BIG DRY CREEK
ANNUAL WATER QUALITY SUMMARY
FOR 2018

Prepared for the
Big Dry Creek Watershed Association
Board of Directors

Prepared by
Wright Water Engineers, Inc.

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Abbreviations and Acronyms

ac	acute
AEP	annual exceedance probability
BDCWA	Big Dry Creek Watershed Association
BMW	Barr Milton Watershed
CDPHE	Colorado Department of Public Health and Environment
CDPS	Colorado Discharge Permit System
cfs	cubic feet per second
ch	chronic
CWQCC	Colorado Water Quality Control Commission
CWQCD	Colorado Water Quality Control Division
DM	Daily Maximum
DMR	Discharge Monitoring Report
DO	dissolved oxygen
EDAS	Ecological Data Application System
EPA	U.S. Environmental Protection Agency
HSW	High Scoring Water
kg	kilograms
mg/L	milligrams per liter
MG/YR	million gallons per year
MMI	multi-metric index
MPN	most probable number
MS4	Municipal Separate Storm Sewer System
MWAT	Maximum Weekly Average Temperature
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
TVS	table value standard
UDFCD	Urban Drainage and Flood Control District
µg/L	micrograms per liter
USGS	U.S. Geological Survey
WWTP	wastewater treatment plant

INTRODUCTION AND BACKGROUND

The Big Dry Creek Watershed Association (BDCWA) is a 501(c)(3) non-profit corporation focused on developing a sound scientific understanding of water quality, flow, aquatic life, and habitat conditions in the Big Dry Creek watershed and acting to improve these conditions. To support these objectives, BDCWA implements an instream monitoring program and analyzes results from the program on an annual basis. The monitoring program is described in the *Cooperative Sampling and Analysis Plan for the Mainstem of Big Dry Creek* (SAP), which was reviewed and updated in 2018 and can be obtained from the BDCWA website (www.bigdrycreek.org). The monitoring program is conducted by the City and County of Broomfield, City of Westminster, City of Northglenn, and the City of Thornton. The program includes water quality, flow, and biological monitoring. On an annual basis, data collected under this program are reviewed by the BDCWA Board and uploaded into a master database and then analyzed for compliance with stream standards, for water quality trends, and with regard to other priorities or areas of interest to BDCWA.

Following a brief introduction to the monitoring program and an overview of field conditions during 2018, this report summarizes findings from the 2018 monitoring program, focusing on these primary topics:

- Annual data summary and comparison to stream standards
- Targeted discussion regarding these key water quality constituents:
  - *E. coli*
  - Metals (iron)
  - Nutrients
- Biological monitoring
- Annual flow conditions
- Quality assurance/quality control
- Recommendations and conclusions

Data summaries and statistical analysis appendices supporting these discussions also accompany this report.

OVERVIEW OF MONITORING ACTIVITIES AND FIELD CONDITIONS DURING 2018

During 2018, the City and County of Broomfield and the cities of Northglenn, Thornton, and Westminster (Cities) worked together to collect water quality and flow data along the main stem of Big Dry Creek (Figure 1), consistent with the long-term BDCWA monitoring program, as described in the SAP (BDCWA 2018) and in Table 1. The Cities and BDCWA also helped to fund

operation of the U.S. Geological Survey (USGS) gauging station at Westminster behind Front Range Community College.

A conceptual-level understanding of the hydrologic regime for Big Dry Creek is important due to its significant effect on pollutant loading and instream concentrations. For general context, Figure 31 (later in this report) provides a conceptual summary of the key discharges and diversions along the creek, along with the USGS gauging station locations.

Figure 1. Big Dry Creek Watershed Location Map

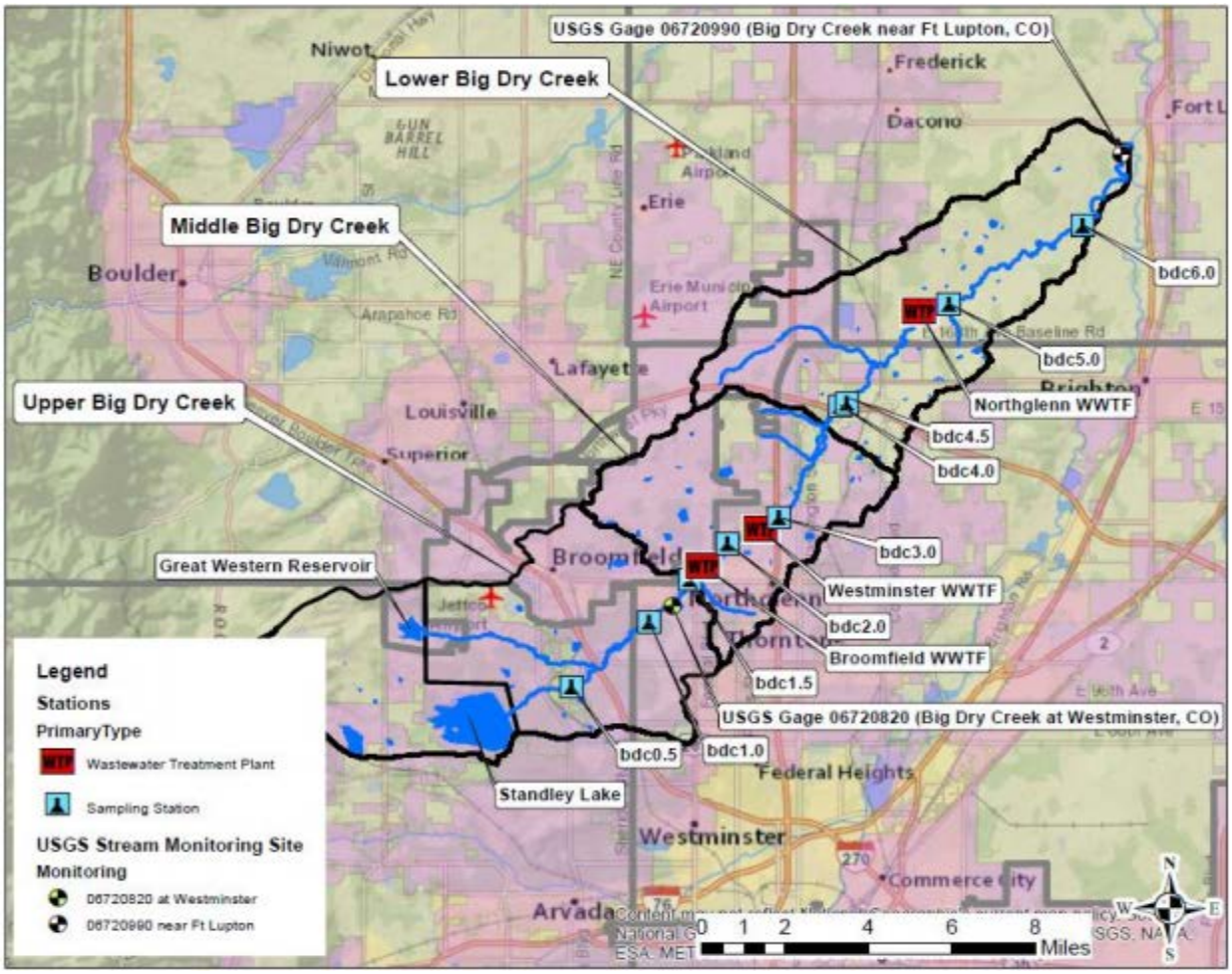


Table 1. Description of Instream Monitoring Locations in 2018

Site	Location/Selection Criteria	Constituents
bdc0.5	Big Dry Creek at Old Wadsworth Ave. Represents background conditions upstream of the WWTP outfalls, and urbanization impacts.	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
bdc1.0	Big Dry Creek at 112th Ave. Represents conditions downstream of the confluence with Walnut Creek and Rocky Flats discharge.	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
bdc1.5	Big Dry Creek at 120th Ave. Represents conditions immediately upstream of Broomfield's WWTP (BWWTP) outfall.	Water Quality, Flow
bdc1.5C	Big Dry Creek downstream of 120th Ave. upstream of the BWWTP. Serves as reference site representing habitat conditions prior to the BWWTP outfall.	Habitat, Macroinvertebrates, Fish
bdc2.0	Big Dry Creek at 128th Ave. Represents conditions downstream of BWWTP and upstream of the Westminster WWTP (WWWTP) outfall.	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
bdc3.0	Big Dry Creek at I-25 Represents conditions downstream of the WWWTP outfall, but upstream of Northglenn.	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
bdc4.5	Big Dry Creek downstream of York St. Represents urban development impacts, agricultural impacts, and background conditions for the Northglenn WWTP (NWWTP). (Replaces bdc4.0; site moved downstream April 2011 for safety reasons)	Water Quality
bdc5.0	Big Dry Creek at Weld County Rd. 4. Represents conditions downstream of the NWWTP, and agricultural influences.	Water Quality, Habitat, Macroinvertebrates, Fish
bdc6.0	Big Dry Creek at Weld County Rd. 23 near the confluence with the S. Platte. Represents conditions just prior to the confluence with the South Platte River (end of Segment 15).	Water Quality
120th & BDC	Big Dry Creek at 120th Avenue. Same approximate location as bdc1.5.	Mercury

During 2018, water quality samples were collected and analyzed for a variety of constituents, resulting in over 2,800 records being added into the BDCWA water quality database. Most metals, boron, and cyanide were monitored on a quarterly basis. The sampling frequency for total recoverable iron increased from quarterly to monthly in May 2018. All other constituents were monitored on a monthly basis. Mercury is monitored at only one location at 120th Avenue due to the high cost of mercury analysis at sufficiently low detection limits. The Big Dry Creek monitoring program is an ambient-based program. The program does not target wet-weather events, but typically includes one or more sampling events associated with precipitation that happen to fall on the designated sampling date.

Table 2 summarizes field conditions during each sampling event, as recorded at various locations in the watershed. Based on information shown in Table 2, Standley Lake releases occurred from April through September. Some of the January and December samples at upstream locations were affected by icy conditions. At bdc3.0 below the Westminster WWTP, construction zone conditions were present from January through June. Although none of the sampling dates were affected by significant precipitation, high flow conditions were present on September 13, limiting instream access for flow measurements. During several months, instream flows could not be monitored at bdc2.0 from May through September because of deep pools created by beaver dams.

Table 2. Summary of Field Conditions during 2018 Sampling Events

Date	Precip. (inches)[1]	Release (cfs)[1]	Flow (cfs)[2]		Comments
	Standley Lake	Standley Lake	USGS Westminster	USGS Ft. Lupton	
11-Jan-18	0	0	2.12	22.5	No Standley releases this month. BDC 0.5 & 1.0 inaccessible due to ice. No precip. at Standley Lake Dam on sample date.
08-Feb-18	0	0	1.98	25.2	No Standley releases this month. No precip. at Standley Lake Dam on sample date.
15-Mar-18	0.2	0	1.55	16.3	No Standley releases this month. 0.2" of precip. at Standley Lake Dam and Thornton on sample date.
11-Apr-18	0	0	3.58	20.5	No Standley releases this month. BDC1.5 & 2.0 inaccessible due to trail closure. No precip. at Standley Lake Dam on sample date.
10-May-18	0	10.81	14.0	9.74	Regular Standley releases from 4/26-6/17, average of 17.0 cfs. Standley releasing at 10.81 cfs on sample date. No precip. at Standley Lake Dam on sample date.
14-Jun-18	0	5.54	21.0	37.5	Regular Standley releases from 4/26-6/17, average of 17.0 cfs, and 6/19-6/22, average of 29.3 cfs. Standley releasing at 5.54 cfs on sample date. No precip. at Standley Lake Dam on sample date.
12-Jul-18	0	10.88	14.5	19.0	Regular Standley releases from 7/4-7/13, average of 13.1 cfs. Standley releasing at 10.88 on sample date. No precip. at Standley Lake Dam on sample date.
09-Aug-18	0	0	7.65	59.2	No Standley releases on sample date, releases made 8/6-8/8 at an average rate of 30.0 cfs. No precip. at Standley Lake Dam on sample date.
13-Sep-18	0	30.54	32.7	56.0	Regular Standley releases from 8/14-9/23, average of 22.3 cfs. Standley releasing at 30.54 cfs on sample date. Beaver dam ponding in bdc2.0 area. No precip. at Standley Lake Dam on sample date.
11-Oct-18	0	0	3.32	27.9	No Standley releases this month. No precip. at Standley Lake Dam on sample date.
08-Nov-18	0	0	1.79	19.2	No Standley releases this month. No precip. at Standley Lake Dam on sample date.
13-Dec-18	0	0	1.93	22.3	No Standley releases this month. BDC 0.5 & 1.0 inaccessible due to ice. No precip. at Standley Lake Dam on sample date.

[1] Standley Lake precipitation and release data recorded at Standley Lake Dam by dam tender.

[2] USGS flow data were obtained from USGS NWIS website for USGS 06720820 Big Dry Creek at Westminster and USGS 06720990 Big Dry Creek at Mouth near Fort Lupton.

APPLICABLE STREAM STANDARDS, DATA SUMMARY, AND OVERALL ASSESSMENT OF STANDARDS ATTAINMENT

Table 3 identifies the currently applicable Colorado Water Quality Control Commission (CWQCC) stream standards for Segment 1 of Big Dry Creek. Attainment of stream standards is evaluated based on comparison of specific statistical values to chronic stream standards and determining whether acute standards are exceeded in any samples. For most constituents, the relevant statistic for comparison to the chronic standard is the 85th percentile value. Exceptions include use of the 50th percentile value for metals with standards in the total recoverable form, the geometric mean[1] for *E. coli*, and the 15th percentile value for dissolved oxygen (DO) and the lower acceptable range for pH. More complex evaluation approaches are required for *E. coli*, selenium, ammonia, and temperature, as described later in this report. (*Note that from a regulatory perspective, five years of data would be used in such a comparison to standards, with the exception of E. coli*.)

The time periods evaluated in this report vary, depending on the nature of the water quality and/or regulatory issue. For constituents with current or historic water quality concerns, five to ten years of data may be included in the discussion, whereas for most other constituents, new data collected during 2018 are the primary focus.

To calculate hardness-based stream standards, a hardness value of 333 mg/L was used, consistent with the value used by the Colorado Water Quality Control Division (CWQCD) wastewater discharge permits for Broomfield, Westminster, and Northglenn. The mean hardness value for the stream as a whole during 2018 was 366 mg/L. Hardness values have a significant effect on certain metals standards. For example, a hardness value of 250 mg/L results in a chronic zinc standard of 271 μg/L, whereas a hardness value of 350 mg/L results in a chronic zinc standard of 362 μg/L (i.e., the higher the hardness value, the less stringent the water quality standard is for certain metals; using 333 mg/L is conservative). For purposes of the 303(d) List (which identifies impaired stream segments), the CWQCD uses the mean hardness value associated with the five-year assessment period for assessment of chronic table value standards for metals. Alternatively, a detailed assessment where the chronic table value standard is calculated for each paired hardness/concentration data may also be conducted. The acute table value standards for metals are calculated for each paired hardness/concentration and attainment is determined for each data pair (CWQCD 2015).

[1] The geometric mean is calculated as the nth root of the product of n values. The geometric mean is used for regulatory purposes because it dampens the impact of extremely high or low values, relative to the arithmetic mean.

Table 3. Regulation 38 Stream Standards for Big Dry Creek

1. Mainstem of Big Dry Creek, including all tributaries and wetlands, from the source to the confluence with the South Platte River, except for specific listing in Segments 4a, 4b, 5 and 6.

COSPBD01	Classifications
Designation	Agriculture
UP	Aq Life Warm 2
	Recreation P
Qualifiers:	
Other:	

*chlorophyll a (mg/m^2)(chronic) = applies only above the facilities listed at 38.5(4).
*Phosphorus(chronic) = applies only above the facilities listed at 38.5(4).
*Selenium(acute) = 19.1 ug/L from 11/1 - 3/31
TVS from 4/1 - 10/31.
Refer to Section 38.6(4)(d).
*Selenium(chronic) = 15 ug/L from 11/1 - 3/31
7.4 ug/L from 4/1 - 10/31.
Refer to Section 38.6(4)(d).

Physical and Biological	DM	MWAT
Temperature °C	WS-I	WS-I
	acute	**chronic**
D.O. (mg/L)	---	5.0
pH	6.5 - 9.0	---
chlorophyll a (mg/m^2)	---	150*
E. Coli (per 100 mL)	---	205

Inorganic (mg/L)	acute	chronic
Ammonia	TVS	TVS
Boron	---	0.75
Chloride	---	---
Chlorine	0.019	0.011
Cyanide	0.005	---
Nitrate	100	---
Nitrite	---	4.5
Phosphorus	---	0.17*
Sulfate	---	---
Sulfide	---	0.002

Metals (ug/L)	acute	chronic
Aluminum	---	---
Arsenic	340	100(T)
Beryllium	---	100(T)
Cadmium	TVS	TVS
Chromium III	TVS	TVS
Chromium III	---	100(T)
Chromium VI	TVS	TVS
Copper	TVS	TVS
Iron	---	1000(T)
Lead	TVS	TVS
Manganese	TVS	TVS
Mercury	---	0.01(t)
Molybdenum	---	150(T)
Nickel	TVS	TVS
Selenium	---	varies*
Selenium	varies*	---
Silver	TVS	TVS
Uranium	---	---
Zinc	TVS	TVS

In addition to the stream standards and classifications for Big Dry Creek, it is also important to be aware of the 303(d) Listing Methodology, which provides additional information on how impairment decisions are made and how streams can be delisted from being impaired. This methodology is updated every two years. The 2018 Listing Methodology included several significant changes, particularly for *E. coli*, which is a constituent of concern for Big Dry Creek. Highlights of the *E. coli* listing methodology changes include:

- In 2010, the CWQCC adopted a two-month averaging period for the assessment of existing *E. coli* criteria. As of 2018, to evaluate this two-month criteria, the CWQCD calculates the geometric mean for *E. coli* data over rolling 61-day intervals with each sample beginning a new interval for the entire period of record. Waterbody segments with data intervals made up of two samples, after any bias correction, that indicate impairment of the *E. coli* standard are placed on the Monitoring and Evaluation List. Segments with *E. coli* data sets comprised of four samples where there is overwhelming evidence of non-attainment are placed on the 303(d) List. If there are three or four samples with an indication of impairment but the evidence is not overwhelming, the segment is placed on the M&E List. Data sets of five or more samples indicating any degree of non-attainment are added to the 303(d) List.
- For delisting, *E. coli* results must be provided for five samples within 61 days (collected during the same months that indicated exceedances for listing from the most recent two years).

Practically speaking, BDCWA's monitoring program does not collect samples at a frequency that enables assessment or delisting under this methodology since the sample program results in two samples per monitoring location per 61-day period. For this reason, the CWQCD's previous assessment approach based on the 2016 Listing Methodology has been retained in this report.

OVERVIEW OF WATER QUALITY DATA

Table 4 provides a summary of the numbers of samples collected and key summary statistics for each constituent analyzed during 2018 and identifies whether the stream attained the standard for each constituent with an applicable stream standard. See the 2018 303(d) Listing Methodology for additional information on standards assessment.

A complete summary of individual sampling event results during 2018 for each monitoring station is provided in Appendix B. These data have been added to the BDCWA water quality database and included in the CWQCD's "data call" for the Regulation 38 rulemaking hearing.[2] Box plots and time series plots were created showing results by location for each constituent analyzed in

[2] The Issues Formulation Hearing for Regulation 38 is scheduled for November 2019 and the Rulemaking Hearing is in June 2020.

2018 and are included in Appendix C. Quality control (QC) samples, collected in accordance with the Big Dry Creek SAP (BDCWA 2018), are provided in Appendix D.

Discharge monitoring report (DMR) data from municipal wastewater treatment plant (WWTP) discharges to Big Dry Creek during 2018 are provided in Appendix E. The DMR samples were collected in accordance with Colorado Discharge Permit System (CDPS) permit requirements and are provided as a courtesy from the City and County of Broomfield, the City of Westminster, and the City of Northglenn to provide supplemental information on the quality of discharges to Big Dry Creek at the time of instream sample collection. Broomfield, Westminster, and Northglenn are permitted to discharge to Big Dry Creek, and all three did so during 2018.

Appendix F provides instream iron monitoring results at two sites on lower Big Dry Creek that are monitored by Metro Wastewater biweekly.

Table 4. Statistical Summary for 2018 Big Dry Creek Data and Comparison to Standards

Analyte	Count	Minimum	Maximum	Average	15th %	50th %	85th %	Stream Standard	Exceeds Std?
Monthly Field Parameters									
CONDUCTIVITY (uS/cm)	90	339	2690	1298	712	1311	1785		
DO (mg/L)	90	4.7	12.4	8.9	7.2	9.0	10.8	5	No
pH (SU)	90	6.9	8.1	7.6	7.3	7.6	7.8	6.5-9.0	No
TEMPERATURE (°C)	90	-3.37	18.77	8.55	1.37	8.37	14.92	WS-1 Mar-Nov = 24.2(ch), 29.0 (ac) Dec-Feb= 12.1(ch), 14.5(ac)	NE
FLOW (cfs)	27	3.9	56.1	22.9	10.4	21.5	33.6		
Monthly Laboratory Analysis									
ALKALINITY (mg/L)	90	53.0	301.0	159.7	103.7	159.0	211.3		
CALCIUM, Total (mg/L)	90	42.0	180.0	99.8	62.1	100.5	129.0		
CHLORIDE, D (mg/L)	90	29.5	464.0	129.6	63.0	124.5	173.2		
CHLOROPHYLL-a, corr_ (ug/L)	89	ND	56.3	5.2	2.1	3.8	7.2		
CHLOROPHYLL-a, uncor_ (ug/L)	89	1.7	66.4	8.0	3.8	6.3	10.6		
E_ coli (MPN/100 mL)	90	2	2420	216	73	273	602	205	Yes
HARDNESS (mg/L)	90	135.3	676.0	365.6	221.5	375.1	471.3		
MAGNESIUM, D (mg/L)	90	7.4	57.4	28.3	15.8	29.1	38.0		
NITROGEN, TOTAL (mg/L)	90	0.33	16.75	5.53	0.70	4.95	10.28	2.01*	Yes (future)
NO3+NO2 (mg/L)	90	0.05	15.76	4.77	0.29	3.98	8.89	100	No
NO2 (mg/L)	90	ND	0.17	0.04	ND	0.03	0.07	4.5	No
AMMONIA, Total (mg/L)	90	ND	0.43	0.06	ND	0.05	0.12	TVS	No
PHOSPHORUS, ORTHO AS P (mg/L)	90	ND	1.14	0.20	ND	0.11	0.47		
PHOSPHORUS, TOTAL (mg/L)	90	0.0	1.39	0.32	0.06	0.23	0.63	0.17*	Yes (future)
POTASSIUM, D (mg/L)	90	2.2	13.7	7.0	3.1	6.6	10.5		
SODIUM, D (mg/L)	90	21.3	384.0	136.8	64.7	137.5	183.0		
SULFATE, D (mg/L)	90	54.9	658.0	265.8	128.8	275.0	370.6		
TDS (mg/L)	90	208.0	1780.0	802.6	430.7	827.0	1083.0		
TOC (mg/L)	90	2.4	9.1	6.2	4.2	6.7	8.0		
TSS (mg/L)	90	2.8	110.0	24.8	6.6	24.2	39.3		
TURBIDITY (NTU)	90	2.6	72.5	18.8	5.7	18.4	28.4		
Quarterly Laboratory Analysis									
BORON, Total (mg/L)	30	ND	0.29	0.15	0.08	0.16	0.24	0.75	No
CYANIDE, Total (mg/L)	30	ND	ND	ND	ND	ND	ND	0.005	No
ARSENIC, Trec (mg/L)	30	ND	0.0017	0.0003	ND	ND	0.0011	0.100/0.340	No
CADMIUM, D (mg/L)	30	ND	0.0001	0.0000	ND	ND	ND	0.001/0.0078	No
CHROMIUM, D (mg/L)	30	ND	0.0010	0.0001	ND	0.0001	0.0002	See Note	No
COPPER, D (mg/L)	30	0.0033	0.0202	0.0072	0.0041	0.0058	0.0106	0.025/0.042	No
IRON, Trec (mg/L)	70	ND	1.0700	0.3797	ND	0.4200	0.5700	1.000	No
LEAD, D (mg/L)	30	ND	0.0004	0.0001	ND	0.0001	0.0002	0.0091/0.232	No
MANGANESE, D (mg/L)	30	0.0032	0.6820	0.0734	0.0126	0.0339	0.0669	2.463/4.457	No
Mercury, Tot (ug/L)	13	ND	0.0090	0.0025	0.0010	0.0020	0.0040	0.01	No
NICKEL, D (mg/L)	30	0.0005	0.0031	0.0018	0.0009	0.0020	0.0025	0.144/1.296	No
SELENIUM, D (mg/L)	30	ND	0.0134	0.0042	0.0011	0.0037	0.0058	Varies	No
SILVER, D (mg/L)	30	ND	ND	ND	ND	ND	ND	0.0025/0.016	No
ZINC, D (mg/L)	30	ND	0.0400	0.0104	0.0002	0.0058	0.0270	0.347/0.400	No

Notes: Geometric mean is provided for E. coli instead of arithmetic mean. Table Value Standards (TVS) calculated based on a hardness of 333 mg/L.
Standard Notes: * = not yet applicable; ac/ch = acute/chronic; NE = Not Evaluated; ND = Non-detect; Varies = more complex standard.
Chromium III and VI standards apply; dissolved chromium was non-detect. WS-1 indicates warm water tier 1 temperature standard, but was not evaluated.

Segment 1 (the main stem) of Big Dry Creek is listed on the 2018 303(d) List for Colorado for non-attainment of stream standards for *E. coli* for the entire segment and for total recoverable iron for the portion of the stream below Weld County Road 8 (CWQCC 2018). In the past, Big Dry Creek had also been listed as impaired for selenium (on the 2008, 2010, and 2012 303(d) Lists), but this listing was removed as a result of the update to the 303(d) List in January 2016. The most current Big Dry Creek data show attainment of all currently applicable standards with the exception of *E. coli*. The iron impairment in the lower watershed is based on data collected by Metro Wastewater Reclamation District (Metro); Metro's 2018 data set continues to show iron impairment in the lower watershed. A brief synopsis of the two current regulatory issues includes:

- *E. coli:* Big Dry Creek did not meet the *E. coli* standard during 2018. A Total Maximum Daily Load (TMDL) for *E. coli* in Big Dry Creek segment COSPBD01 was approved by the U.S. Environmental Protection Agency (EPA) in September 2016. Special studies related to sources of *E. coli* in the watershed were conducted by Wright Water Engineers (WWE) and BDCWA during 2007 and 2008 and provided to the CWQCD and were used in the development of this TMDL. During 2016-2017, Broomfield initiated additional special studies in response to the TMDL.

- Iron: Although BDCWA's long-term water quality data set shows attainment of the total recoverable iron standard, the portion of Big Dry Creek below Weld County 8 was identified as impaired on the 2016 303(d) List based on data submitted by Metro. The Metro data set is also discussed in this report and summarized in Appendix F.

More detailed discussion of *E. coli* and iron follows, along with discussion of several other constituents of regulatory interest such as nutrients.

E. COLI

BDCWA has 19 years of *E. coli* data collected on a monthly basis at eight instream locations, as well as DMR data from the WWTPs (Tables 5 through 7 and Figures 2 through 4). Standards assessment methods for *E. coli* have changed over time with regard to the duration (timeframe) during which standards are assessed. This analysis is based on the 2016 303(d) Listing methodology (WQCD 2015), which assessed attainment of the stream standard in fixed bimonthly time steps (e.g., January-February, March-April). If the geometric mean of a single two-month period exceeds the standard of 205 MPN/100 mL, then the stream does not attain recreational water quality standards. The 2018 303(d) Listing Methodology included changes to the *E. coli* assessment method and a 61-day rolling average will be utilized for future 303(d) Listing decisions as opposed to a fixed two-month interval (WQCD 2017).

Prior to discussion of findings related to *E. coli*, the following tables and figures are presented:

- Table 5 summarizes *E. coli* data by monitoring location on an annual basis for the entire period of record. Although annual geometric means are not used by the CWQCD to assess attainment, the tabular summary is still useful for general information regarding trends over time and identifying locations where *E. coli* is persistently elevated. The historic data show significant reductions in the Broomfield WWTP's effluent concentrations following WWTP upgrades and expansion in the 2001-2004 time period. Significant reductions in Westminster's WWTP effluent concentrations are also apparent beginning in 2008, following plant upgrades including UV treatment and other operational changes. Table 5 also indicates the *E. coli* concentrations in 2018 were generally lower than what has been observed since about 2010 at most monitoring locations.

- Tables 6 and 7 summarize bimonthly data for the last five years and 2018 only, respectively. Table 6 is useful for showing which bimonthly time periods tend to be elevated over time. To assess attainment of the *E. coli* standard, five or more samples should be collected in each 61-day time period. Under the 2016 303(d) Listing Methodology, when this sample frequency was not available, then a longer period of record for each bimonthly time period could be used; therefore, a five-year summary is included in this analysis, even though this assessment method is no longer utilized by the CWQCD. (Note: BDCWA conducted weekly *E. coli* monitoring in 2003 but has monitored *E. coli* on a monthly basis since that time.)

- Figure 2 provides boxplots of *E. coli* from 2014-2018 from upstream to downstream to show the range of concentrations at each upstream to downstream monitoring location. Figure 3 shows the 2014-2018 geometric mean concentrations from upstream to downstream, and Figure 4 shows the bimonthly 2018 concentrations from upstream to downstream.

Table 5. Annual Geometric Mean Summary of Big Dry Creek *E. coli* Data

Year	bdc0.5	bdc1.0	bdc1.5	bdc10.0 (Broom. WWTP)[2]	bdc2.0	bdc11.0 (West. WWTP)[2]	bdc3.0 (I-25)	bdc4.5	bdc5.0	bdc6.0
2000	212	151	389	--	**574**	--	294	500	212	323
2001	477	118	332	215	**649**	68	387	634	442	510
2002	858	230	363	364	**934**	16	536	441	451	572
2003 [3]	191	210	293	27	**615**	24	382	225	249	339
2004	279	181	217	18	346	28	205	187	156	**377**
2005	152	122	281	26	**328**	35	204	113	182	301
2006	76	241	316	20	309	48	214	163	179	**333**
2007	196	177	257	14	324	66	230	231	198	**364**
2008	266	197	267	10	**461**	6	439	376	290	380
2009 [4]	61	78	147	5	207	14	**251**	137	149	197
2010	111	191	193	12	**483**	16	376	280	235	368
2011	64	228	323	6	622	8	518	537	380	**730**
2012	267	397	260	7	**555**	8	544	497	390	545
2013	239	214	292	3	398	10	424	342	272	**505**
2014	119	269	254	5	323	9	371	410	287	**1085**
2015	257	251	230	4	311	9	**528**	415	266	490
2016	207	254	221	5	312	18	358	315	300	**536**
2017	178	194	217	5	327	19	**444**	392	349	371
2018	81	89	194	3	277	15	**352**	273	314	300

Notes:

1. Pink-shaded cells exceed the stream standard; bold values are the highest annual geometric mean.
2. Broom. = Broomfield; West. = Westminster; Northglenn excluded due to historically infrequent discharge to Big Dry Creek. During 2015-2018, Northglenn discharged to Big Dry Creek more frequently; the geometric mean annual DMR values for Northglenn's Discharge were 18 MPN/100 mL in 2015, 9.7 MPN/100 mL in 2016, 4.8 MPN/100 mL in 2017 and 5.2 MPN in 2018.
3. For consistency between sampling years, the 2003 weekly samples were converted to monthly geometric means prior to calculating the annual geometric mean for 2003.
4. The 2009-2018 Broomfield and Westminster geometric means are based on Discharge Monitoring Report (DMR) values. The 2000-2008 samples were based on grab samples of the WWTP effluent as part of the synoptic monitoring program.

Table 6. Bimonthly Summary of Instream Big Dry Creek *E. coli* Data for Five-Year Period

Geometric Mean *E. coli* (#/100 mL) 2014-2018						
			Recreation Season			
Station	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sept-Oct	Nov-Dec
bdc0.5	58	42	272	366	308	103
bdc1.0	37	41	398	634	282	184
bdc1.5	142	57	332	622	378	220
bdc2.0	288	74	230	863	382	467
bdc3.0	371	129	332	835	596	543
bdc4.5	394	75	421	675	453	543
bdc5.0	201	96	393	653	441	302
bdc6.0	227	441	767	882	460	465
All Sites	166	86	370	670	402	308

Note: Pink-shaded values exceed the stream standard.

Figure 2. Big Dry Creek *E. coli* Boxplots (2014-2018)

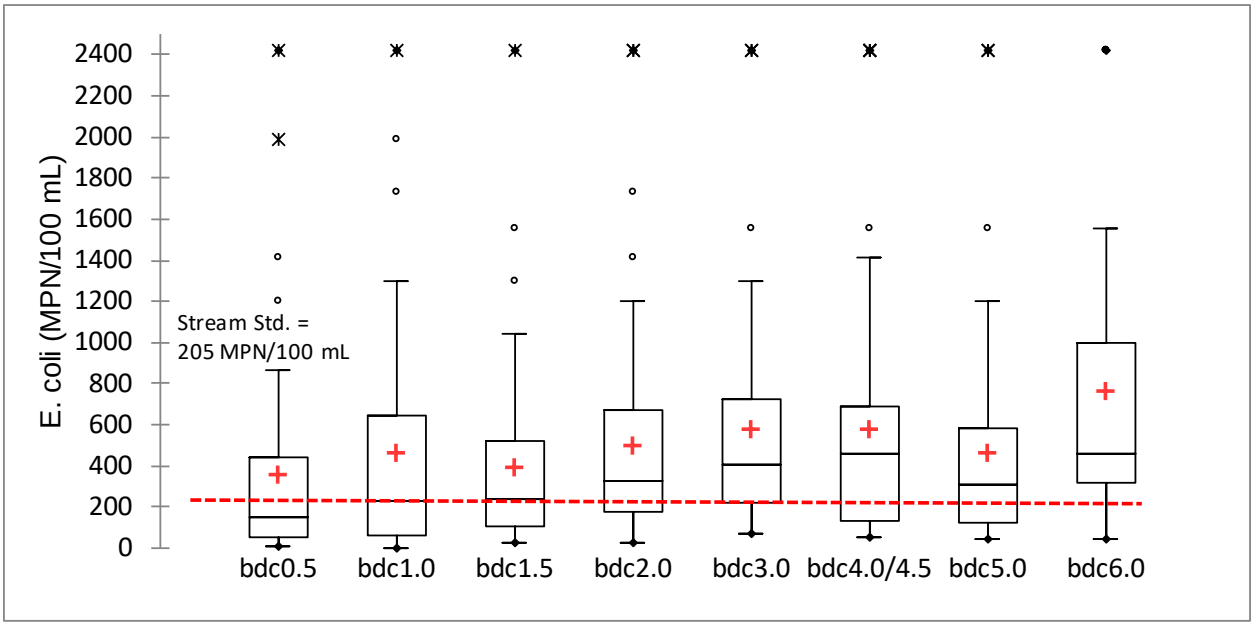


Figure 3. Big Dry Creek *E. coli* Geometric Mean Concentrations (2014-2018)

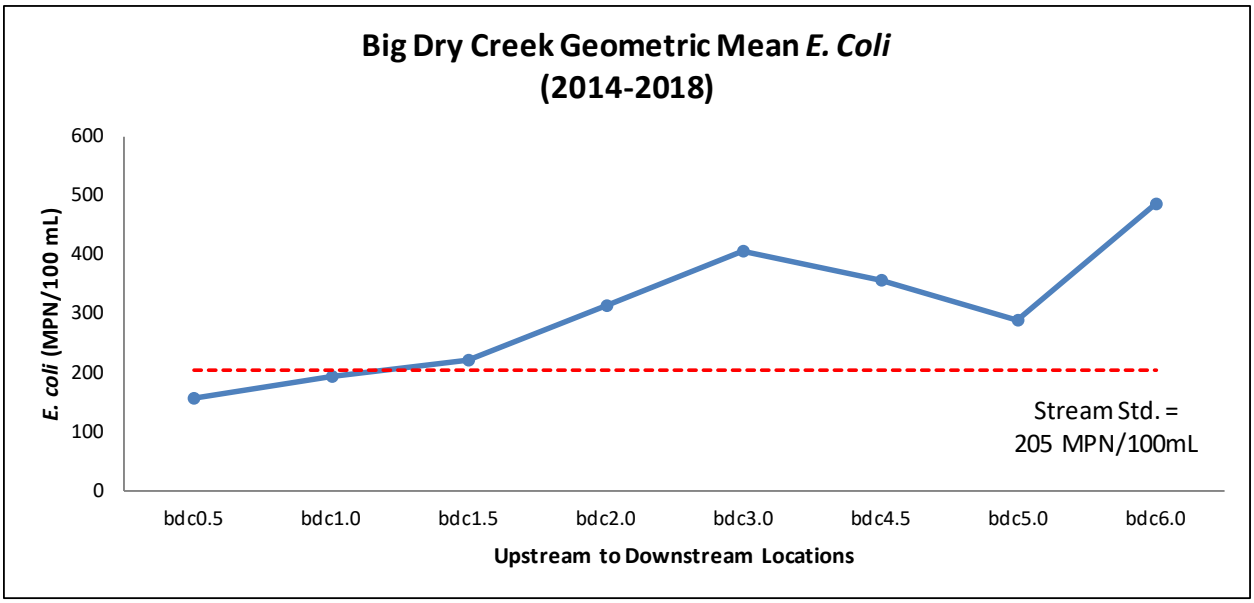
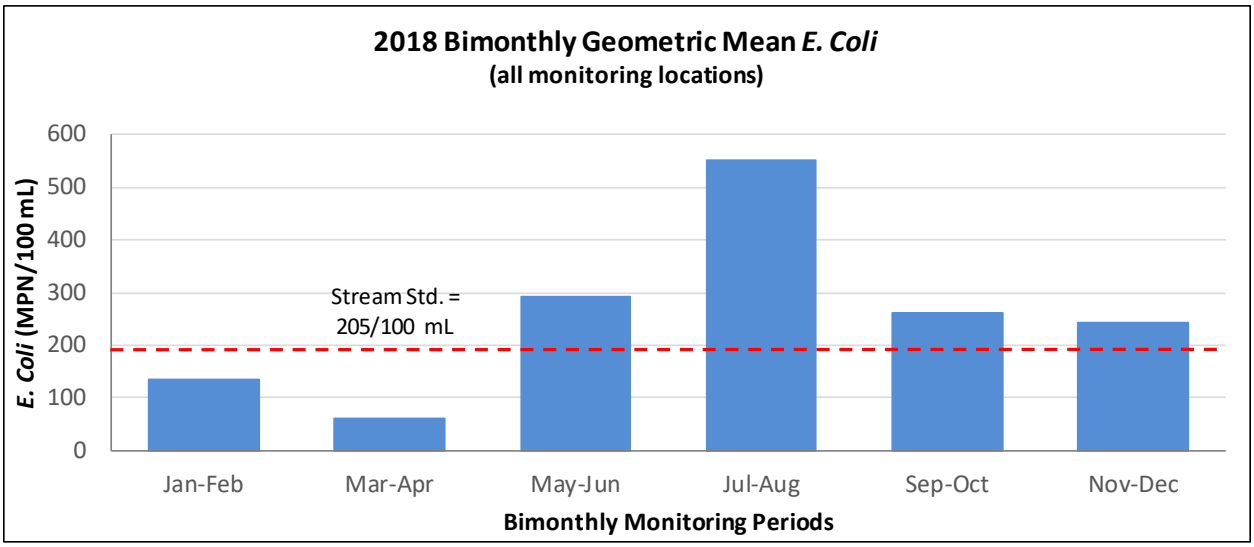


Table 7. 2018 *E. coli* Data

E. coli (MPN/100 mL) 2018												
					Recreation Season							
Station ID	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
BDC0.5	ICE	57	12	26	26	146	517	579	106	152	38	ICE
BDC1.0	ICE	14	2	125	102	1300	214	276	94	229	54	ICE
BDC1.5	102	101	144	NS	127	1046	548	435	119	270	48	205
BDC2.0	411	145	54	NS	71	308	345	687	205	436	1414	344
BDC3.0	435	308	243	107	186	488	387	921	308	388	366	727
BDC4.5	435	99	70	50	115	980	727	727	345	299	326	580
BDC5.0	172	117	76	326	122	2420	461	770	462	614	210	291
BDC6.0	150	79	46	129	291	2420	461	2420	326	388	236	326
Geometric Mean	135		60		294		552		260		242	

Figure 4. Big Dry Creek *E. coli* 2018



Based on review of the *E. coli* data, the following observations are noteworthy:

- Geometric mean concentrations for 2018 were generally within the range of annual geometric mean values observed for the period of record.
- The 2018 data set does not meet stream standards for the May-June, July-August, September-October, or November-December assessment periods. The 2014-2018 data set does also does not meet these assessment periods. Additionally, for the five-year period, bdc6.0 exceeded the standard during all of the bimonthly assessment periods. The August sample result at bdc6.0 exceeded the upper quantitation limit of 2,419 MPN/100 mL. Based on field observations and Google Earth aerial photos, cattle are present in and along the stream above bdc6.0 and are hypothesized to contribute to elevated *E. coli* in this portion of the stream.
- For 2014-2018, the highest *E. coli* concentrations for all stations were experienced during the May-October recreation season. Statistically significant seasonal differences in *E. coli* concentrations have been consistently observed, with winter values being significantly lower than summer values (WWE 2012).
- Based on review of geometric mean concentrations from 2003-2018, *E. coli* concentrations are consistently the lowest in samples from the Broomfield and Westminster WWTP discharges (Table 5), which are well below the stream standard.
- Boxplots of upstream to downstream monitoring locations (Figure 2) show highly variable ranges of *E. coli* concentrations at each monitoring location. Various explanatory relationships between *E. coli* and variables such as flow, temperature, total organic carbon, DO and other variables have been evaluated, but without fully

explaining *E. coli* trends (WWE 2009, WWE 2011). Additionally, initial limited-scope microbially source tracking conducted by the City and County of Broomfield in the vicinity of the Broomfield WWTP was relatively inconclusive regarding sources of E. coli. Because human DNA markers can still be detected in disinfected wastewater, human markers are found instream along with bird, beaver and canine markers.

As part of the TMDL for Big Dry Creek, the CWQCD developed load duration curves for three portions of Big Dry Creek. The segment was divided into three distinct reaches to account for changes in land use, influences from instream flow (diversions, reservoir releases, WWTP contributions, etc.), and location of permitted point sources. The three reaches correspond to Standley Lake to bdc1.5 (bdc0.5 to bdc1.5), from bdc1.5 to 152nd Ave. (bdc2.0 and bdc3.0), and 152nd Avenue to the Weld County Line (bdc4.0 to bdc6.0). These curves are based on data from 2003 through 2014 and are shown in Figures 5 through 7. These figures illustrate that recreation season (May-October) stream loads generally exceed the allowable stream load for *E. coli* during all flow regimes. The TMDL has assigned load reductions needed for each of these three portions of the stream. BDCWA is currently working on a watershed plan update to identify next steps related to the *E. coli* TMDL in terms of source identification and potentially feasible load reductions.

Figure 5. Load Duration Curve for BDC1.5 and the USGS Gauge at Westminster
(Source: CWQCD 2016)

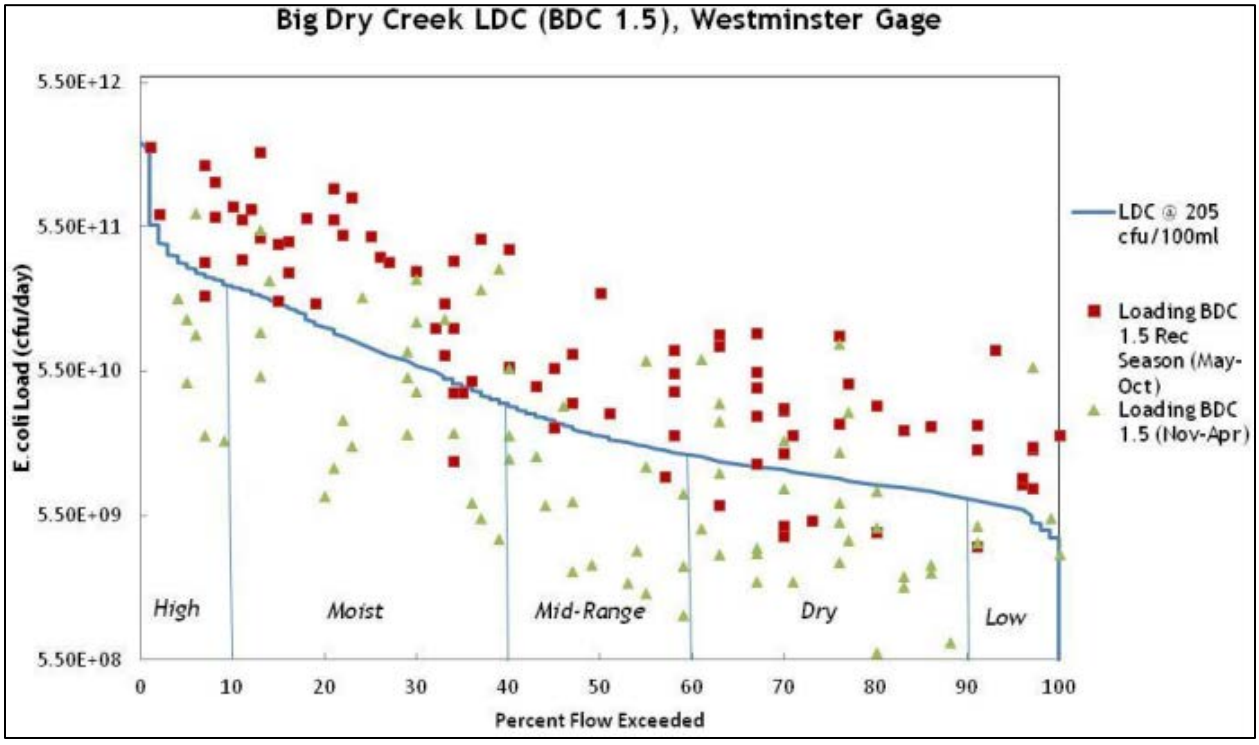


Figure 6. Load Duration Curve for BDC2.0 and the USGS Gauge at Westminster
(Source: CWQCD 2016)

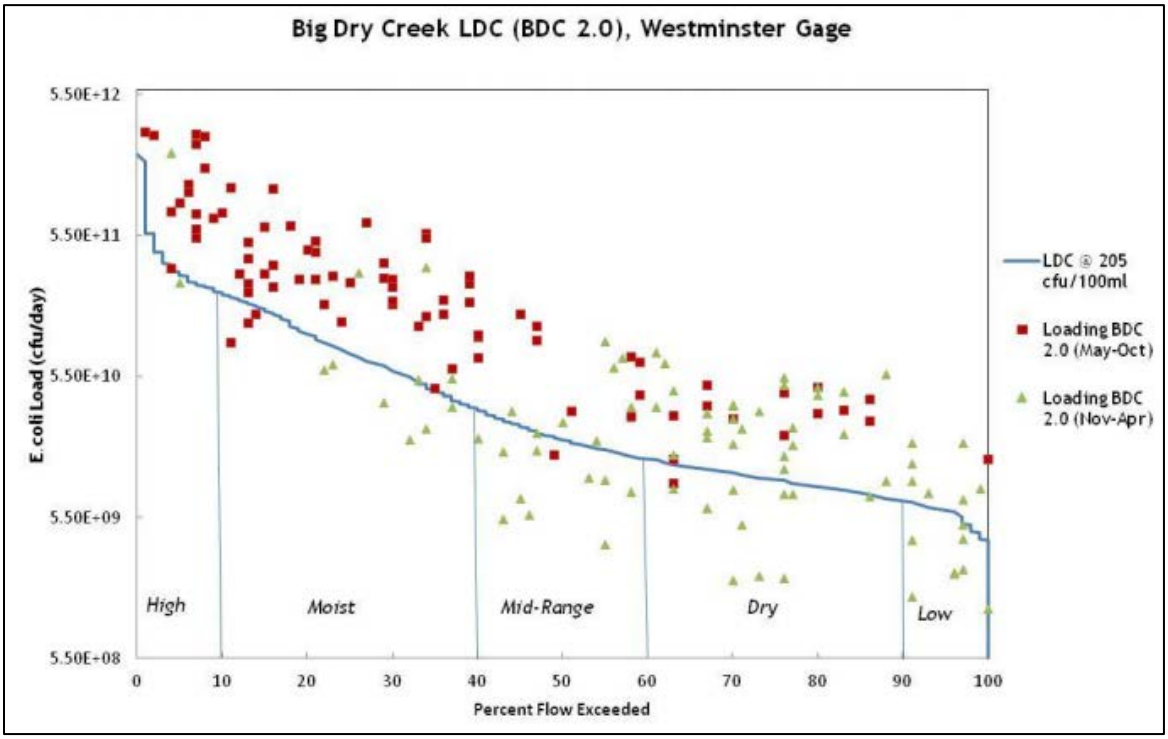
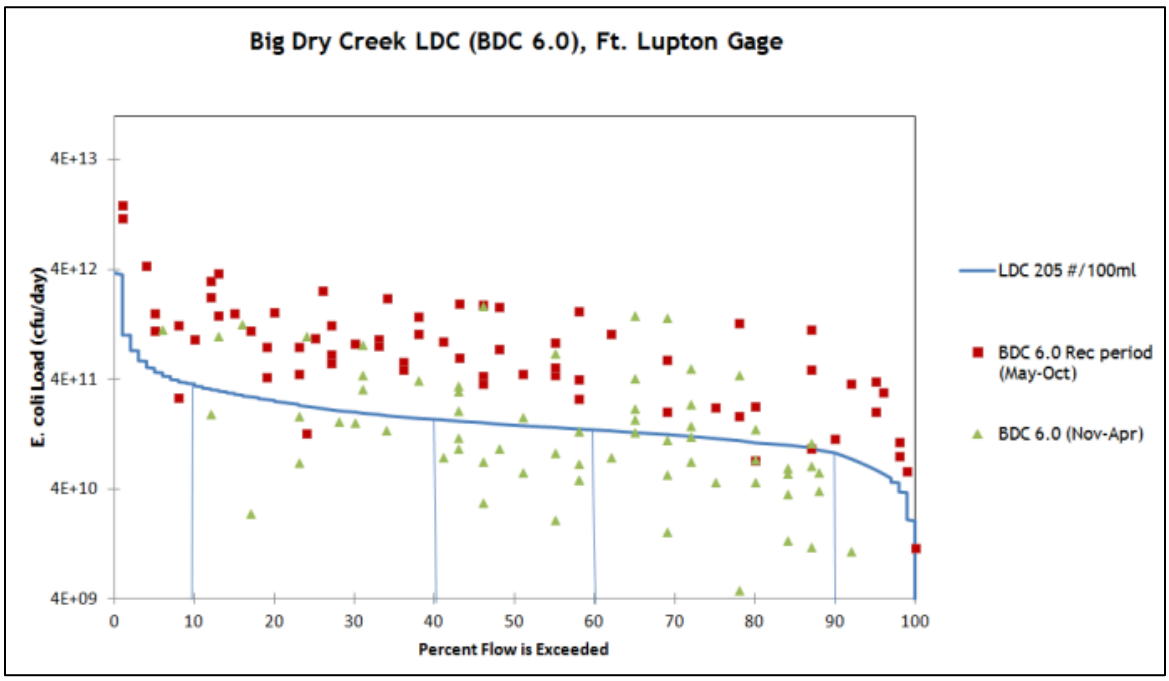


Figure 7. Load Duration Curve for BDC6.0 and the USGS Gauge at Fort Lupton
(Source: CWQCD 2016)



METALS

Based on long-term analysis of Big Dry Creek data, selenium has historically been identified as the primary metal of interest for Big Dry Creek; however, adoption of a site-specific standard for selenium on Big Dry Creek has resulted in attainment of the selenium standard. Based on the 2016 and 2018 303(d) Lists, total recoverable iron is now the primary metal of interest. See Appendices B and C for boxplots and time series plots for Big Dry Creek samples analyzed for metals, with additional information on selenium and iron discussed further below.

