthly totals and averages. The total monthly turn-in volume ranged from 1,482 af in August to 7,819 af in April. The de-facto headworks for the SLC, Dos Amigos Pumping Plant (DAPP), is located upstream of WWD and regulates flows within the SLC portion of the Aqueduct. During the five months the WWD program was active, DAPP pumped 1,418,781 af with a minimum volume of 140,133 af in April to a maximum volume of 365,112 af in June.

Figure 3-1 Daily Inflows to the Aqueduct from Westlands Water District and Calculated Percentage-of-Aqueduct Values



DAPP Pumping, af	140,133	268,701	365,112	363,167	281,668
Total Turn-in Volume, af	7,819	8,233	5,227	5,860	1,482
Average Monthly POA	5.9 ^a	3.0	1.4	1.6	0.5

Notes:

af = acre-feet, DAPP = Dos Amigos Pumping Plant, POA = percentage-of-Aqueduct

POA of 100 percent during April represents a day when DAPP was inactive.

^aCalculations for monthly POAs begins on the first day of turn-in operations.

The percent of Aqueduct water originating from WWD groundwater, referred to as percentage-of-Aqueduct (POA), provides a useful measure of potential influence from turn-in operations. The formula used to produce the POA value compares the total turn-in volume to the total Aqueduct volume, which is comprised of both turn-in contributions and DAPP pumping. Figure 3-1 shows the

average POA for each month turn-ins were active. For the April POA calculation, the total DAPP volume only included water pumped on and after the day WWD turn-in operations started. On April 12, DAPP did not pump any water, but WWD turn-ins were operating. The resulting POA value for this day was 100 percent. This value indicates that turn-ins were responsible for total inflow, but not the total volume, in the Aqueduct for that day. The monthly POAs ranged from 0.5 percent in August to 5.9 percent in April. The low POA during August coincides with a large DAPP-pumping volume and a small turn-in volume. Conversely, the higher POAs during April coincide with low-pumping volumes at DAPP, including the single day of non-operation, and a moderate turn-in volume.

Wellhead Water Quality

The agreement with WWD allowed turn-ins to operate based on specific water quality requirements and limitations. Some of these requirements are holdovers from previous groundwater turn-in programs, while others are unique to this situation. Both types of requirements are covered in the water quality monitoring plan for this program (U.S. Bureau of Reclamation 2016). As with other turn-in programs, well owners who wished to participate in the program were required to provide a full Title 22 (California Code of Regulations, Sections 64431–64439) water quality scan from wellhead sampling within the past three years. The Title 22 primary and secondary MCLs for drinking water were then used as standards for determining acceptable water quality. Short-term secondary MCLs serve as the standard for three constituents. These are 2,200 $\mu\text{S}/\text{cm}$ (microSiemens per centimeter) for conductivity, 600 mg/L (milligrams per liter) for sulfate, and 1,500 mg/L for total dissolved solids (TDS). But during the year, WWD used a TDS concentration of 1,100 mg/L as internal acceptance criterion.

Beyond requiring the Title 22 water quality scan every three years, the 2015 agreement also requires a separate sample each year that Title 22 water quality scans are not collected. This sample consists of a short list of constituents to be collected before any well begins pumping. The constituents of concern (COC) on this short list of constituents, referred to as “10 COC” samples, are shown in the corresponding column on Table 3-1. Wells that reported COCs greater than the agreed-upon standard in either a Title 22 or a “10 COC” sample set could be retested to determine if the well complies. Wells that produced a baseline sample, either a Title 22 scan or a “10 COC” sample set in compliance with the agreed-upon standards, were then allowed to begin turn-ins for that year.

Once wells start operating, owners/operators must collect regular ongoing samples. These samples fall into two categories. During the first week of operations, each well has samples collected for the

Table 3-1 Sample Lists of Constituents of Concern Required for Westlands Water District Wells Participating in the 2016 Turn-in Program

Constituent	Program MCL ^a	“10 COC”	Table 4a	Table 4b
Arsenic	0.01 mg/L	X	X	X
Boron	2 mg/L	X	NR	X
Bromide	NA	X	X	NR
Chloride	250 mg/L	X	X	X
Total Chromium	0.05 mg/L	NR	X	NR
Hexavalent Chromium	0.01 mg/L	NR	X	NR
Conductivity	2,200 µS/cm	X	X	NR
Gross Alpha	15 pCi/L	NR	X	NR
Manganese	0.05 mg/L	X	X	X
Mercury	0.002 mg/L	NR	X	X
Nitrate	45 mg/L	X	X	X
Total Organic Carbon	NA	X	X	NR
Selenium	20 µg/L	NR	X	X
Sulfate	600 mg/L	X	X	X
Total Dissolved Solids	1,500 mg/L ^c	X	X	X

Notes:

“10 COC” = constituents of concern (COC) on a sort list of constituents in Title 22, MCL = maximum contaminant level, mg/L = milligrams per liter, NA = not applicable, NR = not required, pCi/L = picoCuries per liter, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

Tables and sample lists are found in *2016 San Luis Canal Pump-in Program Water Quality Monitoring Plan* (U.S. Bureau of Reclamation 2016).

^aMCLs were modified for conductivity, selenium, sulfate, and total dissolved solids. Some constituents don’t have an MCL.

^bWestlands Water District used 1,100 mg/L during the year as an internal acceptance criterion.

constituents found in Table 4a of the monitoring plan (Table 3-1). The second sample set, found in Table 4b of the monitoring plan (Table 3-1), is collected during the second–fourth week of well operation and monthly thereafter. These samples assist in determining whether the well was producing water of predictable, reliable, and acceptable quality as stated in DWR’s non-Project pump-in policy (Appendix A).

Many of the wells participating in 2016 had valid Title 22 samples already submitted for past turn-in operations. For those wells that did not have the required Title 22 samples, the owner/operator collected these samples prior to starting operations in 2016. Table 3-2 provides the list of participating wells and shows general information about each well. The table also includes a well number assigned to each well for the purposes of this report. Also listed for each well is the Aqueduct milepost (MP) where the well discharges into the Aqueduct. Some wells also have secondary piping installed that allows for discharge to other locations as well.

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Table 3-2 Wells or Conveyances Participating in the 2016 Westlands Water District Pump-in Program in the San Luis Field Division

Well Number	Aqueduct Pool	Discharge Location ^a	State Well ID Number	Pumping Capacity (cfs)	Well Number	Aqueduct Pool	Discharge Location ^a	State Well ID Number	Pumping Capacity (cfs)
1	15	110.02R	141327E01	4.4	32	20	158.95L	201817G01	1.5
2	15	115.43L	Lateral 7 ^b	25	33	20	158.95L	201820E01	2
3	16	117.52L	151419F01	3	34	20	159.98R	201819N01	NL
4	16	117.52L	151419Q01	3	35	20	159.98R	201831C01	3.2
5	16	118.46R	151431D02	4.5	36	20	160.68L	201832E01	3.7
6	17	124.18L	161412N02	3	37	20	161.49L	201831Q01	3
7	17	127.40L	161521L01	4	38	20	161.60L	211805C01	1.5
8	17	127.40L	161521N02	3.8	39	20	161.63L	211809D02	2.3
9	17	128.49R	171401R01	3.5	40	20	162.08L	211805M01	3.5
10	17	128.49R	171413A06	3.5	41	20	162.08L	211809L01	2.9
11	17	128.50L	161533J02	5	42	20	162.10R	211806G01	3.9
12	17	128.54L	161532A06	5.5	43	20	162.64L	211808B01	3
13	17	130.81R	171510M01	4	44	20	163.18R	211807E01	3
14	17	130.81R	171503D01	5	45	20	163.59L	211808N01	5.6
15	18	131.66L	171501P02	2.5	46	20	164.11R	211818G03	3
16	18	131.66L	171502Q02	2.5	47	20	164.55LA	211817N03	3
17	18	133.80L	171601N03	4	48	20	164.55LA	211823B02	0.99
18	18	133.80L	171614Q01	4	49	20	164.55LA	211815M02	0.99
19	18	137.31L	171623J01	2.3	50	20	164.55LB	211816N01	4.5
20	18	137.31L	171623M01	4	51	20	164.55LB	211816P01	3.8
21	18	137.83L	181606F01	4	52	20	164.55LB	211822E02	5.5
22	18	141.02R	181620M01	2.5	53	20	164.55RB	211823E01	1.5
23	19	152.75L	191723R01	3	54	21	164.95R	211829E02 ^c	NL
24	19	153.10R	191726E01	NL	55	21	164.95R	211833G01 ^c	NL
25	19	154.10L	191830M01	3.5	56	21	164.95R	Reservoir	6
26	19	154.10L	191736A01	4.5	57	21	164.95R	211833N02 ^c	2.2
27	19	155.15L	191831N01	2	58	21	166.90L	211827K02	2.5
28	20	155.63L	201806F01	1	59	21	166.90L	211828G06	0.99
29	20	156.36R	201712H01	3.5	60	21	169.48L	211835D01	1
30	20	156.36R	201714K01	4.4	61	21	169.48L	211835Q02	0.5
31	20	156.37L	201806Q02	3					

Notes:

cfs = cubic feet per second, NL = not listed

Well numbers were assigned to each well or conveyance as generic identifiers for each well are based on location down the Aqueduct.

^aAqueduct milepost and side (L = left, R = right).

^bLateral 7 turn-in conveyed water from several wells into the Aqueduct as well as water from the San Joaquin River via Mendota Pool.

^cThese wells were manifolded together and discharged to one turn-in location. That turn-in location was used to collect the weekly samples.

Once pumping began for a well, the weekly Table 4a and Table 4b sampling began. Most individual wells only operated for a short time and, as a result, did not need to collect all weekly or monthly samples. All water quality samples collected in 2016 are provided in Appendix B, Table B-1. This

table includes all results for “10 COC”, Table 4a, and Table 4b sampling. It also includes results for Title 22 water quality scans taken during 2016, showing all 15 constituents found in the other three sample lists. The Appendix B, Table B-1 also provides the raw data for both original and retested baseline samples, where applicable. Table 3-3 shows statistical analyses for all wellhead data from the 2016 turn-in program. Throughout the year, several different laboratories were used for analysis of different wells and as a result, the minimum reporting limit (MRL) often varied between samples. For statistical analysis purposes, all samples less than their MRL were analyzed at the MRL. Figure 3-2 presents all wellhead data graphically, showing the individual and median results for each well, organized left to right, by the well number assigned in Table 3-2. For clarity in the graphs and ease of identification, all sample results that were less than MRL were graphed at zero. Both the statistical table and graphs do not include original results for retested samples. Because Lateral 7 is located within the us/ds sampling locations, its data (collected by Reclamation) was included in both the statistics and graphs for WWD turn-ins. Nevertheless, the 5-year agreement’s monitoring plan stipulated that monitoring requirements for Lateral 7 be separated from the individual wells. As such, Lateral 7 water quality was included to reflect influences from the whole WWD turn-in program between Check 13 and Check 21. The requirements, data, and analysis specific to Lateral 7 are discussed later in this chapter.

Arsenic

Arsenic ranged from <0.002 to 0.013 mg/L, with an average of 0.004 mg/L (Table 3-3). Eight samples at five different wells exceeded the MCL of 0.01 mg/L, while 112 samples, 38 percent of the total, were less than the MRL. Wells in the northern-most and southern-most portions of WWD’s project area tended to have higher concentrations than in the center except for Well 31, which had the highest reported sample results (Figure 3-2A).

Boron

Boron ranged from <0.1 to 2.4 mg/L, with an average of 0.89 mg/L (Table 3-3). Three samples exceeded the MCL of 2.0 mg/L for boron in drinking water and seven samples, 3 percent, were less than the MRL. Higher concentrations largely occurred in northern wells, while central and southern wells had stable averages from 0.5 to 1.0 mg/L (Figure 3-2B).

Bromide

Bromide ranged from 0.024 to 1.4 mg/L, with an average of 0.41 mg/L (Table 3-3). Most samples reported below 0.5 mg/L, with 10 samples, 8 percent, reported below their MRL (Figure 3-2C). Higher concentrations were reported sporadically for wells throughout WWD’s project area with the highest average value of 1.25 mg/L reported for Well 31.

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Table 3-3 Water Quality Summary of Constituents of Concern in Westlands Water District Wells Pumping to the Aqueduct, April–August 2016

Statistic	Arsenic	Boron	Bromide	Chloride	Total Chromium	Hexavalent Chromium (µg/L)	Conductivity (µS/cm)
Sample List ^a	4a and 4b	4b	4a	4a and 4b	4a	4a	4a
MRL	0.002	0.1	Variable ^d	1	Variable ^d	0.2	1
Program MCL ^b	0.01	2.0	-	250	0.05	10	2,200
Average ^c	0.004	0.89	0.41	63	<0.01	0.48	1,259
Median ^c	0.003	0.81	0.31	52	<0.01	<0.2	1,300
Minimum	<0.002	<0.1	0.024	3	0.0012	<0.2	32
Maximum	0.013	2.4	1.4	250	0.0301	7.6	2,182
Count	294	263	119	294	62	41	120
<MRL (#)	112	7	10	0	41	35	0
<MRL (%)	38	3	8	0	66	85	0
>MCL (#)	8	3	0	0	0	0	0

Statistic	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	Nitrate	TOC	Selenium (µg/L)	Sulfate	TDS
Sample List ^a	4a	4a and 4b	4a and 4b	4a and 4b	4a	4a and 4b	4a and 4b	4a and 4b
MRL	Variable ^d	0.01	0.2	Variable ^d	Variable ^d	Variable ^d	1	5
Program MCL ^b	15	0.05	2	45	-	20	600	1,500
Average ^c	2.0	0.03	<0.2	6.9	0.77	3.8	404	801
Median ^c	1.3	0.02	<0.2	1.7	<0.2	2	440	870
Minimum	<MRL ^d	<0.01	<0.2	<0.5	<0.2	<0.4	<1	<5
Maximum	10.1	0.3	<0.2	58	14	22	870	1,500
Count	41	273	164	294	119	236	294	294
<MRL (#)	11	109	164	121	68	124	1	2
<MRL (%)	27	40	100	41	57	53	0.3	1
>MCL (#)	0	25	0	1	0	1	3	0

Notes:

MCL = maximum contaminant level, MRL = method reporting limit, pCi/L = picoCuries per liter, TDS = total dissolved solids, TOC = total organic carbon, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted. Statistics in this table do not include original results for retested samples. Appendix B shows all raw data.

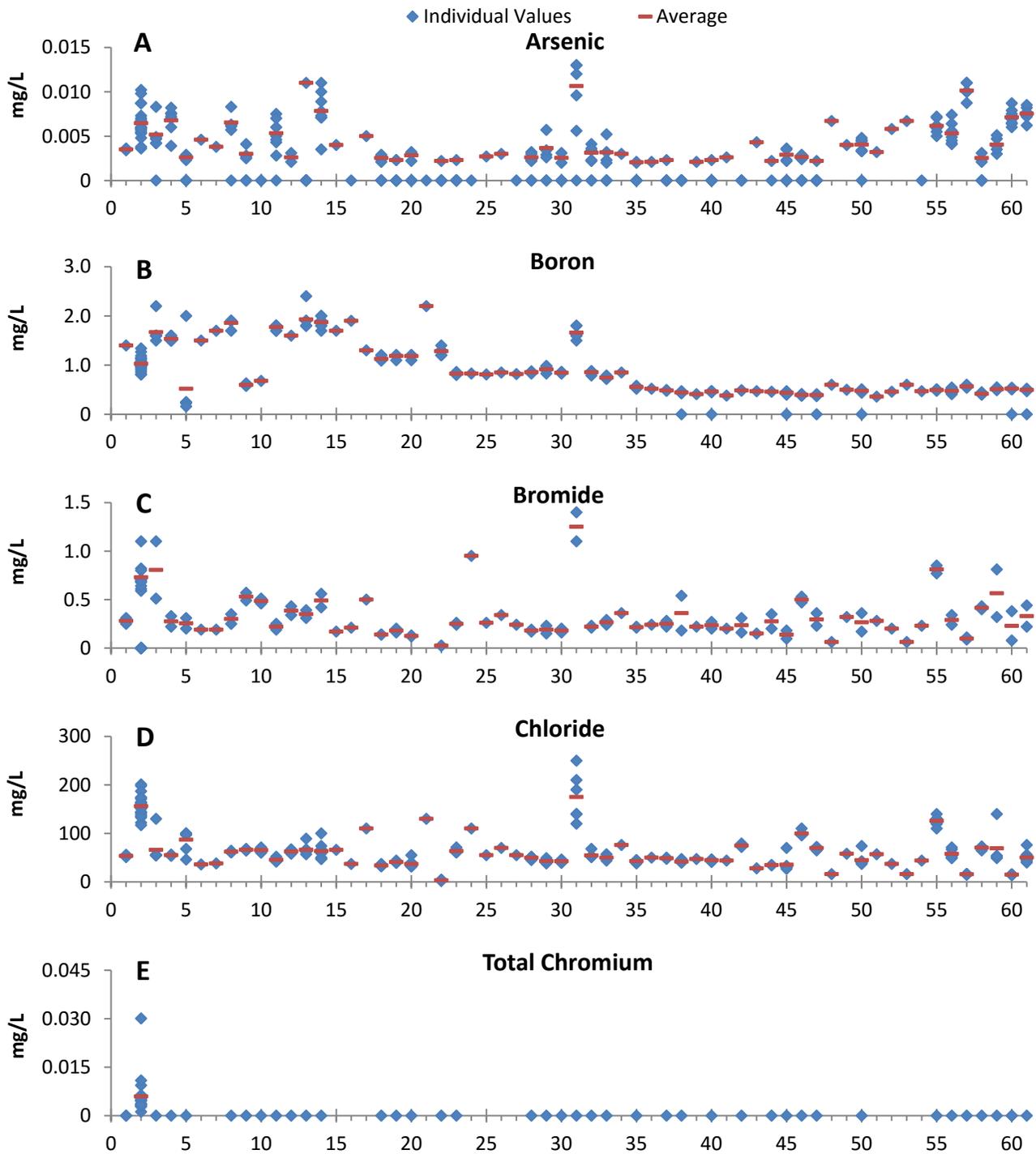
^aSample List = Short-list COC samples found in Table 4a and/or 4b of the 2016 San Luis Canal Pump-in Program Water Quality Monitoring Plan (U.S. Bureau of Reclamation 2016).

^bMCLs were modified for conductivity, selenium, sulfate, and total dissolved solids.

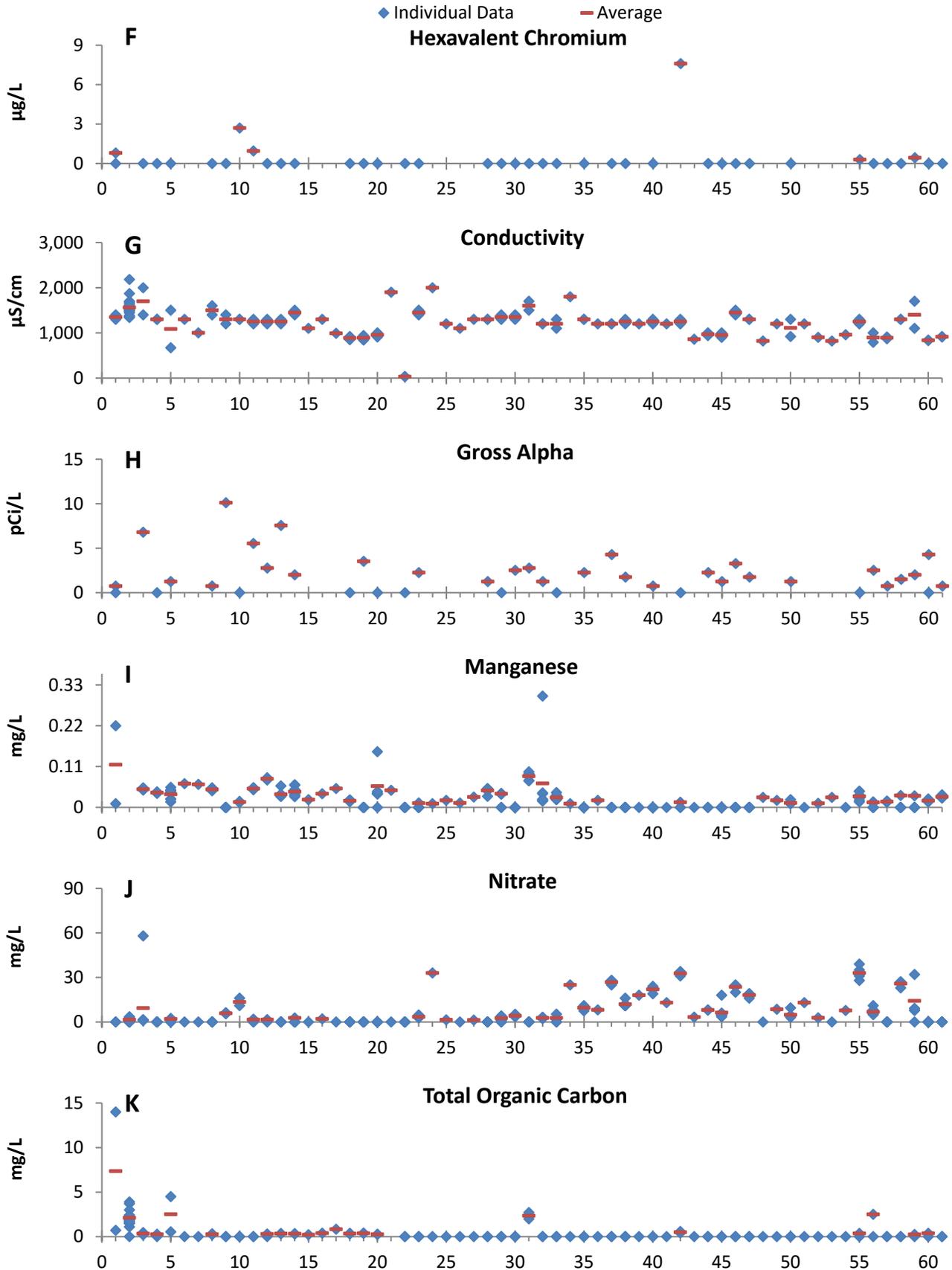
^cNon-detectable results were analyzed at the MRL.

^dThe MRL for each sample is shown in Appendix B. Some samples reported concentrations less than the MRL of other samples.

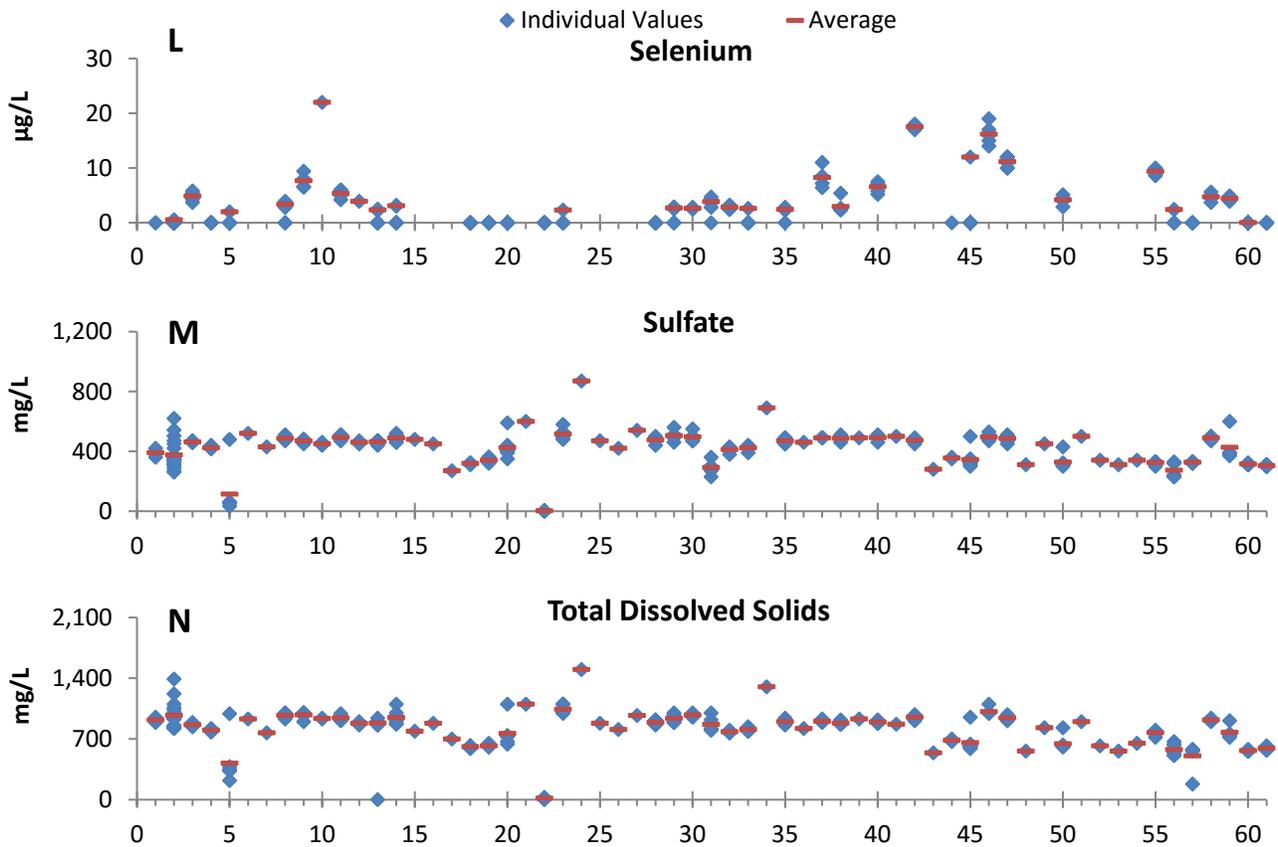
Figure 3-2 Water Quality Constituents-of-Concern in Westlands Water District Wells and Lateral 7 Discharging to the Aqueduct, April–August 2016



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Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016



Notes:

mg/L = milligrams per liter, pCi/L = picoCuries per liter, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter

Statistics in this chart do not include original results for retested samples. Appendix B shows all raw data.

Well numbers are identified in Table 3-3.

Averages are reported for those wellheads with more than two data points per well.

Chloride

Chloride ranged from 3 to 250 mg/L, with an average of 63 mg/L (Table 3-3). No samples reported less than the MRL of 1 mg/L nor did any samples exceed the MCL of 250 mg/L. Most wells reported averages less than 80 mg/L, with just eight wells reported average values greater than 80 mg/L (Figure 3-2D).

Total Chromium

The total chromium (trivalent plus hexavalent chromium, unfiltered) dataset reported mixed results because of the different MRLs used for individual wells compared with those used for Lateral 7. All samples from the individual wells were reported less than the MRL of 0.01 mg/L. Lateral 7 samples had a lower MRL and reported samples ranging from 0.0012 to 0.0301 mg/L (Table 3-3). Because the bulk of the data, 66 percent of total, reported <0.01 mg/L the overall average for the dataset was equal to <0.01 mg/L. While all of Lateral 7's samples were above their MRL, only two samples exceeded the MRL of 0.01 mg/L used for the individual wells (Figure 3-2E).

Hexavalent Chromium

Hexavalent chromium (filtered) ranged from <0.2 to 7.6 µg/L (micrograms per liter), with an average of 0.48 µg/L (Table 3-3). No samples exceeded the MCL of 10 µg/L, while 85 percent of samples were below the MRL. The six samples that were above the MRL varied in concentration and geography (Figure 3-2F). The highest concentration occurred at Well 42, while Wells 1, 10, 11, 55, and 59 reported concentrations slightly above the MRL.

Conductivity

Conductivity ranged from 32 to 2,182 µS/cm, with an average of 1,259 µS/cm (Table 3-3). No samples were less than the MRL or greater than the MCL. Most wells reported samples from 1,100 to 1,400 µS/cm with no major trends geographically (Figure 3-2G). Well 22 was the exception, with two samples that were noticeably below the bulk of data from other wells.

Gross Alpha

The radiological parameter gross alpha ranged from less than the MRL to 10.1 pCi/L (picoCuries per liter), with an average of 2.0 pCi/L (Table 3-3). No gross alpha samples exceeded the MCL of 15 pCi/L. Twenty-seven percent were less than the MRL, which varied between samples because of background radiation levels. The presence and concentration of gross alpha were dispersed sporadically throughout the project area. Except for slightly higher values in northern wells, there was no clear geographic correlation for gross alpha (Figure 3-2H).

Manganese

Manganese ranged from <0.01 to 0.3 mg/L, with an average of 0.03 mg/L (Table 3-3). While the maximum observed concentration was high, only three samples exceeded 0.1 mg/L. One hundred nine samples, 40 percent, reported below the MRL and 26 samples, 9.5 percent, exceeded the secondary MCL of 0.05 mg/L for manganese in drinking water. The bulk of samples with results greater than the MRL were from the northern half of all wells (Figure 3-2I).

Mercury

All 164 samples for mercury reported below the MRL of 0.002 µg/L (Table 3-3). For this reason, mercury is not included in Figure 3-2.

Nitrate

Nitrate ranged from <0.5 to 58 mg/L, with an average of 6.9 mg/L (Table 3-3). One sample exceeded the MCL of 45 mg/L, while 122 samples, 41 percent, reported less than the MRL. The bulk of samples less than the MRL occurred in the northern half of all wells, but were interspersed with

several higher individual values (Figure 3-2J). The highest individual value was reported for Well 3, yet subsequent samples for this well were all 1.5 mg/L or less.

Total Organic Carbon

TOC ranged from <0.2 to 14 mg/L, with an average of 0.77 mg/L (Table 3-3). Sixty-eight samples, 57 percent, were less than the MRL. Well 1 reported the highest individual value of 14 mg/L, yet the subsequent sample was 0.71 mg/L (Figure 3-2K). The remaining wells with samples greater than the MRL were dispersed geographically without any clear correlation with location and concentration.

Selenium

Selenium ranged from <0.4 to 22 µg/L, with an average of 3.8 µg/L (Table 3-3). One sample exceeded the MCL of 20 µg/L, and this well stopped operating after this sample was analyzed. In contrast, 124 samples (53 percent of the total), reported less than the MRL. Higher-concentrated individual and average samples occurred around Well 10 and around Well 45 (Figure 3-2L).

Sulfate

Sulfate ranged from <1 to 870 mg/L, with an average of 404 mg/L (Table 3-3). Three samples exceeded the secondary MCL of 600 mg/L, while one sample, 0.3 percent of the total, reported less than the MRL. The majority of wells reported the bulk of their values from 300 to 500 mg/L; wells that reported values above and below this range were dispersed widely throughout the project area (Figure 3-2M).

Total Dissolved Solids

TDS ranged from <5 to 1,500 mg/L, with an average of 801 mg/L (Table 3-3). Two samples were less than the MRL of 5 mg/L, 1 percent of the total. No samples were greater than the secondary MCL of 1,500 mg/L, but the highest recorded value was equal to the MCL. The majority of wells reported the bulk of their values from 650 to 950 mg/L. Wells that reported values above and below this range were dispersed widely throughout the project area (Figure 3-2N).

Aqueduct Water Quality Changes

DWR collected hourly conductivity measurements us/ds of the WWD turn-ins at Check 13 and Check 21. These measurements help with the evaluation of conductivity changes that are possibly attributable to turn-ins. The data are collected every hour and can show continuous trends and detailed changes that are not evident in the monthly grab samples. Aside from changes in conductivity, trends at these locations also help show the influence that Aqueduct and turn-in operations have on downstream migrating parcels of water. These operations include both the

volume and POA of water admitted by WWD as well as the flow rate within the Aqueduct because of DAPP pumping (Figure 3-1). Furthermore, these operations and their effects on conductivity can be extrapolated to help explain trends observed for other COCs as well.

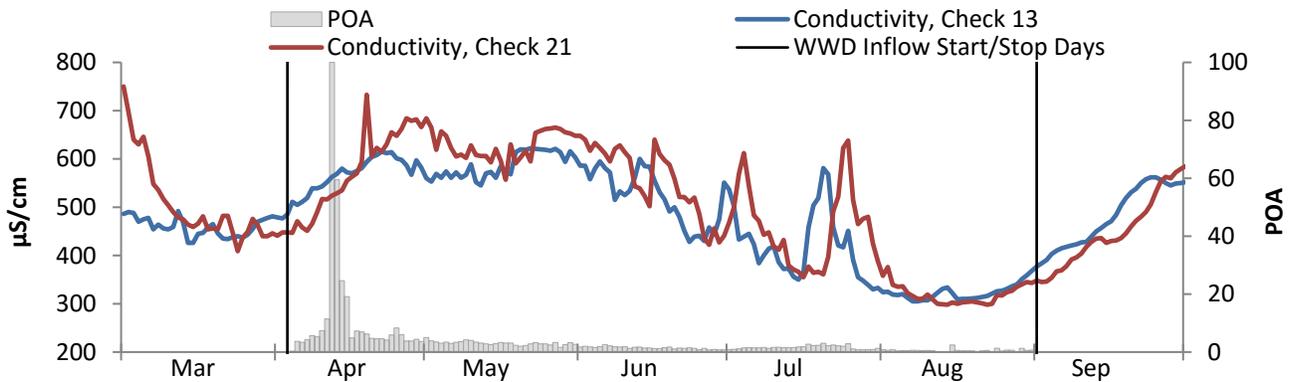
Figure 3-3 displays the conductivity measurements from us/ds locations along with the daily POAs for all WWD turn-ins combined. The period of record for this figure extended from one month prior to the start of turn-ins to one month after turn-ins ended. This timeframe showed trends with and without turn-in contributions and illustrated the length of time before us/ds concentrations converged following turn-ins. The us/ds conductivity differences ranged from -220 to 206 $\mu\text{S}/\text{cm}$ during this turn-in period (Figure 3-3). The difference between conductivity at these locations may have been caused by turn-in contributions, but this comparison between locations is complicated by the travel time needed for water to move the 101 miles between sampling locations.

Concentrations at the us/ds locations fluctuated throughout the turn-in period, depending on turn-in and Aqueduct operations. The largest us/ds increase depicted on Figure 3-3 was 264 $\mu\text{S}/\text{cm}$ and occurred on the first day graphed (March 1). Downstream measurements slowly declined from that point toward the range of measurements observed at the upstream location. From mid-March until the turn-ins started on April 4, us/ds differences remained less than $\pm 50 \mu\text{S}/\text{cm}$. Shortly before turn-ins began, conductivity at both Check 13 and Check 21 began to increase with measurements at Check 21 trailing behind those at Check 13.

The first major divergence between us/ds measurements, excluding a single-day spike downstream, occurred at the very end of April, when upstream conductivity began to decrease while downstream conductivity continued to increase. This occurred about a week and a half after the highest POA values of the year. The divergence during this time reached a maximum value of 124 $\mu\text{S}/\text{cm}$ on May 1. After this point, us/ds measurements slowly converged to nearly equal values in mid-May. For the remainder of the year, both Check 13 and Check 21 measurements showed roughly the same trends with large fluctuations in the latter half of the summer. During this time, us/ds differences showed a few periods of decreases larger than 100 $\mu\text{S}/\text{cm}$ and a few periods of increases larger than 100 $\mu\text{S}/\text{cm}$.

The cause of these periods of large us/ds divergence is evident in the graphed data shown on Figure 3-3, showing downstream values trailing behind those upstream by 4–5 days. This effect was because of the travel time between sampling locations. When the data is adjusted to compensate for travel times, the trends at the two locations (i.e., occurrence of peaks and valleys in the graphed conductivity data) matched up well. When comparing us/ds conductivity, considering compensations for travel time, the downstream peaks tended to have higher concentrations than the corresponding peaks upstream.

Figure 3-3 Conductivity at Check 13 and Check 21, Inflows from Westlands Water District and Percentage Increase in Conductivity to the Aqueduct



Notes:

POA = percentage-of-Aqueduct, WWD = Westlands Water District, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter

The effect of travel times on us/ds comparisons is a factor on conductivity as well as on other COCs throughout the year, and this was one of the complicating issues affecting this analysis. The offset distance between peaks and valleys in the data can provide an estimate of the travel time; but without full modeling of flows and operations, a reliable determination of travel time and its impact cannot be stated. So, while it is clear from the occurrence and magnitude of higher conductivity values downstream that conductivity increased in the Aqueduct, even when adjusted for the estimated travel time, the true impact of any turn-in operations was likely less than the 206 $\mu\text{S}/\text{cm}$ increase, which was observed in the raw data.

Water quality influences from WWD on all COC concentrations within the Aqueduct were determined by using discrete grab samples. These samples were collected by DWR at locations upstream (Check 13) and downstream (Check 21) of the WWD turn-ins. Samples were typically collected at these locations on the same day. For this reason, the samples did not account for travel time over the 101-mile distance between locations. As such, water collected at one location will not constitute the same parcel of water collected at the other. Consequently, differences in COC concentrations within a sample pair did not necessarily represent a specific influence from turn-ins to the Aqueduct. Yet, differences in sample pairs over time illustrated prevailing trends showing the preponderance of changes attributable to turn-ins. These prolonged trends were used to make conclusions regarding effects from WWD groundwater inflows. Overall, us/ds changes for nearly all constituents were small compared to the natural variation in the Aqueduct upstream of WWD turn-ins.

The results from us/ds samples were analyzed and are depicted graphically in Figure 3-4, including sample pairs for the month before and after the turn-in period. Figure 3-4 also displays the daily

combined POA for all WWD turn-ins. Only two Aqueduct samples exceeded an MCL; both were downstream samples that exceeded the manganese secondary MCL of 0.05 mg/L for drinking water. All Aqueduct water quality data for 2016 are tabulated in Appendix B.

Arsenic

Arsenic samples showed minor increases or no change between us/ds locations, which is consistent with expected results based on wellhead concentrations. Sample pairs had upstream increases of 0.001 mg/L in April and June and did not change during the other turn-in months (Figure 3-4A). The first downstream increase in arsenic occurred two weeks after turn-ins began and one week after POAs reached the highest level of the year. In May, the month with the second largest average POA behind April, downstream arsenic decreased to the level seen upstream, then increased again in June. In July and August, upstream arsenic increased to 0.003 mg/L and downstream arsenic remained at this level through September. The presence of slight downstream increases is consistent with the average wellhead concentration of 0.004 mg/L, which was greater than all upstream concentrations during months with turn-ins (Table 3-3).

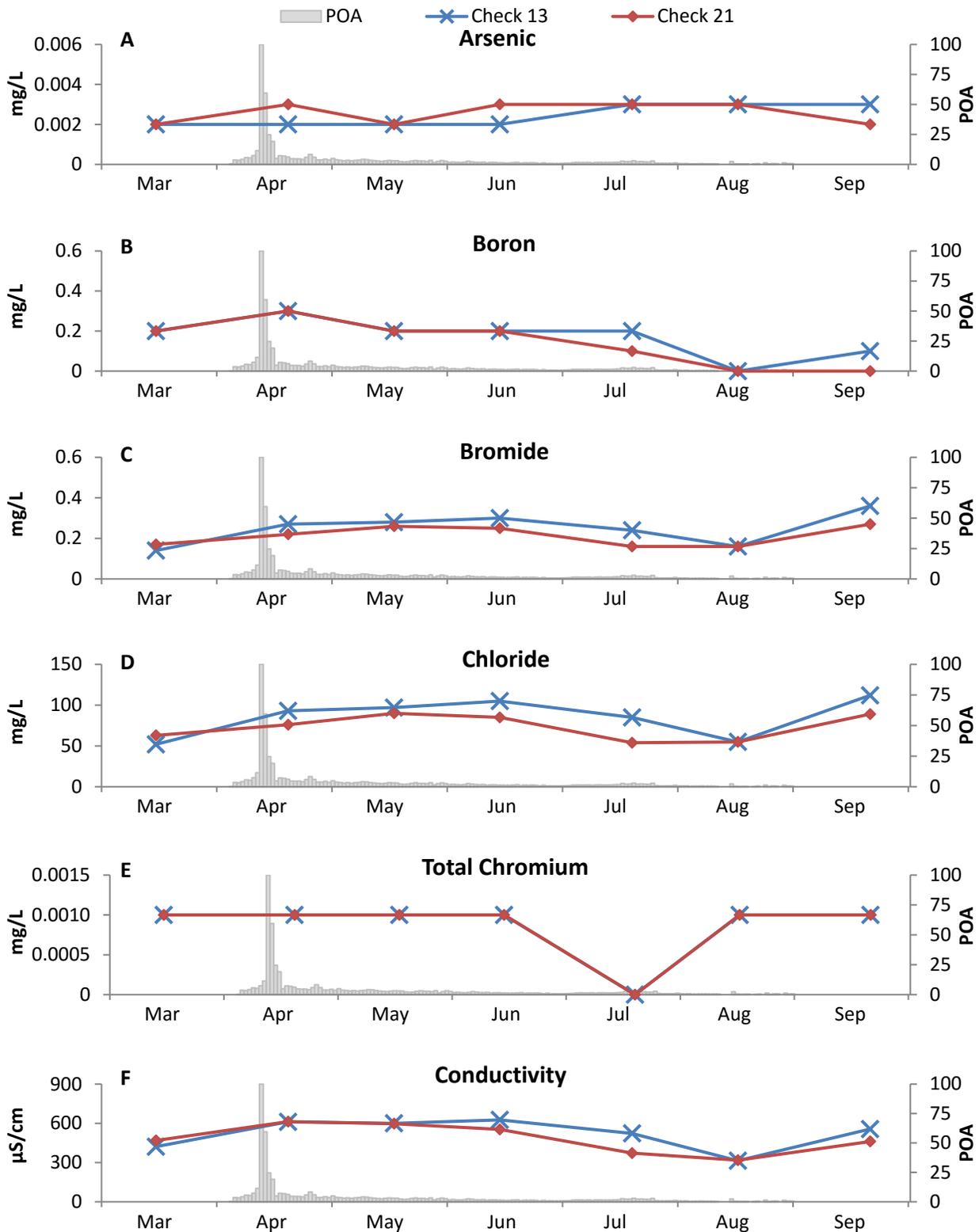
Boron

Downstream boron was equal to upstream concentrations for all but one decreasing sample pair, which is inconsistent with higher-concentration wellhead samples relative to the Aqueduct. Both upstream and downstream boron increased after turn-ins began, before slowly declining together through the end of the turn-in period, except in July when downstream concentrations declined slightly more (Figure 3-4B). The mirrored trends in us/ds samples and the single decreasing pair are inconsistent with wellhead concentrations that had a higher average concentration of 0.89 mg/L (Table 3-3), compared with upstream concentrations.

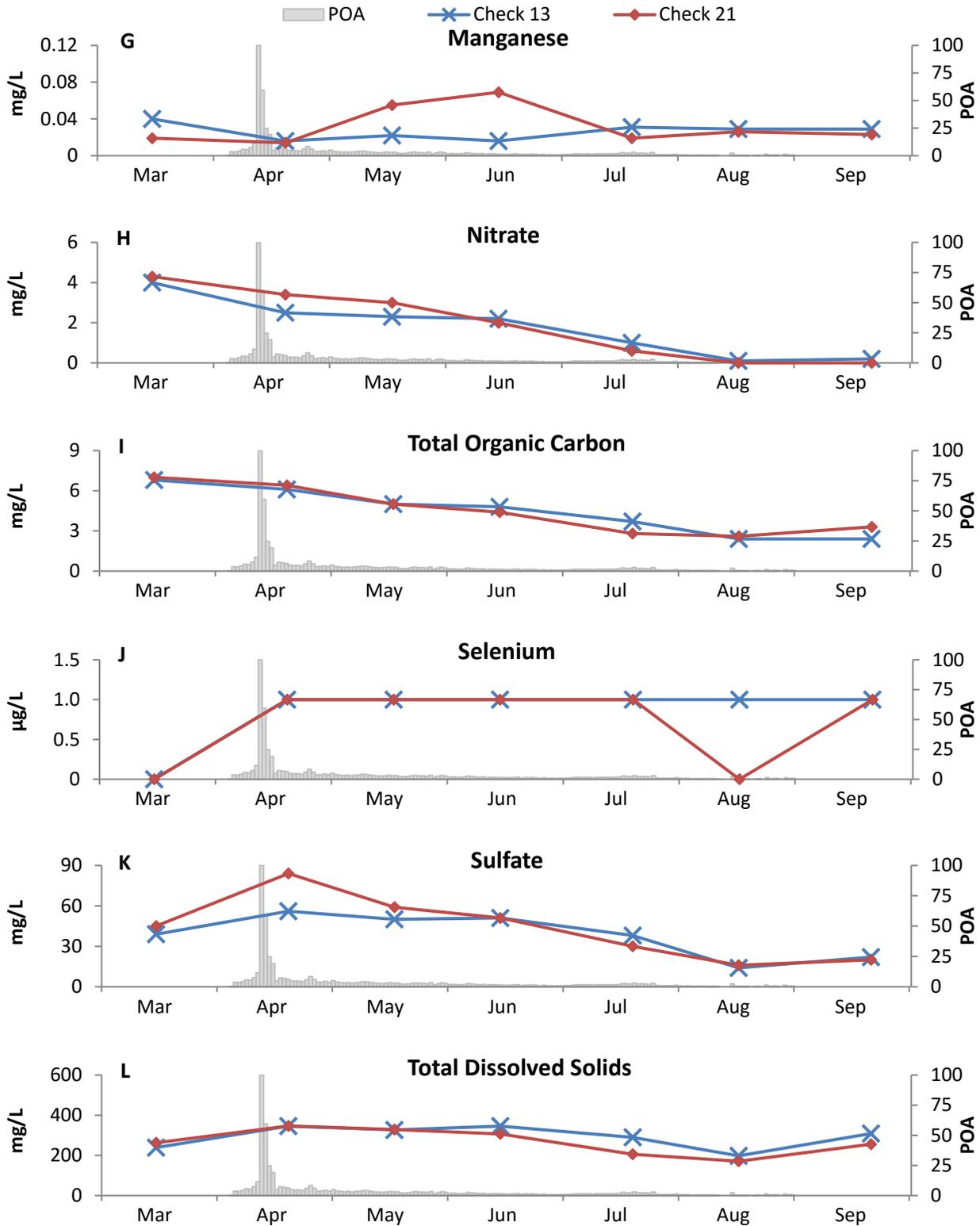
Bromide

Nearly all bromide sample pairs showed decreases, which is inconsistent with higher-concentration wellhead samples relative to the Aqueduct. Both upstream and downstream concentrations slowly increased from March to June after which point both locations slowly declined again, with downstream bromide remaining lower by -0.02 to -0.08 mg/L, until August when us/ds samples were equal (Figure 3-4C). Following the cessation of turn-in activity, concentrations at both locations increased sharply with the upstream increase values rising more than the downstream increase values. The slight decreases in us/ds bromide concentrations are inconsistent with wellhead samples that averaged 0.41 mg/L (Table 3-3) in contrast with upstream concentrations that never exceeded 0.3 mg/L.

Figure 3-4 Water Quality Constituents-of-Concern at Check 13 and Check 21 and Westlands Water District Percentage-of-Aqueduct Values



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Notes:
 mg/L = milligrams per liter, POA = percentage-of-Aqueduct, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
 POAs of 100 percent during April represent days when Dos Amigos Pumping Plant was inactive.

Chloride

Chloride sample pairs followed an almost identical trend to bromide, but in this case, the trend agreed with wellhead-sample results. Both upstream and downstream concentrations slowly increased from March to June after which point both locations slowly declined again, with downstream chloride remaining lower by -7 to -31 mg/L, until August when us/ds samples were equal (Figure 3-4D). A similar trend was seen after turn-ins ended—a sharp increase at both locations with a slightly lower concentration downstream. The slight decreases in us/ds chloride concentrations are consistent with wellhead samples that averaged 63 mg/L (Table 3-3) contrasted with upstream concentrations that were no lower than 85 mg/L until August.

Total Chromium

Downstream total chromium (trivalent plus hexavalent chromium, unfiltered) remained equal to concentrations upstream throughout the turn-in period, but correlations with wellhead data were difficult to quantify. Total chromium at both locations remained at the MRL of 0.001 mg/L throughout the sample period, except in July when both locations were less than the MRL (Figure 3-4E). The lack of influence from turn-ins on total chromium concentrations coincided with wellhead samples, where all samples except Lateral 7 were less than the MRL (Figure 3-2E). But this comparison is unreliable because of the high MRL of 0.01 mg/L for all wells except Lateral 7 (Table 3-3).

Conductivity

During the turn-in period, conductivity decreased in a larger number of sample pairs and at a larger magnitude than increasing pairs; these decreases are inconsistent with wellhead-sample results. Conductivity decreases occurred in May–June, ranging from -3 to -151 $\mu\text{S}/\text{cm}$, while increases occurred in April and August, ranging from 2 to 4 $\mu\text{S}/\text{cm}$ (Figure 3-4F). The monthly trend for both locations was relatively smooth, with a slight increase through June followed by a slightly sharper decline into August. The smooth trend in discrete conductivity samples conflicted with the highly variable hourly conductivity measurements shown in Figure 3-3. This illustrates the potential for complex water quality trends to occur between discrete grab sample events. The analysis of Figure 3-3 showed more occurrences of increasing downstream conductivity when adjusted for estimated travel time, whereas the discrete samples show a prevalence toward decreasing conductivity. In this case, the timing of grab sample collection events provided data that was counter to the overall trend. This explains why decreases dominated the us/ds conductivity dataset, despite wellhead samples that averaged 1,259 $\mu\text{S}/\text{cm}$ (Table 3-3) contrasted with upstream concentrations that did not exceed 626 $\mu\text{S}/\text{cm}$.

Manganese

Manganese sample pairs had mixed results during the year; some trends agreed with the wellhead average, while others differed. Following the first month of turn-ins, downstream manganese increased sharply through June while upstream levels remained low (Figure 3-4G). The amount of increase for these samples (0.033 and 0.053 mg/L) are both larger than the variation observed in upstream concentrations throughout the period of operation, ranging from 0.016 to 0.031 mg/L. Both the May and June downstream samples exceeded the secondary MCL of 0.05 mg/L for manganese in drinking water. In July, downstream concentrations declined sharply to slightly less than upstream levels; both locations remained steady at these concentrations through the end of the sample period. The large downstream increase conflicted with the overall wellhead sample average of 0.03 mg/L (Table 3-3), which was very close to typical upstream concentrations. The increase may be explained by impacts from high concentration wells— 9 percent of samples were above the secondary MCL. On the other hand, any possible influence from these wells may have been offset by the low concentration wells—40 percent of samples were less than the MRL.

Mercury

Mercury reported less than the MRL of 0.2 µg/L in all five us/ds sample pairs (Appendix B) and consequently was not graphed on Figure 3-4. The lack of us/ds change concurred with wellhead samples that also reported <0.2 µg/L for all samples (Table 3-3).

Nitrate

Increases in nitrate occurred downstream during the months of highest POA, which concurred with the expected results based on turn-in concentrations, but subsequent decreases and an equivalent pair conflicted with this expectation. Both sampling locations declined throughout the turn-in period, with the first two sample pairs increasing by 0.9 and 0.7 mg/L, followed by two pairs decreasing by -0.1 and -0.4 mg/L, and the final pair showing no change (Figure 3-4H). The two increases happened during the months of largest POAs, while decreases occurred in months of lower POAs. The increases during higher POAs are consistent with the wellhead average of 6.9 mg/L (Table 3-3), which was higher than all upstream samples. The lack of increase during months of low POAs suggests turn-ins had much less impact in these months.

Total Organic Carbon

TOC sample pairs had minor variations throughout the sample period, with only a few samples that are consistent with expected results based on wellhead average. Both sampling locations declined throughout the turn-in period, with two sample pairs increasing by 0.2 and 0.3 mg/L and two pairs decreasing by -0.4 to -0.9 mg/L, with one pair not changing (Figure 3-4I). The largest increase

occurred one week after the highest POAs of the year, while the two decreases happened in months of low POAs. These results conflicted with wellhead samples that averaged 0.77 mg/L (Table 3-3), contrasted with upstream samples that were no lower than 2.4 mg/L. This suggests TOC concentrations should have exhibited larger decreases during higher POAs.