Selenium

Elevated selenium concentrations in the upper reach of Big Dry Creek are due to naturally occurring selenium in geologic formations. BDCWA conducted special studies in 2006-2007 to support a site-specific standard. Background on this site-specific standard can be obtained in Regulation 38 (https://www.colorado.gov/pacific/sites/default/files/38_2017%2803%29.pdf). The site-specific standard includes irrigation and non-irrigation seasonal standards assessed at three specific monitoring locations: bdc1.5, bdc2.0 and bdc4.0/4.5.[3]

Based on the site-specific selenium standards for Big Dry Creek, the 2018 data set, as well as the data set for the most recent five years (2014 through 2018), attains both the non-irrigation season (winter) and irrigation season (summer) standards for Big Dry Creek, as summarized in Table 8. WWTP grab samples collected during this time period were below chronic and acute stream standards.

Table 8. Big Dry Creek Selenium Data Summary (2014-2018)

Selenium (µg/L)				
	Irrigation Season		Non-irrigation Season	
	2013-2018 (Apr-Oct)	Reg. 38 Standard	2013-2018 (Nov-Mar)	Reg. 38 Standard
All Sites (85th %)	5.5	N/A	7.6	N/A
bdc1.5, 2.0, 4.5 (85th %)	6.5	7.4 (ch)	9.5	15.0 (ch)
bdc1.5, 2.0, 4.5 (Max)	13.4	18.4 (ac)	13.0	19.1 (ac)

[3] In 2015, the CWQCC adopted a formal change to the site-specific selenium standard assessment locations in Regulation 38 because sampling location bdc4.0 was relocated in 2011 for safety reasons and has been replaced with bdc4.5, although both sites may still be used for standards assessment, if needed.

Iron

BDCWA currently monitors total recoverable iron (Figure 8) on a monthly basis, after increasing the sample frequency from quarterly to monthly in May 2018. In 2018, only one BDCWA stream sample slightly exceeded the stream standard of 1 mg/L and the median of the last five years attained the standard. Nonetheless, Big Dry Creek is on the 303(d) List for total recoverable iron due to monitoring conducted by Metro Wastewater twice per month at two locations in the lower watershed. The first site "BDC-8" is located where Big Dry Creek crosses Weld County Road 8 and has been monitored by Metro since 2007. This site is located in proximity to BDCWA site bdc6.0. The second site is "BDC" (Figure 10) and is located approximately 30-50 yards upstream of the State Engineer's gauge "Big Dry Creek at Mouth" also known as BIGDAFCO (see Figure 28 for general location). Both of these sites slightly exceeded the stream standard of 1 mg/L during 2018, with median values of 1.04 mg/L and 1.19 mg/L for BDC-8 and BDC, respectively.

The expected source of elevated iron is streambank and soil erosion in the watershed. Previous analyses by BDCWA have shown that total iron and TSS are highly correlated, with both concentrations tending to be elevated during storm events.

Figure 8. BDCWA Monitoring Locations for Total Iron

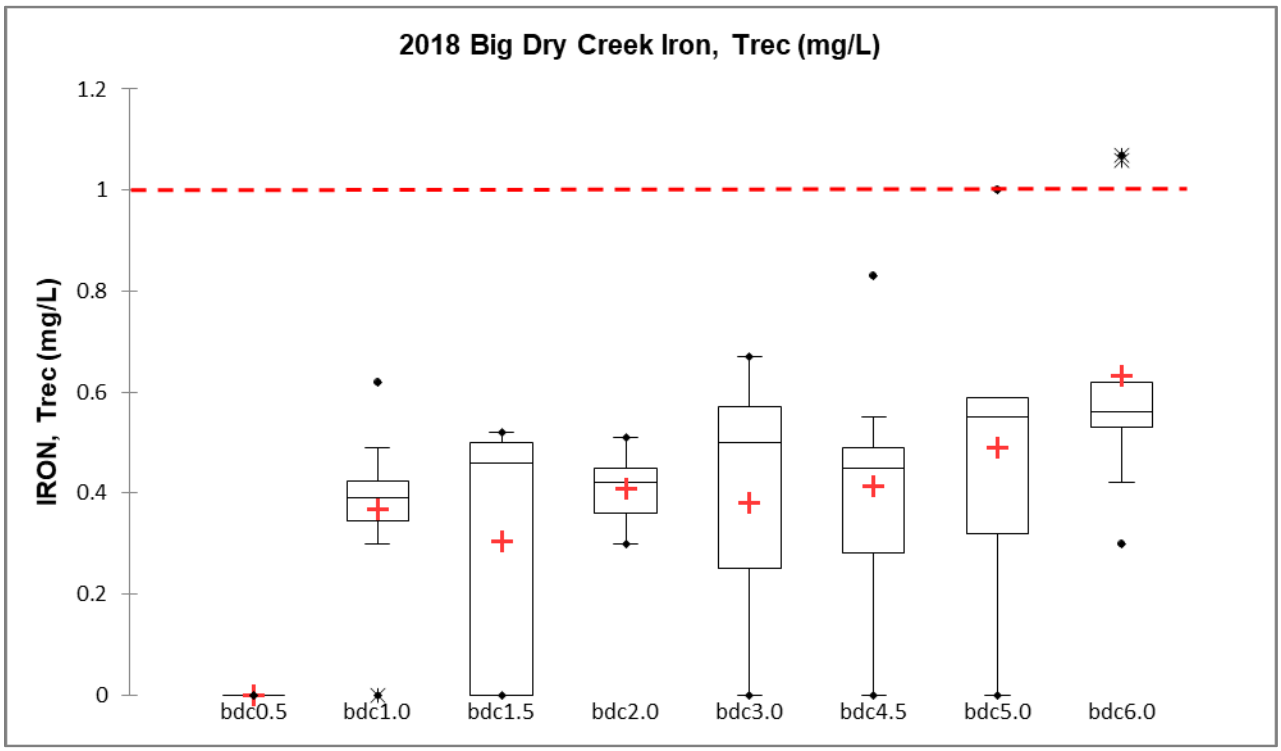


Figure 9. Metro Wastewater Monitoring Location BDC-8 for Total Iron 2012-2018

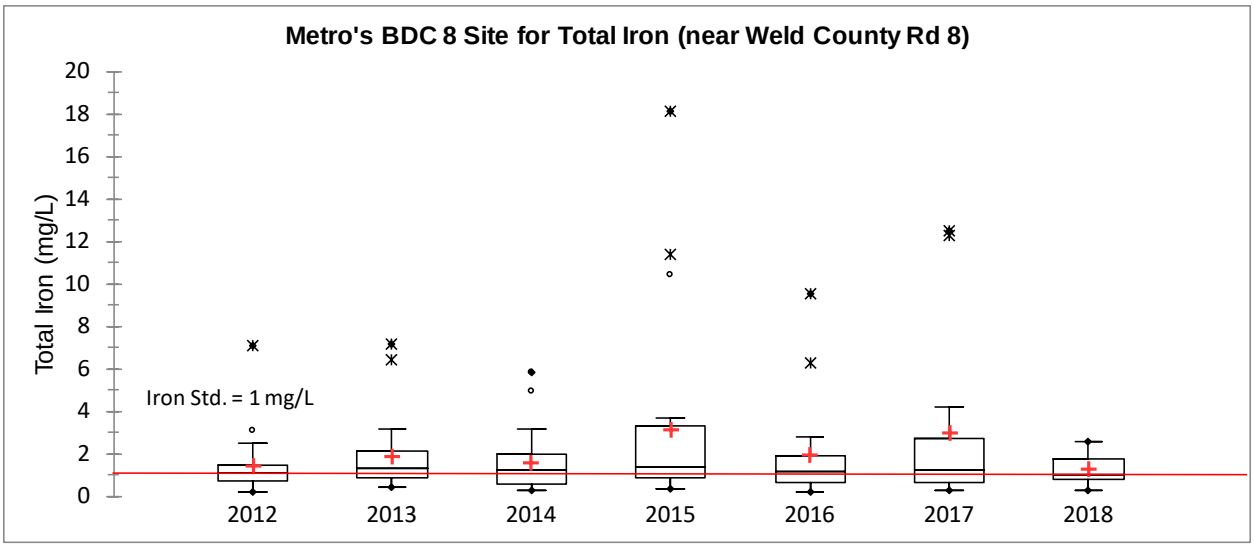
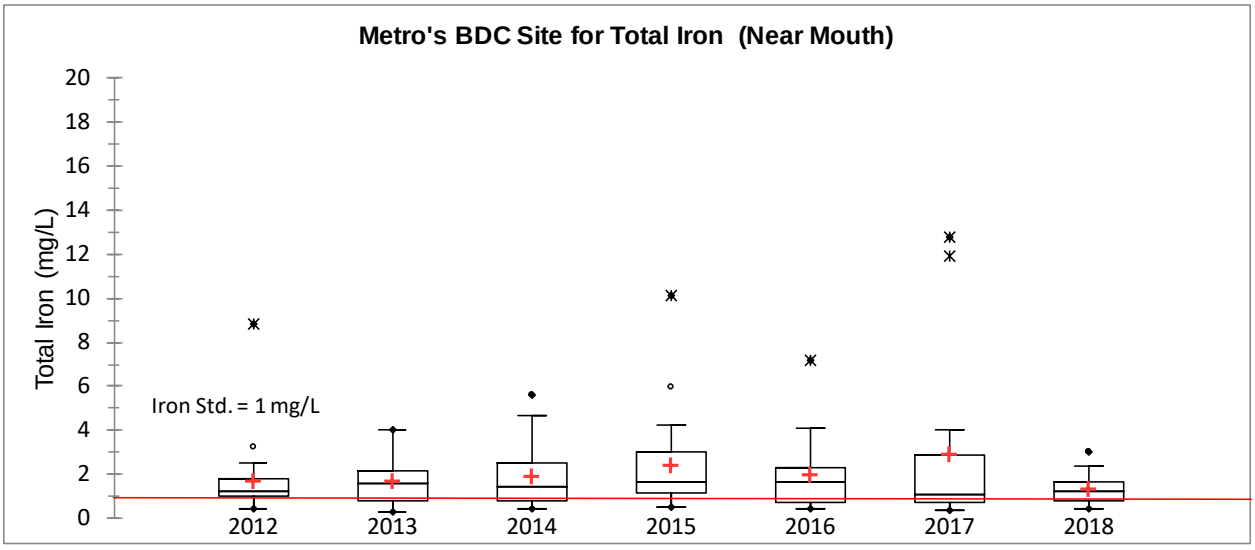


Figure 10. Metro Wastewater Monitoring Location BDC for Total Iron 2012-2018



Other Metals

As previously summarized in Table 4 and shown in Appendix C, Big Dry Creek attains instream standards for metals other than iron below Weld County Road 8. A few specific observations regarding metals based on Table 4 and Appendices B and C include:

- Mercury: In 2008, BDCWA changed its monitoring approach for mercury and is now using the EPA 1631e analysis method at one monitoring location at 120th Avenue. This analysis method has much lower detection limits, providing more meaningful data, but is also much costlier, thus limiting analysis to one location. In April 2018, the Broomfield

Wastewater Laboratory began conducting the analysis in-house. Prior to that date, Albion Environmental conducted the analysis. All thirteen samples collected at this location in 2018 were below the stream standard. Only two mercury exceedances have been documented in the 2008-2018 period of record at 120th Avenue. One exceedance occurred on June 5, 2015 and the other occurred on August 1, 2014. Albion Environmental reported that the August 1, 2014 sample had a much higher than typical amount of suspended matter and that mercury adsorbs to particulate matter, potentially causing the elevated mercury result (Communication between Albion Environmental and the City and County of Broomfield, August 31, 2014). The cause of the June 5, 2015 elevated sample result is not known.

- During the Regulation 38 triennial review in 2015, the molybdenum and chromium-3 standards were updated to be consistent with Regulation 31. BDCWA does not currently monitor for molybdenum and chromium is typically below detection limits.

- Although many stream segments in Colorado have temporary modifications in place for the total recoverable arsenic fish + water standard, Big Dry Creek has a more easily attainable chronic aquatic life standard for arsenic of 100 ug/L. Big Dry Creek routinely attains this standard.

NUTRIENTS

Currently applicable nutrient standards for the main stem of Big Dry Creek include ammonia, nitrate and nitrite. In 2012, the CWQCC adopted new interim nutrient criteria for total phosphorus and total nitrogen, which are expected to become effective for the main stem of Big Dry Creek in 2027 (CWQCC 2012, 2017). Additionally, Big Dry Creek has been assigned a Load Allocation in a downstream TMDL for Barr Lake and Milton Reservoir and has been assigned a load reduction target for total phosphorus.

A discussion of ammonia, nitrate and nitrite results, a brief background on Colorado's nutrient criteria, and a summary of nitrogen and phosphorus data for Big Dry Creek are provided below.

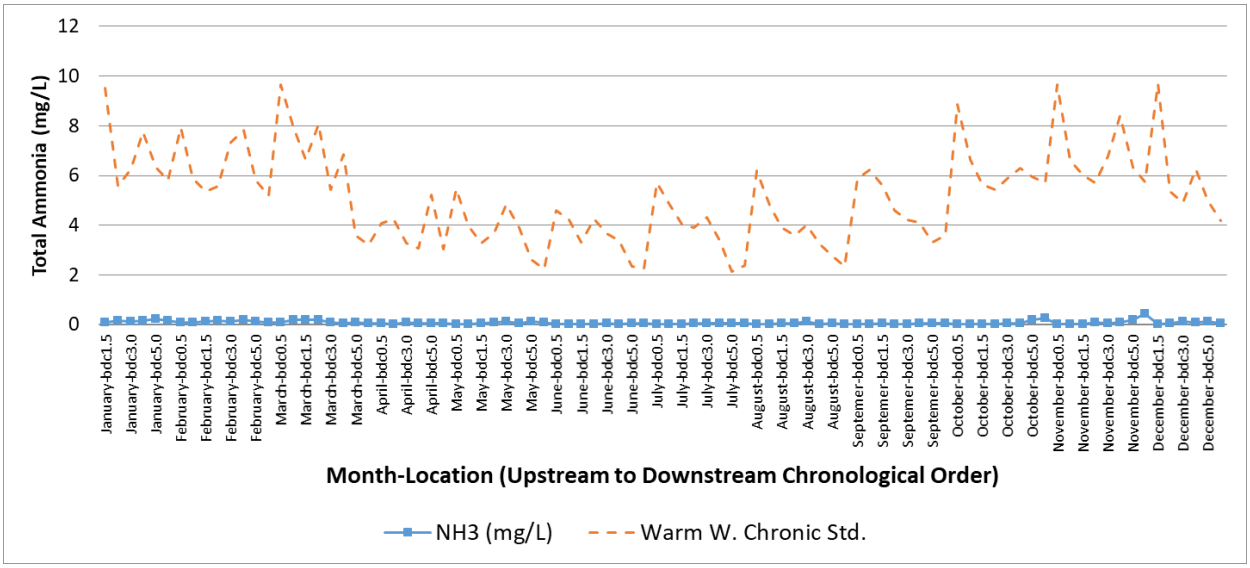
Ammonia

After a five-year transition period from an unionized ammonia standard to a total ammonia standard, a total ammonia standard became effective on Big Dry Creek on January 1, 2012. In 2013, EPA published a revision to the aquatic life criteria for ammonia. Although these criteria have not yet been adopted in Colorado, these criteria can be accessed at EPA's website: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/ammonia/index.cfm.
As part of Colorado's 10-year Water Quality Road Map, ammonia standards will be revisited in 2027.

Total ammonia concentrations for Big Dry Creek are plotted in Figure 11, along with the chronic standards, which are calculated using a formula based on pH and temperature. During 2018, the

stream attained both chronic and acute total ammonia standards. Acute standards are higher than chronic standards and are not shown in Figure 11 since all results were below chronic standards.

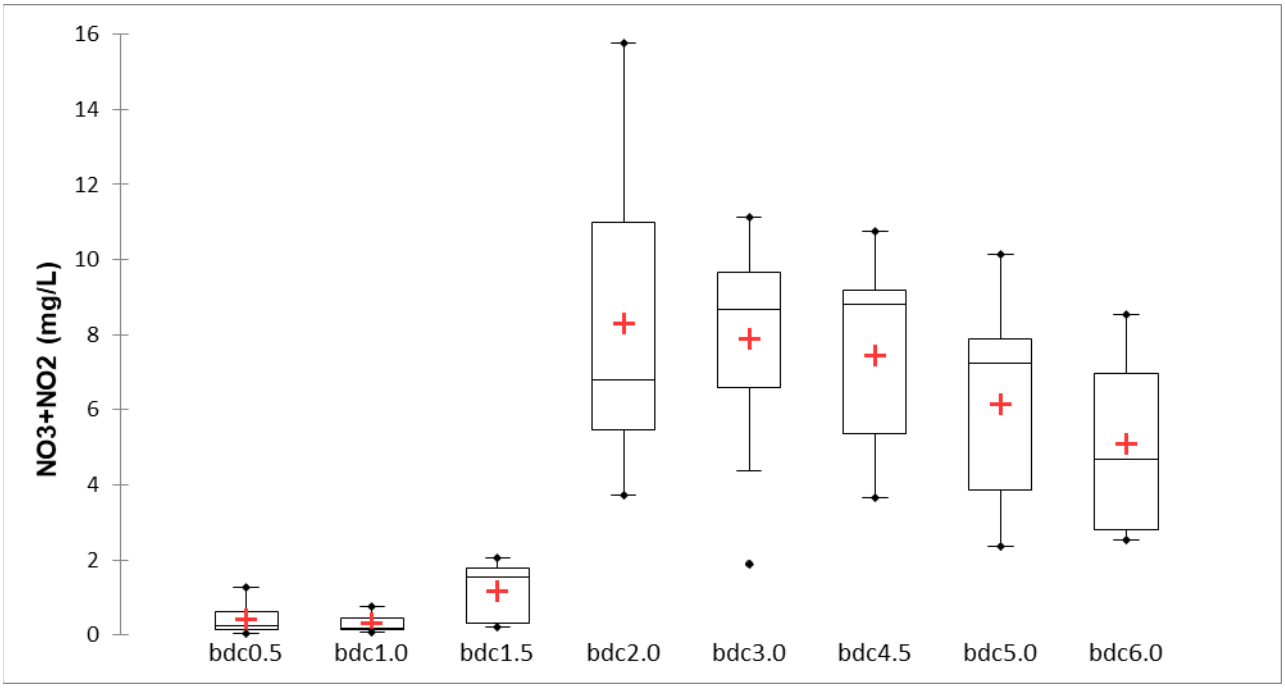
Figure 11. Comparison of Big Dry Creek 2018 Ammonia Data to Chronic Ammonia Standards



Nitrate and Nitrite

The CWQCC adopted a nitrate standard of 100 mg/L for Big Dry Creek in 2015 for the protection of agricultural uses. As shown in Figure 12, Big Dry Creek's instream nitrate/nitrite concentrations are well below 100 mg/L at all sampling locations. An increase in instream nitrate concentrations occurs below the WWTP discharges, but gradually decreases in the agricultural area, consistent with the trend for total nitrogen. Nitrite concentrations at all locations on Big Dry Creek are well below the 4.5 mg/L stream standard.

Figure 12. Big Dry Creek 2018 Nitrate/Nitrite



Colorado's 2012 Nutrient Criteria for Nitrogen and Phosphorus (as updated Dec. 2017)

Nationally, statewide, and locally, control of nutrient loading to streams is a significant regulatory topic. In June 2012, the CWQCC adopted Regulation 85 (Nutrient Management Control) and updated the nutrient portion of Regulation 31 (Colorado Basic Standards). Although many requirements under these regulations originally had a 10-year delay until May 31, 2022, some requirements became effective in 2013. For example, monitoring requirements for municipal WWTPs, a data gap evaluation process for the municipal separate storm sewer (MS4) discharge permit holders, and other requirements, became effective in 2013. Additionally, municipal wastewater dischargers to Big Dry Creek will also be affected by discharge permit limits for total phosphorus and total inorganic nitrogen (TIN) in Regulation 85. These limits are expected to be included in permits issued under the next permit cycle, along with compliance plans to allow time to implement upgrades to meet the limits. Permit renewals for WWTP discharges to Big Dry Creek are anticipated in 2019.

As a result of requirements under Regulation 85, BDCWA has developed an instream nutrient monitoring plan, which was implemented in March 2013. Additionally, MS4s in the Big Dry Creek watershed participated in a joint nutrient data gap analysis for stormwater runoff characterization in conjunction with the Colorado Stormwater Council and Urban Drainage and Flood Control District (UDFCD) (WWE et al. 2013). This "data gap analysis" was submitted to and accepted by the CWQCD in fulfillment of the Regulation 85 requirement for MS4s pertaining characterizing nutrients in urban runoff.

Under Regulation 31, interim nutrient "values" were developed that may be applicable to Big Dry Creek in the future.[4] These interim values include:

- Median annual total phosphorus (TP) concentration of 0.17 mg/L, and
- Median annual total nitrogen (TN) concentration of 2.01 mg/L.

Both interim values have a once every five years allowable exceedance frequency. Additionally, streams with recreational uses have a not-to-exceed 150 mg/m^2 chlorophyll-*a* interim value for attached algae. At the June 2015 Regulation 38 Rulemaking Hearing, it was determined that the total phosphorus and chlorophyll-a standards would not apply at this time to the mainstem of Big Dry Creek downstream of Standley Lake, because the lake is filled by ditches that withdraw water downstream of multiple permitted domestic wastewater treatment facilities. These standards may, however, apply in the future after 2027.

At the October 2017 CWQCC Rulemaking Hearing related to nutrients, the CWQCD presented its 10-year water quality roadmap for pollutants including TN, TP, cadmium, ammonia, selenium, arsenic and temperature. As a result of this hearing, phased adoption of instream TN and TP standards was extended from 2022 to 2027. As part of this decision, a new CWQCC policy, Policy 17-1 Voluntary Incentive Program for Early Nutrient Reductions, was adopted. The Roadmap and Incentives Policy were a result of extensive stakeholder meetings and dialogue through the Water Quality Forum. Among other provisions, the Incentive Program will allow a WWTP to accrue time under a post-2027 compliance schedule through trading or watershed nutrient reductions as part of its nutrient reduction plan. Such opportunities should be further explored as part of the Big Dry Creek Watershed Management Plan Update during 2019.

The Incentive Program will encourage facilities to make voluntary reductions of nutrients, and in exchange the facility will receive an extended compliance schedule as well as certainty about the year in which the facility will need to meet water quality based effluent limits. An extended compliance schedule means the facility will be given additional time to comply with effluent limits that would be based on water quality standards or variances adopted in 2027 or nutrient-related waste load allocations.

Big Dry Creek data for nitrogen and phosphorus are discussed further below. Monitoring for chlorophyll-*a* as attached algae has not been conducted for Big Dry Creek to date. Monitoring procedures are not currently well-defined for a stream like Big Dry Creek which has a sandy bottom through much of watershed.

[4] For consistency with terminology used in Regulation 31, the term interim nutrient "value" has been used, as opposed to criterion or standard. These "values" may be adopted as stream standards in the future but have not been adopted as stream standards on the main stem of Big Dry Creek.

Total Nitrogen

Total nitrogen is calculated based on total Kjeldahl nitrogen (TKN) plus nitrate/nitrite or through direct analysis of total nitrogen. TKN includes organic nitrogen and ammonia. During 2017, BDCWA changed its analysis methodology for total nitrogen from a calculation-based method to a laboratory analysis method (conductimetric persulfate determination of total nitrogen using Timberline analyzer; 4500-N C). Figure 13 provides box plots of total nitrogen from upstream to downstream during 2018, also showing the interim total nitrogen value in Regulation 31 of 2.01 mg/L. Figure 14 provides a matrix of boxplots illustrating total nitrogen trends from 2013 to 2018.

Figure 13. Big Dry Creek 2018 Total Nitrogen

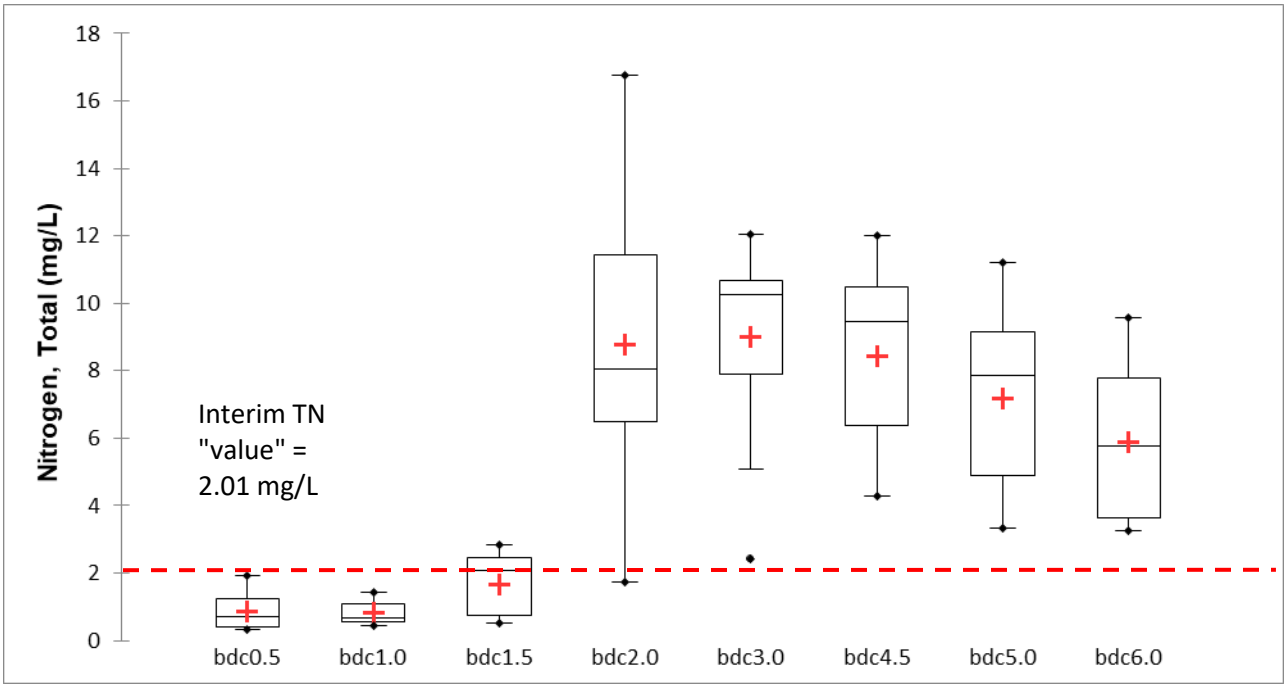
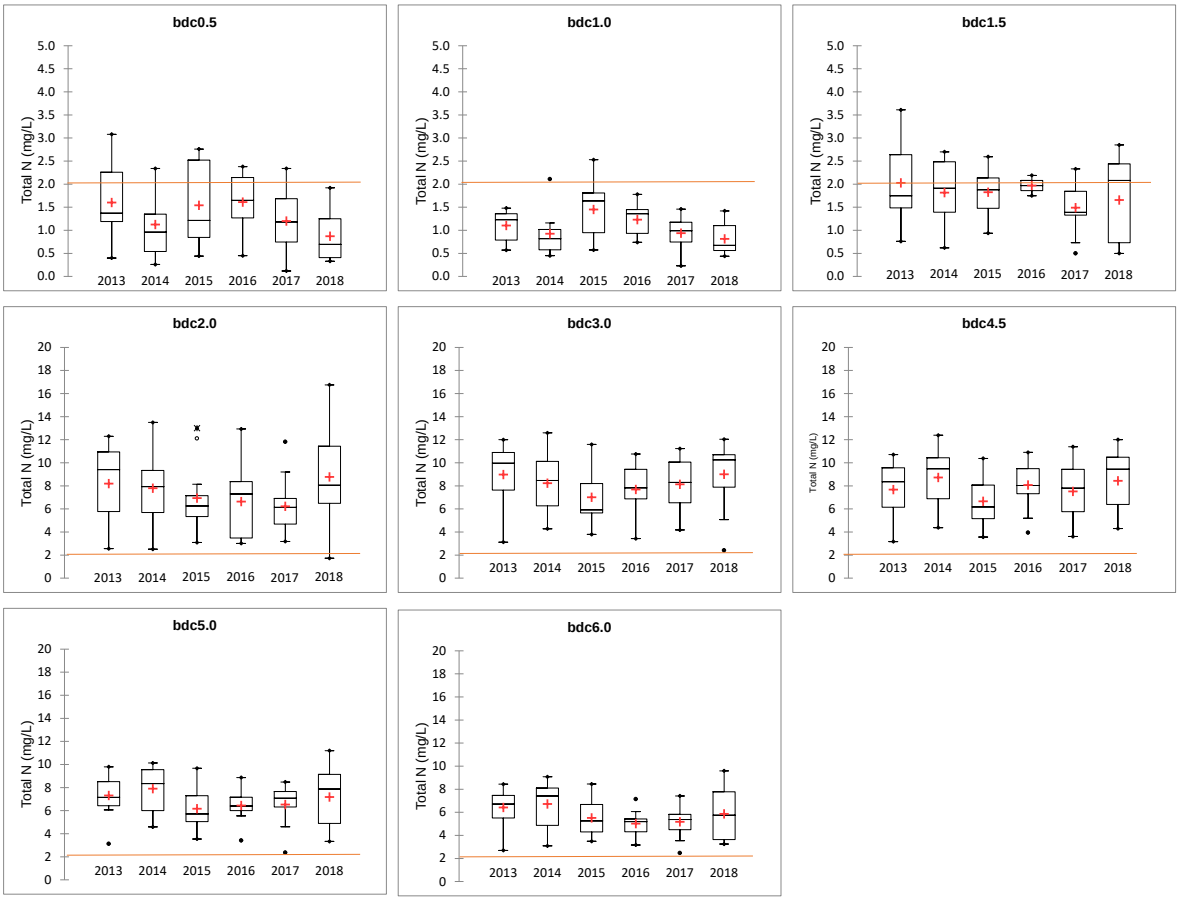


Figure 14. Total Nitrogen Trends (2013-2018)



Key observations from Figure 13 include:

- At locations upstream of the WWTP discharges to Big Dry Creek (bdc0.5, bdc1.0 and bdc1.5), the 2018 median TN values ranged from 0.68 to 1.58 mg/L. This indicates that locations upstream of the WWTPs are likely to meet the interim stream value.

- Below the Broomfield WWTP at bdc2.0, a noticeable increase in TN concentrations is observed. The 2018 median concentration at bdc2.0 was 7.62 mg/L, exceeding the interim TN value.

- Below the Westminster WWTP at bdc3.0, the 2018 median TN concentration was 10.23 mg/L, exceeding the interim TN value.

- Although a declining instream trend in TN moving downstream from bdc3.0 is suggested, instream TN is still well above the interim nitrogen value at all locations downstream from the WWTP discharges. Dilution from instream flows and natural losses associated with the nitrogen cycle result in lower TN concentrations downstream.

From Figure 14, there are not clear trends over time at individual monitoring locations from 2013 to 2018, with year-to-year variability present at each location. Upstream to downstream trends for the period of record are similar to those discussed for 2018. In summary, despite WWTP upgrades over the past decade at the Broomfield and Westminster WWTPs, the interim total nitrogen value would not be attained under current conditions in Big Dry Creek from below the Broomfield WWTP discharge to the South Platte River. Additionally, bdc1.5 upstream of the Broomfield WWTP had a median concentration of 2.08 mg/L in 2018, slightly exceeding the interim value of 2.01.

Phosphorus

Phosphorus is of interest to BDCWA in two contexts: 1) Colorado's new interim total phosphorus values, and 2) the downstream Barr-Milton TMDL, as discussed below.

Phosphorus in Relation to Colorado's Interim Total Phosphorus Values

Total phosphorus concentrations in Big Dry Creek are of interest with regard to the interim warm water total phosphorus value (0.17 mg/L) adopted by the CWQCC in June 2012. Based on conditions described in nutrient-related criteria in Regulation 31, these interim values are not expected to be adopted as stream standards for the main stem of Big Dry Creek prior to 2027. Nonetheless, it is important to develop an understanding of nutrient conditions in Big Dry Creek with regard to these interim values. Table 9 and Figure 15 show that Big Dry Creek would have difficulty meeting this interim value from below the Broomfield WWTP to the South Platte River, with the median phosphorus concentration during 2018 ranging from 0.16 to 0.46 mg/L at locations in this reach. Figures 16a-d provide boxplots of annual total phosphorus concentrations over time at selected monitoring locations upstream of the Broomfield WWTP (bdc1.5), below Broomfield's discharge (bdc2.0), below Westminster's discharge (bdc3.0), and in the agricultural area (bdc6.0). These figures show that locations upstream of the Broomfield WWTP can meet the interim total phosphorus value. Significant reductions in total phosphorus are evident beginning in 2010 below Broomfield's discharge. Significant reductions in total phosphorus below Westminster's discharge are evident beginning in 2009. Despite overall phosphorus reductions at both WWTPs, median annual total phosphorus concentrations are still above the interim total phosphorus value from below the Broomfield WWTP to the confluence with the South Platte River.

Figure 15. Big Dry Creek 2018 Total Phosphorus

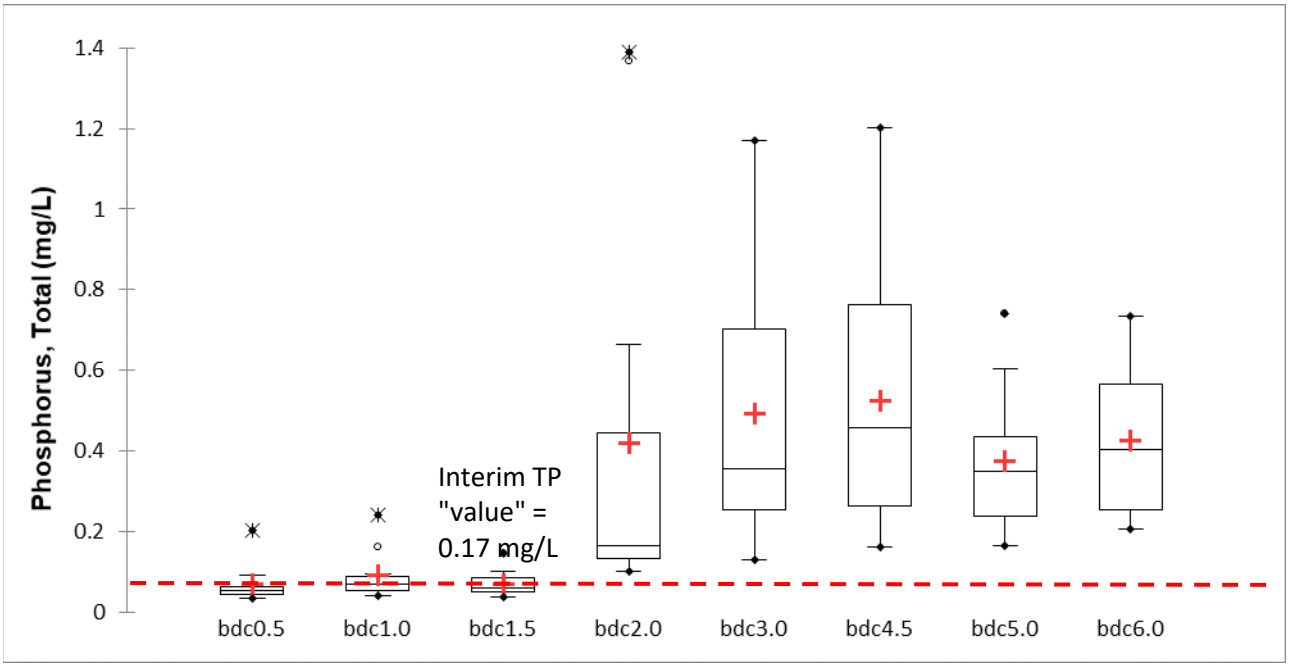
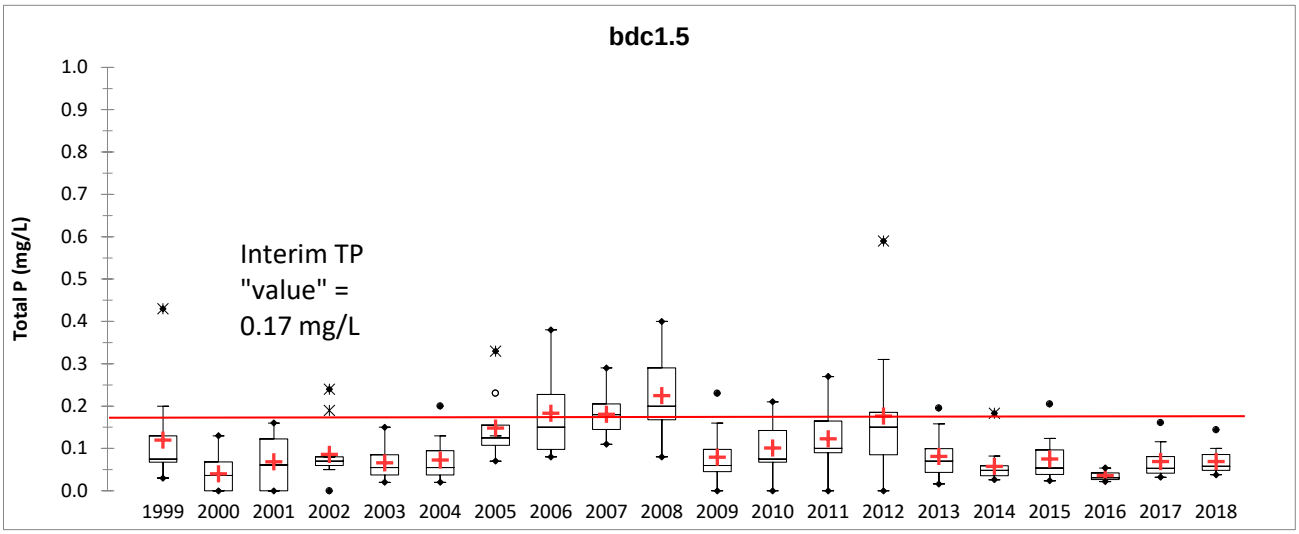


Table 9. Median Annual Total Phosphorus (mg/L) 1999-2018

Year	bdc0.5	bdc1.0	bdc1.5	bdc2.0	bdc3.0	bdc4.0/4.5	bdc5.0	bdc6.0
1999	0.04	0.07	0.08	0.72	1.81	1.27	1.45	1.21
2000	0.00	0.07	0.04	0.43	1.85	1.60	1.45	1.25
2001	0.00	0.06	0.06	0.47	1.90	1.10	1.20	0.93
2002	0.00	0.06	0.07	1.20	2.25	1.50	1.80	1.60
2003	0.04	0.04	0.05	0.75	2.25	1.55	1.40	1.15
2004	0.04	0.05	0.05	0.23	1.75	1.15	1.10	0.94
2005	0.09	0.12	0.12	1.32	2.54	1.68	1.68	1.40
2006	0.12	0.13	0.15	0.48	2.04	1.38	1.30	1.13
2007	0.12	0.16	0.18	0.85	2.21	1.24	1.29	1.23
2008	0.14	0.23	0.20	0.90	1.73	1.18	1.10	1.22
2009	0.03	0.07	0.06	0.84	0.76	0.57	0.77	0.60
2010	0.06	0.09	0.08	0.13	0.34	0.31	0.33	0.44
2011	0.07	0.10	0.10	0.17	0.55	0.49	0.32	0.49
2012	0.11	0.13	0.15	0.27	0.96	0.85	0.68	0.62
2013	0.04	0.07	0.07	0.27	0.78	0.64	0.52	0.48
2014	0.04	0.04	0.05	0.48	0.52	0.63	0.58	0.53
2015	0.04	0.09	0.05	0.20	0.66	0.50	0.45	0.55
2016	0.04	0.06	0.03	0.21	0.72	0.68	0.56	0.43
2017	0.08	0.06	0.05	0.30	0.99	0.78	0.64	0.55
2018	0.05	0.07	0.06	0.16	0.36	0.46	0.35	0.40

Figure 16 (a-d). Total Phosphorus over Time at Selected Big Dry Creek Monitoring Locations



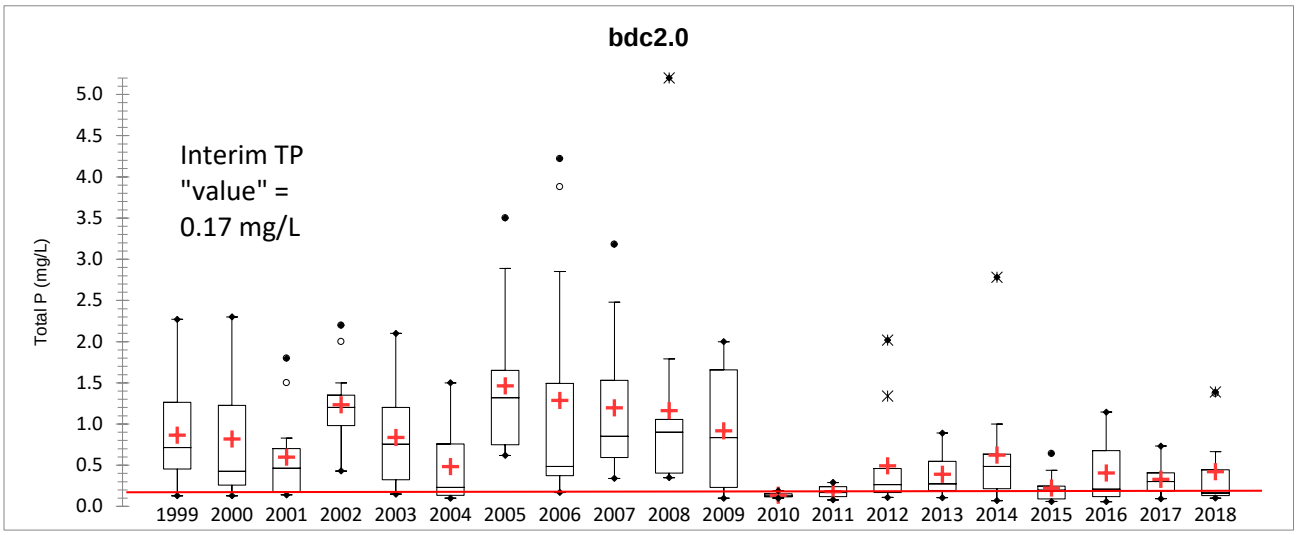
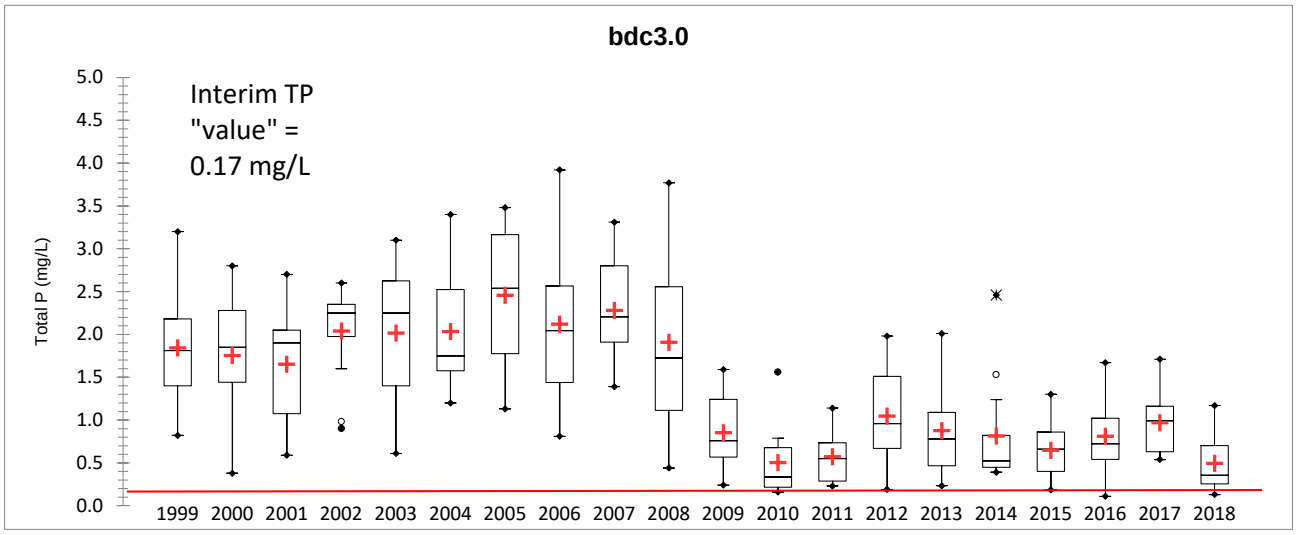
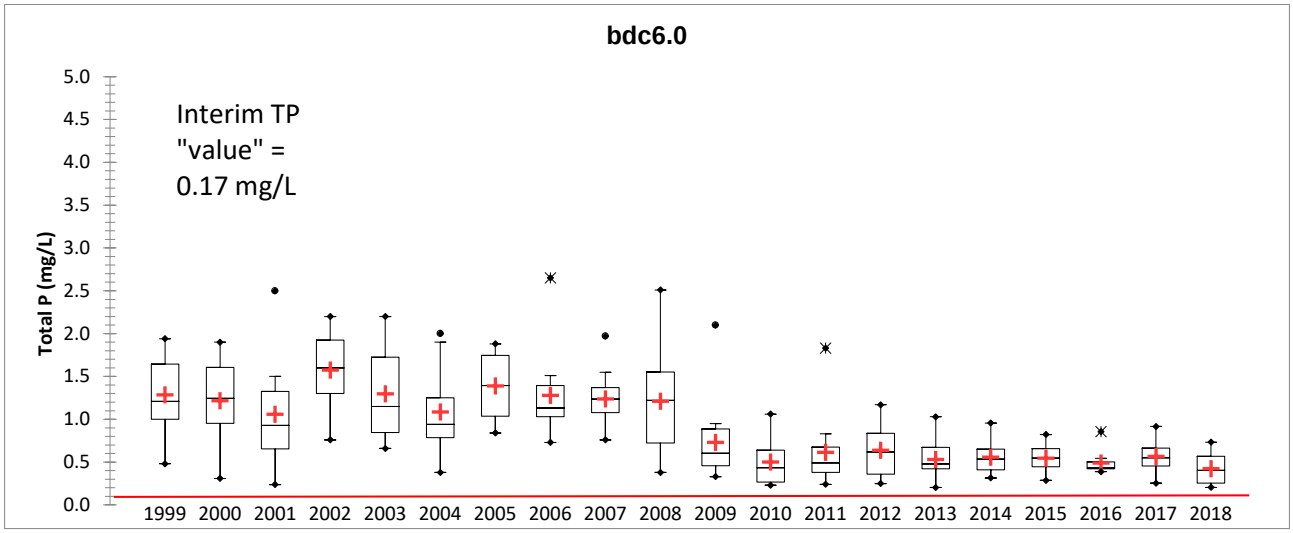


Figure 15 (a-d) (cont). Total Phosphorus over Time at Selected Big Dry Creek Monitoring Locations





Phosphorus in Relation to Barr-Milton TMDL

The Barr-Milton Watershed Association (BMW) is addressing pH exceedances and low dissolved oxygen in the Barr-Milton reservoir system. These pH exceedances and low dissolved oxygen are attributed to excessive algal growth caused by nutrient loading, specifically phosphorus. BMW has established a database for modeling conditions in the reservoirs and has included water quality data from Big Dry Creek, as well as many other tributaries upstream of the Barr-Milton system. BDCWA representatives have participated in various aspects of the BMW effort over the years. In August 2009, AECOM released the final report titled "Watershed and Lake Modeling for a TMDL Evaluation of Barr Lake and Milton Reservoir," which forms the underlying basis for the TMDL.[5] In July 2013, EPA approved the Barr-Milton TMDL for pH and DO, which is focused on controlling phosphorus loads to the reservoirs. In the final TMDL, Big Dry Creek was identified as contributing approximately 5.9 percent of the phosphorus loading to Milton Reservoir. Big Dry Creek has been targeted for a 20 percent total phosphorus load reduction from 2,301 kg/yr down to 1,840 kg/yr (Integral 2011).[6] Because Big Dry Creek is identified as a nonpoint source of loading, "application of BMPs to the greatest extent feasible" is the recommended approach for achieving these reductions.

Table 10 and summarize changes in total phosphorus concentrations at bdc6.0 over time, indicating total phosphorus concentration reductions on the order of 67 percent since 2003 and 61 percent since 2004. Figures 17 and 18 show reductions in the annual average total phosphorus concentrations over time in the Broomfield and Westminster WWTP discharges, respectively. Additionally, phosphorus concentrations in the Westminster WWTP had been rebounding over the past few years, but decreased in 2018. Total phosphorus load reductions for the overall watershed (based on bdc6.0) over time are also shown in Figure 17. Although phosphorus concentrations remained relatively constant from 2013 to 2018, phosphorus loads varied due to fluctuating flow volumes.

[5] As of 2019, this model is being updated. BDCWA has provided data to the BMW Association to support the model update. BMW has been working on updating the WASP and SWAT models for the past year. The model outputs are being compared to empirical (real) data from 2011 through 2017. With the floods of 2013 and recent phosphorus treatment at Metro Wastewater, phosphorus concentrations in both Barr and Milton Reservoirs are at about half of the 2003-04 concentrations. BMW is also working on calculating recent annual loads from various different sources. (Personal Communication with Steve Lundt, April 5, 2019)

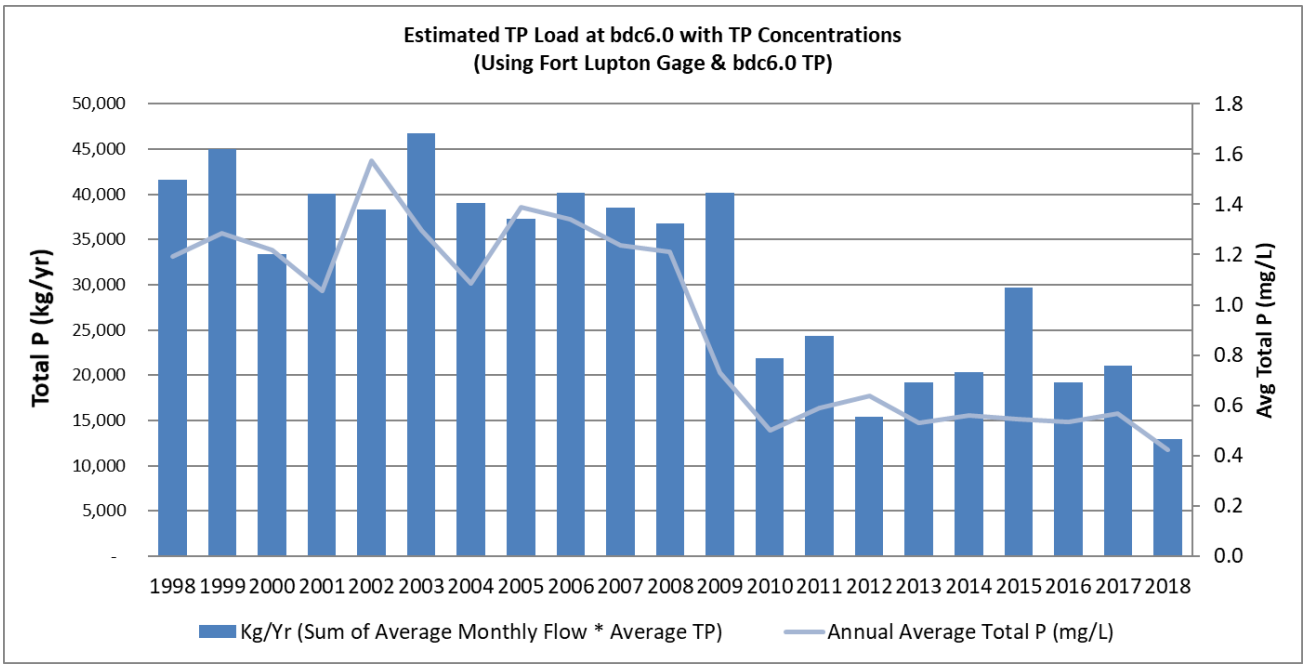
[6] This load reduction applies to the portion of the Big Dry Creek load that enters Milton Reservoir, which is a significantly smaller load than occurs at bdc6.0.

Table 10. Total Phosphorus Concentrations at bdc6.0 (2003-2018)

Year	No. of Samples	Median	Mean	Min.	Max.	25th Percentile	75th Percentile
2003	12	1.15	1.30	0.66	2.20	0.85	1.73
2004	12	0.94	1.08	0.38	2.00	0.78	1.25
2005	12	1.40	1.39	0.84	1.88	1.04	1.75
2006	11	1.13	1.28	0.73	2.65	1.03	1.39
2007	12	1.23	1.24	0.76	1.97	1.08	1.37
2008	12	1.22	1.21	0.38	2.51	0.72	1.55
2009	12	0.60	0.73	0.33	2.10	0.46	0.89
2010	12	0.44	0.50	0.23	1.06	0.27	0.64
2011	11	0.49	0.62	0.24	1.83	0.38	0.68
2012	12	0.62	0.64	0.25	1.17	0.36	0.84
2013	12	0.48	0.53	0.20	1.03	0.42	0.67
2014	12	0.53	0.56	0.32	0.96	0.41	0.65
2015	12	0.55	0.55	0.29	0.82	0.45	0.66
2016	10	0.43	0.49	0.39	0.86	0.42	0.50
2017	12	0.55	0.57	0.25	0.92	0.45	0.66
2018	12	0.40	0.42	0.21	0.73	0.25	0.57
% Reduction in P (mg/L) (2003 - 2018)		**65%**	**67%**				
% Reduction in P (mg/L) (2004 - 2018)		57%	61%				

Note: For 2016 data, May and December total phosphorus results were not available for use in these calculations.

Figure 17. Decreases in Total P Loads at bdc6.0 Plotted with TP Concentration Data



Note: 2013 load estimate uncertain due to missing flow data following September Flood. The 2016 load estimate is uncertain due to missing phosphorus results for May and December 2016. Estimated phosphorus concentrations were substituted for those months for purposes of an annual load estimate.

Figure 18. Decreases in Total P Concentrations in Broomfield WWTP Discharge (2002-2018)

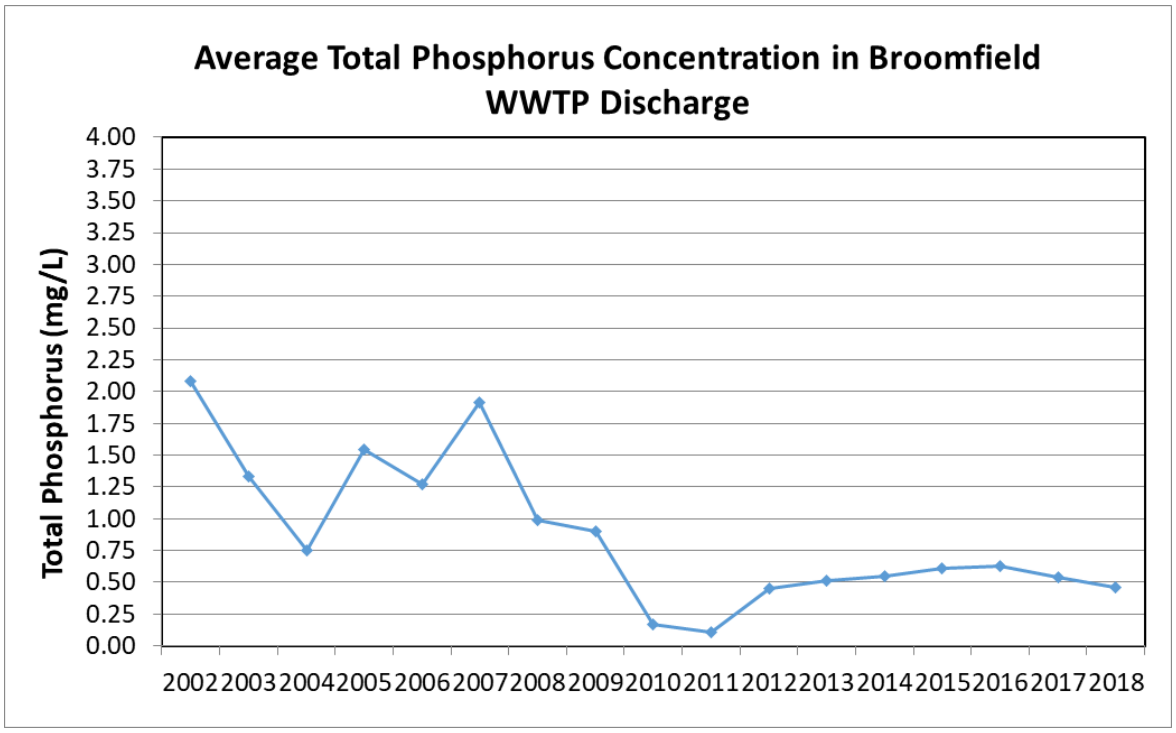
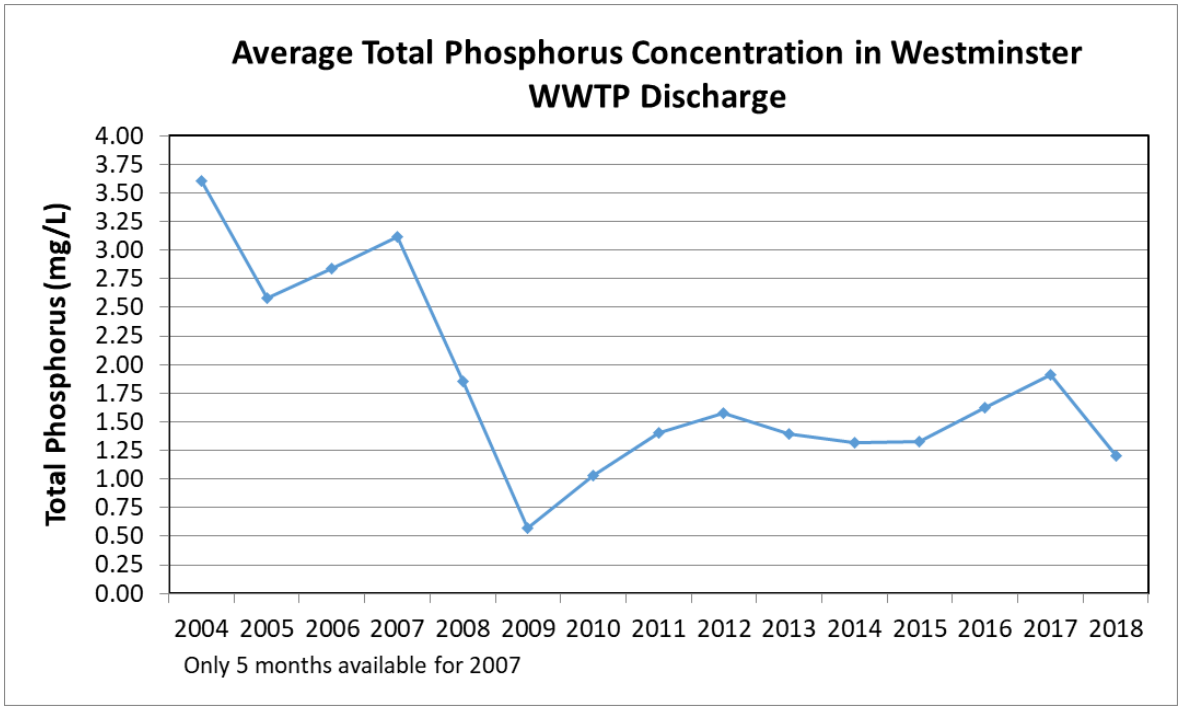


Figure 19. Decreases in Total P Concentrations in Westminster WWTP Discharge (2004-2018)



As a result of the Barr-Milton TMDL process, BDCWA reviewed phosphorus data collected along Big Dry Creek, with primary focus on monitoring station bdc6.0, which is the downstream-most instream monitoring location on Big Dry Creek in the agricultural portion of Weld County. Although instantaneous flow measurements are conducted by BDCWA on a monthly basis, the USGS Fort Lupton gauging station is combined with the bdc6.0 water quality data to estimate loads because the USGS gauge provides a more comprehensive data set. Several key observations include:

- As shown in Figure 16d and Table 10, total instream phosphorus concentrations have decreased significantly over time, with the average 2018 concentration at bdc6.0 (0.42 mg/L) being approximately 67 percent lower than the 2003 average concentration (1.30 mg/L) and approximately 61 percent lower than the 2004 average concentration (1.08 mg/L). For purposes of the Barr-Milton modeling, 2003-2004 was used as a baseline.

- Phosphorus loading has also decreased substantially, as shown in Figure 17. Pollutant loads are calculated based on pollutant concentration multiplied by flow volume.

- Both Broomfield and Westminster WWTP discharges show substantial reductions in total phosphorus concentrations since 2004 (Figure 18 and Figure 19, respectively). Both WWTPs have implemented major upgrades in recent years and have been in the process of optimizing plant operations following these upgrades. In 2018, average total phosphorus concentrations were 0.46 mg/L for Broomfield and 1.20 mg/L for Westminster.

- In addition to phosphorus concentration reductions at the Broomfield and Westminster WWTPs, both cities have implemented significant reclaimed water programs, which help to manage nutrient loading to Big Dry Creek. Factors such as population growth and demand for reclaimed water affect volumes discharged. The current and future effects of reclaimed water programs have not been fully evaluated for purposes of this report but are important considerations should more in-depth analysis be conducted related to Big Dry Creek phosphorus loading to the South Platte River.

- Historically, Northglenn has discharged infrequently to Big Dry Creek, however, during 2015 through 2018, Northglenn discharged to Big Dry Creek much more frequently. In 2017, Northglenn discharged to Big Dry Creek on most days, beginning in mid-March and continuing through the year. These discharges represent a new source of phosphorus loads to Big Dry Creek relative to the 2003-2004 baseline conditions used in the Barr Milton TMDL.

- As illustrated in Figure 31 (later in this report), the hydrology of Big Dry Creek is highly managed and complex. Future evaluation of measures to reduce phosphorus loading from Big Dry Creek must consider these complexities. Other hydrology-related considerations include:

- It is important to be aware that bdc6.0 is located upstream from the USGS gauge. Instantaneous flow measurements at bdc6.0 and the average daily flow measurements at the USGS Fort Lupton gauge vary substantially. On average, flows at the USGS gauge are approximately 20 percent higher than measured flows at bdc6.0; however, there is large variation in the magnitude of the difference between individual pairs of flow measurements.

- It is important that the water quality sample location used for modeling Big Dry Creek phosphorus contributions to the South Platte River be located upstream of the Lupton Bottoms discharge to Big Dry Creek. Sampling location bdc6.0 is upstream of Lupton Bottoms, but Metro Wastewater Reclamation District also collects water quality samples below Lupton Bottoms ditch, which may be influenced by South Platte water discharged from the Lupton Bottoms ditch to Big Dry Creek.

TEMPERATURE

The currently applicable classification for temperature standards on Big Dry Creek is Warm Stream Tier I (WS-I), due to the presence of the Johnny darter in some locations in the upper portion of the stream. Attainment of standards is assessed based on comparison of the maximum weekly average temperature (MWAT) and daily maximum (DM) temperature to seasonal temperature standards established for March-November and December-February. Values above these standards are allowed under these conditions:

- The DM may exceed the acute temperature standard once every three years. The DM means the highest two-hour average water temperature recorded during a given 24-hour period.

- The MWAT may exceed the chronic standard once every three years (1E3). The MWAT is calculated as the largest mathematical mean of multiple, equally spaced, daily temperatures over a seven-day consecutive period, with a minimum of three data points spaced equally through the day.

- Values measured during conditions meeting air temperature, low-flow, winter "shoulder season" or "warming event" excursion criteria in Regulation 31 and the 2018 303(d) Listing Methodology are not considered exceedances.

The WQCD determines whether temperature limits are to be included in permits in accordance with the Basic Standards 31.14(14) "Integration into Discharge Permits." Currently, the municipal WWTP dischargers to Big Dry Creek are required to "report only" under terms of the current permits, but temperature limits are anticipated in the 2019 permit renewals. Additional instream monitoring data have been collected at several instream locations in support of this effort using HOBO data loggers recording temperature measurements at 15-minute intervals. These data sets have not been fully evaluated for purposes of this report; however, the cities report that

attainment of the standard will be challenging during certain time periods (Personal Communication with Lesa Julian, City and County of Broomfield, March 2012).

For a more robust evaluation of temperatures on Big Dry Creek in the vicinities of the WWTP discharges, 15-minute incremental temperature data collected as part of CDPS DMRs for each WWTP should be obtained and reviewed but is beyond the scope of this report.

MACROINVERTEBRATE DATA AND MMI ANALYSIS

BDCWA conducts a biennial macroinvertebrate monitoring program during the month of October in even years. This section provides a summary of multi-metric index (MMI) results for macroinvertebrate data collected in the fall of 2008, 2010, 2012, 2014 and 2016 for the aquatic monitoring program on Big Dry Creek. Although aquatic life monitoring was conducted in 2018, summary data were not yet available for inclusion in this report. Analysis in this section was provided by Aquatics Associates, Inc., with more detailed information for fish, macroinvertebrates, and habitat available in biennial reports completed by Aquatics Associates (2014), along with a forthcoming report addressing sampling conducted during 2016.

Background on Aquatic Life Use Attainment Policy 10-1

The CWQCC adopted Policy 10-1 on October 12, 2010 (CWQCC 2010), which provides for the evaluation of the biotic integrity of streams through use of a multi-metric index (MMI) calibrated for the State of Colorado (Jessup 2010). Policy 10-1 was updated on August 7, 2017 (CWQCC 2017) and included a recalibration of the MMI (Jessup and Stribling 2017). This recalibration resulted in a different algorithm used in the CWQCD's Ecological Data Application System (EDAS) to calculate the MMI, as well as different attainment and impairment thresholds for determining attainment and impairment. For continuity with scores calculated for BDCWA's long-term data set, the new 2017 methodology has **not** been applied to the 2016 data set for purposes of this report. Initial data shared by Aquatics Associates at the December 2017 BDCWA meeting suggests that the new EDAS Version 4.0 could potentially identify bdc5.0 as impaired under the new methodology. This should be further explored after the 2018 biological sampling event on Big Dry Creek.

EDAS (Version 3.3H.2k CO) was used to calculate MMI and other metrics for the Big Dry Creek analysis summarized below. Application of this method requires the collection and analysis of benthic macroinvertebrate samples according to Policy 10-1 protocols (CWQCC 2010). Use-attainment thresholds have been established for three separate stream biotypes which include Transition (Biotype 1), Mountain (Biotype 2), and Plains & Xeric (Biotype 3). The Big Dry Creek study sites are all designated as Biotype 3 per EDAS. The thresholds for Biotype 3 streams are

MMI >37 for use attainment and MMI <22 for impairment.[7] Class 1 streams (Cold or Warm) with MMI scores falling in between the attainment and impairment thresholds require additional analysis using two auxiliary metrics, the Hilsenhoff Biotic Index and the Shannon Diversity Index. However, this additional analysis does not apply to Class 2 streams, which is the classification for Big Dry Creek Segment 1. Also, MMI scores >44 for Biotype 3 streams indicate a high scoring water (HSW) and any drop in HSW scores of 22 points or more for samples collected 12 or more months apart within a 5-year span of time may indicate impairment. Failure to meet use attainment thresholds for streams in their particular biotype may result in the affected segment(s) being listed as provisionally impaired for aquatic life on the 303(d) List. For differing MMI scores on the same representative segment taken in different calendar years, the most recent MMI score is used in the impairment listing decision. The representative nature of all aquatic life data is to be considered before listing decisions are made. Clear and convincing evidence is required to show impairment (CWQCC 2018).

Big Dry Creek MMI Results

Results of the MMI analyses for the macroinvertebrate samples collected at the six BDC sites in the fall of 2008, 2010, 2012, 2014 and 2016 are presented in Table 11 and Figure 20. All samples for the five years met or were better than the impairment threshold (MMI score of 22), and over the five sampling years, no consistent upward or downward trends were noted. All 2016 MMI values met use attainment (MMIs > 37 threshold for Class 2 streams) except for bdc5.0. All sites except bdc5.0 were also High Scoring Waters (MMI >44 for Biotype 3). The highest 5-year mean MMI score for any individual site was 59.9 (range 49.9-64.7) at site bdc0.5, with the lowest mean score at site bdc2.0 (42.9, range 29.6-56.4).

Over the five sampling years, 22 of the 30 total samples collected were classified as HSW with MMIs >44. Upstream sites bdc0.5 and bdc1.0 were HSW in all five years, with sites bdc1.5c and bdc3.0 attaining HSW scores in four of the five sampling years. Site bdc5.0 attained HSW scores in two of the five years. In 2014, site bdc2.0 was identified as an HSW for the first time, which continued into 2016. Over the 2008-2016 timeframe, no 22-point decline in MMIs for HSW occurred relative to 2008, although site bdc3.0 was close, with a 21.4-point drop between years 2008 and 2010, as was bdc5.0, with a 21-point drop between 2008 and 2016.

During 2016, the MMI at bdc5.0 was the lowest on record; however, field observations did not identify unusual conditions that would be contributing to these scores. Preliminary review of the raw data suggested that the score may be due in part to relatively high numbers of aquatic worms; however, more detailed data evaluation will be conducted to further assess conditions

[7] In the 2017 update to Policy 10-1, the MMI attainment threshold is 42 and the impairment threshold is 29; however, scores calculated using the previous version of EDAS cannot be directly compared to the new thresholds due to changes in the calculation algorithm in the new version of EDAS.

at this site (Personal Communication with Tami Schneck, 2017). As previously noted, this site may be considered impaired utilizing EDAS V. 4.0.

Based on the MMI results for the six sampling sites for the five most recent years analyzed, the aquatic macroinvertebrate community in Big Dry Creek is generally healthy and meets MMI use-attainment criteria for aquatic life in Class 2 warm water streams. Additionally, the long-term data set demonstrates the significant year-to-year variability that can occur at individual sites.

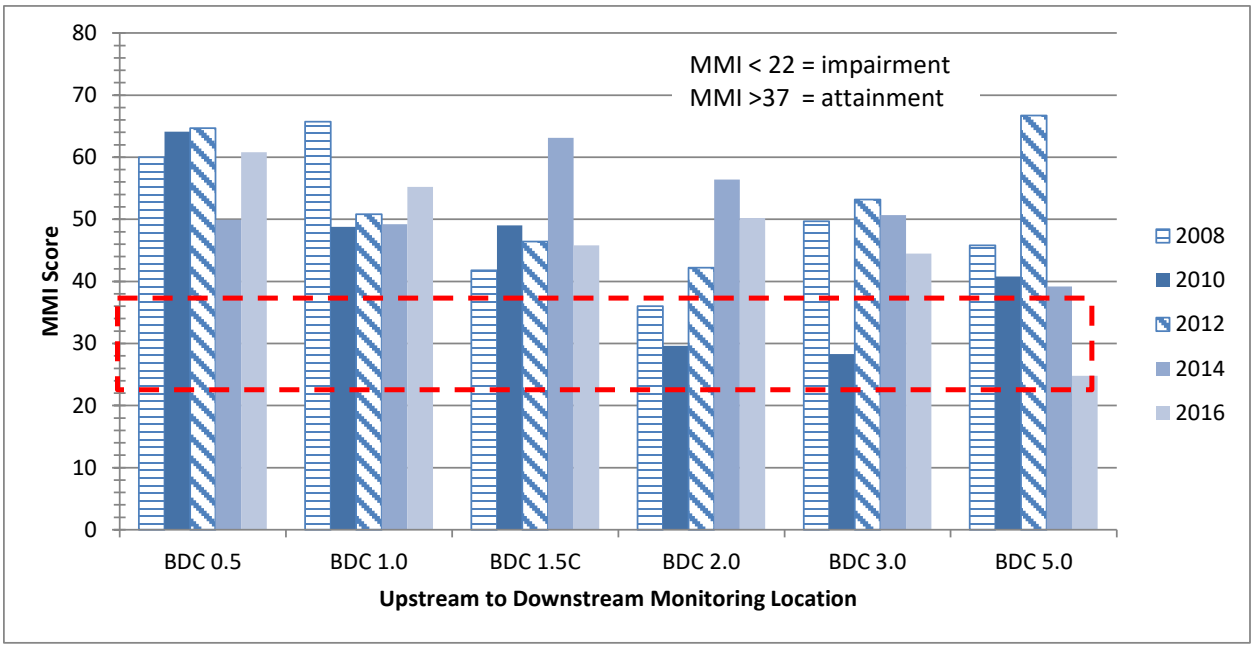
More detailed analysis of the 2016 monitoring is provided by Aquatics Associates and was presented to BDCWA at a public meeting in December 2017. The BDCWA data set was also shared with the CWQCD in a submittal on February 22, 2017.

Table 11. Fall MMI Scores for Big Dry Creek Sites (2008-2016)
(Source: Aquatics Associates 2015, with updates from Tami Schneck 2017)

Site	Location	Bio-type	MMI Score 2008	MMI Score 2010	MMI Score 2012	MMI Score 2014	MMI Score 2016	5-Year Mean
BDC 0.5	d/s from Old Wadsworth Ave., at Church Ranch Open Space	3	**60.0**	**64.1**	**64.7**	**49.9**	**60.8**	**59.9**
BDC 1.0	u/s from 112th Ave.	3	**65.7**	**48.8**	**50.8**	**49.2**	**55.2**	**53.9**
BDC 1.5C	d/s from 120th Ave., u/s Broomfield WWTP	3	41.8	**49.0**	**46.4**	**63.1**	**45.8**	**49.2**
BDC 2.0	u/s from 128th Ave., d/s from Broomfield WWTP	3	36.0	29.6	42.2	**56.4**	**50.2**	42.9
BDC 3.0	at I-25, d/s from Westminster WWTP	3	**49.7**	28.3	**53.2**	**50.7**	**44.5**	**45.3**
BDC 5.0	d/s from Weld County Rd. 4	3	**45.8**	40.8	**66.7**	39.2	24.8	43.5

Notes: Bold indicates High Scoring Water (MMI >44 for Biotype 3). MMI Impairment threshold for Class 2 streams is <22. Revisions to Policy 10-1 adopted in 2017 have not been applied to the analysis in this table or in Figure 23. Analysis by Tami Schneck of Aquatics Associates, Inc.

Figure 20. Biennial Big Dry Creek MMI Scores (2008-2016)



FLOW CONDITIONS

The hydrology of Big Dry Creek is discussed below in terms of: 1) annual streamflows relative to period of record, 2) WWTP discharges, and 3) seasonal variation related to release and diversion patterns.

Stream Flows

Stream gauges are managed by several entities in the watershed. A discussion of USGS gauges and a Colorado Division of Water Resources gauge are discussed further below.

USGS Stream Flow Measurements for 2018

USGS mean daily discharge data for the Westminster and Fort Lupton gauges are shown in Figures 21 and 22. Figures 23 and 24 identify peak stream flows for the period of record at both gauges. Figures 25 and 26 show a comparison of monthly flows at both gauges for selected years and periods of interest. Figure 27 shows the average annual streamflows at both gauges.

During 2018, average daily flows at the Westminster gauge ranged from 0.3 cubic feet per second (cfs) to 162 cfs with an average of 10.8 cfs. Average daily flows for the Fort Lupton gauge data ranged from 0.5 cfs to 231 cfs with an average of 33.4 cfs. Peak flows at both gauges were within historic ranges (Figures 23 and 24).

Figure 21. Mean Daily Discharge at USGS Gauge Big Dry Creek at Westminster, CO

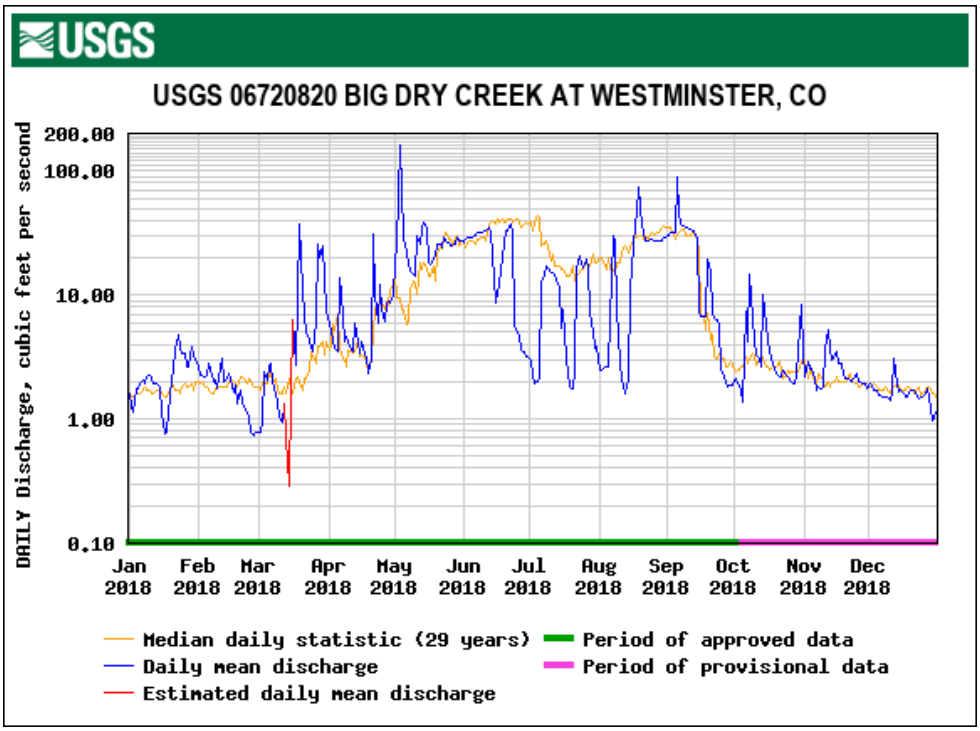


Figure 22. Mean Daily Discharge at USGS Gauge Big Dry Creek at Fort Lupton, CO

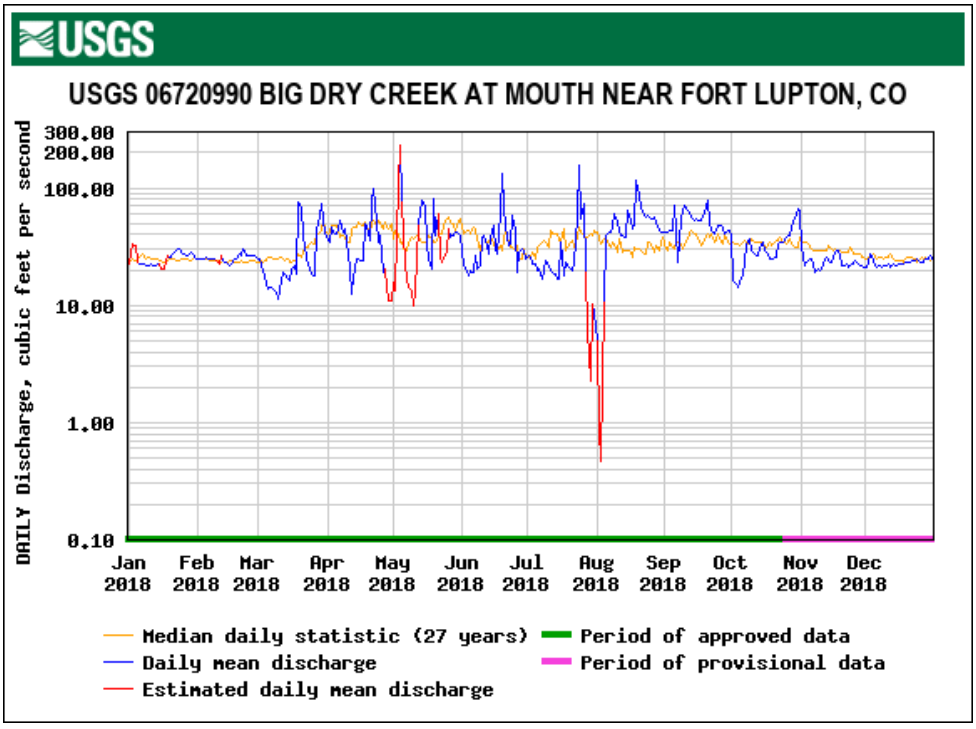


Figure 23. Annual Peak Streamflow at USGS Gauge Big Dry Creek at Westminster

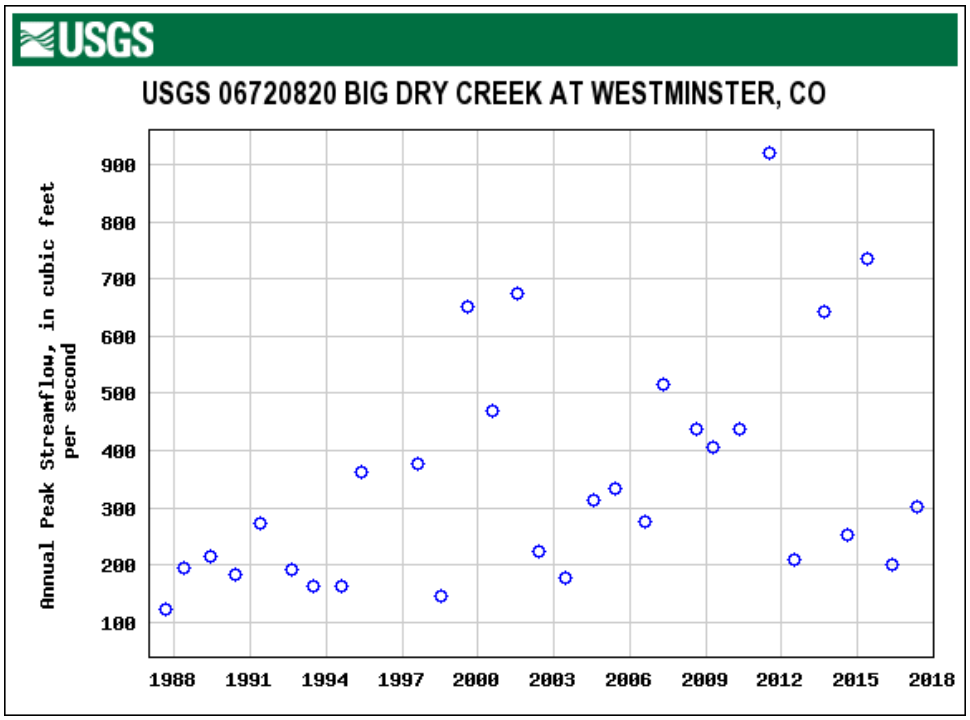


Figure 24. Annual Peak Streamflow at USGS Gauge Big Dry Creek at Fort Lupton

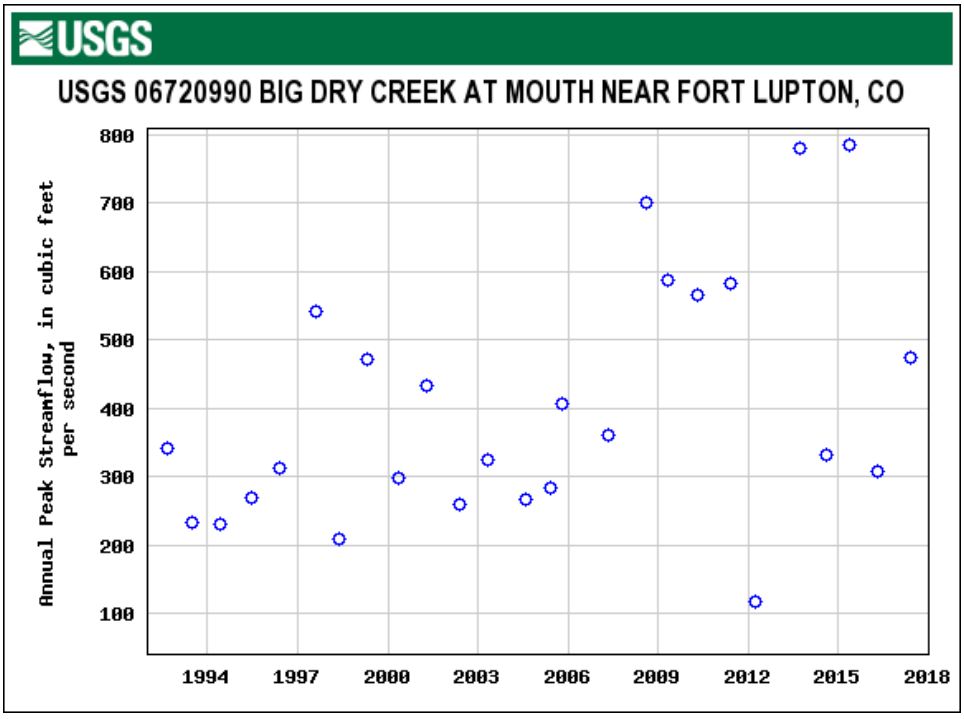


Figure 25. Comparison of Monthly Flows at USGS Westminster Gauge for Selected Years

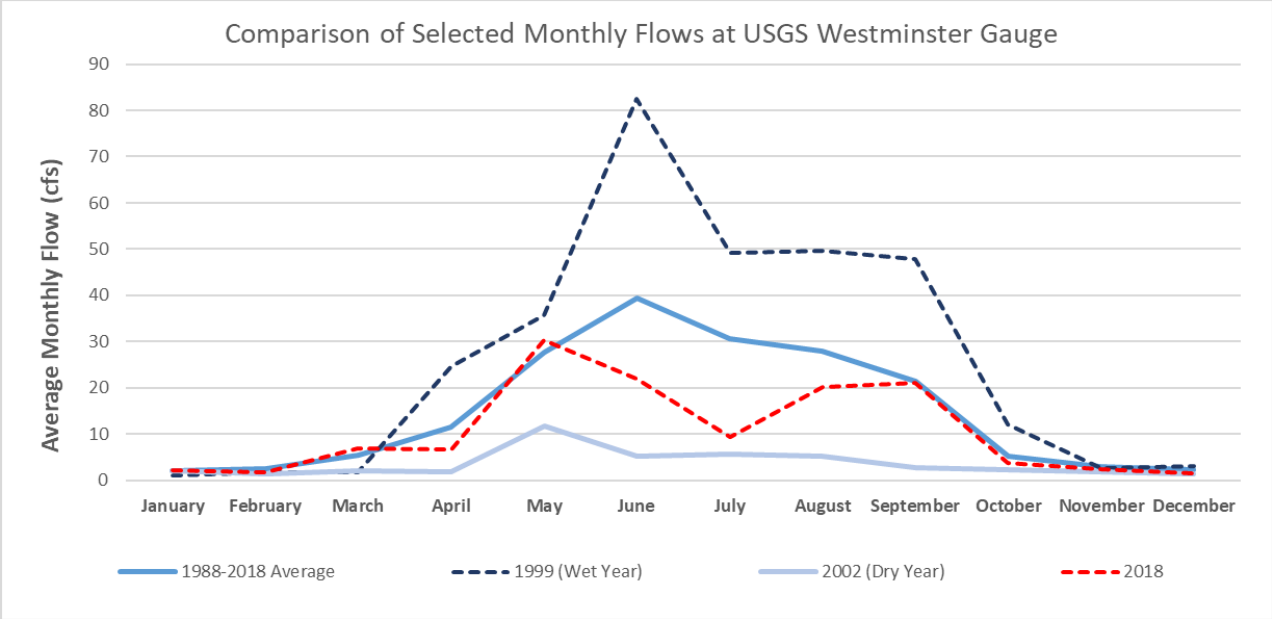


Figure 26. Comparison of Monthly Flows at USGS Fort Lupton Gauge for Selected Years

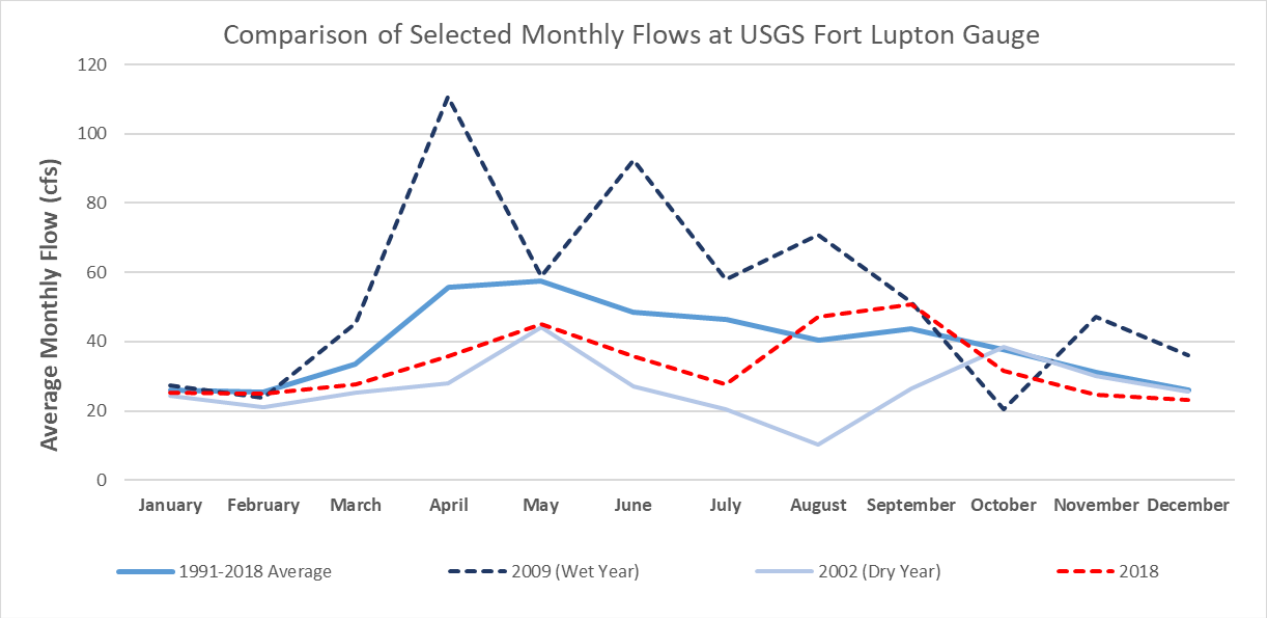
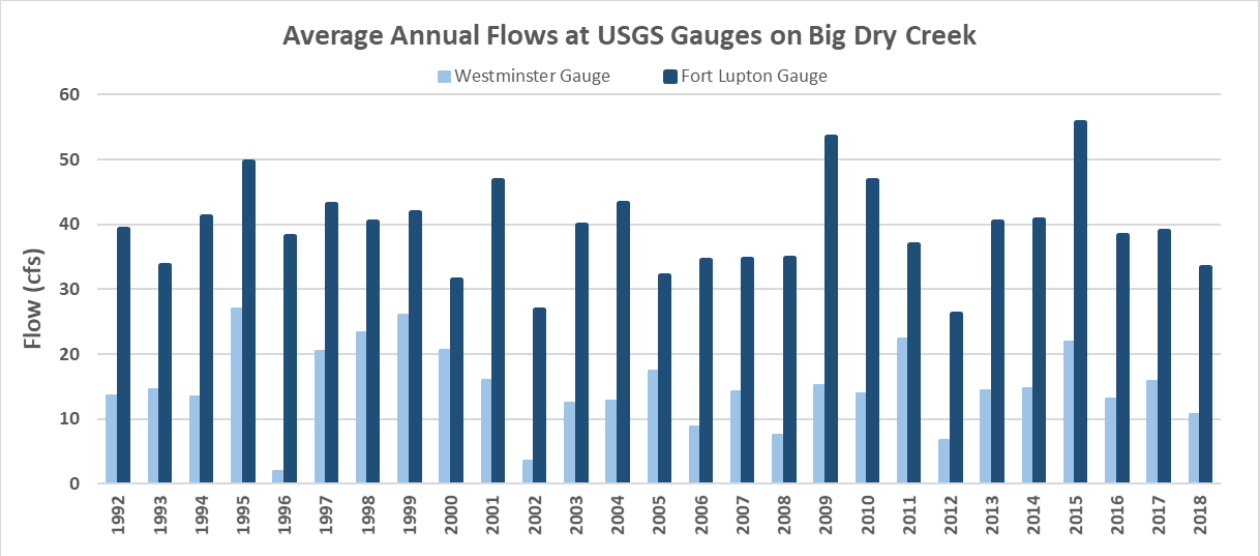


Figure 27. Average Annual Streamflows Measured at USGS Gauges



Note: Some data missing at Ft. Lupton gauge in December 2013 due to ice.

Colorado Division of Water Resources Stream Flow Measurements for 2018

Although BDCWA has historically used the two USGS stream gauges on Big Dry Creek for purposes of analysis in this annual report, other gauge data are available for various locations on Big Dry Creek. These locations include four relatively new gauges operated by Northern Water, which are not yet providing routine data. A flood alert gauge was installed by Urban Drainage and Flood Control District near I-25 and Thorn Creek golf course, but it is not calibrated to measure baseflow conditions. Another gauge is operated by the Colorado Division of Water Resources (CDWR) and is named Big Dry Creek Near Ft. Lupton, CO (BIGDAFCO). BIGDAFCO is located approximately 3.8 stream miles upstream of the USGS's 06720990 Big Dry Creek at Fort Lupton stream gauge.[8] Between the two gauges, several notable hydrologic influences occur (Figure 28), including augmentation returns to Big Dry Creek, a diversion off of the South Platte River to Big Dry Creek and a diversion from Big Dry Creek to the Lupton Bottoms Ditch. Additionally, there are irrigation tail waters accruing to the system in the intervening reach due to irrigation practices as well as percolation return flows from irrigation. The Lupton Bottoms diversion is situated in such a way that it can receive water from both Big Dry Creek and the South Platte River. The Lupton Bottoms Ditch has a diversion structure on the South Platte River which diverts water to Big Dry Creek. Below this confluence point, another diversion structure diverts water from Big Dry Creek into their ditch system. Regardless of the irrigation waters returning to the system between the two gauge sites, the interactions among the Lupton Bottoms ditch, the South Platte River and Big Dry

[8] Metro Wastewater's instream monitoring location "BDC" is located 30-50 yards upstream of BIGDAFCO.

Creek cause significant and regular differences in flows measured by CDWR and the USGS (Figure 29).[9] (Personal Communication with Russel Stroud, CDWR).

Figure 28. Relationship between BIGDAFCO and USGS 06720990
(Source: Russell Stroud, CDWR)

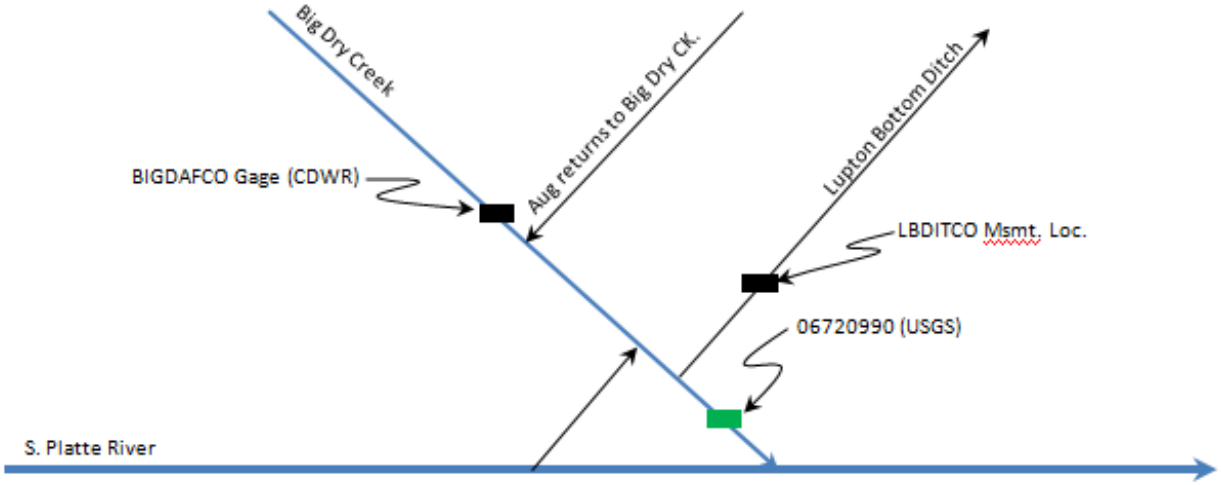
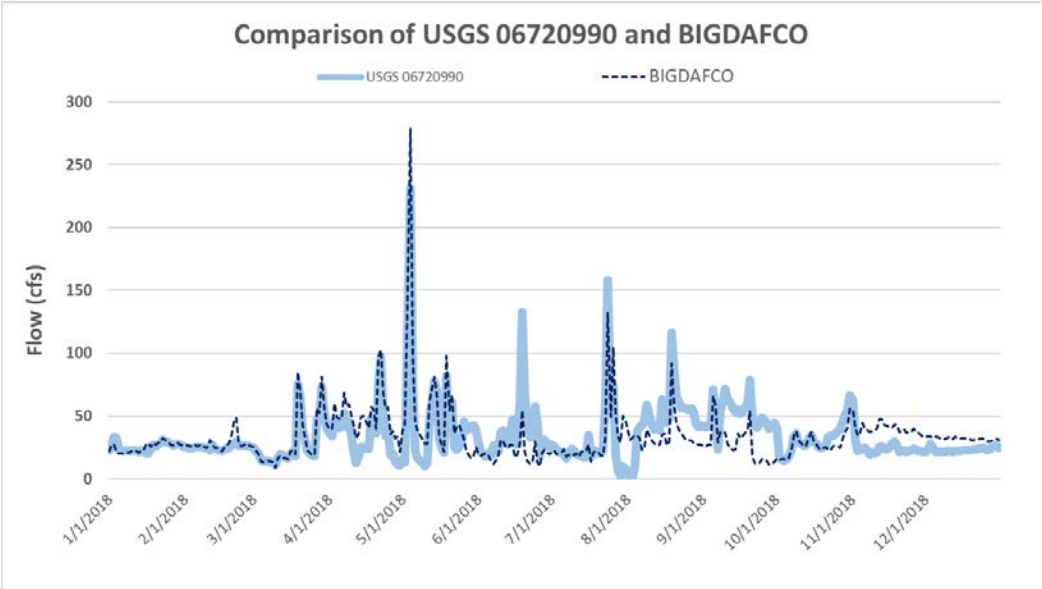


Figure 29. Comparison of Colorado Division of Water Resources and USGS Gauge Measurements for 2018



[9]CDWR recently relocated the BIGDAFCO stream gauge slightly downstream from its historic location. This relocation was done to address several issues including aging infrastructure, damage incurred to the gauge by the 2013 flood event and frequent and regular backwater conditions due to debris as a result of farming and ranching practices in the immediate vicinity of the old gauge location.