Selenium

Selenium was equal in all but one us/ds pairs; any impacts from turn-ins were difficult to quantify because of their higher MRL. During the turn-in period, both upstream and downstream samples remained at the MRL of 1 µg/L, except for one downstream sample that was less than the MRL (Figure 3-4J). This indicated the influence from turn-ins was minor-to-nonexistent, but this was difficult to quantify because most wellhead samples, 53 percent, were reported at the MRL of 2 µg/L (Table 3-3).

Sulfate

Sulfate primarily increased in us/ds sample pairs; this tendency toward increasing concentrations is consistent with high-sulfate samples collected from the turn-ins. Upstream sulfate slowly declined throughout the sampling period, while downstream sulfate had a large increase during the first month of turn-ins followed by a consistent decline through the end of turn-in activities (Figure 3-4K). The largest increase, 28 mg/L in April, occurred a week after the highest POAs of the year, while smaller deviations of -8 to 9 mg/L occurred during months of lower POAs. The large increase and its coincidence with high POAs is consistent with the wellhead average of 404 mg/L (Table 3-3), contrasted with upstream samples that were no greater than 56 mg/L.

Total Dissolved Solids

During the turn-in period, TDS decreased in a larger number of sample pairs and at a larger magnitude than increasing pairs; these decreases are inconsistent with wellhead-sample results. In the first two months of turn-ins, during the highest POAs, us/ds sample pairs increased by 1 to 2 mg/L after which point us/ds pairs decreased by -27 to -84 mg/L (Figure 3-4L). The lack of increases during high POAs and the prevalence of large decreases are inconsistent with wellhead samples that averaged 801 mg/L (Table 3-3), as compared with upstream samples that were no greater than 346 mg/L. This inconsistency mirrored a similar result for the closely related constituent, conductivity. The possible explanation for inconsistencies in conductivity results—that is, the timing of discrete grab sample collections contrasted with variable trends in the Aqueduct—may also explain the inconsistency observed for TDS.

Detailed Lateral 7 Water Quality Analysis

The 2016 WWD turn-in program included an individual monitoring plan for groundwater conveyed through Lateral 7. This provision is similar to the requirement in the 2015 monitoring plan but differs from other past WWD turn-in projects. The water in Lateral 7 originates in the Mendota Pool, which comingles groundwater from WWD wells with surface water from the Delta-Mendota Canal (DMC), San Joaquin River, and Fresno Slough. The added influence on Lateral 7 water quality from these surface-water sources, absent in other WWD turn-ins, necessitated the more stringent requirements that was placed on this turn-in.

During the 2016 turn-in program, WWD admitted 14,486 af of water to the Aqueduct through the Lateral 7 facility (Table 3-4). Monthly turn-in totals ranged from 1,482 af in August to 4,146 af in May. Monthly POAs for Lateral 7 ranged from 0.5 percent in August to 2.8 percent in April. Daily turn-in volumes and POAs varied largely throughout the turn-in period; Figure 3-5 displays daily Lateral 7 POAs as bars on each graph. On one occasion, pumping at DAPP stopped, while Lateral 7 turn-ins continued. The resulting POAs for these days were 100 percent, which indicated that turn-ins were responsible for total inflow but not the total volume in the Aqueduct for that day (Figure 3-5). Lateral 7 also made up a slight majority, 51 percent, of all water admitted by WWD in 2016 (Table 3-4). During April–July, the percentage of water admitted through Lateral 7 ranged from 43 to 52 percent. But in August, turn-ins from all individual wells stopped and Lateral 7 was the only WWD facility to admit water.

The monitoring procedures for Lateral 7 are comparable to those for the individual wells, discussed previously, although the Lateral 7 sampling frequency was higher. Monitoring for Lateral 7 consisted of samples, collected by Reclamation during Lateral 7 operations, from Lateral 7 and from two Aqueduct locations—one sample each upstream and downstream of the Lateral 7. Analysis of these samples included all the COCs measured for the individual wells, except mercury. Sampling was required weekly for the first month and monthly thereafter, although Reclamation collected extra samples in 2016. Additionally, Reclamation was also required to take field measurements for conductivity and turbidity during the aforementioned sampling. Statistical results for the Lateral 7 grab samples and field measurements are shown on Table 3-5. The raw data is tabulated in Appendix B.

The us/ds samples bracketing Lateral 7 help with the identification of possible influence from Lateral 7 on Aqueduct water quality concentrations. These sampling locations were located upstream at Lincoln Ave. bridge (MP 113.82) and downstream at Manning Ave. bridge (MP 117.47). The proximity of these samples to Lateral 7 (MP 115.43) limits the influence travel time and downstream migrating slugs of differing water quality have on paired samples. Furthermore, these

Table 3-4 Monthly Totals for Lateral 7 Inflows, Average Monthly POA values, and Percent of Total Westlands Water District Volume

	Lateral 7 Inflow (af)	Average Monthly POA	Percent of Total WWD Volume (af)
April	4,033	2.8	52
May	4,146	1.5	50
June	2,225	0.6	43
July	2,601	0.7	44
August	1,482	0.5	100
Total Volume or Percent^a	14,486	1.0	51

Notes:

af = acre-feet, POA = percentage-of-Aqueduct, WWD = Westlands Water District

^aPercent values refer to the POA or the Lateral 7 percent of total volume for the whole year combined.

sampling locations exclude other WWD turn-in facilities, and as a result, isolate Lateral 7 and its influence on Aqueduct water quality. The concentration ranges and statistical analysis for us/ds samples pairs are shown on Table 3-6. The raw results for each sample pair are graphed in Figure 3-5 and tabulated in Appendix B.

Arsenic

Arsenic exhibited only minor us/ds divergences during the turn-in period, and this was a trend not well supported by Lateral 7 sample results. The majority of sample pairs showed downstream increases of 0.0006 mg/L or less, while the remaining pairs decreased by -0.0004 mg/L or did not change (Table 3-6). These deviations were small, relative to upstream Aqueduct concentrations of 0.0019 to 0.003 mg/L. The downstream increases occurred early in the turn-in period, during periods of high or increasing POAs (Figure 3-5A). Concentrations in the Lateral 7 samples supported the prevalence of arsenic increases, but the low POA values for much of the year likely limited further increases. Arsenic in Lateral 7 ranged from 0.0036 to 0.0102 mg/L, with an average of 0.0064 mg/L (Table 3-5). The maximum concentration for Lateral 7 came in the initial sample and was the only sample to exceed the MCL of 0.01 mg/L for arsenic in drinking water.

Boron

Boron frequently increased in us/ds sample pairs; a result that is consistent with samples collected from Lateral 7. All but two pairs increased within a range of 0.001 to 0.102 mg/L (Table 3-6). Concentrations at both locations steadily decreased throughout the sampling period, with one exception in July, and the largest increases occurred in the first five sample events (Figure 3-5B).

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Table 3-5 Water Quality Summary of Constituents-of-Concern in Inflows from the Turn-in Lateral 7 to the San Luis Canal, April–August 2016

Statistic	Arsenic	Boron	Bromide	Chloride	Total Chromium	Conductivity (µS/cm)
MRL	0.002	0.1	1 ^c	1	0.0005	1
Program MCL ^a	0.01	2.0	NA	250	0.05	2,200
Average ^b	0.0064	1.03	0.86	156	0.0059	1,562
Median ^b	0.006	0.99	1.00	153	0.0046	1,543
Minimum	0.0036	0.81	0.59	117	0.0012	1,340
Maximum	0.0102	1.34	1.1	201	0.0301	2,182
Count	21	21	21	21	21	21
<MRL (#)	0	0	10	0	0	0
<MRL (%)	0	0	48	0	0	0
>MCL ^b (#)	1	0	NA	0	0	0

Statistic	Nitrate	Total Organic Carbon	Selenium (µg/L)	Sulfate	Total Dissolved Solids	Turbidity (NTU)
MRL	Variable ^d	1	0.4	1	5	NL
Program MCL ^a	45	NA	20	600	1,500	NA
Average ^b	1.46	2.1	0.406	375	972	48
Median ^b	1.20	1.9	<0.4	349	956	44
Minimum	<0.5	<1	<0.4	260	822	27
Maximum	3.5	3.9	0.531	620	1,390	141
Count	21	21	21	21	21	21
<MRL (#)	7	1	20	0	0	0
<MRL (%)	33	5	95	0	0	0
>MCL ^b (#)	0	NA	0	1	0	NA

Notes:

MCL = maximum contaminant level, MRL = method reporting limit, NA = not applicable, NL = not listed, NTU = nephelometric turbidity units, pCi/L = picoCuries per liter, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

^aMCLs were modified for conductivity, selenium, sulfate, and total dissolved solids. Some constituents don't have an MCL.

^bNon-detectable results were analyzed at the MRL.

^cMRLs varied for different samples; 10 samples reported at an MRL of 1 mg/L despite other samples being below that value. This upwardly skews the overall average.

^dMRLs varied for different samples. The MRLs used were 0.5 mg/L, 0.8 mg/L, 1 mg/L, and 6.2 mg/L.

These larger increases occurred during the periods of high POAs, which is consistent with Lateral 7's average boron concentration of 1.03 mg/L (Table 3-5), as compared with the maximum upstream concentration of 0.239 mg/L.

Table 3-6 Upstream/Downstream Concentration Changes for Lateral 7

Analyte	Concentration Range		Increases			Decreases			No Change
	Check 13 (Upstream)	Check 21 (Downstream)	# of Samples	Range	Average	# of Samples	Range	Average	# of Samples
Arsenic	0.0019 – 0.003	0.002 – 0.0031	14	0.0001 – 0.0006	0.0002	3	-0.0001 – -0.0004	-0.0002	4
Boron	0.059 – 0.239	0.0643 – 0.336	19	0.001 – 0.102	0.0175	1	-0.004	-0.004	1
Bromide	<0.5 – 0.54	<0.5 – 0.55	2	0.01 – 0.5	0.26	0	NS	NS	19
Chloride	51.4 – 100	52.2 – 100	15	0.3 – 9.3	2.1	5	-1.4 – -3.8	-2.5	1
Total Chromium	<0.0005 – 0.0012	<0.0005 – 0.00086	7	0.00006 – 0.00086	0.0004	4	-0.00001 – -0.0012	-0.0004	10
Conductivity (µS/cm)	280 – 637	316 – 654	19	2 – 105	25	2	-15 – -18	-17	0
Nitrate	<0.5 – 5.2	<0.5 – 3.9	8	0.02 – 2.3	0.44	8	-0.1 – -3.99	-0.78	5
Total Organic Carbon	2.8 – 6.8	2.9 – 7	3	0.1	0.1	9	-0.1 – -2	-0.4	7
Selenium (µg/L)	<0.4 – <0.4	<0.4 – <0.4	0	NS	NS	0	NS	NS	21
Sulfate	12.8 – 49.9	14.8 – 73	20	0.7 – 23.1	5.9	1	-1.9	-1.9	0
Total Dissolved Solids	168 – 372	168 – 381	14	2 – 38	15	5	-1 – -7	-4	2
Turbidity (NTU)	3.3 – 11.3	3.3 – 11.5	15	0.1 – 6.1	1.4	6	-0.4 – -2.5	-1.1	0

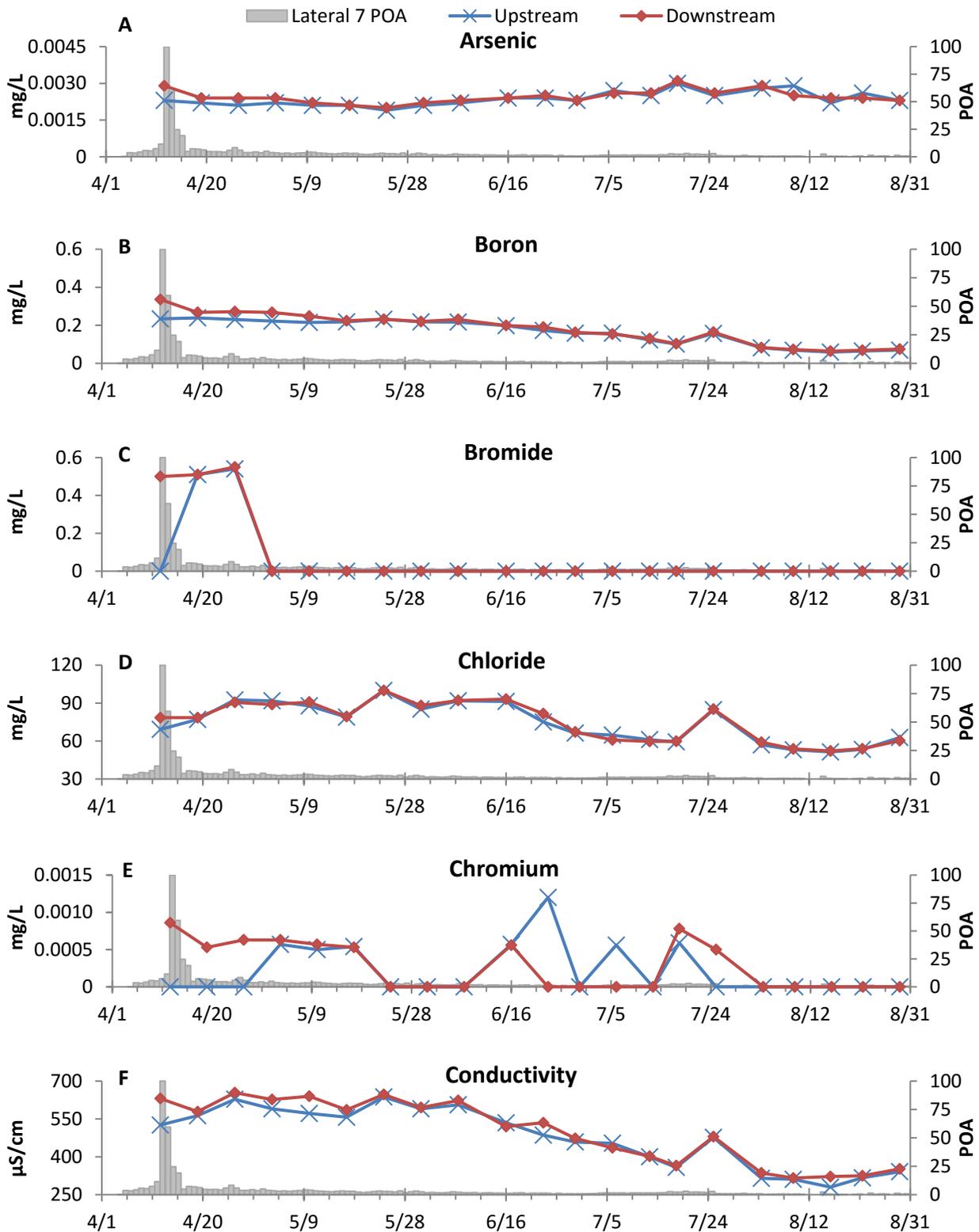
Notes:

Chromium [VI] = hexavalent chromium, mg/L = milligrams per liter, NS = no sample, NTU = nephelometric turbidity units, pCi/L = picoCuries per liter, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
 All measurements are mg/L (milligrams per liter) unless noted.

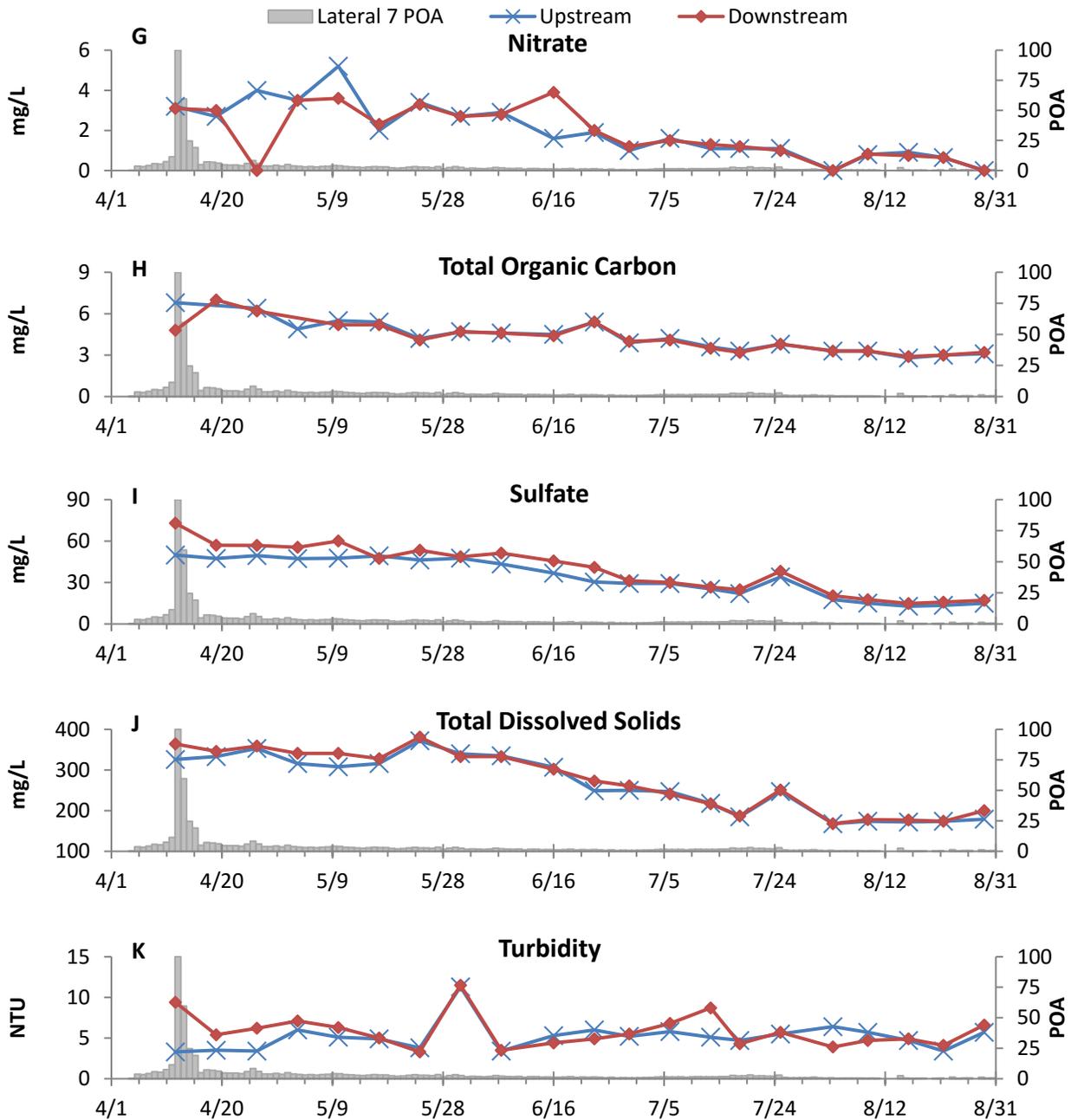
Bromide

Bromide concentrations did not change in all but two us/ds sample pairs; the lack of significant increases is inconsistent with Lateral 7 sample results. The first pair sampled was difficult to analyze because of the <MRL value reported upstream (<0.5 mg/L) compared with the result of 0.5 mg/L downstream. The second pair resulted in equivalent us/ds concentrations at 0.51 mg/L followed by an increasing pair from 0.54 to 0.55 mg/L. All other us/ds samples were less than the MRL of 0.5 mg/L (Table 3-6 and Figure 3-5C). The overall preponderance of equivalent downstream concentrations conflicted with Lateral 7 samples that ranged from 0.59 to 1.1 mg/L (Table 3-5).

Figure 3-5 Constituents-of-Concern Water Quality Upstream and Downstream of Lateral 7 in the San Luis Canal^a



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Notes:

mg/L = milligrams per liter, NTU = nephelometric turbidity unit, POA = percentage-of-Aqueduct, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter

The secondary y-axis (POA) is truncated to better show values less than 20 percent; two values exceed the truncation, equaling 100 percent. POAs of 100 percent during April represent days when Dos Amigos Pumping Plant was inactive.

^aUpstream location at Lincoln Avenue (milepost 113.82), downstream location at Adams Avenue (milepost 117.47).

While these values were higher than all upstream concentrations, definitive comparisons were difficult because 48 percent of Lateral 7 samples were reported as less than an MRL of 1 mg/L.

Chloride

Chloride exhibited only minor deviations throughout the sample period; the lack of significant increases is inconsistent with Lateral 7 sample results. The majority of sample pairs showed downstream increases of 9.3 mg/L or less, while the remaining pairs decreased by -3.8 mg/L or less and one pair did not change (Table 3-6). These deviations represented a negligible change relative to Aqueduct concentrations of 51.4 to 100 mg/L at the upstream site. The trends for us/ds samples were almost identical throughout the sampling period, showing only small fluctuations (Figure 3-5D). The lack of significant change in us/ds sample pairs was unexpected, because Lateral 7 samples ranged from 117 to 201 mg/L with an average of 156 mg/L (Table 3-5), as compared with the maximum upstream concentration of 100 mg/L.

Total Chromium

Total chromium (trivalent plus hexavalent chromium, unfiltered) exhibited some minor increases and decreases, though most sample pairs showed no change; the lack of significant increases is inconsistent with Lateral 7 sample results. While the us/ds deviations appeared large relative to upstream concentrations, the net change tended to be small. Further, when results less than the MRL were analyzed to be equal to zero, the range of deviations was -0.0012 to 0.00086 mg/L (Table 3-6). This range, nonetheless, was misleading because all deviating sample pairs, with one exception, were comparisons between one site at the MRL and the other site which was slightly above the MRL (Figure 3-5E). This indicates us/ds deviations may have been less than the values within the above range. The prevalence of equivalent sample pairs and relatively minor increases in others conflicted with Lateral 7 samples that ranged from 0.0012 to 0.0301 mg/L and averaged 0.0059 mg/L (Table 3-5), as compared with upstream samples that were no greater than 0.0012 mg/L.

Conductivity

Sample pairs for conductivity overwhelmingly increased downstream, except there were two decreases; the preponderance of increases is consistent with Lateral 7 measurements. All but two sample pairs increased by 2 to 105 $\mu\text{S}/\text{cm}$, while the two decreases were -15 and -18 $\mu\text{S}/\text{cm}$ (Table 3-6). Samples from both locations slightly declined during the sample period with the largest us/ds increases occurring in the first two months of operations when POAs were higher (Figure 3-5F). The two decreases, along with smaller increases, occurred later when POAs were lower. The abundance of increasing sample pairs coincided with Lateral 7 measurements that

ranged from 1,340 to 2,182 $\mu\text{S}/\text{cm}$ and averaged 1,562 $\mu\text{S}/\text{cm}$ (Table 3-5), as compared with the maximum upstream measurement of 637 $\mu\text{S}/\text{cm}$.

Nitrate

Nitrate sample pairs were split evenly between increasing and decreasing results; short-term trends can be explained by concentrations reported for Lateral 7. Eight sample pairs increased by 0.02 to 2.3 mg/L, eight sample pairs decreased by -0.1 to -3.99 mg/L, and five sample pairs did not change (Table 3-6). The presence of deviating and equivalent sample pairs was intermixed throughout the sample period. The only clear trend was the prevalence of larger fluctuations early in the sample period followed by only slight changes in the last two months (Figure 3-5G). The larger fluctuations early in the year coincided with higher upstream aqueduct concentrations from 2 to 5.2 mg/L, while the smaller fluctuations in the last two months coincided with upstream concentrations from <0.5 to 1.9 mg/L. By comparison, the nitrate concentrations for Lateral 7 ranged from <0.5 to 3.5 mg/L with an average of 1.46 mg/L (Table 3-5). These statistics were slightly skewed by differing reporting limits between samples, including one sample reported as <6.2 mg/L. Regardless of this inconsistency, the bulk of the reportable data during the first half of the sampling period was less than upstream concentrations, which explained the two large decreases during that time. Conversely, the bulk of the reportable data in the second half of the sampling period was very close to the upstream concentrations, which explained the lack of large deviations during that time. The single large increase occurred on June 16 when the upstream concentration dropped while the downstream concentration elevated. This may be partially explained by the two Lateral 7 samples taken prior to this decrease, 3.1 and 3.5 mg/L, which represented the highest reportable concentrations for the year.

Total Organic Carbon

The bulk of TOC us/ds sample pairs reported downstream decreases, which is consistent with Lateral 7 sample results. Nine sample pairs decreased by -0.1 to -2 mg/L, three pairs increased by 0.1 mg/L each, and seven pairs did not change (Table 3-6). Samples from both locations slightly declined during the sample period with the largest and most consistent us/ds decreases occurring in the first two months of operations when POAs were higher (Figure 3-5H). For the remainder of the year, us/ds sample pairs showed small deviations from -0.1 to 0.1 mg/L, coinciding with low POA values. The presence of larger decreases during high POAs is consistent with Lateral 7 TOC concentrations that ranged from <1 to 3.9 mg/L and an average of 2.1 mg/L (Table 3-5), as compared with the higher concentrations upstream that averaged 4.3 mg/L.

Selenium

Selenium samples reported $<0.4 \mu\text{g/L}$ in all 21 us/ds sample pairs (Table 3-6) and for this reason, was not graphed on Figure 3-5. This lack of us/ds change was expected because all selenium samples at Lateral 7, except one, were also $<0.4 \mu\text{g/L}$ (Table 3-5).

Sulfate

Sulfate primarily increased downstream of Lateral 7, which is consistent with sample results from Lateral 7. All sample pairs but one increased by 23.1 mg/L or less, while the one exception decreased by -1.9 mg/L (Table 3-6). Samples from both locations declined throughout the sample period with the largest us/ds increases occurring in the first half of the sampling period when POAs were higher and smaller increases in the second half of the year when POAs were lower (Figure 3-5I). Except for one small increase and the single decrease, us/ds increases in the first half of the sampling period ranged from 7.1 to 23.1 mg/L, while increases during the second half ranged from 0.7 to 4.1 mg/L. These increases and the coincidence between larger increases and higher POAs is consistent with Lateral 7 samples that ranged from 260 to 620 mg/L and averaged 375 mg/L (Table 3-5), as compared with the lower concentration range of 12.8 to 49.9 mg/L at the upstream location.

Total Dissolved Solids

TDS primarily increased downstream of Lateral 7, which is consistent with sample results from Lateral 7. The majority of us/ds samples (14 pairs) increased by 38 mg/L or less, five pairs decreased by -7 mg/L or less, and two pairs did not change (Table 3-6). TDS concentrations slowly declined at both locations throughout the sample period with most of the larger increases, 6 to 38 mg/L, occurring in the first month when POAs were high (Figure 3-5J). During the months with lower POAs, us/ds deviations were smaller and ranged from -7 to 12 mg/L except for two notably larger increases. The abundance of increasing sample pairs and the coincidence between larger increases and higher POAs, is supported by Lateral 7 results that ranged from 822 to 1,390 mg/L and averaged 972 mg/L (Table 3-5), as compared with the lower concentration range of 168 to 372 mg/L at the upstream location.

Turbidity

Turbidity primarily increased downstream of Lateral 7, which is a result that is consistent with turbidity measurements taken from Lateral 7. The majority of us/ds samples, 15 pairs, increased by 0.1 to 6.1 nephelometric turbidity units (NTU), while six pairs decreased by -0.4 to -2.5 NTU (Table 3-6). Measurements from both locations fluctuated throughout the year, with one large spike observed at both locations on May 31 (Figure 3-5K). Most of the large us/ds increases occurred in

the first month of operations, when POAs were higher, and smaller increases and decreases occurred following that point, when POAs were lower. The preponderance of increasing sample pairs is supported by Lateral 7 turbidity measurements, which ranged from 27 to 141 NTU and had an average of 48 NTU (Table 3-5), as compared with the lower concentration range of 3.3 to 11.3 NTU at the upstream location.

IV. San Joaquin Field Division

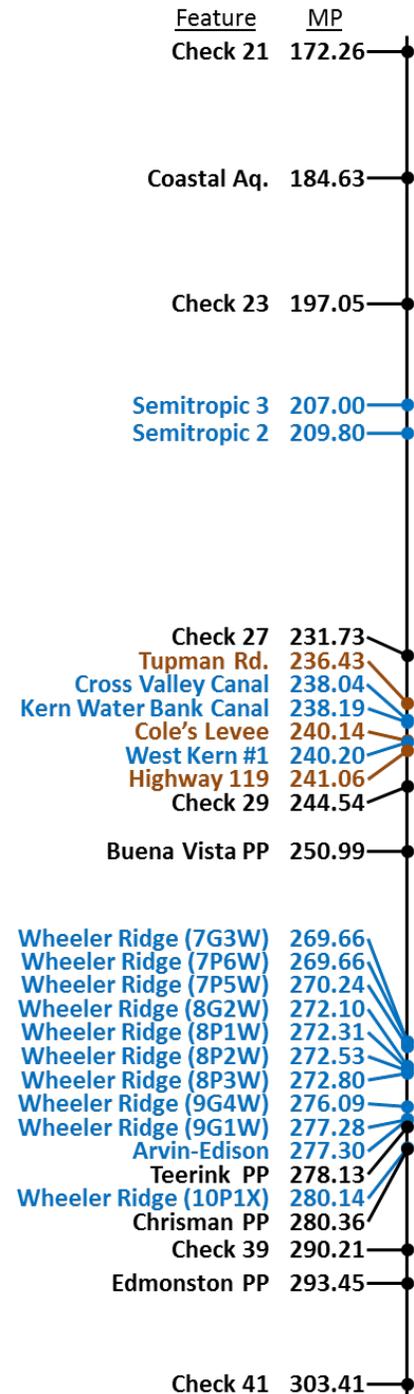
Turn-ins to the Aqueduct during 2016 were most extensive in the San Joaquin Field Division (SJFD), which extends from Check 21 to just past Edmonston Pumping Plant (EPP). Turn-in structures are located along the Aqueduct from MPs 207.00–280.14 (Figure 4-1). In 2016, there were 17 individual turn-in locations active in the SJFD, owned or operated by six different agencies or districts.

- Semitropic Water Storage District (SWSD) operated two turn-in structures—Semitropic 3 (SWSD 3) at MP 207 and Semitropic 2 (SWSD 2) at MP 209.8.
- Kern County Water Agency (KCWA) operated the Cross Valley Canal (CVC) at MP 238.04.
- Kern Water Bank Authority (KWBA) operated the Kern Water Bank Canal (KWBC) at MP 238.19.
- West Kern Water District (WKWD) operated one Aqueduct turn-in structure (West Kern #1) at MP 240.2. WKWD also pumped groundwater into CVC from a separate bank of wells.
- Wheeler Ridge-Maricopa Water Storage District (WRMWSD) operated 10 turn-in structures from MPs 269.66–280.14.
- Arvin-Edison Water Storage District (AEWSD) operated one turn-in structure at MP 277.30.

SWSD operates two turn-in structures capable of conveying groundwater from more than 442 wells in their service area. These wells are part of the Semitropic Groundwater Banking Program, which uses both locations, SWSD 3 and SWSD 2, as turn-in/turn-out structures for transferring water into and out of the program area.

CVC conveys groundwater and surface water to the Aqueduct from a number of entities and sources. The entities include KCWA-member units and nonmembers that operate groundwater

Figure 4-1 Schematic of Aqueduct Features in the San Joaquin Field Division including Turn-in Entity Sample Sites and Turn-in Structure Locations



Notes: MP = milepost, PP = pumping plant

recharge basins around the Kern Fan area. Participants include the Irvine Ranch Water District's (IRWD's) Strand Ranch Integrated Banking Project (SRIBP) and the Rosedale Rio-Bravo Water Storage District (Rosedale). Rosedale, a KCWA-member unit, operates 10 wells and IRWD operates seven wells. WKWD, also a KCWA-member unit, operates as many as five wells that deliver groundwater directly to CVC. Note that WKWD also pumps from a separate group of wells directly into the Aqueduct at the turn-in structure identified as West Kern #1. Cawelo Water District delivers groundwater and surface water from Friant-Kern Canal to CVC via Cawelo's conveyance channels. CVC also accepts groundwater from KWBA, Pioneer Property, City of Bakersfield's 2800 Acres, and the Berrenda Mesa Project. Additionally, CVC does not always convey all of its capacity to the Aqueduct. When demands within KCWA's service area requires deliveries, either all or a portion of the water in CVC is moved eastward toward the demand and away from the Aqueduct (positive mode).

KWBC conveys groundwater to the Aqueduct from up to 96 recovery wells located around the Kern Fan. Along with KWBA wells, several other entities participated in pumping groundwater to KWBC. These included the Pioneer Property, the Berrenda Mesa Project, the City of Bakersfield's 2800 Acres, and various private lands surrounding these projects. As stated previously, CVC has the ability to convey KWBA water to the Aqueduct. When this occurs, such water is counted in the CVC total turn-in volume and analyzed along with other water conveyed through CVC.

The West Kern Banking Project operates as many as 13 wells that discharge directly to the Aqueduct at their West Kern #1 turn-in structure. WKWD groundwater delivered directly to the CVC comes from a separate set of wells. The portion of WKWD groundwater conveyed through the CVC is incorporated with that turn-in's data. All discussion of WKWD groundwater in this report refers only to the West Kern #1 turn-in.

WRMWSD operates 10 turn-in structures. Each of these structures conveys groundwater from individual wells or from several wells that were manifolded into a single pipeline.

AEWSD operates a single turn-in structure, the AEWSD Canal, with numerous wells in AEWSD's service area available for participation. Kern Delta Water District (KDWD) also pumped groundwater from four wells into the AEWSD Canal. Other potential sources of water to the AEWSD Canal throughout the year include water from the CVC, Kern River, Friant-Kern Canal, and AEWSD farm wells. Similar to CVC, turn-ins from AEWSD and SWSD increased or decreased, depending on internal demand within their respective service areas. Internal demand was usually largest Monday–Friday and smallest on the weekends, resulting in changes to Aqueduct inflows corresponding with those periods.

Turn-in Volumes

Turn-in volumes for all SJFD participants totaled 170,303 af in 2016 (Table 4-1). CVC contributed the largest volume, which was 81,075 af for the year. This volume was 48 percent of the total volume from all SJFD turn-ins combined. The second largest source was AEWSD with 29,819 af (18 percent). KWBC contributed 25,861 af (15 percent). WRMWSD contributed 16,864 af (9.9 percent) from all 10 turn-in structures combined. SWSD contributed 14,512 af (8.5 percent) from both turn-ins; SWSD 3 contributed 13,255 af (7.8 percent) and SWSD 2 contributed 1,257 af (0.7 percent). WKWD contributed the smallest volume of water to the Aqueduct of any agency with 2,172 af (1.3 percent). The water WKWD pumped directly into CVC is not included in this total; it is included in the total volume for CVC.

Inflows to the SJFD from the Aqueduct upstream of Check 21 totaled 1,877,627 af for the year. Turn-ins comprised 8.3 percent of the water entering the SJFD during 2016, which includes the water entering the SJFD at Check 21 and the previously discussed SJFD turn-in volume. This value is much less than the same statistic for 2015, which was 37 percent (California Department of Water Resources 2016).

The total monthly volume for all turn-ins combined varied from 1,324 af in December to 48,142 af in April, excluding June when no turn-ins were active (Table 4-1 and Figure 4-2). CVC and WRMWSD were the only turn-ins to operate in the second half of the year. SWSD contributed the majority of its turn-in water from SWSD 3; their other turn-in, SWSD 2, only operated for the first few days of January. Monthly turn-in volumes were usually highest at CVC with volumes ranging from 178 af in February to 21,230 af in April. The exception to this was January and February when WRMWSD and AEWSD contributed the largest volumes because of operational shutdowns upstream in the Aqueduct during these months. Also during these months, AEWSD's source water was local groundwater but later months included Friant-Kern Canal water or were exclusively from that source. WKWD contributions to the Aqueduct were the smallest of all turn-ins for the first two months of operations, but contributed slightly more water than several other turn-ins during its last month of operations—a rare occurrence for this small turn-in.

Inflow variations from most sources reflect internal demands within the service areas of each turn-in entity. Internal demands typically increase during the summer months, when a greater proportion of the pumped groundwater is used within each individual service area for agricultural irrigation and possibly for drinking water. When these internal demands decrease from fall through spring, groundwater contributions to the Aqueduct typically increase. But since 2016 was a wetter year than recent years, a higher availability of water limited the need for local agencies to transport or transfer water using the Aqueduct.

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

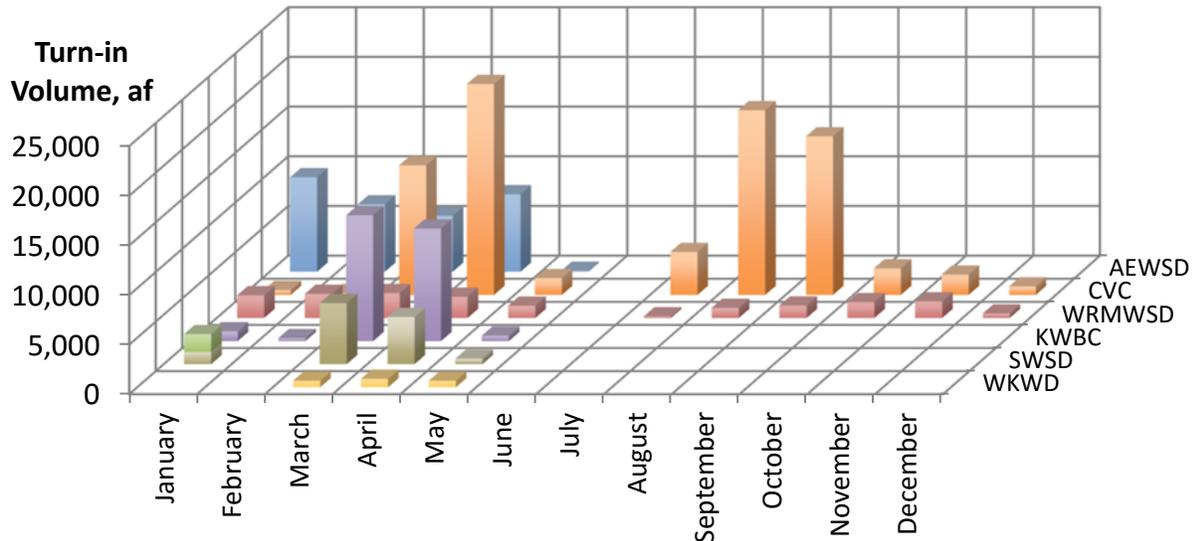
Table 4-1 Annual and Monthly Turn-in Volumes in the San Joaquin Field Division, 2016

	Inflow Check 21	SWSD 3	SWSD 2	CVC	KWBC	WKWD	WRMWS D	AEWSD	Monthly Total
January	11,146	1,781	1,257	492	989	0	2,288	9,506	16,313
February	25,846	0	0	178	300	0	2,435	6,787	9,700
March	118,779	6,159	0	13,048	12,681	660	2,516	5,626	40,690
April	120,249	4,762	0	21,230	11,341	855	2,150	7,804	48,142
May	231,785	553	0	1,693	550	657	1,251	96	4,800
June	300,075	0	0	0	0	0	0	0	0
July	301,723	0	0	4,320	0	0	174	0	4,494
August	244,645	0	0	18,585	0	0	1,028	0	19,613
September	172,868	0	0	15,960	0	0	1,269	0	17,229
October	166,874	0	0	2,666	0	0	1,605	0	4,271
November	92,777	0	0	2,048	0	0	1,679	0	3,727
December	90,860	0	0	855	0	0	469	0	1,324
Annual Total	1,877,627	13,255	1,257	81,075	25,861	2,172	16,864	29,819	170,303
% of Total Pump-in		7.8	0.7	48	15	1.3	9.9	18	

Notes:

AEWSD = Arvin-Edison Water Storage District, af = acre-feet, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWS D = Wheeler Ridge-Maricopa Water Storage District

Figure 4-2 Monthly Turn-in Volumes in the San Joaquin Field Division, 2016



Notes:

AEWSD = Arvin-Edison Water Storage District, af = acre-feet, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWS D = Wheeler Ridge-Maricopa Water Storage District

Percentage-of-Aqueduct

The POA values were calculated for each participant or facility in the SJFD (Table 4-2 and Figure 4-3). POA values incorporate the total monthly turn-in volume for a specific turn-in combined with the total monthly Aqueduct volume passing that turn-in structure. The total monthly Aqueduct volume passing each turn-in structure was determined by using the formula

$$\text{Monthly volume at the nearest gauge} - \text{intervening deliveries} + \text{intervening turn-ins.}$$

This formula provides the most accurate volume used in the POA calculations for each turn-in structure. Note that these calculations are monthly totals and, as such, POAs would vary on any given day with specific turn-in and Aqueduct flow conditions. The average POA for each turn-in on Table 4-2 only includes months when a turn-in was operational. Since POAs reflect the percentage of all water flowing past a particular turn-in, all of the POAs (except SWSD 3) include upstream flows composed of both Aqueduct and SJFD turn-in waters.

Table 4-2 Monthly Percentages-of-Aqueduct Flow Composed of Turn-in Water, 2016

	SWSD 3	SWSD 2	CVC	KWBC	WKWD	WRMWSD	AEWSD
January	17	14	5.9	11	0	24	48
February	0	0	1.4	2.3	0	26	45
March	5.5	0	11	9.7	0.50	2.1	4.6
April	4.5	0	18	8.9	0.67	1.8	6.3
May	0.28	0	0.94	0.30	0.36	0.74	0.06
June	0	0	0	0	0	0	0
July	0	0	2.2	0	0	0.10	0
August	0	0	10	0	0	0.65	0
September	0	0	11	0	0	0.94	0
October	0	0	1.8	0	0	1.2	0
November	0	0	2.4	0	0	2.1	0
December	0	0	1.1	0	0	0.63	0
Average Monthly POA	6.9	14	6.1	6.4	0.51	5.5	21

Notes:

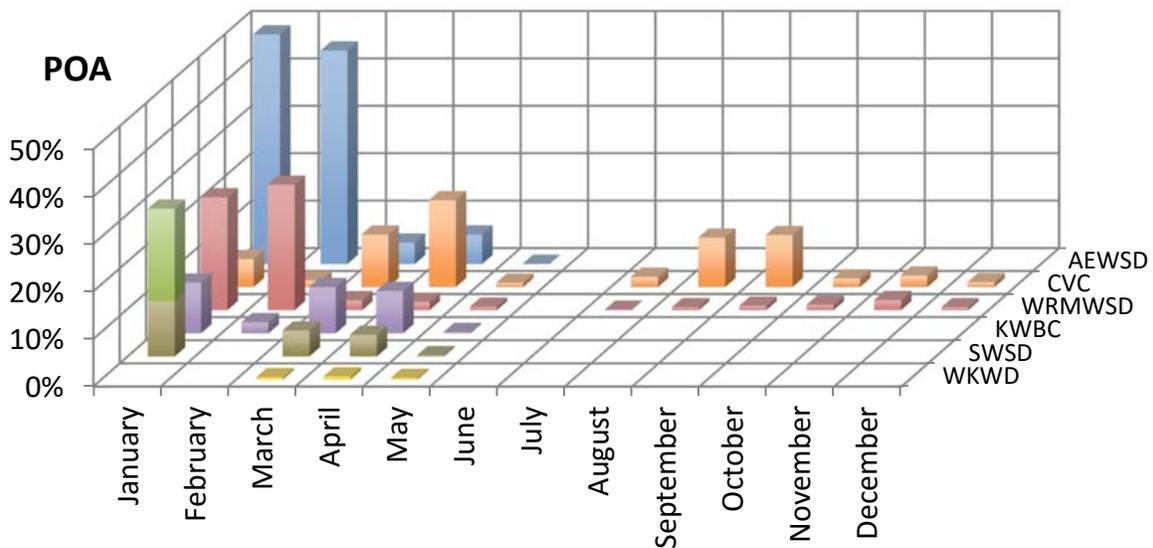
AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal,

POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

POA values exhibited large variations between participants and fluctuated throughout the year for each turn-in. AEWSD had the highest average POA value for the year of 21 percent, because of the very high POAs of 48 and 45 percent in January and February, respectively (Table 4-2 and Figure 4-3). WRMWSD also produced high POA values in January and February (24 and 26 percent, respectively); but lower POAs later in the year, ranging from 0.1 to 2.1 percent, brought the annual

average down to 5.5 percent. Both SWSD turn-ins also reported higher annual averages of 6.9 percent (SWSD 3) and 14 percent (SWSD 2). Yet, these values were skewed by higher POAs in January, because the stoppage of Aqueduct flows that month incorporated just a few days of operations. For SWSD 3, POAs after January did not exceed 5.5 percent. For SWSD 2, the turn-in did not operate after Aqueduct flows restarted, meaning the annual average shown in Table 4-2 represents just a few days of operations for the whole year. Slightly lower annual averages were reported for CVC and KWBC (6.1 and 6.4 percent, respectively), which also had lower maximum POAs than most other turn-ins—11 percent for both turn-ins. The only turn-in with lower POAs was WKWD, which had an annual average of 0.51 percent and a maximum monthly POA of 0.67 in April.

Figure 4-3 Monthly Percentages-of-Aqueduct Flow Composed of Turn-ins, 2016



Notes:

AEWS = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Project Operations

SWP operations in the SJFD varied throughout the year, based on water availability and demand. Water entering SJFD at Check 21 originated as exports from the south Sacramento-San Joaquin Delta, releases from San Luis Reservoir, and turn-ins by WWD. Monthly flow volumes at Check 21 ranged from 11,146 af in January to 301,723 af in July (Table 4-3 and Figure 4-4), with a total annual volume of 1,873,743 af. Further downstream at Buena Vista Pumping Plant (BVPP), monthly pumping volumes ranged from 8,004 to 190,507 af with a smaller total volume of 1,431,891 af. The volume of water pumped at EPP represented the total amount of water exiting the downstream end of the SJFD. In 2016, this volume ranged from 16,035 to 160,169 af per month with a total volume

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

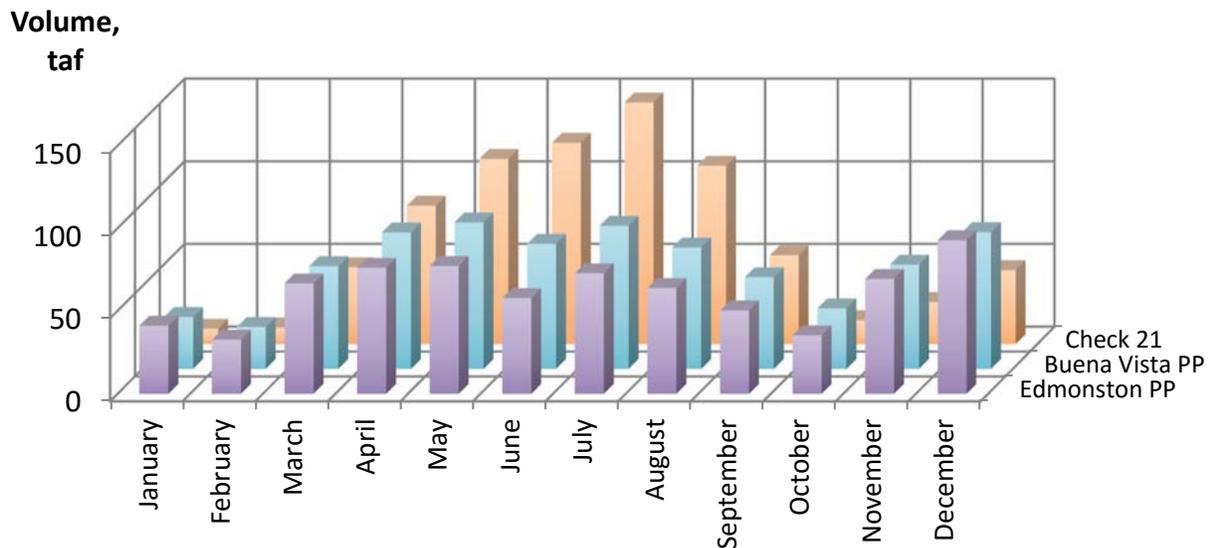
Table 4-3 Monthly Pumping and Aqueduct Flow throughout the San Joaquin Field Division, 2016

	Check 21	Buena Vista Pumping Plant	Edmonston Pumping Plant
January	11,146	8,695	19,863
February	25,846	8,004	16,035
March	118,779	123,265	125,689
April	120,249	124,282	126,151
May	231,785	180,325	160,169
June	300,075	190,507	158,982
July	301,723	188,012	155,853
August	244,645	171,224	144,985
September	172,868	141,723	127,213
October	166,874	140,275	128,000
November	92,777	79,758	74,525
December	86,976	75,821	72,993
Annual Total	1,873,743	1,431,891	1,310,458

Note:

All measurements are in acre-feet.

Figure 4-4 Monthly Pumping and Aqueduct Flow throughout the San Joaquin Field Division, 2016



Notes:

PP = pumping plant, taf = thousand acre-feet

of 1,310,458 af. During periods when monthly volumes upstream were less than downstream volumes, apparent during the first four months of the year, turn-ins provided the additional volume. Through coordinated schedules of pumping, turn-in discharges, and check-structure operations, DWR was consistently able to deliver available water in the SJFD and further south throughout 2016.

Along with pumping rates and turn-in volume, check-structure gate operations can affect flows and water quality downstream. Check structures are equipped with two-to-four radial gates spanning the width of the Aqueduct and are operated to regulate flow and water level (pool elevation). There are more than 60 check structures on the Aqueduct; they are spaced approximately 2–12 miles apart, depending on the design capacity of the reach in which they are located. The check-structure gates are routinely manipulated (i.e., opened, closed, or adjusted) throughout the day to accommodate changes in pumping rates and Aqueduct flow. These changes allow DWR to take advantage of diurnal/nocturnal electricity cost differences at pumping plants (on- and off-peak pumping). During 2016, the largest factor affecting gate operations was the need to stop or regulate flow during maintenance and repair activities in the Aqueduct. This was the case for some gate closures during January and February. During this time, several turn-ins operated and satisfied water needs in their areas and further south.

Check-structure gate operations in the SJFD have been assessed in the past to quantify the frequency and duration of closures. Gate closures between Check 21 and Check 41 are determined by using top-of-the-hour gate-position data. These data provide the height at which each gate was open at the top of the hour, and consequently does not include closures shorter than one hour. The following analysis for 2016 gate closures only incorporated data that indicated a full closure of the entire check structure. The limitation of gate-operation data to full closures lasting longer than one hour is to create a manageable dataset that only includes the gate operations that have the most impact. During 2016, Check 38 was missing data for January 1–February 6. Consequently, it is unknown whether the check structure was fully closed at all during this time.

There are 17 check structures from Check 21 to Check 41 and 14 checks had at least one closure during the year. The total number of closures for each check ranged from zero at Check 24, Check 39, and Check 41 to 170 closures at Check 37 (Table 4-4). Most closures were short and the pooling of water behind the gates was brief. The average duration of closures for the year ranged from one hour at Check 32 and Check 33 to more than 47 hours at Check 28; but some averages were skewed by long-term closures early in the year. Six checks had single closures lasting longer than ten days—all occurring in January and February. The longest single closures in this dataset lasted more than 52 days at Check 28 and Check 29. Table 4-5 shows these closures, and other

Table 4-4 Number of Consecutive Day Closures, Longest Closure Length, and Average Closure Length for Each Check Structure, 2016

	Total #	>12 Hours	>1 Days	>5 Days	>10 Days	Longest closure		Average closure	
						Days	hrs:mins	Days	hrs:mins
Check 21	5	1	0	0	0	0	15:00	0	6:43
Check 22	38	12	5	0	0	1	22:00	0	11:02
Check 23	40	10	1	0	0	1	5:00	0	7:55
Check 24	0	0	0	0	0	0	0	0	0
Check 25	10	0	0	0	0	0	11:00	0	4:04
Check 26	40	6	2	2	1	38	9:00	1	9:36
Check 27	47	5	2	2	1	42	13:00	1	6:43
Check 28	29	1	1	1	1	52	3:00	1	23:16
Check 29	34	2	1	1	1	52	19:00	1	18:14
Check 31	39	4	3	1	1	47	2:00	1	12:28
Check 32	2	0	0	0	0	0	1:00	0	0:57
Check 33	1	0	0	0	0	0	1:00	0	0:57
Check 34	61	13	7	3	1	16	19:00	0	21:07
Check 37	170	15	2	0	0	1	3:00	0	6:00
Check 38 ^a	17	0	0	0	0	0	10:00	0	7:26
Check 39	0	0	0	0	0	0	0	0	0
Check 41	0	0	0	0	0	0	0	0	0

Notes: Total number of closures represents all closures in the top-of-the-hour dataset.

^aData for Check 38 was missing January 1–February 6. Consequently, these statistics are not representative of the entire year.

smaller closures, as color-coded monthly percentages representing the proportion of each month a check structure was closed. Six checks had monthly closure percentages that were no greater than 25 percent, one check had monthly closure percentages no greater than 50 percent, one check had monthly closure percentages no greater than 75 percent, and six checks had monthly closure percentages of 75 percent or more during the year.

The most frequent and longest lasting period of check closures occurred during January and February when flow was stopped downstream of Check 29 to allow for repair work in Pool 30. During these months, Check 29 was closed 90 percent of time—representing just a few days at the beginning of January and a few days at the end of February when the check was open. The check structures immediately upstream (Check 26, Check 27, and Check 28) also experienced long-term closures. Likewise, downstream of the construction, pumping at BVPP (located where Check 30 would fall numerically) was stopped and Check 31 was closed for a similar amount of time as the upstream checks. While Aqueduct flow was stopped, turn-ins downstream of Check 31 continued to operate and supplied water to users further south. Additionally, check structures near the southern

Table 4-5 Percent of Each Month in which Check-Structure Gates were Fully Closed, 2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Check 21	5	0	0	0	0	0	0	0	0	0	0	0
Check 22	27	27	0.8	2	0	0	0	0	0	0.8	2	0.3
Check 23	15	17	2	6	0	0	0	0	0.3	1	2	1
Check 24	0	0	0	0	0	0	0	0	0	0	0	0
Check 25	0.7	0	3	1	0.5	0	0	0	0	0	0	0
Check 26	75	88	3	6	0.1	0	0	1	0	0.8	6	9
Check 27	89	89	5	5	0.1	0.1	0	0.9	0	0.5	6	8
Check 28	90	88	0	0	0.5	1.0	0	0	0	0.5	4	9
Check 29	90	90	0	0	0.7	0.8	0	1	0	1	6	12
Check 31	86	93	0	0	0.9	0.1	0	1	0	3	5	11
Check 32	0.3	0	0	0	0	0	0	0	0	0	0	0
Check 33	0.1	0	0	0	0	0	0	0	0	0	0	0
Check 34	62	90	4	7	2	0	0.3	0.7	0	0.7	5	11
Check 37	41	60	4	6	2	0.8	0.5	1	0	5	8	15
Check 38	0 ^a	0 ^a	0	0	0	0	0	0	0	0	2	15
Check 39	0	0	0	0	0	0	0	0	0	0	0	0
Check 41	0	0	0	0	0	0	0	0	0	0	0	0

Legend:	<25	25–50	50–75	>75
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Note:

All values in percent and includes all closures in the top-of-the-hour dataset.

^aData for Check 38 was missing January 1–February 6.

turn-ins (Check 34 and Check 37) were also closed at times to further manage pool elevations and water availability. Following the end of construction, normal Aqueduct operations resumed and full check closures became less frequent. For March through the end of the year, the largest percent closure during any month was 15 percent in December at two checks. The infrequency and short duration of closures after February stands in contrast to past years when check structure gates were manipulated more frequently to better manage available water during those dry years.

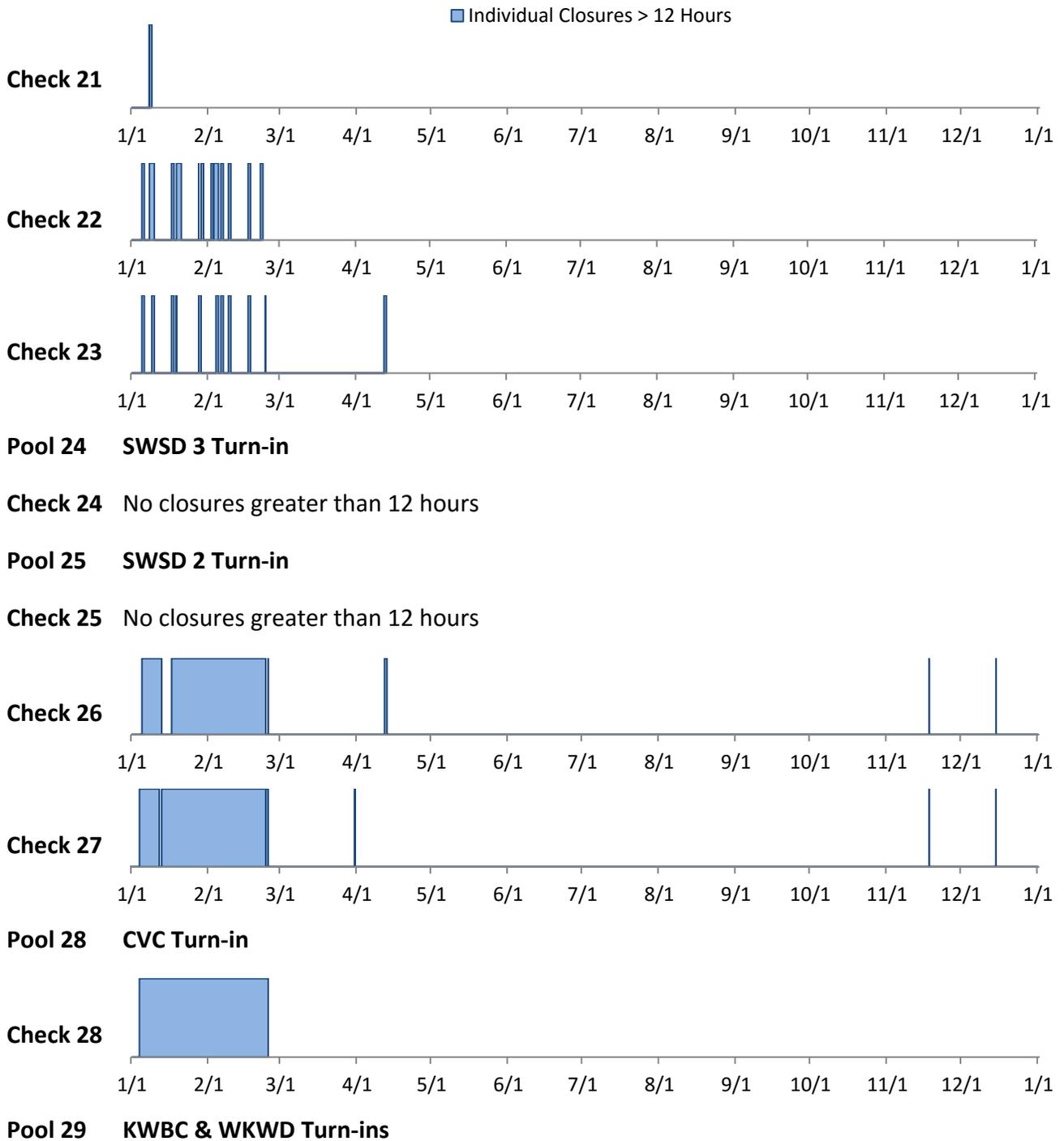
The direct impact of these closures on water quality in the Aqueduct is threefold. The first is the direct effect on water quality grab (discrete) sample results from each pool. Discrete samples are collected from the upstream side of a check structure, meaning a prolonged check closure would result in the accumulation of stagnant water in that pool. The second direct effect occurs when turn-ins are active and the opening or closing of gates, along with varied pumping rates, generates pulse-flow conditions. When this happens, downstream migrating parcels of water contain variable mixtures of constituents created by the pooling of water upstream of closed gates. In the case of a long-term check closure, waters between pools of the Aqueduct can be hydrologically separated,

producing waters of dissimilar composition and quality on either side of the structure. The third effect, though it is less direct, is the interruption of downstream flow from pool to pool. This disruption affects typical Aqueduct water quality analysis methods, which compare upstream and downstream samples. Knowing when check structures are closed can help with interpreting comparison samples collected along the Aqueduct.

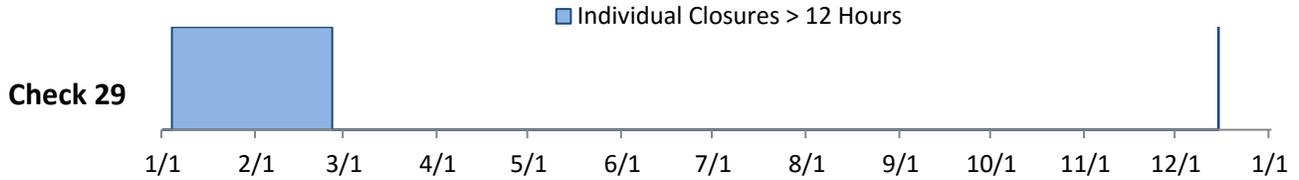
Figure 4-5 illustrates all closures lasting longer than 12 hours at SJFD check structures from Check 21 to Check 41. Each vertical bar or block represents a period of at least 12 consecutive “closed” data points from the top-of-the-hour dataset. In general, thin bars represent a single short-duration closure while wide blocks represent a single long-duration closure. Tightly packed bars represent multiple short-duration closures separated by short periods of open gates. Figure 4-5 also identifies, by pool number, the location of the turn-ins active during 2016 and also the locations of pumping plants within the SJFD. These facilities also have the ability to regulate flow in the Aqueduct, but hourly data similar to the check structure data was not obtained for pumping plants in 2016. Since the pumping plants are operated in conjunction with surrounding check structures to maintain water levels and flow in the Aqueduct, it is unlikely the operation of these facilities was significantly different from the check structures.

Figure 4-5 does not show the periods when check-structure gates are lowered, but are not fully closed. Partial closures happen more routinely than full closures, but perform the same function of regulating flow and water elevation in each pool. Partial closures can also affect water quality in the Aqueduct, in particular, when turn-ins are active. Examples of these effects were documented in Appendix D in *Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2013* (California Department of Water Resources 2014).

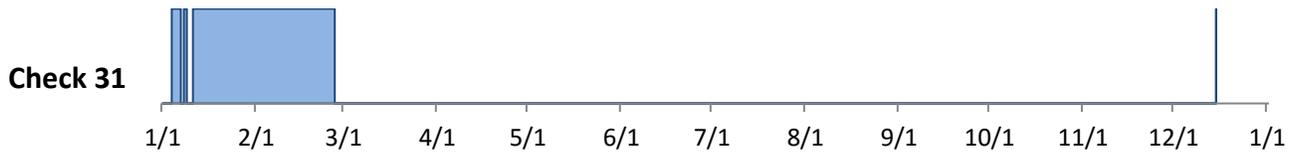
Figure 4-5 Individual Closures at Check Structures Lasting Longer than 12 Hours for 2016 and Locations of Turn-in Facilities



Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016



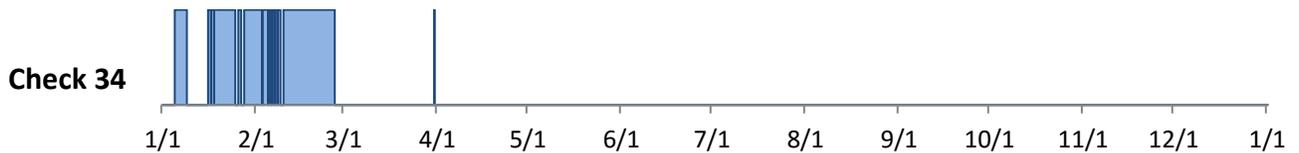
Buena Vista Pumping Plant



Check 32 No closures greater than 12 hours

Check 33 No closures greater than 12 hours

Pool 34 WRMWSD Turn-ins

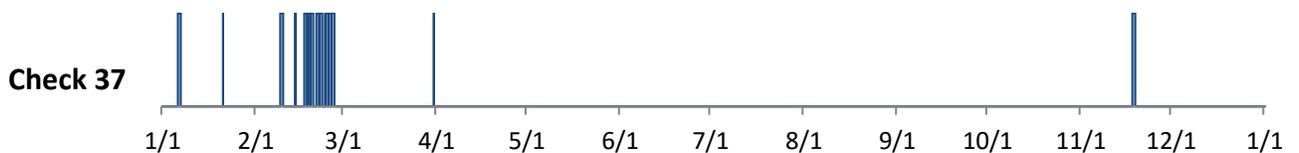


Pool 35 WRMWSD & AEWSD Turn-ins

Teerink Pumping Plant

Pool 36 WRMWSD Turn-in

Chrisman Pumping Plant



Check 38 No closures greater than 12 hours. No data for January 1–February 6.

Check 39 No closures greater than 12 hours

Edmonston Pumping Plant

Check 41 No closures greater than 12 hours

Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District
 Figures only include closures lasting longer than 12 hours.
 Similar hourly data was not obtained for the pumping plants.

Turn-in Water Quality

Throughout their operations, turn-in entities collected water quality samples from their input structures on the Aqueduct. The parameters sampled in SJFD included several COCs previously discussed in this report: arsenic, bromide, chloride, total chromium, hexavalent chromium, conductivity, nitrate, organic carbon, sulfate, TDS, and two radiological parameters—gross alpha or uranium. Appendix C lists all sample results by location and origin of data.

Some parameters, such as arsenic, chromium, and organic carbon, can be collected as total (unfiltered) and/or dissolved (filtered) samples. The sample type used in this report was typically the larger dataset for each constituent. But when there is no consistency between all turn-ins, total and dissolved fractions appeared together, as occurs for arsenic and organic carbon at WRMWSD. Because data originated from several laboratories, some of the COCs have more than one MRL. Given these disparities, some data were analyzed below the MRL of other data. For the purpose of consistency, data reported as <MRL were incorporated in the calculations and graphs as a value at the MRL. Because of the quarterly sampling schedule and low turn-in volumes for each individual WRMWSD turn-in structure, all WRMWSD data were combined to form a single dataset. Data from each of these turn-ins are shown separately in Appendix C. Also, while both SWSD turn-ins operated during 2016, SWSD 2 only operated for three days at the beginning of the year (as a continuation of the 2015 turn-in program). As such, no water quality data was collected from this turn-in.

Water quality data are presented in two different graphical formats and a statistics table. As previously stated, data below the MRL are graphed at the value of that MRL. A time-series plot provides an assessment of water quality trends for each COC at each turn-in throughout the year. In these plots, a bold border around a point identifies it as a sample less than the MRL. Additionally, the average concentration of all samples for a turn-in are shown as dashed lines in the background of the figure. While they span the width of the figure, they only represent data from the period of operation for each turn-in. Box-and-whisker plots present the median value bracketed by the first and third quartiles, and are shown as boxes. Whiskers on each box represent the highest and lowest non-outlying values, which are defined as points within 1.5x of the first and third quartile range. Any outlying values appear as individual points above or below the whiskers. Below the plots, a table provides common statistical information for each turn-in, including the number of samples less than the MRL and the number of samples greater than the MCL.

These box-and-whisker plots also display the annual average Aqueduct concentration from the nearest sampling sites upstream of each turn-in, identified in Table 4-6. The average at each turn-in only includes data from months that the turn-in was active. Statistical information for these upstream samples is provided at the bottom of each statistical table. Several variables are inherent

Table 4-6 Nearest Upstream Sampling Sites and Associated Turn-in Entities

Turn-in Entity	Upstream Sampling Sites	Averaging Period
SWSD 3	Check 21 and Check 23	January, March–May
CVC	Check 27 and Tupman Road	March–April, July–November
KWBC	Check 27 and Tupman Road	March–April
WKWD	Cole’s Levee	March–April
WRMWSD	Hwy 119 and Check 29	March–May, July–December
AEWSD	Hwy 119 and Check 29	March–May

Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

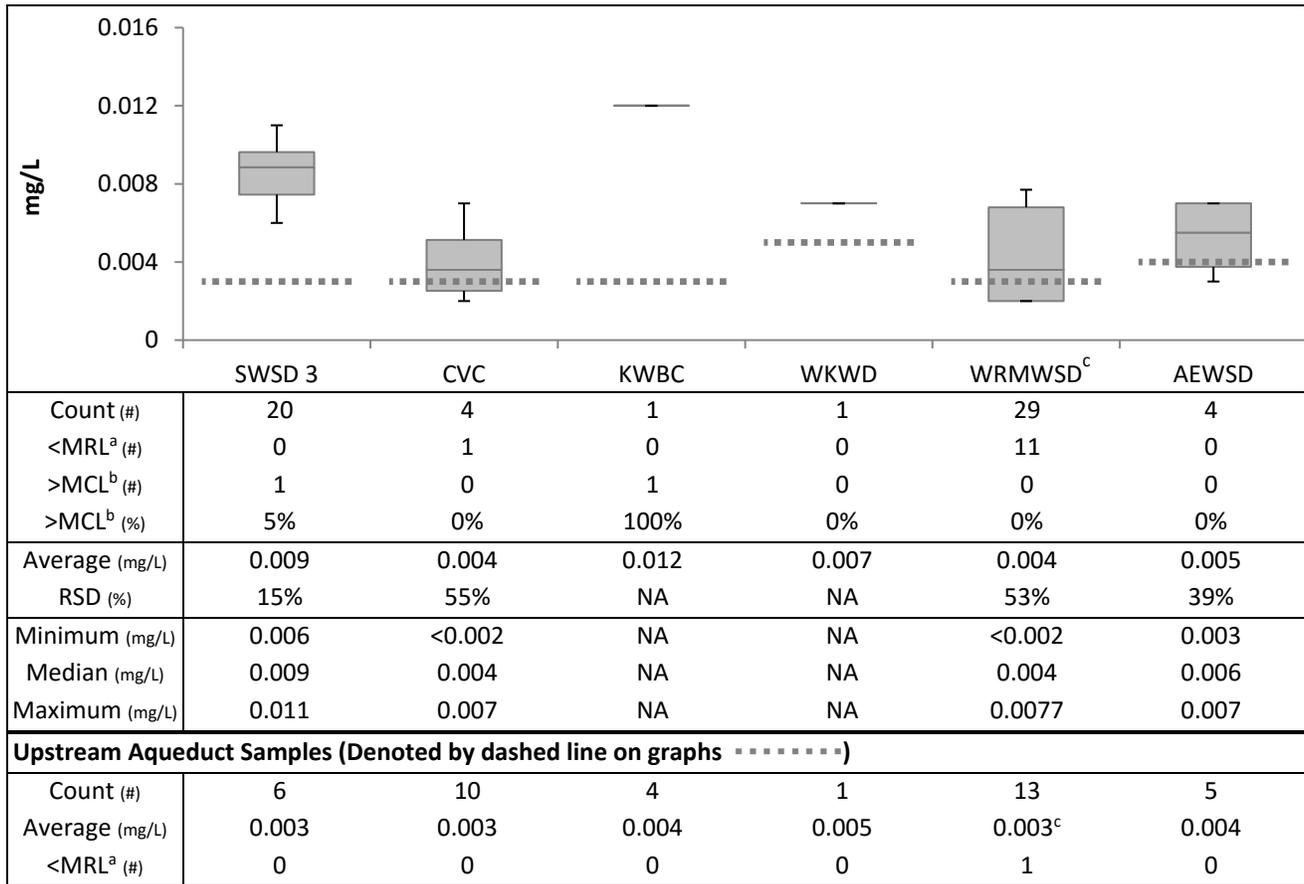
in the calculation of upstream averages, and accordingly, they do not necessarily represent specific or exact changes in concentration downstream of each turn-in. Only general comparisons can be made because multiple sites with variable sampling dates are combined in the calculation of each unique average. A more accurate analysis of concentration changes in the Aqueduct downstream of turn-ins is presented in the next section, titled “California Aqueduct Water Quality.”

Arsenic

The highest arsenic concentration was 0.012 mg/L in the one KWBC sample that was collected (Figure 4-6). Of the turn-ins that reported more than one sample, SWSD 3 had the highest average of 0.009 mg/L in its 20 samples. SWSD 3 samples reported a range of 0.006 to 0.011 mg/L. The maximum value of 0.011 mg/L was reported for one sample and was the only result, other than KWBC’s single sample, that reported greater than the MCL of 0.01 mg/L for arsenic in drinking water. AEWSD reported an average of 0.005 mg/L with a range of 0.003 to 0.007 mg/L. CVC and WRMWSD had very similar results, though CVC reported total arsenic and WRMWSD reported dissolved arsenic (filtered). Both CVC and WRMWSD reported averages of 0.004 mg/L and minimums that were less than the MRL of 0.002 mg/L. For CVC, one of four samples collected was below the MRL; for WRMWSD, 11 of 29 samples collected were below the MRL. Likewise, their maximum values were also close to each other, 0.007 mg/L (CVC) and 0.0077 mg/L (WRMWSD). WKWD reported its sole sample at 0.007 mg/L. Average arsenic concentrations for all turn-ins were above their upstream Aqueduct averages, which ranged from 0.003 to 0.005 mg/L (Figure 4-6).

Deviations in arsenic concentrations were apparent for several turn-ins (Figure 4-7). Arsenic concentrations for SWSD 3 showed no definitive trend over time, but rather fluctuated by ± 0.002 mg/L around the average throughout the sampling period. CVC samples remained no greater than 0.0045 mg/L through July before rising to 0.007 mg/L in November. The results for WRMWSD,

Figure 4-6 Arsenic Turn-in Statistics and Box-and-Whisker Plot



Notes:

AEWSO = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

The upstream sample sites used for each turn-in are shown in Table 4-6.

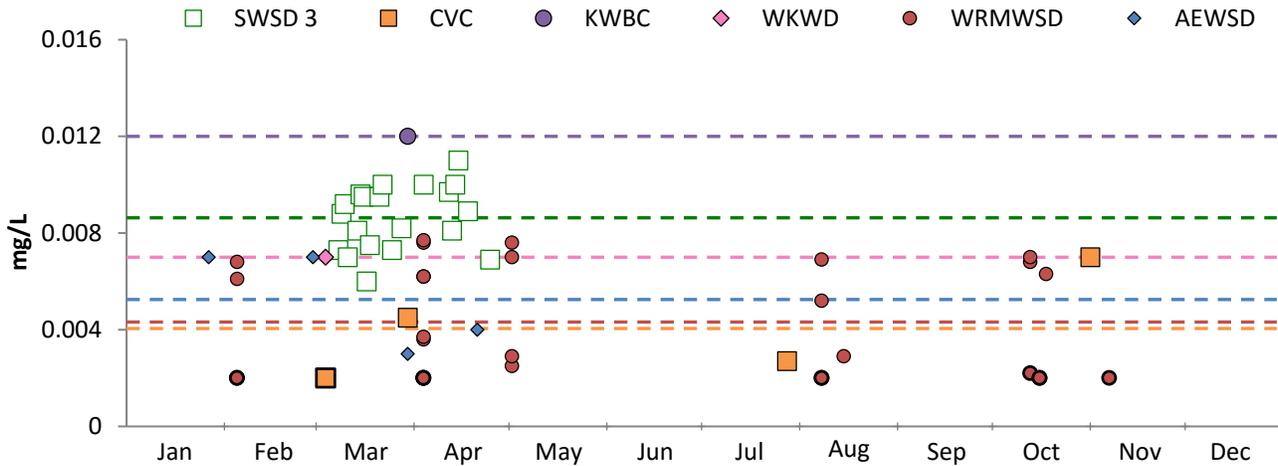
^aThe MRL was either 0.001, 0.002, or 0.0022 mg/L (see Appendix C). Some results reported concentration less than the MRL of other samples.

^bMCL for arsenic is 0.01 mg/L.

^cArsenic for WRMWSD is dissolved/filtered. All others are unfiltered.

as a whole, fluctuated greatly around the average, with no clear temporal trends. This was because of the inclusion of all 10 WRMWSD wells into one dataset. AEWSO reported higher concentrations in the January and February samples, 0.007 mg/L in each, and lower samples in March and April, 0.004 mg/L or less. This was because of a shift in the source of AEWSO water from groundwater originating exclusively in the AEWSO wellfields in January and February to an exclusive Friant-Kern Canal water source in April.

Figure 4-7 Time-Series Plot for Arsenic in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

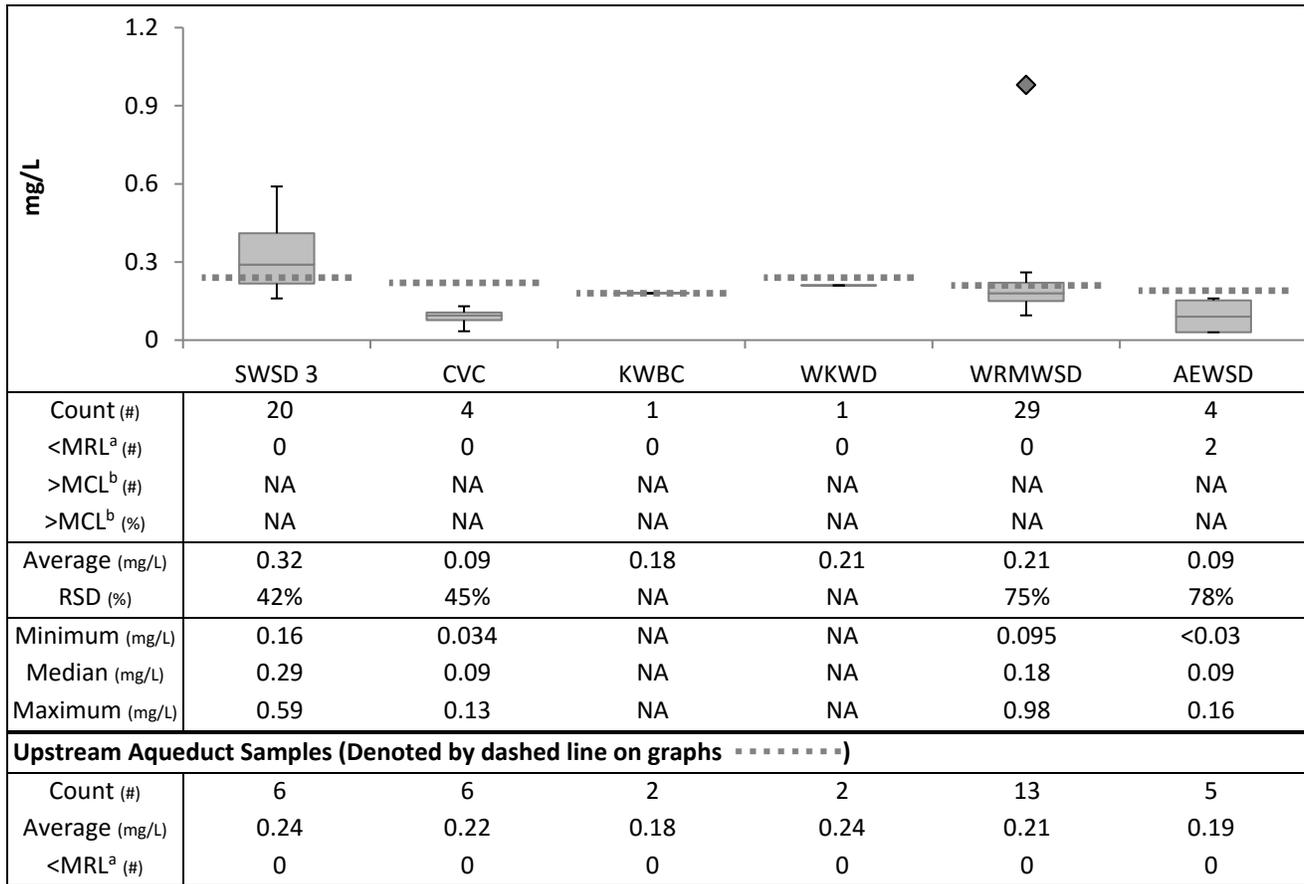
Arsenic for WRMWSD is dissolved/filtered. All others are unfiltered.

Bromide

SWSD 3 had the highest average bromide concentration of 0.32 mg/L and a range of 0.16 to 0.59 mg/L (Figure 4-8). The sole samples collected for KWBC and WKWD were lower than SWSD 3 at 0.18 and 0.21 mg/L, respectively. WRMWSD averaged 0.21 mg/L and reported the largest range because of one outlier sample with a high value equal to 0.98 mg/L. Both CVC and AEWSD averaged 0.09 mg/L for each of their four samples. AEWSD reported two samples below the MRL of 0.03 mg/L, which were the only samples <MRL for all turn-ins. Except for SWSD 3, all average turn-in concentrations were equal to or below upstream Aqueduct averages. There is no MCL for bromide in drinking water.

Bromide concentrations for SWSD 3 showed a declining trend during the sampling period, with only one sample greater than the average for the month of April (Figure 4-9). CVC samples reported close to the average except for one sample in July that was slightly lower. WRMWSD samples fluctuated around the average throughout the year, with the previously mentioned outlier sample in August being the only large deviation. AEWSD concentrations were higher than the MRL in the January and February samples, but were less than the MRL for March and April.

Figure 4-8 Bromide Turn-in Statistics and Box-and-Whisker Plot



Notes:

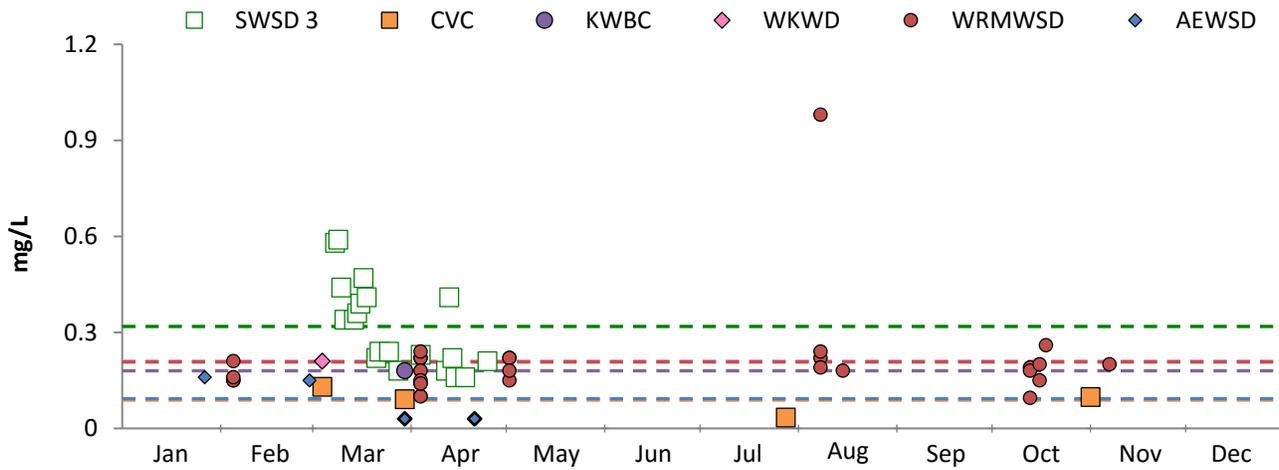
AEWSO = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe MRL equaled 0.03 mg/L for both <MRL samples and no samples reported less than the MRL of other samples.

^bThere is no MCL for bromide.

Figure 4-9 Time-Series Plot for Bromide in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

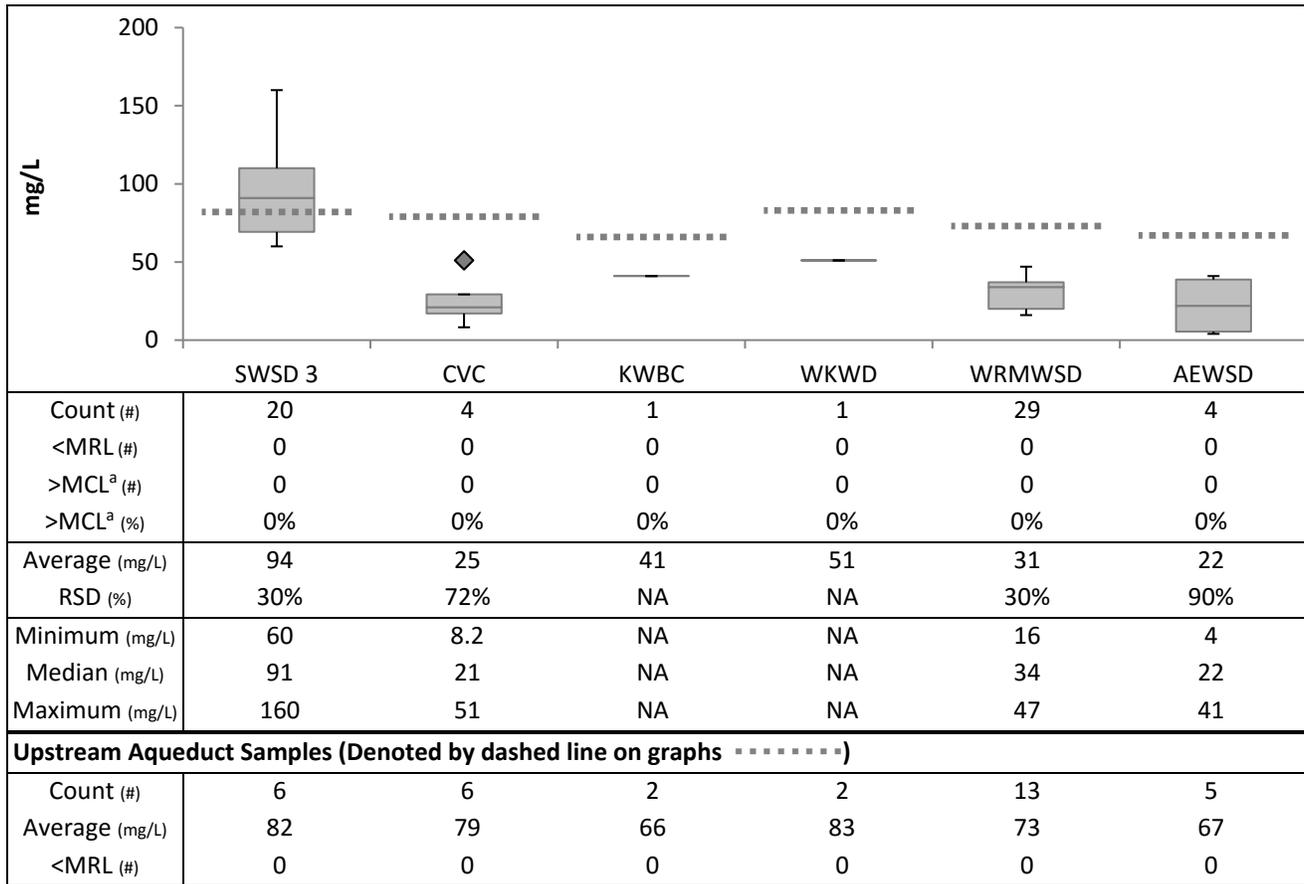
Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

Chloride

SWSD 3 had the highest average chloride concentration of 94 mg/L as well as the highest individual result and largest range, which was 60–160 mg/L (Figure 4-10). KWBC and WKWD both reported moderate concentrations, compared with other turn-ins, for their single samples—41 and 51 mg/L, respectively. WRMWSD reported an average of 31 mg/L, while CVC reported a slightly lower average of 25 mg/L, including a single outlier sample with a high value of 51 mg/L. AEWSD reported the lowest average at 22 mg/L as well as the lowest individual result, 4 mg/L. Except for SWSD 3, all turn-ins averaged less than their upstream Aqueduct average. No sample results were less than the MRL, nor were any results greater than the recommended secondary MCL of 250 mg/L for chloride in drinking water.

Chloride concentrations for SWSD 3 showed a sharply declining trend during the sampling period, with only one sample greater than the average during the month of April (Figure 4-11). CVC samples also declined sharply in March from 51 to 21 mg/L. The first sample, after CVC restarted operations in July, showed an even lower concentration of 8.2 mg/L before rising to 21 mg/L in the final sample of the year. WRMWSD samples fluctuated around the average throughout the year, again because of the diversity between the 10 turn-in locations. AEWSD concentrations were higher in January and February (38 and 41 mg/L, respectively), but declined to single digit concentrations in March and April, again because of the differing sources of turn-in water for these months.

Figure 4-10 Chloride Turn-in Statistics and Box-and-Whisker Plot



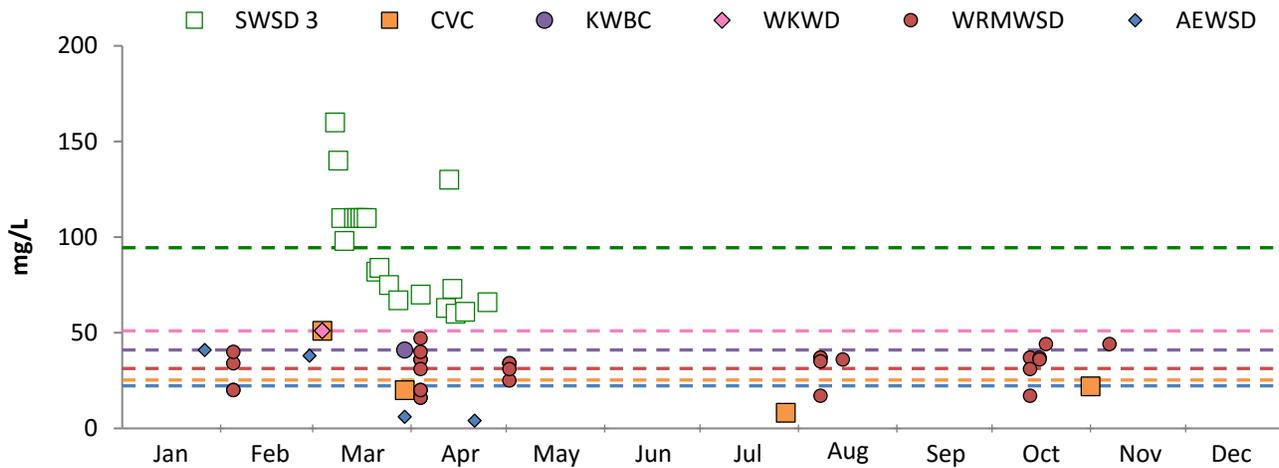
Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe recommended secondary MCL for chloride is 250 mg/L.

Figure 4-11 Time-Series Plot for Chloride in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

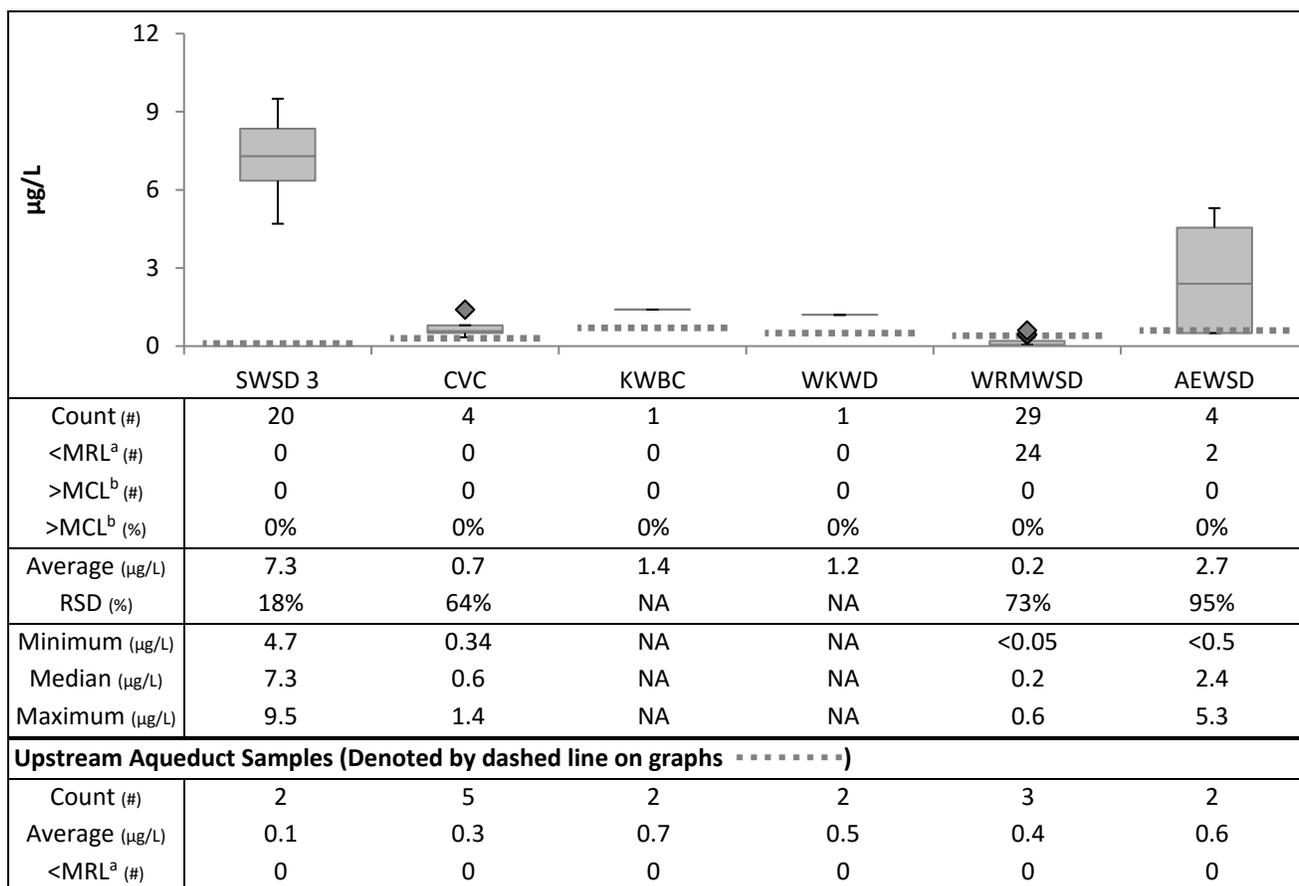
Total Chromium

Total chromium (trivalent plus hexavalent chromium, unfiltered) concentrations were not graphed, because of the paucity of data at some turn-ins, the prevalence of non-detectable results, and inconsistent MRLs between laboratories. The highest average concentration of 0.01 mg/L came from the SWSD turn-ins and WRMWSD, but this value was also the MRL for both agencies (Appendix C). A high MRL, such as this one, prevents the ability to draw any meaningful conclusions regarding trends that would occur at levels less than the MRL. The total chromium dataset for SWSD had 20 samples, 18 of which were equal to 0.01 mg/L and the remaining two were 0.011 mg/L. In contrast, WRMWSD sampled for dissolved chromium (trivalent plus hexavalent chromium, filtered) and all 29 samples were less than the MRL. Both CVC and WKWD had one sample reported for total chromium, each was equal to less than the MRL of 0.002 mg/L. KWBC did not have any total or dissolved chromium samples collected. AEWSD averaged 0.003 mg/L with a range of less than the MRL (0.001 mg/L) to 0.006 mg/L. No turn-in samples exceeded the MCL of 0.05 mg/L for total chromium in drinking water.

Hexavalent Chromium

Hexavalent chromium (filtered) was highest at SWSD 3, with an average of 7.3 µg/L and a maximum concentration of 9.5 µg/L (Figure 4-12). The second highest average was 2.7 µg/L at AEWSD, with a range of <0.5 to 5.3 µg/L. KWBC and WKWD both reported slightly lower concentrations for their single samples—1.4 and 1.2 µg/L, respectively. CVC and WRMWSD reported the lowest averages of 0.7 and 0.2 µg/L, respectively, and the lowest individual results of 0.34 and <0.05 µg/L, respectively.

Figure 4-12 Hexavalent Chromium Turn-in Statistics and Box-and-Whisker Plot



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, µg/L = micrograms per liter

The upstream sample sites used for each turn-in are shown on Table 4-6.

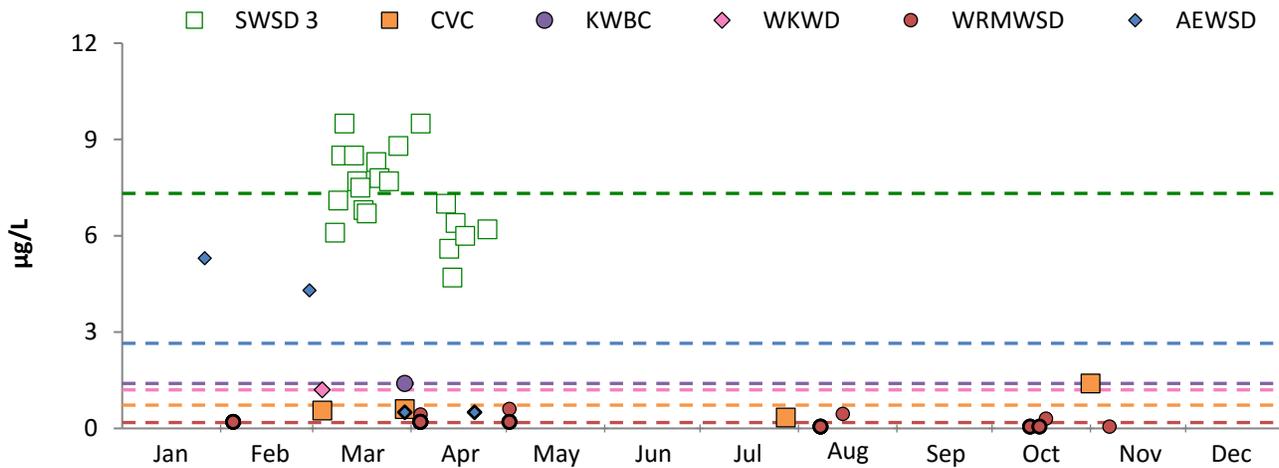
^aThe MRL was either 0.05 or 0.2 µg/L (see Appendix C). Some results reported concentration less than the MRL of other samples.

^bThe MCL for hexavalent chromium is 10 µg/L.

The average value and analysis for WRMWSD is slightly affected by using of two different MRLs, either 0.05 or 0.2 µg/L depending on the sample. In all, 24 of 29 samples at WRMWSD were less than the MRL; two samples at AEWSD were the only other samples less than their MRL. WRMWSD was the only turn-in that reported an average less than its upstream Aqueduct average. No turn-in samples exceeded the MCL of 10 µg/L for hexavalent chromium in drinking water.

SWSD 3 samples were higher in the first month of sampling and then declined in April when only one sample was greater than the annual average. (Figure 4-13). CVC samples remained from 0.34 to

Figure 4-13 Time-Series Plot for Hexavalent Chromium in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, µg/L = micrograms per liter
 Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

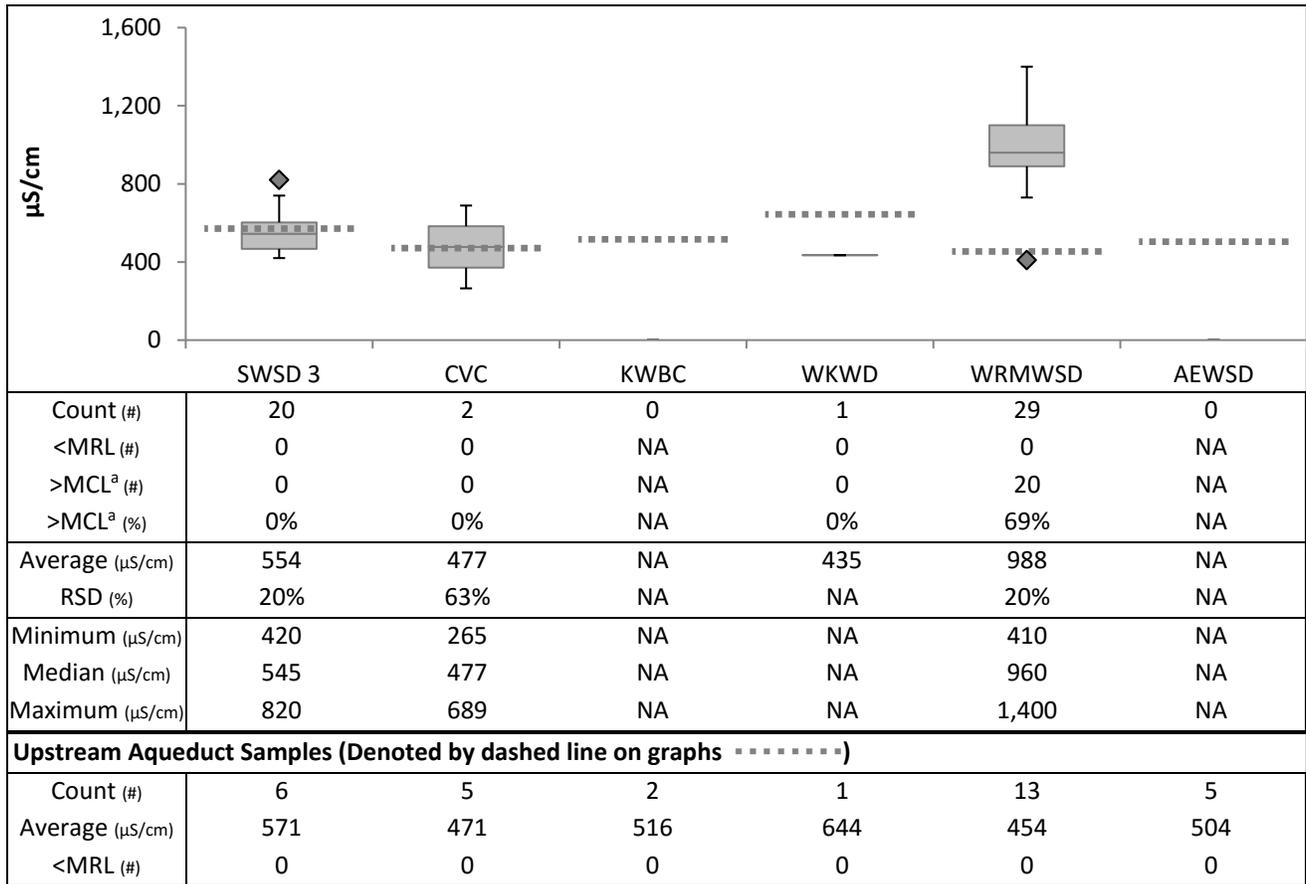
0.6 µg/L through July and then increased to 1.4 µg/L in November. WRMWSD reported the majority of its samples below the MRL throughout the year. The only WRMWSD turn-in structures that reported samples greater than the MRL were 9G1W (in one of three samples) and 10P1X (in all four samples). AEWSD concentrations were higher than the MRL in the January and February samples, but were less than the MRL for March and April.

Conductivity

Conductivity was highest for WRMWSD, which averaged 988 µS/cm and had a range of 410 to 1,400 µS/cm (Figure 4-14). In all, 20 of 29 samples for WRMWSD (69 percent) were greater than the recommended secondary MCL of 900 µS/cm for conductivity in drinking water. SWSD 3 had an average of 554 µS/cm, with a range of 420 to 820 µS/cm. CVC had a slightly lower average of 477 µS/cm and a range of 265 to 689 µS/cm for its two samples. WKWD’s single sample equaled 435 µS/cm. Neither KWBC nor AEWSD recorded any conductivity measurements. WRMWSD was the only turn-in that reported samples greater than the secondary MCL. CVC and WRMWSD were the only turn-ins that reported annual averages higher than their upstream Aqueduct average.