Wastewater Treatment Plant Discharges

Table 12 and Figure 30 summarize total annual WWTP discharges to Big Dry Creek over time for the Westminster, Broomfield and Northglenn WWTPs since 2004. Through implementation of reclaimed water programs, both Broomfield and Westminster have been working to limit or reduce discharges to Big Dry Creek. The volume of wastewater discharged is a critically important component in determining nutrient loading to the stream. For purposes of the Barr-Milton TMDL load reduction objectives, the year 2004 is the baseline year for measuring progress relative to the TMDL. Thus, volume changes relative to 2004 can affect overall nutrient loading relative to the TMDL.

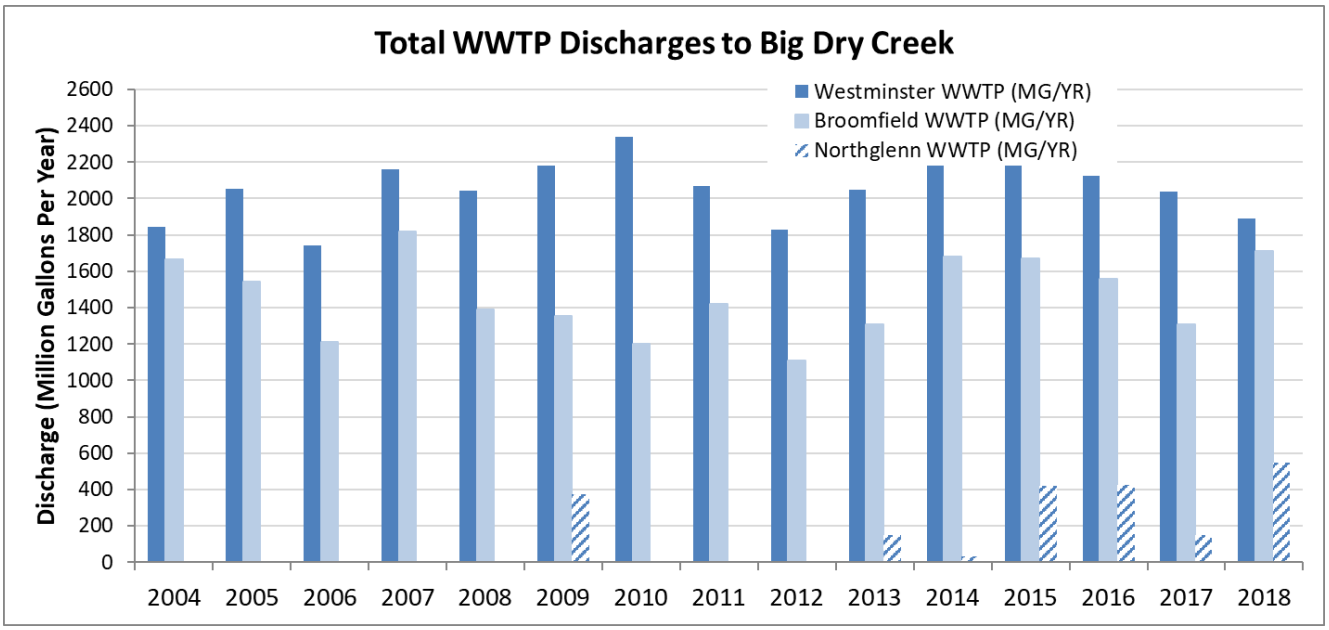
During 2018, Northglenn's WWTP discharged about 546 million gallons (MG) to Big Dry Creek from two different outfalls (004A, Bull Reservoir, and 007A, UV building), which was the largest discharge from Northglenn to date. Discharges switched from 004A to 007A on August 13, 2018. Historically, Northglenn discharged primarily to Bull Reservoir, which releases flows to Bull Canal.

Table 12. Annual WWTP Discharges to Big Dry Creek

	Westminster WWTP (MG/YR)	Broomfield WWTP (MG/YR)	Northglenn WWTP (MG/YR)
2004	1843	1663	NR
2005	2051	1545	NR
2006	1742	1211	NR
2007	2161	1817	NR
2008	2043	1392	NR
2009	2183	1355	374
2010	2337	1201	0
2011	2070	1418	0
2012	1827	1109	0
2013	2050	1310	151
2014	2229	1681	34
2015	2326	1668	420
2016	2123	1559	423
2017	2039	1309	147
2018	1891	1709	546

NR = not reported for purposes of report; historically, Northglenn rarely discharged to Big Dry Creek.

Figure 30. Annual WWTP Discharges to Big Dry Creek



Seasonal Flow Regime

In 2011, an evaluation of Standley Lake discharges, irrigation diversions and WWTP discharges was completed for the 2005-2009 time period (WWE 2011). This evaluation was updated in 2018 as part of the BDCWA watershed plan update, with flows included through 2017. Figure 31 summarizes the primary hydrologic influences on Big Dry Creek, based on analysis of the most recent five years of data for 2013-2017.

Figure 32 and Figure 33 illustrate how sources of flows in the creek vary seasonally. Figure 32 illustrates months of year when the stream is dominated by releases from Standley Lake. Figure 33 illustrates the relative proportion of wastewater flows in the creek in the lower watershed seasonally. Key observations include:

- Significant seasonal variation in release patterns from Standley Lake is present in accordance with releases for irrigation purposes. During June through September, Standley Lake releases comprise 50 to 75 percent of the flows measured at the USGS Westminster gauge. During April, May and October the percent of instream flow from Standley releases is on the order of 5 to 10 percent of the flows at the Westminster gauge.

- With regard to relative percentages of WWTP discharges, during the winter months of December through March, WWTP flows comprise roughly 50 percent or more of the flows present at bdc6.0. During the summer and fall months, WWTP flows are on the order of 25 to 40 percent of the flows at bdc6.0.

Variations in dominant sources of water in the creek during different seasons affect water quality conditions in the creek. For example, in the absence of Standley Lake releases, selenium may be

elevated in the upper watershed. With regard to nutrient loading, it is important to recognize that winter months are dominated by wastewater contributions and relatively low flow conditions. Summer months have higher flows with lower relative contributions from wastewater.

Figure 31. Hydrologic Influences Affecting the Main Stem of Big Dry Creek

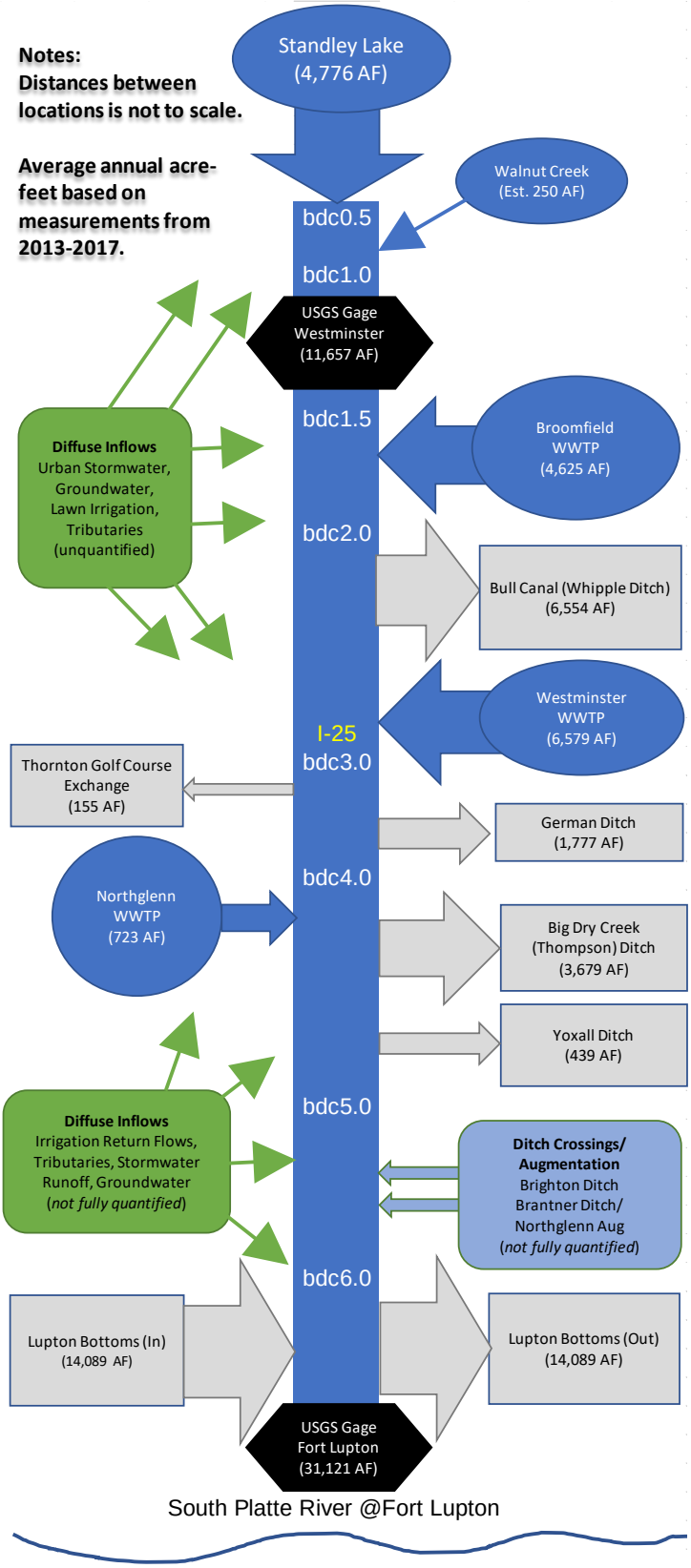


Figure 32. Average Monthly Percentage of Standley Lake Releases Relative to Big Dry Creek Flows at the USGS Westminster Gauge (2013-2017)

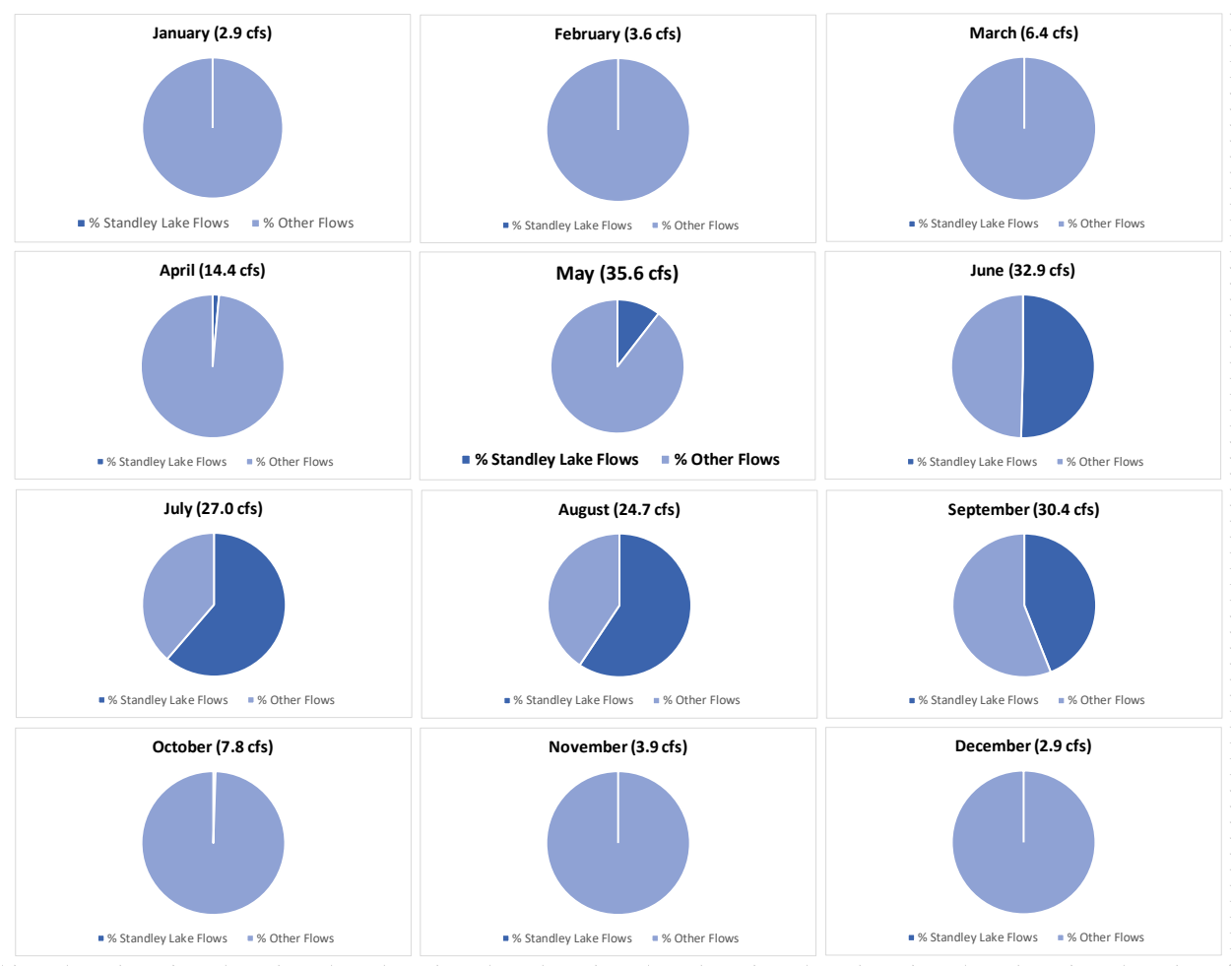
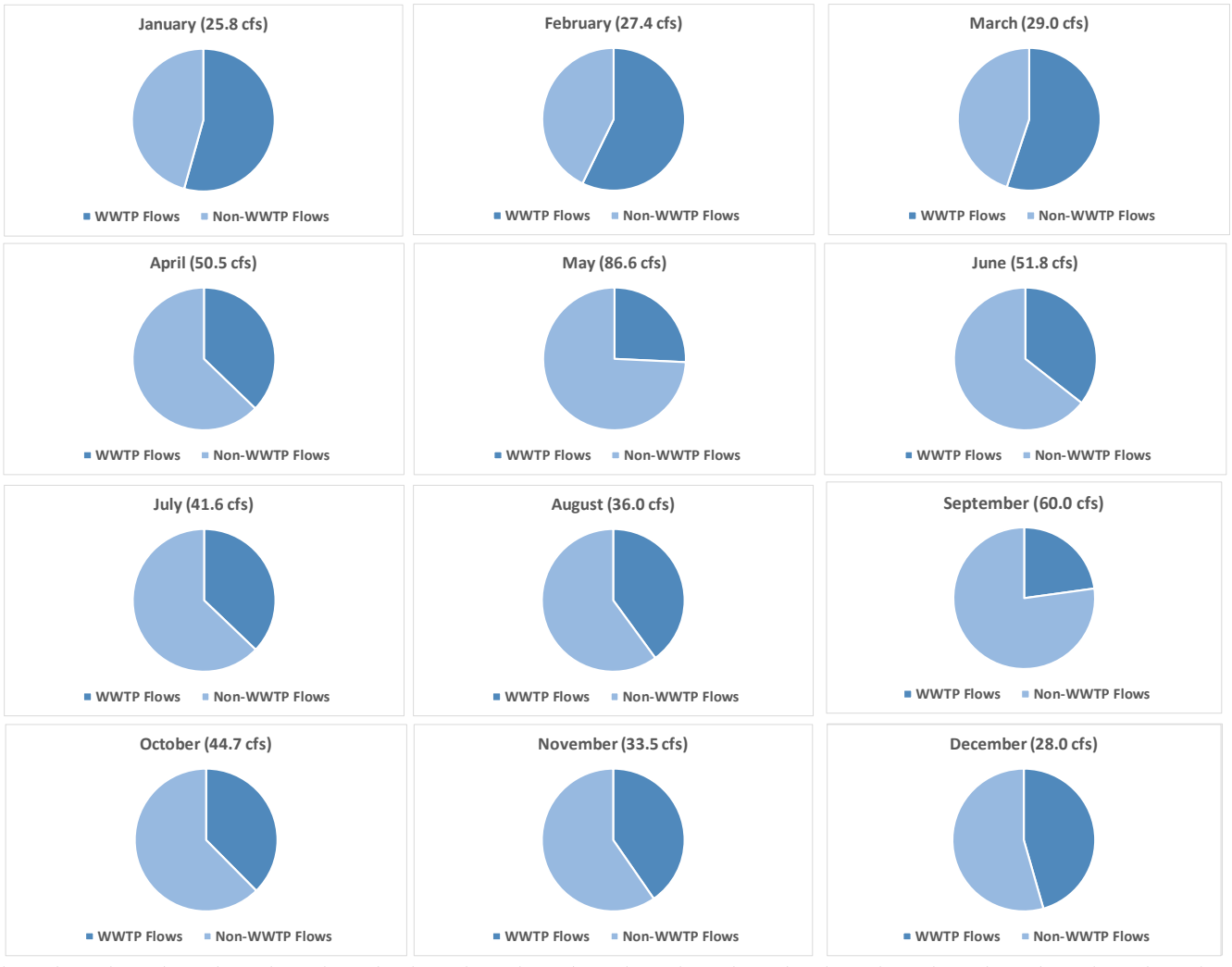


Figure 33. Average Monthly Percentage of Municipal WWTP Releases Relative to Big Dry Creek Flows at the USGS Fort Lupton Gauge (2013-2017)



QUALITY ASSURANCE/ QUALITY CONTROL PROGRAM

During 2018, quality assurance/quality control (QA/QC) samples were collected using the guidelines set forth in the Big Dry Creek SAP (BDCWA 2018). Under this program, field blanks and duplicates are collected and analyzed in accordance with Table 13.

Appendix D summarizes analysis of field blank, trip blank, and duplicate samples for 2018. Analysis of relative percent differences (RPD) for the sample duplicates shows acceptable accuracy for most constituents. As would be expected, RPD values for *E. coli* are high, which is typical for *E. coli* and illustrates how variable *E. coli* results can be. RPD results for one total phosphorus pair is notably high (24.8 percent), as is one total nitrogen pair (89.1 percent RPD), one ammonia pair (28.6 percent RPD) and two selenium pairs (84.8 percent and 54.4 percent RPD). The laboratory was aware of the anomalous total phosphorus duplicate pair and intended to re-run the analysis, however the sample was disposed of before they were able to do so.

Results for field blanks from March and September 2018 did not show detectable concentrations for most constituents, nor did results for trip blanks which were collected during every monthly sampling event in 2018. The QA sampling program was followed during 2018, and several field replicates and trip blanks not required under QA program were also provided. For example, ammonia was included in the nutrient duplicates for many nutrient QC events.

Table 13. Field Quality Control Program in 2018 Sampling and Analysis Plan

Month	QC Test	Site
March	Field blanks (complete set) Field duplicates and blanks for nutrients @bdc2.0	6.0 – (represents max equipment use) 2.0 – TKN, NO_3/NO_2, TP
June	Field duplicates for Constituents of Concern (Represents high flows) Field duplicates for nutrients @bdc2.0	1.5 – Selenium 2.0 – *E. coli* 2.0 – TKN, NO_3/NO_2, TP
September	Field duplicates, full set Field blanks and duplicates for nutrients @ bdc2.0	5.0 –most constituents detected at this site. 2.0 – TKN, NO_3/NO_2, TP
December	Field duplicates for Constituents of Concern (Represents low flows) Field duplicates for nutrients @bdc2.0	1.5 – Selenium 2.0 – *E. coli* 2.0 – TKN, NO_3/NO_2, TP

CONCLUSIONS AND RECOMMENDATIONS

1. Water quality in Big Dry Creek attained stream standards for currently applicable stream standards, with the exception of *E. coli* for the entire stream and iron for the reach below Weld County Road 8

2. *E. coli* concentrations are elevated at multiple instream locations, with the highest concentrations present at bdc3.0 at I-25 area. *E. coli* concentrations in the WWTP discharges are very low and do not exceed stream standards. As part of the BDCWA Watershed Plan update, additional efforts to identify sources of *E. coli* are needed. The current program is useful for identifying elevated stream reaches and trends over time but is not sufficient for identifying and mitigating sources of *E. coli.*

3. Although total recoverable iron samples collected and analyzed by BDCWA show attainment of the total recoverable iron standard at all monitoring locations, additional data collected by Metro Wastewater in the lower watershed show elevated iron concentrations. For this reason, Big Dry Creek below Weld County Road 8 is listed as impaired on the 2018 303(d) List. Elevated iron concentrations are expected to be due to stream bank and soil erosion in the lower watershed.

4. For the most recent five-year analysis period (2014-2018), Big Dry Creek attained its site-specific selenium standard. In 2016, the stream was removed from the 303(d) List of impaired waters.

5. Big Dry Creek does not attain the interim warm water instream nitrogen and phosphorus "interim values" below WWTP discharges (from the Broomfield WWTP to the South Platte River). Although these values are not expected to be adopted as stream standards on the main stem of Big Dry Creek prior to December 31, 2027, addressing nutrient sources on Big Dry Creek should be an increasing area of focus for BDCWA. More stringent CDPS permit limits are expected in the forthcoming permit renewal for the WWTPs. Under the new CWQCC Policy 17-1, a Voluntary Incentive Program for Early Nutrient Reductions was established. The Incentive Program will allow a wastewater treatment plant to accrue time under a post-2027 compliance schedule through trading or watershed nutrient reductions as part of its nutrient reduction plan. Such opportunities should be further explored as part of the Big Dry Creek Watershed Management Plan Update during 2019.

6. Phosphorus concentrations and loads to Big Dry Creek have decreased over time as a result of treatment plant upgrades at the Broomfield and Westminster WWTPs, along with reuse programs that continue to be implemented at these WWTPs. Despite these improvements, the stream would not meet the interim total phosphorus criteria from below the Broomfield WWTP to the confluence with the South Platte River.

7. Big Dry Creek does not show impairment of aquatic life uses through 2016, based on calculation of MMI scores in accordance with CWQCC's Aquatic Life Use Attainment Policy

10-1 prior to update of the policy in 2017. Scores were calculated at six biological monitoring locations for fall monitoring conducted during 2008, 2010, 2012, 2014 and 2016. MMI scores vary substantially, both temporally and spatially. The 2016 MMI result at bdc5.0 may show impairment based on the updated Policy 10-1; therefore, timely calculation of MMI scores for the 2018 sampling results using the new methodology is recommended prior to the 2020 303(d) Listing process. Results for 2018 will be included in next year's annual report.

8. Stream flows were moderate during 2018. Stream flow is a significant factor influencing instream water quality and pollutant loads. WWTP discharges from Northglenn were higher than historic discharges, as were discharges from Broomfield.

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Appendix A. Supplemental Figures

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Appendix B. Big Dry Creek 2017 Instream Sampling Results

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Appendix C. Boxplots and Time Series Plots for Big Dry Creek 2017 Instream Sampling Program

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Appendix D. Big Dry Creek 2017 Quality Control (QC) Samples

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Appendix E. 2018 WWTP Discharge Samples for Broomfield, Westminster and Northglenn Collected for CDPS Discharge Monitoring Reports

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Appendix F. Metro Wastewater 2018 Sampling on Lower Big Dry Creek

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Appendix A. Supplemental Figures

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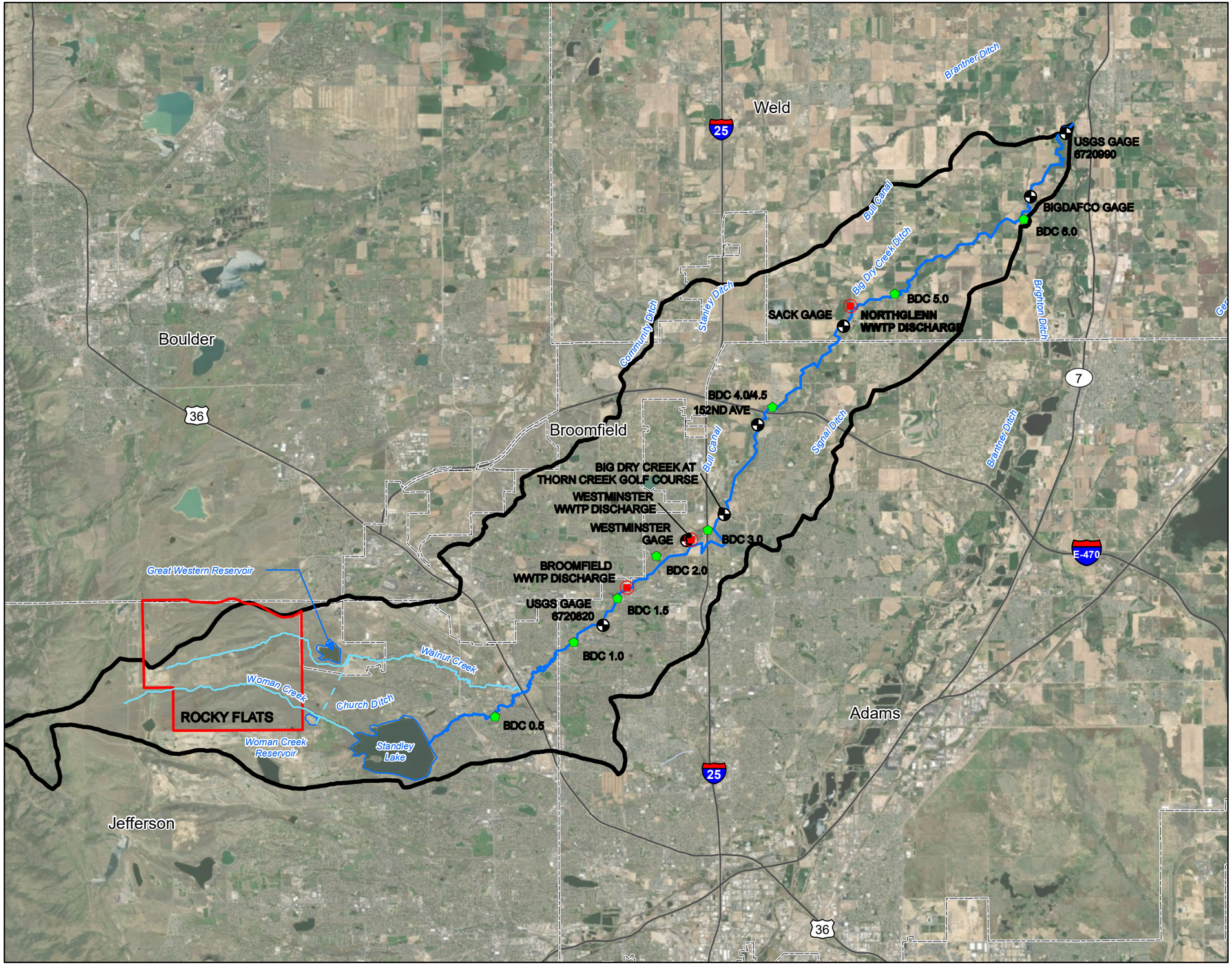
Map 1

BIG DRY CREEK WATERSHED

KEY FEATURES AND MONITORING LOCATIONS



Legend

- Wastewater Discharge
- Monitoring Location
- Stream Gage
- Big Dry Creek
- Big Dry Creek Watershed

N
W E
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0 6,000 12,000 24,000 FEET

PROJECT NO. 971-179.091

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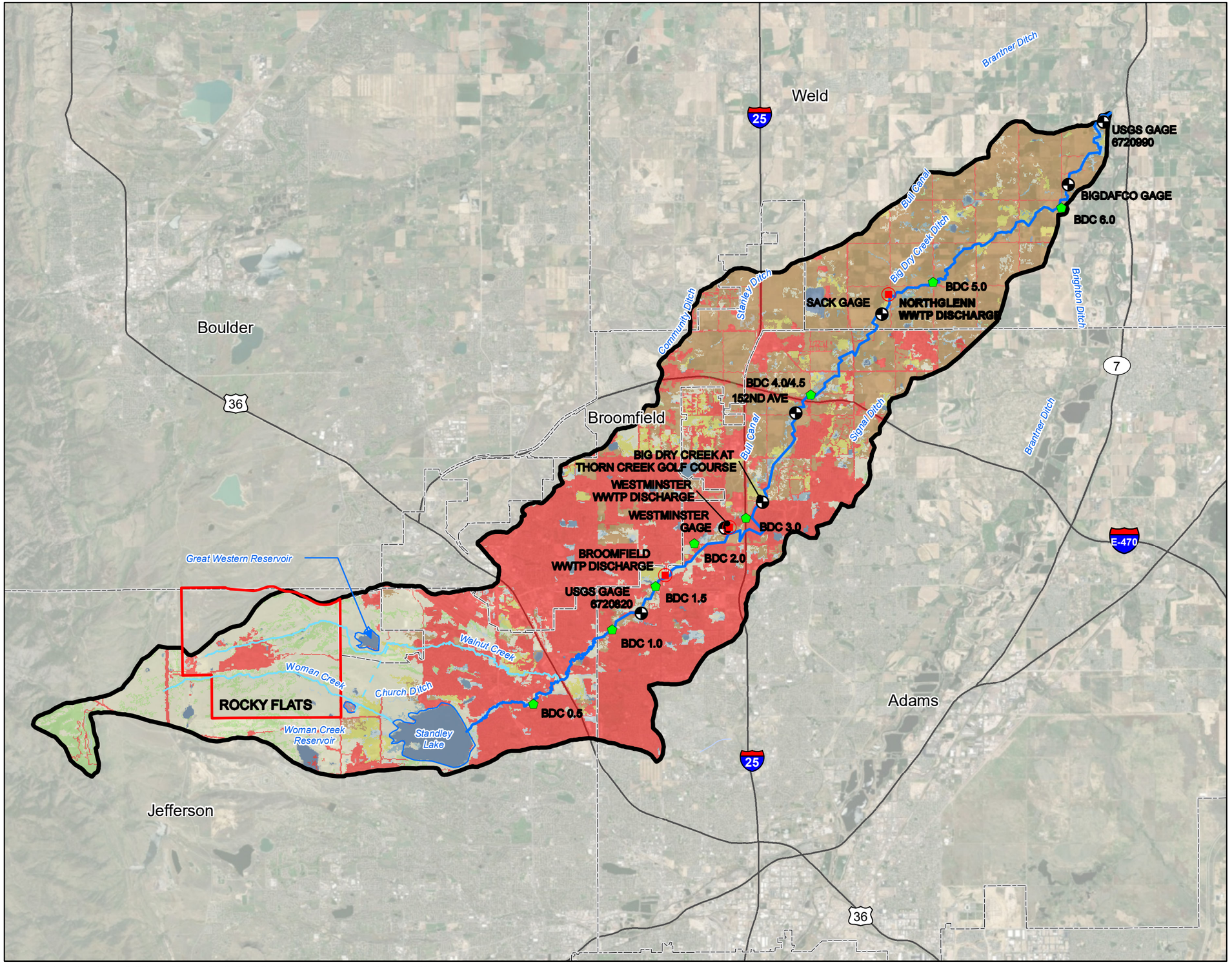

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Map 2

BIG DRY CREEK WATERSHED

LAND USE

Legend

- Wastewater Discharge
- Monitoring Location
- Stream Gage
- Big Dry Creek
- Big Dry Creek Watershed

Land Use

- Open Water
- Urban/Developed/Roads
- Forest/Shrubland
- Grassland/Herbaceous
- Cultivated Crops
- Pasture/Hay

N W E S

0 6,000 12,000 24,000 FEET

WRIGHT WATER ENGINEERS, INC.

PROJECT NO. 971-179.091

Appendix B. Big Dry Creek 2017 Instream Sampling Results

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Appendix B
Big Dry Creek 2018 Instream Sampling Results - General Water Quality

Activity Start Date	Station ID	Alkalinity (mg/L)	Boron, Total (mg/L)	Calcium, Total (mg/L)	Chloride, D (mg/L)	Chlorophyll-a, corr (ug/L)	Chlorophyll-a, uncor (ug/L)	Conductivity (uS/cm)	Cyanide, Total (mg/L)	DO (mg/L)	*E. coli* (MPN/100 mL)	Hardness (mg/L)
Detection Limit		1	0.01	1	0.5	1	1	0.5	0.005	0	1	Calculated
11-Jan-18	bdc1.5	259.0		150.0	228.0	4.4	6.6	2137		11.4	102	574
11-Jan-18	bdc2.0	196.0		118.0	177.0	5.2	8.2	1719		10.4	411	448
11-Jan-18	bdc3.0	147.0		114.0	130.0	2.6	3.8	1303		9.1	435	397
11-Jan-18	bdc4.5	168.0		110.0	145.0	7.2	11.6	1488		10.3	435	405
11-Jan-18	bdc5.0	192.0		109.0	147.0	9.0	13.8	1674		10.8	172	429
11-Jan-18	bdc6.0	212.0		132.0	159.0	12.1	15.6	1793		12.0	150	501
08-Feb-18	bdc0.5	197.0		110.0	141.0	56.3	66.4	1490		12.1	57	405
08-Feb-18	bdc1.0	207.0		127.0	278.0	8.2	10.5	2040		11.6	14	471
08-Feb-18	bdc1.5	250.0		158.0	260.0	5.8	8.2	2250		11.4	101	583
08-Feb-18	bdc2.0	124.0		84.0	137.0			1494		10.2	145	309
08-Feb-18	bdc3.0	125.0		112.0	121.0	2.7	4.1	1200		11.8	308	373
08-Feb-18	bdc4.5	146.0		96.8	130.0	3.6	5.1	1337		12.3	99	357
08-Feb-18	bdc5.0	183.0		110.0	137.0	3.0	5.5	1423		12.4	117	399
08-Feb-18	bdc6.0	162.0		133.0	139.0	4.8	7.4	1477		12.1	79	465
15-Mar-18	bdc0.5	230.0	0.10	120.0	228.0	3.2	5.1	2053	ND	9.1	12	493
15-Mar-18	bdc1.0	245.0	0.12	155.0	464.0	6.1	8.9	2690	ND	8.9	2	606
15-Mar-18	bdc1.5	301.0	0.24	170.0	318.0	1.6	3.3	2624	ND	8.1	144	661
15-Mar-18	bdc2.0	151.0	0.12	65.2	126.0	1.1	2.3	2375	ND	4.8	54	252
15-Mar-18	bdc3.0	124.0	0.17	78.8	120.0	1.3	2.5	1132	ND	8.2	243	291
15-Mar-18	bdc4.5	137.0	0.19	89.2	132.0	1.5	2.8	1313	ND	9.1	70	345
15-Mar-18	bdc5.0	166.0	0.21	98.0	136.0	2.7	3.4	1467	ND	9.2	76	386
15-Mar-18	bdc6.0	191.0	0.22	108.0	149.0	2.5	4.0	1558	ND	9.4	46	426
11-Apr-18	bdc0.5	210.0		112.0	192.0	2.7	4.7	1817		8.3	26	444
11-Apr-18	bdc1.0	192.0		105.0	272.0	5.7	7.4	1770		8.2	125	411
11-Apr-18	bdc3.0	130.0		83.0	150.0	3.2	4.8	1247		8.2	107	309
11-Apr-18	bdc4.5	158.0		113.0	157.0	2.7	4.2	1477		9.1	50	414
11-Apr-18	bdc5.0	182.0		122.0	162.0	3.2	6.0	1590		9.2	326	455
11-Apr-18	bdc6.0	182.0		115.0	160.0	16.0	18.2	1461		9.1	129	407
10-May-18	bdc0.5	78.0		56.0	37.6	4.8	6.3	480		9.8	26	181
10-May-18	bdc1.0	120.0		75.0	76.6	3.9	6.2	765		9.2	102	252
10-May-18	bdc1.5	132.0		85.0	80.8	4.3	7.2	885		8.5	127	288
10-May-18	bdc2.0	124.0		90.0	99.8	2.1	3.6	1144		8.0	71	327
10-May-18	bdc3.0	138.0		100.0	105.0	2.2	3.9	1148		8.1	186	346
10-May-18	bdc4.5	168.0		113.0	127.0	1.9	3.5	1447		8.8	115	409
10-May-18	bdc5.0	184.0		129.0	131.0	2.7	5.8	1592		8.8	122	472
10-May-18	bdc6.0	196.0		128.0	132.0	7.6	10.3	1239		9.0	291	444
14-Jun-18	bdc0.5	62.0	ND	43.2	35.1	2.1	2.9	395	ND	12.2	146	144
14-Jun-18	bdc1.0	93.0	ND	51.6	55.0	3.1	5.2	540	ND	9.2	1300	179
14-Jun-18	bdc1.5	102.0	ND	52.8	58.5	2.8	5.5	605	ND	9.0	1046	190
14-Jun-18	bdc2.0	101.0	0.07	50.8	61.4	1.6	4.1	1053	ND	7.6	308	189
14-Jun-18	bdc3.0	103.0	0.08	57.2	66.9	3.2	5.1	893	ND	7.5	488	212
14-Jun-18	bdc4.5	121.0	0.10	74.0	81.0	6.3	10.0	913	ND	8.2	980	272
14-Jun-18	bdc5.0	137.0	0.13	71.6	89.7	11.7	14.5	992	ND	8.0	2420	283
14-Jun-18	bdc6.0	161.0	0.16	84.4	101.0	14.4	23.2	1158	ND	7.1	2420	330
12-Jul-18	bdc0.5	65.0		47.0	33.8	2.0	3.2	391		8.7	517	153
12-Jul-18	bdc1.0	77.0		51.0	44.7	4.6	8.0	494		7.4	214	173
12-Jul-18	bdc1.5	90.0		59.0	50.4	4.2	8.0	570		6.8	548	201
12-Jul-18	bdc2.0	123.0		82.0	82.5	2.7	5.4	740		6.4	345	301
12-Jul-18	bdc3.0	95.0		61.0	74.3	2.2	5.7	796		7.3	387	224
12-Jul-18	bdc4.5	138.0		81.2	104.0	3.4	5.8	1122		7.6	727	310
12-Jul-18	bdc5.0	155.0		100.0	116.0	6.2	10.6	1308		7.4	461	377
12-Jul-18	bdc6.0	190.0		113.0	125.0	7.1	12.3	1416		7.8	461	426
09-Aug-18	bdc0.5	73.0		51.0	34.0	1.7	3.3	432		7.7	579	167
09-Aug-18	bdc1.0	105.0		64.0	61.0	4.9	8.2	683		7.2	276	220
09-Aug-18	bdc1.5	119.0		69.0	66.1	5.5	9.5	803		7.3	435	245
09-Aug-18	bdc2.0	107.0		66.0	69.3	5.8	9.4	811		6.9	687	239
09-Aug-18	bdc3.0	114.0		74.0	75.7	4.3	8.8	904		7.0	921	273
09-Aug-18	bdc4.5	115.0		69.6	74.7	4.2	7.2	897		7.2	727	259
09-Aug-18	bdc5.0	133.0		81.0	86.5	9.4	15.8	1069		7.0	770	303
09-Aug-18	bdc6.0	166.0		95.0	104.0	17.8	22.3	1242		7.4	2420	360
13-Sep-18	bdc0.5	53.0	0.09	42.0	29.5	2.4	4.7	339	ND	8.8	106	135
13-Sep-18	bdc1.0	70.0	0.08	47.0	34.5	4.2	9.0	412	ND	9.0	94	154
13-Sep-18	bdc1.5	79.0	0.09	49.0	37.9	3.8	7.5	469	ND	9.2	119	164
13-Sep-18	bdc2.0	223.0	0.29	116.0	96.9	3.3	7.2	556	ND	9.3	205	437
13-Sep-18	bdc3.0	106.0	0.12	68.0	56.4	2.7	5.8	697	ND	9.6	308	235
13-Sep-18	bdc4.5	117.0	0.16	83.6	78.9	2.8	6.5	950	ND	10.8	345	296
13-Sep-18	bdc5.0	140.0	0.19	88.0	88.6	3.8	6.6	1057	ND	10.8	462	319
13-Sep-18	bdc6.0	170.0	0.22	97.0	99.0	5.5	8.6	1220	ND	10.2	326	364
11-Oct-18	bdc0.5	210.0		113.0	124.0	ND	1.7	1362		4.7	152	414
11-Oct-18	bdc1.0	193.0		120.0	150.0	5.9	7.9	1446		7.2	229	430
11-Oct-18	bdc1.5	230.0		133.0	159.0	6.9	8.6	1659		7.2	270	489
11-Oct-18	bdc2.0	160.0		99.0	117.0	6.9	9.0	1273		6.8	436	361
11-Oct-18	bdc3.0	147.0		90.0	112.0	4.3	6.6	1217		6.9	388	332
11-Oct-18	bdc4.5	157.0		97.2	119.0	4.3	6.3	1325		7.5	299	361
11-Oct-18	bdc5.0	172.0		101.0	120.0	4.3	12.3	1352		7.8	614	377
11-Oct-18	bdc6.0	210.0		111.0	123.0	7.5	14.1	1419		8.2	388	411
08-Nov-18	bdc0.5	250.0		173.0	190.0	8.0	9.0	1902		9.4	38	617

Appendix B
Big Dry Creek 2018 Instream Sampling Results - General Water Quality

Activity Start Date	Station ID	Alkalinity (mg/L)	Boron, Total (mg/L)	Calcium, Total (mg/L)	Chloride, D (mg/L)	Chlorophyll-a, corr (ug/L)	Chlorophyll-a, uncor (ug/L)	Conductivity (uS/cm)	Cyanide, Total (mg/L)	DO (mg/L)	*E. coli* (MPN/100 mL)	Hardness (mg/L)
Detection Limit		1	0.01	1	0.5	1	1	0.5	0.005	0	1	Calculated
08-Nov-18	bdc1.0	256.0		140.0	215.0	3.3	4.8	1872		9.9	54	516
08-Nov-18	bdc1.5	250.0		170.0	215.0	1.6	4.1	2110		10.7	48	620
08-Nov-18	bdc2.0	177.0		117.0	130.0	3.2	4.3	1236		8.9	1414	401
08-Nov-18	bdc3.0	143.0		101.0	124.0	2.1	3.3	1153		8.8	366	346
08-Nov-18	bdc4.5	162.0		118.0	136.0	2.0	4.7	1391		9.7	326	418
08-Nov-18	bdc5.0	196.0		129.0	138.0	2.9	4.9	1476		10.2	210	449
08-Nov-18	bdc6.0	220.0		126.0	137.0	3.2	6.2	1551		10.2	236	455
13-Dec-18	bdc1.5	290.0	0.23	180.0	296.0	5.3	7.0	2483	ND	11.2	205	676
13-Dec-18	bdc2.0	230.0	0.25	157.0	258.0	3.7	6.3	2140	ND	9.2	344	574
13-Dec-18	bdc3.0	153.0	0.21	108.0	158.0	2.4	3.7	1429	ND	9.0	727	387
13-Dec-18	bdc4.5	172.0	0.24	116.0	166.0	3.1	5.5	1605	ND	9.3	580	427
13-Dec-18	bdc5.0	183.0	0.25	124.0	160.0	4.4	6.8	1656	ND	10.2	291	458
13-Dec-18	bdc6.0	205.0	0.28	142.0	162.0	8.3	11.5	1740	ND	11.1	326	514