Conductivity concentrations for SWSD 3 showed a declining trend during the sampling period, with only one sample greater than the average for the month of April (Figure 4-15). The two CVC samples

Figure 4-14 Conductivity Turn-in Statistics and Box-and-Whisker Plot



Notes:

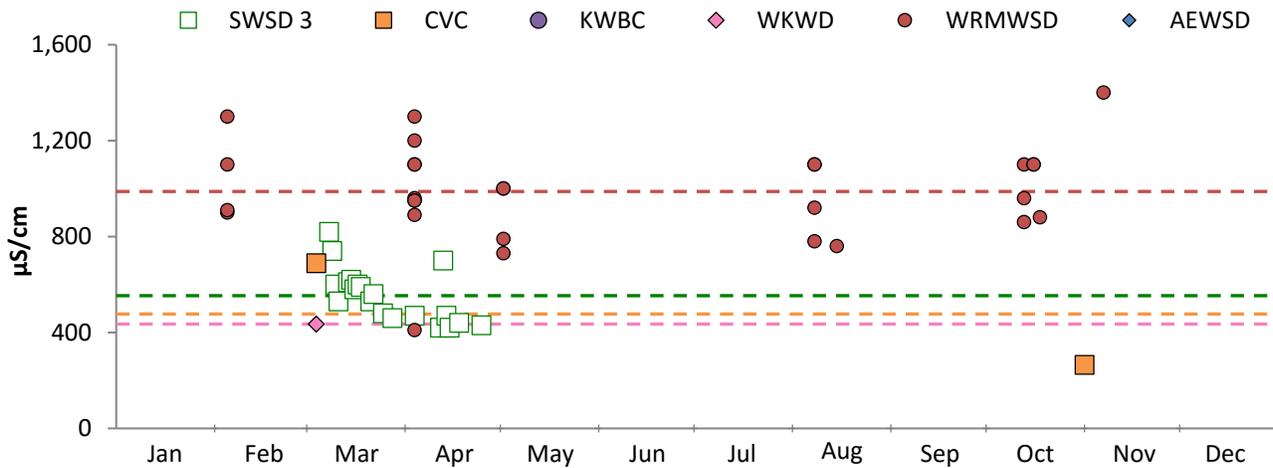
AEWSO = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, µS/cm = microSiemens per centimeter

The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe recommended secondary MCL for conductivity is 900 µS/cm.

showed a decrease from 689 µS/cm in March to 265 µS/cm in November. WRMWSD samples fluctuated around the average throughout the year; this was because of the diversity between the 10 turn-in locations.

Figure 4-15 Time-Series Plot for Conductivity in Turn-ins



Notes:

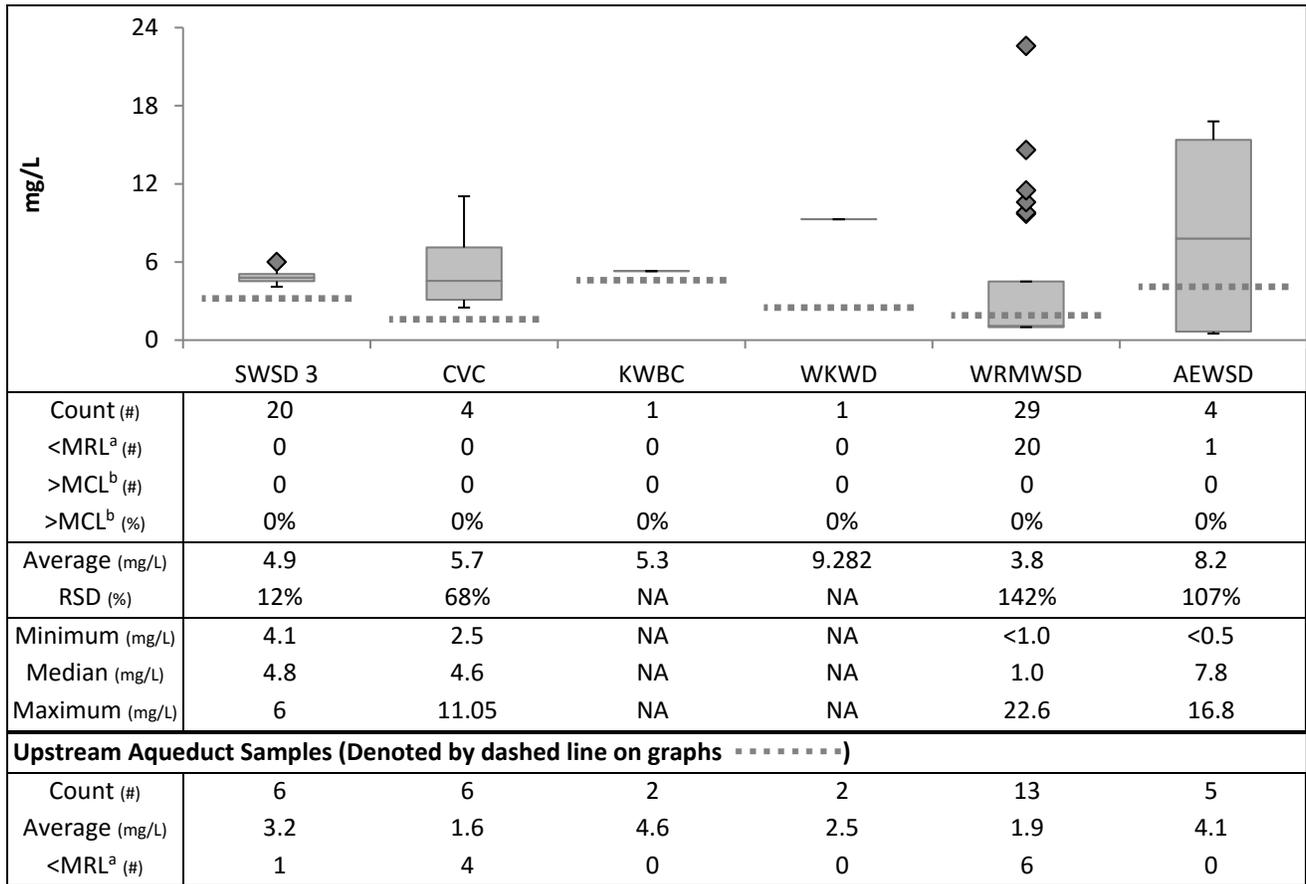
AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter

Nitrate

The highest average nitrate concentration was 8.2 mg/L at AEWSD, with a range of <0.5 to 16.8 mg/L (Figure 4-16). The single sample collected for WKWD (9.282 mg/L) was higher than AEWSD’s average, but lower than AEWSD’s maximum values. KWBC’s single sample was slightly lower at 5.3 mg/L. The four samples at CVC reported a moderate range, compared with other turn-ins, of 2.5 to 11.05 mg/L and an average of 5.7 mg/L. Comparatively, SWSD 3 had a very small range of 4.1 to 6 mg/L and an average of 4.9 mg/L. WRMWSD had the largest range of all turn-ins, <1 to 22.6 mg/L, but also had the lowest average of 3.8 mg/L. This low average, despite reporting the highest individual sample, was caused by the preponderance of samples that were less than the MRL of 1 mg/L (20 of 29 samples). The large and disparate range of results for WRMWSD was attributable to the compiling of several individual WRMWSD turn-ins into one composite dataset. In this case, seven of 10 turn-ins reported all samples that were less than the MRL, and three turn-ins (9G1W, 9G4W, and 10P1X) reported all nine of the outlier samples that were greater than the MRL. Of all turn-in agencies, WRMWSD was the only one that reported an average concentration that was less than its upstream Aqueduct average. No samples exceeded the MCL of 45 mg/L for nitrate in drinking water.

Nitrate at SWSD 3 had a slightly declining trend during the sampling period (Figure 4-17). In the first half of the year, CVC samples decreased sharply from March–April. During the second half of the year, CVC samples increased from July into November. For the three WRMWSD structures that reported concentrations greater than the MRL, only one (10P1X) showed any significant

Figure 4-16 Nitrate Turn-in Statistics and Box-and-Whisker Plot



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

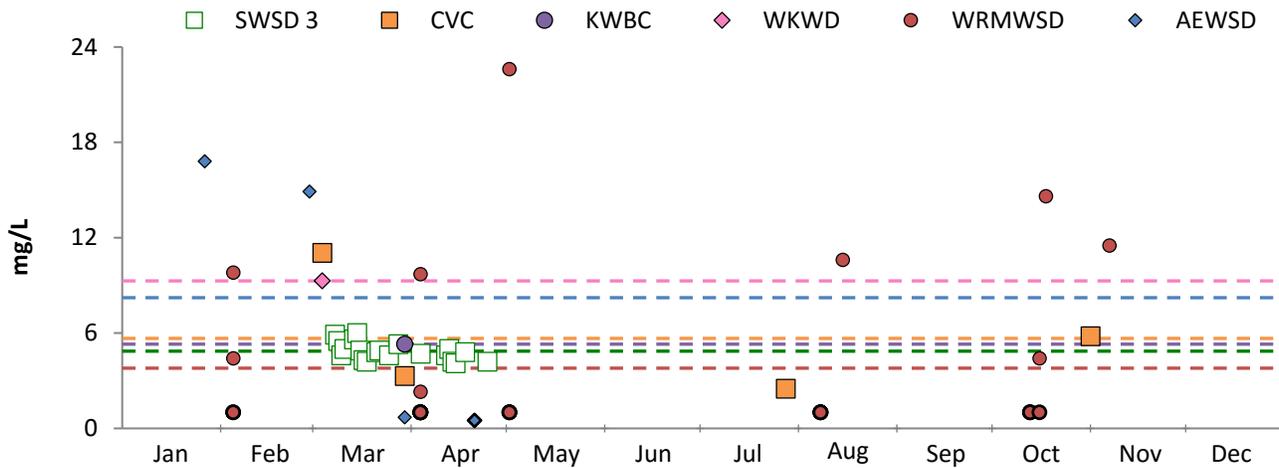
The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe MRL was either 0.05, 0.096, 0.1, or 1 mg/L (see Appendix C). Some results reported concentration less than the MRL of other samples.

^bThe MCL for nitrate is 45 mg/L.

deviations—increasing from 2.3 to 22.6 mg/L from April–May and having comparatively moderate values in August and October (Appendix C). AEWSD concentrations were higher in January and February (16.8 and 14.9 mg/L, respectively), but declined to less than 1 mg/L in March and April. This was because of a shift in the source of AEWSD water from groundwater originating exclusively in the AEWSD wellfields in January and February to exclusive Friant-Kern Canal water in April.

Figure 4-17 Time-Series Plot for Nitrate in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

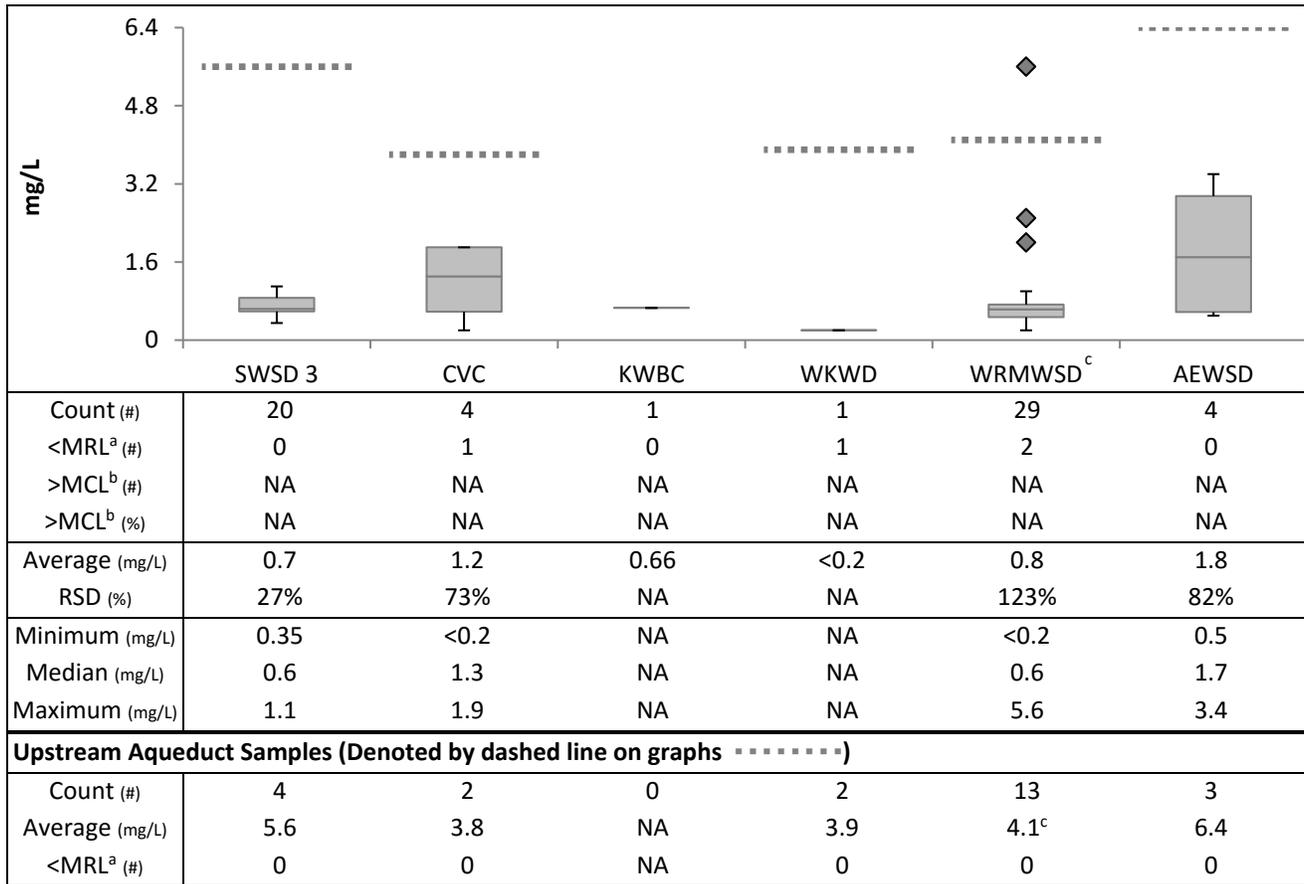
Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

Total Organic Carbon

All turn-ins averaged TOC from 0.66 to 1.8 mg/L except for WKWD’s single sample, which was <0.2 mg/L (Figure 4-18). The maximum reported concentration for all turn-ins was 5.6 mg/L (DOC, filtered) at WRMWSD. All turn-ins averaged well below their upstream Aqueduct averages, which ranged from 3.8 to 6.4 mg/L. There was no upstream TOC sample during KWBC’s active period, but the single KWBC sample was less than the DOC average of 6.8 mg/L during this time (Appendix C).

TOC at the SWSD 3 showed an increasing trend during the sampling period, with just two March samples greater than the annual average and just one April sample less than the average (Figure 4-19). CVC samples increased sharply from <0.2 mg/L in March to 1.9 mg/L in April; TOC remained at this elevated level in the July sample before declining to 0.71 mg/L in November. For WRMWSD, only two structures reported concentrations greater than 1 mg/L. The initial sample at 10P1X had the highest concentration for all turn-in samples (5.6 mg/L), but the concentration at that structure decreased the next month and remained less than or equal to 1 mg/L. Conversely, 7P5W was less than 1 mg/L in April and May, and then increased to 2 mg/L or more during the second half of the year. AEWSD showed a similar increase from concentrations less than 1 mg/L in January and February to greater than 2.5 mg/L in March and April, because of the shift in the source of turn-in water.

Figure 4-18 Total Organic Carbon Turn-in Statistics and Box-and-Whisker Plot



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

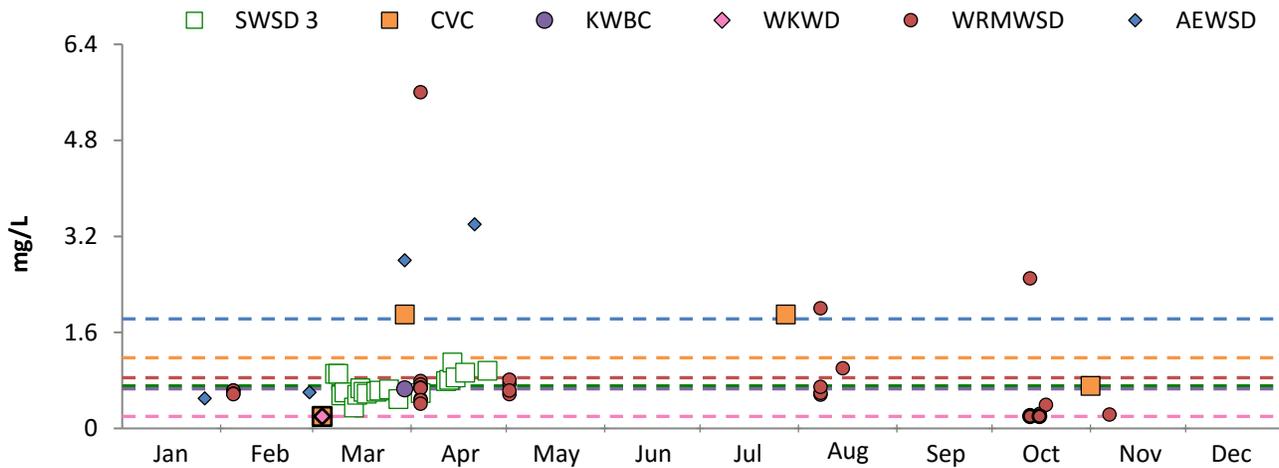
The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe MRL equaled 0.2 mg/L for all samples.

^bThere is no MCL for organic carbon.

^cOrganic carbon for WRMWSD is dissolved/filtered. All others are unfiltered.

Figure 4-19 Time-Series Plot for Total Organic Carbon in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

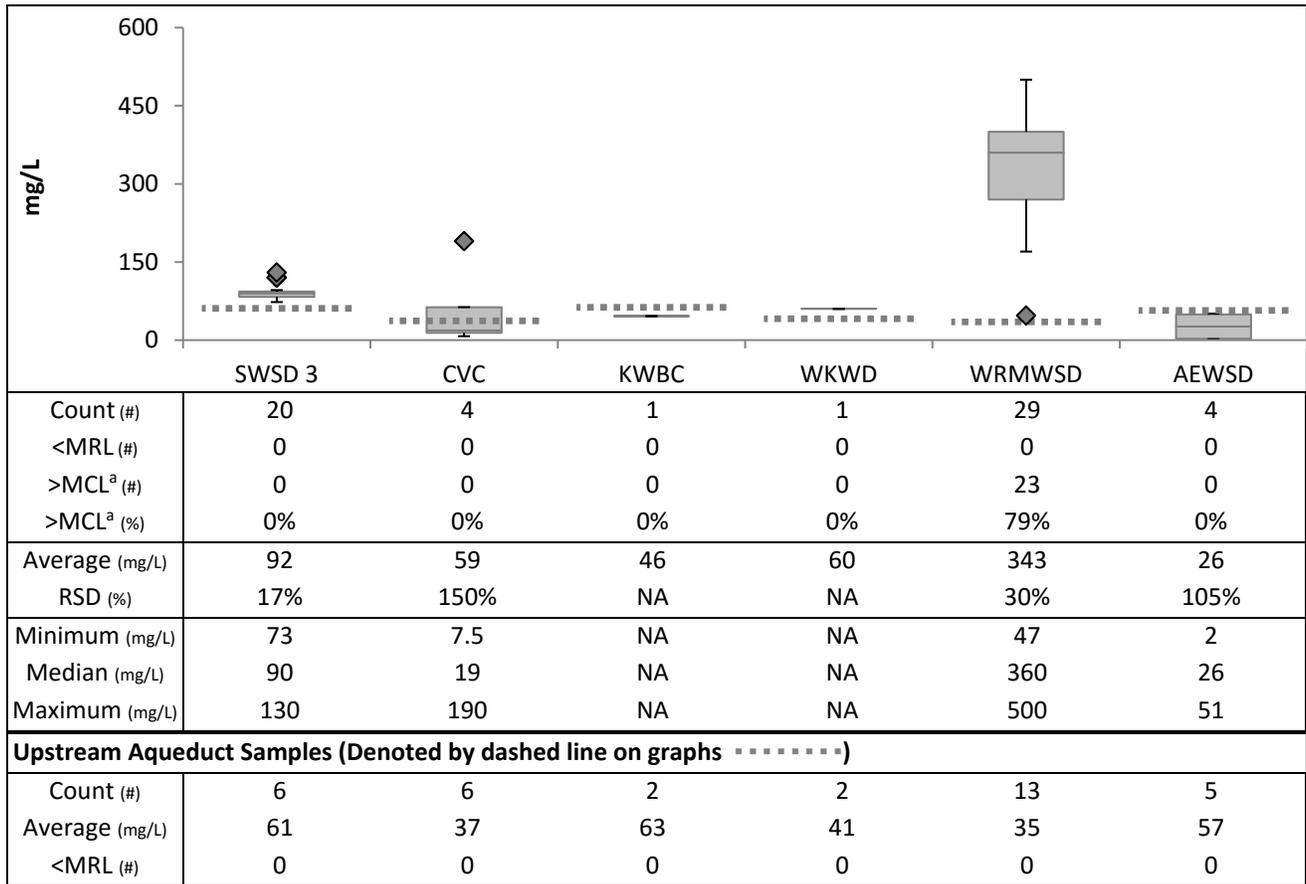
Organic carbon for WRMWSD is dissolved/filtered. All others are unfiltered.

Sulfate

WRMWSD reported the highest average, highest individual sample, and largest range for sulfate, with an average of 343 mg/L and a range of 47 to 500 mg/L (Figure 4-20). The highest sulfate concentration for WRMWSD occurred at the turn-in 8G2W, which shut down shortly after this sample was analyzed. Additionally, WRMWSD had 79 percent of samples greater than the recommended secondary MCL of 250 mg/L for sulfate in drinking water. No other turn-ins reported samples greater than this MCL. SWSD 3 reported the next highest average of 92 mg/L with a range of 73 to 130 mg/L. CVC had a higher individual maximum than SWSD 3 with an outlier sample at 190 mg/L, but the remaining samples were 21 mg/L or less, bringing the average down to 59 mg/L. The individual samples for KWBC and WKWD reported moderate concentrations at 46 and 60 mg/L, respectively. AEWSD reported the lowest average, 26 mg/L, and a range of 2 to 51 mg/L. WRMWSD and SWSD 3 were the only locations that recorded averages higher than their upstream Aqueduct averages. Additionally, WKWD's single sample also exceeded the upstream average.

Seasonal trends for sulfate at SWSD 3 showed a slight decline from March into April, except for three samples greater than 100 mg/L between both months (Figure 4-21). CVC samples declined sharply from the first to second sample of the year (190 to 16 mg/L, respectively), then remained at 21 mg/L or less for the remaining samples. WRMWSD samples deviated widely around the overall average, depending on turn-in structure. Most turn-in structures remained at a steady

Figure 4-20 Sulfate Turn-in Statistics and Box-and-Whisker Plot



Notes:

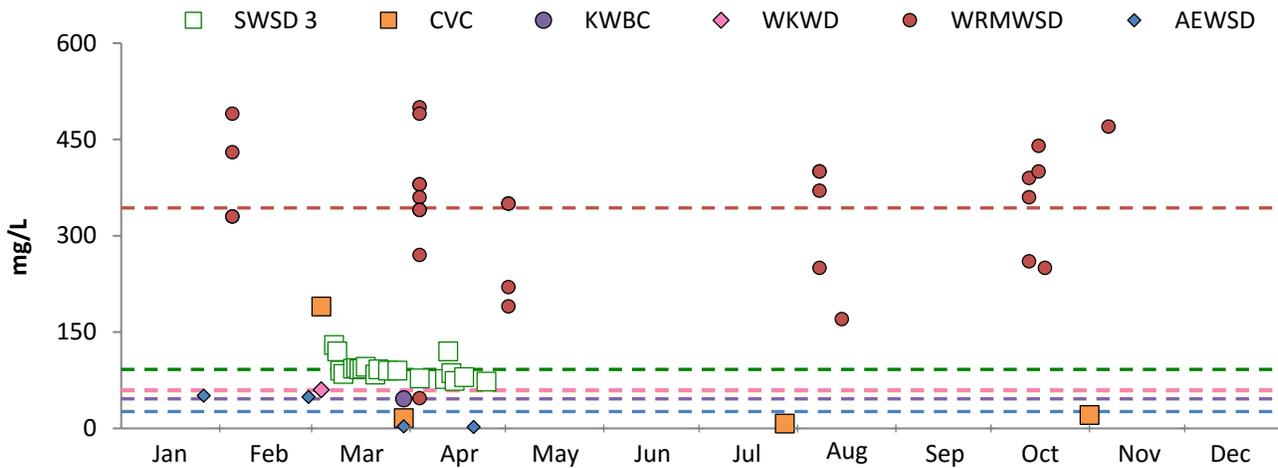
AEWSO = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe recommended secondary MCL for sulfate is 250 mg/L.

concentration throughout the year, except for 10P1X. That structure increased from the low outlier concentration in the first sample to 190 mg/L in the second sample, and then from that sample on, continually reported the lowest sulfate concentrations (Appendix C). AEWSO concentrations were higher in January and February (51 and 49 mg/L, respectively), but declined to 3 mg/L or less in March and April.

Figure 4-21 Time-Series Plot for Sulfate in Turn-ins



Notes:

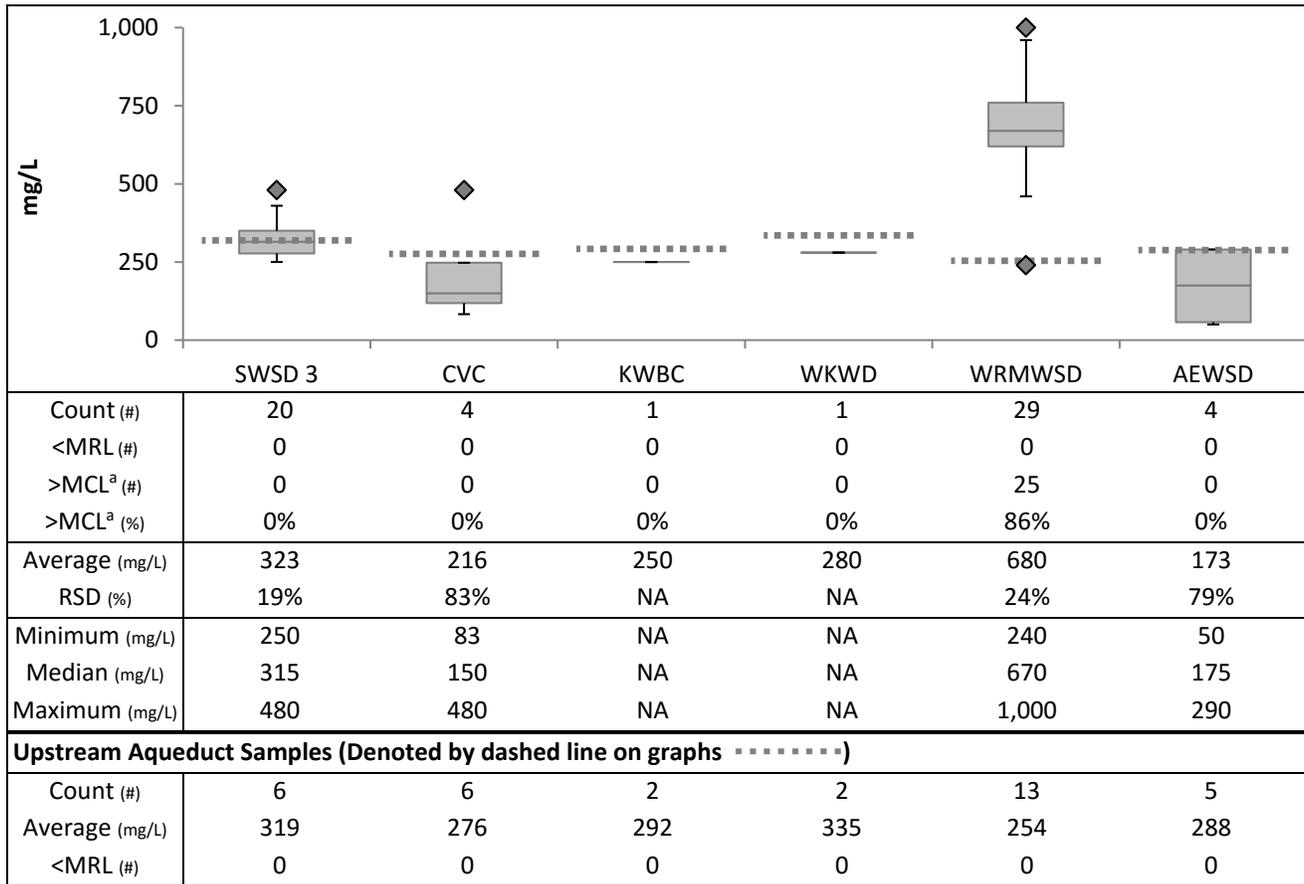
AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Total Dissolved Solids

WRMWSD reported the highest average, highest individual sample, and largest range for TDS, with an average of 680 mg/L and a range of 240 to 1,000 mg/L (Figure 4-22). The four highest individual TDS results came from the same structure (9G1W). Except for two samples, all other structures reported concentrations less than 800 mg/L. In all, 25 of 29 samples at WRMWSD reported higher than the recommended secondary MCL of 500 mg/L for TDS in drinking water. No other turn-ins exceeded this MCL. SWSD 3 had the second highest average of 323 mg/L and a range of 250 to 480 mg/L, while CVC had a lower average of 216 mg/L and a wider range of 83 to 480 mg/L. The individual samples for KWBC and WKWD were between the previously two mentioned averages at 250 and 280 mg/L, respectively. AEWSD had the lowest average of 173 mg/L and a range of 50 to 290 mg/L. WRMWSD and SWSD 3 were the only two turn-ins that reported averages greater than their upstream Aqueduct averages.

SWSD 3 showed a slight decline in TDS from March into April, except for three samples greater than or equal to 400 mg/L between both months (Figure 4-23). CVC samples declined from the first to the second sample of the year (480 to 130 mg/L, respectively), then fluctuated by no more than 50 mg/L for the remaining samples. WRMWSD samples deviated widely around the overall average, depending on the turn-in structure. Most turn-in structures remained at a steady concentration throughout the year, except for 10P1X. That structure increased from the low outlier concentration

Figure 4-22 Total Dissolved Solids Turn-in Statistics and Box-and-Whisker Plot



Notes:

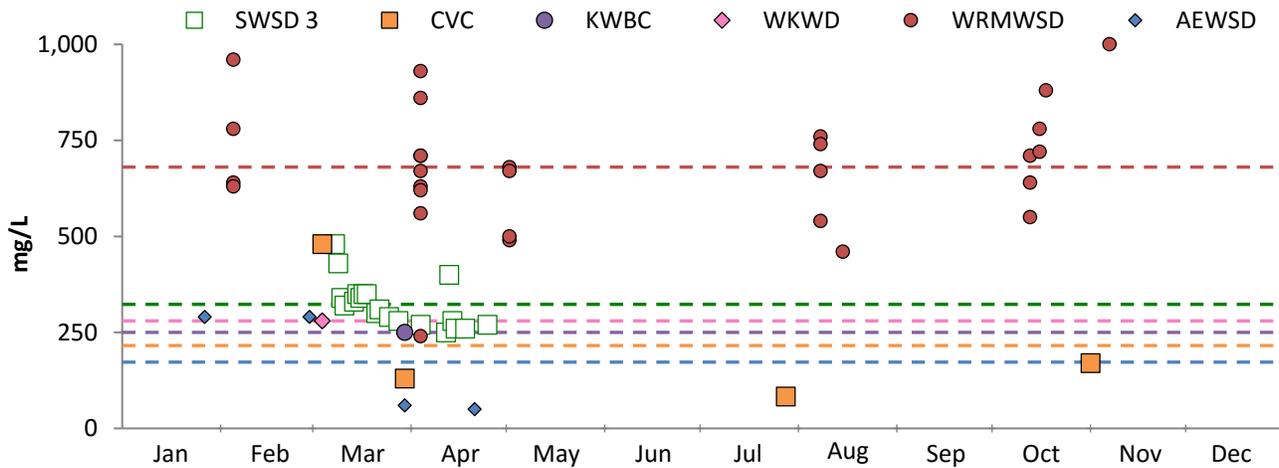
AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, mg/L = milligrams per liter, MRL = method reporting limit, NA = not applicable, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

The upstream sample sites used for each turn-in are shown on Table 4-6.

^aThe recommended secondary MCL for total dissolved solids is 500 mg/L.

in the first sample to moderate concentrations approximately 580 mg/L in the second and third samples, and then increased to 880 mg/L for the last sample (Appendix C). AEWSD concentrations were higher in January and February (290 mg/L in both months) and then declined to 60 mg/L or less in March and April.

Figure 4-23 Time-Series Plot for Total Dissolved Solids in Turn-ins



Notes:

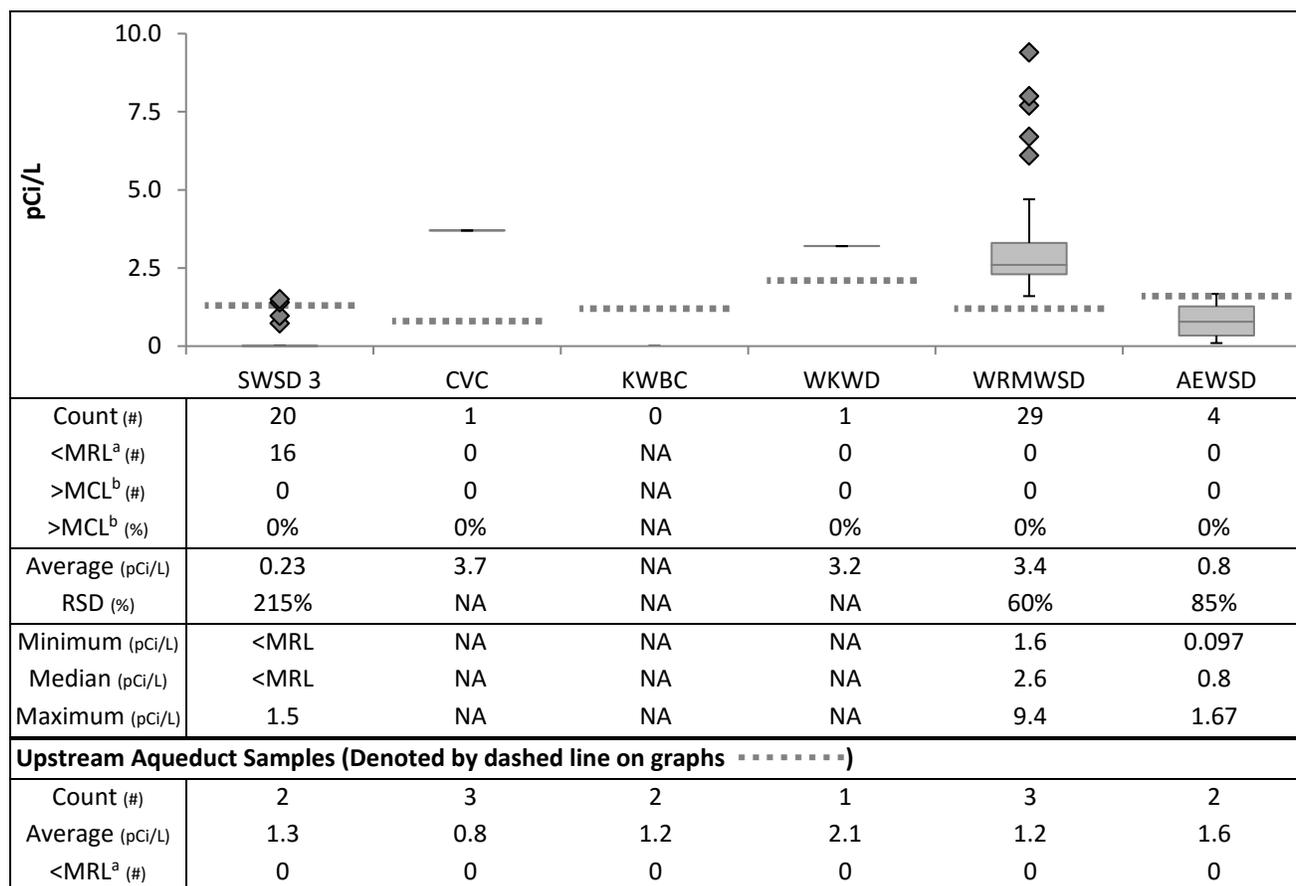
AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Uranium

WRMWSD reported the highest average, highest individual sample, and largest range for uranium, with an average of 3.4 pCi/L and a range of 1.6 to 9.4 pCi/L (Figure 4-24). This included five outlier samples with high values—all of them were greater than 5 pCi/L. CVC and WKWD each had only one sample collected and their results were close to the WRMWSD average at 3.7 and 3.2 pCi/L, respectively. SWSD 3 reported a lower average at 0.23 pCi/L and a range of <MRL to 1.5 pCi/L. AEWSD reported the lowest average 0.8 pCi/L and a range of 0.097 to 1.67 pCi/L. Individual samples at CVC and WKWD as well as the average at WRMWSD all exceeded their upstream Aqueduct averages. No samples were greater than the MCL of 20 pCi/L for uranium in drinking water.

The four samples at SWSD 3 varied widely in March, from 0.73 to 1.5 pCi/L; the April sample was moderate by comparison at 0.97 pCi/L (Figure 4-25). WRMWSD samples fluctuated around the annual average depending on the turn-in structure, but only two structures reported any samples greater than 4 pCi/L. The only significant deviations between samples at a given structure occurred at 10P1X, which increased from 1.6 to 6.1 pCi/L between the first two samples. AEWSD concentrations were higher in January and February (1.14 and 1.67 pCi/L, respectively), but declined to 0.421 pCi/L or less in March and April because of the shift in the source of turn-in water.

Figure 4-24 Uranium Turn-in Statistics and Box-and-Whisker Plot



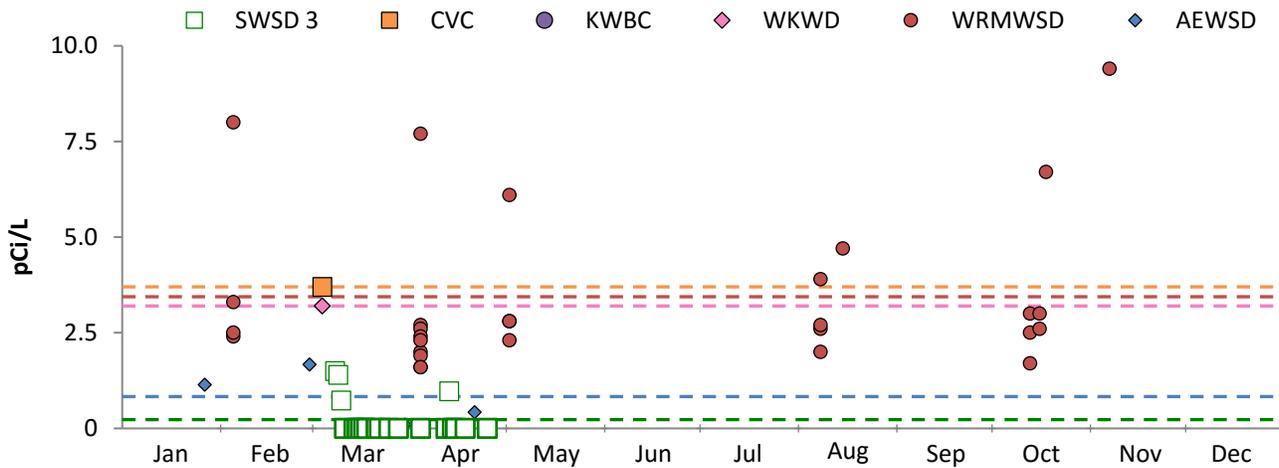
Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, MCL = maximum contaminate level, MRL = method reporting limit, NA = not applicable, pCi/L = picoCuries per liter, RSD = relative standard deviation, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

^aThe MRL is different between samples. The <MRL samples at SWSD 3 are analyzed and graphed equal to zero.

^bThe MCL for uranium is 20 pCi/L.

Figure 4-25 Time-Series Plot for Uranium in Turn-ins



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, pCi/L = picoCuries per liter, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Values <MRL (method reporting limit) are graphed at the MRL and displayed with a bold border.

California Aqueduct Water Quality

To determine potential impacts from turn-ins on Aqueduct water quality, a us/ds assessment was performed in the SJFD. The assessment utilized water quality sampling stations that bracketed one or more turn-ins. Paired samples, those collected within one or two days of each other, illustrated water quality changes that are possibly attributable to turn-in activity. DWR collected samples at six locations on the Aqueduct. Several turn-in agencies also collected samples at three additional locations. The locations of sampling sites along the Aqueduct naturally divided the SJFD into three sections, each containing one or more turn-ins.

Table 4-7 delineates the three sections within the SJFD; it lists the enclosed turn-ins for each section and their bracketing us/ds water quality stations. The SJFD, as a whole, encompasses all turn-ins between Checks 21 and 41; the Northern Section brackets SWSD 2 and SWSD 3 (although no us/ds samples were collected during SWSD 2’s brief period of activity); the Central Section brackets CVC, KWBC, and WKWD; and the Southern Section brackets AEWSD and WRMWSD. Within the Central Section, Tupman Road and Cole’s Levee bracket CVC and KWBC whereas Cole’s Levee and Hwy 119 bracket WKWD; all three of these sites were monitored by KCWA-member units.

If more than one upstream or downstream samples are available on a given date, only the closest sample to the corresponding upstream or downstream sample was used. For instance, from January–April samples were collected at Check 39, which was used as the downstream sample site

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Table 4-7 Nearest Upstream and Downstream Water Quality Sampling Stations on the California Aqueduct that Bracket Specific Turn-ins

Section	Upstream Stations	Monitoring Agency	Bracketed Turn-ins	Downstream Stations	Monitoring Agency	Distance (Aqueduct miles)
Whole SJFD	Check 21	DWR	All SJFD turn-ins	Check 41	DWR	131.15
Northern	Check 23	DWR	SWSD 3	Check 27	DWR	34.68
Central	Tupman Road	KCWA	CVC and KWBC	Cole's Levee	KCWA	3.71
	Check 27	DWR	CVC, KWBC, and WKWD	Check 29	DWR	12.81
	Cole's Levee	WKWD	WKWD	Hwy 119	WKWD	0.92
Southern	Check 29	DWR	AEWSD and WRMWSD	Check 41	DWR	58.87

Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, DWR = California Department of Water Resources, KCWA = Kern County Water Agency, KWBC = Kern Water Bank Canal, SJFD = San Joaquin Field Division, SWSD 3 = Semitropic Water Storage District Turn-in 3, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

for the us/ds analysis in those months. After April, Check 39 was no longer sampled, so the downstream sample site used for the us/ds analysis changed to Check 41. The us/ds analysis was also limited to months in which the enclosed turn-ins were active. For instance, in the Northern Section, us/ds samples in March and April were analyzed, while us/ds samples in August and September, when SWSD was not operating, were not. Similarly, no us/ds sample pairs in June for any turn-ins were included in any analysis or statistics. Tables 4-8–4-10 provide statistics on the occurrence and range of us/ds changes for each section. Figures 4-26–4-34 show the raw values for us/ds samples in each section. Additionally, the graphs covering the entire SJFD include the total monthly turn-in volume and Check 21 flow (Table 4-1), whereas the graphs covering the three SJFD sections include the monthly POA for each enclosed turn-in (Table 4-2).

The proximity of most bracketing stations mitigates the influence of travel time and Aqueduct operations on us/ds analysis, but not all paired samples have this benefit. For the analysis of the entire SJFD, which is examining water quality changes from all turn-ins combined, the distance between stations (131 miles) made detailed comparisons difficult. Instead, this broad comparison revealed large trends seen throughout the year, factoring in the influence from all turn-ins and

Table 4-8 Upstream/Downstream Concentration Changes for the Northern Section of the San Joaquin Field Division

Analyte	Concentration Range (of all samples, not just pairs)		Increases			Decreases			No Change
	Check 23 (Upstream)	Check 27 (Downstream)	# of Samples	Range	Average	# of Samples	Range	Average	# of Samples
Arsenic	0.002 – 0.003	0.003 – 0.003	1	0.001	0.001	0	NS	NS	1
Bromide	0.18 – 0.19	0.15 – 0.2	1	0.02	0.02	1	-0.03	-0.03	0
Chloride	66 – 67	53 – 76	1	5	5	1	-6	-6	0
Dissolved Chromium	<0.001 – <0.001	<0.001 – 0.001	2	0.001	0.001	0	NS	NS	0
Chromium [VI] (µg/L)	0.14 – 0.15	0.13 – 0.92	2	0.28 – 0.78	0.53	0	NS	NS	0
Conductivity (µS/cm)	491 – 572	314 – 525	1	15	15	1	-47	-47	0
Nitrate	4 – 4.4	<0.1 – 5	2	0.2 – 0.6	0.4	0	NS	NS	0
Dissolved Organic Carbon	6.8 – 7	3.1 – 7.3	1	0.3	0.3	1	-0.6	-0.6	0
Sulfate	49 – 83	16 – 72	1	4	4	1	-11	-11	0
Total Dissolved Solids	276 – 323	163 – 300	1	7	7	1	-23	-23	0

Notes:

Chromium [VI] = hexavalent chromium, NS= no sample, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
All measurements are mg/L (milligrams per liter) unless noted.

Aqueduct operations. Conversely, the distance between stations bracketing WKWD (approximately 1,500 yards from the turn-in to the downstream sample site) is likely too short to allow complete blending with Aqueduct flows. Consequently, us/ds differences are not deemed reliable indicators of WKWD influence. This is considered a minor concern because of the relatively small turn-in volume from WKWD, the short turn-in period, and the subsequent low potential for influence.

The occurrence of small changes downstream of turn-ins, relative to the total range of concentrations observed upstream of those turn-ins, is common in the analysis presented in this chapter. The majority of sample pairs for all turn-ins report us/ds deviations that are far smaller than the variation in the Aqueduct absent those turn-ins, represented by each turn-in’s upstream samples throughout the period of operation. Some sample pairs did report us/ds deviations close to

Table 4-9 Upstream/Downstream Concentration Changes for the Central Section of the San Joaquin Field Division

Analyte	Concentration Range (of all samples, not just pairs)		Increases			Decreases			No Change
	Check 27 & Tupman Rd. (Upstream)	Cole's Levee & Check 29 (Downstream)	# of Samples	Range	Average	# of Samples	Range	Average	# of Samples
Arsenic	0.0008 – 0.003	0.0014 – 0.0047	3	0.0006 – 0.001	0.001	1	-0.0001	0.0001	2
Bromide	0.15 – 0.4	0.14 – 0.39	1	0.01	0.01	4	-0.01 – -0.02	-0.02	1
Chloride	53 – 130	46 – 120	1	2	2	5	-2 – -10	-7	0
Dissolved Chromium	<0.001 – 0.001	<0.001 – 0.001	0	NS	NS	1	-0.0005	-0.0005	3
Chromium [VI] (µg/L)	0.08 – 0.92	0.11 – 0.84	3	0.03 – 0.04	0.03	1	-0.2	-0.2	1
Conductivity (µS/cm)	314 – 603	295 – 644	0	NS	NS	5	-5 – -67	-27	0
Nitrate	<0.096 – 5	<0.096 – 5	1	0.2	0.2	1	-0.2	-0.2	4
Dissolved Organic Carbon	3.1 – 7.3	2.5 – 8	0	NS	NS	4	-0.25 – -0.65	-0.4	0
Sulfate	16 – 72	16 – 60	1	3	3	2	-2 – -12	-7	3
Total Dissolved Solids	163 – 320	151 – 430	1	10	10	4	-2 – -28	-15	1

Notes:

Chromium [VI] = hexavalent chromium, NS = no sample, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
All measurements are mg/L (milligrams per liter) unless noted.

the range of upstream concentrations, but only hexavalent chromium samples reported us/ds deviations exceeding the range of upstream concentrations. This effect is likely the case because the turn-in volumes and POAs were so low in 2016 that sources or influences other than turn-ins had a more profound effect on Aqueduct concentrations.

Arsenic

Arsenic downstream of all SJFD turn-ins was higher than concentrations upstream for almost all 2016 sample pairs (Figure 4-26A). This result is consistent with turn-in averages that were greater than the upstream Aqueduct average for all turn-ins (Figure 4-6). The greatest variance between us/ds samples occurred at the beginning of the year when the shutdown at Check 29 stopped downstream Aqueduct flow; the resulting Check 41 concentrations were, in large part, because of

Table 4-10 Upstream/Downstream Concentration Changes for the Southern Section of the San Joaquin Field Division

Analyte	Concentration Range (of all samples not just pairs)		Increases			Decreases			No Change
	Check 29 (Upstream)	Check 39 & Check 41 (Downstream)	# of Samples	Range	Average	# of Samples	Range	Average	# of Samples
Arsenic	0.002 – 0.004	0.002 – 0.005	1	0.001	0.001	0	NS	NS	6
Bromide	0.14 – 0.38	0.15 – 0.37	2	0.01 – 0.02	0.02	2	-0.01	-0.01	3
Chloride	48 – 115	51 – 121	3	2 – 3	2	4	-2	-2	0
Dissolved Chromium	<0.001 – 0.001	<0.001 – 0.002	4	0.0005 – 0.001	0.00	0	NS	NS	3
Chromium [VI] (µg/L)	0.17 – 0.72	1 – 1.2	2	0.28 – 0.77	0.53	0	NS	NS	0
Conductivity (µS/cm)	295 – 601	321 – 606	4	5 – 34	18	3	-1 – -30	-12	0
Nitrate	<0.1 – 5	<0.1 – 5.3	1	0.3	0.3	1	-0.5	-0.5	5
Dissolved Organic Carbon	2.5 – 8	2.3 – 5.8	2	0.3 – 0.5	0.4	5	-0.2 – -2.95	-0.8	0
Sulfate	16 – 60	21 – 66	5	1 – 8	4	1	-1	-1	1
Total Dissolved Solids	151 – 332	178 – 336	5	3 – 19	8	2	-1 – -32	-17	0

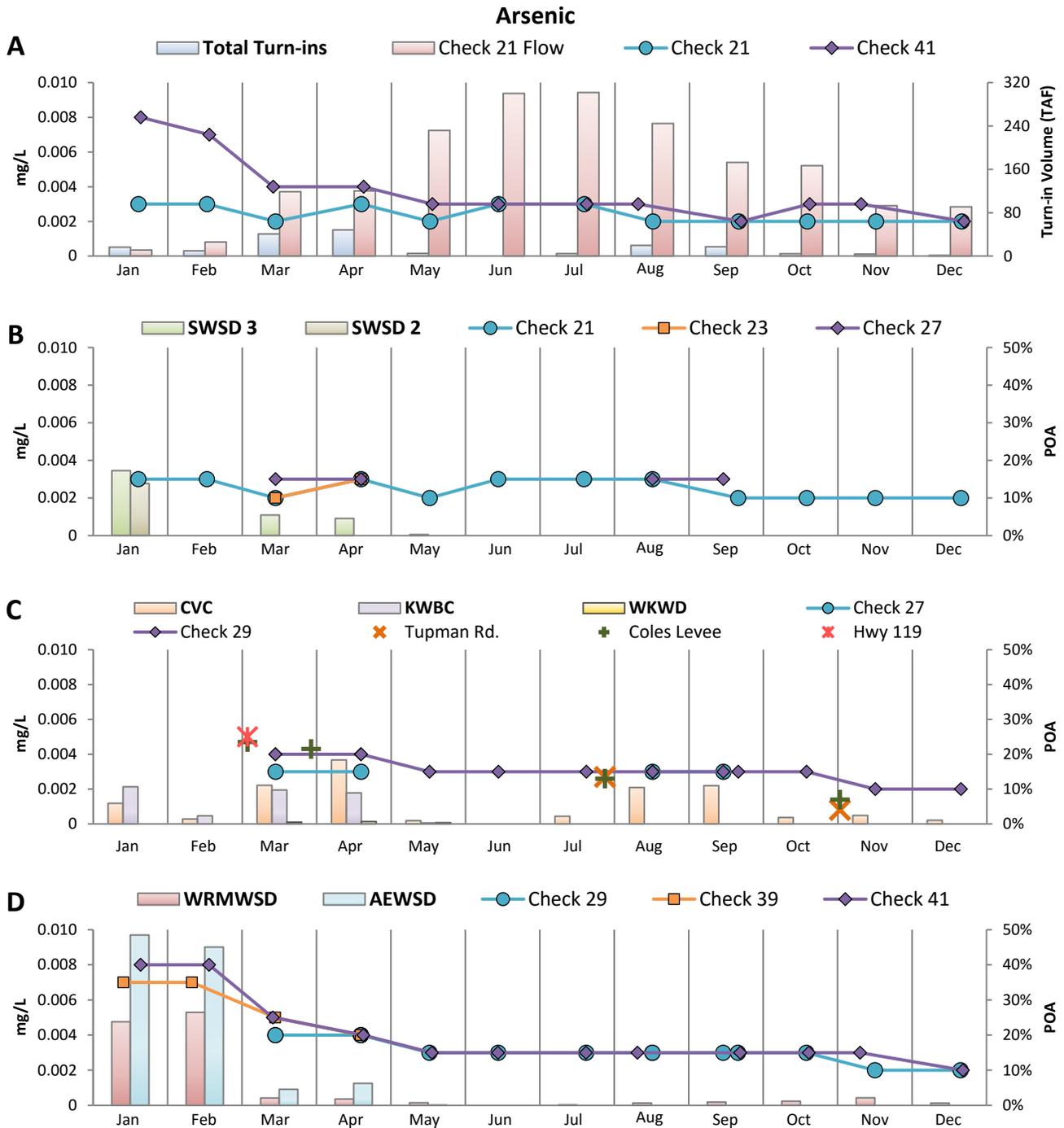
Notes:

Chromium [VI] = hexavalent chromium, NS = no sample, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
All measurements are mg/L (milligrams per liter) unless noted.

Southern Section turn-ins. For the rest of the year, us/ds samples showed slight increases or no changes. These results fluctuated throughout the year with no clear correlation to the ratio of turn-in volume to Aqueduct flow at Check 21. Assessments of us/ds change in past years have regularly identified a relationship in which the magnitude of us/ds divergence depended on baseline concentrations for both the turn-ins and the Aqueduct compared to the POA for each turn-in. The occurrence of increases in March and April during higher POAs, as well as the lack of us/ds change in July during the low POAs, conformed to this relationship, but the us/ds results for other months conflicted with this relationship. No Aqueduct samples exceeded the MCL for arsenic in drinking water.

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Figure 4-26 Upstream/Downstream Arsenic for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWS = Wheeler Ridge-Maricopa Water Storage District

Arsenic increased from Check 23 to Check 27 in one sample pair and did not change in the other, which is a consistent result with concentrations reported for SWSD 3. This single increase (0.001 mg/L) occurred in March when the two upstream sample locations both reported a lower concentration than both the previous and following months (Table 4-8 and Figure 4-26B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. In April, upstream concentrations increased to the level previously reported in February, which also equaled the downstream concentration in both March and April. The occurrence of an increase in the Northern Section was expected because SWSD 3 averaged 0.009 mg/L compared with the upstream concentrations of 0.002 and 0.003 mg/L in these months (Figure 4-6). The lack of a second us/ds increase in April and the absence of larger increases in general were likely because of the small relative turn-in volume for SWSD 3; POAs equaled 4.5 and 5.5 percent in March and April, respectively.

In the Central Section, arsenic increased downstream in half of all samples, a result that is consistent with concentrations reported for the enclosed turn-ins. The three increasing pairs were relatively small, 0.0006 to 0.001 mg/L, while the single decrease was even smaller, -0.0001 mg/L, and the remaining two pairs did not change (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The two largest increases, both 0.001 mg/L, occurred in March and April when the combined Central Section turn-in POAs were their highest (Figure 4-26C). These results follow the expected POA relationship based on turn-in results of 0.004 mg/L average at CVC, 0.007 mg/L at WKWD, and 0.012 mg/L at KWBC (Figure 4-6). The lack of increases later in the year was also expected because the two higher average arsenic turn-ins, KWBC and WKWD, both stopped operation for a few days into May, and the sole turn-in in this section to continue beyond May, CVC, reported a lower average concentration and small POAs.

Downstream arsenic in the Southern Section was highest when POAs were high and us/ds samples remained at equal concentrations for all but one pair when POAs were low; this trend conformed to expected results based on averages reported for the bracketed turn-ins. The sole sample pair to show any change occurred in March and resulted in a 0.001 mg/L increase (Table 4-10), although a second increase also appeared in November for unpaired samples taken six days apart (Figure 4-26D). This analysis, nonetheless, does not take into account January and February. During these months, downstream flow was stopped at Check 29, meaning there would have been no upstream samples to compare with for paired samples. The resulting concentrations at Check 39 and Check 41 during these months were almost entirely because of the two Southern Section turn-ins and coincided with turn-in concentrations of up to 0.007 mg/L (Figure 4-7). Following the resumption of Aqueduct flow, downstream concentrations slowly declined to a consistent

0.003 mg/L for most of the year. The high downstream concentrations when POAs were high correlates to the average concentrations for WRMWSD and AEWSD of 0.004 and 0.005 mg/L, respectively (Figure 4-6). Likewise, the lack of us/ds change in paired samples for May through the end of the year correlated to very low POAs for WRMWSD and the cessation of turn-ins from AEWSD.

Bromide

The majority of bromide samples decreased downstream of the SJFD turn-ins (Figure 4-27A). This result is consistent with turn-in averages that were less than their upstream Aqueduct averages for all turn-ins except SWSD 3 (Figure 4-8). The largest decreases happened in the first two months of the year when Check 29 was closed and the majority of water sampled at Check 41 originated from Southern Section turn-ins. Variations amongst us/ds locations for the remainder of the year were smaller and fluctuated in contrast to turn-in concentrations, indicating influences other than turn-ins affected us/ds trends.

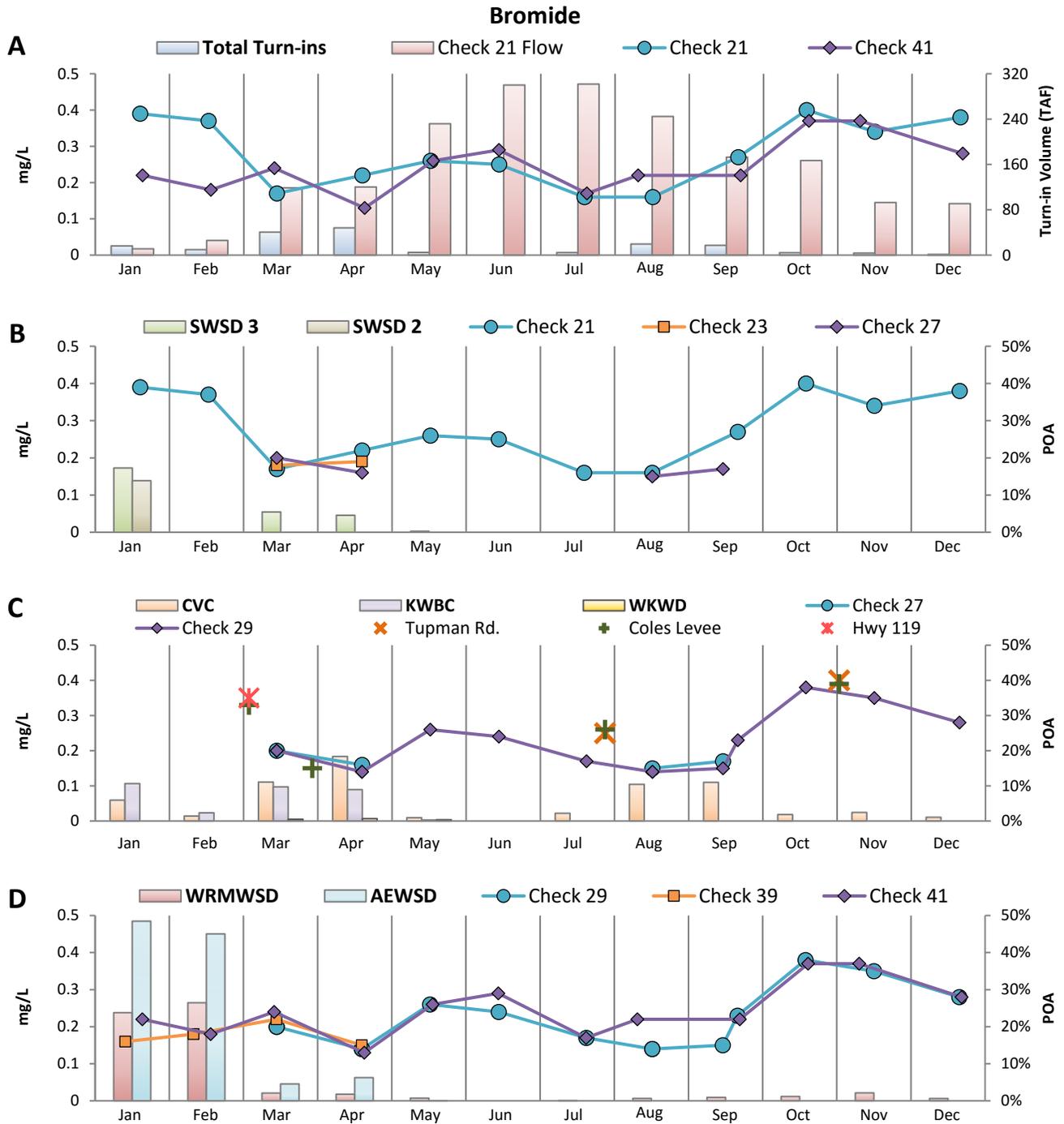
In the Northern Section, us/ds bromide increased and decreased in one pair each, which is consistent with concentrations reported for SWSD 3. The sole increase (0.02 mg/L) occurred in March and the sole decrease (-0.03 mg/L) occurred in April (Table 4-8 and Figure 4-27B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. Based on the average turn-in concentration of 0.32 mg/L compared with the upstream average of 0.24 mg/L (Figure 4-8), downstream increases would be expected. But lower than average results were reported at SWSD 3 during April (Figure 4-9), which may explain the sole decrease that month.

Bromide decreased in the majority of Central Section sample pairs, a result that is consistent with turn-in sample concentrations. The magnitude of downstream decreases ranged from -0.01 to -0.02 mg/L, while a single increase was 0.01 mg/L and one pair did not change (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. Three of the four increasing sample pairs occurred in April, August, and September when POAs were higher (Figure 4-27C). The prevalence of decreases and their correlation with higher POAs conformed to turn-in results of 0.09 mg/L average at CVC, 0.18 mg/L at KWBC, and 0.21 mg/L at WKWD, all of which were less than or equal to their upstream averages (Figure 4-8).

Sample pairs for the Southern Section fluctuated with mostly minor deviations throughout the year, but precise influences from turn-ins were difficult to identify. Concentrations decreased for two

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Figure 4-27 Upstream/Downstream Bromide Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

pairs by -0.01 mg/L in each, increased by 0.01 and 0.02 mg/L in two pairs, and did not change in three pairs (Table 4-10). Turn-in averages of 0.21 mg/L at WRMWSD and 0.09 mg/L at AEWSD (Figure 4-8) were lower than or equal to their upstream averages, suggesting contributions should have resulted in decreases. But the timing of these variations showed a poor relationship to POAs with the increase occurring in March during slightly higher POAs and decreases in September and October during low POAs (Figure 4-27D). This analysis, consequently, does not take into account what occurred in January and February. During these months, downstream flow was stopped at Check 29, meaning there would be no immediate upstream samples to compare with for paired samples. When downstream samples are compared with samples at Check 21, large decreases were evident. The lower bromide concentrations at Check 41 coincided with lower concentrations from these two turn-ins in these months, all of which were 0.21 mg/L or less (Figure 4-9) compared with concentrations of 0.37 mg/L or greater at Check 21.

Chloride

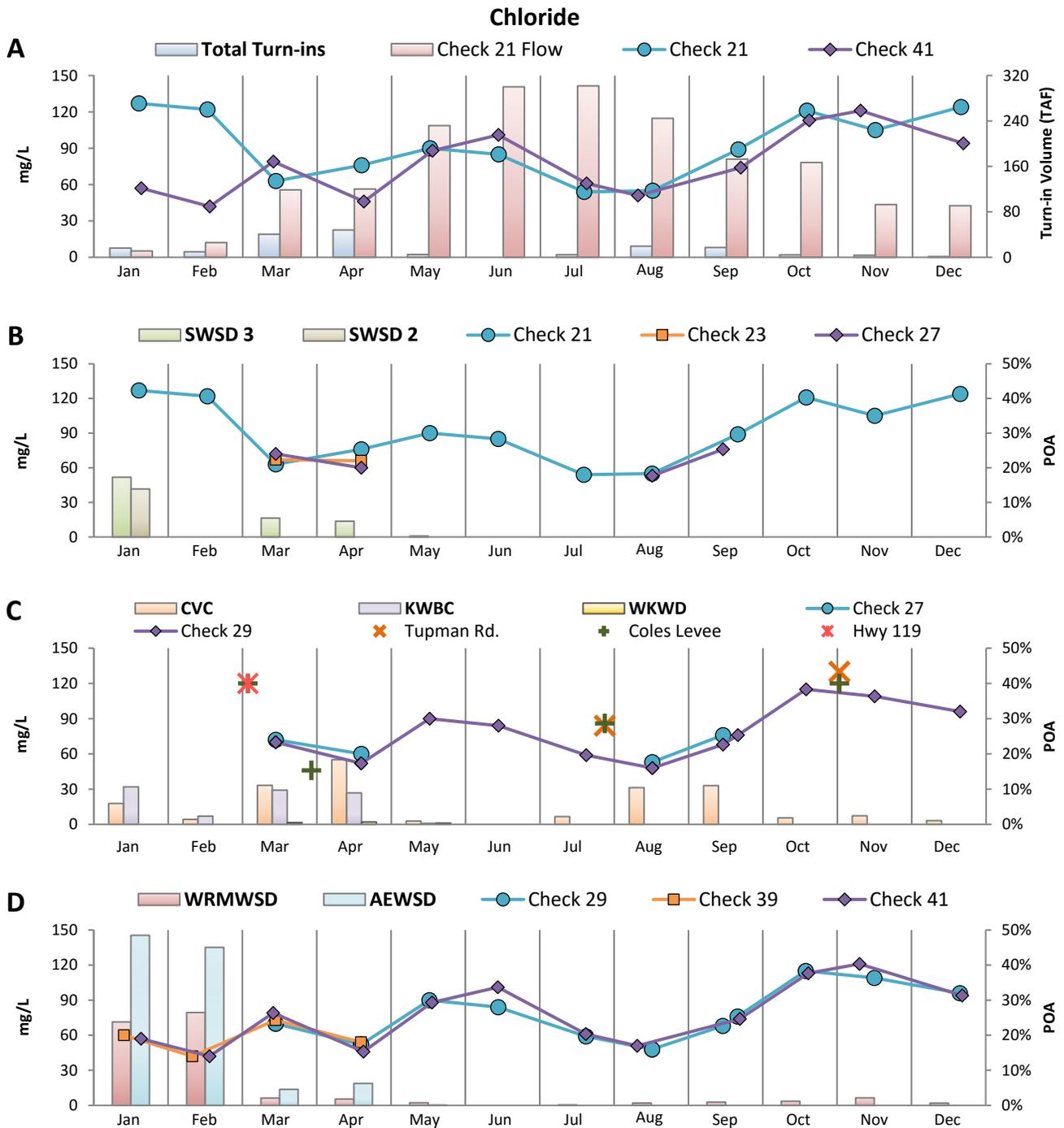
The majority of chloride samples decreased downstream of the SJFD turn-ins (Figure 4-28A). This result is consistent with turn-in averages that were less than their upstream Aqueduct averages for all turn-ins except SWSD 3 (Figure 4-10). The largest decreases happened in the first two months of the year when Check 29 was closed and the majority of water sampled at Check 41 originated from Southern Section turn-ins. Variations amongst us/ds locations for the remainder of the year were smaller and fluctuated in contrast to turn-in concentrations, indicating influences other than turn-ins affected us/ds trends. No Aqueduct samples exceeded the MCL for chloride in drinking water.

In the Northern Section, us/ds chloride increased and decreased in one pair each, which did not conflict with individual concentrations reported for SWSD 3. The sole increase (5 mg/L) occurred in March and the sole decrease (-6 mg/L) occurred in April (Table 4-8 and Figure 4-28B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. Based on the average turn-in concentration of 94 mg/L compared with the upstream average of 82 mg/L (Figure 4-10), downstream increases would be expected. Still, lower than average results were reported at SWSD 3 during April (Figure 4-11), which may explain the sole decrease that month.

Chloride decreased in all but one Central Section sample pairs, a result that is consistent with turn-in sample concentrations. The magnitude of downstream decreases ranged from -2 to -10 mg/L, while a single increase was 2 mg/L (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. Four of the five pairs showing increases occurred in March, April, August, and September when POAs were higher (Figure 4-28C), but the largest decrease occurred during the low POA month of

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Figure 4-28 Upstream/Downstream Chloride Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

November. Nevertheless, the prevalence of decreases and their correlation with higher POAs conformed to turn-in results of 25 mg/L average at CVC, 41 mg/L at KWBC, and 51 mg/L at WKWD; all of which were less than their upstream averages (Figure 4-10).

Sample pairs for the Southern Section primarily decreased throughout the year, a result that is consistent with turn-in sample concentrations. Concentrations decreased for four pairs by -2 mg/L each and increased by 2 to 3 mg/L in three pairs (Table 4-10). Turn-in averages of 31 mg/L at WRMWSD and 22 mg/L at AEWSD (Figure 4-10) were both lower than their upstream averages, suggesting contributions should have resulted in decreases. But the timing of the us/ds variations showed a poor relationship to POAs with the largest increase occurring in March during slightly higher POAs and decreases occurring late in the year during low POAs (Figure 4-28D). This analysis, notwithstanding, did not take into account what occurred in January and February. During these months, downstream flow was stopped at Check 29, meaning there would be no immediate upstream samples to compare with for paired samples. When downstream samples were compared with samples at Check 21, large decreases were evident. The lower chloride concentrations at Check 41 coincided with lower concentrations from these two turn-ins, all of which were less than 41 mg/L (Figure 4-11) compared with concentrations of 122 mg/L or greater at Check 21.

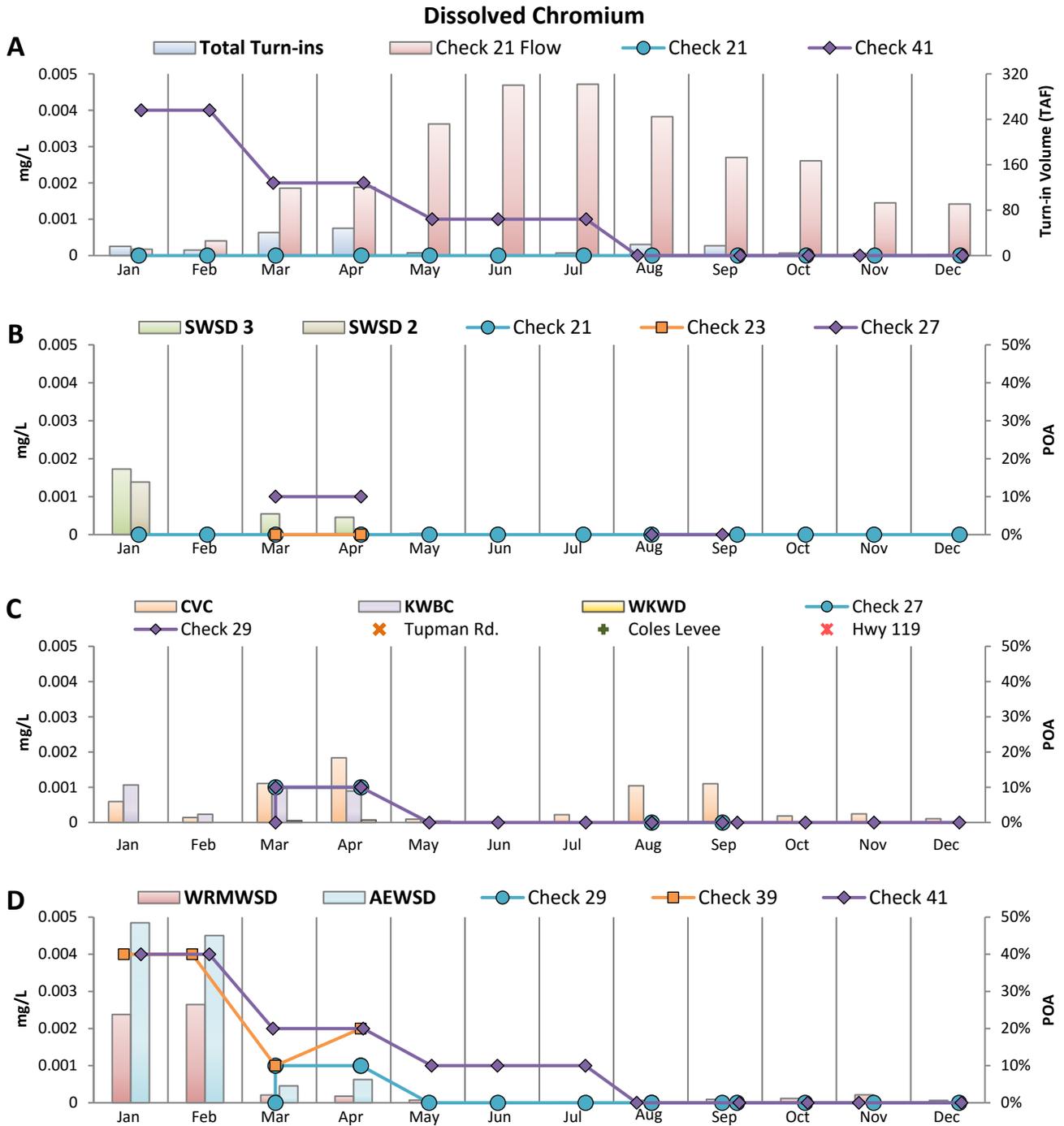
Dissolved Chromium

Dissolved chromium (trivalent plus hexavalent chromium, filtered) was higher downstream of the SJFD turn-ins for all samples during the first half of 2016 (Figure 4-29A). Meaningful comparisons of us/ds deviations and turn-in contributions were difficult to identify because of issues found in the turn-in dataset—namely, there were limited data for some turn-ins, there were an abundance of non-detectable results, and there were inconsistent MRLs between laboratories. Nonetheless, the overall us/ds trends indicated turn-ins, as a whole, increased dissolved chromium in the SJFD during higher inflows in the first half of 2016. Concentrations upstream of all SJFD turn-ins at Check 21 remained less than the MRL (0.001 mg/L) throughout the year. Conversely, downstream samples at Check 41 started at 0.004 mg/L for January and February, then gradually decreased to <MRL for August–December. The months with the greatest increases coincided with months where turn-in volumes were larger compared with total Aqueduct flows. No Aqueduct samples exceeded the MCL for chromium in drinking water.

Both Northern Section sample pairs increased for dissolved chromium; these increases are consistent with elevated chromium results for SWSD 3. The two increasing sample pairs, in March and April, were increases from <0.001 mg/L upstream to 0.001 mg/L downstream (Table 4-8 and Figure 4-29B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. The presence of increases is expected based on turn-in results, but the small size of these increases contrasts with much higher concentrations in

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Figure 4-29 Upstream/Downstream Dissolved Chromium Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

the turn-in—averaging 0.01 mg/L for total chromium (Appendix C)—compared with the upstream Aqueduct average of <0.001 mg/L.

Dissolved chromium downstream of the Central Section turn-ins showed minor-to-no deviations within sample pairs, which was supported by the available turn-in samples. CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The only sample pair that showed any difference was in March, where a duplicated downstream sample reported at both <0.001 and 0.001 mg/L, and compared with the upstream result of 0.001 mg/L, all other sample pairs did not show any deviation (Table 4-9 and Figure 4-29C). This result was expected because it was based on total chromium data for the Central Section turn-ins, which was limited to one result of <0.002 mg/L for CVC and WKWD each (Appendix C).

Dissolved chromium in the Southern Section also had mixed results depending on the time of year; a result that is consistent with turn-in data and project operations. Downstream increases of 0.0005 to 0.001 mg/L occurred March–July with the remaining sample pairs reporting no change between us/ds samples, all of which were equal to <0.001 mg/L (Table 4-10 and Figure 4-29D). This analysis, notwithstanding, did not take into account what occurred in January and February. During these months, downstream flow was stopped at Check 29, meaning there would be no immediate upstream samples to compare with for paired samples. When downstream samples were compared with samples at Check 21, large increases were evident. For both months, downstream concentrations were equal to 0.004 mg/L compared with concentrations equal to <0.001 mg/L at Check 21. Comparisons of turn-in and Aqueduct concentrations were difficult for WRMWSD, because all its samples were reported as less than an MRL of 0.01 mg/L (Appendix C), which was much higher than all upstream concentrations. For AEWSD, January and February samples reported at 0.006 and 0.005 mg/L, respectively, and March and April samples reported at <0.001 and 0.001 mg/L, respectively (Appendix C). The former set of samples indicated AEWSD may have had an influence on the higher concentrations reported downstream. But because of the high MRL at WRMWSD, it is unclear to what extent, if any, WRMWSD had on these increases.

Hexavalent Chromium

Hexavalent chromium (filtered) was not routinely monitored in the Aqueduct. Seven locations on the Aqueduct were sampled in 2016 and, of these collected samples, nine formed us/ds sample pairs. The bulk of these pairings occurred in March and April, with the remaining pairs in the summer and fall. Because of the small number of samples and their dispersal throughout the year, the Aqueduct hexavalent chromium samples are not graphed, but all raw data results are available in Appendix C. Of the nine sample pairs, seven pairs increased, one pair decreased, and one pair did

not change (Appendix C). No Aqueduct samples exceeded the MCL for hexavalent chromium in drinking water.

In the Northern Section, two pairs increased by 0.28 and 0.78 $\mu\text{g/L}$ in March and April (Table 4-8), respectively. These increases were large compared with the range of upstream concentrations, 0.14–0.15 $\mu\text{g/L}$ (Table 4-8). In the Central Section, the March and April sample pairs decreased (-0.2 $\mu\text{g/L}$) and did not change, respectively, followed by three pairs that slightly increased by 0.03 or 0.04 $\mu\text{g/L}$ (Table 4-9). These increases were small compared with the range of upstream concentrations, 0.08 to 0.92 $\mu\text{g/L}$ (Table 4-9). In the Southern Section, the March and April sample pairs increased by 0.28 and 0.77 $\mu\text{g/L}$, respectively (Table 4-10). These increases were similar in size to the range of concentrations observed upstream, 0.17 to 0.72 $\mu\text{g/L}$ (Table 4-10). The tendency toward increasing sample pairs us/ds of all sections is consistent with turn-in results. The average hexavalent chromium results for the turn-ins ranged from 7.3 $\mu\text{g/L}$ at SWSD 3 to 0.2 $\mu\text{g/L}$ at WRMWSD, compared with Aqueduct averages from 0.1 and 0.7 $\mu\text{g/L}$ (Figure 4-12). Furthermore, WRMWSD was the only turn-in that reported an average less than its upstream Aqueduct average.

Conductivity

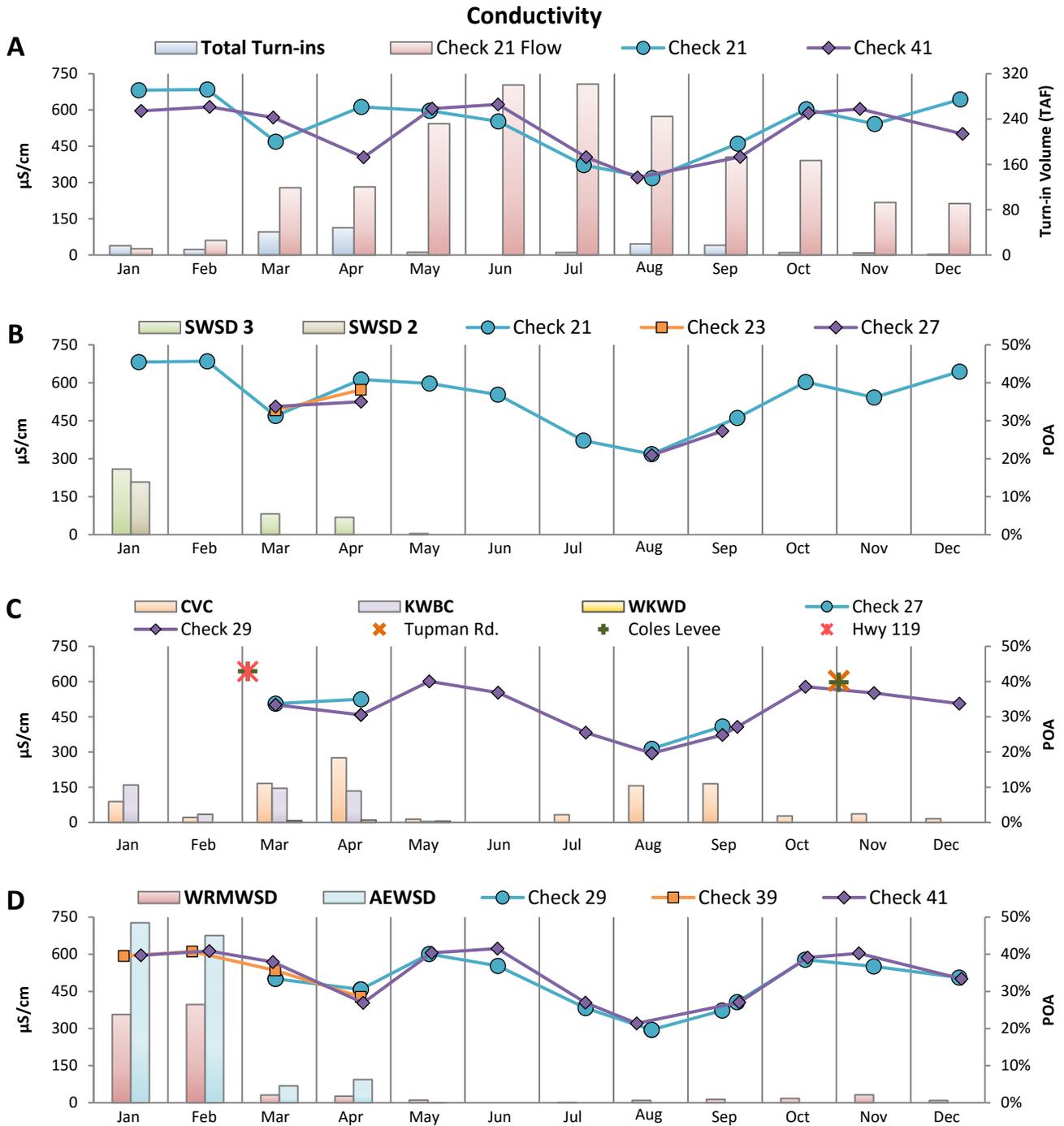
Conductivity downstream of the SJFD turn-ins fluctuated for most of the year (Figure 4-30A). This result is consistent with turn-in averages that also fluctuated with respect to their upstream averages (Figure 4-14). This variability was further emphasized in the direction and magnitude of individual deviations throughout the year. For instance, both increases and decreases were reported for the first four months of the year when turn-ins comprised a larger portion of Aqueduct water than in other months. Variations amongst us/ds locations for the remainder of the year were smaller and showed less influence from turn-ins. No Aqueduct samples exceeded the recommended secondary MCL for conductivity in drinking water.

In the Northern Section, us/ds conductivity increased and decreased in one pair each, which is consistent with measurements reported for SWSD 3 that were close to the upstream average. The sole increase (15 $\mu\text{S/cm}$) occurred in March and the sole decrease (-47 $\mu\text{S/cm}$) occurred in April (Table 4-8 and Figure 4-30B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. Based on the average turn-in measurement of 554 $\mu\text{S/cm}$, compared with the upstream average of 571 $\mu\text{S/cm}$ (Figure 4-14), downstream decreases would be expected. But higher-than-average results were reported at SWSD 3 during March (Figure 4-15), which may explain the sole increase that month.

Conductivity decreased in all Central Section sample pairs; still, precise comparisons to turn-in data were difficult to make because of the paucity of data for this section. All five sample pairs decreased

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Figure 4-30 Upstream/Downstream Conductivity Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, $\mu\text{S}/\text{cm}$ = microSiemens per centimeter

with a range of -5 to -67 $\mu\text{S}/\text{cm}$ (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The five decreases occurred throughout the year with very little correlation to POAs; high POAs in March correlated to a small increase, while high POAs in April correlated to a large decrease (Figure 4-30C). The influences on us/ds pairs from turn-ins were difficult to ascertain since CVC only reported two samples and KWBC reported none (Figure 4-14). WKWD reported a single sample during its operational period, 435 $\mu\text{S}/\text{cm}$ compared with 644 $\mu\text{S}/\text{cm}$ upstream (Figure 4-14). In turn, the us/ds sample pair for Cole's Levee and Hwy 119 reported a slight decrease of -1 $\mu\text{S}/\text{cm}$ (Figure 4-30C).

Sample pairs for the Southern Section fluctuated with slightly more increases reported; consequently, precise comparisons to turn-in data were difficult to make because of the paucity of data for this section. Conductivity measurements increased for four pairs by 5 to 34 $\mu\text{S}/\text{cm}$ and decreased by -1 to -30 $\mu\text{S}/\text{cm}$ in three pairs (Table 4-10). The turn-in average for WRMWSD, 988 $\mu\text{S}/\text{cm}$, was higher than the upstream average, 454 $\mu\text{S}/\text{cm}$, but no conductivity data were reported at AEWS (Figure 4-14). The timing of increasing sample pairs showed a poor relationship to POAs with only one increase, in March, occurring during high POAs, which was then followed by a large decrease during high POAs in April (Figure 4-30D). The inconsistency between the WRMWSD average and us/ds results, indicated AEWS may have had a reducing effect on Aqueduct measurements. Furthermore, lower measurements at Check 39 and Check 41 compared with Check 21 in January and February occurred when Check 29 was closed and the bulk of water at Check 39 and Check 41 originated from Southern Section turn-ins. The measurement at Check 41 during these months, 613 $\mu\text{S}/\text{cm}$ or less, was much lower than concurrent WRMWSD samples.

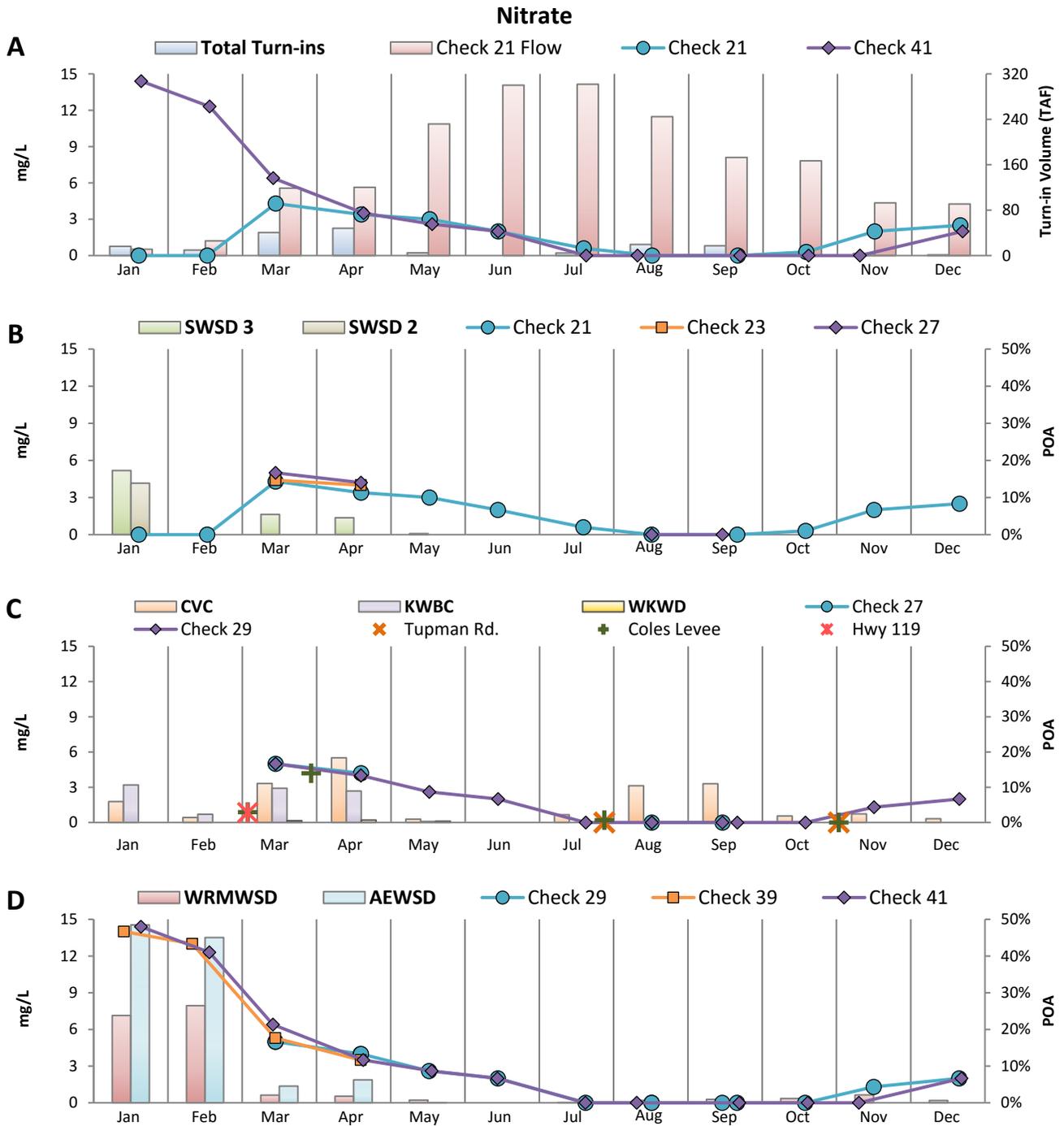
Nitrate

Nitrate downstream of all SJFD turn-ins was evenly split between increases and decreases, with small deviations from March onward (Figure 4-31A); this result was, at times, unexpected when comparing turn-in samples with Aqueduct averages. Downstream increases were largest in January and February when the closure at Check 29 prevented downstream flow past that point. During this time, the bulk of water at Check 41 was supplied by Southern Section turn-ins; their higher-than-Aqueduct concentrations are consistent with this result. But after April, all Check 41 samples were either equal to or less than Check 21 concentrations, despite the higher-than-Aqueduct concentrations for active turn-ins. No Aqueduct samples exceeded the MCL for nitrate in drinking water.

In the Northern Section, us/ds nitrate increased in both sample pairs, which is consistent with concentrations reported for SWSD 3. The two increases ranged from 0.2 to 0.6 mg/L in April and March, respectively (Table 4-8 and Figure 4-31B). Because the two SWSD turn-ins only operated for

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Figure 4-31 Upstream/Downstream Nitrate Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

a few days in January and February, no Aqueduct samples were available for those months. These increases were expected, based on the average turn-in concentration of 4.9 mg/L compared with the upstream average of 3.2 mg/L (Figure 4-16).

Sample pairs for nitrate in the Central Section showed very little deviation throughout the year, a result that is inconsistent with average turn-in sample concentrations. Nitrate increased by 0.2 mg/L and decreased by -0.2 mg/L in one pair each, the remaining four sample pairs did not change (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The slight decrease occurred in April during higher POAs and the slight decrease occurred in July during low POAs (Figure 4-31C). This was counterintuitive to the expected results, based on higher-than-Aqueduct samples for these turn-ins; CVC reported an average of 5.7 mg/L compared with the average of 1.6 mg/L upstream, KWBC's single sample was 5.3 mg/L compared with 4.6 mg/L upstream, and WKWD's single sample was 9.282 mg/L compared with 2.5 mg/L (Figure 4-16).

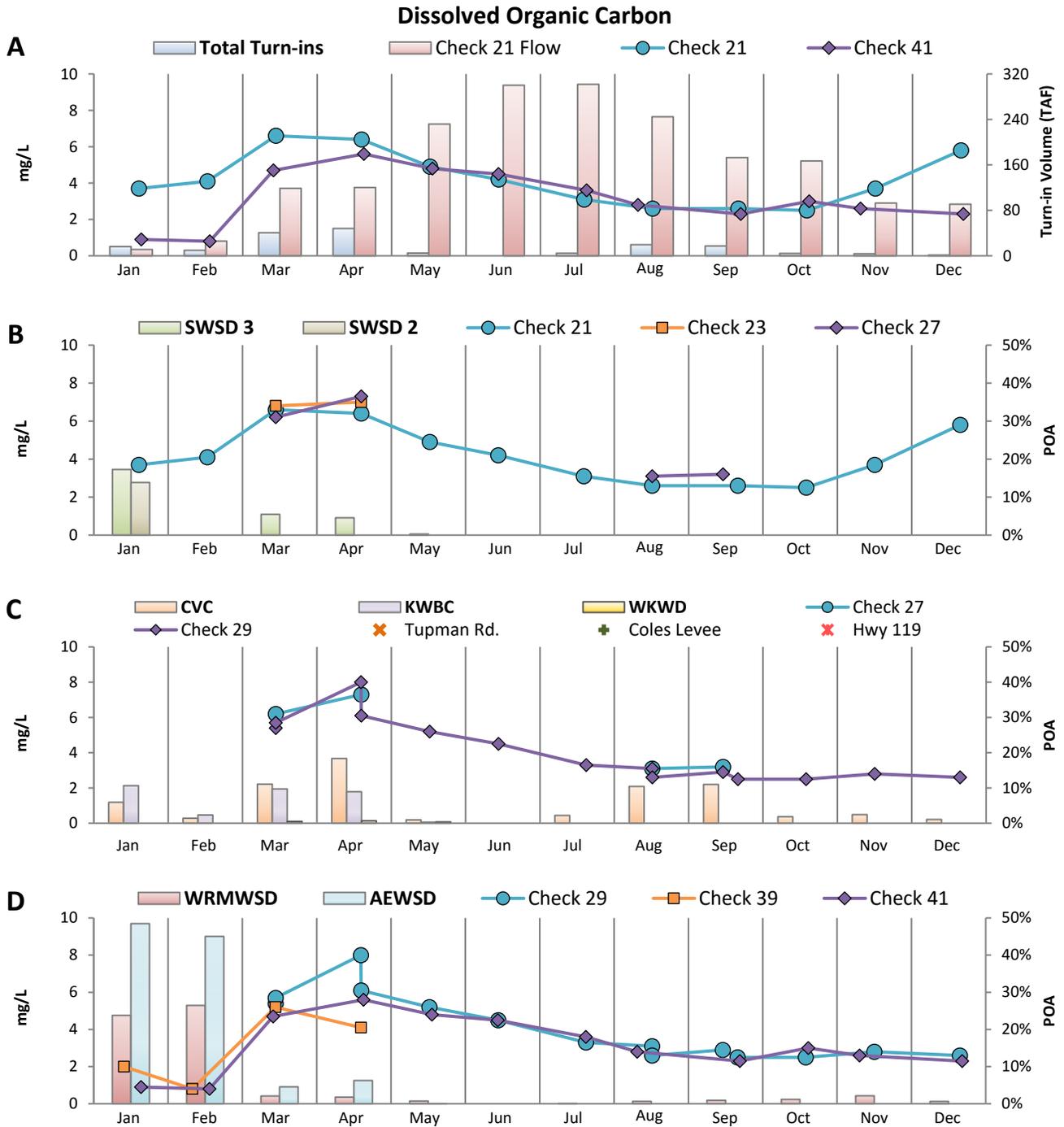
Sample pairs for the Southern Section were evenly split between increases and decreases, with small deviations occurring from April onward; this result is consistent with differing in turn-in concentrations throughout the year. Nitrate increased by 0.3 mg/L in March, decreased by -0.5 mg/L in April, and did not change in the remaining five pairs (Table 4-10 and Figure 4-31D). Turn-in averages of 3.8 mg/L at WRMWSD and 8.2 mg/L at AEWSD (Figure 4-16) were both higher than their upstream averages, suggesting contributions should have resulted in increases. But the average for WRMWSD is skewed upwards by three turn-in structures that reported high concentration samples; in all, 20 of 29 WRMWSD samples reported at <1 mg/L. Additionally, AEWSD reported high concentrations for January and February, followed by very low concentrations in March and April (Figure 4-17). This latter trend coincided with Check 39 and Check 41 samples in January and February that were much higher than concentrations reported at Check 21. The residual influence from these higher concentrations may explain the smaller increase observed in March, despite the lower turn-in concentrations that month. The single decrease and unchanging sample pairs from that point through the end of the year indicated that the three high-concentration WRMWSD structures were likely overwhelmed by the <MRL-concentrations coming from the remaining seven turn-in structures, as well as the increased flow coming downstream in the Aqueduct.

Dissolved Organic Carbon

DOC (filtered) samples downstream of all SJFD turn-ins were lower than upstream concentrations for almost all months of the year (Figure 4-32A); this is consistent with turn-in sample results. This relationship was also true for TOC (unfiltered) (Appendix C), which was sampled reliably in the

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Figure 4-32 Upstream/Downstream Dissolved Organic Carbon Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

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turn-in samples, whereas the majority of Aqueduct samples were tested for DOC. The timing and magnitude of us/ds decreases coincided with months of higher turn-in volume, except for the November and December decreases. Downstream decreases were largest in January and February when the closure at Check 29 prevented downstream flow past that point. During this time, the bulk of water at Check 41 was supplied by Southern Section turn-ins; their lower-than-Aqueduct concentrations are consistent with this result. One unpaired sample decrease in November and one paired sample decrease in December coincided with lower turn-in volumes. In this case, the decreases stemmed from a quick increase in DOC concentrations upstream of the turn-ins.

In the Northern Section, us/ds DOC increased and decreased in one pair each, which is inconsistent with concentrations reported for SWSD 3. The sole decrease (-0.6 mg/L) occurred in March and the sole increase (0.3 mg/L) occurred in April (Table 4-8 and Figure 4-32B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. Based on the average turn-in TOC concentration of 0.7 mg/L, compared with the upstream average of 5.6 mg/L (Figure 4-18), greater downstream decreases would be expected.

DOC decreased in all Central Section sample pairs, which is consistent with concentrations reported for enclosed turn-ins. All four sample pairs decreased with a range of -0.25 to -0.65 mg/L (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The four decreases occurred throughout the year with very little correlation to POAs; high POAs in March correlated to a small decrease, but an even higher combined POA in April resulted in a smaller decrease (Figure 4-32C). Based on the average turn-in concentrations for TOC in this section, greater downstream decreases would be expected. The average TOC for CVC of 1.2 mg/L and single TOC values of 0.66 mg/L at KWBC and <0.2 mg/L at WKWD were much lower than upstream TOC averages of 3.8 mg/L for CVC and 3.9 mg/L for WKWD (Figure 4-18). There was no upstream TOC sample for KWBC.

Sample pairs for the Southern Section primarily decreased, which is consistent with concentrations reported for enclosed turn-ins. DOC sample pairs decreased in five instances by -0.2 to -2.95 mg/L and increased in two pairs by 0.3 and 0.5 mg/L (Table 4-10). The timing of decreasing sample pairs showed a good relationship to POAs, with the largest decreases occurring in March and April during higher POA periods (Figure 4-32D). The months with the largest POA values, January and February, coincided with the Check 29 closure where the bulk of water at Check 39 and Check 41 originated from Southern Section turn-ins. During this time, the concentrations at Check 41 were lower than concurrent samples at Check 21. Both trends were supported by turn-in averages of 0.8 mg/L at WRMWSD (DOC) and 1.8 mg/L at AEWSD (TOC), both of which were lower than their upstream averages of 4.1 and 6.4 mg/L, respectively (Figure 4-18).

Sulfate

Concentrations for sulfate downstream of all SJFD turn-ins were consistently higher than upstream concentrations (Figure 4-33A), which is an expected result based on turn-in concentrations. The timing and magnitude of us/ds increases coincided with months of higher turn-in volume and months with lower turn-in volumes coincided with smaller deviations; the exception being a decrease in March. Downstream increases were largest in January and February when the closure at Check 29 prevented downstream flow past that point. During this time, the bulk of water at Check 41 was supplied by Southern Section turn-ins, which had mixed results respective to their upstream averages. In March, during higher turn-in volumes, a downstream decrease was reported, but this was likely because of a sole brief increase in upstream sulfate compared with surrounding months. No Aqueduct samples exceeded the recommended secondary MCL for sulfate in drinking water.

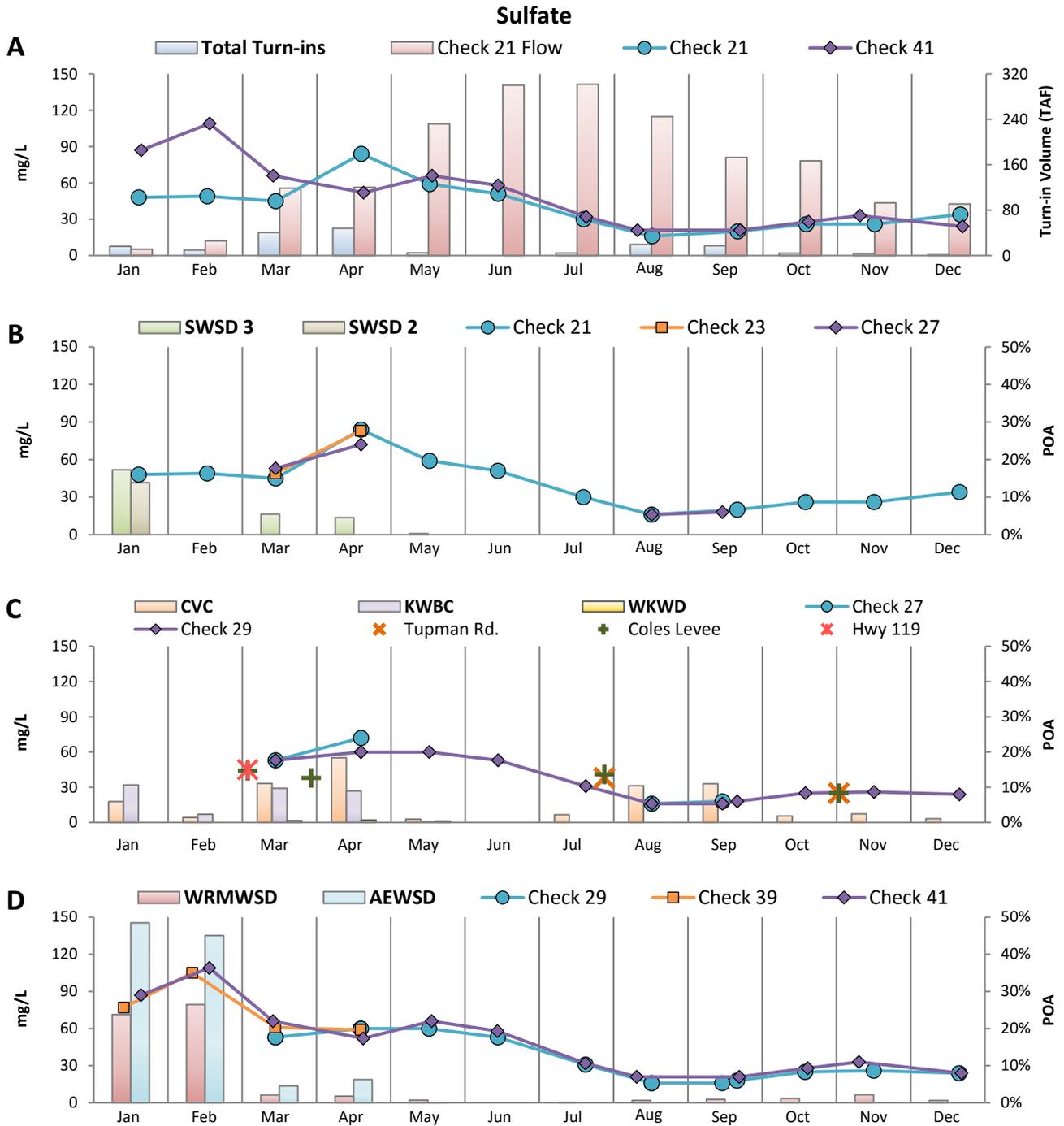
Sulfate increased and decreased downstream of the Northern Section turn-ins in one pair each, which is consistent with concentrations reported for SWSD 3. The sole increase (4 mg/L) occurred in March and the sole decrease (-11 mg/L) occurred in April (Table 4-8 and Figure 4-33B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. Based on the average turn-in concentration of 92 mg/L for SWSD 3, compared with the upstream average of 61 mg/L (Figure 4-20), greater downstream increases would be expected. Yet, sulfate concentrations in SWSD 3 slightly declined to less than the annual average in April (Figure 4-21). This reduction in sulfate would have limited downstream increases from SWSD 3, but does not fully explain the us/ds decrease that month.