Activity Start Date	Station ID	Magnesium, D (mg/L)	pH (SU)	Potassium, D (mg/L)	Sodium, D (mg/L)	Sulfate, D (mg/L)	TDS (mg/L)	Temperature (°C)	TOC (mg/L)	TSS (mg/L)	Turbidity (NTU)
Detection Limit		1	0	0.5	1	1	1	NA	0.25	2.0	0.1
11-Jan-18	bdc1.5	48.5	7.02	3.7	230.0	480	1320	-1.44	4.7	8.8	8.6
11-Jan-18	bdc2.0	37.3	7.74	8.5	174.0	346	1040	1.82	6.3	25.0	7.7
11-Jan-18	bdc3.0	27.4	7.63	11.9	135.0	256	793	6.78	8.9	14.0	9.5
11-Jan-18	bdc4.5	31.7	7.39	11.3	151.0	304	911	3.60	8.2	40.0	25.2
11-Jan-18	bdc5.0	38.0	7.62	10.4	173.0	372	1070	2.10	7.3	34.0	24.7
11-Jan-18	bdc6.0	41.5	7.70	9.4	181.0	412	1110	1.13	6.8	18.0	14.2
08-Feb-18	bdc0.5	31.7	7.36	3.9	159.0	310	925	0.25	4.9	30.0	33.1
08-Feb-18	bdc1.0	37.3	7.69	4.0	221.0	336	1180	0.01	5.1	8.8	11.0
08-Feb-18	bdc1.5	45.7	7.77	4.0	244.0	444	1350	0.93	5.0	12.0	9.9
08-Feb-18	bdc2.0	24.1	7.74	10.4	133.0	208	756	6.78	7.1	8.8	6.8
08-Feb-18	bdc3.0	22.7	7.36	11.6	122.0	206	723	8.22	8.0	18.0	9.1
08-Feb-18	bdc4.5	28.0	7.38	11.4	142.0	256	833	5.80	7.8	24.0	15.7
08-Feb-18	bdc5.0	30.3	7.70	10.8	147.0	288	873	4.63	7.5	24.0	18.7
08-Feb-18	bdc6.0	32.3	7.80	10.4	151.0	300	912	3.90	7.3	30.0	22.2
15-Mar-18	bdc0.5	47.0	6.99	4.0	277.0	514	1350	0.88	6.0	4.8	3.8
15-Mar-18	bdc1.0	53.2	7.36	5.2	364.0	506	1710	2.21	6.5	10.0	7.0
15-Mar-18	bdc1.5	57.4	7.57	4.6	384.0	658	1780	2.29	5.4	14.0	5.9
15-Mar-18	bdc2.0	21.7	7.17	11.4	128.0	189	715	8.57	7.6	21.0	5.8
15-Mar-18	bdc3.0	23.0	7.68	12.5	128.0	224	741	8.38	8.4	8.6	5.7
15-Mar-18	bdc4.5	29.8	7.54	11.5	150.0	290	878	5.72	7.7	6.4	5.4
15-Mar-18	bdc5.0	34.4	7.70	10.8	165.0	332	956	4.73	7.7	4.8	4.9
15-Mar-18	bdc6.0	37.9	7.80	9.8	179.0	368	1040	5.07	7.2	15.0	7.1
11-Apr-18	bdc0.5	39.8	7.58	4.6	226.0	406	1150	6.53	7.8	2.8	3.4
11-Apr-18	bdc1.0	36.1	7.53	4.3	220.0	302	1070	7.94	8.1	3.2	5.6
11-Apr-18	bdc3.0	24.8	7.78	11.4	138.0	230	777	10.72	8.5	7.2	5.3
11-Apr-18	bdc4.5	32.0	7.83	10.2	163.0	311	927	9.11	8.1	8.4	5.0
11-Apr-18	bdc5.0	36.6	7.26	10.2	181.0	362	1020	9.37	8.3	9.2	8.9
11-Apr-18	bdc6.0	29.2	7.84	13.7	165.0	278	915	9.94	9.1	31.0	19.0
10-May-18	bdc0.5	9.9	7.18	2.4	34.4	76	279	7.51	2.4	5.0	6.3
10-May-18	bdc1.0	15.8	7.60	3.0	66.4	126	430	9.96	4.7	17.0	15.0
10-May-18	bdc1.5	18.5	7.78	3.1	83.6	153	522	10.82	4.7	25.0	21.6
10-May-18	bdc2.0	24.9	7.67	6.3	111.0	208	679	12.27	6.0	10.0	11.8
10-May-18	bdc3.0	23.3	7.37	8.7	113.0	212	678	13.62	6.7	14.0	11.5
10-May-18	bdc4.5	30.9	7.62	8.4	146.0	308	900	13.68	6.4	13.0	11.9
10-May-18	bdc5.0	36.3	7.95	9.4	165.0	366	974	13.96	7.1	10.0	11.0
10-May-18	bdc6.0	30.2	8.05	10.2	147.0	314	929	14.68	6.6	40.0	27.6
14-Jun-18	bdc0.5	8.9	7.44	2.5	26.3	66	229	8.35	2.5	4.6	6.0
14-Jun-18	bdc1.0	12.3	7.54	2.8	44.0	86	314	10.83	4.2	25.0	18.3
14-Jun-18	bdc1.5	14.1	7.77	2.7	52.5	101	380	12.57	4.1	33.0	27.2
14-Jun-18	bdc2.0	15.0	7.53	4.8	63.2	116	425	13.77	4.8	25.0	24.0
14-Jun-18	bdc3.0	16.7	7.67	5.3	73.0	139	467	14.74	5.6	27.0	20.8
14-Jun-18	bdc4.5	21.2	7.70	5.6	94.4	203	588	15.39	5.9	27.0	20.7
14-Jun-18	bdc5.0	25.2	7.91	5.7	109.0	228	646	17.13	6.5	29.0	24.9
14-Jun-18	bdc6.0	28.9	7.92	6.2	128.0	270	752	17.40	6.1	110.0	72.5
12-Jul-18	bdc0.5	8.6	7.09	2.4	23.5	64	245	10.88	2.6	5.0	3.8
12-Jul-18	bdc1.0	11.1	7.36	2.6	35.4	87	308	13.66	2.9	53.0	24.6
12-Jul-18	bdc1.5	13.1	7.55	2.5	45.6	108	356	15.02	2.8	38.0	29.5
12-Jul-18	bdc2.0	23.4	7.51	5.2	92.2	201	613	16.15	4.5	29.0	25.3
12-Jul-18	bdc3.0	17.5	7.28	6.6	75.6	149	508	17.24	5.2	41.0	28.4
12-Jul-18	bdc4.5	26.0	7.54	8.1	114.0	245	706	17.94	7.7	21.0	18.6
12-Jul-18	bdc5.0	31.0	7.90	7.9	137.0	306	829	18.77	6.3	34.0	27.0
12-Jul-18	bdc6.0	34.9	7.87	7.7	150.0	330	899	17.82	6.5	42.0	30.9
09-Aug-18	bdc0.5	9.7	6.87	2.2	29.3	65	260	13.26	3.1	6.4	6.9
09-Aug-18	bdc1.0	14.6	7.37	3.1	59.6	116	420	14.61	4.1	29.0	26.4
09-Aug-18	bdc1.5	17.7	7.62	3.0	72.4	143	476	14.31	3.7	29.0	23.2
09-Aug-18	bdc2.0	18.1	7.65	6.5	76.0	134	500	15.39	5.0	47.0	28.4
09-Aug-18	bdc3.0	21.4	7.52	7.3	90.2	161	561	15.57	5.6	38.0	28.9
09-Aug-18	bdc4.5	20.8	7.69	5.4	85.3	180	562	16.18	5.5	57.0	41.8
09-Aug-18	bdc5.0	24.4	7.78	7.7	105.0	238	678	17.12	6.5	73.0	48.8
09-Aug-18	bdc6.0	29.8	7.92	8.3	127.0	275	788	16.81	6.7	71.0	46.5
13-Sep-18	bdc0.5	7.4	7.05	2.5	21.3	55	208	14.30	2.8	14.0	16.1
13-Sep-18	bdc1.0	8.8	7.10	2.6	28.9	67	253	13.07	3.2	31.0	27.8
13-Sep-18	bdc1.5	10.2	7.32	2.5	34.5	78	283	12.78	3.8	37.0	37.4
13-Sep-18	bdc2.0	35.7	7.53	3.2	132.0	312	882	13.36	4.8	38.0	41.9
13-Sep-18	bdc3.0	15.9	7.53	3.9	63.8	139	432	14.72	3.7	28.0	25.3
13-Sep-18	bdc4.5	21.2	7.61	5.6	92.5	204	602	13.89	5.8	37.0	42.3
13-Sep-18	bdc5.0	24.1	7.81	6.1	106.0	232	658	13.80	4.7	50.0	43.8
13-Sep-18	bdc6.0	29.5	7.74	5.2	126.0	282	774	13.84	4.3	57.0	53.6
11-Oct-18	bdc0.5	31.9	7.18	4.3	141.0	272	850	2.53	7.4	4.2	2.6
11-Oct-18	bdc1.0	31.7	7.57	4.7	145.0	298	902	2.84	8.0	7.0	6.5
11-Oct-18	bdc1.5	38.0	7.73	4.4	174.0	355	1060	3.22	7.6	5.0	4.7
11-Oct-18	bdc2.0	27.6	7.76	8.9	126.0	238	799	6.78	7.5	16.0	9.7
11-Oct-18	bdc3.0	26.1	7.61	10.8	129.0	238	749	8.34	7.5	24.0	13.2
11-Oct-18	bdc4.5	28.8	7.60	10.2	139.0	275	839	7.38	7.8	29.0	18.4
11-Oct-18	bdc5.0	30.3	7.68	10.1	140.0	291	874	6.35	7.3	35.0	21.7
11-Oct-18	bdc6.0	32.4	7.72	9.4	145.0	306	898	5.55	7.3	40.0	22.1
08-Nov-18	bdc0.5	45.0	6.99	4.1	208.0	420	1170	-0.58	7.0	5.6	4.7

Activity Start Date	Station ID	Magnesium, D (mg/L)	pH (SU)	Potassium, D (mg/L)	Sodium, D (mg/L)	Sulfate, D (mg/L)	TDS (mg/L)	Temperature (°C)	TOC (mg/L)	TSS (mg/L)	Turbidity (NTU)
Detection Limit		1	0	0.5	1	1	1	NA	0.25	2.0	0.1
08-Nov-18	bdc1.0	40.4	7.58	4.2	201.0	389	1090	-0.25	7.1	4.8	5.4
08-Nov-18	bdc1.5	47.4	7.67	4.0	229.0	459	1250	0.47	6.9	5.6	5.3
08-Nov-18	bdc2.0	26.4	7.72	9.6	130.0	238	745	4.85	7.4	30.8	21.1
08-Nov-18	bdc3.0	22.7	7.39	11.5	119.0	223	691	9.10	7.9	17.2	13.0
08-Nov-18	bdc4.5	29.9	7.27	10.6	148.0	297	825	5.13	8.0	16.4	14.9
08-Nov-18	bdc5.0	30.8	7.62	10.1	148.0	322	861	4.67	7.3	24.8	19.3
08-Nov-18	bdc6.0	34.0	7.71	9.0	156.0	344	939	3.58	6.9	30.0	24.4
13-Dec-18	bdc1.5	55.0	6.98	3.8	294.0	534	1560	-3.37	5.7	12.4	9.7
13-Dec-18	bdc2.0	44.1	7.77	6.6	238.0	414	1280	-1.20	6.9	24.4	18.4
13-Dec-18	bdc3.0	28.6	7.84	10.3	156.0	278	890	3.92	8.2	20.8	11.9
13-Dec-18	bdc4.5	33.4	7.63	9.5	172.0	344	1020	0.47	8.7	36.0	24.7
13-Dec-18	bdc5.0	36.1	7.83	9.7	180.0	362	1030	-0.94	8.1	33.0	22.9
13-Dec-18	bdc6.0	38.7	7.96	8.9	184.0	398	1090	-2.14	7.7	45.0	28.1

Appendix B.
Big Dry Creek 2018 Sampling Results - Nutrients

Activity Start Date	Station ID	NH3 (mg/L)	NO2 (mg/L)	NO3+NO2 (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Ortho as P (mg/L)	Phosphorus, Total (mg/L)
Detection Limit		0.03	0.01	0.02	0.03	0.01	0.010
11-Jan-18	bdc1.5	0.08	0.01	2.04	2.85	0.01	0.058
11-Jan-18	bdc2.0	0.15	0.03	8.77	10.01	1.08	1.390
11-Jan-18	bdc3.0	0.12	0.04	8.95	10.31	0.87	1.060
11-Jan-18	bdc4.5	0.16	0.09	8.75	10.44	0.70	0.880
11-Jan-18	bdc5.0	0.21	0.13	7.72	9.02	0.45	0.604
11-Jan-18	bdc6.0	0.15	0.07	6.63	6.91	0.34	0.460
08-Feb-18	bdc0.5	0.07	ND	0.76	1.55	ND	0.065
08-Feb-18	bdc1.0	0.07	0.01	0.70	1.22	ND	0.072
08-Feb-18	bdc1.5	0.11	0.01	1.81	2.41	0.01	0.039
08-Feb-18	bdc2.0	0.14	0.05	13.19	12.86	0.07	0.185
08-Feb-18	bdc3.0	0.11	0.05	11.12	12.04	0.26	0.422
08-Feb-18	bdc4.5	0.17	0.07	10.31	11.27	0.36	0.526
08-Feb-18	bdc5.0	0.10	0.07	10.15	11.20	0.28	0.412
08-Feb-18	bdc6.0	0.07	0.07	8.55	9.59	0.25	0.374
15-Mar-18	bdc0.5	0.07	0.02	0.57	1.35	ND	0.033
15-Mar-18	bdc1.0	0.20	0.02	0.49	1.42	ND	0.058
15-Mar-18	bdc1.5	0.18	0.04	1.75	2.47	0.02	0.046
15-Mar-18	bdc2.0	0.17	0.10	15.76	16.75	1.14	1.369
15-Mar-18	bdc3.0	0.09	0.08	10.46	11.84	0.94	1.170
15-Mar-18	bdc4.5	0.04	0.06	10.74	12.01	0.98	1.202
15-Mar-18	bdc5.0	0.08	0.06	8.63	9.53	0.65	0.742
15-Mar-18	bdc6.0	0.05	0.05	7.79	8.45	0.52	0.635
11-Apr-18	bdc0.5	0.05	0.01	0.30	0.91	ND	0.058
11-Apr-18	bdc1.0	ND	ND	0.07	0.56	ND	0.094
11-Apr-18	bdc3.0	0.09	0.05	10.39	10.65	0.48	0.640
11-Apr-18	bdc4.5	0.04	0.04	9.01	8.82	0.37	0.471
11-Apr-18	bdc5.0	0.06	0.04	7.13	7.22	0.29	0.397
11-Apr-18	bdc6.0	0.03	0.07	3.98	4.94	0.41	0.626
10-May-18	bdc0.5	ND	ND	0.16	0.39	ND	0.202
10-May-18	bdc1.0	ND	ND	0.18	0.52	ND	0.240
10-May-18	bdc1.5	0.04	ND	0.37	0.79	ND	0.050
10-May-18	bdc2.0	0.08	0.02	5.26	6.85	0.58	0.664
10-May-18	bdc3.0	0.11	0.02	5.66	7.24	0.62	0.890
10-May-18	bdc4.5	0.04	0.04	5.81	7.05	0.57	0.801
10-May-18	bdc5.0	0.12	0.05	3.91	5.20	0.32	0.509
10-May-18	bdc6.0	0.08	0.07	2.77	3.51	0.48	0.733
14-Jun-18	bdc0.5	ND	ND	0.14	0.43	ND	0.042
14-Jun-18	bdc1.0	ND	ND	0.17	0.57	ND	0.067
14-Jun-18	bdc1.5	ND	ND	0.29	0.67	ND	0.091
14-Jun-18	bdc2.0	ND	0.01	3.85	4.40	0.03	0.106
14-Jun-18	bdc3.0	0.03	0.02	4.37	5.07	0.09	0.165
14-Jun-18	bdc4.5	ND	0.03	3.69	4.30	0.32	0.442
14-Jun-18	bdc5.0	0.03	0.04	2.37	3.33	0.20	0.295
14-Jun-18	bdc6.0	0.03	0.04	2.53	3.74	0.30	0.547
12-Jul-18	bdc0.5	ND	ND	0.13	0.33	ND	0.058
12-Jul-18	bdc1.0	ND	ND	0.13	0.44	ND	0.162
12-Jul-18	bdc1.5	ND	ND	0.29	0.67	ND	0.100
12-Jul-18	bdc2.0	0.05	0.01	5.70	6.13	0.04	0.164
12-Jul-18	bdc3.0	0.05	0.03	6.89	8.11	0.16	0.283
12-Jul-18	bdc4.5	0.04	0.08	5.83	6.86	0.59	0.748
12-Jul-18	bdc5.0	0.05	0.08	3.75	4.59	0.22	0.336
12-Jul-18	bdc6.0	0.05	0.06	2.81	3.67	0.23	0.343
09-Aug-18	bdc0.5	ND	ND	0.13	0.40	ND	0.092
09-Aug-18	bdc1.0	ND	ND	0.21	0.75	0.01	0.073
09-Aug-18	bdc1.5	0.05	ND	0.59	1.07	0.01	0.144

Appendix B.
Big Dry Creek 2018 Sampling Results - Nutrients

Activity Start Date	Station ID	NH3 (mg/L)	NO2 (mg/L)	NO3+NO2 (mg/L)	Nitrogen, Total (mg/L)	Phosphorus, Ortho as P (mg/L)	Phosphorus, Total (mg/L)
09-Aug-18	bdc2.0	0.06	0.03	6.81	8.06	0.11	0.224
09-Aug-18	bdc3.0	0.12	0.05	7.98	9.01	0.21	0.354
09-Aug-18	bdc4.5	ND	0.02	3.98	4.96	0.12	0.301
09-Aug-18	bdc5.0	0.05	0.04	2.93	4.21	0.19	0.362
09-Aug-18	bdc6.0	ND	0.03	2.52	3.54	0.23	0.434
13-Sep-18	bdc0.5	ND	ND	0.05	0.48	ND	0.046
13-Sep-18	bdc1.0	ND	ND	0.07	0.68	ND	0.053
13-Sep-18	bdc1.5	0.06	ND	0.22	0.50	ND	0.064
13-Sep-18	bdc2.0	ND	ND	3.71	1.73	0.03	0.110
13-Sep-18	bdc3.0	ND	ND	1.89	2.41	0.08	0.130
13-Sep-18	bdc4.5	0.04	0.01	3.66	4.52	0.17	0.235
13-Sep-18	bdc5.0	0.03	0.01	4.01	5.00	0.11	0.196
13-Sep-18	bdc6.0	0.03	0.01	4.16	3.25	0.13	0.231
11-Oct-18	bdc0.5	ND	0.02	1.28	1.92	0.01	0.036
11-Oct-18	bdc1.0	ND	0.02	0.77	1.30	ND	0.050
11-Oct-18	bdc1.5	ND	0.01	1.56	2.14	ND	0.053
11-Oct-18	bdc2.0	ND	0.02	8.31	9.65	0.03	0.101
11-Oct-18	bdc3.0	0.05	0.02	8.61	10.28	0.07	0.164
11-Oct-18	bdc4.5	0.04	0.03	8.88	10.06	0.07	0.160
11-Oct-18	bdc5.0	0.17	0.08	7.33	8.52	0.07	0.164
11-Oct-18	bdc6.0	0.24	0.14	5.23	6.56	0.11	0.205
08-Nov-18	bdc0.5	ND	ND	0.65	0.95	ND	0.042
08-Nov-18	bdc1.0	ND	ND	0.39	0.67	ND	0.039
08-Nov-18	bdc1.5	ND	0.01	1.71	2.08	ND	0.038
08-Nov-18	bdc2.0	0.09	0.05	13.49	12.95	0.07	0.152
08-Nov-18	bdc3.0	0.06	0.03	9.43	10.23	0.13	0.358
08-Nov-18	bdc4.5	0.08	0.04	9.71	10.27	0.15	0.232
08-Nov-18	bdc5.0	0.18	0.13	8.43	8.57	0.15	0.228
08-Nov-18	bdc6.0	0.43	0.17	6.97	7.56	0.15	0.237
13-Dec-18	bdc1.5	ND	0.02	2.04	2.58	ND	0.080
13-Dec-18	bdc2.0	0.04	0.06	6.27	7.17	0.07	0.158
13-Dec-18	bdc3.0	0.10	0.04	8.77	10.83	0.13	0.286
13-Dec-18	bdc4.5	0.09	0.05	8.89	10.62	0.14	0.274
13-Dec-18	bdc5.0	0.10	0.14	7.45	9.83	0.12	0.242
13-Dec-18	bdc6.0	0.03	0.05	6.96	8.67	0.15	0.259

Activity Start Date	Station ID	Arsenic, Trec (mg/L)	Cadmium, D (mg/L)	Chromium, D (mg/L)	Copper, D (mg/L)	Iron, Trec (mg/L)	Lead, D (mg/L)	Manganese, D (mg/L)	Nickel, D (mg/L)	Selenium, D (mg/L)	Silver, D (mg/L)	Zinc, D (mg/L)
Detection Limit		0.0010	0.00005	0.00009	0.00008	0.25	0.00005	0.00005	0.00007	0.0001	0.00005	0.0003
15-Mar-18	bdc0.5	ND	ND	0.00015	0.01250	ND	0.00013	0.68200	0.00192	0.0059	ND	0.0016
15-Mar-18	bdc1.0	0.0012	ND	0.00010	0.00826	0.49	0.00010	0.37500	0.00252	0.0057	ND	0.0012
15-Mar-18	bdc1.5	ND	ND	0.00010	0.01240	0.28	0.00010	0.24200	0.00215	0.0111	ND	0.0007
15-Mar-18	bdc2.0	ND	ND	0.00095	0.01120	0.36	0.00012	0.06850	0.00232	0.0037	ND	0.0151
15-Mar-18	bdc3.0	ND	ND	0.00027	0.01510	0.26	0.00024	0.05880	0.00205	0.0034	ND	0.0400
15-Mar-18	bdc4.5	ND	0.000051	0.00020	0.02020	ND	0.00021	0.06180	0.00232	0.0049	ND	0.0287
15-Mar-18	bdc5.0	ND	ND	0.00050	0.00820	ND	0.00021	0.06380	0.00261	0.0047	ND	0.0267
15-Mar-18	bdc6.0	0.0011	0.000078	0.00011	0.00867	0.30	0.00019	0.06190	0.00309	0.0049	ND	0.0198
10-May-18	bdc0.5	-	-	-	-	ND	-	-	-	-	-	-
10-May-18	bdc1.0	-	-	-	-	0.36	-	-	-	-	-	-
10-May-18	bdc1.5	-	-	-	-	0.50	-	-	-	-	-	-
10-May-18	bdc2.0	-	-	-	-	0.30	-	-	-	-	-	-
10-May-18	bdc3.0	-	-	-	-	0.25	-	-	-	-	-	-
10-May-18	bdc4.5	-	-	-	-	0.28	-	-	-	-	-	-
10-May-18	bdc5.0	-	-	-	-	0.28	-	-	-	-	-	-
10-May-18	bdc6.0	-	-	-	-	0.55	-	-	-	-	-	-
14-Jun-18	bdc0.5	ND	ND	ND	0.00559	ND	ND	0.04660	0.00088	ND	ND	ND
14-Jun-18	bdc1.0	ND	ND	ND	0.00410	0.62	0.00005	0.01770	0.00115	0.0008	ND	ND
14-Jun-18	bdc1.5	ND	ND	ND	0.00448	0.52	0.00030	0.01410	0.00123	0.0011	ND	ND
14-Jun-18	bdc2.0	ND	ND	0.00010	0.00776	0.47	ND	0.01430	0.00123	0.0018	ND	0.0041
14-Jun-18	bdc3.0	ND	ND	ND	0.00552	0.50	0.00006	0.02120	0.00143	0.0019	ND	0.0075
14-Jun-18	bdc4.5	ND	ND	0.00009	0.00407	0.48	0.00010	0.01540	0.00157	0.0029	ND	0.0080
14-Jun-18	bdc5.0	0.0013	ND	0.00012	0.00483	0.59	0.00008	0.01730	0.00219	0.0027	ND	0.0054
14-Jun-18	bdc6.0	0.0014	0.000051	0.00012	0.00524	1.06	0.00011	0.02430	0.00262	0.0034	ND	0.0061
12-Jul-18	bdc0.5	-	-	-	-	ND	-	-	-	-	-	-
12-Jul-18	bdc1.0	-	-	-	-	0.40	-	-	-	-	-	-
12-Jul-18	bdc1.5	-	-	-	-	0.46	-	-	-	-	-	-
12-Jul-18	bdc2.0	-	-	-	-	0.42	-	-	-	-	-	-
12-Jul-18	bdc3.0	-	-	-	-	0.62	-	-	-	-	-	-
12-Jul-18	bdc4.5	-	-	-	-	0.39	-	-	-	-	-	-
12-Jul-18	bdc5.0	-	-	-	-	0.50	-	-	-	-	-	-
12-Jul-18	bdc6.0	-	-	-	-	0.53	-	-	-	-	-	-
09-Aug-18	bdc0.5	-	-	-	-	ND	-	-	-	-	-	-
09-Aug-18	bdc1.0	-	-	-	-	0.39	-	-	-	-	-	-
09-Aug-18	bdc1.5	-	-	-	-	0.46	-	-	-	-	-	-
09-Aug-18	bdc2.0	-	-	-	-	0.36	-	-	-	-	-	-
09-Aug-18	bdc3.0	-	-	-	-	0.57	-	-	-	-	-	-
09-Aug-18	bdc4.5	-	-	-	-	0.55	-	-	-	-	-	-
09-Aug-18	bdc5.0	-	-	-	-	0.59	-	-	-	-	-	-
09-Aug-18	bdc6.0	-	-	-	-	0.56	-	-	-	-	-	-
13-Sep-18	bdc0.5	ND	ND	ND	0.00648	ND	ND	0.03880	0.00076	0.0003	ND	0.0017
13-Sep-18	bdc1.0	ND	ND	ND	0.00384	0.39	ND	0.00941	0.00051	0.0006	ND	ND
13-Sep-18	bdc1.5	ND	ND	ND	0.00918	0.51	ND	0.00320	0.00058	0.0011	ND	ND
13-Sep-18	bdc2.0	ND	ND	0.00010	0.00467	0.37	ND	0.01180	0.00094	0.0134	ND	0.0033
13-Sep-18	bdc3.0	ND	ND	ND	0.00440	0.56	ND	0.02080	0.00089	0.0021	ND	0.0015
13-Sep-18	bdc4.5	0.0010	ND	ND	0.00406	0.45	ND	0.01060	0.00132	0.0036	ND	0.0064
13-Sep-18	bdc5.0	0.0011	ND	ND	0.00346	0.57	ND	0.00843	0.00176	0.0036	ND	0.0072
13-Sep-18	bdc6.0	0.0017	ND	ND	0.00331	0.57	ND	0.01890	0.00212	0.0041	ND	0.0018
11-Oct-18	bdc0.5	-	-	-	-	ND	-	-	-	-	-	-
11-Oct-18	bdc1.0	-	-	-	-	0.30	-	-	-	-	-	-
11-Oct-18	bdc1.5	-	-	-	-	ND	-	-	-	-	-	-
11-Oct-18	bdc2.0	-	-	-	-	0.51	-	-	-	-	-	-
11-Oct-18	bdc3.0	-	-	-	-	0.67	-	-	-	-	-	-
11-Oct-18	bdc4.5	-	-	-	-	0.83	-	-	-	-	-	-
11-Oct-18	bdc5.0	-	-	-	-	1.00	-	-	-	-	-	-
11-Oct-18	bdc6.0	-	-	-	-	1.07	-	-	-	-	-	-
08-Nov-18	bdc0.5	-	-	-	-	ND	-	-	-	-	-	-
08-Nov-18	bdc1.0	-	-	-	-	ND	-	-	-	-	-	-
08-Nov-18	bdc1.5	-	-	-	-	ND	-	-	-	-	-	-
08-Nov-18	bdc2.0	-	-	-	-	0.43	-	-	-	-	-	-
08-Nov-18	bdc3.0	-	-	-	-	ND	-	-	-	-	-	-
08-Nov-18	bdc4.5	-	-	-	-	0.25	-	-	-	-	-	-
08-Nov-18	bdc5.0	-	-	-	-	0.32	-	-	-	-	-	-
08-Nov-18	bdc6.0	-	-	-	-	0.42	-	-	-	-	-	-
13-Dec-18	bdc1.5	ND	ND	0.00013	0.00944	ND	0.00033	0.07430	0.00196	0.0090	ND	0.0006
13-Dec-18	bdc2.0	ND	ND	0.00013	0.00677	0.45	0.00020	0.05160	0.00224	0.0074	ND	0.0081
13-Dec-18	bdc3.0	ND	ND	0.00022	0.00711	ND	0.00019	0.05100	0.00207	0.0044	ND	0.0352
13-Dec-18	bdc4.5	ND	ND	0.00017	0.00591	0.49	0.00036	0.04890	0.00225	0.0056	ND	0.0301
13-Dec-18	bdc5.0	ND	ND	0.00017	0.00488	0.55	0.00022	0.02890	0.00236	0.0055	ND	0.0271
13-Dec-18	bdc6.0	ND	0.000066	0.00021	0.00471	0.62	0.00014	0.03920	0.00280	0.0057	ND	0.0227

Appendix B
Big Dry Creek 2018 Instream Sampling Results - Mercury

Activity Start Date	Station ID	Mercury, Trec (ug/L)
Detection Limit		0.0005
11-Jan-2018	bdc1.5	0.0010
14-Feb-2018	bdc1.5	0.0015
12-Mar-2018	bdc1.5	0.0010
11-Apr-2018	bdc1.5	0.0010
10-May-2018	bdc1.5	0.0010
7-Jun-2018	bdc1.5	0.0030
19-Jul-2018	bdc1.5	0.0090
30-Jul-2018	bdc1.5	0.0040
9-Aug-2018	bdc1.5	ND
6-Sep-2018	bdc1.5	0.0040
3-Oct-2018	bdc1.5	0.0030
7-Nov-2018	bdc1.5	0.0020
6-Dec-2018	bdc1.5	0.0020

Appendix B

Big Dry Creek 2018 Instream Sampling Results - Flow

Activity Start Date	Station ID	Flow (cfs)
11-Jan-18	bdc2.0	4.71
11-Jan-18	bdc6.0	14.90
08-Feb-18	bdc2.0	11.50
08-Feb-18	bdc6.0	39.80
15-Mar-18	bdc6.0	17.20
11-Apr-18	bdc6.0	29.40
10-May-18	bdc6.0	9.07
14-Jun-18	bdc0.5	20.83
14-Jun-18	bdc1.0	24.10
14-Jun-18	bdc1.5	23.35
14-Jun-18	bdc6.0	28.70
12-Jul-18	bdc3.0	21.04
12-Jul-18	bdc6.0	24.80
09-Aug-18	bdc2.0	17.99
09-Aug-18	bdc3.0	24.76
09-Aug-18	bdc6.0	42.40
13-Sep-18	bdc3.0	18.23
13-Sep-18	bdc6.0	56.10
11-Oct-18	bdc2.0	10.59
11-Oct-18	bdc3.0	25.69
11-Oct-18	bdc6.0	32.90
08-Nov-18	bdc2.0	3.93
08-Nov-18	bdc3.0	30.14
08-Nov-18	bdc6.0	41.10
13-Dec-18	bdc2.0	4.19
13-Dec-18	bdc3.0	19.47
13-Dec-18	bdc6.0	21.50

Appendix C. Boxplots and Time Series Plots for Big Dry Creek 2017 Instream Sampling Program

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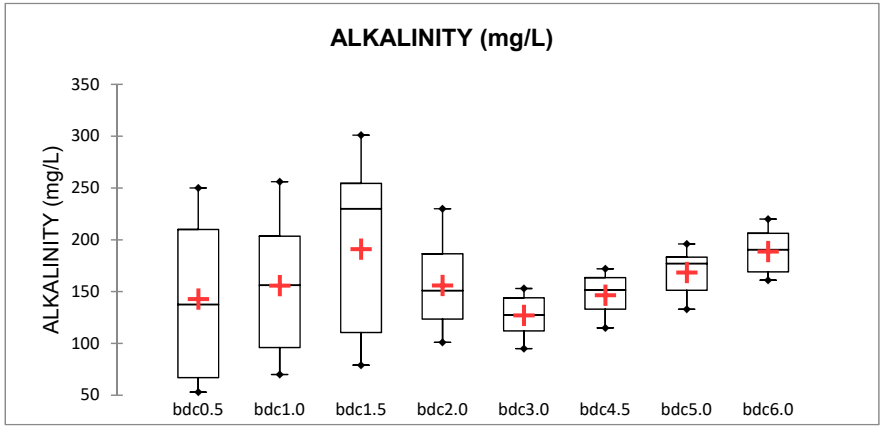
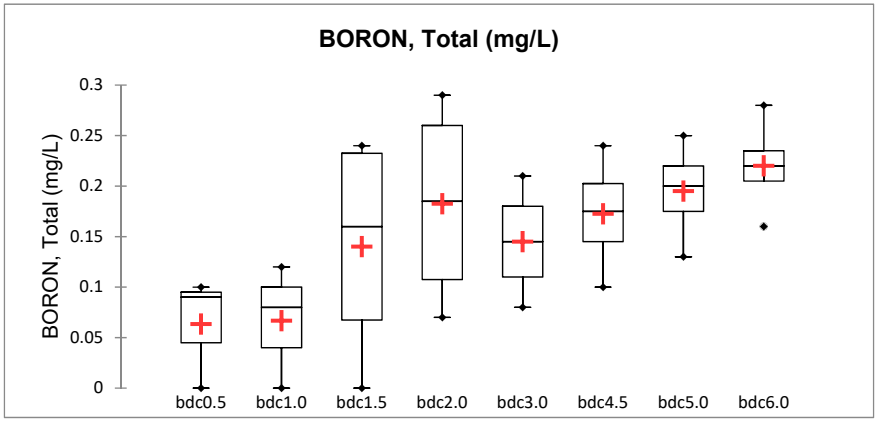
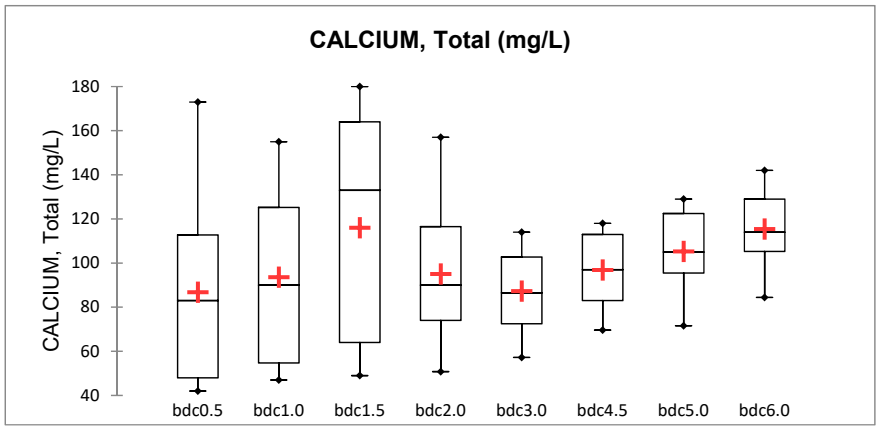
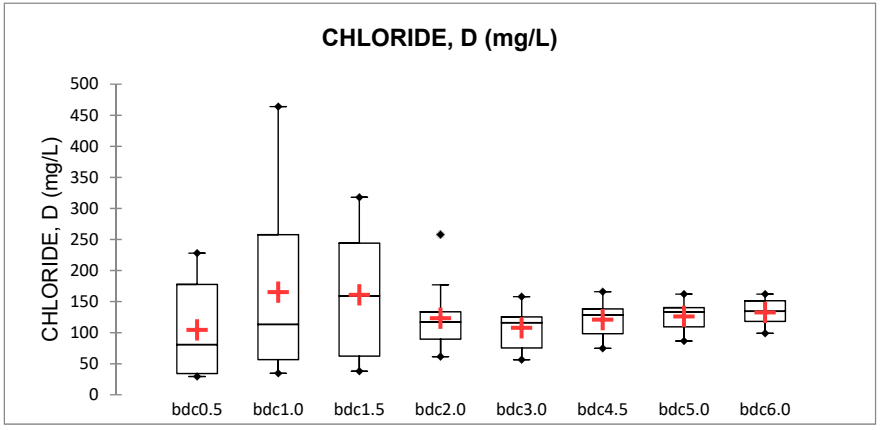
Appendix C

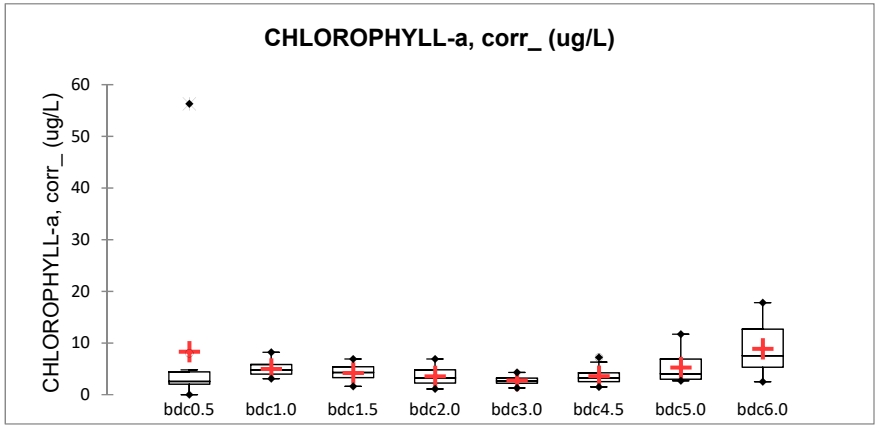
Box Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality Parameters

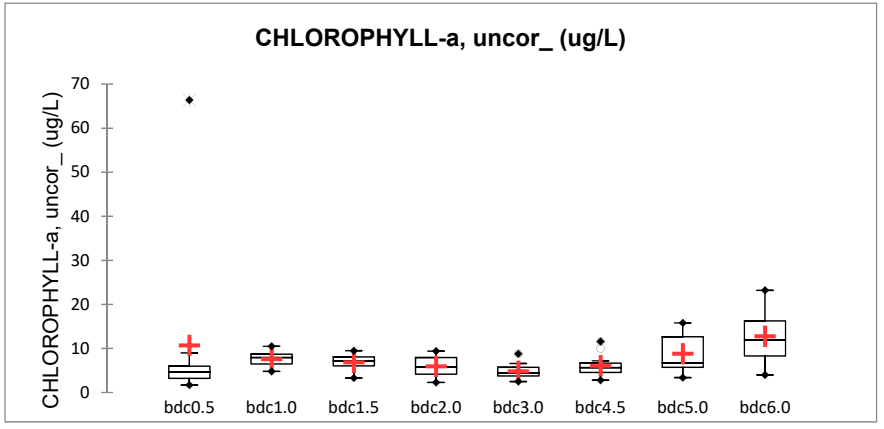






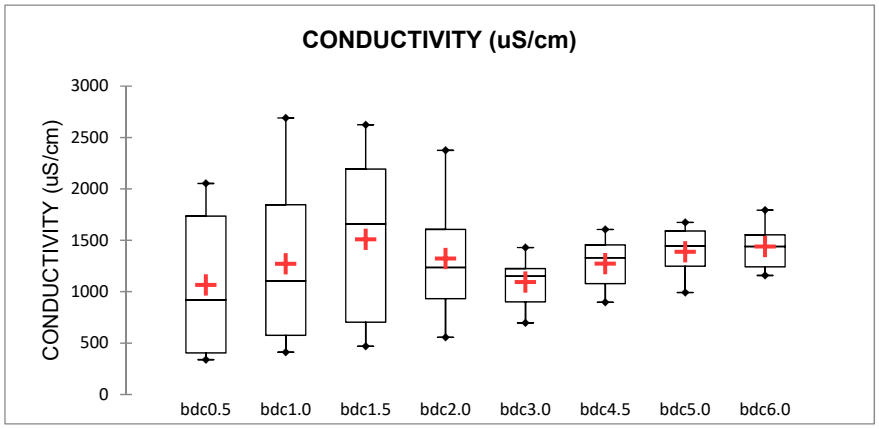


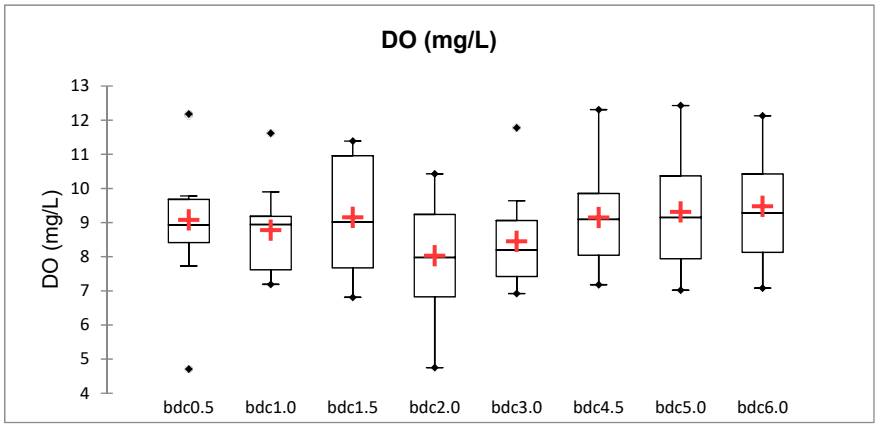


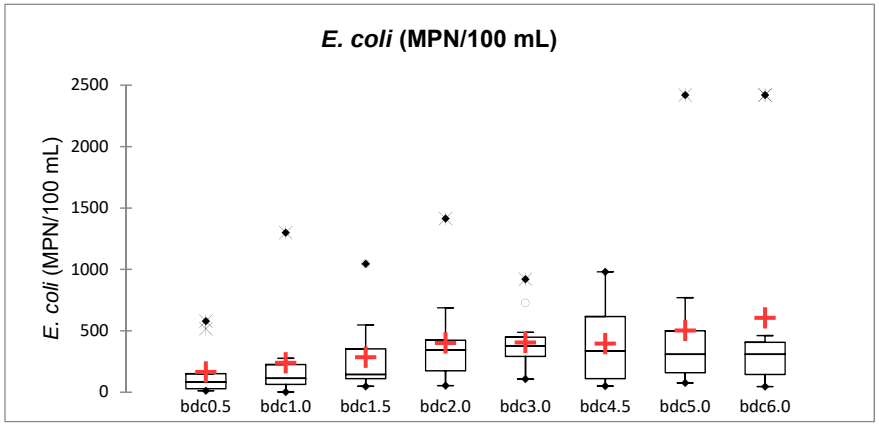


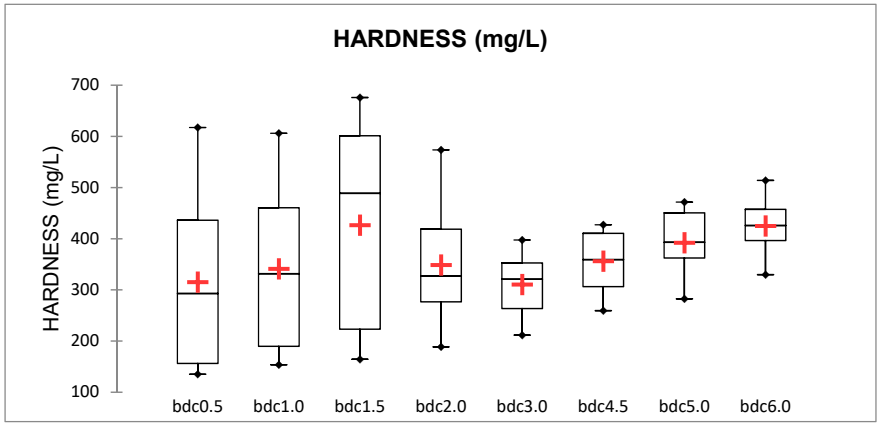
Appendix C

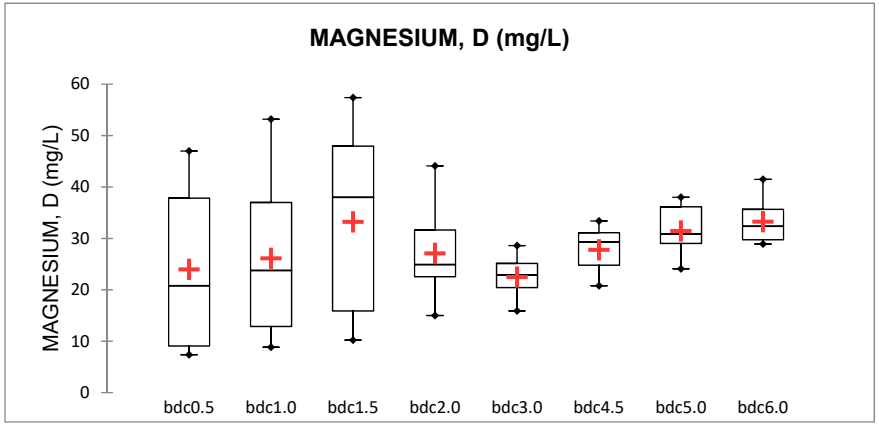
Box Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality Parameters

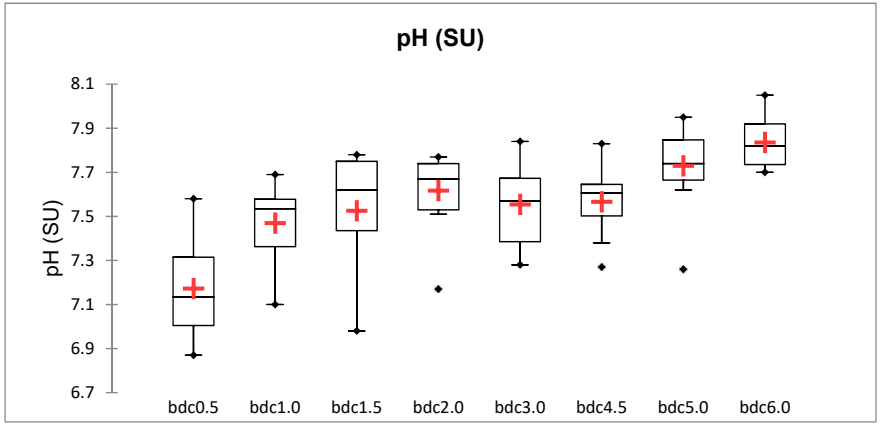


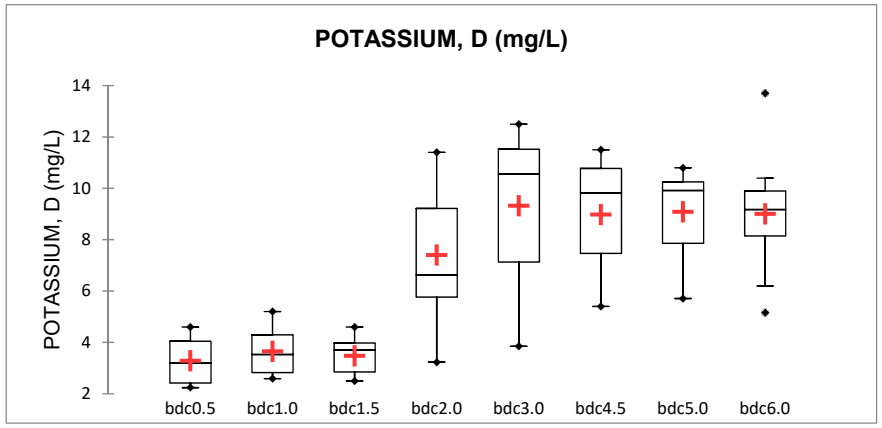


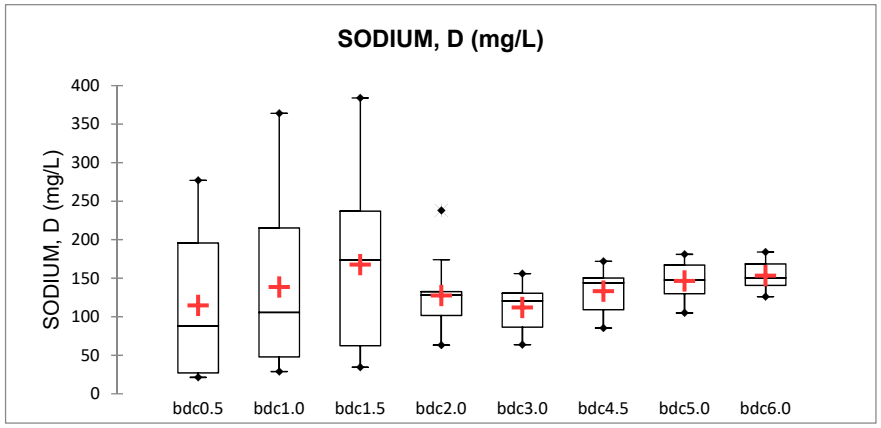


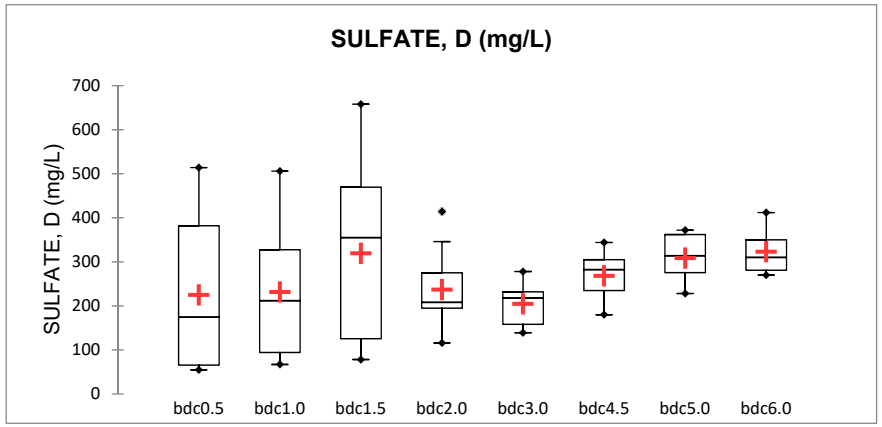


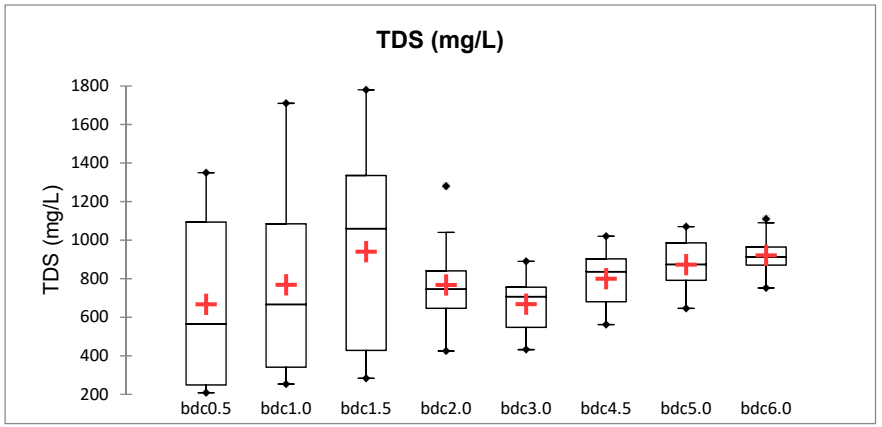


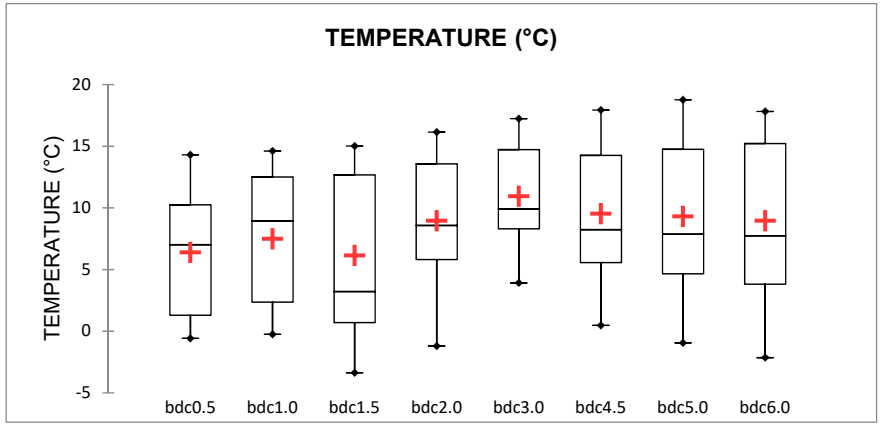


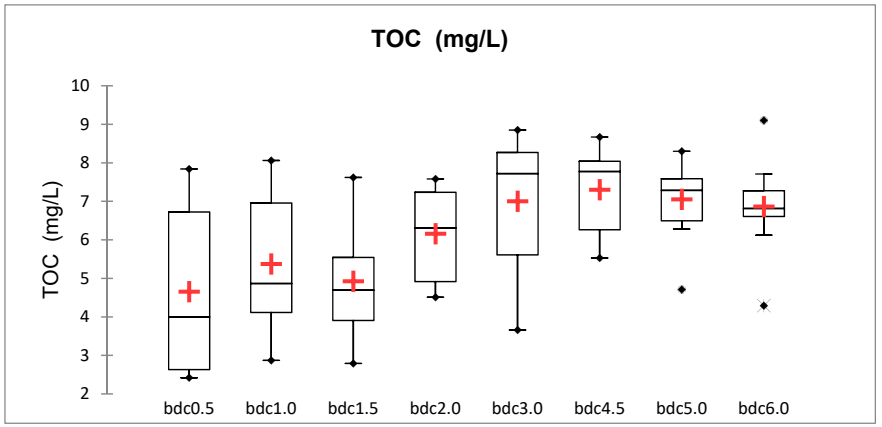

POTASSIUM, D (mg/L)
POTASSIUM, D (mg/L)
14
12
10
8
6
4
2
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0