Sulfate exhibited mixed results in Central Section sample pairs, which is consistent with concentrations reported for enclosed turn-ins. Two sample pairs decreased by -2 and -12 mg/L, one pair increased by 3 mg/L, and three pairs did not change (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The largest decrease occurred in April during the high POAs; consequently, a slightly decreasing pair and non-changing sample pairs also occurred during high POAs (Figure 4-33C). This inconsistency with respect to the overall POA relationship coincided with turn-in concentrations that were also inconsistent with respect to their upstream averages. The average for CVC of 59 mg/L and single sulfate values of 46 mg/L at KWBC and 60 mg/L at WKWD varied compared with their upstream averages of 37 mg/L for CVC, 63 mg/L for KWBC, and 41 mg/L for WKWD (Figure 4-20).

Sample pairs for the Southern Section primarily increased, which is consistent with samples reported for enclosed turn-ins. Sulfate sample pairs increased in five instances from 1 to 8 mg/L, decreased by -1 mg/L in one pair, and did not change in one pair (Table 4-10). Turn-in averages for

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Figure 4-33 Upstream/Downstream Sulfate Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

sulfate in the Southern Section were disparate, with an average of 343 mg/L for WRMWSD and an average of 26 mg/L for AEWS; these were compared with upstream averages of 35 mg/L for WRMWSD and 57 mg/L for AEWS (Figure 4-20). The months with the largest POA values, January and February (Figure 4-33D), coincided with the Check 29 closure where the bulk of water at Check 39 and Check 41 originated from Southern Section turn-ins. During this time, the concentrations at Check 41 were higher than concurrent samples at Check 21. This is consistent with turn-in concentrations for these months that were greater than the upstream value for both WRMWSD and AEWS (Figure 4-21). In March, when POAs fell, the us/ds increase was less pronounced. The largest decrease of the year occurred in April when AEWS reported a higher POA than in March, which also coincided with a very low sulfate concentration from AEWS (Figure 4-21). After April, only WRMWSD operated in the Southern Section and the subsequent increases were small, compared with background concentrations and variations, likely because the very low POAs from WRMWSD offset the higher-than-Aqueduct sulfate concentrations.

Total Dissolved Solids

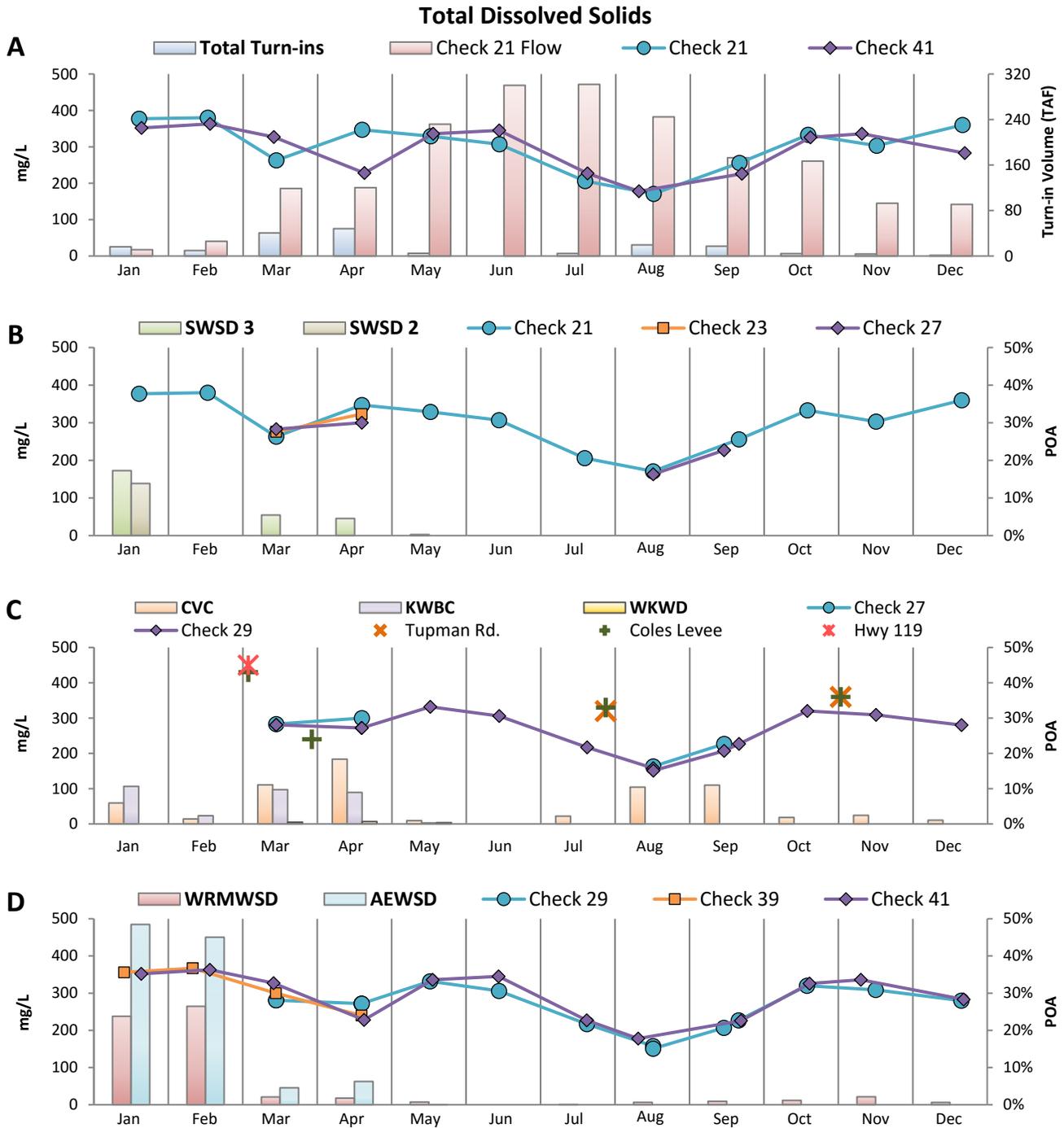
TDS primarily decreased downstream of the SJFD turn-ins with fluctuating values throughout the year (Figure 4-34A). This result is consistent with turn-in averages that also fluctuated with respect to their upstream averages (Figure 4-22). This consistency was further emphasized in the direction and magnitude of individual deviations throughout the year. For instance, both increases and decreases were reported for the first four months of the year when turn-ins made a larger portion of Aqueduct water. Variations amongst us/ds locations for the remainder of the year were smaller and showed less influence from turn-ins. No Aqueduct samples exceeded the MCL for TDS in drinking water.

In the Northern Section, us/ds TDS increased and decreased in one pair each, which is consistent with measurements reported for SWSD 3 that were close to the upstream average. The sole increase (7 mg/L) occurred in March and the sole decrease (-23 mg/L) occurred in April (Figure 4-34B). Because the two SWSD turn-ins only operated for a few days in January and February, no Aqueduct samples were available for those months. These small deviations were expected based on the average turn-in measurement of 323 mg/L, compared with the upstream average of 319 mg/L (Table 4-8 and Figure 4-22). Furthermore, higher-than-average results were reported during March and lower-than-average results were reported during April (Figure 4-23), which may further explain the direction of us/ds changes in those months.

TDS decreased in most Central Section sample pairs; this was an overall trend that is consistent with turn-in concentrations. Four sample pairs decreased with a range of -2 to -28 mg/L, one pair increased by 10 mg/L, and one pair did not change (Table 4-9). CVC and KWBC both operated in a limited capacity in January and February, but because of operational constraints caused by the

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Figure 4-34 Upstream/Downstream Total Dissolved Solids Concentrations for (A) the San Joaquin Field Division: Check 21 and Check 41, (B) the Northern Section: Check 21 to Check 27, (C) the Central Section: Check 27 to Hwy 119, and (D) the Southern Section: Check 29 to Check 41



Notes:

AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, KWBC = Kern Water Bank Canal, mg/L = milligrams per liter, POA = percentage-of-Aqueduct, SWSD 2 = Semitropic Water Storage District Turn-in 2, SWSD 3 = Semitropic Water Storage District Turn-in 3, TAF = thousand acre-feet, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Check 29 shutdown, these turn-ins only supplied water locally and us/ds samples were not available for collection. The four decreases occurred during two periods of the year and correlated to higher POAs, while the increase and equivalent pair occurred during lower POAs (Figure 4-34C). This POA relationship coincided well with concentrations for the two larger turn-ins that were all less than upstream concentrations; CVC averaged 216 mg/L compared to 276 mg/L upstream and KWBC reported a single value of 250 mg/L compared with 292 mg/L (Figure 4-22). In contrast, the POA relationship did not fit for WKWD where its single sample, 280 mg/L, was lower than the upstream sample, 335 mg/L (Figure 4-22). But the corresponding us/ds sample pair reported an increase of 20 mg/L (Figure 4-34C). It is likely the low POA from this turn-in (0.5 percent in March) limited its influence and the us/ds increase is because of, in larger part, unrelated variations in the Aqueduct.

Sample pairs for the Southern Section primarily increased, which is consistent with samples reported for enclosed turn-ins. TDS sample pairs increased in five instances from 3 to 19 mg/L and decreased by -1 and -32 mg/L in two pairs (Table 4-10). Turn-in averages for TDS in the Southern Section were disparate with an average of 680 mg/L for WRMWSD and an average of 173 mg/L for AEWS; these were compared with upstream averages of 254 mg/L for WRMWSD and 288 mg/L for AEWS (Figure 4-22). The months with the largest POA values, January and February (Figure 4-34D), coincided with the Check 29 closure where the bulk of water at Check 39 and Check 41 originated from Southern Section turn-ins. During this time, the concentrations at Check 41 were slightly lower than concurrent samples at Check 21. This is consistent with samples of lower concentration reported for AEWS, which had a larger POA, but conflicted with the much higher concentration WRMWSD samples during this time (Figure 4-23). In March, upstream samples decreased while Check 41 remained close to the February concentration, despite AEWS concentrations falling to a much lower level. This was likely because of lingering high-concentration water from February. TDS at Check 41 decreased in April while upstream TDS slightly increased, resulting in the us/ds decrease. This coincided with a larger proportion of water coming from AEWS, compared with WRMWSD, and the lowest TDS concentration reported for AEWS, 50 mg/L (Figure 4-23). After April, only WRMWSD operated in the Southern Section and the subsequent small increases coincided with WRMWSD's higher-than-Aqueduct sulfate concentrations and relatively small POAs.

V. Southern Field Division

Antelope Valley-East Kern Water Agency (AVEK) pumped 1,056 af of groundwater into the Aqueduct during 2016 (Table 5-1). With low water allocations, AVEK determined a need for additional deliveries to AVEK’s water treatment plants (Antelope Valley-East Kern Water Agency 2014). AVEK pumped from four wells connected to a shared turn-in/turn-out facility at Aqueduct MP 357.72, located nearly three miles upstream of Pearblossom Pumping Plant (PPP). Well S-1 operated January–April, as a continuation of the 2015 program, while Well ES-2R, Well ES-3, and Well ES-4 started a new turn-in program in July and this operated through October.

Table 5-1 Monthly Antelope Valley-East Kern Water Agency Groundwater Turn-in Volumes, Pearblossom Pumping Plant Volumes, and Percentage-of-Aqueduct Values for all Antelope Valley-East Kern Water Agency Turn-ins Combined

	AVEK Volume	Pearblossom Pumping Plant	POA (%)
January	168	7,317	2.2
February	152	11,598	1.3
March	145	33,557	0.4
April	74	58,832	0.1
July	13	106,075	0.01
August	169	108,263	0.2
September	226	98,728	0.2
October	109	73,222	0.1
Total	1,056	497,592	0.6^a

Notes:

AVEK = Antelope Valley-East Kern Water Agency, POA = percentage-of-Aqueduct

All volumes are in acre-feet.

^aThe value in the Total POA field represents the average of all POAs during active months.

In a similar fashion to other turn-in programs, this section uses Aqueduct and turn-in volumes to calculate turn-in POA values. Table 5-1 provides monthly and total values for PPP pumping and turn-in POAs. During the AVEK turn-in periods, PPP pumped 497,592 af of water with a minimum monthly volume of 7,317 af in January and a maximum monthly volume of 108,263 af in August. The monthly POA values averaged 0.6 percent and ranged from a low of 0.01 percent in July to a high of 2.2 percent in January.

Each of the AVEK wellheads had water quality samples collected to determine concentration and consistency for the COCs. Table 5-2 shows the results for all wellhead samples along with individual well averages and statistics for all wells as a whole. Since Well S-1 was operating as a continuation

Table 5-2 Water Quality Constituents-of-Concern in Antelope Valley-East Kern Water Agency

		Arsenic	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Nitrate	Sulfate	TDS
S-1	Average	<0.001	0.091	18	0.0035	4.0	385	6.8	57	265
ES-2R	Average	<0.001	0.23	47	0.0020	2.2	478	8.7	55	305
ES-3	Average	<0.001	0.045	8.1	0.0047	5.1	338	3.3	43	230
ES-4	Average	<0.001	0.015	2.7	0.0045	5.1	310	1.2	41	213
All Wells	Min	<0.001	0.013	2.2	0.0016	1.9	310	1	40	200
	Average	<0.001	0.094	18.9	0.0037	4.1	376	4.7	48	251
	Max	<0.001	0.24	49	0.0048	5.3	480	8.8	58	310

Notes:

Cr⁶⁺ = hexavalent chromium, EC = electrical conductivity, Max = maximum, MCL = maximum contaminate level, Min = minimum

TDS = total dissolved solids, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

of the 2015 program; it was only required to collect quarterly samples. The remaining three wells operated under a new program and collected the required weekly samples at startup. They did not operate long enough to trigger the quarterly sampling requirement.

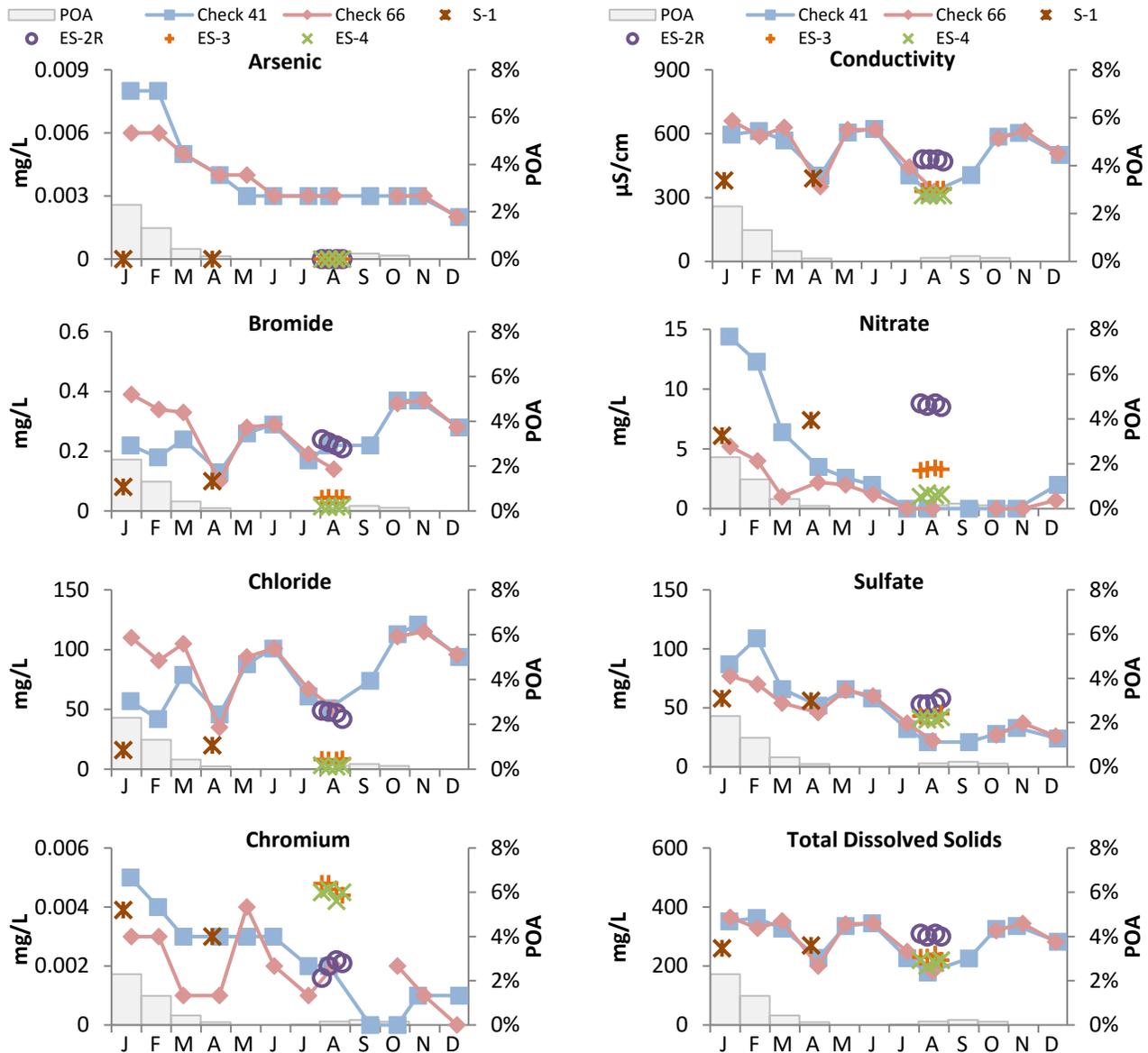
DWR collected monthly samples upstream (Check 41) and downstream (Check 66) of the AVEK turn-in. The comparability between these sites is less reliable than other us/ds sample pairs, because Check 66 is 100 miles downstream of Check 41. The travel time for water across this distance makes direct comparisons within sample pairs difficult, but differences in sample pairs over time illustrate prevailing trends showing the preponderance of changes attributable to turn-ins. Figure 5-1 displays all raw results for Aqueduct and AVEK wellhead samples. The graphs also provide the monthly POA values at the AVEK turn-in structure.

Overall, there appears to be very little impact from AVEK turn-ins to water quality in the Aqueduct (Figure 5-1). This result was because of both low-inflow volume and low-to-moderate COC concentrations for AVEK wells compared with upstream Aqueduct concentrations. Sample pairs primarily showed minor increases or decreases, and downstream trends largely mirrored those measured upstream. Several us/ds deviations follow the expected POA relationship based on turn-in and Aqueduct concentrations; but far more us/ds deviations contradicted or showed no clear agreement with the expected POA relationship.

Sample pairs varied in number and magnitude for all COCs throughout the turn-in period (Figure 5-1). For January–April, when only Well S-1 was active, turn-in concentrations were less than upstream concentrations for all but three individual samples. In April, the turn-in nitrate

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Figure 5-1 Water Quality Constituents-of-Concern at Check 41, Check 66, and Antelope Valley-East Kern Water Agency Wells Along with Monthly Antelope Valley-East Kern Water Agency Percentage-of-Aqueduct Values



Notes:
 mg/L = milligrams per liter, $\mu\text{S/cm}$ = microSiemens per centimeter
 Non-detects are graphed at zero.

concentration was 7.4 mg/L compared with 3.5 mg/L upstream, the turn-in sulfate concentration was 56 mg/L compared with 52 mg/L upstream, and the turn-in TDS concentration was 270 mg/L compared with 228 mg/L upstream. Despite these higher-than-Aqueduct concentrations, all us/ds sample pairs in April decreased downstream. Similarly, some lower-than-Aqueduct turn-in

concentrations in January coincided with us/ds increases, notably for bromide, chloride, and conductivity. Both trends contradicted the expected POA relationship based on turn-in and Aqueduct concentrations. In contrast, there are also some us/ds pairs that conform to the expected POA relationship, most notably decreases in arsenic, chromium, and nitrate.

For July–October, many more turn-in samples reported concentrations higher than upstream samples. Arsenic and chloride were the only COCs for which all turn-in samples were less than upstream concentrations. Conductivity, sulfate, and TDS reported turn-in concentrations slightly above upstream concentrations. Chromium and nitrate both reported turn-in concentrations from one or more wells that were much higher than upstream concentrations. Yet, similar to the results for Well S-1, these higher-than-Aqueduct concentrations had very little impact on us/ds sample pairs. For all COCs, us/ds pairs exhibited minor increases and decreases throughout the turn-in period, except for arsenic and nitrate, which showed no us/ds changes. The us/ds analysis was hampered in September by the lack of a downstream sample. Still, the analysis of surrounding sample pairs indicated there was likely little impact from turn-ins during this month as well.

The only notable us/ds change during this period was an increase in chromium from <0.001 mg/L at Check 41 to 0.002 mg/L at Check 66 in October (Figure 5-1). This us/ds change fitted well with the expected POA relationship. But the very low POA for that month, 0.1 percent, likely limited any real effect the turn-ins may have had on this increase. Because this increase is the only slight indication of possible turn-in influence and there is a lack of expected us/ds deviations for all other sample pairs, it is unlikely the AVEK turn-in had any discernable influence on Aqueduct concentrations.

VI. Conclusions

In 2016, a total of 199,980 af of non-Project water was admitted to the Aqueduct. Non-Project waters originate from sources other than the Sacramento-San Joaquin Delta. These inflows can aid in supplying water to areas experiencing shortages during periods of drought or years with below-normal snowpack runoff. The majority of non-Project water provided in 2016 originated as groundwater pumping in the SJFD (86 percent), followed by surface and/or groundwater inflows in the San Luis Field Division (SLFD) and Southern Field Division (SFD).

San Luis Field Division

A total of 28,621 af of non-Project turn-in water was pumped into the Aqueduct in the SLFD between Check 13 and Check 21 during April–August. This water was supplied from wells piped directly to the Aqueduct and from wells further away that transport water to the Aqueduct through Mendota Pool and WWD’s Lateral 7 facility. The goal for all WWD turn-ins was to use the Aqueduct as a conveyance facility to redistribute water from a time or location of surplus availability to a time or location of deficiency. Monthly volumes for all WWD turn-ins combined, ranged from 1,482 af to 8,233 af, composing from 0.5 to 5.9 percent of the water entering the Aqueduct from groundwater inflows and pumping at DAPP. Sixty-one wells participated, many of which participated in prior pump-in programs as well.

As with other turn-in programs and WWD turn-ins during previous years, water quality monitoring for individual wells and Lateral 7 required samples to be collected at specified intervals to show acceptable and reliable water quality from these sources. Similarly, us/ds samples were again collected in the Aqueduct at Check 13 and Check 21. In addition, samples were also collected at locations immediately adjacent to Lateral 7 to isolate the influence of Lateral 7 from other turn-ins. The following summary includes us/ds analysis encompassing all WWD turn-ins, including Lateral 7, based on the Check 13 and Check 21 data and the sites adjacent to Lateral 7.

Results for the us/ds analysis encompassing all turn-ins showed no consistent increases for any constituents downstream of the WWD turn-ins. Some constituents showed a minor predilection toward increasing downstream concentrations, and coincided with higher-than-Aqueduct concentrations reported for the turn-in samples. These constituents included arsenic, manganese, nitrate, and sulfate. While other constituents, such as bromide, conductivity, and TDS, showed a minor predilection toward decreasing downstream concentrations, despite their higher-than-Aqueduct concentrations reported for the turn-in samples. Similarly, us/ds samples for both boron and selenium showed minor-to-no change, in contrast to the higher-than-Aqueduct concentrations reported for those turn-in samples. Lastly, equivalent or decreasing downstream concentrations were reported for chloride, chromium, mercury, and TOC, coinciding with lower-than-Aqueduct

concentrations for these constituents. Only two Aqueduct samples exceeded an MCL; both were downstream samples that exceeded the manganese secondary MCL of 0.05 mg/L for drinking water.

The us/ds analysis for samples immediately adjacent to Lateral 7 were more definitive and coincided better with the expected results based on turn-in samples. Downstream increases, in concurrence with higher-than-Aqueduct turn-in concentrations, were reported for arsenic, boron, chloride, conductivity, sulfate, TDS, and turbidity. Decreasing or equivalent us/ds pairs, in concurrence with lower-than-Aqueduct and similar-to-Aqueduct turn-in concentrations, were reported for bromide, nitrate, TOC, and selenium. In contrast, chromium was equivalent in most sample pairs, despite its higher-than-Aqueduct turn-in concentrations. It should be noted that the majority of both increases and decreases downstream of Lateral 7 were very small in magnitude compared with upstream Aqueduct concentrations. No samples adjacent to Lateral 7 exceeded any drinking water MCLs.

Specific findings are described below.

Arsenic. Concentrations did not change between us/ds locations in three sample pairs and increased by 0.001 mg/L in two pairs during the sampling period. The prevalence of equivalent or slightly increasing pairs is partially supported by wellhead concentrations, but more frequent or greater increases would be expected based on the wellhead average of 0.004 mg/L that was higher than all upstream samples. Likewise, very small us/ds increases (up to 0.0006 mg/L) occurred in most samples directly downstream of Lateral 7. This contrasts with to a much higher average for Lateral 7 samples of 0.0064 mg/L, compared with a maximum concentration of 0.003 mg/L upstream.

Boron. Concentrations were equal between us/ds locations in all but one decreasing sample pair, which is inconsistent with higher-concentration wellhead samples relative to the Aqueduct. The wellhead samples averaged 0.89 mg/L compared with the maximum upstream concentration of 0.3 mg/L. In contrast, the larger and more frequent increases (up to 0.102 mg/L) during periods of higher POAs at Lateral 7, are consistent with that turn-in's concentrations. In this case, Lateral 7 averaged 1.03 mg/L, compared with a maximum of 0.239 mg/L immediately upstream.

Bromide. Nearly all bromide sample pairs showed decreases, which is inconsistent with higher-concentration wellhead samples relative to the Aqueduct. The wellhead samples averaged 0.41 mg/L compared with the maximum upstream concentration of 0.3 mg/L during the turn-in period. Similarly, results us/ds of Lateral 7 samples also conflicted with turn-in concentrations. The predominance of us/ds samples showed no change, remaining at <0.5 mg/L for much of the year. In contrast, Lateral 7 samples ranged from 0.59 to 1.1 mg/L. This analysis was affected by the

prevalence of samples (48 percent) that reported less than an MRL of 1 mg/L, despite other samples reporting values below that MRL.

Chloride. Nearly all chloride sample pairs showed decreases, which is consistent with lower-concentration wellhead samples relative to the Aqueduct. The wellhead samples averaged 63 mg/L compared with the average upstream concentration of 87 mg/L during the turn-in period. In an opposite trend, chloride downstream of Lateral 7 primarily increased (up to 9.3 mg/L), which is consistent with higher-concentration turn-in samples compared with the Aqueduct. Lateral 7 averaged 156 mg/L, compared to a maximum of 100 mg/L upstream.

Total Chromium. Downstream total chromium (trivalent plus hexavalent chromium, unfiltered) remained equal to concentrations upstream throughout the turn-in period, but correlations with wellhead data were difficult to quantify. Both locations remained at the MRL of 0.001 mg/L throughout the sample period, except for July when both locations were less than the MRL. The lack of influence from turn-ins on total chromium concentrations coincided with wellhead samples, where all samples except Lateral 7 were less than the MRL. But this comparison is unreliable because of the high MRL (0.01 mg/L) for all wells except Lateral 7. The us/ds analysis for Lateral 7 was also complicated by the prevalence of us/ds concentrations fluctuating above and below that turn-in's MRL of 0.0005 mg/L. Still, the bulk of these samples showed no change between locations, which contrasted with Lateral 7 samples that averaged 0.0059 mg/L.

Hexavalent Chromium. No hexavalent chromium (filtered) samples were collected in the Aqueduct during this time. Turn-in influences for hexavalent chromium were likely small because 85 percent of wellhead samples were less than the MRL of 0.2 µg/L.

Conductivity. During the turn-in period, conductivity decreases were larger and more frequent than increasing pairs, which is inconsistent with wellhead-sample results. These samples averaged 1,260 µS/cm compared with a maximum upstream measurement of 626 µS/cm. Consequently, this trend for discrete grab samples conflicted with the trend shown in hourly measurements provided by real-time monitoring equipment located at the us/ds sampling sites. These data showed a prevalence of increasing conductivity downstream, which concurred with wellhead-sample results. Likewise, the discrete grab samples collected adjacent to Lateral 7 also showed a prevalence of us/ds increases (up to 105 µS/cm). This concurred with Lateral 7 measurements, averaging 1,562 µS/cm, compared with the maximum upstream measurement of 637 µS/cm.

Manganese. Downstream concentrations increased in fewer sample pairs but by a greater magnitude during the turn-in period. These increases coincided with higher-than-Aqueduct turn-in concentrations, averaging 0.03 mg/L compared with an average of 0.02 mg/L upstream. But these

increases occurred during months of lower POAs, whereas the month of highest POA had a slight decrease downstream. This indicated influences other than turn-in probably accounted for the large downstream increase that was observed for manganese. No Lateral 7 samples were collected for manganese.

Mercury. Concentrations reported <MRL of 0.002 µg/L in all five us/ds sample pairs, which is consistent with wellhead samples that also reported all mercury concentrations <MRL. No Lateral 7 samples were collected for mercury analysis.

Nitrate. Nitrate sample pairs had minor variations throughout the sample period, with early increases coinciding with expected results based on wellhead average and POAs. Wellhead samples averaged 6.9 mg/L compared with the maximum upstream concentration of 2.5 mg/L. An opposite trend was observed for us/ds samples around Lateral 7, which was an equal number of increases and decreases but a larger magnitude of decreases (from -3.99 to 2.3 mg/L). This trend also concurred with the expected results based on the Lateral 7 average of 1.46 mg/L, compared with the average upstream concentration of 2.02 mg/L.

Total Organic Carbon. Sample pairs were evenly split between increases and decreases, but the timing of each and the small magnitude of change (from -0.9 to 0.3 mg/L) conflicted with expected results based on lower-than-Aqueduct wellhead concentrations. Wellhead samples averaged 0.77 mg/L, compared with the minimum upstream concentration of 2.4 mg/L. In contrast, Lateral 7 sample pairs had larger and more frequent downstream decreases (up to -2 mg/L), which concurred with the expected results based on Lateral 7's average of 2.1 mg/L, compared with the minimum upstream concentration of 2.8 mg/L.

Selenium. Concentrations remained at 1 µg/L, both upstream and downstream, except for one downstream decrease of <1 µg/L. The inclination toward decreasing or no change sample pairs is inconsistent with the higher-than-Aqueduct wellhead average of 3.8 µg/L. But this average is skewed upwards by the majority (53 percent) of wellhead samples that reported less than the MRL of 2 µg/L, which is higher than the recorded Aqueduct concentrations. Lateral 7 us/ds samples showed no change throughout the turn-in period with all samples reporting at <0.4 µg/L. This lack of change is consistent with Lateral 7 concentrations that were equal to <0.4 µg/L for 95 percent of the samples.

Sulfate. Sulfate primarily increased in us/ds sample pairs. This trend is consistent with high-sulfate samples collected from the turn-ins, which averaged 405 mg/L compared with the maximum upstream concentration of 56 mg/L. Likewise, sample pairs adjacent to Lateral 7 also primarily

increased (up to 23.1 mg/L) in accordance with turn-in samples that averaged 375 mg/L, compared with the maximum upstream concentration of 49.9 mg/L

Total Dissolved Solids. TDS primarily decreased in us/ds sample pairs, which is inconsistent with lower-than-Aqueduct wellhead samples. Turn-in concentrations averaged 801 mg/L compared with the maximum upstream concentration of 346 mg/L. In contrast, sample pairs adjacent to Lateral 7 primarily increased (up to 38 mg/L) in accordance with turn-in samples that averaged 972 mg/L, compared with the maximum upstream concentration of 372 mg/L.

Turbidity. Turbidity was only measured in and adjacent to Lateral 7 because of this turn-in's potential impacts from Mendota Pool surface-water introductions. These samples primarily increased downstream (up to 6.1 NTU), which coincided with turn-in samples that averaged 48 NTU, compared with the maximum upstream measurement of 11.3 NTU.

San Joaquin Field Division

Turn-in Volumes

Groundwater turn-in volumes for all SJFD turn-in entities totaled 170,303 af. CVC contributed the largest volume of the year with 81,075 af. This volume was 48 percent of the total volume for all SJFD turn-ins combined. The second largest source was AEWSD with 29,819 af (18 percent). KWBC contributed 25,861 af (15 percent). WRMWSD contributed 16,864 af (9.9 percent) from all 10 turn-in structures combined. SWSD contributed 14,512 af (8.5 percent) from both turn-ins, SWSD 3 contributed 13,255 af (7.8 percent), and SWSD 2 contributed 1,257 af (0.7 percent). WKWD contributed the smallest volume of water to the Aqueduct of any agency with 2,172 af (1.3 percent).

All SJFD turn-ins operated January–May with the exceptions of SWSD 3, which did not operate in February; SWSD 2, which only operated for a few days at the beginning of the year; and WKWD, which did not start operations until March. All turn-ins were inactive during June, after which point only CVC and WRMWSD restarted operations in July and continued through December. Turn-ins comprised 8.3 percent of the water entering the Aqueduct in the SJFD with flows at Check 21 comprising the rest. This was much less than the same statistic for 2015 (37 percent).

Project Operations

Monthly flow volumes at Check 21 ranged from 11 thousand acre-feet (taf) in January to 301 taf in July, with a total annual volume of 1.87 million acre-feet (maf). Further downstream at BVPP, monthly pumping volumes ranged from 8 to 190 taf, with a smaller total volume of 1.43 maf. Finally, monthly pumping at EPP ranged from 16 to 160 taf, with a total annual volume of 1.31 maf.

During periods when monthly volumes at Check 21 were less than downstream demands, turn-ins provided the additional volume.

Check structures on the Aqueduct can be opened and closed to control flow and pool elevation during periods of off-peak pumping. Extended check closures can affect Aqueduct water quality by altering the makeup of water collected at each sampling site and by altering the rate at which water flows between the us/ds locations used in the Aqueduct water quality analysis. Fourteen of the 17 check structures analyzed from Check 21 to Check 41 had one or more hour-long closures during the year. Ten checks had individual closures lasting longer than 24 hours and six checks had closures lasting longer than five days. Check 28 and Check 29 had the longest individual closures, each lasting 52 days during January and February. These two closures, as well as shorter closures at these and adjacent checks during January and February, were done to stop flow at Check 29 and manage water availability in the SJFD during Aqueduct repairs in Pool 30.

Turn-in and Aqueduct Water Quality

Throughout the year, DWR and the turn-in entities collected water quality samples for COCs from each turn-in and the Aqueduct. An assessment of water quality was performed by using us/ds sample pairs bracketing 1) both SWSD turn-ins; 2) CVC, KWBC, and WKWD; and 3) WRMWSD and AEWSD.

Overall, COCs that routinely increased in the Aqueduct included arsenic, dissolved chromium, hexavalent chromium, and sulfate. COCs that routinely decreased in the Aqueduct included bromide, chloride, DOC, and salinity (conductivity and TDS). The magnitude and direction of all COC concentration changes were sometimes associated with low or high turn-in flows relative to those in the Aqueduct. This was evident in July when the lowest relative turn-in volumes corresponded to some of the smallest us/ds changes. Yet, the overall effect of turn-in water on Aqueduct concentrations appears to be small. The majority of sample pairs reported us/ds deviations far smaller than the variation in the Aqueduct absent those turn-ins, represented by upstream Aqueduct samples throughout the period of operation. Some sample pairs did report us/ds deviations close to the range of upstream concentrations, but only hexavalent chromium samples reported us/ds deviations exceeding the range of upstream concentrations. This effect is likely the case because the turn-in volumes and POAs were so low in 2016 that sources or influences other than turn-ins had a more profound effect on Aqueduct concentrations.

Additionally, extended check closures in January and February affected Aqueduct concentrations by preventing or minimizing the comingling of upstream Aqueduct flows with turn-in water. This often resulted in noticeably higher or lower concentrations at Check 41 compared with Check 21,

depending on the Southern Section turn-in concentrations in those months. No Aqueduct samples exceeded the drinking water MCL for any COC. Definitive effects on Aqueduct water quality from WKWD could not be verified because of low volumes and a distance between us/ds stations that is too short to allow complete blending of inflows.

Specific findings are described below.

Arsenic. Concentrations increased downstream of turn-ins for the majority of all us/ds sample pairs, which is a result that is consistent with higher-than-Aqueduct concentrations reported for the turn-ins. In seven of nine samples, arsenic leaving the SJFD at Check 41 was higher than arsenic entering the SJFD at Check 21 (Table 6-1). Larger downstream increases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. The MCL of 0.01 mg/L for arsenic in drinking water was not exceeded in Aqueduct sampling.

Arsenic increased by 0.001 mg/L in one sample pair bracketing the SWSD 3 turn-in and did not change in the other (Table 6-1). The increase was consistent with the SWSD 3 turn-in average of 0.009 mg/L, compared with the lower average of 0.003 mg/L upstream in the Aqueduct.

Arsenic increased in half of all sample pairs bracketing CVC and KWBC, with an overall average change of 0.0004 mg/L, and did not change in a third of samples (Table 6-1). The increases were consistent with turn-in average of 0.004 mg/L at CVC and the single sample result of 0.012 mg/L at KWBC, compared with the lower upstream Aqueduct averages of 0.003 and 0.004 mg/L, respectively.

Arsenic was equivalent for all but one us/ds sample pair for March–December with an overall average change of 0.0001 mg/L (Table 6-1). This lack of definitive change is consistent with moderate turn-in concentrations for both WRMWSD and AEWSD and low turn-in volumes for the latter half of the year. WRMWSD averaged 0.004 mg/L (dissolved arsenic, filtered) and AEWSD averaged 0.005 mg/L, compared with upstream Aqueduct averages of 0.003 and 0.004 mg/L, respectively. But no upstream samples were available in January and February when the bulk of Check 41 water was supplied by Southern Section turn-ins. During these months, Check 41 reported the highest concentrations of the year. These high concentrations coincided with higher turn-in volumes and moderately higher than average turn-in concentrations for both Southern Section turn-ins.

Bromide. Concentrations decreased downstream of turn-ins for the majority of all us/ds sample pairs, which is consistent with lower-than-Aqueduct concentrations for all turn-ins except SWSD 3.

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Table 6-1 Concentration Changes at Water Quality Stations Bracketing the Three Turn-in Sections and San Joaquin Field Division

Bracketing Checks	Bracketing SJFD			Bracketing SWSD			Bracketing CVC, KWBC, and WKWD			Bracketing WRMWSD and AEWSD		
	Check 21 to Check 41			Check 23 to Check 27			Check 27 to Check 29 Tupman to Cole's Levee			Check 29 to Check 39 & Check 41		
Arsenic	7 2 0	↑ 0.0016	0.005 0	1 1 0	↑ 0.0005	0.001 0	3 2 1	↑ 0.0004	0.001 -0.0001	1 6 0	↑ 0.0001	0.001 0
Bromide	2 1 6	↓ -0.061	0.07 -0.19	1 0 1	↓ -0.005	0.02 -0.03	1 1 4	↓ -0.008	0.01 -0.02	2 3 2	↑ 0.001	0.02 -0.01
Chloride	2 0 7	↓ -23.6	16 -80	1 0 1	↓ -0.5	5 -6	1 0 5	↓ -5.2	2 -10	3 0 4	↓ -0.1	3 -0.1 -2
Dissolved Chromium^a	6 3 0	↑ 0.0016	0.004 0	2 0 0	↑ 0.001	0.001 0.001	0 3 1	↓ -0.0001	0 -0.0005	4 3 0	↑ 0.0005	0.001 0
Hexavalent Chromium^b (µg/L)	2 0 0	↑ 0.96	1.05 0.86	2 0 0	↑ 0.53	0.78 0.28	3 1 1	↓ -0.02	0.04 -0.2	2 0 0	↑ 0.53	0.77 0.28
Conductivity (µS/cm)	3 0 6	↓ -48.8	100 -209	1 0 1	↓ -16	15 -47	0 0 5	↓ -26.6	-5 -67	4 0 3	↑ 4.9	34 -30
Nitrate	4 1 4	↑ 3.01	14.4 -0.6	2 0 0	↑ 0.4	0.6 0.2	1 4 1	↔ 0	0.2 -0.2	1 5 1	↓ -0.03	0.3 -0.5
Dissolved Organic Carbon	2 0 7	↓ -1.3	0.5 -3.5	1 0 1	↓ -0.15	0.3 -0.6	0 0 4	↓ -0.36	-0.25 -0.65	2 0 5	↓ -0.49	0.5 -2.95
Sulfate	7 0 2	↑ 10	60 -32	1 0 1	↓ -3.5	4 -11	1 3 2	↓ -1.8	3 -12	5 1 1	↑ 2.9	8 -1
Total Dissolved Solids	3 0 6	↓ -20.3	64 -119	1 0 1	↓ -8	7 -23	1 1 4	↓ -8.1	10 -28	5 0 2	↑ 1.3	19 -32

Legend:

A	E	A = # of Increases	D = Net Change Icon (based on average change)	E = Highest Concentration Change
B	D	B = # Equivalent		F = Average Concentration Change
C	G	C = # of Decreases		G = Lowest Concentration Change

Notes: AEWSD = Arvin-Edison Water Storage District, CVC = Cross Valley Canal, SJFD = San Joaquin Field Division, KWBC = Kern Water Bank Canal, SWSD = Semitropic Water Storage District, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter.

All concentrations are in mg/L unless otherwise noted.

^aHexavalent + trivalent, filtered.

^bHexavalent chromium for SJFD was measured at Checks 23 and 39.

Six of nine bromide samples were lower at Check 41 than at Check 21 (Table 6-1). Sample pairs bracketing certain turn-ins reported increases and equivalent sample pairs, but these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. Larger downstream decreases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins.

Bromide increased and decreased downstream of SWSD 3 in one sample pair each with an overall average change of -0.005 mg/L (Table 6-1). The split results for us/ds variations are consistent with turn-in results that reported slightly higher concentrations in March, coinciding with the increasing sample pair, and slightly lower concentrations in April, coinciding with the decreasing sample pair.

Bromide decreased in almost all sample pairs bracketing CVC and KWBC with an overall average change of -0.008 mg/L (Table 6-1). The declines were consistent with turn-in average of 0.09 mg/L at CVC and the single sample result of 0.18 mg/L at KWBC, compared with the lower upstream Aqueduct averages of 0.22 and 0.18 mg/L, respectively.

Bromide was equivalent in three sample pairs and increased or decreased in two pairs each, resulting in an overall average change of 0.001 mg/L (Table 6-1). The frequency of equivalent pairs and slightly increasing average deviation conflicts with turn-in averages of 0.21 mg/L at WRMWSD and 0.09 mg/L at AEWSD, compared with the upstream Aqueduct averages of 0.21 and 0.19 mg/L, respectively. But in January and February, when downstream flow was stopped prior to the Southern Section, Check 41 reported bromide concentrations lower than Check 21, which coincided with the lower-than-Aqueduct concentrations reported for the turn-ins.

Chloride. Concentrations decreased downstream of turn-ins for the majority of all us/ds sample pairs. This trend is consistent with lower-than-Aqueduct concentrations for all turn-ins except SWSD 3. Chloride concentrations were lower at Check 41 than at Check 21 for seven of nine samples (Table 6-1). Sample pairs bracketing certain turn-ins reported an increase in sample pairs, but these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. Larger downstream decreases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No Aqueduct samples exceeded the secondary MCL for chloride in drinking water.

Chloride increased and decreased downstream of SWSD 3 in one sample pair each with an overall average change of -0.5 mg/L (Table 6-1). The split results for us/ds variations are consistent with

turn-in results that reported slightly higher concentrations in March, coinciding with the increasing sample pair, and slightly lower concentrations in April, coinciding with the decreasing sample pair.

Chloride decreased in all but one sample pairs bracketing CVC and KWBC, with an overall average change of -5.2 mg/L (Table 6-1). The declines were consistent with turn-in concentrations that averaged 25 mg/L at CVC and the single sample result of 41 mg/L at KWBC, compared with the upstream Aqueduct averages of 79 and 66 mg/L, respectively.

Chloride decreased in a slight majority of sample pairs bracketing WRMWSD and AEWSA, with an overall average change of -0.1 mg/L (Table 6-1). This slight trend is consistent with turn-in averages of 31 mg/L for WRMWSD and 22 mg/L for AEWSA, compared with upstream Aqueduct averages of 73 and 67 mg/L, respectively. Furthermore, in January and February, when downstream flow was stopped prior to the Southern Section, Check 41 concentrations were much lower than Check 21, which coincided with the lower-than-Aqueduct concentrations reported for the turn-ins.

Dissolved Chromium. Concentrations for dissolved chromium (trivalent plus hexavalent chromium, filtered) increased downstream of turn-ins for the majority of all us/ds sample pairs, but the influence of turn-ins on us/ds deviations was difficult to determine because of the limitations in the turn-in dataset. Dissolved chromium concentrations were greater at Check 41 than at Check 21 in six of nine samples (Table 6-1). Sample pairs bracketing certain turn-ins reported decreases and equivalent sample pairs, but these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. The largest downstream increases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No total or dissolved chromium samples in the Aqueduct exceeded the MCL for chromium in drinking water.

Dissolved chromium increased by 0.001 mg/L (Table 6-1) in both sample pairs bracketing SWSD 3. This small increasing trend is consistent with higher-than-Aqueduct concentrations reported for the turn-in, but larger increases would be expected based on the average turn-in concentration of 0.01 mg/L (total chromium), compared with the upstream Aqueduct average of <0.001 mg/L.

Dissolved chromium was either unchanged or decreased in all sample pairs bracketing CVC and KWBC, with an average overall change of -0.0001 mg/L (Table 6-1). The unchanging and declining results were consistent with the only total chromium sample collected in this section, a CVC sample equal to <0.002 mg/L (total chromium).

Dissolved chromium increased in a slight majority of sample pairs bracketing WRMWSD and AEWSA, with an average overall change of 0.0005 mg/L, and did not change in the remainder (Table 6-1).

Comparisons with turn-in concentrations were difficult because all WRMWSD samples reported less than the MRL of 0.01 mg/L, whereas AEWS D reported an average of 0.003 mg/L. Based on the AEWS D average, decreases would be expected, but any positive or negative influence from WRMWSD cannot be ascertained with certainty.

Hexavalent Chromium. Concentrations increased downstream of turn-ins for the majority of all us/ds sample pairs in the limited hexavalent chromium (filtered) dataset. This result is consistent with higher-than-Aqueduct concentrations for all turn-ins except WRMWSD. No Aqueduct samples exceeded the MCL for hexavalent chromium in drinking water.

Hexavalent chromium increased in both available sample pairs bracketing SWSD 3, with an overall average change of 0.53 µg/L (Table 6-1). This result is consistent with the higher-than-Aqueduct average for this turn-in, 7.3 µg/L, compared with 0.1 µg/L upstream.

In contrast, sample pairs bracketing CVC and KWBC reported an average overall change of -0.02 µg/L (Table 6-1), despite the majority of pairs reporting increases. This conflicting result was caused by a larger decrease in March that skewed the average downwards. The predominance of increasing pairs is consistent with higher-than-Aqueduct averages of 0.7 µg/L at CVC and the single sample result of 1.4 µg/L at KWBC, compared with upstream Aqueduct averages of 0.3 µg/L and 0.7 µg/L, respectively.

Hexavalent chromium increased in both available sample pairs bracketing WRMWSD and AEWS D, with an overall average change of 0.53 µg/L (Table 6-1). These results conflicted with turn-in concentrations at that time. The overall average for WRMWSD concentrations was less than the Aqueduct, 0.2 µg/L, compared with 0.4 µg/L, while the overall average for AEWS D was greater than the Aqueduct, 2.7 µg/L, compared with 0.6 µg/L. But the timing of these increases, in March and April, conflicted with below average hexavalent chromium concentrations at AEWS D, <0.5 µg/L in both months.

Conductivity. Measurements decreased downstream of turn-ins for the majority of all us/ds sample pairs; trends within sections of the SJFD are consistent with turn-in concentrations. Conductivity measurements were lower at Check 41 than at Check 21 in six of nine samples (Table 6-1). Sample pairs bracketing certain turn-ins reported increasing sample pairs, but these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. Small downstream decreases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No Aqueduct samples exceeded the secondary MCL for conductivity in drinking water.

Conductivity increased and decreased downstream of SWSD 3 in one sample pair each, with an overall average change of $-16 \mu\text{S}/\text{cm}$ (Table 6-1). This result is consistent with the SWSD 3 average of $554 \mu\text{S}/\text{cm}$ that was lower than the upstream Aqueduct average, $571 \mu\text{S}/\text{cm}$. Furthermore, above average conductivity was reported in March, which coincided with the increasing sample pair.

Conductivity decreased in all sample pairs bracketing CVC and KWBC, with an overall average change of $-26.6 \mu\text{S}/\text{cm}$ (Table 6-1). The declines were greater than expected based on turn-in samples. Yet, this dataset is very limited, which prevents reliable determinations of turn-in impacts. CVC reported an average of $477 \mu\text{S}/\text{cm}$ for two samples, compared with $471 \mu\text{S}/\text{cm}$ in the Aqueduct upstream. But these two samples only cover part of the CVC operational period and no samples were collected for KWBC.

Conductivity increased in a slight majority of sample pairs bracketing WRMWSD and AEWSD, with an overall average change of $4.9 \mu\text{S}/\text{cm}$, and decreased in the remainder (Table 6-1). The slight tendency toward increasing us/ds samples is consistent with the higher-than-Aqueduct concentrations reported for WRMWSD—averaging $988 \mu\text{S}/\text{cm}$, compared with $454 \mu\text{S}/\text{cm}$ upstream. But no conductivity samples were collected for AEWSD, which prevented accurate comparisons. In January and February, when downstream flow was stopped prior to the Southern Section, Check 41 concentrations were slightly lower than Check 21. These decreases, during a period of larger inflows from AEWSD combined with the small variations in the following months, suggest AEWSD had a reducing effect on Aqueduct conductivity levels.

Nitrate. The majority of all sample pairs showed no change between us/ds locations, primarily because of results in the Central and Southern Sections. This overall trend contradicted the higher-than-Aqueduct concentrations from turn-ins. Changes in nitrate concentrations between Check 21 and Check 41 were evenly split with four pairs each increasing and decreasing and one pair not changing (Table 6-1). The largest downstream increases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No Aqueduct samples exceeded the MCL for nitrate in drinking water.

Nitrate increased in both Northern Section sample pairs with an overall average change of $0.4 \text{ mg}/\text{L}$ (Table 6-1). The increases were consistent with the turn-in average of $4.9 \text{ mg}/\text{L}$ at SWSD 3, compared with the lower average of $3.2 \text{ mg}/\text{L}$ upstream in the Aqueduct.

Nitrate did not change in the majority of sample pairs bracketing CVC and KWBC, with an overall average change of $0 \text{ mg}/\text{L}$ (Table 6-1). The lack of increasing samples pairs conflicted with the turn-in average of $5.7 \text{ mg}/\text{L}$ at CVC and the single sample result of $5.3 \text{ mg}/\text{L}$ at KWBC, compared with the upstream Aqueduct averages of 1.6 and $4.6 \text{ mg}/\text{L}$, respectively.

Nitrate did not change in the majority of sample pairs bracketing WRMWSD and AEWSD, with an overall average change of -0.03 mg/L (Table 6-1). The lack of increasing samples pairs conflicted with the turn-in averages of 3.8 mg/L (WRMWSD) and 8.2 mg/L (AEWSD), compared with the upstream Aqueduct averages of 1.9 and 4.1 mg/L, respectively. The lack of significant increases in March and April may be partially explained by a shift in source water for AEWSD that introduced water of lower nitrate concentration to the Aqueduct. In January and February, when downstream flow was stopped prior to the Southern Section, Check 41 concentrations were much higher in nitrate than Check 21. These increases, in contrast to the previously mentioned sample pairs, conformed to the expected us/ds deviations based on the aforementioned turn-in concentrations.

Dissolved Organic Carbon. Concentrations for DOC (filtered) decreased downstream of turn-ins for the majority of us/ds sample pairs, which is a result that is consistent with lower-than-Aqueduct concentrations for TOC (unfiltered) in all turn-ins. Seven of nine sample pairs reported DOC concentrations lower at Check 41 than at Check 21 (Table 6-1). Sample pairs bracketing certain turn-ins reported increasing sample pairs, but these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. Larger downstream decreases occurred early and late in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins.

DOC was evenly split with one sample each increasing and decreasing downstream of SWSD 3, with an overall average change of -0.15 mg/L (Table 6-1). The declining sample pair is consistent with turn-in concentrations, but greater magnitude decreases would be expected based on the TOC turn-in average of 0.7 mg/L at SWSD 3, compared with the average of 5.6 mg/L upstream in the Aqueduct.

DOC decreased in all sample pairs bracketing CVC and KWBC, with an overall average change of -0.36 mg/L (Table 6-1). The declines were consistent with the TOC average of 1.2 mg/L at CVC, compared with an upstream Aqueduct average of 3.8 mg/L. The single KWBC sample was similarly low at 0.66 mg/L, but no upstream TOC sample was collected during its period of operations.

DOC decreased in the majority of sample pairs bracketing WRMWSD and AEWSD, with an overall average change of -0.49 mg/L (Table 6-1). The decreases are consistent with turn-in averages of 0.8 mg/L for WRMWSD (DOC) and 1.8 mg/L for AEWSD (TOC), compared with an average of 4.1 mg/L (DOC) upstream of WRMWSD and 6.4 mg/L (TOC) upstream of AEWSD. The propensity for decreasing DOC downstream of these turn-ins was reinforced by samples in January and February, when downstream flow was stopped prior to the Southern Section that showed Check 41 concentrations lower than those at Check 21.

Sulfate. The results for all us/ds sample pairs had a slight inclination toward increasing concentrations, but there was no common trend between sections or the SJFD as a whole. The slight inclination toward increases and overall lack of consistent trend concurred with turn-in averages that were evenly split between higher-than-Aqueduct and lower-than-Aqueduct concentrations. Seven of nine monthly samples reported sulfate concentrations higher at Check 41 than at Check 21 (Table 6-1). Sample pairs bracketing certain turn-ins reported equivalent or decreasing sample pairs, but these deviations were countered or not large enough to substantially alter the overall increasing effect turn-ins had on Aqueduct concentrations. The largest of the increases occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No Aqueduct samples exceeded the secondary MCL for sulfate in drinking water.

Sulfate was evenly split with one sample each increasing and decreasing downstream of SWSD 3, with an overall average change of -3.5 mg/L (Table 6-1). The negative overall average is inconsistent with the turn-in average of 92 mg/L at SWSD 3, compared with the upstream Aqueduct average of 61 mg/L. This discrepancy may be partially explained by lower than average sulfate at SWSD 3 in April, which coincided with the sole us/ds decrease and may have curtailed any increase possible in that month.

Sulfate did not change in half of the sample pairs bracketing CVC and KWBC, with an overall average change of -1.8 mg/L, and decreased in a third of samples (Table 6-1). The predominance of non-changing pairs coincided with turn-in samples that were inconsistent with respect to Aqueduct concentrations. CVC reported a higher-than-Aqueduct average of 59 mg/L, compared with the upstream Aqueduct average of 37 mg/L, and KWBC reported a lower-than-Aqueduct sample of 46 mg/L, compared with 63 mg/L upstream.

Sulfate increased in all but two sample pairs bracketing WRMWSD and AEWSD, with an overall average change of 2.9 mg/L (Table 6-1). The increases are consistent with influence from WRMWSD—averaging 343 mg/L, compared with a 35 mg/L upstream Aqueduct average. In contrast, AEWSD reported a lower average of 26 mg/L, compared with an upstream Aqueduct average of 57 mg/L. The prominence of increasing sulfate downstream of these turn-ins was reinforced by samples in January and February, when downstream flow was stopped prior to the Southern Section that showed Check 41 concentrations higher than those at Check 21.

Total Dissolved Solids. Concentrations decreased downstream of turn-ins for the majority of all us/ds sample pairs, which is a result consistent with lower-than-Aqueduct concentrations for a most turn-ins. Six of nine monthly samples reported TDS concentrations lower at Check 41 than at Check 21 (Table 6-1). Sample pairs bracketing certain turn-ins reported increasing sample pairs, but

these deviations were countered or not large enough to substantially alter the overall decreasing effect turn-ins had on Aqueduct concentrations. Slight decreases also occurred early in the year, coinciding with check structure closures that caused the bulk of water sampled at Check 41 to originate from Southern Section turn-ins. No Aqueduct samples exceeded the secondary MCL for TDS in drinking water.

TDS was evenly split with one sample each increasing and decreasing downstream of SWSD 3, with an overall average change of -8 mg/L (Table 6-1). The inconsistent results and small relative changes are consistent with the turn-in average of 323 mg/L at SWSD 3 that was very close to the upstream Aqueduct average of 319 mg/L.

TDS decreased in the majority of sample pairs bracketing CVC and KWBC, with an overall average change of -8.1 mg/L (Table 6-1). The declines were consistent with the turn-in average of 216 mg/L at CVC and the single sample of 250 mg/L at KWBC, compared with the higher upstream Aqueduct averages of 276 and 292 mg/L, respectively.

TDS increased in the majority of sample pairs bracketing WRMWSD and AEWSD, with an overall average change of 1.3 mg/L. The increases are consistent with influence from WRMWSD—averaging 680 mg/L, compared with a 254 mg/L upstream Aqueduct average. In contrast, AEWSD reported a lower average of 173 mg/L, compared with an upstream Aqueduct average of 288 mg/L. The individual influence of each turn-in is reinforced by January and February samples, when downstream flow was stopped prior to the Southern Section. In these samples, Check 41 concentrations were lower in TDS than Check 21. These decreases coincided with AEWSD samples that had higher POAs during these months and lower-than-Aqueduct concentrations, but conflicted with the much higher concentrations for WRMWSD in these months.

Southern Field Division

In the SFD for 2016, AVEK pumped 1,056 af of groundwater into the Aqueduct. This turn-in had very little influence on Aqueduct water quality because of its small relative inflow volume and good water quality. The largest monthly turn-in volume happened in September with 226 af, compared with 98,728 af pumped at PPP that month (POA equal to 0.2 percent). The largest POA for AVEK was also relatively small at 2.2 percent in January. Higher-than-Aqueduct turn-in concentrations were reported in at least one sample for all COCs, except arsenic and chloride. Despite these results, no significant us/ds deviations were reported during the turn-in period and those deviations that occurred showed poor relationship with concurrent turn-in concentration and inflow percentages.

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Appendix A. Department of Water Resources Water Quality Policy and Implementation Process for Acceptance of Non-Project Water into the State Water Project (October 2012)

It is the Department of Water Resources (DWR) policy to assist with the conveyance of water to provide water supply, and to protect the State Water Project (SWP) water quality within the California Aqueduct. To facilitate this policy DWR provides the following implementation process for accepting non-project water into the SWP (Policy). For purposes of this document, SWP and California Aqueduct are interchangeable and the same.

POLICY PROVISIONS

DWR shall consider and evaluate all requests for Non-Project (NP) water input directly into the SWP conveyance facilities based upon the criteria established in this document. NP water shall be considered to be any water input into the SWP for conveyance by the SWP that is not directly diverted from the Sacramento-San Joaquin Delta or natural inflow into SWP reservoirs.

The proponent of any NP water input proposal shall demonstrate that the water is of consistent, predictable, and acceptable quality.

DWR will consult with State Water Project (Contractors), existing NP participants and the Department of Public Health (DPH) on drinking water quality issues relating to NP water as needed to assure the protection of SWP water quality.

Nothing in this document shall be construed as authorizing the objectives of Article 19 of the SWP water supply contracts or DPH drinking water maximum contaminant levels to be exceeded. This Policy shall not constrain the ability of DWR to operate the SWP for its intended purposes and shall not adversely impact SWP water deliveries, operation or facilities.

EVALUATING NP WATER PROPOSALS

DWR shall use a two-tiered approach for evaluating NP water for input into the California Aqueduct.

NP Tier 1

Tier 1 NP pump-in proposals (PIP) shall exhibit water quality that is essentially the same, or better, than what occurs in the California Aqueduct. PIP's considered to be tier 1 shall be approved by DWR (see baseline water quality tables 1 through 4).

NP Tier 2

Tier 2 PIP's are those that exhibit water quality that is different and possibly worse than in the California Aqueduct and/or have the potential to cause adverse impacts to the Contractors. Tier 2 PIP's shall be referred to a NP Facilitation Group (FG), which would review the project and if needed make recommendations to DWR in consideration of the PIP.

SWC Facilitation Group

This advisory group consists of representatives from each Contractor that chooses to participate and DWR. The group shall review tier 2 PIP's based on the merits, impacts, mitigation, water quality monitoring, cost/benefits or other issues of each PIP and provide recommendations to DWR. Upon initial review of tier 2 PIP by DWR, it shall then be submitted to the FG for review. A consensus recommendation from the FG would be sought regarding approval of the PIP. DWR shall base its decision on the merits of the PIP, recommendations of the FG and the PIP's ability to provide overall benefits to the SWP and the State of California.

Blending Water Sources

Blending of multiple water sources prior to inflow into the SWP is acceptable and may be preferred depending upon water quality of the PIP. Blending of water in this manner may be used to qualify a project as NP Tier 1.

Mixing (blending) within the California aqueduct can be considered but shall not be adjacent to municipal and industrial (M&I) delivery locations. PIP's that are coordinating water discharged to maintain or improve SWP water quality are an example of the mixing approach. The PIP shall demonstrate by model or an approach acceptable to DWR and the FG that the water is adequately mixed before reaching the first M&I customer. Generally NP PIP's that involve mixing with SWP water shall be considered NP Tier 2.

Baseline Water Quality

To aid in developing and evaluating PIP's both historical and current SWP water quality levels shall be considered. A representative baseline water quality summary is shown in Tables 1 through 4 by using historical SWP water quality records at O'Neill Forebay.

NP IMPLEMENTATION PROCESS

Project Proposals

The NP project proponent requesting to introduce water into the SWP shall submit a detailed PIP to DWR. The proponent shall demonstrate that the NP water is of consistent, predictable and reliable quality, and is responsible for preparing and complying with any and all contracts, environmental documents, permits or licenses that are necessary consistent with applicable laws, regulations, agreements, procedures, or policies.

Project Description

The proponent will submit to DWR a PIP describing the proposed program, identifying the water source(s), planned operation, characterizing the inflow water quality and any anticipated impacts to SWP water quality and/or operations. The PIP should be submitted at least one month prior to proposed start up to allow for DWR and FG review. The PIP shall include:

- Project proponent names, locations, addresses, and contact person(s).
- Maps identifying all sources of water, point of inflow to the SWP and ultimate fate of the introduced water.
- Terms and conditions of inflow, timing, rates and volumes of inflow, pumping, conveyance and storage requirements.

- Construction details of any facilities located adjacent to the SWP including valves, meters, and pump and piping size.
- All potential impacts and/or benefits to downstream SWP water contractors.
- Detailed water quality data for all sources of water and any blend of sources that will be introduced into the SWP.
- Identify anticipated water quality changes within the SWP.
- Identify other relevant environmental issues such as subsidence, ground water overdraft or, presents of endangered species.
- Provide performance measures and remedial actions that will be taken in the event projected SWP water quality levels are not met.
- Reference an existing contract or indicate that one is in process with DWR to conduct a PIP.

Water Quality Monitoring

In order to demonstrate that the water source(s) are of consistent, predictable, and acceptable quality the NP proponent shall monitor water quality. The proponent shall, for the duration of the program, regularly report on operations as they affect water quality, monitoring data and water quality changes. Both DPH title 22 and a short list of Constituents of Concern (COC) shall be monitored for based upon one of the following water quality monitoring options.

Constituents of Concern. Current COC are Arsenic, Bromide, Chloride, Nitrate, Sulfate, Organic Carbon, and Total Dissolved Solids. These COC's may be changed as needed.

Water Quality Monitoring Options. NP proponents shall select one of the testing options below and perform all water quality testing and provide analytical results in a timely manner as described herein. Monitoring shall be conducted for initial well start-up, periodic well re-testing and on-going testing during operation. Well data should be no more than three years old. Title 22 results should be provided to DWR and the FG within two weeks of testing and COC results within one week of testing, unless other schedules are agreed upon by DWR and the FG.

Option 1 - Baseline tests for Individual Wells

Well Start-up: Title 22 tests are required for all wells participating in the program prior to start-up. An existing title 22 test that is no more than three years old may be used. A Title 22 test may be substituted for any well near a similar well with a Title 22 test of record.

Well Re-testing: Title 22 test for all wells participating every three years.

Ongoing Monitoring: COC tests are required for all discharge locations to the SWP at start up and quarterly thereafter for new programs and resumption of established programs. New programs or those with constituents that may potentially degrade the SWP shall conduct at least weekly COC sampling of all discharge locations until the proponent demonstrates that the NP water is of consistent, predictable and reliable quality. Once the nature of the discharge has been clearly established, the COC tests are required quarterly for each discharge point.

Option 2 - Baseline tests for Representative Wells

Well Start-up: COC tests of record are required for all wells participating in the program and Title 22 tests of record are required for representative wells comprising a subset of all wells. This would

typically be a group of wells that are manifold together and discharge to one pipe. Representative wells shall be identified on a case-by-case basis to be representative of the manifold area, well proximity, and water levels.

Well Re-testing: Same as required in Option 1.

On-going Monitoring: COC tests are required for all discharge locations to the SWP at start up and monthly thereafter for the duration of the program and annually at each well. New programs or those with constituents that may potentially degrade the SWP shall conduct weekly COC sampling of all discharge locations until the proponent demonstrates that the NP water is of consistent, predictable and reliable quality.

Option 3 – Self Directed

A PIP may propose a water quality monitoring program for approval by DWR and the FG that is different from options 1 or 2. It must include COC and title 22 testing that will fully characterize water pumped into the SWP and be at an interval to show a consistent, predictable and reliable quality.

Analytical Methods

Analytical laboratories used by project proponents shall be DPH certified by the Environmental Laboratory Accreditation Program (ELAP) and use EPA prescribed and ELAP accredited methods for drinking water analysis. Minimum Reporting Levels must be at least as low as the DPH required detection limits for purposes of reporting (DLR). The current DLRs are listed on the DPH website at [Http://www.cdph.ca.gov/certlic/drinkingwater/Pages/MCLsandPHGs](http://www.cdph.ca.gov/certlic/drinkingwater/Pages/MCLsandPHGs). DWR shall continue to use Bryte Chemical Laboratory as it's analytical and reference lab.

Flow Measurements

The project proponent shall maintain current, accurate records of water production rate and volume from each source, as well as, each point of discharge into the SWP. All flow measurements shall be submitted to regularly to DWR.

RECONSIDERATION

If an NP proponent disagrees with the FG or DWR decision or feels that there is an overriding benefit of the proposal, the proponent may request reconsideration from DWR on the basis of overriding public benefit or water supply deficiency. DWR shall consider these requests on a case-by-case basis.

ONGOING PROGRAM

Any NP Proponent who has successfully established a NP water inflow program (Including existing Kern Fan Banking Projects, Kern Water Bank, Pioneer and Berrenda Mesa Projects, Semitropic Water Storage District Wheeler Ridge Mariposa Water Storage District and Arvin Edison Water Storage District) may reinstate the program by notifying DWR at least ten days before inflow is scheduled to begin and provide the following information:

- Updated water quality data and/or updated modeling that adequately reflects the quality of water to be introduced into the SWP.
- Turn-in location.

- Expected rate and duration of inflow. DWR shall notify the FG of this reinitiating of inflow.
- Water quality monitoring schedule that meets the objective of this policy.

FUTURE NP PROGRAMS

Future NP projects should be planned and designed considering the following items:

- Projects involving water quality exceeding primary drinking water standards shall show that the water shall be treated or blended before it enters the SWP to prevent water quality impacts.
- The project proponent of a Tier 2 proposal should clearly identify and establish that water inflow shall be managed and operated such that poor quality water will be blended with better quality water so that SWP water quality will not be degraded upon acceptable levels as determined by the FG and DWR.
- If a significant water supply deficiency exists and it is recommended by the FG that raw water quality criteria be set aside to ensure adequate supply, such action shall be subject to approval by the DPH.
- The project proponent of a NP inflow program which degrades SWP water quality shall identify mitigation to downstream water contractors for water quality impacts associated with increased water supply or treatment costs.

DWR ROLE

DWR shall seek, as needed, DPH or SWC recommendations on changes or additions to this document governing the NP water quality projects. The FG shall review proposed changes or additions prior to implementation by DWR, as needed.

DWR and or the United States Bureau of Reclamation (for San Luis Canal inflow) shall have ultimate responsibility for approving the water quality of all NP inflow, as well as, the oversight of monitoring and tracking the water quality of operating programs. DWR shall also ensure that the proponents of the NP inflow program perform according to their proposals, and will take appropriate action in the event of non-conformance.

Project Proposal Review Process

Upon receipt of a proposal for PIP, DWR shall review it for adequacy. DWR shall consider all PIPs based upon these guidelines. Review shall take no more than one month after receiving a complete program proposal. If necessary, DWR will convene timely meetings with the FG during the review.

At a minimum the review will include

- Examination of all documents and data for completeness of the PIP.
- Notification of the affected Field Divisions, and the FG has been received by DWR.
- Consideration by DWR of comments from all parties before the final decision.
- Upon completion of the review DWR will notify the proponent and FG of the acceptance of the PIP or explain the reason(s) for rejecting it.
- DWR may reconsider a decision on a PIP based upon a recommendation from the FG. Reconsideration by DWR will be on a case-by-case basis.

Periodic Review

DWR may schedule periodic reviews of each operating NP inflow with input from the FG. As part of the review, program proponents shall provide the following information:

- Summary of deliveries to the Aqueduct.
- Water quality monitoring results.
- Proposed changes in the program operation.

The review may result in changes in monitoring and testing required of the program proponent as a result of;

- New constituents being added to the EPA /DPH list of drinking water standards.
- Changes in the maximum contaminant levels for the EPA/DPH list of drinking water standards.
- Identification of new constituents of concern.
- Changes in the water quality provided by the program.
- Changes in constituent background levels in the California Aqueduct.

This procedure shall recognize emerging contaminants and/or those detrimental to agricultural viability as they are identified by the regulatory agencies and shall set appropriate standards for water introduction based upon ambient levels in the California Aqueduct or State Notification Levels. Emerging contaminants are those that may pose significant risk to public health, but as yet do not have an MCL. Currently the Office of Environmental Health Hazard Assessment and the DPH establish Public Health Goals and Notification Levels, respectively. These levels, though not regulated, do provide health-based guidance to water utilities and can require public notification if exceeded.

Water Quality Review

DWR shall track and periodically report to the FG on water quality monitoring results on the SWP from NP water inflow and make all water quality data available to the public upon request.

- DWR shall review analyze and maintain all records of water quality testing conducted by the proponent of the well(s), source(s) and discharge(s) into the SWP.
- DWR shall determine what additional water quality monitoring, if any, is necessary within the SWP to ensure adequate protection of SWP water quality. DWR shall conduct all water quality monitoring within the SWP.
- DWR may prepare periodic reports of NP projects.

On-site Surveillance

The appropriate Field Division within DWR will be responsible for review and approval of all construction activities within the SWP right-of-way. Plans showing the discharge system piping, valves, sampling point, meters and locations must be submitted and approved prior to any construction. In addition, the appropriate Field Division will be responsible for confirmation of all meter readings and water quality monitoring conducted by the proponent.

- Field division staff may visit, inspect, and calibrate meters and measure flow conditions at each source or point of inflow into the SWP.

- Flow meters, sampling ports and anti-siphon valves must be conveniently located near the SWP right-of-way.
- Field division staff may collect water samples at each source or point of discharge into the SWP.
- The appropriate Field Division shall conduct additional water quality monitoring within the SWP, if deemed necessary, to assure compliance with the NP Inflow Criteria.
- DWR shall monitor aqueduct water quality and analyze several “split samples” of the water at the point of introduction into the aqueduct to ensure consistent analytical results.

Table A1 HISTORICAL WATER QUALITY CONDITIONS 1988 TO 2011 AT O'NEILL FOREBAY OUTLET (mg/L)

Parameter	Mean	Min.	Max.	Std. Dev.
Aluminum	0.03	0.01	0.527	0.05
Antimony	0.002	0.001*	0.005	0.002
Arsenic	0.002	0.001	0.004	0.001
Barium	0.05	0.05	0.068	0.002
Beryllium	0.001*	0.001*	0.001*	0.000
Bromide	0.22	0.04	0.54	0.16
Cadmium	0.003	0.001	0.005	0.002
Chromium	0.004	0.001	0.011	0.002
Copper	0.004	0.001	0.028	0.003
Fluoride	0.1	0.1	0.5	0.1
Iron	0.037	0.005	0.416	0.050
Manganese	0.009	0.005	0.06	0.007
Mercury	0.001	0.0002	0.001	0.0004
Nickel	0.001	0.001	0.004	0.0005
Nitrate	2.9	0.2	8.1	1.6
Selenium	0.001	0.001	0.002	0.0001
Silver	0.003	0.001	0.005	0.002
Sulfate	42	14	99	15
Total Organic Carbon	4.0	0.8	12.6	1.6
Zinc	0.007	0.005	0.21	0.01

*These values represent reporting limits. Actual values would be lower

Table A2 O'Neill Forebay Outlet Total Dissolved Solids Criteria by Water Year Classification, 1988-2011 (mg/L)

Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet	227.2	262.5	295.4	228.9	213.8	231.2	184.4	226.5	181.5	171.4	195.7	157.3
Near Normal	317.9	324.7	351.7	295.4	268.1	302.7	270.0	285.1	230.1	211.9	170.9	202.6
Dry	286.4	319.6	370.0	362.0	344.2	305.2	240.4	278.2	307.3	234.8	269.0	336.6
Critical	256.6	312.9	372.9	367.0	361.0	335.0	307.1	291.8	335.1	325.7	339.4	328.8

* Year type is based on water year classification. Below normal and above normal year types have been combined into one designation called "near normal."

Table A3 O'Neill Forebay Outlet Bromide Criteria by Water Year Classification, 1988-2011 (mg/L)

Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet	0.19	0.24	0.28	0.13	0.10	0.12	0.12	0.17	0.12	0.12	0.13	0.10
Near Normal	0.31	0.31	0.34	0.21	0.15	0.15	0.18	0.22	0.15	0.15	0.14	0.19
Dry	0.25	0.29	0.35	0.35	0.24	0.20	0.17	0.24	0.27	0.13	0.29	0.41
Critical	0.26	0.28	0.32	0.37	0.33	0.27	0.22	0.22	0.28	0.28	0.32	0.37

* Year type is based on water year classification. Below normal and above normal year types have been combined into one designation called "near normal."

Table A4 O'Neill Forebay Outlet Total Organic Carbon Criteria by Water Year Classification, 1988-2011 (mg/L)

Year Type*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet	2.8	2.9	3.9	5.2	4.8	3.8	3.9	3.4	3.1	3.2	3.1	2.7
Near Normal	3.7	4.1	4.0	7.0	6.3	5.6	4.7	4.4	4.0	3.3	3.3	3.4
Dry	3.0	3.0	4.0	5.7	4.8	5.7	4.5	3.6	3.7	2.9	2.9	2.7
Critical	2.8	3.1	3.3	4.9	6.0	5.7	4.7	4.0	3.8	3.9	4.0	3.5

* Year type is based on water year classification. Below normal and above normal year types have been combined into one designation called "near normal."

Appendix B. San Luis Field Division Water Quality Grab Sample Results

Table B-1 Constituents of Concern from Westlands Water District Wellhead Monitoring, April–August 2016

State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
141327E01	1	Title 22	4/20/2016	3.4	1.4	0.31	51	<0.01	0.8	1,300	0.747	0.01	<0.2	<1	14	<2	360	890
		Table 4a	6/29/2016	3.6	NS	0.25	56	<0.01	<0.2	1,400	NS	0.22	<0.2	<1	0.71	<2	420	950
Lateral 7	2	NA	4/12/2016	10.2	1.12	0.82	164	0.0094	NS	1,443	NS	NS	NS	0.56	<1	<0.4	260	956
		NA	4/19/2016	5.3	1.08	1.1	164	0.0036	NS	1,481	NS	NS	NS	<6.2	3.9	<0.4	268	928
		NA	4/26/2016	7.3	1.19	<1	144	0.0049	NS	1,505	NS	NS	NS	1.7	3.7	<0.4	349	966
		NA	5/3/2016	9.8	1.27	<1	144	0.0046	NS	1,543	NS	NS	NS	1.7	1.1	<0.4	349	966
		NA	5/10/2016	8.7	1.14	<1	143	0.0056	NS	1,509	NS	NS	NS	1.6	2.1	<0.4	373	968
		NA	5/17/2016	3.6	0.81	<1	201	0.0012	NS	1,701	NS	NS	NS	<0.5	3	<0.4	303	1,010
		NA	5/24/2016	3.8	0.812	<1	198	0.0028	NS	1,588	NS	NS	NS	1.4	2.2	<0.4	311	980
		NA	5/31/2016	5.5	0.971	0.61	171	0.0055	NS	1,594	NS	NS	NS	3.1	2	<0.4	350	953
		NA	6/7/2016	5.9	0.985	<1	153	0.0064	NS	1,546	NS	NS	NS	3.5	1.9	<0.4	342	822
		NA	6/16/2016	4.8	0.859	0.7	140	0.0033	NS	1,352	NS	NS	NS	<0.5	2.4	<0.4	287	822
		NA	6/23/2016	5.4	0.93	0.68	133	0.0048	NS	1,375	NS	NS	NS	1.2	2.4	<0.4	317	828
		NA	6/29/2016	6	1.34	0.8	187	0.003	NS	2,182	NS	NS	NS	<0.8	1.6	<0.4	620	1,390
		NA	7/6/2016	6.6	0.993	0.68	122	0.0037	NS	1,474	NS	NS	NS	1.3	1.9	<0.4	332	938
		NA	7/13/2016	5.8	0.895	0.59	117	0.0049	NS	1,340	NS	NS	NS	0.6	2	<0.4	328	848
		NA	7/18/2016	7	0.994	0.64	136	0.0109	NS	1,358	NS	NS	NS	0.53	1.8	<0.4	349	838
		NA	7/25/2016	8.7	0.957	0.71	136	0.0301	NS	1,378	NS	NS	NS	<0.5	1.9	0.531	350	856
		NA	8/3/2016	6.8	1.02	0.69	151	0.0035	NS	1,600	NS	NS	NS	<0.5	1.5	<0.4	471	1,040
		NA	8/9/2016	6.6	1.06	<1	162	0.0046	NS	1,688	NS	NS	NS	1.3	1.5	<0.4	503	1,100
NA	8/16/2016	5.7	0.984	<1	162	0.0055	NS	1,658	NS	NS	NS	1.2	2.2	<0.4	421	932		
NA	8/22/2016	6	1.15	<1	174	0.0033	NS	1,871	NS	NS	NS	1	1.5	<0.4	542	1,220		
NA	8/29/2016	5.9	1.02	<1	174	0.0033	NS	1,621	NS	NS	NS	<1	1.7	<0.4	450	1,060		
151419F01	3	10 COC	3/28/2016	8.3	2.2	1.1	130	NS	NS	2,000	NS	0.076	NS	58	0.46	NS	670	1,300
		10 COC	4/6/2016	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	880
		10 COC	4/14/2016	NS	NS	NS	NS	NS	NS	NS	NS	0.047	NS	NS	NS	NS	NS	470

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
151419F01	3	Table 4a	4/25/2016	4.2	1.5	0.51	55	<0.01	<0.2	1,400	6.8	0.047	<0.2	1.5	0.2	5.1	460	850
		Table 4b	5/2/2016	4.7	1.6	NS	55	NS	NS	NS	NS	0.048	NS	1.2	NS	5.4	460	890
		Table 4b	5/9/2016	4.2	1.6	NS	56	NS	NS	NS	NS	0.049	NS	1	NS	4.3	470	870
		Table 4b	5/16/2016	<2	1.6	NS	55	NS	NS	NS	NS	0.05	<0.2	1.2	NS	3.7	460	850
		Table 4b	6/13/2016	4.9	1.6	NS	55	NS	NS	NS	NS	0.049	<0.2	1.2	NS	4.9	460	870
		Table 4b	7/11/2016	4.7	1.6	NS	55	NS	NS	NS	NS	0.053	<0.2	1.2	NS	5.8	460	840
151419Q01	4	10 COC	3/28/2016	7.6	1.6	0.33	56	NS	NS	1,300	NS	0.04	NS	<1	<0.2	NS	420	790
		Table 4a	4/25/2016	6	NS	0.22	54	<0.01	<0.2	1,300	NS	0.038	<0.2	<1	0.27	<2	420	810
		Table 4b	5/2/2016	7.5	1.5	NS	55	NS	NS	NS	NS	0.039	<0.2	<1	NS	<2	420	810
		Table 4b	5/9/2016	7.2	1.5	NS	56	NS	NS	NS	NS	0.04	NS	<1	NS	<2	440	810
		Table 4b	5/16/2016	3.9	1.5	NS	54	NS	NS	NS	NS	0.04	<0.2	<1	NS	<2	420	790
		Table 4b	6/13/2016	8.2	1.6	NS	55	NS	NS	NS	NS	0.04	<0.2	<1	NS	<2	420	820
151431D02	5	10 COC	3/15/2016	2.9	2	0.2	46	NS	NS	1,500	NS	0.19	NS	<1	0.53	NS	480	990
		10 COC	4/4/2016	NS	NS	NS	NS	NS	NS	NS	NS	0.054	NS	NS	NS	NS	NS	NS
		Table 4a	4/25/2016	2.6	NS	0.31	100	<0.01	<0.2	670	1.26	0.047	<0.2	1.7	4.5	<2	63	380
		Table 4b	5/3/2016	<2	0.24	NS	100	NS	NS	NS	NS	0.042	NS	2.1	NS	<2	57	340
		Table 4b	5/10/2016	2.6	0.25	NS	98	NS	NS	NS	NS	0.015	<0.2	2.4	NS	<2	57	350
		Table 4b	5/16/2016	<2	0.24	NS	99	NS	NS	NS	NS	0.023	<0.2	2	NS	<2	56	340
		Table 4b	6/13/2016	2.3	0.23	NS	97	NS	NS	NS	NS	0.045	<0.2	1.6	NS	2	51	330
		Table 4b	7/11/2016	<2	0.16	NS	68	NS	NS	NS	NS	0.022	<0.2	<1	NS	<2	33	220
161412N02	6	10 COC	3/24/2016	4.6	1.5	0.19	36	NS	NS	1,300	NS	0.064	NS	<1	<0.2	NS	520	930
161521L01	7	10 COC	3/18/2016	3.8	1.7	0.19	38	NS	NS	1,000	NS	0.08	NS	<1	<0.2	NS	430	770
		10 COC	4/25/2016	NS	NS	NS	NS	NS	NS	NS	NS	0.062	NS	NS	NS	NS	NS	NS
161521N02	8	10 COC	3/24/2016	8.3	1.7	0.35	63	NS	NS	1,400	NS	0.053	NS	<1	0.22	NS	490	930
		Table 4a	4/25/2016	6.2	NS	0.25	64	<0.01	<0.2	1,600	0.755	0.045	<0.2	<1	0.32	3.9	510	1,000
		Table 4b	5/2/2016	6.1	1.9	NS	62	NS	NS	NS	NS	0.048	NS	<1	NS	2.8	480	1,000
		Table 4b	5/9/2016	5.7	1.9	NS	63	NS	NS	NS	NS	0.048	NS	<1	NS	<2	470	970
		Table 4b	5/16/2016	<2	1.9	NS	61	NS	NS	NS	NS	0.049	<0.2	<1	NS	<2	480	960
		Table 4b	6/13/2016	6.3	1.9	NS	61	NS	NS	NS	NS	0.048	<0.2	<1	NS	<2	490	960

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS	
161532A06	12	10 COC	3/22/2016	3.1	1.6	0.43	67	NS	NS	1,300	NS	0.1	NS	1.6	<0.2	NS	470	900	
		10 COC	4/1/2016	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.08	NS	NS	NS	NS	NS	NS
		Table 4a	4/18/2016	2.1	NS	0.34	58	<0.01	<0.2	1,200	2.77	0.074	<0.2	<1	0.3	3.9	450	860	
161533J02	11	10 COC	3/17/2016	7.5	1.8	0.25	46	NS	NS	1,200	NS	0.048	NS	1.5	<0.2	NS	490	910	
		Table 4a	4/8/2016	7	NS	0.19	52	<0.01	0.95	1,300	5.54	0.049	NS	1.6	<0.2	5.9	490	950	
		Table 4b	4/15/2016	4.3	1.8	NS	46	NS	NS	NS	NS	0.052	NS	1.5	NS	6	490	940	
		Table 4b	4/22/2016	5	1.8	NS	45	NS	NS	NS	NS	0.051	<0.2	1.7	NS	5.7	500	940	
		Table 4b	4/29/2016	6	1.7	NS	46	NS	NS	NS	NS	0.05	<0.2	1.7	NS	5.2	490	920	
		Table 4b	5/13/2016	2.8	1.8	NS	45	NS	NS	NS	NS	0.051	<0.2	1.7	NS	4.2	470	930	
		Table 4b	5/31/2016	NS	NS	NS	NS	NS	NS	NS	NS	0.053	NS	NS	NS	NS	NS	NS	NS
		Table 4b	6/10/2016	4.6	1.7	NS	42	NS	NS	NS	NS	0.048	<0.2	<1	NS	5.4	510	960	
Table 4b	7/8/2016	<2	1.8	NS	42	NS	NS	NS	NS	0.053	<0.2	<1	NS	5	510	990			
171401R01	9	10 COC	3/17/2016	2.8	0.58	0.49	68	NS	NS	1,200	NS	<0.01	NS	6.1	<0.2	NS	480	1,000	
		Table 4a	4/11/2016	<2	NS	0.57	67	<0.01	<0.2	1,400	10.1	<0.01	NS	5.8	<0.2	6.6	480	1,000	
		Table 4b	4/18/2016	2.5	0.59	NS	67	NS	NS	NS	NS	<0.01	<0.2	5.7	NS	9.4	480	1,000	
		Table 4b	4/25/2016	<2	0.58	NS	66	NS	NS	NS	NS	<0.01	<0.2	5.6	NS	6.5	470	1,000	
		Table 4b	5/2/2016	2.6	0.61	NS	66	NS	NS	NS	NS	<0.01	NS	5.9	NS	7.7	470	980	
		Table 4b	6/13/2016	4.1	0.6	NS	65	NS	NS	NS	NS	<0.01	<0.2	6.1	NS	8	460	970	
		Table 4b	7/11/2016	<2	0.63	NS	65	NS	NS	NS	NS	<0.01	<0.2	5.8	NS	7.8	450	900	
171413A06	10	10 COC	3/22/2016	<2	0.68	0.46	60	NS	NS	1,300	NS	0.016	NS	16	<0.2	NS	460	940	
		Table 4a	4/11/2016	<2	NS	0.51	71	<0.01	2.7	1,300	NS	0.013	NS	11	<0.2	22	440	930	
171501P02	15	10 COC	4/8/2016	4	1.7	0.17	66	NS	NS	1,100	NS	0.021	NS	<1	0.22	NS	480	790	
171502Q02	16	10 COC	4/8/2016	12	1.9	0.21	37	NS	NS	1,300	NS	0.037	NS	2.1	0.39	NS	450	880	
		10 COC	6/10/2016	<2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
171503D01	14	10 COC	3/10/2016	7.1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
		10 COC	3/24/2016	11	1.7	0.56	100	NS	NS	1,500	NS	0.061	NS	<1	0.3	NS	510	1,100	
		Table 4a	4/8/2016	10	NS	0.42	47	<0.01	<0.2	1,400	2.01	0.06	<0.2	2.7	0.34	3.2	520	1,000	
		Table 4b	4/15/2016	8.9	1.8	NS	74	NS	NS	NS	NS	0.048	NS	<1	NS	3	480	970	
		Table 4b	4/22/2016	7.1	1.9	NS	67	NS	NS	NS	NS	0.042	NS	<1	NS	<2	500	930	
		Table 4b	4/29/2016	7.8	1.9	NS	62	NS	NS	NS	NS	0.035	<0.2	<1	NS	<2	500	910	

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS	
171503D01 (con't)	14 (con't)	Table 4b	5/13/2016	7.1	1.8	NS	59	NS	NS	NS	NS	0.033	<0.2	<1	NS	<2	480	880	
		Table 4b	6/10/2016	7.3	2	NS	50	NS	NS	NS	NS	NS	0.029	<0.2	<1	NS	<2	460	910
		Table 4b	7/8/2016	3.5	2	NS	48	NS	NS	NS	NS	NS	0.031	<0.2	<1	NS	<2	460	870
171510M01	13	10 COC	3/17/2016	<2	1.8	0.39	67	NS	NS	1,200	NS	0.032	NS	<1	0.32	NS	470	940	
		Table 4a	4/8/2016	<2	NS	0.31	89	<0.01	<0.2	1,300	7.55	0.03	NS	<1	0.35	2.2	470	890	
		Table 4b	4/15/2016	<2	1.8	NS	65	NS	NS	NS	NS	NS	0.03	<0.2	<1	NS	2.5	470	900
		Table 4b	4/22/2016	<2	1.8	NS	63	NS	NS	NS	NS	NS	0.031	NS	<1	NS	<2	470	870
		Table 4b	5/6/2016	<2	1.9	NS	63	NS	NS	NS	NS	NS	0.033	NS	<1	NS	<2	460	870
		Table 4b	5/13/2016	11	2.4	NS	64	NS	NS	NS	NS	NS	0.058	<0.2	<1	NS	<2	470	<5
		Table 4b	6/10/2016	<2	1.9	NS	62	NS	NS	NS	NS	NS	0.033	<0.2	<1	NS	<2	460	860
		Table 4b	7/8/2016	<2	1.9	NS	57	NS	NS	NS	NS	NS	0.036	<0.2	<1	NS	<2	440	860
171601N03	17	10 COC	3/17/2016	5	1.3	0.5	110	NS	NS	990	NS	0.051	NS	<1	0.83	NS	270	700	
171614Q01	18	10 COC	3/17/2016	2.7	1.1	0.14	37	NS	NS	850	NS	0.02	NS	<1	0.37	NS	320	620	
		Table 4a	4/8/2016	2.9	NS	0.14	33	<0.01	<0.2	920	NS	0.017	NS	<1	0.3	<2	320	610	
		Table 4b	4/15/2016	<2	1.1	NS	33	NS	NS	NS	NS	NS	0.017	<0.2	<1	NS	<2	320	620
		Table 4b	4/22/2016	<2	1.1	NS	33	NS	NS	NS	NS	NS	0.016	<0.2	<1	NS	<2	320	620
		Table 4b	4/29/2016	2.4	1.1	NS	33	NS	NS	NS	NS	NS	0.017	<0.2	<1	NS	<2	320	610
		Table 4b	5/13/2016	<2	1.2	NS	32	NS	NS	NS	NS	NS	0.016	<0.2	<1	NS	<2	310	590
		Table 4b	6/10/2016	2.1	1.2	NS	35	NS	NS	NS	NS	NS	0.019	<0.2	<1	NS	<2	320	620
		Table 4b	7/8/2016	<2	1.1	NS	35	NS	NS	NS	NS	NS	0.02	<0.2	<1	NS	<2	320	600
171623J01	19	10 COC	3/17/2016	2.3	1.2	0.16	40	NS	NS	840	NS	<0.01	NS	<1	0.37	NS	330	610	
		Table 4a	4/8/2016	<2	NS	0.2	41	<0.01	<0.2	940	3.52	<0.01	NS	<1	0.39	<2	330	620	
		Table 4b	4/15/2016	<2	1.2	NS	40	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	330	630
		Table 4b	4/22/2016	<2	1.2	NS	41	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	360	650
		Table 4b	4/29/2016	<2	1.2	NS	40	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	360	620
		Table 4b	5/13/2016	<2	1.1	NS	39	NS	NS	NS	NS	NS	<0.01	NS	<1	NS	<2	340	610
		Table 4b	6/10/2016	2.3	1.2	NS	44	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	320	620
		Table 4b	7/8/2016	<2	1.2	NS	42	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	350	610
171623M01	20	10 COC	3/17/2019	3.2	1.2	0.12	32	NS	NS	910	NS	0.039	NS	<1	0.26	NS	390	670	
		Table 4a	4/8/2016	<2	NS	0.13	33	<0.01	<0.2	1,000	NS	0.037	NS	<1	0.26	<2	400	730	

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS	
171623M01 (con't)	20 (con't)	Table 4b	4/15/2016	3.1	1.2	NS	33	NS	NS	NS	NS	0.036	<0.2	<1	NS	<2	400	730	
		Table 4b	4/22/2016	<2	1.2	NS	32	NS	NS	NS	NS	NS	0.038	<0.2	<1	NS	<2	400	730
		Table 4b	4/29/2016	<2	1.2	NS	40	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	350	640
		Table 4b	5/20/2016	<2	1.1	NS	55	NS	NS	NS	NS	NS	0.15	<0.2	<1	NS	<2	590	1,100
		Table 4b	6/10/2016	2.2	1.2	NS	33	NS	NS	NS	NS	NS	0.043	<0.2	<1	NS	<2	440	740
181606F01	21	10 COC	2/25/2016	<2	2.2	NS	130	NS	NS	1,900	NS	0.046	NS	<1	NS	NS	600	1,100	
181620M01	22	10 COC	3/17/2016	<2	1.2	0.025	3.8	NS	NS	32	NS	<0.01	NS	<1	<0.2	NS	3.5	14	
		Table 4a	4/8/2016	<2	NS	0.024	4.5	<0.01	<0.2	33	NS	<0.01	NS	<1	<0.2	<2	3.2	26	
		Table 4b	4/22/2016	<2	1.2	NS	2.6	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	1.3	18
		Table 4b	4/29/2016	<2	1.3	NS	2.7	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	1.9	13
		Table 4b	5/6/2016	2.2	1.3	NS	2.8	NS	NS	NS	NS	NS	<0.01	NS	<1	NS	<2	1.3	14
		Table 4b	6/10/2016	<2	1.3	NS	3	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	<1	16
		Table 4b	7/8/2016	<2	1.4	NS	3.1	NS	NS	NS	NS	NS	<0.01	<0.2	<1	NS	<2	1.9	<5
191723R01	23	10 COC	3/31/2016	<2	0.81	0.24	66	NS	NS	1,500	NS	<0.01	NS	4.7	<0.2	NS	580	1,100	
		Table 4a	4/15/2016	2.3	NS	0.26	63	<0.01	<0.2	1,400	2.27	<0.01	<0.2	3.3	<0.2	2.3	530	1,100	
		Table 4b	4/22/2016	<2	0.8	NS	61	NS	NS	NS	NS	NS	<0.01	<0.2	3.1	NS	<2	520	1,100
		Table 4b	4/29/2016	<2	0.81	NS	62	NS	NS	NS	NS	NS	<0.01	<0.2	3.3	NS	<2	510	1,000
		Table 4b	5/6/2016	<2	0.86	NS	61	NS	NS	NS	NS	NS	<0.01	NS	3.2	NS	<2	490	1,000
		Table 4b	6/3/2016	<2	0.84	NS	71	NS	NS	NS	NS	NS	0.011	<0.2	2.8	NS	<2	500	1,000
		Table 4b	7/7/2016	<2	0.84	NS	61	NS	NS	NS	NS	NS	0.012	<0.2	3.4	NS	<2	480	1,000
191726E01	24	10 COC	3/8/2016	<2	0.83	0.95	110	NS	NS	2,000	NS	0.01	NS	33	<0.2	NS	870	1,500	
191736A01	26	10 COC	3/18/2016	3	0.85	0.34	70	NS	NS	1,100	NS	0.012	NS	<1	<0.2	NS	420	810	
191830M01	25	10 COC	3/18/2016	2.7	0.81	0.26	55	NS	NS	1,200	NS	0.019	NS	1.4	<0.2	NS	470	880	
191831N01	27	10 COC	3/18/2016	<2	0.82	0.24	55	NS	NS	1,300	NS	0.028	NS	1.3	<0.2	NS	540	970	
201712H01	29	10 COC	3/18/2016	2.9	0.89	0.23	49	NS	NS	1,300	NS	0.038	NS	1.2	<0.2	NS	560	1,000	
		Table 4a	4/22/2016	<2	NS	0.15	43	<0.01	<0.2	1,400	NS	<0.01	<0.2	3.9	<0.2	2.9	510	970	
		Table 4b	4/29/2016	<2	0.83	NS	43	NS	NS	NS	NS	NS	<0.01	<0.2	4.1	NS	2.5	510	980
		Table 4b	5/6/2016	2.6	0.9	NS	43	NS	NS	NS	NS	NS	0.036	NS	1	NS	<2	500	890
		Table 4b	6/3/2016	3.4	0.98	NS	38	NS	NS	NS	NS	NS	0.037	<0.2	<1	NS	<2	460	900
		Table 4b	7/7/2016	5.7	0.98	NS	41	NS	NS	NS	NS	NS	0.036	<0.2	<1	NS	<2	490	890

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
201714K01	30	10 COC	3/18/2016	2	0.86	0.2	46	NS	NS	1,300	NS	<0.01	NS	5.2	<0.2	NS	550	1,000
		Table 4a	4/22/2016	<2	NS	0.16	42	<0.01	<0.2	1,400	2.52	<0.01	<0.2	4	<0.2	2.8	500	990
		Table 4b	4/29/2016	<2	0.84	NS	43	NS	NS	NS	NS	<0.01	<0.2	4.1	NS	2.6	490	990
		Table 4b	5/6/2016	<2	0.84	NS	43	NS	NS	NS	NS	<0.01	NS	4.1	NS	2.7	470	960
		Table 4b	6/3/2016	<2	0.86	NS	39	NS	NS	NS	NS	<0.01	<0.2	3.4	NS	2.6	500	950
		Table 4b	7/7/2016	3.1	0.83	NS	43	NS	NS	NS	NS	<0.01	<0.2	4.3	NS	2.5	470	970
201806F01	28	10 COC	3/16/2016	<2	0.87	0.19	52	NS	NS	1,300	NS	0.03	NS	<1	<0.2	NS	500	900
		Table 4a	4/6/2016	2.2	NS	0.17	51	<0.01	<0.2	1,300	1.26	0.046	NS	<1	<0.2	<2	480	860
		Table 4b	4/15/2016	3.2	0.87	NS	50	NS	NS	NS	NS	0.051	<0.2	<1	NS	<2	480	920
		Table 4b	4/22/2016	2.3	0.84	NS	49	NS	NS	NS	NS	0.047	<0.2	<1	NS	<2	480	890
		Table 4b	4/29/2016	<2	0.86	NS	51	NS	NS	NS	NS	0.05	NS	<1	NS	<2	490	920
		Table 4b	5/6/2016	<2	0.86	NS	50	NS	NS	NS	NS	0.048	NS	<1	NS	<2	470	880
		Table 4b	6/3/2016	2.3	0.83	NS	45	NS	NS	NS	NS	0.045	<0.2	<1	NS	<2	440	880
		Table 4b	7/7/2016	3	0.85	NS	49	NS	NS	NS	NS	0.049	<0.2	<1	NS	<2	470	880
201806Q02	31	10 COC	3/16/2016	<2	1.8	1.1	210	NS	NS	1,700	NS	0.11	NS	<1	2	NS	360	1,000
		10 COC	3/31/2016	NS	NS	NS	NS	NS	NS	NS	NS	0.072	NS	NS	NS	NS	NS	NS
		Table 4a	4/22/2016	5.6	NS	1.4	250	<0.01	<0.2	1,500	2.77	0.072	<0.2	<1	2.7	4.7	230	920
		Table 4b	4/29/2016	9.6	1.8	NS	190	NS	NS	NS	NS	0.091	<0.2	<1	NS	4.3	270	860
		Table 4b	5/13/2016	12	1.5	NS	140	NS	NS	NS	NS	0.09	<0.2	<1	NS	3.6	300	800
		Table 4b	6/3/2016	13	1.6	NS	120	NS	NS	NS	NS	0.096	<0.2	<1	NS	2.8	290	820
		Table 4b	7/7/2016	13	1.6	NS	140	NS	NS	NS	NS	0.083	<0.2	<1	NS	<2	300	810
201817G01	32	10 COC	3/31/2016	4.1	0.87	0.23	52	NS	NS	1,200	NS	0.039	NS	2.4	<0.2	NS	410	770
		Table 4a	4/22/2016	2.2	NS	0.21	51	<0.01	<0.2	1,200	1.26	0.037	<0.2	2.4	<0.2	2.5	410	770
		Table 4b	4/29/2016	3.4	0.88	NS	53	NS	NS	NS	NS	0.3	<0.2	3	NS	2.7	420	780
		Table 4b	5/13/2016	2.3	0.79	NS	52	NS	NS	NS	NS	0.017	<0.2	3.2	NS	3.2	410	780
		Table 4b	5/20/2016	3.6	0.86	NS	53	NS	NS	NS	NS	0.018	<0.2	2.8	NS	3	420	790
		Table 4b	6/3/2016	<2	0.86	NS	68	NS	NS	NS	NS	0.02	<0.2	2.4	NS	2.4	380	790
		Table 4b	7/7/2016	<2	0.87	NS	53	NS	NS	NS	NS	0.022	<0.2	2.8	NS	3.2	430	800
201819N01	34	10 COC	3/31/2016	3	0.85	0.36	76	NS	NS	1,800	NS	0.01	NS	25	<0.2	NS	690	1,300