SODIUM, D (mg/L)
SODIUM, D (mg/L)
400
350
300
250
200
150
100
50
0
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0

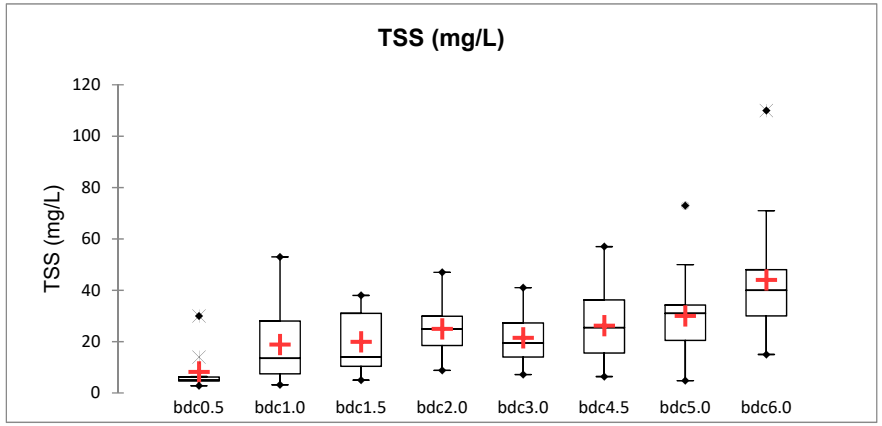

SULFATE, D (mg/L)
SULFATE, D (mg/L)
700
600
500
400
300
200
100
0
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0

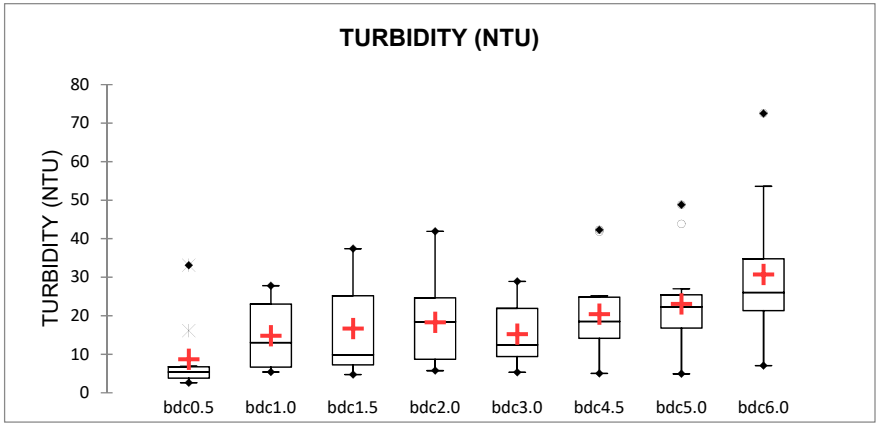

TDS (mg/L)
TDS (mg/L)
1800
1600
1400
1200
1000
800
600
400
200
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0

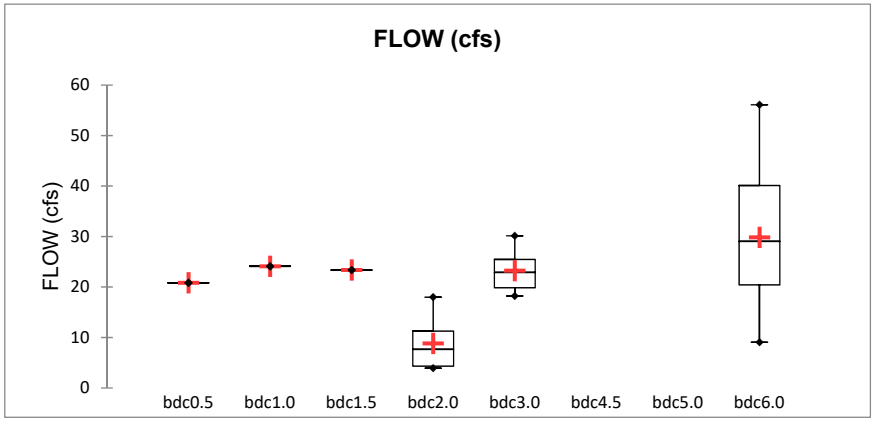

TEMPERATURE (°C)
TEMPERATURE (°C)
20
15
10
5
0
-5
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0


TOC (mg/L)
TOC (mg/L)
10
9
8
7
6
5
4
3
2
bdc0.5
bdc1.0
bdc1.5
bdc2.0
bdc3.0
bdc4.5
bdc5.0
bdc6.0

Appendix C
Box Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality Parameters

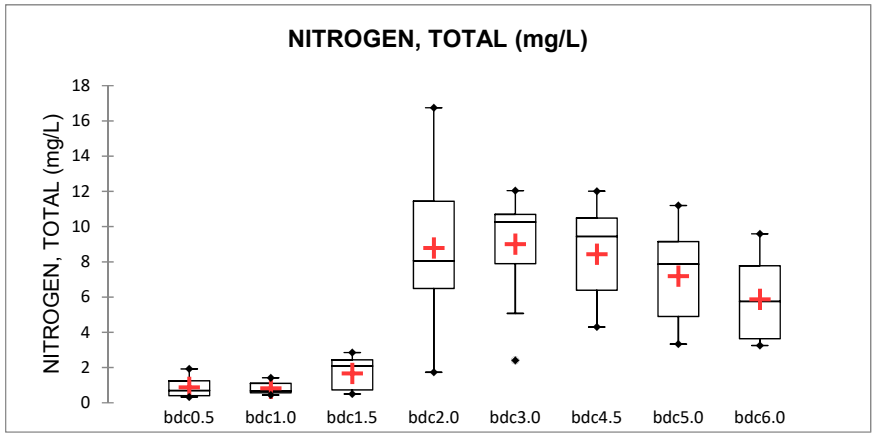


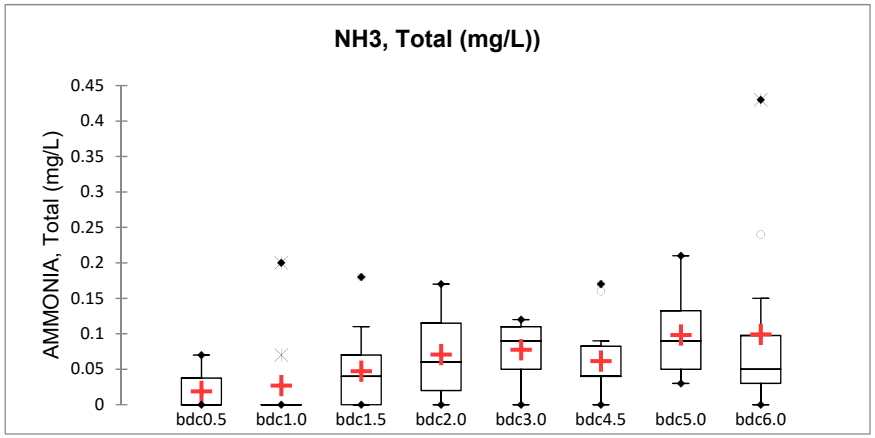


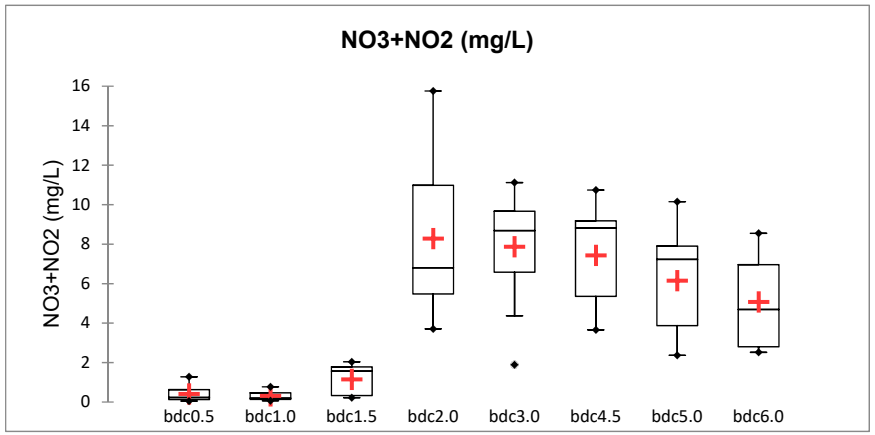


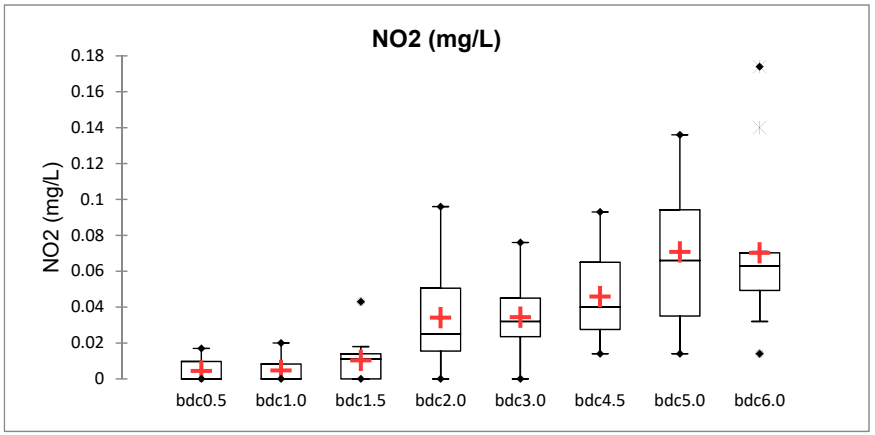
Note: Cyanide boxplots not shown,-- all values are non-detect

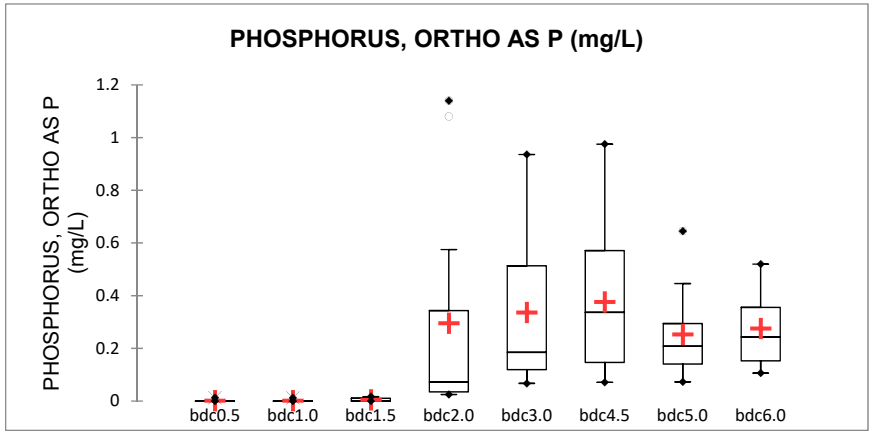
Appendix C
Box Plots for Big Dry Creek 2018 Instream Sampling Program - Nutrients

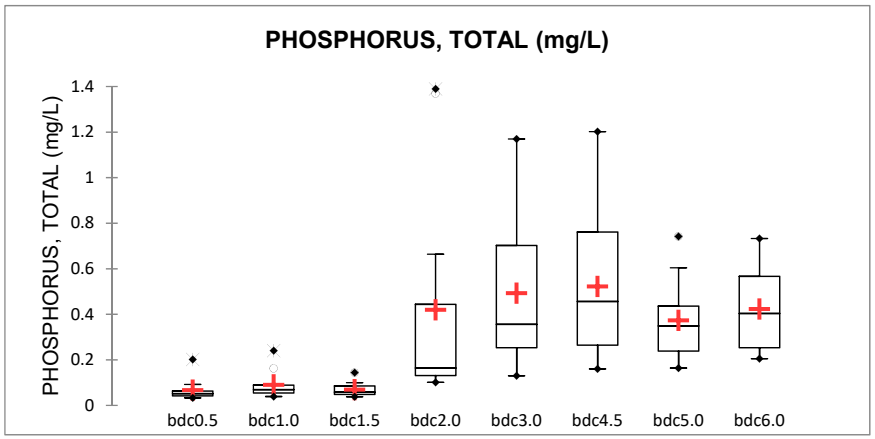




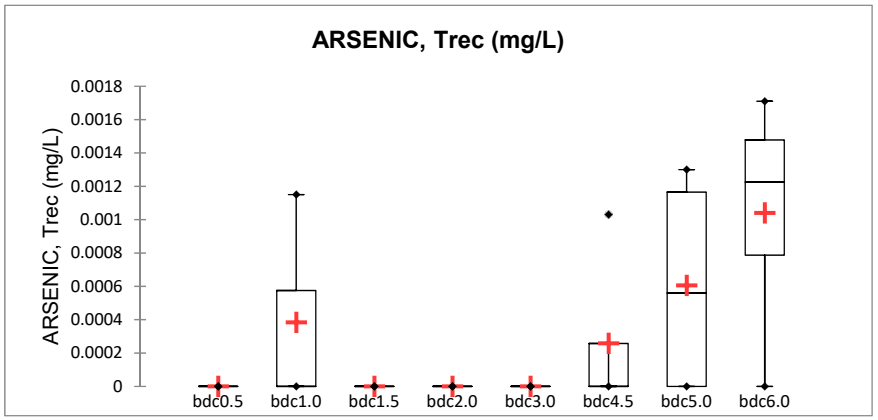


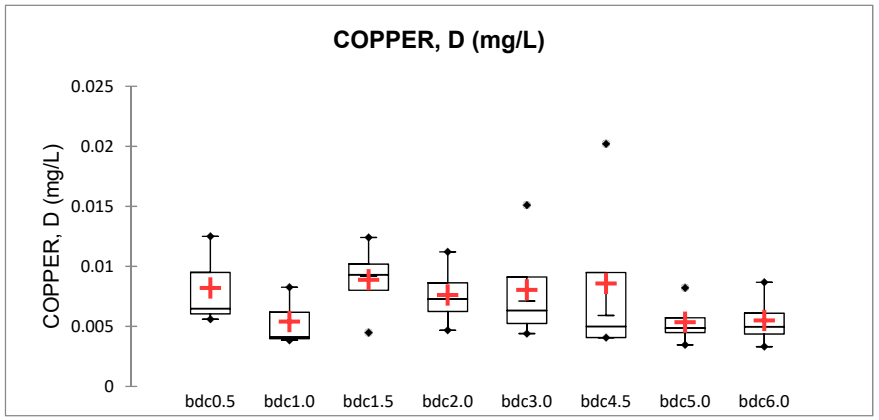


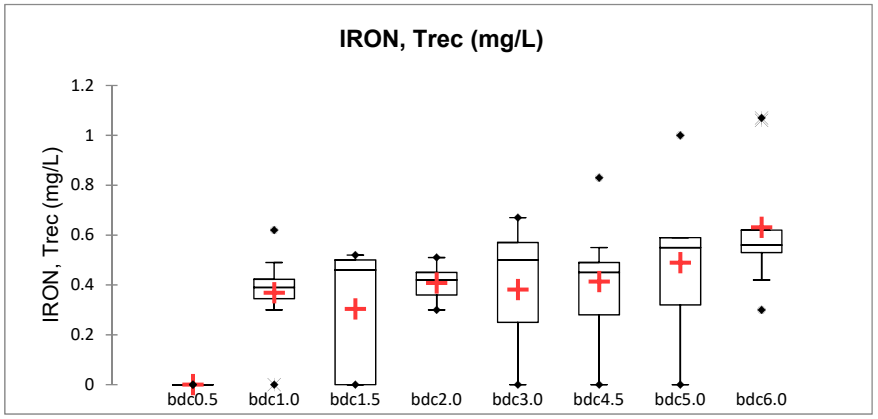


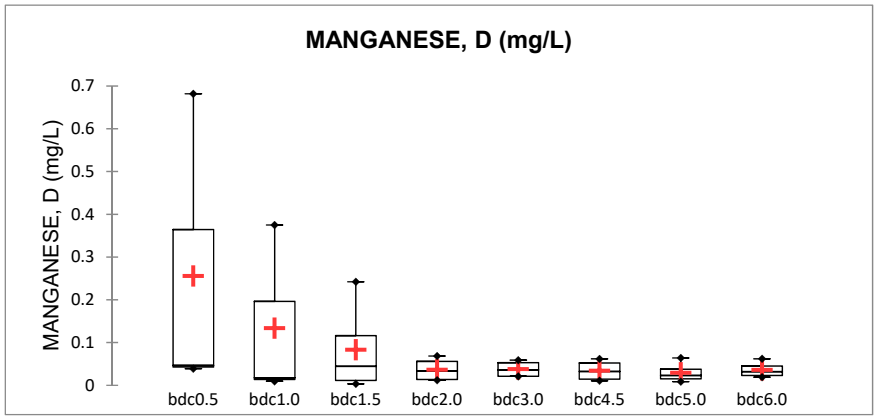


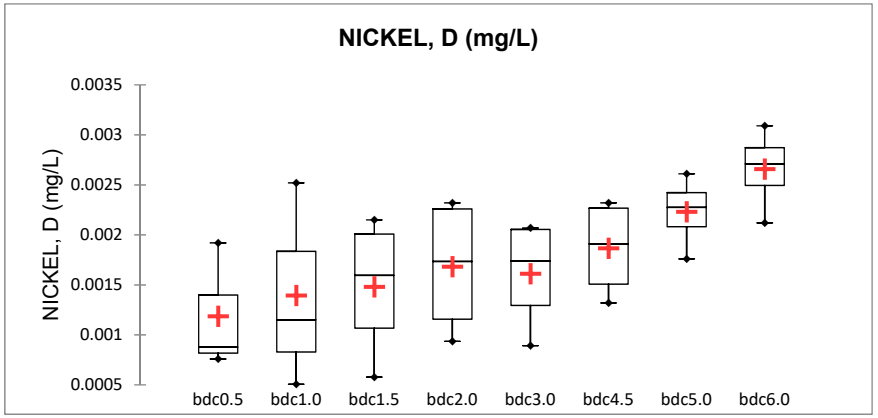
Appendix C
Box Plots fro Big Dry Creek 2018 Instream Sampling Program - Metals

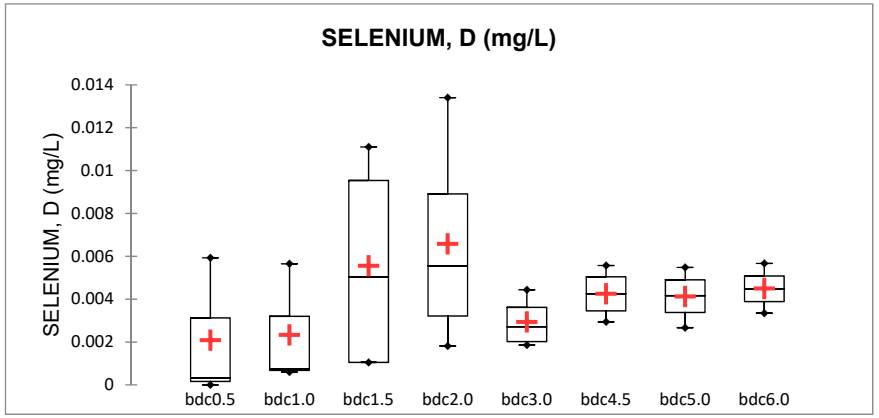




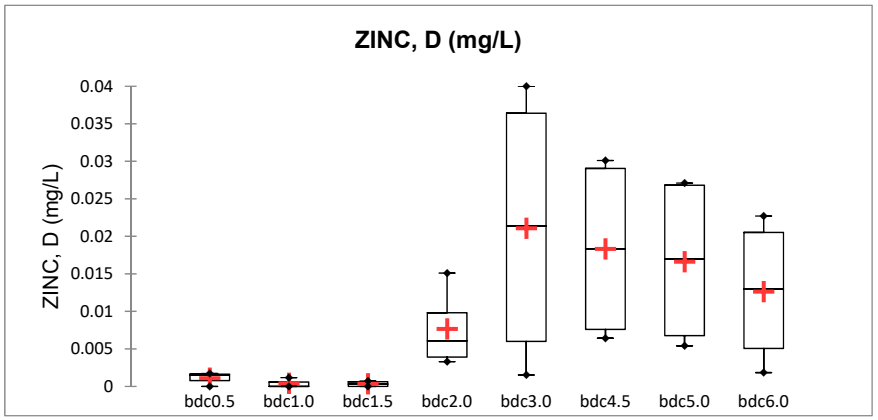


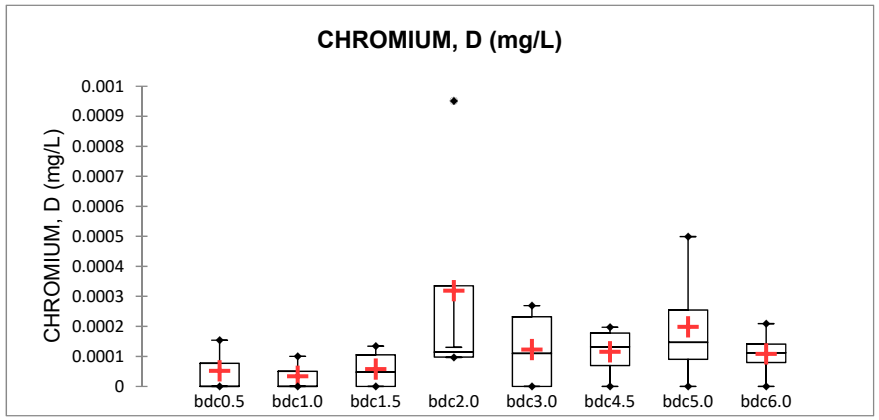


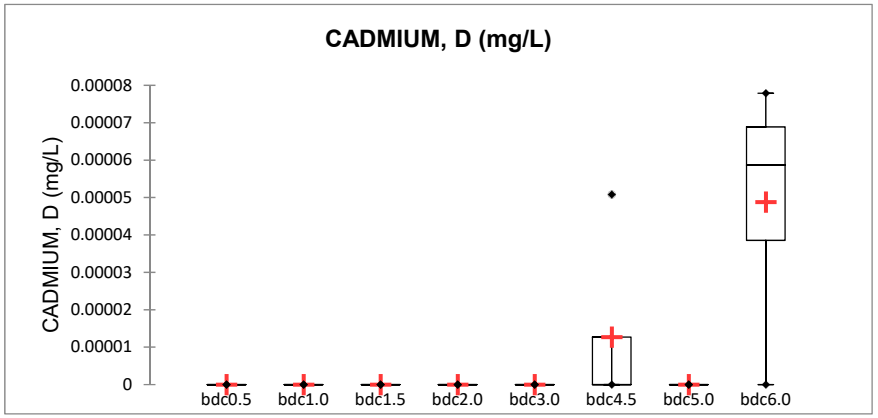


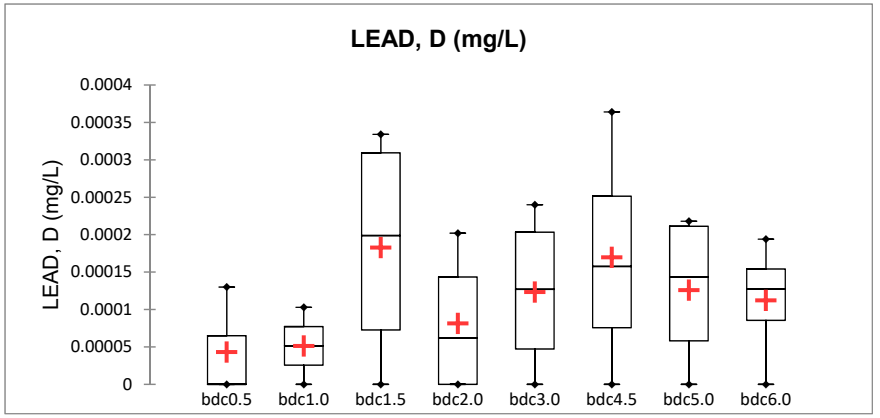


Appendix C
Box Plots fro Big Dry Creek 2018 Instream Sampling Program - Metals





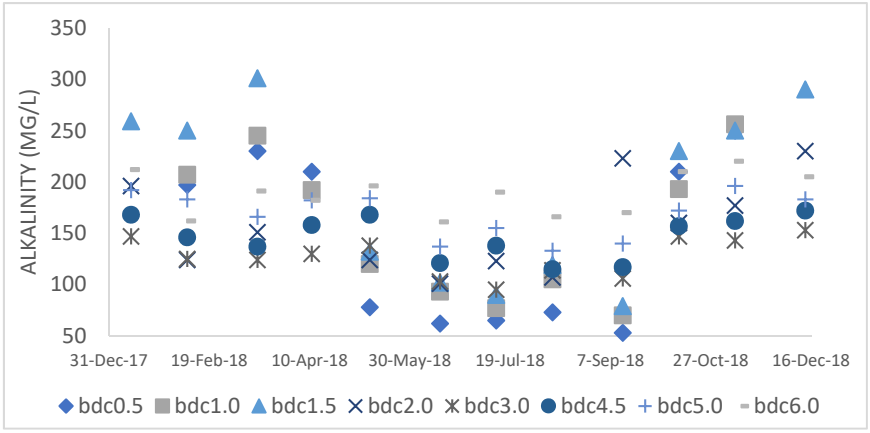


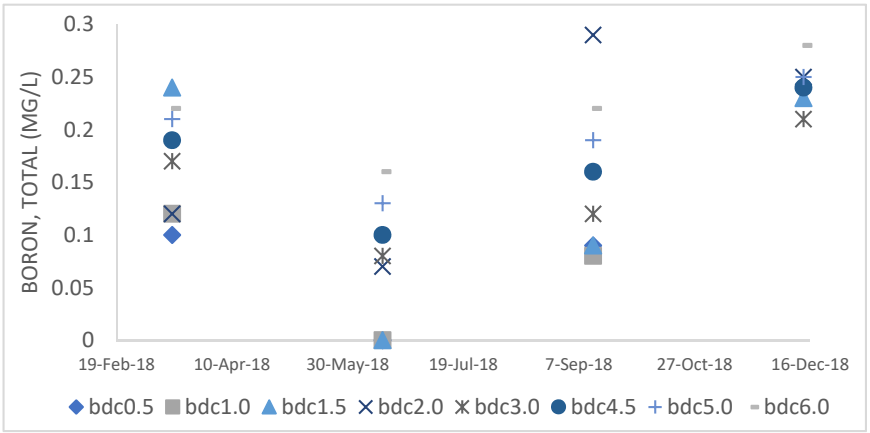


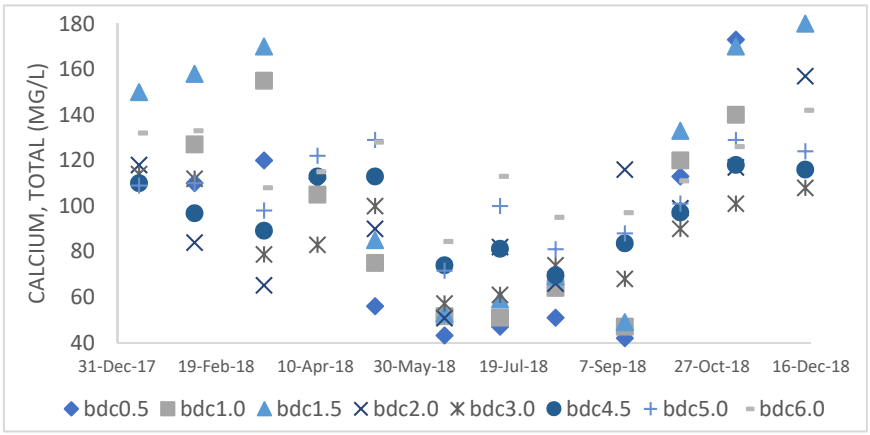
Note: Silver was not detected in 2018 and is not show. Mercury is only mointored at one location and is not shown.

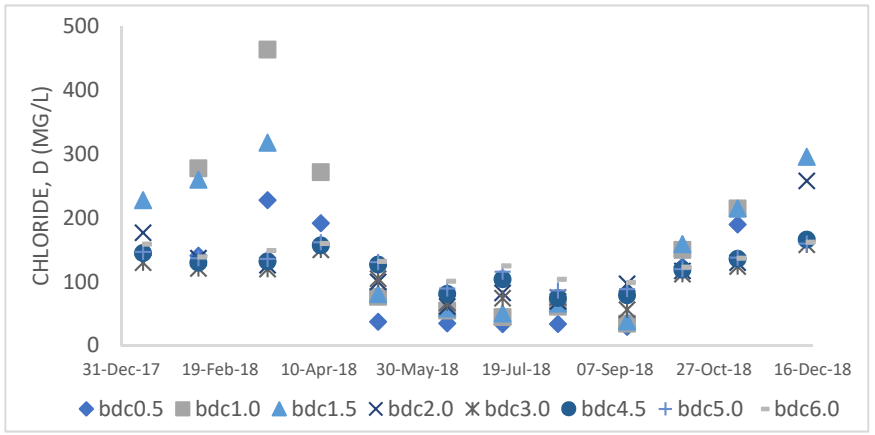
Appendix C

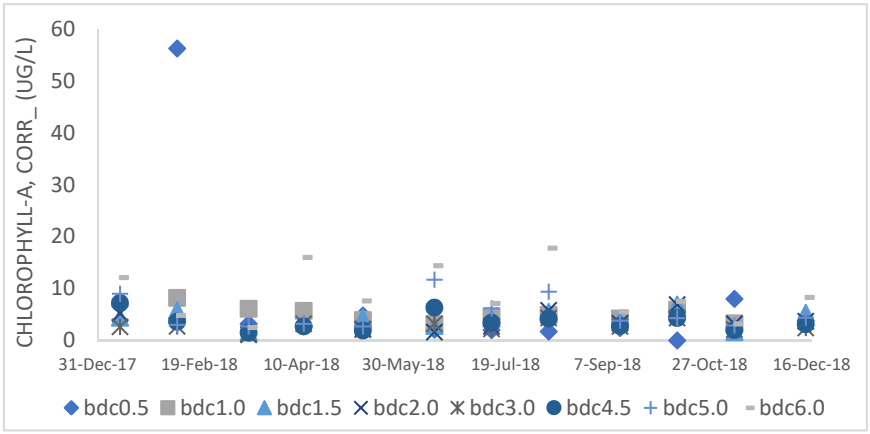
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality

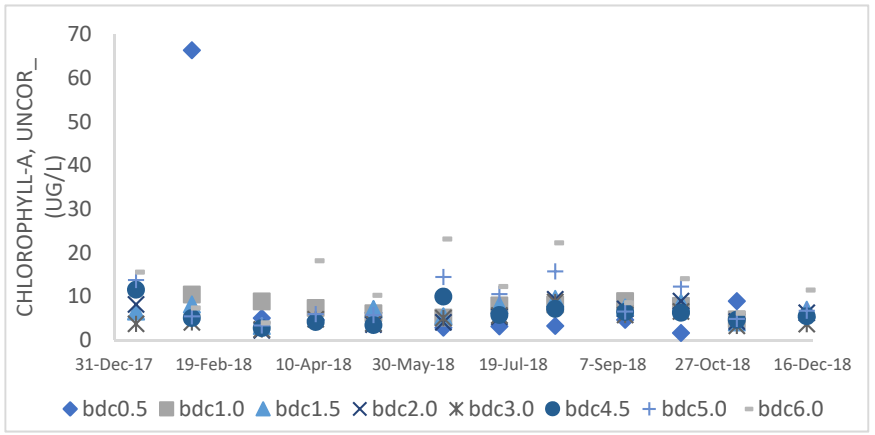




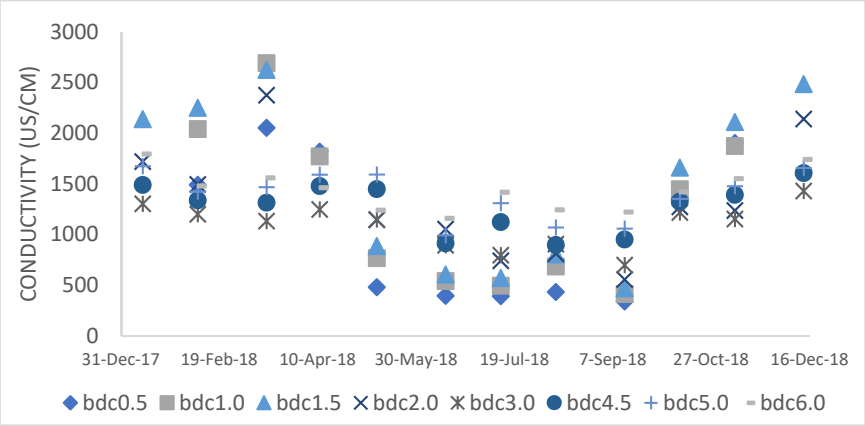


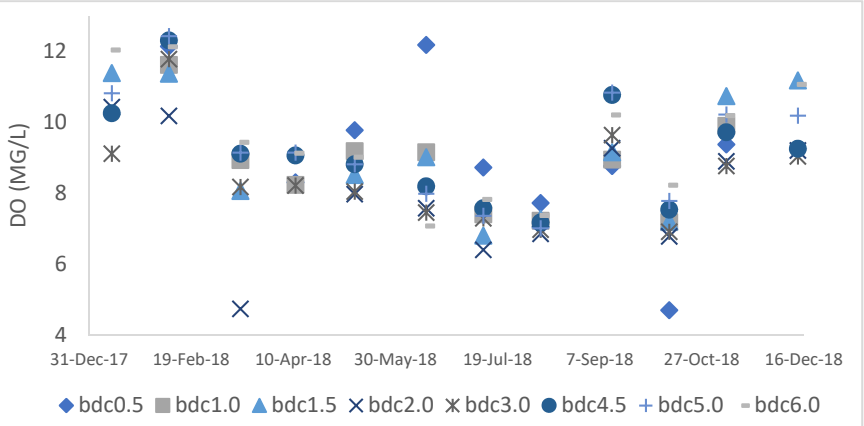


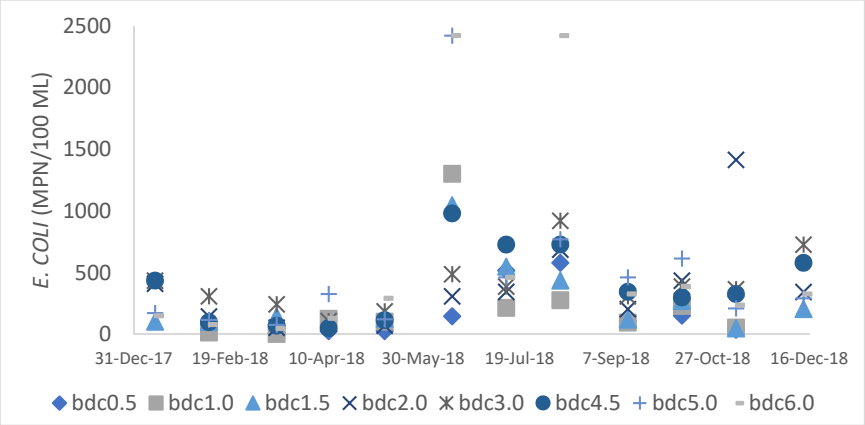


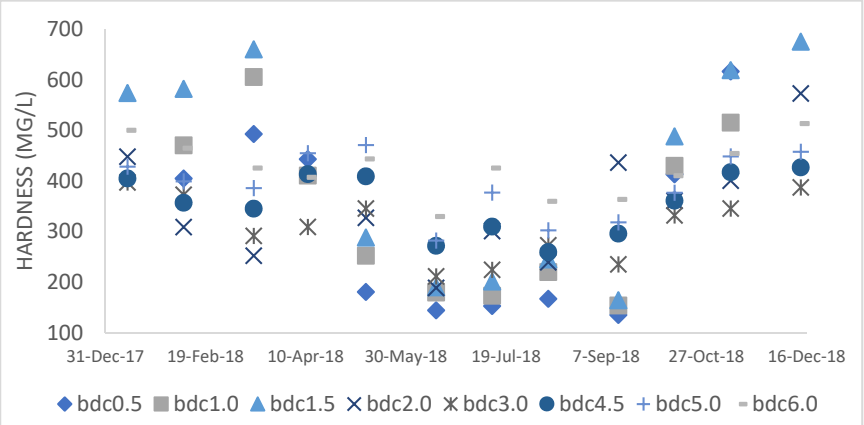


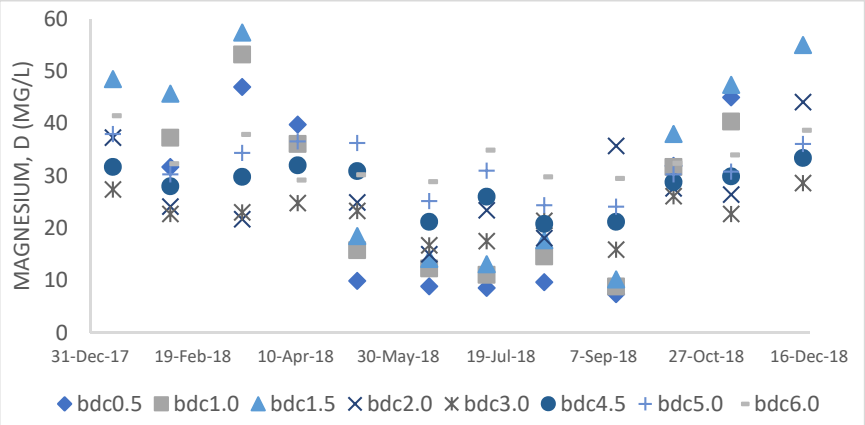
Appendix C
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality

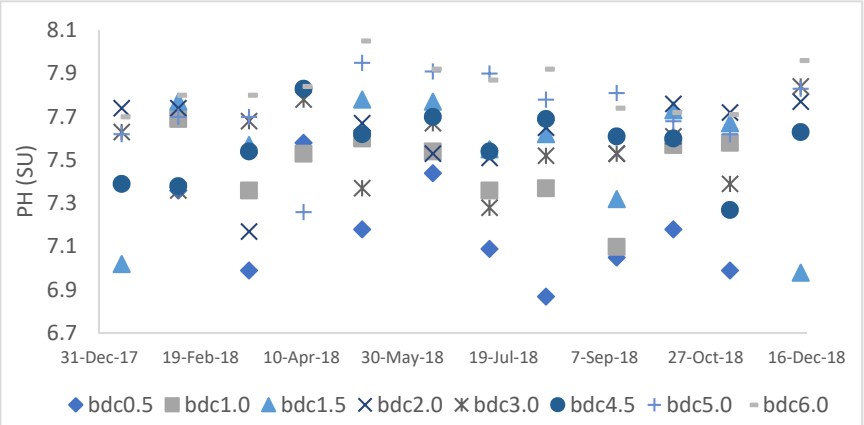


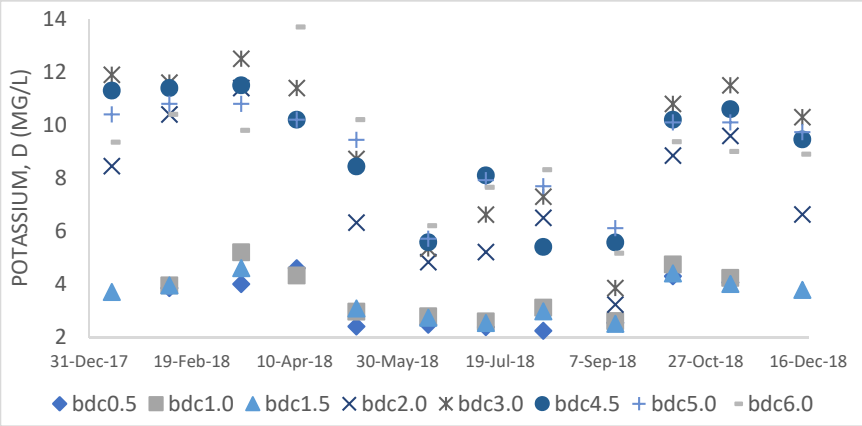


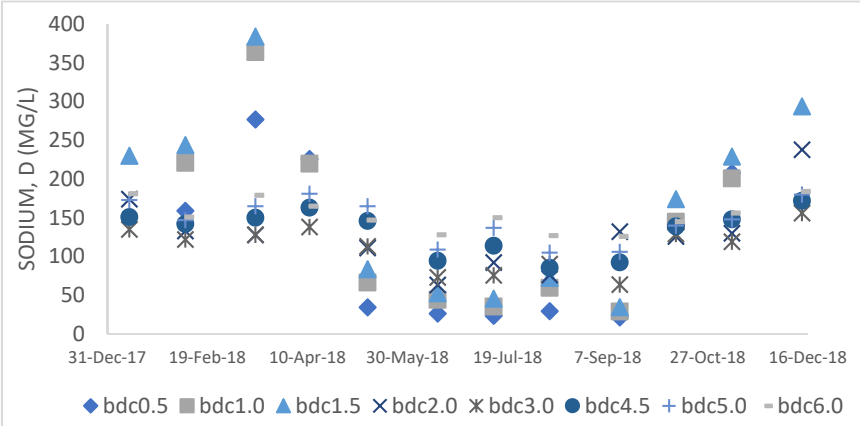









POTASSIUM, D (MG/L)
14
12
10
8
6
4
2
31-Dec-17
19-Feb-18
10-Apr-18
30-May-18
19-Jul-18
7-Sep-18
27-Oct-18
16-Dec-18
bdc0.5 bdc1.0 bdc1.5 bdc2.0 bdc3.0 bdc4.5 bdc5.0 bdc6.0


SODIUM, D (MG/L)
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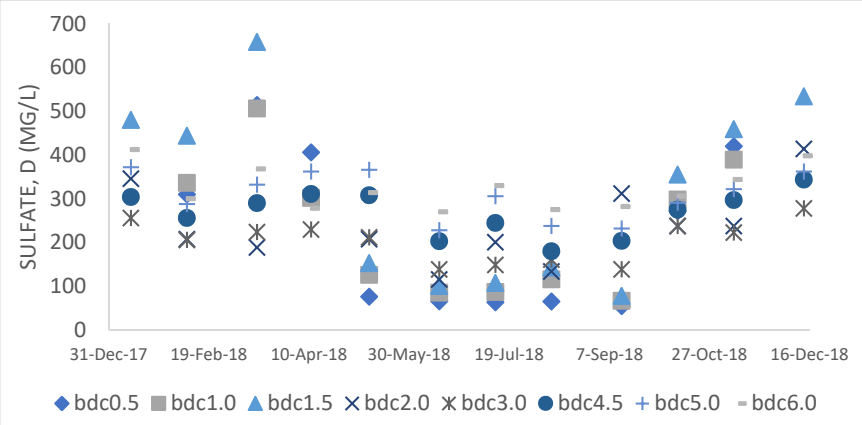
350
300
250
200
150
100
50
0
31-Dec-17
19-Feb-18
10-Apr-18
30-May-18
19-Jul-18
7-Sep-18
27-Oct-18
16-Dec-18
bdc0.5 bdc1.0 bdc1.5 bdc2.0 bdc3.0 bdc4.5 bdc5.0 bdc6.0


SULFATE, D (MG/L)
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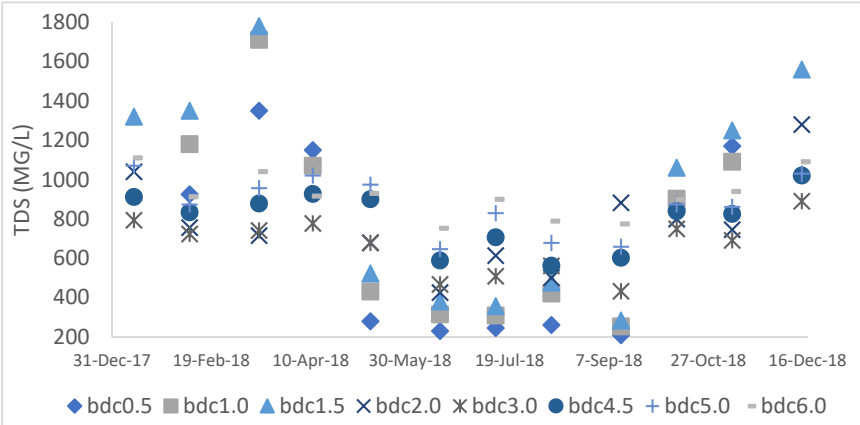
600
500
400
300
200
100
0
31-Dec-17
19-Feb-18
10-Apr-18
30-May-18
19-Jul-18
7-Sep-18
27-Oct-18
16-Dec-18
bdc0.5 bdc1.0 bdc1.5 bdc2.0 bdc3.0 bdc4.5 bdc5.0 bdc6.0


TDS (MG/L)
1800
1600
1400
1200
1000
800
600
400
200
31-Dec-17
19-Feb-18
10-Apr-18
30-May-18
19-Jul-18
7-Sep-18
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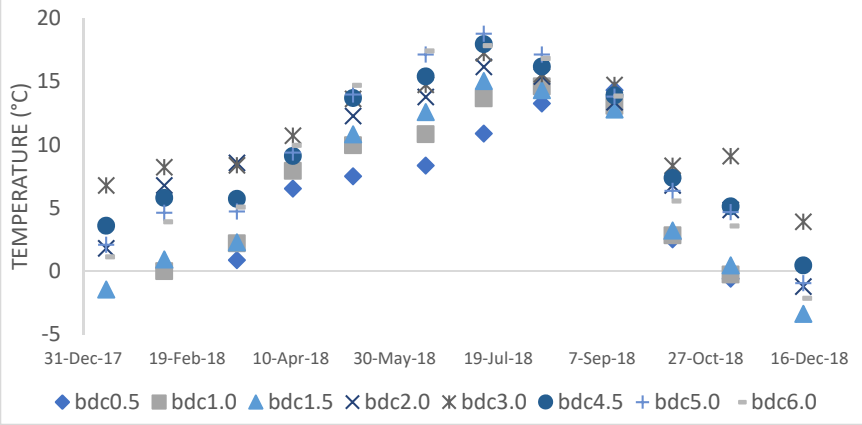
TEMPERATURE (°C)
20
15
10
5
0
-5
31-Dec-17
19-Feb-18
10-Apr-18
30-May-18
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7-Sep-18
27-Oct-18
16-Dec-18
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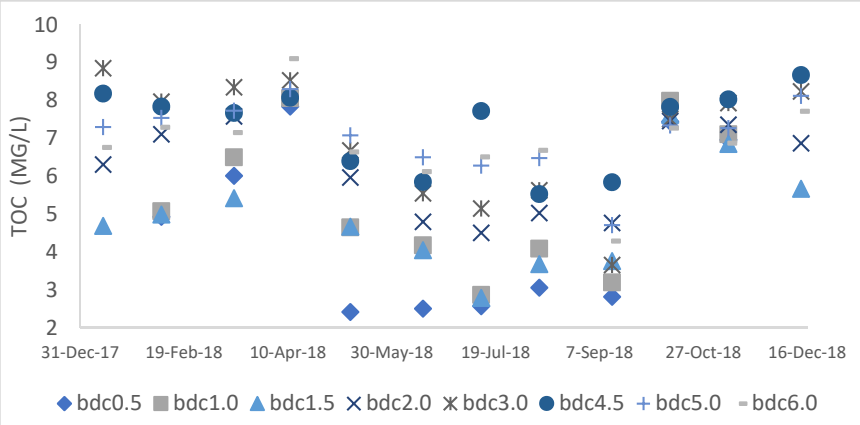
TOC (MG/L)
10
9
8
7
6
5
4
3
2
31-Dec-17
19-Feb-18
10-Apr-18
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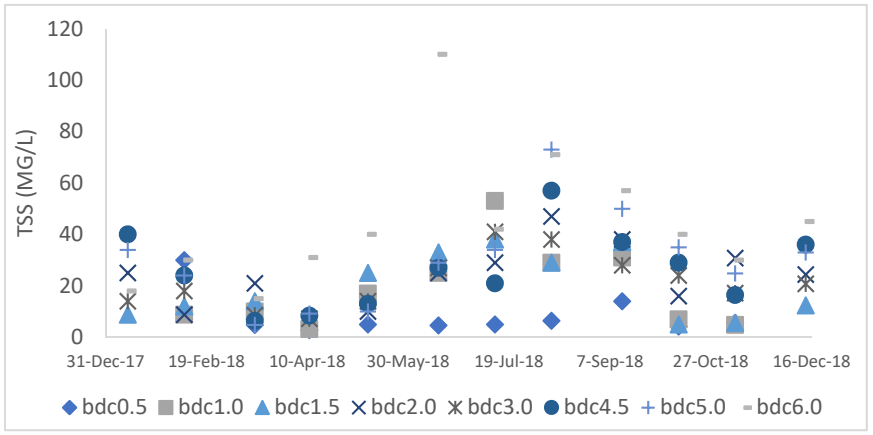
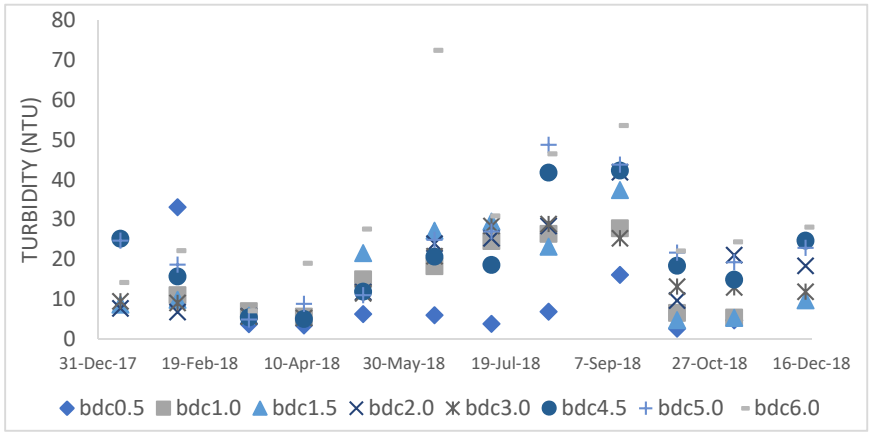
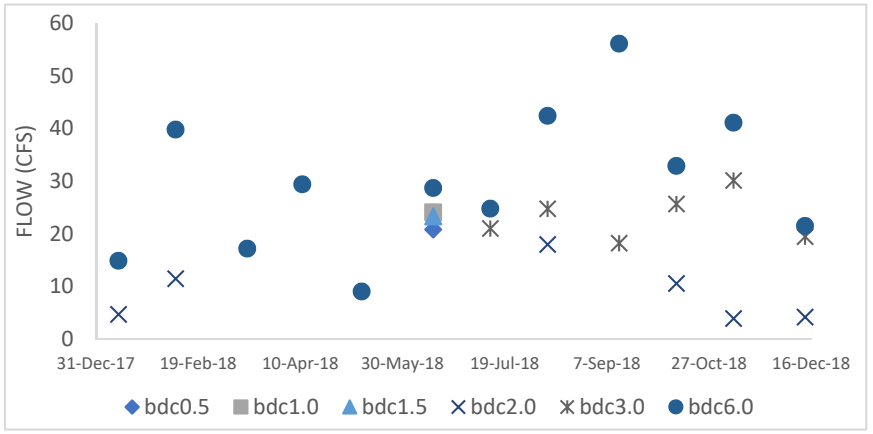
19-Jul-18
7-Sep-18
27-Oct-18
16-Dec-18
bdc0.5 bdc1.0 bdc1.5 bdc2.0 bdc3.0 bdc4.5 bdc5.0 bdc6.0

Appendix C
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - General Water Quality

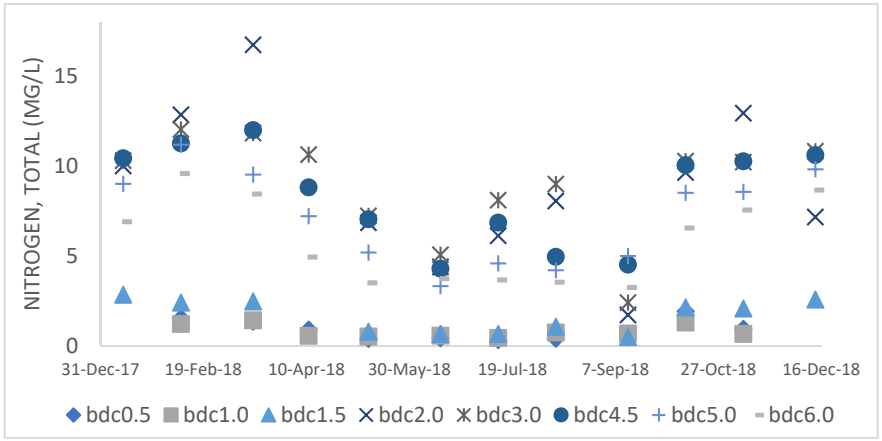


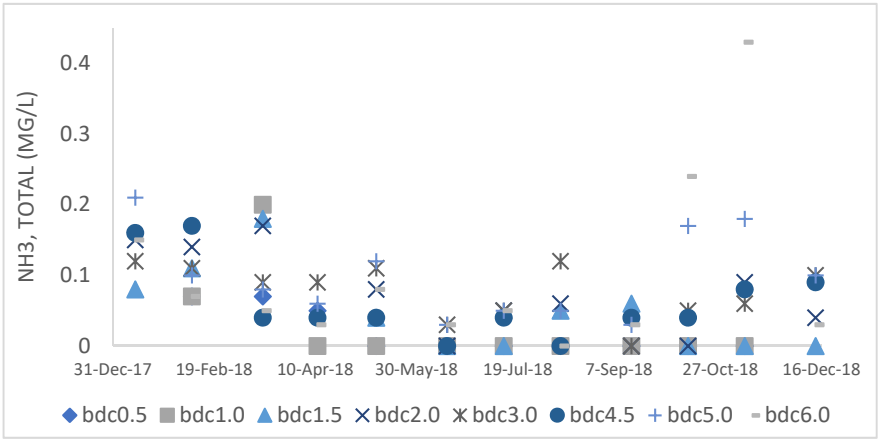


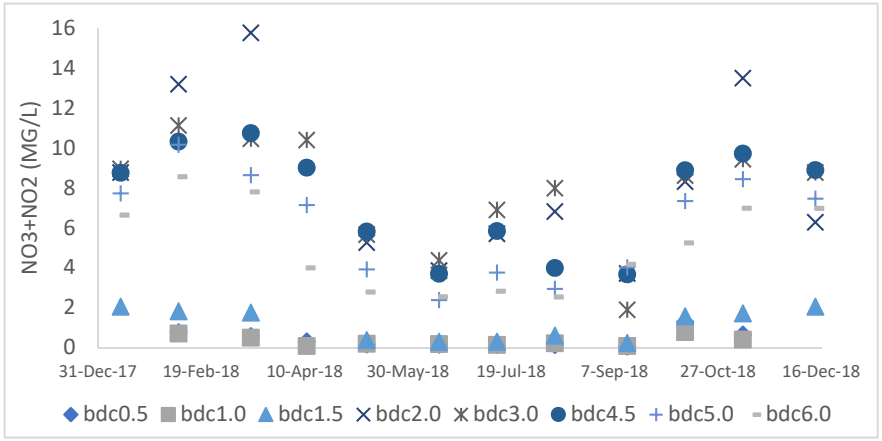


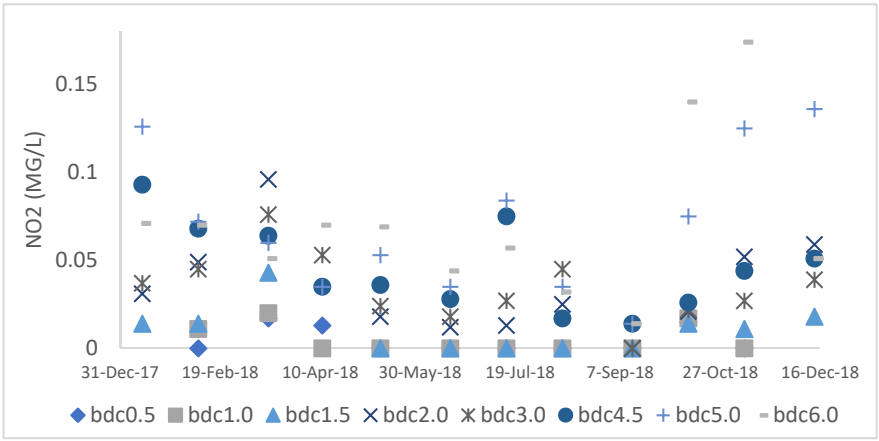
Note: Cyanide Scatter Plots not shown, all values are non-detect.

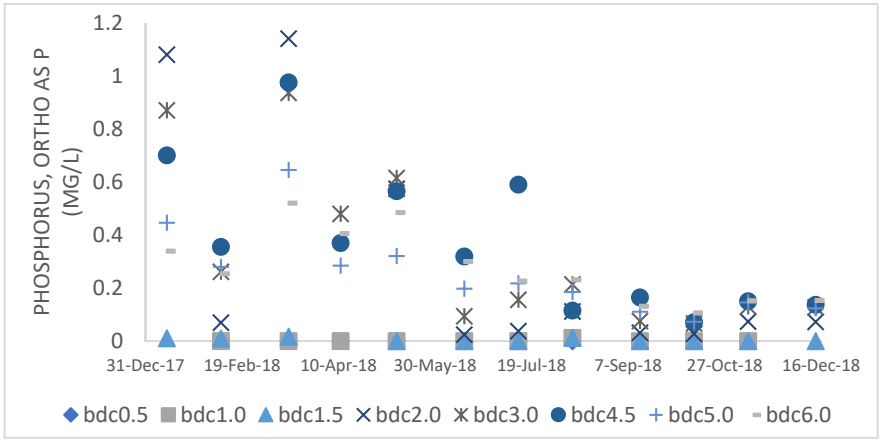
Appendix C
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - Nutrients

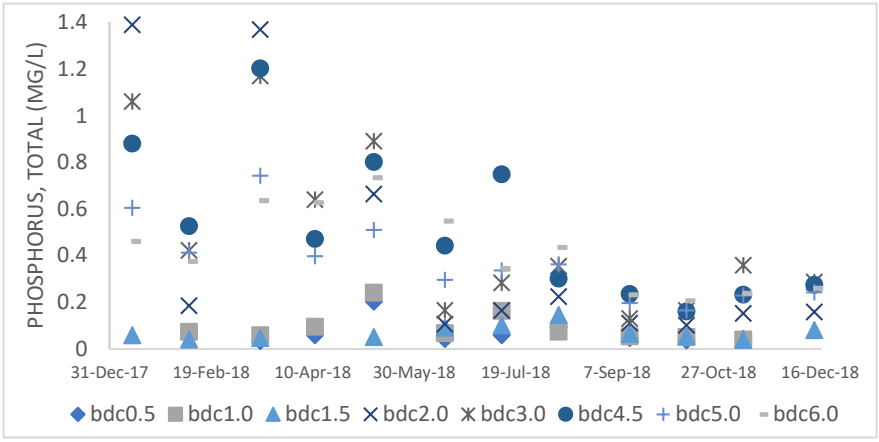




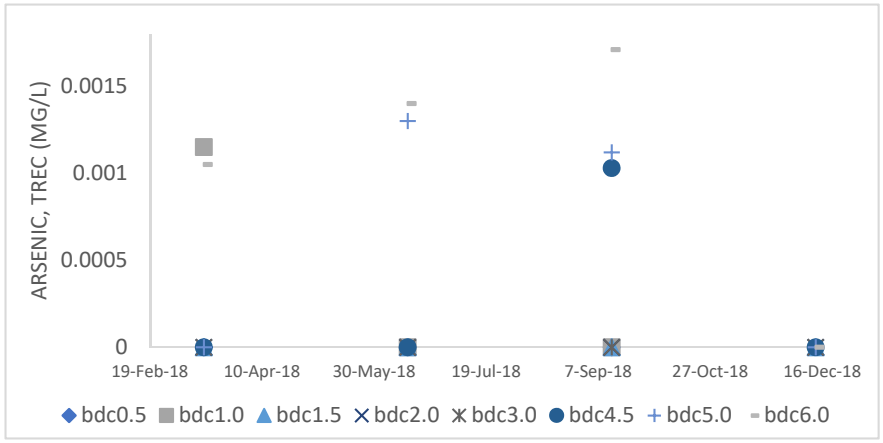


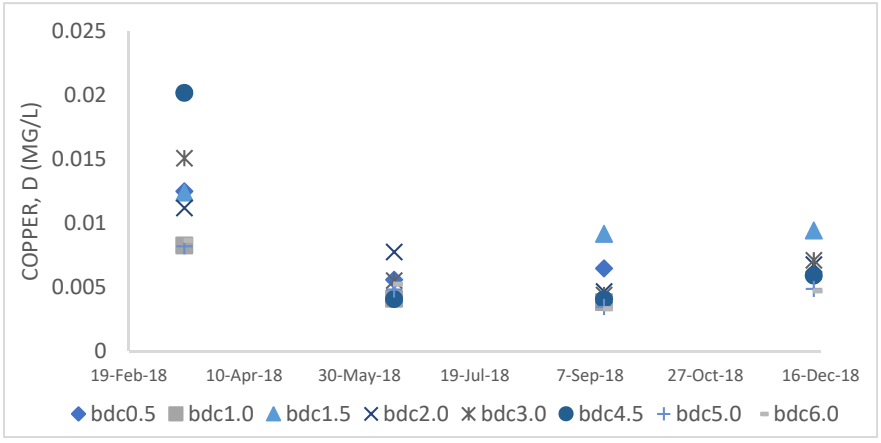


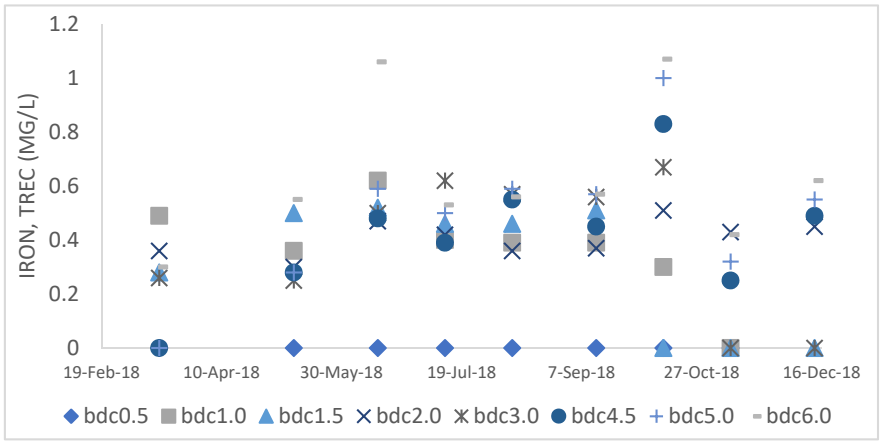


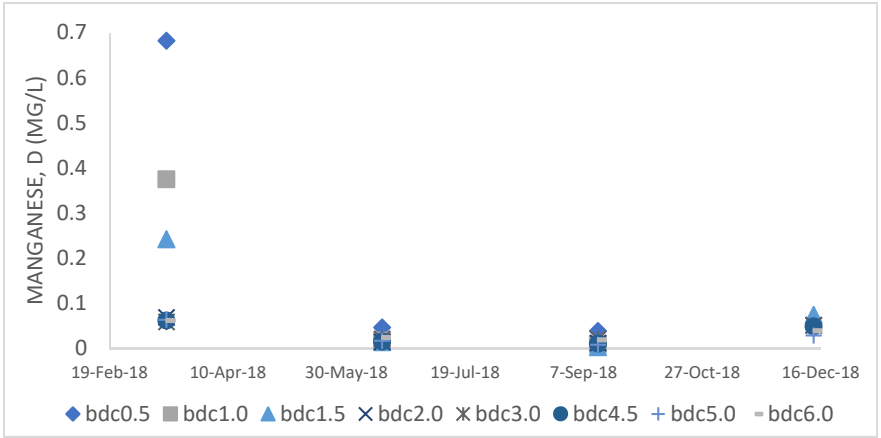


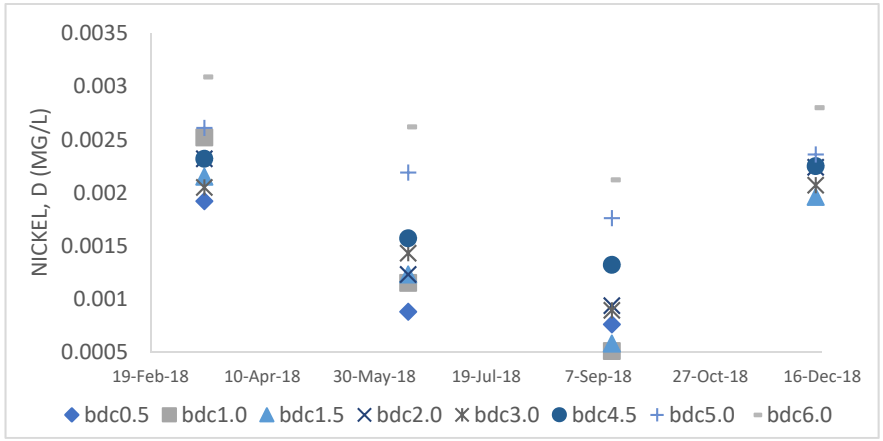
Appendix C
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - Metals

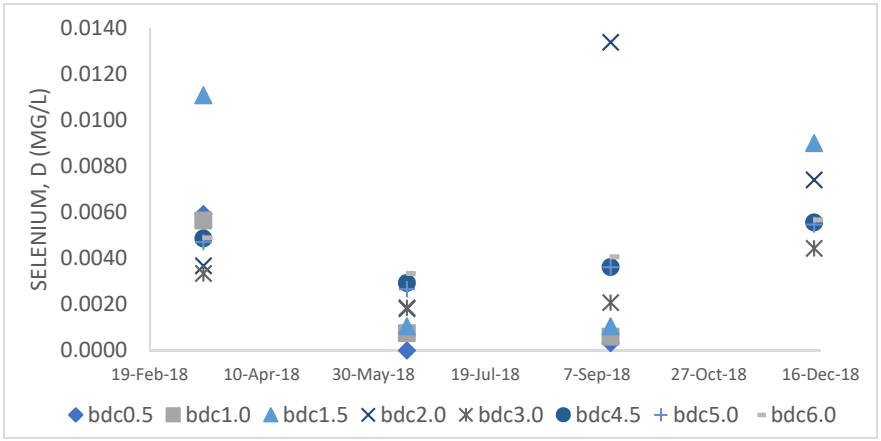




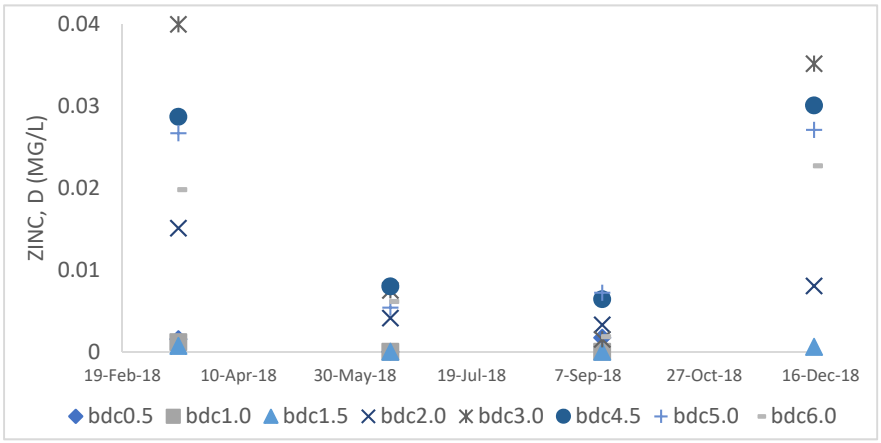


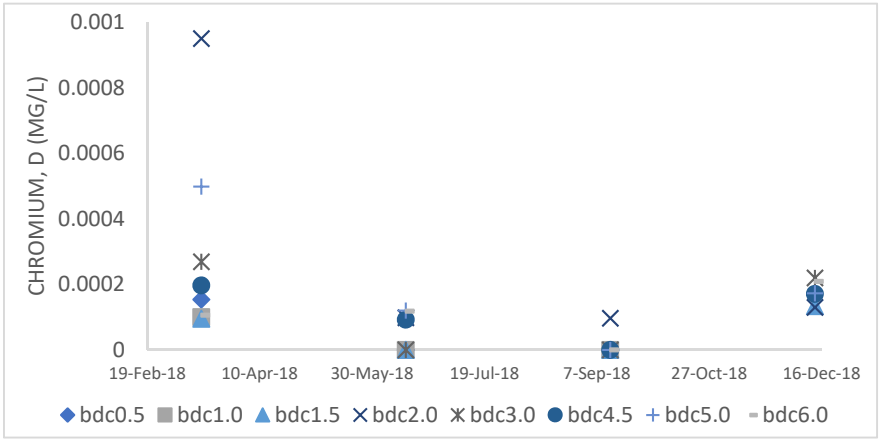


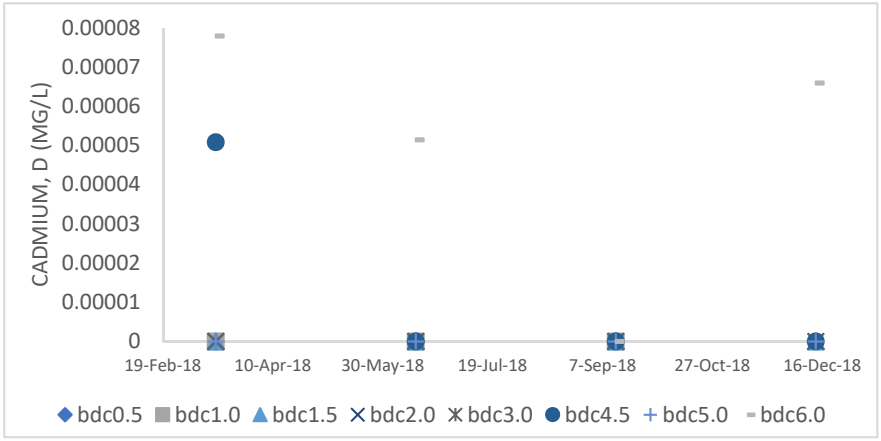


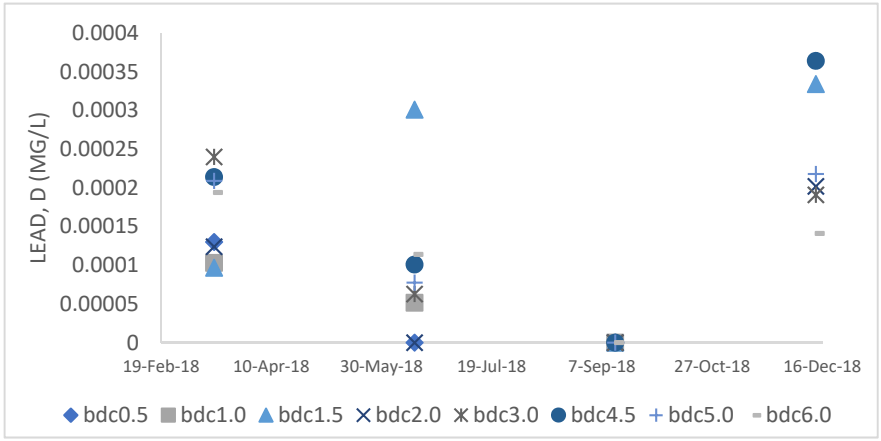


Appendix C
Scatter Plots for Big Dry Creek 2018 Instream Sampling Program - Metals









Note: Silver was not detected in 2018 and is not shown. Mercury is noly mointored at one location and is not shown.

Appendix D. Big Dry Creek 2017 Quality Control (QC) Samples

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Appendix D
Big Dry Creek 2018 Quality Control (QC) Samples - Field Duplicates

Activity Start Date	Station ID	Activity Type	Conductivity (uS/cm)	DO (mg/L)	pH (SU)	Temperature (°C)	Alkalinity (mg/L)	Calcium, Total (mg/L)	Chloride, D (mg/L)	Chlorophyll-a, corr (ug/L)	Chlorophyll-a, uncor (ug/L)	*E. coli* (MPN/100 mL)	Hardness (mg/L)	Magnesium, Dissolved (mg/L)	Nitrogen, Total (mg/L)	NO3+NO2 (mg/L)	NO2 (mg/L)	Ammonia, Total (mg/L)	Phosphorus, Ortho as P (mg/L)	Phosphorus, Total (mg/L)	Potassium, Dissolved (mg/L)	Sodium, Dissolved (mg/L)
15-Mar-18	bdc2.0	Field Duplicate													16.77	14.52		0.16		1.311		
15-Mar-18	bdc2.0	Routine Sample													16.75	15.76		0.17		1.369		
Relative % Difference															0.1%	8.2%		6.1%		4.3%		
14-Jun-18	bdc2.0	Field Duplicate										326			4.86	4.18				0.136		
14-Jun-18	bdc2.0	Routine Sample										308			4.4	3.85				0.106		
Relative % Difference												5.7%			9.9%	8.2%				24.8%		
14-Jun-18	bdc5.0	Field Duplicate																				
14-Jun-18	bdc5.0	Routine Sample																				
Relative % Difference																						
13-Sep-18	bdc2.0	Field Duplicate													4.51	3.9				0.118		
13-Sep-18	bdc2.0	Routine Sample													1.73	3.71				0.11		
Relative % Difference															89.1%	5.0%				7.0%		
13-Sep-18	bdc5.0	Field Duplicate	1051	10.48	7.85	13.7	137	87	88.8	3.6	7.1	345	316.48	24	4.79	ND	0.013	ND	0.106	0.191	5.97	106
13-Sep-18	bdc5.0	Routine Sample	1057	10.84	7.81	13.8	140	88	88.6	3.8	6.6	462	318.57	24.1	5	4.01	0.014	0.03	0.111	0.196	6.11	106
Relative % Difference			0.6%	3.4%	0.5%	0.7%	2.2%	1.1%	0.2%	5.4%	7.3%	29.0%	0.7%	0.4%	4.3%	NC	7.4%	NC	4.6%	2.6%	2.3%	0.0%
13-Dec-18	bdc2.0	Field Duplicate										518			7.36	6.28		0.03		0.157		
13-Dec-18	bdc2.0	Routine Sample										344			7.17	6.27		0.04		0.158		
Relative % Difference												40.4%			2.6%	0.2%		28.6%		0.6%		
13-Dec-18	bdc5.0	Field Duplicate																				
13-Dec-18	bdc5.0	Routine Sample																				
Relative % Difference																						

Appendix D
Big Dry Creek 2018 Quality Control (QC) Samples - Field Duplicates

Activity Start Date	Station ID	Activity Type	Sulfate, Dissolved (mg/L)	TDS (mg/L)	TOC (mg/L)	TSS (mg/L)	Turbidity (NTU)	Iron, Trec (mg/L)	Boron, Total (mg/L)	Cyanide, Total (mg/L)	Arsenic, Trec (mg/L)	Cadmium, Dissolved (mg/L)	Chromium, Dissolved (mg/L)	Copper, Dissolved (mg/L)	Lead, Dissolved (mg/L)	Manganese, Dissolved (mg/L)	Nickel, Dissolved (mg/L)	Selenium, Dissolved (mg/L)	Silver, Dissolved (mg/L)	Zinc, Dissolved (mg/L)
15-Mar-18	bdc2.0	Field Duplicate																		
15-Mar-18	bdc2.0	Routine Sample																		
Relative % Difference																				
14-Jun-18	bdc2.0	Field Duplicate																		
14-Jun-18	bdc2.0	Routine Sample																		
Relative % Difference																				
14-Jun-18	bdc5.0	Field Duplicate																0.00108		
14-Jun-18	bdc5.0	Routine Sample																0.00267		
Relative % Difference																		84.8%		
13-Sep-18	bdc2.0	Field Duplicate																		
13-Sep-18	bdc2.0	Routine Sample																		
Relative % Difference																				
13-Sep-18	bdc5.0	Field Duplicate	233	656	5.54	49	45.6	0.61	0.18		ND			0.00324		0.0101	0.00177	0.00368		0.00628
13-Sep-18	bdc5.0	Routine Sample	232	658	4.71	50	43.8	0.57	0.19		0.00112			0.00346		0.00843	0.00176	0.00362		0.00721
Relative % Difference			0.4%	0.3%	16.2%	2.0%	4.0%	6.8%	5.4%		NC			6.6%		18.0%	0.6%	1.6%		13.8%
13-Dec-18	bdc2.0	Field Duplicate																		
13-Dec-18	bdc2.0	Routine Sample																		
Relative % Difference																				
13-Dec-18	bdc5.0	Field Duplicate																0.00957		
13-Dec-18	bdc5.0	Routine Sample																0.00548		
Relative % Difference																		54.4%		

Appendix D
Big Dry Creek 2018 Quality Control (QC) Samples - Field Blanks

Trip Start Date	Station ID	Activity Category	Alkalinity (mg/L)	Ammonia, Total (mg/L)	Arsenic, Trec (mg/L)	Boron, Total (mg/L)	Cadmium, Dissolved (mg/L)	Calcium, Total (mg/L)	Chloride, Dissolved (mg/L)	Chlorophyll-a, corr (ug/L)	Chlorophyll-a, uncor (ug/L)	Chromium, Dissolved (mg/L)	Conductivity (uS/cm)	Copper, Dissolved (mg/L)	Cyanide, Total (mg/L)	DO (mg/L)	*E. coli* (MPN/100 mL)	Hardness (mg/L)	Iron, Trec (mg/L)	Lead, Dissolved (mg/L)	Magnesium, Dissolved (mg/L)
15-Mar-18	Field Blank	Field Blank	1	0.04	ND	ND	ND	0.2	ND	ND	ND	ND	18	0.00227	ND	6.32	ND	4.62	ND	0.0000716	ND
13-Sep-18	Field Blank	Field Blank		ND																	

Trip Start Date	Station ID	Activity Category	Manganese, Dissolved (mg/L)	Nickel, Dissolved (mg/L)	Nitrogen, Total (mg/L)	NO2 (mg/L)	NO3+NO2 (mg/L)	pH (SU)	Phosphorus, Ortho as P (mg/L)	Phosphorus, Total (mg/L)	Potassium, Dissolved (mg/L)	Selenium, Dissolved (mg/L)	Silver, Dissolved (mg/L)	Sodium, Dissolved (mg/L)	Sulfate, Dissolved (mg/L)	TDS (mg/L)	Temperature (°C)	TOC (mg/L)	TSS (mg/L)	Turbidity (NTU)	Zinc, Dissolved (mg/L)
15-Mar-18	Field Blank	Field Blank	0.00705	0.0000956	ND	ND	ND	8.95	ND	0.015	ND	ND	ND	ND	ND	5	14.01	0.4	ND	0.128	0.00104
13-Sep-18	Field Blank	Field Blank			ND		ND			0.012											

Appendix D

Big Dry Creek 2018 Quality Control (QC) Samples - Trip Blanks

Trip Start Date	Station ID	Activity Type	Alkalinity (mg/L)	Chlorophyll-a, corr (ug/L)	Chlorophyll-a, uncor (ug/L)	Cyanide, Total (mg/L)	*E. coli* (MPN/100 mL)
11-Jan-18	Trip Blank	Trip Blank	2	ND	ND		ND
08-Feb-18	Trip Blank	Trip Blank	2	ND	1.9		ND
15-Mar-18	Trip Blank	Trip Blank	2	ND	ND	ND	ND
11-Apr-18	Trip Blank	Trip Blank	2	ND	ND		ND
10-May-18	Trip Blank	Trip Blank	1	ND	ND		ND
14-Jun-18	Trip Blank	Trip Blank	1	ND	ND	ND	ND
12-Jul-18	Trip Blank	Trip Blank	1	ND	ND		ND
09-Aug-18	Trip Blank	Trip Blank	2	ND	ND		ND
13-Sep-18	Trip Blank	Trip Blank	2	ND	ND	ND	ND
11-Oct-18	Trip Blank	Trip Blank	2	ND	ND		ND
08-Nov-18	Trip Blank	Trip Blank	0	ND	ND		ND
13-Dec-18	Trip Blank	Trip Blank	1	ND	ND	ND	ND

Appendix E. 2018 WWTP Discharge Samples for Broomfield, Westminster and Northglenn Collected for CDPS Discharge Monitoring Reports

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Appendix E
Big Dry Creek 2017 Broomfield WWTP Effluent Data

Lab Data Entry Daily 1/1/2018 - 12/31/2018	TSS (mg/L)	cBod 5 (mg/L)	Phos Total P (mg/L)	Ammonia (mg/L)	NO2 & NO3 (mg/L)	TKN (mg/L)	TIN1 (mg/L)	TN (mg/L)	Alk Tot (mg/L)	Cod Hi Level (mg/L)	Cyanide (ug/L)	*E.coli* (#/100mL)	Flow (MGD)
1/1/2018			1.06	0.13	16	1.27	16.13	17.27					0.938
1/2/2018	6	2.91	1.44	0.13	14.6	1.97	14.73	16.57	45.6	31	<4	4.1	1.414
1/3/2018	7	2.77	1.31	0.09	15.9	1.25	15.99	17.15				3	1.295
1/4/2018			0.97	0.13	18.7	3.2	18.83	21.9					1.167
1/5/2018			1.12	0.14	19.8	2.24	19.94	22.04					1.136
1/6/2018			1.17	0.19	19	2.72	19.19	21.72					0.848
1/7/2018			1.11	0.19	16.6	2.76	16.79	19.36					0.872
1/8/2018			1.13	0.15	14.8	2.28	14.95	17.08				4.1	1.082
1/9/2018	7.2	2.39	1.4	0.14	17.3	2.01	17.44	19.31	43.6			1	1.205
1/10/2018			2.47	0.12	16.8	2.06	16.92	18.86					1.718
1/11/2018	9.6	2.14	2.48	0.15	18.1	2.57	18.25	20.67					1.649
1/12/2018			1.85	0.14	16.9	2.55	17.04	19.45					1.543
1/13/2018			1.15	0.14	16.1	2.25	16.24	18.35					1.824
1/14/2018			1.08	0.5	17.2	2.18	17.7	19.38					1.872
1/15/2018			0.8	0.36	14	1.67	14.36	15.67					2.686
1/16/2018	8.5	3.46	0.15	0.2	13.6	1.36	13.8	14.96	57.8			8.5	2.272
1/17/2018	6.1	2.64	0.08	0.16	14.1	3.25	14.26	17.35				1	3.28
1/18/2018			0.09	0.3	16.6	1.1	16.9	17.7					5.319
1/19/2018			0.07	0.22	15.3	0.84	15.52	16.14					5.238
1/20/2018			0.08	0.32	15.8	2.07	16.12	17.87					4.828
1/21/2018			0.06	0.42	14.4	2.83	14.82	17.23					5.163
1/22/2018			0.06	0.22	13	2.26	13.22	15.26				3.1	5.705
1/23/2018	5.8	3.67	0.06	0.2	13	4.3	13.2	17.3	43			4.1	5.37
1/24/2018	6.4	2.92	0.06	0.19	13.8	1.66	13.99	15.46					5.271
1/25/2018			0.06	0.17	15.3	1.99	15.47	17.29					5.185
1/26/2018			0.06	0.35	15.1	2.97	15.45	18.07					5.158
1/27/2018			0.06	0.25	16.4	1.37	16.65	17.77					5.354
1/28/2018			0.06	0.15	13.4	1.31	13.55	14.71					5.279
1/29/2018			0.06	0.12	12.7	1.27	12.82	13.97				1	5.629
1/30/2018	6.45	4.04	0.1	0.17	14.7	1.75	14.87	16.45	51.4			6.3	5.371
1/31/2018	5.6	3	0.06	0.12	16.2	1.11	16.32	17.31					5.102
2/1/2018			0.06	0.09	16.7	1.05	16.79	17.75					5.09
2/2/2018			0.06	0.14	17.3	1.24	17.44	18.54					5.377
2/3/2018													5.092
2/4/2018													5.243
2/5/2018												4.1	5.466
2/6/2018									58.4			1	5.499
2/7/2018	5.8	3.11	0.08	0.17	17.5	2.2	17.67	19.7					5.239
2/8/2018	6.1	2.23	0.06	0.19	17.1	2.16	17.29	19.26					5.222
2/9/2018													5.139
2/10/2018													4.82
2/11/2018													4.352
2/12/2018	5		0.06	0.07	13.6	2.05	13.67	15.65		28		1	3.539
2/13/2018									47			2	3.806
2/14/2018	4.5	2.08	0.15	0.08	17	1.6	17.08	18.6		36			3.324
2/15/2018	3.6	4.29	0.36	0.06	18.5	0.93	18.56	19.43					3.241
2/16/2018	3.1		0.27	0.09	17.9	1.61	17.99	19.51		37			4.015
2/17/2018													5.567
2/18/2018													4.945
2/19/2018													4.984
2/20/2018									42.2			2	4.899
2/21/2018	6.5	2.33	1.45	0.04	18.6	1.43	18.64	20.03				17.1	5.035
2/22/2018	2.4	2.18	1.44	0.01	18.5	1.47	18.51	19.97					5.701
2/23/2018													5.26
2/24/2018													5.293
2/25/2018													5.243
2/26/2018												3	5.605
2/27/2018			1.1	0.09	16.5	1.01	16.59	17.51	50.4			1	5.406
2/28/2018	2.5	2.54	1.12	0.09	17.4	1.25	17.49	18.65					5.227
3/1/2018	2.7	2.13	1.07	0.06	17.1	0.68	17.16	17.78					5.322
3/2/2018			0.46	0.08	18.1	2.05	18.18	20.15					5.476
3/3/2018													5.487
3/4/2018													5.303
3/5/2018												2	5.245
3/6/2018									39.2			1	5.307
3/7/2018	3.4	2.38	0.09	0.08	19.5	1.09	19.58	20.59		33			5.219
3/8/2018	3.9	1.7	0.22	0.06	19.5	2.22	19.56	21.72					5.091
3/9/2018													4.123
3/10/2018													4.944
3/11/2018													5.261
3/12/2018												1	5.588
3/13/2018									38.6			2	5.496
3/14/2018	4.3	2.14	1.08	0.12	18.7	2.82	18.82	21.52					4.18
3/15/2018	3.6	2	1	0.13	18.9	3.73	19.03	22.63					3.25
3/16/2018													4.205
3/17/2018													5.191
3/18/2018													5.467
3/19/2018												2	5.997
3/20/2018									49			1	5.696
3/21/2018	3.7	2.42	0.34	0.14	17.3	2.31	17.44	19.61					5.442
3/22/2018	3.3	1.97	0.7	0.09	19.1	1.7	19.19	20.8					5.518
3/23/2018													4.957
3/24/2018													5.271
3/25/2018													4.765
3/26/2018												3.1	5.502
3/27/2018									51.6			2	5.648
3/28/2018	3.6	2.16	0.25	0.15	15.1	2.89	15.25	17.99					5.281
3/29/2018	4.2	1.9	0.15	0.1	13.7	2.83	13.8	16.53					5.909
3/30/2018													5.631
3/31/2018													5.479
4/1/2018													5.822
4/2/2018												3	4.248
4/3/2018									60			3.1	4.529
4/4/2018	4.6	2.23	0.28	0.13	16.6	2.45	16.73	19.05					5.528
4/5/2018	4.8	2.01	0.6	0.15	16.1	2.29	16.25	18.39					4.927
4/6/2018													4.574
4/7/2018													5.736
4/8/2018													5.096
4/9/2018	6.4		0.33	0.16	13	2.07	13.16	15.07		30		2	5.663
4/10/2018									56			3.1	5.544
4/11/2018	5.9	1.78	1.09	0.24	18.4	3.16	18.64	21.56		26			5.171
4/12/2018	4.5	1.7	0.96	0.14	17	2.02	17.14	19.02			<4		5.177
4/13/2018	5.1		0.61	0.18	18.1	2.34	18.28	20.44		29			4.498
4/14/2018													4.589
4/15/2018													3.836
4/16/2018												1	3.88
4/17/2018									56			2	3.166
4/18/2018	5.5	2.48	1.98	0.14	16.6	4.67	16.74	21.27					3.187
4/19/2018	5.1	1.76	2.11	0.14	16.6	3.12	16.74	19.72					3.542
4/20/2018													3.76
4/21/2018													5.326
4/22/2018													4.586
4/23/2018												8.5	5.089
4/24/2018									59.2			2	6.1
4/25/2018	5.4	2.26	2.54	0.09	16.1	1.46	16.19	17.56					5.787
4/26/2018	5.9	2.42	2.36	0.08	15.3	1.42	15.38	16.72					5.729

Lab Data Entry Daily 1/1/2018 - 12/31/2018	TSS (mg/L)	cBod 5 (mg/L)	Phos Total P (mg/L)	Ammonia (mg/L)	NO2 & NO3 (mg/L)	TKN (mg/L)	TIN1 (mg/L)	TN (mg/L)	Alk Tot (mg/L)	Cod Hi Level (mg/L)	Cyanide (ug/L)	*E.coli* (#/100mL)	Flow (MGD)
4/27/2018													5.714
4/28/2018													5.538
4/29/2018			2.56	0.14	15.2	1.76	15.34	16.96					5.502
4/30/2018			1.54	0.1	13.8	1.49	13.9	15.29				2	5.875
5/1/2018									56			2	5.67
5/2/2018	5	1.88	2.39	0.06	18	2.54	18.06	20.54					5.962
5/3/2018	5.5	1.9	2.32	0.08	17.3	2.14	17.38	19.44					7.357
5/4/2018													6.597
5/5/2018													6.335
5/6/2018													5.74
5/7/2018												6.3	6.452
5/8/2018	3.7	3.92	3.6	0.09	14.3	1.74	14.39	16.04	86.2	26		1	6.098
5/9/2018													5.936
5/10/2018	4.5	1.68	1.89	0.08	16.2	1.41	16.28	17.61					6.074
5/11/2018													5.78
5/12/2018													6.17
5/13/2018													5.754
5/14/2018												3	6.449
5/15/2018	4.1	1.97	0.94	0.04	13.3	2.19	13.34	15.49	88			6.2	6.036
5/16/2018													5.965
5/17/2018	4.3	1.94	0.96	0.04	15	2.32	15.04	17.32					5.849
5/18/2018													6.163
5/19/2018													6.261
5/20/2018													5.667
5/21/2018												3.1	6.342
5/22/2018	4.3	2.2	0.98	0.09	13.4	2.19	13.49	15.59	89.2			3.1	5.979
5/23/2018													6.041
5/24/2018	4	2.09	0.6	0.14	14.6	1.62	14.74	16.22					6.02
5/25/2018													5.765
5/26/2018													5.94
5/27/2018													5.632
5/28/2018													6.09
5/29/2018	3.4	3.96	1.45	0.09	13.8	2.31	13.89	16.11	81.2			2	6.051
5/30/2018												2	6.082
5/31/2018	3.3	1.87	1.09	0.12	14.1	2.74	14.22	16.84					5.927
6/1/2018			0.74	0.12	14.8	1.91	14.92	16.71					5.78
6/2/2018			0.72	0.39	16.9	1.62	17.29	18.52					5.701
6/3/2018													5.692
6/4/2018												4.1	6.103
6/5/2018	3.4	1.9	0.35	0.15	14.5	2.39	14.65	16.89	72.2			2	5.847
6/6/2018													5.78
6/7/2018	3.7	2.11	0.17	0.11	15.5	2.19	15.61	17.69					5.758
6/8/2018													5.765
6/9/2018													5.679
6/10/2018													5.867
6/11/2018												1	5.836
6/12/2018	3.6	1.8	0.18	0.16	14.6	3.11	14.76	17.71	64.6	27		1	5.881
6/13/2018													5.859
6/14/2018	3.9	0.99	0.12	0.09	15.6	2.73	15.69	18.33					5.841
6/15/2018													5.638
6/16/2018													5.707
6/17/2018													5.967
6/18/2018												2	6.096
6/19/2018	3.3	2.24	0.28	0.1	13.4	3.37	13.5	16.77	74.8			6.3	6.249
6/20/2018													6.151
6/21/2018	3.6	3.21	0.28	0.14	14.8	3.57	14.94	18.37					6.186
6/22/2018													5.91
6/23/2018													6.012
6/24/2018													5.514
6/25/2018												10.7	6.269
6/26/2018	4.9	4.1	0.15	0.14	15.1	3.6	15.24	18.7	72			2	5.823
6/27/2018	6.5	2.42	0.28	0.16	15.7	3.1	15.86	18.8					5.856
6/28/2018													5.958
6/29/2018													5.654
6/30/2018													5.861
7/1/2018													5.969
7/2/2018												5.2	5.889
7/3/2018	7.4	2.8	0.09	0.15	15	3.6	15.15	18.6	64.2				5.658
7/4/2018													5.622
7/5/2018	6.5	3.48	0.07	0.12	14.2	6.5	14.32	20.7				15.3	5.656
7/6/2018													6.305
7/7/2018													6.477
7/8/2018													6.057
7/9/2018												20.1	6.189
7/10/2018	6.4	2.9	0.07	0.08	15.8	2.79	15.88	18.59	59.4	37	<4	13.2	5.942
7/11/2018													5.951
7/12/2018	5.7	2.37	0.06	0.06	15.9	2.37	15.96	18.27					6.074
7/13/2018													5.853
7/14/2018													5.803
7/15/2018													6.047
7/16/2018												4.1	6.153
7/17/2018	4.1	2.41	0.06	0.09	12.1	1.9	12.19	14	67.2			18.3	6.145
7/18/2018													6.114
7/19/2018	5.3	3.76	0.13	0.1	17.7	1.86	17.8	19.56					5.979
7/20/2018													5.883
7/21/2018													5.894
7/22/2018													6.14
7/23/2018												2	6.717
7/24/2018	6.3	3.17	0.06	0.12	11.1	2.2	11.22	13.3	83.8			4.1	6.455
7/25/2018													6.489
7/26/2018	6.4	3.08	0.06	0.12	14.6	2.16	14.72	16.76					6.731
7/27/2018													6.667
7/28/2018													6.299
7/29/2018													6.319
7/30/2018			0.06	0.1	12.6	1.01	12.7	12.6				4.1	6.313
7/31/2018	4	3	0.06	0.12	13.3	1.29	13.42	13.3	87.4			4.1	6.219
8/1/2018			0.06	0.13	14.4	1.94	14.53	16.34					6.201
8/2/2018	5.2	3.18	0.08	0.09	14.7	2.32	14.79	17.02					6.089
8/3/2018													6.003
8/4/2018													6.06
8/5/2018													6.219
8/6/2018												2	6.241
8/7/2018	4.9	5.42	0.1	0.1	12.2	1.39	12.3	13.59	81.2	36		1	6.262
8/8/2018													6.286
8/9/2018	4.2	2.41	0.21	0.1	16.9	1.97	17	18.87					6.21
8/10/2018													6.136
8/11/2018													5.943
8/12/2018													6.279
8/13/2018												2	6.188
8/14/2018	2.7	4.01	0.06	0.1	13.8	0.8	13.9	14.6	73.2			4.1	6.305
8/15/2018													6.331
8/16/2018	4.9	4.07	0.06	0.12	16.4	1.12	16.52	17.52					6.203
8/17/2018													6.044
8/18/2018													6.189
8/19/2018													6.943
8/20/2018	5		0.26	0.1	10.2	6.63	10.3	16.83		32		1	6.541