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201820E01	33	10 COC	3/31/2016	5.2	0.79	0.29	57	NS	NS	1,300	NS	0.033	NS	5.3	<0.2	NS	440	840
		Table 4a	4/15/2016	3.2	NS	0.24	50	<0.01	<0.2	1,100	NS	0.022	<0.2	2.1	<0.2	2.6	430	810
		Table 4b	4/22/2016	<2	0.73	NS	49	NS	NS	NS	NS	0.022	<0.2	2.1	NS	<2	430	810
		Table 4b	4/29/2016	<2	0.72	NS	50	NS	NS	NS	NS	0.026	<0.2	1.8	NS	<2	430	810
		Table 4b	5/6/2016	2.3	0.73	NS	50	NS	NS	NS	NS	0.021	NS	2.1	NS	<2	420	810
		Table 4b	6/3/2016	2	0.73	NS	44	NS	NS	NS	NS	0.022	<0.2	<1	NS	<2	390	790
		Table 4b	7/7/2016	<2	0.77	NS	50	NS	NS	NS	NS	0.04	<0.2	<1	NS	<2	420	790
201831C01	35	10 COC	3/31/2016	2	0.56	0.21	45	NS	NS	1,300	NS	<0.01	NS	11	<0.2	NS	490	940
		Table 4a	4/22/2016	<2	NS	0.22	44	<0.01	<0.2	1,300	2.27	<0.01	<0.2	9.8	<0.2	2.3	470	920
		Table 4b	4/29/2016	<2	0.58	NS	44	NS	NS	NS	NS	<0.01	<0.2	9.7	NS	2.5	450	900
		Table 4b	5/6/2016	<2	0.56	NS	44	NS	NS	NS	NS	<0.01	NS	9.7	NS	2.8	450	900
		Table 4b	5/13/2016	<2	0.52	NS	42	NS	NS	NS	NS	<0.01	<0.2	9.9	NS	2.3	490	890
		Table 4b	6/3/2016	2.1	0.56	NS	38	NS	NS	NS	NS	<0.01	<0.2	7.5	NS	2.3	460	890
		Table 4b	7/7/2016	<2	0.56	NS	42	NS	NS	NS	NS	<0.01	<0.2	9.5	NS	<2	480	860
201831Q01	37	10 COC	3/18/2016	2.3	0.49	0.28	50	NS	NS	1,200	NS	<0.01	NS	28	<0.2	NS	490	890
		Table 4a	4/6/2016	<2	NS	0.22	49	<0.01	<0.2	1,200	4.28	<0.01	<0.2	28	<0.2	11	490	900
		Table 4b	4/15/2016	<2	0.49	NS	48	NS	NS	NS	NS	<0.01	<0.2	27	NS	8.5	490	930
		Table 4b	4/22/2016	<2	0.48	NS	48	NS	NS	NS	NS	<0.01	<0.2	25	NS	7.2	490	900
		Table 4b	4/29/2016	<2	0.48	NS	48	NS	NS	NS	NS	<0.01	<0.2	26	NS	6.4	490	900
201832E01	36	10 COC	6/2/2016	2.1	0.52	0.24	50	NS	NS	1,200	NS	0.019	NS	8.1	<0.2	NS	460	820
211805C01	38	10 COC	3/14/2016	<2	0.46	0.18	42	NS	NS	1,300	NS	<0.01	NS	12	<0.2	NS	510	880
		Table 4a	4/5/2016	<2	<0.1	0.54	41	<0.01	<0.2	1,200	1.76	<0.01	<0.2	11	<0.2	2.5	480	870
		Table 4b	4/12/2016	<2	0.43	NS	40	NS	NS	NS	NS	<0.01	<0.2	11	NS	2.3	490	870
		Table 4b	4/19/2016	<2	0.43	NS	47	NS	NS	NS	NS	<0.01	<0.2	16	NS	5.4	500	920
		Table 4b	4/26/2016	<2	0.43	NS	41	NS	NS	NS	NS	<0.01	<0.2	11	NS	2.6	460	890
		Table 4b	5/3/2016	<2	0.47	NS	41	NS	NS	NS	NS	<0.01	NS	11	NS	2.6	490	880
		Table 4b	6/21/2016	<2	0.44	NS	40	NS	NS	NS	NS	<0.01	<0.2	12	NS	2.4	480	870
211805M01	40	10 COC	3/14/2016	<2	0.47	0.2	46	NS	NS	1,300	NS	<0.01	NS	24	<0.2	NS	510	920
		Table 4a	4/5/2016	<2	<0.1	0.27	45	<0.01	<0.2	1,200	0.755	<0.01	<0.2	22	<0.2	6.9	500	900
		Table 4b	4/12/2016	<2	0.46	NS	45	NS	NS	NS	NS	<0.01	<0.2	22	NS	7.5	490	890

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
211805M01 (con't)	40 (con't)	Table 4b	4/19/2016	2.3	0.46	NS	45	NS	NS	NS	NS	<0.01	<0.2	22	NS	5.2	490	880
		Table 4b	4/26/2016	<2	0.45	NS	46	NS	NS	NS	NS	<0.01	NS	23	NS	6.6	500	880
		Table 4b	5/3/2016	<2	0.47	NS	45	NS	NS	NS	NS	<0.01	NS	22	NS	7.2	490	880
		Table 4b	6/21/2016	<2	0.45	NS	45	NS	NS	NS	NS	<0.01	<0.2	22	NS	6.7	490	900
		Table 4b	7/5/2016	<2	0.47	NS	41	NS	NS	NS	NS	<0.01	<0.2	19	NS	5.8	460	910
211806G01	42	10 COC	3/16/2016	<2	0.49	0.16	79	NS	NS	1,300	NS	0.014	NS	34	0.4	NS	480	980
		Table 4a	4/6/2016	<2	NS	0.31	72	<0.01	7.6	1,200	NS	<0.01	NS	31	0.58	17	450	910
		Table 4b	4/15/2016	<2	0.48	NS	73	NS	NS	NS	NS	<0.01	<0.2	33	NS	18	490	960
211807E01	44	10 COC	3/16/2016	<2	0.46	0.35	34	NS	NS	1,000	NS	<0.01	NS	8	<0.2	NS	350	700
		Table 4a	4/15/2016	2.2	NS	0.2	35	<0.01	<0.2	940	2.27	<0.01	<0.2	8.1	<0.2	<2	360	670
211808B01	43	10 COC	4/1/2016	4.3	0.47	0.15	28	NS	NS	860	NS	<0.01	NS	3.3	<0.2	NS	280	540
211808N01	45	10 COC	3/14/2016	<2	0.45	0.18	33	NS	NS	1,000	NS	<0.01	NS	6	<0.2	NS	350	640
		Table 4a	4/5/2016	2.3	<0.1	0.097	31	<0.01	<0.2	900	1.26	<0.01	<0.2	4.6	<0.2	<2	330	600
		Table 4b	4/12/2016	<2	0.46	NS	31	NS	NS	NS	NS	<0.01	<0.2	4.6	NS	<2	320	620
		Table 4b	4/19/2016	3.6	0.47	NS	30	NS	NS	NS	NS	<0.01	NS	4.5	NS	<2	320	610
		Table 4b	4/26/2016	2.2	0.44	NS	31	NS	NS	NS	NS	<0.01	<0.2	4.6	NS	<2	330	620
		Table 4b	5/3/2016	<2	0.41	NS	70	NS	NS	NS	NS	<0.01	NS	18	NS	12	500	950
		Table 4b	6/7/2016	3.5	0.45	NS	30	NS	NS	NS	NS	<0.01	<0.2	4.7	NS	<2	310	590
		Table 4b	7/5/2016	<2	0.4	NS	27	NS	NS	NS	NS	<0.01	<0.2	3.5	NS	<2	300	620
211809D02	39	10 COC	4/7/2016	2.1	0.41	0.22	47	NS	NS	1,200	NS	<0.01	NS	18	<0.2	NS	490	930
211809L01	41	10 COC	4/7/2016	2.6	0.38	0.2	44	NS	NS	1,200	NS	<0.01	NS	13	<0.2	NS	500	870
211815M02	49	10 COC	4/7/2016	4	0.5	0.32	58	NS	NS	1,200	NS	0.019	NS	8.5	<0.2	NS	450	830
211816N01	50	10 COC	3/14/2016	<2	0.44	0.36	74	NS	NS	1,300	NS	0.021	NS	9.5	<0.2	NS	430	830
		Table 4a	4/5/2016	4.5	<0.1	0.17	42	<0.01	<0.2	920	1.26	0.01	<0.2	4.4	<0.2	4.3	320	620
		Table 4b	4/12/2016	3.4	0.47	NS	41	NS	NS	NS	NS	0.011	<0.2	4.3	NS	4.3	320	620
		Table 4b	4/19/2016	4.4	0.49	NS	41	NS	NS	NS	NS	0.011	<0.2	4.1	NS	2.9	310	620
		Table 4b	4/26/2016	3.3	0.46	NS	42	NS	NS	NS	NS	0.01	<0.2	4.3	NS	4.1	320	610
		Table 4b	5/3/2016	3.3	0.49	NS	41	NS	NS	NS	NS	0.011	NS	4.3	NS	5.1	310	630
		Table 4b	6/7/2016	4.6	0.48	NS	39	NS	NS	NS	NS	0.011	<0.2	4.2	NS	4.5	310	610
		Table 4b	7/5/2016	4.8	0.51	NS	37	NS	NS	NS	NS	0.012	NS	3.1	NS	4	300	620

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
211816P01	51	10 COC	4/7/2016	3.2	0.36	0.28	57	NS	NS	1,200	NS	<0.01	NS	13	<0.2	NS	500	900
211817N03	47	10 COC	3/14/2016	<2	0.4	0.36	71	NS	NS	1,300	NS	<0.01	NS	19	<0.2	NS	510	930
		Table 4a	4/5/2016	<2	<0.1	0.23	72	<0.01	<0.2	1,300	1.76	<0.01	<0.2	19	<0.2	11	490	950
		Table 4b	4/12/2016	<2	0.38	NS	70	NS	NS	NS	NS	<0.01	<0.2	18	NS	12	500	960
		Table 4b	4/19/2016	2.2	0.4	NS	70	NS	NS	NS	NS	<0.01	<0.2	18	NS	10	450	980
		Table 4b	4/26/2016	<2	0.38	NS	71	NS	NS	NS	NS	<0.01	<0.2	19	NS	11	470	940
		Table 4b	5/3/2016	<2	0.41	NS	70	NS	NS	NS	NS	<0.01	NS	18	NS	12	500	950
		Table 4b	6/7/2016	<2	0.37	NS	69	NS	NS	NS	NS	<0.01	<0.2	18	NS	12	490	910
		Table 4b	7/5/2016	<2	0.4	NS	65	NS	NS	NS	NS	<0.01	<0.2	16	NS	10	480	930
211818G03	46	10 COC	3/11/2016	<2	0.41	0.53	110	NS	NS	1,500	NS	<0.01	NS	25	<0.2	NS	480	1,000
		Table 4a	4/5/2016	<2	NS	0.47	100	<0.01	<0.2	1,400	3.27	<0.01	NS	24	<0.2	14	490	1,000
		Table 4b	4/12/2016	2.4	0.38	NS	97	NS	NS	NS	NS	<0.01	NS	24	NS	16	530	1,000
		Table 4b	4/19/2016	<2	0.4	NS	97	NS	NS	NS	NS	<0.01	<0.2	24	NS	17	470	1,000
		Table 4b	4/26/2016	<2	0.38	NS	98	NS	NS	NS	NS	<0.01	<0.2	24	NS	15	490	1,000
		Table 4b	5/3/2016	<2	0.41	NS	96	NS	NS	NS	NS	<0.01	NS	24	NS	16	500	1,000
		Table 4b	6/7/2016	2.9	0.38	NS	100	NS	NS	NS	NS	<0.01	<0.2	20	NS	19	510	1,100
211822E02	52	10 COC	4/7/2016	5.8	0.46	0.2	37	NS	NS	900	NS	0.011	NS	2.8	<0.2	NS	340	620
211823B02	48	10 COC	4/7/2016	6.7	0.6	0.062	16	NS	NS	820	NS	0.027	NS	<1	<0.2	NS	310	560
211823E01	53	10 COC	4/7/2016	6.7	0.6	0.062	16	NS	NS	820	NS	0.027	NS	<1	<0.2	NS	310	560
211827K02	58	10 COC	3/28/2016	2.4	0.45	0.43	73	NS	NS	1,300	NS	0.032	NS	26	<0.2	NS	490	900
		Table 4a	4/7/2016	<2	NS	0.4	71	<0.01	<0.2	1,300	1.51	<0.01	NS	27	<0.2	4.5	490	930
		Table 4b	4/12/2016	3.1	0.41	NS	70	NS	NS	NS	NS	<0.01	<0.2	26	NS	4.9	490	910
		Table 4b	4/19/2016	2.1	0.41	NS	71	NS	NS	NS	NS	<0.01	<0.2	26	NS	3.7	500	910
		Table 4b	4/26/2016	<2	0.4	NS	72	NS	NS	NS	NS	<0.01	<0.2	27	NS	4.8	500	920
		Table 4b	5/3/2016	<2	0.43	NS	71	NS	NS	NS	NS	<0.01	NS	26	NS	5.6	490	940
		Table 4b	6/10/2016	<2	0.41	NS	65	NS	NS	NS	NS	<0.01	<0.2	23	NS	4.8	470	930
211828G06	59	10 COC	3/8/2016	3	0.55	0.81	140	NS	NS	1,700	NS	<0.01	NS	32	<0.2	NS	600	1,200
		10 COC	5/16/2016	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	910
		Table 4a	6/3/2016	3.5	NS	0.32	51	<0.01	0.44	1,100	2.01	<0.01	<0.2	8	0.24	4.4	380	750
		Table 4b	6/10/2016	4.7	0.5	NS	49	NS	NS	NS	NS	<0.01	<0.2	7.7	NS	3.9	370	760

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State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS
211828G06 (con't)	59 (con't)	Table 4b	6/16/2016	5.1	0.5	NS	54	NS	NS	NS	NS	<0.01	<0.2	9.2	NS	4.9	390	740
		Table 4b	6/24/2016	3.9	0.49	NS	52	NS	NS	NS	NS	NS	0.031	<0.2	<1	NS	4.6	390
211829E02	54	10 COC	4/5/2016	<2	0.47	0.23	44	NS	NS	960	NS	<0.01	NS	7.7	<0.2	NS	340	650
211833G01	55	10 COC	3/14/2016	5	0.5	0.77	130	NS	NS	1,300	NS	0.033	NS	35	<0.2	NS	330	770
		Table 4a	4/12/2016	6.2	NS	0.85	140	<0.01	0.29	1,200	NS	0.043	<0.2	39	0.36	10	330	800
		Table 4b	4/19/2016	7.1	0.5	NS	130	NS	NS	NS	NS	0.024	<0.2	33	NS	8.6	330	790
		Table 4b	4/26/2016	5.5	0.48	NS	130	NS	NS	NS	NS	0.044	<0.2	33	NS	9.7	330	780
		Table 4b	5/3/2016	5.9	0.5	NS	120	NS	NS	NS	NS	0.031	NS	32	NS	9.9	330	790
		Table 4b	6/7/2016	7.2	0.48	NS	120	NS	NS	NS	NS	0.018	<0.2	31	NS	8.8	320	720
		Table 4b	7/5/2016	6.1	0.51	NS	110	NS	NS	NS	NS	0.015	<0.2	28	NS	9.3	300	760
211833N02	57	10 COC	3/14/2016	8.74	0.55	0.087	16	NS	NS	910	NS	0.015	NS	<1	<0.2	NS	330	180
		Table 4a	4/12/2016	10	NS	0.11	15	<0.01	<0.2	870	0.755	0.015	<0.2	<1	<0.2	<2	330	570
		Table 4b	4/26/2016	10	0.55	NS	16	NS	NS	NS	NS	0.015	<0.2	<1	NS	<2	330	580
		Table 4b	5/3/2016	11	0.59	NS	16	NS	NS	NS	NS	0.016	NS	<1	NS	<2	330	570
		Table 4b	6/7/2016	11	0.54	NS	16	NS	NS	NS	NS	0.015	<0.2	<1	NS	<2	320	560
		Table 4b	7/5/2016	10	0.6	NS	15	NS	NS	NS	NS	0.017	<0.2	<1	NS	<2	320	570
211835D01	60	Title 22	3/14/2016	6.4	0.51	0.078	15	<0.01	<0.2	840	NS	0.018	<0.2	<1	0.38	0.0072	320	560
		Table 4a	4/5/2016	6	<0.1	0.38	15	<0.01	<0.2	830	4.28	0.015	<0.2	<1	<0.2	<2	320	570
		Table 4b	4/12/2016	7.1	0.52	NS	15	NS	NS	NS	NS	0.017	<0.2	<1	NS	<2	310	580
		Table 4b	4/19/2016	6.9	0.52	NS	15	NS	NS	NS	NS	0.016	NS	<1	NS	<2	320	560
		Table 4b	4/26/2016	6.5	0.53	NS	15	NS	NS	NS	NS	0.018	<0.2	<1	NS	<2	320	560
		Table 4b	5/3/2016	7.5	0.53	NS	15	NS	NS	NS	NS	0.02	NS	<1	NS	<2	310	570
		Table 4b	6/7/2016	7.9	0.51	NS	15	NS	NS	NS	NS	0.023	<0.2	<1	NS	<2	310	560
		Table 4b	7/5/2016	8.7	0.54	NS	14	NS	NS	NS	NS	0.017	<0.2	<1	NS	<2	310	560
211835Q02	61	10 COC	3/21/2016	7.7	0.47	0.44	76	NS	NS	910	NS	0.034	NS	<1	<0.2	NS	300	620
		Table 4a	4/5/2016	6.2	<0.1	0.22	56	<0.01	<0.2	920	0.755	0.029	<0.2	<1	<0.2	<2	310	610
		Table 4b	4/12/2016	7.3	0.48	NS	50	NS	NS	NS	NS	0.028	<0.2	<1	NS	<2	310	610
		Table 4b	4/19/2016	7.5	0.51	NS	48	NS	NS	NS	NS	0.029	<0.2	<1	NS	<2	300	580
		Table 4b	4/26/2016	7.2	0.5	NS	46	NS	NS	NS	NS	0.028	<0.2	<1	NS	<2	310	600
		Table 4b	5/3/2016	8.2	0.51	NS	45	NS	NS	NS	NS	0.027	NS	<1	NS	<2	300	590

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

State Well ID	Report Well #	Sample Type	Date	Arsenic (µg/L)	Boron	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Gross Alpha (pCi/L)	Manganese	Mercury (µg/L)	NO ₃	TOC	Selenium (µg/L)	SO ₄	TDS		
211835Q02 (con't)	61 (con't)	Table 4b	6/7/2016	8.5	0.49	NS	40	NS	NS	NS	NS	0.025	<0.2	<1	NS	<2	300	570		
		Table 4b	7/5/2016	7.6	0.52	NS	42	NS	NS	NS	NS	NS	0.028	<0.2	<1	NS	<2	300	570	
Reservoir	56 ^a	10 COC	3/14/2016	7.4	0.54	0.34	59	NS	NS	1,000	NS	<0.01	NS	11	<0.2	NS	330	670		
		Table 4a	4/12/2016	4.9	NS	0.24	52	<0.01	<0.2	790	2.52	0.014	<0.2	6.2	2.5	<2	230	510		
		Table 4b	4/19/2016	4.2	0.43	NS	57	NS	NS	NS	NS	NS	<0.01	NS	5.4	NS	<2	240	510	
		Table 4b	4/26/2016	4.1	0.41	NS	67	NS	NS	NS	NS	NS	0.015	NS	5.1	NS	2.4	240	540	
		Table 4b	5/3/2016	4.5	0.44	NS	71	NS	NS	NS	NS	NS	0.012	<0.2	5	NS	<2	230	550	
		Table 4b	6/7/2016	6.4	0.51	NS	50	NS	NS	NS	NS	NS	NS	<0.01	<0.2	8.1	NS	2.4	320	630
		Table 4b	7/5/2016	5.6	0.54	NS	49	NS	NS	NS	NS	NS	NS	<0.01	<0.2	6.5	NS	<2	320	640

Notes:

Cr⁶⁺ = hexavalent chromium, EC = electrical conductivity, NA = not applicable, NO₃ = nitrate, NS = no sample, pCi/L = picoCuries per liter, SO₄ = sulfate, T22 = Title 22 water quality scan, TDS = total dissolved solids, TOC = total organic carbon, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted. Table shows all results from all sample collection types (T22, 10 COC, Table 4a, and Table 4b). The specific constituents analyzed differs between collection types. Lateral 7 samples do not fall into the aforementioned sample types. Report well # column refers to the number assigned on Table 3-2 and are graphed on Figure 3-2.

^aThe location labeled Reservoir included waters from three wells (Report Well #'s 54–7).

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Table B-2 Water Quality Data for California Aqueduct Sample Sites in the San Luis Field Division, March–September 2016

State Well ID	Date	Arsenic	Boron	Bromide	Chloride	Total Chromium	Conductivity (µS/cm)	Manganese	Mercury (µg/L)	Nitrate	Total Organic Carbon	Selenium (µg/L)	Sulfate	Total Dissolved Solids
Check 13	3/15/2016	0.002	0.2	0.14	52	0.001	421	0.04	<0.2	4	6.8	<1	39	239
	4/19/2016	0.002	0.3	0.27	93	0.001	611	0.016	<0.2	2.5	6.1	1	56	346
	5/17/2016	0.002	0.2	0.28	97	0.001	600	0.022	<0.2	2.3	5	1	50	327
	6/14/2016	0.002	0.2	0.3	105	0.001	626	0.016	<0.2	2.2	4.8	1	51	346
	7/19/2016	0.003	0.2	0.24	85	<0.001	523	0.031	<0.2	1	3.7	1	38	290
	8/16/2016	0.003	<0.1	0.16	55	0.001	314	0.029	<0.2	0.1	2.4	1	14	198
	9/20/2016	0.003	0.1	0.36	112	0.001	556	0.029	<0.2	0.2	2.4	1	22	309
Check 21	3/15/2016	0.002	0.2	0.17	63	0.001	469	0.019	<0.2	4.3	7	<1	45	263
	4/19/2016	0.003	0.3	0.22	76	0.001	613	0.014	<0.2	3.4	6.4	1	84	347
	5/17/2016	0.002	0.2	0.26	90	0.001	597	0.055	<0.2	3	5	1	59	329
	6/14/2016	0.003	0.2	0.25	85	0.001	553	0.069	<0.2	2	4.4	1	51	307
	7/19/2016	0.003	0.1	0.16	54	<0.001	372	0.019	<0.2	0.6	2.8	1	30	206
	8/16/2016	0.003	<0.1	0.16	55	0.001	318	0.026	<0.2	<0.1	2.6	<1	16	171
	9/20/2016	0.002	<0.1	0.27	89	0.001	461	0.023	<0.2	<0.1	3.3	1	20	256

Notes:

µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

Table B-3 Water Quality Data for California Aqueduct Sample Sites Upstream and Downstream of Lateral 7

Sample Location	Date	Arsenic	Boron	Bromide	Chloride	Total Chromium	Conductivity (µS/cm)	Nitrate	Total Organic Carbon	Selenium (µg/L)	Sulfate	Total Dissolved Solids	Turbidity (NTU)
Lincoln Ave.	4/12/2016	0.0023	0.234	<0.5	69	<0.0005	526	3.2	6.8	<0.4	50	326	3.3
	4/19/2016	0.0022	0.239	0.51	77	<0.0005	563	2.7	NS	<0.4	47	333	3.5
	4/26/2016	0.0021	0.231	0.54	93	<0.0005	628	4.0	6.4	<0.4	50	353	3.4
	5/3/2016	0.0022	0.222	<0.5	92	0.00057	590	3.5	4.9	<0.4	47	316	6
	5/10/2016	0.0021	0.215	<0.5	88	0.0005	572	5.2	5.5	<0.4	48	308	5.1
	5/17/2016	0.0021	0.218	<0.5	79	0.00054	557	2.0	5.4	<0.4	49	316	4.9
	5/24/2016	0.0019	0.232	<0.5	100	<0.0005	637	3.4	4.2	<0.4	46	372	3.8
	5/31/2016	0.0021	0.218	<0.5	85	<0.0005	590	2.7	4.7	<0.4	48	340	11.3
	6/7/2016	0.0022	0.217	<0.5	92	<0.0005	606	2.9	4.6	<0.4	43	335	3.4
	6/16/2016	0.0024	0.198	<0.5	91	0.00057	535	1.6	4.5	<0.4	37	307	5.3
	6/23/2016	0.0024	0.173	<0.5	75	0.0012	486	1.9	5.4	<0.4	30	249	6
	6/29/2016	0.0023	0.158	<0.5	66	<0.0005	459	1.0	3.9	<0.4	29	250	5.2
	7/6/2016	0.0027	0.158	<0.5	65	0.00056	454	1.6	4.2	<0.4	29	247	5.8
	7/13/2016	0.0025	0.123	<0.5	61	<0.0005	400	1.1	3.6	<0.4	25	218	5.1
	7/18/2016	0.003	0.101	<0.5	59	0.00059	358	1.1	3.3	<0.4	22	185	4.7
	7/25/2016	0.0025	0.157	<0.5	85	<0.0005	477	1.1	3.8	<0.4	34	247	5.5
	8/3/2016	0.0028	0.0815	<0.5	57	<0.0005	315	<0.5	3.3	<0.4	18	168	6.4
	8/9/2016	0.0029	0.0688	<0.5	53	<0.0005	311	0.8	3.3	<0.4	15	174	5.7
	8/16/2016	0.0022	0.059	<0.5	51	<0.0005	280	0.9	2.8	<0.4	13	172	4.7
	8/22/2016	0.0026	0.0646	<0.5	53	<0.0005	317	0.7	3.0	<0.4	14	174	3.4
8/29/2016	0.0023	0.0695	<0.5	63	<0.0005	341	<0.5	3.1	<0.4	15	179	5.7	
Manning Ave.	4/12/2016	0.0029	0.336	0.5	79	0.00086	631	3.1	4.8	<0.4	73	364	9.4
	4/19/2016	0.0024	0.268	0.51	79	0.00053	579	3.0	7.0	<0.4	57	346	5.4
	4/26/2016	0.0024	0.272	0.55	91	0.00063	654	<4.0	6.2	<0.4	57	359	6.2
	5/3/2016	0.0024	0.268	<0.5	89	0.00063	627	3.5	NS	<0.4	56	341	7.1
	5/10/2016	0.0022	0.248	<0.5	91	0.00057	640	3.6	5.2	<0.4	60	341	6.3
	5/17/2016	0.0021	0.224	<0.5	79	0.00053	586	2.3	5.2	<0.4	47	328	5

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Sample Location	Date	Arsenic	Boron	Bromide	Chloride	Total Chromium	Conductivity (µS/cm)	Nitrate	Total Organic Carbon	Selenium (µg/L)	Sulfate	Total Dissolved Solids	Turbidity (NTU)
Manning Ave. (con't)	5/24/2016	0.002	0.232	<0.5	100	<0.0005	647	3.3	4.1	<0.4	53	381	3.3
	5/31/2016	0.0022	0.22	<0.5	88	<0.0005	595	2.7	4.7	<0.4	49	333	11.5
	6/7/2016	0.0023	0.231	<0.5	92	<0.0005	623	2.8	4.6	<0.4	51	333	3.5
	6/16/2016	0.0024	0.199	<0.5	93	0.00056	520	3.9	4.4	<0.4	46	302	4.4
	6/23/2016	0.0025	0.191	<0.5	82	<0.0005	535	2.0	5.4	<0.4	41	273	4.9
	6/29/2016	0.0023	0.163	<0.5	67	<0.0005	473	1.2	4.0	<0.4	31	261	5.5
	7/6/2016	0.0026	0.154	<0.5	61	<0.0005	436	1.5	4.1	<0.4	30	241	6.8
	7/13/2016	0.0026	0.13	<0.5	60	<0.0005	402	1.3	3.5	<0.4	27	217	8.7
	7/18/2016	0.0031	0.103	<0.5	60	0.00078	365	1.2	3.2	<0.4	25	187	4.3
	7/25/2016	0.0026	0.164	<0.5	85	0.0005	480	1.0	3.8	<0.4	38	251	5.7
	8/3/2016	0.0029	0.0829	<0.5	59	<0.0005	336	<0.50	3.3	<0.4	20	168	3.9
	8/9/2016	0.0025	0.0727	<0.5	54	<0.0005	316	0.8	3.3	<0.4	18	178	4.7
	8/16/2016	0.0024	0.0643	<0.5	52	<0.0005	322	0.8	2.9	<0.4	15	177	4.9
	8/22/2016	0.0024	0.0687	<0.5	54	<0.0005	325	0.7	3.0	<0.4	16	174	4.1
8/29/2016	0.0023	0.0749	<0.5	60	<0.0005	352	<0.5	3.2	<0.4	17	200	6.6	

Notes:

NS = no sample, NTU = nephelometric turbidity units, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

Appendix C. San Joaquin Field Division Water Quality Grab Sample Results

Table C-1 Water Quality Data for Groundwater Turn-ins to the California Aqueduct in the San Joaquin Field Division 2016

Inflow Source	Mile Post	Data Source	Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Nitrate	TOC	Sulfate	TDS	Uranium (pCi/L)	Gross Alpha
SWSD 3	207.00	SWSD	3/8/2016	0.002	0.0073	0.58	160	0.01	6.1	820	5.9	0.91	130	480	1.5	NS
		SWSD	3/9/2016	0.002	0.0088	0.59	140	0.01	7.1	740	5.5	0.91	120	430	1.4	NS
		SWSD	3/10/2016	0.002	0.0092	0.44	110	0.011	8.5	600	4.6	0.55	90	340	0.73	NS
		SWSD	3/11/2016	0.002	0.007	0.34	98	0.011	9.5	530	5	0.6	85	320	<MRL	NS
		SWSD	3/14/2016	0.002	0.0081	0.34	110	0.01	8.5	610	5.6	0.35	93	330	<MRL	NS
		SWSD	3/15/2016	0.002	0.0096	0.36	110	0.01	7.7	620	6	0.56	94	350	<MRL	NS
		SWSD	3/16/2016	0.002	0.0095	0.39	110	0.01	7.5	580	4.9	0.67	92	340	<MRL	NS
		SWSD	3/17/2016	0.002	0.006	0.47	110	0.01	6.8	600	4.3	0.61	93	350	<MRL	NS
		SWSD	3/18/2016	0.002	0.0075	0.41	110	0.01	6.7	590	4.2	0.58	96	350	<MRL	NS
		SWSD	3/21/2016	0.002	0.0095	0.22	82	0.01	8.3	530	4.8	0.61	84	300	<MRL	NS
		SWSD	3/22/2016	0.002	0.01	0.24	84	0.01	7.8	560	4.9	0.63	92	310	<MRL	NS
		SWSD	3/25/2016	0.002	0.0073	0.24	75	0.01	7.7	480	4.6	0.65	90	290	<MRL	NS
		SWSD	3/28/2016	0.002	0.0082	0.18	67	0.01	8.8	460	5.3	0.49	90	280	<MRL	NS
		SWSD	4/4/2016	0.002	0.01	0.23	70	0.01	9.5	470	4.7	0.59	78	270	<MRL	NS
		SWSD	4/12/2016	0.002	0.0097	0.18	63	0.01	7	420	4.6	0.79	77	250	<MRL	NS
		SWSD	4/13/2016	0.002	0.0081	0.41	130	0.01	5.6	700	5	0.81	120	400	0.97	NS
		SWSD	4/14/2016	0.002	0.01	0.22	73	0.01	4.7	470	4.2	1.1	86	280	<MRL	NS
		SWSD	4/15/2016	0.002	0.011	0.16	60	0.01	6.4	420	4.1	0.85	74	260	<MRL	NS
SWSD	4/18/2016	0.002	0.0089	0.16	61	0.01	6	440	4.8	0.93	80	260	<MRL	NS		
SWSD	4/25/2016	0.002	0.0069	0.21	66	0.01	6.2	430	4.2	0.96	73	270	<MRL	NS		
CVC	238.04	WKWD	3/4/2016	NS	<0.002	0.13	51	<0.002	0.56	689	11.05	<0.20	190	480	3.7	NS
		KCWA	3/30/2016	NS	0.0045	0.091	20	NS	0.6	NS	3.3	1.9	16	130	NS	<2.11
		KCWA	7/28/2016	NS	0.0027	0.034	8	NS	0.34	NS	2.5	1.9	7.5	83	NS	2.77
		KCWA	11/1/2016	NS	0.007	0.098	22	NS	1.4	265	5.8	0.71	21	170	NS	3.02
KWBC	238.19	KCWA	3/30/2016	NS	0.012	0.18	41	NS	1.4	NS	5.3	0.66	46	250	NS	<2.11
WKWD	240.20	WKWD	3/4/2016	NS	0.007	0.21	51	<0.002	1.2	435	9.282	<0.20	60	280	3.2	NS

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Inflow Source	Mile Post	Data Source	Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Nitrate	TOC	Sulfate	TDS	Uranium (pCi/L)	Gross Alpha
WRMWSD 7G3W	269.66	WRMWSD	4/4/2016	<0.002	NS	0.22	36	<0.01 ^a	<0.2	1,100	<1	0.67 ^b	380	710	2.7	NS
		WRMWSD	5/2/2016	0.0025	NS	0.22	34	<0.01 ^a	<0.2	1,000	<1	0.74 ^b	350	680	2.8	NS
		WRMWSD	8/8/2016	<0.002	NS	0.22	37.0	<0.01 ^a	<0.050	1,100	<1	0.56 ^b	400	760	2.6	NS
		WRMWSD	10/16/2016	<0.002	NS	0.2	37	<0.01 ^a	<0.050	1,100	<1	<0.20 ^b	400	720	2.6	NS
WRMWSD 7P6W	269.66	WRMWSD	4/4/2016	<0.002	NS	0.22	36.0	<0.01 ^a	<0.2	1,100	<1	0.49 ^b	380	710	2.6	NS
		WRMWSD	5/2/2016	0.0029	NS	0.22	34.0	<0.01 ^a	<0.2	1,000	<1	0.57 ^b	350	670	2.8	NS
		WRMWSD	8/8/2016	<0.002	NS	0.24	37.0	<0.01 ^a	<0.050	1,100	<1	0.59 ^b	400	740	3.9	NS
		WRMWSD	10/13/2016	<0.0022	NS	0.19	37.0	<0.01 ^a	<0.050	1,100	<1	<0.20 ^b	390	710	2.5	NS
WRMWSD WRM7 / 7P5W	270.24	WRMWSD	4/4/2016	0.0062	NS	0.18	31.0	<0.01 ^a	<0.2	890	<1	0.79 ^b	270	560	2	NS
		WRMWSD	5/2/2016	0.0076	NS	0.15	25.0	<0.01 ^a	<0.2	730	<1	0.81 ^b	220	490	2.3	NS
		WRMWSD	8/8/2016	0.0069	NS	0.19	35	<0.01 ^a	<0.050	780	<1	2 ^b	250	540	2.7	NS
		WRMWSD	10/13/2016	0.0068	NS	0.18	31	<0.01 ^a	<0.050	860	<1	2.5 ^b	260	550	3	NS
WRMWSD 8G2W	272.1	WRMWSD	4/4/2016	0.0036	NS	0.1	16	<0.01 ^a	<0.2	1,200	<1	0.73 ^b	500	860	1.6	NS
WRMWSD 8P1W	272.31	WRMWSD	4/4/2016	0.0076	NS	0.1	16.0	<0.01 ^a	<0.2	960	<1	0.68 ^b	360	670	1.9	NS
		WRMWSD	8/8/2016	0.0052	NS	0.98	17	<0.01 ^a	<0.050	920	<1	0.69 ^b	370	670	2	NS
		WRMWSD	10/13/2016	0.007	NS	0.095	17.0	<0.01 ^a	<0.050	960	<1	0.22 ^b	360	640	1.7	NS
WRMWSD 8P2W	272.53	WRMWSD	2/5/2016	0.0061	NS	0.15	20.0	<0.01 ^a	<0.2	900	<1	0.63 ^b	330	640	2.4	NS
		WRMWSD	4/4/2016	0.0077	NS	0.15	20.0	<0.01 ^a	<0.2	950	<1	0.67 ^b	340	630	2.4	NS
WRMWSD 8P3W	272.8	WRMWSD	2/5/2016	0.0068	NS	0.15	20.0	<0.01 ^a	<0.2	910	<1	0.63 ^b	330	630	2.5	NS
		WRMWSD	4/4/2016	0.0062	NS	0.14	20	<0.01 ^a	<0.2	950	<1	0.47 ^b	340	620	2.3	NS
WRMWSD 9G4W	276.09	WRMWSD	2/5/2016	<0.002	NS	0.16	34.0	<0.01 ^a	<0.2	1,100	4.4	0.58 ^b	430	780	3.3	NS
		WRMWSD	10/16/2016	<0.002	NS	0.15	36	<0.01 ^a	<0.050	1,100	4.4	0.24 ^b	440	780	3	NS
WRMWSD 9G1W	277.28	WRMWSD	2/5/2016	<0.002	NS	0.21	40	<0.01 ^a	<0.2	1,300	9.8	0.57 ^b	490	960	8	NS
		WRMWSD	4/4/2016	<0.002	NS	0.24	40.0	<0.01 ^a	<0.2	1,300	9.7	0.41 ^b	490	930	7.7	NS
		WRMWSD	11/7/2016	<0.002	NS	0.2	44	<0.01 ^a	0.054	1,400	11.5	0.23 ^b	470	1,000	9.4	NS
WRMWSD 10P1X	280.14	WRMWSD	4/4/2016	0.0037	NS	0.14	47.0	<0.01 ^a	0.43	410	2.3	5.6 ^b	47	240	1.6	NS
		WRMWSD	5/2/2016	0.007	NS	0.18	31.0	<0.01 ^a	0.6	790	22.6	0.63 ^b	190	500	6.1	NS
		WRMWSD	8/15/2016	0.0029	NS	0.18	36.0	<0.01 ^a	0.45	760	10.6	1 ^b	170	460	4.7	NS
		WRMWSD	10/18/2016	0.0063	NS	0.26	44.0	<0.01 ^a	0.3	880	14.6	0.39 ^b	250	880	6.7	NS

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Inflow Source	Mile Post	Data Source	Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	Nitrate	TOC	Sulfate	TDS	Uranium (pCi/L)	Gross Alpha
AEWSD	277.3	AEWSD	1/27/2016	NS	0.007	0.16	41	0.006	5.3	NS	16.8	0.5	51	290	1.14	NS
		AEWSD	2/29/2016	NS	0.007	0.15	38	0.005	4.3	NS	14.9	0.6	49	290	1.67	NS
		AEWSD	3/30/2016	NS	0.003	<0.03	6	<0.001	<0.5	NS	0.7	2.8	3	60	0.097	NS
		AEWSD	4/21/2016	NS	0.004	<0.03	4	0.001	<0.5	NS	<0.5	3.4	2	50	0.421	NS

Notes:

AEWSD = Arvin-Edison Water Storage District, Cr⁶⁺ = hexavalent chromium, CVC = Cross Valley Canal, EC = electrical conductivity, KCWA = Kern County Water Agency, KWBC = Kern Water Bank Canal, NS = no sample, pCi/L = picoCuries per liter, SWSD 3= Semitropic Water Storage District Turn in 3, TDS = total dissolved solids, TOC = total organic carbon, WKWD = West Kern Water District, WRMWSD = Wheeler Ridge-Maricopa Water Storage District, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

^aSample was dissolved chromium.

^bSample was dissolved organic carbon.

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Table C-2 Water Quality Data for California Aqueduct Sample Sites in the San Joaquin Field Division, 2016

Inflow Source	Mile Post	Data Source	Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Dissolved Chromium	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	NO ₃	DOC	TOC	SO ₄	TDS	U (pCi/L)	Gross Alpha
Check 21	172.26	DWR	1/19/2016	0.003	0.003	0.39	127	<0.001	<0.001	NS	682	<0.1	3.7	4	48	377	NS	NS
		DWR	2/16/2016	0.003	0.003	0.37	122	<0.001	<0.001	NS	685	<0.1	4.1	4.3	49	380	NS	NS
		DWR	3/15/2016	0.002	0.002	0.17	63	<0.001	0.001	NS	469	4.3	6.6	7	45	263	NS	NS
		DWR	4/19/2016	0.003	0.003	0.22	76	<0.001	0.001	NS	613	3.4	6.4	6.4	84	347	NS	NS
		DWR	5/17/2016	0.002	0.002	0.26	90	<0.001	0.001	NS	597	3	4.9	5	59	329	NS	NS
		DWR	6/14/2016	0.003	0.003	0.25	85	<0.001	0.001	NS	553	2	4.2	4.4	51	307	NS	NS
		DWR	7/19/2016	0.003	0.003	0.16	54	<0.001	<0.001	NS	372	0.6	3.1	2.8	30	206	NS	NS
		DWR	8/16/2016	0.002	0.003	0.16	55	<0.001	0.001	NS	318	<0.1	2.6	2.6	16	171	NS	NS
		DWR	9/20/2016	0.002	0.002	0.27	89	<0.001	0.001	NS	461	<0.1	2.6	3.3	20	256	NS	NS
		DWR	10/18/2016	0.002	0.002	0.4	121	<0.001	0.001	NS	603	0.3	2.5	2.6	26	333	NS	NS
		DWR	11/15/2016	0.002	0.002	0.34	105	<0.001	<0.001	NS	542	2	3.7	2.4	26	303	NS	NS
DWR	12/20/2016	0.002	0.002	0.38	124	<0.001	<0.001	NS	644	2.5	5.8	2.8	34	360	NS	NS		
Check 23	197.05	DWR	3/15/2016	0.002	0.002	0.18	67	<0.001	NS	0.14	491	4.4	6.8	NS	49	276	1.1	0.82
		DWR	4/19/2016	0.003	0.003	0.19	66	<0.001	NS	0.15	572	4	7	NS	83	323	1.4	0.413
Check 27	231.73	DWR	3/15/2016	0.002	0.003	0.2	72	0.001	NS	0.92	506	5	6.2	NS	53	283	1	0.99
		DWR	4/19/2016	0.003	0.003	0.16	60	0.001	NS	0.43	525	4.2	7.3	NS	72	300	1.3	1.5
		DWR	8/16/2016	0.003	0.003	0.15	53	<0.001	NS	0.13	314	<0.1	3.1	NS	16	163	0.19	0.79
		DWR	9/14/2016	0.002	0.003	0.17	76	<0.001	NS	NS	409	<0.1	3.2	NS	18	227	NS	NS
Tupman Rd.	236.43	KCWA	7/28/2016	NS	0.0027	0.25	84	NS	NS	0.08	NS	<0.096	NS	4.2	38	320	NS	1.76
		KCWA	11/1/2016	NS	0.0008	0.4	130	NS	NS	0.13	603	<0.096	NS	3.3	25	360	NS	2.52
Cole's Levee	240.14	WKWA	3/4/2016	NS	0.0047	0.33	120	NS	<0.002	0.23	644	0.884	NS	3.6	44	430	2.1	NS
		KCWA	3/30/2016	NS	0.0043	0.15	46	NS	NS	0.84	NS	4.2	NS	4.1	38	240	NS	<2.11
		KCWA	7/28/2016	NS	0.0026	0.26	86	NS	NS	0.11	NS	0.2	NS	4.5	41	330	NS	1.26
		KCWA	11/1/2016	NS	0.0014	0.39	120	NS	NS	0.16	597	<0.096	NS	3.5	25	360	NS	<1.49
Hwy 119	241.06	WKWA	3/4/2016	NS	0.005	0.35	120	NS	0.0078	0.22	643	0.8398	NS	3.6	45	450	2.1	NS
Check 29	244.54	DWR	3/15/2016	<0.001	0.004	0.2	70	<0.001	0.001	0.72	501	5	5.4	5.5	53	281	1.6	1.4
		DWR	3/15/2016	0.004	0.004	0.2	70	0.001	NS	NS	501	5	5.7	NS	53	281	NS	NS
		DWR	4/19/2016	0.004	0.004	0.14	52	0.001	0.001	0.43	458	4	8	8.5	60	272	1.6	2
		DWR	4/19/2016	0.004	0.004	0.14	52	0.001	NS	NS	458	4	6.1	NS	60	272	NS	NS

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Inflow Source	Mile Post	Data Source	Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Dissolved Chromium	Total Chromium	Cr ⁶⁺ (µg/L)	EC (µS/cm)	NO ₃	DOC	TOC	SO ₄	TDS	U (pCi/L)	Gross Alpha
Check 29 (con't)	244.54 (con't)	DWR	5/17/2016	0.003	0.003	0.26	90	<0.001	0.001	NS	601	2.6	5.2	5.2	60	332	NS	NS
		DWR	6/14/2016	0.003	0.003	0.24	84	<0.001	0.001	NS	553	2	4.5	4.8	53	306	NS	NS
		DWR	7/20/2016	0.002	0.003	0.17	59	<0.001	<0.001	NS	383	<0.1	3.3	3.4	31	217	NS	NS
		DWR	8/16/2016	0.003	0.003	0.14	48	<0.001	NS	0.17	295	<0.1	3.1	NS	16	158	0.28	1.8
		DWR	8/16/2016	0.003	0.003	0.14	48	<0.001	<0.001	NS	295	<0.1	2.6	2.9	16	151	NS	NS
		DWR	9/14/2016	0.002	0.003	0.15	68	<0.001	NS	NS	373	<0.1	2.9	NS	16	207	NS	NS
		DWR	9/20/2016	0.002	0.003	0.23	76	<0.001	0.001	NS	407	<0.1	2.5	3	18	227	NS	NS
		DWR	10/18/2016	0.002	0.003	0.38	115	<0.001	<0.001	NS	578	<0.1	2.5	2.7	25	320	NS	NS
		DWR	11/15/2016	0.002	0.002	0.35	109	<0.001	<0.001	NS	551	1.3	2.8	2.8	26	309	NS	NS
DWR	12/20/2016	0.002	0.002	0.28	96	<0.001	<0.001	NS	506	2	2.6	2.4	24	280	NS	NS		
Check 39	290.21	DWR	1/13/2016	0.007	0.007	0.16	60	0.004	NS	3.7	593	14	2	NS	77	356	1.6	2.76
		DWR	2/10/2016	0.007	0.007	0.18	42	0.004	NS	3.3	611	13	0.8	NS	105	367	2.2	3.49
		DWR	3/15/2016	0.004	0.005	0.22	73	0.001	NS	1	535	5.3	5.2	NS	61	300	1.7	2.1
		DWR	4/19/2016	0.004	0.004	0.15	54	0.002	NS	1.2	428	3.5	4.1	NS	59	240	1.1	0.77
Check 41	303.41	DWR	1/20/2016	0.008	0.008	0.22	57	0.004	0.005	NS	596	14.4	0.9	0.9	87	352	NS	NS
		DWR	2/17/2016	0.007	0.008	0.18	42	0.004	0.004	NS	613	12.3	0.8	0.8	109	363	NS	NS
		DWR	3/14/2016	0.004	0.005	0.24	79	0.002	0.003	NS	569	6.4	4.7	5.4	66	327	NS	NS
		DWR	4/20/2016	0.004	0.004	0.13	46	0.002	0.003	NS	404	3.5	5.6	5.8	52	228	NS	NS
		DWR	5/18/2016	0.003	0.003	0.26	88	0.001	0.003	NS	606	2.6	4.8	5.2	66	336	NS	NS
		DWR	6/14/2016	0.003	0.003	0.29	101	0.001	0.003	NS	623	2	4.5	4.8	58	345	NS	NS
		DWR	7/20/2016	0.003	0.003	0.17	61	0.001	0.002	NS	405	<0.1	3.6	4.2	32	227	NS	NS
		DWR	8/10/2016	0.003	0.003	0.22	51	<0.001	0.002	NS	321	<0.1	2.8	3	21	178	NS	NS
		DWR	9/21/2016	0.002	0.003	0.22	74	<0.001	<0.001	NS	406	<0.1	2.3	2.7	21	226	NS	NS
		DWR	10/19/2016	0.003	0.003	0.37	113	<0.001	<0.001	NS	587	<0.1	3	3	28	326	NS	NS
		DWR	11/9/2016	0.003	0.003	0.37	121	<0.001	0.001	NS	604	<0.1	2.6	2.9	33	336	NS	NS
DWR	12/21/2016	0.002	0.002	0.28	94	<0.001	0.001	NS	501	2	2.3	2.3	24	283	NS	NS		

Notes:

Cr⁶⁺ = hexavalent chromium, DOC = dissolved organic carbon, DWR = California Department of Water Resources, EC = electrical conductivity, KCWA = Kern County Water Agency, NO₃ = nitrate, NS = no sample, pCi/L = picoCuries per liter, SO₄ = sulfate, TDS = total dissolved solids, TOC = total organic carbon, U = uranium, WKWD = West Kern Water District, µg/L = micrograms per liter, µS/cm = microSiemens per centimeter
 All measurements are mg/L (milligrams per liter) unless noted.

Appendix D. Southern Field Division Water Quality Grab Sample Results

Table D-1 Water Quality Data for Groundwater Turn-ins from Antelope Valley-East Kern Water Agency, 2016

Well ID	Date	Arsenic	Bromide	Chloride	Total Chromium	Hexavalent Chromium (µg/L)	Conductivity (µS/cm)	Nitrate	Sulfate	Total Dissolved Solids
S-1	1/13/2016	<0.001	0.081	16	0.0039	4.3	380	6.1	58	260
	4/13/2016	<0.001	0.1	20	0.003	3.6	390	7.4	56	270
ES-2R	8/3/2016	<0.001	0.24	49	0.0016	1.9	480	8.8	53	310
	8/10/2016	<0.001	0.23	48	0.002	2.2	480	8.6	53	300
	8/18/2016	<0.001	0.22	47	0.0022	2.2	480	8.8	54	310
	8/24/2016	<0.001	0.21	42	0.0021	2.4	470	8.5	58	300
ES-3	8/3/2016	<0.001	0.043	8.1	0.0048	5	330	3.2	43	230
	8/10/2016	<0.001	0.046	7.7	0.0048	5.2	340	3.3	42	230
	8/18/2016	<0.001	0.044	7.8	0.0046	5.2	340	3.4	43	240
	8/24/2016	<0.001	0.045	8.6	0.0044	5.1	340	3.3	45	220
ES-4	8/3/2016	<0.001	0.015	3.3	0.0045	4.8	310	1	41	220
	8/10/2016	<0.001	0.013	2.2	0.0046	5.3	310	1.3	40	200
	8/18/2016	<0.001	0.014	2.2	0.0042	5.1	310	1.1	40	210
	8/24/2016	<0.001	0.016	3	0.0045	5	310	1.2	42	220

Notes:

µg/L = micrograms per liter, µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.

Water Quality Assessment of Non-Project Turn-ins to the California Aqueduct, 2016

Table D-2 Water Quality Data for California Aqueduct Sample Sites Upstream and Downstream of the Antelope Valley-East Kern Water Agency Turn-in, 2016

Station Name	Mile Post	Sample Date	Dissolved Arsenic	Total Arsenic	Bromide	Chloride	Dissolved Chromium	Total Chromium	Conductivity (µS/cm)	Nitrate	Sulfate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids
Check 41	303.41	1/20/2016	0.008	0.008	0.22	57	0.004	0.005	596	14.4	87	0.9	0.9	352
		2/17/2016	0.007	0.008	0.18	42	0.004	0.004	613	12.3	109	0.8	0.8	363
		3/14/2016	0.004	0.005	0.24	79	0.002	0.003	569	6.4	66	4.7	5.4	327
		4/20/2016	0.004	0.004	0.13	46	0.002	0.003	404	3.5	52	5.6	5.8	228
		5/18/2016	0.003	0.003	0.26	88	0.001	0.003	606	2.6	66	4.8	5.2	336
		6/14/2016	0.003	0.003	0.29	101	0.001	0.003	623	2	58	4.5	4.8	345
		7/20/2016	0.003	0.003	0.17	61	0.001	0.002	405	<0.1	32	3.6	4.2	227
		8/10/2016	0.003	0.003	0.22	51	<0.001	0.002	321	<0.1	21	2.8	3	178
		9/21/2016	0.002	0.003	0.22	74	<0.001	<0.001	406	<0.1	21	2.3	2.7	226
		10/19/2016	0.003	0.003	0.37	113	<0.001	<0.001	587	<0.1	28	3	3	326
		11/9/2016	0.003	0.003	0.37	121	<0.001	0.001	604	<0.1	33	2.6	2.9	336
12/21/2016	0.002	0.002	0.28	94	<0.001	0.001	501	2	24	2.3	2.3	283		
Check 66	403.41	1/21/2016	0.006	0.006	0.39	110	0.003	0.003	660	5.2	77	2	2.1	365
		2/18/2016	0.006	0.006	0.34	91	0.003	0.003	589	4	70	2.1	2.1	328
		3/14/2016	0.005	0.005	0.33	105	0.001	0.001	630	1	54	3.6	3.7	353
		4/20/2016	0.004	0.004	0.1	35	<0.001	0.001	352	2.2	46	5.1	5.2	200
		5/18/2016	0.003	0.004	0.28	94	0.001	0.004	619	2	65	5.5	6.2	342
		6/15/2016	0.003	0.003	0.29	101	<0.001	0.002	620	1.2	60	5.1	5.1	345
		7/20/2016	0.003	0.003	0.19	67	<0.001	0.001	444	<0.1	37	4.2	4.4	249
		8/15/2016	0.003	0.003	0.14	51	<0.001	0.002	330	<0.1	22	3	3.9	182
		10/19/2016	0.003	0.003	0.36	111	<0.001	0.002	578	<0.1	27	2.6	3.2	320
		11/15/2016	0.003	0.003	0.37	115	<0.001	0.001	613	<0.1	37	2.8	3.7	344
		12/19/2016	0.002	0.002	0.28	96	<0.001	<0.001	508	0.7	26	3	2.5	282

Notes:

µS/cm = microSiemens per centimeter

All measurements are mg/L (milligrams per liter) unless noted.