Appendix E
Big Dry Creek 2017 Broomfield WWTP Effluent Data

Lab Data Entry Daily 1/1/2018 - 12/31/2018	TSS (mg/L)	cBod 5 (mg/L)	Phos Total P (mg/L)	Ammonia (mg/L)	NO2 & NO3 (mg/L)	TKN (mg/L)	TIN1 (mg/L)	TN (mg/L)	Alk Tot (mg/L)	Cod Hi Level (mg/L)	Cyanide (ug/L)	*E.coli* (#/100mL)	Flow (MGD)
8/21/2018	5.3	3.9	0.06	0.1	13.4	0.1	13.5	13.5	87.6			2	6.482
8/22/2018	5.7		0.15	0.1	14.7	2.26	14.8	16.96		30			6.534
8/23/2018	5.3	4.2	0.12	0.11	14.3	1.03	14.41	15.33					6.328
8/24/2018	4.7		0.07	0.12	13.9	1.97	14.02	15.87		29			6.183
8/25/2018													6.268
8/26/2018													6.439
8/27/2018												2	6.591
8/28/2018									87.6			2	5.942
8/29/2018													5.914
8/30/2018	3.3	5.15	0.3	0.11	18	0.96	18.11	18.96					6.218
8/31/2018	2.3	3.41	0.33	0.13	20.8	2.34	20.93	23.14					5.898
9/1/2018			0.07	0.12	15.4	0.1	15.52	15.5					5.832
9/2/2018													5.787
9/3/2018													6.211
9/4/2018	2.1	3.86	0.09	0.13	11	3.5	11.13	14.5	83.4			2	4.378
9/5/2018			0.07	0.02	12.2	5.53	12.22	17.73				1	4.697
9/6/2018	7.1	3.03	0.06	0.16	12.5	2.94	12.66	15.44					4.915
9/7/2018													6.325
9/8/2018													6.136
9/9/2018													6.309
9/10/2018												3.1	6.217
9/11/2018	1.9	3.9	0.06	0.13	15	1.63	15.13	16.63	74.2	54		6.3	4.561
9/12/2018			0.06	0.11	12.4	1.73	12.51	14.13					3.846
9/13/2018	2.27	0.89	0.06	0.09	14.3	2.4	14.39	16.7					3.98
9/14/2018													3.918
9/15/2018													3.566
9/16/2018													3.8
9/17/2018												3	4.04
9/18/2018	7	6.04	0.06	0.22	15.3	1.4	15.52	16.7	63.2			3	3.956
9/19/2018			0.13	0.15	15.7	1.24	15.85	16.94					3.799
9/20/2018	3.1	2.63	0.06	0.16	15	2.45	15.16	17.45					4.424
9/21/2018													5.829
9/22/2018													5.841
9/23/2018													6.1
9/24/2018												23.3	5.351
9/25/2018	4.3	1.17	0.06	0.16	12.4	0.82	12.56	13.22	68			2	3.744
9/26/2018			0.06	0.1	13	1.26	13.1	14.26					3.706
9/27/2018	1.7	2.14	0.18	0.13	12	2.38	12.13	14.38					3.755
9/28/2018													4.403
9/29/2018													5.883
9/30/2018			0.1	0.21	11.4	0.29	11.61	11.69					6.162
10/1/2018			0.07	0.14	11.9	1.8	12.04	13.7				2	6.061
10/2/2018	1.1	1.21	0.06	0.13	13.3	0.1	13.43	13.4	71.6			1	4.424
10/3/2018			0.06	0.11	14	1.91	14.11	15.91					3.722
10/4/2018	1.6	1.39	0.06	0.15	14.9	1.33	15.05	16.23					3.673
10/5/2018			0.06	0.11	14.2	1.16	14.31	15.36					3.732
10/6/2018													3.68
10/7/2018													4.561
10/8/2018			0.09	0.11	11.3	0.69	11.41	11.99				2	5.276
10/9/2018	2.9	1.47	0.06	0.09	11.4	0.88	11.49	12.28	76	24	<4	2	5.346
10/10/2018			0.11	0.1	13.4	1.07	13.5	14.47					5.982
10/11/2018	2.7	1	0.13	0.14	14.5	0.23	14.64	14.73					5.15
10/12/2018			0.07	0.13	14.3	0.59	14.43	14.89					4.306
10/13/2018													5.524
10/14/2018													6.297
10/15/2018			0.06	0.12	12.9	0.77	13.02	13.67				1	5.89
10/16/2018	3.9	1.88	0.06	0.08	14.7	0.1	14.78	14.8	84.6			4.1	6.001
10/17/2018			0.06	0.09	16.4	1.49	16.49	17.89					5.742
10/18/2018	3.4	1.4	0.06	0.1	16.6	0.79	16.7	17.39					4.23
10/19/2018			0.28	0.09	15.7	0.93	15.79	16.63					4.663
10/20/2018													5.508
10/21/2018													5.729
10/22/2018			0.46	0.09	13.3	0.31	13.39	13.61				42.8	5.212
10/23/2018	3	1.3	0.84	0.1	13.8	0.33	13.9	14.13	85			1	5.984
10/24/2018			0.06	0.14	14.7	0.58	14.84	15.28					5.713
10/25/2018	3.2	1.24	0.09	0.13	13.8	0.76	13.93	14.56					5.473
10/26/2018			0.06	0.12	13.4	0.48	13.52	13.88					5.403
10/27/2018													5.463
10/28/2018													5.607
10/29/2018			0.69	0.17	14	0.39	14.17	14.39				5.2	5.531
10/30/2018	2.53	1.26	2.12	0.97	16.1	0.62	17.07	16.72	62.8			1	5.619
10/31/2018			1.78	3.76	13.4	2.61	17.16	16.01					5.523
11/1/2018	2.2	1.26	1.92	0.6	15.7	0.2	16.3	15.9					5.535
11/2/2018			1.13	0.17	15.5	0.56	15.67	16.06					5.384
11/3/2018			0.16	0.26	17.7	0.24	17.96	17.94					5.524
11/4/2018			0.06	0.34	15.1	0.5	15.44	15.6					5.758
11/5/2018			0.06	0.09	12.6	0.1	12.69	12.7				2	4.456
11/6/2018	2.2	2.07	0.35	0.94	12.6	0.1	13.54	12.7	69.2	28		1	3.372
11/7/2018			0.06	0.09	16.1	0.1	16.19	16.2					2.059
11/8/2018	1.67	1.02	0.13	0.12	16.2	0.1	16.32	16.3					2.458
11/9/2018			0.06	0.14	16.7	0.1	16.84	16.8					2.284
11/10/2018			0.06	0.45	17.2	0.1	17.65	17.3					2.473
11/11/2018			0.06	0.15	12.7	2.05	12.85	14.75					2.598
11/12/2018			0.06	0.31	14.5	0.1	14.81	14.6					2.753
11/13/2018	1.6	1.2	0.07	0.12	14.8	0.17	14.92	14.97	58.8			4.1	2.339
11/14/2018			0.06	0.08	16.3	0.14	16.38	16.44				1	2.377
11/15/2018	1.5	0.54	0.06	0.06	16.5	0.35	16.56	16.85					2.373
11/16/2018			0.06	0.12	18.1	0.68	18.22	18.78					2.242
11/17/2018			0.08	0.13	17.4	0.96	17.53	18.36					2.453
11/18/2018			0.12	0.45	15.7	0.7	16.15	16.4					2.528
11/19/2018	1.7	1.73	0.13	0.08	13.8	0.99	13.88	14.79				1	0.91
11/20/2018	1.4	1.04	0.49	0.08	16.8	1.47	16.88	18.27	52.2			1	1.533
11/21/2018			0.2	0.12	19.2	0.83	19.32	20.03					1.717
11/22/2018			0.13	0.59	15.8	1.23	16.39	17.03					0.888
11/23/2018			0.06	0.11	12.2	0.78	12.31	12.98					1.09
11/24/2018			0.06	0.46	15.4	0.1	15.86	15.5					1.046
11/25/2018			0.06	0.1	14.8	0.56	14.9	15.36					1.609
11/26/2018			0.06	0.1	12.9	0.26	13	13.16				2	1.479
11/27/2018	1.5	2	0.06	0.12	17.3	0.23	17.42	17.53	44.8				1.164
11/28/2018			0.38	0.21	20.3	0.1	20.51	20.4					1.546
11/29/2018	2.3	0.93	0.61	0.12	17.4	0.61	17.52	18.01				1	1.137
11/30/2018			0.1	0.15	17.4	2.03	17.55	19.43					1.059
12/1/2018			0.11	0.12	16	0.59	16.12	16.59					0.96
12/2/2018													0.821
12/3/2018	1.73		0.06	0.12	14	0.38	14.12	14.38		30		2	1.346
12/4/2018	1.87	1.27	0.06	0.14	12.8	0.65	12.94	13.45	51.6			2	0.774
12/5/2018	1.87		0.06	0.14	15.6	0.27	15.74	15.87		29			1.026
12/6/2018	1.53	1.17	0.06	0.13	16.8	0.1	16.93	16.9					0.84
12/7/2018	1.93		0.12	0.35	17	3.26	17.35	20.26		29			0.967
12/8/2018													0.943
12/9/2018													0.971
12/10/2018			0.27	0.13	12.5	5.4	12.63	17.9				1	1.673
12/11/2018	1.6	1.66	0.11	0.13	14	5.97	14.13	19.97	47.8			1	0.941
12/12/2018			0.35	0.12	16.7	0.42	16.82	17.12					1.065
12/13/2018	2.2	1.4	0.12	0.1	17	0.28	17.1	17.28					1.023
12/14/2018			0.06	0.18	17.3	0.27	17.48	17.57					1.214

Appendix E
Big Dry Creek 2017 Broomfield WWTP Effluent Data

Lab Data Entry Daily 1/1/2018 - 12/31/2018	TSS (mg/L)	cBod 5 (mg/L)	Phos Total P (mg/L)	Ammonia (mg/L)	NO2 & NO3 (mg/L)	TKN (mg/L)	TIN1 (mg/L)	TN (mg/L)	Alk Tot (mg/L)	Cod Hi Level (mg/L)	Cyanide (ug/L)	*E.coli* (#/100mL)	Flow (MGD)
12/15/2018													1.114
12/16/2018													1.002
12/17/2018			0.21	0.13	15.6	1.22	15.73	16.82				1	1.383
12/18/2018			0.11	0.33	17.6	1.45	17.93	19.05	53.4				1.049
12/19/2018	1.77	0.9	0.34	0.37	21.5	2.02	21.87	23.52				1	0.886
12/20/2018	2	0.97	0.06	0.17	19.1	1.06	19.27	20.16					0.983
12/21/2018			0.13	0.13	18	1.58	18.13	19.58					1.081
12/22/2018													1.01
12/23/2018													1.254
12/24/2018			0.06	0.2	14.5	2	14.7	16.5					0.967
12/25/2018	1.53	1.08	0.07	0.3	12.8	1.48	13.1	14.28	60.8				0.52
12/26/2018			0.06	0.12	14.6	1.08	14.72	15.68					0.659
12/27/2018	2	1.5	0.12	0.1	14.6	1.2	14.7					1	0.775
12/28/2018			0.08	0.09	17.2	1.12	17.29					2	0.877
12/29/2018													1.083
12/30/2018			0.73	0.14	18.8	1.34	18.94						1.063
12/31/2018			0.53	0.23	15.2	0.91	15.43						1.073

Date	Flow (MGD)	BOD (mg/L)	BOD (pounds)	TSS (mg/L)	*E. coli* (#100/mL)	NH3 (Timberline) (mg/L)	NO2+NO3 (calc. TIN-NH3) (mg/L)	TIN (Timberline) (mg/L)	TN (Timberline) (mg/L)	T-P (Lachat) (mg/L)	Sodium (mg/L)	Chloride (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	<	Bromide (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	NO2 (mg/L)
1/1/2018	6.77	8.2		10		0.10	9.71	9.81		0.66											0.05
1/2/2018	6.71	7.0		9.4	31	0.10	8.86	8.97			99.0	114		79.5	19.0	15.4	<	0.25	0.76	168	0.05
1/3/2018	7.19	6.9			22	0.43	8.54	8.97													0.11
1/4/2018	6.64																				
1/5/2018	6.65																				
1/6/2018	6.99																				
1/7/2018	7.26	7.5																			0.10
1/8/2018	6.68	5.0			30																0.07
1/9/2018	6.92	5.5				0.07	9.31	9.38					584								0.03
1/10/2018	6.82	5.4		6.9		0.16	10.07	10.23													
1/11/2018	6.65			7.6	22	0.12	10.91	11.03	12.20	1.36											
1/12/2018	6.59																				
1/13/2018	6.91																				
1/14/2018	7.03	7.8		7.8		0.11	10.49	10.60		2.20	97.5	111		52.0	19.4	15.7	<	0.25	0.77	171	0.07
1/15/2018	6.80	6.6		8.2	8	0.05	9.61	9.67													0.04
1/16/2018	6.44	7.1			29	0.06	9.21	9.28													0.04
1/17/2018	6.62	7.9																			
1/18/2018	6.67																				
1/19/2018	6.67																				
1/20/2018	6.87																				
1/21/2018	7.07					0.10	10.65	10.76													0.08
1/22/2018	6.68	7.3		8.8	21	0.09	9.94	10.02													0.07
1/23/2018	6.54	5.2		7.4	7	0.06	10.23	10.29		1.23											0.04
1/24/2018	6.63	4.9																			
1/25/2018	6.62																				
1/26/2018	6.51																				
1/27/2018	6.98																				
1/28/2018	7.26			7.5		0.08	10.24	10.32													0.06
1/29/2018	6.83	5.6		6.2	24	0.06	9.16	9.22		1.48											0.03
1/30/2018	6.88	5.1			8	0.05	9.78	9.83													0.03
1/31/2018	6.60	5.1																			
2/1/2018	6.33																				
2/2/2018	6.48																				
2/3/2018	7.08																				
2/4/2018	6.99	7.2																			0.07
2/5/2018	6.65	5.9			13																0.04
2/6/2018	6.43	5.2				0.09	9.20	9.29													0.03
2/7/2018	6.53	4.9		4.4		0.07	9.36	9.42													
2/8/2018	6.71			3.6	41	0.09	10.04	10.13	11.10	0.90											
2/9/2018	6.23																				
2/10/2018	6.46																				
2/11/2018	6.99	6.1		5.5		0.21	10.51	10.72		1.55											0.09
2/12/2018	6.35			4.4	6	0.12	8.99	9.11													0.07
2/13/2018	6.54	3.6			13	0.12	9.47	9.59					623								0.07
2/14/2018	6.60	3.8																			
2/15/2018	6.48	3.3																			
2/16/2018	6.37																				
2/17/2018	6.91																				
2/18/2018	7.03																				0.06
2/19/2018	6.57	3.8		3.6		0.03	8.64	8.67													0.03
2/20/2018	6.24	3.5		2.8	5	0.03	8.88	8.90		1.30											0.02
2/21/2018	6.39	3.8			8	0.03	9.00	9.03													
2/22/2018	6.33																				
2/23/2018	6.23																				
2/24/2018	6.76																				
2/25/2018	7.16			3.7		0.04	8.67	8.70													0.06
2/26/2018	6.64	3.4		3.4		0.03	7.69	7.70		2.38											0.02
2/27/2018	6.52	3.3			11	0.03	8.71	8.72													0.05
2/28/2018	6.50	4.1			5																
3/1/2018	6.53																				
3/2/2018	6.56																				
3/3/2018	6.99																				
3/4/2018	7.33	4.2		3.8		0.15	8.19	8.34		3.30											0.08
3/5/2018	6.54	2.3		4.4	11	0.11	6.80	6.91													0.06
3/6/2018	6.46	4.1			16	0.25	7.86	8.11													0.10
3/7/2018	6.09	2.7																			
3/8/2018	6.96																				
3/9/2018	5.43																				
3/10/2018	5.27																				
3/11/2018	7.08	2.6																			0.09
3/12/2018	6.68	2.2			2																0.03
3/13/2018	5.98	2				0.08	8.21	8.29					618								0.04
3/14/2018	6.11	2.0		2.9		0.07	8.88	8.95													
3/15/2018	6.24			2.6	12	0.08	9.52	9.61	10.50	1.76											
3/16/2018	6.77																				
3/17/2018	6.70																				
3/18/2018	7.27			3.9		0.13	8.65	8.78													0.09
3/19/2018	7.00	3.4		3.4	4	0.07	7.55	7.61													0.03
3/20/2018	6.92	2.8			6	0.06	8.02	8.08		0.26											0.04
3/21/2018	6.89	3.8																			
3/22/2018	6.97																				
3/23/2018	6.38																				
3/24/2018	6.69																				
3/25/2018	7.20					0.07	9.78	9.85													0.03
3/26/2018	6.82	2.5		3.1	7	0.04	9.36	9.40		0.66											0.02
3/27/2018	7.05	2.0		3.4	4	0.04	9.45	9.49													0.02
3/28/2018	6.97	2.4																			
3/29/2018	7.06																				
3/30/2018	6.77																				
3/31/2018	7.44																				
4/1/2018	7.41			4.6		0.04	9.63	9.67													0.03
4/2/2018	6.62	2.8		3.6	4	0.04	9.18	9.22													0.03
4/3/2018	7.02	3.1			4	0.04	9.65	9.69		0.75	109	122		172	24.0	12.9	<	0.25	0.78	202	0.05
4/4/2018	6.92	2.7																			
4/5/2018	6.92																				
4/6/2018	6.72																				
4/7/2018	6.74																				
4/8/2018	7.72																				0.06
4/9/2018	6.91	3.3				0.07	7.49	7.56													0.03
4/10/2018	6.14	4.3		4.4	10	0.07	8.73	8.80					641								0.04
4/11/2018	5.68	4.1		4.7	12	0.09	9.83	9.92	9.96	0.41											
4/12/2018	6.22																				
4/13/2018	6.71																				
4/14/2018	6.95																				
4/15/2018	5.76	3.9		5.6		0.20	10.58	10.78		1.07	106	123		161	21.4	13.0	<	0.25	0.76	191	0.10
4/16/2018	6.39	3.9		5.7	32	0.14	8.96	9.09													0.09
4/17/2018	5.98	3.3			22	0.12	10.05	10.16													0.06
4/18/2018	5.81	3.6																			
4/19/2018	6.79																				
4/20/2018	6.49																				
4/21/2018	7.84																				
4/22/2018	7.12	4.4				0.06	10.63	10.69													0.04
4/23/2018	7.42	4.6		7.8	38	0.06	8.63	8.69		0.77											0.03
4/24/2018	6.12	4.8		8.0	7	0.07	9.27	9.34													0.03
4/25/2018	7.02	4.8																			
4/26/2018	7.45																				
4/27/2018	6.19																				
4/28/2018	7.66																				
4/29/2018	4.85					0.10	10.37	10.47													0.03
4/30/2018	6.60	4.9		6.0	46	0.08	9.06	9.14													0.02
5/1/2018	6.04	4.4		5.5	30	0.07	10.07	10.14		0.48											0.02
5/2/2018	6.61	4.8																			
5/3/2018	9.22																				
5/4/2018	8.48																				
5/5/2018	7.19																				
5/6/2018	7.51	5.4																			0.02
5/7/2018	7.79	3.5			12																0.02
5/8/2018	7.04	3.3		4.8		0.05	7.95	8.01					714								0.02
5/9/2018	6.94	3.3				0.05	8.81	8.86													
5/10/2018	6.03			3.8	15	0.05	9.08	9.14	9.84	1.07											
5/11/2018	6.01																				
5/12/2018	6.21																				
5/13/2018	7.11	3.7		5.6		0.04	8.26	8.30		0.99											0.02
5/14/2018	7.23	2.9		4.1	15	0.05	7.41	7.45													0.01
5/15/2018	6.59	2.7			11	0.04	7.90	7.94													0.01
5/16/2018	6.55	2.7																			

Date	Flow (MGD)	BOD (mg/L)	BOD (pounds)	TSS (mg/L)	*E. coli* (#100/mL)	NH3 (Timberline) (mg/L)	NO2+NO3 (calc. TIN-NH3) (mg/L)	TIN (Timberline) (mg/L)	TN (Timberline) (mg/L)	T-P (Lachat) (mg/L)	Sodium (mg/L)	Chloride (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	<	Bromide (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	NO2 (mg/L)
5/17/2018	2.75																				
5/18/2018	4.43																				
5/19/2018	6.09																				
5/20/2018	7.13			4.6		0.07	9.35	9.42													0.02
5/21/2018	6.05			3.8	23	0.08	7.71	7.80		1.04											0.02
5/22/2018	6.09	2.3			7	0.07	7.92	7.99													0.02
5/23/2018	4.02	3.3																			
5/24/2018	4.22	4.0																			
5/25/2018	3.76																				
5/26/2018	4.58																				
5/27/2018	3.64																				0.03
5/28/2018	5.34	5.2		6.2		0.10	7.75	7.85													0.03
5/29/2018	3.42	6.1		5.9	15	0.11	8.35	8.46		1.33											0.03
5/30/2018	3.26	6.2			19	0.12	9.05	9.17													
5/31/2018	3.18																				
6/1/2018	3.23																				
6/2/2018	3.33																				
6/3/2018	3.49			6.4		0.10	10.43	10.53													0.03
6/4/2018	2.73			5.2	16	0.08	8.91	8.99		1.89											0.03
6/5/2018	2.80	4.9			17	0.10	10.12	10.22													0.03
6/6/2018	1.40	5.4																			
6/7/2018	2.37																				
6/8/2018	1.66																				
6/9/2018	2.63																				
6/10/2018	2.19																				
6/11/2018	2.36	3.3																			0.03
6/12/2018	1.12	3.9		6.4	10	0.06	10.49	10.55					667								0.03
6/13/2018	1.60	4.1				0.08	10.79	10.87													0.03
6/14/2018	2.26			5.2	9	0.05	10.71	10.76	12.74	3.16											
6/15/2018	0.68																				
6/16/2018	2.64																				
6/17/2018	3.23			6.6		0.08	10.56	10.64		3.48											0.07
6/18/2018	3.81	4.7		6.1	15	0.07	9.61	9.69													0.05
6/19/2018	3.62	5.0			8	0.07	9.88	9.94													0.06
6/20/2018	6.07	6.3																			
6/21/2018	4.46																				
6/22/2018	2.71																				
6/23/2018	2.36																				
6/24/2018	3.04	8.9				1.38	8.05	9.43													
6/25/2018	2.32	7.9		12	21	1.67	7.84	9.51		1.58											0.46
6/26/2018	2.44	7.2		10	20	0.82	8.64	9.46													0.41
6/27/2018	2.29	7.6																			0.33
6/28/2018	1.12																				
6/29/2018	1.03																				
6/30/2018	1.30																				
7/1/2018	1.85			10		0.25	8.81	9.06		2.50											0.20
7/2/2018	0.73	4.9		10	15	0.31	8.36	8.67													0.17
7/3/2018	1.50	5.4			17	0.27	9.96	10.23			106	122		85.0	25.2	14.0	<	0.25	0.82	186	0.21
7/4/2018	2.02	6.7																			
7/5/2018	1.49																				
7/6/2018	1.04																				
7/7/2018	1.46																				
7/8/2018	2.04																				
7/9/2018	2.79	7.5																			0.30
7/10/2018	0.72	8.1		9.6	15	0.37	8.89	9.27													0.24
7/11/2018	1.45	8.4				0.30	10.07	10.36													0.23
7/12/2018	0.63			12	13	0.64	9.09	9.72	11.69	3.42			646								
7/13/2018	0.63																				
7/14/2018	0.73																				
7/15/2018	2.05	7.7		13		0.25	9.86	10.11			103	118		74.0	25.0	14.2	<	0.25	0.82	178	
7/16/2018	2.72	6.2		10	27	0.15	10.17	10.33		2.78											0.17
7/17/2018	0.85				19	0.12	11.27	11.39													0.08
7/18/2018	2.53	6.7																			0.08
7/19/2018	1.74																				
7/20/2018	0.62																				
7/21/2018	1.18																				
7/22/2018	2.60	5.4				0.19	10.23	10.42													0.08
7/23/2018	1.96	5.1		8.2	15	0.13	10.15	10.28													0.05
7/24/2018	2.88	4.3		8.0	16	0.13	10.63	10.76		2.34											0.05
7/25/2018	4.50	4.8																			
7/26/2018	5.00																				
7/27/2018	3.98																				
7/28/2018	4.46																				
7/29/2018	4.60					0.11	11.02	11.13		2.86											0.04
7/30/2018	3.98	4.8		7.0	27	0.10	9.86	9.96													0.04
7/31/2018	2.84			6.2	9	0.10	10.32	10.42													0.04
8/1/2018	2.32	4.6																			
8/2/2018	3.00																				
8/3/2018	1.24																				
8/4/2018	2.05																				
8/5/2018	2.85																				0.03
8/6/2018	2.66	5.8			18																0.03
8/7/2018	3.34	5.2		5.7		0.08	8.82	8.90													0.04
8/8/2018	2.05	6.6				0.07	8.87	8.95													
8/9/2018	2.40	4.0		4.8	19	0.05	9.25	9.31	11.22	1.66											
8/10/2018	2.67																				
8/11/2018	2.09																				
8/12/2018	2.93			8.6		0.10	9.23	9.34		1.44											0.04
8/13/2018	2.45				31	0.04	7.83	7.87													0.03
8/14/2018	2.41	4.7		6.2	15	0.05	9.32	9.37					620								0.04
8/15/2018	2.60	3.8																			
8/16/2018	1.57	3.3																			
8/17/2018	0.89																				
8/18/2018	3.19																				
8/19/2018	4.05																				0.03
8/20/2018	4.17	3.3		3.3		0.05	8.55	8.60													0.02
8/21/2018	3.74	4.3		2.8	13	0.06	9.21	9.27		0.70											0.03
8/22/2018	3.83	4.4			16	0.07	9.78	9.85													
8/23/2018	3.98																				
8/24/2018	2.41																				
8/25/2018	2.31																				
8/26/2018	2.84	5.8		4.4		0.10	8.57	8.67		0.84											0.03
8/27/2018	2.48			2.9	8.0	0.15	7.76	7.91													0.02
8/28/2018	1.41	4.9			16	0.09	8.58	8.67													0.03
8/29/2018	2.40	3.0																			
8/30/2018	1.93	3.8																			
8/31/2018	1.55																				
9/1/2018	1.03																				
9/2/2018	2.22			3.6																	0.02
9/3/2018	2.91	3.5		4.2		0.06	8.57	8.64													0.02
9/4/2018	3.21	4.5			13	0.06	7.67	7.72		0.27											0.02
9/5/2018	3.71	3.8			20	0.08	8.60	8.67													
9/6/2018	5.14																				
9/7/2018	4.78																				
9/8/2018	4.13																				
9/9/2018	4.76	4.4																			0.02
9/10/2018	3.86	3.6			8.6																0.02
9/11/2018	3.16	3.9		4.0		0.06	9.63	9.69					644								0.02
9/12/2018	2.53	5.4				0.09	9.42	9.51													
9/13/2018	2.75			4.9	7.4	0.07	9.83	9.90	11.37	0.83											
9/14/2018	2.30																				
9/15/2018	2.52																				
9/16/2018	2.78	7.1		5.8		0.09	8.66	8.75													0.02
9/17/2018	2.70	5.7		8.4	16	0.07	7.72	7.79		0.25											0.02
9/18/2018	2.64	7.3			13	0.08	8.79	8.87													0.03
9/19/2018	3.47																				
9/20/2018	4.37																				
9/21/2018	3.76																				
9/22/2018	3.76																				
9/23/2018	4.02					0.07	9.36	9.43		0.44											0.02
9/24/2018	3.19	3.3		3.9	14	0.07	8.41	8.48													0.02
9/25/2018	2.84	2.5		3.5	12	0.06	9.42	9.48													0.02
9/26/2018	2.15	3.1																			
9/27/2018	2.62																				
9/28/2018	2.59																				
9/29/2018	3.01																				

Date	Flow (MGD)	BOD (mg/L)	BOD (pounds)	TSS (mg/L)	*E. coli* (#100/mL)	NH3 (Timberline) (mg/L)	NO2+NO3 (calc. TIN-NH3) (mg/L)	TIN (Timberline) (mg/L)	TN (Timberline) (mg/L)	T-P (Lachat) (mg/L)	Sodium (mg/L)	Chloride (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	<	Bromide (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	NO2 (mg/L)
9/30/2018	4.24	3.3		4.7		0.06	9.30	9.36													
10/1/2018	3.58	2.9		3.5	13	0.08	7.48	7.56													
10/2/2018	3.55	4.5			20	0.06	8.31	8.37		0.28	102	116		64.5	16.6	12.9	<	0.25	0.82	171	0.02
10/3/2018	4.03	3.4																			0.02
10/4/2018	3.88																				0.02
10/5/2018	3.70																				
10/6/2018	4.81																				
10/7/2018	5.39																				0.02
10/8/2018	5.44	3.4			12																0.02
10/9/2018	5.52	3.4		4.1		0.03	8.49	8.51													0.03
10/10/2018	5.83	3.8				0.03	9.26	9.28													
10/11/2018	5.79			4.0	13	0.03	9.83	9.85	12.51	0.28											
10/12/2018	5.91																				
10/13/2018	6.08																				
10/14/2018	6.49	6.1		6.9		0.03	8.51	8.53		0.31	104	116		66.5	17.0	12.7	<	0.25	0.81	172	0.03
10/15/2018	5.91	4.1		5.8	15	0.06	7.23	7.29													0.03
10/16/2018	6.05	6.5			20	0.03	8.05	8.05													0.03
10/17/2018	6.32	6.9																			
10/18/2018	6.47																				
10/19/2018	6.40																				
10/20/2018	6.66																				
10/21/2018	6.16					0.08	8.23	8.31		0.47											
10/22/2018	5.33	4.9		7.7	35	0.06	6.82	6.89					561								0.03
10/23/2018	5.08	4.8		6.9	7	0.07	8.72	8.79													0.03
10/24/2018	5.20	5.1																			0.03
10/25/2018	6.14																				
10/26/2018	5.56																				
10/27/2018	6.81																				
10/28/2018	5.81	5.0				0.07	8.17	8.24													0.03
10/29/2018	5.29	5.4		6.6	25	0.06	7.30	7.36													0.03
10/30/2018	5.72	4.7		6.6	16	0.05	8.67	8.72		0.36											0.03
10/31/2018	6.27	5.1																			
11/1/2018	6.33																				
11/2/2018	6.43																				
11/3/2018	6.76																				
11/4/2018	6.99	8.8																			0.07
11/5/2018	6.46	6.5			33																0.03
11/6/2018	6.17	7.4		12.7		0.05	9.50	9.55													0.03
11/7/2018	6.04					0.05	10.84	10.89													
11/8/2018	5.97	6.7		9.1	11	0.04	11.62	11.66	12.96	0.45											
11/9/2018	5.89																				
11/10/2018	6.45																				
11/11/2018	7.31			10.7		0.09	9.27	9.36													0.08
11/12/2018	6.28	6.1		8.5	46	0.06	7.66	7.72					606								0.04
11/13/2018	6.06	6.7			44	0.05	8.81	8.85		0.40											0.03
11/14/2018	6.19	6.6																			
11/15/2018	6.19																				
11/16/2018	6.17																				
11/17/2018	6.25																				
11/18/2018	6.53			10.0		0.14	8.70	8.84		0.43											0.06
11/19/2018	6.17	6.4		8.8	34	0.08	7.62	7.70													0.03
11/20/2018	6.15	6.7			48	0.07	8.39	8.46													0.03
11/21/2018	6.36																				
11/22/2018	6.47																				
11/23/2018	6.28																				
11/24/2018	6.41																				
11/25/2018	6.62	7.8				0.16	8.58	8.74													0.08
11/26/2018	6.22	6.9		10.6	43	0.09	7.78	7.87		0.37											0.04
11/27/2018	7.16	7.6		12.4	47	0.08	8.44	8.52													0.05
11/28/2018	6.98	7.8																			
11/29/2018	6.19																				
11/30/2018	5.88																				
12/1/2018	6.34																				
12/2/2018	6.57	9.5		11.2		0.04	10.78	10.82													0.05
12/3/2018	6.01	8.2		12.9	22	0.05	9.28	9.33													0.03
12/4/2018	6.02	8.4			31	0.03	10.39	10.43		0.43											0.04
12/5/2018	6.05	8.9																			
12/6/2018	5.93																				
12/7/2018	5.98																				
12/8/2018	6.35																				
12/9/2018	6.67																				0.06
12/10/2018	6.19	7.9																			0.04
12/11/2018	6.21	7.5		10.3	22	0.03	9.56	9.58					593								0.03
12/12/2018	6.18	7.2				0.04	10.46	10.50													
12/13/2018	6.05			12.5	31	0.06	10.86	10.92	14.09	0.42											
12/14/2018	6.09																				
12/15/2018	6.45																				
12/16/2018	6.73			10.5		0.04	9.78	9.82		0.46											0.07
12/17/2018	6.25	7.8		12.0	44	0.03	8.52	8.55													0.04
12/18/2018	6.44	7.8			39	1.62	11.75	13.38													0.24
12/19/2018	6.31	7.5																			
12/20/2018	6.08																				
12/21/2018	6.38																				
12/22/2018	6.29																				
12/23/2018	6.48																				
12/24/2018	6.46			9.8																	0.06
12/25/2018	5.91			9.3		0.13	9.35	9.48		0.40											0.06
12/26/2018	6.07	7.2	364		33	0.08	10.45	10.53													0.05
12/27/2018	6.03	7.3	367		15	0.10	9.78	9.88													
12/28/2018	6.04																				
12/29/2018	6.28																				
12/30/2018	6.57																				
12/31/2018	6.24	8.40		11.1		0.44	9.91	10.35													0.17

Appendix E
Big Dry Creek 2018 Northglenn WWTP Effluent Data

Big Dry Creek Daily 1/1/2018 - 12/31/2018	Outfall Location	Flow (MGD)	Alk Tot CaCO3 (mg/L)	Solids TSS (mg/L)	BOD 5 (mg/L)	*E. coli* (#/100mL)	NH3 (mg/L) (Timberline)	Cyanide WAD (ug/L)	Copper PD (ug/L)	Selenium PD (ug/L)	NO5 (Timberline) (mg/L)	TN (Timberline) (mg/L)	TP (mg/L)
3/11/2018	004A	0.395											
3/12/2018	004A	0.375	175			11.9	1.8						
3/13/2018	004A	0.363		3.7	4.16		1.79	<5	1.3	0.8			
3/14/2018	004A	0.359					1.88						
3/15/2018	004A	0.36					1.74				3.3	4.6	0.287
3/16/2018	004A	0.157		5.6	4.52		1.71						
4/9/2018	004A	0.291											
4/10/2018	004A	0.448					1.437	<5	1.6	0.8			
4/11/2018	004A	0.382					1.139				2.41	4.55	0.228
4/12/2018	004A	0.336		6.8	7.6	5.2	0.117						
4/13/2018	004A	0.338		6.6	6.05		1.396						
4/14/2018	004A	1.318					1.39						
4/15/2018	004A	1.783											
4/16/2018	004A	1.761	177	4.6	5.95	4.1	1.289	<5	1.5				
4/17/2018	004A	1.726		5.5	6.74		1.197						
4/18/2018	004A	1.727					1.086						
4/19/2018	004A	1.189					0.96						
4/20/2018	004A	1.232					0.843						
4/21/2018	004A	1.194											
4/22/2018	004A	1.246					0.661						
4/23/2018	004A	1.794					0.647						
4/24/2018	004A	1.779					0.571	<5	2				
4/25/2018	004A	1.785					0.48						
4/26/2018	004A	1.774	200	7.8	6.81	1	0.416				1.73	3.94	0.161
4/27/2018	004A	1.778		11.6									
4/28/2018	004A	1.823											
4/29/2018	004A	1.776					0.195						
4/30/2018	004A	1.814	143	11	11.66	<1	0.228						
5/1/2018	004A	1.869					0.276						
5/2/2018	004A	1.853					0.287						
5/3/2018	004A	1.851		7.4	7.49		0.384	<5	1	1.2			
5/4/2018	004A	1.826											
5/5/2018	004A	1.816											
5/6/2018	004A	1.805					0.369						
5/7/2018	004A	1.805	142	6.4	8.84	<1	0.427						
5/8/2018	004A	1.828		7	9.04		0.446						
5/9/2018	004A	1.868					0.495	<5	1.3				
5/10/2018	004A	1.904					0.614				1.32	4.1	0.19
5/11/2018	004A	1.879											
5/12/2018	004A	1.818											
5/13/2018	004A	1.798					0.763						
5/14/2018	004A	1.814					0.823						
5/15/2018	004A	1.825	160				0.874	<5	1.5				
5/16/2018	004A	1.81		7.3	6.4	2	0.928						
5/17/2018	004A	1.844		5.7	6.12		0.906						
5/18/2018	004A	1.848											
5/19/2018	004A	1.838											
5/20/2018	004A	1.833					1.01						
5/21/2018	004A	1.811					1.03						
5/22/2018	004A	1.796	163			4.1	0.99						
5/23/2018	004A	1.784		3.3	5.26		1.04	<5	1.3				
5/24/2018	004A	1.777		3	4.66		1.05						
5/25/2018	004A	1.787											
5/26/2018	004A	1.803											
5/27/2018	004A	1.772					1.14						
5/28/2018	004A	1.637					1.15						
5/29/2018	004A	1.727					1.14						
5/30/2018	004A	1.826	161	6.2	7.98	5.2	1.08				2	4.47	0.315
5/31/2018	004A	1.825		2.8			1.05	<5	1.2				
6/1/2018	004A	1.819											
6/2/2018	004A	1.865											
6/3/2018	004A	1.802					1.01						
6/4/2018	004A	1.787					1						
6/5/2018	004A	1.769					0.94						
6/6/2018	004A	1.763	171	3.5	5.94	5.2	0.96						
6/7/2018	004A	1.756		4.7	6.56		1	<5	2.1	<0.8			
6/8/2018	004A	1.754											
6/9/2018	004A	1.78											
6/10/2018	004A	1.779					0.97						
6/11/2018	004A	1.795					0.965	<5	8.6				
6/12/2018	004A	1.08					0.935						
6/13/2018	004A	0.39	157	3.7	5.81	4.1	0.964						
6/14/2018	004A	0.196		3.3	6.17		0.968				1.9	4.00	0.288
6/25/2018	004A	0.37											
6/26/2018	004A	0.779	163	8.2	9.73	21.6	0.939	<5	2.8		2.13	4.72	0.364
6/27/2018	004A	1.112					0.964						
6/28/2018	004A	1.513					0.942						
6/29/2018	004A	1.724					0.974						
6/30/2018	004A	1.793					0.954						
7/1/2018	004A	1.661		2.8	5.15		1.03						
7/2/2018	004A	1.567	163	5.4	4.37	3	0.984	<5	4.6	1.8			
7/3/2018	004A	1.601					0.949						
7/4/2018	004A	1.621					0.97						
7/5/2018	004A	1.583					0.938						
7/6/2018	004A	1.624											
7/7/2018	004A	1.542											
7/8/2018	004A	1.12		5.8	9.75								
7/9/2018	004A	1.619	165	6		5.1	1	<5	7.2				
7/10/2018	004A	1.473					0.944						
7/11/2018	004A	1.631					1.04						
7/12/2018	004A	1.613					0.887				1.56	3.75	0.377
7/13/2018	004A	1.652					0.848						
7/14/2018	004A	1.567											
7/15/2018	004A	2.106	165	5.2	10.63		0.492						
7/16/2018	004A	2.248		4.8		6.3	0.652	<5	4.4				
7/17/2018	004A	2.356					0.465						
7/18/2018	004A	2.142					0.425						
7/19/2018	004A	2.065					0.262						
7/20/2018	004A	2.145											
7/21/2018	004A	1.987											
7/22/2018	004A	2.038	141	9.2	18.01		0.208						
7/23/2018	004A	2.275		10.2	9.93	10.8	0.216	<5	1.4				
7/24/2018	004A	2.099					0.193				1.17	3.50	0.574
7/25/2018	004A	5.327					0.211						

Appendix E
Big Dry Creek 2018 Northglenn WWTP Effluent Data

Big Dry Creek Daily 1/1/2018 - 12/31/2018	Outfall Location	Flow (MGD)	Alk Tot CaCO3 (mg/L)	Solids TSS (mg/L)	BOD 5 (mg/L)	*E. coli* (#/100mL)	NH3 (mg/L) (Timberline)	Cyanide WAD (ug/L)	Copper PD (ug/L)	Selenium PD (ug/L)	NO5 (Timberline) (mg/L)	TN (Timberline) (mg/L)	TP (mg/L)
7/26/2018	004A	6.464					0.204						
7/27/2018	004A	6.393											
7/28/2018	004A	6.446											
7/29/2018	004A	6.391		18.5			<0.1						
7/30/2018	004A	6.499		8.57	11.73	9.7	<0.1						
7/31/2018	004A	6.363					0.129						
8/1/2018	004A	2.745					<0.1	<5	1.5	<0.8			
8/2/2018	004A	1.365					0.119						
8/3/2018	004A	4.204											
8/4/2018	004A	5.343					0.13						
8/5/2018	004A	5.266	134	15.6	10.43		0.195						
8/6/2018	004A	2.218		9.2	9.5	40.2		<5	6.3				
8/7/2018	004A	0											
8/8/2018	004A	2.858					0.372						
8/9/2018	004A	5.395					0.235				0.561	2.52	0.521
8/10/2018	004A	5.296					0.19						
8/11/2018	004A	5.073											
8/12/2018	004A	4.553		24	14.53		<0.1						
8/13/2018	004A	2.30	142	17	15.55	25.9	0.179	<5	1.7				
8/13/2018	007A	1.584											
8/14/2018	007A	2.888					0.633						
8/15/2018	007A	3.025		14.4	14.12		0.542						
8/16/2018	007A	3.117		11.3	14.01	4.1	0.391	<5	3.4	1			
8/17/2018	007A	3.012					0.298						
8/18/2018	007A	3.03					0.304						
8/19/2018	007A	3.31					0.622						
8/20/2018	007A	3.073				54.5	0.763						
8/21/2018	007A	3.023		15.3	11.69		0.316						
8/22/2018	007A	2.958		13.4	5.71		0.373	<5	4.2		9.74	10.5	1.23
8/23/2018	007A	2.902				82	0.951						
8/24/2018	007A	2.867											
8/25/2018	007A	3.033											
8/26/2018	007A	3.109					1.13						
8/27/2018	007A	2.984				4.1	1.33	<5	3.1				
8/28/2018	007A	2.931		7.8	5.09		0.276						
8/29/2018	007A	2.865		9.2	7.16		0.19						
8/30/2018	007A	2.758				1	0.178						
8/31/2018	007A	3.129											
9/1/2018	007A	3.196											
9/2/2018	007A	2.981					0.842						
9/3/2018	007A	3.29					0.368						
9/4/2018	007A	1.451		6.8	8.15	9.7	1.83	<5	2.8	<0.8			
9/5/2018	007A	0.798		9	12.26		1.55						
9/24/2018	007A	2.104											
9/25/2018	007A	2.814		5		6.3	1.87	<5	1.6				
9/26/2018	007A	2.733					4.06						
9/27/2018	007A	2.76		3.6	3.4		1.06				5.83	7.43	0.186
9/28/2018	007A	2.777					0.523						
9/29/2018	007A	2.895					0.193						
9/30/2018	007A	3.056					0.24						
10/1/2018	007A	2.857					1.14	<5	2.5	0.9			
10/2/2018	007A	2.859					0.486						
10/3/2018	007A	2.901		7.8	6.22	3	0.616						
10/4/2018	007A	2.729		7.8	6.1	<1	0.266						
10/5/2018	007A	2.82					0.47						
10/6/2018	007A	2.918											
10/7/2018	007A	3.119					0.47						
10/8/2018	007A	3.006		6.6	9.08	7.4	0.584	<5	3.3				
10/9/2018	007A	2.933		6.2	9.93	53.8	0.46						
10/10/2018	007A	2.587					0.25						
10/11/2018	007A	2.798					1.16				4.47	6.42	0.178
10/12/2018	007A	2.689											
10/13/2018	007A	2.877											
10/14/2018	007A	3.101					0.43						
10/15/2018	007A	2.869				6.3	0.58	<5	3.4				
10/16/2018	007A	2.86					0.21						
10/17/2018	007A	2.865		4.4	6.43		0.161						
10/18/2018	007A	2.727		4.6	6.13		0.226		11.7	0.9			
10/19/2018	007A	2.785											
10/20/2018	007A	2.881											
10/21/2018	007A	2.99					0.439						
10/22/2018	007A	2.889		4.2	10.03		0.658						
10/23/2018	007A	2.74		3.3	3.83	5.1	0.322	<5	6.9				
10/24/2018	007A	2.76					0.362				3.74	5.57	0.175
10/25/2018	007A	2.778					0.434						
10/26/2018	007A	2.653											
10/27/2018	007A	2.85											
10/28/2018	007A	2.965		3.3	6.54		1.19						
10/29/2018	007A	2.615		4.3	7.81	1	2.24	<5	3.9				
10/30/2018	007A	3.03					1.22						
10/31/2018	007A	2.753					2.12						
11/1/2018	007A	2.975					1.18						
11/2/2018	007A	2.866											
11/3/2018	007A	3.049											
11/4/2018	007A	3.135					1.31						
11/5/2018	007A	2.752		5.8	8.91	2	2.19	<5	3.6	<0.8			

Appendix E
Big Dry Creek 2018 Northglenn WWTP Effluent Data

Big Dry Creek Daily 1/1/2018 - 12/31/2018	Outfall Location	Flow (MGD)	Alk Tot CaCO3 (mg/L)	Solids TSS (mg/L)	BOD 5 (mg/L)	*E. coli* (#/100mL)	NH3 (mg/L) (Timberline)	Cyanide WAD (ug/L)	Copper PD (ug/L)	Selenium PD (ug/L)	NO5 (Timberline) (mg/L)	TN (Timberline) (mg/L)	TP (mg/L)
11/6/2018	007A	2.871		5.6	13.59		1.42						
11/7/2018	007A	2.797					1.44						
11/8/2018	007A	2.853					1.44				3.65	6.19	0.203
11/9/2018	007A	2.901											
11/10/2018	007A	2.96											
11/11/2018	007A	3.141					2.08						
11/12/2018	007A	2.937					3.2						
11/13/2018	007A	2.831		5.4	10.41	10.9	2.11	<5	4				
11/14/2018	007A	2.835		7.4	10.19		1.51						
11/15/2018	007A	2.682					1.89						
11/16/2018	007A	2.607											
11/17/2018	007A	2.768											
11/18/2018	007A	2.844					2.55						
11/19/2018	007A	2.596		6.2	9.29	4.1	2.82	<5	10.9				
11/20/2018	007A	2.608		5.8	9.07		1.32						
11/21/2018	007A	2.651					1.03						
11/22/2018	007A	2.776					1.5						
11/23/2018	007A	2.535											
11/24/2018	007A	2.737											
11/25/2018	007A	2.748					3.13						
11/26/2018	007A	2.662		6.8	10.39	5.2	3.8						
11/27/2018	007A	1.417		6.8	9.57		2.07						
11/28/2018	007A	1.307					0.39	<5	3.1		3.22	5.59	0.259
11/29/2018	007A	1.308					0.391						
11/30/2018	007A	1.327											
12/1/2018	007A	1.475											
12/2/2018	007A	1.313		7	9.56		0.774						
12/3/2018	007A	1.31		7.6	9	7.3	0.336						
12/4/2018	007A	1.381				2	0.404						
12/5/2018	007A	1.303					0.266	<5	2.9	<0.8			
12/6/2018	007A	1.301					0.255						
12/7/2018	007A	1.301											
12/8/2018	007A	1.302											
12/9/2018	007A	1.303		14	16.3		2.25	<5	7.4				
12/10/2018	007A	1.362		9	12.4	1	0.241						
12/11/2018	007A	1.347					0.133						
12/12/2018	007A	1.301					0.103						
12/13/2018	007A	1.302			13.6		0.211				4.83	6.89	0.259
12/14/2018	007A	1.32											
12/15/2018	007A	1.309											
12/16/2018	007A	1.304		7	7.09		0.121						
12/17/2018	007A	1.3		6.2	8.68	12.2	0.1	<5	5.3				
12/18/2018	007A	1.299					0.119						
12/19/2018	007A	1.309					0.123						
12/20/2018	007A	1.509					0.182						
12/21/2018	007A	1.509											
12/22/2018	007A	1.51											
12/23/2018	007A	1.509		9.6	10.8		0.878						
12/24/2018	007A	1.509					0.754						
12/25/2018	007A	1.509		12.6	13.54		0.789	<5	5.2				
12/26/2018	007A	1.509				2	0.597				4.41	6.68	0.261
12/27/2018	007A	1.509					0.376						
12/28/2018	007A	1.509											
12/29/2018	007A	1.509											
12/30/2018	007A	1.509					0.895						
12/31/2018	007A	1.509					0.512						

Appendix F. Metro Wastewater 2018 Sampling on Lower Big Dry Creek

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Appendix F
Metro Wastewater 2018 Monitoring of Big Dry Creek - Iron

Site	Date	Iron (mg/L)	Fraction
BDC	3-Jan-18	0.043	Dissolved
BDC	17-Jan-18	0.035	Dissolved
BDC	7-Feb-18	0.035	Dissolved
BDC	21-Feb-18	0.035	Dissolved
BDC	7-Mar-18	0.025	Dissolved
BDC	21-Mar-18	0.023	Dissolved
BDC	4-Apr-18	0.024	Dissolved
BDC	18-Apr-18	0.031	Dissolved
BDC	2-May-18	0.022	Dissolved
BDC	16-May-18	0.022	Dissolved
BDC	6-Jun-18	0.050	Dissolved
BDC	20-Jun-18	0.020	Dissolved
BDC	10-Jul-18	0.012	Dissolved
BDC	15-Aug-18	0.031	Dissolved
BDC	5-Sep-18	0.009	Dissolved
BDC	19-Sep-18	0.042	Dissolved
BDC	3-Oct-18	0.017	Dissolved
BDC	17-Oct-18	0.077	Dissolved
BDC	20-Nov-18	0.023	Dissolved
BDC	5-Dec-18	0.020	Dissolved
BDC	3-Jan-18	0.434	Total
BDC	17-Jan-18	0.695	Total
BDC	7-Feb-18	1.040	Total
BDC	21-Feb-18	1.650	Total
BDC	7-Mar-18	0.707	Total
BDC	21-Mar-18	3.040	Total
BDC	4-Apr-18	1.390	Total
BDC	18-Apr-18	2.070	Total
BDC	2-May-18	1.530	Total
BDC	16-May-18	2.280	Total
BDC	6-Jun-18	1.240	Total
BDC	20-Jun-18	2.390	Total
BDC	10-Jul-18	1.130	Total
BDC	15-Aug-18	2.030	Total
BDC	5-Sep-18	1.600	Total
BDC	19-Sep-18	1.370	Total
BDC	3-Oct-18	0.947	Total
BDC	17-Oct-18	0.938	Total
BDC	7-Nov-18	1.140	Total
BDC	20-Nov-18	0.788	Total
BDC	5-Dec-18	0.701	Total
BDC	18-Dec-18	0.597	Total

Site	Date	Iron (mg/L)	Fraction
BDC-8	3-Jan-18	0.048	Dissolved
BDC-8	17-Jan-18	0.039	Dissolved
BDC-8	7-Feb-18	0.041	Dissolved
BDC-8	21-Feb-18	0.031	Dissolved
BDC-8	7-Mar-18	0.031	Dissolved
BDC-8	21-Mar-18	0.025	Dissolved
BDC-8	4-Apr-18	0.028	Dissolved
BDC-8	18-Apr-18	0.028	Dissolved
BDC-8	2-May-18	0.021	Dissolved
BDC-8	16-May-18	0.019	Dissolved
BDC-8	6-Jun-18	0.052	Dissolved
BDC-8	20-Jun-18	0.012	Dissolved
BDC-8	10-Jul-18	0.000	Dissolved
BDC-8	15-Aug-18	0.023	Dissolved
BDC-8	5-Sep-18	0.000	Dissolved
BDC-8	19-Sep-18	0.042	Dissolved
BDC-8	3-Oct-18	0.018	Dissolved
BDC-8	17-Oct-18	0.168	Dissolved
BDC-8	20-Nov-18	0.032	Dissolved
BDC-8	5-Dec-18	0.031	Dissolved
BDC-8	3-Jan-18	0.658	Total
BDC-8	17-Jan-18	1.450	Total
BDC-8	7-Feb-18	0.896	Total
BDC-8	21-Feb-18	1.370	Total
BDC-8	7-Mar-18	0.417	Total
BDC-8	21-Mar-18	2.590	Total
BDC-8	4-Apr-18	1.350	Total
BDC-8	18-Apr-18	1.950	Total
BDC-8	2-May-18	1.060	Total
BDC-8	16-May-18	1.800	Total
BDC-8	6-Jun-18	0.715	Total
BDC-8	20-Jun-18	1.850	Total
BDC-8	10-Jul-18	0.846	Total
BDC-8	15-Aug-18	1.810	Total
BDC-8	5-Sep-18	2.550	Total
BDC-8	19-Sep-18	1.600	Total
BDC-8	3-Oct-18	0.253	Total
BDC-8	17-Oct-18	0.731	Total
BDC-8	7-Nov-18	0.976	Total
BDC-8	20-Nov-18	1.010	Total
BDC-8	5-Dec-18	0.960	Total
BDC-8	18-Dec-18	0.826	Total